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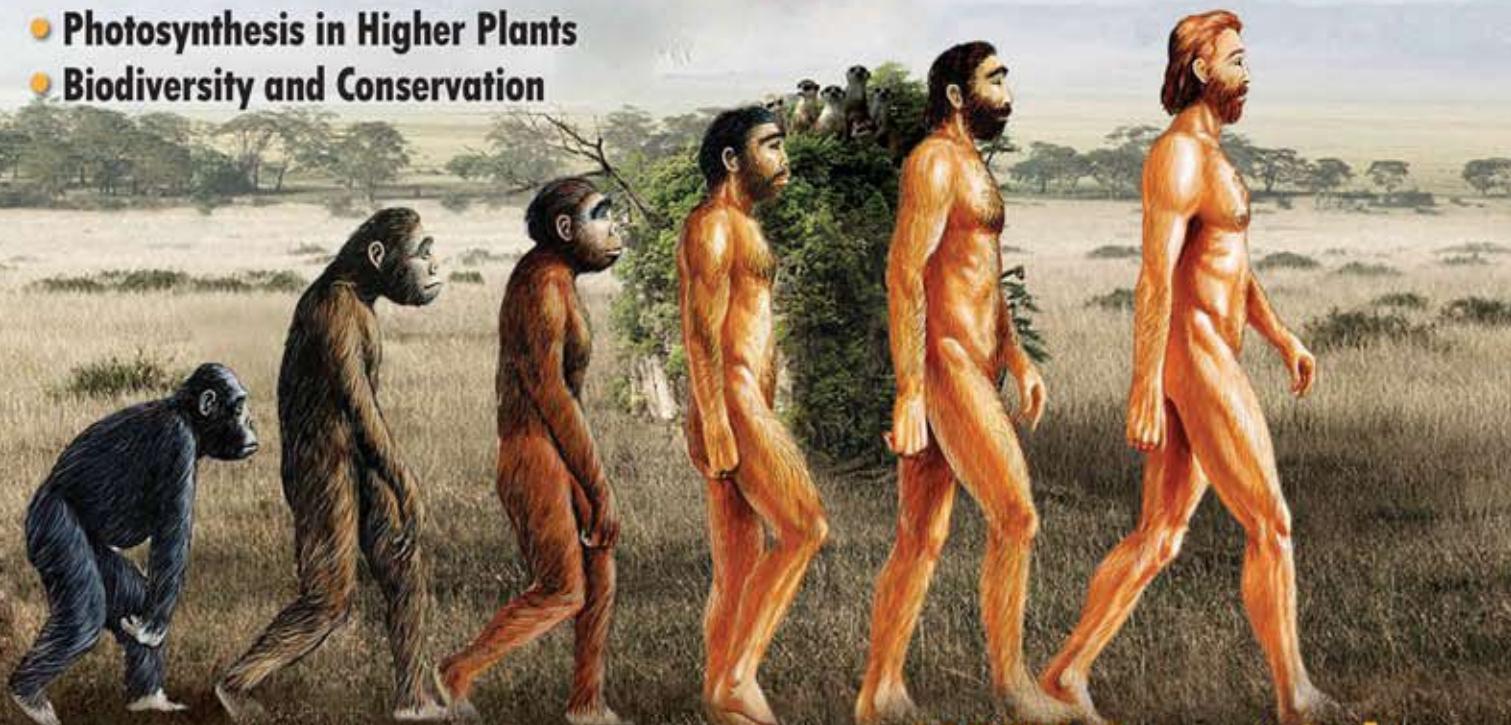
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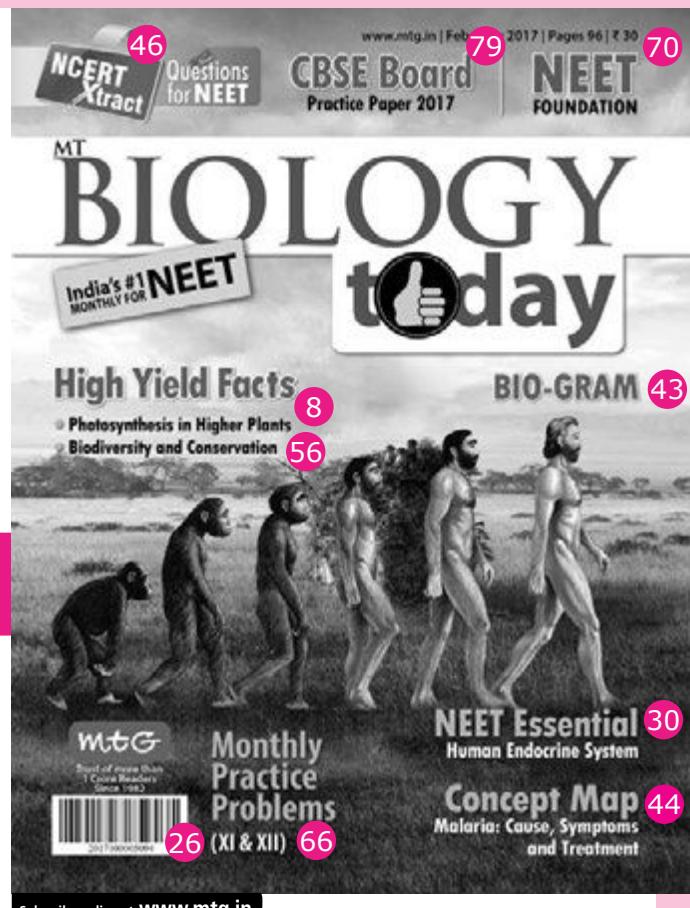
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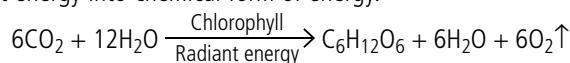
HIGH YIELD FACTS



Class XI

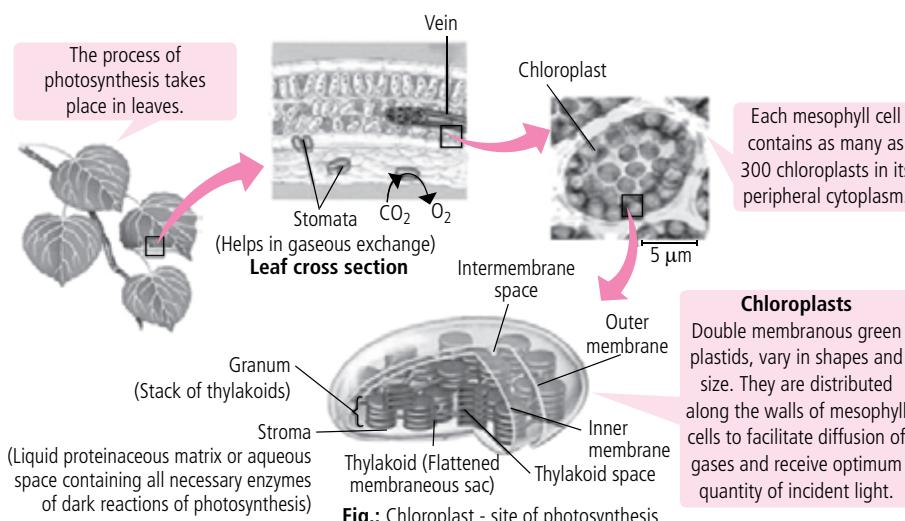
Photosynthesis in Higher Plants

- Life on earth ultimately depends upon energy derived from the sun. Photosynthesis is essentially the only mechanism of energy input into the living world. The only exception occurs in **chemosynthetic bacteria**, that obtain energy by oxidising inorganic substrates such as ferrous ions and sulphur in the earth's crust, or by oxidising hydrogen sulphide released from volcanic action.
- Photosynthesis is simply defined as, formation of carbohydrates from carbon dioxide and water by illuminated green cells of plants with oxygen and water as the by-products. It can also be defined as the capture of photons of light by green plant cells and conversion of their radiant energy into chemical form of energy.



- Photosynthesis occurs in plants, algae and some species of bacteria. About 90% of total photosynthesis in the world is performed by algae in oceans and in freshwater. Photosynthetic organisms are called **photoautotrophs**, since they can produce their own food.

SITE OF PHOTOSYNTHESIS



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

Table : Historical summary of early photosynthesis research

1727	Stephen Hales recognised the importance of sunlight, air and green leaves for nourishment of plants.
1774	Joseph Priestley found that a burning candle would soon get extinguished in closed space of bell jar. Similarly, a mouse kept in closed space would soon get suffocated and die. However, when a mint plant accompanied them in bell jar, neither the candle got extinguished nor the mouse died. The plant also grew. Priestley, therefore, hypothesised that foul air or phlogiston produced during burning of candle or animal (mice) respiration could be converted into pure air or dephlogiston by plants (mint). In 1774, Priestley discovered oxygen .
1779	Jan Ingenhousz in his experiment with an aquatic plant showed that in bright sunlight, small bubbles were formed around the green parts while in the dark, such bubbles did not form. He found these bubbles to be of oxygen. He thus, confirmed that purification of air or formation of dephlogiston is carried out by green plants only in the presence of sunlight.
1845	Von Mayer proved that green plants convert solar energy into chemical energy during the process of photosynthesis.
1864	Julius von Sachs demonstrated that green parts in plant produce glucose which is stored as starch. Starch is the first visible product of photosynthesis.
1884-1888	Engelmann split light into its components by the prism and then illuminated <i>Cladophora</i> (a green alga) placed in a suspension of aerobic bacteria. He found that bacteria accumulated in the region of blue and red light of the split spectrum. He thus, discovered the effect of different wavelengths of light on photosynthesis and plotted the first action spectrum of photosynthesis.
1905	Blackmann propounded the 'law' or principle of limiting factors. He also proposed the occurrence of a dark phase in photosynthesis.
1931	Van Neil, on the basis of his studies with purple and green sulphur bacteria, demonstrated that photosynthesis is a light dependent reaction in which hydrogen from an oxidisable compound reduces carbon dioxide to form sugar. $2\text{H}_2\text{A} + \text{CO}_2 \xrightarrow{\text{Light}} 2\text{A} + \text{CH}_2\text{O} + \text{H}_2\text{O}$ In green sulphur bacteria when hydrogen sulphide, instead of water, was used as hydrogen donor, no oxygen was evolved. He inferred that oxygen evolved by green plants comes from water, but not from carbon dioxide, as thought earlier.
1937	Hill stated that evolution of oxygen occurs in light reaction performed by isolated illuminated chloroplasts in the presence of suitable electron acceptors and absence of carbon dioxide.
1941	Ruben and Kamen demonstrated that oxygen evolved during photosynthesis comes from water and not from carbon dioxide. For this, they used water with heavy isotope of oxygen, ^{18}O .
1954	Arnon <i>et al.</i> discovered photophosphorylation. He also showed fixation of carbon dioxide by previously illuminated, isolated chloroplasts by using radioactive carbon ^{14}C in carbon dioxide.
1954-55	Calvin traced the pathway of carbon fixation by using $^{14}\text{CO}_2$ and gave the C_3 cycle, now known after him as Calvin cycle. Calvin was awarded Nobel Prize for this in 1960.
1957	Emerson found red drop and photosynthetic enhancement or Emerson effect .
1960	Hill and Bendall proposed Z-scheme of two photosystems.
1961	Peter Mitchell proposed chemiosmotic theory of ATP synthesis.
1965-66	Hatch and Slack discovered supplementary mechanism of CO_2 fixation, called C_4 pathway in certain tropical plants (grasses and nongrasses).

RAW MATERIALS FOR PHOTOSYNTHESIS

Carbon dioxide

- In land plants, carbon dioxide is obtained from the atmosphere through the **stomata**. However small quantities of carbonates are also absorbed from the soil through the roots.
- Hydrophytes get their carbon dioxide supply from the aquatic environment as bicarbonates, through their general surface.

Light

- Light is the visible part of electromagnetic radiations. Electromagnetic radiations are a form of energy that consist of a stream of tiny particles called **photons**, which travel in waves.
- Sunlight or solar radiations reaching the earth have wavelengths between 300 nm (in the ultraviolet range) to 2600 nm (in the infra-red range).
- Part of the spectrum used in photosynthesis has a wavelength between 400-700 nm. It is called **photosynthetically active radiation (PAR)**.
- The energy contained in a photon is termed as **quantum**. The energy content of a quantum is related to its wavelength.
- Blue** and **red** regions of the light spectrum are the most effective in photosynthesis. Blue wavelengths of light carry more energy while red wavelengths have lesser energy i.e., shorter the wavelength, greater is the energy present in it.
- The most efficient wavelength of light effective in photosynthesis is that of red light. Green light is the least effective in photosynthesis.

Water

- In the process of photosynthesis, the source of liberated oxygen is water. Photosynthetic land plants absorb a large amount of water from the soil through the root hairs.
- But, relatively very small amount of this absorbed water (about 1%) is used in the process of photosynthesis.
- Aquatic photosynthetic plants absorb water through their body surface.

Chloroplasts

- These are the actual sites of photosynthesis because of the presence of photosynthetic pigments and photosynthetic unit in thylakoid membranes.

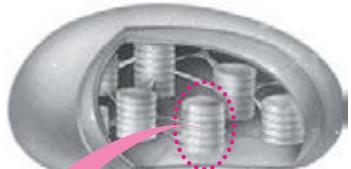
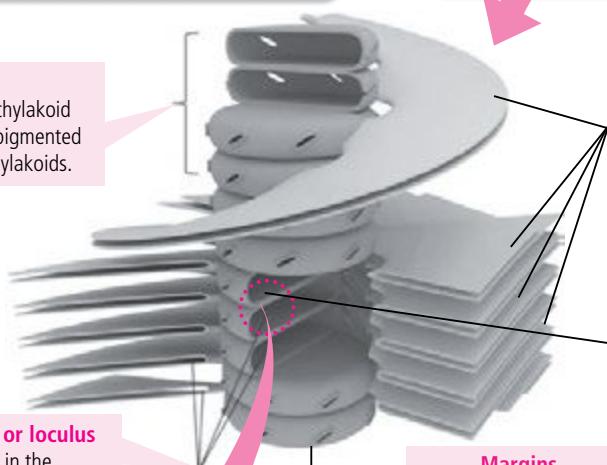


Fig.: Chloroplast

Grana stacks

Grana may have 20-50 thylakoid discs. They appear more pigmented due to aggregation of thylakoids.



Stroma lamellae

Thylakoids lying outside the grana are called stroma thylakoids or lamellae.

Partition

(Area where thylakoid membranes are appressed together).

Margins

(Free sides of thylakoids)

Thylakoid lumen or loculus

Space present in the thylakoid of a granum.

Unappressed region

Margin

Granum thylakoid

Grana

Stroma

Various proteins project into stroma and loculus with hydrophobic amino acids associated with membrane phospholipids

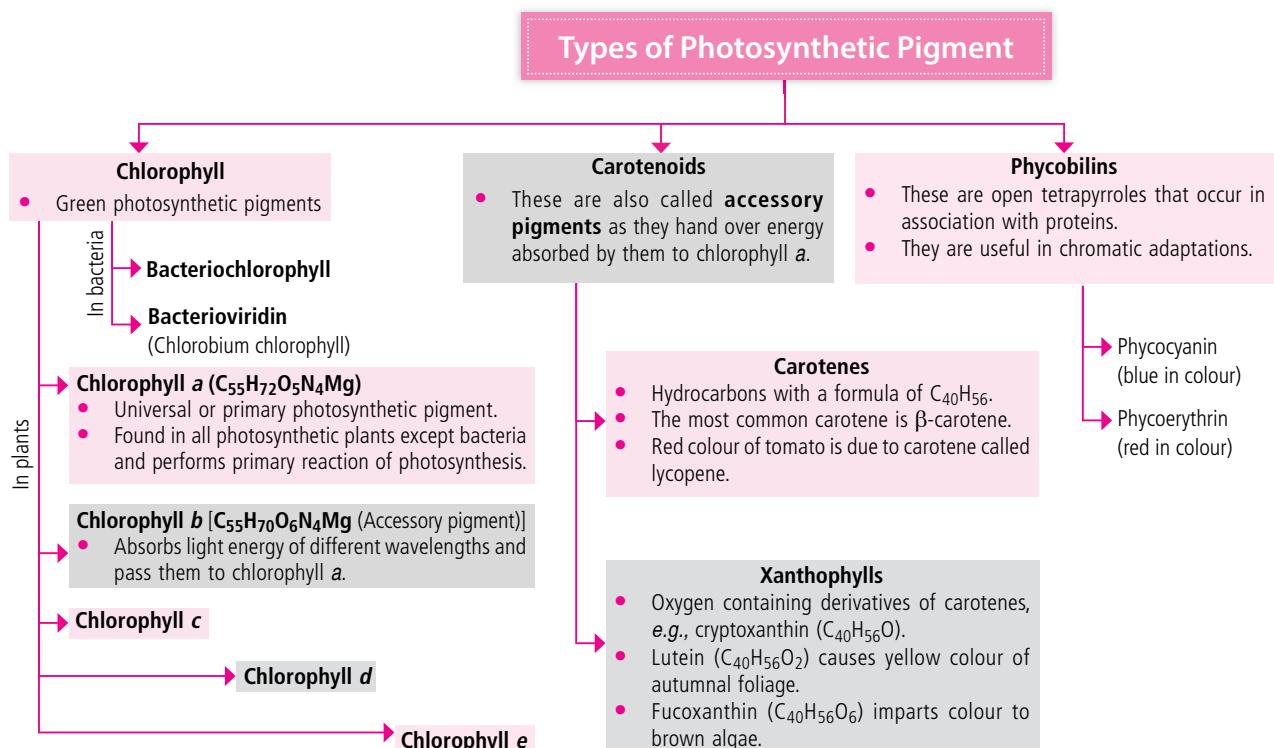
Fig.: Arrangement of thylakoids in chloroplast

Thylakoid membrane possesses four major complexes:

-  **Photosystem II** (Present mostly in appressed regions)
-  **Photosystem I** (Present in non-appressed as well as stromal lamellae)
-  Cytochrome b_6f
-  ATP synthase or coupling factor (Takes part in photophosphorylation)

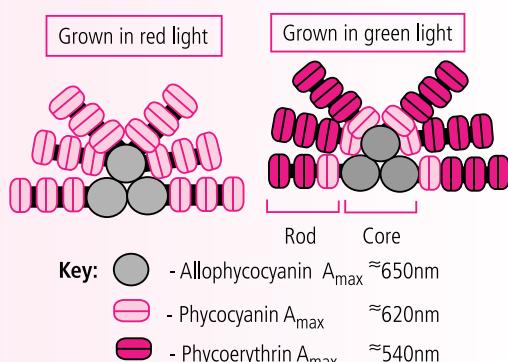
Photosynthetic Pigments

- Those pigments which occur on photosynthetic thylakoids of chloroplasts and take part in absorption of light energy for the purpose of photosynthesis are known as **photosynthetic pigments**.



Complementary chromatic adaptation

Many photosynthetic organisms can acclimate to the quantity and quality of light present in their environment. In certain cyanobacteria the wavelengths of available light in the environment control the synthesis of specific polypeptides of the light harvesting antenna complex or phycobilisome. This phenomenon is called complementary chromatic adaptation and phycobilisomes play a very important role in it. They change the orientation and arrangement of the phycobiliproteins depending upon the available wavelength. Each phycobiliprotein has a specific absorption and fluorescence emission maximum in the visible range of light.



Emerson enhancement effect

- Robert Emerson** observed that the red light of wavelength longer than 680 or 690 nm was not effective in photosynthesis. He found a sharp reduction in the rate of photosynthesis when monochromatic light of more than 680 nm wavelength (red region of the spectrum) was used alone. It is called **red drop**.
- He also observed that rate of photosynthesis increased when the longer and the shorter wavelengths were supplied simultaneously.
- He thus, concluded that simultaneous application of light of shorter and longer wavelengths, increases the rate of photosynthesis. This is called **Emerson's enhancement effect**.

Absorption spectrum

- A graph showing amount of energy of different wavelengths of light absorbed by a substance is called **absorption spectrum**.
- Chlorophyll *a* and *b* show maximum absorption in blue-violet and red wavelengths.

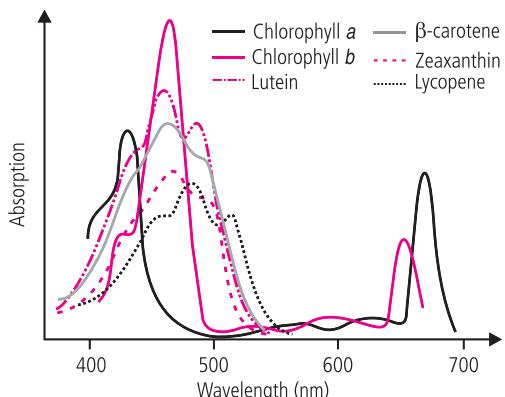


Fig.: Absorption spectrum of photosynthetic pigments

Absorption and Action Spectrum

Action spectrum

- The graphic curve depicting the relative rates of photosynthesis at different wavelengths of light is called action spectrum.
- Action spectrum of photosynthesis corresponds closely to absorption spectra of chlorophylls *a* and *b* showing that the latter are the main photosynthetic pigments.

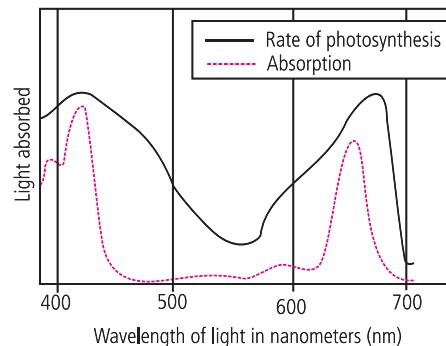


Fig.: Action spectrum of photosynthesis superimposed on absorption spectrum of chlorophyll *a*

PHOTOSYNTHETIC UNIT

- A photosynthetic unit is the smallest group of pigment molecules which takes part in a photochemical act or conversion of light energy into chemical energy.
- It has a **photocentre** or **reaction centre** which is fed by about 200 harvesting pigment molecules.
- The photocentre consists of a dimer of special chlorophyll *a* molecules, P₇₀₀ or P₆₈₀. Reaction centre absorbs light energy at longer wavelengths.
- The harvesting molecules form a protein based complex called **light harvesting complex (LHC)**. Light harvesting complex consists of two parts, **antenna** and **core molecules**.

Functioning of Photosynthetic Unit

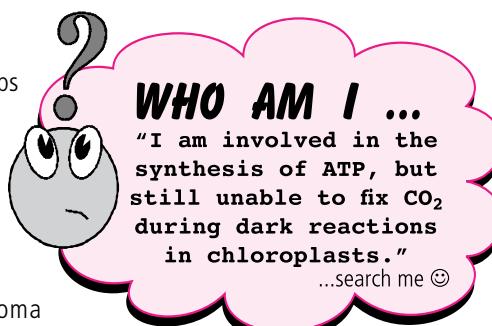
- The activation and transfer of energy by photosynthetic unit takes place in different steps.
- The antenna molecules absorb light of wavelength shorter than that of photocentre.
- On absorption of light energy, antenna molecules get excited. The excited molecule pushes an electron to its outer orbital and hands over this energy to other excited antenna molecules by resonance and finally comes to ground state.
- The energy is then handed over to core molecules by resonance which is then supplied to photocentre.
- The photocentre gets excited on absorption of energy and comes to ground state after extruding an electron to repeat the cycle.
- The electron released by the photocentre of photosynthetic unit is accepted by primary electron acceptor and this electron further transferred to the chain of electron acceptors.

PHOTOSYSTEMS OR PIGMENT SYSTEMS

- In green plants, photosynthetic units occur in the form of two distinct groups called photosystems I and II.
- They are named after the sequence in which they were discovered.
- Each of the photosystem contains a different reaction centre and 250–400 pigment molecules.

Photosystem I

- It is located on both non-appressed part of grana as well as stroma thylakoids.
- It comprises of more chl *a* molecules and comparatively lesser chl *b* and carotenoids.



- It takes part in both cyclic and non-cyclic photophosphorylation.
- The PS I reaction centre complex is a large multisubunit complex.
- The core antenna and P₇₀₀ are bound to two proteins Psa A and Psa B.
- The antennae pigments form a bowl surrounding the electron transfer cofactors present in the centre of the complex.
- In their reduced form, the electron carriers that function in the acceptor region of PS I are all extremely strong reducing agents.
- Three membrane associated iron-sulphur proteins known as Fe-S are present.

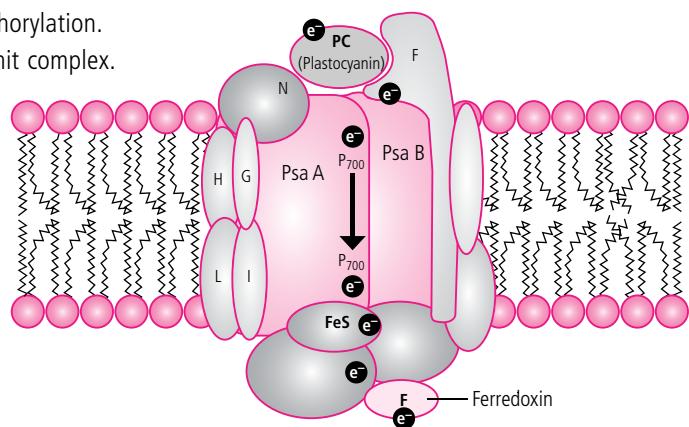


Fig.: Photosystem I

Photosystem II

- It is located in appressed part of grana thylakoids.
- It comprises of equal amount of chl *a* and chl *b* molecules, but carotenoids are higher in amount than that of PS I.
- It also includes cytochrome *b*₆-*f* complex and plastocyanin.
- It takes part only in non-cyclic photophosphorylation, in association with PS I.
- PS II is contained in a multisubunit protein supercomplex which has two complete reaction centers and some antennae complexes.
- The core of the reaction centre consists of two membrane proteins known as D1 and D2.
- The primary donor chlorophyll (P₆₈₀), additional chlorophylls, carotenoids, pheophytins and plastoquinones are bound to the membrane proteins D1 and D2.
- Other proteins serve as antenna complexes or are involved in oxygen evolution.

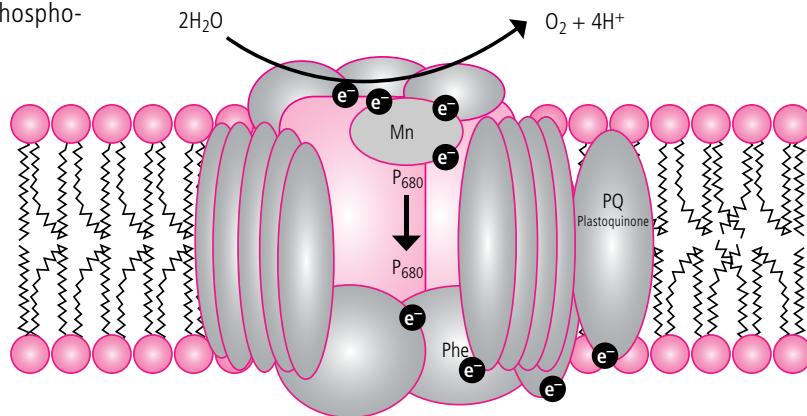


Fig.: Photosystem II

MECHANISM OF PHOTOSYNTHESIS

- The process of photosynthesis occurs in two phases:

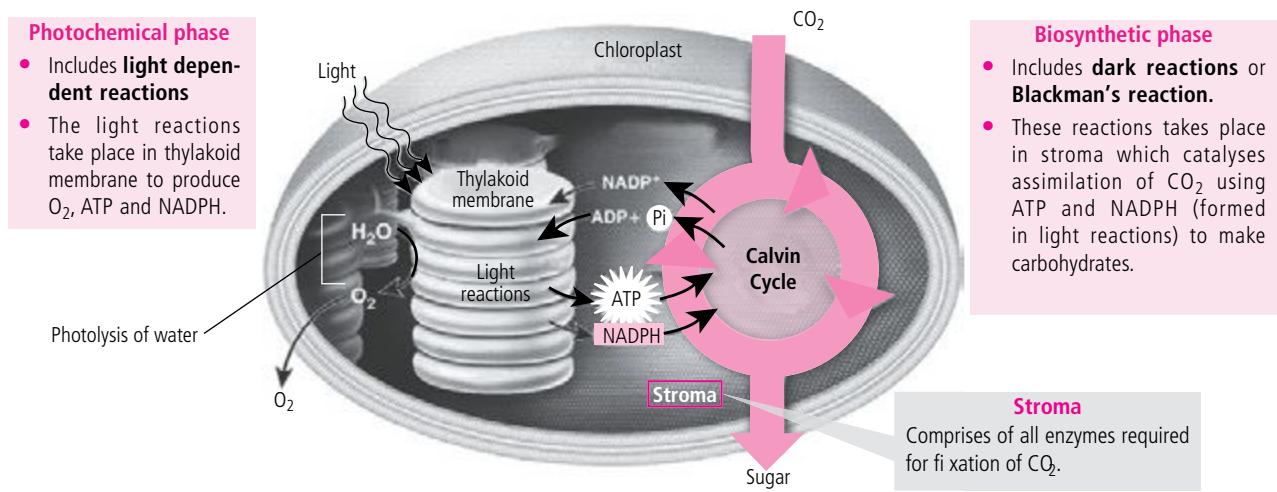


Fig.: Phases in process of photosynthesis

Light Dependent Reactions

- These take place inside thylakoids and involve absorption of light energy by photosynthetic pigments and its conversion into chemical energy in the form of ATP, i.e., photophosphorylation; and photolysis of water leading to formation of NADPH₂ and liberation of oxygen.

Photophosphorylation

- The term photophosphorylation was coined by **Arnon et al.** in 1954.
- Formation of ATP in the chloroplast by photosynthesis is called photophosphorylation.
- Photophosphorylation is also called photosynthetic phosphorylation. It differs from oxidative phosphorylation.
- It is of two main types:

(i) Cyclic photophosphorylation

- It is a process of photophosphorylation in which an electron expelled by the excited photocentre is returned to it after passing through a series of electron carriers.
- It is performed by photosystem I only.
- It occurs under conditions of low light intensity, wavelength longer than 680 nm and when carbon dioxide fixation is inhibited.
- It is more efficient in ATP production as 4 ATP per 6 photons are produced in it.

(ii) Non-cyclic photophosphorylation

- It is the normal process of photophosphorylation in which the electrons expelled by the excited photocentre do not return to it.
- Non-cyclic photophosphorylation is carried out in collaboration of both photosystems I and II.
- Electrons released during photolysis of water are picked up by photocentre of PS II called P₆₈₀. It is passed through a series of electron carriers – **phaeophytin**, **PQ**, **cytochrome b₆-f complex** and **plastocyanin** in a downhill journey releasing energy at each step.
- While passing over cytochrome complex, the electron loses sufficient energy for the synthesis of ATP.
- The electron is handed over to photocentre P₇₀₀ of PS I by plastocyanin. P₇₀₀ extrudes the electron which passes through special chlorophyll X, Fe-S complex, ferredoxin to finally reach NADP⁺.
- The latter then combines with H⁺ (released during photolysis of water) with the help of NADP-reductase to form NADPH.
- This is called **Z scheme** due to its characteristic zig-zag shape based on redox potential of different electron carriers.

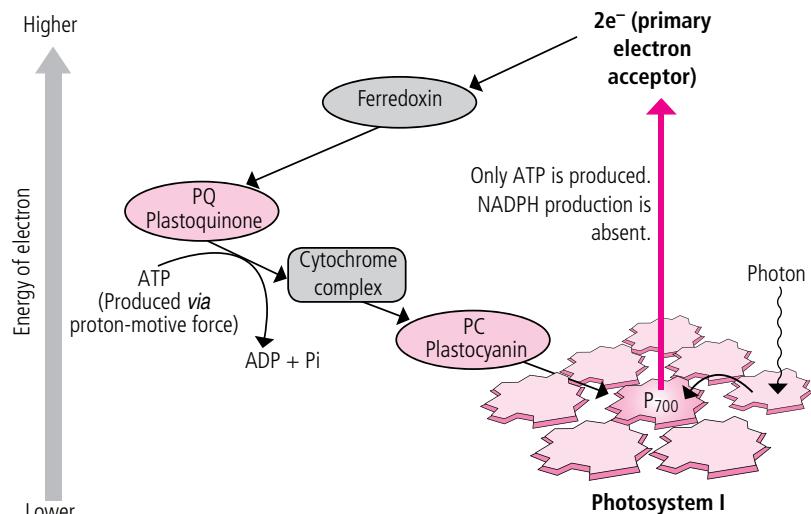


Fig.: Cyclic photophosphorylation

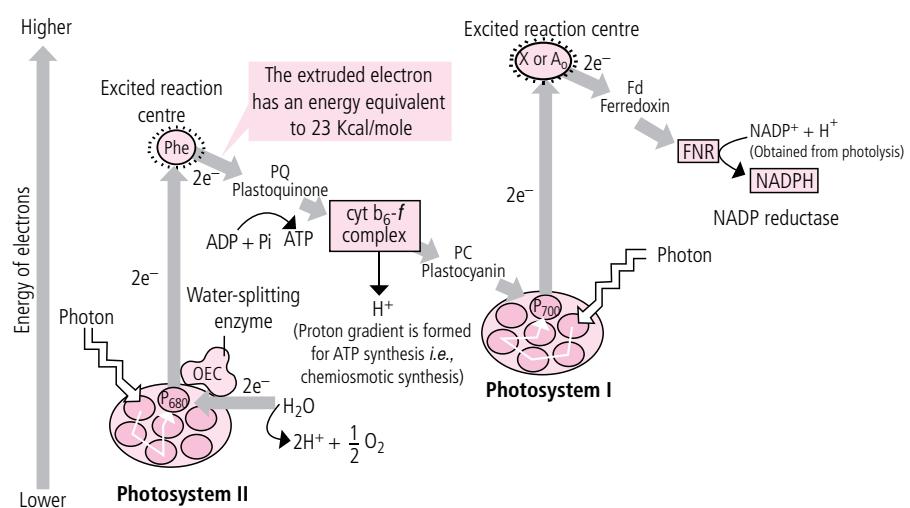
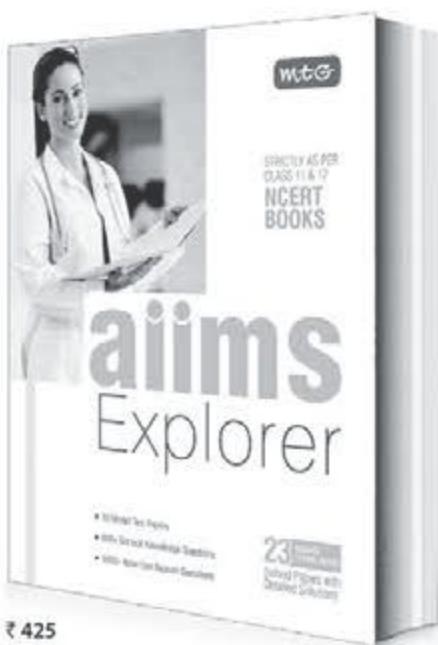


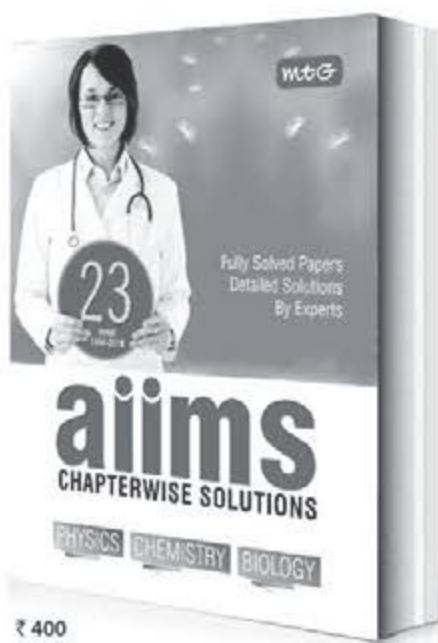
Fig.: Non-cyclic photophosphorylation and electron transport during photochemical phase

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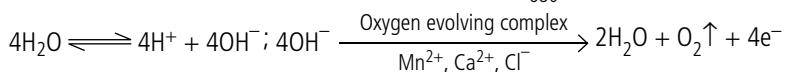


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Photolysis of water

- Photolysis or photocatalytic splitting of water is the phenomenon of breaking up of water into hydrogen and oxygen.
- It is carried out by oxygen evolving complex (OEC), present in PS II and is attached to inner surface of thylakoid membrane.
- OEC complex has four Mn ions and two other ions Ca^{2+} and Cl^- which helps in liberation of oxygen.
- The light energised changes in Mn removes electrons from OH^- component of water forming oxygen.
- Electron carrier transfers the released electrons to P_{680} .



Chemiosmotic Hypothesis of ATP Synthesis

- It was propounded by **Peter Mitchell** in **1961** in the case of mitochondria and chloroplast. He was awarded the Nobel Prize for Chemistry in 1978 for this discovery.
- This hypothesis explains the relationship between the potential energy present within a concentration gradient of ions across a membrane and the use of this potential energy in the formation of ATP.
- According to this view, electron transport, both in respiration and photosynthesis produces a **proton gradient**. Here, the gradient develops inside the thylakoid lumen in chloroplasts.

