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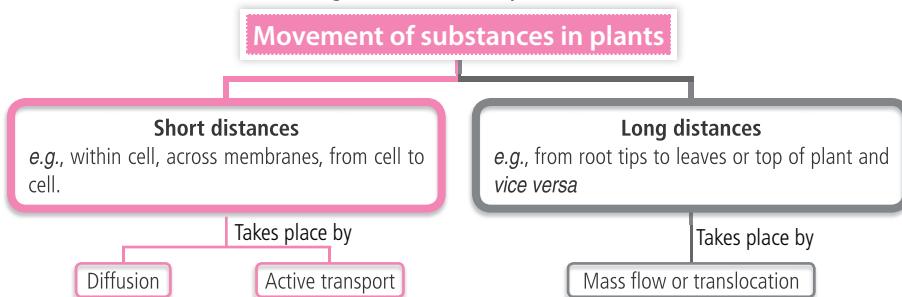
HIGH YIELD FACTS



Class XI

Transport in Plants

- Plants like other living organisms, i.e., humans and animals, also need to transport various types of substances such as gases, minerals, water, hormones, food and organic solutes to short as well as long distances. All this transport takes place in absence of interstitial fluid as well as regular circulation system.



MEANS OF TRANSPORT

- The passage of substances into and out of the cells is carried out by either of the methods:

They are pores in the membrane proteins. They have binding sites for a particular solute to be transported.

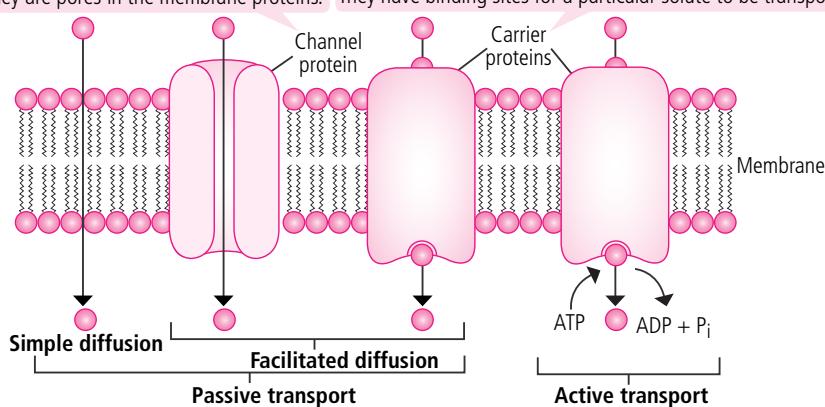
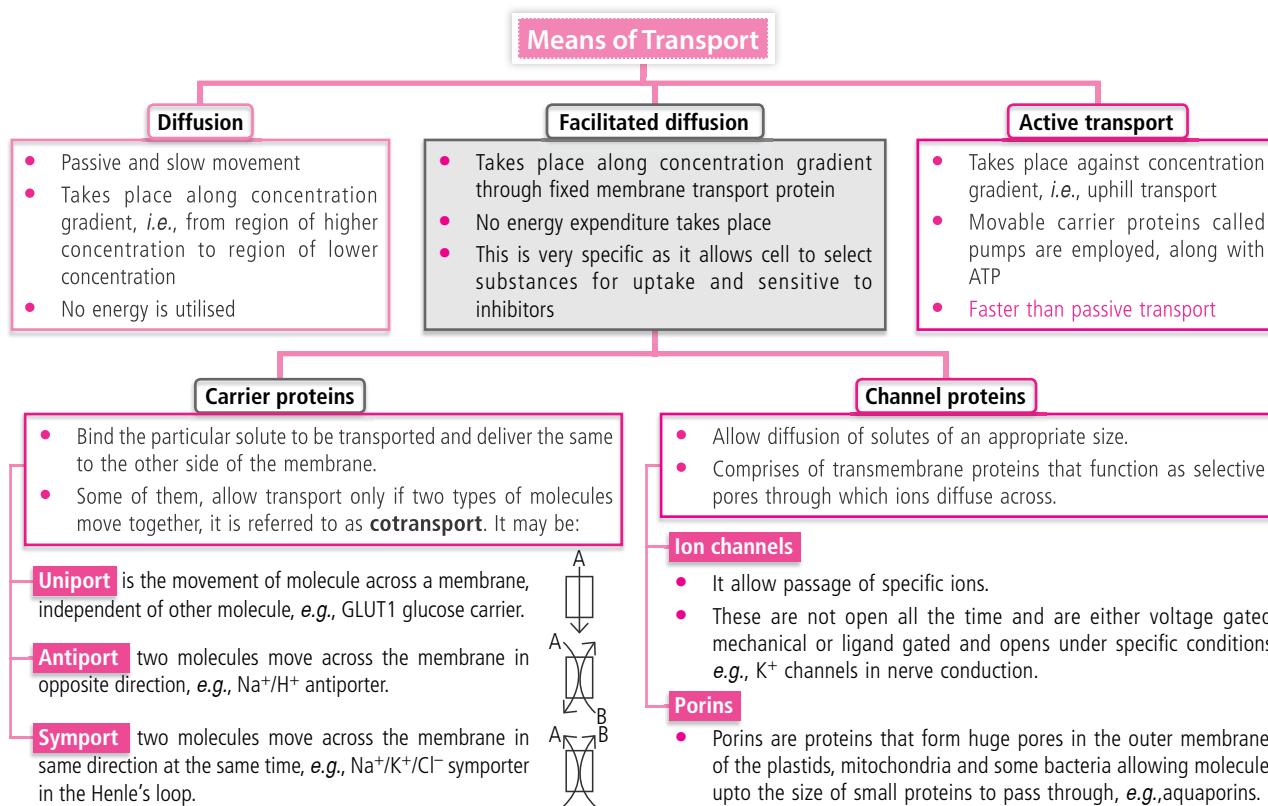


Fig.: Methods of transport of ions and solutes across membranes.

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	2012	2013	2014	2015	2016
AIPMT/NEET	-	1	-	2	3
AIMS	1	-	-	-	1
AMU	2	1	-	-	-
Kerala	3	-	2	3	2
K-CET	3	4	-	-	1
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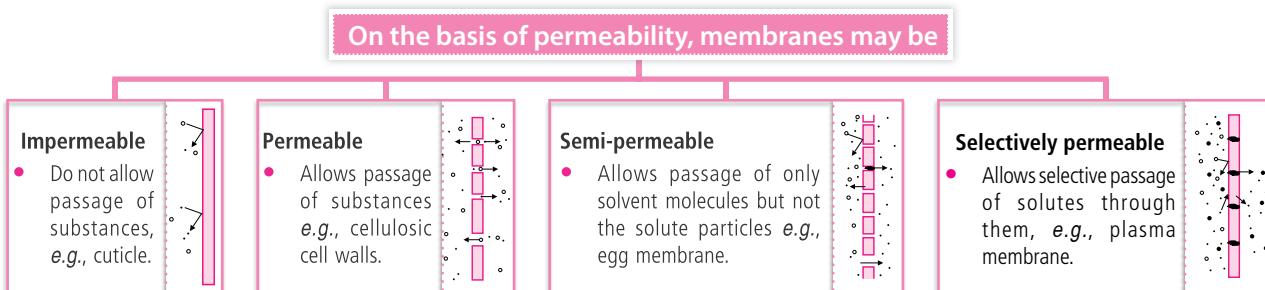


PLANT WATER RELATIONS

- Water is essential for all physiological activities of the plant. It provides a medium in which substances get dissolved and undergo various types of reactions. To comprehend plant-water relations, an understanding of the following standard terms is necessary.

Membrane Permeability

- It refers to the ability of a membrane to allow passage of gases, liquids and solutes through it. It depends upon the composition of membrane and nature of substances passing through it.

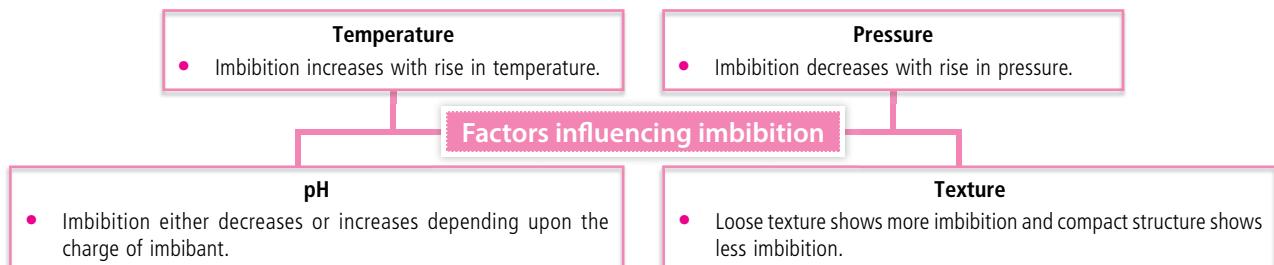


Imbibition

- Imbibition is the phenomenon of absorption of water or any other liquid by the solid particles of a substance, without forming a solution. Solid substances or adsorbents which take part in imbibition are called **imbibants**, e.g., seeds, dry wood. The liquid, usually water, which is imbibed is known as **imbibate**.
- Proteins are powerful imbibants as compared to polysaccharides** like starch, cellulose or lignin. Pure gelatin adsorbs water more quickly than cellulose or lignin.

Amount of imbibition depends upon:

- Water potential gradient between adsorbent and water.
- Affinity of adsorbent for water.



Significance of imbibition in plants

- It is the initial step in seed germination.
- Imbibition is the dominant step in the initial stage of water absorption by roots.
- Water moves into ovules ripening into seeds, by the process of imbibition.
- Breaking of seed coat in germinating seeds is due to greater imbibitional swelling of the seed kernel, as compared to seed covering.

Water Potential (ψ_w)

- Water potential is the fundamental concept for understanding movement of water. Water molecules possess kinetic energy. In liquid and gaseous form, water molecules are in random motion that is both rapid and constant. The difference between the free energy of water molecules in pure water, and the energy of water in any other system (e.g., water in a solution or in a plant cell or tissue) is termed the **water potential**. It is represented by Greek letter ψ (psi) or more accurately ψ_w . The value of ψ_w is measured in **bars**, **pascals** or **atmosphere**.
- Water always moves from the area of high water potential or high energy to the area of low water potential or low energy. The **water potential** of a solution can be **determined using pure water as the standard of reference**.
- The **pure water, at normal temperature and pressure has a water potential of zero (0)**. The presence of solute particles reduces the free energy of water, and thus decreases the water potential (negative value). Therefore, the water potential of a solution is always less than zero. Hence, water always moves from the less negative potential (e.g., -100 kPa) to more negative potential (e.g., -200 kPa).
- In cell contents, the water potential is determined by three major sets of internal factors, i.e., **matric potential (ψ_m)**, **solute potential (ψ_s)** and **pressure potential (ψ_p)**. A fourth factor, **gravity potential (ψ_g)** also sometimes influences the water potential of cell sap, when the contents face tension, due to force of gravity. The water potential in a plant cell or tissue can be written as the sum of matric potential, solute potential and pressure potential.

$$\psi_w = \psi_m + \psi_s + \psi_p \quad (\psi_g \text{ is omitted as it is negligible as compared to the osmotic } \psi_s \text{ and } \psi_p)$$

- **Matric potential (ψ_m)** is the component of water potential influenced by the presence of matrix and has got a **negative value**. It is significant, in case of dry seeds, young cells, etc., but negligible in hydrated or mature cells. It is not significant in osmosis, so often disregarded. Thus, equation may be simplified as

$$\psi_w = \psi_s + \psi_p$$

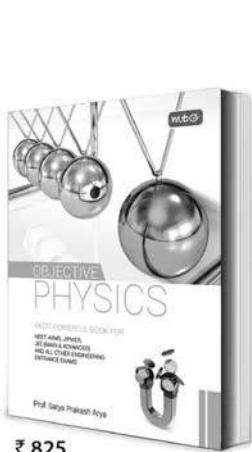
- **Solute potential** is also known as **osmotic potential**. It is defined as the decrease in the water potential of a solution over its pure state, as a result of the presence of solutes. Solute potential or osmotic potential (ψ_s) is always in negative value. The more the solute molecules, the lower is the solute potential (ψ_s).
- For a solution at atmospheric pressure, water potential (ψ_w) will be equal to solute potential (ψ_s).

$$\psi_w = \psi_s \text{ (at atmospheric pressure)}$$

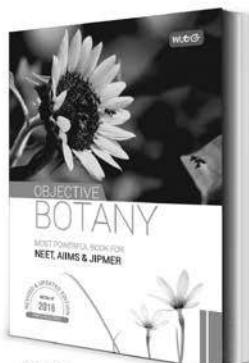
Hydrostatic Pressure or Pressure Potential (ψ_p)

- **Hydrostatic pressure** or **pressure potential** is the pressure which develops in an osmotic system due to osmotic entry or exit of water from it. A positive hydrostatic pressure develops in a system or plant cell due to the entry of water into it, which is also called **turgor pressure** while negative hydrostatic pressure or **tension** develops due to loss of water. Negative hydrostatic pressure develops in xylem due to loss of water during transpiration. This is very important in transport of sap over long distances in plants.

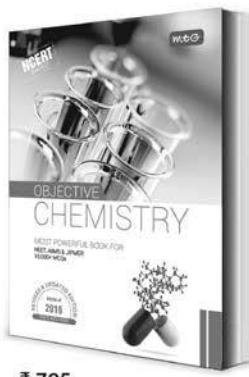
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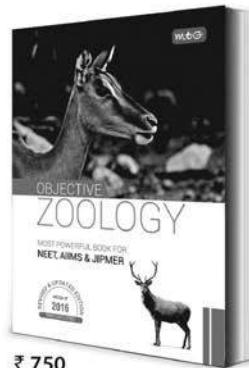
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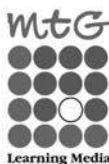
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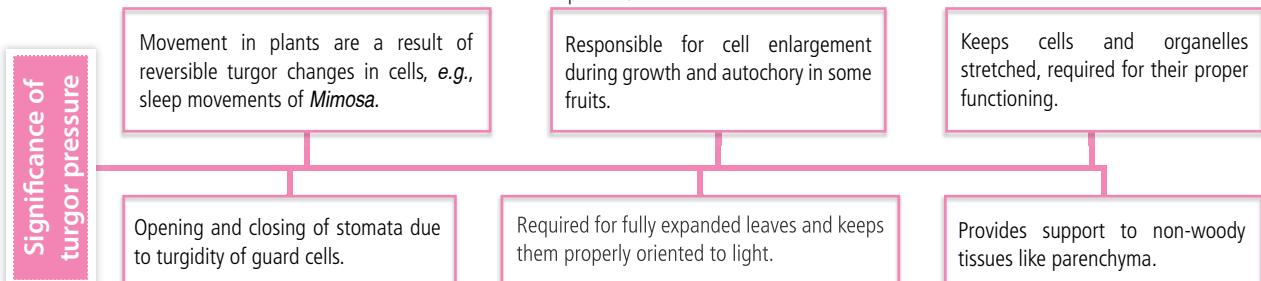
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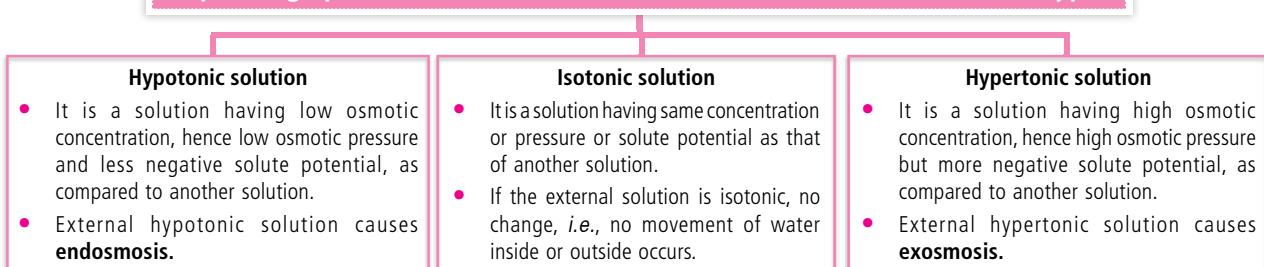
- Due to turgor pressure, the protoplast of a plant cell will press the cell wall to the outside. The cell wall, being elastic, presses the protoplast with an equal and opposite force. The force exerted by the cell wall over the protoplast is called **wall pressure (WP)**.
- Normally, **wall pressure is equal and opposite to turgor pressure**, except when the cell becomes flaccid. The values of these two opposing forces continue to rise, till the cell becomes fully swollen or **turgid**. In this state, the value of wall or turgor pressure becomes equal to osmotic potential, $\psi_p = \psi_s$.



Osmosis

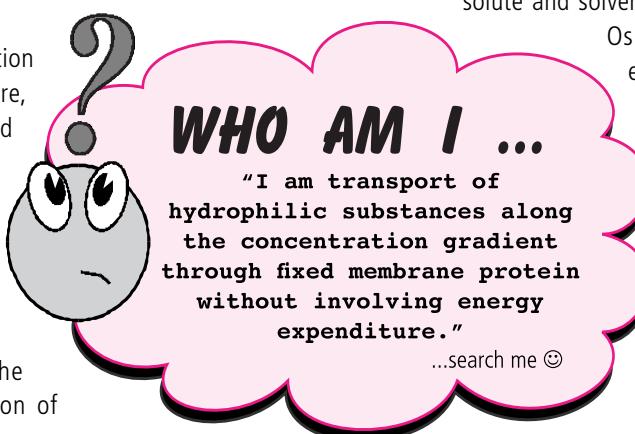
- Osmosis is a special type of diffusion of water that occurs through a semipermeable membrane. It is the **movement of solvent or water molecules from the region of their higher diffusion pressure or free energy to the region of their lower diffusion pressure or free energy across a semipermeable membrane**.
- Osmosis is of two types – **endosmosis** and **exosmosis**.
- Endosmosis** is the osmotic entry of water into a cell, organ or system.
- Exosmosis** is the osmotic withdrawal of water from a cell, organ or system.
- The direction and rate of osmosis depends upon the sum of two forces – pressure gradient (gradient of ψ_p) and concentration gradient (gradient of ψ_s). The net force or gradient is determined by the difference in the water potential of solutions separated by a semipermeable membrane.
- A solution which can cause an osmotic entry of water into it is called osmotically active solution.

Depending upon the osmotic concentration, the solution can be of three types



Osmotic pressure

- Osmotic pressure of a solution is equivalent to the pressure, which must be exerted upon it, to prevent the flow of solvent into it, across a semi-permeable membrane. It is usually measured in **pascals**, Pa or **bars** or **atmosphere**. It largely depends upon the ratio between concentration of



solute and solvent particles in a given solution.

Osmotic pressure is numerically equal to osmotic potential (ψ_s) but osmotic potential has a negative value, while osmotic pressure (π) has a positive value.

- The instrument used for measuring osmotic pressure is called osmometer, e.g., Berkeley and Hartley's osmometer, Pfeffer's osmometer.

Factors influencing osmosis

- Presence of imperfect semipermeable membrane disturbs osmosis.
- Concentration of dissolved solute on the both sides of semipermeable membrane also influences osmosis.
- Osmosis is also influenced by differences in pressure.

Plasmolysis

- Shrinkage of the protoplast of a cell, from its cell wall, under the influence of a hypertonic solution is called **plasmolysis**. Due to withdrawal of water from the cytoplasm and central vacuole of cell, the size of the protoplast reduces. This is the first stage of plasmolysis called, **limiting plasmolysis**. The hypertonic external solution continues to withdraw water from the central vacuole and protoplast, by exosmosis, which withdraws itself from the corners and results in **incipient plasmolysis**. At this stage, hypertonic solution enters the cell in between the protoplast and the cell wall. Due to continued exosmosis, protoplast shrinks further and withdraws from the cell wall except at very few points. It is known as **evident plasmolysis**.

Deplasmolysis

- The swelling up of a plasmolysed protoplast, under the influence of hypotonic solution is called **deplasmolysis**. It is possible only immediately after plasmolysis, due to endosmosis, else the cell protoplast gets permanently damaged.

Interrelationship between OP, TP and DPD.

The difference in the concentration of solutions, on two sides of a semipermeable membrane, results in the flow of water from solution of low concentration to solution of higher concentration. When a cell is placed in a hypotonic solution, water enters into the cell and the turgor pressure of the cell increases. As a result of increase in TP, the wall pressure of the cell also increases (equal in magnitude but opposite in direction).

Here, the value of diffusion pressure deficit or suction pressure (actual force responsible for entry of water into cell) will be equal to osmotic pressure minus wall pressure.

$$\text{i.e., DPD (SP)} = \text{OP} - \text{WP} \text{ (as WP} = \text{TP) hence, DPD} = \text{OP} - \text{TP}$$

In a flaccid cell, the TP is zero, therefore, $\text{DPD} = \text{OP} - 0 = \text{OP}$

Thus, DPD will be equal to OP in case of flaccid cell and the water will enter the cell with a force equal to the OP of the cell. When a flaccid cell is placed in water, endosmosis starts as a result of which, OP of the cell starts decreasing, while TP starts increasing. A stage comes, when OP and TP become equal, so DPD becomes zero.

Now, the cell is said to be in fully **turgid condition**.

In a turgid cell, the value of $\text{OP} = \text{TP}$ i.e., $\text{DPD} = \text{OP} - \text{TP}$

$$\text{So, DPD} = 0$$

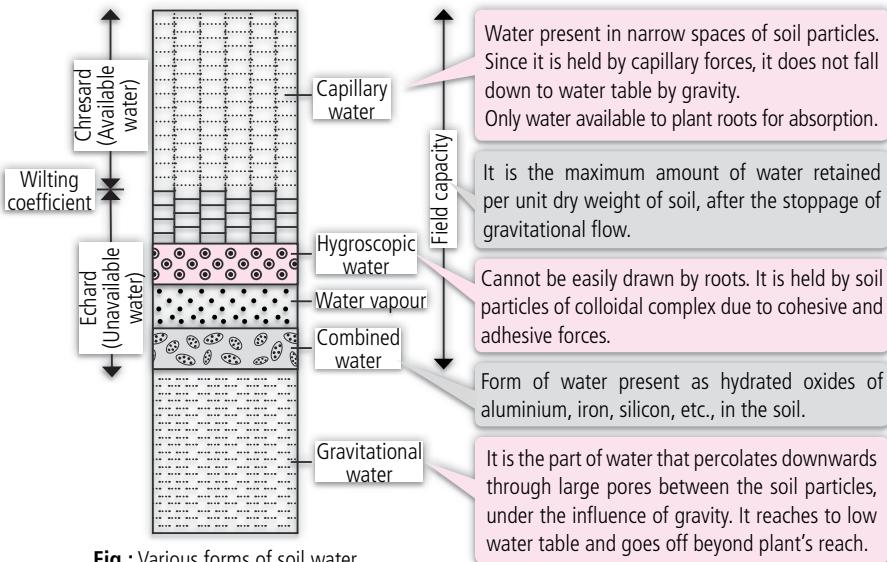
Thus, there will be no absorption of water by the cell in a fully turgid condition.

DPD or SP determines the direction of movement of water (water always moves from a cell of lower DPD to a cell of higher DPD).

WATER ABSORPTION

- Plants absorb water from the soil with the help of their roots. This water is found in different forms in the soil.
- The total amount of water present in soil is called **holard**. The water available to the plant is called **chresard**, while the rest of soil water unavailable to plants is called **echard**.
- The source of soil water is rain or irrigation. A part of rain water does not enter the soil and is drained away from soil surface, it is called **run-away water**.
- Soil moisture beyond field capacity produces water logging. If soil water is not replenished from time to time, plants may show permanent wilting and die. It is known as **permanent wilting percentage (PWP)** or **permanent wilting coefficient (PWC)**.
- Though plants have potentiality to absorb water through their entire surface, only the underground root system is specialised to absorb water as water is mostly available in soil. Roots are extensive and grow rapidly in the soil.
- The most efficient region of water absorption is the root hair zone comprising of thousands of root hair.

- Root hair are delicate, short lived and thin walled slender extensions of root epidermal cells that increase the surface area of root and help in absorption of water from soil.
- The cell wall of root hair is composed of two layers:
 - The outer layer made up of **pectic substance** that helps to adhere soil particles and absorb capillary water.
 - The inner layer made up of cellulose.
- The cell wall of root hair is permeable to both solute and solvent molecules.



Pathways of Water Movement in Roots

- Once water is absorbed by root hairs, it can move deeper into root layers to reach xylem by two distinct pathways:
- Apoplast pathway**- In this, the water passes from root hair to xylem through the walls of intervening cells without crossing any membrane or cytoplasm. It occurs exclusively through intercellular spaces and cell walls depending on the gradient. The movement is interrupted by the presence of impermeable lignosuberin Caspary strips in the walls of endodermal cells.
- Symplast pathway**- In symplastic movement, the water passes from cell to cell through their protoplasm, without entering cell vacuoles. However at one place, it (water) needs to pass through plasma membrane, hence called **transmembrane pathway**. Intercellular movement in symplast pathway occurs through plasmodesmata i.e., cytoplasmic strands between adjacent cells. The movement of water is slower than apoplast pathway and takes place down the potential gradient. It is also aided by cytoplasmic streaming of individual cells.
- Most of the water in roots flows via apoplast, since the cortical cells are loosely packed. However, upon reaching endodermis which is impervious to water, water moves through symplast. From here, water passes into pericycle and finally reaches xylem.
- Once inside xylem, water is again free to move between cells, along the pressure gradient.

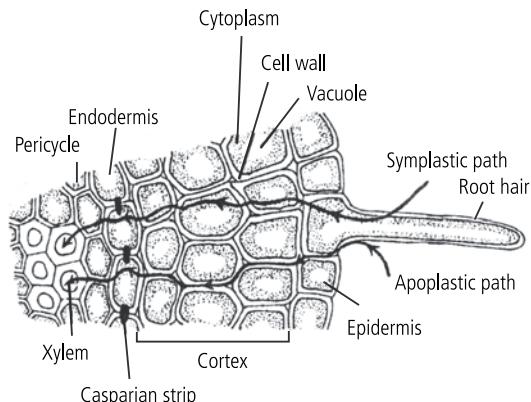


Fig.: Symplastic and apoplastic pathways of water movement in root

Some plants have additional structures associated with them that help in water (and mineral) absorption. A **mycorrhiza** is a symbiotic association of a fungus with a root system. The fungal filaments form a network around the young root or they penetrate the root cells. The hyphae have a very large surface area that absorb mineral ions and water from a much larger volume of soil, that perhaps, a root cannot do. The fungus provides minerals and water to the roots; in turn, the roots provide sugars and N-containing compounds to the mycorrhiza. Some plants have an obligate association with the mycorrhiza. For example, *Pinus* seeds cannot germinate and establish without the presence of mycorrhiza.

Mechanism of Water Absorption

Water absorption is of two types. It largely depends on osmotic potential of soil solution.

Passive water absorption

- The absorption occurs independently of any root activity, along the potential gradient, hence called passive.
- Due to presence of osmotically active cell sap, water potential of root cells is negative (-3 to -8 bars) as compared to water potential of soil water (-0.1 to -0.3 bars). This results in movement of water into root hair cell.
- Once soil water enters the root hair cell, it passes into apoplast and symplast of cortical, endodermal and pericycle cells and finally into the xylem channels, owing to very low water potential due to tension caused by transpiration in aerial parts.
- The rate of water absorption is approximately equal to the rate of transpiration.
- It is manifested in the form of transpiration pull.

Active water absorption

- The absorption occurs due to forces or activity of roots itself.
- The osmotic potential of soil solution plays a very important role in the absorption of water.
- The absorption takes place due to osmotic differences between soil water and cell sap.
- The soil water have less OP therefore greater water potential as compared to cell sap having higher OP and hence more negative water potential. Thus, the water enters into the cell sap due to water potential gradient.
- The water moves from cell to cell, along the concentration gradient and finally reaches endodermis and pericycle, from where it enters xylem and is translocated upwards.
- It is manifested in the form of root pressure.

ASCENT OF SAP

- The upward movement of sap (water with dissolved nutrients) from the roots towards the tips of stem branches and leaves is referred to as **ascent of sap**.
- This upward movement of water occurs through tracheary elements of xylem, against the force of gravity.
- The sap is lifted to great heights upto 110-130 m of tall trees. The rate of translocation is 25-75 cm/minute.
- Various theories have been put forward to explain the mechanism of ascent of sap. Among them, the main are vital force theory, root pressure theory and transpiration pull theory.

Vital Force Theory

- A common vital force theory about the ascent of sap was put forward by **Sir J.C. Bose** in 1923. It is called **pulsation theory** and it believes that the innermost cortical cells of the root absorb water from the outer side and pump the same into xylem channels.

Root Pressure Theory

- Root pressure theory was put forward by **Priestley (1916)**. Root pressure refers to **positive hydrostatic pressure** which sometimes develops in the xylem sap of roots as a result of metabolic activities of roots. It is a manifestation of active water absorption.
- Root pressure is observed in certain seasons which favour optimum metabolic activity and reduce transpiration. Root pressure is maximum during rainy season (in tropical regions) and spring season (in temperate habitats). It is retarded or absent under conditions of starvation, low temperature, drought and reduced availability of oxygen. Root pressures are usually not more than **+1 to +2 bars**. Therefore, it could account for the ascent of sap only to a height of about 20 m.
- Hence, this theory can account for the ascent of sap only in the herbaceous plants. The magnitude of pressure developed is too small to push the water to the apical regions, in the tall trees. Besides, root pressure is not found in all plants. No or little root pressure is found in gymnosperms which have some of the tallest trees in the world. In rapidly transpiring plants, no root pressure is found, instead a negative pressure is found under such conditions.

Transpiration Pull or Cohesion-Tension Theory

- This is the most widely accepted theory for ascent of sap, proposed by **Dixon and Jolly** in 1894.
- The key features of this theory are:
 - Transpiration pull is exerted on the water column.
 - Continuous water column in xylem is due to cohesive and adhesive properties of water molecule.

Transpiration pull

- Water is lost from mesophyll cells to the intercellular spaces of leaves as a result of **transpiration**. The water vapours move out of the plant through stomata. As a result of loss of water from mesophyll cells, the **diffusion pressure deficit (DPD) increases**.
- With the increase of diffusion pressure deficit, these cells absorb water from adjoining cells, ultimately the water is absorbed from xylem elements of vascular bundles of leaf.
- Since the xylem elements are filled with continuous water column, a tension or pull called **transpiration pull** develops at the top of the column. This tension or pull is transmitted down from petiole to stem and finally to roots leading to upward movement of water.

Cohesion and adhesion of water in xylem

- Xylem tracheids and trachea are long tubular structures filled with water, extending from root to leaf. Thus, one end of xylem (continuous with one another) is in the root and other end is in the leaf. Water molecules remain attached to one another by a strong mutual force of attraction called **cohesive force**, which is due to the presence of **hydrogen bonds** amongst adjacent water molecules.
- Supplementing the cohesion between water molecules is **adhesion** between water molecules and the walls of tracheary elements of xylem. Thus, according to this theory, water ascends in the plant because of transpiration pull and this column of water remains continuous because of cohesive and adhesive forces of water molecules. Cohesion and adhesion produces **surface tension** that accounts for high capillarity through tracheids and vessels.

TRANSPERSION

- The loss of water in the form of vapours from the living tissues of aerial parts of plant is called transpiration.
- Approximately 98-99% of water absorbed by a plant is lost in transpiration, 0.2% is utilised in photosynthesis while the remaining is retained in the plant during growth.
- Most of the transpiration (90%) occurs through foliar surface (leaves) and is known as **foliar transpiration**. Rest of the parts as young stem, flowers, fruits, etc., also transpire. Transpiration from stem is called **cauline transpiration**.

Cuticular transpiration

Occurs through the **cuticle** or **epidermal cells** of the leaves and constitutes only 3-10% of the total transpiration. It continues throughout day and night. In herbaceous shade loving plants, it may be upto 50% of the total transpiration due to their thin cuticle.

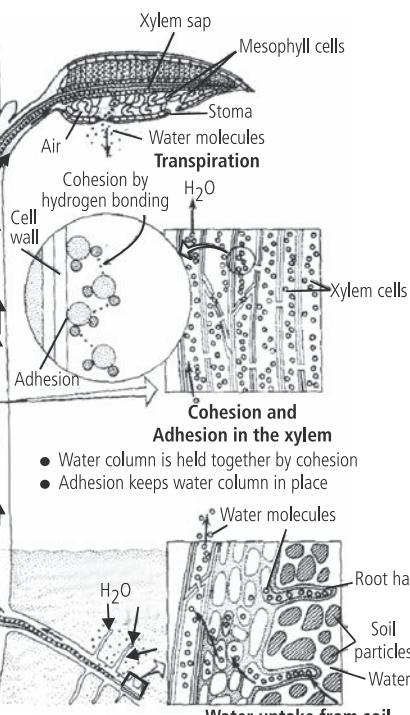


Fig. : Transpiration pull, cohesion of water molecules and adhesion between water molecules and wall of xylem elements

Stomatal transpiration

Occurs through **stomata**, and constitutes about 50-97% of the total transpiration. The stomatal transpiration continues till the stomata are kept open.

Types of transpiration

Lenticular transpiration

It is found only in the **woody branches** of the trees where lenticels occurs and constitute only 0.1% of the total transpiration. It continues throughout day and night.

Bark transpiration

Occurs through **corky covering** of the stems. Bark transpiration is very little but its measured rate is often more than lenticular transpiration due to larger area. Bark transpiration also occurs continuously during day and night.

Stomatal Apparatus

- The stomata are **tiny pores** present in the **epidermal surface** of leaves, young stems and in certain fruits (e.g., banana, *Citrus*, cucumber, etc.).
- It is surrounded by kidney shaped or bean shaped epidermal cells called **guard cells**. In monocots, the guard cells generally are **dumb-bell shaped**. These cells are living, have nucleus, chloroplasts and cytoplasm.

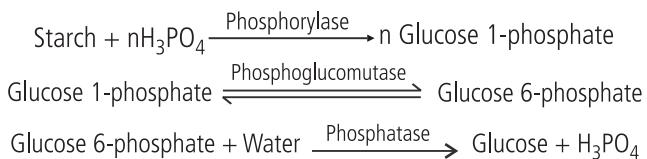
- The walls of guard cells are thickened on inner side and have one or two pairs of wall extensions or **ledges** to prevent entry of water drops into stomata.
- The outer walls of guard cells are thin and more elastic. These guard cells are surrounded by some specialised epidermal cells called **subsidiary cells** or **accessory cells**.
- Stomata are meant for gaseous exchange during photosynthesis and respiration as well as they are the main source of transpiration.
- When turgidity increases within the two guard cells flanking each stomatal aperture or pore, the thin outer walls bulge out and force the inner walls into a crescent shape. The opening of the stomata is also aided due to the orientation of the **microfibrils** in the cell walls of the guard cells.
- When the guard cells lose turgor, due to water loss (or water stress), the elastic inner walls regain their original shape, thus, the guard cells become flaccid and the stomata get closed.

Mechanism of stomatal movement

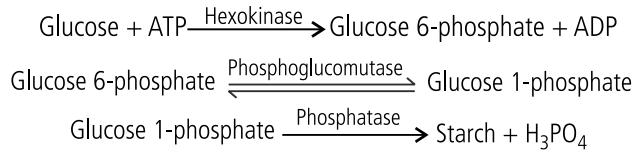
- Various theories about the mechanism of stomatal movements have been proposed, of which, the two most important theories are discussed here.

Starch sugar interconversion theory

- This was proposed by **Lloyd** and **Sayre** but was later modified by **Steward** in 1964.
- According to this theory, change in pH affects the opening and closing of stomata. This change in pH is due to the presence or absence of CO_2 which is dependent on availability of light.
- During day time, in the presence of light, CO_2 is utilised for photosynthesis and hence does not accumulate in the guard cells and pH of the guard cells increases to 7. Hence, the enzyme favours the formation of glucose-1-phosphate from starch and inorganic phosphate.



- Glucose being osmotically active, lowers the water potential of the cell sap, thus there is an influx of water into the guard cells and the stomata open.
- At night, in the absence of light, CO_2 evolved in respiration accumulates in the cell sap and dissolves in water to form carbonic acid and pH of the cell sap decreases to 5 (acidic).
- At this pH, starch synthesis is favoured from glucose-1-phosphate.



