www.mtg.in | December 2017 | Pages 96 | ₹ 30

CBSE Board
Unitwise Practice Paper 2018

NCERT Xtract
New Questions for NEET

PMT
Practice Paper

MT

BIOLOGY today

India's #1 MONTHLY FOR NEET

Monthly Practice Problems
(XI & XII)

Biology Olympiad Problems

Concept Map
Asexual Reproduction

High Yield Facts
- Plant Kingdom
- Evolution-I

NEET Essential
Secondary Growth in Plants

2017100009374

ALLEN CAREER INSTITUTE
KOTA (RAJASTHAN)
path to success

www.onlinetestseries.in

ALERT!

The IIT Joint Admission Board (JAB) has announced that the Joint Entrance Examination (Advanced) will go online from 2018.

Don't panic! ALLEN Career Institute has always helped students for their right exam preparation with best resources prepared by ALLEN's Outstanding Academic and R&D team. JEE Advanced is going Online and to equip you with Exact Simulation for the Online Exam Temperament, ALLEN brings to you the Most Trusted and Advanced Online Test Series Platform **www.onlinetestseries.in**. Don't left behind; thousands are already Online ! Benchmark your Preparation Today with ALLEN !

Compete with Largest Pool of Talented Students (Inclusive our Classroom Students)

Full syllabus 12 Major Online Tests @ ₹600

Practice on exact Simulation of Online Exam

To know more logon to www.onlinetestseries.in

CORPORATE OFFICE : "SANKALP",CP-6, Indra Vihar, Kota-324005 (Raj.)
Email: support@onlinetestseries.in | **Website:** www.allen.ac.in | dlp.allen.ac.in

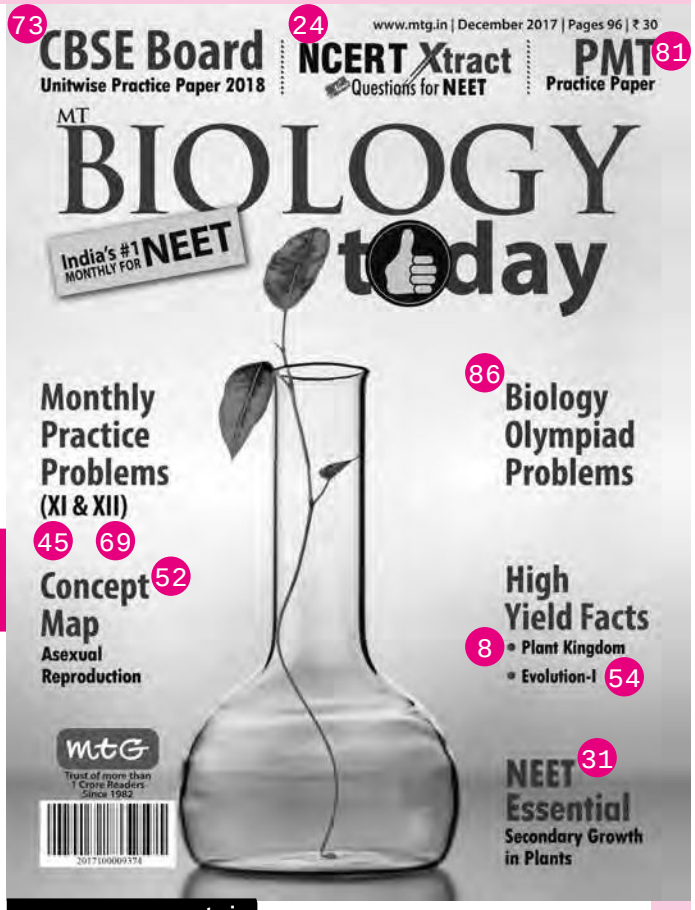
MT BIOLOGY today

Vol. XIX No. 12 December 2017

Corporate Office:
Plot 99, Sector 44 Institutional Area,
Gurgaon -122 003 (HR), Tel : 0124-6601200
e-mail : info@mtg.in website : www.mtg.in

Regd. Office:
406, Taj Apartment, Near Safdarjung Hospital,
Ring Road, New Delhi - 110029.
Managing Editor : Mahabir Singh
Editor : Anil Ahlawat

CONTENTS



Printed and Published by Mahabir Singh on behalf of MTG Learning Media Pvt. Ltd. Printed at HT Media Ltd., B-2, Sector-63, Noida, UP-201307 and published at 406, Taj Apartment, Ring Road, Near Safdarjung Hospital, New Delhi - 110029.
Editor : Anil Ahlawat

HIGH YIELD FACTS

Class XI

PLANT KINGDOM

Plant kingdom comprises of multicellular photosynthetic organisms constituting the predominant producers of the biosphere. They may be aquatic, terrestrial or may even occupy other habitats. They comprise of hundreds of thousands of different species. Owing to this vast diversity and number of species, various classification systems have been formulated from time to time. For example, Linnaeus (1754) divided plant kingdom into 25 classes on basis of number of stamens and carpels, their union and their presence or absence in a flower, etc. Linnaeus' system was wholly artificial, based on sexual characters of plants. Later, natural systems of classification were also proposed based upon knowledge and interpretation of structure and development of various plant groups.

Plant kingdom is classified based on phylogeny and inter-relationships into Cryptogamae and Phanerogamae.

Kingdom Plantae

Cryptogamae

- Plants called cryptogams do not bear seeds *i.e.*, they are seedless plants.
- Plant body does not bear flowers and fruits.

Thallophyta

- Plant body is undifferentiated and is known as thallus.
- It may range from microscopic unicellular to macroscopic multicellular forms.
- The plants are non-vascular and chloro-phyllous.
- It includes only algae.

Bryophyta

- Represent group of plants growing in amphibious habitat.
- They are simpler and smaller embryophytes.

Pteridophyta

- Referred as to first land to plants or vascular cryptogams as they possess xylem and phloem.

Phanerogamae

- Phanerogams are seed bearing plants.
- The plant body is differentiated into root, stem and leaves.
- They bear conspicuous reproductive structures like cones or flowers.
- These are vascular plants.

Gymnospermae

- Naked seed bearing plants.

Angiospermae

- Plants bear seeds enclosed within fruits.
- Most evolved group of plant kingdom.

Analysis of various PMTs from 2013-2017

	2013	2014	2015	2016	2017
AIPMT/NEET	4	4	1	4	–
AIIMS	1	2	3	2	2
AMU	1	–	1	–	–
Kerala	–	5	4	–	–
K-CET	2	2	–	–	–
J & K	–	2	–	–	–

ALGAE

Algae are chlorophyllous thallophytes characterised by absence of embryo stage and presence of non-jacketed gametangia with fertile cells.

- As per Linnaeus' two kingdom classification, all members of algae were grouped into plant kingdom along with bacteria and fungi.
- As per Whittaker's classification, the members of algae were grouped in three kingdoms *i.e.*, **Monera** (blue-green algae), **Protista** (dinoflagellates, diatoms, etc.) and **Plantae** (Rhodophytes, Phaeophytes and Chlorophytes).

General Characteristics

- **Habitat :** Algae are of universal occurrence and they are found in a variety of habitats, such as freshwater, sea water, on snow, on rocks and on/or within the plant and animal bodies. Of these, aquatic forms are most common.
- **Forms :** Algae may be unicellular, colonial, filamentous, siphonaceous or parenchymatous.
- The algal plant body is covered by mucilage which protects it from epiphytic growth and decaying effect of water.
- Vascular and mechanical tissues are absent, therefore the body is flexible and easily gets swayed without being torn.
- Nutrition is photosynthetic. Grana are absent in chloroplast. The chloroplast varies in appearance among different algal forms, *e.g.*, cup shaped, girdle shaped, reticulate or ribbon shaped, discoid, spiral and stellate.
- Algae contain chlorophyll *a, b, c, d, e,* carotenes and xanthophylls. Additional pigments like phycobilins, fucoxanthin occur in specific groups.
- Pyrenoids are associated with chloroplast for storage of starch. The reserve food may be starch, laminarin, mannitol, oil, fats, etc., which differ among different algal members.
- Vegetative and asexual modes of reproduction are present. Vegetative reproduction may take place by fragmentation (*e.g., Ulothrix, Oedogonium*), fission (*e.g.,Chlamydomonas*), hormogonia (*e.g., Oscillatoria*), tubers (*e.g., Chara*), budding (*e.g., Protosiphon*), etc.
- Asexual reproduction takes place by flagellated **zoospores** (*e.g., Ulothrix, Oedogonium*); non-motile, thin walled **aplanospore** (*e.g., Microspora*) and non-motile, thick walled hypnospores (*e.g., Pediastrum, Chlamydomonas nivalis*), thick walled akinetes (*e.g., Cladophora*), palmella stage (*e.g., Chlamydomonas*).
- Under favourable conditions, algae show sexual reproduction which may be isogamous or heterogamous (*i.e.*, anisogamous and oogamous). Sex organs are non-jacketed and one celled called gametangia.
- Life cycle may be haplontic, diplontic, haplobiontic and diplobiontic.

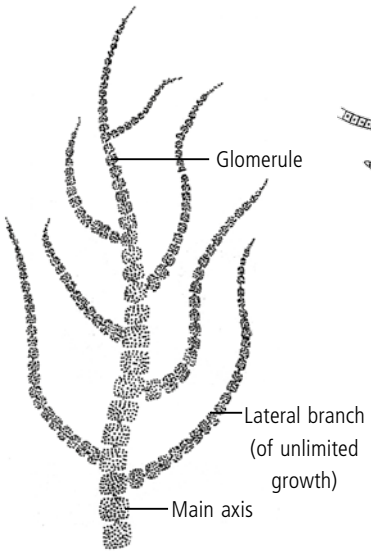


Fig.: *Batrachospermum*

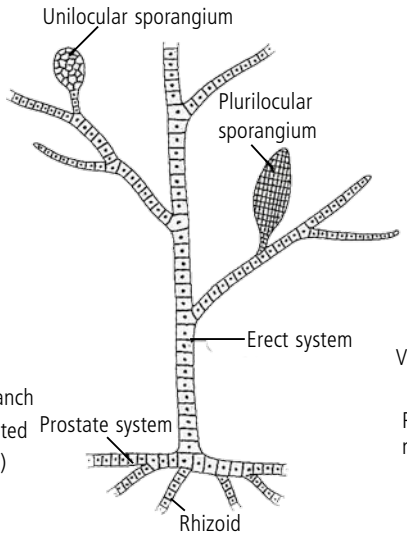


Fig.: *Ectocarpus*

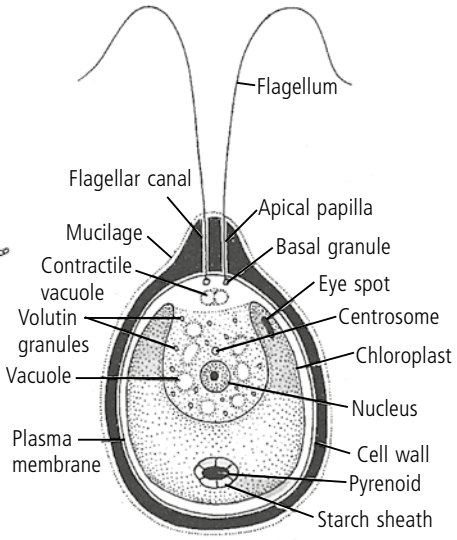


Fig.: *Chlamydomonas*

Algae of unusual habitats

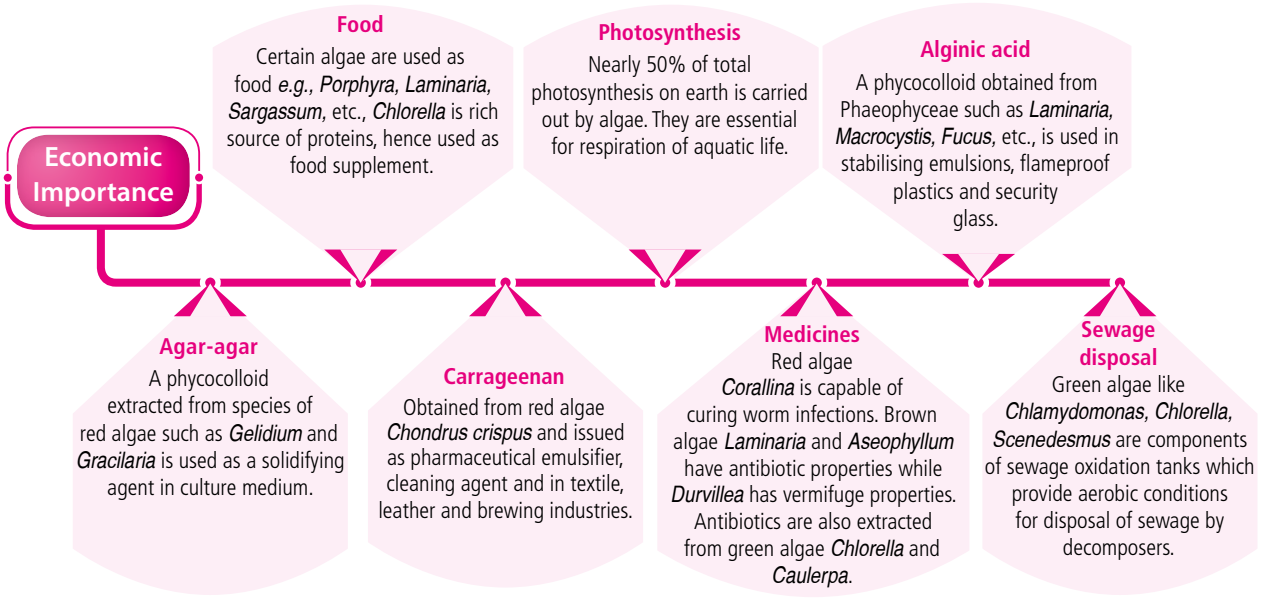
- **Halophytic algae -** Occur in saline sea water and salt lakes and can withstand high concentration of salts, *e.g.*, *Chlamydomonas ehrenbergii*, *Stephanoptera*.
- **Epiphytic algae -** Grow on larger algae, bryophytes and angiosperms, *e.g.*, *Oedogonium* and *Microspora* are found attached to larger species of *Vaucheria*, *Cladophora* and *Rhizoclonium*.
- **Epizoic algae -** Grow on animals such as snails, fishes and tortoise, *e.g.*, *Cladophora crispata* (epizoic on snail).
- **Endozoic algae -** Occur in tissues of animals, *e.g.*, *Zoochlorella* in *Hydra viridis*.
- **Cryophytic algae -** Grow on ice or snow and impart attractive colours to snow covered mountains, *e.g.*, *Haematococcus nivalis* imparts red colour to alpine and arctic mountains while *Chlamydomonas yellowstonensis* and *Mesotaenium* species are responsible for green snow in Europe.
- **Parasitic algae -** Grow as parasites on many plants and animals, *e.g.*, *Cephaleuros virescens* causes red rust in tea and coffee plantations.
- **Thermophytes -** Occur in hot water springs (50-70°C temperature) as are able to survive high temperatures due to absence of well organised nucleus, *e.g.*, *Oscillatoria brevis*, *Heterohormogonium* sp.

Classification of Algae

- Based upon phylogeny, affinities and interrelationships, algae is classified into various classes by **Dr. F. E. Fritsch**. However, according to Whittaker's system of classification, algae are mainly divided into three classes: Chlorophyceae, Phaeophyceae and Rhodophyceae.

Table: Characteristics of different classes of algae

Classes	Structure	Occurrence	Major pigments	Reserve food material	Reproduction		
					Vegetative	Asexual	Sexual
Chlorophyceae, (Green algae) *e.g.*, *Spirogyra*, *Ulothrix*	Unicellular, colonial, coenobial, filamentous, siphonaceous. Cell wall cellulosic and pectic, pyrenoid single or compound, embedded. Motile cells with 2-4 equal flagella.	Mostly fresh-water, a few marine. A marked tendency towards terrestrial habitat.	Chl. *a* and *b*, carotenes and xanthophyll.	True starch and sugar.	Fragmentation or fission.	Zoospores.	Isogamous to advanced oogamous.
Phaeophyceae (Brown algae) *e.g.*, *Fucus*, *Sargassum*	Filamentous branched, usually heterotrichous, outer layer of cell wall composed of alginic and fucinic acids and inner layer is cellulosic, motile cells with 2 lateral flagella, pyrenoid single, stalked or projected.	Mostly marine.	Chl. *a* and *c*, fucoxanthin, flavoxanthin, β-carotenes.	Laminarin, mannitol.	Fragmentation or adventitious branching.	Zoospores, aplanospores, etc.	Isogamous to oogamous.
Rhodophyceae (Red algae) *e.g.*, *Polysiphonia*, *Porphyra*	Unicellular, filamentous or pseudoparenchymatous, cell wall cellulosic and pectic, motile cells not known, pyrenoids simple or compound, embedded sometimes stalked.	Mostly marine.	Chl. *a* and *d*, phycoerythrins, phycocyanin, allophycocyanin, carotenoids.	Floridean starch.	Fragmentation.	Monospores, carpospores, etc.	Advanced oogamous type.



BRYOPHYTES

- Bryophytes are non-vascular terrestrial plants of moist habitats in which a multicellular diploid sporophyte lives as a parasite on an independent multicellular haploid gametophyte. It includes over 25,000 species. This group requires water for fertilisation, therefore called as **"amphibians of plant kingdom"**.

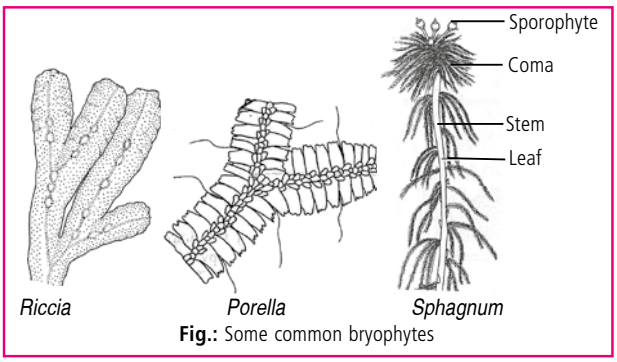


Fig.: Some common bryophytes

General Characteristics

- Bryophytes live in damp and shady habitats, often found in rainy season forming green carpets or mats on damp soil, rocks, walls, tree trunks, etc.
- The dominant phase of the plant is a free living gametophyte.
- Rhizoids (instead of roots) are present. They may be unicellular or multicellular.
- Vegetative reproduction is quite common. It may take place by fragmentation, tubers, gemmae buds, adventitious branches, etc.
- Accessory spores are not formed.
- Sexual reproduction is oogamous *i.e.*, fusion of a non-motile passive egg cell and biflagellated active male gamete.
- Sex organs are multicellular and jacketed and are of two types : **antheridium** (male) and **archegonium** (female).
- Antheridium produces a number of flagellated male gametes called sperms or antherozoids.
- Archegonium is flask shaped with tubular single layered neck (having 5-6 rows of cells) and a swollen venter (1-2 layered wall) enclosing a sterile venter canal cell and a fertile egg.
- The sterile neck canal cells and venter canal cells of archegonium degenerate, gelatinise, absorb water and swell up into mucilage. It opens the lid of neck and leads a passage upto oosphere.
- An external layer of water is essential for the swimming of male gametes to archegonia.

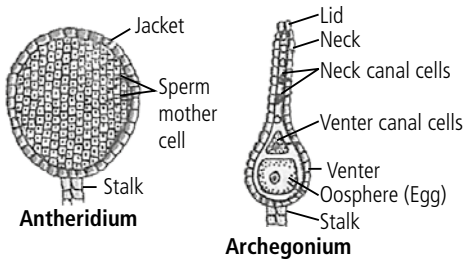


Fig.: Antheridium and archegonium

- Fertilisation leads to formation of embryo inside archegonium. The embryo grows into a sporophyte, which is parasitic on gametophyte. Since it is dependent on gametophyte, it is called **sporogonium**.

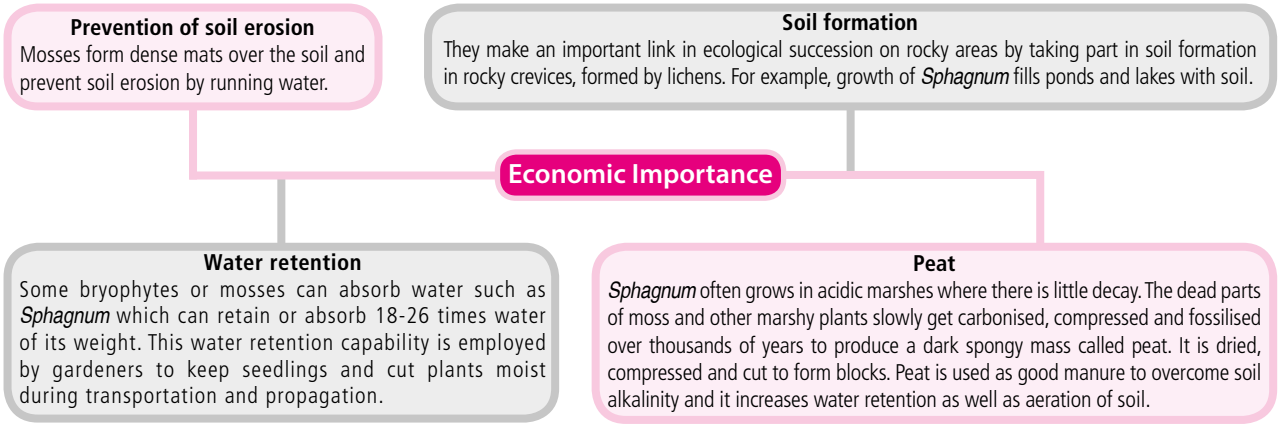
- Sporophyte consists of foot, seta and capsule. In some members, however, the sporophyte is represented either only by capsule or by foot and capsule.
- Sporogonium produces haploid meiospores inside its capsule. On germination, each spore produces a gametophyte either directly or through a juvenile stage called **protonema**.
- Bryophytes show heteromorphic or heterologous alternation of generations.

Classification of Bryophytes

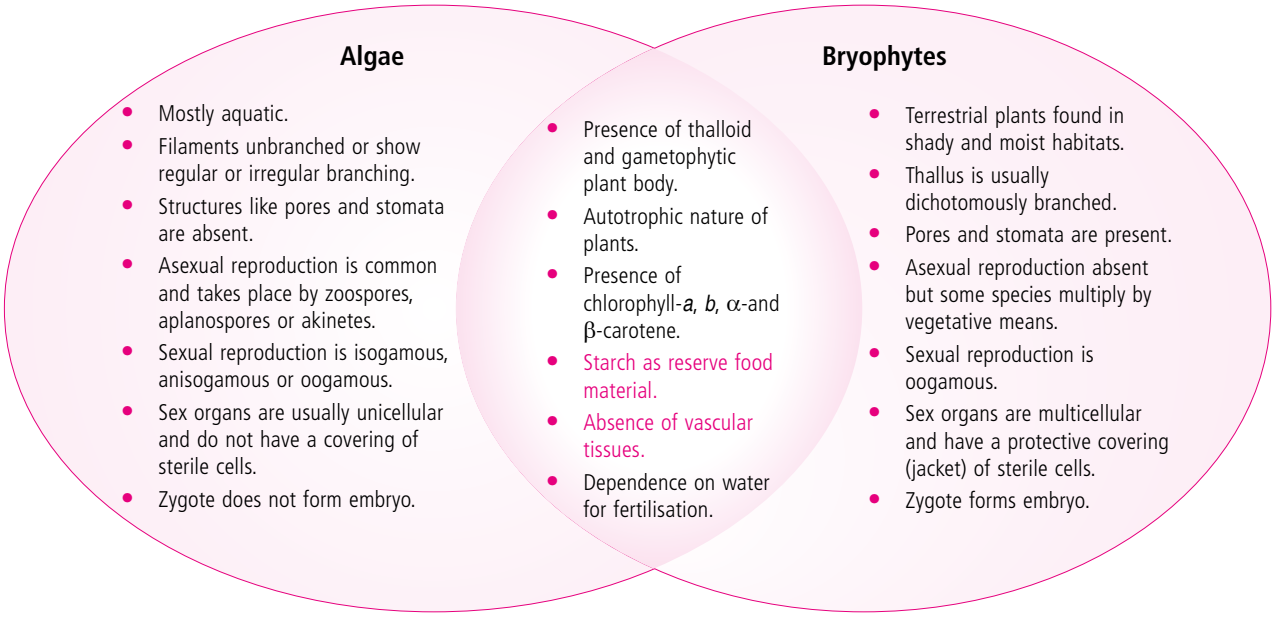
Table: Characteristics of different classes of bryophytes

Features	Hepaticopsida	Anthoceropsida	Bryopsida
Common name	Liverworts	Hornworts	Mosses
Gametophytic plant body	May be thallose or foliose, unicellular and unbranched, smooth walled and tuberculated rhizoids.	Thallose, unicellular, unbranched, smooth walled and rhizoids.	Gametophyte has two growth stages: thalloid protonema stage and leafy gametophore stage. Rhizoids are multicellular, branched with oblique septae.
Sex organs	Present on dorsal surface of thallus.	Present on dorsal surface of thallus.	Develop from the superficial cells at the apex of leafy gametophore.
Sporophyte or sporogonium	Simple, represented by capsule only *e.g., Riccia* or differentiated into foot, seta and capsule, *e.g., Marchantia*.	Differentiated into a bulbous foot, small meristematic seta and long cylindrical capsule.	Differentiated into foot, seta and capsule.
Elaters	Generally present, absent in some like *Riccia.*	Pseudoelaters are present in the capsule.	Absent.
Sporogenous cells	Develop from endothecium.	Develop from amphithecium whereas endothecium forms sterile columella.	Develops from inner fertile layer of amphithecium, whereas endothecium forms sterile columella.
Examples	*Riccia, Marchantia, Sphaerocarpos*, etc.	*Anthoceros, Notothylas, Megaceros,* etc.	*Sphagnum, Polytrichum, Funaria,* etc.

Economic Importance of Bryophytes



Affinities of Bryophytes with Algae



PTERIDOPHYTES

- Pteridophytes are seedless vascular plants, *i.e.*, vascular cryptogams having sporophytic main plant body and inconspicuous gametophyte. They are called as "Botanical snakes", evolved after amphibians (bryophytes).

General Characteristics

- They grow in a variety of habitats but mostly they are terrestrial plants that thrive well in abundant moisture and shade while some flourish well in xeric conditions.
- The sporophytic plant body is differentiated into true roots, stem and leaves.
- On the basis of leaf structure, pteridophytes may be **microphyllous** (having simple leaves with single vein, which do not form leaf gaps in the stem stele), *e.g., Equisetum* and **megaphyllous** (having pinnatified leaves with complex sereis of veins that form prominent leaf gaps in the stem stele), *e.g., Pteris*.
- The branching of the stem may be dichotomous type or monopodial.
- Pteridophytes show presence of vascular tissues, *i.e.*, xylem and phloem. In xylem, true vessels are absent while in phloem, companion cells and sieve tubes are absent.
- The vascular system of pteridophytes varies in different groups showing stelar system ranging from simple protostele, siphonostele or a dictyostele.
- They reproduce asexually by means of spores, produced in small capsules called sporangia. Leaves bearing sporangia are called **sporophylls** which may be widely scattered or clustered in definite areas and structures called **cones** or **strobili**.

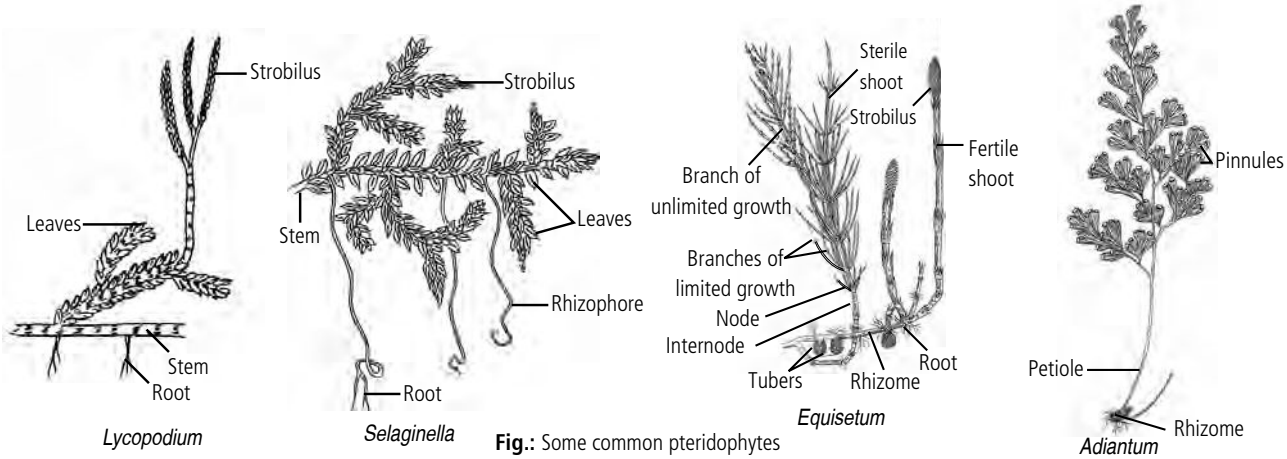


Fig.: Some common pteridophytes

- The diploid spore mother cells or **sporocytes** within the sporangia undergo meiosis or reduction division to form spores. These spores may be similar as in majority of pteridophytes called **homosporous** *e.g.*, *Lycopodium* and *Dryopteris* or different with two types of spores (microspores and megaspores) called **heterosporous** *e.g.*, *Selaginella* and *Salvinia*.
- Spores upon germination give rise to haploid gametophytes or prothallus bearing multicellular, jacketed sex organs.
- Gametophytes formed from homospores are **monoecious** (both antheridia and archegonia are borne on same prothallus) while those formed from heterospores are **dioecious** (antheridia and archegonia develop on separate male and female prothallus).
- Antheridia are small and sessile comprising of androcytes, each of which produces a motile antherozoid. Archegonia are partially embedded and consist of 4-rowed neck.
- Water is essential for fertilisation, as it assists in carrying bi-or multiflagellate sperms to archegonia.
- Pteridophytes exhibit alternate succession of sporophytic and gametophytic generation.

Evolution of Seed Habit

- The ability of plant to form seed is called seed habit. It is considered to have originated in pteridosperms during Devonian-carboniferous periods. The development of zygote into young embryo within female gametophyte in heterosporous plants *e.g.*, *Selaginella* is a precursor to the evolution of seed habit.
- The differentiation of spores into microspores and megaspores and their dependence on the parent sporophyte for the nutrition are certain features considered as pre-requisites for the formation of seeds.

Classification of Pteridophytes

Pteridophyta

Psilophytopsida
- These are **oldest** and simplest vascular plants.
- All members are extinct.
- Plant body was sporophytic, stem dichotomously branched.
- Rootless, rhizoids were present.
- **Homosporous**
- Their gametophytes are not known.
- *E.g., Rhynia, Homeophyton,* etc.

Lycopsida
- Commonly called **club mosses** or **spike mosses**.
- Roots, stem and leaves are present.
- Members are microphyllous.
- **Homosporous** (*Lycopodium*) or **heterosporous** (*Selaginella*).

Sphenopsida
- At nodes, whorls of small leaves are present.
- Sporangia develop stalked sporangiophores bearing compact strobilus at tips.
- Ridges and grooves are found in stem.
- Always **homosporous**, *e.g., Equisetum.*

Pteropsida
- Largest and most highly evolved group.
- Sporangia develop in groups called sori on ventral surface of leaves.
- **Homosporous** (*Dryopteris, Pteris*) or **heterosporous** (*Marsilea*).

Economic Importance of Pteridophytes

Economic Importance

Food
Pteridophytes constitute a good source of food to animals. Sporocarps of *Marsilea* are cooked and eaten by certain tribals.

Binding of soil
Pteridophytes bind the soil even along hill slopes, thus, preventing soil erosion.

Scouring
Stems of some plants are used in scouring or cleaning of utensils and polishing of metals, *e.g., Equisetum.*

Nitrogen fixation
Some ferns *e.g.,* water fern *Azolla* form symbiotic association with nitrogen fixing cyanobacterium *Anabaena azollae*. These are used as biofertilisers in paddy fields.

Medicines
Rhizomes of male shield fern are used to obtain anti-helminthic drug. *Equisetum* is used in preparation of diuretic, haemostatic and haemopoietic drugs.

Ornamentals
Ferns are known for their attractive foliage, hence are grown as ornamental plants and used in bouquets and floral decorations.

Affinities of Pteridophytes with Bryophytes

Bryophytes

- Gametophyte is the dominant phase in the life cycle.
- Plant body is thalloid or foliose.
- Vascular tissue is absent.
- Sporophyte is completely dependent upon the gametophyte.

- Jacketed sex organs.
- Flagellated male gametes.
- Fertilisation in film of water.
- Encapsulation of embryo in archegonium.
- Heteromorphic alternation of generation.
- Sexual reproduction oogamous; the male and female reproductive structures are known as antheridia and archegonia respectively.

Pteridophytes

- Sporophyte is the dominant phase in the life cycle.
- Plant body is differentiated into root, stem and leaves.
- Vascular tissue is present.
- Sporophyte is autotrophic and independent.

Stelar System in Pteridophytes

The central vascular cylinder of primary axis of pteridophytes is usually referred to as stele. It is delimited from cortex by the pericycle and includes xylem, phloem and pith (if any). According to stelar theory proposed by Van Tieghem and Douliot (1886), stele is the fundamental unit of vascular system. According to Schmidt (1982), two main types of stele are recognised in pteridophytes.

Protostele

- Non-medullated stele, comprising of a central core of xylem, surrounded by phloem.
- Considered to be most primitive both phylogenetically and ontogenetically.

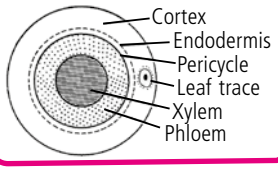
Siphonostele

- Medullated stele, comprises of a modified protostele with a central pith.
- More advanced than protostele.