Stroma (Low H^+ concentration, High pH)

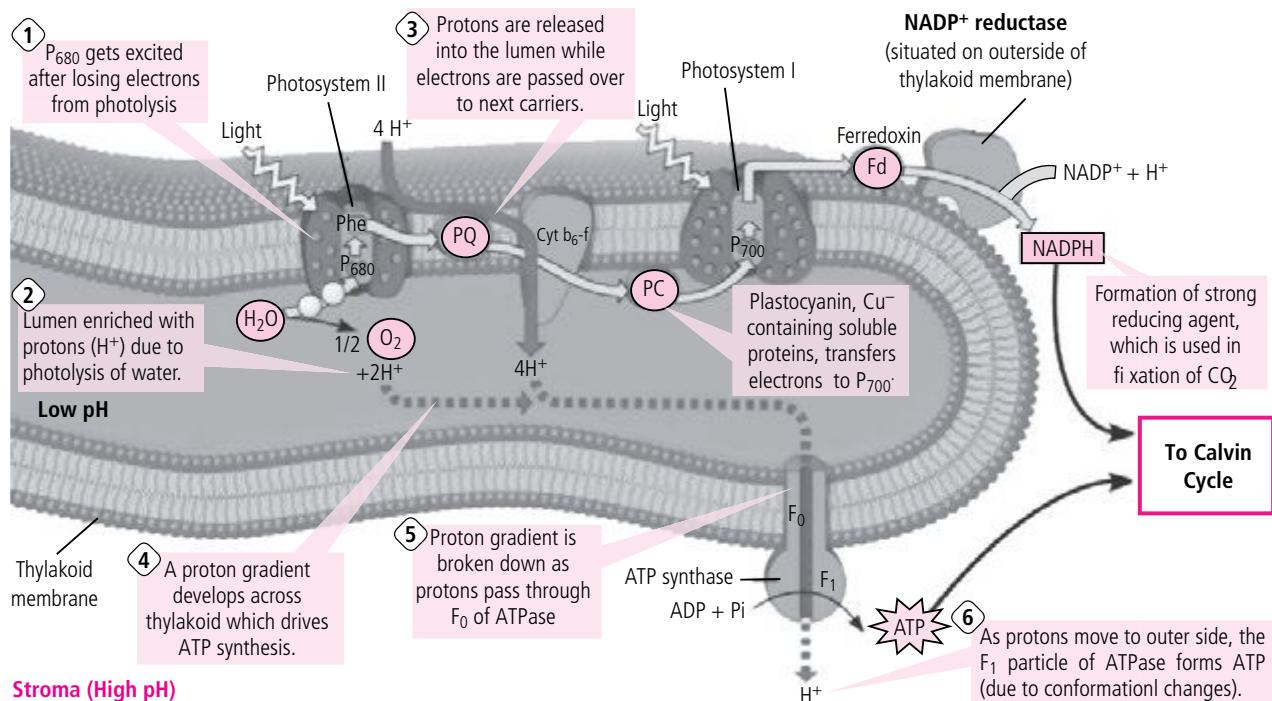


Fig.: Mechanism of chemiosmotic synthesis of ATP in chloroplast

Dark Reactions

- Dark reaction was first of all established by **F.F. Blackman** (1905) and later on studied in detail by **Dr. Calvin, Benson** and **J. Bassham** and for this work they were awarded Nobel Prize (1961).
- Biosynthetic or dark phase occurs in **stoma** or **matrix of chloroplast**, as all the enzymes required for the process are present there.
- There are two main pathways for the biosynthetic or dark phase – **Calvin cycle** and **C_4 dicarboxylic acid cycle (Hatch Slack pathway)**. A third pathway is **CAM metabolism** which is intermediate between the two.
- The plants exhibiting Calvin cycle and C_4 dicarboxylic acid pathway are called C_3 and C_4 plants respectively.

Calvin Cycle

- Carbon dioxide fixation in the presence of ATP and NADPH, and its conversion to glucose, through a series of reaction, catalysed by specific enzymes is termed as **Calvin cycle**.
- The cycle was discovered by **Calvin, Benson** and their colleagues in California, U.S.A.
- The techniques used for studying different steps were radioactive tracer techniques - **^{14}C chromatography** and **autoradiography** and the materials used were microscopic, unicellular algae *Chlorella* and *Scenedesmus*.
- Calvin cycle or photosynthetic carbon reduction cycle is divided into the following three phases :

 - Carboxylation:** In this phase, CO_2 combines with its acceptor RuBP (Ribulose 1, 5-biphosphate) with the help of enzyme RuBisCo. It results in the formation of two molecules of 3-PGA (phosphoglyceric acid), the first stable product.
 - Glycolytic reversal:** The processes involved in this step are reversal of the processes found in the steps during glycolysis of respiration. Here, the 3-PGA is reduced to produce glyceraldehyde-3-phosphate, a key product used in synthesis of both carbohydrates and fats.
 - Regeneration of RuBP:** It involves a series of reactions which result in formation of carbon acceptor RuBP and make it ready to accept another molecule of CO_2 .

- Overall reaction of C_3 cycle: $6\text{RuBP} + 6\text{CO}_2 + 18\text{ATP} + 12\text{NADPH} \longrightarrow 6\text{RuBP} + \text{C}_6\text{H}_{12}\text{O}_6 + 18\text{ADP} + 18\text{Pi} + 12\text{NADP}^+$
- The steps involved in Calvin cycle are summarised in the given figure.

Photorespiration

- The process of photorespiration was first demonstrated in **tobacco plants** by **Decker and Tio** (1959). Since then, it has been reported in a large number of plants, particularly those which perform C_3 cycle.
- Photorespiration is defined by **Krotkov (1963)** as an extra input of oxygen and extra release of carbon dioxide by green plants in light.
- The process occurs in **chloroplast, peroxisome** and **mitochondria**.
- The process of photorespiration is cyclic. It is also called **photosynthetic carbon oxidative** or **PCO cycle**.
- Ribulose biphosphate carboxylase (RuBisCO), the main enzyme of Calvin cycle that fixes carbon dioxide, acts as ribulose biphosphate oxygenase under low atmospheric concentration of carbon dioxide and increased concentration of oxygen. It splits a molecules of Ribulose- 1, 5, biphosphate into one molecule each of 3- PGA and 2-phosphoglycolic acid.

In the photorespiratory pathway, there is neither synthesis of sugars, nor of ATP. Rather, it results in the release of carbon dioxide with the utilisation of ATP. Since, there is no synthesis of ATP or NADPH, photorespiration is regarded as a wasteful process.

The schematic representation of photorespiratory pathway is given on next page.

Hatch Slack pathway or C_4 cycle

- Kortschak et al.** (1965) reported that rapidly photosynthesising sugarcane leaves produce a 4-C compound like aspartic acid and malic acid as a result of carbon dioxide fixation.

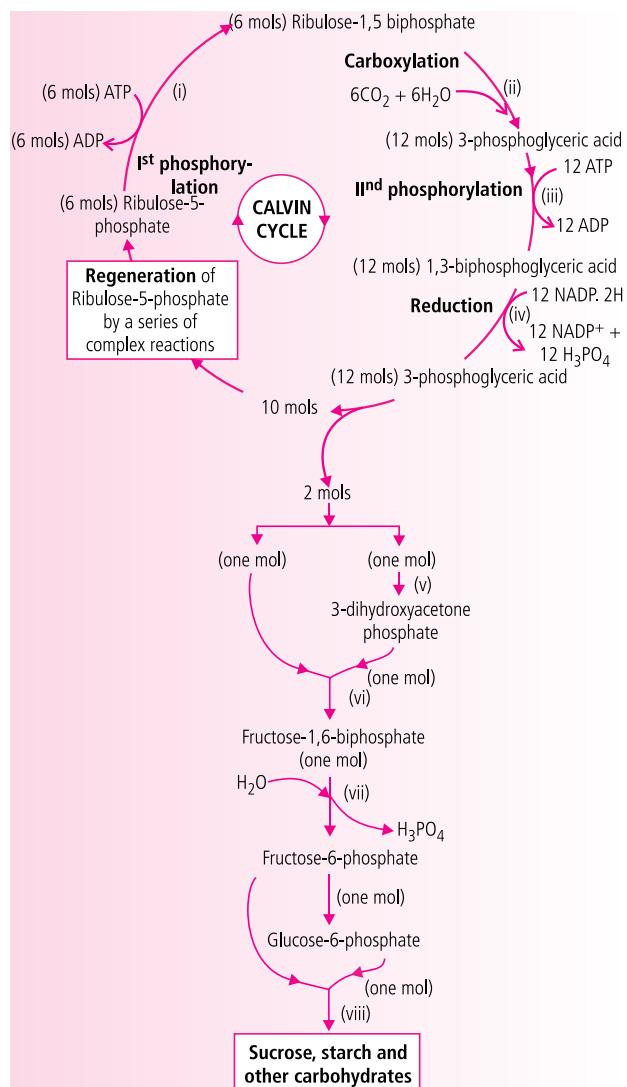


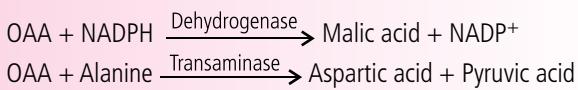
Fig.: Simplified diagram of Calvin cycle starting from 6 mol of CO_2

- This was later supported by **M.D. Hatch** and **C.R. Slack** (1966) and they reported that a 4-C compound oxaloacetic acid (OAA) is the first stable product in carbon dioxide reduction process in tropical grasses..
- This led to an alternative pathway of carbon dioxide fixation, which is known as **Hatch Slack pathway** or C₄ cycle (as 4-C compound is first stable product) or HSK pathway.
- This pathway was first reported in tropical grasses, e.g., members of Family **Gramineae** like sugarcane, maize, sorghum, etc., but later in other **sub-tropical plants** like *Atriplex* and *Amaranthus*.
- These C₄ plants have a characteristic leaf anatomy called **kranz anatomy** (wreath or ring). In kranz anatomy, the mesophyll is not differentiated into palisade and spongy tissue.
- The vascular bundles are surrounded by sheath of large parenchymatous cells called **bundle sheath cells** which are in turn surrounded by **mesophyll cells**. These cells are connected by plasmodesmata.
- The chloroplasts in **Bundle sheath cells** are larger in size, lack grana (agranal chloroplasts) and contain starch grains. They possess RuBisCO enzyme and are well protected from oxygen being released from mesophyll cells.
- The chloroplast in **mesophyll cells** are smaller in size, contain grana and lack starch grains. Mesophyll cells are specialised to perform light reaction, evolve oxygen and produce assimilatory powers - ATP and NADPH.
- In C₄ plants, there occur **two carboxylation reactions**, first in mesophyll chloroplast and second in bundle sheath chloroplast. The C₄ cycle takes place in four phases:

Initial fixation

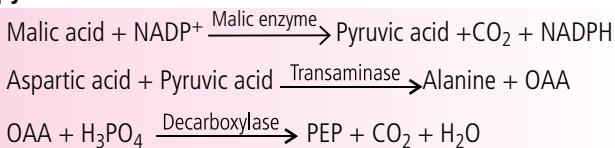
- Phosphoenol pyruvate or PEP combines with carbon dioxide, in presence of PEPcase to form **oxaloacetic acid (OAA)**.
- $$\text{PEP} + \text{CO}_2 + \text{H}_2\text{O} \xrightarrow{\text{PEP carboxylase}} \text{OAA} + \text{H}_3\text{PO}_4$$

- OAA is reduced to **malic acid** or transaminated to form **aspartic acid**.



Transport

- Malic acid or aspartic acid is translocated to bundle sheath cells, where it is decarboxylated (or deaminated in case of aspartic acid) to form **pyruvate** and **carbon dioxide**.



Final fixation

- Carbon dioxide released in bundle sheath cells is then fixed through Calvin cycle. Hence, RuBP is secondary or final acceptor of carbon dioxide in C₄ plants.

Regeneration of PEP

- Pyruvate and PEP formed in bundle sheath cells are sent back to mesophyll cells, where PEP is regenerated, using ATP.

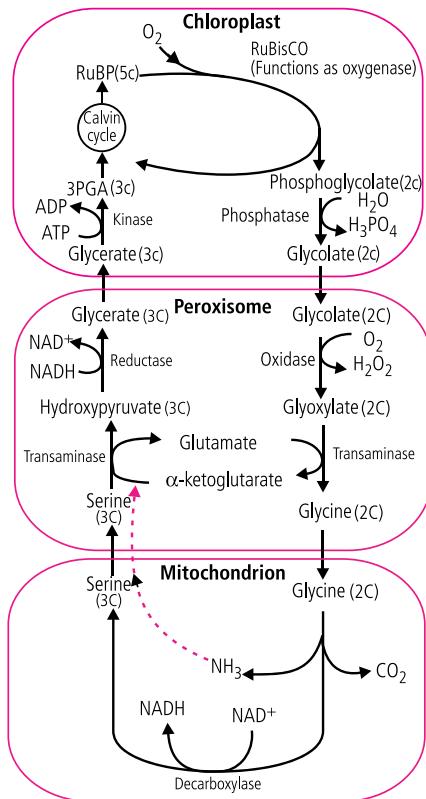
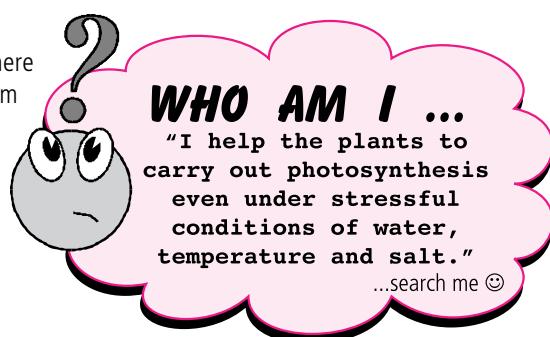
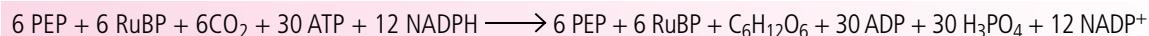


Fig.: Schematic of photorespiratory pathway



- In C₄ plants, for formation of one mole of hexose (glucose), 30 ATP and 12 NADPH are required.

Net reaction for C₄ cycle is:



C₃ plants

- Optimum temperature for photosynthesis is 10–25°C.
- Plants are adapted to all types of climate.
- It involves Calvin cycle or C₃ cycle.
- Leaf anatomy is of normal type.
- First stable product is PGA during photosynthesis, where RuBP acts as the carbon dioxide acceptor.
- Photorespiration rate is high.
- Utilise 18 molecules of ATP for the production of 1 molecule of glucose.

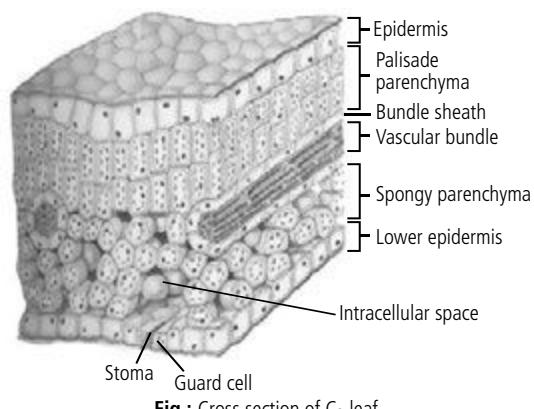


Fig.: Cross section of C₃ leaf

Comparison of C₃ and C₄ plants

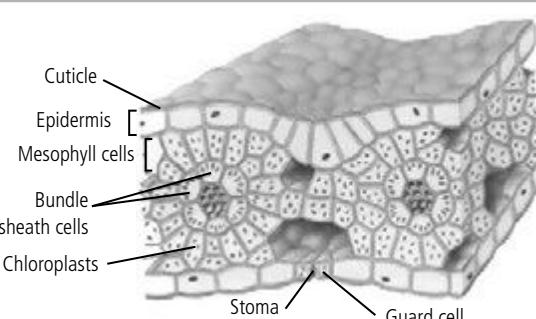


Fig.: Cross section of C₄ leaf

C₄ plants

- Optimum temperature for photosynthesis is 30–45°C.
- Plants are adapted to relatively hot climatic regions of the equator and of the tropics.
- It involves Hatch Slack pathway or C₄ cycle.
- Leaf anatomy is of special type (Kranz anatomy).
- First stable product is OAA during photosynthesis where PEP acts as the carbon dioxide acceptor.
- Photorespiration rate is negligible or absent.
- Utilise 30 molecules of ATP for the production of 1 molecule of glucose.

Crassulacean Acid Metabolism (CAM)

- It is a mechanism of photosynthesis involving double fixation of CO₂ which occurs mostly in **succulents** (xerophytes) like *Opuntia*, *Agave*, *Aloe*, *Sedum*, *Kalanchoe*, etc.
- The most characteristic feature of these plants is that their stomata remain **open at night** (in dark) but **closed during the day** (in light). Thus, CAM is a kind of adaptation in succulents to carry out photosynthesis without much loss of water.
- All reactions of CAM occur in mesophyll cells.
- In these plants, there occurs **dark acidification**, i.e., during night, malic acid is formed which breaks up into carbon dioxide and pyruvic acid in daytime, and carbon dioxide released is utilised in C₃ cycle.
- In CAM plants, **OAA** (oxaloacetic acid) formed is reduced to **malic acid** and is accumulated in the vacuole.
- During night, stomata open and carbon dioxide is absorbed from outside which is fixed with the help of PEP carboxylase. The acceptor is phosphoenol pyruvate or PEP.

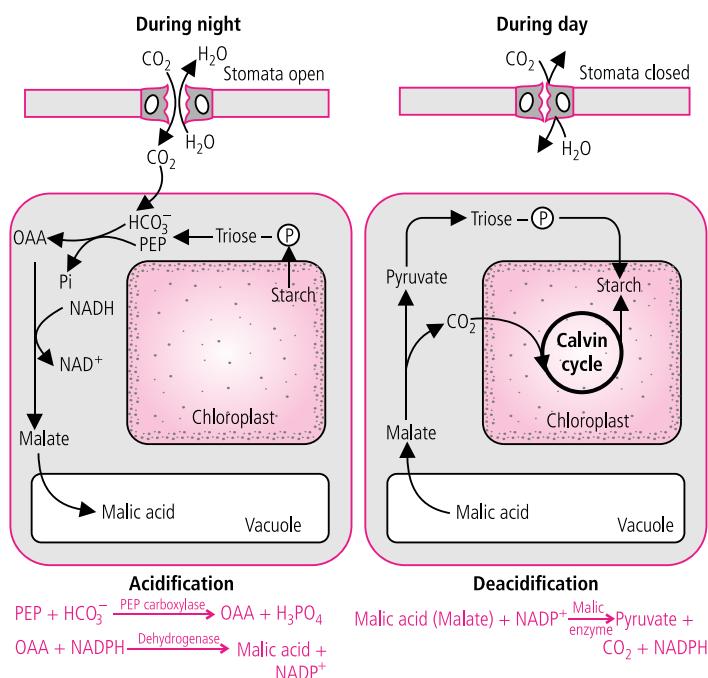


Fig.: Mechanism of Crassulacean acid metabolism showing CO₂ uptake from outside during night and its utilisation during daytime

- During daytime, malic acid undergoes oxidative decarboxylation and carbon dioxide is released from an organic acid during daytime. This is called **deacidification**.
- The diurnal acidification and deacidification during the night and daytime respectively is called **CAM (Crassulacean Acid Metabolism)**. This helps in conserving water and thus, is important for the survival of succulents.

BLACKMAN'S LAW OF LIMITING FACTORS

- A limiting factor is defined as a factor which is deficient to such an extent that increase in its magnitude directly increases the rate of process. The effect of limiting factors was first studied by Blackman (1905) who established the '**Principle of Limiting Factors**'.
- The principle of limiting factors states that when a process is conditioned as to its rapidity by a number of separate factors, the rate of the process is limited by the pace of the slowest factor.

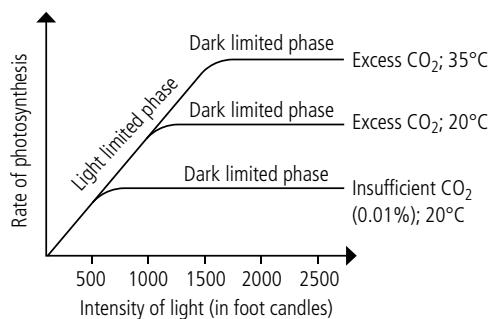


Fig.: Blackman's law of limiting factors

HAR GOBIND SINGH KHORANA CREATOR OF FIRST ARTIFICIAL GENE



Har Gobind Singh Khorana (1922-2011) was a renowned biochemist of Indian-American origin. He was the first person to demonstrate the role of nucleotides in protein synthesis.

He was born in a poor Hindu family as the youngest sibling in Raipur, Punjab (today Tehsil Kabirwala, Punjab, Pakistan). His father worked as "patwari", a village taxation officer. He completed his B.Sc in 1943 and M.Sc in chemistry from Punjab University, Lahore 1945. He was awarded a scholarship by the Government of India to study at the University of Liverpool where Roger J.S. Beer supervised his Ph.D. research. Khorana spent his post doctoral year (1948-1949) at the Eidgenössische Technische Hochschule in Zurich with Professor Vladimir Prelog.

He stayed in Cambridge from 1950 to 1952. In 1952 he was offered a job at University of British Columbia Vancouver where, along with a group of researchers, he began to work in the field of phosphate esters and nucleic acids. In 1960, Khorana moved to the Institute of Enzyme Research at the University of Wisconsin. He deeply studied nucleic acids found in RNA. Using chemical synthesis, Dr. Khorana deduced that the code for serine is UCU and for leucine is CUC and some codons are responsible for signaling to the cells to start or stop the manufacture of proteins.

He showed that the genetic code consists of three-letter words (codon) and synthesised each of 64 codons. His findings confirmed that four types of nucleotides are arranged on the spiral staircase of the DNA molecule. He also synthesised coenzyme A.

Khorana became the Alfred Sloan Professor of Biology and Chemistry at Massachusetts Institute of Technology (MIT) in 1970. He successfully synthesised the first ever artificial gene in 1972. Genetic Engineering had been possible only due to the ability to synthesise DNA. In 1980s, he studied the structure and function of rhodopsin, a light sensitive protein found in the eye. He shared the Nobel Prize in 1968 for Physiology or Medicine with Marshall W. Nirenberg and Robert W. Holley for discoveries related to the genetic code and its function in protein synthesis. He also received many other awards and honours including Padma Vibhushan Presidential award. The University of Wisconsin-Madison, the Government of India (Department of Biotechnology) and the Indo-US Science and Technology Forum jointly started the Khorana Program in 2007 to build a seamless community of scientists, industrialists and social entrepreneurs in the U.S and India.

He was married in 1952 to a Swiss girl, Esther Elizabeth Sibler. They had three children, Julia Elizabeth, Emily Anne and Dave Roy. He died of natural causes at the age of 89 on 9th November 2011 in Concord, Massachusetts.



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FACTORS AFFECTING PHOTOSYNTHESIS

External factors

Light

- At low light intensity, the rate of photosynthesis is reduced. As the light intensity increases, the rate of photosynthesis also increases.
- There is a point in light intensity where there is no gaseous exchange in photosynthesis. It is called **light compensation point**.
- The light intensity at which a plant can achieve maximum rate of photosynthesis is called **light saturation point**. Its value is **800-1000 ft candles** (10% of full sunlight) **in shade plants**, **50-70% of full sunlight in C₃ sun plants** and upto **200% of full sunlight in C₄ sun plants**.

Temperature

- Temperature** does not influence photochemical phase of photosynthesis (light reaction) but affects the biochemical phase (dark reactions).
- The optimum temperature is **10-25°C for C₃ plants** and **30-45°C for C₄ plants**.
- When temperature is increased from minimum to optimum, the rate of photosynthesis doubles for every 10°C rise in temperature.
- Above the optimum temperature, the rate of photosynthesis shows an initial increase for short duration but later declines. This decline with time is called **time factor**.

Carbon dioxide

- Increase in the concentration of carbon dioxide upto 0.05% increases the rate of photosynthesis in most C₃ plants. But a decline is observed beyond 0.1%.
- When carbon dioxide concentration is reduced, there comes a point at which illuminated plant parts stop absorbing carbon dioxide from their environment. It is known as **carbon dioxide compensation point or threshold value**.
- At this value, carbon dioxide fixed in photosynthesis is equal to carbon dioxide evolved in respiration and photorespiration.
- The value is **25-100 ppm in C₃ plants** and **0 -10 ppm in C₄ plants**. The reason for low compensation value for C₄ plants is the greater efficiency of carbon dioxide fixation through PEP carboxylase.

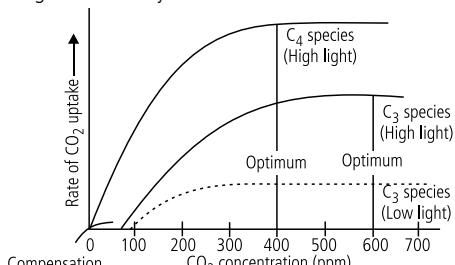


Fig.: Graph showing effects of CO₂ concentration on photosynthesis of C₃ and C₄ plants

Water

- The amount of water used in photosynthesis is very small, i.e., less than 1%.
- The rate of photosynthesis falls in water deficient soils.
- During excessive transpiration, the stomata get closed. This results in the fall in the rate of photosynthesis because carbon dioxide cannot enter through the cuticle of the leaf.

Oxygen

- Small quantity of **oxygen** is essential for photosynthesis, except in some anaerobic bacteria.
- C₃ plants show optimum photosynthesis at low oxygen concentration. It is due to the reason that oxygen results in oxidation of photosynthetic pigments, intermediates and enzymes, in the presence of strong light (**photo-oxidation**).
- Oxygen competes with carbon dioxide for reducing power. It also converts RuBP-carboxylase to RuBP oxygenase.
- At a very high oxygen content, the rate of photosynthesis begins to decline in all plants. The phenomenon is called **Warburg effect**.

Internal factors

Chlorophyll content

Chlorophyll is essential for photosynthesis but its rate is not determined by chlorophyll content. The sun plants containing less chlorophyll show higher rate of photosynthesis as compared to shade loving plants having more chlorophyll.

Age of leaf

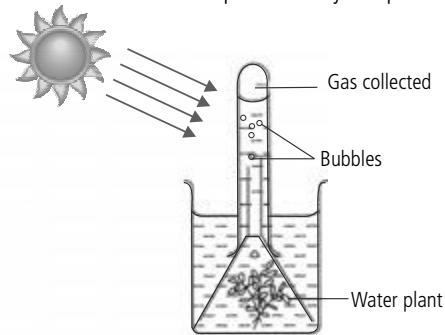
The rate of photosynthesis in a young leaf increases till it attains maturity. Later, with the onset of senescence the rate declines with the degradation of chlorophyll.

Leaf anatomy

Special anatomy such as **kranz anatomy** in leaves of tropical plant increases the efficiency of photosynthesis. Leaf anatomy also influences a variety of other factors such as rate of diffusion of CO₂, availability of light and rate of translocation of end products.

SPEED PRACTICE

1. Emerson effect indicates the existence of
 - (a) two photosystems
 - (b) two photosynthetic pigments
 - (c) two photophosphorylations
 - (d) none of these.
2. The most possible advantage of kranz anatomy in leaves of C₄ plants is
 - (a) consumption of less energy in CO₂ fixation
 - (b) excessive photolysis of water
 - (c) absence of competition between CO₂ and O₂ for active sites of RuBisCo
 - (d) all of these.
3. Which of the following can be referred to as "Hill reagent" in plants?
 - (a) ATP
 - (b) NADP⁺
 - (c) NADPH
 - (d) FADH₂
4. The effect of high CO₂ concentration and high values of ATP/ADP ratio will be
 - (a) increase in rate of Calvin cycle
 - (b) decrease in rate of Krebs' cycle
 - (c) decrease in rate of Calvin cycle and increase in rate of Krebs' cycle.
 - (d) both (a) and (b).
5. The chlorophyll structure proposed by Stoll and Fischer comprises of a
 - (a) head of four pyrrole rings and an alcoholic phytol tail
 - (b) head of phytol and tail of four pyrrole rings
 - (c) head of linked carbons and tail of four pyrrole rings
 - (d) head of four pyrrole rings and tail of linked nitrogens.
6. If in an experiment the radioactive ¹⁴C containing carbon dioxide is provided to a C₃ plant, the radioactivity will first appear in the compound
 - (a) glyceraldehyde 3-phosphate
 - (b) phosphoglyceric acid
 - (c) phosphoenol pyruvate
 - (d) ribulose-1, 5, biphosphate.
7. Read the following statements regarding photorespiration and select the incorrect ones.
 - I. RuBP binds with O₂ and forms one molecule of phosphoglycerate and phosphoglycolate.
 - II. RuBP binds with O₂ and is converted into two molecules of phosphoglycolate.
 - III. There is no synthesis of sugar as well as ATP in this process.
- IV. This process releases CO₂ along with consumption of ATP.
 - (a) I and III only
 - (b) II and IV only
 - (c) II only
 - (d) III only
8. The bundle sheath cells of a C₄ plant are
 - (a) rich in PEPcase but lack RuBisCo
 - (b) rich in RuBisCo and PEPcase
 - (c) rich in RuBisCo but lack PEPcase
 - (d) without chloroplasts.
9. The energy required to synthesise one molecule of glucose via Calvin cycle is
 - (a) 3 ATP and 2 NADPH
 - (b) 12 ATP and 18 NADPH
 - (c) 18 ATP and 12 NADPH
 - (d) 2 ATP and 3 NADPH.
10. DCMU, a potent herbicide kills plant by inhibiting
 - (a) photosystem II
 - (b) photosystem I
 - (c) Calvin cycle
 - (d) Krebs' cycle.
11. The given figure shows an experimental set-up to investigate photosynthesis. The plant was exposed to different light intensities and the rate of photosynthesis was estimated by counting the number of bubbles produced by the plant.



The results are as follows :

Light intensity (unit)	1	2	3	4	5
Number of bubbles	4	20	24	28	28

What could be inferred from the given experiment?

- (a) The rate of photosynthesis increases with increasing light intensities.
- (b) Light intensity limits photosynthesis upto a certain extent.
- (c) The rate of photosynthesis in the given experimental set-up is determined by the rate of production of gaseous oxygen.
- (d) All of these

- 12.** In light reaction of photosynthesis, manganese ions are associated with
 (a) oxygen evolving complex
 (b) cytochrome b_6-f complex
 (c) ferredoxin
 (d) plastocyanin.

- 13.** Photosynthesis cannot continue for long if during light reaction, only cyclic photophosphorylation takes place. This is because
 (a) only ATP is formed and NADPH and H^+ is not formed
 (b) photosystem I stops getting excited at a wavelength of light beyond 680 nm
 (c) there is unidirectional cyclic movement of the electrons
 (d) there is no evolution of O_2 .

- 14.** In an experiment demonstrating the evolution of oxygen in *Hydrilla*, sodium bicarbonate is added to water in the experimental set-up. 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.

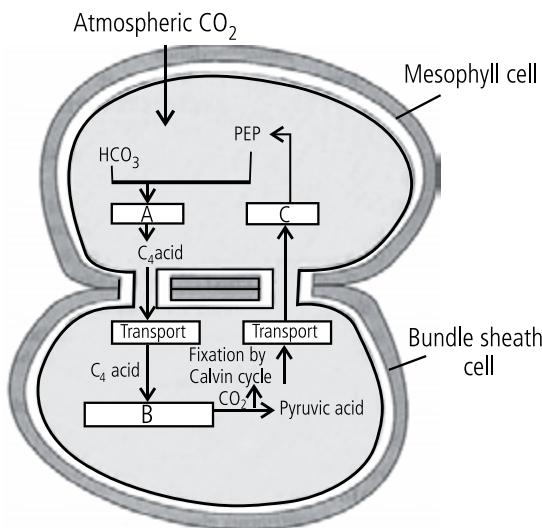
- 15.** A decrease in photosynthetic rate with increased availability of oxygen is called
 (a) Richmond Lang effect (b) Warburg effect
 (c) Emerson effect (d) none of these.

- 16.** Match column I with column II and select the correct option.
- | Column I | Column II |
|------------------------------------|--------------------------------|
| A. Oxygen evolving complex | (i) Monomorphic chloroplasts |
| B. C_3 plants | (ii) High oxygen concentration |
| C. Photorespiration | (iii) Kranz anatomy |
| D. C_4 plants | (iv) Photolysis of water |
| (a) A-(ii), B-(iv), C-(iii), D-(i) | |
| (b) A-(i), B-(iii), C-(ii), D-(iv) | |
| (c) A-(iv), B-(i), C-(ii), D-(iii) | |
| (d) A-(ii), B-(i), C-(iv), D-(iii) | |

- 17.** Read the following statements and identify the correct ones.
 (i) Z scheme of light reaction takes place only in the presence of PS I.
 (ii) Only PS I is functional in cyclic photophosphorylation.
 (iii) Cyclic photophosphorylation results in synthesis of ATP and $NADPH_2$.

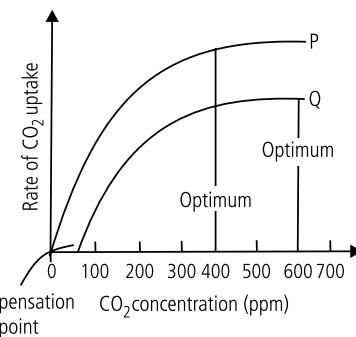
- (iv) Stroma lamellae lack PS II and NADP.
 (a) (ii) and (iv) only (b) (i) and (ii) only
 (c) (ii) and (iii) only (d) (iii) and (iv) only

- 18.** Refer to the given figure of C_4 pathway and select the correct options for A, B and C.



A	B	C
(a) Decarboxylation	Reduction	Regeneration
(b) Fixation	Transamination	Regeneration
(c) Carboxylation	Decarboxylation	Reduction
(d) Fixation	Decarboxylation	Regeneration

- 19.** Identify curves P and Q in the given graph which shows the effects of CO_2 concentration on photosynthesis of C_3 and C_4 plants and select the correct option.



- (a) P belongs to C_4 species and Q belongs to C_3 species.
 (b) P belongs to C_3 species and Q belongs to C_4 species.
 (c) Both P and Q belong to C_4 species, with P obtained at high light intensity and Q obtained at low light intensity.
 (d) Both P and Q belong to C_3 species, with P obtained at high light intensity and Q obtained at low light intensity.

- 20.** Which of the following events are responsible for the development of proton gradient across the membrane of the thylakoid?
- Splitting of water molecule at the stroma side.
 - Splitting of water molecules to the inner side of membrane of thylakoid.
 - Movement of electrons through two photosystems.
 - Removal of $\text{NADPH} + \text{H}^+$ from the lumen.
 - Removal of protons from the stroma by NADP reductase.
- (a) I, III and V only (b) II, III and IV only
 (c) II and IV only (d) II, III and V only
- 21.** The active component of photosystem I is composed of
- chlorophyll *a* with absorption peak at 680 nm
 - chlorophyll *a* with absorption peak at 700 nm
 - chlorophyll *d* with absorption peak at 680 nm
 - chlorophyll *a* and *d* with absorption peak at 700 nm.
- 22.** The first product of CO_2 fixation in Hatch-Slack Pathway is
- formation of oxaloacetate by carboxylation of phosphoenol pyruvate (PEP) in the bundle sheath cells
 - formation of oxaloacetate by the carboxylation of phosphoenol pyruvate (PEP) in the mesophyll cells
 - formation of phosphoglyceric acid in the mesophyll cells
 - formation of phosphoglyceric acid in the bundle sheath cells.
- 23.** Which one of the following groups of organisms does not evolve oxygen during photosynthesis?
- Red algae
 - Photosynthetic bacteria
 - C_4 plants with Kranz anatomy
 - Blue green algae
- 24.** Match column I with column II and select the correct option.
- | Column I | Column II |
|---|--------------------------------------|
| A. RuBisCo | (i) Accessory photosynthetic pigment |
| B. PEPcase | (ii) Absorption maxima at 700 nm |
| C. PS II | (iii) C_3 cycle |
| D. Carotenoids | (iv) Absorption maxima at 680 nm |
| E. PS I | (v) C_4 cycle |
| (a) A-(ii), B-(iv), C-(iii), D-(i), E-(v) | |
| (b) A-(iii), B-(v), C-(iv), D-(i), E-(ii) | |
| (c) A-(v), B-(i), C-(ii), D-(iv), E-(iii) | |
| (d) A-(iii), B-(i), C-(iv), D-(ii), E-(v) | |
- 25.** Which one of the following is identified as the water soluble pigment?
- Xanthophyll
 - Chlorophyll
 - Carotenoid
 - Phycobilin
- 26.** What differentiates PS II from PS I in photochemical reaction of photosynthesis?
- (a)** Production of NADPH
(b) Production of ATP
(c) Both (a) and (b)
(d) None of these
- 27.** Identify A, B, C and D in the given figure showing Z-scheme of light reaction.
-
- | A | B | C | D |
|--------------------|----------------|----------------|----------|
| (a) PS II | PS I | e^- acceptor | LHC II |
| (b) LHC II | e^- acceptor | PS I | PS II |
| (c) PS I | PS II | e^- acceptor | LHC II |
| (d) e^- acceptor | LHC II | PS II | PS I |
- 28.** During photosynthesis, light is not required directly for
- conversion of ADP to ATP
 - reduction of NADP^+ to NADPH
 - the formation of 3-phosphoglycerate from carbon dioxide and ribulose 1, 5 biphosphate
 - splitting of water.
- 29.** During Calvin cycle, ATP is consumed during
- carboxylation phase only
 - regeneration phase only
 - both carboxylation and reduction phases
 - both reduction and regeneration phases.
- 30.** Which of the following statements are incorrect regarding action spectrum?
- It shows the amount of light absorbed at different wavelengths.
 - It is a graphical representation of the rate of photosynthesis at different wavelengths of light.
 - It can be studied directly.
 - It requires study of light utilisation at various wavelengths.
- (a) (ii) and (iv) only (b) (i) and (iii) only
 (c) (i), (iii) and (iv) only (d) (i), (ii) and (iii) only

ANSWER KEY

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



MPP-8 | MONTHLY Practice Problems

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.

- Neural Control and Coordination
- Chemical Coordination and Integration

Total Marks : 160

Duration : 40 Min.

1. Thyroxine and Triiodothyronine are synthesised by attaching iodine to amino acid _____.
 (a) threonine (b) tyrosine
 (c) tryptophan (d) proline
2. Consider the following statements and select the incorrect one(s).
 - I. Mesencephalon comprises of crura cerebri that relays impulses back and forth between the pons and medulla.
 - II. Diencephalon region of prosencephalon is associated with maintaining homeostasis and has thirst and satiety centre.
 - III. Rhombencephalon includes corpora quadrigemina and it regulates the heart rate and salivation.
 (a) I and III (b) II only
 (c) II and III (d) III only
3. Complete the given table by correctly identifying A, B, C and D.