- Starch being osmotically inactive, decreases the osmotic concentration of guard cell. Thus, water moves out and guard cells become flaccid and stomata close.

Absence of glucose in guard cells at the time of stomatal opening.

Opening and closing of stomata is rapid while sugar changes are slow.

Objections to starch sugar interconversion theory

Carbon dioxide concentration alone does not account for wide changes in pH of guard cells.

Hydrolysis of starch does not explain the increase in osmotic pressure of guard cells.

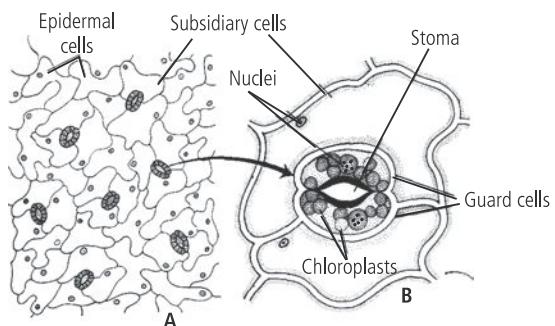
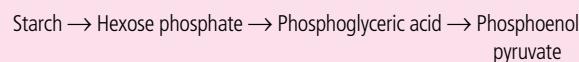


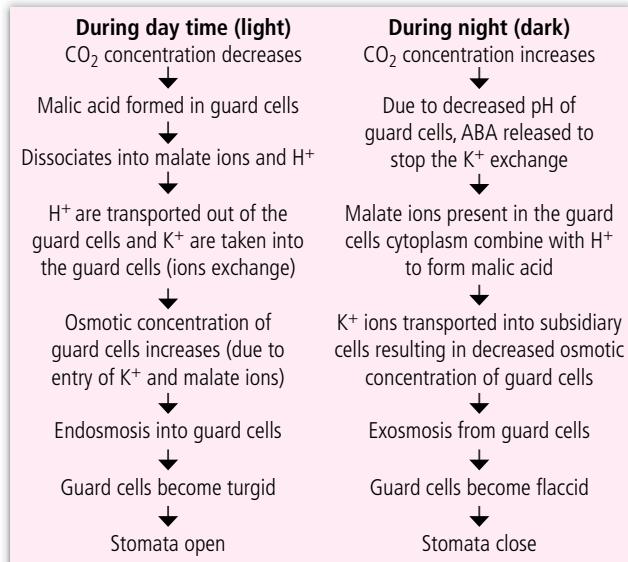
Fig.: A. Lower epidermis of a leaf to show stomata
B. Structure of stomata

Malate or K⁺ ion pump hypothesis

- This theory was put forward by **Levitt** in **1974** and is the most widely accepted theory.
- According to this theory, the pH of the guard cells rises due to active H⁺ uptake by guard cell chloroplasts or mitochondria, CO₂ assimilation by mesophyll and guard cells.
- The rise in pH causes hydrolysis of starch to form organic acids i.e., phosphoenol pyruvate.



- Phosphoenol pyruvic acid then combines with CO₂ in the presence of PEP carboxylase enzyme to produce oxaloacetic acid (OAA) and then malic acid.



Flow chart : The events leading to stomatal opening and closing during light and dark

CO₂ concentration affects stomatal movements. High CO₂ concentration in intercellular spaces of leaves causes closure of stomata while low CO₂ concentration induces its opening.

Growth hormones like cytokinins are essential for opening while ABA takes part in stomatal closure.

Minerals like K⁺ and a number of other minerals, e.g., P, N, Mg, Ca, etc. are also essential for stomatal movements.

Factors affecting stomatal movement

Light intensity is required for opening (light) and closing (darkness) of stomata. Maximum opening occurs in red and blue light.

Temperature leads to opening of stomata upto certain extent only. Normally, high temperature above 30°C leads to closing of stomata even in daytime.

Water stress or deficiency causes closure of stomata due to rise in DPD of epidermal cells.

Factors Affecting Transpiration

External factors

Light

Increase in light intensity increases transpiration.

Temperature

Rate of transpiration is directly proportional to increase in temperature. It doubles with every 10°C rise and decreases with low temperature.

Relative humidity

The rate of transpiration is inversely proportional to the relative humidity i.e., the rate of transpiration increases when relative humidity is lower and decreases with increase in relative humidity.

Atmospheric pressure and wind velocity

The rate of transpiration increases with low atmospheric pressure, which enhances evaporation. The wind velocity increases the rate of transpiration by removing saturated air around the leaves.

Availability of water

Reduced availability of soil water causes wilting or loss of turgidity resulting in drooping and rolling thus reduces transpirational rate.

Internal factors

Leaf area

Greater the leaf area, more is the rate of transpiration.

Leaf structure

Various aspects like thickness of cuticle decreases transpiration. The number of stomata and type of stomata also influences the rate of transpiration. The sunken stomata reduces transpiration.

Root-shoot ratio

The low root-shoot ratio decreases the rate of transpiration while a high ratio increases the rate of transpiration.

Significance of Transpiration

- It controls the **rate of absorption of water** from soil and is responsible for **ascent of sap**.

- It helps in absorption of mineral salts.
- It regulates the plant temperature by contributing to cooling of leaves and also the surroundings.
- It protects the leaves from heat injury, particularly under conditions of high temperature and intense sunlight.

Transpiration as necessary evil

Transpiration causes loss of huge amount of water absorbed by plants and leads to wilting and injury in plants. It also checks photosynthesis, reduces growth and if too severe, may cause death due to desiccation.

In spite of various detrimental effects, the plants cannot avoid transpiration due to their peculiar structure of leaves which is basically meant for gaseous exchange during respiration and photosynthesis and also for the required pull for ascent of sap. Therefore, transpiration is also regarded as "necessary evil" by **Curtis** (1926) or "unavoidable evil" by **Steward** (1959).

Antitranspirants

- Plant antitranspirants are chemical substances, whether naturally synthesised by plants themselves or synthetic materials applied to plants, which reduce the rate of transpiration effectively.
- An ideal antitranspirant is one which decreases the transpiration rate without affecting CO₂ fixation in photosynthesis. There are two types of antitranspirants: **metabolic inhibitors** and **surface films**.

Metabolic inhibitors reduce transpiration by reducing the stomatal opening for a period of two or more weeks without influencing other metabolic processes. The most promising of these inhibitors is phenyl mercuric acetate. Another is abscisic acid (ABA). Film forming chemicals check transpiration by forming a thin film on the transpiring surface. They are sufficiently permeable to carbon dioxide and oxygen to allow photosynthesis and respiration but prevent movement of water vapours through them. The important chemicals of this group are silicon emulsions, colourless plastic resins and low viscosity waxes.

CO₂ is an effective antitranspirant which induces partial closure of stomata when its concentration is raised from 300 ppm in atmosphere to 500 ppm.

GUTTATION

- Loss or excretion of water in the **form of liquid droplets** from the tips and margins of leaves is called **guttation**. It was first studied by **Bergerstein** in **1887**. All plants do not show guttation.
- In general, guttation occurs when transpiration rate is very low as compared to rate of water absorption. Due to this, root pressure is developed and water is pushed out through specialised pores at vein endings called **hydathodes**. So guttation is not due to activity of hydathodes but due to root pressure.
- Each hydathode consists of a group of loosely arranged colourless parenchymatous cells called **epithem**. It lies over the tip of a vascular strand and communicates with the outside through a permanent pore in epidermis called **water pore** or **water stoma**.
- The guttated liquid is never pure water. It contains **0.6-2.5 gm/litre** of solutes— both organic (carbohydrates, organic acids, amino acids, enzymes) and inorganic (Ca²⁺, Mg²⁺, K⁺, Na⁺, CO₃²⁻, SO₄²⁻, Cl⁻). These salts sometimes are redissolved back into leaves and cause '**salt injury**'.
- Guttation takes place either at night or early in the morning. Dry soils, poorly aerated soils, heavily salted or mineral deficient soils and the atmospheric conditions promoting transpiration inhibit guttation.

BLEEDING

- It is the exudation of sap or watery solution from the cut or injured parts of the plant, e.g., *Agave*, *Acer*, *Vitis*, etc. It occurs due to root pressure, phloem pressure, local pressure in xylem (stem pressure) and latex or resin.

TRANSLOCATION OF MINERAL NUTRIENTS

Uptake of Mineral Ions

- Since minerals are present in the soil as charged particles and their concentration in soil is lower than that present in roots, the minerals cannot be passively absorbed by roots.
- Therefore, they are actively absorbed by the roots and require energy as movement of ions from soil to root occurs against concentration gradient.

- Specific proteins or ion pumps present in the membrane of root hairs actively pump ions into the cytoplasm of the epidermal cells.
- Transport proteins of endodermal cells act as control points which adjusts the quantity and types of solutes that reach xylem. The suberised root endodermis allows active transport of ions in one direction only *i.e.*, inwardly.

Translocation of Mineral Ions

- Once the ions reach xylem *via* active uptake through roots, it is transported upto all parts of plants through **transpiration stream**.
- In **xylem sap**, nitrogen travels as **inorganic ions**, as well as **organic form of amino acids** and related compounds. Small amounts of P and S are passed in xylem as organic compounds. There is also exchange of materials between xylem and phloem. Therefore, mineral elements pass up xylem in both inorganic and organic forms.
- They reach the area of their sink, namely young leaves, developing flowers, fruits and seeds, apical and lateral meristems and individual cells for storage. Minerals are unloaded at fine vein endings through diffusion. They are picked up by cells through active uptake.
- There is remobilisation of minerals from older senescing parts. The senescing leaves send out many minerals like nitrogen, sulphur, phosphorous, etc., to the young growing leaves and other sink *via* nickel.

TRANSLOCATION OF ORGANIC SOLUTES : PHLOEM TRANSPORT

- The movement of organic food or solute in soluble form from one organ to another organ is called translocation of solutes. It involves long distance transport of organic solutes from **source** (leaves, region of photosynthesis and storage) to **sink** (the region of utilisation).
- As the source-sink relationship is variable, the direction of movement of organic solutes in phloem can be **bidirectional** *i.e.*, upwards or downwards or **multidirectional** *i.e.*, upward, downward and lateral translocation.

Evidences in Favour of Downward Conduction of Solutes

- Downward conduction of solutes through phloem is evident from **ringing or girdling experiment**.
- In this experiment, all the tissues of the stem outside the vascular cambium are removed in a ring. The phloem is also removed. The upper part of the plant is attached to lower part only by external xylem cylinder and pith. Accumulation of food occurs in the form of swelling just above the ring, which suggests that in absence of phloem, downward translocation of food is stopped. In a girdled plant, **roots die first** and ultimately shoot dies. This is because the upper part of stem gets ample amount of water supply (as transport of water and minerals occurs through xylem). But as the roots die due to starvation, the upper part of stem also dies in the course of time.

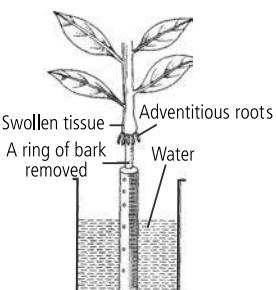


Fig.: Ringing (girdling) experiment

Mechanism of Phloem Translocation

- Several theories have been put forward to explain the mechanism of translocation of organic nutrients through phloem. The most accepted theory is of **Mass flow hypothesis** or **Pressure flow hypothesis** given by **Munch (1930)** and supported by Crafts.
- According to this theory, translocation of solutes takes place in bulk, through phloem along a gradient of turgor pressure from higher concentration of its soluble form (source) to lower concentration of its soluble form (sink). Because in leaves (source), osmotic concentration remains always high (due to photosynthesis) and in roots (sink), osmotic concentration remains low, so mass flow of organic food continues from leaves to roots (*i.e.*, along a gradient of turgor pressure).
- The organic substances present in mesophyll cells are passed into the sieve tubes through their companion cells by an active process. A high osmotic concentration, therefore, develops in the sieve tubes of the source.

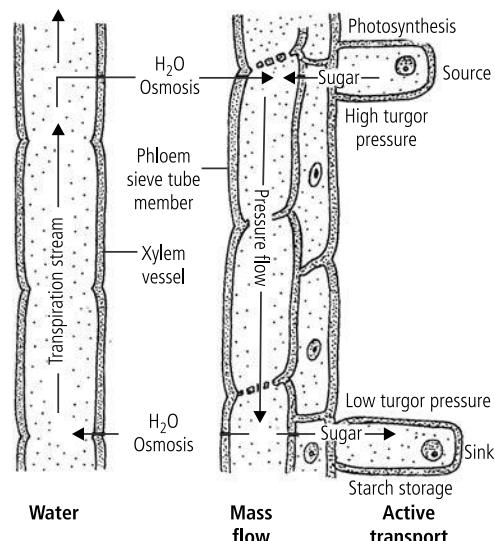


Fig.: Translocation of organic substances (assimilates) according to mass flow or pressure flow hypothesis

- Thus, the sieve tubes absorb water from the surrounding xylem and develop a high turgor pressure. It causes the flow of organic solution towards the area of low turgor pressure.
- A low turgor pressure is maintained in the sink region by converting soluble organic substances into insoluble form.

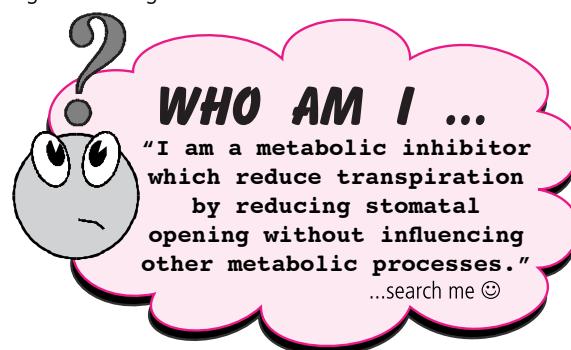
Objections to this theory

Vacuoles of adjacent sieve tube cells are not continuous. The cytoplasm near sieve plates exerts resistance to mass flow.

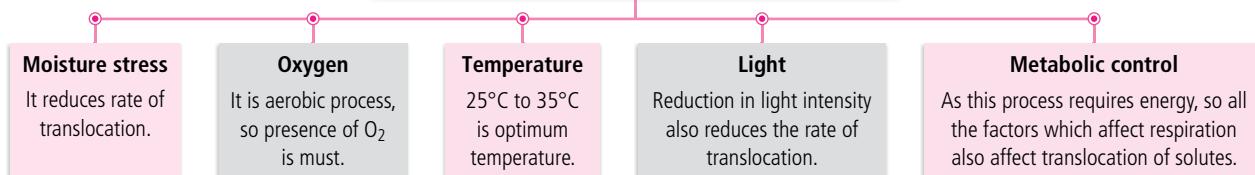
The rate of flow of water (72 cm/hr) and solutes (35 cm/hr) are different in the same sieve tube as observed by Catalado *et al* in 1972.

Water deficit does not affect phloem transport.

The cells at the source end of mass flow should be turgid but are often found to be flaccid as in germinating tubers, corms, etc.



Factors Affecting Translocation of Solutes

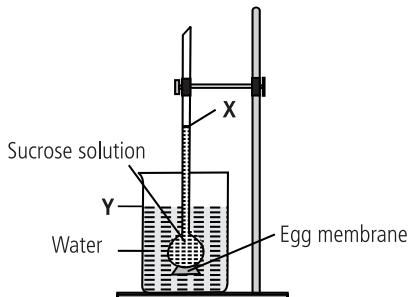


SPEED PRACTICE

- Which of the following transports take place across the biomembranes with the help of channel proteins ?
 - Simple diffusion
 - Active transport
 - Facilitated diffusion
 - Diffusion *via* uniport
- Which one of the following statements is incorrect ?
 - Cellulosic cell walls allow the passage of gases, solvent or solute.
 - Plasma membrane allows the selective passage of solute.
 - Suberised cell walls do not allow the passage of gases, solvent or solute.
 - Parchment membrane allows the movement of solute but prevent the movement of solvent molecules.
- Imbibition capacity is maximum in
 - proteins followed by starch, pectin and phycocolloids
 - phycocolloids followed by lignin, proteins and starch
 - proteins followed by lignin, starch and cellulose
 - phycocolloids followed by proteins, starch and cellulose.
- Match column I with column II and select the correct option from the codes given below.

Column I	Column II
(i) Osmotic potential of pure water	A. It is always less than zero
(ii) Chemical potential of pure water	B. It is always negative
(iii) Pressure potential	C. It is always zero
(iv) Water potential of solution	D. It is usually positive
(a) (i)-B, (ii)-C, (iii)-D, (iv)-A	
(b) (i)-A, (ii)-B, (iii)-C, (iv)-D	
(c) (i)-B, (ii)-C, (iii)-A, (iv)-D	
(d) (i)-A, (ii)-C, (iii)-D, (iv)-B	
- The swelling up of a plasmolysed protoplast under the influence of hypotonic solution is due to
 - endosmosis
 - imbibition
 - exosmosis
 - diffusion.
- Read the following statements and choose the correct one from the options given below.
 - Turgor pressure develops in a system due to osmotic entry of solvent in it.

- (ii) Diffusion pressure deficit develops in pure solvent due to increase in free energy of a solvent in an osmotic system.
- (iii) Osmotic pressure develops in a solution when it is separated from pure solvent by permeable membrane.
- (iv) Wall pressure develops due to force exerted by the wall over the protoplast against expansion of osmotic system.
- (a) (i) and (iii) only (b) (i) and (iv) only
 (c) (i), (ii) and (iii) only (d) (i), (ii), (iii) and (iv)
- 7.** Study the given table of differences between apoplastic and symplastic pathways and choose the incorrect ones.
- | Apoplast pathway | Symplast pathway |
|---|---|
| (i) Water passes from root hair to xylem through the wall of intervening cells. | Water passes from cell to cell through transmembrane pathway. |
| (ii) Apoplast pathway is directly affected by metabolic state of root. | Symplast pathway is not affected by metabolic state of root. |
| (iii) It is faster than symplast pathway. | It is slower than apoplast pathway. |
| (iv) It provides some resistance in the movement of water. | It provides no or little resistance in the movement of water. |
- (a) (i) and (ii) only (b) (ii) only
 (c) (iii) and (iv) only (d) (iii) only
- 8.** Water column present in tracheary elements in plants is maintained due to
 (i) transpiration pull
 (ii) cohesive and adhesive forces
 (iii) decrease in turgor pressure
 (iv) increase in diffusion pressure deficit.
 (a) (i), (ii) and (iii) only (b) (ii) and (iii) only
 (c) (i) and (iv) only (d) (i), (ii), (iii) and (iv)
- 9.** Match column I with column II and select the correct option.
- | Column I | Column II |
|---|--------------------|
| (i) Root Pressure Theory | A. J.C Bose |
| (ii) Vital Force Theory | B. Priestley |
| (iii) Theory of Capillarity | C. Dixon and Jolly |
| (iv) Cohesion Tension Theory | D. Levitt |
| (v) Malate Pump Hypothesis | E. Bohm |
| (a) (i)-A, (ii)-C, (iii)-B, (iv)-D, (v)-E | |
| (b) (i)-B, (ii)-A, (iii)-E, (iv)-C, (v)-D | |
| (c) (i)-C, (ii)-A, (iii)-D, (iv)-E, (v)-B | |
| (d) (i)-B, (ii)-C, (iii)-A, (iv)-D, (v)-E | |
- 10.** Read the given statements and select the correct option.
Statement A : Chresard is the amount of water available to plants from total water content present in soil.
Statement B : Chresard consist of hygroscopic water, combined water, water vapour and 25% of capillary water.
- (a) Both statements A and B are correct and B is the correct explanation of A.
 (b) Both statements A and B are correct but B is not the correct explanation of A.
 (c) Statement A is correct but statement B is incorrect.
 (d) Both statements A and B are incorrect.
- 11.** The most promising metabolic inhibitor which reduces transpiration by reducing the stomatal opening is
 (a) abscisic acid (b) phenyl mercuric acetate
 (c) silicon emulsion (d) carbon dioxide.
- 12.** Read the following statements and select the option which correctly fill the blanks.
 (i) The value of osmotic pressure depends on concentration of _____.
 (ii) A solution having high osmotic concentration as compared to another solution is _____.
 (iii) A positive pressure develops in a plant cell or system due to entry of water is called _____.
 (i) solute (ii) hypotonic (iii) suction pressure
 (b) solvent (iv) isotonic (v) osmotic pressure
 (c) solution (vi) hypotonic (vii) wall pressure
 (d) solute (viii) hypertonic (ix) turgor pressure
- 13.** Which of the following figures show incipient plasmolysis in *Spirogyra* cell?
-
- 14.** Which is most effective region of water absorption in roots ?
 (a) Zone of differentiation
 (b) Zone of elongation
 (c) Meristematic zone
 (d) Zone of mature cells
- 15.** The loss of water in the form of vapour during transpiration occurs mostly through
 (a) stomata (b) cuticle
 (c) bark (d) lenticels.
- 16.** Which of the following is responsible for opening of stomata?
 (a) High CO₂ concentration and availability of water
 (b) Low CO₂ concentration and high pH
 (c) Light and low pH
 (d) High pH and low osmotic concentration of guard cells



After few days, which of the following would have occurred?

- (a) A rise in level X and a drop in level Y
 - (b) A drop in level of both X and Y
 - (c) A rise in level of both X and Y
 - (d) A drop in level X and a rise in level Y

- 23.** Refer the given table and select the option that correctly fills the blanks in it.

Property	Simple diffusion	Facilitated transport	Active transport
Highly selective	A	Yes	B
Uphill transport	No	C	Yes
Requires ATP	No	D	Yes

- | A | B | C | D |
|----------|----------|----------|----------|
| (a) No | Yes | No | No |
| (b) Yes | Yes | Yes | No |
| (c) No | No | No | Yes |
| (d) No | Yes | Yes | Yes |

Ascent of sap is

 - (a) upward movement of water in the plant
 - (b) downward movement of organic nutrients
 - (c) upward and downward movement of water in the plant
 - (d) redistribution of inorganic substances in the plant.

A wooden peg inserted in a rock causes its breaking during the rainy season. It is due to development of

 - (a) turgor pressure (b) osmotic pressure
 - (c) imbibition pressure (d) plasmolysis.

A thin film of water, held by the soil particles, under the influence of internal attractive force, is called

 - (a) capillary water (b) combined water
 - (c) hygroscopic water (d) gravitational water.

Read the given statements and select the correct option.

Statement A : The process of diffusion does not require any input of energy.

Statement B : Diffusion involves movement of particles from a region of higher concentration to a region of lower concentration.

 - (a) Both statements A and B are correct and statement B is the correct explanation of statement A.
 - (b) Both statements A and B are correct but statement B is not the correct explanation of statement A.
 - (c) Statement A is correct and statement B is incorrect.
 - (d) Both statements A and B are incorrect.

28. If a soft stemmed plant, is cut horizontally near the base of its stem with a sharp blade on early morning of a humid day, drops of solution ooze through cut stem. This is due to
(a) guttation (b) bleeding
(c) transpiration pull (d) root pressure.

29. Stomata : Transpiration : : Hydathode :

30. Sunken stomata are found in

- (a) xerophytes (b) hydrophytes
(c) mesophytes (d) opsanophytes.

ANSWER KEY

- | | | | | | | | | | |
|------------|-----|------------|-----|------------|-----|------------|-----|------------|-----|
| 1. | (c) | 2. | (d) | 3. | (d) | 4. | (a) | 5. | (a) |
| 6. | (b) | 7. | (c) | 8. | (d) | 9. | (b) | 10. | (c) |
| 11. | (b) | 12. | (d) | 13. | (b) | 14. | (a) | 15. | (a) |
| 16. | (b) | 17. | (a) | 18. | (a) | 19. | (d) | 20. | (b) |
| 21. | (c) | 22. | (a) | 23. | (a) | 24. | (a) | 25. | (c) |
| 26. | (c) | 27. | (a) | 28. | (d) | 29. | (a) | 30. | (a) |

MPP

MONTHLY Practice Paper

Class XI

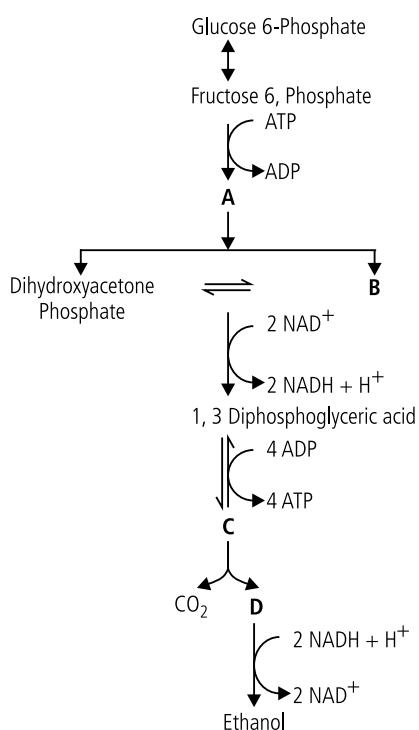
This specially designed column enables students to self analyse their extent of understanding of specified chapters. Give yourself four marks for correct answer and deduct one mark for wrong answer. Self check table given at the end will help you to check your readiness.



Total Marks : 160

Duration : 40 Min.

1. Observe the given flow chart showing steps of anaerobic respiration and identify the compounds A, B, C and D.



A	B	C	D
(a) Citrate	Pyruvic acid	Succinate	Glyceraldehyde 3-phosphate
(b) Succinate	Citrate	Pyruvic acid	Acetaldehyde
(c) Fructose 1, 6-Diphosphate	Glyceraldehyde 3-phosphate	Pyruvic acid	Acetaldehyde
(d) Glyceraldehyde 3-phosphate	Fructose 1, 6-biphosphate	Citric acid	Oxaloacetate

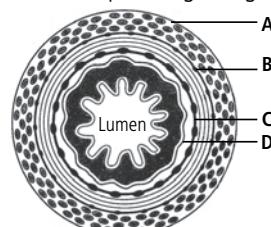
2. Thermoacidophiles are able to thrive in hot sulphur springs and low pH because of the presence of
 (a) pseudomurein in cell walls
 (b) branched chain lipids in cell membrane
 (c) long chain fatty acids called mycolic acids in cell wall
 (d) repeating units of N-acetyl glucosamine (NAG) and N - acetyl muramic acid (NAM) in cell wall.

3. Select the correct option that fills the blanks in the given statements correctly.
 (i) *Spirogyra* is also called A. It multiplies vegetatively by B.
 (ii) Bromine is obtained from C whereas potash is abundantly found in D.

A	B	C	D
(a) Gulf weed	fragmentation	<i>Gelidium</i>	<i>Corallina</i>
(b) pond scum	fragmentation	<i>Polysiphonia</i>	<i>Macrocystis</i>
(c) Irish moss	budding	<i>Chondrus</i>	<i>Dictyota</i>
(d) water silk	fission	<i>Fucus</i>	<i>Laminaria</i>

4. Identify the mismatched pair.
 (a) *Herdmania* - Vanadium
 (b) *Salamander* - Uropygial gland
 (c) *Pila* - Osphradium
 (d) *Hirudinaria* - Erythrocytus

5. Study the given diagram showing T.S. of alimentary canal and select the incorrect option regarding it.



- (a) A is made up of areolar tissue and is continuous with the mesentery.
 (b) B forms a network of nerve cells and parasympathetic nerve fibres and controls peristalsis.
 (c) C consists of network of nerve cells and sympathetic nerve fibres and controls secretion of intestinal juice.
 (d) D is a part of submucosa that forms gastric glands in the stomach.
- 6.** Consider the following statements regarding taxonomy and select the correct option.
 (a) Classical taxonomy employs only few characters of species for classification and is based upon typological concept.
 (b) Numerical taxonomy is based on one or more derived characters or ancestral characters and creates new subgroups on its basis.
 (c) Cladistic taxonomy classifies organisms on the basis of comparative cytological studies, number, structure and meiotic behaviour of chromosomes.
 (d) Cytotaxonomy classifies organisms on the basis of differences and similarities of large number of characters obtained through statistical methods from various branches of biology.
- 7.** Consider the given statements and select the correct option stating which statements are true (T) and which are false (F).
 (i) The colony of *Volvox* is called coenobium.
 (ii) *Gracilaria* is eukaryotic marine brown algae that grows in lagoons.
 (iii) *Adiantum*, also called male shield fern, is found in moist places and is perennial.
 (iv) Adders tongue fern has maximum number of chromosomes ($2n = 1262$).
(i) (ii) (iii) (iv)
 (a) F T F T
 (b) F T T F
 (c) T T F F
 (d) T F F T
- 8.** Match column I with column II and select the correct option.

Column I	Column II
(i) Arachnids	w. Respiratory trees
(ii) Apoda	x. Blood fluke
(iii) Holothuroidea	y. Book lungs
(iv) <i>Schistosoma</i>	z. Blind worms
(a) (i)-y, (ii)-z, (iii)-w, (iv)-x	
(b) (i)-z, (ii)-x, (iii)-y, (iv)-w	
(c) (i)-w, (ii)-z, (iii)-y, (iv)-x	
(d) (i)-x, (ii)-w, (iii)-y, (iv)-z	
- 9.** Consider the given statements and select the incorrect pair of statements from the options given below.
 (i) C_3 plants consume more energy (2 ATP molecules extra) than C_4 plants for fixing each molecule of CO_2 .
- (ii) During photosynthesis, blue light favours carbohydrate accumulation while red light stimulates protein synthesis.
 (iii) C_3 plants show optimum rate of photosynthesis at high oxygen concentration which starts declining with the decrease in O_2 content.
 (iv) The value of atmospheric CO_2 concentration at which the rate of photosynthesis is equivalent to rate of respiration is called compensation point.
(a) (i) and (iv) only (b) (ii), (iii) and (iv) only (c) (i), (ii) and (iii) only (d) All of these
- 10.** In monocots, the pericycle does not form
 (a) cambium (b) lateral roots
 (c) endodermis (d) central pith.
- 11.** The vertebral formula of humans is
 (a) $C_8 T_{10} L_{(4)} S_{(5)} C_6$ (b) $C_7 T_{12} L_{(5)} S_{(5)} C_4$
 (c) $C_7 T_{12} L_5 S_{(5)} C_{(4)}$ (d) $C_{12} T_7 L_5 S_{(5)} C_{(4)}$
- 12.** Read the given table and identify A, B and C.
- | Respiratory gases | Approximate partial pressure of gases | |
|----------------------------|--|-------------------------|
| | Deoxygenated blood (mmHg) | Oxygenated blood (mmHg) |
| Oxygen (PO_2) | 40 | A |
| Carbon dioxide (PCO_2) | B | 40 |
| Nitrogen (PN_2) | 573 | C |
- | A | B | C |
|----------|----------|----------|
| (a) 104 | 90 | 596 |
| (b) 95 | 45 | 573 |
| (c) 40 | 45 | 0 |
| (d) 95 | 32 | 565 |
- 13.** Out of the following reactions occurring during digestion of food the incorrect one is
 (a) Diglyceride $\xrightarrow{\text{Bile}}$ Emulsified fat
 (b) Proteins $\xrightarrow{\text{Pepsin}}$ Peptides
 (c) Casein $\xrightarrow{\text{Rennin}}$ Paracasein
 (d) Maltose $\xrightarrow{\text{Maltase}}$ Glucose + Glucose.
- 14.** The reserve food in euglenoids and diatoms respectively is
 (a) cyanophycean starch, chitin
 (b) paramylon, leucosin
 (c) lipid globules, volutin globules
 (d) leucosin, glycogen.

- 15.** Sugarcane and maize bear A roots while *Curcuma* and *Maranta* have B roots.

 - A - stilt
 - B - haustorial
 - A - stilt
 - B - nodulose
 - A - assimilatory
 - B - clinging
 - A - fusiform
 - B - napiform

16. Consider the following statements and choose the option with correct set of statements.

 - Thorns and spines are modified structures of leaves.
 - Phylloclade are flattened petiole that carries out the function of leaf lamina.
 - Betula* shows a compact unisexual, hanging spike which matures and falls as a single unit called catkin.
 - Carcerulus are schizocarpic fruits that develops from superior multilocular ovary.
 - (i) and (iii) only
 - (ii) and (iv) only
 - (iii) and (iv) only
 - (i) and (ii) only

17. Refer to the given reactions of photorespiration and identify the enzymes A, B and C respectively.

 - Glyoxylate + Glutamate $\xrightarrow{\text{A}}$ Glycine + α -ketoglutarate
 - Hydroxypyruvate + NADH $\xrightarrow{\text{B}}$ Glycerate + NAD⁺
 - Glycerate + ATP $\xrightarrow{\text{C}}$ 3-phosphoglycerate + ADP

Enzyme A	Enzyme B	Enzyme C
(a) Kinase	Catalase	Decarboxylase
(b) Reductase	Transketolase	Oxidase
(c) Transaminase	Reductase	Kinase
(d) Oxidase	Oxygenase	Phosphatase

18. Study the given figure of an electrocardiogram and select the incorrect statement.

The diagram shows a standard ECG tracing with the following features:

 - A small bump labeled "P" at the start of the cycle.
 - A sharp downward deflection labeled "Q".
 - A very tall, narrow upward deflection labeled "R".
 - A sharp downward deflection labeled "S".
 - A smaller upward deflection labeled "T".
 - A flat baseline between the cycles.
 - The lengthened P-R interval is due to inflammation of atria and AV node.
 - The enlarged Q-R wave indicates a myocardial infarction.
 - Flat T-wave denotes adequate oxygen supply.
 - Normal duration of P-R interval is < 0.12 to 0.2 s, QRS complex is < 0.10 s, and Q-T interval is < 0.42 s.

19. The thinning of excess flowers and young fruits in walnut to permit better growth of remaining fruits is achieved by applying

 - auxin
 - ethylene
 - gibberellin
 - cytokinin.

20. Identify the incorrect statement regarding given hormones.

 - Cortisol stimulates the breakdown of fats in adipose tissue and releases fatty acids in the blood.