Types of Protostele

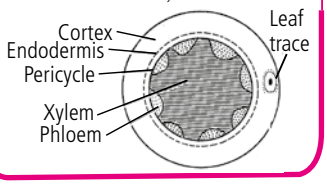
Haplostele

- Simplest, primitive type of stele.
- Consists of solid xylem core surrounded by ring of phloem.
- Found in *Psilotum, Selaginella, Lycopodium.*



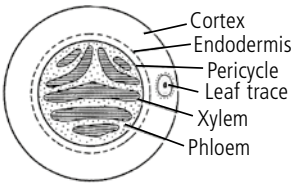
Actinostele

- Xylem is star shaped with many radiating arms.
- Phloem is present in small patches in between the radiating arms of xylem.
- Found in *Psilotum, L. serratum.*



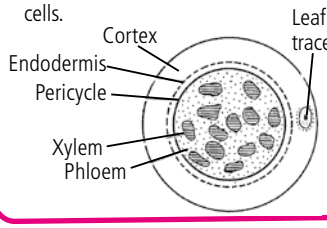
Plectostele

- The central xylem core breaks into more or less parallel plates, each of which is surrounded by phloem.
- Found in *L.clavatum* and *L. volubile.*



Mixed protostele

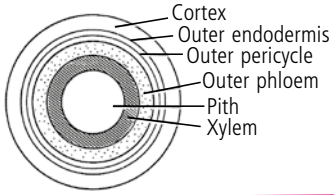
- The solid xylem core is broken into small groups of tracheids that remain embedded in phloem.
- Comprises of mixed pith *i.e.*, groups of tracheids intermixed with parenchyma cells.



Types of Siphonostele

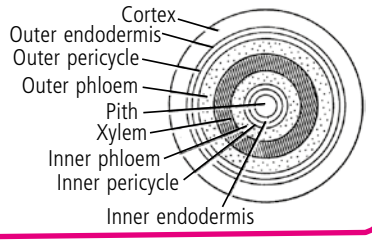
Ectophloic siphonostele

- Steles have a single phloem ring external to xylem.
- *E.g., Equisetum, Osmunda,* etc.



Amphiphloic siphonostele

- Steles have a ring of phloem each external and internal to the xylem.
- Characteristically have two endodermal layers- outer endodermis - lies outside the outer phloem and inner endodermis - lies inner to inner phloem, outside the pith.



GYMNOSPERMS

- Gymnosperms are plants with naked seeds, having freely exposed ovules on megasporophylls. They are referred to as **phanerogams without ovary** and act as connecting link between pteridophytes and angiosperms.

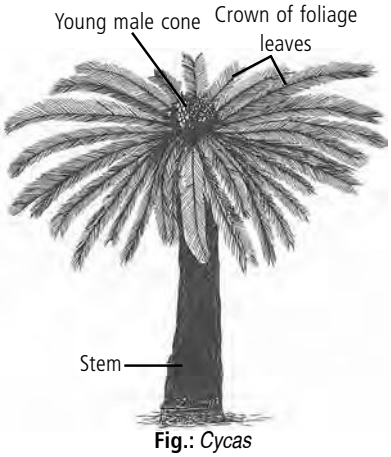


Fig.: *Cycas*

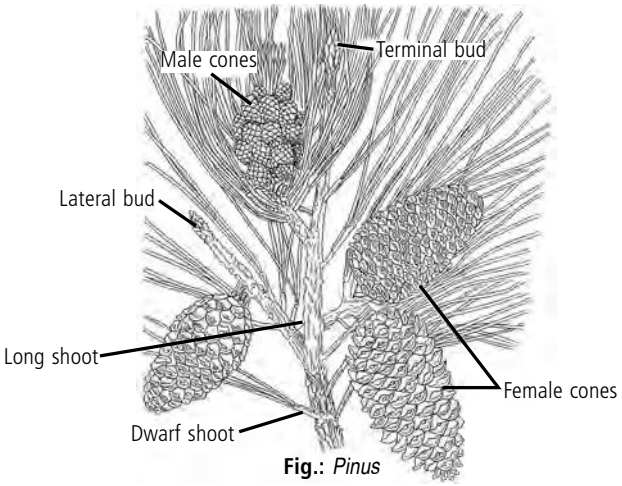


Fig.: *Pinus*

General Characteristics

- There are about 70 genera and 725 species of living gymnosperms distributed throughout the temperate and tropical regions of the world.
- Sporophyte is dominant and differentiated into root, stem and leaves. Usually tap roots are present. Roots of some taxa have symbiotic relationship with algae (*e.g.*, coralloid roots of *Cycas*) or fungi (*e.g.*, mycorrhizal roots of *Pinus*.) Stem is erect, aerial and woody. It may be branched or unbranched.
- Leaves are dimorphic *i.e.*, foliage and scale leaves. Flowers are absent, instead sporophylls, *i.e.*, microsporophylls and megasporophylls are aggregated to form distinct **cones** or **strobili**.
- Plants may be dioecious (*e.g., Cycas*) or monoecious (*e.g., Pinus*) and are heterosporous producing microspores and megaspores.
- Gametophytic generation is much reduced. The pollen grain forms the first male gametophyte while the female gametophyte is represented by functional megaspore.

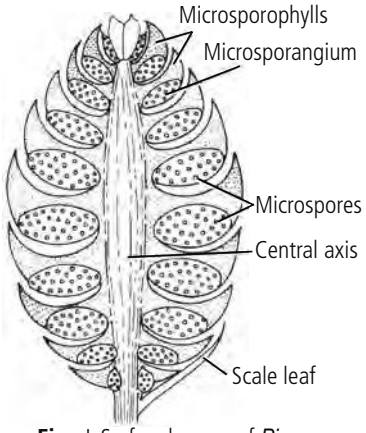


Fig.: L.S of male cone of *Pinus*

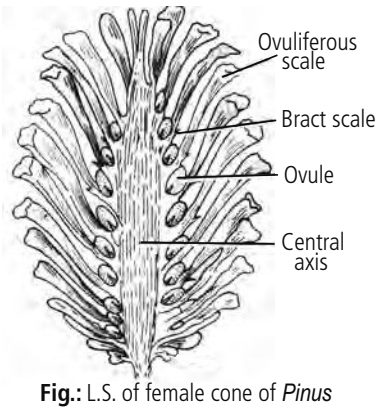
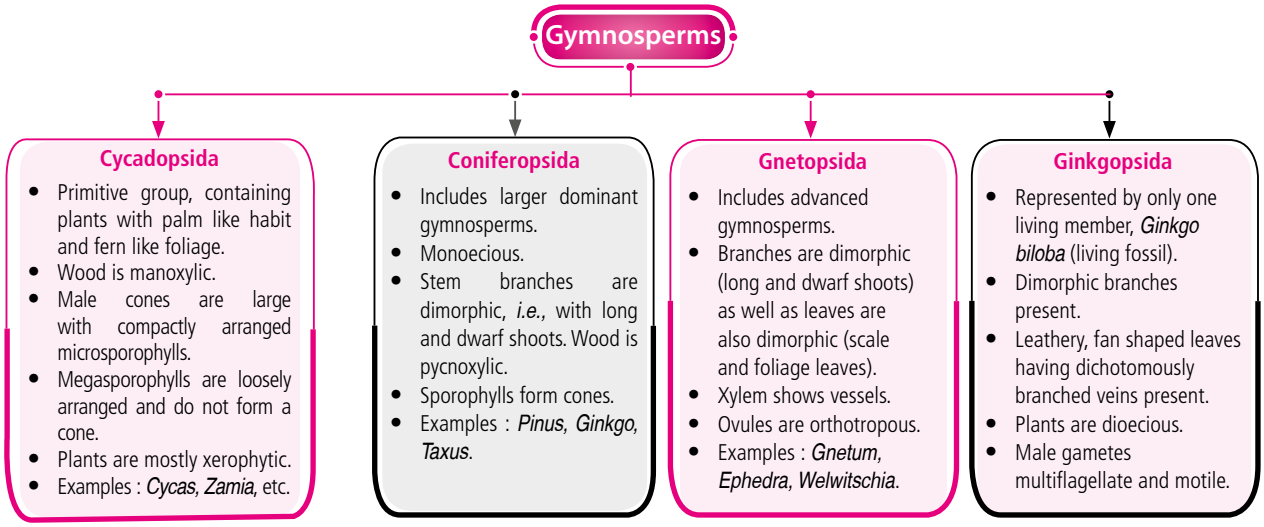


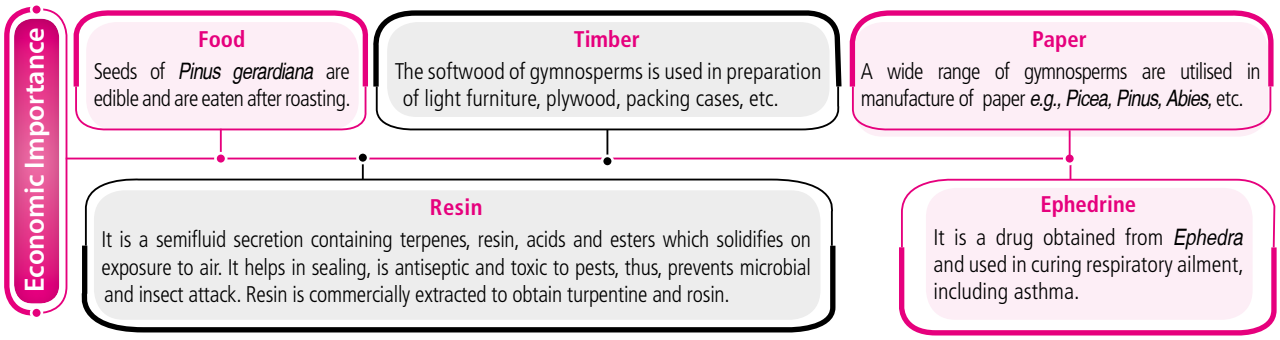
Fig.: L.S. of female cone of *Pinus*

- Pollination takes place by wind and pollen grains directly reach the ovules. The male gametes reach the female gamete by forming a tube *i.e.*, **siphonogamy**, to affect fertilisation.
- Endosperm is gametophytic and derived from female gametophyte. Polyembryony is common in *Pinus*. Naked ovule develops into seed, the ovular integuments form seed coat. The number of cotyledons may be one or two or a whorl of many.
- Fruits are not formed due to absence of ovary.
- Xylem does not possess vessels (except in Gnetales) and phloem does not possess companion cells and sieve tubes.
- Vascular bundles are open in stem, thus secondary growth is present.

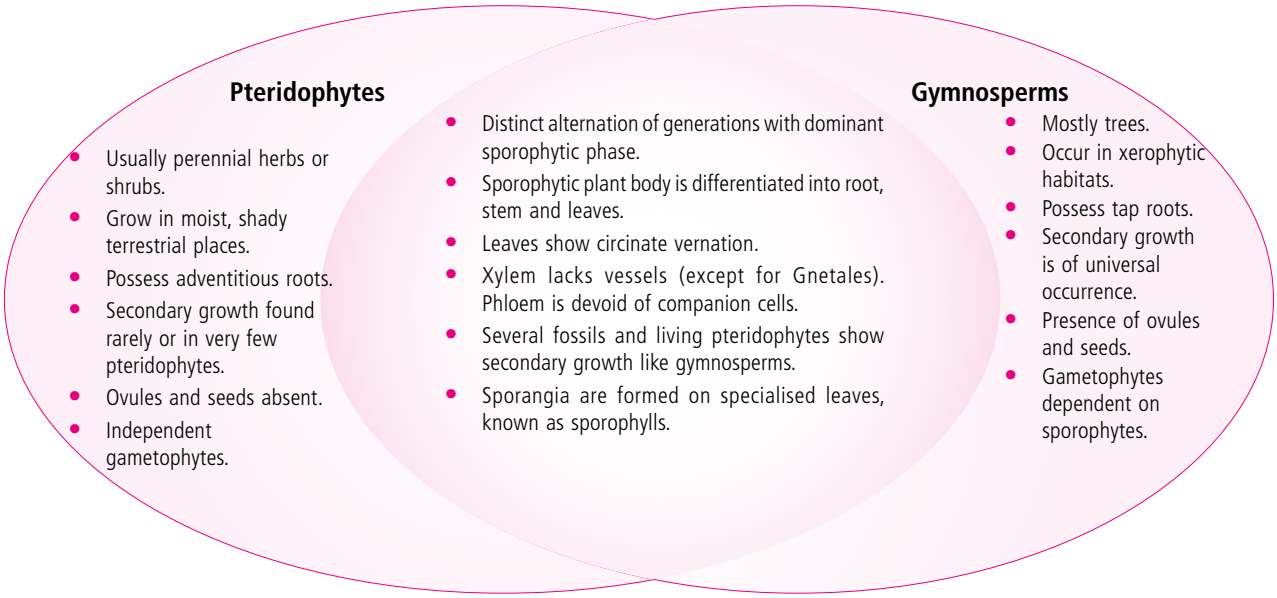
Classification of Gymnosperms



Economic Importance of Gymnosperms



Affinities of Gymnosperms with Pteridophytes



ANGIOSPERMS

- Angiosperms are seed plants in which sporophylls are organised into flowers and seeds are produced inside fruits. They are the most highly evolved plants and form the dominant vegetation of present day earth.

General Characteristics

- Angiosperms or flowering plants occur in most environments on the earth.
- Plant body is sporophytic and represented by herbs, shrubs, trees, twiners, trailers, climbers, etc.
- Sporophyte is differentiated into roots, stem and leaves.
- Xylem possesses tracheids and vessels while phloem possesses sieve tubes and companion cells. Vascular bundles are conjoint and collateral and open in dicots, hence show secondary growth.
- Sporophylls are aggregated to form flowers. Both microsporophylls and megasporophylls are specialised to form stamen and carpel, producing male and female gametes respectively.
- Archegonia is absent and female gametophyte is represented by embryo sac.
- Pollination takes place by several agencies *viz.*, wind, water, animals, etc.
- **Double fertilisation** is characteristic feature of angiosperms, wherein of two male gametes, one fuses with egg to form zygote while other fuses with central cell to form PEN (Primary endosperm nucleus).
- Endosperm is triploid, formed after fertilisation and represents a new structure.
- The ovary develops into fruit and ovules ripen into seeds, after fertilisation. This is another peculiar feature of angiosperms.

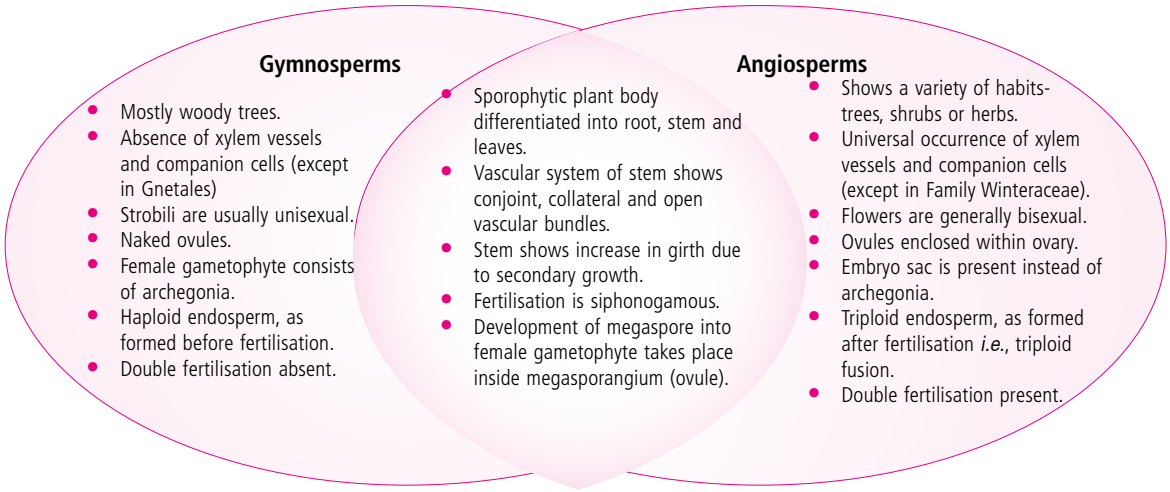
Classification of Angiosperms

- Angiosperms are divided into two sub-groups – dicots (two cotyledons) and monocots (single cotyledon).

Table: Comparison between dicots and monocots

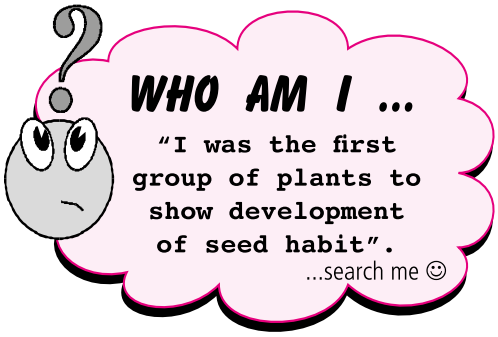
Features	Dicots	Monocots
Cotyledons	Usually two	One cotyledon
Flowers	Penta or tetramerous	Trimerous
Pollen grains	Three germ pores	Single germinal furrow
Venation	Reticulate	Parallel, except a few
Primary root	Often long lived forming tap root system. Adventitious roots occur in some.	Short-lived, tap roots absent, instead adventitious roots are found.
Stem tissue	Concentric arrangement of tissue system *viz.* epidermis, cortex, endodermis, pericycle, pith, etc.	Tissue system undifferentiated, a ground tissue occurs.
Vascular bundles of stem	Arranged in a ring and possess cambium (open), thus, secondary growth present.	Scattered, cambium is absent (closed).
Root	Pith absent or small. Vascular bundles 8 or less.	Pith present. Vascular bundles more than 8.
Xylem vessels	Polygonal in outline.	Rounded in outline.

Affinities of Angiosperms with Gymnosperms



ALTERNATION OF GENERATION

- Different plant groups complete their life cycles in different patterns. The phases in which the life cycle is completed follow each other rigidly. This is called alternation of generations.
- Life cycle may be of three types: haplontic, diplontic and haplodiplontic.
- There is a single vegetative individual or somatic phase. It is haploid and is often called gametophyte. The haploid plant body may be unicellular, colonial or multicellular.
- It gives rise to haploid gametes. The gametes fuse and produce a diploid zygote. The zygote remains single-celled. It does not multiply itself, neither does it give rise to a multicellular diploid structure. Instead it may take some rest. Meiosis occurs at the time of zygote germination. Four haploid nuclei are formed as a result. Three of them degenerate in some cases and the haploid protoplast of the zygote gives rise to new plant.



- In others the protoplast of the zygote cleaves into four meiospores.
- The latter may divide further into 8-16 spores before liberation. An alternation of generations is absent since the plant does not have two cytologically distinct somatic phases.
- **Haplontic life cycle** occurs in many algae such as *Volvox, Spirogyra* and *Chlamydomonas*, etc.
- There is a single somatic phase or vegetative individual. It is diploid and is often called sporophyte though it produces gametes in its body or sex organs. The diploid plant body is elaborated by the growth of the diploid zygote. It may multiply vegetatively and by producing accessory spores. Meiosis occurs in the plant body or its sex organs at the time of gamete formation. Therefore, the gametes are the only haploid structures in the life. They fuse during fertilisation and give rise to the diploid individual of the progeny. Alternation of generations is absent in diplontic life history.
- **Diplontic life cycle** occurs in *Fucus, Cladophora, Cauterapa*, etc.
- This type of life history involves the sequential recurrence of two well developed somatic phases or vegetative individuals, gametophyte and sporophyte. The sporophyte possesses diploid chromosome number (2n). Meiosis takes place in it at the time of formation of meiospores. The haploid meiospores germinate to produce haploid gametophytes. The gametophytes produce gametes. The fusion product of gametes is a diploid zygote which develops into the sporophytic thallus of the progeny. There is thus a clear alternation of generations between a haploid gamete producing gametophyte and a diploid spore producing sporophyte in diplohaplontic life history.
- **Haplodiplontic life cycle** occurs in bryophytes, pteridophytes and some algae such as *Dictyota*.

SPEED PRACTICE

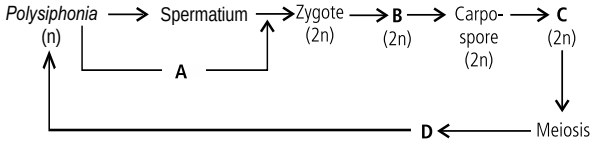
1. In which of the following plants, stem is jointed and ribbed with leaves and branches are borne in whorls?
(a) *Equisetum* (b) *Selaginella*
(c) *Lycopodium* (d) *Cooksonia*

2. Circinate vernation in ferns refers to
(a) specialised pattern of leaf development in which leaf unrolls from the fiddle head
(b) system of leaf gaps in the stem
(c) acropetally arranged fronds
(d) presence of sori on the leaf surface.

3. Select the mismatched pair.
(a) *Selaginella* - Club moss
(b) *Dryopteris* - Maiden hair fern
(c) *Ophioglossum* - Adders tongue fern
(d) *Equisetum* - Horsetail fern

4. In which of the following options, do all listed genera belong to the same class of pteridophytes?
(a) *Lycopodium, Psilotum, Selaginella, Rhynia*
(b) *Rhynia, Cooksonia, Psilotum, Tmesipteris*
(c) *Selaginella, Lycopodium, Equisetum, Dryopteris*
(d) *Psilotum, Adiantum, Lycopodium, Equisetum*

5. Complete the following flow chart by selecting the correct option.



	A	B	C	D
(a)	Carpogonium	Cystocarp	Tetrasporo-phyte	Tetraspore
(b)	Cystocarp	Carpo-gonium	Tetrasporo-phyte	Tetraspore
(c)	Tetrasporophyte	Cystocarp	Carpogonium	Tetraspore
(d)	Cystocarp	Carpo-gonium	Tetraspore	Tetrasporo-phyte

6. Match column I with column II and select the correct option from the given codes.

	Column I		Column II
A.	Alginic acid	(i)	*Rhodomela*
B.	Bromine	(ii)	*Gracilaria*
C.	Agar	(iii)	*Chlamydomonas*
D.	Sewage oxidation	(iv)	*Polysiphonia*
		(v)	*Gelidium*
		(vi)	*Laminaria*
		(vii)	*Scenedesmus*
		(viii)	*Sargassum*

(a) A-(ii, v) , B-(iii, iv), C-(i, viii), D-(vi, vii)
(b) A-(vi, viii), B-(i, iv), C-(ii, v), D-(iii, vii)
(c) A-(vi, iii) , B-(ii, v), C-(i, viii), D-(iv, vii)
(d) A-(vi, viii), B-(vii, iv), C-(ii, v), D-(i, iii)

7. Which of the following characters represents the affinities of *Gnetum* with angiosperms and differences with *Cycas* and *Pinus*?
(a) Presence of vessel in xylem
(b) Two integuments
(c) Embryo development
(d) Absence of resin duct

8. Which of the following plants exhibits double fertilisation?
(a) *Draparnaldia* (b) *Mussaenda*
(c) *Pellia* (d) *Araucaria*

9. Read the given statements and select the incorrect ones.
(i) A coenobium is a colony having definite number of cells embedded in a common matrix.
(ii) All algae are autotrophic.
(iii) Heterotrichy is a condition wherein branches get modified into leaves and air bladders.
(iv) In *Volvox*, asexual reproduction occurs through formation of palmella stage.
(a) (i), (iii) and (iv) (b) (ii), (iii) and (iv)
(c) (i), (ii) and (iii) (d) (i), (ii) and (iv)

10. Which of the following differentiates conifers from grasses?
(a) Formation of endosperm before fertilisation
(b) Production of seeds from ovules
(c) Lack of xylem tracheids
(d) All of these

11. In which of the following aspect do bryophytes resemble algae?
(a) Thallus like plant body, absence of asexual spores and autotrophic nutrition.
(b) Thallus like plant body, lack of vascular tissues and autotrophic nutrition.
(c) Filamentous body, presence of vascular tissues and autotrophic nutrition.
(d) Differentiation of plant body into true root, stem and leaves and autotrophic nutrition.

12. In the prothallus of a vascular cryptogam, the antherozoids and eggs mature at different times. As a result
(a) there is high degree of sterility
(b) one can conclude that the plant is apomictic
(c) self fertilisation is prevented
(d) there is no chance of cross fertilisation.

13. Haplodiplontic alternation of generation occurs in
(a) *Funaria, Spirogyra, Selaginella*
(b) *Spirogyra, Rhizopus, Selaginella*
(c) *Funaria, Selaginella, Cycas*
(d) *Rhizopus, Funaria, Spirogyra.*

14. Which of the following is a characteristic feature of gymnosperms?
(a) The gymnosperms are homosporous.
(b) The male and female gametophytes do not have independent free living existence.
(c) The pollen grain is released from the megasporangium.
(d) The ovules are enclosed within the ovary.

15. Asexual reproduction in liverworts takes place by
(a) fragmentation of thalli and gemmae formation
(b) gemmae formation and akinete formation
(c) spore formation and isogamy
(d) fragmentation and zoospore formation.

16. Select the wrong statement.
(a) In Oomycetes, female gamete is smaller and motile, while male gamete is larger and non-motile.
(b) *Chlamydomonas* exhibits both isogamy and anisogamy however *Fucus* shows oogamy.
(c) Isogametes are similar in structure, function and behaviour.
(d) Anisogametes differ in size, function or behaviour.

17. *Selaginella* and *Salvinia* are considered to represent a significant step towards evolution of seed habit because
(a) female gametophyte is free and gets dispersed like seeds

(b) female gametophyte lacks archegonia
(c) embryo develops in female gametophyte which is retained on parent sporophyte
(d) none of these.

18. Choose the correct order of colours with respect to pigments, chlorophyll *b*, phycoerythrin and fucoxanthin.
(a) Green, red and brown (b) Brown, green and red
(c) Red, green and brown (d) Green, brown and red

19. *Sphagnum* is commonly used as packing material for transshipment of living materials due to its
(a) capacity to absorb and retain water
(b) easy availability
(c) nature to grow anywhere
(d) all of these.

20. Which of the following statements about *Cycas* is incorrect?
(a) It has circinate vernation.
(b) Its roots contain some blue-green algae.
(c) Its xylem is mainly composed of xylem vessel.
(d) It has unbranched columnar stem covered by persistent leaf bases.

21. Match the column I with column II and choose the correct answer from codes given below.

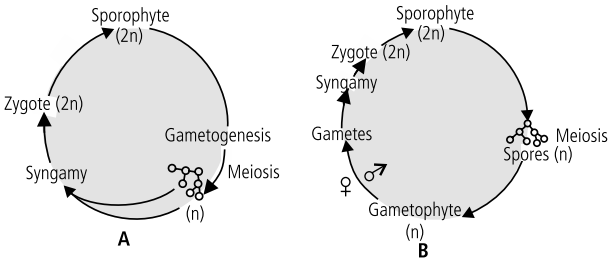
	Column I		**Column II**
A.	*Polytrichum*	(p)	Devil's apron
B.	*Riccia*	(q)	Pond scum
C.	*Spirogyra*	(r)	Moss
D.	*Laminaria*	(s)	Liverwort

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

22. Consider the following statements and select the correct option stating which ones are true (T) and which ones are false (F).
(i) Both stem and leaves of *Funaria* are sporophytic structures.
(ii) Coralloid roots are irregular, negatively geotropic, dichotomously branched coral like root, which possess root hairs and root caps.
(iii) *Ginkgo biloba* has not changed for the several millions of years since its appearance in triassic period.
(iv) In seedless vascular plants, the gametophyte must develop on moist soil with a thin sheet of water.
(v) *Ophioglossum reticulatum* is a fern species with highest number of chromosomes.

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

23. Refer to the given figures.



Select the correct statement regarding them.
(a) Figure A is life cycle pattern in *Chara* in which sporophytic generation is dominant and dependent while gametophytic generation is highly reduced and independent.
(b) Figure B is life cycle pattern in *Dictyota* with clear alternation of generation between a haploid gamete producing gametophyte and a diploid spore producing sporophyte.
(c) Figure A is life cycle pattern in *Adiantum* in which zygote remains single celled and protoplast of the zygote cleaves into meiospores.
(d) Figure B is the life cycle pattern in *Cladophora* in which the zygote remains single celled, it does not multiply itself.

24. If the leaf cells of *Funaria* have 24 chromosomes, then what will be the number of chromosomes in its seta?
(a) 12 (b) 24
(c) 48 (d) 36

25. An unorganised arrangement of reproductive structures of gymnosperm is given below. Identify their correct sequence of arrangement and select the correct option.
(i) Spores
(ii) Sporangia
(iii) Strobili
(iv) Sporophylls
(a) (i)→(iii)→(ii)→(iv) (b) (i)→(ii)→(iv)→(iii)
(c) (i)→(ii)→(iii)→(iv) (d) (ii)→(i)→(iv)→(iii)

26. Read the given statements regarding angiosperms and select the incorrect ones.
(i) Sporophylls are aggregated to form flowers.
(ii) Embryo sac have a three celled egg apparatus.
(iii) Size ranges from almost microscopic *Wolffia* to tall tree of *Eucalyptus*.
(iv) Synergids and antipodals degenerate before fertilisation.
(v) Embryo sac formation is preceded by meiosis.
(a) (ii) and (v) (b) (i) and (iv)
(c) (v) only (d) (iv) only

27. Which of the following genera have fungal association in form of mycorrhiza?

(a) *Pinus* (b) *Cycas*
(c) *Cedrus* (d) *Sequoia*

28. Read the following statements and select the incorrect ones.

(i) The pollen tube in *Cycas* is of haustorial nature.
(ii) In *Cycas*, antherozoids are motile.
(iii) The upper fertile portion of the microsporophyll of *Cycas* is called apophysis.
(iv) The megasporophylls of *Cycas* are not organised into cones instead they occur in close spirals around stem apex in acropetal succession.
(v) The secondary wood of *Cycas* is pycnoxylic.

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

29. Select the haploid structures from the given list.

(i) Protonemal cell
(ii) Primary endosperm nucleus of dicot
(iii) Leaf cell of moss
(iv) Prothallus cell of fern
(v) Gemma cup of *Marchantia*
(vi) Ovum of a liverwort
(vii) Zygote of a fern
(viii) Meristem cell of monocot

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

30. Fill the blanks in the given statements and select the correct option.

(i) _____ are peculiar to *Selaginella*.
(ii) The sperms of _____ are the largest in the biological world.
(iii) In *Marchantia*, two types of _____ are anchoring smooth walled and capillary conducting tuberculate.
(iv) _____ causes red rust of tea.

	(i)	(ii)	(iii)	(iv)
(a)	Rhizome	*Cycas*	roots	*Cephaleuros*
(b)	Rhizophore	*Cycas*	rhizoids	*Cephaleuros*
(c)	Rhizophore	*Eucalyptus*	rhizoids	*Scendesmus*
(d)	Rhizophore	*Eucalyptus*	rhizoids	*Scendesmus*

ANSWER KEY

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

☺☺

UNSCRAMBLE ME

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

Column I	Column II
1. IOESNS	(a) Rope like twisted subterranean masses of hyphae.
2. XNTOIYCO	(b) The common ancestor of great apes and man.
3. ENALVME	(c) A type of stipule that fuses to form a hollow tube encircling the stem.
4. EAYAPCR	(d) A hormone responsible for vigorous contraction of the uterine muscles.
5. NSATCAUELEC	(e) A biopesticide obtained from neem.
6. UPIRSDHEYCTO	(f) A state of stunted mental and physical growth due to congenital deficiency or thyroxine.
7. IOZSRPHOHMR	(g) Special sponge-like tissue found in epiphytic roots.
8. TOEREACH	(h) The protein which forms dense, hard matrix of bone.
9. CRIDAZNTAHIA	(i) A plant with reduced stem or without stem.
10. MCIENISRT	(j) The mollusc, used as currency in old days.

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.

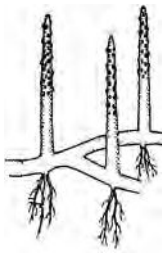
NCERT Xtract

New

Questions for NEET

Morphology of Flowering Plants

1. Which of the following statements are correct regarding the roots shown in the given figure?



I. These are modified fibrous roots that harbour nitrogen fixing bacteria.
II. These are modified adventitious roots that store food.
III. They are found in plants growing in mangroves or saline swamps near the sea shore.
IV. They give out CO_2 through pneumathodes near their tips.

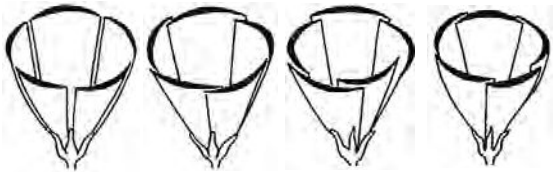
(a) I and III (b) II and III
(c) III and IV (d) II, III and IV

2. Dichotomous stem branching in which the growing point gets divided into two in the region of branching is rare in angiosperms, yet it can be observed in
(a) *Dalbergia* (b) *Asclepias syriaca*
(c) *Zizyphus* (d) *Carissa carandas*.

3. Select the incorrectly matched pair.
(a) Anthophore – Internode between calyx and corolla – *Silene*
(b) Gynophore – Internode between androecium and gynoecium – *Cleome*
(c) Androphore – Internode between calyx and androecium – *Cassia*
(d) Carpophore – Thalamus prolonged into gynoecium to form a central axis – Coriander

4. The leaves possess a certain arrangement of veins and veinlets on its lamina to serve for
(a) conduction of water and reduce the effect of wilting
(b) translocation of organic nutrients
(c) skeletal support
(d) all of these.

5. Refer to the given aestivations (A-D) and select the correct statements regarding them.



A B C D

I. A is valvate aestivation that occurs in corolla of *Brassica*.
II. B is vexillary aestivation that occurs in corolla of China rose.
III. D is ascending imbricate aestivation that occurs in petals of *Cassia*.
IV. C is quincuncial aestivation that occurs in corolla of *Solanum nigrum*.