	Activity	Response
(i)	Blinking of eye	A
(ii)	Typing	B
(iii)	Breast feeding	C
(iv)	Peristalsis of alimentary canal	D

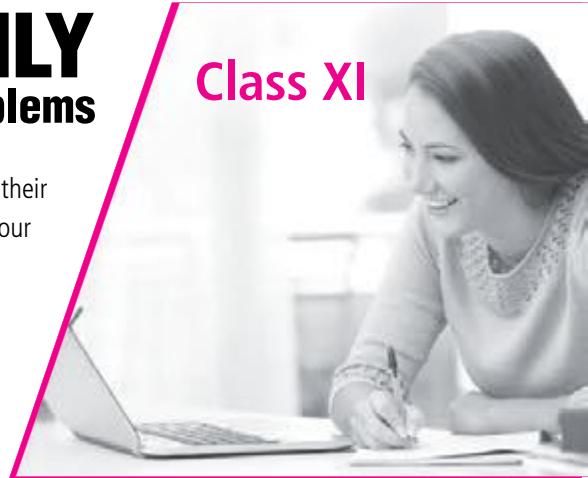
A	B	C	D
(a) Unconditioned reflex	Unconditioned reflex	Conditioned reflex	Cerebral reflex
(b) Unconditioned reflex	Conditioned reflex	Unconditioned reflex	Unconditioned reflex
(c) Conditioned reflex	Unconditioned reflex	Spinal reflex	Unconditioned reflex
(d) Conditioned reflex	Conditioned reflex	Unconditioned reflex	Spinal reflex
4. _____ demarcates the sensitive part of retina from its non sensory part.
 (a) Choroid (b) Fovea centralis
 (c) Retinal gliocytes (d) Ora serrata
5. Adrenal cortex is divided into three zones. The inner region called (i) secretes (ii), the middle layer (iii) secretes (iv) and the outer zone known as (v) secretes (vi).
 (a) (i) zona fasciculata, (ii) glucocorticoids,
 (v) zona reticularis
 (b) (ii) gonadocorticoids, (iii) zona fasciculata,
 (v) zona glomerulosa, (vi) mineralocorticoids
 (c) (i) zona fasciculata, (iv) cortisone,
 (v) zona glomerulosa, (vi) mineralocorticoid
 (d) (i) zona reticularis, (ii) glucocorticoids,
 (vi) zona fasciculata
6. Match column I with column II.

Column I	Column II
A. Algesireceptor	(i) Central neural system
B. Frigidoreceptor	(ii) Ruffini's corpuscles
C. GABA	(iii) Sympathetic neural system
D. Caloreceptor	(iv) Mechanoreceptor
E. Noradrenaline	(v) Krause's corpuscles
(a) A-(ii), B-(i), C-(iv), D-(v), E-(iii)	
(b) A-(v), B-(ii), C-(i), D-(iii), E-(iv)	
(c) A-(iv), B-(v), C-(i), D-(ii), E-(iii)	
(d) A-(iii), B-(i), C-(v), D-(iv), E-(ii)	
7. Read the following statements and select the correct option.

Statement 1: α cells of pancreas produce glucagon that stimulates the liver to convert stored glycogen into glucose.

Statement 2 : β cells of pancreas produces insulin that is antagonistic to glucagon.

 - (a) Both statements 1 and 2 are correct and statement 2 is the correct explanation of statement 1.
 - (b) Both statements 1 and 2 are correct but statement 2 is not the correct explanation of statement 1.
 - (c) Statement 1 is correct but statement 2 is incorrect.
 - (d) Both statements 1 and 2 are incorrect.



- 9.** Match the following and select the correct option.

Cerebral lobes		Functions
A.	Parietal lobe	(i) Controls intellectual ability to abstract
B.	Occipital lobe	(ii) Sensory perception of heat and cold
C.	Frontal lobe	(iii) Decodes and interprets sound
D.	Temporal lobe	(iv) Decodes and interprets visual information
(a)	A-(iii), B-(iv), C-(ii), D-(i)	(b) A-(ii), B-(iv), C-(i), D-(iii)
(c)	A-(iv), B-(i), C-(iii), D-(ii)	(d) A-(i), B-(ii), C-(iv), D-(iii)

- 10.** Which hormone requires extracellular receptors to generate second messengers for their action?

 - (a) Serotonin
 - (b) Aldosterone
 - (c) Thyroid stimulating hormone
 - (d) Thyroxine

- 11.** A person suffering from Addison's disease has

 - (a) high blood sugar level, and high Na^+ and K^+ in plasma
 - (b) low blood sugar level, low Na^+ and high K^+ in plasma
 - (c) high blood sugar level, low Na^+ and K^+ in plasma
 - (d) low blood sugar level, high Na^+ and K^+ in plasma.

12. _____ is the first anticholinesterase inhibitor approved in the United States for the treatment of Alzheimer's disease.

 - (a) Dopamine
 - (b) Tacrine
 - (c) Donepezil
 - (d) Ubuprofen

- 13.** In a resting nerve fibre, the axoplasm contains

 - (a) low concentration of Na^+ and high concentration of K^+
 - (b) low concentration of K^+ and high concentration of Na^+
 - (c) equal concentration of Na^+ and K^+ to maintain equilibrium
 - (d) none of these.

- 14.** The type of neurons present in dorsal root ganglia of spinal nerves is

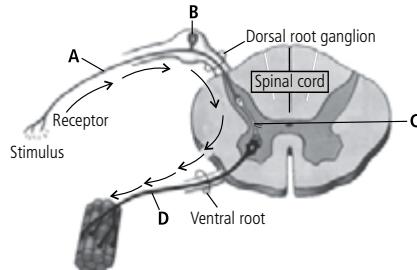
 - (a) unipolar
 - (b) pseudounipolar
 - (c) bipolar
 - (d) multipolar.

15. Consider the following statements and select the option stating which ones are true (T) and which ones are false (F).

 - (i) Cerebellum shows branched tree like arrangement of grey and white matter called the arbor vitae.
 - (ii) Myelon is covered with a thin innermost duramater, the middle webby arachnoid membrane and an outer tough piamater.
 - (iii) Limbic system is also referred as emotional brain.
 - (iv) Corpus striatum, the largest nucleus present in the basal ganglia is a mass of white matter.

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

- 16.** Observe the given figure of reflex arc and identify A, B, C and D.



- (a) A-Afferent nerve fibre; B-Sensory neuron;
C-Inter neuron; D-Efferent nerve fibre
 - (b) A-Efferent nerve fibre; B-Motor neuron;
C-Effecter; D-Afferent nerve fibre
 - (c) A-Motor nerve fibre; B-Collateral fibre;
C-Cerebral aqueduct; D-Interneuron
 - (d) A-Presynaptic neuron; B-Postsynaptic neuron;
C-Synaptic cleft; D-Neurilemma

- 17.** Broca's motor speech area is located in

- (a) cerebellar hemisphere
 - (b) frontal lobe of cerebrum
 - (c) epithalamus of diencephalon
 - (d) cerebral peduncles of mesencephalon.

- 18.** Select the option which correctly fills the blanks in the following statements.

- (i) _____ are modified oil glands present on the edges of the eyelids.
 - (ii) _____ is also called gland of emergency.
 - (iii) Parasympathetic nerves arise from the _____ region of the neural system.

(i)	(ii)	(iii)
Nasolacrimal glands	Pituitary gland	thoracolumbar
Glands of Moll	Thyroid gland	sacral
Meibomian glands	Adrenal gland	craniosacral
Lacrimal glands	Pineal gland	lumbar

19. Cones present in retina are sensitive to bright light. They contain iodopsin pigment. Cone cells that contain _____ are sensitive to red light. Cones containing chlorable pigment are sensitive to _____ light, while pigment _____ recognicos blue light.

- (a) (i)-erythrolable, (ii)-green, (iii)-cyanolable
(b) (i)-cyanolable, (ii)-white, (iii)-erythrolable
(c) (i)-cyanolable, (ii)-green, (iii)-erythrolabe
(d) (i)-erythrolable, (ii)-black, (iii)-cyanolable

- 20.** Which of the following is/are the functions of atrial natriuretic factor (ANF)?

 - (a) It inhibits the release of renin.
 - (b) It reduces aldosterone secretion.
 - (c) It inhibits NaCl reabsorption in the collecting duct.
 - (d) All of these

21. Read the following statements and select the correct option.

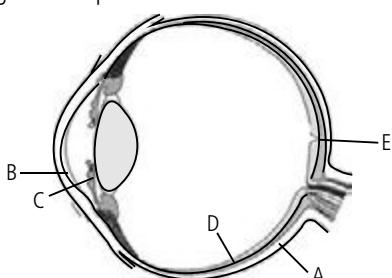
Statement 1 : In electrical synapse, gap junction provides continuity between the presynaptic and postsynaptic neurons.

Statement 2 : Electrical synapses are relatively rare and are found in cardiac muscle fibres and epithelial cells of lens.

- found in cardiac muscle fibres and epithelial cells of lungs.

 - (a) Both statements 1 and 2 are correct and statement 2 is the correct explanation of statement 1.
 - (b) Both statements 1 and 2 are correct but statement 2 is not the correct explanation of statement 1.
 - (c) Statement 1 is correct but statement 2 is incorrect.
 - (d) Both statements 1 and 2 are incorrect.

22. Observe the given figure and select the incorrect statements regarding labelled parts A – E.



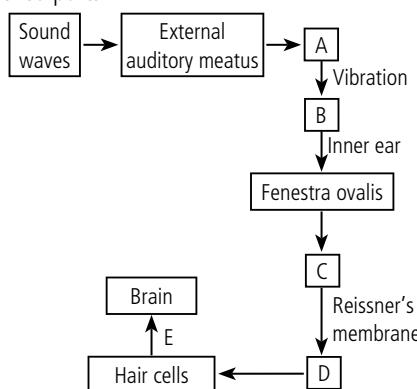
23. (i) is the largest cranial nerve that arises from the ventral surface of the (ii). Spinal nerves include eight pairs of (iii) nerves, twelve pairs of (iv) nerves, five pairs of (v) and (vi) nerves and one pair of (vii) nerves.

	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)
(a)	Olfactory	nasal chamber	lumbar	sacral	cochlear	thoracic	maxillary
(b)	Facial	pons varolii	maxillary	oculo-motor	lumbar	sacral	cochlear
(c)	Vagus	medulla oblongata	cochlear	thoracic	oculo-motor	maxillary	lumbar
(d)	Trigeminal	pons varolii	cervical	thoracic	lumbar	sacral	coccygeal

- 24.** Cholinergic nerve fibres comprises of

 - (a) preganglionic sympathetic and parasympathetic neurons
 - (b) some sympathetic postganglionic neurons
 - (c) parasympathetic postganglionic neurons
 - (d) all of these.

25. Study the given flow chart of hearing mechanism and identify the labelled parts A-F.



- (a) A-Tympanic cavity, B-Eustachian tube, C-Scala media, D-Scala vestibuli, E-Vestibular nerve
 - (b) A-Tympanic membrane, B-Ear ossicles, C-Scala vestibuli, D-Scala media, E-Cochlear nerve
 - (c) A-Eustachian tube, B-Tympanic membrane, C-Ampulla, D-Fenestra rotunda, E-Trigeminal nerve
 - (d) A-Tunnel of Corti, B-Tectorial membrane, C-Spiral ganglion, D-Organ of Corti, E-Vagus nerve

26 Who discovered "Role of cAMP in hormone action"?

- (a) Earl W. Sutherland Jr. (b) Alfred Gilman
(c) F C Kendall (d) Thomas Addison

27 Which of the following statements are correct?

- Which of the following statements are correct?

 - I. Aldosterone regulates the blood sodium and water level.
 - II. Melatonin hormone regulates circadian rhythms.
 - III. Cortisol promotes phagocytic activities of WBCs.
 - IV. Oxytocin is a peptide hormone whereas thyrocalcitonin is a protein hormone.

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

28. Match column I with column II.

Column I	Column II
A. Neuron	(i) Spinal cord
B. Fornix	(ii) Lipofuscin
C. Parafollicular cells	(iii) Pituitary gland
D. Filum terminale	(iv) Cerebrum
E. Sella turcica	(v) Thyroid gland
(a)	A-(ii), B-(iv), C-(v), D-(i), E-(iii)
(b)	A-(iv), B-(v), C-(iii), D-(ii), E-(i)
(c)	A-(iii), B-(iv), C-(i), D-(v), E-(ii)
(d)	A-(iii), B-(ii), C-(v), D-(i), E-(iv)

- 29.** A proteolytic enzyme exhibiting some properties of hormones is
 (a) erythropoietin (b) renin
 (c) calcitriol (d) thymosin.

- 30.** Modified sweat glands at the edge of the eyelids are
 (a) glands of Moll (b) glands of Zeis
 (c) tarsal glands (d) lacrimal glands.

- 31.** Study the given table and identify A, B, C and D.

Disease	Hormone	Secretion
Grave's disease	A	Hypersecretion
Cushing's syndrome	Cortisol	B
C	ADH	Hyposecretion
Osteoporosis	D	Hypersecretion

- (a) A-Melanotrophin, B-Hyposecretion,
 C-Acromegaly, D-Thyroxine
 (b) A-Cortisone, B-Hyposecretion,
 C-Gigantism, D-Luteinizing hormone
 (c) A-Oxytocin, B-Hypersecretion,
 C-Diabetes mellitus, D-Glucagon
 (d) A-Thyroid, B-Hypersecretion,
 C-Diabetes insipidus, D-Parathormone.

- 32.** Which of the following is not a function of hypothalamus?
 (a) It controls growth and sexual behaviour.
 (b) It maintains homeostasis.
 (c) It regulates respiration and heart beat.
 (d) It relays information between cerebrum and cerebellum.

- 33.** The thinnest and smallest cranial nerve is _____.
 (a) accessory nerve (b) trochlear nerve
 (c) hypoglossal nerve (d) abducens nerve

- 34.** Identify the hormone from the given characteristics.
 (i) It is secreted by the mucosa of small intestine.
 (ii) It stimulates gall bladder to release bile juice.
 (a) Enterogastrone
 (b) Pancreatic polypeptide
 (c) Cholecystokinin-pancreozymin
 (d) Vasoactive intestinal peptide

- 35.** Synthetic oxytocin injected into cows and buffaloes to produce more milk is
 (a) pitressin (b) prolactin
 (c) pitocin (d) somatropin.

- 36.** Which of the following statements is correct?
 (a) Cortisol is used in transplantation surgery to suppress antibody formation in donor's body.

- (b) Preganglionic fibres of sympathetic neural system are longer than the postganglionic fibres.
 (c) The action of water soluble hormones are faster and long lasting than the actions of lipid soluble hormones.
 (d) Inner butterfly shaped area of spinal cord is grey matter.

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

Column I	Column II
P. Amino acid hormone	(i) ADH
Q. Steroid hormone	(ii) Insulin
R. Peptide hormone	(iii) Thyroxine
S. Protein hormone	(iv) Serotonin
T. Iodothyronines	(v) Calcitriol
	(vi) Epinephrine
	(vii) Growth hormone
(a)	P-(vii); Q-(i), (iii); R-(vi); S-(ii), (v); T-(iv)
(b)	P-(iv), (vi); Q-(v); R-(i); S-(ii), (vii); T-(iii)
(c)	P-(iii), (i); Q-(iv), (v); R-(vi); S-(vii); T-(ii)
(d)	P-(i); Q-(iii), (vi); R-(v); S-(ii), (iv); T-(vii)

- 38.** Which hormone regulates calcium and phosphate balance between blood and body tissues?
 (a) Calcitriol (b) Collip's hormone
 (c) Thyrocalcitonin (d) Duocrinin

- 39.** Match the following and select the correct option.

Column I	Column II
A. Oxytocin hormone	(i) Gonads
B. Somatostatin	(ii) Kidneys
C. Luteinising hormone	(iii) Mammary gland
D. Mineralocorticoid	(iv) Pancreas
(a)	A-(iv), B-(i), C-(ii), D-(iii)
(b)	A-(ii), B-(iii), C-(i), D-(iv)
(c)	A-(iii), B-(iv), C-(i), D-(ii)
(d)	A-(i), B-(iii), C-(ii), D-(iv)

- 40.** A hormone stimulates growth and development of seminal vesicles and sperm formation in the B.

A	B
(a) Testosterone	seminiferous tubule
(b) Luteinizing hormone	prostate gland
(c) FSH	scrotum
(d) GnRH	epididymis

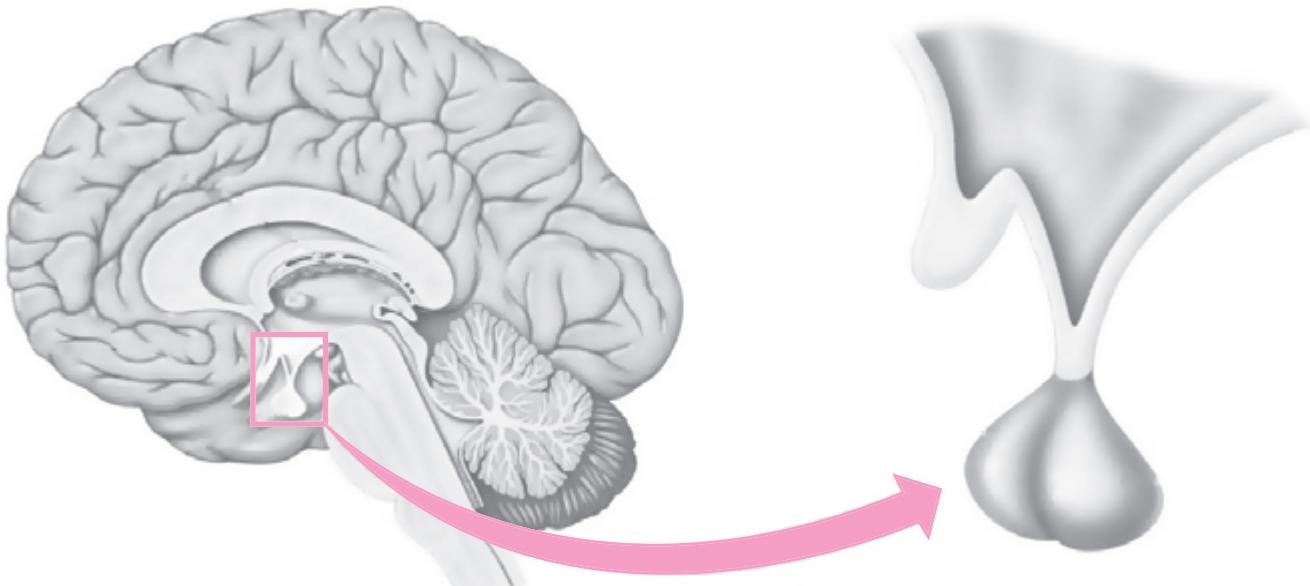
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SELF CHECK

Check your score! If your score is

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

> 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.



NEET ESSENTIAL

HUMAN ENDOCRINE SYSTEM

Cell functions are broadly controlled by nervous and endocrine system. Endocrine system achieves coordination and integration by the release of physiologically active substances called **hormones** directly into the blood stream. It has slower action (*i.e.*, much longer latent period) and affects number of cells over a longer period.

In vertebrate body, glands are classified into exocrine and endocrine glands on the basis of presence and absence of ducts.

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.

Types of Gland

Exocrine glands

- Glands with ducts
- Secretions of these glands are carried by ducts to a particular organ.
- *E.g.*, salivary glands, liver, etc.

Endocrine glands

- Ductless glands or glands of internal secretion.
- Their secretion get absorbed into immediate surrounding blood circulation to reach a specific organs to initiate particular metabolic change.
- Chemicals secreted are called hormones.
- *E.g.*, pituitary, hypothalamus, etc.

Endocrine Glands

○ Holocrine glands

Endocrine glands which secrete only hormones. *E.g.*, thyroid, parathyroid, adrenal, pituitary gland

○ Heterocrine glands

Glands which have dual functions (secretion of hormones and some other functions). *E.g.*, pancreas, testes, ovaries, etc.

Characteristics of Hormones

- Hormones are secretory products of ductless glands released directly into the circulation in **small amounts** in response to a **specific stimulus** and on delivery in circulation produces response on the target cells or organs.
- Hormones interact with their target cells *via* receptors, or by passing directly through cell membrane.
- As regulators, hormones stimulate or inhibit the rate and magnitude of biochemical reactions by their control of enzymes and thereby cause morphological, biochemical and functional changes in the target tissues. For example, a hormone does not provide energy but it modulates energy producing processes and regulates the circulating levels of energy producing substrates such as glucose, fatty acids, etc.
- Hormones have a **longer latent period** than that associated with neurons following their stimulation. For example, following the injection of oxytocin, milk ejection occurs in a few minutes; while following the application of a stimulus to a nerve, the muscle contracts within few milliseconds.
- Most hormones are metabolised rapidly after secretion and they get inactivated mainly in the liver and kidney.

Amino acid Derivative Hormones

- Epinephrine, nor-epinephrine,
- T₃, melatonin, serotonin

Protein Hormones

- Hormones generally water soluble and circulate unbound in plasma.
- Hormones are synthesised on ribosomes, attached to ER.
- E.g., anterior pituitary hormones, parathormone, insulin, glucagon, etc.

Classification of Hormones

Steroid Hormones

- Hydrophobic, lipid soluble substances synthesised from cholesterol.
- E.g., aldosterone, cortisol, androgens, etc.

Peptide Hormones

- Hormones of posterior lobe of pituitary gland.
- E.g., oxytocin and vasopressin

Hypothalamus secrete neurohormones that act on the cells of the pituitary gland.
Releasing hormones: GHRH, ARH, TRH, GnRH, PRH
Inhibitory hormones: GHIH, PIH, MSHIH

Pituitary gland secretes multiple hormones that regulate the endocrine activities of the adrenal cortex, thyroid gland and reproductive organs, e.g., ACTH, TSH, FSH, LH, etc.

Thyroid gland secretes hormones that affect metabolic rate and calcium levels in body fluids, e.g., **thyroxine, calcitonin, tri-iodothyronine**.

Thymus gland secrete **thymosin** involved in the stimulation and coordination of the immune response.

Adrenal gland secretes hormones involved with mineral balance, metabolic control and resistance to stress; the adrenal medulla release **epinephrine** and **nor-epinephrine** and adrenal cortex secretes **cortisol, aldosterone**, etc.

Pancreas secretes hormones that regulate the rate of glucose uptake and utilisation by body tissues, e.g., **insulin, glucagon**.

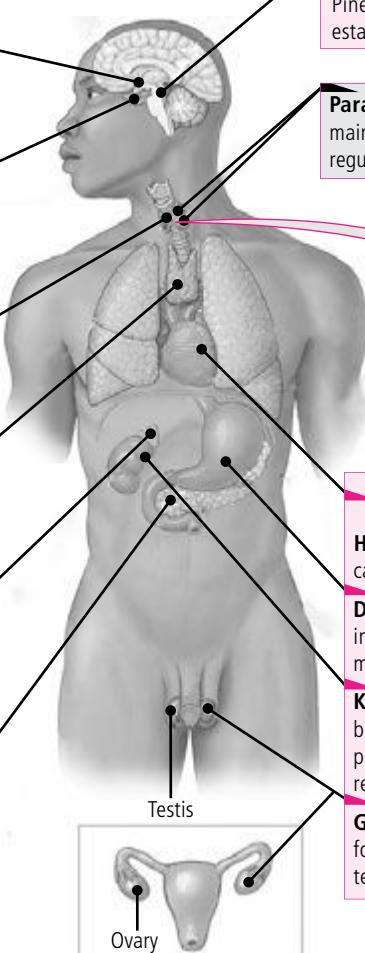


Fig.: Human Endocrine Glands

Pineal gland secretes **melatonin**, a sleep hormone. Pineal gland acts as biological clock which helps to establish circadian rhythms.

Parathyroid glands secrete **parathormone** which maintains proper levels of calcium and phosphorus by regulating renal action.

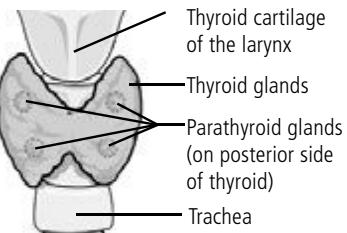


Fig.: Enlarged view of thyroid gland

Organs with secondary endocrine functions

Heart: Secretes hormones ANF from cells of atria, called **cardiocytes**.

Digestive Tract: Secretes numerous hormones involved in the coordination of system functions, glucose metabolism and appetite, e.g., gastrin, secretin, etc.

Kidneys: Secret hormones that regulate red blood cell production and the rate of calcium and phosphate absorption by the intestinal tract, e.g., renin erythropoietin, calcitriol.

Gonads: Secret hormones affecting gamete formation and sexual characteristics, e.g., estrogen, testosterone, etc.

HUMAN ENDOCRINE GLANDS

Hypothalamus (Supreme Commander)

It is a neuroendocrine organ that produces several neurohormones and its target organ is pituitary. Hypothalamus is the basal part of diencephalon (a part of forebrain) and it regulates a wide spectrum of body functions.

The hormones produced by hypothalamus are of two types, the **releasing hormones** (which stimulate secretions of pituitary hormones) and the **inhibiting hormones** (which inhibit secretions of pituitary hormones).

Table : Hormones of hypothalamus

	Hormones	Functions
(i)	Adrenocorticotrophic releasing hormone (ARH) or corticotropin releasing hormone	Stimulates the anterior lobe of the pituitary gland to secrete its adrenocorticotropic hormone (ACTH).
(ii)	Thyrotropin releasing hormone (TRH)	Stimulates the anterior lobe of the pituitary gland to secrete its thyroid stimulating hormone (TSH) or thyrotropin.
(iii)	Growth hormone-releasing hormone (GHRH)	Stimulates the anterior lobe of the pituitary gland to release its growth hormone (GH) or somatotropin.
(iv)	Growth hormone-Inhibitory hormone (GHIH) or Somatostatin	Inhibits the secretion of growth hormone from the anterior lobe of the pituitary gland.
(v)	Gonadotropin releasing hormone (GnRH)	Stimulates the anterior lobe of the pituitary gland to secrete two gonadotrophic hormones: (follicle stimulating hormone (FSH) and luteinising hormone (LH)).
(vi)	Prolactin releasing hormone (PRH)	Stimulates the anterior lobe of the pituitary gland to secrete its prolactin.
(vii)	Prolactin inhibitory hormone (PIH)	Inhibits the secretion of prolactin from the anterior lobe of pituitary gland.
(viii)	MSH releasing hormone (MSRRH)	Stimulates the intermediate lobe of the pituitary gland to secrete its melanocyte stimulating hormone (MSH).
(ix)	MSH inhibitory hormone (MSIH)	Inhibits the secretion of melanocyte stimulating hormone from the intermediate lobe of the pituitary gland.

Pituitary Gland (Master Endocrine Gland)

It is **smallest endocrine gland** present in a depression called sella turcica of sphenoid bone in skull. It attached to the brain by a stalk called **infundibulum** which is continuous with the hypothalamus.

Morphologically there are two main lobes – **anterior lobe** or adenohypophysis or pars distalis and **posterior lobe** or neurohypophysis or pars nervosa. A third lobe called intermediate lobe or pars intermedia is a part of adenohypophysis.

Two main lobes of pituitary gland

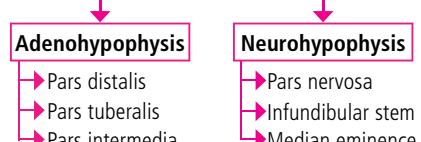


Table : Hormones of pituitary gland

	Hormones	Functions
Hormones of anterior lobe		
(i)	Growth hormone (GH) or Somatotropin hormone (STH)	Stimulates growth, promotes protein anabolism, etc.
(ii)	Thyroid stimulating hormone (TSH) or thyrotropin	Controls growth and activity of thyroid gland and influences iodine uptake.
(iii)	Adrenocorticotrophic hormone (ACTH)	Stimulates adrenal cortex to produce its hormones.

(iv)	Gonadotropins hormones (a) Follicle stimulating hormone (FSH) (b) Interstitial cell-stimulating hormone (ICSH) in males or Luteinising hormone (LH) in females	Stimulates gamete production, secretion of sex hormones, development of follicles. Stimulates the Leydig's cells of testis and induces secretion of testosterone hormones in males and development of corpus luteum and ovulation in females.
(v)	Luteotropic hormone (LTH) or Prolactin	Stimulates the growth of mammary glands during pregnancy and secretion of milk after child birth.
Hormone of intermediate lobe		
(vi)	Melanocyte stimulating hormone (MSH)	Growth and development of melanocytes which gives colour to skin.
Hormones of posterior lobe		
(vii)	Oxytocin	Stimulates ejection of milk from mammary glands; and contraction of uterus during parturition.
(viii)	Antidiuretic hormone (ADH) or Vasopressin	Regulates water balance and stimulates contraction of smooth muscles, blood vessels and results in rise in blood pressure.

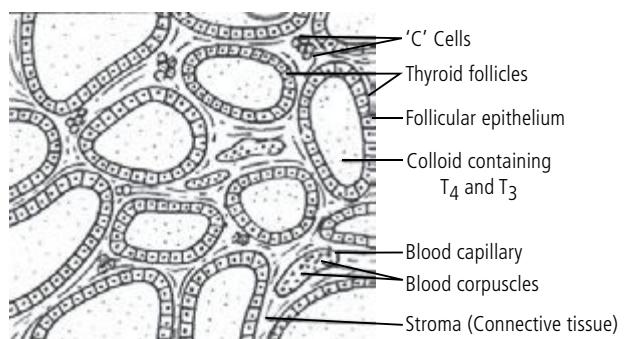
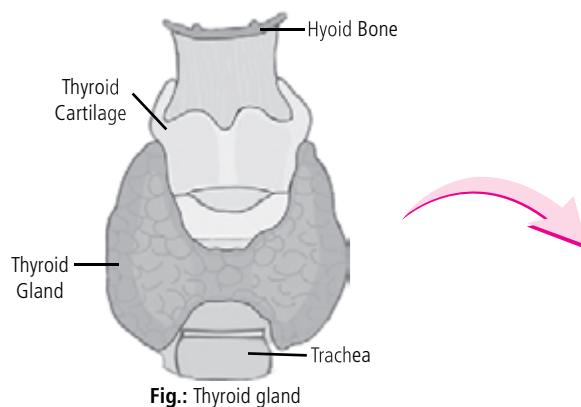


Pineal Gland

It develops from the ectoderm of the embryo. Pineal gland secretes a hormone called **melatonin** which plays a very important role in the regulation of 24 hours (**diurnal**) rhythm of our body. For example, it helps in maintaining the normal rhythms of sleep-wake cycle and in mammals it acts as inhibitory factor for sexual maturation and also help to lightens skin colour. **Serotonin** is a neurotransmitter found in pineal gland.

Thyroid Gland

It is the **largest endocrine gland** and it develops from the endoderm of the embryo. It is present between the trachea and larynx.



It is a bilobed organ and two lobes are connected with isthmus. The microscopic structure of the thyroid gland shows **thyroid follicles** composed of cubical epithelium and filled with a homogenous material called **colloid**. Small amount of loose connective tissue forms **stroma** of the gland. Besides containing blood capillaries, the stroma contains small clusters of specialised **parafollicular cells** or 'C' cells.

Thyroid gland secretes

three hormones: Thyroxine, tri-iodothyronine and calcitonin. Thyroxine (T_4) and tri-iodothyronine (T_3) are secreted by thyroid follicular cells. Both are iodinated forms of an amino acid tyrosine. T_3 is more active and potent than T_4 . T_4 gets converted into T_3 by removal of 1 iodine atom.

Functions of Thyroid Hormones

- Regulate the **metabolic rate** of the body and maintain **BMR** (basal metabolic rate)
- Regulate **growth** of body tissues and development of **mental faculties**
- Stimulate **tissue differentiation** (e.g., promote metamorphosis of tadpoles into adult frogs)
- Regulate carbohydrate and fat metabolism

Calcitonin (Calcium lowering hormone) is secreted by C-cells of the thyroid gland. Calcitonin is secreted in response to high blood calcium level. Calcitonin suppress release of calcium ions from the bones and lowers the calcium level.

Disorders of Thyroid gland

Hyperthyroidism: Excessive secretion of thyroid hormones results in **Grave's disease** or **exophthalmic goitre** characterised by bulging eyes due to fluid accumulation, loss of weight, nervousness and rapid heart beat.

Hypothyroidism: Deficiency of thyroid hormones causes **cretinism** in infants. Symptoms are retarded growth, undeveloped sex organ, mental retardation. **Myxoedema** or **gull's disease** is caused by deficiency of thyroxine in adults. It is characterised by puffy appearance due to fat accumulation in subcutaneous tissue, lack of alertness, slow heart beat, etc.

Parathyroid Glands

The parathyroid glands develop from the endoderm of the embryo. The parathyroid glands consist of four separate glands located on the posterior surface of the lobes of the thyroid gland. They consist of two types of cells : **chief cells** (small) and **oxyphil cells** (large). The chief cells secrete **parathormone** or **Collip's hormone**. Parathyroids are under the feed back control of blood calcium level.

Parathyroid hormone (PTH) increases the Ca^{2+} level in the blood by withdrawing calcium from the bones into the plasma. PTH also stimulates resorption of Ca^{2+} by the renal tubules and increases Ca^{2+} absorption from the digested food. It is, thus, clear that PTH is a hypercalcemic hormone. A fall in blood calcium stimulates release of parathormone and rise in blood calcium inhibits secretion of parathormone. **Parathormone is antagonistic to calcitonin.**

Disorders of parathyroid gland

- Hyposecretion** - Deficiency of PTH causes fall in Ca^{2+} level of blood. It causes convulsions and cramps, this is called parathyroid tetany or hypocalcemic tetany.
- Hypersecretion** - Excess of PTH draws more calcium from bones, causing their demineralisation leading to **osteoporosis**.

Thymus Gland

This gland is derived form the endoderm of the embryo. It is located in the mediastinum between the sternum and aorta. It is a soft, pinkish, bilobed mass of lymphoid tissue. **It is a prominent gland at the time of birth but it gradually atrophies with age.**

Hassall's corpuscles are spherical or oval bodies present in the thymus. They are **phagocytic** in function. Thymus secretes a hormone named **thymosin** which stimulates the development and differentiation of immunologically competent T-cells, increasing resistance to infections.

Adrenal Gland (Suprarenal Gland)

Adrenal glands are paired structures (conical, yellowish bodies) located on the top of kidneys. These are also called as glands of emergency.

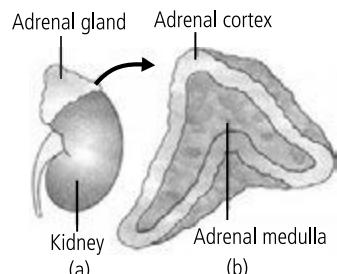


Fig.: (a) Adrenal gland on kidney (b) Section showing two parts of adrenal gland

Adrenal gland has two parts

Adrenal Cortex

- It is derived from the mesoderm of the embryo.
- It is divided into three layers: (i) **Zona glomerulosa** is the **outer zone** that lies just below the capsule. It secretes hormones called **mineralocorticoids**, that affect mineral homeostasis
- (ii) **Zona fasciculata** is the **middle and widest zone** and consists of cells arranged in long, straight columns which secrete **glucocorticoids** because they regulate glucose homeostasis.
- (iii) **Zona reticularis** is the **inner zone** and consists of cells arranged in branching cords which secrete **gonadocorticoids** or **sex corticoids**.

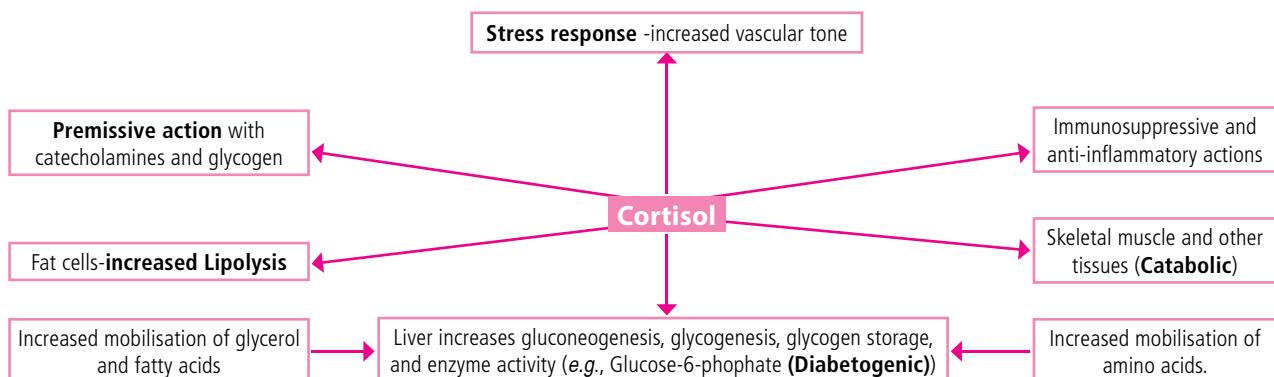
Adrenal Medulla

- It develops from the neuroectoderm of the embryo.
 - The adrenal medulla secretes two hormones: **nor-epinephrine (nor-adrenaline)** and **epinephrine (adrenaline)** which are commonly called **catecholamines**. Nor-epinephrine and epinephrine are derived from the amino acid tyrosine.
- Adrenal medulla consists of **chromaffin cells**. These cells are modified postganglionic cells of sympathetic nervous system and are connected with preganglionic motor fibres of sympathetic nervous system.
- Sympathetic nervous system and adrenal medulla function as an integrated system and is called sympathoadrenomedullary system.

Corticoids

(i) Mineralocorticoids: They maintain water and electrolyte balance and blood volume in the body by regulating mineral metabolism. The major mineralocorticoid is **aldosterone**, commonly called **salt-retaining hormone**. Low sodium level in body stimulates release of aldosterone. It causes retention of sodium from the kidney and increased urinary excretion of potassium.