- 27.** The type of respiration that occurs temporarily during starvation when both carbohydrates and fats are not available is referred to as
 (a) floating respiration (b) protoplasmic respiration
 (c) aerobic respiration (d) anaerobic respiration.
- 28.** The voluntary control of micturition by maintaining tonic contraction of the skeletal muscles forming the external sphincter is regulated by
 (a) hypogastric nerve
 (b) pelvic nerve
 (c) parasympathetic nerve
 (d) pudendal nerve.
- 29.** The flower showing floral formula $\oplus \varphi K_{(5)} C_{(5)} A_5 G_{(2)}$ belongs to Family
 (a) Liliaceae (b) Solanaceae
 (c) Poaceae (d) Ranunculaceae.
- 30.** Match column I with column II (There can be more than one match for items in column I).
- | Column I | Column II |
|-----------------|------------------------|
| P. Mycolic acid | (i) Kupffer's cell |
| Q. Pyrenoids | (ii) Massules |
| R. Lysosomes | (iii) <i>Spirogyra</i> |
| S. Sphaerosomes | (iv) <i>Nocardia</i> |
| T. Centriole | (v) <i>Ulothrix</i> |
| | (vi) Oleosins |
| | (vii) Leucocytes |
- (a) P-(iii), (v); Q-(i), (vii); R-(ii); S-(iv); T-(vi)
 (b) P-(iv); Q-(iii), (v); R-(i), (vii); S-(vi); T-(ii)
 (c) P-(vi); Q-(ii); R-(i), (vii); S-(iii), (v); T-(iv)
 (d) P-(ii), (iv); Q-(iii); R-(v); S-(vi); T-(i), (vii)
- 31.** The elements essential for the translocation of organic substances in the phloem are
 (a) manganese and copper (b) boron and potassium
 (c) molybdenum and zinc (d) sulphur and potassium.
- 32.** The given diagram represents the parts of human ear. Select the option which correctly identify any four of the labelled parts (A - K).
-
- (a) A - Pinna, C - Malleus, F - Incus, G - Cochlea
 (b) A - Lobule, F - Incus, I - Eustachian tube, J - Membranous labyrinth
 (c) D - Tympanic cavity, G - Stapes, I - Fenestra ovalis, K - Cochlea
 (d) B - Tympanic cavity, E - Incus, L - Stapes, H - Auditory nerve
- 33.** Mr. X has undeveloped and non-functional secondary sex organs, low pitched voice and does not produce sperms due to failure of testosterone secretion. He is suffering from
 (a) hypergonadism (b) eunuchoidism
 (c) hypogonadism (d) gynaecomastia.
- 34.** In order to initiate nodule formation by bacteria, the roots of a legume secrete a chemical attractant known as
 (a) betaines (b) leghaemoglobin
 (c) ammonia (d) hydrazine.
- 35.** The receptors present in free nerve endings that respond to pain are
 (a) algosireceptors (b) statoreceptors
 (c) caloreceptors (d) tangoreceptors.
- 36.** Consider the following statements regarding glomerular filtration and choose the incorrect one.
 (i) Glomerular filtrate and blood plasma are similar in composition except that the glomerular filtrate is devoid of blood corpuscles.
 (ii) There is continuous ultrafiltration through glomerular capillaries due to high blood pressure in them.
 (iii) An increase in blood pressure in afferent arterioles decreases the blood flow to glomerulus, thus affecting the glomerular filtration rate.
 (iv) Constriction of renal arteries by sympathetic nerves decreases the filtration rate.
 (a) (i) and (iv) only (b) (ii) and (iii) only
 (c) (i) and (iii) only (d) (ii) and (iv) only
- 37.** Select the mismatched pair.
- | | |
|----------------|-------------------------|
| (a) Usnic acid | - <i>Cladonia</i> |
| (b) Terramycin | - <i>S. ramosus</i> |
| (c) Halophile | - <i>Sulfolobus</i> |
| (d) Penicillin | - <i>P. chrysogenum</i> |
- 38.** Identify the hormone from given functions.
- (I) It causes involuntary contraction of walls of intestine, urinary bladder and blood vessels.
 (II) It reabsorbs water from the distal convoluted tubule and collecting ducts of the nephron of kidneys.
 (a) Pitressin (b) Oxytocin
 (c) Cortisone (d) Aldosterone
- 39.** Identify the hormone from given functions.
- (I) Dicot leaves are dorsiventral whereas monocot leaves are isobilateral.
 (II) Cellular slime moulds have multinucleate protoplasmic body called plasmodium.
 (III) During nitrification, ammonium ions are oxidised to nitrites with the help of *Nitrobacter* bacteria and nitrites are changed to nitrates by *Nitrosomonas* bacteria.

- (IV) The substrate for photorespiration are glucose and organic acids.
 (V) Pepsin and renin enzymes are absent in invertebrates.
 (a) (I), (III) and (V) only (b) (I) and (V) only
 (c) (III) and (V) only (d) (I), (III) and (IV) only

- 40.** A person faces difficulty in understanding spoken or written words due to the injury in a particular area of the temporal lobe of cerebrum. This neural disorder is
 (a) Broca's aphasia (b) Wilson's disease
 (c) Wernicke's aphasia (d) schizophrenia.

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SELF CHECK



No. of questions attempted
 No. of questions correct
 Marks scored in percentage

Check your score! If your score is

> 90%	EXCELLENT WORK !	You are well prepared to take the challenge of final exam.
90-75%	GOOD WORK !	You can score good in the final exam.
74-60%	SATISFACTORY !	You need to score more next time.
< 60%	NOT SATISFACTORY!	Revise thoroughly and strengthen your concepts.

T.H. MORGAN

THE FLYMAN OF GENETICS



Thomas Hunt Morgan (1866-1945) was an American evolutionary biologist and father of experimental genetics who won Nobel Prize in Medicine in 1933 for discovering the role of 'chromosomes in heredity'. He was born on September 25, 1866, at Lexington, Kentucky, U.S.A. to Charlton Hunt Morgan and Ellen Key Howard Morgan.

Morgan at age of 16, in the preparatory department, attended the state college of Kentucky (now the University of Kentucky) where he took B.Sc degree in 1886. He did his postgraduate work at Johns Hopkins University, where he studied morphology with W.K. Brooks and physiology with H.Newell Martin.

His doctoral dissertation was a thorough and well-respected investigation of the embryology of sea spiders. Under Brooks, Morgan completed his thesis work on the embryology of sea spiders – collected during the summers of 1889 and 1890 at the Marine Biological Laboratory in Woods Hole, Massachusetts – to determine their phylogenetic relationship with other arthropods. He concluded that with respect to embryology, they were more closely related to spiders than crustaceans. Based on the publication of this work, Morgan was awarded his Ph.D. from Johns Hopkins in 1890 and was also awarded the Bruce Fellowship in Research and visited Europe, working especially at the Marine Zoological Laboratory at Naples which he visited again in 1895 and 1900.

From 1891-1904 he was a Professor at Bryn Mawr College, where he taught biology and other natural science subjects. He continued his own research and published books and papers on embryology and zoology. In 1904, he joined Columbia University as Professor of Experimental Zoology.

There, Morgan had become interested in species variation and in 1911, he established the "Fly Room" to determine how a species

changed over time. For the next 17 years, in a 16 X 23 ft. room, described by many as cramped, dusty, smelly and cockroach ridden. Morgan and his students did ground-breaking genetic research using *Drosophila melanogaster* or fruit fly. Morgan and his students (Alfred Sturtevant, Calvin Bridges, Hermann Muller and others), developed the ideas and provided the proof for the chromosomal theory of heredity, genetic linkage, chromosomal crossing over and non-disjunction. He demonstrated linkage and in his first paper he dealt with the demonstration of sex linkage of the gene for white eyes in the fly, the male fly being heterogametic. On the basis of the analysis of large body of facts, obtained by him, he put forward the theory of linear arrangement of the genes in the chromosomes, expanding his theory in his book, *Mechanism of Mendelian Heredity* (1915).

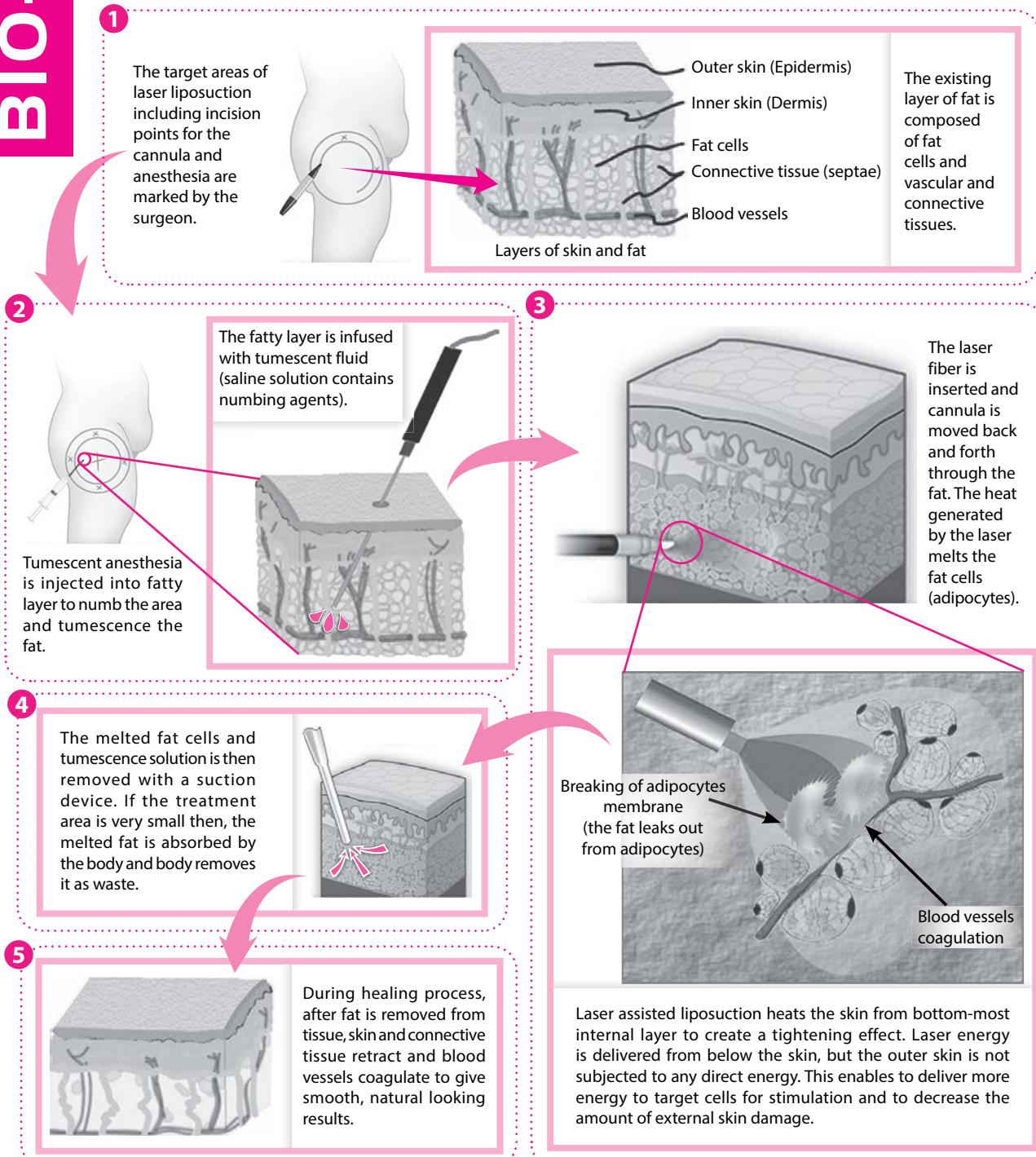
In addition to this genetical work, he also made contributions of great importance to experimental embryology and to regeneration. Among his many embryological discoveries, the demonstration that gravity is not, as Roux's work had suggested, important in the early development of the egg has great importance while to study regeneration he made several important contributions, an outstanding one being his demonstration that regeneration is not an adaptation evolved to meet the risks of loss of parts of the body as shown in Hermit Crab. On this part of his work he wrote his book *Regeneration*.

Morgan wrote many books such as *Heredity and Sex* (1913), the *Physical Basis of Heredity* (1919), *Evolution and Genetics* (1925) and *Experimental Embryology* (1927). In 1924, he was awarded the Darwin Medal and in 1939 the Copley Medal of the society. In 1933 he received Nobel Prize for his work in establishing the chromosomal theory of inheritance. Morgan married Lilian Vaughan Sampson, in 1904, who had been a student at Bryn Mawr college and who often assisted him in his research. They had one son and three daughters. Although Morgan officially retired from his position at Cal Tech in 1941, he continued to work in the lab until his death on 4th December 1945.



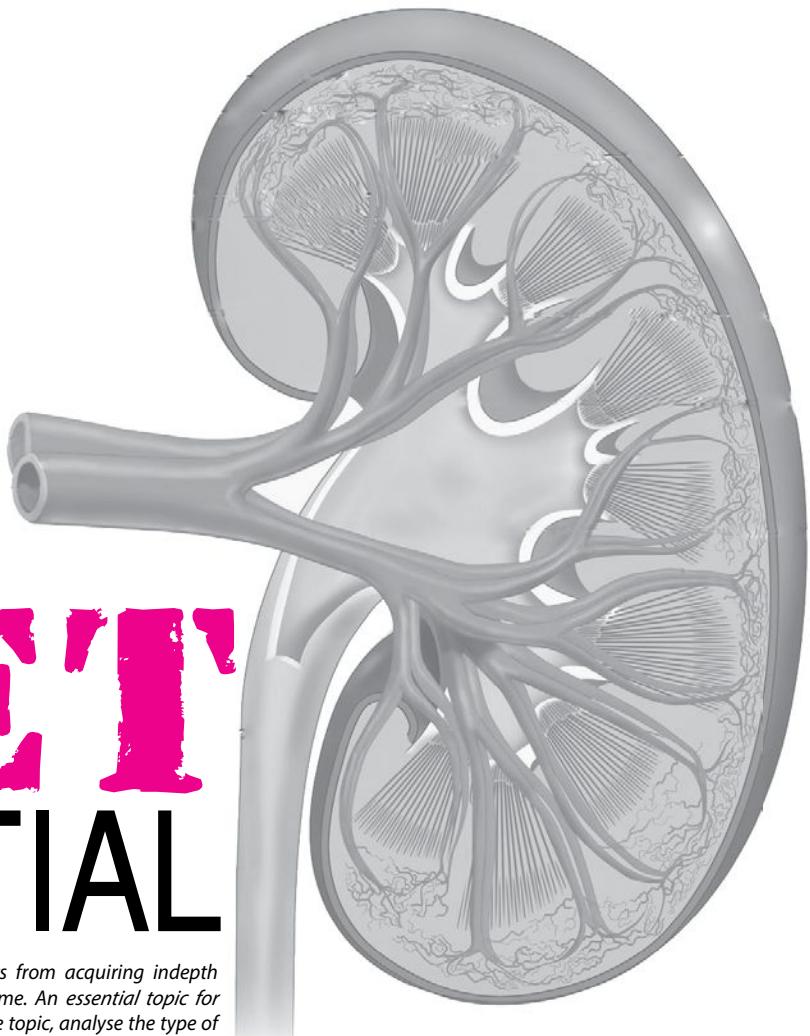
Laser Liposuction

Liposuction removes fat from the body using suction. During laser liposuction small, thin, blunt tipped tubes (cannula) are inserted through tiny cuts in the skin. This laser assisted procedure uses laser to rupture and liquefies fat cells instantly which makes them easier to remove through a much smaller incision. Fat is suctioned out through these cannula, as tubes are moved around under the skin to target specific fat deposits. The main purpose of liposuction is to reshape some areas of body and not to reduce body weight. It is used on "problem" areas that have not responded well to diet and exercise.



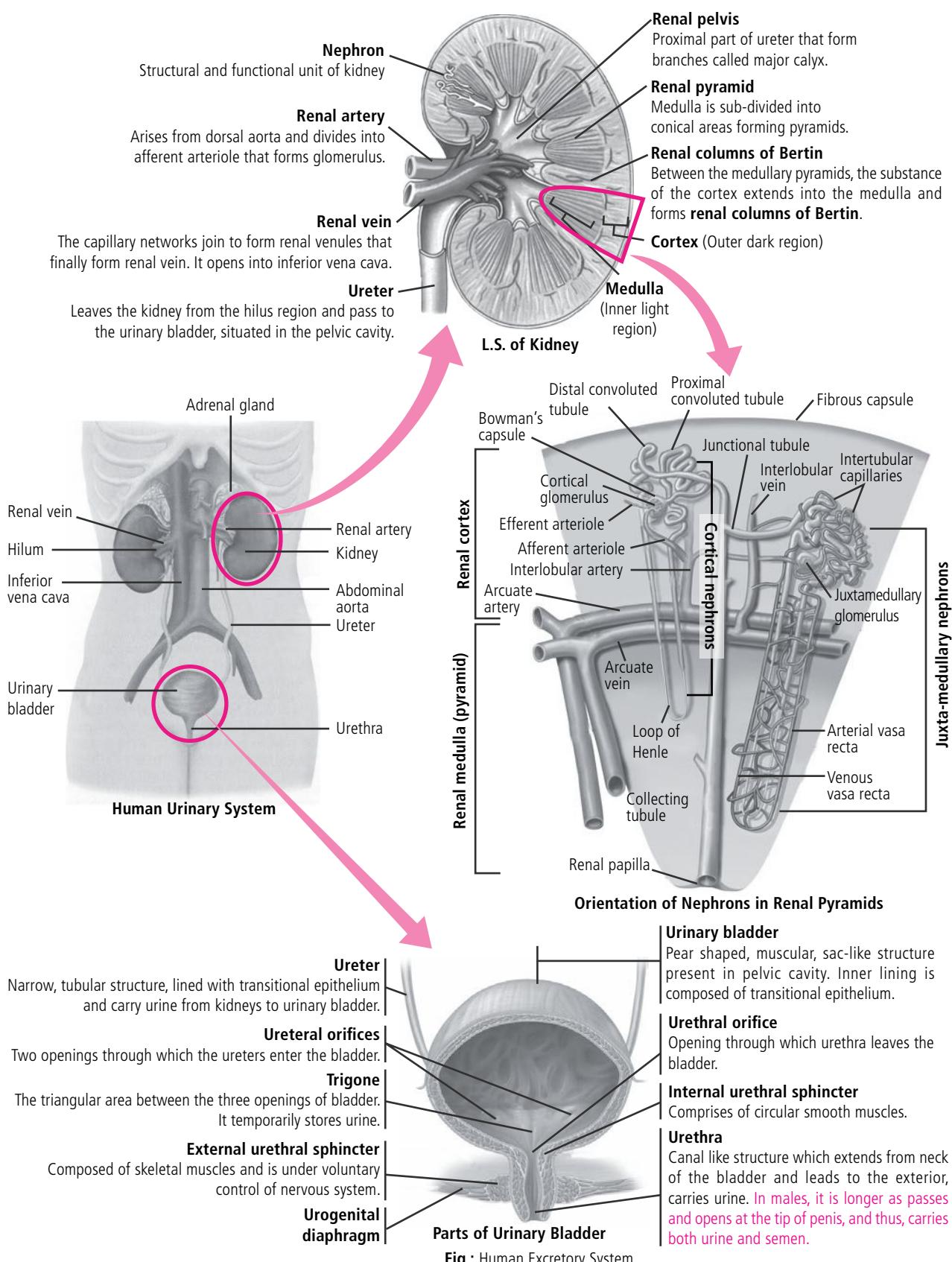
NEET' ESSENTIAL

The syllabus for NEET is very vast which impedes students from acquiring indepth knowledge and covering the entire syllabus at the same time. An essential topic for NEET is therefore presented here to enable students grasp the topic, analyse the type of questions and SCORE HIGH.



HUMAN EXCRETORY SYSTEM

- **Excretion** is the process of getting rid of waste products and nitrogenous by-products of metabolism. Through excretion, organisms control osmotic pressure, i.e., balance between inorganic ions and water and maintain acid-base balance. The process thus, promotes homeostasis.
- In humans, the excretory materials primarily consist of the waste products of metabolism, which include urea, (from proteins), uric acid (from nucleic acids), creatinine (from muscles), foreign chemicals as drugs, food additives, etc., and are excreted in urine, sweat and respiratory gases (CO_2).
- In humans, excretion takes place through a well developed system of organs called urinary system. The human excretory system includes a pair of kidneys, a pair of ureters, a urinary bladder and urethra.
- Besides kidneys, other organs like lungs, skin, liver, etc., are also associated with disposal of waste products.
- The excretory activity of the kidneys is modulated by specialised hormones that regulate the amount of absorption within the nephron, the functional unit of kidney.



Kidneys

- There is a pair of dark red, bean shaped kidneys, each with a notch called **hilus**, from where blood vessels, lymph vessels, nerves and ureter enter or leave the kidney.

Location

- They are located in upper dorsal region of abdominal cavity, on either side of vertebral column and are protected by floating ribs.
- The right kidney is slightly lower than left kidney because of the liver.

Structure

- Fibrous connective tissue layer, called **renal capsule** covers the kidney and protects it from infection and injuries.
- Renal capsule is surrounded by **adipose capsule** and another outer fibrous membrane, **renal fascia**. Both the layers protect the kidneys.
- Inner to renal capsule is outer dark reddish **cortex** and inner pale **medulla**.
- **Inner medulla** contains 10-15 medullary pyramids, which terminate into renal papilla.
- Papillae projects into 'calyces', such 10-15 minor calyces join to form two **major calyces** which come out through pelvis of kidney to the widened end of the ureter.

Table : Types of Nephron

	Cortical Nephrons	Juxta-Medullary Nephrons
(i)	They comprise 85%-86% of the nephrons in the kidney.	They comprise 14%-15% of the nephrons in the kidney.
(ii)	They have smaller size glomeruli located in the renal cortex.	They have larger size glomeruli located at the junction of the cortex and the medulla of the kidney.
(iii)	They possess short loops of Henle which penetrate only as far as the outer layer of the renal medulla before turning back to the cortex; some of their loops are restricted to the cortex.	They possess long loops of Henle which penetrate deep into the medulla and sometimes reach the tip of the renal papillae before turning back towards the cortex.
(iv)	The descending limb of loop of Henle contains a thin segment whereas ascending limb contains a thick segment .	Both the descending and ascending limbs of loop of Henle contain thin segments .
(v)	Its Henle loop manifest a vascular supply in the form of peritubular capillary plexus .	Its Henle loop manifest a vascular supply in the form of vasa recta .
(vi)	Rate of filtration is slow .	Rate of filtration is fast .
(vii)	These nephrons play a major role in excretion of waste products in dissolved form in the urine.	These nephrons are important in the 'counter current system' by which the kidneys concentrate urine .

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Nephron

- Nephrons are the basic functional units of kidney. There are approximately 1-1.3 million nephrons in each kidney which drain into renal pelvis. The total length of nephron ranges from 45-65 mm. It consists of two parts:

Renal Corpuscle

Glomerular membrane

Epithelium →

It has cells called **podocytes (foot cells)**, as they possess foot like processes called **pedicels**. The space between pedicels are called **slit pores** through which glomerular filtrate filters.

Endothelium →

Endothelium of glomerular capillaries is perforated by small holes called **fenestrae**. It allows plasma filtration with retention of plasma proteins and blood cells.

Basement membrane →

Provides bed for capillary endothelium and is mainly composed of meshwork of collagen and proteoglycan fibrillae, with large spaces through which fluid can filter.

Afferent arteriole →

Efferent arteriole →

Bowman's capsule

Double layered cup shaped structure. Lumen of capsule is **capsular space** continuous with narrow lumen of renal tubule. Outer parietal layer is composed of squamous cells and is continuous with proximal tubule and inner visceral layer surrounds glomerulus.

Glomerulus

Formed by invagination of a tuft of capillaries into Bowman's capsule. The capillaries are supplied by **afferent arteriole** and blood leaves from tuft by **efferent arteriole**.

Renal Tubule

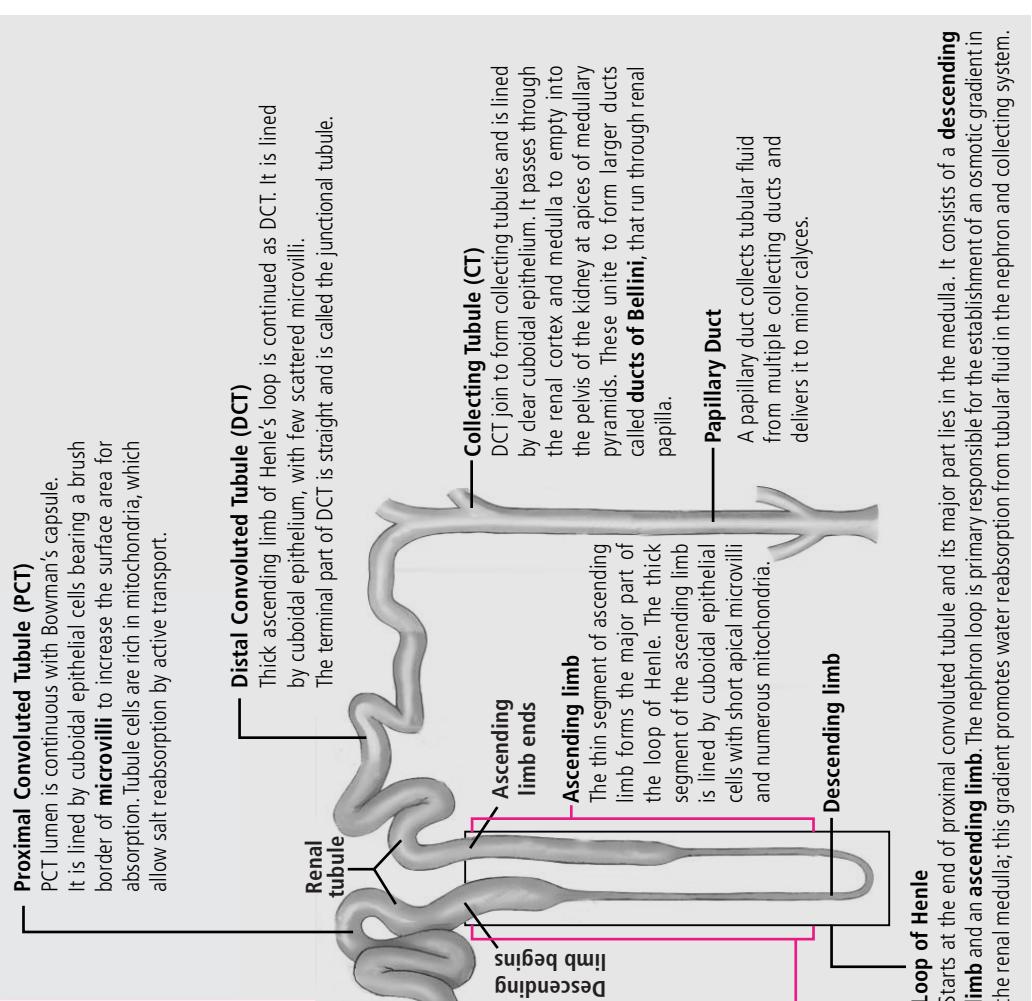


Fig.: The Structure of Nephron

Juxtaglomerular Apparatus (JGA)

- The JGA is a combination of specialised tubular and vascular cells located at the vascular pole where the afferent and efferent arterioles enter and leave the glomerulus.

It is composed of three types of cells:

- Juxtaglomerular cells (JG cells)-** These are smooth muscle cells of afferent and efferent arterioles which are swollen and contain dark granules.
 - JG cells have well developed Golgi apparatus and endoplasmic reticulum, abundant mitochondria and ribosomes. They synthesise, store and release a proteolytic enzyme **renin**, stored in granules of the JG cells.
 - JG cells are **baroreceptors** and respond to changes in pressure gradient between afferent arteriole and interstitium. They are innervated by sympathetic nerve fibres.
- Macula densa cells-** These are specialised tubular epithelial cells located at the site where thick segment of ascending limb of loop of Henle is continued as DCT.
 - These cells are in direct contact with mesangial cells, in close contact with JG cells, and adjoining with both the afferent and efferent arterioles.
 - The cells of macula densa have prominent nuclei and function as **chemoreceptors**, stimulated by decreased Na^+ load, thereby causing increased renin release.
- Mesangial cells or Lacs cells-** They are supporting cells located in the interval between macula densa and afferent and efferent arterioles. They bear processes that form a lace like network.
 - They are contractile and play a role in regulation of glomerular filtration.

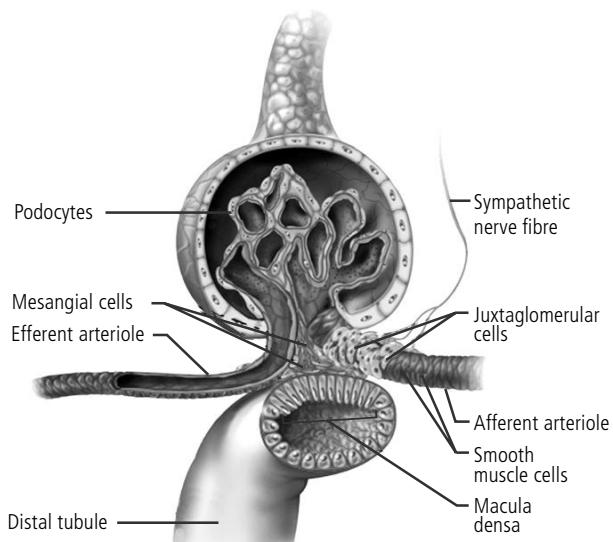


Fig.: Structure of Juxtaglomerular Apparatus

URINE FORMATION

- Urine formation involves three main processes, which take place in different parts of nephron.

Glomerular Filtration (Ultrafiltration)

- The first step in urine formation is filtration of blood. On an average, 1100-1200 ml of blood is filtered by kidneys per minute.
- The glomerular capillaries are narrower than the afferent renal arterioles. Therefore, the blood pressure in the glomerular capillaries becomes very high so that there is continuous process of ultrafiltration (filtration under pressure) through the semi-permeable glomerular capillaries. Thus, water and many dissolved substances from the blood are filtered into the lumen of the Bowman's capsule through its walls.
- The **glomerular filtrate** contains a large amount of water and other dissolved substances such as urea, uric acid, creatinine, amino-acids, glucose, sodium, potassium, vitamins, etc. The blood flows into efferent renal arterioles. Thus, the glomerular filtrate and blood plasma are similar except that glomerular filtrate does not have proteins and fats.

Urine Formation

Glomerular filtration Tubular reabsorption Tubular secretion

Myogenic mechanism

An increase in blood pressure increases blood flow to the glomerulus by stretching afferent arteriole. When the wall of the arteriole contracts, the diameter of the afferent arteriole is reduced that increases the flow of blood.

Neural control

Blood vessels of the kidney are innervated by nerve fibres of the sympathetic neural system. When activated, the nerve fibres bring about constriction of renal arteries and cause decrease in renal flow and glomerular filtration rate.

Autoregulation of glomerular filtration

Juxtaglomerular mechanism

Juxtaglomerular apparatus (JGA) cells secrete enzymes like renin that modulate blood pressure and thus renal blood flow. This regulates GFR.

Tubular Reabsorption

- Glomerular filtrate enters proximal convoluted tubule (PCT) from the Bowman's capsule. Tubular reabsorption is absorption of selected materials from the filtrate into blood of peritubular capillaries or vasa recta.

- Reabsorption involves both **passive** and **active transport** across the tubular epithelium.

Table : Tubular reabsorption of major substances in mammalian nephron

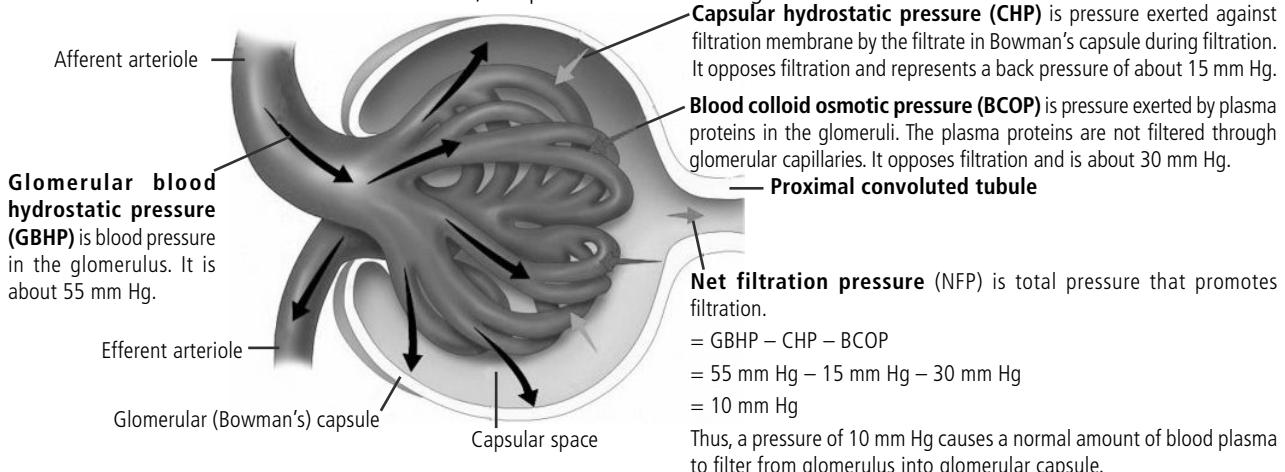
Part of tube	Reabsorption of various substances
1. Proximal convoluted tubule	<ul style="list-style-type: none"> 70-80% of electrolytes and water are reabsorbed in PCT. Maintains the pH and ionic balance of body fluids by selective secretion of hydrogen ions, ammonia and potassium ions into the filtrate and by absorption of HCO_3^- from it. Sodium and potassium are reabsorbed by primary active transport (energy derived from ATP or other high energy phosphate compound). Glucose and amino acids are reabsorbed by secondary active transport (energy is derived from ionic concentration gradients). Water is reabsorbed by osmosis. Chloride ions, urea and other solutes are reabsorbed by diffusion.
2. Loop of Henle (a) Descending limb of loop of Henle. (b) Ascending limb of loop of Henle	<ul style="list-style-type: none"> Permeable to water and almost impermeable to electrolytes. Water from filtrate is reabsorbed, but sodium and other solutes are not reabsorbed here. The filtrate thus becomes hypertonic to blood plasma.
	<ul style="list-style-type: none"> Impermeable to water but permeable to K^+, Cl^- and Na^+ and partially permeable to urea. As concentrated filtrate pass upward, it gets diluted due to passage of electrolytes to medullary fluid. Filtrate thus becomes hypotonic to blood plasma.
3. Distal convoluted tubule	<ul style="list-style-type: none"> Active reabsorption of sodium ions from the filtrate under the influence of aldosterone and water under the influence of antidiuretic hormone (ADH). Filtrate becomes isotonic to blood plasma.
4. Collecting Duct	<ul style="list-style-type: none"> The entire duct is permeable to water, thus considerable amount of water is reabsorbed here, under the influence of ADH which makes filtrate hypertonic to blood plasma. Sodium is reabsorbed under the influence of aldosterone. The filtrate is now called urine. Thus, urine is hypertonic to blood and isotonic to medullary fluid.

Tubular Secretion

- It is opposite of tubular reabsorption.
- It involves the removal of selected materials from the nephric filtrate into the blood of the peritubular blood capillaries.
- The removal of ammonia, urea, uric acid, creatine, creatinine, hippuric acid, etc from the blood into the filtrate takes place by secretion.
- Secretion of ammonia, potassium, hydrogen and HCO_3^- ions into the filtrate in distal convoluted tubule takes place by active transport only. Removal of H^+ and ammonia ions from the blood into the tubule maintains the pH of blood (6-8).

Pressures in Renal Circulation

- In the small arteries and afferent arterioles, the pressure is 100 mm Hg.



Glomerular filtration rate (GFR)

- It refers to the volume of the glomerular filtrate formed each minute by all the nephrons in both the kidneys.
- Normal value of GFR is 125 ml/minute or about 170-180 L/day.

Filtration fraction (FF)

- Filtration fraction is the fraction of renal plasma which becomes the filtrate. It is the ratio between renal plasma flow and glomerular filtrate.

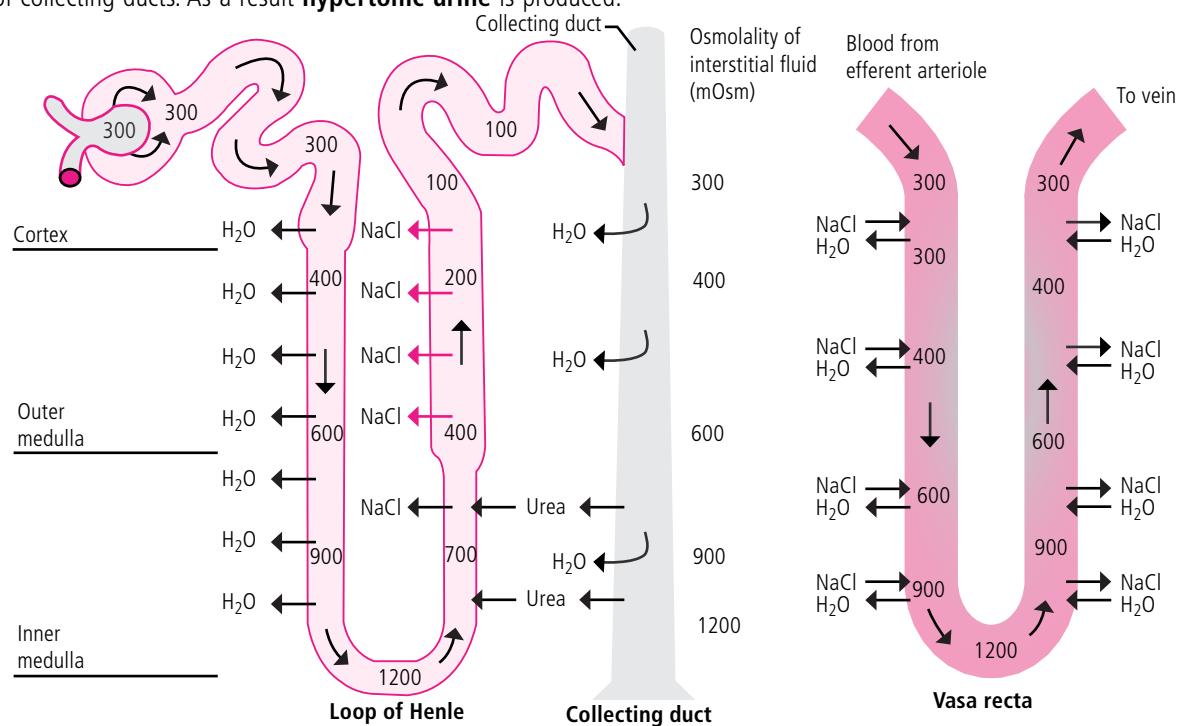
$$\text{Thus, filtration fraction} = \frac{\text{Glomerular filtration rate}}{\text{Renal plasma flow}} \times 100 = \frac{125 \text{ ml/min}}{650 \text{ ml/min}} = 19.2 \%$$

- The normal filtration fraction varies from 15-20%.