(a) I and III (b) II and IV
(c) I, II and III (d) All of these

6. Study the given figures, showing different inflorescences and select the option which correctly identifies them.

A B C

	A	B	C
(a)	Spadix	Corymb	Catkin
(b)	Spike	Raceme	Catkin
(c)	Spikelet	Corymbose	Spadix
(d)	Capitulum	Corymb	Spike

7. Refer to the given figures of leaves and select the option which correctly identifies the type of venation in them.

X Y Z

	X	Y	Z
(a)	Multicostate convergent reticulate	Unicostate divergent parallel	Multicostate convergent parallel
(b)	Multicostate divergent reticulate	Unicostate convergent reticulate	Multicostate divergent parallel
(c)	Multicostate divergent reticulate	Multicostate convergent parallel	Multicostate divergent parallel
(d)	Unicostate divergent reticulate	Multicostate divergent parallel	Multicostate divergent reticulate

8. Select the incorrect statements regarding various forms of stem.

I. The branched, erect and weak cylindrical stem with scars and remnants of fallen leaves is called caudex.

II. Jointed stem with solid prominent nodes and hollow internodes is called culm.

III. A leafy shoot bearing flowers is called scape.

IV. In reduced stem, nodes and internodes are not distinguishable.

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

9. Which of the following is not the characteristic of Family Fabaceae?

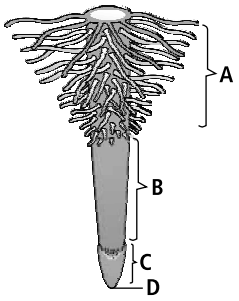
(a) Petals have vexillary aestivation.
(b) Inflorescence is racemose type.
(c) Flower is actinomorphic.
(d) Gynoecium is monocarpellary with unilocular ovary.

10. Select the option which correctly identifies the type of fruit found in given plants (i) – (iv).

(i) Castor (ii) Lemon
(iii) *Zizyphus* (iv) Banyan

	(i)	(ii)	(iii)	(iv)
(a)	Sorosis	Drupe	Pome	Pepo
(b)	Syconus	Amphisarca	Berry	Lomentum
(c)	Regma	Achene	Nut	Follicle
(d)	Regma	Hesperidium	Drupe	Syconus

11. Identify the labels A – D from the given figure and select the correct statements regarding them.



I. Maximum water absorption occurs in A region.

II. C is the region of elongation that increases the length of root.

III. The external cells of B absorbs water and mineral salts from the soil.

IV. D lubricates the passage of root through the soil and protects region C.

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

12. It is a green stem of limited growth which originates in the axil of scale leaf and has taken over the function of photosynthesis from the leaves. It is

(a) phylloclade of *Opuntia*
(b) phyllode of *Acacia*
(c) cladode of *Ruscus*
(d) offset of *Pistia.*

13. Read the given characteristics observed in a leaf.

I. The leaflets are borne laterally on an elongated axis called rachis, which represents the midrib or lateral vein of leaf.

II. The leaflets are odd in number borne in opposite pairs with a terminal unpaired leaflet.

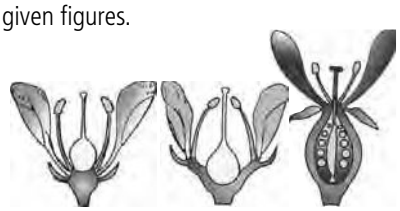
Select the option which correctly identifies the type of leaf.

(a) Bipinnate compound leaf
(b) Paripinnate compound leaf
(c) Tripinnate compound leaf
(d) Imparipinnate compound leaf

14. Select the incorrect match.

	Type of fruit		Edible part
(a)	Drupe	–	Mesocarp
(b)	Syconus	–	Fleshy receptacle
(c)	Pome	–	Pericarp
(d)	Hesperidium	–	Placental hair

15. Select the option which correctly identifies types of flower regarding position of floral parts on thalamus with their examples in the given figures.



A B C

	A	B	C
(a)	Perigynous–Cucumber	Hypogynous–China rose	Epigynous–Peach
(b)	Hypogynous–Mustard	Perigynous–Rose	Epigynous–Guava
(c)	Epigynous–Brinjal	Hypogynous–China rose	Perigynous–Plum
(d)	Hypogynous–China rose	Epigynous–Peach	Perigynous–Guava

16. Read the given characteristics and identify the type of inflorescence.

I. It is a type of simple racemose inflorescence.
II. The axis is flattened to form a receptacle.
III. Flowers are sessile called florets.
IV. This type of inflorescence is found in *Tagetes* and sunflower.

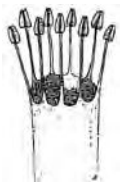
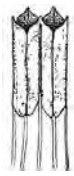
(a) Capitulum (b) Umbel
(c) Spadix (d) Catkin

17. Read the following statements and choose the correct ones.

I. In all fleshy or succulent fruits pericarp remains undifferentiated.
II. Offsets are one internode long remains found at ground level in rosette plants.
III. Etaerio is a group of simple fruitlets that develop from fused ovaries of multiple flowers.
IV. Caryopsis is a false or pseudocarpic fruit.

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

18. Which of the following figures represents synandrous condition of stamens?

(a)  (b) 

(c)  (d) 

19. Read the given characteristics of an unknown plant.

(i) It is a perennial herb.
(ii) Leaves simple, exstipulate with sheathing bases and parallel venation.
(iii) Trimerous, hypogynous and pentacyclic flowers having undifferentiated calyx and corolla as perianth.
(iv) Androecium consists of six stamens in two whorls.
(v) Gynoecium is tricarpellary, syncarpous ovary trilocular with axile placentation.
(vi) Fruits is capsule or berry.

According to the given characteristics, the plant belongs to the Family

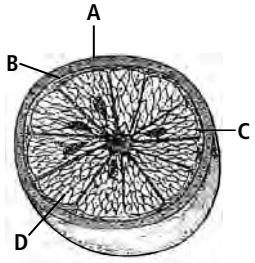
(a) Solanaceae (b) Fabaceae
(c) Liliaceae (d) Malvaceae.

20. Select the option which correctly fills blanks (i)-(iv).

A. Gram seed is covered by two seed coats - outer (i) and inner (ii).
B. The embryo axis in gram seed is present between (iii).
C. Gram seed is (iv).

	(i)	(ii)	(iii)	(iv)
(a)	testa	tegmen	cotyledons	endospermic
(b)	chalaza	testa	cotyledons	non-endospermic
(c)	tegmen	testa	radicle	endospermic
(d)	testa	tegmen	cotyledons	non-endospermic

21. Refer to the given figure of a fruit and select incorrect statement regarding it.



(a) B represents aleurone layer.
(b) C represents membranous endocarp.
(c) A and B form a common covering around all loculi.
(d) D represents placental hair which form edible part of fruit.

22. Match column I with column II and select the correct option from the given codes.

	Column I		Column II
A.	Climbing roots	(i)	*Tinospora*
B.	Stilt roots	(ii)	*Vanda*
C.	Assimilatory roots	(iii)	*Tecoma*
D.	Hygroscopic roots	(iv)	*Jussiaea*
E.	Floating roots	(v)	*Pandanus*

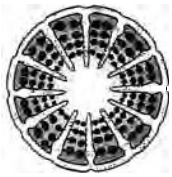
(a) A-(iii), B-(v), C-(i), D-(ii), E-(iv)
(b) A-(iv), B-(iii), C-(ii), D-(v), E-(i)
(c) A-(iii), B-(ii), C-(iv), D-(i), E-(v)
(d) A-(v), B-(ii), C-(i), D-(iii), E-(iv)

23. Read the given statements regarding androecium of a flower and select the incorrect ones.

I. Stamen comprises of a stalk-like style and a knob-like terminal anther.
II. Anther is usually dithecous having two lobes attached by a sterile connective tissue.
III. Staminode is an underdeveloped male reproductive part but bears functional pollen grains.
IV. In syngenesious condition, stamens are fused by filaments only, anthers remain free and fusion of filaments produces many groups.

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

24. Carefully observe the given figure of placentation and identify the correct statements regarding it.



I. It is found in a compound or syncarpous ovary.
II. Two or more longitudinal placentae develop along the ovary wall.
III. The ovule bearing placentae grow inwardly to form incomplete septa.
IV. The ovary is always unilocular in this type of placentation.

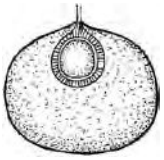
(a) I, II and III (b) III and IV
(c) I and IV (d) II and IV

25. From the given table of differences between phylloclade and phyllode, identify the correct set of differences.

	Phylloclade	Phyllode
(i)	It is a flattened petiole or rachis of a leaf performing photosynthesis.	It is a modified green stem capable of performing photosynthesis.
(ii)	It arises in the axil of caducous leaf.	It does not arise in the axil of leaf.
(iii)	It has unlimited growth.	Growth is limited.
(iv)	It is always vertical in position.	It can be vertical or horizontal in its orientation.
(v)	It is usually succulent and stores water and food.	It is rarely succulent.

(a) (i), (iii) and (iv) (b) (ii), (iii) and (iv)
(c) (ii), (iii) and (v) (d) All of these

26. Study the given figure showing L.S. of cherry fruit and select the correct option regarding it.

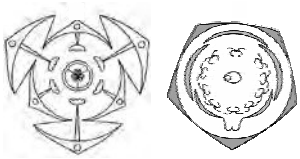


(a) The fruit is derived from an inferior ovary.
(b) The fruit wall is differentiated into epicarp, mesocarp and endocarp.
(c) Epicarp and mesocarp are non-edible but endocarp is fleshy and edible in this fruit.
(d) Litchi, *Calotropis*, *Michelia* also possess this type of fruit.

27. Which of the following statements is incorrect for the seed shown in the figure?

(a) It contains a papery structure called perisperm which represents persistent nucellus.
(b) It possesses a special food storing tissue called endosperm.
(c) It is a dicotyledonous seed.
(d) It has an aleurone layer of protein rich cells on the outerside of endosperm.

28. Read the statements regarding the floral diagrams A and B and choose the correct one.



A B

(a) A belongs to Family Solanaceae having bicarpellary, syncarpous, bilocular gynoecium with swollen placenta.
(b) A represents Family Liliaceae with bicarpellary apocarpous gynoecium having marginal placentation.
(c) B belongs to Family Papilionaceae having special corolla consisting of a posterior petal called standard, two lateral petals called wings, two anterior petals forming a keel.
(d) B belongs to Family Asteraceae having tricarpellary syncarpous superior ovary and diadelphous condition of stamen.

29. In *Podostemum*, the green flattened structures grow along rocks in shallow water and are fixed at intervals by holdfasts called haptera. They also bear small flowering shoots at intervals. This structure in *Podostemum* is

(a) offset (b) phyllode
(c) floating roots (d) photosynthetic root.

30. Match column I with column II and select the correct option. (There can be more than one match for column I).

Column I	Column II
(i) Legume	A. Larkspur
(ii) Follicle	B. Pea
(iii) Caryopsis	C. Wheat
(iv) Capsule	D. *Abrus*
	E. *Datura*
	F. Oat
	G. Cotton
	H. Milkweed

(a) (i)-B, D; (ii)-A, H; (iii)-C, F; (iv)-E, G
(b) (i)-A, C; (ii)-B, E; (iii)-D, H; (iv)-F, G
(c) (i)-C, D; (ii)-E, F; (iii)-A, B; (iv)-G, H
(d) (i)-A, H; (ii)-B, D; (iii)-C, G; (iv)-E, F

31. Read the following statements and select the correct ones.

I. Thorns are modified stem structures with vascular cylinder surrounded by a bark of thick walled cells.

II. Spines are superficial outgrowths of stem or leaves that do not have vascular supply.

III. Prickles are modified leaves or leaf parts with vascular supply and can easily be plucked off.

IV. Bristles are stiff hair that become thickened due to deposition of silica or calcium carbonate.

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

32. Which of the following floral diagrams represents complete actinomorphic flower with valvate aestivation in calyx and corolla, epipetalous stamens and bicarpellary, syncarpous superior ovary?

(a) 
(b) 
(c) 
(d) 

33. Which of the following does not bear compound racemose inflorescence?

(a) *Asphodelus*
(b) *Brassica oleracea*
(c) *Foeniculum vulgare*
(d) *Ageratum*

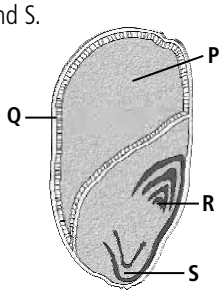
34. Read the given paragraph carefully.

The inflorescence appears as a flower having a small conical receptacle surrounded by an involucre of coloured bracts possessing nectariferous glands internally, it contains pedicellate, achlamydeous, unisexual flowers. Single female flower is centrally placed surrounded by numerous centrifugally arranged male flowers.

Select the option which correctly identifies the type of inflorescence (A) and family (B) in which it is found.

	A	B
(a)	Cymose head	Solanaceae
(b)	Hypanthodium	Moraceae
(c)	Verticillaster	Labiatae
(d)	Cyathium	Euphorbiaceae

35. Refer to the given figure and select the correct option regarding its parts labelled P, Q, R and S.



(a) P occupies most of the interior of the grain on the broader and lower sides.
(b) Q is only one cell thick where cells have thin walls and dense cytoplasm filled with starch grains.
(c) S has a terminal pore for emergence of first leaf during germination.
(d) R is the protective sheath of radicle.

36. The whole leaf is modified into an open pitcher for storing rain water in

(a) *Dischidia* (b) *Sarracenia*
(c) *Nepenthes* (d) *Utricularia.*

37. The growing point terminates into a flower. Flowers are basipetally arranged and open at long intervals and occur in groups. Insects cannot pollinate many flowers in one visit. This kind of inflorescence is of

(a) simple racemose (b) compound racemose
(c) cymose (d) none of these.

38. The given figure best represents

(a) an umbel bearing pedicellate flowers
(b) a typical raceme with an elongated peduncle bearing pedicellate flowers
(c) spadix possessing a fleshy peduncle
(d) corymb with an unbranched peduncle bearing pedicellate flowers in acropetal manner.

39. Match column I with column II and select the correct option from the given codes.

	Column I	Column II
A.	Leaflet tendrils	(i) *Lens culinaris*
B.	Petiolar tendrils	(ii) *Smilax*
C.	Stipular tendrils	(iii) *Lathyrus aphaca*
D.	Rachis tip tendrils	(iv) *Nepenthes*
E.	Whole leaf tendrils	(v) *Lathyrus odoratus*

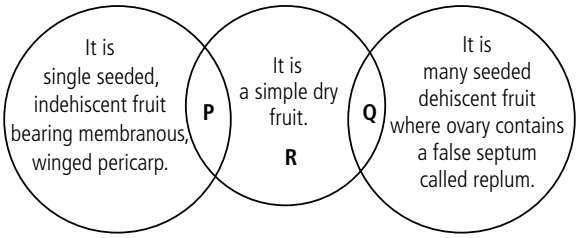
(a) A-(v), B-(ii), C-(iv), D-(iii), E-(i)
(b) A-(v), B-(iv), C-(ii), D-(i), E-(iii)
(c) A-(iv), B-(iii), C-(ii), D-(i), E-(v)
(d) A-(ii), B-(i), C-(iv), D-(v), E-(iii)

40. Select the correctly matched pair.

(a) Trifoliolate leaf – *Balanites*
(b) Quadrifoliolate leaf – *Butea*
(c) Unifoliolate leaf – *Citrus*
(d) Bifoliolate leaf – *Bombax*

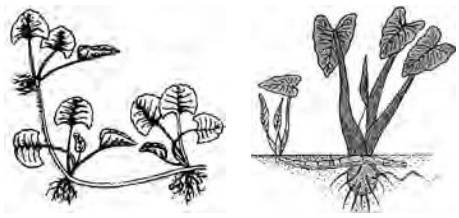
HIGHER ORDER THINKING SKILLS QUESTIONS (HOTS)

41. Refer to the given Venn diagram and select the correct option regarding P, Q and R.



(a) P is a samaroid fruit present in plants where seeds are dispersed by the agency of wind.
(b) Q is elongated fruit that dehisces by two valves starting from base upwards to expose the replum bearing seeds.
(c) R develops from a flower having polycarpellary apocarpous gynoecium where pericarp remains dry and undifferentiated.
(d) P could be cypsela present in *Sonchus*, Q could be follicle present in larkspur and R could be simple samara present in *Ulmus*.

42. Study the given figures A and B.



A **B**

Select the option which identifies the correct statements regarding them.

I. It is a diffused trailer of *Euphorbia prostrata* that spreads in one direction only.
II. It is an elongated horizontal stolon of jasmine, the tip of which grows above the level of ground.
III. It is a runner of *Centella asiatica* that arises from erect shoot and bears horizontal or prostrate branches called crowns.
IV. It is a stolon of *Colocasia*, the tip of which does not come above ground.

	A	**B**
(a)	I	IV
(b)	II	III
(c)	III	IV
(d)	I	III

43. Refer to the given list of plants and identify how many of these possess fruits which are multi-seeded, dry, simple and dehiscent in which the pericarp splits open to expose the seeds?

Ulmus, *Sonchus*, Maize, Rice, Cashewnut, Candytuft, Mustard, Larkspur, Pea, *Abrus*, Groundnut, Fennel, *Abutilon, Acacia, Mimosa*

(a) Eight (b) Nine
(c) Seven (d) Five

44. Study the given table regarding certain features (i to iv) of two plant families: Solanaceae and Fabaceae.

Features	**Plant families**	
	Solanaceae	**Fabaceae**
(i) Inflorescence	Raceme, spike or rarely solitary	Axillary or extra- axillary helicoid cyme
(ii) Flower	Complete, actinomorphic	Complete, zygomorphic
(iii) Androecium	Stamens five, epipetalous	Stamens ten, diadelphous, sometimes monadelphous
(iv) Gynoecium	Bicarpellary syncarpous ovary with axile placentation and swollen placentae	Monocarpellary, unilocular ovary with marginal placentation

Which of these features of plant families have been correctly described?

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

45. Refer to the given figure of twigs A and B and select the option which includes correct statements regarding them.

A **B**

I. Only one leaf is borne on a node and leaves of adjacent nodes lie roughly towards opposite sides.
II. Two leaves are borne on the opposite sides of a single node.
III. Leaves of the successive nodes lie in same plane forming two rows on stem as in *Syzygium*.
IV. Leaves of adjacent nodes lie at right angles forming four rows of leaves on stem, as in *Calotropis*.
V. More than three leaves develop from a single node as in *Zinnia*.

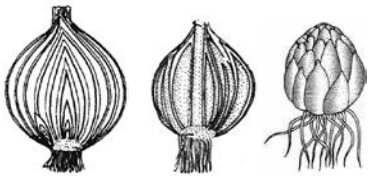
	A	B
(a)	I, IV	II, V
(b)	II, III	II, IV
(c)	I, III	II, V
(d)	I, V	III, II

46. Match column I with column II and III and select the correct option from codes given below.

	Column I	Column II	Column III
A.		(i) Axile	(p) Marigold
B.		(ii) Parietal	(q) Lemon
C.		(iii) Free central	(r) Primrose
D.		(iv) Basal	(s) Mustard

(a) A-(iv)-(p); B-(i)-(q); C-(iii)-(r); D-(ii)-(s)
(b) A-(iii)-(s); B-(i)-(r); C-(ii)-(p); D-(iv)-(q)
(c) A-(iv)-(q); B-(iii)-(s); C-(i)-(p); D-(ii)-(r)
(d) A-(iv)-(q); B-(i)-(r); C-(ii)-(s); D-(iii)-(p)

47. Refer to the given figure and select the correct option regarding A-C.



A B C

	A	B	C
(a)	Simple tunicated bulb	Scaly bulb	Compound tunicated bulb
(b)	Fleshy scales represent leaves	Fleshy scales represent buds	Fleshy scales overlap one another on margin
(c)	Covering sheath is absent	Covered by corky skin	Covered by a membranous sheath
(d)	Found in onion	Found in lily	Found in garlic

48. Following are some characteristics of a plant family.
(i) Flower : Complete, bisexual, actinomorphic
(ii) Calyx : Sepals 5, gamosepalous
(iii) Corolla : Petals 5, gamopetalous
(iv) Androecium : Stamens five, polyandrous, epipetalous
(v) Gynoecium : Bicarpellary, syncarpous, superior ovary

Select the floral formula that corresponds to the above mentioned family.

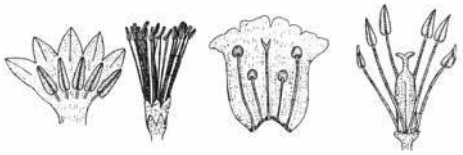
(a) $\oplus\ \varphi\ K_{(1)+4}\ C_{(5)}\ A_{(5)}\ \underline{G}_2$

(b) $\%\ \delta\ K_{(5)}\ \overbrace{C_{1+2+(2)}\ A_{1+(4)}}\ \underline{G}_2$

(c) $\oplus\ \delta\ K_{(5)}\ \overbrace{C_{(5)}\ A_5}\ \underline{G}_{(2)}$

(d) $\oplus\ \delta\ K_5\ C_{(5)}\ A_{(5)}\ \underline{G}_2$

49. Refer to the given figure (A-D).



A B C D

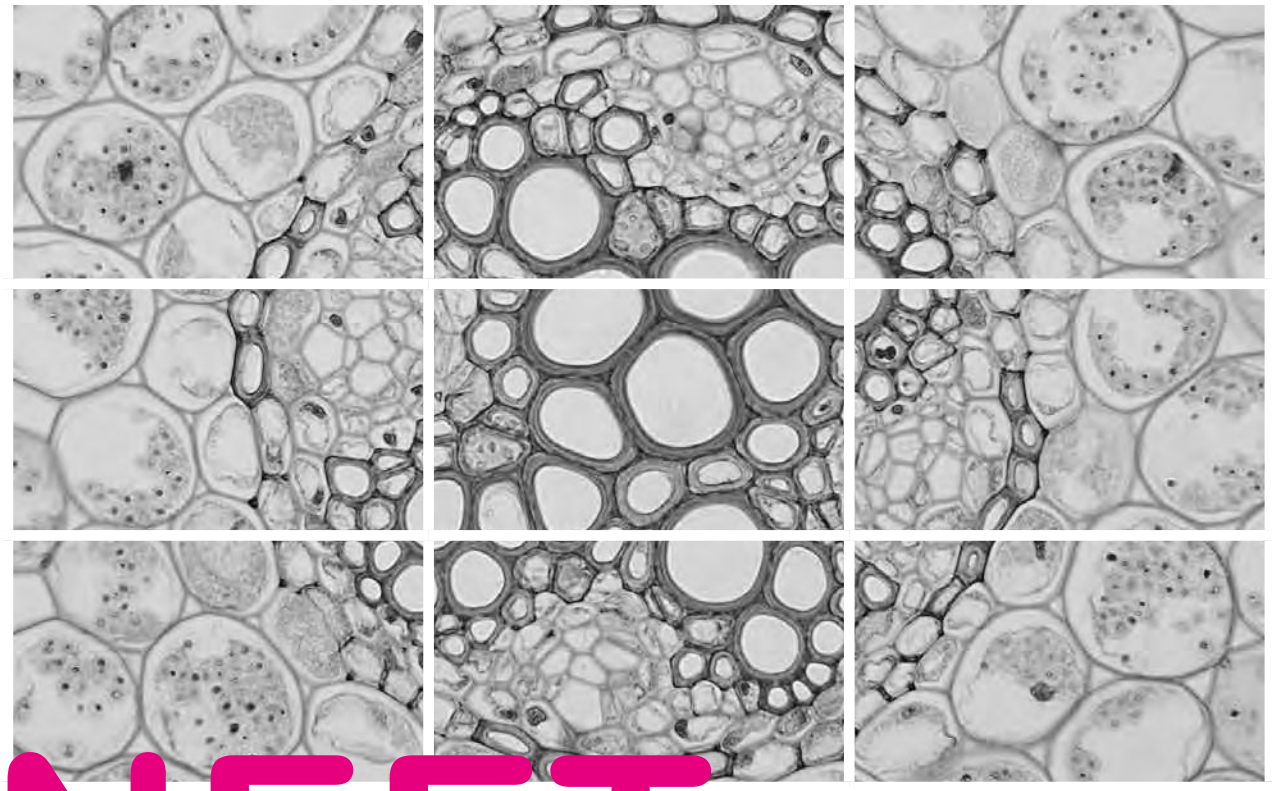
Select the option which identifies type of stamens with its correct example.

	A	B	C	D
(a)	Inserted stamens – *Solanum nigrum*	Exserted stamens – *Acacia*	Didynamous stamens – *Ocimum*	Tetradynamous stamens – Mustard
(b)	Exserted stamens – *Cassia*	Antiphyllous stamens – *Althaea*	Epipetalous stamens – *Citrus*	Didynamous stamens – *Cucurbita*
(c)	Tetradynamous stamens – *Ocimum*	Exserted stamens – Mustard	Inserted stamens – *Datura*	Didynamous stamens – *Passiflora*
(d)	Exserted stamens – *Datura*	Inserted stamens – *Allium cepa*	Gynandrous stamens – *Calotropis*	Tetradynamous stamens – *Ocimum*

50. A floral diagram is a diagrammatic representation of transverse section of a floral bud. Which of the following aspects of a flower cannot be determined with the help of a floral diagram?
(a) Number of the floral parts of each type
(b) Cohesion and adhesion of one or more parts
(c) Aestivation of the floral parts
(d) Type of inflorescence to which it belongs

ANSWER KEY

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



NEET ESSENTIAL

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

SECONDARY GROWTH IN PLANTS

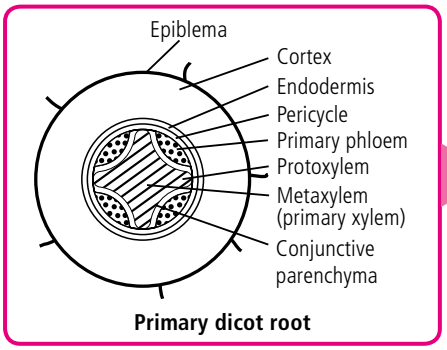
The growth of plant at various stages *i.e.*,from embryonic stage till maturity, includes both increase in length and girth, which is a result of activity of different meristems. For example promeristem present in the youngest stage of growing plant or organ gives rise to primary meristem by cell division. The primary meristems are the apical growing regions of root and stem that make up the fundamental structure of plant body. Some of the primary meristems (*e.g.*, cambium) give rise to secondary meristem. The secondary meristems develop at certain stages during development of a plant organ. These are usually lateral, lying along the side of stem and root. The lateral meristems (primary and secondary *e.g.*, cambium, interfascicular cambium, cork-cambium, etc.) give rise to secondary permanent tissues that are responsible for secondary growth or thickness of plant body.

This increase in thickness due to addition of secondary tissues cut off by cambium and cork cambium in the stelar and extra stelar regions respectively is known as secondary growth in plants.

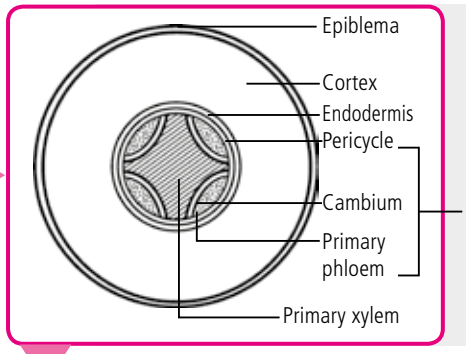
SECONDARY GROWTH IN DICOT ROOT

Except some annuals, most of the dicots and gymnosperms show secondary growth in their roots. Secondary growth in roots occurs a few centimetres behind the apex. It occurs due to addition of new tissues cut off by cambium and cork cambium in the interior as well as in peripheral region. It occurs mainly due to the activity of two secondary meristems-vascular cambium and cork cambium.

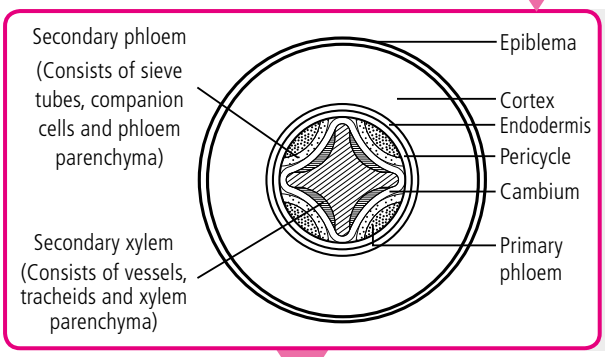
Stelar Growth by Vascular Cambium



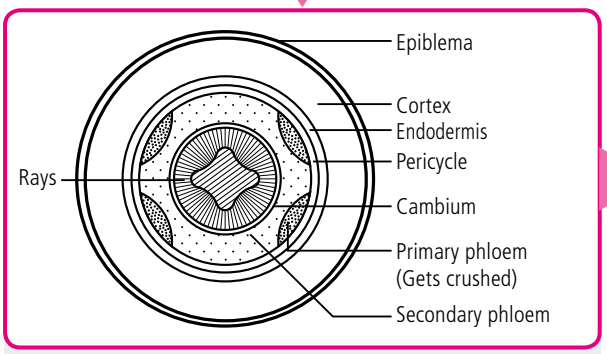
Primary dicot root



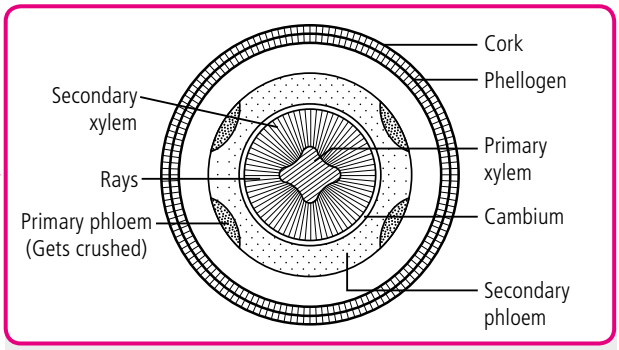
The conjunctive tissue on the inner side of phloem becomes meristematic and gives rise to cambial strip. The number of cambial strips is equivalent to number of phloem bundles.



The cells of cambium strips (vascular cambium) divide repeatedly to produce new cells both towards inner as well as outer side. The cells produced towards inner side (centripetally) differentiate into secondary xylem elements and those produced towards outer side (centrifugally) differentiate into secondary phloem. Subsequently, the cells of pericycle lying towards outer side of protoxylem divide by tangential division. It divides and forms a strip of cambium there as well and joins with the cambium strips formed earlier on either side of xylem. Thus, a continuous wavy band of cambium is formed, extending over the xylem and down the phloem. Secondary growth commences with the activity of this cambium band.



The wavy band of cambium soon becomes circular and thus, a cambium ring is produced. The entire cambial ring becomes actively meristematic and gives rise to secondary xylem on the inner side and secondary phloem on the outer side.



Against the protoxylem, the cambium forms distinct and widening radial bands of parenchyma that constitute the primary medullary rays. These rays extend upto secondary phloem. These are made up of two parts- xylem or wood ray (present in xylem) and phloem ray (present in secondary phloem). They help in radial conduction of substances.

Extrastelar Growth by Cork Cambium

- Phellogen consists of only one type of initial cells.
- Cells of phellogen divide both towards the outside as well as inside forming cork or phellem and secondary cortex or phelloderm, respectively.
- It results in the formation of outer protective covering consisting of multilayered cork, cork cambium and multilayered secondary cortex, which collectively constitute periderm.
- The secondary cortex of root does not contain chloroplasts and is very much compressed being thin walled. It ultimately gets disorganised and sloughs off. Endodermis also meets the same fate while epiblema dies out.
- Lenticels may also form in places.
- The bark of root forms a thin protective covering and is not extensive.

Since the root lies underground, it is not subjected to variations of aerial conditions and therefore unlike stem, annual rings are rarely formed in roots. Though the secondary wood forms the main bulk, the primary xylem bundles remain intact and can be easily recognised under a microscope.

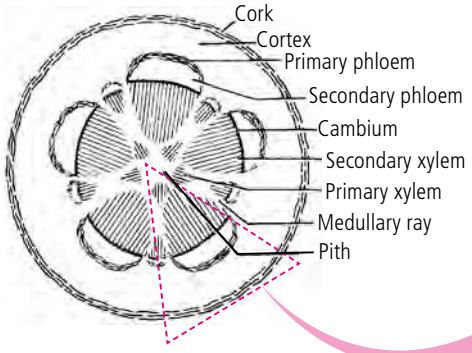


Fig.: T.S. of root of *Tinospora* (Diagrammatic)

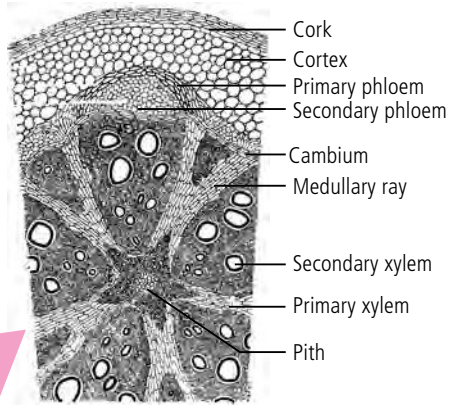


Fig.: Detailed structure of a part of T.S. of root of *Tinospora*

Bark

All the dead tissues lying outside the active cork cambium constitute the bark of plant. It includes epidermis, lenticels, cork and sometimes hypodermis or portion of cortex depending upon position of cork cambium. The deeper the origin of cork cambium, the thicker is the bark. Bark protects against parasitic fungi and insects, prevents water loss by evaporation and guards against variations of external temperature. It is insect repellent, decay proof, fire proof and is used in obtaining drugs or as spices.

It may be of two types

Ring bark

When cork cambium appears in form of complete ring.
E.g., *Betula.*

Scale bark

When cork cambium appears in strips, it takes the form of scales.
E.g., guava.

SECONDARY GROWTH IN DICOT STEM

The dicotyledonous stems are characterised by presence of fascicular (or intrafascicular) cambium (primary meristem) derived from procambium of shoot apical meristem between xylem and phloem. Interfascicular cambium (secondary meristem) arises from the cells of medullary rays which occur at the level of intrafascicular strips. This joins on to the fascicular cambium on either side and form a complete ring known as cambium ring or vascular cambium.

The cells of cambium mostly divide by periclinal divisions. Out of the two cells produced from single cell of cambium, one differentiates into secondary tissue and the other remains cambial cell. In this way the cambial cells, by repeated divisions, add new cells either towards centre or towards periphery and the cambium still remains single layered.