(ii) Glucocorticoids : They affect carbohydrate metabolism however they also affect metabolism of proteins and fats.



Summary: The Principal actions of Glucocorticoids

(iii) Sexcorticoids: Sexcorticoids include both male and female sex hormones. **Androgens** are important for development of male foetus and stimulate the development of **male secondary sexual characters**. **Estrogen** controls the appearance of **female secondary sexual characters**.

Catecholamines

- (a) Nor-epinephrine** - It regulates the blood pressure under normal condition. It causes constriction of essentially all the blood vessels of the body. It causes increased activity of the heart, inhibition of gastrointestinal tract, dilation of the pupils of the eyes and so forth.
- (b) Epinephrine** - It is secreted at the time of emergency. Epinephrine has a greater effect on cardiac activity than nor-epinephrine. It causes only weak constriction of the blood vessels of the muscles in comparison with a much stronger constriction that results from nor-epinephrine.

Addison's Disease

Due to deficiency of mineralocorticoids and glucocorticoids. Its symptoms include low blood sugar, low plasma Na^+ , high K^+ plasma, increased urinary Na^+ , nausea, vomiting, diarrhoea.

Cushing's Syndrome

Caused by excess of cortisol. It is characterised by high blood sugar, appearance of sugar in the urine, rise in plasma Na^+ , fall in plasma K^+ , rise in blood volume, high blood pressure, etc.

Conn's Syndrome

Due to excessive production of aldosterone. Its symptoms include a high plasma Na^+ , low plasma K^+ , rise in blood volume, high blood pressure and polyuria.

Adrenal Virilism

Appearance of male characters in female is called virilism. Excessive production of male sexcorticoids (androgens) produces male secondary sexual characters like beard, moustache, hoarse voice in woman.

Gynaecomastia

Development of enlarged mammary glands (breasts) in the males, due to excessive secretion of estrogens in males. Decreased testosterone may also lead to gynaecomastia.

Pancreas

It is derived from the **endoderm of the embryo**. Pancreas is a composite gland which acts as both exocrine and endocrine gland. The endocrine pancreas consists of groups of cells called '**Islets of Langerhans**'.

Table: Hormones of pancreas

	Hormones	Cells of Islets	Function
(i)	Insulin	β cells	Stimulates glycogenesis, promotes synthesis of proteins and fats. Acts on cells of liver muscle and adipose tissue.
(ii)	Glucagon	α cells	Stimulates glycogenolysis in the liver and muscles; increases the amount of sugar in blood.
(iii)	Somatostatin (SS)	δ cells	Suppresses the release of hormones from the pancreas and digestive tract.
(iv)	Pancreatic polypeptide (PP)	Pancreatic polypeptide cells	Inhibits the release of digestive secretion of the pancreas.

Disorders of Pancreas**Hyperglycemia** (Diabetes mellitus)

It is due to insulin deficiency, resulting in elevation in blood sugar level hence glucose appears in urine. There is high blood cholesterol and ketone body formation. Symptoms are excessive urine production, thirst and eating.

Hypoglycemia

It is due to excess of insulin or deficiency of glucagon and blood glucose level falls below normal. Symptoms include weakness, profuse sweating, convulsions and requires urgent intake of sugar.

Kidneys

They develop from the **mesoderm** of the embryo.

Hormones of kidneys

Renin

Renin acts upon a plasma-protein, **angiotensinogen**, separating a compound, called angiotensin-II from it. **Angiotensin-II** accelerates heart beat and constricts arterioles, thereby increasing blood pressure.

It also stimulates secretion of aldosterone and enhances water and sodium reabsorption from nephrons.

Erythropoietin

The oxygen shortage stimulates the kidney cells to secrete a hormone named erythropoietin. It stimulates the bone marrow to increase the production of RBCs.

Calcitriol

Calcitriol is the active form of vitamin **cholecalciferol** (vitamin D). It promotes absorption of Ca^{2+} and phosphorus in the small intestine and accelerates bone formation.

Gonads

They develop from the mesoderm of the embryo. The gonads are sex glands. Both testis and ovary serve dual function, as they act as primary sex organs (produce gametes) as well as endocrine glands (secrete hormones).

Testis: It is composed of **seminiferous tubules** and **stromal** or **interstitial tissue**. The **Leydig's cells** or **interstitial cells**, secrete hormones called **androgens**, mainly **testosterone**.

Testosterone stimulates growth and development of **male sex organs** and **secondary sexual characters** like beard, moustache and low pitch voice, stimulates **spermatogenesis** and promotes growth of **bones** and **muscles**.

Male hypogonadism: It is due to deficiency of androgens (hypofunction of Leydig's cells), deficiency of sperm formation (hypofunction of Sertoli cells) and masculinization and male secondary sex organs do not develop.

Ovary: It is composed of ovarian follicles and stromal tissues. Hormones secreted by ovaries are: **estrogen** secreted by the **growing ovarian follicles**, **progesterone**, **relaxin** and **inhibin** secreted by corpus luteum.

Estradiol is the principal estrogen. It stimulates the development of female secondary sex characters and maturation of ova, development of uterine epithelium.

Progesterone stimulates further development of uterine lining and mammary gland, required for formation of placenta and maintenance of pregnancy.

Relaxin is secreted only during later stages of pregnancy and inhibin inhibits production of FSH and GnRH.

Female hypogonadism: Due to deficiency of estrogens (female sex hormones) pituitary gonadotropins (LH, FSH or both) or can represent primary ovary failure. It results in the lack of development of female secondary sexual characters.

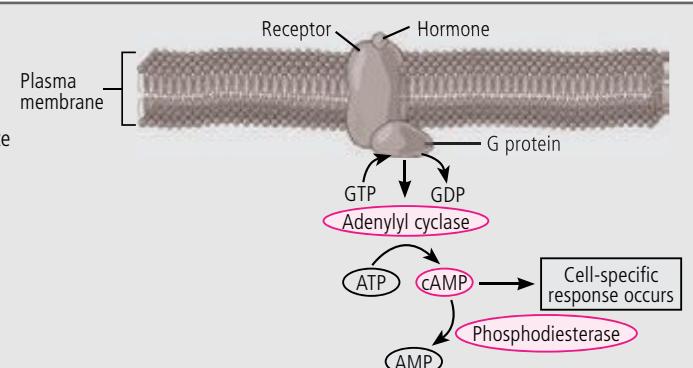
MECHANISM OF HORMONE ACTION

Hormones are of mainly two types- water soluble (e.g., amino acid derivatives, peptides and protein hormones) and lipid soluble (e.g., steroid hormones). Water soluble hormones require extracellular receptors that generate second messengers (e.g., cAMP) for carrying out their activity. Lipid soluble hormones can pass through cell membranes and directly enter the cells.

Two mechanisms of hormone action

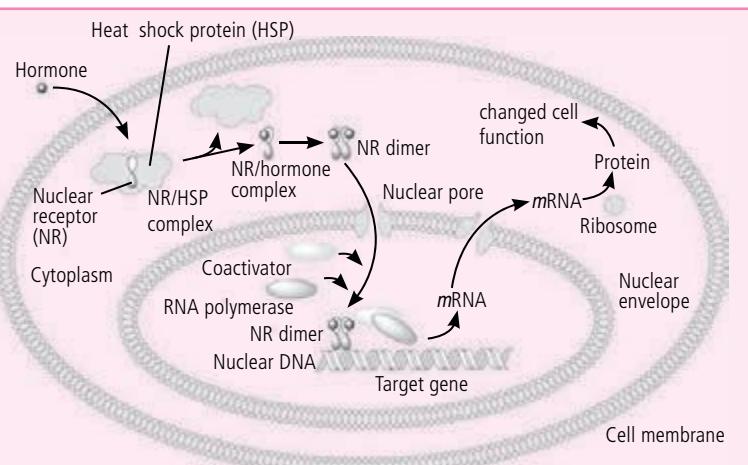
cAMP mediated hormone activity

Most proteins and polypeptide hormones, many amino acid derivatives, specially catecholamines and some of prostaglandins (because of their large size, cannot enter the cells) binds to intracellular receptors. They act as the **first messenger** and exert their effect by combining with specific fixed receptor site over the outer surface of the cell membrane, thereby activating the enzyme **adenylyl cyclase** on the inner surface of the membrane. This increases formation of intracellular cAMP from ATP. cAMP, the **second messenger**, is a basic regulator of cell metabolism, it acts by conversion of inactive protein kinases to their active form.



Transcription and translation effect

Steroid hormones being lipid soluble can easily enter into the target cells and exert their effect by combining to a specific cytoplasmic receptor protein in a target cell (i.e., cell that responds to the hormone). Each receptor molecule binds to hormone, forming a complex that enters the nucleus and becomes attached to the chromatin, the genetic material. The complex activates DNA, stimulates the transcription (i.e., formation of mRNA) of a particular gene and specific mRNA synthesis increases. The specific mRNA enters the cytoplasm, where it directs the ribosomes to synthesize specific proteins (translation). These proteins may be enzymes, structural proteins, receptor proteins or secretory proteins.



ROLE OF HORMONES IN HOMEOSTASIS

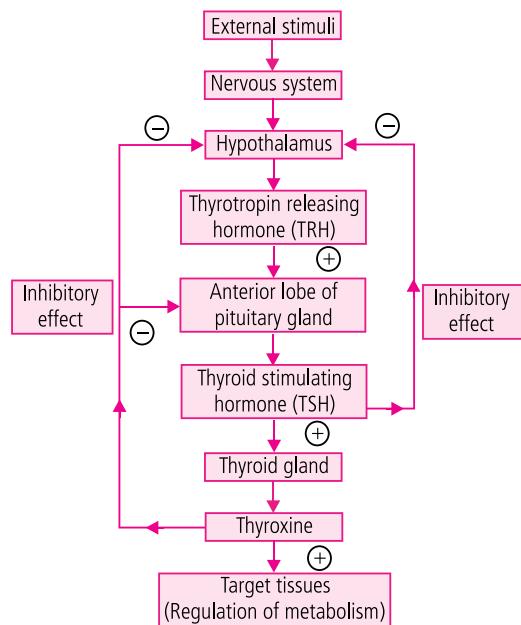
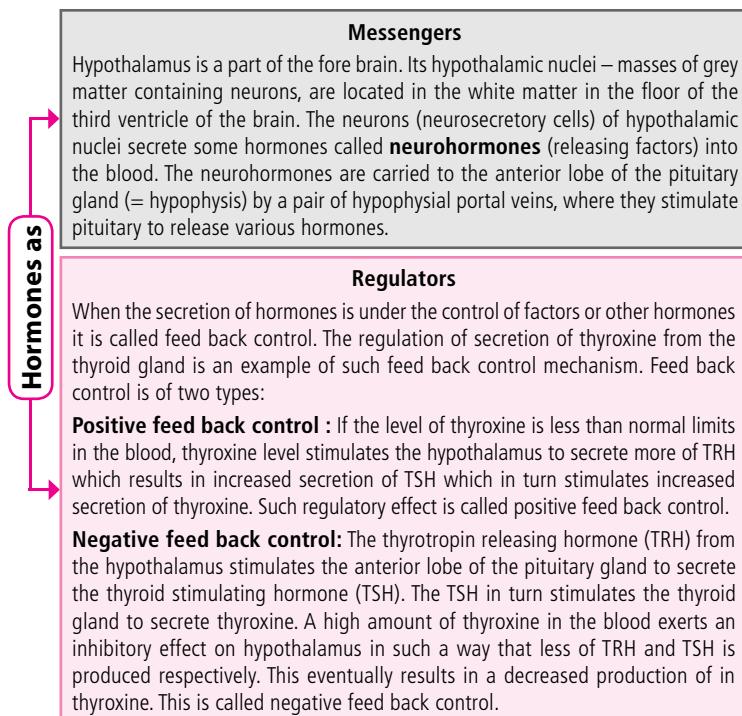


Fig.: Feed back control involving the hypothalamus, anterior lobe of pituitary gland, thyroid gland and target tissues

POWER EXERCISE

New MCQs

- 1.** Which of the following statements are correct regarding hormones?

 - I. They have low molecular weight.
 - II. Hormones do not affect growth differentiation.
 - III. They can be organic and inorganic in nature.
 - IV. Hormone controlled reactions are irreversible.

(a) I and II only (b) I and IV only
 (c) I, II and IV only (d) I, II and III only

2. Which of the following pair is not correctly matched ?

 - Oxytocin- Ejection of milk from mammary glands after child birth
 - Estrogen - Stimulates the maturation of ova
 - Inhibin - Inhibits the production of FSH
 - Luteotropic hormone - Stimulates the Leydig's cells to secrete progesterone

3. Collip's hormone or A is secreted from B cells. It regulates the metabolism of C and is antagonistic to D. Identify A, B, C and D.

A	B	C	D
(a) calcitonin	parafollicular	calcium	thyrocalcitonin
(b) parathormone	oxyphil	phosphate	calcitriol

4. If baby's anterior lobe of pituitary is damaged due to an accident, then from which of the following disorders is he most likely to suffer?