Increase in filtration fraction produces increase in protein concentration of blood of peritubular capillaries which leads to increase reabsorption in the PCT.

COUNTER CURRENT MECHANISM

- The kidneys possess a special mechanism for concentrating the urine, called counter current mechanism.
- Since the flow of filtrate in two limbs of loop of Henle is in opposite direction, it forms a counter current.
- The main function of counter current mechanism is to concentrate NaCl in interstitial fluid and causing water to diffuse out of collecting ducts. As a result **hypertonic urine** is produced.



Keys: = Active transport = Passive transport

Fig.: Counter Current Mechanism

MPP CLASS XI

ANSWER

KEY

- | | | | | |
|---------|---------|---------|---------|---------|
| 1. (c) | 2. (b) | 3. (b) | 4. (b) | 5. (d) |
| 6. (a) | 7. (d) | 8. (a) | 9. (c) | 10. (a) |
| 11. (c) | 12. (b) | 13. (a) | 14. (c) | 15. (c) |
| 16. (c) | 17. (c) | 18. (c) | 19. (b) | 20. (c) |
| 21. (d) | 22. (b) | 23. (a) | 24. (b) | 25. (b) |
| 26. (a) | 27. (b) | 28. (d) | 29. (b) | 30. (b) |
| 31. (b) | 32. (c) | 33. (b) | 34. (a) | 35. (a) |
| 36. (c) | 37. (c) | 38. (a) | 39. (b) | 40. (c) |

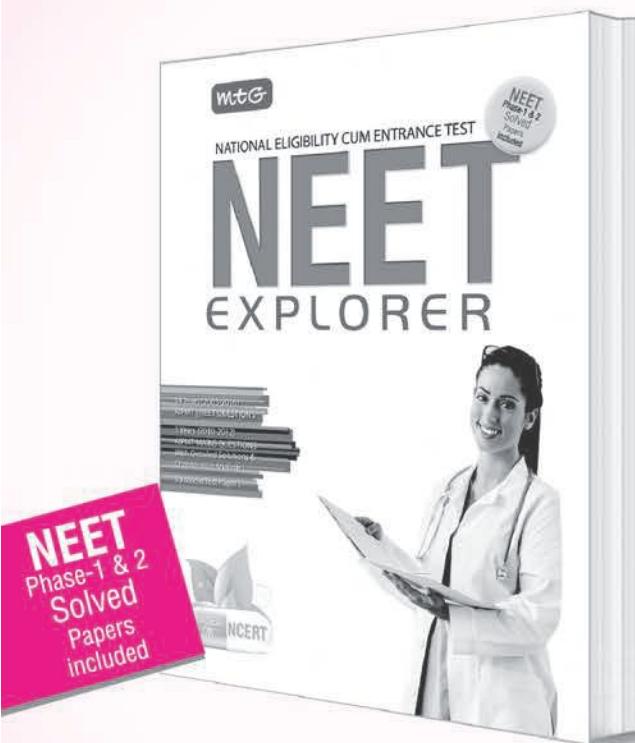
UNSCRAMBLED WORDS

JANUARY 2017

- | | |
|-----------------|------------------|
| 1-d-EPIBLEMA | 2-h-ROULEAUX |
| 3-g-BIOPIRACY | 4-i-EMASCULATION |
| 5-f-TYPHLOSOLE | 6-b-AMPHETAMINE |
| 7-e-INTERFERONS | 8-c-FUCOXANTHIN |
| 9-j-ARBOVIRUS | 10-a-HELICOTREMA |

Winners: Akshata Karur (Gujarat) Shreya Bhat (Karnataka), Subhojit Halder (Kolkata), Ujjwal Choudhary (New Delhi), Nitesh Kumar Sahoo (Odisha)

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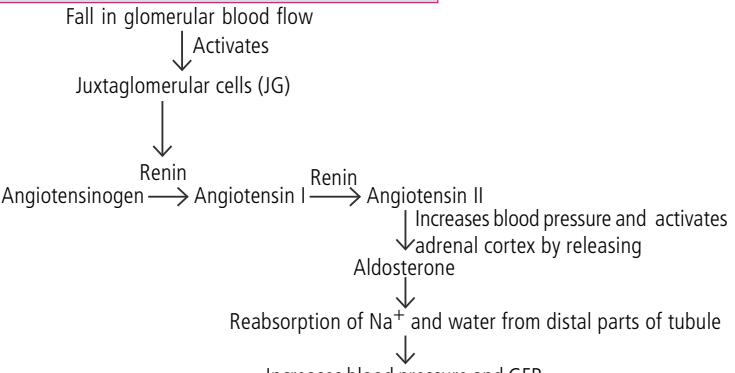
- This mechanism depends on the loops of Henle, vasa recta, collecting ducts and interstitial fluid.
- The proximity between the **loop of Henle's** and **vasa recta**, as well as the counter current in them help in maintaining an increasing osmolarity towards the inner medullary interstitial fluid, *i.e.*, from 300 mOsm L^{-1} in the cortex to about 1200 mOsm L^{-1} in the inner medulla. **This gradient is mainly caused by NaCl and urea.**
- NaCl is transported by the ascending limb of loop of Henle which is exchanged with the descending capillary of vasa recta. NaCl is returned to the medullary interstitial fluid by the ascending capillary of vasa recta.
- Small amounts of urea enter the thin segment of the ascending limb of loop of Henle which is transported back to the medullary interstitial fluid by the collecting duct.
- The counter current mechanism helps to maintain a concentration gradient in the medullary interstitial fluid which helps in an easy absorption of water from the filtrate present in the collecting duct. This increases the concentration of the filtrate (urine). Human kidneys can produce about four times concentrated urine than the initial filtrate formed.

Regulation of Kidney Function

Control by Antidiuretic Hormone (ADH)

- An excessive loss of fluid from the body can activate osmoreceptors which stimulate the hypothalamus to release ADH from neurohypophysis.
- ADH facilitates water reabsorption from latter parts of tubule, thereby preventing diuresis.
- Increase in body fluid volume can switch off the osmoreceptors and suppress the ADH release to complete the feedback.

Control by Juxtaglomerular Apparatus (JGA)



- Also called renin angiotensin mechanism.

Control by Atrial Natriuretic Factor (ANF)

- ANF opposes the regulation by RAAS. The walls of the atria of the heart release ANF in response to an increase in blood volume and pressure. ANF inhibits release of renin from the JGA and thereby inhibits NaCl reabsorption by the collecting duct and reduces aldosterone release from the adrenal gland. **Thus ADH, RAAS and ANF regulate the functions of kidneys. As a result they control body fluid osmolarity, salt concentration, blood pressure and blood volume.**

MICTURITION

- The expulsion of urine from the urinary bladder is called micturition.
- Micturition is a reflex process but in adults it can be controlled voluntarily to some extent.
- The urinary bladder and the internal sphincter are supplied by both **sympathetic** and **parasympathetic nervous systems** of autonomic nervous system whereas, the external sphincter is supplied by the **somatic nerve**.

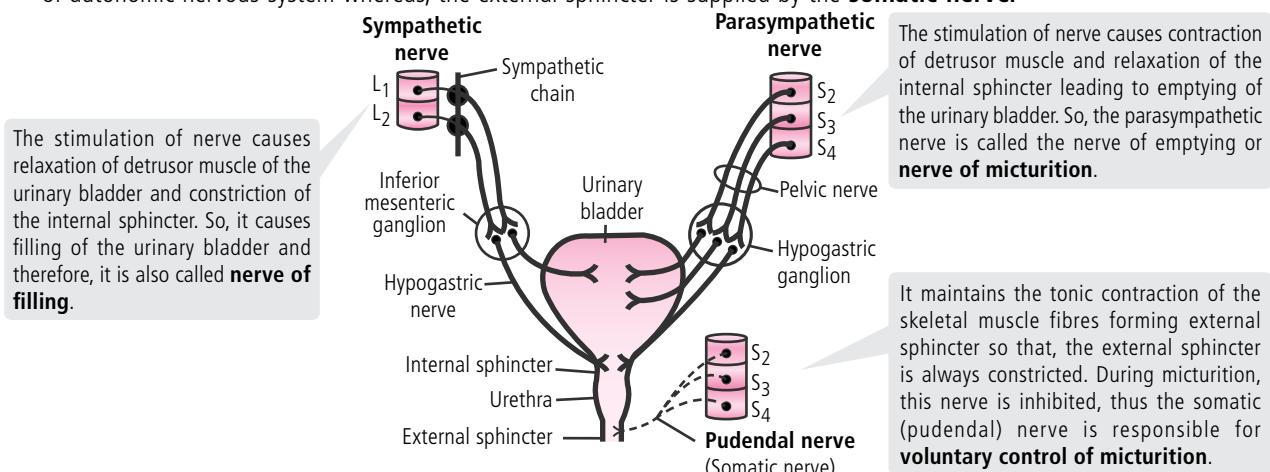


Fig.: Nerve supply to urinary bladder and sphincters

Constituents of Urine

Physical properties

- Urine is a transparent, light yellow liquid with a slightly acidic pH (average pH 6.0).
- The colour of urine is caused by the pigment **urochrome**, which is a breakdown product of haemoglobin from worn out red blood corpuscles.
- The pH range of urine is normally between 4.5 and 8.2 depending upon the amount of acidic and basic foods in the diet. Fruits increase the acidity and vegetables increase the alkalinity of the urine. A high-protein diet also produces an acid urine because of acidic products from amino acid metabolism.
- A normal adult person secretes about 1.5 litres of urine in 24 hours.
- Substances that increase the formation of urine are called diuretics such as tea, coffee and alcoholic beverages.
- When the urine is allowed to stand for some time it smells strongly of ammonia due to bacterial degradation of urea to ammonia.

Chemical composition

- About 95% of the volume of urine is water, other substances form only about 5%.
- Organic substances include nitrogen, urea, creatine, creatinine, ammonia, uric acid, hippuric acid, oxalic acid, amino acids, allantoin, vitamins, hormones and enzymes.
- The inorganic substances include chloride, phosphate, sulphate, potassium, sodium, calcium, magnesium, iodine, arsenic and lead.
- Glucose is normally absent in the urine.

Uremia

Uremia is characterised by high concentration of non-protein nitrogen which include urea, uric acid, creatinine, etc. Excess of urea accumulated in blood is removed by haemodialysis.

Renal Calculi

Formation of stone or insoluble mass of crystallised salts (oxalates, etc.) in kidney. It gives rise to severe colic pain.

Renal Failure

Decrease or cessation of glomerular filtration, when both kidneys abruptly stop working. The urine production is affected.

Diabetes Insipidus

Characterised by excessive dilute urine and intense thirst caused. It is by ADH deficiency.

DISORDERS OF EXCRETORY SYSTEM

Nephritis

Inflammation of kidney that may result from various causes. Also called Bright's disease.

Oedema

Accumulation of excess fluid in tissues is called oedema. It is an increase in the volume of extracellular fluids without a change in their osmolality. It is usually caused by an excess of sodium ions, which in turn causes water retention.

Renal Tubular Acidosis

Person is unable to secrete adequate quantities of hydrogen ions and as a result, large amounts of sodium bicarbonate are continuously lost into the urine.

Hypertension

Excessive secretion of renin leads to formation of angiotensin, resulting in hypertension.

GROUNDBREAKING DISCOVERY

US-Indian Teen Finds Cheap Way to Make Salt Water Drinkable

An Indian-American student has found a cheaper and easier method to turn salt water into drinkable fresh water and his research has caught the attention of major technology firms and universities.

Chaitanya Karamchedu from Portland, Oregon, is turning heads across the country all because of a science experiment that began in his high school classroom.

The Jesuit High School Senior told KPTV that he has big plans of changing the world.

"1 in 8 people do not have access to clean water, it's a crying issue that needs to be addressed," said Karamchedu. He made up his mind to address the matter himself.

"The best access for water is the sea, so 70 per cent of the planet is covered in water and almost all of that is the ocean, but the problem is that's salt water," said Karamchedu. Isolating drinkable water from the ocean in a cost effective way is a problem that has stumped scientists for years.

"Scientists looked at desalination, but it's all still inaccessible to places and it would cost too much to implement on a large scale," Karamchedu said. Karamchedu figured it out, on his own, in a high school lab.

"The real genesis of the idea was realising that sea water is not fully

saturated with salt," he was quoted as saying.

By experimenting with a highly absorbent polymer, the teenager discovered a cost effective way to remove salt from ocean water and turn it into fresh water.

"It's not bonding with water molecules, it's bonding to the salt," said Karamchedu.

"People have been looking at the problem from one view point, how do we break those bonds between salt and the water? Chai came in and thought about it from a completely different angle," said Jesuit High School Biology Teacher Dr. Lara Shamieh.

"People were concentrated on that 10 per cent of water that is bonded to the salt in the sea and no one looked at the 90 per cent that was free. Chai just looked at it and said if 10 per cent is bonded and 90 per cent is free, then why are we so focused on this 10 per cent, let's ignore it and focus on the 90," Shamieh said.

It is a breakthrough that is estimated to impact millions of lives if ever implemented on a mass scale.

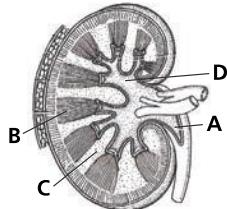
"What this is compared to current techniques, is that it's cheap and accessible to everyone, everyone can use it," said Shamieh.

Courtesy : The Economic Times

POWER EXERCISE

New MCQs

1. Refer to the given figure and identify the correct labellings for A-D.



A	B	C	D
(a) Renal pelvis	Medullary pyramid	Ducts of Bellini	Renal papilla
(b) Renal pelvis	Medullary pyramid	Renal column of Bertin	Major calyx
(c) Hilum	Renal papilla	Renal column of Bertin	Medullary Pyramid
(d) Ureter	Major calyx	Ducts of Bellini	Minor calyx

2. Which of the following statements is correct?
- (a) Lacin cells of JGA function as chemoreceptors that feed information to juxtaglomerular cells.
 - (b) PCT have numerous mitochondria for reabsorption of salt by active transport.
 - (c) Both glomerular hydrostatic pressure and capsular hydrostatic pressure oppose glomerular filtration.
 - (d) Tubular secretion takes place by both diffusion and active transport.
3. In which part of renal tubule, does filtrate become hypertonic to blood plasma?
- (a) Ascending limb of Henle's loop
 - (b) Proximal convoluted tubule
 - (c) Distal convoluted tubule
 - (d) Descending limb of loop of Henle
4. Match the following.

Column I	Column II
1. Podocytes	p. Macula densa cells
2. Juxtaglomerular apparatus	q. Parasympathetic nerve
3. Nerve of micturition	r. Visceral layer of Bowman's capsule
4. Detrusor muscle	s. Cortical nephron
	t. Basement layer of glomerular membrane
	u. Urinary bladder
	v. Pudendal nerve
(a) 1-r, 2-p, 3-q, 4-u	(b) 1-t, 2-p, 3-v, 4-u
(c) 1-r, 2-s, 3-q, v, 4-s	(d) 1-r, 2-p,s, 3-v, 4-t,u

5. Which of the following blood vessels constitute portal system?

- (a) Efferent arteriole and renal vein
- (b) Afferent arteriole and efferent arteriole
- (c) Efferent arteriole and peritubular capillary
- (d) Renal artery and peritubular capillary

6. Select the option which correctly fills the given blanks.

- (i) _____ nephrons are involved in counter current mechanism.
- (ii) _____ nephrons do not have vasa recta.
- (iii) In _____ nephrons, glomeruli are present in inner margin of cortex.
- (iv) _____ nephrons control plasma volume when water supply is short.

(i)	(ii)	(iii)	(iv)
(a) Juxta-medullary	Cortical	cortical	Juxta-medullary
(b) Juxta-medullary	Cortical	juxta-medullary	Juxta-medullary
(c) Cortical	Cortical	juxta-medullary	Juxta-medullary
(d) Cortical	Juxta-medullary	juxta-medullary	Cortical

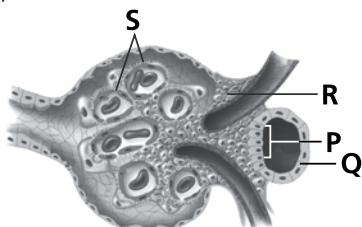
7. Osmolarity gradient in counter current mechanism is maintained by

- (a) NaCl and urea
- (b) Na⁺ and HCO₃⁻
- (c) Na⁺, K⁺ and H₂O
- (d) H₂O and NaCl.

8. Which of the following pairs is not correctly matched?

- | | |
|------------------------------------|---|
| (a) Distal convoluted tubule | – water reabsorption under ADH influence |
| (b) Proximal convoluted tubule | – sodium reabsorption by diffusion |
| (c) Collecting duct | – filtrate becomes hypertonic to blood plasma |
| (d) Ascending limb of Henle's loop | – impermeable to water |

9. Refer to the given figure of juxtaglomerular apparatus and select an option which correctly identifies any three of the labelled parts (P – S).



Exam Section

1. Read the following statements and choose the correct option.

 - (i) The glomerular filtration rate in a healthy individual is about 180 mL per day.
 - (ii) All the constituents of the plasma pass into the lumen of Bowman's capsule.

- (iii) 70-80% of electrolytes and water are reabsorbed in the PCT.
 - (iv) Angiotensin II increases the glomerular blood pressure and GFR.
 - (v) The counter current systems contribute in concentrating the filtrate.

(a) (i) and (ii) only are correct.

(b) (v) alone is correct.

(c) (ii), (iii) and (iv) only are correct.

(d) (iii), (iv) and (v) only are correct.

(e) (i), (iv) and (v) only are correct.

(Kerala PMT, 2016)

2. The basic functional unit of human kidney is
(a) Henle's loop (b) nephron
(c) nephridia (d) pyramid.

(J & K, 2015)

3. The juxtaglomerular apparatus is a special region formed by close placement and cellular modifications in

 - (a) proximal convoluted tubule and distal convoluted tubule
 - (b) loop of Henle and collecting duct
 - (c) afferent arteriole and distal convoluted tubule
 - (d) afferent arteriole and proximal convoluted tubule.

(AMU, 2015)

4. Human urine is usually acidic because

 - (a) potassium and sodium exchange generates acidity
 - (b) hydrogen ions are actively secreted into the filtrate
 - (c) the sodium transporter exchanges one hydrogen ion for each sodium ion, in peritubular capillaries
 - (d) excreted plasma proteins are acidic.

(AIPMT, 2015)

5. Identify the correct statement regarding urine formation.

 - (a) Counter current mechanism works around the glomerulus and PCT.
 - (b) To prevent diuresis, ADH facilitates water reabsorption from the latter parts of the tubule.
 - (c) Maximum absorption of electrolytes occurs in the Henle's loop.
 - (d) A decrease in blood pressure can increase the glomerular filtration rate.
 - (e) The collecting duct is impermeable to water and thus helps in diluting the urine.

(Kerala PMT, 2014)

6. Which of the following causes an increase in sodium reabsorption in the distal convoluted tubule?

 - (a) Increase in aldosterone levels
 - (b) Increase in antidiuretic hormone levels
 - (c) Decrease in aldosterone levels
 - (d) Decrease in antidiuretic hormone levels

(AIPMT, 2014)

(J & K, 2014)

8. Proximal convoluted tubule of nephron is responsible for
(a) filtration of blood
(b) maintenance of glomerular filtration rate
(c) selective reabsorption of glucose, amino acid, NaCl and water
(d) reabsorption of salts only. (WB-JEE, 2014)

(WB-JEE, 2014)

9. Juxtaglomerular cells secrete **A** when there is a fall in **B** ion concentration.

Choose the correct pair labelled as A and B.

- (a) A : Renin, B : Chloride
 - (b) A : Carbonic anhydrase, B : Sodium
 - (c) A : ATPase, B : Potassium
 - (d) A : Renin, B : Sodium

(K-CET, 2014)

- 10.** Which of the following is true for excretion in humans?

 - (a) Glucose and amino acids are reabsorbed in PCT by simple diffusion.
 - (b) DCT is impermeable to water.
 - (c) On an average, 25-30 gm of urea is excreted out per day.
 - (d) Maximum reabsorption occurs in the loop of Henle.

(AIIMS 2013)

12. Glucose and amino acids are reabsorbed in the
(a) proximal tubule (b) distal tubule
(c) collecting duct (d) loop of Henle.

(WB-JEE, 2011)

13. Which one of the following statements is correct with respect to kidney function regulation?

 - (a) When someone drinks lot of water, ADH release is suppressed.
 - (b) Exposure to cold temperature stimulates ADH release.
 - (c) An increase in glomerular blood flow stimulates formation of angiotensin II.
 - (d) During summer, when body loses lot of water by evaporation, the release of ADH is suppressed.

(AIPMT Prelims, 2011)

- 14.** Mark the wrong match from the following.

 - (a) Bowman's capsule - Glomerular filtration
 - (b) DCT - Absorption of glucose
 - (c) Henle's loop - Concentration of urine
 - (d) PCT - Absorption of Na^+ and K^+ ions

(IITP-CPMT 2010)

15. Which one of the following statements in regard to the excretion by the human kidneys is correct?

 - (a) Descending limb of loop of Henle is impermeable to water.
 - (b) Distal convoluted tubule is incapable of reabsorbing HCO_3^- .
 - (c) Nearly 99 per cent of the glomerular filtrate is reabsorbed by the renal tubules.
 - (d) Ascending limb of loop of Henle is impermeable to electrolytes.

(AIPMT Prelims, 2010)

Assertion & Reason

The following questions consist of two statements each : assertion (A) and reason (R). To answer these questions, mark the correct alternative as directed below:

- (a) If both A and R are true and R is the correct explanation of A.
 - (b) If both A and R are true but R is not the correct explanation of A.
 - (c) If A is true but R is false.
 - (d) If both A and R are false.

- Assertion :** Filtrate becomes hypertonic in DCT.
Reason : DCT is impermeable to water and permeable to electrolytes.
 - Assertion :** Urine produced by human kidneys is concentrated.
Reason : Collecting duct absorbs water from the filtrate.
 - Assertion :** Alcohol intake cause excessive urination.
Reason : Alcohol decrease ANF level, which lowers water reabsorption.
 - Assertion :** Person suffering from renal failure is generally anaemic.
Reason : Hormone erythropoietin responsible for RBC formation is produced by kidneys.
 - Assertion :** The final reabsorption of water from urine into blood occurs through collecting duct, producing hyperosmotic urine.
Reason : During counter current mechanism, ascending portion of vasa recta returns NaCl to medullary interstitial fluid.

Short Answer Type Questions

- Fill in the blanks.
 - Pressure exerted against the filtration membrane by the filtrate in Bowman's capsule during filtration is _____.
Blood pressure in glomerulus is about _____ mm Hg.
 - Pressure exerted by plasma proteins in glomeruli is _____.
 - What is filtration fraction? How is it calculated?
 - How do atrial natriuretic factor regulates kidney functions?
 - How urination gets affected by alcohol consumption?

ANSWER KEY

New MCQs

1. (b) 2. (b) 3. (d) 4. (a) 5. (c)
6. (b) 7. (a) 8. (b) 9. (c) 10. (d)
11. (b) 12. (b) 13. (c) 14. (d) 15. (a)

Exam Section

1. (d) 2. (b) 3. (c) 4. (b) 5. (b)
6. (a) 7. (a) 8. (c) 9. (d) 10. (c)
11. (a) 12. (a) 13. (a) 14. (b) 15. (c)

Assertion & Reason

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

Short Answer Type Questions

1. (i) capsular hydrostatic pressure

(ii) 60

(iii) blood colloidal osmotic pressure

2. The part of the renal plasma which becomes the filtrate is called filtration fraction. It is the ratio between renal plasma flow and glomerular filtrate. It is expressed in percentage. Thus,

$$\text{Filtration fraction} = \frac{\text{Glomerular filtration rate}}{\text{Renal plasma flow}} \times 100$$

3. Atrial natriuretic factor (ANF) opposes the regulation by RAAS. The walls of the atria of the heart release ANF in response to an increase in blood volume and pressure. ANF inhibits release of renin from the JGA and thereby inhibits NaCl reabsorption by the collecting duct and reduces aldosterone release from the adrenal gland.
4. ADH facilitates water reabsorption from latter parts of the tubule, thereby preventing diuresis. Alcohol decreases the level of ADH. This lowers reabsorption of water and increases loss of water in urine. Therefore, beverages having a high content of alcohol cause excessive urination and dehydration.



NEET 2017*

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DATE OF ENTRANCE TEST

NATIONAL ELIGIBILITY CUM ENTRANCE TEST will be conducted on Sunday, the 7th May, 2017 from 10:00 am to 01:00 pm. The duration of test will be 3 hours.

PATTERN OF THE ENTRANCE TEST

The Entrance Test shall consist of one paper containing 180 objective type questions (four options with single correct answer) from Physics, Chemistry and Biology (Botany & Zoology) to be answered on the specially designed machine-readable sheet using Ball Point Pen provided by CBSE at examination centre only.

- (i) Candidates can opt for Question Paper in either of the following

languages (As per letter nos. V.11025/35/2012-MEP(Pt.) dated 08.12.2016 & 16.01.2017 received from MoH&FW)

HINDI	ENGLISH	GUJARATI	MARATHI	ORIYA
BENGALI	ASSAMESE	TELUGU	TAMIL	KANNADA

- (ii) Option of medium of Question Paper should be exercised while filling in the application form and the option once exercised by candidates cannot be changed later.
(iii) Candidates opting for English would be provided Test Booklet in English only.
(iv) Candidates opting for Hindi would be provided Bilingual Test Booklet i.e., in Hindi and in English.
(v) Candidates opting for vernacular languages would be provided Bilingual Test Booklet i.e., in selected language and in English.

SYLLABUS

The Question Paper for the test shall be based on a common syllabus notified by the Medical Council of India.

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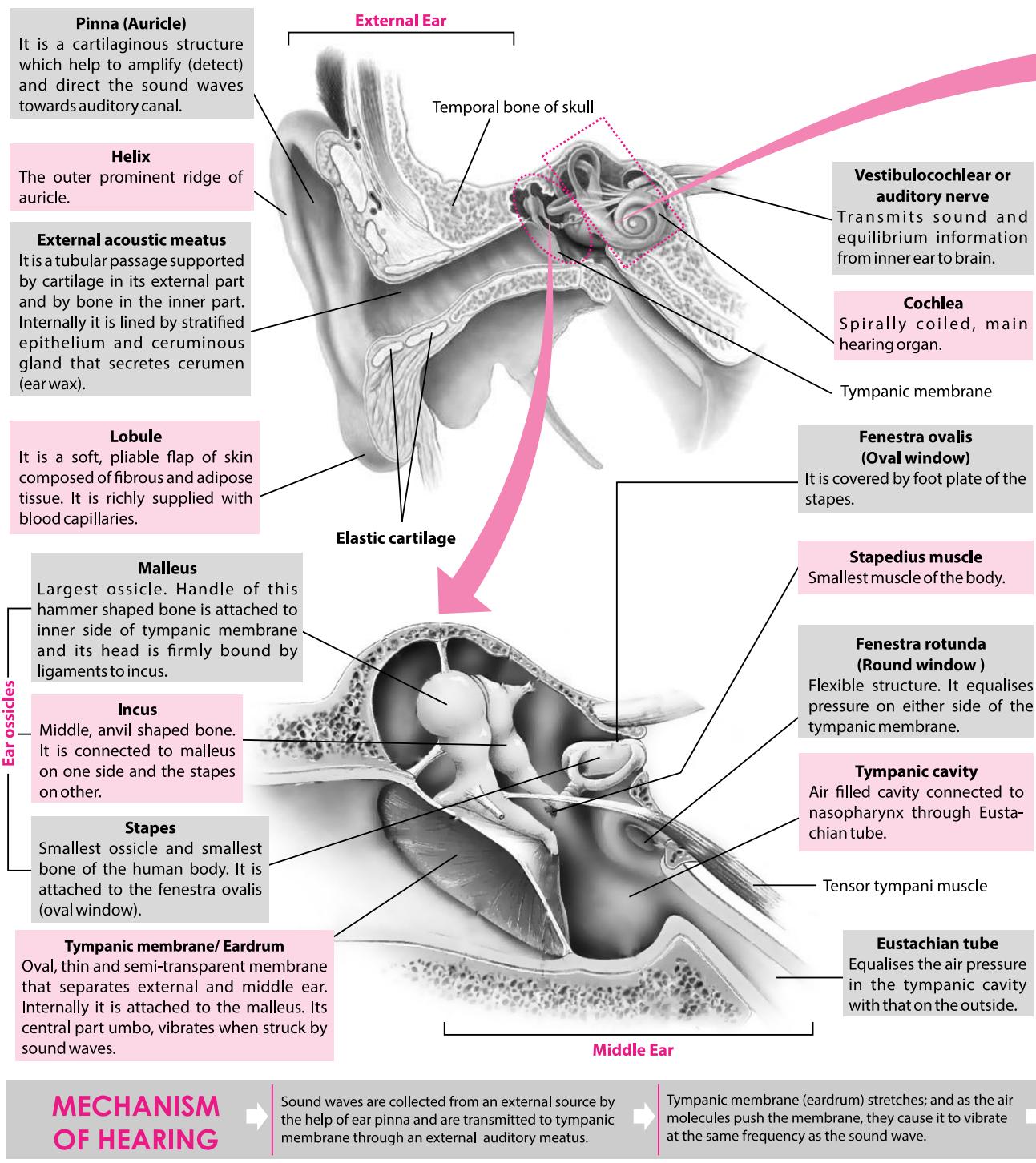
Schedule for online submission of application forms	31.01.2017 to 1.03.2017
Last date for successful final transaction of fee	01.03.2017
Date of uploading of Admit-Cards on website	15.04.2017
Date of examination, NEET-2017	07.05.2017
Declaration of Result	08.06.2017

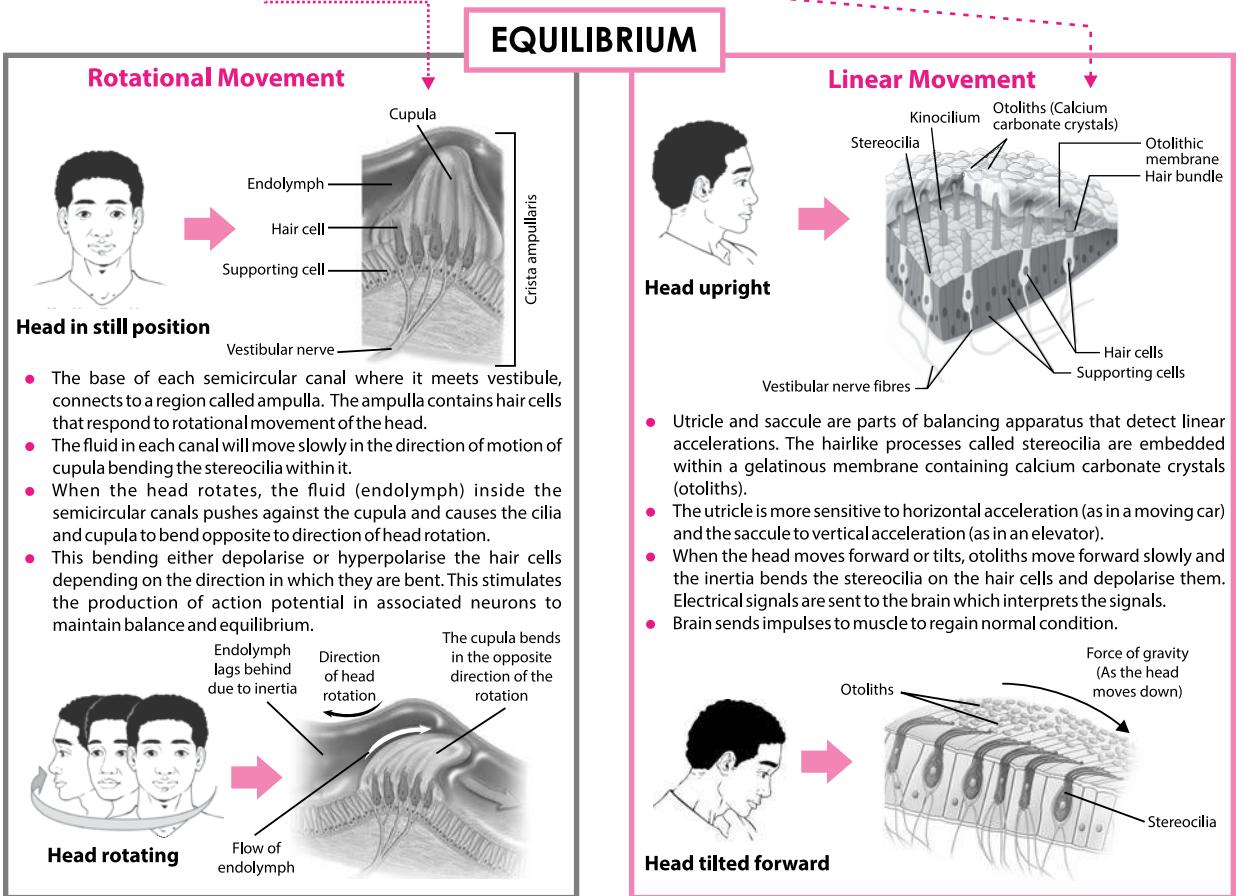
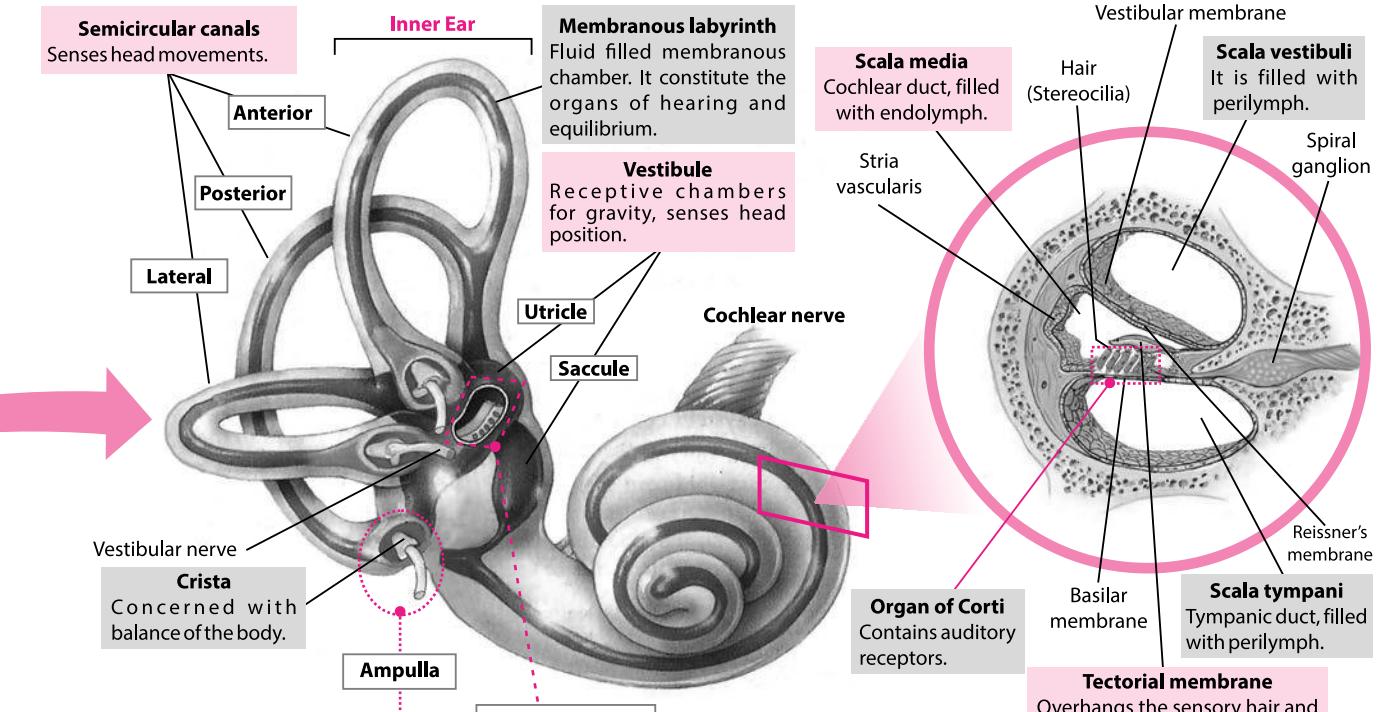
*For more details, please refer to latest prospectus.