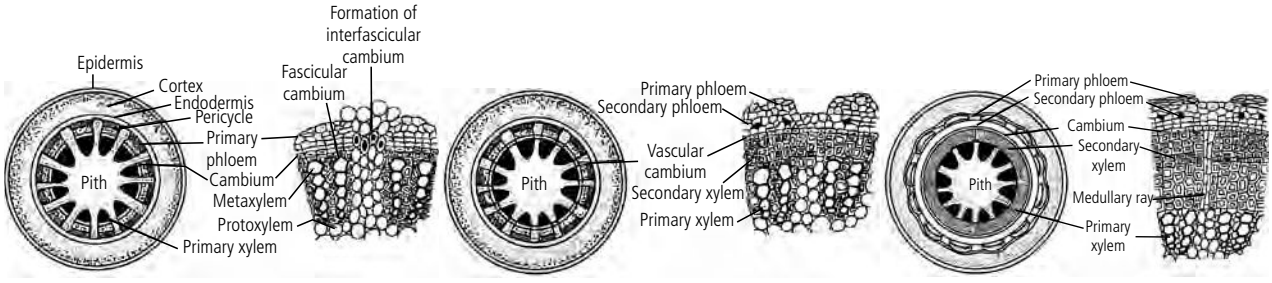


Fig.: Diagrammatic representation of various stages of secondary growth in dicot stem

Vascular cambium is composed of two types of initials - elongated spindle shaped **fusiform initials** and shorter isodiametric **ray initials**.

Activity of Vascular Cambium

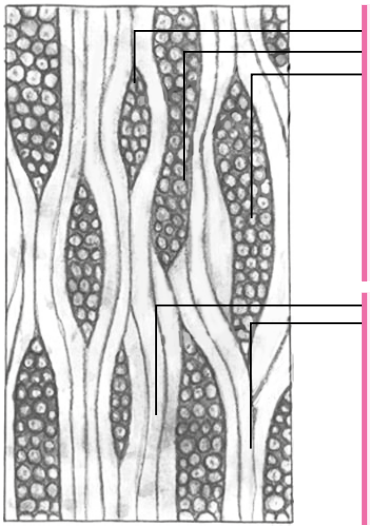


Fig.: L.S. of vascular cambium

Rays initials

- Ray initials form the radial or horizontal system of secondary tissues.
- Ray initials of cambium ring divide by tangential divisions and add new cells at places forming narrow bands of parenchyma which passes through both secondary xylem and secondary phloem. These are called medullary rays. They are one to few layers in thickness and several layers in height. Medullary rays are responsible for radial conduction of solutes and maintain connection between pith and cortex.

Fusiform initials

- Fusiform initials form axial system of secondary vascular tissues.
- These initials divide on outerside to form new cells which remain meristematic for a definite period and later get differentiated into secondary phloem. The primary phloem gets crushed.
- They divide on inner side to form secondary xylem.

Secondary Vascular Tissues

- The **secondary phloem** comprises of sieve tubes, companion cells, phloem parenchyma and band patches of bast fibres. Many textile fibres of commercial value as jute, hemp, flax, etc., are the bast fibres of secondary phloem.
- The secondary phloem does not grow in thickness as the primary and older secondary phloem present on outer side gets crushed with the development of new functional phloem.
- The secondary xylem consists of scalariform and pitted vessels, tracheids, numerous wood fibres arranged usually in radial rows and some wood parenchyma.
- Since the cambium is more active on inner side, the xylem increases more rapidly in bulk than the phloem and forms a compact mass. Due to continued formation of secondary xylem and pressure exerted by it, the cambium, phloem and surrounding tissues are gradually pushed outwards. Though some primary tissues get crushed but the primary xylem remains intact in or around the centre.
- The bulk of secondary xylem is referred to as wood and its width increases with the age of the plant.

Annual Rings

- The annual or yearly growth of wood in the form of distinct concentric rings are called annual rings. Distinct annual rings are formed in areas with distinct climatic variations *i.e.*, experiencing two seasons, which affects the uniform activity of cambium throughout the year.
- The age of the plant can be determined by counting the number of growth rings, formed in it.
- As each annual ring corresponds to one year's growth.

Formation of annual rings

- In regions with distinct seasonal variations, *i.e.*, favourable (spring or rainy) and unfavourable (autumn, winter or dry summer) the cambium activity is not uniform. During favourable seasons when the temperature, sunshine and humidity is optimum, the need for sap transport is acute to increase in production and activity of foliage leaves. Therefore, cambium is more active forming a greater number of vessels with wider cavities or larger, pitted vessels.

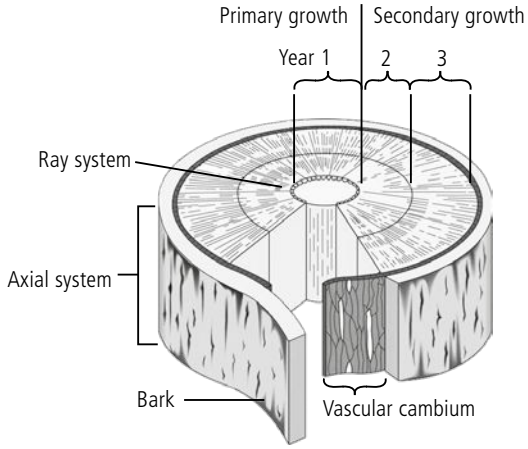


Fig. : Drawing of a 4-year old woody stem showing the growth increment as annual rings.

– On the contrary, during unfavourable seasons or inactive period, there is less demand for sap transport as cambium is less active and consequently narrower elements are formed. In tropical areas where only one kind of season prevails *i.e.*, long dry summers, distinct rings are not formed.
– The number of annual rings as well as the width of rings formed in successive years vary greatly in plants.

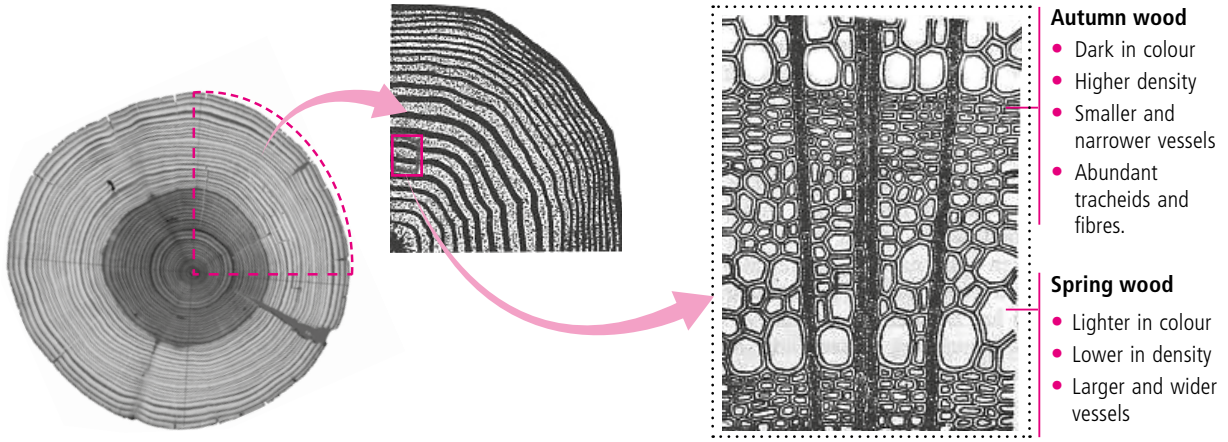


Fig.: Detailed structure of annual rings

– The wood formed during spring is called spring wood or early wood while that formed in winter is called winter or late wood.
– These two types of wood appear together as concentric ring known as annual ring in the transverse section of stem. A sharp contrast between late autumn wood and early spring wood makes the successive rings distinct even to naked eye.
– The transition from spring to autumn wood is gradual but the transition from autumn wood to spring wood of next year is sudden.

Dendrochronology is the science of dating and analysing annual growth rings of trees.

Heartwood and Sapwood

Stem Wood

In older trees, the wood of stem gets differentiated into two zones : heartwood and sapwood.

Sapwood
- Also called alburnum.
- Outer light coloured part with living cells.
- Used for conduction of water and mineral salts from root to leaf.
- Less durable and susceptible to microbial (fungal) or insect attack.

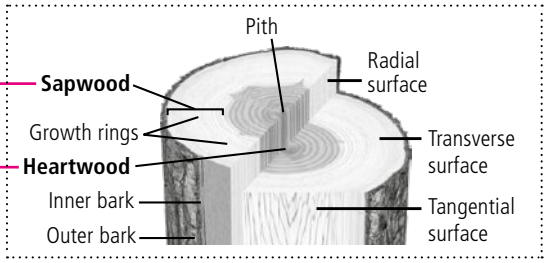


Fig.: T.S. of a tree trunk

Heartwood
- Also called duramen.
- Inner, dark coloured with dead cells.
- Non-functional as vessels become plugged with **tyloses**, the parenchymatous ingrowths. Hence, the function is mechanical support only.
- Strong and durable as dead cells are lignified and filled with antiseptic extractives as oils, resins, gums, tannins, aromatic substances, etc. Therefore, resistant to microbial attack.

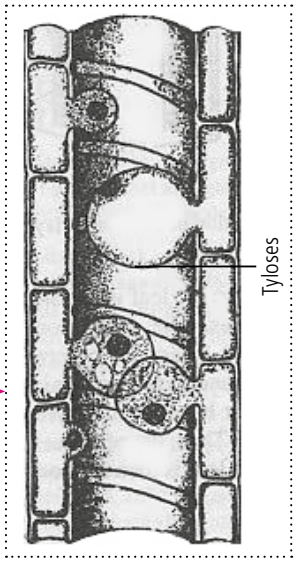
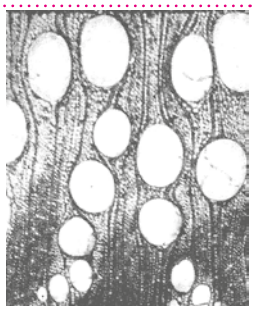


Fig.: Vessels with tyloses

Softwood and Hardwood

Softwood refers to the gymnosperm wood devoid of vessels. It is also called non-porous wood. It is mainly composed of tracheids (90-95%) and fibres, though vascular rays constitute 5-10% of wood. It is easy to work with *e.g.*, *Cedrus*, *Pinus*. Despite being called 'soft', all of them are not soft.

Hardwood is the technical term for dicot wood which possesses abundant vessels. It is also called **porous wood.** In such wood, the fibres are abundant while tracheid content is very low (<5%).



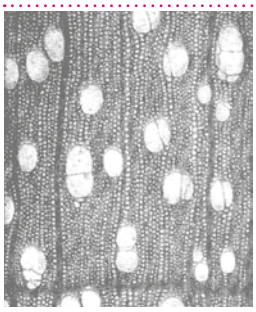
Ring porous

The wood in which vessels are comparatively broad in spring wood and quite narrow in autumn wood *e.g.*, *Dalbergia sissoo*.

Two types of porous wood

Diffuse porous

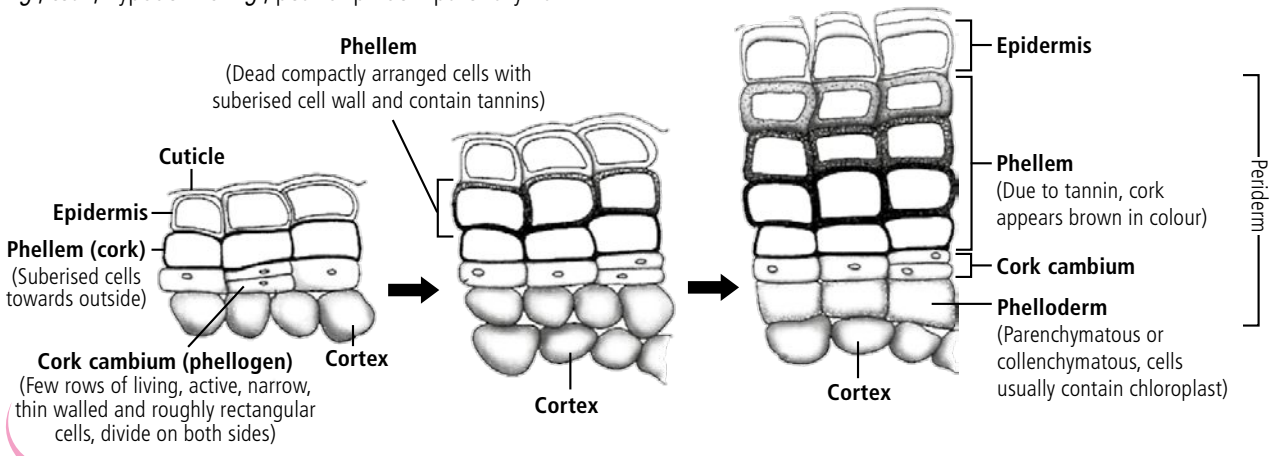
The wood where large sized vessels are distributed throughout spring wood and autumn wood *e.g.*, *Syzygium cumini*.



Ring porous wood is considered to be more advanced than diffuse porous wood as it provides better transition in case of high requirements by the plant.

Activity of Cork Cambium

So as to prevent damage due to rupturing of outer ground tissues owing to formation of secondary vascular tissues and to increase in girth, dicot stems give rise to **cork cambium** or **phellogen** in its outer cortical cells. In rare cases, it may arise from epidermis *e.g.*, teak, hypodermis *e.g.*, pear or phloem parenchyma.



Sometimes, phellogen produces aerating pores instead of cork, which are referred to as lenticels.

Fig.: Activity of cork cambium : Formation of phellogen, phelloderm and phellem

Lenticels

These are aerating pores in the bark of plants that appear as raised scars containing oval or oblong depressions on the surface. These occur only in woody trees either in scattered or longitudinal rows, produced beneath the stoma of epidermis.

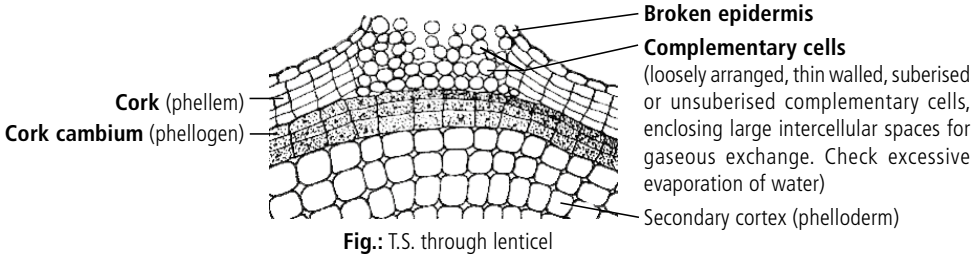


Fig.: T.S. through lenticel

During winter, the lenticels get closed in temperate plants due to formation of compact closed cells over the complementary cells.

Economic importance of cork

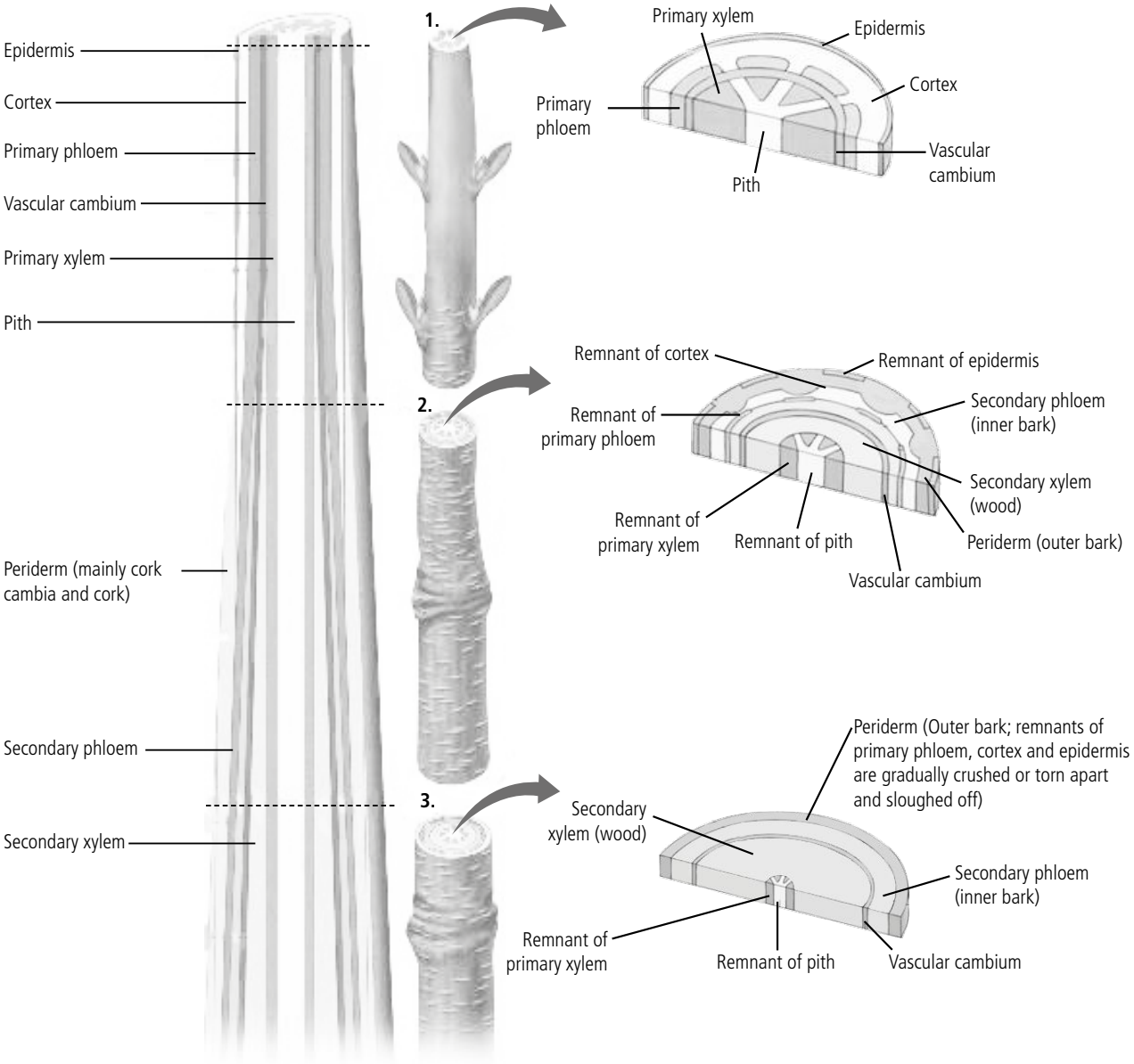
- Prevention of loss of water by evaporation.
- Light, compressible, non reactive and fire resistant.
- Protection against entry of microorganisms, mechanical injury and extremes of temperature.
- Light, being filled with air, hence used as bottle stoppers, shock absorber, insulator.

Significance of Secondary Growth

- Adds girth to plant and provides support to its increasing weight.
- The corky bark produced, protects the interior from abrasion, heat, cold and infection.
- Adds new conducting tissues for replacing old nonfunctioning ones for meeting increased demand.

An Overview of Secondary Growth in Dicot stem

Primary and secondary growth in a three-year-old stem



CASE STUDY OF SECONDARY GROWTH IN ROOT AND STEM

Secondary Growth in Ficus Root

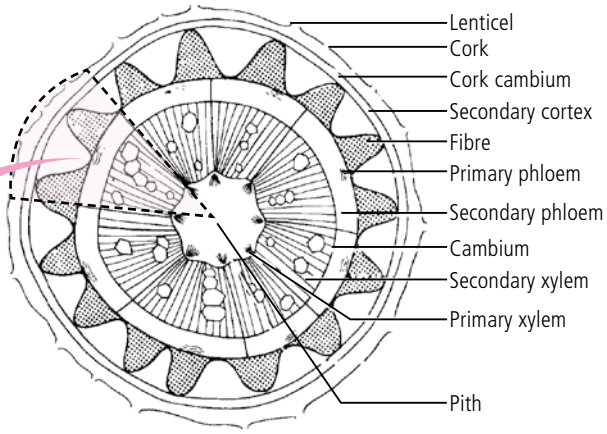


Fig.: T.S. of root of *Ficus* (diagrammatic)

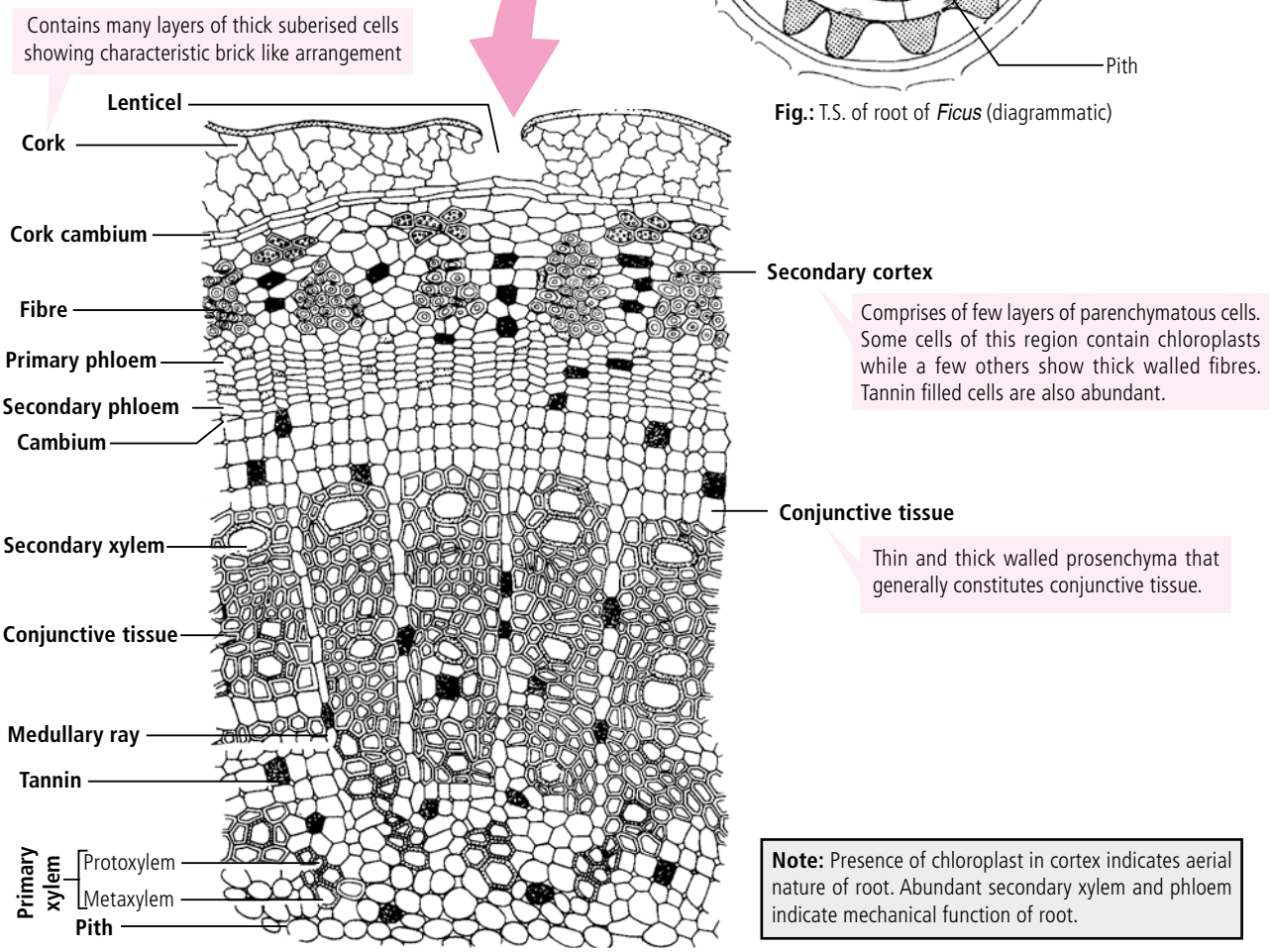


Fig.: *Ficus* : Detailed structure of a part of T.S. of root

Secondary Growth in Vitis Stem

Vitis vinifera (grapevine) is a liana type of plant and is appropriate for the study of internal structure of a typical dicot stem. The transverse section of its stem showing the various parts of both primary and secondary origin is as follows.

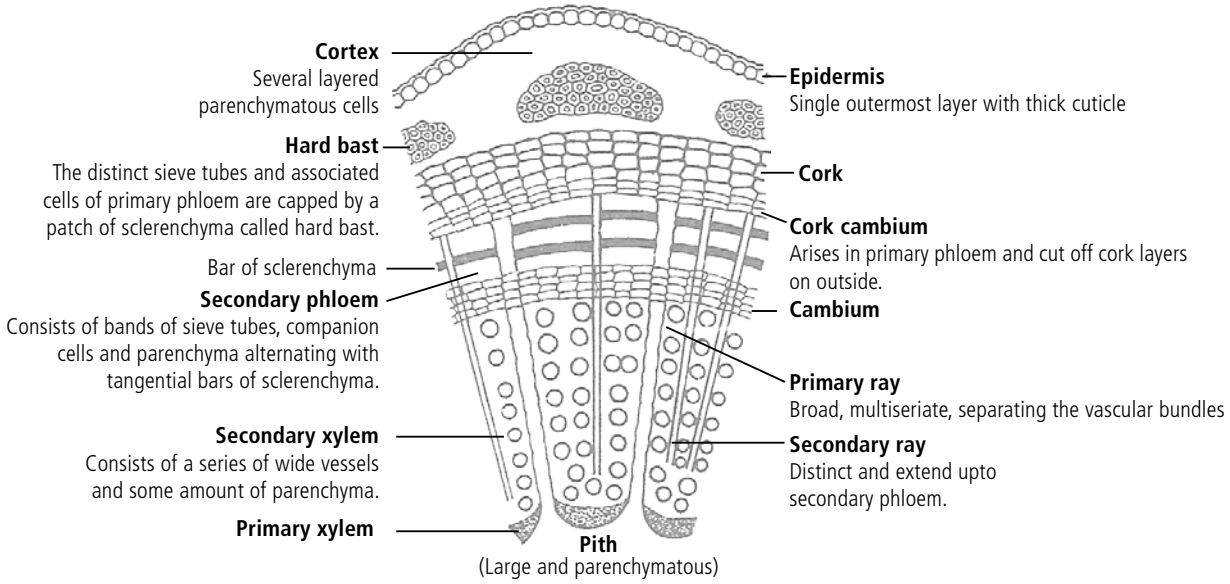


Fig.: Secondary growth in stem of *Vitis vinifera*

ANOMALOUS SECONDARY GROWTH

The term anomalous secondary growth is used to indicate the forms of cambial activity that deviate from commonly occurring secondary growth. The anomalies may be in growth in thickness, resulting in peculiar structures of xylem and phloem. Anomaly may arise on account of abnormal activity of normally positioned cambium or normal activity of abnormally positioned cambium anomalous growth varies considerably in different plants.

Anomalous Secondary Growth in Dicots

Anomalous growth in dicot root

Secondary growth begins with the formation of primary cambium. It is formed from the parenchyma cells between the xylem and phloem groups except opposite the two protoxylem groups where it arises from pericycle. This cambium produces a ring of closely arranged collateral vascular bundles. It ceases to function. The second cambial ring now develops from phloem parenchyma outside the first cambial ring. It forms secondary collateral vascular bundles. These are separated by radially formed secondary parenchyma. This cambial ring also ceases to function. The third ring of cambium is now produced from the pericycle. At this stage, pericycle divides and becomes many layered from which cambial rings develop successively. As a result, ring of vascular bundles alternating with storage parenchyma are formed. All the cambia are normal in behaviour producing xylem and phloem in usual way but the outer cambia are progressively less active than the inner cambia. Consequently thinner rings appear in outward direction.

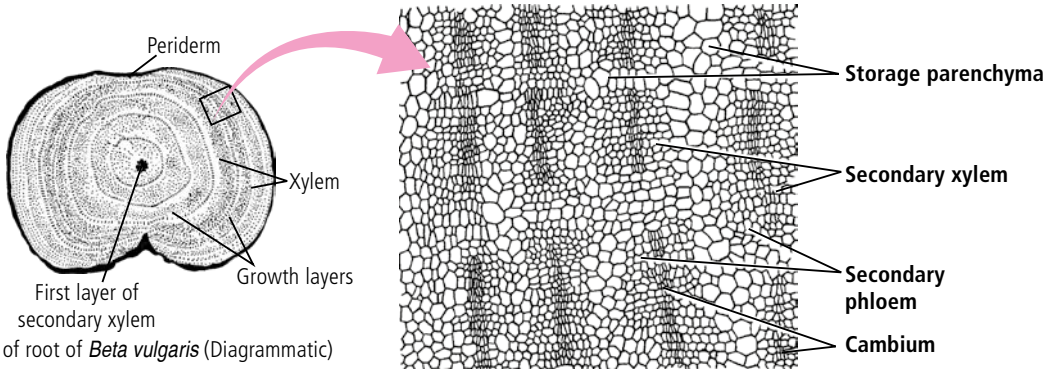


Fig.: T.S. of root of *Beta vulgaris* (Diagrammatic)

Fig.: Detailed structure of a part of T.S. of root of *Beta vulgaris*

Anomalous growth in dicot stem

In a stem, numerous vascular bundles occur in a ring embedded in conjunctive tissue scattered in the centrally located pith. In the beginning, there are numerous scattered primary vascular bundles. These bundles are collateral and open. The cambium of the bundles is active and individual bundles show little amount of secondary growth. This activity stops after some time. These bundles come to lie in the pith and are now called as medullary bundles. Secondary growth begins later with the development of a new cambium outside the stele. This cambium cuts off conjoint and collateral vascular bundles on the outer side. These are secondary bundles which remain embedded in the large amount of conjunctive tissue formed by the cambium. Many rings of vascular bundles are formed which remain embedded in the conjunctive tissue and their phloem consequently gives an appearance of included phloem or phloem islands at number of places.

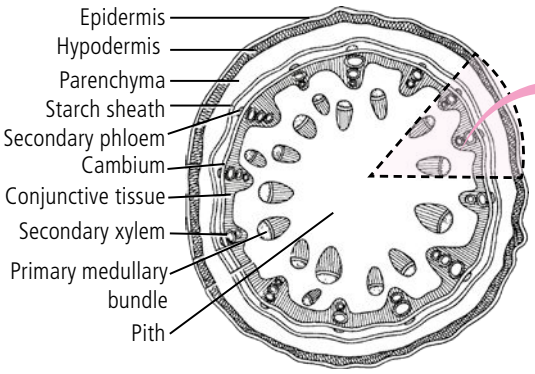


Fig.: T.S. of stem of *Amaranthus* (diagrammatic)

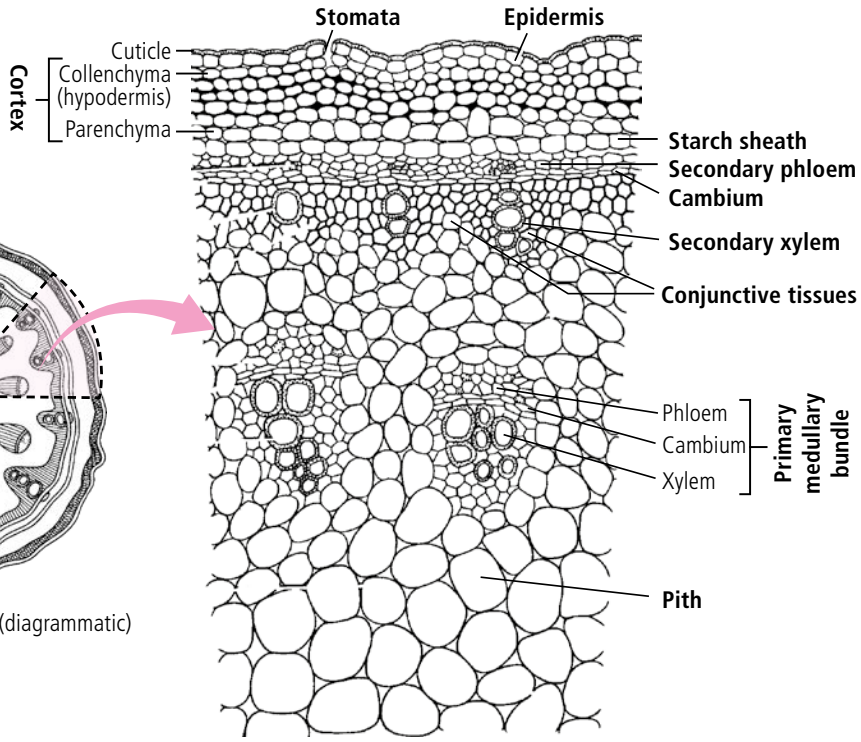


Fig.: *Amaranthus* : Detailed structure of a part of T.S. of stem

Anomalous Secondary Growth in Monocots

Though secondary growth is rare in monocots, it is commonly seen in woody monocotyledons like *Dracaena*, *Yucca*, *Aloe*, *Agave*, etc. In such arborescent monocot stems, the secondary cambium grows in hypodermal region, and forms conjunctive tissue and patches of meristematic cells. The latter grows into secondary vascular bundles. In *Dracaena* at a very late stage during the development, a wide zone of secondary meristem (cambium) develops outside the vascular bundles in the parenchymatous regions. This meristematic tissue cuts off vascular bundles on its inner side. These are concentric (amphivasal) in contrast to the primary bundles which are collateral. The amount of parenchymatous ground tissue also increases, therefore, the diameter of the stem. The cambium (meristematic zone) originates near the leaf primordia. The life of this zone or layer is limited. It stops functioning after sometime and the adjacent cells take over. Another important feature in contrast to cambium of dicotyledons is that cambium in *Dracaena* cuts off both xylem and phloem on its inner side while on its outer face very little amount of parenchyma is produced.