 - Diabetes insipidus
 - Simmond's disease
 - Acromegaly
 - Dwarfism

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

5. Identify the hormones A, B and C in the given flow chart.

```

    graph TD
      H[Hypothalamus] --> A[A]
      A --> AL[Anterior lobe of pituitary]
      AL --> B[B]
      AL --> C[C]
      C --> AG[Adrenal gland deficiency]
      C --> AD[Addison's disease]
  
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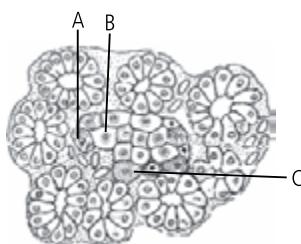
 - A-Corticotropin releasing hormone, B-Adrenocorticotropin hormone, C-Gonadocorticoids
 - A-Gonadotropin releasing hormone, B-Gonadotropin hormone, C-Gonadocorticoids
 - A-Corticotropin releasing hormone, B-Adrenocorticotropin hormone, C-Mineralocorticoids and Glucocorticoids.
 - A-Corticotropin releasing hormone, B-Vasopressin, C-Mineralocorticoids and Glucocorticoids

- 6.** Select the correct statement regarding thyroid hormone.
- In liver and kidneys, triiodothyronine changes to thyroxine.
 - Thyroxine is secreted by the C-cells of thyroid gland and thyrocalcitonin from thyroid follicular cells.
 - They have a stimulating effect on action of neurotransmitters.
 - Hypothyroidism causes exophthalmia resulting in protrusion of eye balls because of fluid accumulation.

- 7.** Match the column I with column II and select the correct option from the codes given below.

Column I	Column II
A. Thymosin	(i) Inhibits secretion of glucagon and insulin
B. Erythropoietin	(ii) Stimulates development of WBCs
C. Melatonin	(iii) Stimulates the bone marrow to increase production of RBCs
D. Somatostatin	(iv) Promotes sleep
(a) (A)-(i), (B)-(ii), C-(iv), D-(iii)	
(b) (A)-(ii), (B)-(iii), C-(iv), D-(i)	
(c) (A)-(iii), (B)-(ii), C-(iv), D-(i)	
(d) (A)-(iv), (B)-(iii), C-(i), D-(ii)	

- 8.** Polydipsia and ketosis are the symptoms of
- hypoglycemia
 - Cushing's syndrome
 - diabetes insipidus
 - diabetes mellitus.
- 9.** Study the given diagram showing the anatomy of pancreas and identify the hormones secreted from labelled parts A, B and C.



- A-Insulin, B-Somatostatin, C-Glucagon
 - A-Pancreatic polypeptide, B-Glucagon, C-Insulin
 - A-Somatostatin, B-Pancreatic polypeptide, C-Glucagon
 - A-Somatostatin, B-Insulin, C-Glucagon
- 10.** Which of the following is a function of prolactin hormone?
- Squeeze milk into large ducts behind nipples.
 - Stimulates maturation of ova and development of uterine epithelium.
 - Activates breast growth during pregnancy.
 - Maintenance of pregnancy and placenta formation.

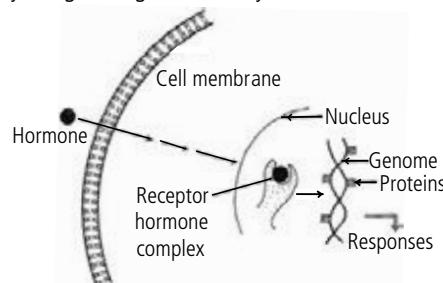
- 11.** Cushing's syndrome is caused due to
- excess secretion of cortisol
 - excessive secretion of aldosterone
 - deficiency of cortisone
 - hyposecretion of androgens.

- 12.** Hypoglycemia can be caused due to
- tumour of beta cells
 - destruction of delta cells
 - deficiency of insulin
 - deficiency of ADH.

- 13.** The hormone which is exclusively found in a pregnant woman is
- relaxin
 - estrogen
 - progesterone
 - luteinising hormone.

- 14.** Smallest endocrine gland is
- pineal gland
 - pituitary gland
 - parathyroid gland
 - thymus gland.

- 15.** Study the given figure carefully.



Which of the following hormone would exhibit the above shown mechanism of hormone action?

- Tyrosine
- Thyroxine
- Oxytocin
- Estrogen

- 16.** Parathyroid tetany is characterised by

- rise in blood calcium levels
- convulsions and spasms due to increase in the excitability of nerves
- osteoporosis and deformed bones
- calcium deposition in kidneys.

- 17.** Which of the following hormone is not secreted by anterior lobe of pituitary?

- Thyrotropin
- Somatotropin
- Vasopressin
- Prolactin

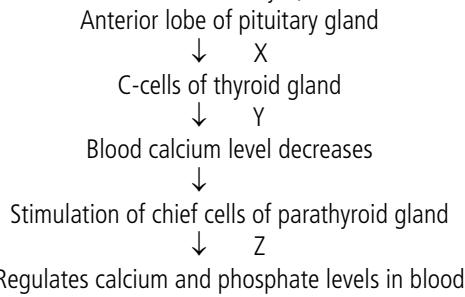
- 18.** The function which does not belongs to testosterone is

- to activate production of FSH
- formation of sperms in testes
- to promote growth of bones, muscles and other tissues
- to regulate normal functioning of secondary male sex organs.

- 19.** Which of the following statements are true ?

- Pineal gland is ectodermal in origin.
- Alfred Gilmans discovered the role of cAMP.
- Estrogen and oxytocin hormones have a synergistic effect on mammary glands.
- (ii) and (iii) only
- (i) and (iii) only
- (iii) only
- (i), (ii) and (iii)

20. Study the following flow chart that shows calcium regulation by different hormones and identify X, Y and Z.



- (a) X-Calcitonin, Y-Thyrotropin, Z-Calcitriol
- (b) X-Thyrotropin, Y-Calcitonin, Z-Parathormone
- (c) X-Thyrotropin, Y-Calcitonin, Z-Parathormone
- (d) X-Thyrotropin releasing hormone, Y-Thyrotropin, Z-Parathormone

- (a) III only
- (b) I and IV
- (c) II and IV
- (d) II and III
- (e) I and II

(Kerala PMT 2015)

7. Gonadotropin releasing hormone is transferred to anterior pituitary by

- (a) left coronary artery
- (b) hypophysial portal veins
- (c) axons of neurosecretory cells
- (d) nuclei of hypothalamus.

(AIIMS 2015)

8. Match the hormones secreted by various endocrine structures and choose the correct option.

- | | |
|---------------------|------------------------------------|
| I. Hypothalamus | A. Melanocyte stimulating hormone |
| II. Pars intermedia | B. Aldosterone |
| III. Pineal gland | C. Gonadotrophin releasing hormone |
| IV. Adrenal medulla | D. Melatonin |
| V. Adrenal cortex | E. Catecholamines |
- (a) I - E, II - A, III - D, IV - B, V - C
 - (b) I - E, II - D, III - A, IV - B, V - C
 - (c) I - B, II - D, III - A, IV - C, V - E
 - (d) I - C, II - A, III - D, IV - B, V - E
 - (e) I - C, II - A, III - D, IV - E, V - B

(Kerala PMT 2014)

9. Fight-or-flight reactions cause activation of

- (a) the parathyroid glands, leading to increased metabolic rate.
- (b) the kidney, leading to suppression of renin-angiotensin-aldosterone pathway.
- (c) the adrenal medulla, leading to increased secretion of epinephrine and nor-epinephrine.
- (d) the pancreas leading to a reduction in the blood sugar levels.

(AIPMT 2014)

10. Which of the following statements is correct in relation to the endocrine system?

- (a) Non-nutrient chemicals produced by the body in trace amounts that act as intercellular messenger are known as hormones.
- (b) Releasing and inhibitory hormones are produced by the pituitary gland.
- (c) Adenohypophysis is under direct neural regulation of the hypothalamus.
- (d) Organs in the body like gastrointestinal tract, heart, kidney and liver do not produce any hormones.

(NEET 2013)

11. A pregnant female delivers a baby who suffers from stunted growth, mental retardation, low intelligence quotient and abnormal skin. This is the result of

- (a) cancer of the thyroid gland
- (b) oversecretion of pars distalis
- (c) deficiency of iodine in diet
- (d) low secretion of growth hormone.

(NEET 2013)

Exam Section

1. Graves' disease is caused due to
- (a) hyposecretion of thyroid gland
 - (b) hypersecretion of thyroid gland
 - (c) hyposecretion of adrenal gland
 - (d) hypersecretion of adrenal gland. (NEET Phase-II 2016)

2. Name a peptide hormone which acts mainly on hepatocytes, adipocytes and enhances cellular glucose uptake and utilisation.
- (a) Insulin
 - (b) Glucagon
 - (c) Secretin
 - (d) Gastrin

(NEET Phase-II 2016)

3. Which of the following pairs of hormones are not antagonistic (having opposite effects) to each other?
- (a) Aldosterone
 - (b) Atrial Natriuretic Factor
 - (b) Relaxin
 - (c) Inhibit
 - (c) Parathormone
 - (c) Calcitonin
 - (d) Insulin
 - (d) Glucagon

(NEET Phase-I 2016)

4. Which one of the following is called intra-specific chemical messenger?
- (a) Pheromones
 - (b) Prostaglandins
 - (c) Corticotrophin
 - (d) Catecholamines

(WB-JEE 2015)

5. Secretion of which of the following hormones is not pituitary dependent?
- (a) Triiodothyronine
 - (b) Testosterone
 - (c) Glucocorticoids
 - (d) Parathyroid hormone

(AMU 2015)

6. The pars distalis region of pituitary does not produce these hormones.
- I. Melanocyte stimulating hormone
 - II. Vasopressin
 - III. Prolactin
 - IV. Growth hormone

12. Decreased levels of estrogen is a common cause for
(a) myasthenia gravis (b) tetany
(c) osteoporosis (d) gout
(e) arthritis.

(Kerala 2012)

13. Choose the mismatched pair from the following.
(a) Insulin – Gluconeogenesis
(b) Glucagon – Glycogenolysis
(c) Oxytocin – Contraction of uterine muscles
(d) Prolactin – Milk production in mammary glands

(Karnataka 2012)

14. Pituicytes are under the control of
(a) adenohypophysis (b) hypothalamus
(c) neurohypophysis (d) both (a) and (c).

(Odisha 2012)

15. The 24 hour (diurnal) rhythm of our body such as the sleep-wake cycle is regulated by the hormone
(a) calcitonin (b) prolactin
(c) adrenaline (d) melatonin.

(AIPMT Mains 2011)

16. Tetany is caused by
(a) hyperparathyroidism (b) hypoparathyroidism
(c) hyperthyroidism (d) hypothyroidism.

(WB-JEE 2011)

17. ACTH is secreted from
(a) adrenal cortex (b) pituitary
(c) adrenal medulla (d) thyroid.

(WB-JEE 2011)

18. What is the effect of GnRH produced by hypothalamus?
(a) Stimulates the synthesis and secretion of androgens.
(b) Stimulates secretion of milk in mammary glands.
(c) Stimulates foetal ejection reflex.
(d) Stimulates synthesis of carbohydrates from non-carbohydrates in liver.

(AIIMS 2010)

19. Which of the following induces parturition ?
(a) Vasopressin (b) Oxytocin
(c) GH (d) TSH

(DU MET 2010)

20. Endemic goitre is a state of
(a) increased thyroid function
(b) normal thyroid function
(c) decreased thyroid function
(d) moderate thyroid function.

(WB-JEE 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.

1. **Assertion :** Hypothalamus is connected to the posterior lobe of pituitary by hypophysial portal veins.

Reason : The hypophysial portal veins carry blood from the hypothalamus to the neurohypophysis.

2. **Assertion :** Atrial natriuretic factor (ANF) is secreted by cardiocytes of heart's atria.

Reason : ANF is secreted when there is an elevation of deoxygenated blood reaching the heart.

3. **Assertion :** Diabetes mellitus is a hypothalamic disorder.

Reason : Low blood glucose level and cholesterol causes diabetes mellitus.

4. **Assertion :** A person suffering from myxoedema has puffy appearance and lack of alertness.

Reason : Excessive secretion of parathormone leads to accumulation of fat in the subcutaneous tissue.

5. **Assertion :** Parathyroid glands are essential for life.

Reason : Removal of parathyroid glands results into spasm of laryngeal muscles, ultimately causes death.

Short Answer Type Questions

1. Fill in the blanks:

- (a) _____ is an autoimmune disorder caused due to destruction of thyroid gland.
(b) _____ gland gets degenerates in old individuals resulting in to weak immune system.
(c) _____ hormone increases the activity of the heart and inhibits the activity of gastrointestinal tract.
(d) _____ is a steroid hormone which stimulates liver to synthesise carbohydrates from non-carbohydrates.

2. Explain synergistic effect of hormones with an example.

3. Differentiate between hyperglycemia and hypoglycemia.

4. Write a short note on thyrocalcitonin.

5. Why hypothalamus is called control center of endocrine system?

ANSWER KEY

New MCQs

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

6. (c) 7. (b) 8. (d) 9. (d) 10. (c)

11. (a) 12. (a) 13. (a) 14. (b) 15. (d)

16. (b) 17. (c) 18. (a) 19. (b) 20. (c)

Exam Section

1. (b) 2. (a) 3. (b) 4. (a) 5. (d)
6. (e) 7. (b) 8. (e) 9. (c) 10. (a)
11. (c) 12. (c) 13. (a) 14. (b) 15. (d)
16. (b) 17. (b) 18. (a) 19. (b) 20. (c)

Assertion & Reason

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

Short Answer Type Questions

1. (a) Hashimoto's disease
(b) Thymus
(c) Nor-adrenaline
(d) Cortisol
2. When two or more hormones complement each other's actions and they are needed for full expression of the hormone effects are called synergistic effects. For example, the production and ejection of milk by mammary glands require the synergistic effects of estrogens, progesterone, prolactin and oxytocin hormones.

3. Differences between hyperglycemia and hypoglycemia are :

	Hyperglycemia	Hypoglycemia
(i)	It is caused due to insulin deficiency.	It is due to excess of insulin.
(ii)	Its symptoms are high blood glucose level, breakdown of muscle tissue and tiredness.	Its symptoms are low blood glucose level, hunger, sweating, irritability and double vision.

4. Thyrocalcitonin or TCT is a peptide (32 amino acids) hormone that is secreted when blood calcium level is high. It lowers the concentration of calcium in the blood by suppressing the release of calcium from bone. Thus, calcitonin has an action opposite to that of the parathyroid hormone on calcium metabolism. It also promotes excretion of calcium by the kidneys and decreases calcium absorption in the stomach.
5. Hypothalamus provides anatomical connection between the nervous and endocrine systems. The functioning of the pituitary gland is often influenced by the hypothalamus and the hormones of pituitary gland regulate the functioning of many other endocrine glands, therefore hypothalamus, is called as control center of endocrine system or supreme commander.



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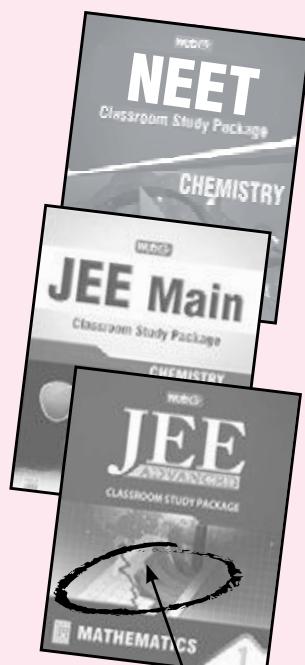
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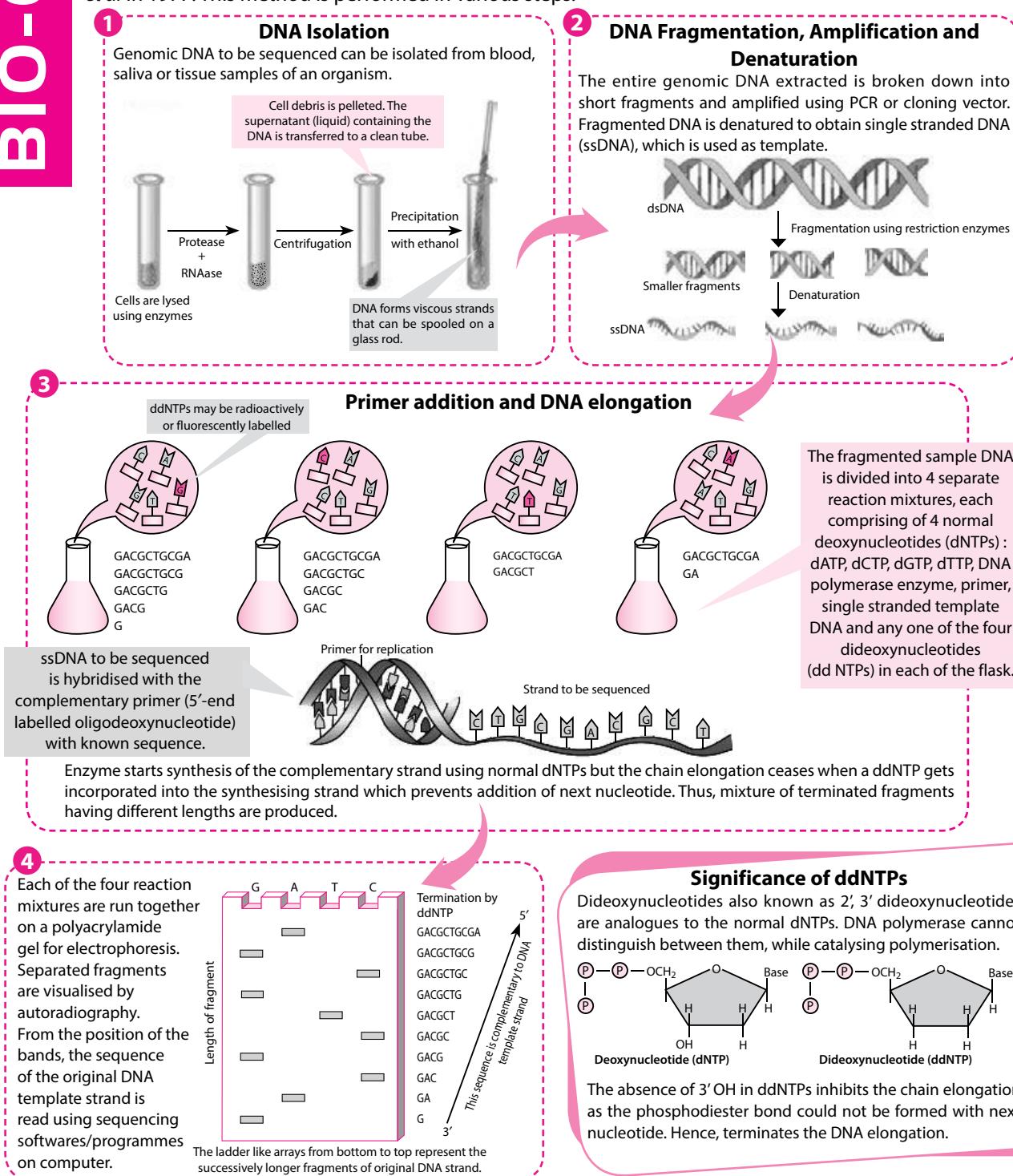
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DNA Sequencing by Sanger's Method

DNA sequencing is the process of determining the precise order of nucleotides i.e., adenine (A), thymine (T), cytosine (C) and guanine (G) along a DNA strand. It helps in genome analysis and hence understanding the biological processes.

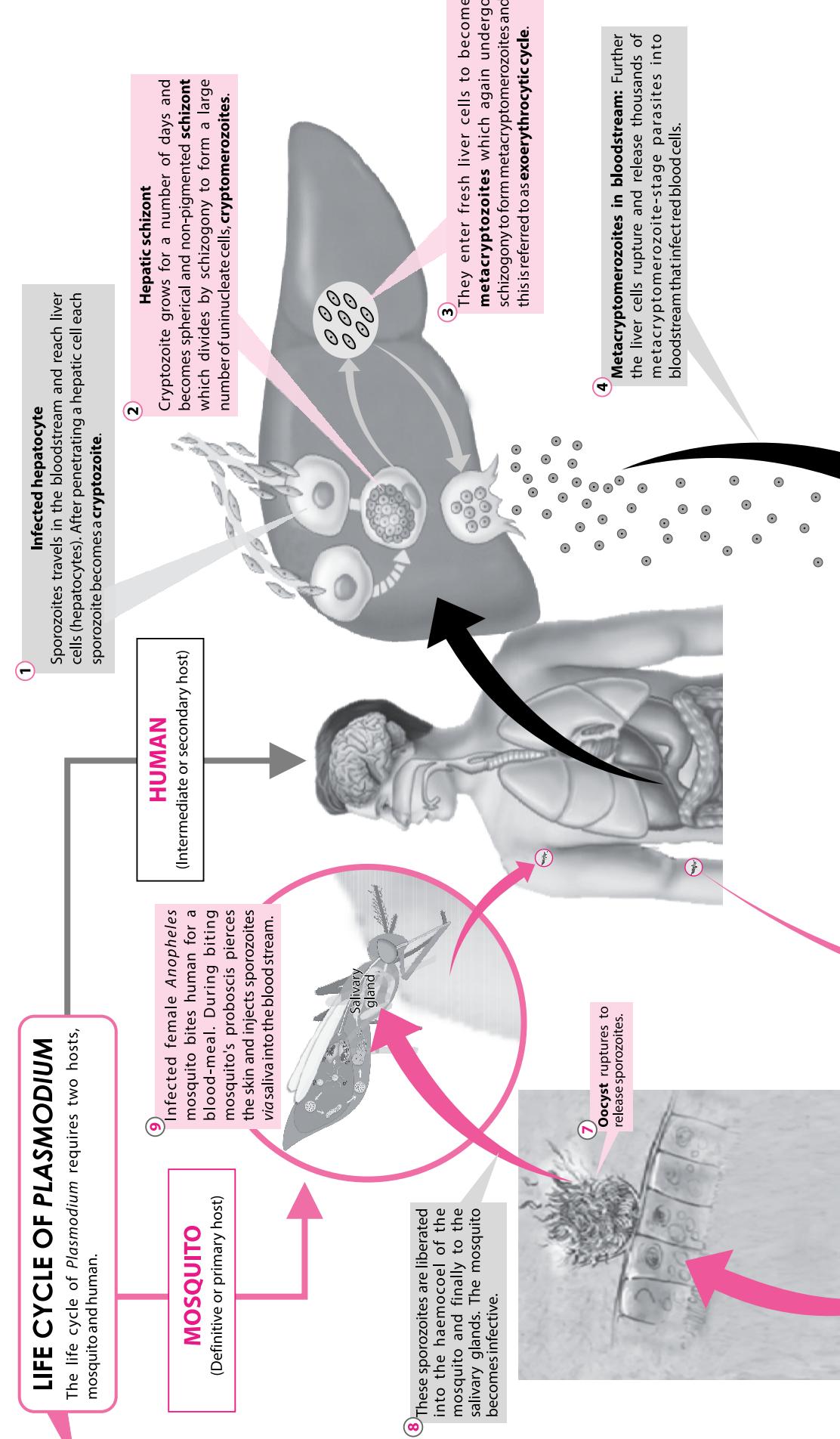
Sanger's classical method is an enzymatic chain termination method of sequencing developed by F. Sanger *et al* in 1977. This method is performed in various steps.

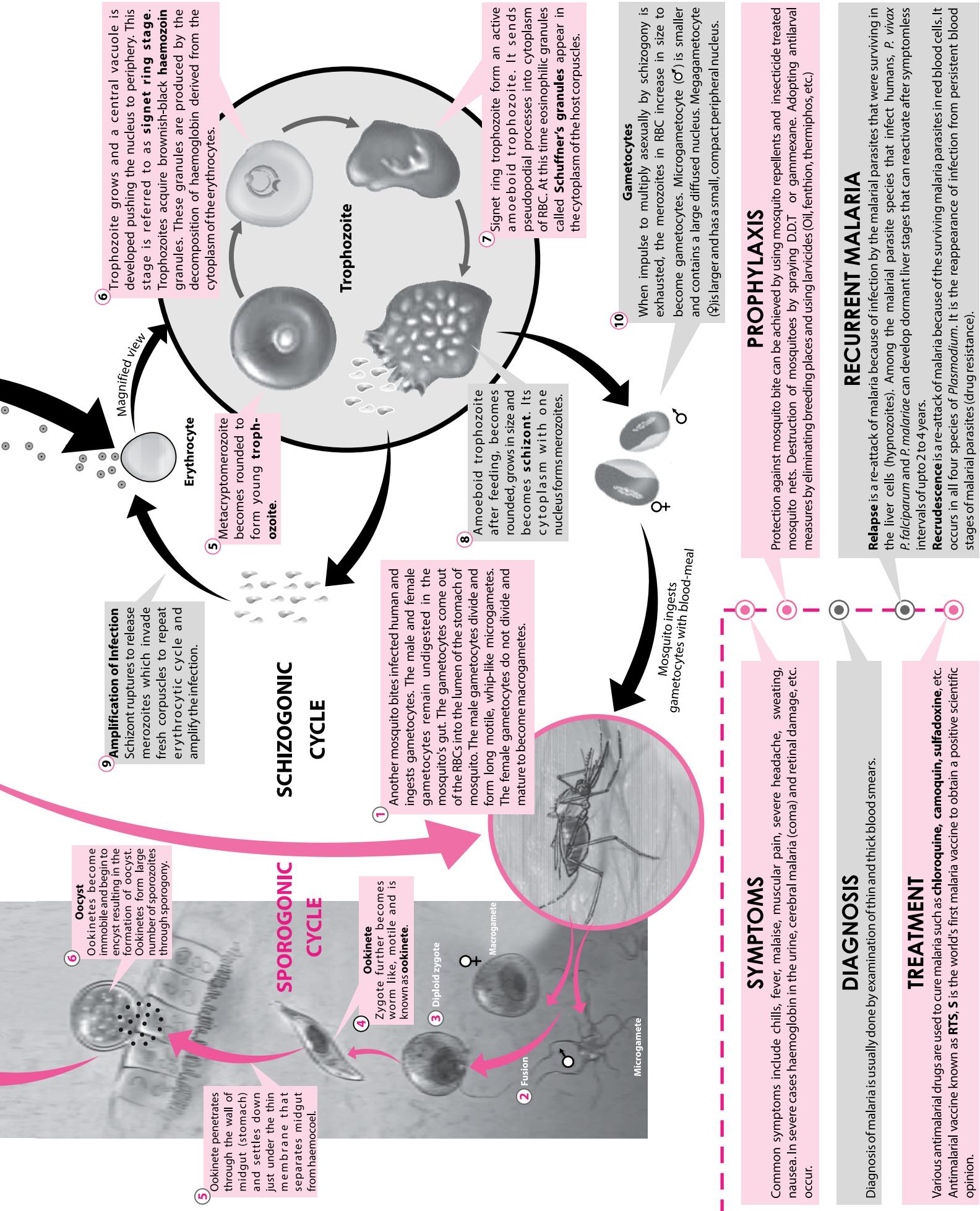


CONCEPT MAP

MALARIA: CAUSE, SYMPTOMS AND TREATMENT

Malaria is an acute febrile illness that results in intermittent fevers; and is caused by a parasite of Genus *Plasmodium* belonging to a protozoan Phylum, Apicomplexa. The parasite shows an alternation of generation accompanied by an alternation of host (**digenetic**). Asexual cycle (schizogonic cycle) occurs inside the red blood cells of the vertebrate host (human) and sexual cycle (sporogonic cycle) occurs in an invertebrate host (*Anopheles* mosquito). Malarial parasite is transmitted to human through the bite of infected female *Anopheles* mosquito during its blood-meal. Distinct species of *Plasmodium* are *Plasmodium vivax* (causes quartan malaria), *Plasmodium malariae* (causes tertian malaria), *Plasmodium falciparum* (causes malignant tertian malaria) and *Plasmodium ovale* (causes mild tertian malaria). **Laveran** (1880) discovered the malarial parasite, *Plasmodium*. **Sir Ronald Ross** (1897) observed that malarial parasite is transmitted by the bite of a female, *Anopheles* mosquito.





New

NCERT Xtract

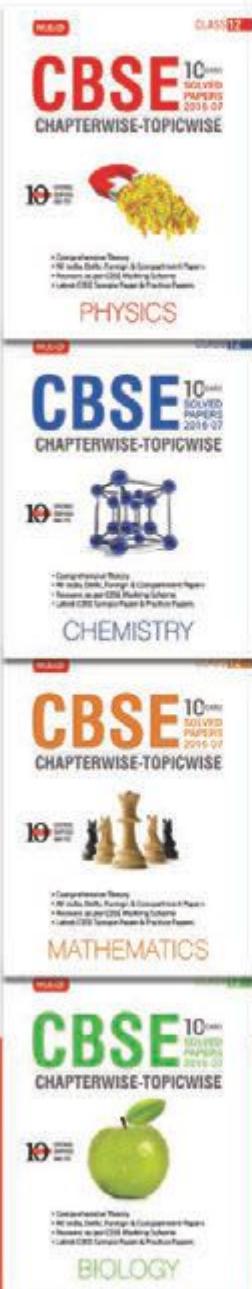
Questions for NEET

Evolution

1. Coacervates are
 - (a) probionts having polysaccharide + protein + H₂O
 - (b) protein aggregates
 - (c) protein and lipid aggregates
 - (d) none of the above.
2. Stings of honey bee and scorpion are the examples of
 - (a) homologous organs
 - (b) analogous organs
 - (c) vestigial organs
 - (d) divergent evolution.
3. Alligators distributed all over the North American continent and East Asia got separated due to certain barriers and developed some mutations, as a result of which they evolved into different species.
This is an example of
 - (a) parallel evolution
 - (b) adaptive radiation
 - (c) restricted distribution
 - (d) discontinuous distribution.
4. Read the given statements and identify the proposition that is not true for Lamarckism.
 - (a) Internal vital force play role in evolution.
 - (b) Acquired characters are passed onto next generation.
 - (c) Changes in environment does not influence the living organism to modify their requirements.
 - (d) Use and disuse of organs results in their development and degeneration respectively.
5. Select the incorrect statement regarding genetic drift.
 - (a) It is an evolutionary force.
 - (b) It may prevent extinction of species.
 - (c) It may fix non-adaptive traits in small populations.
 - (d) It favours only large-sized populations.
6. According to biological species concept put forward by Mayr, species is a/an
 - (a) assemblage of individuals with common morphological features
 - (b) series of population in which individuals can interbreed freely only with each other
7. According to chemical evolution, the first molecule(s) formed on primitive earth were
 - (a) water
 - (b) ammonia
 - (c) glycerol
 - (d) both (a) and (b).
8. Which of the following factors affect the Hardy-Weinberg Principle?
 - (a) Lack of mutation
 - (b) Absence of genetic drift
 - (c) No genetic recombination
 - (d) Natural selection pressure
9. Which of the following factors(s) influence the formation of new species?
 - (a) Mutation
 - (b) Isolation
 - (c) Gene migration
 - (d) All of these
10. Identify the incorrectly matched pair.

(a) Endemic species	— Species restricted to specific area
(b) Synchronic species	— Species of same time period
(c) Monotypic species	— Species occurring in an exclusive geographical area
(d) Allochronic species	— Species of different periods of time
11. Match column I with column II and select the correct option.

Column I (Plant groups)	Column II (Period of origin)
A. Algae	(i) Ordovician
B. Conifers	(ii) Middle palaeozoic
C. Psilophytes	(iii) Permian
D. Monocots	(iv) Silurian
E. Ferns	(v) Oligocene

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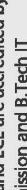
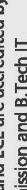
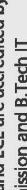
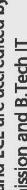
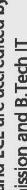
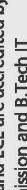
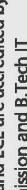
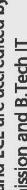
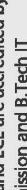
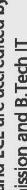
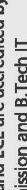
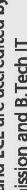
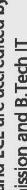
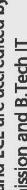
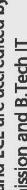
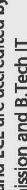
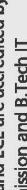
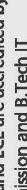
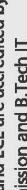
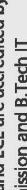
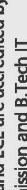
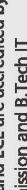
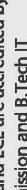
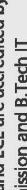
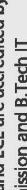
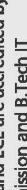
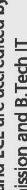
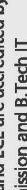
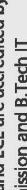
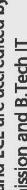
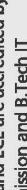
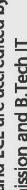
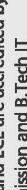
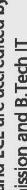
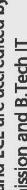
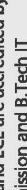
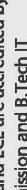
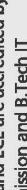
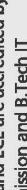
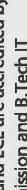
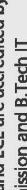
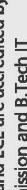
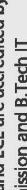
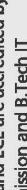
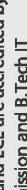
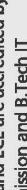
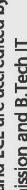
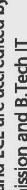
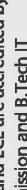
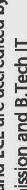
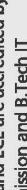
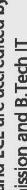
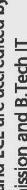
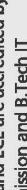
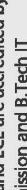
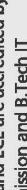
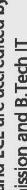
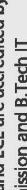
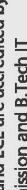
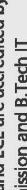
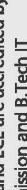
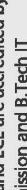
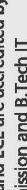
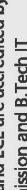
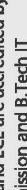
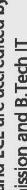
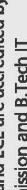
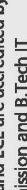
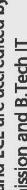
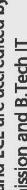
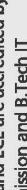
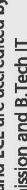
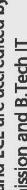
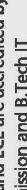
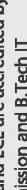
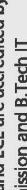
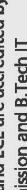
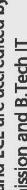
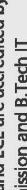
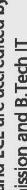
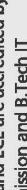
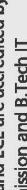
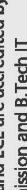
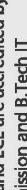
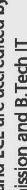
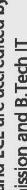
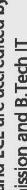
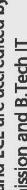
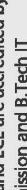
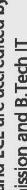
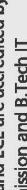
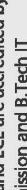
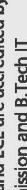
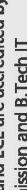
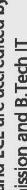
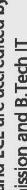
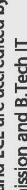
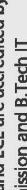
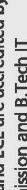
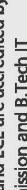
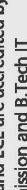
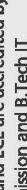
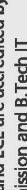
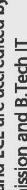
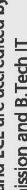
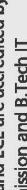
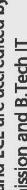
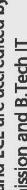
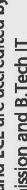
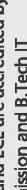
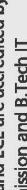
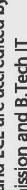
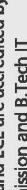
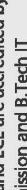
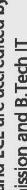
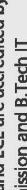
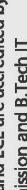
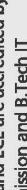
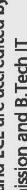
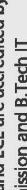
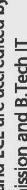
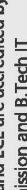
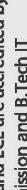
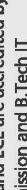
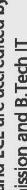
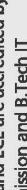
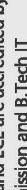
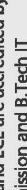
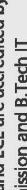
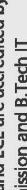
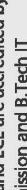
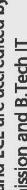
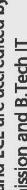
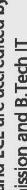
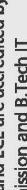
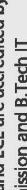
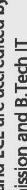
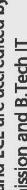
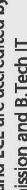
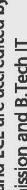
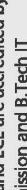
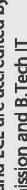
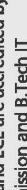
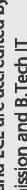
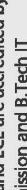
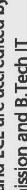
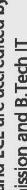
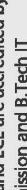
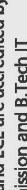
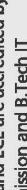
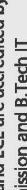
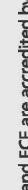
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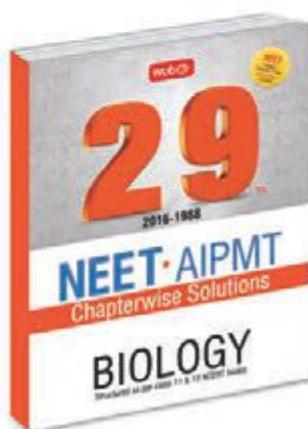
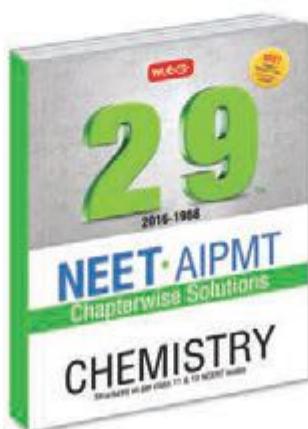
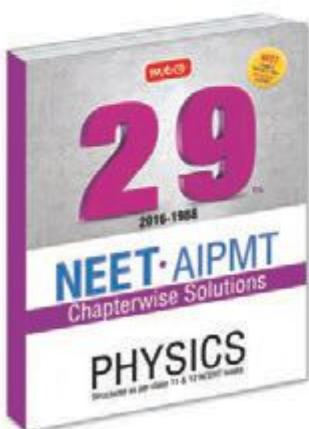
Ranking and Accreditation

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HIGHLIGHTS:

- Chapterwise questions of last 29 years' (2016-1988) of CBSE-PMT/NEET
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- (a) A-(i), B-(iii), C-(ii), D-(iv), E-(v)
 (b) A-(ii), B-(iii), C-(i), D-(v), E-(iv)
 (c) A-(iii), B-(iv), C-(ii), D-(i), E-(v)
 (d) A-(ii), B-(i), C-(v), D-(iv), E-(iii)
- 12.** Select the incorrect statement regarding Peking Man.
 (a) They had a cranial capacity ranging between 850-1100 c.c.
 (b) They made excellent ornaments of elephant tusks.
 (c) They were omnivorous and cannibal.
 (d) They used to live in small groups or tribes.
- 13.** According to Oparin, coacervates are
 (a) non-living collection of organic macromolecules with double layered boundary
 (b) protein-like structures consisting of branched chains of amino acids
 (c) lipid molecules enclosed by a living protein membrane
 (d) non-living structures comprising of organic biomolecules, surrounded by a film of water.
- 14.** Which of the following methods is/are used to determine age of fossils?
 (a) Uranium - lead technique
 (b) Radioactive-carbon dating technique
 (c) Potassium-argon method
 (d) All of these
- 15.** Identify the correct sequence of organic molecules formed during origin of life.
 (a) Water, Methane, Ammonia, Amino acids
 (b) Ammonia, Amino acids, Proteins, Nucleic acids
 (c) Amino acids, Proteins, Nucleic acids, Ammonia
 (d) Amino acids, Ammonia, Enzymes, Proteins, Nucleic acids
- 16.** Select the correct example citing homologous organs.
 (a) Thorn of *Bougainvillea* and tendril of *Cucurbita*
 (b) Wings of an insect and bird
 (c) Pectoral fins of shark and flippers of dolphin
 (d) Stipules of *Lathyrus aphaca* and petiole of *Acacia auriculiformis*.
- 17.** Read the given statements regarding the recapitulation theory and identify the incorrect one.
 (a) Development of frog from tadpole, a larval stage which respires by gills.
 (b) Larva of *Herdmania* shows notochord and tail which are present in adult forms.
 (c) Protonema stage of moss resembles green algae in structure and physiology.
 (d) Absence of nictitating membrane and auricular muscles in humans.
- 18.** The factors contributing towards post-zygotic isolation in a population are
 (i) incompatibility
 (ii) seasonal isolation
 (iii) hybrid inviability
 (iv) hybrid sterility
 (v) mechanical isolation.
 (a) (i), (iii) and (iv) only (b) (ii), (iii) and (v) only
 (c) (ii) and (v) only (d) (iii) and (iv) only
- 19.** The common ancestor of man and ape is
 (a) *Australopithecus africanus*
 (b) *Dryopithecus africanus*
 (c) *Ramapithecus*
 (d) *Pithecanthropus erectus*.
- 20.** In a declining population, the number of individuals reduce to such an extent that one of its small group becomes isolated and restricted in distribution, resulting in the fixation of certain genes. This phenomenon can be referred to as
 (a) gene migration (b) founder effect
 (c) recombination (d) bottleneck effect.
- 21.** Consider the following statements describing the Hugo de Vries mutation theory and choose the correct option stating which one is true (T) and which one is false (F).
 (i) Evolution is a continuous process.
 (ii) Mutations appear suddenly and become operational immediately.
 (iii) Accumulation of variations produce new species.
 (iv) Mutations revolve around the normal character of the species.
- | (i) | (ii) | (iii) | (iv) |
|-------|------|-------|------|
| (a) T | F | T | F |
| (b) F | T | F | T |
| (c) F | T | T | F |
| (d) T | T | T | F |

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.

I	E	M	B	R	O	A	D	S
H	C	A	U	O	N	K	P	T

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

- 22.** Darwin was influenced by Malthus theory of human population. This theory states that
- population grows arithmetically when unchecked
 - due to competition for resources, a balance is maintained between the population and environment
 - imbalance after a certain level in a population, leads to crash caused by various factors such as hunger, floods, epidemics, etc.,
 - none of these.
- 23.** Adaptive radiation in evolution can be best understood by studying examples of
- wings of insect, bird and bat
 - Australian marsupials and placental mammals
 - stings of honey bee and scorpion
 - variety of Australian marsupials.
- 24.** Darwin's theory of natural selection failed to explain
- the formation of new species
 - inheritance of useful variations
 - survival of the fittest
 - the cause of discontinuous variations.
- 25.** Parallel evolution can be defined as
- development of similar adaptive functional structures in unrelated group of organisms
 - convergent evolution found in closely related species
 - divergent evolution showing development of different functional structures from a common ancestral form
 - speciation involving formation of new species as a result of discontinuous and gradual variations.
- 26.** Read the following statements regarding fossilisation.
- Animals and plants get fossilised and preserved in lava of volcano.
 - Replacement of organic parts by mineral deposition is called petrification which occurs only of hard parts e.g., bones.
 - Casts are prints of leaves, stem, etc., in soft mud which become fossilised.
 - Fossils present in the upper strata of earth are older than those present in the lower strata.
- Of the above statements
- I and II are correct
 - II, III and IV are incorrect
 - II and IV are correct
 - III and IV are incorrect.
- 27.** Which of the following is not an example of atavism?
- Long dense hairs in humans
 - Conversion of some stamens and carpels to petal-like structures in *Oxalis*
 - Well developed canine teeth in humans
 - Rudimentary pistil in ray florets of sunflower
- 28.** Industrial melanism in peppered moth occurred due to natural selection. The significant reason for this was
- the light coloured white moths could not be noticed by predatory birds after deposition of soots on bark of trees
 - mutation in light coloured moths due to increase in industrial pollution
 - advantageous selection of black moths on trees in polluted areas, resulting in increase in population of white moths
 - advantageous selection of white moths from trees on polluted areas, resulting in increased population of black moths.
- 29.** From the given characteristics identify the correct pre-historic man.
- They were about 1.8 m tall with well-built body.
 - Broad and arched forehead and also well developed chin.
 - They could walk and run faster.
 - They made excellent tools and cave paintings.
- Cro-Magnon man
 - Neanderthal man
 - Heidelberg man
 - Java ape man
- 30.** Which of the following is an example of missing link?
- Neopilina*
 - Proptopterus*
 - Lycaenops*
 - Latimeria*
- 31.** Match the two columns and select the correct option.
- | Column I
(Ancestors of Man) | Column II
(Period of occurrence) |
|--|---|
| A. <i>Dryopithecus</i> | (i) Holocene |
| B. <i>Australopithecus</i> | (ii) Pleistocene |
| C. Cro-magnon man | (iii) Miocene |
| D. <i>Homo erectus</i> | (iv) Pliocene |
| (a) A-(iii), B-(iv), C-(i), D-(ii) | |
| (b) A-(ii), B-(iii), C-(iv), D-(i) | |
| (c) A-(i), B-(iii), C-(iv), D-(ii) | |
| (d) A-(ii), B-(i), C-(iii), D-(iv) | |
- 32.** Match the column I with column II and select the correct option.
- | Column I | Column II |
|------------------------------------|----------------------------|
| A. Age of reptiles | (i) Devonian period |
| B. Age of amphibians | (ii) Ordovician period |
| C. Age of fishes | (iii) Carboniferous period |
| D. Age of invertebrates | (iv) Jurassic period |
| (a) A-(ii), B-(iii), C-(i), D-(iv) | |
| (b) A-(iv), B-(ii), C-(i), D-(iii) | |
| (c) A-(iv), B-(iii), C-(i), D-(ii) | |
| (d) A-(ii), B-(iv), C-(iii), D-(i) | |
- 33.** Select the correct sequence of stages in biological origin of life.
- Free atoms → Coacervates → Simple organic molecules → Prokaryotes → Genes
 - Inorganic molecules → Complex organic molecules → Genes → Microspheres → Eukaryotes → Prokaryotes
 - Free atoms → Genes → Coacervates → Complex organic molecules → Eukaryotes
 - Inorganic molecules → Simple organic molecules → Microspheres → Gene → Prokaryotes



- 34.** Which of the following is not a missing link between reptiles and mammals?
 (a) *Lycaenops* (b) *Seymouria*
 (c) *Cynognathus* (d) *Basilosaurus*

- 35.** Consider the following statements and select the incorrect one.
 I. Pasteur proposed the theory of biogenesis which explained life originated from pre-existing life.
 II. Spallanzani, an Italian scientist put forth the theory of spontaneous generation.
 III. Theory of Panspermia proposed by Richter stated that life on earth originated from protoplasm reaching earth in the form of spores from universe.
 IV. Oparin and Haldane proposed the theory for biogenic molecular evolution of life.
 (a) I and III only (b) II and IV only
 (c) II, III and IV only (d) III only

- 36.** Which one of the following is incorrectly matched pair?

Genus	Cranial capacity
(a) <i>Pithecanthropus</i>	— 950 c.c.
(b) <i>Sinanthropus</i>	— 1250 c.c.
(c) <i>H. neanderthalensis</i>	— 1450 c.c.
(d) <i>H. fossilis</i>	— 1650 c.c.

- 37.** *Latimeria* is referred as living fossil because
 (a) it is believed to be the ancestor of first amphibians
 (b) it is known to be the oldest living fish
 (c) it is the only known living fish of sub-class Crossopterygii
 (d) it is said to be a connecting link between fishes and amphibians.
- 38.** Identify the correct sequence of ancestors of modern man in ascending order.

- (a) Neanderthal man → Peking Man → Cro-magnon man → Modern man
 (b) *Australopithecus* → *Homo erectus* → Neanderthal man → *Homo sapiens*
 (c) *Homo habilis* → Neanderthal man → Peking man → Cro-magnon man
 (d) *Australopithecus* → *Homo habilis* → Cro-magnon man → Heidelberg man → *Homo sapiens*

- 39.** Read the given statements and select the correct option.

Statement A : Hardy - Weinberg principle states that if gene frequencies remain constant in a population, it is said to be in the state of genetic equilibrium.

Statement B : The change in gene frequencies suggest the progress of evolution but a deviation from Hardy-Weinberg principle.

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

- 40.** Read the given statements and select the incorrect one.

- I. Humans belong to the family Hominidae including single genus of *Homo*.
 II. The primates show monophyletic origin.
 III. Modern man is closer to new world monkeys owing to presence of opposable thumb and dentition of prosimian ancestors.
 IV. Ape is considered as ancestor of humans due to the presence of large brain and broad chest.
 (a) I and III only (b) II and IV only
 (c) III only (d) II only



HIGHER ORDER THINKING SKILLS QUESTIONS (HOTS)

- 41.** From the given characteristics identify the organism and select the correct option accordingly.
 (i) The organism possess a shell, mantle and large muscular foot.
 (ii) It shows segmentally arranged gills and nephridia.
 (iii) It also shows a larval stage.
 The above described organism is a connecting link between
 (a) protozoa and porifera, i.e., *Proterospongia*
 (b) annelida and mollusca i.e., *Neopilina*
 (c) fishes and amphibians i.e., *Latimeria*
 (d) annelida and Mollusca i.e., *Peripatus*.

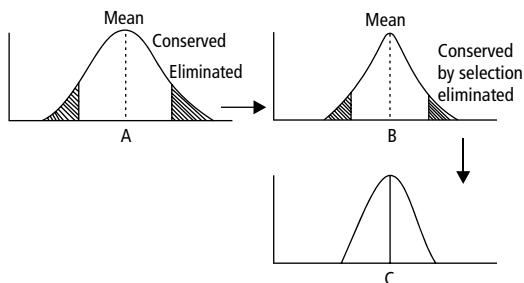
- 42.** Consider the following table of differences between Lamarckism and Darwinism.

	Lamarckism	Darwinism
I.	There is an internal vital force in all organisms.	Does not believe in internal vital force.
II.	Does not believe in survival of the fittest.	Based on the survival of the fittest.
III.	Struggle for existence is very important.	Struggle for existence is not considered.
IV.	Useful characters and variations are transferred to next generation.	Only acquired characters are inherited to next generation.

Choose the option with incorrect pair of differences.

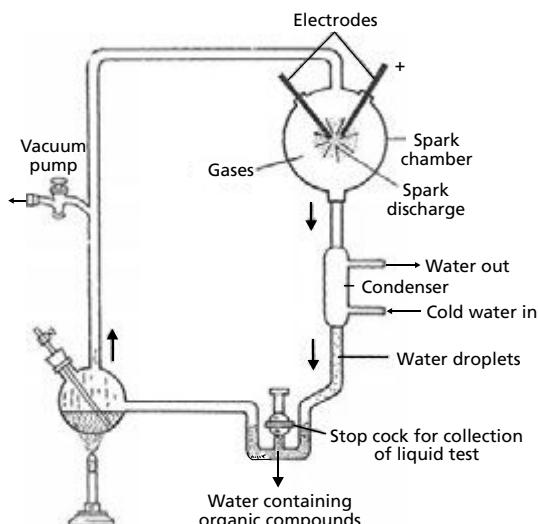
- (a) I and III only (b) II and IV only
- (c) III and IV only (d) I, III and IV only

43. Refer to the given figures and identify the statements correctly describing the process of selection.



- (i) It describes the selection where population changes towards one particular direction.
 - (ii) This selection also operates through differences in breeding potential, thus eliminating extremes from population.
 - (iii) It reduces variation and therefore does not promote evolutionary change.
 - (iv) This type of selection favours both small sized and large sized individuals.
- (a) (i) and (iv) only (b) (ii) and (iii) only
 - (c) (i) and (ii) only (d) (ii), (iii) and (iv) only

44. Refer to the given figure showing experimental set up and identify the statements correctly describing it.



- I. Oparin and Haldane conducted the experiment to test the idea that combination of organic molecules can produce complex organic compounds.
- II. The gases being circulated in this air tight apparatus included methane, carbon dioxide, hydrogen and ammonia.
- III. Formation of simple organic compounds such as amino acids was observed when gaseous mixture was treated

with electrical discharges at 800°C.

IV. Larger molecules like purines, pyrimidines and simple sugars, etc., were formed with treatment of electric discharges from electrodes at 2000°C.

- (a) II, III and IV only (b) II and III only
- (c) II only (d) III only

45. Read the following statements regarding speciation and select the correct ones.

- I. Allopatric speciation is formation of new species from a part of geographically isolated population.
 - II. Sympatric speciation takes place when a population of a species enters the new habitat which acts as a barrier to gene flow between the populations.
 - III. Formation of Darwin's finches which formed separate species in Galapagos islands is an example of parapatric speciation.
 - IV. Quantum speciation is rapid and abrupt mode of speciation which is largely influenced by genetic drift.