CONCEPT MAP

THE EAR

Ears are a pair of sense organs that are situated on the either sides of the head to produce a sensation of hearing and to maintain body's equilibrium and balance. Anatomically, human ear is divided into three regions - external ear, middle ear and inner ear.





Tympanic membrane bows inwards and transmits the sound waves to the ear ossicles.

Perilymph of inner ear receives the vibrations through fenestra ovalis.

Vibrations are further transferred to scala vestibuli and then to scala media through Reissner's membrane of cochlea.

Movements in fluid (endolymph) of scala media and tectorial membrane stimulate the sensory hair of the organ of Corti.

Hair cells receive the impulses and transmit it to the brain through auditory nerve and finally sound is detected by the brain.

MPP | MONTHLY Practice Paper

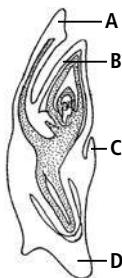
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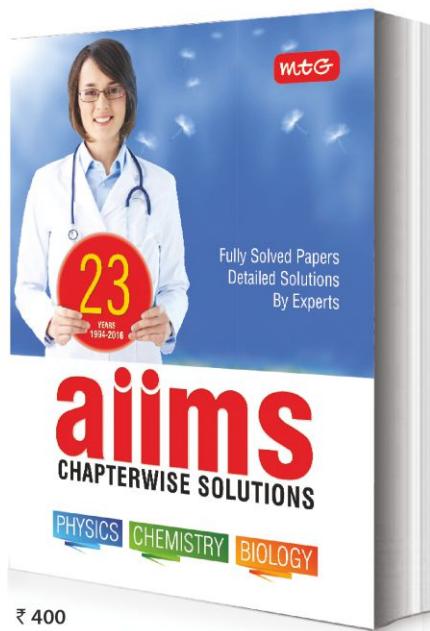
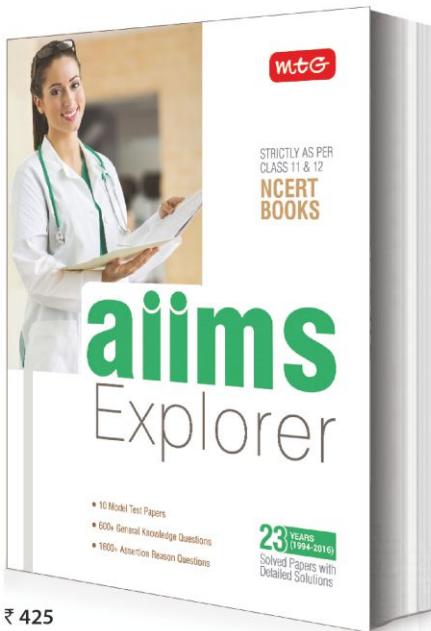
This specially designed column enables students to self analyse their extent of understanding of specified chapters. Give yourself four marks for correct answer and deduct one mark for wrong answer. Self check table given at the end will help you to check your readiness.

Total Marks : 160

Duration : 40 Min.



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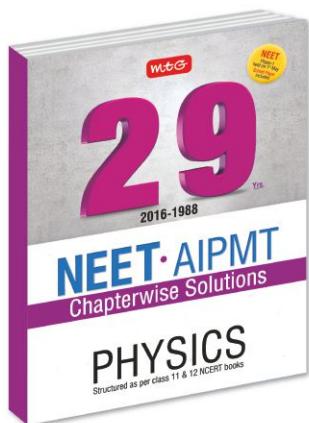


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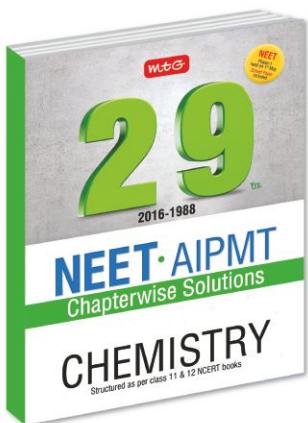


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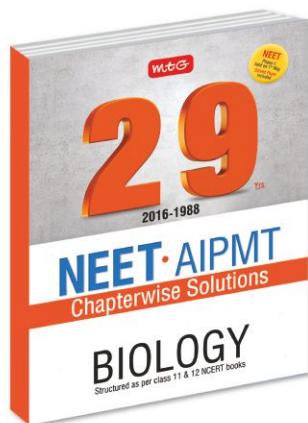
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- (c) C is hollow foliar structure enclosing shoot apex and leaf primordia.
 (d) D represents rudiments of second cotyledon.
- 12.** Read the given table and fill the blanks with appropriate options.
- | | Antibiotic | Microorganism |
|-------|-------------------|-----------------------------|
| (i) | Hamycin | A |
| (ii) | B | <i>Streptomyces rimosus</i> |
| (iii) | Tetracycline | C |
- | A | B | C |
|--|--------------|----------------------------------|
| (a) <i>Streptomyces</i> <i>noursei</i> | Neomycin | <i>Bacillus polymyxa</i> |
| (b) <i>Bacillus</i> <i>polymyxa</i> | Streptomycin | <i>Penicillium chrysogenum</i> |
| (c) <i>Streptomyces</i> <i>pimprei</i> | Terramycin | <i>Streptomyces aureofaciens</i> |
| (d) <i>Streptomyces</i> <i>erythreus</i> | Gentamycin | <i>Bacillus licheniformis</i> |
- 13.** Origin of conifers took place during
 (a) Cretaceous period (b) Permian period
 (c) Cambrian period (d) Devonian period.
- 14.** Which among the following explains the term "dyspareunia"?
 (a) Failure to deposit sperms high in the vagina
 (b) Androgen deficiency in ageing males
 (c) Painful sexual intercourse experienced by woman
 (d) Drug induced ovulation
- 15.** Study the given food web and select the incorrect statement.
-
- (a) Decline in population of frog would increase the population of butterfly and dragonfly.
 (b) Sparrow and frog occupies more than one trophic level in the given food web.
 (c) Both frog and ladybird act as secondary consumers.
 (d) Snake and eagle occupying highest positions in food chain have maximum energy.
- 16.** Select an option in which product formed after digestion by restriction enzyme is not correctly matched.

Restriction enzyme	Product
(a) <i>Bam</i> HI	$\begin{array}{ c c c c } \hline G & & G - A - T - C - C & \\ & & & \\ C - C & - T - A - G & & G \\ \hline \end{array}$
(b) <i>Hae</i> III	$\begin{array}{ c c c c } \hline A - G & & C - T & \\ & & T - C & \\ & & G - A & \\ \hline \end{array}$
(c) <i>Hind</i> II	$\begin{array}{ c c c c } \hline G - T - C & & G - A - C & \\ & & C - A - G & \\ & & C - T - G & \\ \hline \end{array}$
(d) <i>Hind</i> III	$\begin{array}{ c c c c } \hline A & & A - G - C - T - T & \\ & & & \\ T - T - C - G - A & & & A \\ \hline \end{array}$

- 17.** Identify the plant that possesses both chasmogamous and cleistogamous flowers to ensure seed formation.
 (a) *Catharanthus* (b) *Oxalis*
 (c) *Mirabilis* (d) *Vallisneria*
- 18.** Which of the following statements are correct ?
 (i) Mammary glands are modified sweat glands.
 (ii) In dicot embryo, haustorium is the last cell of the suspensor at the end adjacent to the embryo.
 (iii) Eukaryotic DNA, found in nucleus and mitochondria, is circular, double stranded.
 (iv) Carboniferous period is the age of amphibians.
 (v) Haptens are complete antigens.
 (a) (ii), (iii) and (iv) only (b) (iii) and (v) only
 (c) (i) and (iv) only (d) (i), (ii) and (iv) only
- 19.** Which among the following cloning vectors carries smallest fragment of DNA ?
 (a) Cosmid (b) BAC
 (c) Phagemid (d) Lambda phage
- 20.** Which poultry disease is caused by manganese deficiency in ration, resulting in the enlargement of tibiometatarsal joint, twisting and bending of the end of tibia?
 (a) Aspergillosis (b) Coccidiosis
 (c) Mycosis (d) Perosis
- 21.** Cryopreservation is preservation of tissue cultures and animal cells, at _____ in _____.
 (a) -196°C , liquid nitrogen
 (b) 0°C , chilled ethanol
 (c) -180°C , dry ice
 (d) -20°C , formaldehyde
- 22.** In the areas with intense solar radiations, photochemical smog forms
 (a) sulfurous smog (b) brown air
 (c) black air (d) grey air.
- 23.** Consider the following statements regarding female gametophyte in angiosperms.
 I. The angiospermic female gametophyte is an oval multicellular haploid structure embedded in nucellus of ovule.

- II. It comprises of 8 nuclei formed as a result of one mitotic division of MMC and three meiotic divisions of megasporangium.
- III. The micropylar cells act as vegetative cells of embryo sac which provide nourishment to rest of the cells.
- IV. The central cell is the largest haploid cell of gametophyte containing highly vacuolated cytoplasm rich in reserve food.
- V. The synergids of egg apparatus act as shock absorbers during the penetration of pollen tube into embryo sac.
- Of the above statements
- only I and II are correct
 - only II and IV are correct
 - only I and V are correct
 - only II, III and IV are correct.

- 24.** Fill in the blanks with the appropriate option.
- Cytokines produced by lymphocytes in response to viral infections are _____.
 - Chemical released by mast cells, which dilates blood vessels is _____.
 - Pollination through pseudocopulation can be seen in _____.
 - _____ National Park is present in Bharatpur.

(i)	(ii)	(iii)	(iv)
(a) interleukines	serotonin	<i>Salvia</i>	Manas
(b) interferons	histamine	<i>Ophrys</i>	Keoladeo
(c) lymphokines	perforin	<i>Begonia</i>	Kaziranga
(d) tumor necrosis	perforin	<i>Yucca</i>	Dichigam factor

- 25.** Immunoglobulin X is the earliest immunoglobulin to be synthesised by the fetus and it cannot cross the placental barrier. It also helps in complement activation. Identify X.
- IgA
 - IgM
 - IgE
 - IgG

- 26.** What is the F_2 ratio of supplementary genes?
- 15 : 1
 - 9 : 6 : 1
 - 9 : 3 : 4
 - 9 : 7

- 27.** Identify the type of interaction shown by sucker fish attached to shark for getting protection from predators.
- Protocooperation
 - Amensalism
 - Mutualism
 - Commensalism

- 28.** Identify the phase of menstrual cycle from the given events.
- Release of progesterone from corpus luteum.
 - Graafian follicle changes into corpus luteum.
 - Thickening of endometrium and release of watery mucus from uterine glands.
 - Menstrual phase
 - Luteal phase
 - Follicular phase
 - Ovulatory phase

- 29.** Match the following.

Column I		Column II
A. Tsan	(i)	IFNs
B. Louis Pasteur	(ii)	ANDI
C. Alec Issacs	(iii)	Human insulin
D. Dr. Gerald	(iv)	Vaccine
(a) A-(iv), B-(iii), C-(i), D-(ii)		
(b) A-(ii), B-(i), C-(iv), D-(iii)		
(c) A-(iii), B-(iv), C-(i), D-(ii)		
(d) A-(i), B-(iv), C-(ii), D-(iii)		

- 30.** Amino acids deficient in proteins of cereals and millets are

- lysine and cysteine
- cysteine and methionine
- leucine and tryptophan
- lysine and tryptophan.

- 31.** Which of the following is not an organo-pesticide?

- Malathion
- Benzene hexachloride
- Parathion
- Carbamate

- 32.** The yolk is concentrated in the vegetal half in

- telolecithal egg
- homolecithal egg
- centrolecithal egg
- meiolecithal egg.

- 33.** A genetically engineered microbe that scavenge on the oil spills and digest the hydrocarbons of crude oil is

- Bacillus* sp.
- Pseudomonas* sp.
- Escherichia*
- Klebsiella*.

- 34.** Read the given statements and select an option stating which ones are true (T) and which ones are false (F) ?

- Probiotics are non-digestible food ingredients that stimulate bacterial growth in the digestive tract.
- Evidences from haemoglobin indicates that man and gorilla are closely related.
- Homologous organs shows convergent evolution.
- Minisatellite sequence of DNA has 11-60 base pairs flanked by conserved restriction sites.

(i)	(ii)	(iii)	(iv)
(a) T	T	F	T
(b) F	T	T	F
(c) T	F	T	F
(d) F	T	F	T

- 35.** The missing link between amphibians and reptile is

- Lycaenops*
- Ichthyostega*
- Seymouria*
- Archaeopteryx*.

- 36.** Nitrogen fixing bacteria residing in the leaf cavities of the fern, is

- Frankia*
- Anabaena*
- Azospirillum*
- Rhodospirillum*.

- 37.** Match column I with column II. (There can be more than one match for items in column I)

Column I	Column II
A. External syngamy	(i) Linker DNA
B. Chromatosome	(ii) <i>Rhizopus</i>
C. Operons	(iii) Algae
D. Sporulation	(iv) <i>Agaricus</i>
E. pBR322	(v) Lactose
	(vi) <i>Ori</i>
	(vii) Bony fish
	(viii) Nucleosome
	(ix) Repressor protein
	(x) <i>tet</i> ^R
(a) A-(iii), (vii); B-(i), (viii); C-(v), (ix); D-(ii), (iv); E-(vi), (x)	
(b) A-(x), (vi); B-(i), (iv); C-(iii), (v); D-(vii), (ix); E-(ii), (viii)	
(c) A-(i), (viii); B-(ii), (vii); C-(iv), (ix); D-(iii), (x); E-(v), (vi)	
(d) A-(iv), (viii); B-(ii), (vii); C-(iii), (ix); D-(v), (x); E-(i), (vi)	
Select a pair of recalcitrant seeds that can be stored in gene banks under humid air and normal oxygen conditions for shorter duration.	
(a) Cereals and cocoa	(b) Oil palm and legumes
(c) Jackfruit and coconut	(d) Tea and legumes

- 39.** Organisms also referred to as transducers are
(a) producers (b) detritivores
(c) herbivores (d) carnivores.

40. Match the column I (organ formed) with column II (approximate time taken from fertilisation).

Column I	Column II
(i) Development of neural tube and beginning of the brain	(p) 24 th week
(ii) Development of mouth and tongue	(q) 20 th week
(iii) Develop fingerprints	(r) 3 rd week
(iv) Open eyelids	(s) 7 th week
(a) (i)-(r), (ii)-(s), (iii)-(q), (iv)-(p)	
(b) (i)-(s), (ii)-(p), (iii)-(r), (iv)-(q)	
(c) (i)-(r), (ii)-(q), (iii)-(p), (iv)-(s)	
(d) (i)-(p), (ii)-(q), (iii)-(r), (iv)-(s)	

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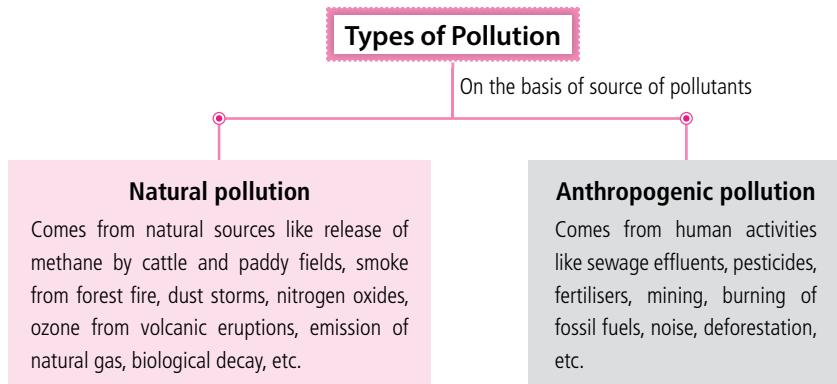
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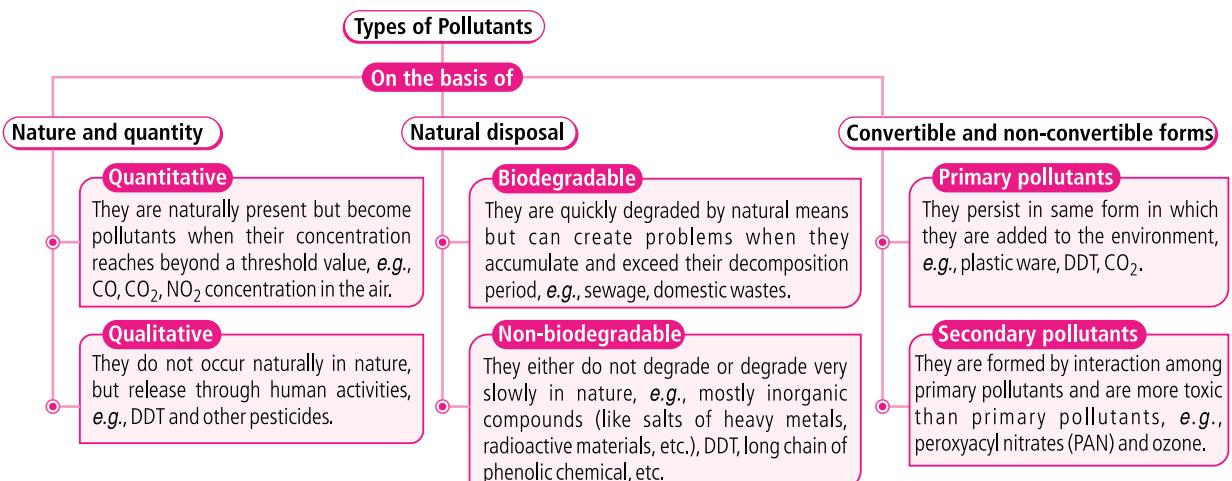
Environmental Pollution

- Pollution** - It is an undesirable change in the physical, chemical or biological characteristics of air, water and land or soil that may harmfully affect the life or create a pollution health hazard of any living organism.



- Different kinds of pollution are:**
 - Air pollution
 - Water pollution
 - Soil pollution
 - Noise pollution
 - Radioactive pollution
- Pollutant** - The agents which cause environmental pollution are called **pollutants**. A pollutant may be defined as a physical, chemical or biological substance, released into the environment, which is directly or indirectly harmful to humans and other living organisms.

	Analysis of various PMTs from 2012-2016				
	2012	2013	2014	2015	2016
AIPMT/NEET	5	4	4	5	5
AIIMS	1	-	3	3	1
AMU	3	6	3	1	-
Kerala	3	-	2	1	3
K.CET	2	3	3	4	2
J & K	-	-	4	2	-



AIR POLLUTION

- Air pollution is defined as the addition of particles, gases and chemicals into the atmosphere that have the potential to adversely affect human health, health of animals, vegetation, natural resources as well as interferes with environmental processes.

Causes of Air Pollution

- Pollen, spores, volcanic gas, marsh gas and harmful chemicals synthesised by electric storms are **natural air pollutants**.
- Anthropogenic sources of air pollution are:
 - **Combustion** of natural gas, petroleum, coal and wood in industries, automobiles, aircrafts, railways, thermal plants, agricultural burning, kitchens, etc.
 - **Metallurgical processing** causing release of mineral dust, fumes containing fluorides, sulphides and metallic pollutants like lead, chromium, nickel, arsenic, cadmium, mercury, etc.
 - **Chemical industries** including pesticides, fertilisers, weedicides and fungicides.
 - **Processing industries** like cotton textiles, wheat flour mills, asbestos.
 - **Welding, stone crushing, gem grinding**, etc.

Primary air pollutants

- Primary air pollutants include the directly emitted substances from identifiable sources.

Table: Primary pollutants, their sources and effects

Pollutant	Sources	Effects
Carbon dioxide (CO ₂)	From burning of fossil fuels mainly.	In excess, it causes headache and nausea. It has a far reaching effect on climate by causing a phenomenon called " greenhouse effect ".
Carbon monoxide (CO)	Incomplete combustion, cigarette smoke, metallurgical operations and naturally by plants as well as animals.	Carbon monoxide combines with haemoglobin, produces carboxy-haemoglobin or COHb . It impairs oxygen transport resulting in giddiness, headache, decreased vision, cardiovascular malfunction and asphyxia.
Nitrogen oxides (NO _x)	Natural, through biological and non-biological activities from nitrates, nitrites, etc.	They cause fading and deterioration of textiles, produce lesions, necrosis, defoliation, die-back and death of many plants. They also cause eye irritation, respiratory troubles, lung oedema, blood congestion, dilation of arteries and also cancer.
Sulphur oxides (SO _x)	Smelting of metallic ores and burning of petroleum and coal in industries, thermal plants, home and motor vehicles.	It leads to chlorosis, necrosis of vegetation, membrane damage and metabolic inhibition in plants. It also causes eye irritation, asthma, bronchitis, etc., in humans.

Hydrogen sulphide (H_2S)	Putrefaction, treatment of sulphur containing ores, refineries, chemical plants and bituminous fuels.	It causes mottled chlorosis and defoliation in plants. It decolourises paints, produces eye irritation, throat irritation and nausea.
Fluorides	Industries which manufacture aluminium , steel and phosphate fertilisers . Small amounts are released during coal combustion.	Fluorides cause fluorosis. It causes chlorosis, necrosis of leaf tips and leaf margins. It leads to abnormal calcification of bones and teeth, frequent diarrhoea, gastrointestinal and neuromuscular disorders.
Hydrocarbons	Incomplete combustion of fuel in automobiles, bacterial decomposition of organic matter.	They cause eye irritation, bronchial disorder. Methane emitted into air causes greenhouse effect.
Particulate matter	Soot, fly ash, dust of various types, fur, hair, spores, pollen grains, etc. released from various sources.	Causes respiratory diseases like tuberculosis, byssinosis (due to cotton dust), allergy and many more diseases in animals and plants.
Chlorofluorocarbons (freons or CFCs)	Refrigerators, propellants, aerosol, paints, etc.	Depletion of ozone in stratosphere increases the amount of UV radiations reaching the earth.

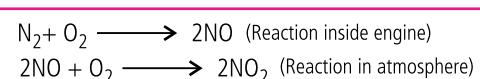
Secondary air pollutants

- They are produced photochemically from primary air pollutants. The enhanced effect of secondary air pollutant is called **synergism**. Some of the secondary air pollutants and their effects are:
 - Smog**- It is opaque or dark fog having condensed water vapour, dust, smoke and gases like SO_2 , H_2S , NO_2 , etc. It produces silvering/glazing and necrosis in plants, allergies, asthma and bronchitis in humans. Smog is of two types : classical smog and photochemical smog.

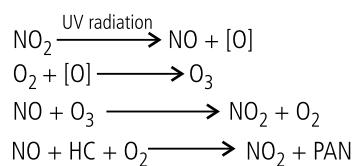
Table: Differences between classical and photochemical smog

	Classical (London) smog	Photochemical (Los Angeles) smog
(i)	It is dark brown and opaque; formed by condensation of water vapours with H_2S and SO_2 over dust or smoke particles at low temperature.	It is grey or yellowish brown, opaque smog formed at high temperature over cities and towns due to still air, emission of nitrogen oxides and volatile hydrocarbons from automobile exhausts and solar energy.
(ii)	Secondary pollutants are absent.	It contains secondary pollutants.
(iii)	It has reducing environment.	It has oxidising environment.
(iv)	In December 1952, classical smog occurred in London (England).	It was first reported over Los Angeles in 1940s.

- Photochemical oxidants** – These are secondary pollutants produced due to photochemical reactions between nitrogen oxides and unsaturated hydrocarbons, e.g., ozone, peroxyacetyl nitrates, aldehydes and phenols.
- Peroxyacetyl nitrate (PAN)** – It is a part of photochemical smog and produced due to reaction between NO_x and hydrocarbons under effect of UV-radiation of sunlight. PAN causes eye irritation, respiratory tract disease in humans. Several enzymes are deactivated by PAN. PAN blocks Hill reaction in plants and causes injury in several plants like alfa-alfa, primose, lettuce, tobacco, etc.
- Ozone** – Being **strong oxidant**, ozone destroys chlorenchyma, produces necrosis, hardens rubber, damages textiles, corrodes surface of marble statues and heritage buildings, injures mucous membranes, dries throat, causes haemorrhages and eye irritation.
- Aldehydes** – These cause irritation in gastro-intestinal and respiratory tracts.



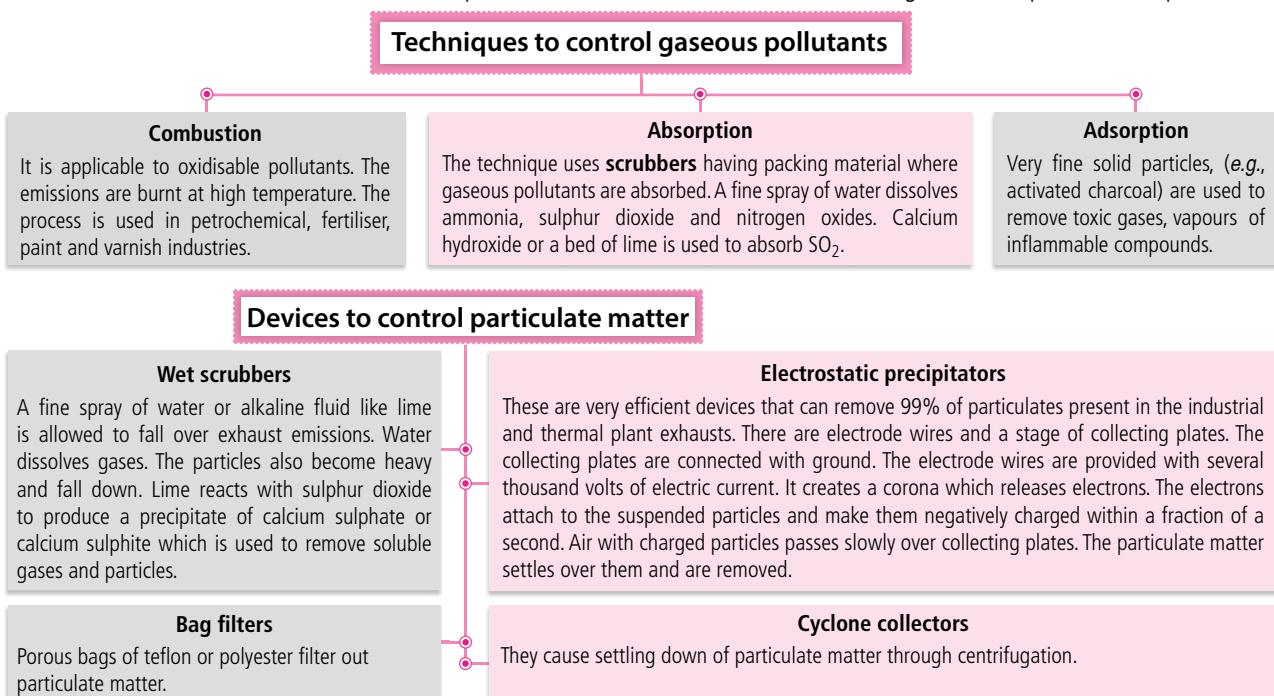
Photochemical reactions



- Pollen and microbes-** They are normal constituents of air. In certain season, pollens are produced in excess and cause allergic reactions such as asthma, bronchitis and rhinitis which are collectively called as **hay fever**. Microbes cause diseases and damage vegetation, food articles, etc.

Control of Air Pollution

- Various methods and devices have been adopted to control and reduce the release of both gaseous and particulate air pollutants.



Some specific methods of controlling air pollution from Automobiles

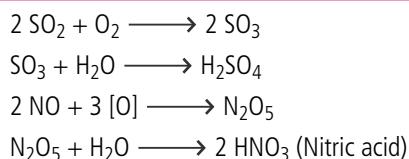
- Leaded petrol should be replaced by unleaded one and diesel with low sulphur diesel. Use of CNG also decreases the release of pollutants in exhausts.
- Vehicles should have tune ups for high air fuel ratio and catalytic converters. **Catalytic converters** have costly metals like platinum-palladium and rhodium as catalysts. Exhaust gases first pass through catalytic converter. Hydrocarbons which have been left unburnt are oxidised to produce carbon dioxide and water. Carbon monoxide is also oxidised to form carbon dioxide. However, nitrogen oxide splits up to form nitrogen gas.
- Automobiles fitted with catalytic converter should not use leaded petrol because lead inactivates the catalyst of the converter.

Industries

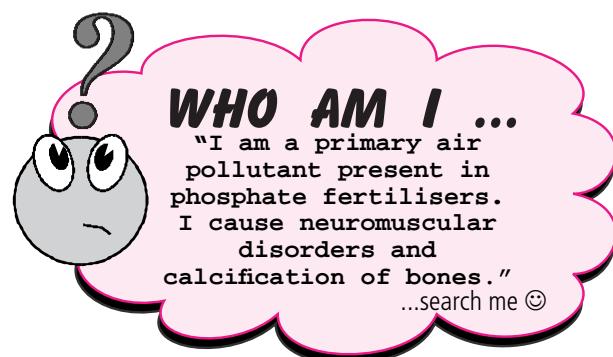
- Industrial emission possesses hot air with harmless gases like nitrogen and oxygen and smoke with particulate matter. Besides adopting above mentioned methods to control air pollution from industries, use of tall chimneys and gravity settling chambers are also effective.

ACID RAIN

- The term 'acid rain' was coined by **Robert August (1872)**. It is a consequence of air pollution.
- It includes the rainfall and other forms of precipitation with a pH of less than 5. pH of normal rain is 5.6 - 6.5.
- It is, in fact, **a mixture of H_2SO_4 and HNO_3** ; the ratio of the two acids vary depending on the relative quantities of sulphur oxides and nitrogen oxides present in the atmosphere. These oxides are mainly produced by combustion of fossil fuels, smelters, industries, power plants, automobile exhausts, domestic fires, etc.



- Acids from atmosphere are deposited over earth in two forms:
 - **Wet deposition** : It occurs in the form of rain, snow or fog.
 - **Dry deposition** : It refers to settling down of wind blown acidic gases (nitrogen oxides and sulphur oxides) and other particles in dry state.



Various Effects of Acid Rain

- Acidic water may carry dissolved aluminium to lakes and streams which clogs the gills of fish and deprives them of oxygen. It is highly toxic to fish and is actually the cause of death of fish.
- Acid rain damages plants by direct effect on foliage and growing point— chlorosis, necrosis, defoliation, die-back, etc.
- It causes leaching of essential minerals of soil.
- Acid rain corrodes metals, marble, painted surfaces, slate, stone, etc. The phenomenon is called **stone leprosy**.
- Acid rain causes reduced rates of photosynthesis and growth; and increased sensitivity to drought and disease.

WATER POLLUTION

- Addition or presence of undesirable substances which degrades the quality of water is called water pollution.



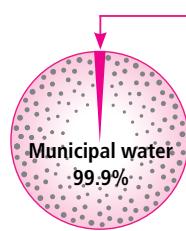
Sources of Water Pollution

- Natural sources:
 - Clay and silt from soil erosion enter water bodies.
 - Minerals get dissolved in water from rocks and soil.
 - Animal wastes and dead fallen leaves fall into water sources.
- Anthropogenic sources:
 - Organic wastes (domestic waste, sewage, effluents of industries, wastes from animal sheds and slaughter houses).
 - Soaps and detergents
 - Surface run offs from agricultural fields having pesticides and fertilisers
 - Oil spills due to accidental discharges of petroleum from oil tankers, offshore oil drilling and oil refineries
 - Heat and radioactive wastes

Table: Differences between point and non-point sources of water pollution

	Point source of water pollution	Non-point source of water pollution
(i)	It is pollution caused by discharge of effluents at one point.	It is pollution caused by discharge of pollutants over a wide area.
(ii)	Due to large scale entry of pollutants at one point, the contamination and harmful effect on quality of water is maximum.	There is some dilution of the effect of pollutants due to large size of area.
(iii)	Treatment plant can be installed in the area of flow of effluents.	Treatment plant is useless for this type of pollution.
(iv)	Other type of control measures are not required.	Control measures are required on a large scale for non-liberation of pollutants.

Domestic Sewage



- Impurities 0.1%**
1. Pathogens, e.g., coliforms and enterococci.
 2. Suspended solids, e.g., sand, silt and clay. Most of the solids tend to settle if waste water is left undisturbed for sometime.
 3. Colloidal material, e.g., faecal matter, bacteria, cloth and paper fibres. Colloid particles form a near permanent colloidal solution. They can be removed only through decomposition of organic matter and addition of chemicals that cause flocculation or clumping of colloidal particles.
 4. Dissolved materials, e.g., nutrients (nitrate, ammonia, phosphate, sodium, calcium).

Fig.: Composition of municipal waste water

Determination of quality of waste water

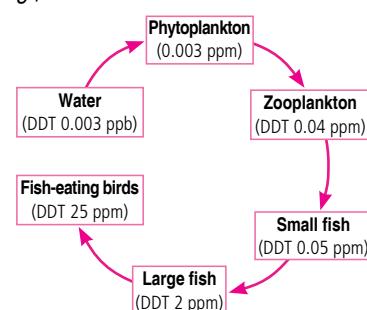
- **Biological oxygen demand (BOD)**: It indicates the quality of waste water. BOD refers to the amount of dissolved oxygen needed by bacteria in decomposing the organic wastes present in water. It is expressed in **milligrams of O₂ per litre of water**. Poorly polluted water body with less organic waste has BOD less than 1500 mg/litre while a strongly polluted one has higher than this, i.e., 4000 mg/L.
- **Chemical oxygen demand (COD)**: It is the amount of oxygen required to oxidise all the reducing substances present in water. It includes BOD, reduced chemicals produced during putrefaction and other oxygen demanding chemicals. Oxygen used up in BOD or COD will reduce the amount of dissolved oxygen (DO).
- Discharge of a domestic sewage into a river will result in rise of BOD because decomposer organisms consume a lot of oxygen. If sewage quantity is large, the whole of dissolved oxygen may be consumed leaving nothing for respiration of fish and other clean water organisms. They, therefore, get killed. However, as sewage is decomposed, there is a gradual rise in dissolved oxygen downstream. Fish and other clean water organisms reappear indicating the recovery of river from sewage pollution.

Eutrophication

- Eutrophication refers to increased productivity of lake and ponds due to nutrient enrichment. It also leads to reduction in dissolved oxygen. It is of two types :
- **Natural eutrophication**- It is nutrient enrichment of a water body due to natural ageing. It is a slow process which may not be detectable in human life time. A young water body has cold, clear water where there is no nutrient enrichment. Runoff and streams draining into it gradually add nutrients, especially nitrogen and phosphorus that encourages growth of aquatic organisms. Organic debris and silt piles up at the bottom but more so near the periphery. Water becomes shallower and warmer. Warm water organisms appear. Marsh plants grow in shallow waters. Floating plants appear. Water body is gradually filled upon the shores and changed into land mass.
- **Cultural eutrophication**- Nutrient enrichment of water bodies due to human activities like passage of sewage, industrial effluents and runoff from fertilised fields rich in nitrates and phosphates. Nutrients present in sewage, agriculture wastes and fertilisers cause dense growth of plants and planktonic algae. They support a good number of animals as well.
- In some cases, eutrophic water bodies support excessive growth of floating plants. Water hyacinth (*Eichhornia crassipes*), the world's most problematic aquatic weed also known as '**Terror of Bengal**' is one such plant that sometimes chokes ponds, lakes and rivers. Algal blooms and floating plants cut off light from submerged plants. The latter die. Thus, there is drastic decrease in oxygen replenishment inside water. It causes organic loading of water.
- Some biota are pollution tolerant species. They are considered to be pollution indicators, e.g., annelid worm *Tubifex* and some insect larvae like *Chironomus*.