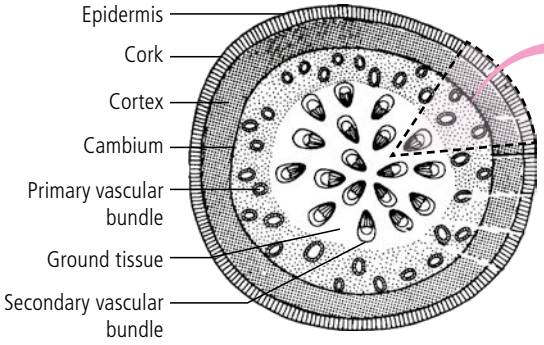


Fig.: T.S. of stem of *Dracaena* (diagrammatic)

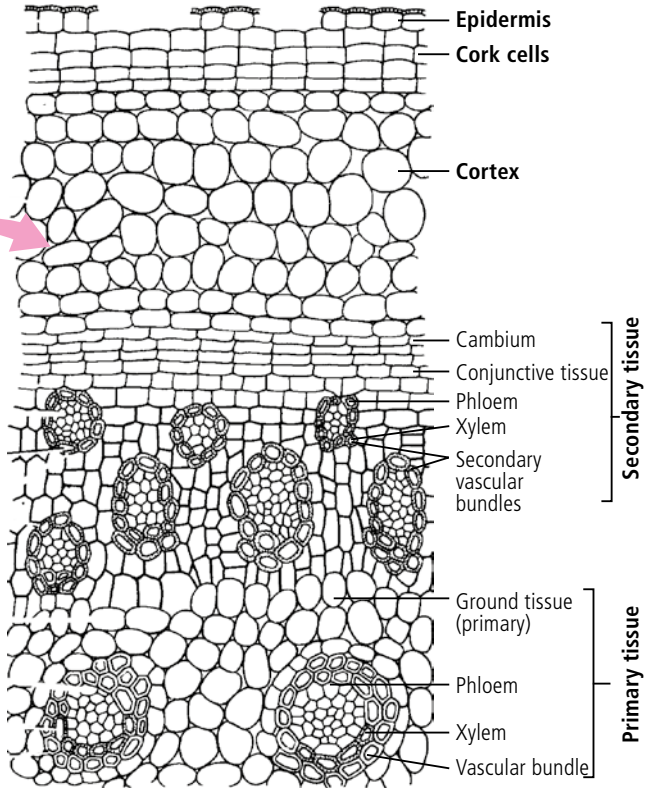


Fig.: Detailed structure of a part of T.S. of stem of *Dracaena*

POWER EXERCISE

New MCQs

1. The roots do not show distinct annual rings because
(a) vascular cambium is not active
(b) roots grow in dark
(c) secondary xylem is not abundant
(d) it grows in soil whose conditions remain more or less same.

2. Which of the following is not a secondary meristem?
(a) Interfascicular cambium
(b) Intrafascicular cambium
(c) Cork cambium
(d) None of these

3. In a cross section of dicot root showing secondary growth, the primary xylem can be distinguished from secondary xylem by which of the following characteristics?
I. Endarch nature II. Exarch nature
III. Central in position IV. Broader and thinner vessels
The primary xylem can be identified by
(a) III and IV only (b) I and IV only
(c) II and III only (d) II, III and IV only.

4. The vascular rays formed in the secondary vascular tissues are mainly involved in
(a) storage of food
(b) radial diffusion of gases
(c) conduction of water and organic food
(d) all of these.

5. In a section of wood trunk obtained from a tree, the part of wood with abundant fibres and high density is referred to as
(a) spring wood (b) autumn wood
(c) early wood (d) sapwood.

6. Ring porous wood is considered to be more advanced than diffuse porous wood as
(a) it is composed of 90-95% tracheids
(b) large sized vessels are present both in spring and autumn wood
(c) broad vessels in spring wood provide better translocation
(d) broad vessels in autumn wood help to fulfill acute requirements.

7. In dicot roots, the cork cambium originates from
   (a) pit (b) hypodermis
   (c) pericycle (d) endodermis.

8. Some of the tree trunks are found hollow at times, this is because
   (a) sapwood is susceptible to microbial attack
   (b) the tracheids of heartwood get plugged by tyloses
   (c) heartwood is also susceptible to attack of wood rotting fungi
   (d) heartwood is stronger and resistant to microbial attack.

9. The phellem in most of the plants appear brown or dark brown in colour as it
   (a) possesses suberised walls
   (b) contains abundant tannins
   (c) is filled with air
   (d) is composed of dead cells.

10. Technically the bark refers to
   (a) all dead cells outside cork cambium
   (b) all dead cells inner to cork cambium
   (c) all cells peripheral to secondary cortex
   (d) all cells outside to vascular cambium.

11. Secondary xylem in wood of normal dicot plants is produced from
   (a) pith and primary xylem
   (b) apical meristem
   (c) cork cambium
   (d) vascular cambium.

12. Sapwood
   (a) is outer functional wood of old stem
   (b) is central non-functional wood of old stem
   (c) is heavier and durable than heartwood
   (d) comprises of dead cells only.

13. Which of the following is produced on inner side and on outer side by cork cambium, respectively?
   (a) Suberised cells Collenchymatous cells
   (b) Dead cells Living cells
   (c) Phellem Phelloderm
   (d) Secondary cortex Cork

14. Anomalous secondary growth in monocot stem is observed in
   (a) *Helianthus* (b) *Nerium*
   (c) *Dracaena* (d) *Cucurbita*.

15. Softwood refers to
   (a) wood of herbaceous stems
   (b) wood of conifers
   (c) wood of dicot stem
   (d) primary stem of dicots.

Exam Section

1. The vascular cambium normally gives rise to
   (a) primary phloem (b) secondary xylem
   (c) periderm (d) phelloderm.
   (NEET 2017)

2. Identify the wrong statement in context of heartwood.
   (a) It is highly durable.
   (b) It conducts water and minerals efficiently.
   (c) It comprises dead elements with highly lignified walls.
   (d) Organic compounds are deposited in it.
   (NEET 2017)

3. Lenticels are involved in
   (a) food transport (b) transpiration
   (c) photosynthesis (d) none of the above.
   (JIPMER 2017)

4. The balloon-shaped structures called tyloses
   (a) originate in the lumen of vessels
   (b) characterise the sapwood
   (c) are extensions of xylem parenchyma cells into vessels
   (d) are linked to the ascent of sap through xylem vessels.
   (NEET Phase-II 2016)

5. As secondary growth proceeds, in a dicot stem, the thickness of
   (a) sapwood increases
   (b) heartwood increases
   (c) both sapwood and heartwood increases
   (d) both sapwood and heartwood remains the same.
   (AIIMS 2016)

6. Pick out the correct statement.
   (a) Spring wood is otherwise called late wood.
   (b) Autumn wood is otherwise called early wood.
   (c) In old trees, the heartwood is involved in the conduction of water.
   (d) In old trees, the sapwood does not conduct water.
   (e) The cambial cells present between primary xylem and primary phloem constitute the intrafascicular cambium.
   (Kerala PMT 2016)

7. Read the different components from (i) to (iv) in the list given below and tell the correct order of the components with reference to their arrangement from outer side to inner side in a woody dicot stem.
   (i) Secondary cortex (ii) Wood
   (iii) Secondary phloem (iv) Phellem
   The correct order is
   (a) (iv), (i), (iii), (ii) (b) (iv), (iii), (i), (ii)
   (c) (iii), (iv), (ii), (i) (d) (i), (ii), (iv), (iii).
   (AIPMT 2015)

8. Fascicular cambium separates the xylem and phloem in
   (a) dicots only
   (b) monocots only
   (c) both dicots and monocots
   (d) none of the above. *(UP CPMT 2015)*

9. When one wood is lighter in colour with a lower density, the other wood is darker with a higher density. They are
   (a) spring wood and autumn wood
   (b) heart wood and late wood
   (c) spring wood and early wood
   (d) sapwood and spring wood
   (e) autumn wood and spring wood. *(Kerala PMT 2014)*

10. During secondary growth the amount of secondary xylem produced is more than the secondary phloem because
   (a) the cambium is more active on the inner side
   (b) the cambium is more active on the outer side
   (c) the cambium is equally active on both sides but the xylem is needed more
   (d) the cambium has no role to play in this difference. *(AMU 2013)*

11. Cork cambium of dicot stem originates from
   (a) dedifferentiated parenchyma cells of cortex
   (b) dedifferentiated collenchyma cells of cortex
   (c) parenchyma cells of medullary ray
   (d) parenchyma cells of pericycle. *(Karnataka CET 2013)*

12. The common bottle cork is a product of
   (a) dermatogen (b) phellogen
   (c) xylem (d) vascular cambium. *(AIPMT Prelims 2012)*

13. Which one of the following is not correct?
   (a) Early wood is characterised by large number of xylary elements.
   (b) Early wood is characterised by vessels with wider cavities.
   (c) Late wood is characterised by large number of xylary elements.
   (d) Late wood is characterised by vessels with narrower cavities. *(AMU 2010)*

14. Medullary rays are made up of
   (a) parenchymatous cells (b) sclerenchymatous cells
   (c) tracheids (d) fibres. *(AMU 2010)*

15. What is/are true about heartwood?
   A. It does not help in water conduction.
   B. It is also called alburnum.
   C. It is dark in colour but very soft.
   D. It has tracheary elements which are filled with tannin, resin, etc.
   (a) B and D (b) A, B and C
   (c) B, C and D (d) A and D *(Karnataka CET 2009)*

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 :** Sapwood is less durable.
   Reason : Sapwood is resistant to microbial attack.

2. **Assertion :** Softwood is also known as nonporous wood.
   Reason : Softwood is devoid of vessels.

3. **Assertion :** In dicot root vascular cambium is a wavy band in the early stage of its activity.
   Reason : In dicot root vascular cambium is secondary in origin.

4. **Assertion :** The age of a plant can be determined by counting the number of annual rings.
   Reason : Annual ring formed in single year consists of softwood and hardwood.

5. **Assertion :** Periderm is the secondary meristem giving rise to cells on both the sides.
   Reason : Phellogen, phellem and periderm together constitute the phelloderm.

Short Answer Type Questions

1. Fill in the blanks.
   (i) As the secondary xylem is formed on the inner side, the vascular cambium slowly moves to outside with the formation of new cells. This process is known as _____.
   (ii) _____ is the science of counting and analysing annual growth rings of trees.
   (iii) The ingrowth of adjacent parenchyma cells into the tracheids and vessels of heartwood are called _____.

2. Write a short note on cork with its economic importance.

3. Differentiate between phellem and phelloderm.

4. Illustrate the secondary growth in a typical dicot stem with the help of a labelled diagram.

ANSWER KEY

New MCQs

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

Exam Section

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

Assertion & Reason

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

Short Answer Type Questions

1. (i) dilation
(ii) Dendrochronology
(iii) tyloses

2. The phellogen produces cork or phellem on outer side. It comprises of dead and compactly arranged rectangular, suberised cells. Due to the presence of tannins they appear dark brown in colour. Cork prevents the loss of water by evaporation and also protects the interior against entry of harmful microorganisms, mechanical injury and extremes of temperature. Cork is light, compressible, non-reactive and resistant to fire. It is also used as stopper for bottles, shock absorption and insulation.

3. The differences between phellem and phelloderm are as follows:

	Phellem	Phelloderm
(i)	Phellem or cork is a tissue formed on the outer side of phellogen or cork cambium.	Phelloderm or secondary cortex is produced on the inner side of phellogen.
(ii)	It is composed of dead cells.	Phelloderm is made of living cells.
(iii)	Phellem is protective in function.	Its cells take part in storage of food.
(iv)	The cell walls become impermeable due to suberisation.	Suberisation is absent.
(v)	Phellem cells are filled with tannins.	Tannins are absent.
(vi)	The cells are compactly arranged except for the presence of lenticels.	The cells enclose small intercellular spaces.
(vii)	Phellogen is more active on the side of phellem, *i.e.*, more phellem is formed as compared to phelloderm.	Phellogen is less active on the side of phelloderm, *i.e.*, less phelloderm is formed as compared to phellem.
(viii)	The outer part of the phellem is peeled off at intervals.	There is no loss of phelloderm.

4. T.S. of dicotyledonous stem showing secondary growth is as follows.

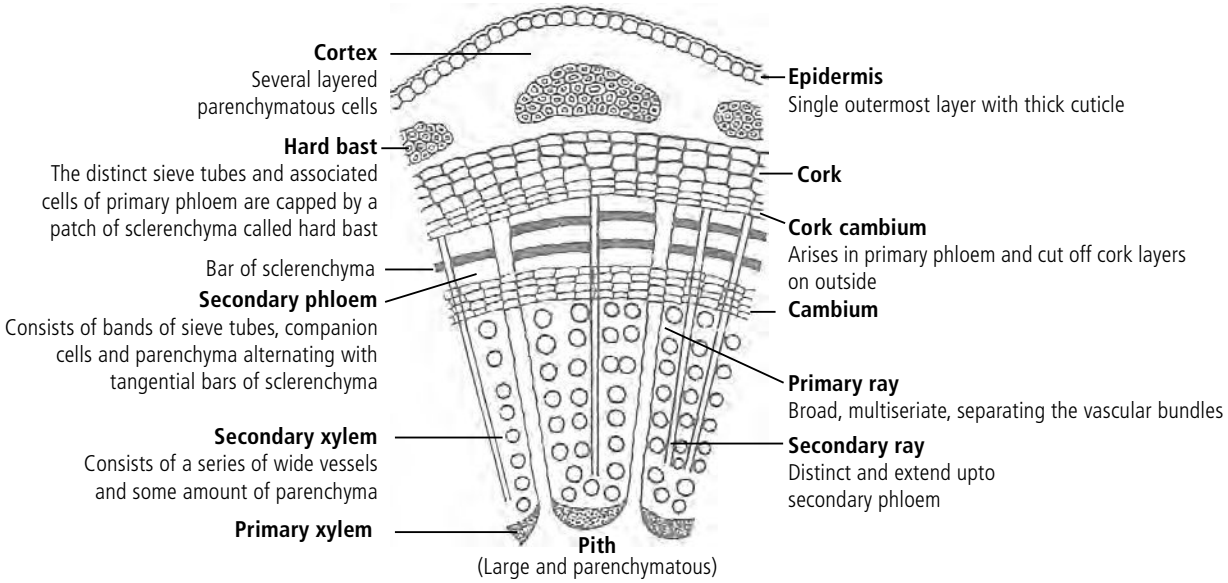


Fig.: Secondary growth in stem of *Vitis vinifera*

☺☺

MPP-8 MONTHLY Practice Problems

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.

- **Digestion and Absorption**
- **Breathing and Exchange of Gases**

Total Marks : 160 **Time Taken : 40 Min.**

1. Which of the following are present in the filiform papillae of the tongue?
(a) Chemoreceptors (b) Thermoreceptors
(c) Tactile receptors (d) Taste buds

2. Brown colour of faeces is due to
(a) sodium glycocholate (b) biliverdin
(c) sodium taurocholate (d) stercobilin.

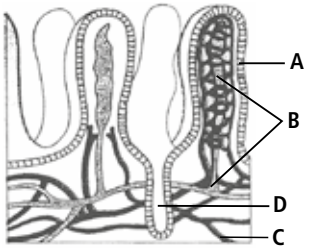
3. The chemosensitive area of respiratory centre in medulla is stimulated by
(a) excess CO_2 and H^+ ions
(b) less O_2 and H^+ ions
(c) less CO_2 and H^+ ions
(d) excess O_2 and H^+ ions.

4. Read the following statements and select the correct option stating which ones are true (T) or false (F).
I. Gluconeogenesis is the formation of glucose from lipid.
II. Bohr effect has a more enhanced effect on promoting O_2 transport than Haldane effect has on CO_2 transport.
III. Pneumotaxic centre's main function is to control depth of expiration.
IV. Paneth cells present in crypts of Lieberkuhn synthesise secretin hormone.

	I	II	III	IV
(a)	T	T	F	F
(b)	T	F	F	F
(c)	T	F	T	T
(d)	F	T	F	T

5. What is the approximate normal composition of alveolar air?
(a) 14% oxygen, 6% carbon dioxide, 80% nitrogen
(b) 21% oxygen, 2% carbon dioxide, 77% nitrogen
(c) 16% oxygen, 3% carbon dioxide, 81% nitrogen
(d) 10% oxygen, 8% carbon dioxide, 82% nitrogen

6. Observe a section of small intestinal mucosa showing villi. Select the option that correctly identifies A, B, C and D.



(a) A-Lacteal, B-Villus, C-Capillary, D-Crypts of Lieberkuhn
(b) A-Villus, B-Lacteal, C-Blood vessel, D-Crypts of Lieberkuhn
(c) A-Artery, B-Lacteal, C-Crypts of Lieberkuhn, D-Villus
(d) A-Crypts of Lieberkuhn, B-Lacteal, C-Vein, D-Villus

7. Accessory pancreatic duct is called
(a) ampulla of Vater (b) duct of Santorini
(c) duct of Wirsung (d) duct of Rivinus.

8. The partial pressure of O_2 when blood enters and leaves the alveolar capillaries are respectively
(a) 86 mmHg, 35 mmHg (b) 45 mmHg, 80 mmHg
(c) 75 mmHg, 40 mmHg (d) 40 mmHg, 95 mmHg.

9. The volume of air that always remains inside the human lungs is described as
(a) residual volume
(b) expiratory reserve volume
(c) inspiratory reserve volume
(d) tidal volume.

10. Select the mismatched pair from the following options.
(a) Peyer's patches – Produce lymphocytes
(b) Pleural fluid – Lubricate pleurae to reduce friction
(c) Lecithin – Lines trachea to prevent collapsing
(d) Castle's intrinsic factor – Vitamin B_{12} absorption

11. To maintain the ionic balance during the transportation of gases, chloride ions shift from
(a) lungs to blood (b) plasma to RBCs
(c) RBCs to plasma (d) blood to lungs.

12. Which of the statements given below are incorrect?
I. Chronic obstructive pulmonary disease refers to coryza.
II. Emphysema is an abnormal distension of bronchioles of the lungs.
III. Fat is more suitable as a stored food than glycogen.
IV. Auerbach's plexus present in submucosa layer of gut controls peristalsis.
V. Brunner's glands found in ileum, open into crypts of Lieberkuhn.
(a) II and III only (b) I, II and V only
(c) I, III, IV and V only (d) I, IV and V only

13. The 'blue baby' syndrome results from
(a) excess of dissolved oxygen
(b) excess of TDS (total dissolved solids)
(c) excess of chloride (d) methemoglobin.

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

	Column I		Column II
A.	Pancreatic juice	(i)	Sodium bicarbonate ions
B.	Saliva	(ii)	Nucleosidases
C.	Intestinal juice	(iii)	Pepsinogen
D.	Bile	(iv)	Trypsinogen
E.	Gastric juice	(v)	Thiocyanate ions

(a) A-(v), B-(i), C-(iii), D-(iv), E-(ii)
(b) A-(iv), B-(v), C-(ii), D-(i), E-(iii)
(c) A-(ii), B-(iii), C-(i), D-(v), E-(iv)
(d) A-(iii), B-(v), C-(ii), D-(i), E-(iv)

15. Which of the following options correctly depicts the sequence of the respiratory organs involved during the process of expiration?
(a) Bronchi → Alveoli → Trachea → Internal nares → Larynx → Pharynx → Nasal cavities → External nares
(b) Alveoli → Bronchi → Trachea → Larynx → Pharynx → Internal nares → Nasal cavities → External nares
(c) Bronchi → Alveoli → Trachea → Pharynx → Larynx → Internal nares → Nasal cavities → External nares
(d) Alveoli → Bronchi → Trachea → Pharynx → Nasal cavities → Larynx → Internal nares → External nares

16. Read the given statements and select the correct option.
Statement 1 : Pepsin can hydrolyse collagen and milk proteins.
Statement 2 : Pepsin is a protease, functional at acidic pH.
(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.

17. Select the correct option with appropriate enzymes that catalyse the following reactions.
(i) Starch → Maltose + Isomaltose + α-Dextrins
(ii) Casein → Paracasein + Whey proteins
(iii) Trypsinogen → Trypsin
(iv) Monoglycerides → Fatty acids + Glycerol

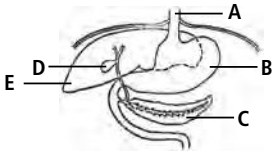
	(i)	(ii)	(iii)	(iv)
(a)	Enterocrinin	Pepsin	Carboxype-ptidase	Lactase
(b)	Pancreatic α-amylase	Rennin	Enterokinase	Lipase
(c)	Salivary amylase	Pepsin	Chymotrypsin	Dextrinase
(d)	Ptyalin	Rennin	Enterokinase	Lipase

18. Vital capacity of lungs is
(a) IRV + ERV (b) IRV + ERV + TV – RV
(c) IRV + ERV + TV + RV (d) IRV + ERV + TV.

19. Identify the correct statement regarding gastrointestinal hormones.
(a) Gastrin increases bile secretion and release of bicarbonates in pancreatic juice.
(b) Duocrinin stimulates pancreas to secrete digestive enzymes.
(c) Somatostatin stimulates the secretion of glucagon.
(d) Enterocrinin stimulates the crypts of Lieberkuhn to release enzymes into intestinal juice.

20. The changes that occur in diaphragm and intercostal muscles when expiration of air takes place are
(a) internal intercostal muscles relax and diaphragm contracts
(b) external intercostal muscles and diaphragm relax
(c) internal intercostal muscles contract and diaphragm relaxes
(d) external intercostal muscles and diaphragm contract.

21. The diagram shows part of the human alimentary canal. Which two structures produce substances involved in the digestion of fat?
(a) A and E
(b) B and D
(c) C and E
(d) D and E



22. Read the given statements and select the incorrect one.
(a) pH of the blood decreases as CO_2 content increases.
(b) Stem cells present in gastric glands help in healing damaged gastric epithelium by multiplying and replacing.
(c) Kupffer cells are phagocytic in nature and eat worn out WBCs, RBCs and bacteria.
(d) Partial pressure of oxygen of inspired air is about 95 mm Hg.

23. When CO_2 concentration in blood increases, breathing becomes
(a) shallower and slow (b) faster and deep
(c) slower and deep (d) there is no effect on breathing.

24. What is common among amylase, rennin and trypsin?
(a) All are produced in stomach
(b) All act at a pH lower than 7
(c) All are proteins (d) All are proteolytic enzymes

25. Calculate the volume of air that remains in lungs after normal expiration from given values :
TV = 500 mL, ERV = 1000 mL
IRV = 2700 mL, RV = 1200 mL.
(a) 3900 mL (b) 1500 mL
(c) 2200 mL (d) 3200 mL

DESIGN YOUR OWN DEGREE.

CHOOSE YOUR OWN CURRICULUM.

DETERMINE YOUR OWN CAREER.

Introducing Inter Disciplinary Experiential Active Learning (IDEAL)

IDEAL gives you the opportunity to select a discipline that will give you a career edge, and also study something you are passionate about. With IDEAL, you can now pursue a Specialization as a part of your Major degree or a Minor in another discipline, earning you extra credits at no additional cost. For instance, you can couple your Major in Mechanical Engineering with a Minor in Finance, or specialize in Artificial Intelligence while majoring in Computer Science. Chart your IDEAL path enriched further by industry internships and technology-enabled active learning that will help you in getting jobs. Begin your journey with SRMJEEE.

Take the SRMJEEE (B.Tech) 2018.
Online applications: Nov. 1, 2017 onwards.

ONLINE EXAM DATES

APRIL 16-30, 2018

TO APPLY

Visit: applications.srmuniv.ac.in
Make e-payment OR send the filled application form with DD for ₹1100. For eligibility and fee details, visit the respective websites.

FOR QUERIES

Call: +91 44 2745 5510
+91 44 4743 7500
Email: admissions.india@srmuniv.ac.in

SRM UNIVERSITY
(Under Section 3 of UGC Act 1956)
www.srmuniv.ac.in
KATTANKULATHUR
RAMAPURAM
DELHI-NCR GHAZIABAD
VADAPALANI

SRM UNIVERSITY
— AP, Amaravati
www.srmap.edu.in

SRM UNIVERSITY
— Delhi-NCR, Sonepat
www.srmuniversity.ac.in

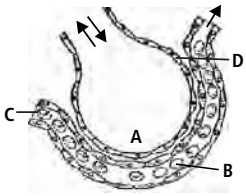
26. In humans, which opening is guarded by sphincter of Oddi?
(a) Opening of hepatopancreatic ampulla into duodenum
(b) Opening of stomach into duodenum
(c) Opening of oesophagus into stomach
(d) Opening of bile duct into gall bladder

27. When people visit high altitudes, at times they suffer from altitude sickness. It occurs due to
(a) decreased proportion of oxygen in air
(b) decreased efficiency of haemoglobin
(c) decreased partial pressure of oxygen
(d) excess of CO_2 in blood.

28. Capacity of maximum expiration of lung after deep inspiration is called
(a) vital capacity (b) functional residual capacity
(c) total lung capacity (d) expiratory capacity.

29. Which one of the following statements is true regarding digestion and absorption of food in humans?
(a) Oxyntic cells in our stomach secrete the proenzyme pepsinogen.
(b) Glucose, fructose and amino acids are absorbed through intestinal mucosa with the help of carrier ions like Na^+.
(c) Chylomicrons are small lipoprotein particles that are transported from intestine into lymphatic capillaries.
(d) About 60% of starch is hydrolysed by salivary amylase in our mouth.

30. A small part of human lung where exchange of gases takes place is diagrammatically represented below. Select the option which represents labelled part (A, B, C or D) correctly identified along with its function.



(a) C : Arterial capillary - Passes oxygen to tissues
(b) D : Capillary wall - Exchange of O_2 and CO_2 takes place here
(c) A : Alveolar cavity - Main site of exchange of respiratory gases
(d) B : Red blood cells - Transport of CO_2 as carboxyhemoglobin

31. Identify the factors which dissociates oxygen from haemoglobin.
(i) Increase in pCO_2 (ii) Decrease in H^+ concentration
(iii) Low body temperature
(iv) Increase in pH (v) Low pO_2
(a) (i), (ii) and (v) (b) (i), (ii), (iv) and (v)
(c) (ii), (iii) and (iv) (d) (i), (iii) and (iv)

32. The first process in the digestion and assimilation of fats is
(a) emulsification (b) enzymatic action
(c) absorption by lacteals (d) storage in adipose tissue.

33. Dental formula of man is

	I	C	Pm	M		I	C	Pm	M
(a)	2/2	1/1	2/2	3/3	(b)	1/1	2/2	3/3	2/2
(c)	2/2	1/1	3/3	2/2	(d)	2/3	2/2	3/2	4/4.

34. Although much CO_2 is carried in blood, yet blood does not become acidic, because
(a) it is absorbed by the leucocytes
(b) it combines with water to form H_2CO_3 which is neutralised by Na_2CO_3
(c) CO_2 transport and blood buffers play an important role in it
(d) it is continuously diffused through the tissues and is not allowed to accumulate.

35. Cholecystectomy (removal of gall bladder) results in
(a) gastric cramps (b) impaired fat digestion
(c) reduced bile production (d) no appreciable change.

36. HCO^-_3 diffuses from erythrocytes to plasma during CO_2 transport and in turn upsets the ionic balance momentarily. In order to maintain the ionic balance, Cl^- pass into the erythrocytes from plasma. The process is known as
(a) carbonation (b) bicarbonate shift
(c) Hamburger's phenomenon
(d) Bohr's effect.

37. Food after getting churned in stomach is called
(a) bolus (b) chyle
(c) chyme (d) none of these.

38. HCl of gastric juice
(a) inactivates gastric amylase and activates pepsin
(b) activates ptyalin and inactivates pepsin
(c) inactivates both α-amylase and pepsin
(d) activates both pancreatic amylase and pepsin.

39. Asthma usually occurs due to an allergic reaction and is characterised by
(a) pain in lungs (b) alveolar wall degradation
(c) spasm in bronchial muscle
(d) damage in diaphragm.

40. Somatostatin which inhibits secretion of glucagon and insulin is secreted from
(a) pancreatic polypeptide cells
(b) delta cells of islets of Langerhans
(c) Brunner's glands of duodenum
(d) argentaffin cells of intestinal glands. ☺☺

Key is published in this issue. Search now! ☺

SELF CHECK

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

Check your score! If your score is

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

CONCEPT MAP

ASEXUAL REPRODUCTION

Life cannot be created *de novo* rather it arises from pre-existing life. Reproduction is the only method by which continuity of life is maintained. It is of two types: asexual and sexual. Asexual reproduction is the formation of new individual without involving fusion of gametes. It is uniparental as offspring are produced by a single parent.

CHARACTERISTICS OF ASEXUAL REPRODUCTION

- It is more primitive than sexual reproduction as it involves only mitotic divisions.
- New organisms are produced from the somatic part of parental organism, so it is also called as somatogenic reproduction.
- New individuals produced are genetically similar to the parent as well as to each other and are called clones. Hence, it plays no role in evolution.
- Unit of reproduction may be either whole parent body, or a bud, or a body fragment, or a single somatic cell.
- It is usually found in lower organisms like protistan protozoans (*Amoeba, Paramecium*), sponges (*Scypha*), coelenterates, (*Hydra, Tubularia,* etc.), certain flatworms (*Planaria*), some worms and tunicates (*Salpa, Ascidia*, etc.). It is absent in higher invertebrates and all vertebrates.

TYPES OF ASEXUAL REPRODUCTION

Fission

- It is a type of asexual reproduction in which the parent organism divides into two or more daughter cells.
- In this type of reproduction, whole parent body acts as the reproductive unit.
- It is of three types:

(a) Binary fission : In this, parent organism divides into two halves, each half forming an independent daughter organism. It can be simple (occurs through any plane, *e.g.*, *Amoeba*), longitudinal (plane of division is longitudinal axis of body, *e.g.*, *Euglena*), transverse (plane of division runs along transverse axis of body, *e.g.*, *Paramecium*) and oblique (plane of division is oblique, *e.g.*, *Ceratium*).

(b) Multiple fission : In this process, parent body divides into many similar daughter organisms. It occurs during unfavourable conditions. Nucleus of the parent divides by repeated amitosis into many nuclei which eventually form several daughter cells. *E.g.*, *Amoeba, Plasmodium* (malarial parasite).

(c) Plasmotomy-Division of multinucleate parent into many multinucleate daughter individuals without division of nuclei. Nuclear division occurs later to maintain number of nuclei. *E.g.*, *Opalina, Pelomyxa.*

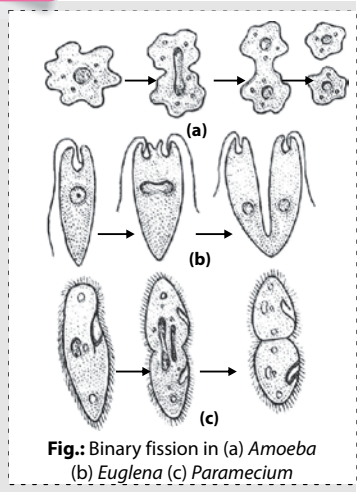


Fig.: Binary fission in (a) *Amoeba* (b) *Euglena* (c) *Paramecium*

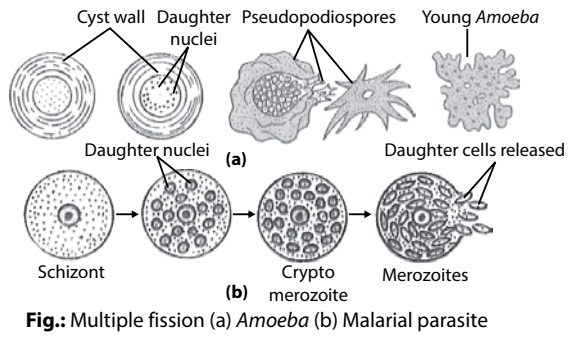


Fig.: Multiple fission (a) *Amoeba* (b) Malarial parasite

Regeneration

- It refers to the growth of new tissues or organs to replace lost or damaged part.
- Regeneration is of two types: **morphallaxis** (formation of whole body from a fragment) and **epimorphosis** (replacement of lost parts). It can be reparative (regeneration of damaged tissue only) or restorative (redevelopment of severed body part). In epimorphosis, a mass of undifferentiated cell referred to as blastema is formed after wound healing and then the blastema cells actively proliferate to restore the lost part of the amputated organ.
- Regeneration is found in *Hydra*, starfish, *Planaria*, etc.

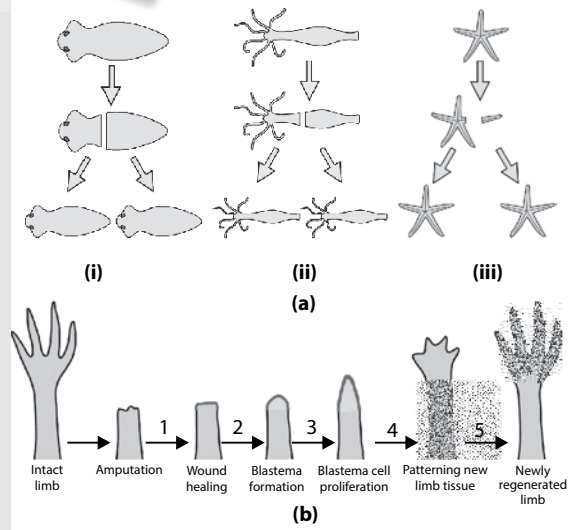


Fig.: (a) Regeneration in (i) *Planaria* (ii) *Hydra* (iii) Starfish (b) Epimorphosis

Budding

- Budding refers to the process of formation of daughter individuals from a small projection or bud arising on the parent body.
- Each bud enlarges, develops parental characters and separates to lead an independent life.
- Budding can be either **exogenous** (formed on the outer surface) *e.g.*, *Hydra*, yeast or **endogenous** (formed inside parent body) *e.g.*, *Spongilla*. In *Spongilla*, bud is called a **gemmule.**

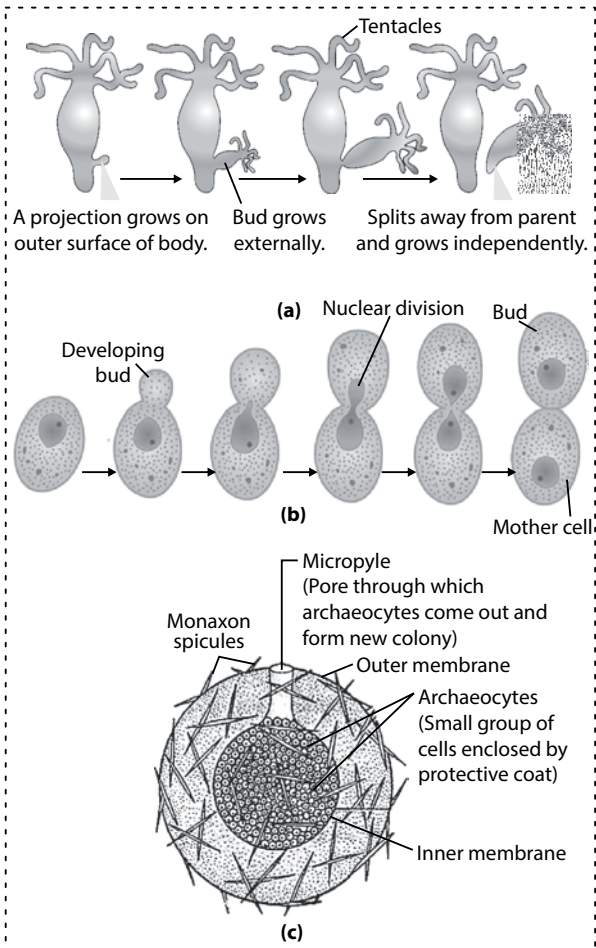


Fig.: (a) Exogenous budding in *Hydra* (b) Exogenous budding in yeast (c) Endogenous budding (gemmule) in *Spongilla*

Fragmentation

- In this type of reproduction, parent body breaks into two or more pieces called fragments.
- Each fragment develops into a new organism.
- In fragmentation, rate of reproduction is high.
- It occurs in flatworms, sea anemones, coelenterates, echinoderms, algae like *Spirogyra*, etc.