- (a) only I and III (b) only II and IV
 - (c) only I and IV (d) All of these

46. Read the given examples of structural evidences and group them under the given appropriate columns.

1. Fins of shark and flippers of dolphin
2. Mouthparts of cockroach and butterfly
3. Proteins in blood of man and apes
4. Stipules of *Lathyrus aphaca* and petiole of *Acacia auriculiformis*
5. Scales of *Asparagus* and spines of Barberry

Convergent evolution	Divergent evolution
(a) 1 and 3	2 and 4
(b) 1 and 4	2, 3 and 5
(c) 1, 2 and 3	4 and 5
(d) 1, 4 and 5	2 and 3

47. The apes are more closely related to humans than the new world monkeys and tarsiers. It can be best established by the evidences obtained from

- (a) banding patterns of chromosome number 3 and 6
- (b) 100% homology in haemoglobin of humans and apes
- (c) both man and ape share only blood group A
- (d) both (a) and (b).

48. A small population of rats including approximately equal number of brown and white rats existed in a village on an island. After flooding, only a few rats managed to escape and survive while the entire village and population of rats was carried away. The population that grew and formed after it, comprised of only brown rats, eliminating white rats completely. This phenomenon can be described as

- (a) founder effect (b) bottleneck effect
- (c) saltation (d) disruptive selection.

- 49.** Study and compare the given skull of two ancestors of man.



Cranial Capacity
approx - 700 c.c.
A

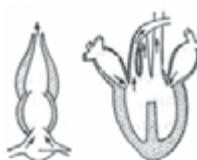


Cranial Capacity
approx - 1650 c.c.
B

Identify the characteristics correctly describing both 'A' and 'B' species.

- A is omnivorous and had teeth similar to that of modern man and was 1.2 - 1.5 m tall.
- B shows orthognathous face with an elevated nose and broad and arched forehead.
- A can be identified as *Homo habilis*, showing bipedal locomotion.
- B is identified as *Pithecanthropus erectus* which became extinct about 10,000 years ago.
 - I and IV only
 - I, II and III only
 - III and IV only
 - I and IV only

- 50.** Study the given figures of heart in four vertebrate classes and choose the correct option related to them.



P



Q



R



S

- The figure P represents a two chambered heart exhibiting single circulation only.
- The figure Q shows incomplete double circulation due to presence of two auricles and one ventricle which mixes the blood.
- Figure R represents a reptilian heart showing presence of sinus venosus and truncus arteriosus.
- Figure S shows a completely divided four chambered heart, with double circulation.
- The correct sequence of evolution is P → Q → R → S.
 - I and V only
 - II, III and IV only
 - I, II and IV only
 - III and V only

ANSWER KEY

- | | | | | |
|---------|---------|---------|---------|---------|
| 1. (a) | 2. (b) | 3. (d) | 4. (c) | 5. (d) |
| 6. (b) | 7. (d) | 8. (d) | 9. (d) | 10. (c) |
| 11. (b) | 12. (b) | 13. (d) | 14. (d) | 15. (b) |
| 16. (a) | 17. (d) | 18. (a) | 19. (b) | 20. (d) |
| 21. (c) | 22. (c) | 23. (d) | 24. (d) | 25. (b) |
| 26. (d) | 27. (d) | 28. (d) | 29. (a) | 30. (c) |
| 31. (a) | 32. (c) | 33. (d) | 34. (b) | 35. (b) |
| 36. (b) | 37. (c) | 38. (b) | 39. (b) | 40. (c) |
| 41. (b) | 42. (c) | 43. (b) | 44. (d) | 45. (c) |
| 46. (b) | 47. (a) | 48. (b) | 49. (b) | 50. (c) |



UNSCRAMBLE ME

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

Column I

- TUIRASONTISPAE
- UCLAIRAUARI
- COINRSSES
- GOATPRMPHSAL
- TDMEAPLSOI
- ISNITHRI
- GNCISESYD
- BLNHSETAOTRSI
- RHEORYAPO
- TRUORUCIBAEL

Column II

- | | |
|-----|---|
| (a) | Plastid complex of a cell. |
| (b) | Study of genetic deterioration of human population. |
| (c) | Technique used for sterilisation of liquids and food. |
| (d) | Death of most or all cells due to disease, injury or failure of blood supply in a tissue. |
| (e) | Connecting link between non-chordata and chordata. |
| (f) | Plant that flowers once in 12 years. |
| (g) | Chronic or acute inflammation of the mucous membrane of the nose. |
| (h) | Pus containing discharge from infected gums. |
| (i) | Cultivation and management of individual specimens of ornamental trees. |
| (j) | Persistent part of spindle apparatus with an interdigitated array of microtubules at the equator in a plant cell. |

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.

HIGH YIELD FACTS



Class XII

Biodiversity and Conservation

- **Biodiversity** is defined as the occurrence of different types of ecosystem, different species of organisms with the whole range of their variants and genes adapted to different environments along with their processes and interactions.
- **Edward Wilson**, a sociobiologist, popularised the term biodiversity.

GLOBAL BIODIVERSITY

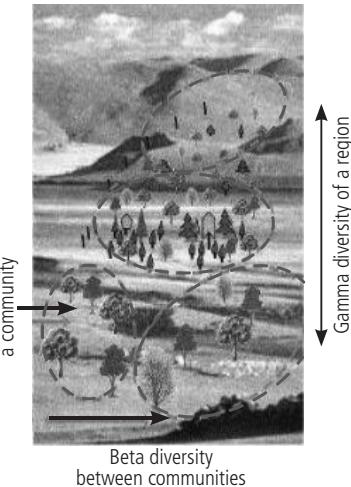
- According to IUCN (2004) total number of known plants and animal species are more than 1.5 million.
- Biodiversity is generated where there are more perturbations and heterogeneity such as in tropical rain forests and coral reefs. But, very harsh conditions reduce biodiversity.
- **Biodiversity in India:** Total number of known species in India are about 1,42,000 (approximately 45,000 plants and around twice animals).
- There are 12 megadiversity regions in the world and India is one of them having 8.1% of total global species diversity.
- India has been divided into ten biogeographical regions (i) Trans Himalayas, (ii) Himalayas, (iii) Desert, (iv) Semi-arid, (v) Western ghats, (vi) Deccan Peninsula, (vii) Gangetic plain, (viii) North East, (ix) Coasts, (x) Islands.
- **Endemic species** are confined to particular region e.g., Western ghats are rich in endemic amphibian species.
- 167 cultivated crops originated in India and it is the home land for 320 wild relatives of crop plants e.g., banana, mango, rice, sugarcane, millets etc. It is also homeland to numerous species.
- Animal species like zebu, water buffalo, chicken, etc., originated in India.
- Secondary home to animals such as sheep, goat, horse, cattle, etc. and plants like maize, potato, tobacco, etc.
- Diversity helps in producing more productive and stable ecosystems which can tolerate various stresses.
- Biodiversity has three inter-related hierarchical levels.

	Analysis of various PMTs from 2012-2016				
	2012	2013	2014	2015	2016
AIPMT/NEET	4	2	4	1	7
AIMS	-	2	2	1	1
AMU	3	5	4	2	-
Kerala	1	-	2	2	2
K.CET	1	3	2	4	-
J & K	1	-	1	-	2

Levels of Biodiversity

Genetic Diversity

- It is the diversity in the number and types of genes and chromosomes in different species and variations in genes and their alleles in same species.
- Variations in the genes of a species increases with increase in size and environmental parameters of the habitat.
- Genetic diversity results in polymorph formation and is **useful in adaptation to changes in environmental conditions**.
- E.g., 50,000 genetically different strains of rice and 1,000 varieties of mango present in India.



Species Diversity

- Variety in the number and richness of species of a region comprises species diversity.
- Number of species per unit area is called **species richness** and number of individuals of different species represent **species evenness**.
- It influences biotic interactions and stability of the community.

Ecological Diversity

- Biodiversity on a wider scale includes variations in the biological communities, the ecosystem of existing communities and interactions among these levels.
- It is of three types: alpha, beta and gamma diversity.

Alpha diversity

Species diversity within community and habitat, depends on species richness and evenness.

Beta diversity

Diversity between communities due to replacement of species with change in the habitat.

Gamma diversity

Diversity in ranges of communities due to diverse habitats or ecosystems over total landscapes.

- Diversity helps in producing more productive and stable ecosystems which can tolerate various stresses.

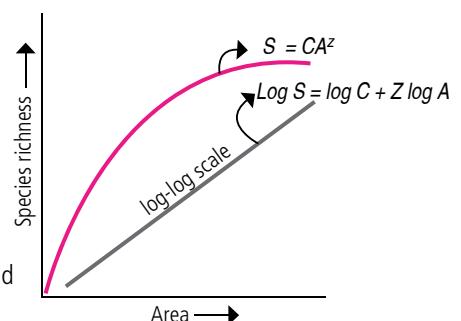
PATTERNS OF BIODIVERSITY

Latitudinal Gradients

- The plant and animal diversity is not uniform but has uneven distribution throughout the world.
- Species diversity decreases from the equator towards the poles.
- Tropics, having a latitudinal range of 23.5°N - 23.5°S , are home for more species in comparison to temperates or polar regions.
- Amazon rainforest situated in South America has the maximum biodiversity on the earth.
- The reasons for higher tropical diversity are:
 - Tropical latitudes have **remained undisturbed** for millions of years allowing species to evolve and flourish unlike temperate areas that have undergone frequent glaciations.
 - Favourable environment** and relatively constant and predictable climate promoted more niche specialisation and thus more diversity.
 - Higher productivity** due to **more solar energy available** in the tropics is related to greater diversity.
 - Reduced competition due to favourable environment and high resource availability, resulted in more diversity.

Species-Area Relationships

- Alexander von Humboldt** proposed that species richness increases with increasing area but upto a certain limit.
 - The relationship between species richness and area turned out to be a rectangular hyperbola for wide variety of taxa.
 - On a logarithmic scale, the relationship is a straight line described by the equation; $\log S = \log C + Z \log A$
- where, S =Species richness, A =Area, Z =Slope of the line (regression coefficient) and C = Y-intercept



- Value of Z is generally in the range of 0.1 to 0.2 irrespective of the taxonomic group or region with the exception of large areas like continents, where the value of Z is in range of 0.6 – 1.2.

IMPORTANCE OF SPECIES DIVERSITY TO THE ECOSYSTEM

- The maintenance of biodiversity is important because of the following reasons:
 - Ecological stability** : Species diversity provides stability to the ecosystem. The more diverse an ecosystem, the better it can withstand environmental stress. In ecosystem with high species diversity, alien species are unable to establish themselves and destruction of part of ecosystem does not degrade it.
 - Productivity** : Ecosystems with higher biodiversity are more productive than those with lower biodiversity. Each species performs a particular function within an ecosystem. They can capture and store energy, produce organic material, decompose organic material, help in cycling of water and nutrients throughout the ecosystem, control erosion or pests, fix atmospheric gases and help regulate climate.
 - Ecosystem health**: Biodiversity provides various checks, controls, negative and positive feedbacks, critical links and keystone species. All the species are interlinked through various types of relationships
 - Ecosystem services**: Biodiversity in ecosystem provides services without which humans can not survive. These include soil fertility, pollinators of plants, predators, decomposition of wastes, purification of the air and water, stabilisation and moderation of the climate, decrease floods, droughts and other environmental disasters. Keystone species are the crucial species that determine the capacity of large number of species to persist in a community.
Protection of keystone species is a priority in conservation efforts, as many important species depend on keystone species for food, reproduction and some other basic needs. Thus, if a keystone species is lost from a conservation area, numerous other species might be lost as well.

BIODIVERSITY LOSS

- Loss of biodiversity is caused by extinction of species.
- A species is considered extinct if no member of species is alive anywhere in the world. Once a species gets extinct, its chances for further evolution are lost.

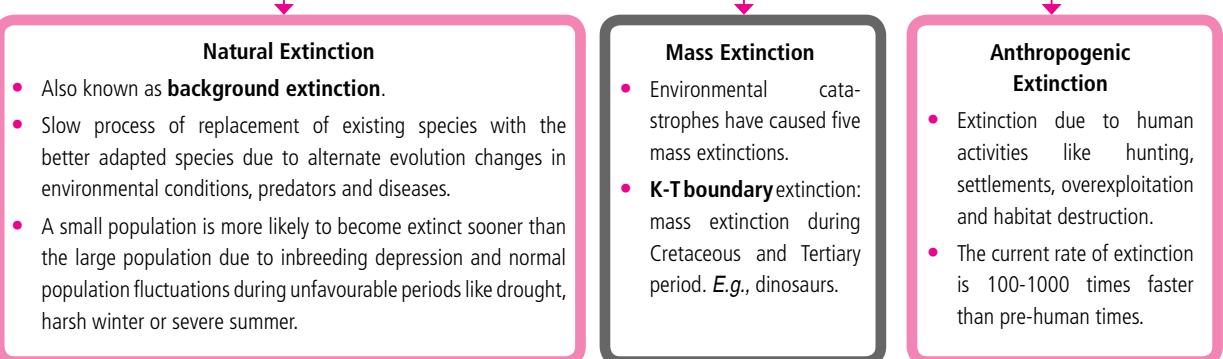
Susceptibility to Extinction

All species do not have an equal probability of going extinct, and some species are more vulnerable to extinction and such species need to be carefully managed for biodiversity conservation.

Population traits which make species susceptible to extinction are:

- Species with very narrow geographical range, e.g., woodland caribou
- Population with small population size and low population density
- Large body size, e.g., Elephant, Bengal tiger, lion
- Low reproductive potential, e.g., blue whale, giant panda
- Higher status of trophic level, e.g., bald eagle, Bengal tiger
- Fixed migratory route and habitat, e.g., blue whale
- Lack of genetic variability
- Inability to switch to alternate foods

Types of Extinction



Causes of Biodiversity Loss

Habitat Destruction and Fragmentation

- Habitat destruction resulting from expansion of human population and activities is the primary cause of loss of biodiversity.
- Factors causing habitat destruction are large industrial and commercial activities, commercial fishing, cattle ranching, etc.
- Habitat fragmentation is the process where large continuous area of habitat is both, reduced in area and divided into two or more fragments. It limits the potential of species for dispersal and colonisation.

Overexploitation

- Increasing human population has escalated the use of natural resources. Overexploitation of resources also occurs when a commercial market develops for previously unexploited species.
- Many species are likely to become endangered or vulnerable to extinction due to overexploitation.

Coextinction

- Coextinctions occur when certain obligatory mutualistic relationships exist in nature, e.g., *Pronuba yuccasella* and *Yucca*. Extinction of one will automatically cause extinction of the other.

Alien Species Invasion

- Introduction of exotic species in a new area for their economic and other uses may kill or eat the native species, or alter their habitat in such a way that many natives are no longer able to persist. E.g., Water hyacinth (*Eichhornia crassipes*) was introduced in Indian waters to reduce pollution but it had clogged water bodies resulting in death of several aquatic plants and animals.
- Island ecosystems are most vulnerable due to their small size and less number of species.

Pollution

- Excessive use of pesticides has polluted both ground water and surface water bodies. Many sensitive species have disappeared.
- Pesticide biomagnification in higher concentration with the rise in trophic level has resulted in drastic decline in the population of fish eating birds and falcons.
- Run off from fertiliser rich fields causes nutrient enrichment of water bodies, called eutrophication. Sewage and other organic remains also result in eutrophication. There is an additional dense growth of plants and animals followed by depletion of oxygen, death of animals and fouling of water.
- Lead and other types of heavy metals poured into water bodies lead to mortality of many animals. Ducks, swans and cranes die of lead poisoning when they take in spent shot gun pellets falling into lakes and marshes. Lead poisoning from industries has killed many cattle drinking that water.
- Spill-over of oil in sea causes death of several marine algae, fish and sea birds.

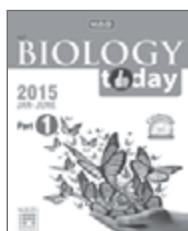
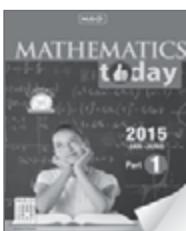
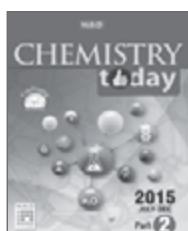
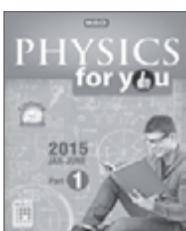
Disturbance and Degradation

- They are of 2 types : Natural and man-made.
- Natural disturbances include forest fire, tree fall, pest infestation, locust attack, etc.
- Man-made disturbances and degradation are more severe as they include felling of trees, use of fire for clearing, collection of litter and overexploitation of other economically important products.

Intensive Agriculture

- Spread of agriculture is at the cost of wetlands, grasslands and forests. Destruction of habitats results in extinction of species. Intensive agriculture is also based on a few high yielding varieties. As a result there is reduction in the genetic diversity.
- It increases vulnerability of the crop plants to sudden attack by pathogens and pests.

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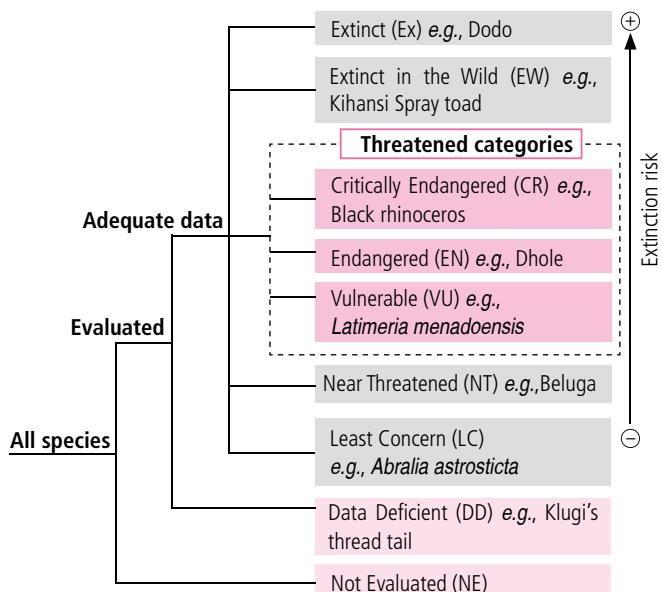
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RED DATA BOOK AND IUCN

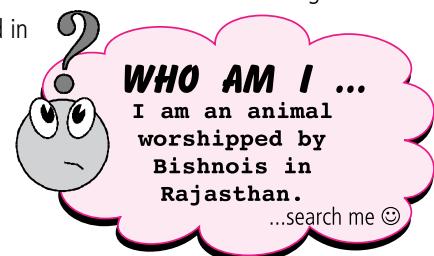
- IUCN (International Union of Conservation of Nature and Natural Resources) is now known as **World Conservation Union (WCU)**. Its headquarters are at Gland, Switzerland.
- A **red data book** or **red list** is maintained at WCU which is a catalogue of taxa facing risk of extinction.
- To highlight the legal status of rare species for the purpose of conservation, IUCN has earlier (1963, 84, 88) established the five main conservation categories.
- These are **extinct, endangered, vulnerable, rare** and **insufficiently known species**.
- Later in 2012 IUCN recognised 9 red list categories of species.
- The great majority of the species on these lists of Red Data Books are plants. However, there are also species of fish, amphibians, reptiles, invertebrates, birds and mammals.
- The purpose of preparation of red list is to:
 - Provide awareness to the degree of threat to biodiversity
 - Provide global index about already declined biodiversity
 - Identify and document the number of species facing high-risk of extinction
 - Prepare conservation priorities and help in conservation action.

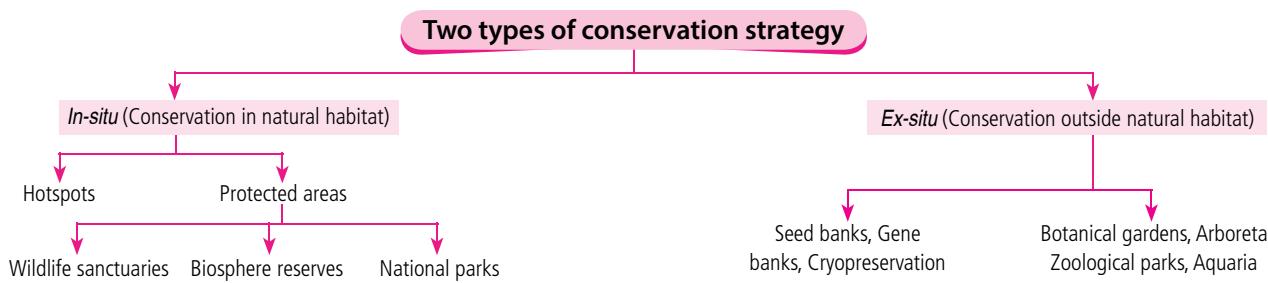


Flow chart: IUCN red list categories

CONSERVATION OF BIODIVERSITY

- Conservation of biodiversity is protection, upliftment and scientific management of biodiversity so as to maintain it at its optimum level and derive sustainable benefits for the present as well as future generations.
- There are some reasons to conserve the biological diversity which can be grouped in three categories:
 - Narrowly Utilitarian-** Useful human products like food, fibres, drugs and medicine, etc.
 - Broadly Utilitarian-** Ecosystem services like provision of pollinators, climate regulation, flood and erosion control, ecological balance through nutrient cycling, etc.
 - Ethical Utilitarian-** Every living species has an intrinsic value though it may not have any direct economic value and also, every species has the right to live.
- The strategies for biodiversity conservation include:
 - All the threatened species should be protected.
 - All the possible varieties, old or new, livestock, aquaculture animals and microbes have to be conserved.
 - Wild relatives of all the economically important organisms should be identified and conserved in protected area.
 - Protecting the resting/feeding places of migratory/wide ranging animal and regulating their exploitation.
 - National Wildlife Protection Laws should be followed, wildlife protection strategies should be formulated and protection programmes should be integrated with international programmes.
 - Determining the reproductive capacity of the exploited species and productivity of the ecosystem.
 - Regulation of international trade in wildlife.
 - Development of reserved or protected areas.
- There are two types of conservation strategies ***in-situ*** and ***ex-situ***.





In-situ conservation

In-situ conservation is protection and conservation of whole ecosystem and its biodiversity at all levels to protect the threatened species. It is further of two types : Hotspots and Protected areas.

Table: *In-situ* conservation

Hotspots		
<ul style="list-style-type: none"> • Hotspots are regions rich in biodiversity but are declared sensitive due to direct or indirect human interference. • Biodiversity hotspots were originally identified by Norman Myers. • Hotspots are determined by four factors: (i) Number of species or species diversity, (ii) Degree of endemism, (iii) Degree of threat to habitat and (iv) Degree of exploitation. • Total number of hotspots all over the world are 34. • India has four hotspots: Indo-Burma region, Eastern Himalayas, Western Ghats-Sri Lanka and Sundaland (Andaman and Nicobar). 		
Protected Areas		
	<ul style="list-style-type: none"> • Areas especially dedicated to the protection and maintenance of biological diversity and of natural and associated cultural resources, maintained and managed through legal or other effective measures. 	
National Parks	Biosphere Reserves	Sanctuaries
<ul style="list-style-type: none"> • Maintained by government and help in betterment of wildlife. • Various activities like cultivation, grazing, forestry, habitat manipulation are prohibited. • At present there are more than 100 National parks in India. 	<ul style="list-style-type: none"> • Multipurpose protected areas. • Initiated by UNESCO under MAB programme. • Biosphere reserves have three zones: <ul style="list-style-type: none"> – Core or natural zone: Undisturbed and legally protected area where no human activity is allowed. – Buffer zone: Limited human activity like research, education and resource utilisation are allowed. – Transition zone: Outermost region where human activity like recreation, cropping, forestry, etc., are allowed. • Importance: <ul style="list-style-type: none"> – Help in restoration of degraded ecosystem – Conservation of genetic resources, ecosystems and species – Sustainable economic development and monitoring – Education and research at national and global levels 	<ul style="list-style-type: none"> • Tracts of land for conservation of fauna. • Grazing, cultivation, harvesting of forest products and private ownership is permitted. • More than 500 sanctuaries are present in India with 3.6% geographical area. <i>E.g.</i>, Jaladapara sanctuary in West Bengal, Periyar sanctuary in Kerala, Dichigam sanctuary in Jammu and Kashmir, etc.

Sacred forests and lakes

- Sacred forests (= sacred groves) are forest patches around places of worship which are held in high esteem by tribal communities.
- They are most undisturbed forest patches, often surrounded by highly degraded landscapes. Not a single branch is allowed to be cut from these forests.
- These help in flourishing of many endemic species which are either rare or have become extinct elsewhere.
- Bishnois of Rajasthan protect *Prosopis cineraria* and Black Buck religiously.
- Some water bodies are also held sacred in certain places, e.g., Khecheopalri lake in Sikkim.

- MAB (Man and Biosphere) Programme was initiated in 1971 by UNESCO (United Nations Educational Scientific and Cultural Organisation) but was introduced in India in 1986. MAB has studied the impact of human interference and pollution on environments and conservation strategies.

Ex-situ Conservation

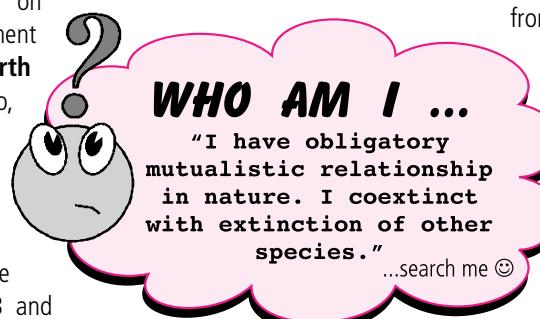
- It is the conservation of endangered species of plants and animals in places apart from their natural habitat. It includes offsite collections and gene banks, which are source of genetic material for breeders and genetic engineers.

Table: Ex-situ Conservation

Offsite Collection				
<ul style="list-style-type: none"> Live collections of wild and domesticated species in botanical gardens, zoological parks, wildlife safari parks, arboreta, etc. Botanical gardens and arboreta have seed banks, tissue culture facilities and zoological parks have captive breeding programmes. Captive breeding helps to maintain the species which have become extinct in wild. As the number increases in captive breeding individuals are selectively released in wild. 				
Gene Banks Maintain stocks of viable seeds, live plants, tissue culture and frozen germplasm with widest range of genetic variability.				
Seed Banks	Orchards	Tissue Culture	Cryopreservation	
Orthodox seeds	Recalcitrant seeds	<ul style="list-style-type: none"> All possible strains and varieties of plants with recalcitrant seeds are maintained. <i>E.g.,</i> litchi, oil, palm, etc. 	<ul style="list-style-type: none"> Technique used for plants with recalcitrant seeds, variable seed progeny, seedless variety or where clone is to be maintained. Callus formation, embryoids, pollen grain culture and shoot tip culture are used for growing such plants. Maintains large number of genotypes in small area, rapid multiplication of endangered species and hybrid rescue. <i>E.g.,</i> banana, potato, etc. 	<ul style="list-style-type: none"> Preservation of embryos, tissue culture, animal cells or tissues, gametes at -196°C (liquid nitrogen) indefinitely. Special techniques are used to revive the cryopreserved material. Endangered organisms are also cryopreserved to prevent extinction.

INTERNATIONAL EFFORTS FOR CONSERVING BIODIVERSITY

- United Nations Conference on Environment and Development (UNCED) also called **Earth Summit** held at Rio de Janeiro, Brazil (1992) promoted Convention on Biological Diversity (CBD) which was signed by 152 countries.
- Recommendations of CBD came into effect in December 1993 and India became part of CBD in May, 1994.



- Commitments of CBD were : (i) Adoption of ways and means to conserve biodiversity. (ii) Managing biodiversity for sustainable use. (iii) Ensuring equitable sharing of benefits from biological diversity including utilisation of genetic resources.

- Second World Summit held in Johannesburg in 2002 was attended by 190 countries, pledging reduction of biodiversity loss at all levels by year 2010.
- Organisations committed for preserving biodiversity are:
 - Green peace** (NGO): provides international support for conservation.

- **WWF** (World Wide Fund for Nature): provides leadership and expertise in arena of conservation.
- **CITES** (Convention in International Trade in Endangered species) helps in restricting of poaching and loss of rare species.

Indian Efforts for Conserving Biodiversity

1952 - IBWL (Indian Board of Wildlife) was established to preserve wildlife.

1972 - National wildlife protection laws were enacted.

1983 - Formulation of wildlife protection strategies.

1988 - National forest policy was formulated stating hills should have 67% and plains should have 33% forest cover.

- Some Institute for biodiversity conservation are.
 - **Indian Institute of Forest Management** in Bhopal.
 - **Wildlife Institute of India** in Dehradun.
 - **Salim Ali centre for Ornithology and Natural History** at Coimbatore.
 - **Ministry of Environment and Forests** (manages *in-situ* conservation)
 - **Joint Forest Management** is practised in 10.25 million hectares of land.
 - **National Bureau of Plant, Animal and Fish Genetic Resources** (manages the majority of *ex-situ* conservation in India).
 - **International Crop Research Institute for Semi-Arid Tropics** (ICRISAT) in Hyderabad conserves germplasm of groundnut, pigeon pea, chick pea, pearl millet and sorghum.



1. A community exhibits species equitability when
 - the number of species per unit area is high
 - one species have more individuals than others
 - species have more or less equal number of individuals
 - different species interact for their mutual benefits.
2. Consider the following statements and select the option that correctly identifies the true (T) and false (F) ones.
 - Ex-situ* conservation of plants and animals provide resources for genetic engineering.
 - In-situ* conservation is adopted to protect endangered species from all adverse factors.
 - In-situ* conservation helps to maintain genetic diversity of all present species.
 - In order to acclimatise the offsprings produced in natural environment, they are shifted to *ex-situ* environment.

(i)	(ii)	(iii)	(iv)
(a) T	T	F	F
(b) F	T	F	T
(c) F	F	T	T
(d) T	F	T	F
3. How is genetic diversity useful in ecosystem?
 - It is useful in evolution of new species.
 - It helps to obtain crop with uniform gene pool.
 - It helps organisms to adapt to changes in environmental conditions.
 - Both (a) and (c)
4. Which of the following is not an objective of biosphere reserves?
 - To protect traditional life style of tribals
 - To restore degraded ecosystems and habitats
 - To ensure cultural, social and ecological sustainable economical development
 - To restrict, research, restoration and conservation of different aspects of ecosystem
5. Select the incorrect match.

(a) Hotspots	– Megadiversity regions
(b) Natural zone	– Legally protected ecosystem
(c) K-T boundary	– Anthropogenic extinction
(d) Gene bank	– Frozen germplasm
6. Read the given statements and select the correct option.

Statement A : Beta diversity depends on species richness and evenness.

Statement B : Beta diversity is diversity in a given community or habitat.

 - Both statements A and B are correct and B is the correct explanation of A.
 - Both statements A and B are correct but B is not the correct explanation of A.
 - Statement A is correct but statement B is incorrect.
 - Both statements A and B are incorrect.

7. Study the given table and identify A, B C, and D.

International Efforts/ Programme	Aim
A	UNESCO programme, studied impact of human interference on environment
Agenda 21	B
C	Restricting poaching of rare species
Earth Summit-1992	D

- | A | B | C | D |
|-----------------------|--|-------------------|--|
| (a) MAB | Sustainable development of diversity in 21 st century | CITES | Convention of Biological Diversity |
| (b) CITES | Promote germplasm conservation | MAB | Conservation of high yield crops |
| (c) Earth Summit-2012 | Establishment of biosphere reserves | UNDP | Restricted tiger hunting |
| (d) IBP | Restricted deforestation | World Summit 2002 | Conservation of endangered species in Brazil |

- 8.** Match the column I with column II.

Column I	Column II
A. Vulnerable species	(i) Nilgai
B. Endangered species	(ii) Cheetah
C. Least concern species	(iii) Golden toad
D. Extinct species	(iv) Red panda
(a) A-(ii), B-(iv), C-(i), D-(iii)	
(b) A-(iv), B-(iii), C-(ii), D-(i)	
(c) A-(ii), B-(iii), C-(iv), D-(i)	
(d) A-(iii), B-(i), C-(iv), D-(ii)	

- 9.** Select the options that correctly fill the blanks.

- (i) Biodiversity Act of India was passed by parliament in ____.

(ii) Odum *et al.* calculate species diversity as number of species per _____ individuals.

(iii) _____ biodiversity appears in a range of communities due to replacement of species with the change in habitat.

(iv) The largest biogeographical region of India is ____.

(i)	(ii)	(iii)	(iv)
(a) 1977	100	α	Trans-Himalayas
(b) 1992	10	γ	Western Ghats
(c) 1998	10,000	δ	Gangetic Plain
(d) 2002	1000	β	Deccan Peninsula

- 10.** Bioprospecting is exploration of

- (a) hotspots for the conservation of critically endangered species
 - (b) molecular, genetic and species level products of economical importance
 - (c) new methods for *ex-situ* conservation
 - (d) new strategies adopted for *in-situ* conservation.

11. Extinction of dinosaurs and a number of other organisms between Cretaceous and Tertiary period over 60 million years ago is an example of

- (a) natural extinction (b) anthropogenic extinction
(c) mass extinction (d) both (a) and (c).

- 12.** Which of the following pairs of animals are susceptible to extinction because of low reproductive potential?

- (a) Blue whale and giant panda
 - (b) Bengal tiger and whooping crane
 - (c) Rhinoceros and bald eagle
 - (d) Woodland caribou and lion

- 13.** Read the following statements.

- I. The species diversity of animals is much less than that of plants.
 - II. Sacred groves are the traditionally protected forest patches where even the cutting of a tree branch is not allowed.
 - III. Pollution adversely affects the health of an organism but does not reduce bio-diversity.

Which of the above statements is /are correct?

- 14.** Silent valley in Kerela is a/an

- 15.** Hanqul and musk deer are mainly conserved in

- (a) Periyar National Park
 - (b) Dachigam National Park
 - (c) Manas Wildlife Sanctuary
 - (d) Desert National Park.

- 16.** Select the incorrect match.

Biosphere Reserve	State
(a) Simlipal	Assam
(b) Gulf of Mannar	Tamil Nadu
(c) Achanakmar	Chhattisgarh
(d) Nilgiri	Karnataka

17. According to species area relationship proposed by Humboldt, species richness

- (a) increases with increasing available resources
 - (b) decreases with increasing explored area upto a certain limit
 - (c) increases with reducing competition in a given area
 - (d) increases with increasing explored area upto a certain limit.

- 18.** Which of the following species is not native to Indian habitat?
 (a) *Blatta orientalis*
 (b) *Clarias gariepinus*
 (c) *Eupatorium odoratum*
 (d) *Lantana camara*
- 19.** Which of the following statements are correct regarding fragmentation of habitats?
 I. It results in disruption of complex interactions amongst species.
 II. It affects the animals requiring large territories.
 III. It causes destruction of species restricted to deeper undisturbed parts of forests.
 IV. Fragmented areas have reduced biodiversity.
 (a) I and II only (b) II and III only
 (c) I, III and IV only (d) I, II, III and IV
- 20.** Which of the following characters would make species more susceptible to extinction?
 (a) Ability of species to switch over to alternate foods
 (b) Species restricted to small geographical area
 (c) Small body size and high reproductive potential
 (d) None of these
- 21.** Read the given statements and select the correct option.
Statement A : Intensive agriculture at the cost of wetlands, grasslands and forests may cause extinction of species.
Statement B : Due to intensive agriculture crop plants become more vulnerable to pathogen attack.
 (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.
- 22.** How many ecological hotspots are present in India? Select the correct option with numbers and their name.
 (a) 1, Himalayas
 (b) 2, Himalayas and Western Ghats
 (c) 3, Himalayas, Western Ghats and Indo-Burma region
 (d) 4, Himalayas, Western Ghats, Gangetic Plains and Deccan Peninsula
- 23.** Which of the following has least global biodiversity among major plant taxa?
 (a) Pteridophytes (b) Gymnosperms
 (c) Bryophytes (d) Algae
- 24.** Equation used to represent relationship between species and area is
 (a) $\log S = \log C + Z \log A$ (b) $\log S = \frac{\log C}{Z \log A}$
 (c) $\log C = \log S + Z \log A$ (d) $\log A = \log C + Z \log S$.

- 25.** Following is the data of four species ($S_1 - S_4$), present (+) or absent (-) in 5 different habitats (P, Q, R, S and T). Which species has the maximum diversity?

	P	Q	R	S	T
S_1	+	-	+	+	+
S_2	+	+	-	-	+
S_3	+	+	+	-	-
S_4	-	+	-	-	-
(a) S_1				(b) S_2	
(c) S_3				(d) S_4	

- 26.** The rivet popper hypothesis for the effect of decrease in biodiversity on the ecosystem is proposed by
 (a) Edward Wilson (b) Paul Ehrlich
 (c) Niles Eldridge (d) Thomas Eisner.

- 27.** Which of the following statements is incorrect?
 (a) Buffer zone surrounds the core area and limited human activities like resource use strategies, research and education are allowed.
 (b) Manipulation zone is the outermost part of biosphere reserve where active cooperation is present between reserve management and local people.
 (c) Restoration region is protected area meant for conservation of threatened species.
 (d) Natural zone area remains undisturbed and is legally protected ecosystem.

- 28.** In which of the following are selected plants and animals conserved outside their natural home?
 (a) Botanical gardens (b) Zoological parks
 (c) National parks (d) Wildlife safari parks

- 29.** Which diversity shows the differences in the potency and concentration of reserpine in the *Rauvolfia vomitaria* growing in different Himalayan ranges?
 (a) Species diversity (b) γ diversity
 (c) α diversity (d) Genetic diversity

- 30.** The Shannon index commonly used in ecological studies measures
 (a) species richness
 (b) species evenness
 (c) both species richness and evenness
 (d) none of these.

ANSWER KEY

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



MPP-8 | MONTHLY Practice Problems

Class XII

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.

- Biodiversity and Conservation
 - Environmental Issues

Total Marks : 160

Duration : 40 Min.

1. Cryopreservation is an (i) preservation technique in which seeds, embryos are stored at (ii) °C in (iii) .

- | | (i) | (ii) | (iii) |
|--------------------|------|-----------------|-------|
| (a) <i>in situ</i> | -186 | liquid nitrogen | |
| (b) <i>ex situ</i> | -196 | dry ice | |
| (c) <i>in situ</i> | -186 | dry ice | |
| (d) <i>ex situ</i> | -196 | liquid nitrogen | |

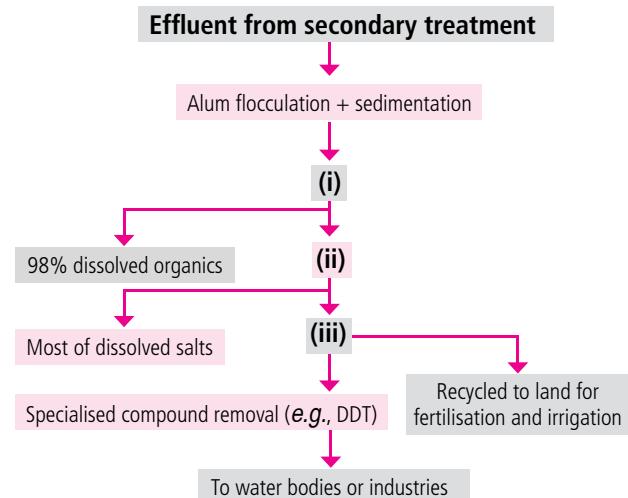
- 2.** Match column I with column II and choose the correct option.

Column I	Column II
A. Mass extinction	(i) <i>Ricinus communis</i>
B. <i>Ex-situ</i> conservation	(ii) <i>Parthenium</i>
C. Weed	(iii) Wooly mammoth
D. Allergic pollen	(iv) Blue whale
E. Endangered	(v) Black-footed ferret
(a) A-(iii) B-(v) C-(ii)	D-(i) E-(iv)
(b) A-(iii) B-(v) C-(i)	D-(ii) E-(iv)
(c) A-(v) B-(iii) C-(ii)	D-(i) E-(iv)
(d) A-(ii) B-(v) C-(i)	D-(iv) E-(iii)

- 3.** Match the following columns and select the correct option.

Column I	Column II	Column III
(i) Ozone depletion	(A) H ₂ S, SO ₂	(p) CO ₂ fertilisation
(ii) Global warming	(B) CFC, NO	(q) Skin cancer
(iii) Acid rain	(C) SO ₂ , NO _x , VOCs	(r) Lung and throat diseases
(iv) Smog	(D) CO ₂ , CH ₄	(s) Stone leprosy
(a) (i)-(B)-(q)	(ii)-(D)-(p)	(iii)-(C)-(s)
(b) (i)-(B)-(r)	(ii)-(C)-(q)	(iii)-(D)-(p)
(c) (i)-(D)-(q)	(ii)-(B)-(p)	(iii)-(C)-(r)
(d) (i)-(A)-(q)	(ii)-(D)-(s)	(iii)-(B)-(p)
		(iv)-(C)-(r)

4. Study the given flow chart for tertiary sewage treatment of effluent and identify the correct option for (i), (ii) and (iii).



- (ii) Algal bloom is the rapid and uncontrolled growth of planktonic algae in a water body.
- (iii) Sewage, runoff from fertilised fields and industrial effluents cause nutrient enrichment of water bodies resulting in cultural eutrophication.
- (iv) Water hyacinth, an indigenous species is an indicator of pollution in water bodies.
- (a) (i) and (ii) only (b) (i) and (iv) only
 (c) (ii) and (iv) only (d) (iv) only
- 8.** Hot spots are characterised by
- (i) large number of endemic species
 (ii) degree of exploitation
 (iii) majority of vulnerable species