Biomagnification

- DDT and few other toxic chemicals do not dissolve in water but dissolve in fats, therefore, they accumulate in the organisms for long period. This is called **bioaccumulation**.
- The accumulated substance does not get metabolised or excreted and is passed on to the next higher trophic level.
- The phenomenon, through which certain pollutants get accumulated in tissues in increasing concentration along the food chains and produce fatal effect is called **bio-magnification** or **biological magnification**.
- DDT and its metabolites cause **thinning of bird's eggshells**. The eggs get crushed by the incubating parent birds. The eggs that remain intact fail to hatch normally.
- Often the birds, eagle and mink that consume fish contaminated with DDT are affected.



Flow chart: Biomagnification of DDT in an aquatic food chain.

Table : Harmful effects of excess of metal contaminants in water

Metals	Harmful effects
Mercury	Minamata disease
Nitrate	Methemoglobinemia or blue baby syndrome in infants (impairs oxygen transport)
Arsenic	Black foot disease
Flouride	Knock knee disease or skeletal flourosis
Copper	Hypertension, uremia
Lead	Anaemia, vomiting, damage to liver, kidneys and brain, neurotoxicity
Zinc	Cramps, renal damage
Cobalt	Diarrhoea, bone defects, paralysis
Chromium	Gastro-intestinal ulcers, nephritis and nervous system disorders
Cadmium	Hypertension, testicular atrophy, skeletal deformities called itai-itai

Control of Water Pollution

- Pollution of water can be checked, or at least minimised, by the following measures:
 - Overuse of fertilisers and pesticides should be avoided. As far as possible less stable pesticides should be used. Organic farming is a better substitute.
 - Hot water should be cooled before release from factories to prevent thermal pollution.
 - Solid wastes should be recycled wherever possible.
 - Domestic and farmyard sewage and industrial waste should be suitably "treated" before releasing them into water. This process can reduce the harmful effect of the wastes.
- Polluted water should be treated in **effluent treatment plants** before their release into water bodies.

Effluent Treatment Plant

There are three steps in sewage treatment :

Primary Treatment

- Primary or physical treatment comprises of shredding, churning, screening and sedimentation.
- Floating and large suspended solids are removed by sequential filtration and then passing the filtrate into large settling tanks, where heavy particles, sand and silt settle down.
- Sometimes, aluminium or iron sulphate is added to the filtrate to precipitate more solids.
- Sediment and residue of sequential filtration constitute **primary sludge**, which is used for biogas generation, composting and combustion. The resulting supernatant is called **effluent** which is put to secondary treatment.



Secondary Treatment

- Secondary or biological treatment involves microbial decomposition of organic matter present in effluent. It may be carried out by either of the methods :
 - In **trickling filter method**, the effluent is allowed to drip through a thick bed of gravel having the sewage fungus.
 - In **activated sludge method**, the effluent is taken to **aeration tanks** having some activated sludge of previous operation. The activated sludge has sewage fungus.
- Effluent is continuously aerated as well as agitated. Sewage fungus forms **flocs**. As the BOD decreases to 10-15% of original sewage, the waste water is taken to large settling tank where flocs of sewage fungus settle down. The supernatant can either be passed into water bodies or can be treated further.
- The organic sediment is passed into **anaerobic sludge digester** where anaerobic microbes (generally **methanogenic bacteria**) decompose the organic matter as well as aerobic microbes. It is accompanied by liberation of biogas and formation of manure or **compost**.

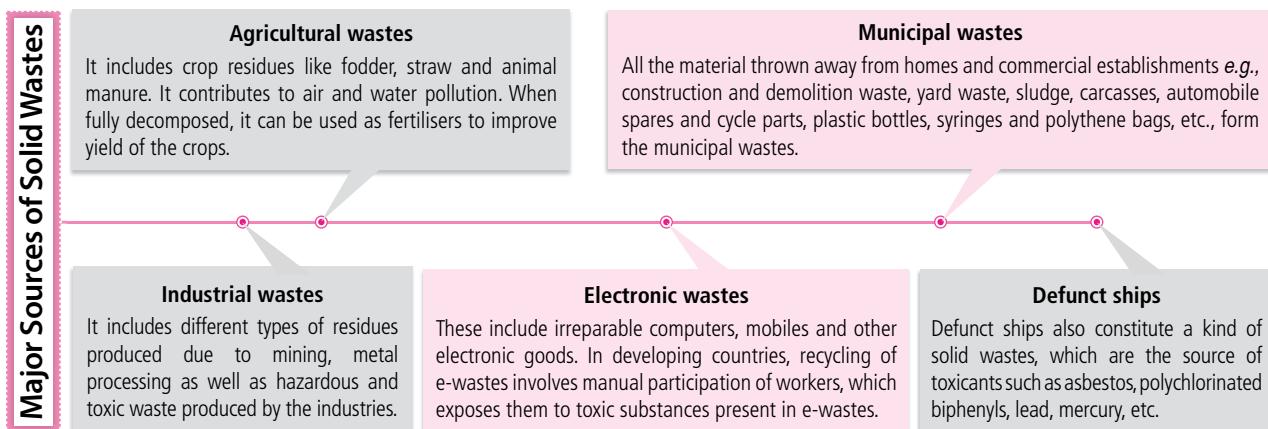


Tertiary Treatment

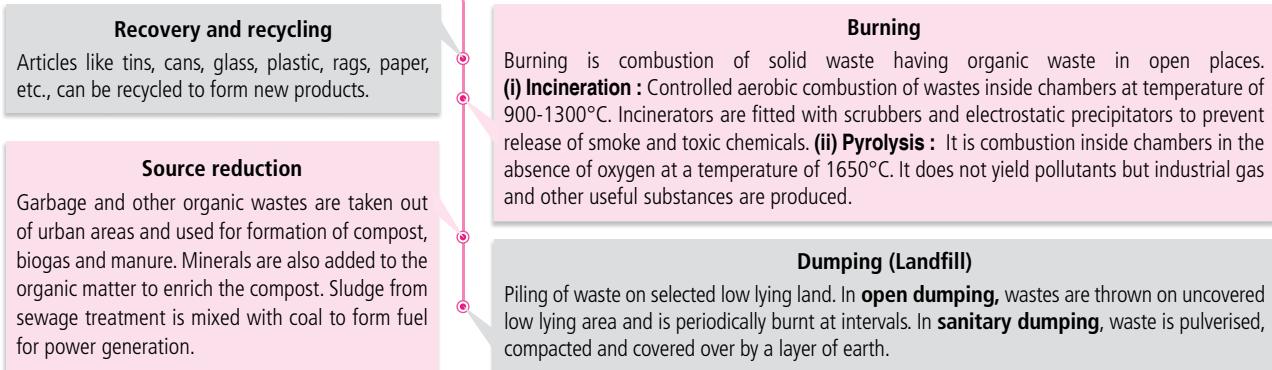
- The cleared water is now **chlorinated** with chlorine or perchlorate salts, ozonised or irradiated with UV to kill pathogens.
- Water can be passed into fields as manured water. It is normalised and treated further with activated carbon for removal of dissolved organics and colouring agents (90%).
- Water is now treated for removal of salts (desalination) and nitrate. Ideally such a water should be recycled to irrigation.
- Another treatment for removal of DDT and other specialised compounds are required if water is to be passed on to reservoirs or used in industries.

SOLID WASTE

- Landscape is polluted with solid wastes. Solid wastes refer to rubbish and trash, solid materials discarded after human use. Solid wastes pollute the environment and reduce the soil fertility. The pollution caused by solid wastes has been termed as the **third pollution or landscape pollution**.



Control of Solid Wastes



NOISE POLLUTION

- A persistent, often extensive and disturbing level of noise considered as a harmful factor in a given environment, is called as **noise pollution**.
- Noise is an unwanted, loud, disturbing sound dumped into ambient atmosphere leading to health hazards.
- Intensity of sound is measured in **decibels** (dB). Moderate conversation produces 60 dB sound and a loud conversation produces 70 dB sound. WHO has recommended a noise of less than 75 dB for industries.

- The loudest sound a person can withstand without much discomfort is about 80 dB. Sounds beyond 80 dB can be safely regarded as pollutant as it harms hearing system.

Sources of Noise Pollution

- Agricultural machines like tractors, harvesters, tubewells, etc.
- Defence equipments such as tanks, artillery, rocket launching, shooting practices, explosions.
- Entertaining equipment like radios, record players, television sets.
- Transport vehicles like scooters, motor-cycles, car, buses, trucks, trains, jet planes, etc.
- Machines and equipments used in industries such as compressors, generators, exhaust fans, dynamite blasting, etc.
- Loud music or speakers at social events, pubs or places of worship as well as use of crackers.

Effects of Noise Pollution

Auditory effects

A sudden loud noise of 150 dB or more may permanently damage ear drum or dislocate ear ossicles. Such a sound level occurs at the time of take off of a jet, rocket or bomb explosion. A prolonged exposure of even low level noise (80-100 dB) as found in many industries and metropolitan cities near the roads may permanently damage hearing ability of humans. Noisy surroundings in the cities reduce the ability to listen to soft voices and whispers.

Non-Auditory effects

Noise pollution causes headache by dilating blood vessels of the brain, eye strain by dilating the pupil, digestive spasms through anxiety. It also causes increase in the rate of heart beat, constriction of blood vessels, decreased heart output and defective night and colour vision. Noise may cause altered breathing pattern resulting in stress. It may cause insomnia or sleeplessness. A sudden high intensity of sound produces a startle reaction which may affect psychomotor performance.

Control of Noise Pollution

- At source control :** Noise can be reduced at the source by either designing and fabricating **silencing devices** for various machines or by **segregating** the noisy machines.
- Green belt vegetation :** Plants are efficient absorbers of noise. Border planting along highways and streets can be effective not only in absorbing the noise but also deflecting it upwards in the air. Green belt vegetation is also termed as **green muffler**.
- Transmission control :** Transmission of noise can be controlled by (i) covering the roomwalls with **sound absorbers** as **acoustic tiles**, (ii) enclosure of machinery with sound absorbing material in industrial zones.
- Ear muffs and ear plugs :** **Ear plugs** are sound blocking devices made up of glass down or cotton wool impregnated with wax that are fitted into the ear canals of the person exposed to noise. Ear muffs are hard shells that are attached to head and cover the external ears completely to block sound.
- Specific legislation and regulations :** Special laws should be made for designing and operation of machines, vibration control, sound-proof cabins, sound absorbing materials, methods for measuring noise, permissible levels of noise etc., e.g., within a radius of 10 miles of airport, no building or factories should be allowed. A big green belt around the airport should be planted.

RADIOACTIVE POLLUTION

- Radioactive pollution is the physical pollution of air, water and soil with radioactive materials e.g., radium, thorium, uranium, etc.
- Radiations can be categorised into two groups –
 - Non-ionising radiations** are constituted by the electromagnetic waves at the longer wavelength of the spectrum ranging from near infra-red rays to radiowaves. These waves have energies enough to excite the atoms and molecules of the medium through which they pass, causing them to vibrate faster but not strong enough to ionise them.
 - Ionising radiations** cause ionisation of atoms and molecules of the medium through which they pass. Electromagnetic radiations such as short wavelength ultra-violet radiations (UV), X-rays, gamma rays and energetic particles produced in nuclear processes, electrically charged particles like alpha and beta particles produced in radioactive decay and neutrons produced in nuclear fission, are highly damaging to living organisms.

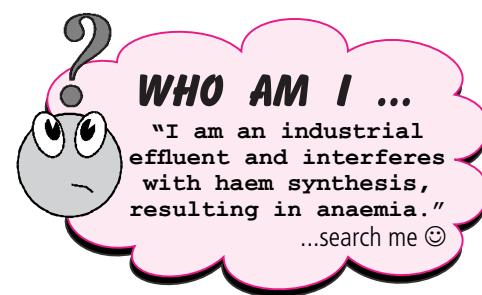
Effects of Radiations

- Somatic damage-** Effects of radiations on somatic cells include reddening of skin, loss of hair, ulceration, fibrosis of the lungs, the formation of holes in tissue, a reduction of white blood cells and induction of cataract in the eyes. This somatic cell damage can also result in cancer and death.

- **Genetic damage**- This damage can subsequently cause genetic damage from gene mutation resulting in abnormalities. Genetic damages are passed on to next generation.

Various Effects of Radioactive Pollutants

- Strontium-90 accumulates in bones to cause bone cancer.
- Iodine-131 damages WBCs, bone marrow, spleen, lymph nodes, cancers of thyroid glands.
- Cesium-137 causes nervous, muscular and genetic changes.
- Radon-222 leads to leukemia, brain tumours and kidney cancer.
- Uranium causes skin cancer and tumours in the miners.



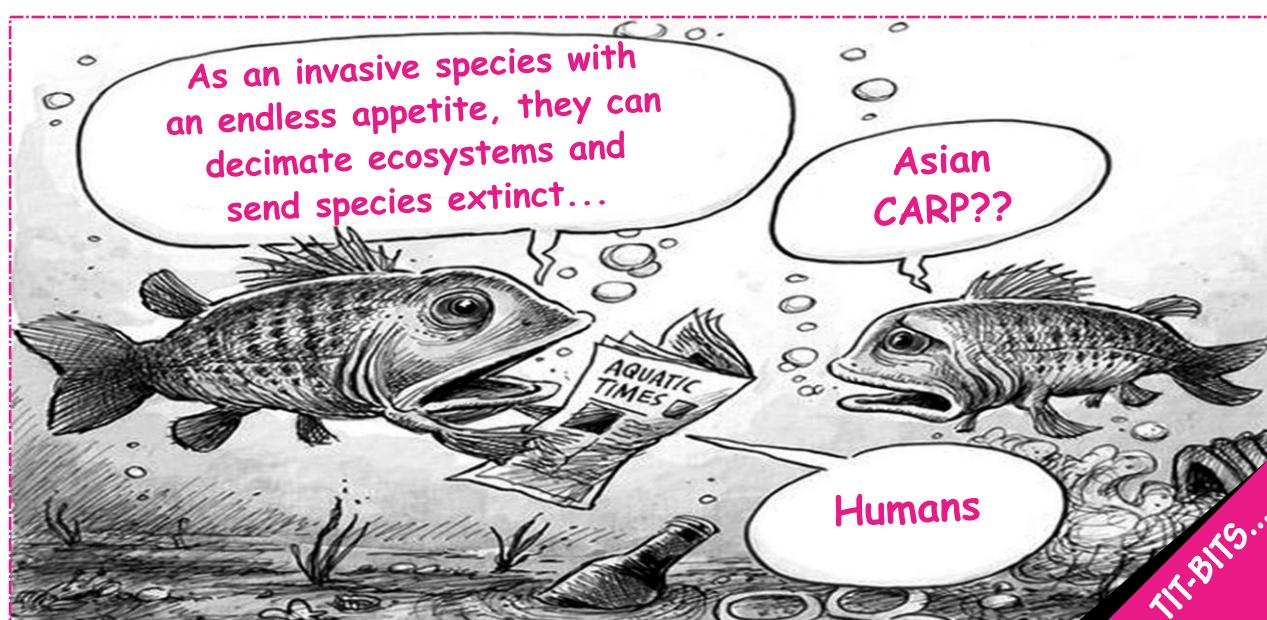
Control of Radioactive Pollution

Following measures can help control radioactive pollution:

- Leakage of radioactive elements from nuclear reactors, laboratories, industries, etc., should be totally checked by strictly enforcing safety measures.
- People working in industries producing or using radioactive material should wear protective garments, and should be screened from radioactive materials by radiation-resistant cases or walls.
- Use of atomic weapons should be checked and banned.
- Radioactive wastes should be properly managed.

Environmental Laws for Controlling Pollution

- **Environment (Protection) Act, 1986-** This law is meant for prevention, control and abatement of environmental pollution by laying down emission norms and setting up of central and state pollution control boards. The act encompasses pollution limits of air, water, soil and noise.
- **Insecticide Act, 1968-** It regulates manufacture, import, sale, transport, distribution and use of insecticides, laying down various rules to reduce risk to human health and health of other organisms.
- **Water (Prevention and Control of Pollution) Act, 1974-** It specifies quality of water for various purposes, ways and means to control water pollution and prevention of detrimental effects on human health and health of other biological entities.
- **Air (Prevention and Control of Pollution) Act, 1981-** The act is meant for preserving quality of air, controlling air pollution and preventing detrimental effects of air pollutants and human health as well as health of other biological entities. By an amendment **in 1987, noise was also recognised as an air pollutant.**





SPEED PRACTICE

1. Which among the following is least responsible for causing air pollution ?
 - (a) Carbon monoxide
 - (b) Sulphur dioxide
 - (c) Hydrocarbons
 - (d) Nitrogen oxide
2. The discolouration and deterioration of buildings, sculptures, painted surfaces, fabrics occur due to
 - (a) hydrogen sulphide
 - (b) sulphur dioxide
 - (c) fluorides
 - (d) freons.
3. Photochemical smog formed at high temperature in cities/towns, mainly consist of
 - (a) nitrogen dioxide, ozone and Peroxyacetyl nitrate
 - (b) sulphur dioxide, hydrocarbons and H₂S
 - (c) hydrocarbons, ozone and aldehydes
 - (d) ketones, sulphur dioxide and ozone.
4. Biochemical oxygen demand is used to measure the
 - (a) industrial pollution and air pollution
 - (b) degree of impurity of water due to organic matter
 - (c) total amount of oxygen present in water
 - (d) percentage of nutrients in water.
5. The concentration of sulphur dioxide above 1 ppm in human beings causes
 - (a) emphysema
 - (b) anaemia
 - (c) minamata
 - (d) siderosis.
6. Which one of the following indicates water pollution?
 - (a) *Chironomous*
 - (b) Lichens
 - (c) *Eichhornia*
 - (d) Algae
7. Select an option that correctly fills the blanks.
 - (i) Sewage, industrial effluents and waste waters are _____.
 - (ii) Acid rain is rainfall and form of precipitation with a pH of _____.
 - (iii) _____ is an anaerobic process which produces secondary pollutants that kills the aquatic organisms as well as bloom forming plants.

(i)	(ii)	(iii)
(a) non-point source pollutant	between 5.6 – 6.5	Bioconcentration
(b) point source pollutant	less than 5	Putrefaction
(c) mobile source pollutant	more than 5	Biomagnification
(d) fixed source pollutant	between 5.5 – 6.0	Eutrophication
8. Which of the following statement about eutrophication is not correct?
 - (a) It causes organic loading of water.
 - (b) It results in the imbalance of ecosystem dynamics of water bodies.
 - (c) It increase the concentration of non-degradable pollutants.
 - (d) In a young water body cold and clear water is present without excess of nutrients.
9. Match the following and select the correct option.

Column I	Column II
(i) Ozone Depleting Substances Rules	p. 1989
(ii) Hazardous Wastes Rules	q. 1981
(iii) Air Prevention and Control of Pollution Act	r. 1974
(iv) Water Prevention and Control of Pollution Act	s. 2000
(a) (i)-p, (ii)-q, (iii)-s, (iv)-r	
(b) (i)-s, (ii)-p, (iii)-q, (iv)-r	
(c) (i)-s, (ii)-p, (iii)-r, (iv)-q	
(d) (i)-p, (ii)-s, (iii)-q, (iv)-r	
10. Which one of the following pairs are non-degradable pollutants?
 - (i) Polythene bags and waste plastics
 - (ii) DDT and domestic garbage
 - (iii) Empty cans and sewage
 - (iv) DDT and BHC
 - (a) (i), (ii) and (iii) only
 - (b) (ii) and (iii) only
 - (c) (i), (iii) and (iv) only
 - (d) (i) and (iv) only
11. Which of the air pollution control devices are used for controlling vehicular air pollution?
 - (a) Catalytic converters
 - (b) Scrubbers
 - (c) Electrostatic precipitators
 - (d) Arresters
12. The gas released in Bhopal gas tragedy is
 - (a) methyl isocyanate and phosgene
 - (b) sulphur dioxide and hydrogen sulphide
 - (c) carbon monoxide and sulphur dioxide
 - (d) ethyl isocyanate and sodium isothiocyanate.
13. Identify the correct match.

	Day	Night
(a) Industrial zone	85 dB	75 dB
(b) Residential zone	70 dB	65 dB
(c) Silence zone	60 dB	50 dB
(d) Commercial zone	65 dB	55 dB

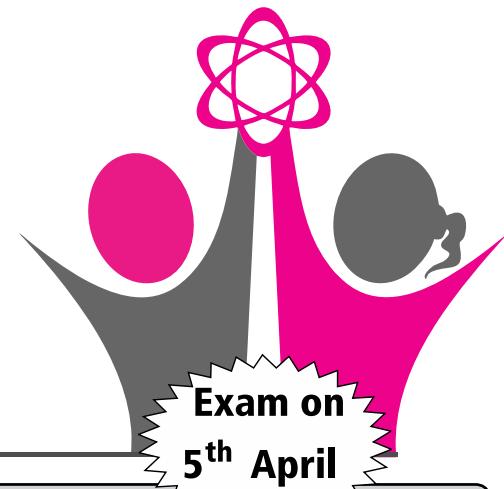


ANSWER KEY

- | | | | | | | | | | |
|------------|-----|------------|-----|------------|-----|------------|-----|------------|-----|
| 1. | (d) | 2. | (b) | 3. | (a) | 4. | (b) | 5. | (a) |
| 6. | (a) | 7. | (b) | 8. | (c) | 9. | (b) | 10. | (d) |
| 11. | (a) | 12. | (a) | 13. | (d) | 14. | (a) | 15. | (d) |
| 16. | (d) | 17. | (a) | 18. | (a) | 19. | (b) | 20. | (a) |
| 21. | (d) | 22. | (c) | 23. | (c) | 24. | (a) | 25. | (b) |
| 26. | (c) | 27. | (a) | 28. | (a) | 29. | (a) | 30. | (d) |

CBSE BOARD

PRACTICE PAPER 2017



GENERAL INSTRUCTIONS

- (i) All questions are compulsory.
- (ii) This question paper consists of five Sections A, B, C, D and E. Section A contains 5 questions of one mark each. Section B contains 5 questions of two marks each, Section C contains 12 questions of three marks each. Section D contains 1 question of VBQ type with four marks and Section E contains 3 questions of five marks each.
- (iii) There is no overall choice. However, an internal choice has been provided in one question of 2 marks, one question of 3 marks and all the three questions of 5 marks weightage. A student has to attempt only one of the alternatives in such questions.
- (iv) Wherever necessary, the diagrams drawn should be neat and properly labelled.

Time Allowed : 3 hours

Maximum Marks : 70

SECTION - A

1. BOD of two samples of water A and B were 120 mg/L and 400 mg/L respectively. Which sample is more polluted?
2. How can retroviruses be used efficiently in biotechnology experiments inspite of them being disease causing?
3. The microscopic pollen grains of the past are obtained as fossils. Mention the characteristic of the pollen grains that makes it happen.
4. All the primary productivity is not available to a herbivore. Give one reason.
5. Thymus of a new born child was degenerating right from birth due to a genetic disorder. Predict its impact on the health of the child.

SECTION - B

6. In a dihybrid cross white eyed, yellow bodied female *Drosophila* crossed with red eyed, brown bodied male *Drosophila* produced in F₂ generation 1.3 percent recombinants and 98.7 percent progeny with parental type combinations. This observation of Morgan deviated from Mendelian F₂ phenotypic dihybrid ratio. Explain, Morgan's observations.

7. How do 'implants' act as an effective method of contraception in human females? Mention its one advantage over contraceptive pills.
8. List any four objectives that you would recommend for biofortification.
9. Nematode-specific genes are introduced into the tobacco plants using *Agrobacterium* vectors to develop resistance in tobacco plants against nematodes. Explain the events that occur in tobacco plant to develop resistance.

OR

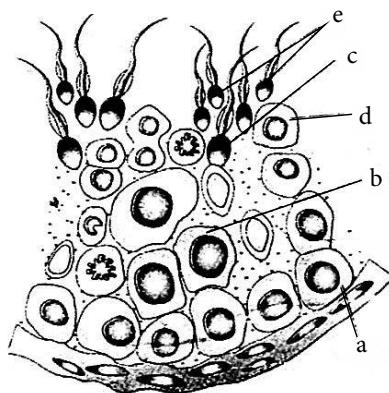
In England, before industrialisation set in, there were more white winged moths than dark winged moths. However the number reversed in the same area when industrialisation set in. How does this observation support natural selection?

10. Name the pioneer and the climax species in a hydrosere. Mention the changes observed in the biomass and the biodiversity of the successive seral communities developing in the water body.

SECTION - C

11. Distinguish between the following:
 - (a) Hibernation and Aestivation
 - (b) Ectotherms and Endotherms

12. (a) Name the labels a, b, c, d and e in the diagram of seminiferous tubule.



- (b) Explain the hormonal regulation of the process of spermatogenesis in humans.
13. The base sequence in one of the strands of DNA is TAGCATGAT.

- (a) Give the base sequence of its complementary strand.
 (b) How are these base pairs held together in a DNA molecule?
 (c) Explain the base complementarity rules. Name the scientist who framed this rule.

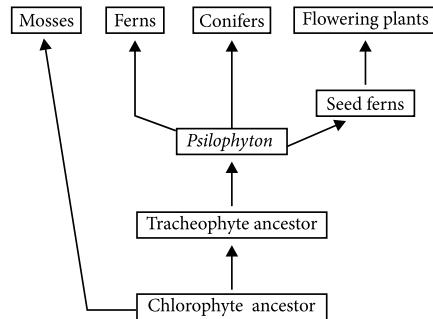
14. (a) List any two situations when a doctor would recommend injection of preformed antibodies into the body of a patient. Name this kind of immunisation and mention its advantages.
 (b) Name the kind of immunity attained when instead of antibodies weakened antigens are introduced into the body.

OR

Explain the pattern of inheritance of haemophilia in humans. Why is the possibility of a human female becoming haemophiliac extremely rare? Explain.

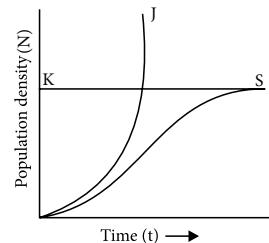
15. (a) Explain the role of baculoviruses as biological control agents. Mention their importance in organic farming.
 (b) Why do farmers prefer biofertilisers to chemical fertilisers these days? Explain.
16. (a) Why are the colourful polystyrene and plastic packaging used for protecting the food, considered an environmental menace?
 (b) Write about the remedy found for the efficient use of plastic waste by Ahmed Khan of Bengaluru.
17. State the significance of pollination. List any four differences between wind-pollinated and insect-pollinated flowers.

18. Study the schematic representation of evolutionary history of plant forms given below and mention :



- (a) The plant form to which ferns and conifers are most related to.
 (b) The nearest ancestors of flowering plants.
 (c) The most primitive group of plants.
 (d) Common ancestry of *Psilophyton* provides to.
 (e) The common ancestor of *Psilophyton* and seed ferns.
 (f) The common ancestors of mosses and tracheophytes.
19. Outcrossing and cross-breeding are two breeding practices in animal husbandry. How are the two practices different from each other and of what advantage are they to the breeders? Explain.

20. (a) A forest hardly has any carnivores. Census of herbivorous mammals was taken and plotted as a graph shown below. Identify the curve that will explain the population growth of herbivores. Give reason to your answer.



- (b) Certain species of wasps are seen to frequently visit fig trees. What type of interaction is seen between them and why?
21. *EcoRI* is used to cut a segment of foreign DNA and that of a vector DNA to form a recombinant DNA. Show with the help of schematic diagrams.
- (a) The set of palindromic nucleotide sequence of base pairs, the *EcoRI* will recognise in both the DNA segments. Mark the site at which *EcoRI* will act and cut both the segments.
 (b) Sticky ends formed on both the segments where the two DNA segments will join later to form a recombinant DNA.
22. A couple with normal vision was informed by their doctor that there is possibility of a colourblind child be born to them. Explain the basis on which the doctor conveyed this

information. Give the genotypes and the phenotypes of all possible children who could have been born to them.

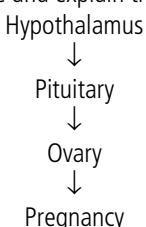
SECTION - D

23. Sanjay lives in a village on a river bank, who earns his livelihood by fisheries. He applied the idea of ecosystem based fisheries management given by one person from an NGO working in village.

- (a) What are the values shown by Sanjay by implementing such advice?
(b) What is ecological objective of such an idea?

SECTION - E

24. (a) Study the flow chart given below. Name the hormones involved at each stage and explain their functions.



- (b) Describe the process of parturition in humans.

OR

- (a) Draw a diagram of an enlarged view of T.S. of microsporangium of an angiosperm and label the following parts:

- (i) Tapetum (ii) Middle layer
(iii) Endothecium (iv) Microspore mother cells

- (b) Mention the characteristic features and function of tapetum.

- (c) Describe the sequence of the process of microsporogenesis in angiosperms.

25. (a) (i) Why are grasshopper and *Drosophila* said to show male heterogamety? Explain.

- (ii) Explain female heterogamety with the help of an example.

- (iii) Show mechanism of sex determination in honeybees with the help of flow chart.

- (b) (i) List the symptoms exhibited by Turner's syndrome sufferer. Explain the cause of this disorder.

- (ii) How chromosomal disorders are different from Mendelian disorders?

OR

- (a) Draw a schematic representation of the structure of a transcription unit and show the following in it:

- (i) Direction in which the transcription occurs
(ii) Polarity of the two strands involved
(iii) Template strand
(iv) Terminator gene

- (b) Mention the function of promoter gene in transcription.

- (c) Explain the role of DNA-dependent RNA polymerase in transcription.

- (d) Write a note on post-transcriptional modifications.

26. (a) "All successions proceed to a similar climax community—the mesic." Explain.

- (b) What are exotic species? Explain with the help of two examples how the exotic species disturb the native species of an ecosystem?

OR

- (a) Mention the role of vectors in recombinant DNA technology. Give examples.

- (b) With the help of diagrammatic representation only, show the steps of recombinant DNA technology.

- (c) Biopiracy should be prevented. State why and how.

SOLUTIONS

- Water body having high BOD is more polluted as compared to water body having low BOD. Hence, water sample B with BOD 400 mg/L is more polluted as compared to water sample A having BOD 120 mg/L.
- Retroviruses are disarmed before using in biotechnology, i.e., their disease causing gene is removed or inactivated, and thus, they transfer only desirable gene in the host cell.
- Sporopollenin is a major component of the hard outer layer called exine of pollen grains. It is chemically very stable

Form IV

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For MTG Learning Media Pvt. Ltd.
Mahabir Singh
Director

as it is not degraded by enzymes and is not affected by high temperature, strong acid or alkali. It is usually well preserved in soils and sediments that makes pollen grains well preserved as fossils.

4. All the primary productivity is not available to a herbivore because a considerable amount of gross primary productivity is used by plants in respiration.
5. Thymus is a primary lymphoid organ and site of maturation of T-lymphocytes. Its degeneration will weaken the immune system and thus, the child will be prone to frequent infections.
6. By conducting the given cross, Morgan concluded that the genes for eye colour and body colour are tightly linked. The linked genes do not show independent assortment but remain together and are inherited, thereby producing only parental type of progeny and show very little recombination.
7. Subcutaneous 'implants' is implantation of synthetic progesterone under the skin. They are an effective contraceptive method as they check ovulation and thicken cervical mucus to prevent sperm transport. Subcutaneous implants are more advantageous than contraceptive pills as they are long lasting, once implanted they are effective upto 5 years.
8. Biofortification is the breeding of crops with higher levels of vitamins and minerals or higher proteins and healthier fats, to improve the public health by practical means. Plant breeding is undertaken for improved nutritional quality of the plants with the objectives of improving :
 - Protein content and quality
 - Oil content and quality
 - Vitamin content
 - Micronutrient and mineral content.

9. Using *Agrobacterium* vectors, nematode specific genes are introduced into the host plant. The introduction of DNA is done such that it produces both sense and anti-sense RNA in the host cells. These two RNAs being complementary to each other form a double stranded RNA (ds RNA) that initiate RNAi and thus, silences the specific mRNA of the nematode. The consequence is that the parasite is not able to survive in a transgenic host expressing specific interfering RNA. The transgenic plant therefore is protected from the parasite.

OR

Natural selection is the process by which those organisms that are best suited to their environment and are able to reproduce well in changed environmental conditions, survive. Example, natural selection in peppered moth, *Biston betularia*.

Before industrialisation, barks of trees was covered by whitish lichens, so white moth escaped unnoticed from predatory birds. Due to industrial smoke and soot, the pale tree trunks became more and more blackened. As a result,

the light moths stood out in contrast to its background, increasing the possibility of being easily detected and eaten by their predators. Decrease in the number of light winged moths and increase in the number of dark variety was the ultimate result. Therefore, evolution favoured the dark winged melanic moths to reproduce more successfully for their adaptation in the polluted areas of England. Evolution of darker form in response to industrial pollution is known as industrial melanism.

10. In a hydrosere (succession in a water body), pioneer species include phytoplanktons and climax species include large trees. There is a gradual increase in the biomass and the level of biodiversity in the successive seral communities. Sequence of communities during hydrosere is shown below:
- Phytoplanktons → Rooted submerged hydrophytes → Floating hydrophytes
- ↓
- Trees (Climax species) ← Woodland ← Sedges ← Reed swamp stage

11. (a) : Differences between hibernation and aestivation are as follows :

	Hibernation	Aestivation
(i)	It is winter sleep as animals pass the winter period in dormant condition. The body temperature drops, breathing and heartbeat becomes slow.	It is summer sleep as animals avoid heat by spending dry hot periods in burrows.
(ii)	The animal rests in a warm place.	Animal rests in a cool/shady and moist place.
(iii)	It is of longer duration and lasts for the whole duration of winter.	It generally lasts for hot dry day time as nights are cooler.

- (b) Differences between ectotherms and endotherms are as follows :

	Ectotherms	Endotherms
(i)	These are cold blooded poikilothermal animals.	These are warm blooded homoeothermal animals.
(ii)	Their body temperature changes with change in environmental temperature.	They maintain constant body temperature despite of changing in ambient temperature.
(iii)	These are conformers and have narrow range of distribution.	These are regulators and have wide range of distribution.

12. (a) In the given diagram of seminiferous tubule;
 - a-Spermatogonium, b-Primary spermatocyte, c-Spermatid, d-Secondary spermatocyte, e-Spermatozoa.
- (b) Gonadotropin releasing hormone (GnRH), secreted by the hypothalamus, stimulates the anterior pituitary gland

to secrete follicle stimulating hormone (FSH). FSH acts on Sertoli cells of the seminiferous tubules of the testes to secrete androgen binding protein (ABP) and inhibin. ABP concentrates testosterone in seminiferous tubules. Testosterone is male sex hormone which stimulates sperm production.

13. (a) The base sequence of the complementary strand of DNA is ATCGTACTA.

(b) The base pairs in a DNA molecule are held together by hydrogen bonds. There are two hydrogen bonds between adenine and thymine; and three hydrogen bonds between cytosine and guanine.

(c) Base complementarity rules or Chargaff's rules are the important generalisations made by Chargaff (1950) on the bases and other components of DNA. These rules are as follows:

(i) Purine and pyrimidine base pairs are in equal amount, that is,

$$\text{adenine} + \text{guanine} = \text{thymine} + \text{cytosine}.$$

$$[A + G] = [T + C], \text{ i.e., } \frac{[A+G]}{[T+C]} = 1$$

(ii) Molar amount of adenine is always equal to the molar amount of thymine. Similarly, molar concentration of guanine is equalled by molar concentration of cytosine.

$$[A] = [T], \text{ i.e., } \frac{[A]}{[T]} = 1; [G] = [C], \text{ i.e., } \frac{[G]}{[C]} = 1$$

(iii) Sugar deoxyribose and phosphate occur in equimolar proportions.