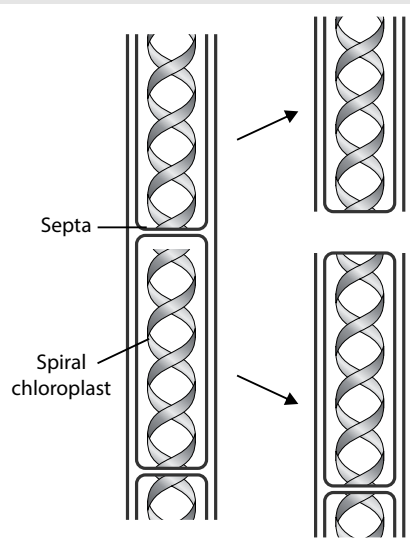


Fig.: Fragmentation in *Spirogyra*

Sporulation

- Spores are minute, single celled, thin or thick walled propagules which are dispersive structures released from the parent body and form new individuals. Spore formation is common in members of monera, protista, algae and fungi. Some of the commonly produced spores are:

(a) Zoospores : Motile and flagellated spores produced inside zoosporangia. Flagella help in proper dispersal in aquatic habitat. *E.g.*, algae and lower fungi like Phycomycetes.

(b) Conidia : Non-motile spores produced singly or in chains by constriction at the tip or lateral side of special hyphal branches called conidiophores. These are dispersed by wind and germinate to form new individuals. *E.g.*, *Penicillium*.

(c) Chlamydospores : Thick walled spores produced directly from hyphal cells. May be terminal or intercalary in position and capable of withstanding unfavourable conditions. *E.g.*, *Rhizopus*.

(d) Oidia : Small fragments of hyphae that are thin walled and do not store reserve food material. Oidia give rise to new hyphae. These are formed under conditions of excess water, sugar and certain salts. *E.g.*, *Agaricus*.

(e) Sporangiospores : Non-motile spores produced inside sporangia. Usually get dispersed by wind and germinate to form new mycelium. *E.g.*, *Rhizopus*, *Mucor*.

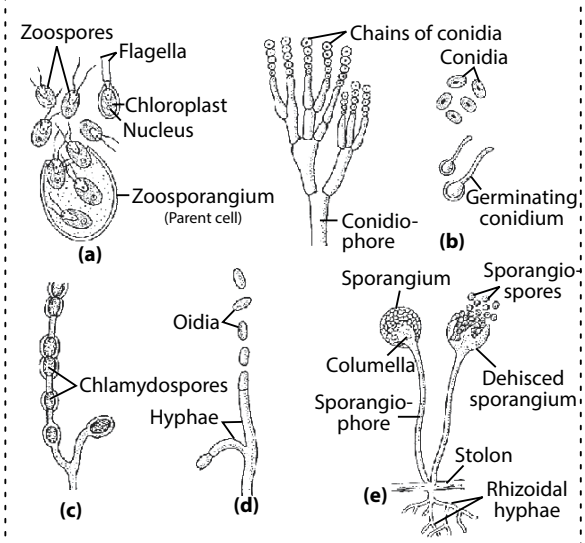


Fig.: Various types of spores (a) Zoospores (b) Conidia (c) Chlamydospores (d) Oidia (e) Sporangiospores

HIGH YIELD FACTS

Class XII

EVOLUTION-I

- Life originated on earth millions of years ago and since then innumerable varieties of living beings have evolved. Human beings are considered to be the most recent and most highly evolved organisms.

THEORIES OF ORIGIN OF LIFE

- The origin of life is explained by various theories put forth by different scientists. Some of the important theories are discussed below.

Theory of Special Creation

- It was supported by **Father Suarez**. It states that : (i) Some supernatural power, called God formed living organisms. (ii) Living organisms were formed all of a sudden. (iii) They have not undergone any change since their formation.

  According to Bible, life was created by God in 6 days.

Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
Heaven and Earth were formed	Sky was separated from water	Dry land and plants	Sun, Moon and Stars	Fish and fowl	Animals including human beings

Theory of Spontaneous Generation (Abiogenesis or Autogenesis)

- It was proposed by **Van Helmont** (1577-1644). It states that life originated abiogenetically only from non-living, decaying and rotting matter like straw, mud, etc., by spontaneous generation.
- Van Helmont proposed that living mice will develop when human sweat and wheat barn are kept together for 21 days.

Abiogenesis was experimentally rejected by Francesco Redi. He proved that organisms could be formed only from pre-existing organisms, *i.e.*, biogenesis.

Analysis of various PMTs from 2013-2017

	2013	2014	2015	2016	2017
AIPMT/NEET	2	2	1	4	–
AIIMS	1	–	2	–	2
AMU	4	–	1	–	–
Kerala	–	1	2	–	–
K-CET	1	2	2	–	–
J & K	–	–	1	–	–

Theory of Biogenesis

(a) Redi's experiment: Francesco Redi (1668) cooked the flesh until no organisms were left alive and placed it in three separate containers.

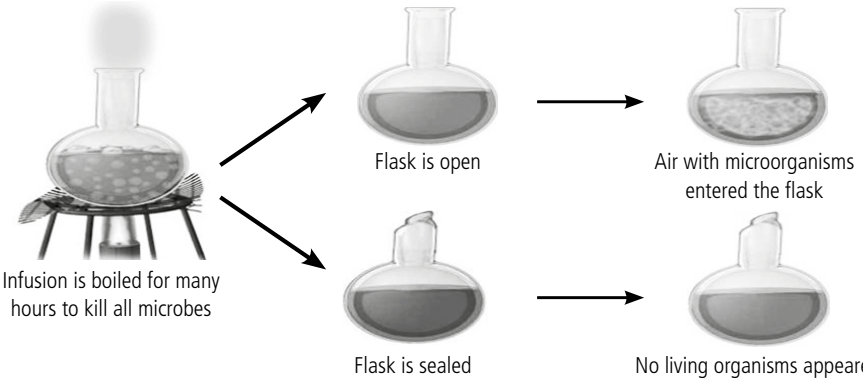
Open container — Flies entered and laid eggs that hatched maggots in meat.

Cork-sealed container — No flies entered and thus no eggs,no formation of maggots in meat.

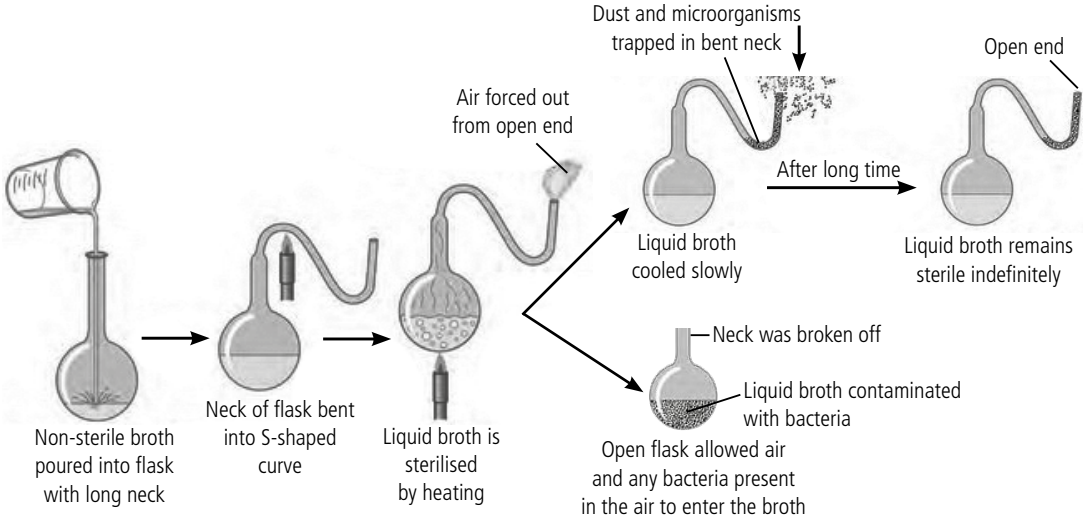
Gauze-covered container — No flies entered, no egg and no formation of maggots in meat.

This experiment confirmed that maggots arise from eggs and not from decaying meat.

(b) Spallanzani's experiment : Spallanzani (1765) disproved the spontaneous generation of microorganisms.



(c) Pasteur's experiment: Louis Pasteur (1822-1895) performed an experiment that discredited the theory of spontaneous generation.



- This experiment proved that the source of microorganisms for fermentation or putrefaction is air. The organisms or life cannot arise spontaneously from nutrient media.

Theory of Panspermia or Cosmozoic or Extraterrestrial

- It was proposed by **Richter** (1865). It states that life came on earth from some other planet in the form of seed or spore called panspermia or cosmozoans hence, it is also called **spore theory**.

- **Objections :** Living matter cannot survive the extreme cold, dryness and intense radiations of interplanetary space. Moreover, this theory does not explain how life originated and from where and how spores reached earth.

Modern Theory of Origin of Life

- Also called **Oparin-Haldane theory**, as it was proposed by Oparin (1923) and supported by Haldane (1928). It stated that primitive life originated in the water bodies on the primitive earth from non-living organic molecules (*e.g.*, RNA, proteins, etc.) by chemical evolution through a series of chemical reactions.
- Oparin's theory is also known as primary abiogenesis which means "abiogenesis first and then biogenesis ever since."

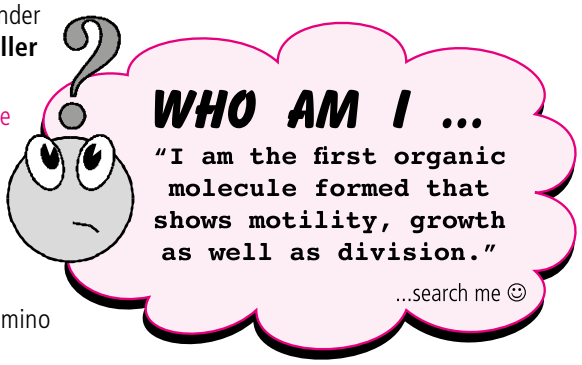
Table : Summary of origin of life

Chemical Evolution (Chemogeny)	Free atoms ↓	H, C, N, etc., essential for formation of protoplasm.
	Simple molecules ↓	Free atoms combined to form simple molecules like H_2, H_2O, CH_4, NH_3, CO_2, etc. Primitive atmosphere was reducing atmosphere (without free oxygen) unlike the present oxidising atmosphere (with free oxygen).
	Simple organic molecules ↓	CH_4, CO_2, H_2O → Sugar, Fatty acids, Glycerol CH_4, CO_2, NH_3 → Amino acids CH_4, H_2O, NH_3, HCN → Nitrogenous bases (Purines, Pyrimidines)
	Complex organic molecules (Macromolecules) ↓	Simple organic molecules accumulated in the ancient seas. In primitive atmosphere, electric discharge, solar energy, lightning, ATP and polyphosphates might have provided the source of energy for polymerisation reactions of organic synthesis. Sugar + Sugar + Sugar → Polysaccharides Fatty acid + Glycerol → Fats Amino acid + Amino acid → Proteins Nitrogen bases + Pentose sugars + Phosphates → Nucleotides Nucleotides + Nucleotides → Nucleic acids
Biological Evolution (Biogeny)	Coacervates or Microspheres ↓	**Oparin** and **Sydney Fox** proposed that complex organic compounds synthesised abiogenetically on the primitive earth later tend to accumulate and formed large colloidal cell-like but non-cellular prebiotic aggregates called **protobionts**. These microscopic, spherical, stable and motile aggregates were called coacervates by Oparin and microspheres by Sydney Fox. **Coacervates** are collection of organic macromolecules surrounded by a film of water molecules. They lack a definite membrane and cannot reproduce. **Microspheres** are small spherical cell-like units formed from proteinoids placed in boiling water and slowly allowed to cool. They have the ability of motility, growth and binary fission. Microspheres can be considered as first living cells.
	Free gene ↓	Self replicating, nucleoprotein complex.
	Earliest cells ↓	Lipid-protein membrane-bound units with enzyme controlled metabolism and nucleic acid regulation but lacked organised nucleus. They were heterotrophs.
	Prokaryotes ↓	Unicellular, cells did not have distinct nucleus and cell organelles. They had evolved to show chemoautotrophism and photoautotrophism (mostly anaerobic). They divide by binary fission.

	Eukaryotes ↓	Cells with distinct nucleus and cell organelles. It is assumed that eukaryotic cells evolved from prokaryotic cells either by symbiotic origin or origin by invagination. (i) **Symbiotic origin :** According to **Margulis** some anaerobic predator host cells engulfed primitive aerobic bacteria but did not digest them. These aerobic bacteria established themselves inside the host cells as symbionts. Such predator host cells became the first eukaryotic cells. The predator host cells that engulfed aerobic bacteria evolved into animal cells while those that captured both aerobic bacteria and blue-green algae became eukaryotic plant cells. The aerobic bacteria established themselves as mitochondria and blue-green algae as chloroplasts. (ii) **Origin by invagination :** According to this view, cell organelles of eukaryotic cells might have originated by invagination of surface membrane of primitive prokaryotic cells.
	Origin of multicellular organisms	Either by failure of separation of daughter cells after cell division or by aggregation of cells. (i) Photosynthetic, *e.g.*, plants. (ii) Heterotrophic, *e.g.*, animals.

EXPERIMENTAL PROOF OF ABIOGENIC MOLECULAR EVOLUTION OF LIFE

- Formation of simple organic compounds from simpler compounds under reducing conditions were experimentally proved by **Stanley Miller** and **Harold Urey**.
- Mixture of methane, ammonia, hydrogen and water vapour were subjected to electric spark of about 75,000 volts and temperature of about 800°C was provided.
- Methane, ammonia, hydrogen were taken in ratio of 2 : 2 : 1. Mixture was passed through condenser and gases were continuously circulated for few days.
- On analysing the composition of liquid inside the apparatus, amino acids like alanine, glycine and aspartic acid were found.



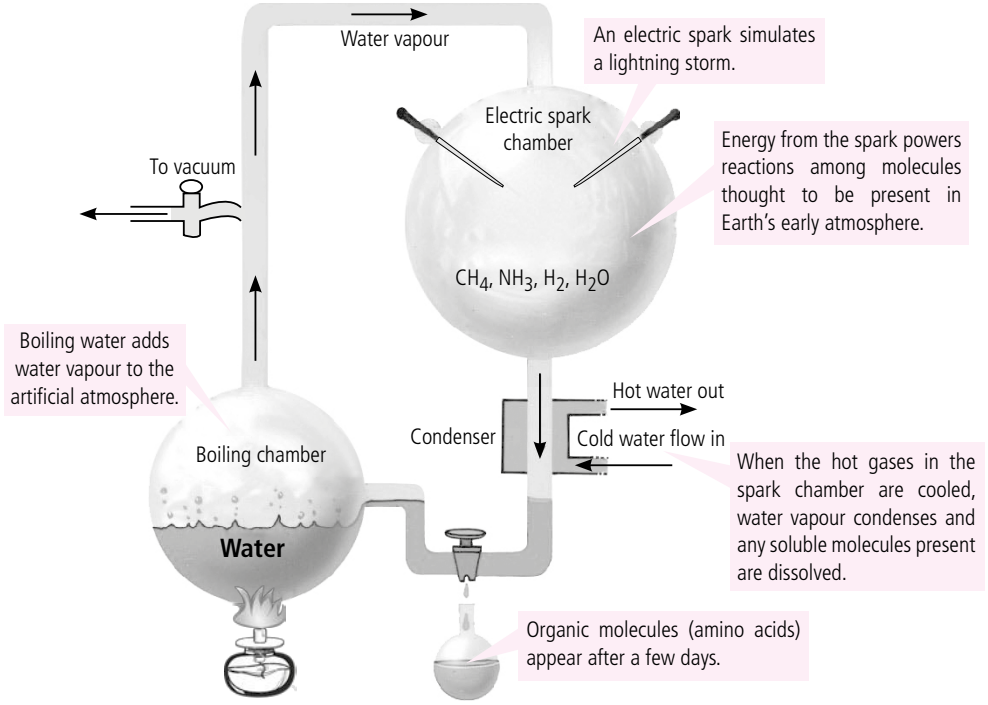


Fig.: Miller's experiment

EVOLUTION

- Evolution means an orderly change from one condition to another. It is believed that chemical evolution was replaced by organic or biological evolution. Organic evolution is a process of cumulative change of living populations and in the descendant populations of organisms. Therefore evolution also refers to genetic changes in populations of organisms through time that lead to differences among them.
- The term was proposed by **Charles Darwin** that signifies "**Descent with modification**" *i.e.*, the present complex plants and animals have evolved from earlier simpler forms of life by gradual changes.

EVIDENCES OF EVOLUTION

- The doctrine of organic evolution is supported by many types of evidences.

A. Morphological and Anatomical Evidences

- These are the proofs of inter-relationship between living organisms of different groups, based on the comparative studies of external and internal morphology (structure). These are of following types:

(I) Homologous organs

- The structures which are different in appearance and perform different functions but have similar basic structure and developmental origin are called homologous organs.
- **Examples:**

(a) Forelimbs of vertebrates like seal, bird, bat, horse, man, cat's paw, etc., look different and perform different functions.

Forelimbs	Seal	Bird	Bat	Horse	Man
Appearance	Flipper	Wing	Support patagium	Elongated	Thumb opposite to fingers
Function	Swimming	Flying	Flying	Running	Grasping

- But even then all these are homologous organs because:
  - These are built on same pentadactyl plan (5-digited) though modified differently to perform different functions and involve reduction in the number of digits, fusion of some bones, etc.
  - These show similar arrangement of structures like bones, blood vessels, muscles, nerves, etc. The bone arrangement reported in these forelimbs is as under:

Part of forelimb	Name of bones
Upper arm	Humerus
Forearm	Radius and Ulna
Wrist	Carpals
Palm	Metacarpals
Fingers	Phalanges

  - These bones are derived from the same part of body.

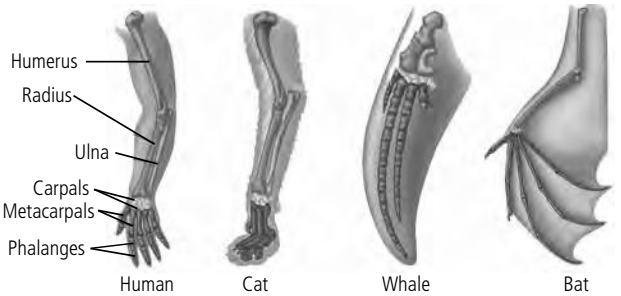


Fig.: Forelimbs of vertebrates as homologous organs

- This relationship between the structures having common basic plan and similar developmental origin is called **homology**, although these structures might have diverged due to their specific function. Presence of homologous organs confirm:
  (i) Common ancestry and inter-relationship.
  (ii) Divergent evolution (same structures have become different in different organisms due to different adaptations) due to adaptive radiations.
- Similarly, the forelimbs of whale, bat, cheetah and human are homologous organs.

(b) Comparative anatomy of heart of vertebrates

- Heart in different vertebrates are similar not only in their position (on ventral side of anterior part of body cavity), general organisation (formed of chambers) and even microscopic structure (formed of cardiac muscles) but also show gradual complexity in its internal structure from fishes to mammals. It is 2-chambered, venous and branchial with single circulation in fishes; 3-chambered and arteriovenous pushing mixed blood in amphibians; structurally 3-chambered but with incompletely partitioned ventricle in the reptiles; and 4-chambered with completely partitioned ventricle in the birds and mammals.

- This shows that heart in all the groups of vertebrates has same basic structural plan which proves their inter-relationship and common ancestry. The gradual complexity of heart in the vertebrate series is due to:
  (i) transition from aquatic to terrestrial mode of life
  (ii) change of mode of respiration from branchial to pulmonary
  (iii) for separation of oxygenated and deoxygenated blood.
- This confirms that the heart of vertebrates have changed in the course of evolution of mammals from fishes. Similarly, the brain of different vertebrates are homologous organs but show gradual complexity from fishes to humans.

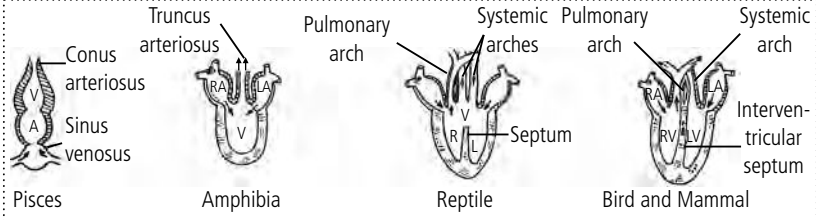


Fig.: Comparative anatomy of heart of vertebrates

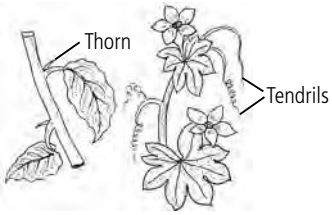


Fig.: Homologous structures : thorns and tendrils in plants

- Legs and mouthparts of insects, thorns of *Bougainvillea* and tendril of *Cucurbita* are also homologous organs.
- Homology seen amongst molecules is called **molecular homology**. Example, proteins found in blood of man and ape are similar. The phylogeny of an organism can be traced by using the base sequence in nucleic acids and amino acid sequence of proteins in related organisms.

(II) Analogous organs

- Structures which are different in their basic structure and developmental origin but appear similar and perform similar function are analogous organs. This relationship between structures of different groups of animals of separate lineage due to their similar function is called **analogy** or **convergent evolution** or **adaptive convergence**.
- **Examples :**

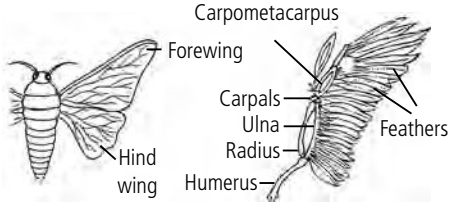


Fig.: Wings of an insect are analogous to wings of bird

– **Insect and bird wing** – These are different in basic anatomical framework and origin, *e.g.*, insect-wing is formed from integument while the bird-wing is a modified forelimb, but are analogous organs as both are flat structures and are adapted for flight. Even the wings of bird (modified forelimb) and wings of bats (patagia of skin) are analogous structures.

– **Both tracheae of an insect and lungs of vertebrates** are adapted for respiration but are not homologous as tracheae are ectodermal in origin while the lungs are endodermal in origin.

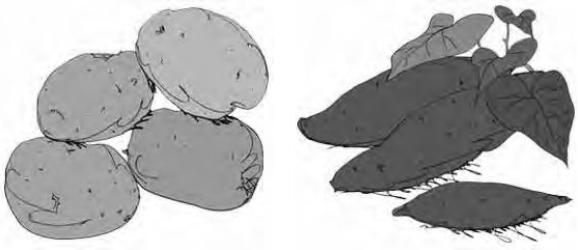


Fig.: Potato showing analogous similarity with sweet potato as both are starchy food items

– **Potato tuber** and **sweet potato** – Both are underground fleshy structures adapted for storage of food and vegetative reproduction but are analogous structures as potato tuber is an underground stem while sweet potato is a fleshy adventitious root.

(III) Connecting links

- The living organisms having the characters of two different taxonomic categories are called **connecting links**.
- **Examples : *Protopterus* (Lung fish) –** It is a connecting link between bony fish in having paired fins, dermal scales, lateral line system and gills and amphibians in having internal nares, lungs and 3-chambered heart.

- ***Ornithorhynchus* (Duck billed platypus)** and ***Tachyglossus* (Spiny ant-eater)** are egg laying mammals. These act as connecting links between mammals in having hair, diaphragm, mammary glands, etc., and reptiles in having large coracoid, being oviparous, laying shelled and polylecithal eggs and having cloaca. So, the prototherians are commonly called **unfinished mammals**.

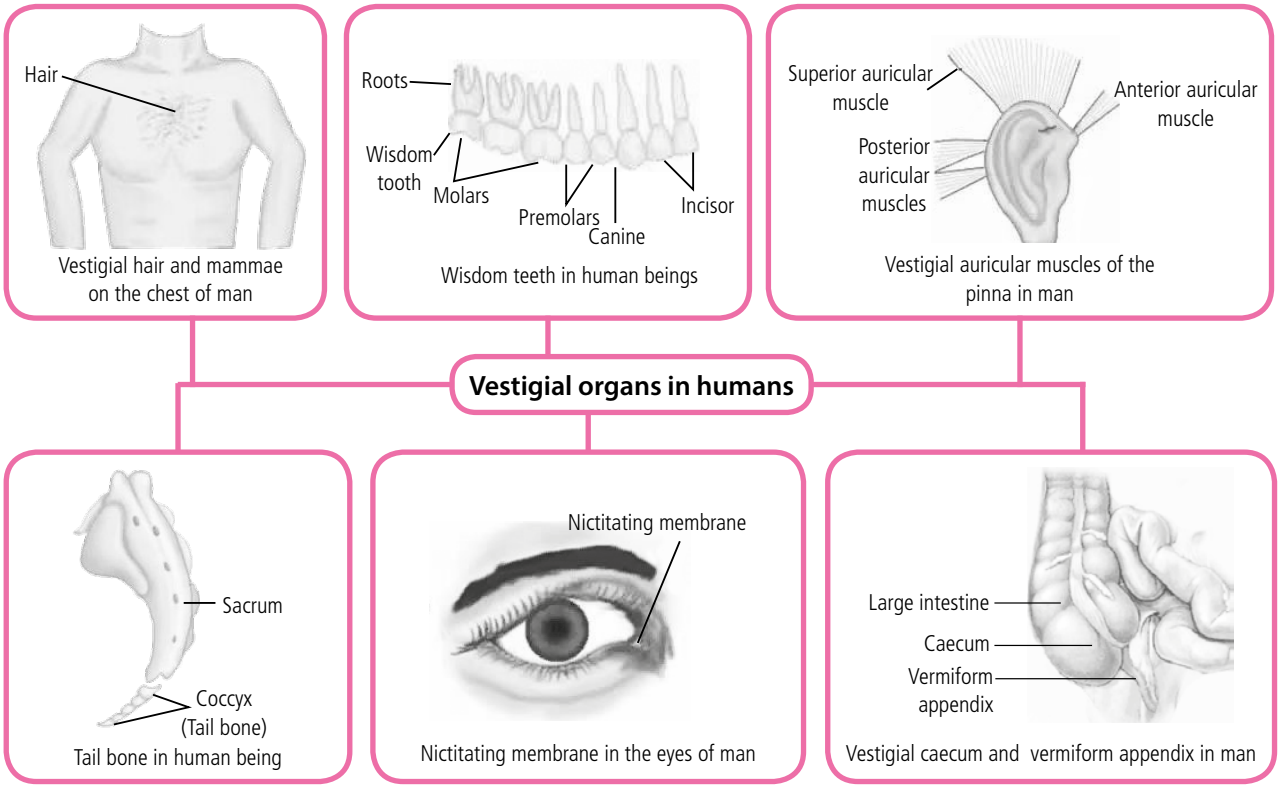
Other well known connecting links are : *Sphenodon,* a primitive reptile with amphibian characters (*e.g.*, amphicoelous vertebrae); *Balanoglossus* between chordates and non-chordates; *Chimaera* (rabbit fish) between cartilage and bony fishes; *Peripatus* (walking worm), between annelids and arthropods; *Coelacanth* between bony fishes and amphibians; *Proterospongia* between protozoa (amoeboid cells) and sponges (with collar cells), and *Neopilina* between annelids and molluscs.

(IV) Vestigial organs

- The vestigial or rudimentary organs are useless remnants of structures or organs that might have been large and functional in the ancestors.

(a) Vestigial organs in man are :

- **Coccyx (Tail bone)** is a small, triangular bone formed by fusion of 4 reduced caudal vertebrae and present at the end of the sacrum. It became vestigial due to bipedal gait and sitting posture of man.
- **Nictitating membrane (Third eyelid** or **Plica semilunaris)** is thin, transparent and freely movable fold that is moved to clean cornea in frog, pigeon, apes, etc. It is vestigial in man as the cornea is cleaned by regular blinking of eye lids.
- **Caecum** and **Vermiform appendix** are very long sized in the herbivores like rabbit, horse, etc., and have symbiotic bacteria that secrete cellulase enzyme to digest the cellulose part of the plant food. These organs are vestigial in man as cellulose of plant food is simplified during the process of cooking, so there is no need of symbiotic digestion of cellulose.



(b) Vestigial organs in plants are :

(i) Leaves are reduced to scales in *Cuscuta, Asparagus, Ruscus*, etc.

(ii) Cutin covered stomata on stems of cacti plants.

(iii) Non-functional flagella on cycad sperms that are passively transported to the egg cells.

(c) Vestigial organs in other animals are :

- **Splint bones** are vestigial 2nd and 4th digits of forelimb as well as hindlimb in horse (***Equus***) due to cursorial mode of locomotion.
- **Vestiges of hindlimbs** and **pelvic girdles**, *e.g.*, femur and ilium in snakes like python and sand boas due to fossorial living and creeping locomotion. This proved evolution of snakes from limbed ancestors.
- **Vestiges of hindlimbs** and **pelvic girdle bones**, *e.g.*, femur and ischium inside the body of Greenland whales showing evolution of whales from limbed ancestors. These have completely disappeared in other whales.

(d) Atavism or reversion

- It is reappearance or refunctioning of some ancestral organs which have either completely disappeared, or are present as vestigial organs.
- **Examples :**

  (i) Birth of a human baby with a small tail. (ii) Development of power of moving pinna in some persons. (iii) Long and dense hair. (iv) Presence of additional mammae in some human beings. (v) Appearance of homodont dentition in many aquatic mammals. (vi) Reduced leaflets of a trifoliate leaf of ***Citrus*** which becomes unifoliate with winged petiole.

B. Embryological Evidences

- These are evidences based on comparative developmental studies of embryos of various animals.
- **Examples :**

– **Similar early development :** All triploblastic animals from flatworms to mammals show similar early developmental processes like **cleavage** (mitotic divisions of zygote), **blastulation** (formation of blastula) and **gastrulation** (formation of gastrula) to transform one-celled zygote into a three-layered **gastrula larva**. Gastrula has three primary germ layers (ectoderm, mesoderm and endoderm). These germ layers form similar structures in various animals. This shows their common ancestry.

– **Similar vertebrate embryos :** The early embryos of the vertebrates like fish, salamander, tortoise, chick, rabbit and human being resemble one another so closely that it becomes difficult to distinguish them. These are similar in having similar form and structures like gill clefts, notochord, tail, eye and ear rudiments, etc. Notochord is replaced by vertebral column.

– **Temporary embryonic structures :** The embryos of certain animals have some temporary structures which disappear or reduce before hatching or birth, *e.g.*, young one of bird with egg-tooth though tooth is not required as embryo feeds upon soft yolk absorbed with vitelline blood vessels but repeats the ancestral characters. This indicates that "birds are glorified reptiles" which means that birds have evolved by the modification of toothed reptiles but teeth are lost to reduce the body weight for flight. The presence of egg tooth in their embryos confirms the repetition of ancestral characters.

– **Recapitulation theory** proposed by **Von Baer** stated that the generalised features like brain, spinal cord, axial skeleton, aortic arches, etc., that are common to all the vertebrates, appeared earlier than the special features like hair (only in mammals), feathers (only in birds), etc., which distinguish various vertebrates that appeared later. Later recapitulation theory was modified as "**Biogenetic Law**" by **Ernst Haeckel**. It states that "**Ontogeny repeats phylogeny**" which means that an individual during its own development (ontogeny) passes through its ancestral history (phylogeny) in an abbreviated form. Thus, the phylogenetic relationship is well exhibited in the embryology.

- **Example:** Presence of fish characters like gills, gill slits, tail with a tail fin, lateral line sense organs, etc., in the tadpole larva of frog. It also shows that in evolution there is trend of moving of life from water to land.

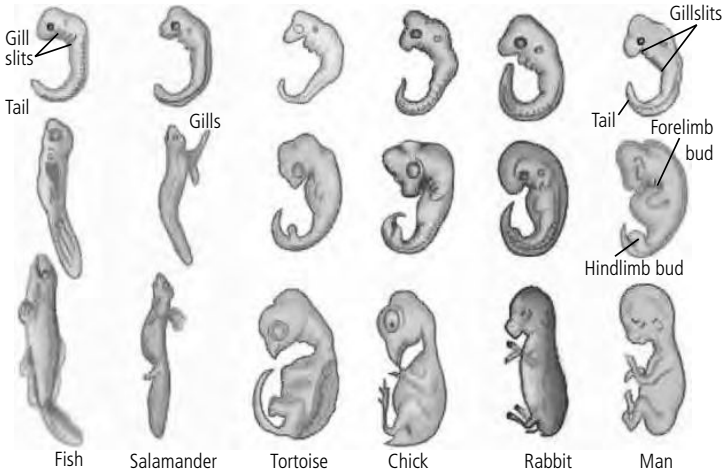


Fig.: Embryos of different vertebrates

C. Biogeographical Evidences

- Biogeography is the pattern of distribution of animals and plants in different parts of the Earth. It shows the evolutionary inter-relationship between living organisms.
- On the basis of distribution of plants and animals on the Earth, A.R. Wallace divided the Earth into six biogeographic realms: Palaearctic, Oriental, Ethiopian, Australian, Nearctic and Neotropical. These realms are separated from one another by major barriers like sea, deserts, mountains.
- It is believed that around the carboniferous period or slightly earlier, all the present day continents were in the form of a single big land mass called **pangaea**. Later on, due to various geological changes, tectonic movements, huge land masses broke off and drifted apart from one another. These land masses became different continents that got separated from one another by barriers, *e.g.*, sea which prevented the free movement of organisms. Each of the continents formed had different environmental conditions, hence plants and animals also evolved differently.