 (iv) high rate of deforestation.
- (a) (i), (ii) and (iii) only (b) (i), (iii) and (iv) only
 (c) (ii), (iii) and (iv) only (d) (i), (ii) and (iv) only
- 9.** Which of the following is an incorrect sequence?
- (a) Urbanisation → Habitat loss → Anthropogenic extinction of Tasmania wolf
 (b) Increase in SO_2 , NO_x concentration in air → Acid rain → Leaching of essential minerals from soil
 (c) Increase in concentration of CO_2 , CFC, CH_4 in air → Ozone depletion → Skin cancer, cataract
 (d) Sewage disposal in water bodies → Nutrient enrichment → Eutrophication → Algal bloom
- 10.** Select the mismatched pair.
- (a) Rare species - Clouded Leopard
 (b) Endangered species - Red panda
 (c) Vulnerable species - Hawaiian monk seal
 (d) Indeterminate species - Mexican prairie Dog
- 11. Statement 1:** Snow blindness cataract leads to diminishing eye sight, photoburning and permanent damage to cornea.
Statement 2: High energy UV radiations reach earth due to ozone depletion and break chemical bonds of proteins and other biomolecules in human body.
- (a) Both statements 1 and 2 are correct and 2 is the correct explanation of 1.
 (b) Both statements 1 and 2 are correct but 2 is not the correct explanation of 1.
 (c) Statement 1 is correct but statement 2 is incorrect.
 (d) Both statements 1 and 2 are incorrect.
- 12.** Which statement is correct regarding K-T extinction?
- (a) Mass extinction between cretaceous and tertiary period.
 (b) Extinction of animals due to inability to switch over to alternate food.
 (c) Sixth extinction due to anthropogenic activities.
 (d) Extinction of species due to low reproductive potential.
- 13.** Match column I with column II and select the correct option.
- | Column I | Column II |
|-----------------------|-----------------------------|
| A. Hot spot | (i) Sundarbans |
| B. Wildlife sanctuary | (ii) Simlipal |
| C. National park | (iii) Aravalli in Rajasthan |
- D. Sacred forest (iv) Western Ghats
 (v) Bir Moti Bagh
 (vi) Khecheopalri in Sikkim
- (a) A-(iv), B-(v), C-(i), D-(iii)
 (b) A-(iv), B-(i), C-(iii), D-(vi)
 (c) A-(i), B-(iii), C-(ii), D-(vi)
 (d) A-(iv), B-(v), C-(ii), D-(i)
- 14.** Biodiversity can be conserved by
- (a) agroforestry (b) social forestry
 (c) maintaining orchards (d) plantation.
- 15.** X is a greenhouse gas, produced by incomplete combustion of biomass. 20% of greenhouse effect is due to X gas. Flooded paddy fields, marshes and cattle are major sources of X. Identify the gas X.
- (a) Chlorofluorocarbons (b) Carbon dioxide
 (c) Nitrous oxide (d) Methane
- 16.** Select the correctly matched combination.
- (a) Insecticide Act-1974 - Regulates distribution and use of insecticides.
 (b) Air (Prevention and control of Pollution) Act -1981- Control release of ozone depleting substance.
 (c) Water (Prevention and control of Pollution) Act -1968 - Prevention of detrimental effects of polluted water on human health.
 (d) Environment (Protection) Act - 1986 - Management and handling of solid waste.
- 17.** Read the given differences between National Park and Sanctuary and select the incorrect ones.
- | | National Park | Sanctuary |
|-------|-------------------------------------|------------------------------------|
| (i) | Protects both flora and fauna. | Only fauna is protected. |
| (ii) | Boundary is not demarcated. | Boundary is demarcated. |
| (iii) | Private ownership is not permitted. | Private ownership is permitted. |
| (iv) | Forest products can be harvested. | Forest products are not harvested. |
- (a) (i) and (ii) (b) (i) and (iii)
 (c) (ii) and (iv) (d) (ii), (iii) and (iv)
- 18.** Greenhouse flux is a phenomenon in which
- (a) a part of energy is radiated back to the earth by greenhouse gases
 (b) an increase in the global temperature occurs due to increase in concentration of greenhouse gases
 (c) some amount of solar radiation is reflected back to space by clouds and dust particles
 (d) some amount of radiation is absorbed by the atmosphere before reaching the earth.
- 19.** Which of the following impurities found in domestic sewage constitute colloidal particles?
- (i) Clay (ii) Faecal matter
 (iii) Nitrate (iv) Paper fibres
 (v) Bacteria (vi) Pesticides
- (a) (i), (ii), (iii), (iv) and (vi) (b) (i), (iii), (iv) and (v)
 (c) (ii), (iii), (v) and (vi) (d) (ii), (iv) and (v)

- 20.** Study the following table and choose the correct option for A, B and C.

	Event	Year	Aim
(i)	Chipko movement	A	Preservation of environment
(ii)	B	1987	Limit production of chlorofluorocarbons
(iii)	C	2002	Reduction of current rate of biodiversity loss at global, local and regional levels.

- (a) A-1974, B-Convention on climate change, C-Helsinki declaration
(b) A-1973, B-Montreal protocol, C-Earth Summit
(c) A-1983, B- Kyoto protocol, C-Beijing Protocol
(d) A-1976, B-Montreal protocol, C-Earth Summit

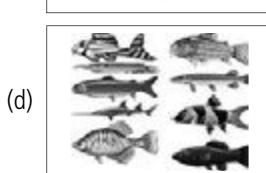
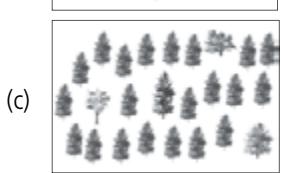
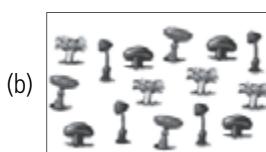
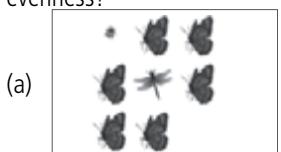
- 21.** Consider the following statements and select the correct option stating which ones are true (T) and which ones are false (F).

- (i) Convention on biological diversity came into effect on 29th December 1993 and ensured equitable sharing of benefits from biodiversity.
 - (ii) In a biosphere reserve, activities like cropping and settlements are allowed in the buffer zone.
 - (iii) Low reproductive potential and lower status of trophic level may be a reason for species extinction.

(i) (ii) (iii)

- | | (A) | (B) | (C) |
|-----|-----|-----|-----|
| (a) | F | T | F |
| (b) | T | F | F |
| (c) | T | F | T |
| (d) | F | T | T |

- 22.** Which of the following species distribution shows maximum evenness?



- 23.** What is the value of regression coefficient Z when species-area relationship is considered for a whole continent?

- 24.** Which of the given statements is incorrect?

- (a) Convention on biological diversity and Convention on climate change promoted by Earth summit at Rio de Janeiro were signed by 152 and 154 nations respectively.

(b) International Union for Conservation of Nature and

- Natural Resources (IUCN) was established in 1963 in Switzerland.

- (c) As per the Kyoto protocol different countries committed to reduce greenhouse gas emissions to a level 5% below 1990 level by 2008-2012.
 - (d) Establishment of biosphere reserves was initiated under Man and Biosphere programme of UNESCO.

- 25.** What is recommended sulphur content in diesel fuels as per Euro V norms?

- (a) 50 ppm (b) < 10 ppm
(c) > 20 ppm (d) 35 ppm

- 26.** Match column I with column II and choose the correct option
(There can be more than one match for items in column I).

Column I	Column II
A. Recalcitrant seeds	(i) Sal
B. Taungya system	(ii) Tea
C. Native to India	(iii) <i>Vitis</i>
D. Metabolise toxic gases	(iv) <i>Sorghum vulgare</i>
E. Pollen allergy	(v) Jack fruit
	(vi) Cocoa
	(vii) <i>Robinia</i>
	(viii) <i>Tubifex</i>
	(ix) Teak
	(x) <i>Chironomus</i>
(a) A-(ii),(v),(vi)	B-(i),(ix)
(b) A-(i),(vi),(viii)	B-(ix)
(c) A-(v),(viii)	B-(vi),(ix)
(d) A-(ii),(v)	B-(i),(vi)
	C-(viii),(x)
	D-(iii),(vii)
	E-(iv)
	D-(iv),(vii)
	E-(ii),(v)
	E-(iv),(vii)
	D-(ii),(x)
	E-(iv)
	E-(iv),(ix)

- 27.** Which international initiative focused on reducing the emission of CFCs and other ozone depleting substances by separating the efforts of developing and developed countries?

- (a) Beijing Protocol (b) Kyoto Protocol
(c) Convention on Climate change
(d) Earth Summit

- 28.** Read the following statements and select the option which correctly fills the blanks.

- correctly fills the blanks.

 - (i) Species facing high risk of extinction in wild in near future due to excessive poaching are _____.
 - (ii) _____ forest is the place on earth with maximum diversity.
 - (iii) Taj Mahal in Agra has deteriorated due to the gas _____.
 - (iv) Peroxyacetyl nitrate cause _____ in leaves.

- | | (i) | (ii) | (iii) | (iv) |
|-----|------------|-----------|---------------|-----------|
| (a) | rare | Greenland | NO_2 | silvering |
| (b) | vulnerable | Columbia | NO_2 | glazing |
| (c) | endangered | Amazon | SO_2 | necrosis |
| (d) | threatened | Ecuador | SO_2 | chlorosis |

- 29.** Which of the following is not a strategy for biodiversity conservation?

- (a) Protection of all threatened species.
 - (b) Preservation of unique ecosystems on priority basis.
 - (c) Implementation of National Wildlife Laws.
 - (d) Planting of sal and teak trees in pure strands to increase forest cover.

- 30.** Which of the following statements is not true in relation to soil pollution?
- DDT and BHC are organochlorine pesticide that persist in soil for longer time and prove harmful to organisms of higher trophic level.
 - Reduction in soil productivity by adding pesticides is called negative soil pollution.
 - Landscape pollution is caused by dumping ash, sludge, industrial wastes, etc., on fertile land.
 - Natural microflora decreases due to use of excessive fertilisers resulting in soil deterioration.

- 31.** Which of the following species has been saved from extinction by *ex situ* conservation through off-site collections?
- Gymnogyps californicus*
 - Blatta orientalis*
 - Pronuba yuccaselles*
 - Prosopis cineraria*

- 32.** Complete the following table by choosing the correct options for W, X, Y and Z.

	Metals	Diseases	Symptoms
(i)	W	Anaemia	Interferes with haeme synthesis
(ii)	X	Minamata	Y
(iii)	Cadmium	Z	Painful skeletal deformities

- | W | X | Y | Z |
|-------------|---------|--------------|------------|
| (a) Mercury | Iron | Liver damage | itai-itai |
| (b) Iron | Copper | Hypertension | Byssinosis |
| (c) Cobalt | Lead | Diarrhoea | Nephritis |
| (d) Lead | Mercury | Meningitis | itai-itai |

- 33.** _____ belong to category of physical water pollutant.
- Helminthes
 - Polychlorinated biphenyls
 - Oil spills
 - Fluorides

- 34.** Read the following statements and select the correct option.

Statement 1 - Deforestation results in reducing primary productivity.

Statement 2 - Deforestation increases atmospheric CO₂ content.

- Both statements 1 and 2 are correct and 2 is the correct explanation of 1.
- Both statements 1 and 2 are correct but 2 is not the correct explanation of 1.
- Statement 1 is correct but statement 2 is incorrect.
- Both statements 1 and 2 are incorrect.

- 35.** Which biosphere reserve of India is not recognised as World Heritage Sites?

- Gulf of Manar
- Nilgiri
- Nanda Devi
- Agasthyamalai

- 36.** Increased concentration of SO₂ causes

- fluorosis and mottling of teeth
- cardiovascular malfunction and asphyxia
- cataract and cancer
- emphysema and bronchitis.

- 37.** Which of the statements given below is correct?

- Incineration is the combustion of solid wastes inside chambers in the absence of oxygen at a temperature of about 1650°C.
- Putrescibility is the property of a material to get decomposed through microbial activity.
- Any sound with a frequency of 70 dB and above is considered to be noise.
- Synergism is the magnified effect of primary pollutants.

- 38.** Which of the following is not an effect of noise pollution?

- Defective night and colour vision
- Damage of nervous system in foetus
- High blood pressure and anxiety
- High mortality of young ones of animals.

- 39.** Read the given statements and select the correct option.

- Hot spots are areas which have high level of species richness and low endemism.
- Ozone layer dissipates the energy of UV radiation and protection from UV rays is proportional to thickness of ozone layers.
- Jhuming cultivation, quarrying and mining are causes of deforestation.
- BOD decreases when domestic sewage is discharged into the river.

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

- 40.** An aquatic ecosystem comprises of water beetles, tadpoles, crustaceans, phytoplankton, carnivorous fishes and frogs. DDT is present in water bodies due to surface run off from agricultural fields. Which organism would have maximum concentration of DDT?

- Phytoplankton
- Crustacean
- Carnivorous fish
- Water beetle

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

- | | | |
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UNIT-VIII : BIOLOGY IN HUMAN WELFARE

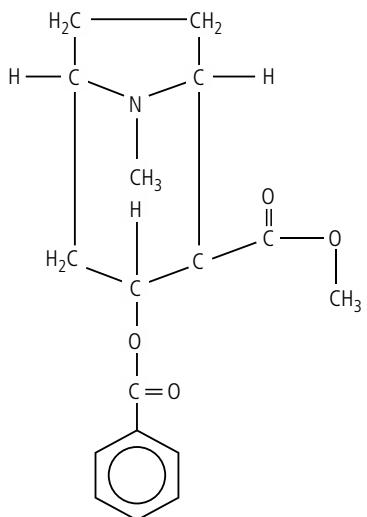
CHAPTER-8 : HUMAN HEALTH AND DISEASES

Multiple Choice Questions

- 👉 1. Tourniquet test is used for the diagnosis of
 - (a) scarlet
 - (b) syphilis
 - (c) dengue
 - (d) typhus.
- 👉 2. Grafted kidney may be rejected in patient due to
 - (a) passive immunity
 - (b) cell mediated immunity
 - (c) humoral immunity
 - (d) innate immunity.
- 👉 3. When a person is suffering from AIDS virus, the first symptom appears when
 - (a) RNA genome of virus replicates
 - (b) macrophages produce virus
 - (c) number of T-lymphocytes decreases
 - (d) virus enters into helper T-cells.
- 👉 4. Sarcomas are the cancers of _____.
 - (a) melanocytes
 - (b) adipose tissue
 - (c) muscular tissues
 - (d) both (b) and (c)
- 👉 5. Select the pair of drugs whose addiction results in slow respiration, slow heart rate and constriction of pupil.
 - (a) Barbiturates and cocaine
 - (b) Caffeine and smack

- (c) Morphine and heroin
- (d) Methadone and cocaine

- 👉 6. Chagas disease is caused due to the transmission of pathogen
 - (a) *Trypanosoma cruzi*
 - (b) *Trypanosoma gambiense*
 - (c) *Trypanosoma rhodesiense*
 - (d) *Glossina morsitans*.
- 👉 7. Identify the chemical structure of the given molecule and select the correct option regarding it.



Drug	Source	Effect
(a) Morphine	<i>Papaver somniferum</i>	Sedative and analgesic
(b) Cocaine	<i>Erythroxylon coca</i>	Vasoconstrictive and delays fatigue
(c) Heroin	<i>Cannabis sativa</i>	Depressive, drowsiness and lethargy
(d) Caffeine	<i>Coffea arabica</i>	Cardiac and respiratory stimulation and increased urine output

8. The correct order of stages in the life cycle of *Plasmodium* is
- Sporozoites (human blood) → Liver → Gametocytes (RBC) → Ookinete (in mosquito stomach) → Sporozoites (salivary gland)
 - Liver → Gametocytes (RBC) → Sporozoites (salivary gland) → Ookinete (in mosquito stomach) → Sporozoites (human blood)
 - Sporozoites (human blood) → Liver → Ookinete (in mosquito stomach) → Gametocytes (RBC) → Sporozoites (salivary gland)
 - Sporozoites (salivary gland) → Gametocytes (RBC) → Liver → Ookinete (in mosquito stomach) → Sporozoites (human blood).

9. MALT (Mucosal - Associated Lymphoid Tissue) is associated with the production of
- B - lymphocytes
 - dendritic cells
 - macrophages
 - all of these.

10. Which of the following statements regarding barriers of innate immunity is incorrect?
- Skin is physical barrier which prevents the entry of bacteria and viruses inside the body.
 - Leucocytes, macrophages, NK cells and the complement system acts as physiological barrier.
 - Urine, cerumen tears, saliva and sebum (sweat) prevent the growth of microbes and constitute the chemical barrier.
 - Polymorphonuclear leucocytes are highly motile phagocytic killers that act as cellular barriers.

Match The Columns

11. Match Column I with Column II.

Column I	Column II
A. Microglial cells	(i) Kidney
B. Kupffer cells	(ii) Lungs
C. Mesangial cells	(iii) Brain
D. Pulmonary alveolar macrophages	(iv) Connective tissue
E. Histiocytes	(v) Liver

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

Column I	Column II
A. Barbiturates	(i) Temazepam
B. Phenothiazines	(ii) Meperidine
C. Narcotics	(iii) Triazolam
D. Psychedelic	(iv) Mephobarbitone
E. Benzodiazepines	(v) Methadone
	(vi) Reserpine
	(vii) Phenobarbitone
	(viii) Chlorpromazine
	(ix) Psilocybine
	(x) Mescaline

Passage Based Question

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

Normal cells have a limited life span. They are usually replaced by new cells through cell division and (i). Normal cells show a property called (ii), by which they inhibit uncontrolled growth of neighbouring cells. The cells proliferate in an unregulated manner and forms clones of cells called (iii). The cancer cells spread to distant sites through body fluids to develop secondary tumor by the process of (iv). (v) when activated under certain conditions could change into oncogenic cells. In (vi) there is chronic enlargement of the production of lymphocytes by lymph nodes and spleen. The techniques such as (vii) and (viii) are useful to detect cancer of internal organs. (ix) and (x) are generally used in the treatment of leukaemia.

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** : Barbiturates are synthetic drugs which reduce anxiety and induce sleep.

Reason : Intake of barbiturates stimulates the excitable cells of CNS.

15. **Assertion** : Cytotoxic T-cells secrete hole forming proteins called perforins.

Reason : Perforins make large round holes in the membrane of foreign cell, thus causing its lysis.

- 16. Assertion :** Rheumatoid arthritis results from progressive erosion of articular cartilage at synovial joints.

Reason : In rheumatoid arthritis, the level of uric acid is raised in the blood and crystals of its salts accumulate in the joints.

- 17. Assertion :** Macrophages act like HIV factory.

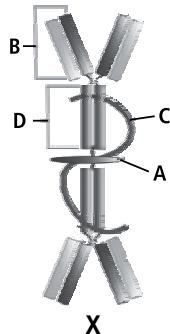
Reason : In macrophages, viral DNA gets incorporated into host cell's DNA and directs the infected cells to produce viruses.

- 18. Assertion :** Rabies virus is transmitted by the bite of rabid (mad) dogs.

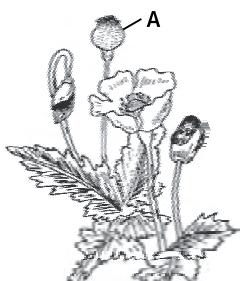
Reason : The virus destroys the brain and causes fear of water, the most characteristic symptom of rabies.

Figure Based Questions

- 19.** Refer to the given structure X and answer the following questions.



- (a) Identify the structure X and mention its significance.
 (b) Identify the parts labelled as A, B, C and D in the given structure.
 (c) How many light and heavy chains and antigen binding sites are present in X ?
 (d) What is the percentage of X in total serum antibody?
- 20.** Carefully observe the given figure and answer the following questions.



- (a) Identify the plant whose flowering branch is shown in the above given figure.
 (b) Identify the plant part A and state its economic importance.
 (c) Name the drugs that are obtained from this plant.
 (d) What are the main effects of the drugs obtained from this plant?

CHAPTER-9 : STRATEGIES FOR ENHANCEMENT IN FOOD PRODUCTION

Multiple Choice Questions

- 1.** Select the correct pair comprising of indigenous breeds of poultry.

- (a) Cornish and Tenis (b) Ancona and Wyandotte
 (c) Aseel and Lolab (d) Brahma and Cochin

- 2.** Which of the following is a column feeder fish?

- (a) *Cirrhinus mrigala* (b) *Labeo rohita*
 (c) *Catla catla* (d) *Anguilla*

- 3.** Select the correct statement.

- (a) Outcrossing is the mating of superior males of one breed with superior females of another breed.
 (b) Crossbreeding is the mating of male and female animals of two different species.
 (c) Inbreeding is the breeding between animals of the same breed for 4-6 generations.
 (d) Outbreeding is the breeding between the unrelated animals that have common ancestors.

- 4.** Select the correct sequence of steps in hybridisation of plants.

- (a) Selfing → Selection → Bagging → Emasculation → Release → Pollination
 (b) Selection → Selfing → Pollination → Emasculation → Release → Testing
 (c) Selection → Selfing → Emasculation → Bagging → Pollination → Testing → Release
 (d) Emasculation → Selfing → Pollination → Testing → Bagging → Release

- 5.** Identify A, B, C and D in the given table and select the correct option.

Crop	Variety	Resistance to disease
Wheat	A	Leaf and stripe rust
B	Pusa Swarnim	White rust
Cowpea	C	Bacterial Blight
Chilli	Pusa Sadabahar	D

A	B	C	D
(a) Himgiri	<i>Brassica</i>	Pusa Komal	Tobacco mosaic virus
(b) Pusa Snowball	Cauli-flower	Pusa Komal	Chilli mosaic Virus
(c) Himgiri	Cowpea	Pusa Shubhra	Hill bunt
(d) Pusa Snowball	<i>Brassica</i>	Pusa Shubhra	Curl blight black rot

6. Read the various steps involved in micropropagation and arrange them in correct sequence.

- (i) The formation of shoot from the cultured explant.
 - (ii) The initiation of culture from an explant on a suitable nutrient medium.
 - (iii) The formation of roots in developed shoots.
 - (iv) The hardening and transplantation of tissue culture raised plants to the field.
- (a) (ii), (i), (iii), (iv) (b) (i), (ii), (iii), (iv)
(c) (ii), (iii), (i), (iv) (d) (i), (iii), (ii), (iv)

7. Select the mismatched pair.

- (a) Murrah - Haryana - Indian Breed
- (b) Deoni - Punjab - Milch Breed
- (c) Malvi - Rajasthan - Draught Breed
- (d) Surti - Gujarat - Indian Breed

8. Which one of the following is not a common SCP producer?

- (a) Bacteria - *Methylophilus methylotropus*
- (b) Cyanobacteria - *Spirulina*
- (c) Filamentous fungi - *Aeromonas salmonicida*
- (d) Yeasts - *Candida utilis*

9. The lysine rich varieties of maize are

- (a) Protina and Jaya
- (b) Shakti and Rattan
- (c) Ratna and Sonalika
- (d) Kalyan sona and Pusa Swarnim.

10. Which of the following statements is not correct regarding applications of micropropagation?

- (a) Micropropagation helps in rapid multiplication of plants.
- (b) Micropropagation results in the formation of somaclones.
- (c) Micropropagation is used for the production of useful autopolyploids.
- (d) Micropropagation maintains the characters of sterile plants.

Match The Columns

11. Match Column I with Column II.

Column I	Column II
A. Mycosis	(i) <i>Argus persicus</i>
B. White diarrhoea	(ii) <i>Piscicola geometra</i>
C. Tick fever	(iii) <i>Candida albicans</i>
D. Infectious coryza	(iv) <i>Haemophilus gallinarum</i>
E. Fish leech	(v) <i>Salmonella pullorum</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. Marine fish	(i) Wessex
B. Allopolyploids	(ii) <i>Rastrelliger</i>
C. Hog breeds	(iii) Triticale
D. Poultry breeds	(iv) Chegu
E. Goat breeds	(v) <i>Sardinella</i>
	(vi) Changthangi
	(vii) Berkshire
	(viii) American cotton
	(ix) Brahma
	(x) Cochin

Passage Based Question

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

An organism having more than two sets of genome in its cell is called (i). Such organisms also constitute some of our important crops such as (ii) and (iii). Polyploidy occurs due to (iv) of chromosomes during (v). It is also induced artificially to obtain crop plants or produce new species. When there is a numerical increase of same genome, the plant is called (vi) while the organism developed by doubling of chromosomes of the plant obtained through hybridisation is called (vii). (viii) is the type in which one genome is in more than diploid state. Such species are commonly (ix). Polyploid plants are (x) as odd number of chromosomes do not form synapsis.

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 :

- (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.

14. **Assertion :** Meristem culture is used to produce virus free sugarcane plants.

Reason : Meristems are actively dividing undifferentiated cells which does not support viral replication.

15. **Assertion :** During brooding, the feed in the form of maize or *dalia* should be given in the first 24-28 hours to chicks.

Reason : Feeding constitutes the proteins, carbohydrates, fats, minerals and vitamins for egg and meat production.

16. **Assertion :** The larvae of honeybee are fed on a special proteinaceous food called bee bread.

Reason : Bee bread is a coarse food which is a mixture of honey and bee milk.

17. Assertion : Isinglass is a gelatinous substance obtained from the air-bladder of Indian salmons and cat fish.

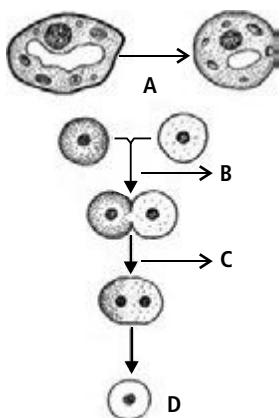
Reason : Isinglass is used in the preparation of special cement and in the clarification of wine and beer.

18. Assertion : Biofortification is breeding of crops with higher levels of vitamins and minerals.

Reason : The improved varieties of rice-Jaya and Ratna are developed as a result of biofortification.

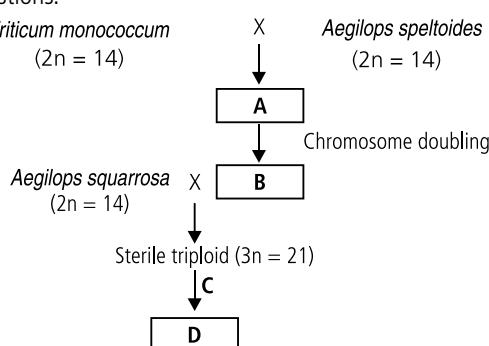
Figure Based Questions

19. Study the given figure of somatic hybridisation and answer the following questions.



- (a) Identify A, B, C and D in the given flow chart.
- (b) Describe the function of A.
- (c) Describe the role of B in somatic hybridisation.
- (d) Which one of the labelled parts develops its own cell wall after fusion of protoplasts in culture medium? Give an example of such plant.

20. Study the given flow chart and answer the following questions.



- (a) What does A represent in the given flow chart?
- (b) Identify the species B in the given flow chart and state its chromosome number.
- (c) Identify C and D and mention their significance in the given cross.
- (d) Name the substance used for chromosome doubling.

CHAPTER-10 : MICROBES IN HUMAN WELFARE

Multiple Choice Questions

1. Which of the following pairs is wrongly matched?

- (a) Yogurt - *Lactobacillus bulgaricus*
- (b) Butter milk - *Streptococcus cremoris*
- (c) Sour Cream - *Streptococcus thermophilus*
- (d) Bread - *Saccharomyces cerevisiae*

2. Identify A, B, C and D in the given table and select the correct option.

Antibiotic	Source	Action
A	<i>Micromonospora purpurea</i>	Effective against Gram (+) ve bacteria
Chloromycetin	B	Typhoid, whooping cough, typhus.
C	<i>Streptomyces fradiae</i>	Antibacterial against Gram negative bacilli
Streptomycin	<i>Streptomyces griseus</i>	D

A	B	C	D
(a) Gentamycin	<i>Streptomyces lavendulae</i>	Neomycin	Meningitis, pneumonia and tuberculosis
(b) Bacitracin	<i>Streptomyces lavendulae</i>	Polymixin	Meningitis, pneumonia and tuberculosis
(c) Gentamycin	<i>Streptomyces venezuelae</i>	Terramycin	Bacterial urinary infection
(d) Polymixin	<i>Streptomyces venezuelae</i>	Aureomycin	Antifungal for thrush

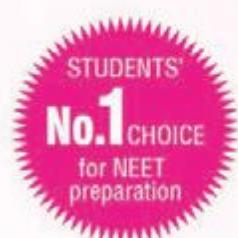
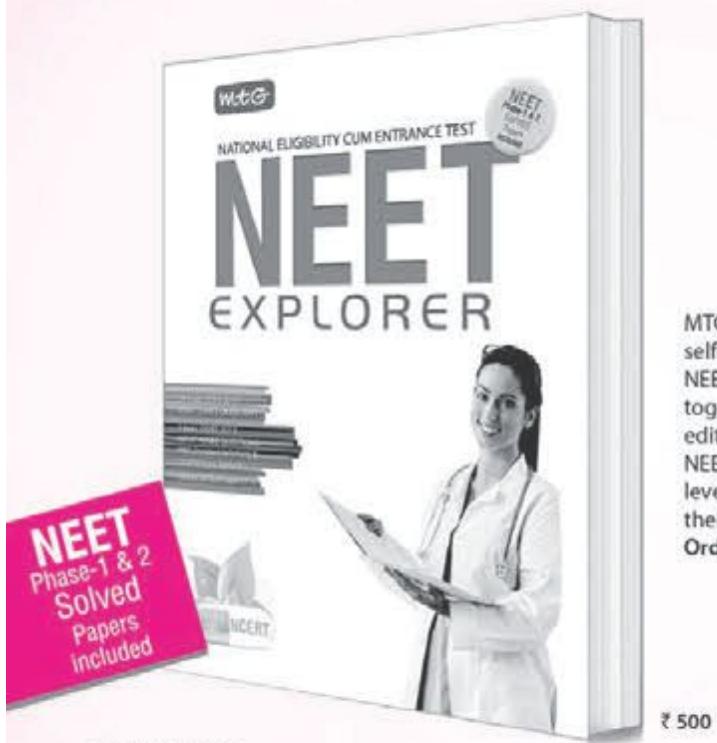
3. Which enzymes obtained from *Rhizopus*, *Aspergillus* and *Bacillus* species are used for separation and designing of textile fibres?

- (a) Pectinases
- (b) Amylases
- (c) Lipases
- (d) Proteases

4. Read the following statements.

- (i) Flocs are masses of bacteria held together by slime and fungal filaments.
- (ii) Aerobic and anaerobic microbes digest the organic mass of the sludge.

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- (iii) Anaerobic digestion takes place by facultative anaerobic microbes which secrete cellulases, proteases and lipases.
- (iv) Cellulose digestion is slower than hemicellulose, lipids and proteins.
- Of the above statements
- (ii), (iii) and (iv) are correct
 - (i), (ii) and (iii) are correct
 - (i), (iii) and (iv) are correct
 - all of them are correct.
- Q5.** Which one of the following statements about bioinsecticides is not correct?
- Rotenones are powerful insecticides but harmless to birds and mammals.
 - The active compounds of pyrethrum are pyrethrin and cinerin.
 - The red variety of sea onion produces a radicide called squill.
 - Thurioside is a chemical used to keep pests away from clothes.
- Q6.** Fermentation activity of *Trichoderma polysporum* produces
- lovastatin
 - cyclosporin A
 - gluconic acid
 - streptokinase.
- Q7.** The percentage of alcohol in rectified spirit is
- 40%
 - 60-70%
 - 95%
 - 100%.
- Q8.** Antibiotics such as streptomycin and neomycin act on bacteria by
- disrupting wall synthesis
 - inhibiting DNA polymerisation
 - disrupting plasmalemma repair and synthesis
 - inhibiting 30S ribosome function.
- Q9.** Nutrient rich cells formed by fungal hyphae provide nourishment during seedling stage of orchids. Such cells are called
- pelotons
 - arbuscules
 - hartig net
 - ericoid.
- Q10.** Name the commercially used acid obtained by the activity of both *Aspergillus niger* and *Penicillium* species.
- Butyric acid
 - Gluconic acid
 - Citric acid
 - Acetic acid

Match The Columns

- 11.** Match Column I with Column II.
- | Column I | Column II |
|-----------------|--------------------------------|
| A. Chymosin | (i) <i>Monascus purpureus</i> |
| B. Citric acid | (ii) <i>Gliocladium virens</i> |
| C. Pectinases | (iii) <i>Aspergillus niger</i> |
| D. Viridin | (iv) <i>Mucor</i> |
| E. Statins | (v) <i>Byssochlamys fulvo</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. Bioherbicide	(i) <i>Beauveria</i>
B. Free living cyanobacteria	(ii) <i>Glomus</i>
C. Bioinsecticide	(iii) <i>Chrysolina</i>
D. Microphos	(iv) <i>Aulosira</i>
E. Mycorrhiza	(v) <i>Phytophthora</i>
	(vi) <i>Quercus</i>
	(vii) <i>Derris</i>
	(viii) <i>Bacillus</i>
	(ix) <i>Stigonema</i>
	(x) <i>Pseudomonas</i>

Passage Based Question

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

(i) are microorganisms which enrich the soil with nutrients by enhancing the availability of nutrients to crops. The microorganisms which act as (i) are mainly (ii), (iii) and (iv). (iv) forms a mutual or symbiotic association with the (v) of higher plants. This association is of two types. Plants with (vi) absorb 2-3 times more of nitrogen, potassium, calcium and phosphorus. In (vii), the hyphal tips passing into the cortical cells produce finely branched masses called (viii). Therefore, (vii) is also known as (ix).

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 :** Curd is more nutritious than milk.

Reason : Curd contains a number of organic acids and vitamins, e.g., B₁₂.

MPP-8 CLASS XI

ANSWER KEY

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

- 15. Assertion :** In alcohol fermentation, using cereals or potato as substrate, either 1% malt or *Rhizopus* is added to nutrient medium.

Reason : Yeast do not possess adequate amylase.

- 16. Assertion :** Streptokinase obtained from the cultures of *Streptococcus* is genetically modified for commercial use.

Reason : Streptokinase is added in detergents for removing oily stains from laundry.

- 17. Assertion :** The activated sludge is used both as inoculum in aeration tanks and for anaerobic sludge digestion.

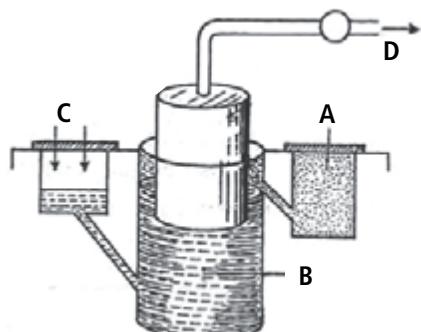
Reason : The spent sludge can be used as manure or compost.

- 18. Assertion :** Rotenones are obtained from the roots of *Azadirachta indica*.

Reason : Rotenones are powerful insecticides which also adversely affect warm-blooded animals.

Figure Based Questions

- 19.** Refer to the given figure of biogas plant and answer the following questions.



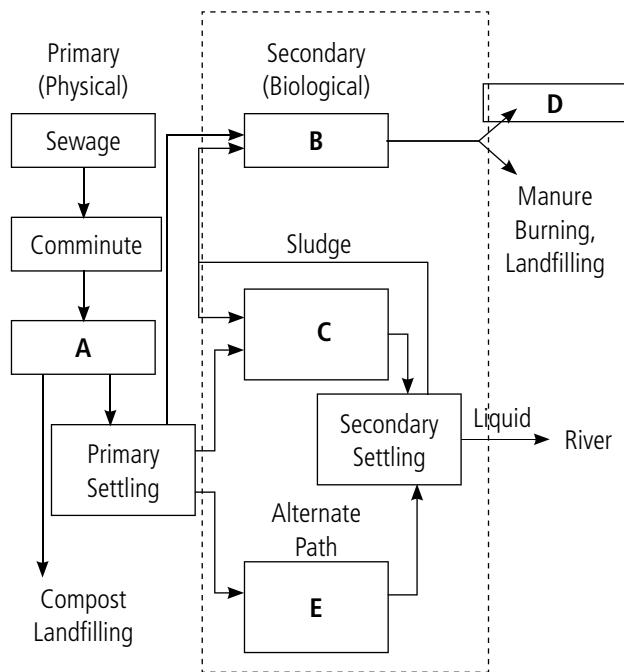
- (a) Identify A, B, C and D in the given diagram.

- (b) State the source and use of A.

- (c) Name the type of organisms present in B and state their significance.

- (d) What is the composition of D? Give some of its uses.

- 20.** Study the given flow chart of sewage treatment and answer the following questions.



- (a) Identify A, B, C, D and E in the given flow chart.

- (b) Name the process by which A is removed during primary settling.

- (c) What is the role of C in sewage treatment?

- (d) What happened to the BOD in C?

SOLUTIONS

CHAPTER-8 : HUMAN HEALTH AND DISEASES

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

6. (a) 7. (b) 8. (a) 9. (d) 10. (b)

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

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

- | | |
|------------------------------|-------------------------|
| 13. (i) cell differentiation | (ii) contact inhibition |
| (iii) tumour | (iv) metastasis |
| (v) Oncogenes | (vi) Hodgkin's disease |
| (vii) radiography | (viii) MRI |
| (ix) Vinblastine | (x) vinorelbine |

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

- 19. (a)** IgA. It is the second most abundant class of antibody after IgG. It provides localised protection in external secretions against bacteria and viruses.

- (b)** A – J-Chain; B – Fab region (Fragment antigen binding); C – Secretory Component; D – Fc region (Fragment crystallisable)

- (c)** IgA being a dimer have four heavy chains and four light chains. Therefore, it has four antigen binding sites.

- (d)** IgA constitutes 10-15% of total antibodies present in serum.

- 20. (a)** *Papaver somniferum*

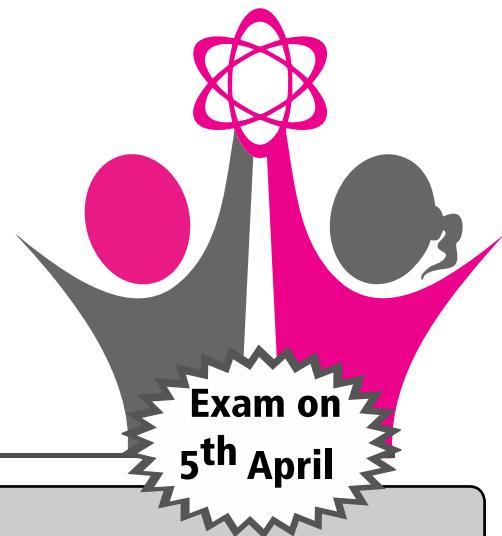
- (b)** The plant part A is identified as the capsule. Afeem (opium) is dried latex that is obtained from this unripe fruit (capsule) of poppy plant.
- (c)** The drugs obtained from opium are – morphine, codeine, heroin, methadone, etc.
- (d)** The drugs obtained from opium mainly act as analgesic (pain-killer) because they relieve pain by binding to specific receptors in central nervous system of the body.
- CHAPTER-9 : STRATEGIES FOR ENHANCEMENT IN FOOD PRODUCTION**
1. (c) 2. (b) 3. (c) 4. (c) 5. (a)
 6. (a) 7. (b) 8. (c) 9. (b) 10. (c)
11. A-(iii), B-(v), C-(i), D-(iv), E-(ii)
 12. A-(ii, v); B-(iii, viii); C-(i, vii); D-(ix, x); E-(iv, vi)
 13. (i) polyploid (ii) wheat
 (iii) banana (iv) non-disjunction
 (v) anaphase (vi) autoploid
 (vii) alloploid (viii) Autoallopolyploidy
 (ix) hexaploid (x) sterile
14. (a) 15. (b) 16. (d) 17. (b) 18. (c)
 19. (a) A – Cellulase and pectinase
 B – PEG
 C – Cell fusion
 D – Somatic hybrid cell
- (b)** The function of A is the digestion of plant cell walls.
(c) B represents PEG (Polyethylene glycol). The protoplast of two plants are brought together and made to fuse in a solution of PEG. It thus, facilitates fusion of protoplasts.
(d) The labelled part D, i.e. somatic hybrid cell, develops its own cell wall after the fusion of protoplasts in culture medium. *E.g., Pomato.*
20. (a) A represents sterile hybrid having ($2n = 14$) made by cross between *T. monococcum* and *Aegilops speltoides*.
(b) The B is identified as allotetraploid, *Triticum durum*. Its chromosome number is $4n = 28$.
(c) C represents chromosome doubling of sterile triploid ($3n = 21$) obtained from cross of *A. squarrosa* and *T. durum*. The D is resultant hexaploid *Triticum aestivum* ($6n = 42$) obtained as a result of chromosome doubling.
(d) Colchicine
- CHAPTER-10 : MICROBES IN HUMAN WELFARE**
1. (c) 2. (a) 3. (b) 4. (d) 5. (d)
 6. (b) 7. (c) 8. (d) 9. (a) 10. (b)
11. A-(iv), B-(iii), C-(v), D-(ii), E-(i)
 12. A-(iii, v); B-(iv, ix); C-(i, vii); D-(viii, x); E-(ii, vi)
 13. (i) Biofertilisers (ii) bacteria
 (iii) cyanobacteria (iv) mycorrhizal fungi
 (v) roots (vi) ectomycorrhiza
 (vii) endomycorrhiza (viii) arbuscules
 (ix) VAM (vesicular-arbuscular mycorrhiza)
14. (a) 15. (a) 16. (c) 17. (b) 18. (d)
 19. (a) A – Sludge
 B – Digester
 C – Dung and Water
 D – Biogas
- (b)** The sludge or the effluent and residue left after the fermentative generation of biogas is rich in minerals, lignin and a part of cellulose. It is therefore, used as a manure.
(c) The organisms present in B is methanogenic bacteria which perform anaerobic breakdown or digestion of biomass.
(d) The biogas comprises of :
 Methane (CH_4) – 50-70%
 Carbon dioxide (CO_2) : 30-40%
 Traces of nitrogen, hydrogen sulphide and hydrogen.
 Biogas provides both storable form of energy and manure. It does not add to pollution. It reduces the chances of spread of faecal pathogens.
20. (a) A – Grit
 B – Sludge digester
 C – Aeration tank
 D – Biogas
 E – Trickling filter
- (b)** Grit is removed by sedimentation during primary settling.
(c) Aeration tanks comprises of various heterotrophic microbes that hastens the decomposition process and results in the formation of flocs. As a result, organic matter is converted to microbial mass and a lot of minerals are released.
(d) BOD in aeration tank reduces when microbes digest organic matter and convert it into microbial mass.
- 😊😊

MPP-8 CLASS XII ANSWER KEY

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

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. Which cell organelle is modified to form the acrosome? Also name the chemical secreted by it.
2. Name two basic amino acids that provide positive charge to histone proteins.
3. *Agrobacterium tumefaciens* is known as a natural genetic engineer. Give reason to support the statement.
4. Name any two organisms which can occupy more than one trophic level in an ecosystem.
5. What causes swelling of the lower limbs in patients suffering from filariasis?

SECTION - B

6. State the role of ethidium bromide and UV-light during gel electrophoresis of DNA fragments.
7. What is a transgenic crop ? Name the plant which is used to produce blood anticoagulant protein. What is this protein called?
8. What are turions? What is their significance?
9. Curd is more nutritious than milk. Justify.
10. Identify a, b and c in the table given below:

	Pattern of inheritance	Monohybrid F ₁ phenotypic expression
1.	Co-dominance	a
2.	b	The progeny resembled only one of the parents.
3.	Incomplete dominance	c

OR

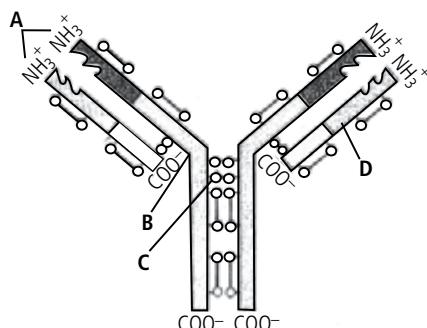
What does the comparison between the eyes of octopus and those of mammals say about their ancestry and evolution?

SECTION - C

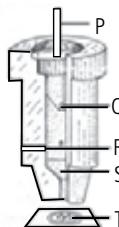
11. Identify the type of the given ecological pyramid and give one example each of pyramid of number and pyramid of biomass in such cases.



12. Name the type of pollination taking place in coconut plant. List five characters of the flowers of coconut plant favouring this type of pollination.
13. Refer to the given structure of an antibody molecule and answer the following.



- (a) Identify the regions marked as A, B, C and D.
- (b) What is the role of region A and C in an antibody molecule?
- (c) Name the two most abundant antibodies found in our body and mention their location and function.
- 14.** When a garden pea plant with violet flowers was crossed with another plant with white flowers, 50% of the progeny bore violet flowers.
- Work out the cross.
 - Name the type of cross and mention its significance.
 - How does the inheritance pattern of flower colour in snapdragon differ from the above?
- 15. (a)** When does the corpus luteum degenerate? Explain the immediate consequences of its degeneration in human female.
- (b) Mention the sites of action and function of the hormones GnRH and FSH during spermatogenesis in human males.
- 16.** A and B are the two different cloning vectors in two different bacterial colonies cultured in chromogenic substrate. Bacterial colonies with cloning vector A were colourless whereas those with B were blue coloured. Explain the cause of the difference in colour that appeared in two colonies.