(iv) A-T base pairs are rarely equal to G-C base pairs.

(v) The ratio of $\frac{[A+T]}{[G+C]}$ is variable but constant for a species. It can be used to identify the source of DNA.

14. (a) If a person is infected with some deadly microbes to which quick immune response is required as in tetanus, we need to directly inject the preformed antibodies or antitoxin. Even in the cases of snake bites, the injection which is given to the patients contains preformed antibodies against the snake venom. This type of immunisation is called artificial passive immunisation. It provides immediate relief but may cause some problems.

(b) In vaccination, a preparation of inactivated/weakened antigenic proteins of pathogens are introduced into the body which induces antibody formation. This produces immune response and the type of immunity is called artificial active immunity.

OR

Haemophilia is a recessive sex-linked disorder. It is genetically due to the presence of a recessive sex linked gene h, carried by X chromosome. Being sex-linked, the gene for haemophilia shows criss-cross inheritance. A

female becomes haemophiliac only when both its X chromosomes carry the gene (X^hX^h). However, such females generally die before birth because the combination of these two recessive alleles is lethal. A female having only one allele for haemophilia (XX^h) appears normal because the allele for normal blood clotting present on the other X chromosome is dominant. Such females are known as carriers. In case of males, a single gene for the defect is able to express itself as the Y chromosome is devoid of any corresponding allele (X^hY). The possibility of human female becoming haemophiliac is extremely rare because she has to be homozygous recessive for the trait, i.e., her father must be a haemophiliac and mother must be atleast a carrier.

15. (a) *Nucleopolyhedrovirus*, a genus of baculoviruses is useful in controlling many insects and other arthropods. They are species-specific, narrow spectrum bioinsecticides with no side effects on plants, mammals, birds, fish and non-target insects. Therefore, they serve as an important component of integrated pest management programme in dealing with ecological sensitive areas. These properties are useful in organic farming .

(b) Chemical fertilisers cause pollution of air, water bodies as well as ground water, besides getting stored in crop plants. Therefore, farmers are pressing for switch over to organic farming which includes the use of manures, biofertilisers, biopesticides. Biofertilisers are microorganisms which bring about nutrient enrichment of soil by enhancing the availability of nutrients to crops. The microorganisms which act as biofertilisers are bacteria, cyanobacteria (blue green algae) and mycorrhizal fungi. Bacteria and cyanobacteria have the property of nitrogen fixation while mycorrhizal fungi preferentially withdraw minerals from organic matter for the plant with which they are associated. Phosphate is also solubilised by some bacteria and by some fungi that form association with plant roots.

16. (a) Colourful polystyrene and plastic packaging used for protecting food to attract customers are considered an environmental menace and should be banned as these are non-biodegradable and persist in the environment for years and cause environmental pollution.

(b) Ahmed Khan, a plastic sack manufacturer of Bengaluru came up with a remedy for efficient use of plastic waste. He developed polyblend, a fine powder of recycled modified plastic, and mixed it with bitumen. In collaboration with R.V. College of Engineering and the Bangalore City Corporation, Ahmed Khan proved that mixture of polyblend and bitumen has better water repellent properties and helped to increase road life by a factor of three. The raw material for creating polyblend is any plastic film waste. Using Khan's technique, by the year 2002, more than 40 kms of road in Bengaluru has already been laid. At this rate, Khan will soon be running short of plastic waste in Bengaluru, to produce polyblend.

- 17.** Transfer of pollen grains from anther to stigma of the flower is called pollination. The significance of pollination is:
- Pollination leads to fertilisation and production of seeds and fruits, which ensures continuity of plant life.
 - The pollination, especially cross pollination results in the production of plants with a combination of characters from two plants. So, it introduces genetic recombinations and hence variations in the progeny.

Differences between wind pollinated and insect pollinated flowers are as follows :

	Wind pollinated flowers	Insect pollinated flowers
(i)	Pollination by wind is called anemophily.	Pollination by insects is called entomophily.
(ii)	The flowers are small.	The flowers are either large or if small, they are grouped to form a large mass.
(iii)	The flowers are inconspicuous due to the absence of bright colours.	The flowers are usually brightly coloured.
(iv)	Flowers are odourless.	Flowers produce an odour.
(v)	The flowers are devoid of nectar and edible pollen.	The flowers usually possess nectar and edible pollen.

- 18.** (a) *Psilophyton*, (b) Seed ferns, (c) Chlorophyte ancestor, (d) Ferns, conifers and seed ferns, (e) Tracheophyte ancestor, (f) Chlorophyte ancestor.

- 19.** Outcrossing is the mating of animals within the same breed but not having common ancestors on either side of their pedigree upto 4-6 generations. Cross-breeding is mating of superior males of one breed with superior females of another breed. Outcrossing is the best breeding method for animals that are below average in milk production, growth rate in beef and cattle, etc. Sometimes, only one outcross helps to overcome inbreeding depression.

Crossbreeding allows the desirable qualities of two different breeds to be combined. The progeny, hybrid animals may themselves be used for commercial production. Alternatively, they may be subjected to some form of inbreeding and selection to develop new stable breeds that may be superior to the existing breeds, e.g., Hisardale is a new breed of sheep developed by crossing Bikaneri ewes and Marino rams.

- 20. (a)** The population growth of herbivores will have J-shaped curve, as population will increase exponentially in the absence of predators, i.e., carnivores. Exponential growth is represented by equation ; $\frac{dN}{dt} = rN$ where,

N - Population density at time t

t - Time

r - Intrinsic rate of natural increase.

- (b)** Many species of fig trees have mutual relationship with the pollinator species of wasp. A given fig species can be pollinated only by its partner wasp species and not by other species. The female wasp uses the fruit not only as an oviposition (egg laying) site but also uses the developing seeds within the fruit for nourishing its larvae. The wasp pollinates the fig inflorescence while searching for suitable egg-laying sites. In return the fig offers the wasp some of its developing seeds as food for the developing wasp larvae.

21. (a)

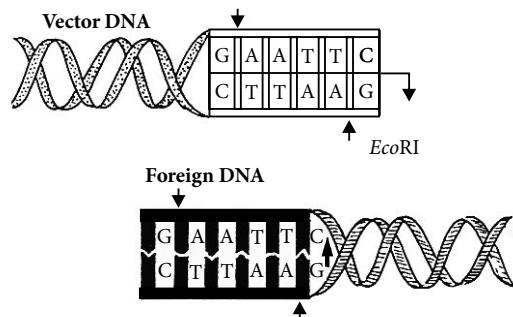


Fig: Segments of a vector and a foreign DNA with the nucleotide sequence recognised by EcoRI.

(b)

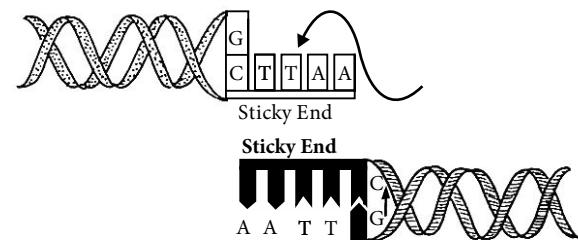


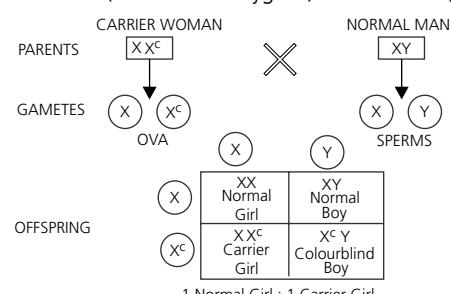
Fig: Vector DNA segment and foreign DNA segment after the action of EcoRI.

- 22.** The doctor must have used pedigree analysis which refers to the analysis of distribution and movement of traits in a series of generations of a family.

The parents with normal vision may give rise to a colourblind child, provided they have following genotypes :

Father : XY (normal)

Mother : XX^c (carrier/heterozygous, normal vision)



The progeny can consist of the following genotypes and phenotypes :

XX	XX ^c	XY	X ^c Y
Normal : female	Carrier : female	Normal : male	Colourblind male

23. (a) Sanjay showed responsibility and respect towards the environment and living organisms. He is open towards accepting new technologies and systems. His attitude towards this new approach shows his responsibility towards sustainable ecosystem and protection of resources and services provided by it. He is also aware of the environment and utilisation of its resources for the mankind as well as ecosystem maintenance.

(b) The objective of such an idea is to ensure sustainable ecosystem. In recent years, there has been increasing recognition of disruption to aquatic ecosystems resulting from factors like climate change, overfishing, nutrient and chemical pollution. The approach of ecosystem based fisheries management maintains an equilibrium between sustainable fisheries, biodiversity and habitat protection.

Fishing affects aquatic life in one way or another. One major impact is on the non-targeted organisms which are removed due to the removal of a single species of large fish, causing a change in the size composition of the non-targeted species as fishing causes a change in the trophic structure.

Ecosystem based fisheries management provide many alternatives like controlled fishing and restocking the population of target species. It also accounts for fishery interactions and biological consideration along with climate change and environmental variability within a single framework.

24. (a) The hormones and their respective functions of the given glands are as follows:-

Hypothalamus secretes, Gonadotropin releasing hormone (GnRH) which stimulates the anterior lobe of pituitary to secrete luteinising hormone (LH) and follicle stimulating hormone (FSH). FSH stimulates the growth of the ovarian follicles and division of primary oocyte within the follicle to form secondary oocyte. It also stimulates the formation of estrogens. LH stimulates corpus luteum to secrete progesterone.

Ovary secretes estrogen and progesterone. Estrogen stimulates the proliferation of endometrium of the uterine wall. Progesterone is essential for the maintenance of endometrium required for implantation of fertilised ovum and for maintenance of pregnancy.

(b) The act of expelling the full term young one from the mother's uterus at the end of gestation period is called parturition. Process of parturition is induced by both nervous system and hormones secreted by the endocrine glands of the mother. The signals for child birth (parturition) originate

from the fully matured foetus and placenta which induce mild uterine contractions called foetal ejection reflex. This causes quick release of oxytocin from the maternal pituitary gland.

Oxytocin acts on the uterine muscle and causes stronger uterine contractions which in turn further stimulates the secretion of oxytocin. The stimulatory reflex between the uterine contraction and oxytocin secretion continues resulting in stronger and stronger contractions. This leads to expulsion of the baby from the uterus through the birth canal.

OR

(a) Sectional view of microsporangium of an angiosperm is as follows:

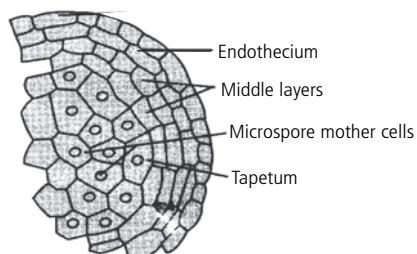


Fig.: T.S. of microsporangium

(b) The characteristics of tapetum are as follows:

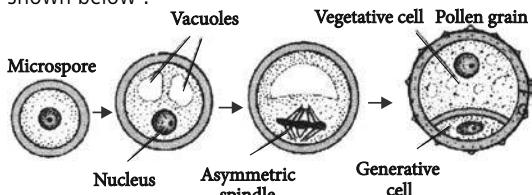
- Tapetal cells are filled with protoplasmic contents as well as nutrients.
- They are either multinucleate or their nucleus becomes polyploid due to endopolyploidy.
- Tapetum is of two types – amoeboid and secretory.
- In amoeboid type, the tapetal cells fuse to form a plasmodium or periplasmodium because it passes in between the sporogenous cells to nourish them.
- The cells of secretory tapetum pass out substances over the sporogenous cells for their growth and differentiation.

Functions of tapetum in an anther are as follows:

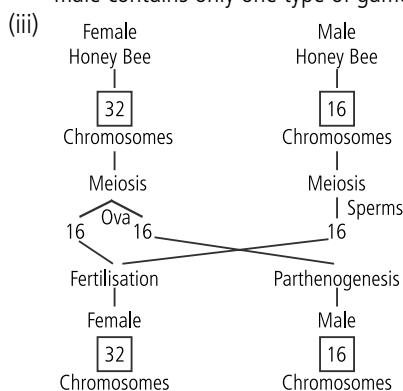
- Nourishment of the developing microspore mother cells and pollen grains.
- It produces lipid rich Ubisch granules containing sporopollenin for exine formation, pollenkitt in case of entomophilous plants, special proteins for the pollen grains to recognise compatibility and hormone IAA.
- It secretes enzyme callase responsible for the degradation of callose wall around pollen tetrad.

(c) In an anther, each cell of the sporogenous tissue is a potential pollen or microspore mother cell (PMC). Each PMC divides by meiosis to form a microspore tetrad. This process is called microsporogenesis. As the anthers mature and dehydrate, the microspores dissociate from each other and develop into pollen grains. The hard outer layer called

the exine is made up of sporopollenin. The inner wall of the pollen grain is called the intine. When the pollen grain is mature it contains two cells, the vegetative cell and the generative cell. Different stages of microsporogenesis are shown below :



- 25.** (a) (i) In male heterogamety, males produce two different types of gametes. In *Drosophila*, the males contain two heteromorphic sex chromosomes, X and Y. In grasshopper, the male have only one sex chromosome, X (XO type). Thus, the males are heterogametic as half male gametes carry X-chromosomes (A+X) and other half, devoid of X chromosome (A + O).
- (ii) In some organisms, females produce two different types of gametes. This is termed as female heterogamety. In birds and some reptiles, female is heterogametic as it, produce 2 types of eggs; (A + Z) and (A + W). Whereas male contains only one type of gamete (ZZ).



- (b) (i) Symptoms exhibited by Turner's syndrome sufferer are :
- (a) sterile females (b) undeveloped breasts
 - (c) puffy fingers (d) webbed neck
 - (e) short stature (f) abnormal intelligence.

Turner's syndrome is due to monosomy. It occurs due to union of an allosome free egg ($22 + 0$) and a normal X sperm or a normal egg and an allosome free sperm ($22 + 0$). The individual has $2n = 45$ chromosomes ($44 + X0$) instead of 46.

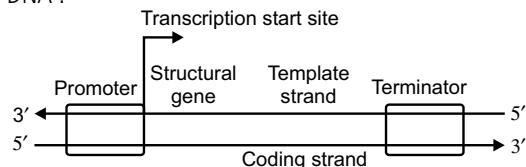
- (ii) Differences between chromosomal and Mendelian disorders are as follows :

	Chromosomal disorders	Mendelian disorders
(i)	The disorders are caused by chromosomal abnormalities.	The disorders are caused by allelic abnormalities.

(ii)	Chromosomal abnormalities develop due to defective synapsis and disjunction.	Allelic abnormalities develop due to mutations.
(iii)	The defect can be known through amniocentesis.	The defect can be predicted through pedigree analysis.
(iv)	The disorder is rarely transmitted.	The disorder is transmitted to the progeny.
(v)	E.g.,-Down's syndrome, Turner's syndrome, Klinefelters' syndrome.	E.g.,-Thalassemia, Sickle cell anaemia, Alzheimer's disease.

OR

- (a) A transcription unit in DNA is defined by these regions in DNA :



- (b) The promoter gene is located towards 5'-end of the coding strand. It is a DNA sequence that has RNA polymerase recognition site and also provide binding site for RNA polymerase. Presence of a promoter in a transcription unit defines the template and coding strands.

- (c) Transcription requires DNA-dependent RNA polymerase. RNA polymerase binds to promoter and initiates transcription. With the help of RNA polymerase the adjacent ribonucleotides held over DNA template join to form RNA chain. Once the polymerase reaches the terminator region, the nascent RNA falls off, so also the RNA polymerase. This results in termination of transcription.

In eukaryotes there are at least three DNA-dependent RNA polymerases in the nucleus. The RNA polymerase I transcribes rRNAs (28S, 18S and 5.8S), whereas the RNA polymerase II transcribes precursor of mRNA and the heterogenous nuclear RNA (hnRNA). RNA polymerase III is responsible for transcription of tRNA, 5S rRNA and some snRNAs. The prokaryotes have only single DNA dependent RNA polymerase.

ANSWERS

WHO AM I...

- Facilitated transport Pg. 12
- Phenyl mercuric acetate Pg. 21
- Fluorides Pg. 58
- Lead Pg. 63

- (d) Primary transcript is often larger than the functional RNAs. This primary transcript is called heterogeneous nuclear RNA or hnRNA, especially in case of mRNA. Post-transcription processing is required to convert primary transcript of all types of RNAs into functional RNAs. It is of four types:
- Cleavage : Larger RNA precursors are cleaved to form smaller RNAs.
 - Splicing : Eukaryotic transcripts possess extra segments called introns or intervening sequences or non - coding sequences. They do not appear in mature or processed RNA. The functional coding sequences are called exons. Splicing is removal of introns and fusion of exons to form functional RNAs.
 - Terminal additions (Capping and Tailing): Additional nucleotides are added to the ends of RNAs for specific functions, e.g., CCA segment in tRNA, cap nucleotides at 5' end of mRNA or poly-A segments at 3' end of mRNA. Cap is formed by modification of GTP into 7-methyl guanosine or 7mG.
 - Nucleotide modifications: They are most common in tRNA- methylation (e.g., methyl cytosine, methyl guanosine), deamination (e.g., inosine from adenine), dihydrouracil, pseudouracil, etc.

26. (a) Based on the nature of the habitat, succession of plants is of two types-hydrarch and xerarch. Hydrarch starts in regions where water is in plenty and progresses from hydric to mesic conditions (adequate moisture conditions). On the other hand, xerarch starts in regions where moisture is present in minimal or negligible amounts such as dry deserts, rocks, etc. and it progresses from xeric to mesic conditions. Hence, both hydrarch and xerach successions lead to medium water conditions, i.e., mesic conditions.

(b) Exotic species is an alien invasive or non-native species, which have been introduced by humans outside their native ranges. Non-native or alien species are often introduced inadvertently by man for their economic and other uses. They often become invasive and drive away the local species. For example:

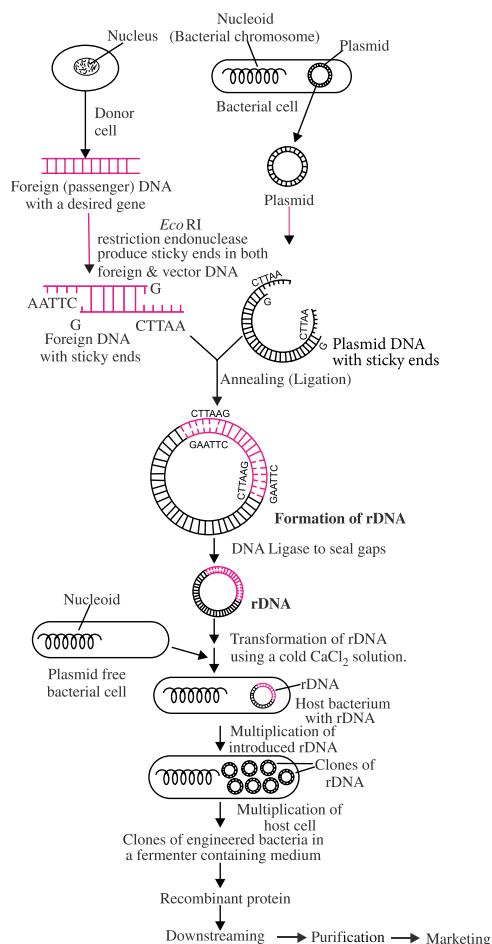
- Water hyacinth (*Eichhornia crassipes*) was introduced in Indian waters to reduce pollution but it turned out to be a problematic species. It has clogged water bodies including wetlands at many places resulting in death of several aquatic plants and animals.
- Nile Perch (a predator fish) was introduced in lake Victoria of South Africa. It killed and eliminated ecologically unique assemblage of over 200 native species of small cichlid fish.

OR

(a) The cloning vectors are DNA molecules that can carry a foreign DNA segment and replicate inside the host cell. Cloning vector carry rDNA and they generally have

high copy number. They can produce multiple number of required gene. Vectors help in easy linking of foreign DNA and in selection of recombinants from non-recombinants. Examples : plasmids, bacteriophages, cosmids, phagemids, yeast artificial chromosome (YAC), bacterial artificial chromosome (BAC) and transposons.

(b) Diagram showing various steps of recombinant DNA technology is given below:



(c) Some multinational companies of industrialised nations have a good economic status but are poor in biodiversity and are exploiting bioresources of developing and underdeveloped countries without authorisation and proper compensation. This is called biopiracy. There has been growing realisation of the injustice, inadequate compensation and benefit sharing between developed and developing countries. Therefore, some nations are developing laws to prevent such unauthorised exploitation of their bio-resources and traditional knowledge. Government grant patents, i.e., rights to an inventor to prevent others from commercial use of his invention. Biopatent system allows private, monopoly rights over cells, genes, animals and plants.





NEET

FOUNDATION

Class-12

Maximise your chance of success in NEET by reading this article. This section is specially designed to optimise your preparation by practising more and more. It is a unit wise series having chapterwise question bank, allowing you to prepare systematically and become more competent.

- 👉 Recall question or single concept question – indicated by a single finger.
- 👉 Application question or question which requires 2 or 3 concepts - indicated by 2 fingers.
- 👉 Application question or question which requires 3 or more concepts - indicated by 3 fingers.

UNIT-IX : BIOTECHNOLOGY

CHAPTER-11 : BIOTECHNOLOGY : PRINCIPLES AND PROCESSES

Multiple Choice Questions

1. Which type of restriction endonucleases are not used in recombinant DNA technology?
(a) Type I only (b) Type II only
(c) Type I and III (d) Type II and III
2. Identify the palindromic sequence.
(a) GAATTCTTAAAG (b) GTAGCGCATCGC
(c) AAAGTGTTACACA (d) ATGCTT
3. Which among the following statements is correct?
(a) Recognition sites in vector help to select transformant host from non-transformants.
(b) Chromosomal DNA can replicate independent of main genome.
(c) Microinjection is vector mediated gene transfer method to inject foreign DNA into nucleus of cell.
(d) Eukaryotes do not have restriction enzymes.
4. Select the correctly matched pair.
(a) Molecular glues - Restriction endonuclease
(b) Passenger DNA - Transposon
(c) Gene taxi - Plasmid
(d) Mobile genetic elements - Foreign DNA
5. Select the correct sequence for the major processes involved in recombinant DNA technology.
(i) Fragmentation of DNA by restriction endonucleases.
(ii) Gene of interest from source DNA is ligated to vector DNA.
(iii) Obtaining purified DNA free from macromolecules like RNA, proteins.
(iv) Insertion of rDNA into host cell.
(v) Extraction of the desired product.
(a) (i), (iii), (ii), (iv), (v) (b) (iii), (iv), (i), (ii), (v)
(c) (iii), (i), (ii), (iv), (v) (d) (ii), (i), (iii), (v), (iv)
6. Which restriction enzyme recognises the given sequence?
$$5' - A \downarrow A - G - C - T - T - 3'$$

$$3' - T - T - C - G - A \uparrow - A - 5'$$

(a) *Hin* III (b) *Eco* RI
(c) *Bam* HI (d) *Alu* I
7. Mg^{2+} is required during which step in a polymerase chain reaction?
(a) Denaturation of DNA
(b) Annealing of primers
(c) Polymerisation of DNA
(d) Beginning of second cycle
8. At what temperature, do oligonucleotide primers anneal to template DNA for gene amplification?
(a) 70 - 75°C (b) 40 - 60°C
(c) 94 - 96°C (d) 68 - 70°C

9. Select the incorrect statement.
- Vector for transferring gene of SV-40 into bacterium was lambda phage.
 - Synthetic DNA can be synthesised without a DNA template.
 - In pBR322, 322 represents molecular weight.
 - cDNA is synthesised on DNA template with the help of reverse transcriptase.
10. Which of the following recombinant proteins is used for preventing clotting of blood?
- Reo Pro
 - OKT - 3
 - Blood clotting factor VIII
 - Blood clotting factor IX

Match The Columns

11. Match Column I with Column II.

Column I	Column II
A. BAC vector	(i) 23 kb
B. Lambda phage vector	(ii) 300 - 350 kb
C. Cosmid vector	(iii) More than 1 Mb
D. YAC vector	(iv) 45 kb

12. Match Column I with Column II. (There can be more than one match for items in Column I).

Column I	Column II
A. Gel electrophoresis	(i) Calcium
B. Restriction endonuclease	(ii) Ampicillin
C. Electroporation	(iii) Agarose
D. DNA mediated gene transfer	(iv) Kanamycin
E. Selectable markers	(v) Lysozyme
	(vi) Ethidium bromide
	(vii) Molecular scissor
	(viii) Calcium chloride
	(ix) Chemical scalpel
	(x) Heat shock

Passage Based Question

13. Complete the given passage with appropriate words or phrases.

Genetic engineering is to alter the nature of genetic material by inserting foreign DNA into the host cell. First step of rDNA technology involves isolation of genetic material. In bacteria, DNA is obtained by treating the cell with (i) and DNA is then purified. (ii) is added for precipitation of purified DNA, resulting in fine thread

formation in suspension. Purified DNA is subjected to (iii). Complementary sticky ends of plasmid and foreign DNA are joined by (iv). Gene of interest from source DNA is ligated to vector DNA and results in formation of (v). Gene of interest is amplified using (vi). Host bacterium is transformed with rDNA using (vii). rDNA in host cell is multiplied followed by multiplication of host cell. Required recombinant protein is obtained from gene of interest.

Assertion & Reason

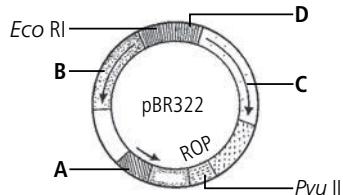
In each of the following questions, a statement of Assertion (A) is given and a corresponding statement of Reason (R) is given just below it. Of the statements, mark the correct answer as :

- if both A and R are true and R is the correct explanation of A
- if both A and R are true but R is not the correct explanation of A
- if A is true but R is false
- if both A and R are false.

14. **Assertion :** In heat shock method, calcium ion increases efficiency of DNA transfer in bacterial cell.
Reason : Calcium ions impart positive charge to DNA.
15. **Assertion :** Ti plasmid of *Agrobacterium tumefaciens* cannot be used as cloning vector.
Reason : T-DNA cannot produce its copies as it is unable to migrate from one chromosomal position to another.
16. **Assertion :** Type I restriction enzymes are not used in rDNA technology.
Reason : Type I restriction enzymes recognise specific site with DNA but do not cut them.
17. **Assertion :** In agarose gel electrophoresis, largest molecule is found at maximum distance from the well.
Reason : Large DNA molecule have maximum recognition sites for restriction enzymes.
18. **Assertion :** Insertional inactivation distinguishes recombinants from non-recombinants.
Reason : Due to insertional inactivation, recombinant colonies do not produce any colour.

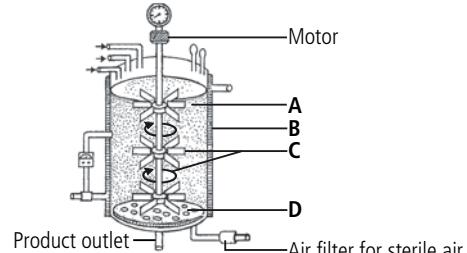
Figure Based Questions

19. Refer to the given figure and answer the following questions.



- What are the characteristics of given vector?
- Identify the labelled part A and give its significance.
- What does B, C and D represent?
- Name the unique recognition sites present in B and C.

- 20.** Study the given figure and answer the following questions.



- (a)** Name the type of bioreactor shown in the figure.
(b) Write the purpose for which this bioreactor is used.
(c) Identify the labelled parts A, B, C and D.

CHAPTER-12 : BIOTECHNOLOGY AND ITS APPLICATIONS

Multiple Choice Questions

- (a) (ii) and (iii) only (b) (i) and (ii) only
 (c) (i), (iii) and (iv) only (d) (i) and (iii) only

6. Which transgenic plant contains 'cow pea trypsin inhibitor' gene for pest resistance?

7. Biopatents are granted for biological entities and for their products. These include

- (i) DNA sequences
 - (ii) strains of microorganisms
 - (iii) all type of plants
 - (iv) cell lines.

- (a) (ii), (iii) and (iv) only (b) (i), (ii) and (iii) only
(c) (i), (ii) and (iv) only (d) (i), (iii) and (iv) only

8. Which pair is not matched correctly?

- (a) Transgenic salmon - First transgenic animal for food production
 - (b) Transgenic pigs - Serve as bioreactors
 - (c) Transgenic sheep - "ANDI" carrying human gene for blood clotting factor IX
 - (d) Transgenic chicken - Resistant to avian leukosis virus

9. Identify the diseases caused by bioweapon agents.

- (i) Anthrax and plague
 - (ii) Small pox and cholera
 - (iii) Botulinum and tularemia
 - (iv) Typhoid and chicken pox
 - (a) (i) and (iii) only (b) (i) and (iv) only
 - (c) (ii) and (iv) only (d) (iii) and (iv) only

10. Select the correct sequence of steps in the production of transgenic animals.

- (i) Selection of proper vector
 - (ii) Identification and separation of desired gene
 - (iii) Introduction of transferred vector in cells and tissues
 - (iv) Combining desired gene with vector
 - (v) Demonstration of integration and expression of foreign gene in transgenic tissue

(a) (ii), (i), (iii), (iv), (v) (b) (i), (iii), (ii), (v), (iv)
(c) (ii), (i), (iv), (iii), (v) (d) (i), (ii), (iv), (v), (iii)

Match The Columns

- 11.** Match Column I with Column II.

Column I	Column II
A. Natural genetic engineer	(i) <i>M. incognita</i>
B. <i>nif</i> gene	(ii) <i>A. tumefaciens</i>
C. Roundworms	(iii) <i>R. meliloti</i>
D. Bt toxin	(iv) <i>R. stolonifer</i>
E. Steroids	(v) <i>B. thuringiensis</i>

12. Match Column I with Column II. (There can be more than one match for items in Column I).

Column I	Column II
A. ELISA	(i) Riboflavin
B. Interferon - β	(ii) Spores
C. Vitamin B ₂	(iii) Ag-Ab interaction
D. Bioweapon	(iv) <i>Ashbya gossypii</i>
E. Gene therapy	(v) Toxins
	(vi) Peroxidase
	(vii) Cystic fibrosis
	(viii) Fibroblasts
	(ix) Duchenne muscular dystrophy
	(x) Macrophages

Passage Based Question

13. Complete the given passage with appropriate words or phrases.

Gene therapy is of two types; (i) and (ii). In (i) functional gene is introduced in (iii) or (iv). First clinical gene therapy was given to patient suffering from SCID. SCID is caused due to defect in the gene for enzyme (v). SCID patients are not able to show immune response against invading pathogens, as (vi) are non-functional. (vi) are extracted from bone marrow of the patient and are grown in culture outside the body. A functional (vii) is then introduced in lymphocytes and are reinjected into patient's (viii). Patient requires periodic infusion of genetically engineered cells.

Assertion & Reason

- In each of the following questions, a statement of Assertion (A) is given and a corresponding statement of Reason (R) is given just below it. Of the statements, mark the correct answer as :
- if both A and R are true and R is the correct explanation of A
 - if both A and R are true but R is not the correct explanation of A
 - if A is true but R is false
 - if both A and R are false.

14. **Assertion :** Monoclonal antibodies are useful for immune suppression during organ transplantation.

Reason : Monoclonal antibodies are highly specific for specific antigens.

15. **Assertion :** Transgenic animals act as bioreactors for molecular farming.

Reason : Molecular farming is mass production of proteins encoded by transgenes in animals.

16. **Assertion :** *Agrobacterium tumefaciens* acts as natural genetic engineer.

Reason : *Agrobacterium tumefaciens* induces the pest resistance in all broad leaved plants.

17. **Assertion :** Insulin cannot be produced using bacterial cells.

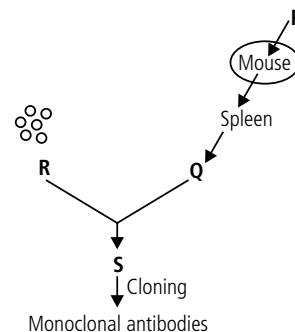
Reason : Bacterial genes posses introns.

18. **Assertion :** Biopiracy includes rules of conduct to regulate activities in relation to biological world.

Reason : Biopiracy allows private, monopoly rights over cells, genes, animals and plants.

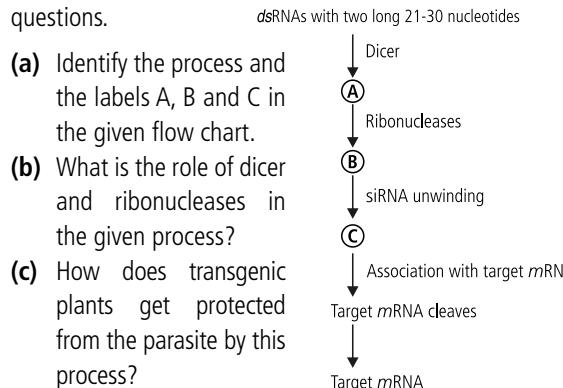
Figure Based Questions

19. Refer to the given flow chart of monoclonal antibody production and answer the following questions.



- What does P, Q and R represent?
- Describe the property of S.
- How monoclonal antibody is different from polyclonal antibody?

20. Refer to the given flow chart and answer the following questions.



MPP CLASS XII ANSWER KEY

- | | | | | |
|---------|---------|---------|---------|---------|
| 1. (a) | 2. (a) | 3. (c) | 4. (a) | 5. (c) |
| 6. (d) | 7. (a) | 8. (b) | 9. (a) | 10. (c) |
| 11. (a) | 12. (c) | 13. (b) | 14. (c) | 15. (d) |
| 16. (b) | 17. (b) | 18. (c) | 19. (d) | 20. (d) |
| 21. (a) | 22. (b) | 23. (c) | 24. (b) | 25. (b) |
| 26. (c) | 27. (d) | 28. (b) | 29. (c) | 30. (d) |
| 31. (b) | 32. (a) | 33. (b) | 34. (d) | 35. (c) |
| 36. (b) | 37. (a) | 38. (c) | 39. (a) | 40. (a) |

SOLUTIONS

CHAPTER-11 : BIOTECHNOLOGY : PRINCIPLES AND PROCESSES

1. (c) 2. (a) 3. (d) 4. (c) 5. (c)
6. (a) 7. (c) 8. (b) 9. (d) 10. (a)

11. A-(ii), B-(i), C-(iv), D-(iii)

12. A-(iii, vi); B-(vii, ix); C-(v, viii); D-(i, x); E-(ii, iv)

13. (i) lysozyme (ii) Chilled ethanol
(iii) restriction digestion (iv) DNA ligase
(v) chimera DNA (vi) PCR
(vii) CaCl_2

14. (c) 15. (d) 16. (a) 17. (d) 18. (a)

19. (a) The given figure is of plasmid vector pBR322. It is an extra-chromosomal, self-replicating, usually circular, double stranded DNA molecules found naturally in many bacteria and some yeast.

(b) Labelled part A represents origin of replication (*Or*). It is a specific sequence of DNA bases which is responsible for initiating replication.

(c) B - Ampicillin resistance gene, C-Tetracycline resistance gene, D - Cleavage site. B and C are antibiotic resistance genes which are useful as selectable markers. These help in selecting transformants (host cells containing vectors) from non - transformants. D is the recognition site for restriction enzyme.

(d) The recognition sites for enzymes *Pst*I and *Pvu*I are present in the ampicillin resistant gene (B) and recognition sites for enzymes *Bam* HI and *Sal*I are present within tetracycline resistant gene (C).

20. (a) Simple stirred tank bioreactor.

(b) Bioreactor is used for biologically converting raw materials into specific products by microbes, plant and animal cells under aseptic conditions.

(c) A – Culture broth, B – Cooling jacket, C – Stirrer blades, D – Sparger.