Biogeographical evidences can be discussed under following headings:

— Discontinuous distribution of closely related species

- Sometimes closely related similar species exist at widely separated places without any representative in intervening territory. This is called **discontinuous distribution**. Two specific examples of discontinuous distribution are given below :

(a) **Alligators.** They occur only in South-eastern United States and Eastern China. The North American continent was connected with East Asia in early Coenozoic. The alligators were distributed over the entire region. But due to certain barriers, the alligators of two regions were separated for long time and developed some mutations. Therefore, these alligators are somewhat different but they are related species of the same genus.

(b) **Lung fishes.** During early stages of continental drift, South America, Africa, Antarctica and Australia were interconnected. Later on they were separated. Antarctica was shifted to a far away place. Now the lung fishes are only found in South America, Africa and Australia.

— Restricted distribution

- When some unique organisms are confined in some parts of the world, due to their habitat isolation, it is called **restricted distribution**.
- For example, monotremes or egg laying mammals occur only in Australia. Marsupials, the pouched mammals, are exclusively found in Australia, New Zealand and South America.
- This restricted distribution of monotremes and marsupials is explained on the basis that Australia, New Zealand and South America were once continuous with the mainland of Asia, but got separated in late Cretaceous Period before the appearance of carnivorous Eutherian mammals. Placental mammals being more adapted, eliminated monotremes and most marsupials on Asian mainland. But the primitive mammals of Australia survived as placental mammals could not reach there because of no land connections. Placental mammals evolved in Asia along different lines and in South America while Australia marsupials also diversified along different lines.

— Adaptive radiation (Divergent evolution)

- Development of different functional structures from common ancestral form is called adaptive radiation. Homologous organs show adaptive radiation or divergent evolution.
- **Examples :**
  - (i) **Darwin's finches of Galapagos island :** Finches found on different islands of Galapagos Island have different types of modified beaks due to different feeding habits, but had common ancestor. Common ancestral seed eating ground finches radiated to different geographical areas and adapted different feeding habits, so developed different types of beaks.
  - (ii) **Australian marsupials :** Marsupials (pouched mammals) survived, flourished and evolved along different lines by divergent evolution.
  - (iii) **Adaptive radiation in mammals :** Adaptive radiation in mammals is based on limb structure and type of locomotion. The primitive common ancestor was a land animal, like modern shrews, with short five-toed plantigrade (walking type of locomotion) limbs with no specific specialisation. From this stem mammal, various modern types of mammals have evolved by the modification of limbs and other structures adapted to a wide variety of habitats.

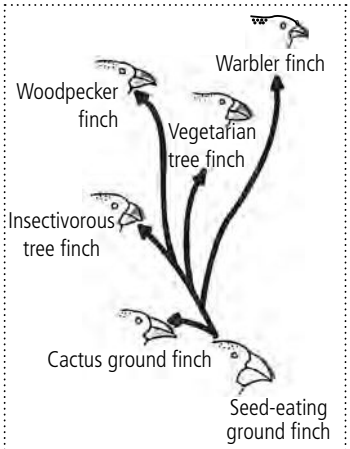


Fig.: Darwin's finches

The five basic modes of locomotion are: running (in deer, cheetah, etc.), burrowing (in moles, rodents and rabbits), tree-climbing (in squirrel and sloth), flying (in bats and flying squirrel) and swimming (in seals, whales, etc.).

Significance : Adaptive radiation helps in macro-evolution (at genus or species level) which divides a group into many new groups.

— **Adaptive convergence (Convergent evolution)**

- Development of similar adaptive functional structures in unrelated groups of organisms is called adaptive convergence or convergent evolution.
- **Examples :** (i) Wings of insect, bird and bat show marked convergent evolution. (ii) Australian marsupials and placental mammals show convergent evolution, *e.g.*, Placental wolf and Tasmanian wolf-marsupial.
- Anteaters such as spiny anteaters and scaly anteaters belong to different Orders of Class Mammalia, not closely related but have acquired similar adaptations for diet of ants, termites and other insects.

Parallel evolution

- When convergent evolution is found in closely related species, it is called parallel evolution. Example: development of running habit in deer (2-toed) and horse (1-toed) with two vestigial splint bones. Tasmanian wolf is a marsupial while wolf is a placental mammal. This also shows parallelism.

D. Palaeontological Evidences

- The fossils are the petrified remains and/or impressions of hard parts of the ancient organisms that are generally preserved in the sedimentary rocks (formed at the sea floor by gradual deposition of soil particles in layer after layer and are richest in fossils) or other media like volcanic ash, ice, peat bogs, sand, mud, etc. These conditions cut off oxygen and prevent decay. These may also be formed from an impression of body part (*e.g.*, footprint) or organic molecules (*e.g.*, oil) or even a coprolite (preserved excreta), etc. So, a fossil is an organic relic of the past life.
- Paleontology is the study of past life based on the fossil records.
- Age of the fossils is determined by dating the rocks in which the fossils occur. It is done by carbon-14 dating technique (carbon-14, a radioisotope produced by cosmic rays, is present in small proportions in air and is assimilated by the plants in the process of photosynthesis. Half life period of ^{14}C is about 5,600 years. If the fossil animal has radioactivity one-eighth of that of living animal, the fossil is about 16,800 years old (three half lives). This method is called **absolute dating**.

Missing links

- These are those extinct organisms that had the characters of two different groups of animals and confirm the path of evolution between these groups.
- *E.g., Archaeopteryx* (also called lizard-bird) is a missing link between reptiles and birds. Some of its reptilian and avian characters are summarised below :

	Reptilian characters	Avian characters
(i)	Presence of similar teeth in jaws.	Presence of feathers on the body.
(ii)	Each finger ending into a claw.	Rounded cranium with intimate fusion of bones.
(iii)	A long tail with free caudal vertebrae.	Forelimbs modified into wings and have only three fingers.
(iv)	Presence of keelless sternum.	Presence of 4-toes in each foot and adapted for perching as in the birds.
(v)	Non-pneumatic bones.	Presence of furcula or wish-bone, jaws modified into beak.

- **Pteridosperms:** These are missing links between ferns and gymnosperms (showed secondary growth and seed-habit).
- **Distribution of fossils in different strata of rocks:** It showed that there is a geological succession of fossils from earliest to the recent rocks. Different aged rock sediments contain different life forms who probably died during the formation of the particular sediment. Different classes of vertebrates appear chronologically in the fossil records. Fossil fishes predate all other vertebrates, with amphibians next, followed by reptiles and then birds and mammals. The fossils showed following changes in this geological succession:

(i) Became more numerous.
(ii) Progressed from simple to more complex forms.
(iii) Many transitional forms have been discovered that link old fossils to modern species, *e.g.*, fossils of various pre-human and human types which show the changes in shape and size of skull during the evolution of man.
(iv) Certain life forms are restricted to certain geological time span.

- **Differences between the past and present forms of life:** Fossil studies showed that plants and animals that existed in past were different from their related living forms. This proves that living organisms are mutable.

Table : Geological time scale with notes on events in the evolution of life and environment

Era	Period	Epoch	Geological and climatic conditions	Flora (Plant life)	Fauna (Animal life)
Coenozoic (Age of mammals and angiosperms)	Quarternary	Recent (Holocene)	End of last ice age, climate warmer, climatic zones distinct.	Dominance of herbs.	Age of man, development of human culture and society.
	Tertiary	Pleistocene	Periodic continental glaciers in north.	Increase of herbs, great decrease of woody plants.	Age of man, extinction of many large mammals.
		Pliocene	Cool and temperate climate away from equator, continuous rise of mountains of Western North America.	Decline of forests, spread of herbs and grassland.	Abundant mammals, man evolving, elephant, horses and camels almost like modern models.
		Miocene	Cooling of climate.	Development of grasses, reduction of forests.	Mammals at height of evolution, first man like apes.
		Oligocene	Lands lower, climate warmer.	Worldwide tropical forests, rise of monocots and flowering plants.	Archaic mammals extinct, appearance of modern mammals like monkeys and apes.
		Eocene	Zoned climatic belts well established.	Extension and dominance of angiosperms.	Placental mammals diversified and specialised, hoofed mammals, *e.g.*, horse and carnivores established.
		Paleocene	Development of climatic belts.	Modernisation of angiosperms.	Evolutionary explosion of mammals and origin of primates.
Rocky Mountain Revolution (Little destruction of fossils)					
Mesozoic (Age of reptiles)	Cretaceous	–	Birth of modern reptiles, development of climatic diversity.	Rise of flowering plants especially monocotyledons, decrease of gymnosperms.	Dinosaurs reached peak, became extinct, toothed birds became extinct, beginning of teleost fishes and modern birds, archaic mammals common.
	Jurassic	–	Culmination of worldwide warm climates.	Cycads and conifers common, appearance of first known flowering plants.	Dominance of dinosaurs, appearance of first toothed birds, spread of reptiles, rise of insectivorous marsupials.
	Triassic	–	Continents exposed, world-wide subtropical climate.	Gymnosperms dominant, declining towards end, extinction of seed fern.	Transition of reptiles to mammals, rise of progressive reptiles and egg laying mammals, extinction of primitive amphibians.

Appalachian Revolution (Some loss of fossils)					
Paleozoic (Age of ancient life)	**Permian**	–	Rise of continents, climate became arid and varied, glaciation in Southern hemisphere.	Dwindling of ancient plants, decline of lycopods and horse tails.	Extinction of amniotes and trilobites, abundance of primitive reptiles, appearance of mammals-like reptiles, decline of amphibia.
	Pennsylvanian	–	Uniform climate throughout world.	Great forests of seed-ferns and gymnosperms (Great tropical coal forests).	Amphibians dominant on land, insects common, appearance of first reptiles.
	Mississippian (Carboniferous)	–	Climate uniform, and humid at first, cooler later as land rose, spread of tropical seas.	Mosses and seed-ferns dominant, gymnosperms increasingly widespread. (Early coal forests).	Rise of insects, sea lilies at peak, spread of ancient sharks.
	Devonian	–	Broad distribution of uniform climates, increased temperature.	First forests, first gymnosperms and first known liverworts, horse tails and ferns.	Diversification in fishes, sharks and lung fishes abundant, evolution of amphibians.
	Silurian	–	Slight climate cooling, extensive continental seas.	First known land plants-clubmosses, algae dominant.	Wide expansion of invertebrates, first insects, rise of jawed fishes.
	Ordovician	–	Climate became progressively warmer.	Algae, fungi and bacteria, first fossils of plant life.	Invertebrates numerous and varied, most modern phyla established. (molluscs). Origin of vertebrates, *i.e.*, jawless fishes.
	Cambrian	–	Warm climate, great submergence of land.	Land plants probably first appeared, marine algae abundant.	First indication of fishes, corals and trilobites abundant, diversified molluscs.
Second Great Revolution (Considerable loss of fossils)					
Proterozoic		–	Cool climate, volcanic eruptions, repeated glaciations.	Primitive aquatic plants, algae, fungi and bacteria.	Shelled protozoans, coelenterates, flatworms, primitive annelids.
First Great Revolution (Considerable loss of fossils)					
Archeozoic		–	Great volcanic activities, no recognisable fossils, indirect evidence of living things from some sedimentary deposits of organic material in rocks.		

E. Biochemical Evidences

- The evidences based on similar biochemical reactions are called biochemical evidences, *e.g.*, similarities in proteins, genes, etc.

Examples :

(i) **Enzymes :** Similar enzymes of different animals are similar in their chemical nature and mode of action.

(ii) **Hormones :** Similar hormones of different vertebrates are similar in their chemical nature, target organ and mode of action. Example :

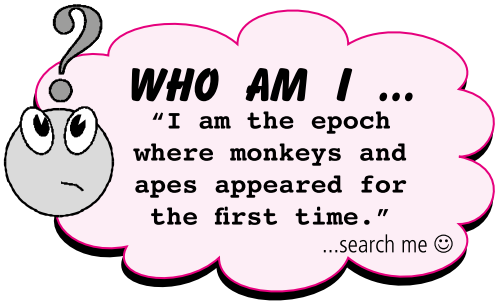
Hormone	Source	Function
Insulin	Pancreas (β-cells)	Glycogenesis

(iii) **Cytochrome C :** This is an electron-carrier protein found in ETC of mitochondria of all living organisms. Its amino acid sequence was determined by **R.E. Dickerson** (1972) in different organisms. He noticed that variations in amino acid sequence prove phylogenetic relationship.

(iv) **Blood and Lymph :** The components of blood and lymph, and their functions are similar in different vertebrates.

(v) **Excretion :** Physiology of excretion also confirms evolution, *e.g.*, (a) The adult frog is ureotelic in excretion while its tadpole larva shows ammonotelism like fishes. (b) The young of a bird is first ammonotelic, then ureotelic and finally uricotelic.

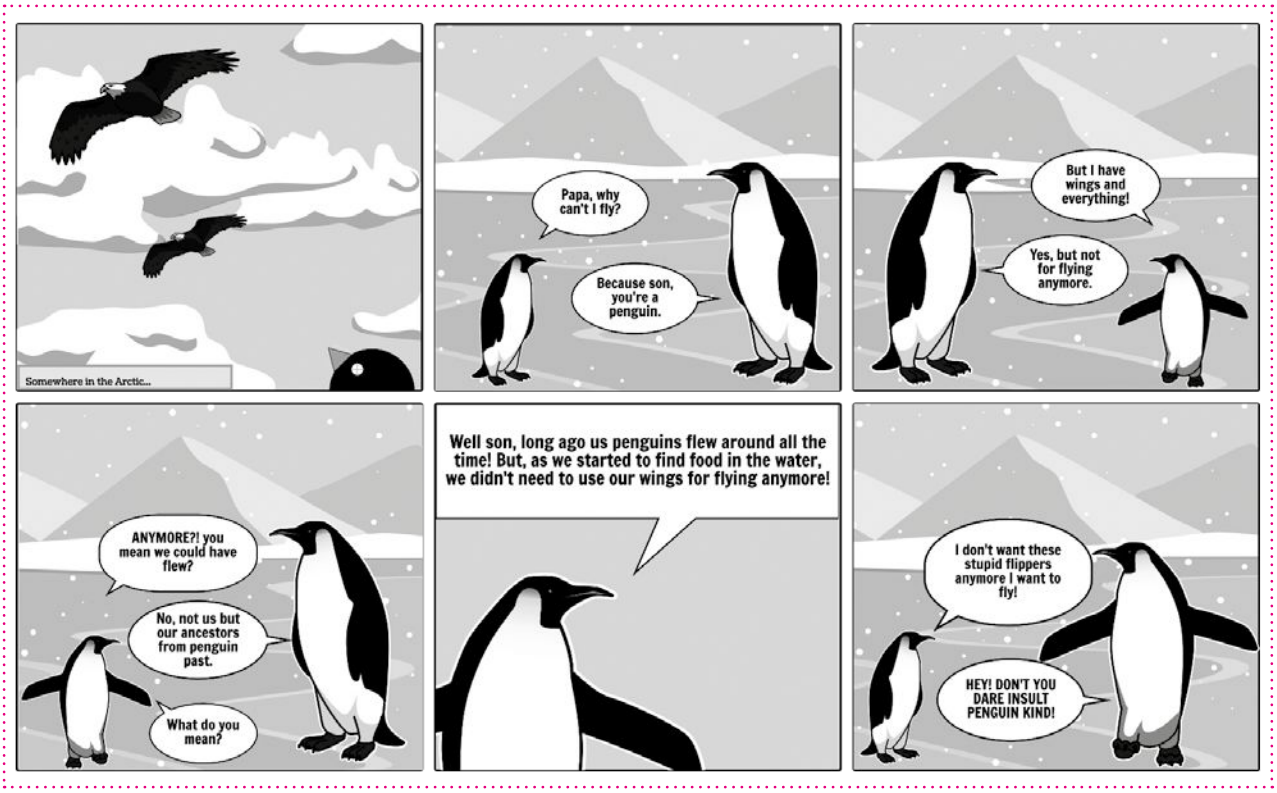
The complexity of nitrogenous wastes increases with the evolutionary process. The repeating of ancestral mode of excretion during the development of an organism is called **biochemical recapitulation**.



F. Cytological Evidences

- All the living organisms are similar in being:
  (i) Cellular in nature and are formed of one (protozoans) or more cells (metazoans).
  (ii) Presence of similar organelles having similar ultrastructure and functions.
  (iii) In all, the cells are formed of similar material called protoplasm having similar physical, chemical and biological properties.
  (iv) Basic metabolic cellular functions are performed in a similar way. All these evidences support that all the organisms are inter-related and have common ancestry.

These similarities between living organisms at the molecular level is called molecular homology. These similarities confirm the relationship of all organisms and show their **descendence from a common stock**.



SPEED PRACTICE

1. First photosynthetic organisms to appear on earth were
   (a) bacteria (b) green algae
   (c) cyanobacteria (d) bryophytes.
2. Resemblance between widely different groups due to common adaptation is
   (a) restricted evolution
   (b) divergent evolution
   (c) convergent evolution
   (d) retrogressive evolution.
3. What is the correct arrangement of periods of Palaeozoic era from oldest to latest in geological time scale?
   (a) Cambrian → Devonian → Ordovician → Silurian → Carboniferous → Permian
   (b) Cambrian → Ordovician → Silurian → Devonian → Carboniferous → Permian
   (c) Cambrian → Ordovician → Devonian → Silurian → Carboniferous → Permian
   (d) Silurian → Devonian → Cambrian → Ordovician → Permian → Carboniferous
4. Who demonstrated that life comes from life with the help of flask of boiled broth?
   (a) Redi (b) Pasteur
   (c) Helmont (d) Arrhenius
5. Which one of the following options gives one correct example each of convergent evolution and divergent evolution?

	Convergent evolution	**Divergent evolution**
(a)	Eyes of octopus and mammal	Bones of forelimbs of vertebrates
(b)	Thorns of *Bougainvillea* and tendrils of *Cucurbita*	Wings of butterfly and bird
(c)	Bones of forelimbs of vertebrates	Wings of butterfly and bird
(d)	Thorns of *Bougainvillea* and tendrils of *Cucurbita*	Eyes of octopus and mammal

6. In which period of Mesozoic era, gymnosperms were dominant?
   (a) Jurassic (b) Triassic
   (c) Cretaceous (d) None of these
7. In evolution the studies can be made at molecular level. For example the protein present in the blood of man and ape are similar. The base sequence in nucleic acids and amino acids sequence in protein in related organism is alike. These are the examples which are specifically referred to in
   (a) convergent evolution
   (b) molecular analogy
   (c) molecular homology
   (d) homoplastic appearance.
8. The strongest evidence for change over a long period of time comes from
   (a) fossils
   (b) DNA
   (c) embryo studies
   (d) direct observation of living species.
9. The forelimbs of man and bat show similar internal patterns of structure, yet they perform different functions. This is an example of
   (a) analogous organs that have evolved due to convergent evolution.
   (b) analogous organs that have evolved due to divergent evolution.
   (c) homologous organs that have evolved due to convergent evolution.
   (d) homologous organs that have evolved due to divergent evolution.
10. Select the correct match of connecting link between two phyla.
    (a) *Archaeopteryx* - Aves and Mammalia
    (b) *Amphioxus* - Echinodermata and Chordata
    (c) *Peripatus* - Annelida and Arthropoda
    (d) *Ornithorhynchus* - Aves and Reptilia
11. Identify the scientist who did not challenge the theory of spontaneous generation.
    (a) Francesco Redi (b) Van Helmont
    (c) Lazzaro Spallanzani (d) Louis Pasteur
12. A baby has been born with a small tail. It is a case exhibiting
    (a) retrogressive evolution
    (b) mutation
    (c) atavism
    (d) metamorphosis.
13. Sequence of substances appearing during the origin of life would have been
    (a) amino acids, ammonia, phosphates, nucleic acids
    (b) ammonia, amino acids, proteins, nucleic acids

(c) nucleotides, amino acids, nucleic acids, enzymes
(d) enzymes, amino acids, proteins, nucleic acids.

14. Which of the following is the correct sequence of events in the origin of life?
I. Formation of protobionts
II. Synthesis of organic monomers
III. Synthesis of organic polymers
IV. Formation of DNA-based genetic systems
(a) I, II, III, IV (b) I, III, II, IV
(c) II, III, I, IV (d) II, III, IV, I

15. Adaptive radiation refers to
(a) evolution of different species from a common ancestor
(b) migration of members of a species to different geographical areas
(c) power of adaptation in an individual to a variety of environments
(d) adaptations due to geographical isolation.

16. The most primitive among the living vascular plants are the
(a) ferns (b) brown algae
(c) mosses (d) cycads.

17. Stanley L. Miller performed the first successful experiment to assess the validity of the claim for origin of organic molecules in the primeval earth condition. The apparatus contained every arrangement except that it was devoid of
(a) ammonia (b) methane
(c) oxygen (d) energy source.

18. What is the difference between spontaneous generation and biogenesis?
(a) Biogenesis supposes that the non-living materials can produce life, while spontaneous generation follows the idea that living things come only from the other living things.
(b) Spontaneous generation and biogenesis both support the theory that non-living materials are the source of living organisms.
(c) Spontaneous generation proposes that the non-living materials can produce life, biogenesis follows the idea that living things come only from other living things.
(d) Spontaneous generation applies only to plants and how they produce life, while biogenesis applies to animals and how they produce life.

19. Tasmanian wolf is a marsupial while wolf is a placental mammal. This shows
(a) convergent evolution
(b) divergent evolution
(c) parallelism
(d) inheritance of acquired characters.

20. Wings of bat, locust and pigeon are
(a) vestigial organs
(b) exoskeletal structures
(c) homologous organs
(d) analogous organs.

21. Which one of the following is incorrect about the characteristics of protobionts (coacervates and microspheres) as envisaged in the abiogenic origin of life?
(a) They were partially isolated from the surroundings.
(b) They could maintain an internal environment.
(c) They were unable to reproduce.
(d) They could separate combinations of molecules from the surroundings.

22. Match the following and select the correct option from the given codes.

	Column I		**Column II**
1.	Mesozoic	(i)	Age of fishes
2.	Devonian	(ii)	Proliferation of reptiles
3.	Palaeocene	(iii)	Raise of modern mammals
4.	Permian	(iv)	Radiation of primitive mammals
		(v)	Extinction of dinosaurs

(a) 1-(v), 2-(iv),3-(iii), 4-(ii)
(b) 1-(v), 2-(i), 3-(iv), 4-(ii)
(c) 1-(iv), 2-(i), 3-(ii), 4-(v)
(d) 1-(v), 2-(i), 3-(iv), 4-(iii)

23. According to biogeographical evidences, Oriental realm and Australian realm were separated by
(a) holarctic region (b) Wallace's line
(c) mountains (d) sea.

24. Who among the following stated that "Ontogeny repeats phylogeny"?
(a) Von Baer (b) Ernst Haeckel
(c) Dr. P.L. Sclater (d) A. R. Wallace

25. Development of running habit in 2-toed deer and 1-toed horse with two vestigial splint bones shows
(a) divergent evolution (b) convergent evolution
(c) parallel evolution (d) both (a) and (b).

ANSWER KEY

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

• Ecosystem

Total Marks : 160 **Time Taken : 40 Min.**

1. Which of the following help in maintaining homeostasis or balance of nature?
(a) Carrying capacity of the environment
(b) Capacity of the ecosystem for recycling of wastes
(c) Feedback system (d) All of these

2. Amount of living biomass present in a unit area of an ecosystem at a given time is referred to as
(a) standing state (b) standing crop
(c) trophic structure (d) net primary productivity.

3. The species that colonise newly distributed habitats and coexist with superiorly more competitive species are called
(a) fugitive species (b) pioneer species
(c) guild (d) climax species.

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

	Column I		Column II
A.	Reducers	(i)	Heterotrophs
B.	Phagotrophs	(ii)	Herbivores
C.	Key industry animals	(iii)	Autotrophs
D.	Transducers	(iv)	Microconsumers

(a) A-(iv); B-(i); C-(ii); D-(iii)
(b) A-(iii); B-(ii); C-(i); D-(iv)
(c) A-(iv); B-(i); C-(iii); D-(ii)
(d) A-(i); B-(iii); C-(iv); D-(ii)

5. Select the correct difference between standing crop and standing state.

	Standing crop	Standing state
(a)	It is the amount of inorganic nutrients present in an ecosystem.	It is the amount of biomass present in an ecosystem.
(b)	It represents part of non-living matter.	It represents entire living matter.
(c)	It cannot be circulated between living and non-living components.	It can be circulated.
(d)	It is regularly depleted and replenished.	It is continuously synthesised and consumed.

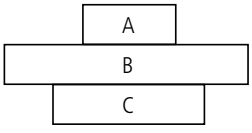
6. Select the wrong statement regarding energy flow in an ecosystem.
(a) Energy flows in one direction only.
(b) About 1-5% of the energy reaching the ground is converted by the green plants into chemical energy.
(c) Energy requirement for maintenance of body gradually decreases in successive trophic levels.
(d) Only 10% of the gross productivity of producers is entrapped by herbivores for their body building.

7. Which of the following is correctly matched?
(a) Frog – Primary consumer
(b) Productivity – Kcal/m^2/yr
(c) Tertiary consumers – Slime moulds
(d) Temperate ecosystem – Ocean

8. The rate of synthesis of organic matter by consumers is
(a) net primary productivity
(b) gross primary productivity
(c) standing state
(d) secondary productivity.

9. Pyramid of biomass in a pond ecosystem is
(a) always upright
(b) inverted
(c) spindle shaped
(d) sometimes inverted and sometimes upright.

10. Refer to the given figure showing pyramid of number in a certain habitat. Identify the habitat and select the correct option.



(a) A-Grass; B-Rabbit; C-Fox
(b) A-Phytoplankton; B-Small fish; C-Large fish
(c) A-Tree; B-Birds; C-Hawk
(d) A-Tree; B-Birds; C-Parasites

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

(i) Pyramid of biomass is upright in forest ecosystem and inverted in grassland ecosystem.

(ii) Pyramid of numbers is inverted in grassland and upright in aquatic ecosystem.

(iii) Pyramid of energy depicts the rate of energy flow or productivity at successive trophic levels.

(iv) Ecological pyramids have no place for detritivores and decomposers though they play important role in an ecosystem.

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

12. Among the following, maximum productivity occurs in

(a) grassland (b) tropical forest

(c) estuaries (d) desert.

13. What will happen if decomposers are completely removed from the ecosystem?

(a) There will be no energy flow.

(b) There will be an increase in the number of detritivores.

(c) Herbivores will not receive solar energy.

(d) The movement of minerals in an ecosystem will be blocked.

14. Consider the following statements and select the correct option that fill in the blanks.

I. _____ food chain begins with host and usually ends in parasite.

II. The sequence of successional stages on sand is known _____.

III. Breaking down of detritus into small particles by earthworm is called _____.

	I	II	III
(a)	Grazing	lithosere	catabolism
(b)	Auxiliary	psammosere	fragmentation
(c)	Detritus	psammosere	mineralisation
(d)	Parasitic	lithosere	humification

15. Read the given statements and select the correct option.

Statement A : Net primary productivity is the amount of organic matter stored by producers per unit time and per unit area.

Statement B : Net productivity decreases with each trophic level.

(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.

16. Which of the following constitutes microecosystem?

(a) Aquarium (b) Pond

(c) Log of wood (d) Kitchen garden

17. Food web

(a) reduces adaptability and competitiveness of the organisms

(b) is monophagous

(c) consists of number of food chains interlinked at various trophic levels

(d) both (b) and (c).

18. The fraction of energy lost when an organism proceeds from one trophic level to the next trophic level is

(a) 10 percent (b) 20 percent

(c) 30 percent (d) 90 percent.

19. Match the following and select the correct option.

	Column I	Column II
A.	Lichen stage	(i) *Heteropogon*
B.	Moss stage	(ii) *Rhizocarpon*
C.	Shrub stage	(iii) *Grimmia*
D.	Perennial grass stage	(iv) *Rubus*

(a) A-(ii); B-(iii); C-(iv); D-(i)

(b) A-(ii); B-(iii); C-(i); D-(iv)

(c) A-(iii); B-(iv); C-(ii); D-(i)

(d) A-(iv); B-(iii); C-(i); D-(ii)

20. Which of the given pyramid is always upright?

(a) Pyramid of energy (b) Pyramid of biomass

(c) Pyramid of numbers (d) Both (a) and (b)

UNSCRAMBLED WORDS

OCTOBER 2017

1-g- AMPHETAMINES	2-i- EPISTASIS
3-f- HELICOTREMA	4-j- AMENSALISM
5-e-THELYTOKY	6-d- CARYOPSIS
7-c-OSTEOMALACIA	8-h- OOPHORITIS
9-b- CHOANODERM	10-a-POLYCYTHEMIA

Winners : Sankhadeep Das, Purba Medinipur (West Bengal), Gayatri Prabhu, Bhramagiri circle (Udupi), Abhishek Serrao, Chikmagalur, (Karnataka), Suman Kumar Ojha, Chikanpara (West Bengal), Soumyadeep dutta

Spellathon Winners

October-2017

1. Manthan Patel
2. D.B. Rakshit Narayanan - Anna Nagar, Chennai

21. Arrange the following ecosystems in descending order depending upon the net primary productivity.
(i) Temperate coniferous forest
(ii) Tropical rainforest
(iii) Savannah
(iv) Temperate deciduous forest
(v) Temperate grassland
(a) (ii), (iv), (i), (iii), (v) (b) (i), (ii), (iii), (v), (iv)
(c) (ii), (i), (iii), (iv), (v) (d) (ii), (i), (iv), (v), (iii)

22. In case of ecological succession, the climax community is best represented by
(a) $P = R$ (b) $P < R$
(c) $P > R$ (d) $P \neq R$.

23. Select the correct match.
(a) Sedimentary cycle – Nitrogen cycle
(b) Guano deposit – Phosphorus cycle
(c) Hydrosphere – Reservoir pool of carbon
(d) *Quercus* – Species of woodland stage

24. If 40 J energy is trapped at producer level, then what amount of energy will be available to hawk as in the given food chain?
Plant $\rightarrow$ Caterpillar $\rightarrow$ Sparrow $\rightarrow$ Hawk
(a) 0.0004 J (b) 0.04 J (c) 4 J (d) 0.004 J

25. Read the given statements and select the correct option.
Statement A : Maximum productivity occurs in coral reefs and estuaries.
Statement B : Both the ecosystems, coral reefs and estuaries have rich nutrient supply.
(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.

26. A zooplankton is living in an aquatic ecosystem. What will be its trophic level?
(a) T_1 (b) T_2 (c) T_3 (d) T_4

27. Which of the following ecosystems has maximum stratification?
(a) Grassland (b) Desert
(c) Tropical rainforest (d) Orchard

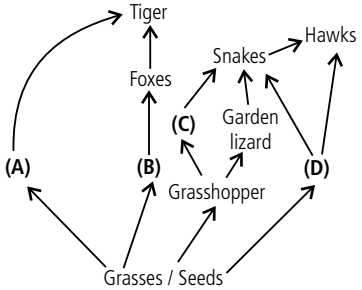
28. In an aquatic ecosystem, the food chain starts from
(a) phytoplankton (b) zooplankton
(c) small fish (d) roaches.

29. Select the correct statement.
(a) Carbon cycle is imperfect cycle while phosphorus cycle is perfect cycle.
(b) Ten percent law was proposed by Odum in 1942.
(c) Grazing food chain helps in releasing inorganic nutrients to the cycling pool.
(d) Seral community is a transitional community which develops in an area during succession.

30. Consider the following statements (A - D) and select the option which correctly fills the blanks.
A. A group of species belonging to a trophic level which exploits a common resource base in a similar fashion is known as _(i)_.
B. _(ii)_ reduces decomposition and causes piling up of detritus.
C. In oceans productivity is limited by _(iii)_ and _(iv)_.
D. Largest reservoir of calcium is _(v)_.

	(i)	(ii)	(iii)	(iv)	(v)
(a)	fugitive species	Temperature	light	oxygen	atmosphere
(b)	guild	Anaerobiosis	light	nitrogen	lithosphere
(c)	fugitive species	Temperature	oxygen	nitrogen	lithosphere
(d)	guild	Anaerobiosis	light	oxygen	atmosphere

31. Identify organisms A, B, C and D in the given food web.



Contributed by : Siddarth Samadarshi (West Bengal), Pratha Sha (Haryana)

SOLUTIONS TO OCTOBER 2017 CROSSWORD

1 A	2 C	H	E	N	E	■	■	■	■	■	■	■	3 L	4 E
■	O	■	5 O	L	I	G	O	T	R	O	P	H	I	C
6 E	R	7 B	8 B	9 R	10 S	11 P	O	R	E	I	N	E	G	A
P	N	I	I	U	■	R	12 L	O	C	U	S	■	A	D
I	E	N	L	B	■	O	13 Z	I	N	C	■	■	S	■
T	A	D	E	O	■	B	■	14 T	U	15 B	I	F	E	X
H	■	I	16 C	R	17 H	E	L	I	C	A	18 S	19 E	S	20 C
E	■	N	A	21 F	L	E	X	O	R	S	I	N	22 M	Y
23 M	24 I	C	R	O	T	O	M	E	■	I	L	G	I	T
■	N	■	U	25 I	O	D	I	N	E	D	U	E	M	O
■	S	■	N	26 S	T	O	C	K	■	I	R	L	I	P
■	U	■	C	27 T	Y	L	O	S	E	U	I	M	C	L
■	L	28 F	L	O	R	A	■	■	■	M	A	A	R	A
■	I	29 L	E	C	I	T	H	I	N	■	N	N	Y	S
■	N	30 M	I	C	R	O	S	O	M	E	S	N	■	M

	A	B	C	D
(a)	Squirrel	Dog	Tortoise	Crow
(b)	Rat	Cat	Bat	Pigeon
(c)	Deer	Squirrel	Rat	Crow
(d)	Deer	Rabbit	Frog	Rat

32. Changes during the process of ecological succession in communities are
(a) quick (b) orderly and sequential
(c) random (d) none of these.

33. Select the incorrect statement.
(a) Oligotrophic state of lake succession is the succession occurring on nutrient poor medium.
(b) Pioneer community is best described as stable and self perpetuating biotic community.
(c) Eutrophic state of lake succession is characterised by nutrient rich medium and organic matter.
(d) Lithosere refers to sequence of successional stages on bare rock.