- 17.** MOET programme has helped in increasing the herd size of the desired variety of cattle. List the steps involved in conducting the programme.
- 18. (a)** Discuss the causes and effects of carbon dioxide fertilisation on plants.
- (b) Define accelerated eutrophication. Mention any two consequences of this phenomenon.
- 19. (a)** Identify the instrument shown in the given figure and correctly label its parts P, Q, R, S and T.
- (b) How is it used in gene transfer methods?
- (c) State its significance in r-DNA technology.
- OR**
- How is gene therapy being used in treating ADA deficient patients ?
- 20.** A childless couple has agreed for a test tube baby programme. List only the basic steps the procedure would involve to conceive the baby.
- 21. (a)** What do you mean by regulation of gene expression?
- (b) State the different levels, at which regulation of gene expression can be exerted in eukaryotes.
- 22. (a)** Show graphical representation of species area relationship as given by Alexander von Humboldt.
- (b) What do steeper slopes mean in the context of biodiversity?



SECTION - D

23. Rahul, 14 years old teenager is good in academics. However, there are few boys in his class who go to pubs for late night parties, consume alcohol and also take drugs. From last few days, Rahul's mother noticed his drop in academic performance, lack of interest in personal hygiene, aggressive and rebellious behaviour, his loss of interest in hobbies, and changed sleeping and eating habits.

- What do you think may be the possible reason for Rahul's changed attitude?
- What are the different measures that should be taken by parents to protect their children from substance abuse?

SECTION - E

24. (a) Give a diagrammatic representation of spermatogenesis in humans.

(b) At which stage of life does gametogenesis begin in human males and females respectively?

(c) Name the organs where gametogenesis gets completed in human males and females respectively.

OR

Give reasons for the following.

- Most zygotes in angiosperms divide only after certain amount of endosperm is formed.
- Micropyle remains as a small pore in the seed coat of a seed.
- Integuments of an ovule harden and water content is highly reduced as the seed matures.
- Anthers of angiosperm flowers are described as ditheous.
- Organisms produced due to sexual reproduction adapt better to the changing environmental conditions.

25. (a) Why are herbivores considered similar to predators in the ecological context? Explain the relationship between the two.

- Differentiate between the following interspecific interactions in a population :
 - Mutualism and parasitism
 - Commensalism and amensalism

(c) Define brood parasitism.

OR

- Define alien plant species. Name three alien plant species introduced in India.
- What are endangered species? Give two examples of Indian endangered animal species.
- In an era where the use of fossil fuels has been proven to be harmful to the environment and humans, alternative sources of energy are sought. Mention briefly any two such non-polluting sources of power generation.

- 26. (a)** Rahul, a 3 years old child suffers from a chromosomal disorder with the following features :
Short stature with small round head, furrowed tongue and partially open mouth. His palm is broad with the characteristic palm crease.
- Mention the name and cause of the disease from which Rahul is suffering.
 - Who described this disorder for the first time?
- (b)** A non-haemophilic couple was informed by their doctor that there is possibility of a haemophilic child be born to them. Explain the basis on which the doctor conveyed this information. Give the genotypes and the phenotypes of all the possible children who could have born to them.

OR

Explain how does the process of natural selection affect Hardy-Weinberg equilibrium. List the other four factors that disturb the equilibrium.

SOLUTIONS

- Acrosome is derived from Golgi complex of spermatid. It secretes hyaluronidase proteolytic sperm lysins.
- Lysine and arginine.
- Ti*(tumor inducing) plasmid obtained from the soil bacterium *Agrobacterium tumefaciens* is capable of transferring and integrating its T-DNA genes into the plant host cells and synthesise the opines creating crown gall tumor in genome plants. Hence, this bacterium is called as natural genetic engineer.
- Man and snakes can occupy more than one trophic level in an ecosystem. Man being herbivorous as well as carnivorous can be primary or secondary consumers. While snakes can be secondary as well as tertiary consumers at the same time.
- Filariasis is caused by *Wuchereria bancrofti*. They occupy and affect the lymph vessels and nodes of the lower limbs causing them to swell like that of an elephant.
- DNA fragments separated by gel electrophoresis can be observed only after staining. Ethidium bromide is used to stain DNA fragments since it binds to DNA by intercalating between nitrogenous bases and fluoresces upon exposure to UV radiation. The UV light increases the fluorescence of ethidium bromide imparting bright orange colour to DNA fragments which helps to view separated DNA fragments.
- Transgenic crops or genetically modified crops contain and express one or more useful foreign genes or transgenes. It has two advantages : (i) Any gene from any organism or a synthetic gene can be incorporated. (ii) Change in genotype is precisely controlled.

The protein hirudin is an anticoagulant protein which is present in leech. Its gene was chemically synthesised and introduced in *Brassica napus*. The seeds of the plant contained hirudin which could be extracted and purified for commercial use.

- A turion is a swollen bud, which contains much stored food. It is detached from the parent plant and remains inactive through the winter and gives rise to a new plant in following spring. Turions are found in a number of water plants, *E.g., Utricularia, Potamogeton*.
- Curd contains a number of organic acids and vitamins including vitamin B_{12} . Lactic acid bacteria (LAB) present in curd check growth of disease causing microbes in stomach and other parts of digestive tract.
- In the given table,
 - Both the forms of a trait are equally expressed in F_1 generation during co-dominance.
 - Is dominance, in which the resulting progeny resembles only one parent.
 - Phenotypic expression of F_1 generation is somewhat intermediate between the two parental forms of a trait, in incomplete dominance.

OR

Eyes of octopus and mammals are analogous organs, which represent convergent evolution, i.e., development of similar adaptive functional structures in unrelated group of organisms. These organs have different structure but perform similar functions. This suggests convergent evolution.

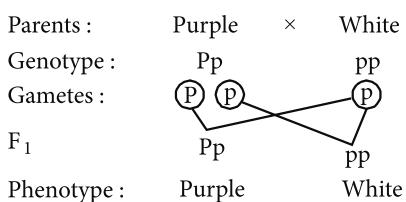
- The given ecological pyramid is spindle - shaped pyramid. In a forest ecosystem, the pyramid of numbers is spindle-shaped. The producers for example, large sized trees, are lesser in number and form the base of the pyramid. The herbivores e.g., fruit eating birds, elephants, deers etc are more in number than the producers. Then there is a gradual decrease in the number of successive carnivores, thus making the pyramid again upright which shows a spindle-shaped structure.
In a pond ecosystem, the pyramid of biomass is either spindle or inverted in shape. As the producers are small organisms (phytoplankton), their biomass is least. The biomass of primary consumers (zooplanktons) is greater than that of producers. The biomass of primary consumers may be less than secondary consumers resulting in inverted shaped pyramid or greater than secondary consumers resulting in spindle-shaped pyramid.
- The pollination taking place in coconut is anemophily (wind pollination). The characters of the anemophilous flowers are :
 - Flowers are small and inconspicuous.
 - The pollen grains are light and non-sticky so that they can be transported through wind currents.
 - They possess well-exposed stamens so that the pollens are easily dispersed into wind currents.
 - Large often-feathery stigma is present to easily trap air-borne pollen grains.
 - Flowers have a single ovule in each ovary and numerous flowers are packed into an inflorescence.
- (a)**
 - A : Antigen binding site
 - B : Hinge
 - C : Disulphide bond
 - D : Variable region of light chain

(b) Region A is antigen binding site. It binds to the specific antigens in a lock and key pattern, forming an antigen-antibody complex. The polypeptide chains of an antibody are joined together by the disulphide bonds (region C) to form a Y-shaped molecule. It joins the two heavy chains and a light chain with heavy chain.

(c) The two most abundant antibodies in our body are

- (i) IgG - It is found in blood, lymph and intestines. It protects against bacteria and viruses by enhancing phagocytosis, neutralising toxins and complement activation. They are the only antibodies to cross the placenta, providing immunity to developing fetus.
- (ii) IgA - It is found mainly in sweat, tears, saliva, colostrum and gastrointestinal secretions in small amount in blood and lymph. It imparts localised protection against bacteria and viruses by external secretions as tears, saliva, etc. It also provides immunity to newly born young ones, though colostrum (the first milk secreted by mother).

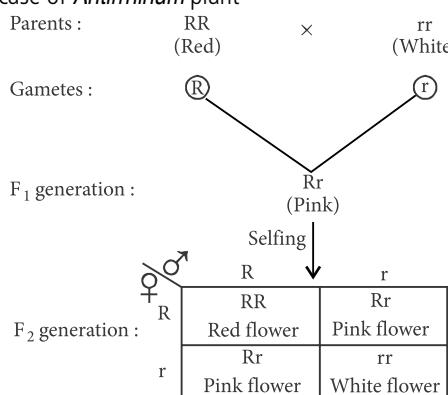
14. (a) 50% of violet flower appear only if the parent is heterozygous for violet flower. The cross can be as follows :



The plants in F₁ will bear purple and white coloured flowers in the ratio 1 : 1.

(b) The cross is test cross. A test cross is performed to find out the genotype of the unknown plant.

(c) In case of *Antirrhinum* plant



Genotype : RR : Rr : rr
1 : 2 : 1

Phenotype : Red : Pink : White
1 : 2 : 1

The inheritance pattern of flower colour in *Antirrhinum* is an example of incomplete dominance.

15. (a) In the absence of fertilisation, the corpus luteum degenerates. Degeneration of the corpus luteum leads to

decrease in the production of progesterone which is required for the maintenance of the endometrium, mucus secretion, etc. Due to reduction of progesterone, endometrium disintegrate, thus causing menstruation and onset of new cycle.

(b) GnRH acts on the anterior lobe of pituitary gland to secrete luteinising hormone (LH) and follicle stimulating hormone (FSH). FSH acts on Sertoli cells of the seminiferous tubules of the testes to secrete an androgen binding protein and inhibin.

16. Presence of the insert (desired DNA or gene) within a gene coding for β -galactosidase results in insertional inactivation of the enzyme β -galactosidase, hence bacterial colonies do not produce any colour. This property is used as a selectable marker to differentiate between recombinants and non-recombinants. Therefore, bacterial colonies with cloning vector A are colourless as they are recombinants with the insert and bacterial colonies with cloning vector B are blue coloured as they are non-recombinants.

17. The steps involved in Multiple Ovulation Embryo Transfer Technology (MOET) are as follows:

- (i) Hormones (with FSH-like activity) are given to the cow for inducing follicular maturation and super ovulation. Thus, instead of one egg, 6-8 eggs are produced per cycle.
- (ii) This cow is either mated with a superior bull or artificially inseminated.
- (iii) The embryos at 8-32 celled stage are recovered and transferred to surrogate mothers. This not only improves the herd size of cattle but also helps to obtain better breed in a short time.

18. (a) The causes of carbon dioxide fertilisation include deforestation, changes in land use, excessive combustion of fossil fuels and biomass, increase in industrial wastes and pollution, etc.

The effects of carbon dioxide fertilisation on plants are increase in rate of photosynthesis, increase in stomatal conductance, and reduced transpiration. This subsequently results in increased root growth, mycorrhizal development and more nitrogen fixation in root nodules of plants. Though all these factors enable the plants to grow more successfully in nutrient deprived soils as well as water scarce regions but these are nullified by negative effects of global warming.

(b) Accelerated eutrophication is nutrient enrichment of water bodies due to human activities like passage of sewage, agricultural waste and fertilisers.

Its consequences are :

- (i) Large amount of nutrients in water causes excessive growth of planktonic (free-floating) algae, called algal bloom which impart characteristic colour to water bodies.
- (ii) Depletion of oxygen content of water leading to the death of the aquatic organisms.

19. (a) The instrument shown is Gene gun.

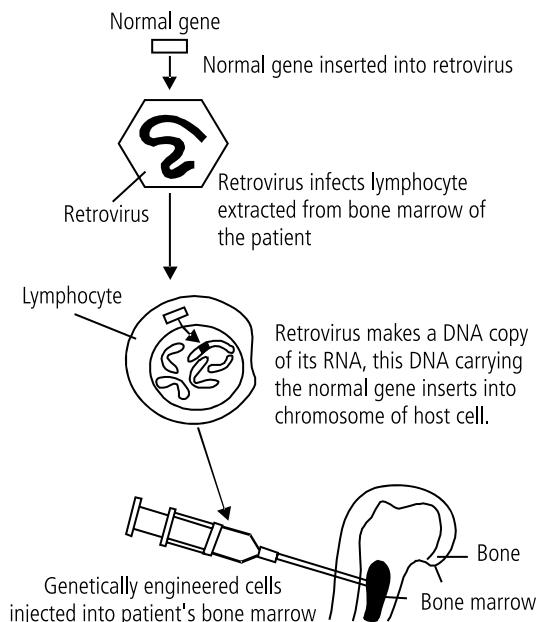
The labelled parts are : (P) Firing pin, (Q) DNA coated pellets (R) Vent, (S) Stopping plate and (T) Target cells.

- (b) Gene gun (or biolistic) method of gene transfer is a vectorless method of gene transfer in which tungsten or gold particles, coated with foreign DNA are bombarded into target cells at a very high velocity.
- (c) This method is suitable and advantageous for introducing desired genes into plant cells. It is also used to insert gene into animals which promote tissue repair into cells, near wound. It is also very useful in development of vaccine but could not be successful in treating genetic disorders.

OR

Gene therapy is the technique of genetic engineering to replace a faulty gene by a normal healthy functional gene. The first clinical gene therapy was given in 1990 to a 4 year old girl with adenosine deaminase deficiency (ADA deficiency). This enzyme is very important for the immune system to function. Severe combined immunodeficiency (SCID) is caused due to defect in the gene for the enzyme adenosine deaminase. SCID patient lacks functional T-lymphocytes and, therefore, fails to fight the infecting pathogens. Lymphocytes are extracted from the patient's bone marrow and a normal functional copy of human gene coding for ADA is introduced into these lymphocytes with the help of retroviral vector. The cells so treated are reintroduced into the patient's bone marrow. The lymphocytes produced by these cells contain functional ADA gene which reactivate the patient's immune system.

Since these cells are not immortal, the patient requires periodic infusion of such genetically engineered lymphocytes. However, if the gene isolated from bone marrow cells producing ADA is introduced into cells at early embryonic stages, it could be a permanent cure. Steps of gene therapy can be summarised in the given diagram:



20. Two principal procedures adopted for test tube baby programme are ZIFT (Zygote Intra Fallopian Transfer) and IUT (Intra Uterine Transfer). The procedure ZIFT involves fusion of ovum and sperm which is done outside the body of a woman, in the laboratory to form a zygote. The zygote is then allowed to divide forming 8 blastomeres and is transferred into the Fallopian tube. If the embryo is with more than 8 blastomeres it is transferred into the uterus known as Intra Uterine Transfer (IUT) to complete its further development. Thus, this involves *in vitro* fertilisation (IVF-fertilisation outside the body in almost similar conditions as that in the body) followed by embryo transfer (ET).

21. (a) Gene expression is the mechanism at the molecular level, by which a gene is able to express itself in the phenotype of an organism. The control over the functioning of genes is called regulation of gene expression.

(b) In eukaryotes, regulation of gene expression can be exerted at four levels:
 (i) transcriptional level, during formation of primary transcript.
 (ii) processing level like splicing, terminal additions or modifications.
 (iii) transport of mRNAs from the nucleus to the cytoplasm and
 (iv) translational level.

22. (a) Species area relationship of biodiversity was given by Alexander von Humboldt while he was exploring the South American jungles. He observed that within a region species richness increased with increasing explored area, but only up to a limit. The relationship between species richness and area for a wide variety of taxa turns out to be a rectangular hyperbola.

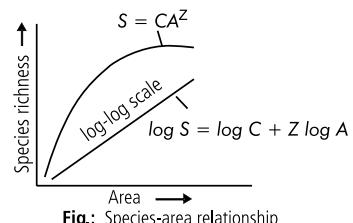


Fig.: Species-area relationship

On a logarithmic scale, the relationship is a straight line described by the equation

$$\log S = \log C + Z \log A$$

where

S = Species richness

A = Area

Z = Slope of the line (regression coefficient)

C = Y-intercept

(b) The value of Z lies in the range of 0.1 to 0.2, regardless of the taxonomic group or the region. But, if the species area relationship among very large areas like the entire continent is analysed, the slope of the line is much steeper. (Z values in the range of 0.6 to 1.2).

23. (a) Rahul is under the constant peer pressure from his friends, who go to late night parties, consume alcohol and take drugs. This might have forced him to do the same. The adverse effects of drugs and alcohol abuse are seen in the form of reckless behaviour, vandalism and violence. His drop in academic performance may be the warning signs of drug and alcohol abuse.

(b) The following are the measures that should be taken by parents to protect their children from substance abuse:-

- Education and counselling to face problems and stresses, and to accept disappointments and failures as a part of life.
- Help from parents and peers should be sought immediately by children, so, that they can be guided appropriately. Besides getting proper advise to sort out their problems, this would help young children to vent out their feelings of anxiety and guilt.
- Appropriate measures should be taken to diagnose the problem and the underlying causes. This would help in initiating proper remedial steps or treatment.
- A lot of help is available in the form of highly qualified psychologists, psychiatrists, de-addiction and rehabilitation programmes to help individuals who have unfortunately got in the habit of drug/alcohol abuse. With such help, the affected individual with sufficient efforts and will power, can get rid of the problem completely and lead a perfectly normal and healthy life.

24. (a) Spermatogenesis is the process of formation of haploid spermatozoa from diploid spermatogonia inside the testes of the male.

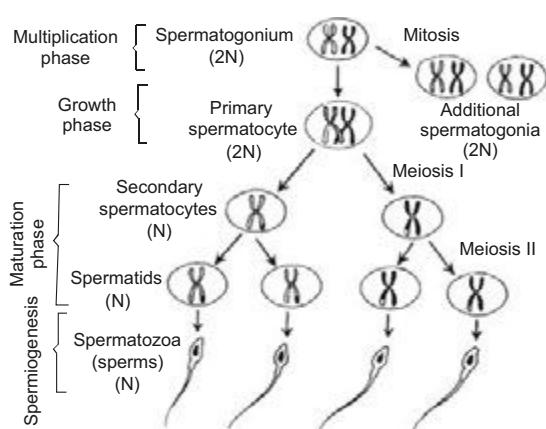


Fig.: Stages in spermatogenesis

It includes following three phases :

(i) Multiplication phase – At sexual maturity, the undifferentiated primordial germ cells divide several times by mitosis to produce a large number of spermatogonia or sperm mother cells. Spermatogonia (2N) are of two types

: type A spermatogonia and type B spermatogonia. Type A spermatogonia serve as the stem cells which divide to form second type of spermatogonia whenever required. Type B spermatogonia are progenitor cells which function as precursors of spermatozoa.

(ii) Growth phase – Each type B spermatogonium actively grows to a larger primary spermatocyte by obtaining nourishment from the nursing cells.

(iii) Maturation phase – Each primary spermatocyte undergoes two successive divisions, called maturation divisions. In the first maturation division (reductional or meiotic) the primary spermatocyte divides into two haploid daughter cells called secondary spermatocytes. Both secondary spermatocytes now undergo second maturation division which is an ordinary mitotic division to form four haploid spermatids, by each primary spermatocyte.

(b) Spermatogenesis in males begins during puberty while oogenesis in females begins during embryonic developmental stage.

(c) Spermatogenesis gets completed in seminiferous tubules of testes while oogenesis gets completed in Fallopian tube.

OR

(a) Most zygotes in angiosperms divide only after certain amount of endosperm is formed so as to obtain nutrition from the endosperm for the developing embryo.

(b) Micropyle remains as a small pore in the seed coat of a seed so as to allow the entry of water and oxygen into the seed at the time of germination.

Contributed by : Susan K Aby, Kerala, Siddharth Lenka, Odisha

SOLUTIONS TO DECEMBER 2016 CROSSWORD

1 A	2 C	3 R	0	4 M	E	5 G	6 A	L	Y																
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(c) The integuments of the ovule lose their protoplasm, develop thick and impermeable walls and get transformed into seed coats (*i.e.*, testa and tegmen). This is to protect the seed when it is in the state of dormancy and until favourable conditions return for germination.

(d) A dithecos (or bithecos) anther is the one that contains two anther lobes. Each anther lobe contains two microsporangia, thus a dithecos anther is tetrasporangiate. Most angiospermous flowers possess dithecos and tetrasporangiate anthers.

(e) The offsprings formed due to sexual reproduction contain the genetic material of both the parents, as they are formed by the fusion of gametes from different parents. Also the gamete formation (through meiosis) involves recombinations, resulting in variations. Variations are a major factor of natural selection and therefore the organisms produced due to sexual reproduction adapt better to the changing environmental conditions. In haplontic organisms (main body haploid), meiosis occurs after zygote is produced, hence variations arise at post fertilisation stage.

25. (a) Herbivores feed on plants only, therefore for plants herbivores are predators. Similarly, carnivores are predators for herbivorous animals but the difference lies in the fact that while herbivores can run away from their predators, plants being immobile cannot run away from its predators. Therefore, plants have evolved a vast array of morphological features *e.g.*, thorns, spines and chemicals such as toxins, nicotine, caffeine, opium, quinine etc., as a means of defense against their predators. This prevents such plants from being targeted by their predators. Thus, the herbivores and the plants show a normal prey-predator relationship as in an ecosystem.

(b) (i) Differences between mutualism and parasitism are:

	Mutualism	Parasitism
1.	It is an association between two organisms in which both are benefitted.	It is an interaction between two living organisms of different species in which one organism called parasite obtains its food from another living organism called host, <i>i.e.</i> , one is benefitted and other is harmed.
2.	Contact between the two organisms is obligatory.	Contact between host and parasite may be temporary or permanent.
3.	Nitrogen fixing blue-green alga or cyanobacterium called <i>Anabaena</i> is associated with water fern <i>Azolla</i> in a mutualistic interaction.	<i>E.g.</i> , <i>Cuscuta</i> is a total stem parasite, malarial parasite is found intracellularly (endoparasite) etc.

(ii) Differences between commensalism and amensalism are:

	Commensalism	Amensalism
1.	In this interaction one species gets benefitted and the other is neither harmed nor benefited.	In this interaction one species is harmed whereas the other is unaffected.
2.	For example, the pilot fish (<i>Naucrates ductor</i>) always accompanies shark and feeds upon the falling pieces of food when shark is eating the prey. The shark does not get any benefit from this association.	For example, <i>Penicillium</i> does not allow the growth of <i>Staphylococcus</i> bacterium. Inhibition is achieved through the secretion of chemicals called allochemicals.

(c) Brood parasitism in birds is an example of parasitism in which the parasitic bird lays its eggs in the nest of its host and the host incubates them. During the course of evolution, the eggs of the parasite bird have evolved to resemble the host's egg in size and colour to reduce the chances of the host bird detecting the foreign eggs and ejecting them from the nest, *e.g.*, cuckoo bird lays its eggs in the nest of crow, which is an example of brood parasitism.

OR

(a) Alien species are non-native species that are introduced inadvertently for economic or other purpose. Such species often becomes invasive and pose a major threat to local or native species, driving them away to limit of extinction. Such alien plant species introduced in India are *Parthenium hysterophorus*, *Eichhornia crassipes* and *Lantana camara*.

(b) The animals or species facing a high risk of extinction in the wild due to decrease in its habitat, excessive predation or poaching are called endangered. The two Indian endangered animals species are great Indian bustard and one-horned rhinoceros.

(c) Solar energy and wind energy are two such sources which provide an efficient power alternative that is clean, abundant and completely environment friendly. Technique of utilising solar energy involves capturing of solar radiations and converting them into usable forms of energy such as heat (or thermal) energy and light energy (or electricity). Wind is harnessed in a variety of ways (by a

ANSWERS

WHO AM I...

- | | |
|--------------------------------|--------|
| 1. Cyclic photophosphorylation | Pg. 12 |
| 2. CAM pathway | Pg. 18 |
| 3. Black buck | Pg. 60 |
| 4. <i>Pronuba yuccaselles</i> | Pg. 62 |

turbine, wind mill, etc.) to generate power (or electricity). Most desirable way of using the wind to generate electricity is by erecting wind turbines.

26. (a) (i) Rahul is suffering from Down's syndrome. The cause of this genetic disorder is the presence of an additional copy of the chromosome number 21 (trisomy of 21).

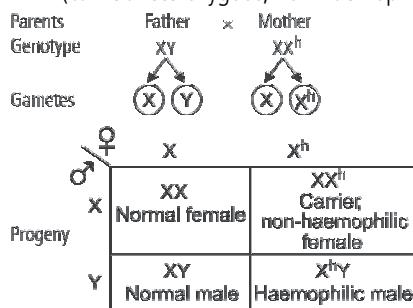
(ii) This disorder was first described by Langdon Down (1866).

(b) 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.

If the non-haemophilic parents give rise to a haemophilic child, the genotypes of them should be :

Father : XY (normal)

Mother : XX^h (carrier/heterozygous, non-haemophilic)



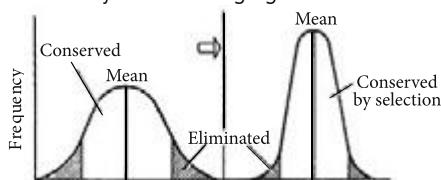
The genotypes and phenotypes of the progeny can be:

XX	XX^h	XY	X^hY	
Normal : Carrier,	: Normal	: Haemophilic		
female	non-haemo-	male	male	
philic female	philic			
1	:	1	:	1

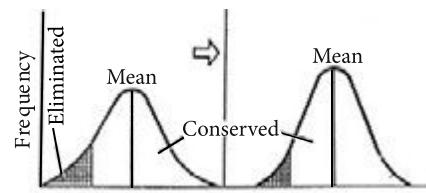
OR

The Hardy's -Weinberg Principle explains the stability of population and species over a number of generations. Natural selection affects Hardy Weinberg equilibrium in the following manner.

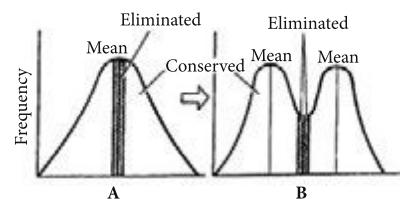
(i) Stabilising or Balancing selection: It favours the average or normal phenotypes and eliminates the extreme variants, that fall towards both ends of the bell-shaped curve. The bell shaped curve for the distribution of measurement of the phenotypic trait produced by stabilising selection can be represented by the following figure:



(ii) Directional or Progressive selection: It favours the phenotype which is extreme and then pushes the distribution curve of the phenotype, of the population, in that direction. Graph representing directional selection can be represented as:



(c) Disruptive or Diversifying selection: The extremes have more adaptable phenotypes than the average ones. Consequently, the original population is disrupted into two more separate groups that later evolve into new species. Graph representing disruptive selection can be represented as:



Other factors that may effect the genetic equilibrium are :

(i) Genetic drift : It refers to the elimination of genes of certain traits when a section of population migrates or dies of natural calamity. It alters the gene frequency of the remaining population.

(ii) Mutation : Gene mutation is a random change in the base sequence of a gene. It occurs by substitution, addition or deletion of one or more bases. This ultimately affects the allele's frequency in the population. The mutated gene may give rise to a new protein or may fail to produce any. This may change the phenotype (trait).

(iii) Gene flow : The phenomenon of addition or removal of alleles when individuals enter or leave a population is called gene flow. If interspecific hybrids are fertile these may lead to formation of new species hence disturbing genetic equilibrium.

(iv) Gene recombination : Addition of new alleles and combination of alleles to the gene pool is an important process during evolution which causes variations.



UNSCRAMBLED WORDS

DECEMBER 2016

- | | |
|---------------------|--------------------|
| 1-c-GIBBERELLINS | 2-f- INTERFERONS |
| 3-e- STATINS | 4-a-MYCOBIONT |
| 5-j- TRANSAMINATION | 6-b-BIOLISTIC |
| 7-i- RHODOSPIRILLUM | 8-d- ARBORICULTURE |
| 9-g- ANGINA | 10-h- ENCYSTATION |

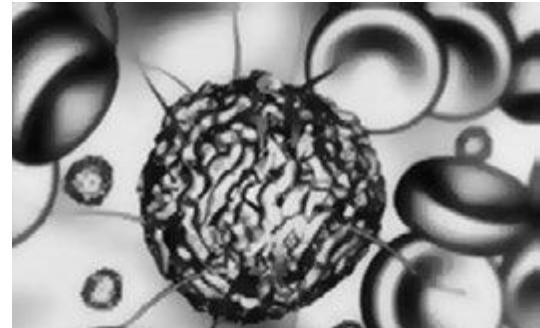
Winners : Mijan Ahamed Khan (West Bengal), Arghadeep Saha, Subham Sinha (Hooghly), Agniva Das (Medinipur)

BIO REPORTER

SYNTHETIC STEM CELLS AS GOOD AS NATURAL ONES

Scientists have developed a synthetic version of cardiac stem cells that offers therapeutic benefits comparable to those from natural ones. The synthetic stem cells are much more durable, have better preservation stability than natural stem cells, and could tolerate harsh freezing and thawing.

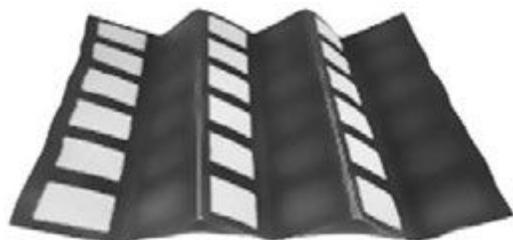
Researchers from the University of North Carolina, Chapel Hill, US and First affiliated hospital of Zhengzhou University, China fabricated a cell mimicking microparticle (CMMP) from poly(lactic-co-glycolic acid) (PLGA), a biodegradable and biocompatible polymer. Researchers also harvested growth factor proteins from cultured human cardiac stem cells and added them to the PLGA. Finally, they coated the particle with cardiac stem cell membrane. When tested *in vitro*, these particles were found to promote the growth of cardiac muscle cells that had been weakened by a heart attack.



Stem cell therapies repair damaged tissue, by secreting proteins and genetic materials. Bone marrow transplant is currently the most widely used form, often performed on patients with cancers of the blood or bone marrow such as leukemia. Traditional stem cell therapy comes with a risk of cancer because scientists are unable to stop the cells replicating and forming tumours. The man-made stem cells are partly constructed from CMMPs, so they do not amplify once implanted in patients reducing the risk of cancer. They are also designed to bypass the body's immune system in order to wipe out the probability of implants being rejected, means patients need not to find a close relative willing to be a donor. This research may be a step towards stem cell production that would enable people to receive beneficial stem cell therapies without costly delays.

BACTERIA POWERED PAPER BATTERY

Researchers at Binghamton University, State University of New York have created a stackable bacteria-powered battery on a single sheet of paper. It is a fully integrated self-powered system which can work as a low-cost, disposable diagnostic/clinical and analytical testing device in resource limiting and remote regions. The battery generates power from microbial respiration when one drop of bacteria containing liquid, which is easily available in the local environment such as municipal waste water, watershed, renewable water etc., is added. The researchers placed a ribbon of silver nitrate underneath a thin layer of wax to create a cathode on one half of a piece of chromatography paper. They then made a reservoir out of a conductive polymer on the other half of the paper, which acted as the anode. Once paper is properly folded and a few drops of bacteria-filled liquid are added, the battery is powered. The device requires layers to include components, such as the anode, cathode and PEM (proton exchange membrane). Scientists were able to generate 31.51 μW at 125.53 μA with six batteries and 44.85 μW at 105.89 μA in a 6x6 configuration. Millions of paper batteries are required to power a common 40-watt light bulb, but on the battlefield or in a disaster situation, it can be of more use. There is enough power to run biosensors that monitor glucose levels in diabetes patients, detect pathogens in a body or perform other life-saving functions.



Microbial fuel cell technology is being researched extensively as microorganisms can harvest electrical power from any type of biodegradable source. The battery on paper showed a very short start up time in comparison to conventional microbial fuel cells (MFCs). This type of paper biobattery can be a future power source for papertronics.



VIT UNIVERSITY LEADS THE RACE AS THE HIGHEST RESEARCH PAPER PUBLISHING UNIVERSITY IN INDIA



Vellore: Adding another feather to its cap, VIT University raced ahead of premier institutions in India in terms of number of research publications.

The institution stands top in the list of Educational Institutes with more than 700 papers in the year 2016. Based on Scopus Database as on 5.1.2017, VIT University has published 2,598 research papers.

VIT University marks a steady rise

Each year, VIT University's publication numbers have only increased. While in 2010 it was 441, in 2011, the university has 620 publications, followed by 906 in 2012, 1,704 in 2013, 2,015 in 2014 and 2402 in 2015. Last year, the university published 2,598 research papers.

Interestingly, a conscious effort to publish more research papers started in 2010.

The university's Chancellor Dr G. Viswanathan explains, "Then, the total number of publications was 441. We decided to give a push to encourage all professors and research students. We started to give them incentives to take up research to bring the institute onpar with top institutions in the country. Following this very effort, the university has today surpassed many expectations and is marching towards the pinnacle".

VIT Schools that are leading the race

Among the various schools in the university, the School of Advanced Sciences badges the top position in terms of publications. This was followed by the School of Bio Science & Technology.

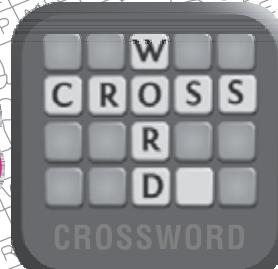
"The engineering schools have also started to contribute. The Curriculum for Applied Learning (CAL) system encourages the undergraduate and post graduate students also to take up research work. Next, we want to improve the quality of publications, then go for patents and products," Dr Viswanathan added.

Prof. G. Buvaneswari, Dean, Academic Research, VIT University, Vellore also added that the h-index, which measures the productivity and citation impact of the publications, was 59 last year as compared to 30 in 2011.

"The university provides research seed money for our faculty members. The faculty also get project funding from government agencies and more than 150 projects are ongoing. The university grants cash rewards for faculty and research scholars", she explained.



CROSS WORD

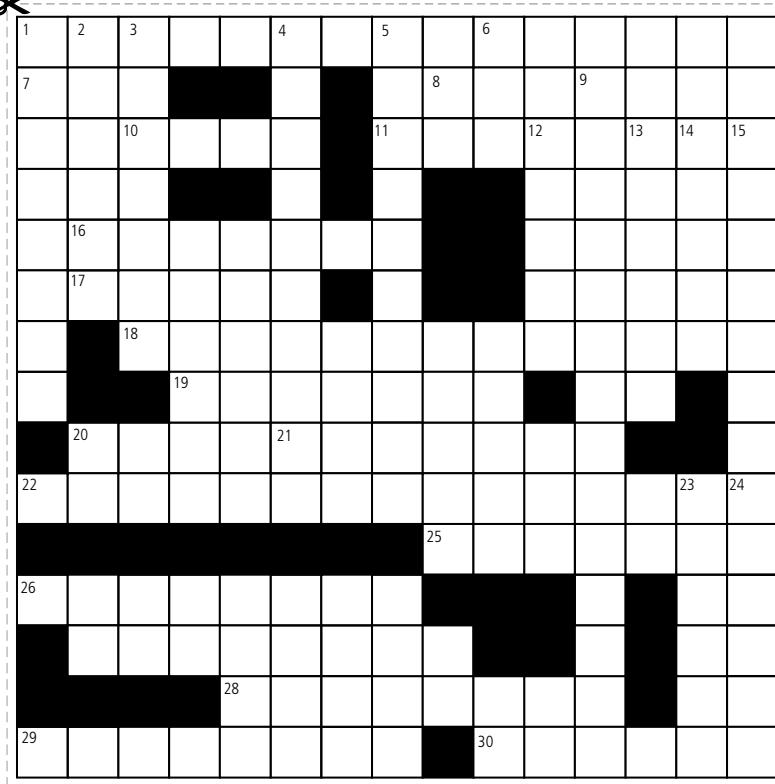


Readers can send their responses at editor@mtg.in or post us with complete address by 25th of every month to win exciting prizes.
Winners' names will be published in next issue.

ACROSS

- The technique of growing plants above the ground with roots suspended in air provided with fine mist of nutrient solution. (10)
- Sudden death of brain cells caused by lack of oxygen due to obstruction of blood flow. (6)
- The flora and fauna occurring in the bottom of a water body. (7)
- A type of false fruit, characteristic of apples and pears. (4)
- A gland in vertebrates lying between the duodenum and the spleen. (8)
- An elongated branched cell that is the fundamental unit of the nervous system. (6)
- An infectious protein that causes scrapie in sheep. (5)
- The transmission of characteristics or variations from parent to offspring. (8)
- The structure on the surface of an antigen that is recognised by specific antibody for binding. (7)
- The green fodder stored in airtight conditions to be used as food for farm animals. (6)
- All the genes contained in a single set of chromosomes. (6)
- A biomolecule formed by heteropolysaccharide chains cross-linked by short tetrapeptides. (13)
- A glucan synthesised by *Streptococcus mutans* used in blood transfusion. (7)
- A condition characterised by combination of hypoxia and hypercapnia. (8)
- A flexible tissue that holds two or more bones together at a moveable joint. (8)
- A hormone that hastens attainment of sexual maturity. (8)
- A renal disease in which volume of urine rises so much at night that the person is compelled to wake up to ease out. (8)
- The scientist who discovered pinocytosis. (5)
- DOWN**
- A series of acidic dyes used as a counter-stain with haematoxylin for colouring tissue smears and sections of animal tissue. (5)
- A ridge on a seed marking the line of fusion between an anatropous (inverted) ovule and the funicle. (5)
- A functionally integrated genetic unit commonly found in prokaryotes for the control of gene expression. (6)

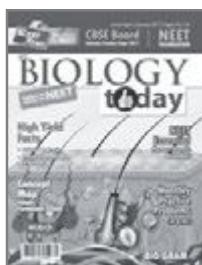
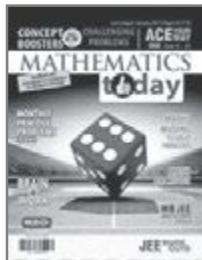
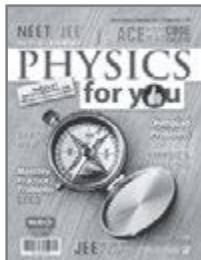
Cut Here



- The mechanical shaking that allows water and oxygen absorption in seeds to break seed coats and remove plugs. (9)
- The resemblance of one species to another or any natural object for the purpose of concealment and protection. (7)
- The loss of water vapour from plants to the atmosphere. (13)
- A white or pale yellow fluid taken up by the lacteals from the intestine. (5)
- The establishment of organisms in an area in which they came by dispersal or migration. (6)
- A contractile protein found in muscle tissue in the form of thin filaments. (5)
- A compound that functions both as neurotransmitter and a signal molecule. (9)
- A protective tissue, consisting of parenchyma cells that develops over a cut or damaged plant surface. (6)
- A storage polysaccharide present in roots and tubers of *Dahlia* that is used in the testing of kidney function. (6)



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