CHAPTER-12 : BIOTECHNOLOGY AND ITS APPLICATIONS

1. (a) 2. (b) 3. (c) 4. (b) 5. (c)
6. (a) 7. (c) 8. (c) 9. (a) 10. (c)

11. A-(ii), B-(iii), C-(i), D-(v), E-(iv)

12. A-(iii, vi); B-(viii, x); C-(i, iv); D-(ii, v); E-(vii, ix)

13. (i) germline gene therapy (ii) somatic cell gene therapy
(iii) sperms (iv) ova
(v) adenosine deaminase (vi) T-lymphocytes
(vii) ADA-cDNA (viii) bone marrow

14. (b) 15. (a) 16. (c) 17. (d) 18. (d)

19. (a) In the given figure, P refers to a specific antigen injected into a mouse, against which antibodies are required. Q refers to antibody producing plasma cells and R refers to myeloma cells, i.e. cancerous plasma cells.

(b) S refers to hybridoma cells which possess immortal growth properties of myeloma cells and antibody producing property of B-cells.

(c) Monoclonal antibody is derived from single B-cell clone and has single binding site whereas polyclonal antibody arise from many B-cell clones and have heterogenous collection of binding sites.

20. (a) Flow chart shows the process of RNA interference (RNAi). A – siRNA, B-RISC (RNA-induced silencing complex), C – Activated RISC.

(b) Dicer cuts the dsRNA molecules into small interfering RNAs (si-RNA). Ribonuclease combines with each si-RNA complexes to form an RNA-induced silencing complex (RISC).

(c) The activated RISC targets complementary mRNA molecules. The siRNA strands act as guides where the RISCs cut the transcripts in an area where the siRNA binds to the mRNA. This destroys the mRNA. When mRNA of the parasite is destroyed, no protein was synthesised. It results in the death of the parasite (nematode) in the transgenic host. Thus, the transgenic plant got itself protected from the parasite.



Spellathon

1. Make as many biological terms as possible using the given letters. Each word should contain the letter given in circle.
2. Minimum 4 letter word should be made.
3. In making a word, a letter can be used as many times as it appears in the box.
4. Make at least 1 seven letter word.



Send your response at editor@mtg.in or post to us with complete address by 25th of every month to win exciting prizes. Winners' name will be declared on 1st of every month on www.mtg.in



Boost your NEET score

Practice Paper 2017

**Exam on
7th May**

- 23.** Match the items in column I with those in column II and choose the correct answer.

Column I

- | | |
|----------------|-------------------------------------|
| 1. Funicle | A. Small opening of ovule |
| 2. Integuments | B. Stalk of ovule |
| 3. Chalaza | C. Protective envelopes of ovule |
| 4. Hilum | D. Junction part of ovule and stalk |
| 5. Micropyle | E. Basal part of the ovule |
- (a) 1-B; 2-C; 3-E; 4-D; 5-A (b) 1-A; 2-C; 3-B; 4-D; 5-E
 (c) 1-B; 2-C; 3-A; 4-D; 5-E (d) 1-B; 2-D; 3-E; 4-A; 5-C

- 24.** Dr. F. Went noted that if coleoptile tips were removed and placed on agar for one hour, the agar would produce a bending when placed on one side of freshly-cut coleoptile stumps. Of what significance is this experiment?

- (a) It made possible the isolation and exact identification of auxin.
 (b) It is the basis for quantitative determination of small amounts of cytokinin.
 (c) It supports the hypothesis that IAA is auxin.
 (d) It demonstrated polar movement of cytokinin.

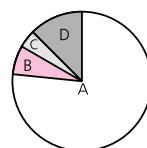
- 25.** A scrubber in the exhaust of a chemical industrial plant removes

- (a) gases like sulphur dioxide
 (b) particulate matter of the size 5 micrometer or above
 (c) gases like ozone and methane
 (d) particulate matter of the size 2.5 micrometer or less.

- 26.** The clotting of blood is severely affected in absence of vitamin K in body because it is essential for

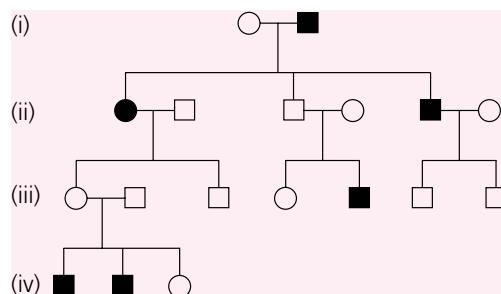
- (a) formation of thromboplastin
 (b) synthesis of prothrombin
 (c) conversion of prothrombin to thrombin
 (d) conversion of fibrinogen of fibrin.

- 27.** Given here is a pie chart representation of the extent of global diversity of invertebrates. What groups the four portions (A-D) represent respectively?



	A	B	C	D
(a)	Insects	Crustaceans	Other animal groups	Molluscs
(b)	Crustaceans	Insects	Molluscs	Other animal groups
(c)	Molluscs	Other animal groups	Crustaceans	Insects
(d)	Insects	Molluscs	Crustaceans	Other animal groups

- 28.** In the following human pedigree, the filled symbols represent the affected individuals. Identify the type of given pedigree.



- (a) Autosomal recessive (b) X-linked dominant
 (c) Autosomal dominant (d) X-linked recessive

- 29.** Consider the given list of characters and select those that are not applicable to the anatomy of dicot roots.

- (i) Presence of conjunctive tissue.
 (ii) Presence of proteinaceous compounds in Caspary strips.
 (iii) Presence of polyarch xylem bundles.
 (iv) Presence of pericycle.
 (a) (i) and (iii) only (b) (iv) only
 (c) (ii) only (d) (i), (iii) and (iv) only

- 30.** The quiescent centre in root meristem serves as a

- (a) site for storage of food which is utilised during maturation
 (b) reservoir of growth hormones
 (c) reserve for replenishment of damaged cells of the meristem
 (d) region for absorption of water.

- 31.** Chloragogen cells of earthworm are similar to which of the following vertebrate organ?

- (a) Kidney (b) Liver
 (c) Spleen (d) Lung

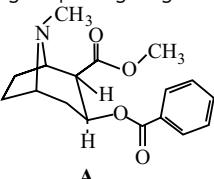
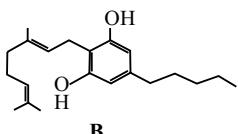
- 32.** Which one of the following groups of animals is correctly matched with its characteristic feature without any exception?

- (a) Reptiles : possess 3-chambered heart with an incompletely divided ventricle.
 (b) Chordates : possess a mouth with an upper and a lower jaw.
 (c) Chondrichthyes : possess cartilaginous endoskeleton.
 (d) Mammals : give birth to young ones.

- 33.** Identify the correctly matched pair.

- (a) Spireme stage – Late prophase
 (b) Congression stage – Metaphase
 (c) Interzonal fibres formation – Telophase
 (d) Reappearance of ER and Golgi bodies – Anaphase

- 34.** The phenomenon causing effect opposite to that of Bohr's effect is called
 (a) Hamburger's phenomenon
 (b) Hering – Breuer reflex
 (c) Haldane effect
 (d) chloride shift.
- 35.** Choose the correct sequence for origin and conduction of heart beat.
 (a) AV node → SA node → Bundle of His → Purkinje fibres
 (b) SA node → Purkinje fibres → AV node → Bundle of His
 (c) SA node → AV node → Bundle of His → Purkinje fibres
 (d) AV node → Purkinje fibres → SA node → Bundle of His
- 36.** In angiosperms, which of the following events takes place after double fertilisation?
 (a) The male gametes fuse with egg to form zygote.
 (b) The primary endosperm nucleus (PEN) develops into endosperm.
 (c) The pollen tube enters the embryo sac.
 (d) The male gametes are discharged into the embryo sac.
- 37.** The water potential in xylem vessel can be represented as
 (a) $\Psi_w = \Psi_s$ (b) $\Psi_s = \Psi_p$
 (c) $\Psi_w = 0$ (d) $\Psi_w = \Psi_s + (-\Psi_p)$.
- 38.** The lipid which participates in blood coagulation is
 (a) lecithin (b) cephalin
 (c) sphingomyelin (d) cerebroside.
- 39.** The plexus of Auerbach
 (a) is a network of nerve cells and sympathetic nerve fibres
 (b) is present between circular muscle fibres and mucosa
 (c) controls peristaltic movements in alimentary canal
 (d) both (b) and (c).
- 40.** All pink flowers are produced in F_1 generation upon crossing red and white flowered *Mirabilis* plants. If the F_1 progenies are selfed, the phenotypic and genotypic ratios are expected to be
 (a) 1 : 2 : 1 and 3 : 1 (b) 3 : 1 and 1 : 2 : 1
 (c) 1 : 2 : 1 and 1 : 2 : 1 (d) 1 : 1 and 1 : 1 : 1 : 1.
- 41.** In plants, the tonoplast facilitates the transport of a number of ions and other materials
 (a) against concentration gradient into vacuole
 (b) along concentration gradient into vacuole
 (c) along concentration gradient into cytoplasm
 (d) against concentration gradient in cytoplasm.
- 42.** Match the following.
- | Column I | Column II |
|-----------------------------|----------------------|
| A. Organ level | (p) <i>Pheretima</i> |
| B. Cellular aggregate level | (q) <i>Fasciola</i> |
| C. Tissue level | (r) <i>Spongilla</i> |
| D. Organ system level | (s) <i>Obelia</i> |
- 43.** Choose the correctly matched pair.
 (a) Tendon - Specialised connective tissue
 (b) Adipose tissue - Dense connective tissue
 (c) Areolar tissue - Loose connective tissue
 (d) Cartilage - Loose connective tissue
- 44.** Consider the statements A and B and choose the correct option accordingly.
- Statement A :** Animals are either unisexual or bisexual.
Statement B : Most of the bisexual animals reproduce by cross-fertilisation.
- (a) Both statements A and B are correct and B is the correct explanation of A.
 (b) Both statements A and B are correct but B is not the correct explanation of A.
 (c) Statement A is correct but statement B is incorrect.
 (d) Both statements A and B are incorrect.
- 45.** A marriage between normal visioned man and colour blind woman will produce which of the following types of offsprings?
 (a) Normal sons and carrier daughters
 (b) Colourblind sons and carrier daughters
 (c) Colourblind sons and 50% carrier daughters
 (d) 50% colourblind sons and 50% carrier daughters
- 46.** Which one of the following statements about all the four of *Spongilla*, leech, dolphin and penguin is correct?
 (a) Penguin is homoiothermic while the remaining three are poikilothermic.
 (b) Leech is a fresh water form while all others are marine.
 (c) *Spongilla* has special collared cells called choanocytes, not found in the remaining three.
 (d) All are bilaterally symmetrical.
- 47.** Mushroom gland is a part of
 (a) male reproductive system of cockroach
 (b) female reproductive system of cockroach
 (c) male reproductive system of frog
 (d) female reproductive system of frog.
- 48.** Which of the following characteristic is not true for coacervates?
 (a) They can incorporate chemicals from surrounding water into their structure.
 (b) They possess single layered outer boundary.
 (c) They have ability to increase in size.
 (d) They can remain in solution for extended period.

- 49.** Each immunoglobulin has two heavy chains and two light chains, the antigen binding site is present in
 (a) variable region of heavy chain
 (b) variable region of both heavy and light chain
 (c) variable region of light chain
 (d) constant region of both light and heavy chain.
- 50.** Three carp fishes, *Catla*, *Labeo* and *Cirrhina*, can be grown together in the same pond more economically as they have
 (a) positive interaction (b) commensalism
 (c) symbiosis (d) no competition for food.
- 51.** Fertilizin-antifertilizin reaction ensures
 (a) prevention of polyspermy
 (b) activation of sperm
 (c) release of lysin
 (d) both (b) and (c).
- 52.** Consider the statements given below regarding contraception and answer as directed thereafter.
 (1) Medical termination of pregnancy (MTP) during first trimester is generally safe.
 (2) Generally chances of conception are nil until mother breast-feeds the infant upto two years.
 (3) Intrauterine devices like copper-T are effective contraceptives.
 (4) Contraception pills may be taken upto one week after coitus to prevent conception.
 Which two of the above statements are correct?
 (a) 1 and 3 only (b) 1 and 2 only
 (c) 2 and 3 only (d) 3 and 4 only
- 53.** Transcription starts non-specifically in the absence of
 (a) sigma factor (b) rho factor
 (c) core enzyme (d) DNA polymerase.
- 54.** During photosynthesis, light is not directly required for
 (a) conversion of ADP to ATP
 (b) reduction of NADP^+ to NADPH
 (c) the formation of 3-phosphoglycerate from carbon dioxide and ribulose 1,5 bisphosphate
 (d) splitting of water.
- 55.** "Richmond Lang effect" refers to
 (a) induction of parthenocarpy by gibberellins
 (b) delaying senescence by cytokinins
 (c) suppression of axillary growth by auxins
 (d) stimulation of stomatal closure by abscisic acid.
- 56.** Metagenesis refers to
 (a) occurrence of a drastic change in form during post-embryonic development
 (b) presence of a segmented body and parthenogenetic mode of reproduction
 (c) presence of different morphic forms
 (d) alternation of generation between asexual and sexual phases of an organism.
- 57.** Stereocilia occur in
 (a) pseudostratified columnar epithelium of trachea
 (b) columnar epithelium of stomach
 (c) stratified columnar epithelium of pharynx
 (d) pseudostratified columnar epithelium of epididymis.
- 58.** Which one of the following statements is correct with regard to the principle of safe blood transfusion?
 (a) The donor's red blood corpuscles should not contain antibodies against the recipient's serum.
 (b) The recipient's serum should not contain antigens against the donor's antibodies.
 (c) The recipient's serum should not contain the antibodies against the red blood corpuscles of the donor.
 (d) The recipient's red blood corpuscles should not contain antibodies against the donor's antigen.
- 59.** Identify the molecules (A) and (B) shown below and select the right option giving their source and use.
- 
A

B
- | Molecule | Source | Use |
|---------------------|---------------------------|--|
| (a) A - Cocaine | <i>Erythroxylum coca</i> | Accelerates the transport of dopamine |
| (b) B - Heroin | <i>Cannabis sativa</i> | Depressant and slows down body functions |
| (c) B - Cannabinoid | <i>Atropa belladonna</i> | Produces hallucinations |
| (d) A - Morphine | <i>Papaver somniferum</i> | Sedative and pain killer |
- 60.** Select the correct match of a microbe and its industrial product.
 (a) *Mortierella renispore* – Pectinase
 (b) *Aspergillus niger* – Streptokinase
 (c) *Streptococci* – Tissue plasminogen activator
 (d) *Lactobacillus bulgaricus* – Gluconic acid
- 61.** Identify the correct pair of antagonistic muscles.
 (a) Sphincters – extensors (b) Rotators – elevators
 (c) Pronators – supinators (d) Dilators – depressors
- 62.** During the propagation of a nerve impulse, the action potential results from the movement of
 (a) K^+ ions from intracellular fluid to extracellular fluid
 (b) Na^+ ions from extracellular fluid to intracellular fluid
 (c) K^+ ions from extracellular fluid to intracellular fluid
 (d) Na^+ ions from intracellular fluid to extracellular fluid.

- 63.** The signal transduction of steroid hormones across the cell is through
 (a) binding of hormone to the cytoplasmic receptor and the complex binds to hormone response element on DNA within promoter DNA
 (b) binding of hormone to the transmembrane receptor which initiates the production of second messenger that activates enzymes which further activates transcription factors
 (c) binding of hormone to the transmembrane receptor which diffuse inside the cell cytoplasm and then activates the enzyme necessary for the activation of transcription factors
 (d) binding of hormone to the cytoplasmic receptor that initiates the production of second messenger which activates enzymes that further activates transcription factors.

64. Wobbling helps to maintain economy in number of tRNA molecules as
 (a) genetic code is specific and unambiguous
 (b) tRNA contains anticodons
 (c) it helps tRNA to read more than one codon at a time
 (d) genetic code is read in an open frame.

65. Perfect homozygous individuals can be produced by
 (a) meristem culture (b) anther culture
 (c) somatic hybridisation (d) protoplast culture.

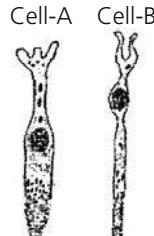
66. Match the column I with column II and select the correct option.

Column I	Column II
A. Warburg effect	p Change in gene frequency by chance
B. Pasteur effect	q Delaying senescence in the leaves by applying cytokinin
C. Emerson effect	r Decline in the consumption of respiratory substrate due to a change from anaerobic to aerobic respiration
D. Wright effect	s Inhibitory effect of O ₂ on photosynthesis
	t Enhancement of photosynthesis by subjecting chlorophyll to two different wavelengths of light.

(a) A-s, B-t, C-q, D-r (b) A-t, B-r, C-p, D-s
 (c) A-t, B-s, C-p, D-q (d) A-s, B-r, C-t, D-p

67. In an experiment demonstrating the evolution of oxygen in *Hydrilla*, sodium bicarbonate is added to water. What would happen if all other conditions are favourable?
 (a) Amount of oxygen evolved decreases as the availability of carbon dioxide increases.
 (b) Amount of oxygen evolved increases as carbon dioxide in water is absorbed by sodium bicarbonate
 (c) Amount of oxygen evolved decreases as carbon dioxide in water is absorbed by sodium bicarbonate
 (d) Amount of oxygen evolved increases as the availability of carbon dioxide increases.

68. Examine the diagram of the two cell types A and B given below and select the correct option.

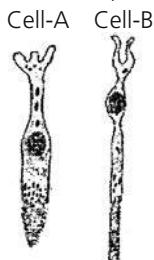


69. Formation of which of the following requires maximum ATP?
 (a) Urea (b) Ammonia
 (c) Uric acid (d) Both (a) and (b)

70. The chemiosmotic coupling hypothesis of oxidative phosphorylation proposes that adenosine triphosphate (ATP) is formed because
 (a) a proton gradient forms across the inner membrane
 (b) there is a change in the permeability of the inner mitochondrial membrane toward adenosine diphosphate (ADP)
 (c) high energy bonds are formed in mitochondrial proteins
 (d) ADP is pumped out of the matrix into the inter-membrane space.

71. Increased shelf life of tomato has been achieved by
 (a) developing better storage technique
 (b) reducing activity of enzyme polygalactouronase
 (c) promoting activity of enzyme polygalactouronase
 (d) enhancing epidermal growth factor.

72. The amount of living material and nutrients present in different trophic levels and soil at a given time are respectively called
 (a) standing crop and standing state respectively
 (b) standing state and standing crop respectively
 (c) standing crop and gross productivity respectively
 (d) biomass and standing crop respectively.



- 73.** The device used to remove 99% of particulate matter present in the exhaust from the thermal power plant is
 (a) catalytic convertor (b) trajectory separator
 (c) scrubber (d) electrostatic precipitator.
- 74.** Competition for resources such as food, light and space is most severe between two
 (a) distantly related species growing in different habitats
 (b) distantly related species growing in same habitat
 (c) closely related species growing in different habitats
 (d) closely related species growing in same habitat.
- 75.** A man suddenly sees a tiger. His heart beat goes up, blood pressure increases, etc. Which hormone is released at this time in his body?
 (a) Parathormone (b) Corticoid
 (c) Adrenaline (d) Thyroxine
- 76.** Restriction enzymes present in several microorganisms cut foreign DNA at specific sites and destroy them. The enzymes do not destroy the cellular DNA because
 (a) the cellular DNA does not have the specific sites
 (b) the susceptible specific sites are masked by proteins
 (c) the restriction enzyme susceptible sites are modified by cellular enzymes
 (d) the restriction enzymes and DNA occupy different compartments.
- 77.** A patient of diabetes mellitus excretes glucose in urine even when he is kept in a carbohydrate free diet. It is because
 (a) fats are catabolised to form glucose
 (b) amino acids are anabolised in liver
 (c) amino acids are discharged in blood stream from liver
 (d) glycogen from muscles are released in the blood stream.
- 78.** If you are asked to classify the various algae into distinct groups, which of the following characters you should choose?
 (a) Presence or absence of flagella
 (b) Structural organisation of thallus
 (c) Chemical composition of the cell wall
 (d) Types of pigments present in the cell
- 79.** The fruit of pineapple develops from
 (a) a multipistillate syncarpous flower
 (b) a multilocular monocarpellary flower
 (c) a cluster of compactly borne flowers on an axis
 (d) unilocular polycarpellary flower.
- 80.** Identify the stage of cell wherein it is infected by virus but the presence of virus particles cannot be made out.
 (a) Infection phase (b) Eclipse phase
 (c) Maturation phase (d) Lysogenic phase
- 81.** The nitrogen fixing bacterium that forms loose association with the roots of crop plants is
 (a) *Azospirillum* (b) *Azotobacter*
 (c) *Bacillus* (d) *Clostridium*.
- 82.** In cyathium inflorescence
 (a) single male flower is surrounded by female flowers
 (b) male and female flowers are borne in different plants
 (c) there is only one male and one female flower
 (d) single female flower is surrounded by many peripheral male flowers.
- 83.** Read the following statements I and II.
 I. Many organs of aquatic plants float in water.
 II. Large air gaps are present in the collenchyma tissues of lotus leaf.
 Select the correct answer.
 (a) Statement I is correct and II is incorrect.
 (b) Statement II is correct and I is incorrect.
 (c) Both statements I and II are correct.
 (d) Both statements I and II are incorrect.
- 84.** The crucial events in aerobic respiration is/are
 (a) the complete oxidation of pyruvate by the stepwise removal of all the hydrogen atoms leaving three molecules of CO_2
 (b) the passing on of the electrons removed as part of the hydrogen atoms to molecular O_2 with simultaneous synthesis of ATP
 (c) both (a) and (b)
 (d) none of these.
- 85.** Refer to the given figure of nephron.
-
- Identify A, B, C and D and select the correct option regarding them.
- (a) A-Glomerulus - a tuft of capillaries formed by afferent arteriole.
 (b) B-PCT-reabsorption of HCO_3^- and selective secretion of H^+ and K^+ occurs here.
 (c) C-DCT-almost all glucose, amino acids, water, Na^+ , K^+ and uric acid are absorbed here.
 (d) D-Collecting duct-extends from the cortex of the kidney to the inner parts of medulla. Large amount of water is secreted in this region.
- 86.** Consider the following four statements (i - iv) regarding kidney transplant and select the two correct ones out of these.
 (i) Even if a kidney transplant is proper, the recipient may need to take immunosuppressants for a long time.
 (ii) The cell-mediated immune response is responsible for the graft rejection.

- (iii) The B-lymphocytes are responsible for rejection of the graft.
 (iv) The acceptance or rejection of a kidney transplant depends on specific interferons.
- The two correct statements are
- (a) (ii) and (iii) only (b) (iii) and (iv) only
 (c) (i) and (iii) only (d) (i) and (ii) only
- 87.** Foetal ejection reflex in human female is induced by
- (a) release of oxytocin from pituitary
 (b) fully developed foetus and placenta
 (c) differentiation of mammary glands
 (d) pressure exerted by amniotic fluid.
- 88.** Which one of the following combinations of organisms are responsible for the formation and flavour of yoghurt ?
- (a) *Lactobacillus bulgaricus* and *Streptococcus thermophilus*
 (b) *Rhizobium meliloti* and *Azotobacter*
 (c) *Bacillus subtilis* and *E. coli*
 (d) *Bacillus megathermus* and *Xanthomonas* sp.
- 89.** Suppose a foreign DNA is ligated at the *Bam* HI site of tetracycline resistance gene in pBR322, the resulting recombinant plasmid will be
- (a) resistant to antibiotic ampicillin only
 (b) resistant to antibiotic tetracycline only
 (c) resistant to both antibiotics ampicillin and tetracycline
 (d) sensitive to both antibiotics ampicillin and tetracycline.
- 90.** Hot spots are priority areas for *in situ* conservation. The key criteria for determining a hot spot is/are
- (a) location in developed/undeveloped country
 (b) vicinity to the sea
 (c) number of endemic species and degrees of threat
 (d) all of these.

ANSWER KEY

- | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1. | (b) | 2. | (a) | 3. | (b) | 4. | (c) | 5. | (d) |
| 6. | (d) | 7. | (b) | 8. | (c) | 9. | (a) | 10. | (b) |
| 11. | (c) | 12. | (b) | 13. | (b) | 14. | (d) | 15. | (c) |
| 16. | (c) | 17. | (a) | 18. | (b) | 19. | (c) | 20. | (a) |
| 21. | (d) | 22. | (d) | 23. | (a) | 24. | (a) | 25. | (a) |
| 26. | (b) | 27. | (d) | 28. | (a) | 29. | (c) | 30. | (c) |
| 31. | (b) | 32. | (c) | 33. | (b) | 34. | (c) | 35. | (c) |
| 36. | (b) | 37. | (d) | 38. | (b) | 39. | (c) | 40. | (c) |
| 41. | (a) | 42. | (d) | 43. | (c) | 44. | (c) | 45. | (b) |
| 46. | (c) | 47. | (a) | 48. | (b) | 49. | (b) | 50. | (d) |
| 51. | (a) | 52. | (a) | 53. | (a) | 54. | (c) | 55. | (b) |
| 56. | (d) | 57. | (d) | 58. | (c) | 59. | (d) | 60. | (c) |
| 61. | (c) | 62. | (b) | 63. | (a) | 64. | (c) | 65. | (b) |
| 66. | (d) | 67. | (d) | 68. | (b) | 69. | (c) | 70. | (a) |
| 71. | (b) | 72. | (a) | 73. | (d) | 74. | (d) | 75. | (c) |
| 76. | (c) | 77. | (a) | 78. | (d) | 79. | (c) | 80. | (b) |
| 81. | (a) | 82. | (d) | 83. | (a) | 84. | (c) | 85. | (a) |
| 86. | (d) | 87. | (b) | 88. | (a) | 89. | (a) | 90. | (c) |



UNSCRAMBLE ME

Unscramble the words given in column I and match them with their explanations in column II.

Column I

1. OMSTYALOMP
2. IYCTNASTNY
3. TEPOSNOL
4. NERFUSOETLCOI
5. SHNRAEPCOE
6. ALNBRILTIFIO
7. MHTAISENI
8. GCOYLHOIN
9. TIAMSVA
10. ESIVTLOGNSEILE

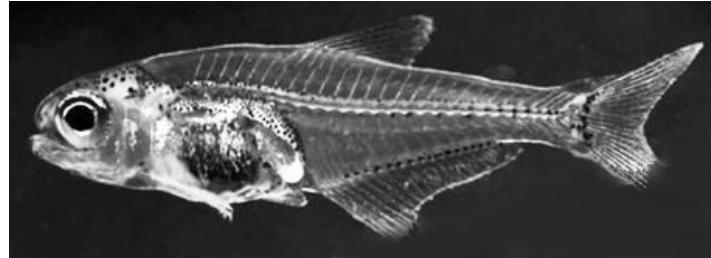
Column II

- | | |
|-----|---|
| (a) | Nutrient rich cells formed by fungal hyphae in seedling stage of orchids. |
| (b) | Synthesis of yolk in the primary oocytes of fishes. |
| (c) | Division of multinucleate parent into many multinucleate daughter individuals without division of nuclei. |
| (d) | Sex-linked inheritance from mother to daughter. |
| (e) | A condition in which the heart muscle contracts very rapidly in an un-coordinated fashion. |
| (f) | Fusion of protoplasts with the help of high voltage. |
| (g) | Reappearance of certain ancestral characters. |
| (h) | Specific proteins that assist folding and transport of newly synthesised proteins. |
| (i) | Folding of leaves in response to darkness. |
| (j) | Released by mast cells and causes the dilation of blood vessels. |

Readers can send their responses at editor@mtg.in or post us with complete address by 25th of every month to win exciting prizes.
 Winners' names will be published in next issue.

Cyanogaster noctivaga - A transparent fish

A remarkable new genus and species of miniature fish has been described by an international team of ichthyologists from the Rio Negro, the largest tributary and one of the most explored parts of the Amazon river, Brazil. This species has been named as *Cyanogaster noctivaga*. 'Cyanogaster' means blue belly and 'noctivaga' means night wanderer. This fish is only known from a single location in the Rio Negro, but since it is a very small fish and seems to be entirely nocturnal, it was easily overlooked. But its bright blue belly caught the eye of the ichthyologists who spotted it. It was found in an acidic blackwater, a similar habitat to that of the smallest known species of fish *Paedocypris progenetica*, which occurs in peaty forest swamps and blackwater streams in Asia. *C. noctivaga* is a strange little animal, completely transparent with an otherwise unique colour pattern, said Dr Ralf Britz, co-author of a paper describing the new fish species and genus in the journal *Ichthyological Exploration of Freshwaters*.



The largest *Cyanogaster* individual collected was 17.4 mm long, which is about 7 mm longer than the smallest fish *P. progenetica*. When alive, *C. noctivaga* is a transparent fish with a blue belly and reddish gill covers, but it quickly loses its bright colours after death. Its eyes are large, and the shape of its snout and its dentition differs from other Characins, marking it out as a new genus. The number and shape of teeth, or dentition, is very useful for naming and classifying fish and especially those of the order Characiformes, the group *C. noctivaga* belongs to. It differs from other members of the subfamily Stevardiinae in having 8 dorsal-fin rays, four teeth in the inner premaxillary tooth series, reduced number of $i + 5$ pelvic-fin rays and the presence of a single conical tooth in the outer premaxillary tooth series. There are hooks on the rays of the pelvic and anal fins in mature males.



NANOBIONIC SPINACH - Detect explosives

Spinach has the image of a healthy superfood loaded with tonnes of nutrients in a low calorie package. Its dark green leaves are important for skin, hair and bone, and provide protein, iron, vitamins and minerals. The possible health benefits of consuming spinach include

improving blood glucose control in diabetics, lowering the risk of cancer, blood pressure, developing asthma, improving bone health and much more.

Now it turns out that with a little scientific engineering, the plant could have another power: the ability to detect explosives. Researchers from MIT, USA embedded spinach leaves with carbon nanotubes i.e., microscopic tubular structures made up of carbon molecules that turn the plants into living sensors. The nanotubes are attached using a technique called vascular infusion, which involves applying a solution of nanoparticles to the underside of the leaf. They placed the sensors into the mesophyll of leaf where most photosynthesis takes place. The carbon nanotubes enable the plants to sense chemical compounds called nitroaromatics, which are used in explosives like landmines. If a nitroaromatic compound present in groundwater is absorbed by the plant, the nanotubes embedded in the spinach leaves release a fluorescent signal. This signal can be picked up by an infrared camera. A small computer device attached to the camera can even relay the results to a user's smartphone.

Besides working on additional sensors including some that track the chemicals which plants use to convey information within their own tissue, researchers have also engineered spinach plants that can detect dopamine, which influences root growth. These sensors could also help botanists learn more about the inner workings of plants, monitor plant health, and maximise the yield of rare compounds synthesised by plants such as the Madagascar periwinkle, which produces drugs used to treat cancer. The goal of plant nanobionics is to introduce nanoparticles into the plant to give it non-native functions.



CROSS WORD



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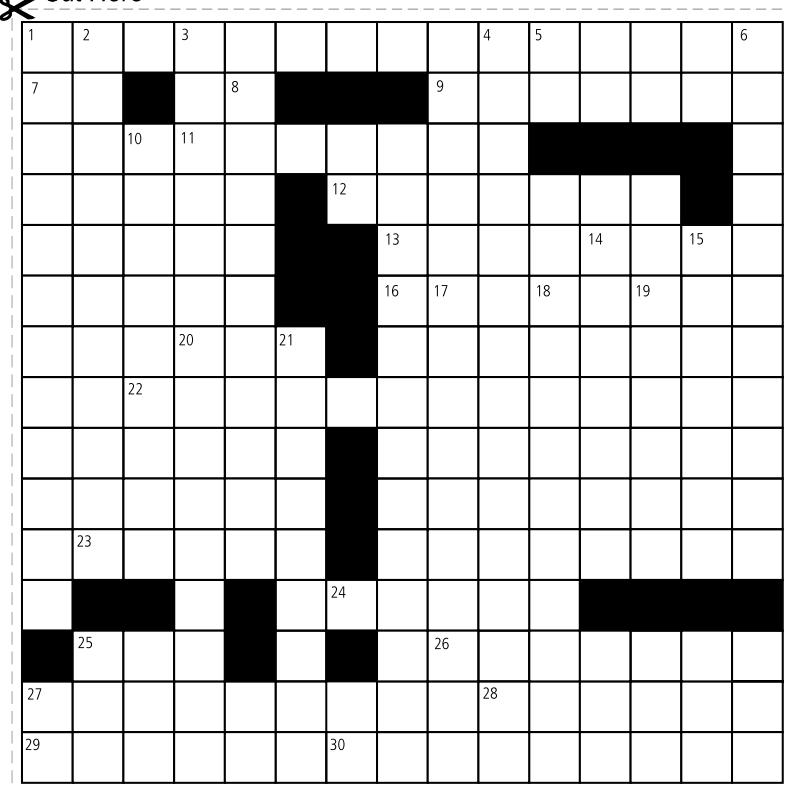
ACROSS

- A deep depression, formed by the ilium, ischium and pubis. (10)
- It is opaque or dark fog having condensed water vapours, dust, smoke and gases. (4)
- A false septum develops between the two parietal placenta in mustard. (6)
- The aggregate of aquatic organisms in a water body capable of moving independently of water currents. (6)
- The region of open water in oceans or seas, adjacent to land or inland waters where the organisms live and swim freely. (7)
- A junction between the axon of one neuron and the dendrites of the next neuron. (7)
- It is the sound producing organ in birds but absent in ostrich, storks and some vultures. (6)
- A dark spongy mass produced as a result of compression and fossilisation of dead parts of moss and other marshy plants. (4)
- Dark coloured amorphous organic matter rich in lignin and cellulose. (5)
- A booklet containing list of characters and their alternates which are helpful in identification of various taxa. (3)
- A phenomenon of reappearance of ancestral characters not found in immediate parents in many individuals. (7)
- A scientist who classified animals on the basis of habitat into aquatic, terrestrial and aerial animals. (9)
- The hard materials secreted by the tiny living polyps of some colonial cnidarians in the sea. (6)
- A condition caused by obstruction in lymphatic system, excessive capillary pressure or too little protein in the blood which accumulate fluid in the tissues. (6)
- A method of introducing DNA cells that are bombarded with high velocity microparticles of gold or tungsten coated with DNA. (9)

DOWN

- An alkaloid that prevents the formation of spindle apparatus during mitosis. (10)
- A flexible, inelastic cord of fibrous collagen tissue attaching a muscle to a bone. (6)
- The epidermal cells capable of synthesising melanin which is transferred to surrounding keratinocytes. (11)
- The defense mechanism in which a chemical is produced by plant tissues in response to attack by a parasite to inhibit its growth. (11)
- Chlorophyll molecule in which central magnesium is replaced by two hydrogen atoms and acts as electron acceptor from P₆₈₀ reaction centre. (11)

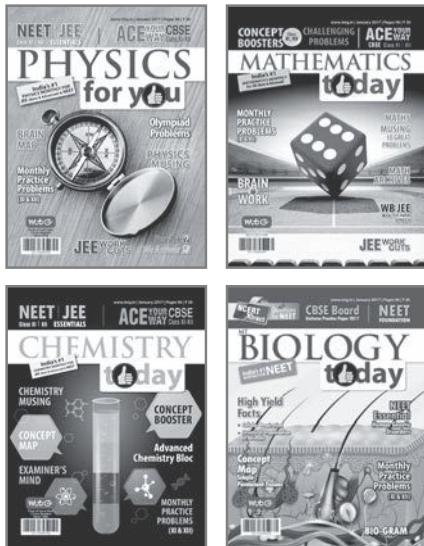
Cut Here



- A missing link between amphibians and reptiles. (9)
- Death of a portion of tissues or organ due to injury, lack of blood supply or disease. (8)
- A large protein fragment produced by the action of enzymes on proteins in the first stages of protein digestion. (7)
- A process of removal of adsorbent in the separation or extraction of DNA bands from the agarose gel. (7)
- The posterior large bilobed petal that overlaps the two smaller lateral petals. (8)
- The total water content present in the soil. (6)
- Rapid spasms as a result of wide contractions in muscles due to low Ca²⁺ in body fluid. (6)
- It is proteinaceous covering around the virus which protects the nucleoid from various physical and chemical agents. (6)
- The process of complete and permanent fusion of two gametes either from different parents or from the same parent to form a zygote. (7)
- A segment of DNA consisting of a stretch of base sequences that codes for one polypeptide chain, one transfer RNA and ribosomal RNA molecule. (7)



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