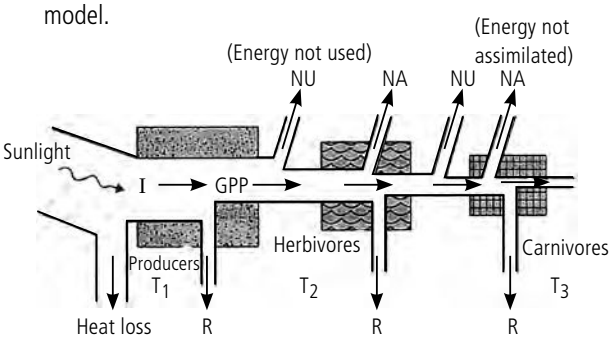
34. Choose the correct sequence of biotic succession for hydrosere.
(a) Phytoplankton → Floating stage → Submerged stage → Sedges → Reed swamp stage → Bushes → Trees
(b) Zooplankton → Floating stage → Submerged stage → Reed swamp stage → Sedges → Bushes → Trees
(c) Phytoplankton → Zooplankton → Submerged stage → Floating stage → Reed swamp stage → Sedges → Bushes → Trees
(d) Zooplankton → Submerged stage → Floating stage → Sedges → Reed swamp stage → Bushes → Trees

35. Which of the following is not an ecosystem service provided by a natural ecosystem?
(a) Carbon fixation (b) Pollination of flowers
(c) Prevention of soil erosion
(d) Aboriculture

36. Select the correct statement regarding xerosere.
(a) It is the ecological succession on bare rocks that are water deficient but rich in organic matter.
(b) Crustose lichens such as *Parmelia* and *Dermatocarpon* are the pioneer community in a xerosere.
(c) *Hypnum* and *Tortula* constitute the annual grass stage of xerosere.
(d) *Zizyphus* and *Capparis* constitute shrub stage of xerosere.

37. The circulation of the essential nutrients between living and non-living components of biosphere is termed as
(a) biogeographic cycle (b) cycling of minerals
(c) biological cycle (d) biogeochemical cycle.

38. Refer to the given figure showing single channel energy flow model.



What fraction of gross productivity/assimilated energy is utilised in respiration by producers (i), herbivores (ii) and carnivores (iii)?

	(i)	(ii)	(iii)
(a)	20%	30%	60%
(b)	10%	20%	30%
(c)	10%	5%	1%
(d)	20%	40%	80%

39. Select the wrong statement regarding carbon cycle.
(a) Oceanic water can retain upto 50 times of CO_2 levels in the air.
(b) The only major reservoir of carbon in the biosphere is lake.
(c) Volcanic eruptions, hotsprings, burning of fossil fuel and weathering add carbon dioxide into the atmosphere.
(d) The recycling of carbon is a self regulating feed back system.

40. Read the following statements.
(i) Removal of tigers from an area will result in increased growth of vegetation of that area.
(ii) Grazing food chain is the major conduit of energy flow in aquatic ecosystem.
(iii) Food chains are sustained by producers and decomposers.
(iv) In a food chain, some organisms like hen operates at one trophic level only.
Select an option which shows correct statements.
(a) (i) and (ii) (b) (ii) and (iv)
(c) (ii) and (iii) (d) (i), (iii) and (iv)

☺☺
Key is published in this issue. Search now! ☺

SELF CHECK

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

Check your score! If your score is

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

CBSE BOARD

UNITWISE PRACTICE PAPER 2018

UNIT - IV

- **Biotechnology : Principles and Processes**
- **Biotechnology and its Applications**

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. Name the technique developed by Kary Mullis. What is the objective of this technique?

2. What is the role of ethidium bromide during agarose gel electrophoresis?

3. The milk produced by the transgenic cow Rosie is better than natural cow milk. Why?

4. Why do DNA fragments move towards the anode during gel electrophoresis?

5. Golden rice is a transgenic variety of rice. What is its characteristic property?

SECTION - B

6. **(a)** How is an exonuclease functionally different from an endonuclease?

(b) Give example of any two endonucleases other than *Sal* I.

7. **(a)** Illustrate the recognition sequence of *Eco* R I. Mention the term used for such sequences.

(b) How does restriction endonuclease act on a DNA molecule?

8. What are shuttle vectors?

9. **(a)** Why are transgenic animals so called?

(b) Name the scientist who introduced the term vaccine. What are edible vaccines?

OR

Name the transgenic variety of tomato. How it remains fresh for longer period than normal variety?

10. How is insertional inactivation of an enzyme used as a selectable marker to differentiate recombinants from non-recombinants?

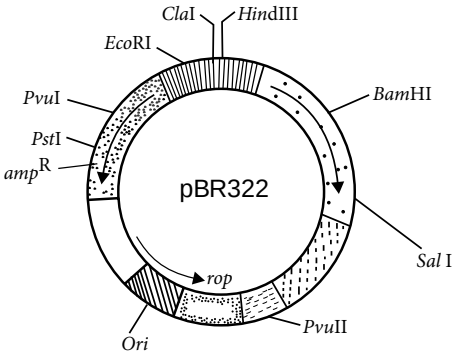
SECTION - C

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

(a) Name the organism in which the vector is inserted to get the copies of the desired gene.

(b) Mention the area labelled in the vector responsible for controlling the copy number of the inserted gene.

(c) Name and explain the role of a selectable marker shown in the vector.



12. How is gene therapy being used in treating ADA deficient patients?

13. What are bioreactors? List five growth conditions that a bioreactor provides for obtaining the desired product.

14. Differentiate between type I, II and III restriction endonucleases.

15. **(a)** Name the bacterium which produces Bt toxin. What is the significance of this toxin?
    (b) Name the gene which codes for this toxin. Why this toxin does not kill the bacterium?
    (c) Name the genes that prevent infection by cotton bollworms and corn borers in pest resistant plants.

16. Explain molecular farming or molecular harvesting.

17. Name and explain the technique used in the separation and isolation of DNA fragments to be used in recombinant DNA technology.

18. **(a)** What do you mean by the term biopiracy?
    (b) What measures are being taken by the Indian Government to prevent biopiracy?

19. What are the basic requirements of a polymerase chain reaction?

OR

How *Agrobacterium tumefaciens* has been made a useful cloning vector to transfer DNA to plant cells?

20. **(a)** How is mature insulin different from proinsulin secreted by pancreas in humans?
    (b) How human functional insulin is produced using rDNA technology?
    (c) Why is the functional insulin thus produced, considered better than the ones used earlier by diabetic patients?

21. DNA being hydrophilic cannot pass through the cell membranes of a host cell. Explain how does recombinant DNA get introduced into the host cell to transform the latter.

22. Explain the process of RNA interference.

SECTION - D

23. Neeraj was having a debate with Mohit regarding the advantages and disadvantages of transgenic animals. Neeraj was of the view that production of transgenic animals violates the integrity of species and animals suffer from cruelty so, it is unethical. On the other hand, Mohit emphasised the benefits that transgenic animals provide to the human race in various fields especially medicine.
    (a) How do transgenic animals benefit humans?
    (b) List the ethical issues related with the production of transgenic animals.
    (c) What values are shown by Neeraj and Mohit?

SECTION - E

24. What is cloning vector? Why is it used? Explain the technique of using such a vector in *E.coli*.

OR

Describe the process of recombinant DNA technology with the help of a neatly labelled diagram.

25. A desired gene was identified in an organism for some experiments. Explain the processes that should be used for
    (a) cutting this desired gene at specific locations.
    (b) synthesis of multiple copies of this desired gene.

OR

    (a) Briefly explain the principle and the role of ELISA.
    (b) How transgenic animals proved to be beneficial in:
        (i) Production of biological products
        (ii) Chemical safety testing?
    (c) Diagrammatically show synthesis of cDNA from RNA.

26. **(a)** How recombinant DNA technology helps in detecting the presence of mutated gene in cancer patients?
    (b) Explain any three methods to force 'alien' or recombinant DNA into host cells.

OR

    (a) List five advantages of using genetically modified plants over conventional ones. What are the health risks on humans by GM plants?
    (b) Describe the responsibility of GEAC, set up by the Indian Government.

SOLUTIONS

1. Kary Mullis developed the technique Polymerase Chain Reaction (PCR). The objective of this technique is selective amplification of specific region of DNA molecule.

2. In gel electrophoresis, ethidium bromide (EtBr) is used to stain separated DNA fragments so that it can be seen as bright orange coloured bands after exposure to UV radiation.

3. The milk produced by transgenic cow Rosie, is enriched with the human protein alpha lactalbumin and is nutritionally more balanced product for human babies than natural cow milk.

4. DNA is a negatively charged molecule and during gel electrophoresis, DNA fragments move towards anode (positive electrode) under the influence of electrical field.

5. Golden rice is a transgenic variety of rice that contains good quantities of β-carotene, a principle source of vitamin A.

6. **(a)** Differences between action of exonucleases and endonucleases are as follows :

	Exonucleases	Endonucleases
(i)	They remove nucleotides from terminal ends of DNA strand.	They make cut at specific positions within the DNA except terminal ends.
(ii)	They act on single strand of DNA or gaps in double stranded DNA.	They cleave one strand or both strands of double stranded DNA.
(iii)	They do not cut RNA.	They may cut RNA.

(b) *Eco* R I and *Hin* d III.

7. **(a)** Recognition sequence of *Eco* R I is :

↓
5′ - GAATTC-3′
3′ - CTTAAG-5′
↑

Such sequences are called palindromic sequences, that are same base pair sequences when read forward or backward direction from central axis of symmetry.

(b) Restriction endonuclease recognises the base sequence at palindrome site in DNA duplex and cuts its strands.

8. Vectors that can exist in both eukaryotic cell and *Escherichia coli* are known as shuttle vectors , *e.g.*, yeast episomal plasmid (YEp). Such vectors contain two types of origin of replication and selectable marker genes, one that functions in *E. coli* and other that functions in eukaryotic cell.

9. **(a)** Transgenic animals are those animals which contain a foreign gene introduced in their genome by recombinant DNA technology. Such a gene is called transgene. Examples are transgenic mice, rabbit, dogs, cows, etc.

(b) Edward Jenner introduced the term vaccine. The genes encoding antigenic proteins can be isolated from pathogens and expressed in plants. Such transgenic plants or their tissues producing antigens can be eaten for vaccination/immunisation and are called as edible vaccines.

OR

Flavr Savr is a transgenic variety of tomato. In this variety native tomato gene, which produces enzyme polygalacturonase is inactivated. The non-availability of this enzyme prevents over-ripening because the enzyme is essential for degradation of cell walls. Thus, fruit remains fresh for long time and it also retains flavour, superior taste and higher quantity of total soluble solids. So, it prevents post harvest and over ripening losses, and is preferred over normal native variety.

10. Insertional inactivation refers to the process where insertion of recombinant DNA (rDNA) within the coding sequence of an enzyme causes its inactivation. The non-recombinants having intact functional gene, *e.g.*, β-galactosidase produce blue colour with chromogenic substrate but when rDNA is inserted within the coding sequence of enzyme β-galactosidase, recombinants do not produce any colour. Hence, recombinants can be easily differentiated from non-recombinants due to insertional inactivation.

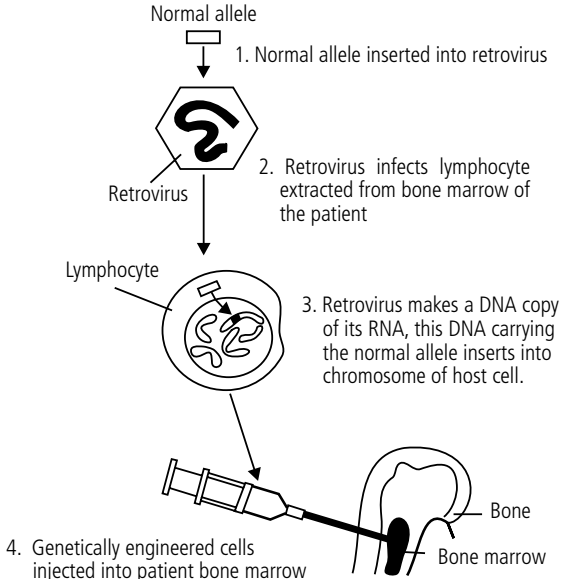
11. **(a)** *Escherichia coli*.

(b) Origin of replication (*ori*) is a sequence from where replication starts and is also responsible for controlling the copy number of the inserted gene.

(c) The given vector contains amp^R as selectable marker. It helps in selecting transformants (host cells containing vector) and eliminating non-transformants. Host cells containing amp^R are resistant to antibiotic ampicillin.

12. 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 years 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 victim's immune system.

Though these cells are not immortal, the patient requires periodic infusion of such genetically engineered lymphocytes. However, if the gene isolated from 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.



13. A bioreactor is a vessel in which raw materials are biologically converted into specific products by microbes, plant and animal cells and their enzymes. These are used for food processing, fermentation, waste treatment, etc.
Growth conditions that a bioreactor provides for obtaining the desired products are as follows:
(i) Controlled environment for optimum product yield.
(ii) Aseptic fermentation for number of days and prevention of escape of viable cells.
(iii) Adequate mixing and aeration for optimum growth and production, without damaging the microorganism.
(iv) Easy and dependable temperature control.
(v) Facility of sampling.

14. Differences between type I, type II and type III restriction endonucleases are as follows:

	Type I	Type II	Type III
(i)	Enzyme structure consists of three different subunits.	Enzyme structure is simple.	Enzyme structure consists of two different subunits.
(ii)	They require ATP, Mg^{2+} and S-adenosyl-methionine for restriction.	They require Mg^{2+} for restriction.	They require ATP, Mg^{2+} and S-adenosyl methionine for restriction.
(iii)	They recognise specific sites within the DNA but do not cut these sites.	They recognise specific sites within the DNA and cut these sites.	They recognise specific sites within the DNA but do not cut these sites.
(iv)	They are not used in recombinant DNA technology.	They are used in recombinant DNA technology.	They are not used in recombinant DNA technology.

15. (a) *Bacillus thuringiensis* produces Bt toxin, an insecticidal protein. This protein kills insects such as lepidopterans (tobacco budworm, armyworm), coleopterans (beetles) and dipterans (flies, mosquitoes), but it does not kill the *Bacillus* (bacterium) itself.

(b) *cry* gene codes for this toxin. The toxin does not kill the bacterium *Bacillus*, as it exists in the form of inactive protoxins. However, once an insect ingests the inactive toxin, it is converted into an active form of toxin, due to the alkaline pH of the gut, which then creates pores in the midgut epithelial cells and cause cell swelling, lysis and finally death of the insect.

(c) Proteins encoded by genes *cry* IAc and *cry* IIAb control the cotton bollworms, while *cry* IIAb controls corn borers.

16. Biological products are useful in treating certain human diseases. They are often very expensive. These expensive biological products can be produced in good quantity in transgenic animals by inserting genes for these products into them. Usually milch animals are used for this purpose so that the biological product is available in their milk and from which the same can be extracted and purified. This process is called molecular farming or molecular harvesting. The important biological products being harvested by this method are proteins α – 1 antitrypsin for treating emphysema, tissue plasminogen activator (goat) etc.

17. Gel electrophoresis is done to separate and isolate DNA fragments. The procedure is as follows :
(i) DNA is cut into fragments by restriction endonucleases.
(ii) DNA fragments separate according to their size or charge.
(iii) DNA fragments being negatively charged, are separated by forcing them to move through matrix under an electric field.
(iv) Agarose, a natural polymer obtained from sea weeds is used as the matrix.
(v) The separated molecules are stained by ethidium bromide and visualised by exposure to UV radiation, as bright orange coloured bands.
(vi) The separated bands of DNA are cut from the agarose gel and extracted from the gel piece by elution.

18. (a) When bioresources of one country are exploited or patented by some multinational companies or organisations of other countries without proper authorisation from concerned country and compensation is referred to as biopiracy.

(b) To prevent unauthorised exploitation of bio-resources and traditional knowledge, the Indian Parliament has recently cleared the second amendment of the Indian Patents Bill, that takes biopiracy issues into consideration, including patent terms, emergency provisions, research and development initiatives.

19. The basic requirements of a polymerase chain reaction are:
(i) DNA template – The desired segment of target DNA molecule that is to be amplified.
(ii) Primers – Two nucleotide primers, usually 10-18 nucleotides long and complementary to the sequences present at the 3′ end of the target DNA segment.
(iii) Enzyme – *Taq* DNA polymerase which is stable at high temperature is required to carry out synthesis of new DNA.

OR

Agrobacterium tumefaciens is a soil-inhabiting bacterium that may invade growing plants at the junction of root and

stem, where it can cause a cancerous growth known as a crown gall. The bacterium, which infects dicotyledonous plants only, contains plasmid (known as a Ti plasmid) that carries the genes for tumour formation. When the bacterium invades the host cells, the Ti plasmid enters the host nuclei. Part of the Ti plasmid become inserted into the chromosome, where it produces copies of itself. For using Ti plasmid as a vector, researchers have eliminated its tumour causing properties while keeping its ability to transfer DNA into plant cells. This bacterium is called natural genetic engineer because genes carried by Ti plasmid produce effect in several parts of the plant.

20. **(a)** Proinsulin has A, B and C polypeptide strands. It is non-functional. The mature insulin has only A and B polypeptide strands and it is functional.

(b) From the human cell, DNA containing insulin gene is isolated. The two DNA sequences corresponding to A and B chains of human insulin is introduced into the plasmids of *E. coli* to produce insulin chains A and B. The extracted chains A and B are combined by creating disulphide bonds to form human insulin (humulin).

(c) The insulin prepared by rDNA technology does not produce sensitive allergic reactions and immunological reactions. Those insulin used earlier, produced allergic reactions and other complications to the foreign protein as earlier insulin were extracted from pancreas of slaughtered cattle and pigs.

21. Competent host is essential for biotechnology experiment. Since DNA is a hydrophilic molecule, it cannot pass through membranes, so the bacterial cells must be made capable to take up DNA *i.e.*, made competent.
This can be achieved by :

(i) Treatment of DNA with divalent cation of $CaCl_2$ or rubidium chloride. Treating them with a specific concentration of a divalent cation, increases the efficiency with which DNA enters the bacterium through pores in its cell wall.

(ii) Heat shock treatment of DNA – Recombinant DNA (rDNA) can be forced into cells by incubating the cells with recombinant DNA on ice, followed by placing them briefly at 42°C (heat shock) and then putting them back on ice. This enables the bacteria to take up the recombinant DNA.

22. Different steps involved in RNA interference are as follows:

(i) Double stranded RNAs are processed into approximately 21-23 nucleotide RNAs with two nucleotides. An RNase enzyme called dicer cuts the dsRNA molecules (from a virus, transposon, or through transformation) into small interfering RNAs (siRNAs).

(ii) Each siRNA complexes with ribonucleases (distinct from dicer) to form an RNA-induced silencing complex (RISC).

(iii) The siRNA unwinds and RISC is activated.

(iv) The activated RISC targets complementary *m*RNA molecules. The siRNA strands act as guides where the RISCs cut the transcripts in an area where the siRNA binds to the *m*RNA. This destroys the *m*RNA.

(v) When *m*RNA of the parasite is destroyed no protein is synthesised. It results in the death of the parasite in the transgenic host.

23. **(a)** Benefits derived from transgenic animals are as follows:

(i) They produce useful biological products, that can be created by introduction of portion of gene, which codes for a particular product such as human protein (α -1- antitrypsin) from transgenic sheep is used to treat emphysema.

(ii) Transgenic mice are being developed for use in testing the safety of vaccine before they are used in humans.

(iii) They carry genes which make them more sensitive to toxic substances than non-transgenic animals. They are then exposed to toxic substances and the effects are studied.

(b) The ethical issues concerned with the production of transgenic animals include:

(i) Introduction of a transgene from one species into another species violates the 'integrity of species'.

(ii) Transfer of human genes into animals (and *vice-versa*) dilutes the concept of 'humanness'.

(iii) When animals are used for production of pharmaceutical proteins, they are virtually reduced to the status of a 'factory'.

(iv) Use of animals in biotechnology causes great suffering to them.

(v) It is disrespectful to living beings, and only exploits them for the benefit of human beings.

(c) Neeraj shows ethical values as he is kind and concerned about the animals while Mohit shows values towards the betterment of human race. Both of them are knowledgeable and have scientific aptitude.

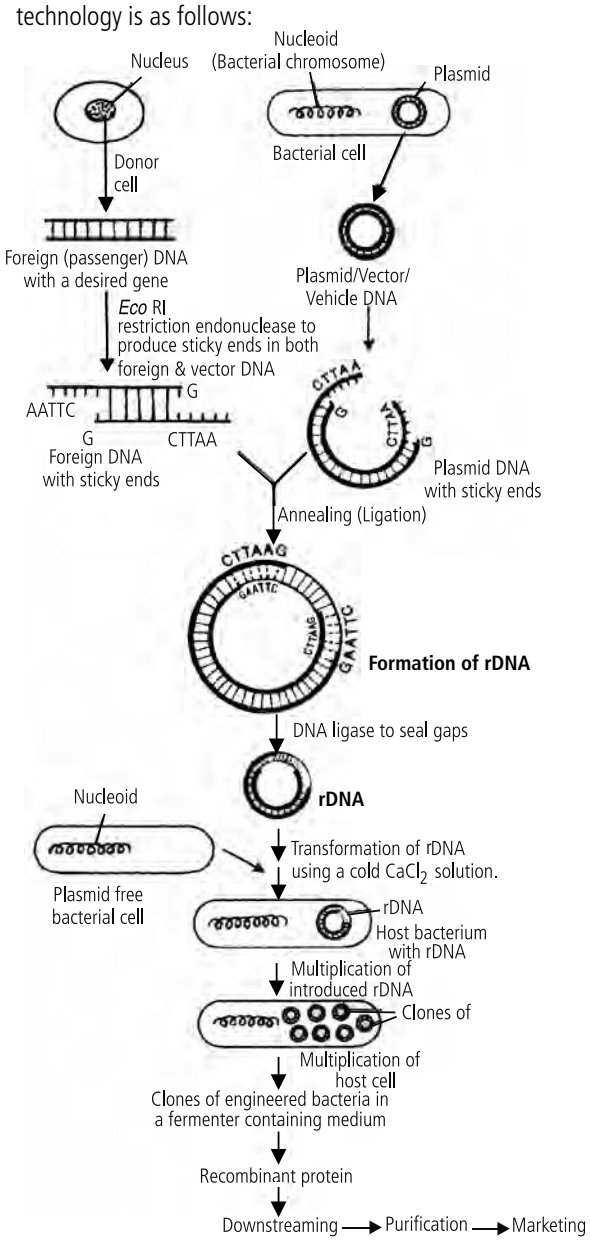
24. The cloning vectors are DNA molecules that can carry a foreign DNA segment and replicate inside the host cell. These are plasmids, bacteriophages, cosmids, phagemids, yeast artificial chromosome (YAC), bacterial artificial chromosome (BAC), transposons and virus.
Cloning vector carry rDNA and they generally have high copy number, they can produce multiple numbers of required gene. Vectors help in easy linking of foreign DNA and in selection of recombinants from non-recombinants.
The entire procedure of gene cloning or recombinant DNA technology may be classified into the following six steps for the convenience in description and on the basis of the chief activity performed.

(i) Production and isolation of the DNA fragments to be cloned.

(ii) Insertion of the isolated gene in a suitable vector to obtain recombinant DNA.
(iii) Introduction of the recombinant DNA into a suitable organism/cell (usually *E.coli*) called host (transformation).
(iv) Selection of the transformed host cells, and identification of the clone containing the desired gene/ DNA fragment.
(v) Multiplication/expression of the introduced gene in the host.
(vi) Where needed, transfer and expression of the gene into another organism.

OR

Diagram showing various steps of recombinant DNA technology is as follows:



25. (a) In order to cut the DNA with restriction enzymes, it needs to be in pure form, free-from other macro-molecules. Since the DNA is enclosed within the membrane, It is required to break the cell open to release DNA along with other macromolecules such as RNA, proteins or lipids. This can be achieved by treating the bacterial cells, plant or animal tissue with enzyme such as lysozyme (bacteria), cellulase (plant cells), etc. Restriction enzyme digestion is performed by incubating purified DNA molecules with restriction enzyme. The cutting of DNA at specific location is done by restriction enzyme which belongs to larger class of enzymes called nucleases. They are of two types; exonucleases (remove nucleotides from the ends of the DNA), endonucleases (make cuts at specific positions within the DNA).

(b) In polymerase chain reaction (PCR), multiple copies of the gene (DNA) of interest are synthesised *in vitro* using two set of primers (oligonucleotides that are complementary to regions of DNA) and the enzyme DNA polymerase. The segment of DNA can be amplified to approximately billion times. The amplification is done performing sequential steps such as DNA denaturation (at 90 – 98°C), annealing of primer-template DNA strands, and primer extension (polymerisation carried out at 72°C). Such repeated amplifications is achieved by the use of thermostable DNA polymerase (*Taq* polymerase obtained from *Thermus aquaticus*), which remains active during high temperature induced denaturation of double stranded DNA.

OR

(a) Enzyme-linked immunosorbent assay (ELISA) is a non-isotopic immunoassay. ELISA is based on the immunochemical principles of antigen antibody reaction.

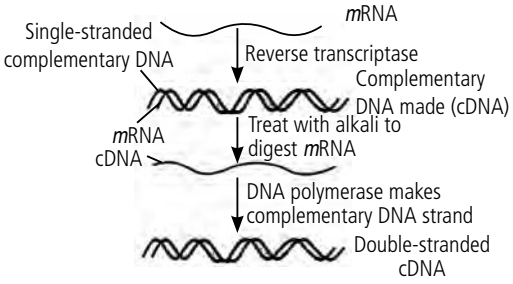
ELISA can detect very small amount of protein with the help of enzymes, *e.g.*, peroxidase, amylase and alkaline phosphatase. ELISA is widely used for the determination of small quantities of proteins (hormones, antigens, antibodies) and other biological substances. The most commonly used pregnancy test for the detection of human chorionic gonadotropin (hCG) in urine is based on ELISA. ELISA is also been used for diagnosis of HIV viruses in AIDS patient.

(b) (i) Transgenic animals that produce useful biological products can be created by the introduction of the DNA segment (or gene) which code for a particular product such as human protein (α-1-antitrypsin) used to treat emphysema. Similar attempts are being made for treatment of phenylketonuria (PKU) and cystic fibrosis. Human genes encoding

valuable proteins have been transferred into rabbits, interleukin 2, growth hormone, tissue plasminogen activator, α_1 antitrypsin, etc. These genes are expressed in mammary tissues and proteins were harvested from milk.

(ii) Transgenic animals are being made that carry genes which make them more sensitive to toxic substances than non-transgenic animals. They are then exposed to the toxic substances and the effects are studied. Transgenic mice is used as model for studying techniques of gene transfer and transgenic production.

(c) Diagrammatic representation of synthesis of cDNA from RNA is as follows:



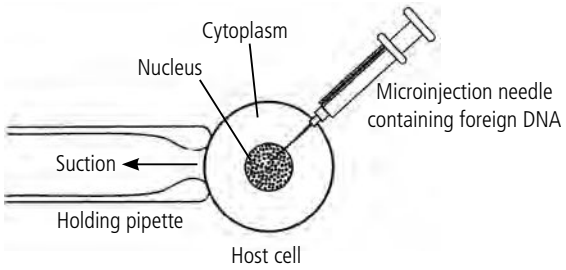
26. (a) PCR (Polymerase Chain Reaction) is used to detect mutations in gene in suspected cancer patients. A single stranded DNA or RNA joined with a radioactive molecule (probe) is allowed to hybridise to its complementary DNA in a clone of cells. It is followed by detection using autoradiography. The clones having the mutated gene will not appear on the photographic film, because the probe will not have the complementarity with the mutated gene.

(b) The three methods which force 'alien' or recombinant DNA into host cells are: electroporation, biolistic method and microinjection.

(i) Electroporation : In this method, electrical impulses induce transient pores in the cell membrane of host cells by using lysozyme or calcium chloride through which foreign DNA molecules are incorporated into cells.

(ii) Biolistic method or Gene gun method : Biolistic is a means of introducing DNA into cells that involves bombardment of cells with high-velocity microprojectiles coated with DNA. In biolistic method tungsten or gold particles, coated with foreign DNA are bombarded into target cells at a very high velocity.

(iii) Microinjection : It is the introduction of foreign gene into nucleus of plant cell or animal cell by using microneedles or micropipettes. It is used in oocyte, egg or embryo.



OR

(a) GM plants have been useful in many ways :

(i) Growing GM crops can help to reduce the use of chemical pesticides, *e.g.*, Bt cotton.

(ii) GM crops are more tolerant to abiotic stresses (cold, drought, salt, heat, etc.).

(iii) They have helped to reduce post-harvest losses, *e.g.*, Flavr savr transgenic tomato.

(iv) Increased efficiency of mineral usage by plants prevents early exhaustion of fertility of soil.

(v) GM plants enhance nutritional value of food. *E.g.*, vitamin A enriched rice.

(vi) GM plants are resistant to herbicides.

(vii) Plants such as popular trees have been genetically engineered to clean up heavy metal pollution from contaminated soil.

GM food can lead the following health problems.

(i) Allergies : The transgenic food may be cause toxicity and or produce allergies. The enzyme produced by the antibiotic resistance gene can cause allergies, because it is a foreign protein.

(ii) Effect on bacteria of alimentary canal : The bacteria present in the human alimentary canal can take up the antibiotic resistance gene that is present in the GM food. These bacteria can become resistant to the concerned antibiotic and will be difficult to manage.

(b) GEAC is Genetic Engineering Approval Committee. It makes decisions regarding the validity of GM research and the safety of introducing GM organisms for public services. The objectives of setting up GEAC by our government are as follows:

(i) To permit the use of GM organisms and their products for commercial applications.

(ii) To adopt procedures for restriction, production, import, export and application of GM organisms.

(iii) To approve for conduct of large scale field trials and release of transgenic crops in the environment.

(iv) To authorise agencies or persons to have large scale production and release of GM organisms into the environment or curb and take punitive action against them.

☺☺

PRACTICE PAPER

PMT

CLASS XII

MOLECULAR BASIS OF INHERITANCE

This paper contains 45 **multiple choice questions**. Each question has four choices (a), (b), (c) and (d), out of which **ONLY ONE** is correct. (Mark only one choice).

Marks : 45 × 4 = 180 **Negative Marking (–1)**

1. How many of the following statements are true in context of human genome?
I. There are 1.4 million SNPs.
II. 99.9% genome is similar in all humans.
III. 32% genome codes for proteins.
IV. Largest human gene is dystrophin with 2.4 billion base pairs.
V. Human genome has maximum number of genes on 1st chromosome *i.e.*, 3968.
(a) 2 (b) 1 (c) 3 (d) 4

2. Find out the correct matching of column I and column II from the codes given below.

Column I		Column II
A.	Helicase	(i) Joining of deoxyribo-nucleotides
B.	23S *r*RNA	(ii) Working within Y-fork
C.	DNA directed RNA polymerase	(iii) Peptide bond formation
D.	DNA polymerase III	(iv) RNA primer

(a) A-(ii), B-(iii), C-(iv), D-(i)
(b) A-(i), B-(ii), C-(iii), D-(iv)
(c) A-(iv), B-(iii), C-(i), D-(ii)
(d) A-(ii), B-(iv), C-(iii),D-(i)

3. Polypeptide chain in eukaryotes is initiated by
(a) glycine (b) leucine
(c) methionine (d) lysine.

4. Euchromatin is
A. loosely packed B. stains light
C. transcriptionally active D. early replicating.
(a) A and C (b) A, B, C and D
(c) B, C and D (d) A, B and C

5. Which one is correct?
(a) DNA replication occurs before mitosis, meiosis and amitosis.
(b) The polarity of DNA template on which leading strand formed is 3′→ 5′.
(c) The products of gene may be *r*RNA, *t*RNA and *m*RNA.
(d) All of these

6. Stability of DNA is due to
(a) hydrogen bonds
(b) stacking interactions between flat aromatic surfaces of adjacent base pairs
(c) van der Waals forces and hydrophobic interactions
(d) all of these.

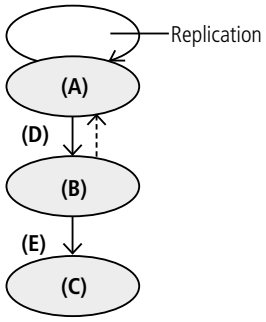
7. Which one of the following is wrongly matched?
(a) Transcription – Writing information from DNA to *m*RNA.
(b) Translation – Using information in *m*RNA to make protein.
(c) Repressor protein – Binds to operator to stop enzyme synthesis.
(d) Operon – Structural genes, operator, promoter and intron.

8. In a RNA strand, two adjacent nucleotides are linked together by
(a) – S – S – linkage
(b) van der Waals forces
(c) 3′ - 5′ phosphodiester bonds
(d) hydrogen bonds.

9. If a double stranded DNA molecule contains 30% T, how much G does it contain?
(a) 20% (b) 30% (c) 40% (d) 50%

Contributed by : *Harpal Singh*, Harpal's Biology Classes, Chandigarh, 09781124215

10. Diagram represents "flow of information in the cell". Choose correct combination of labels.



(a) B - Indicates dsRNA
(b) E - Translocation
(c) D - Enzyme reverse transcriptase
(d) C - Polyamide/Polypeptide

11. Microbe incapable of growing on minimal nutrient medium is
(a) heteroorganotroph (b) auxotroph
(c) prototroph (d) autotroph.

12. T ψ C terminus of *t*RNA is called
(a) 'most specific' part of *t*RNA
(b) enzyme attachment site
(c) ribosomal attachment site
(d) aminoacyl attachment site.

13. Arrange the following in descending order according to their sizes.
(a) DNA → Cistron → *m*RNA → Muton →Recon
(b) DNA → *m*RNA → Cistron → Recon → Muton
(c) Muton → Recon → Cistron → *m*RNA → DNA
(d) DNA → Cistron → *m*RNA → Recon → Muton

14. Read the following statements (i) to (v).
(i) In transcription, adenine pairs with uracil.
(ii) Human genome has about 98% junk DNA.
(iii) Human gene on an average contains 3000 bps and there are about 30,000 genes in human genome.
(iv) Y-chromosome of human genome has least number of genes, *i.e.*, 321 in human genome.
(v) Western blot is used to detect proteins.
How many statements are correct?
(a) 4 (b) 5 (c) 2 (d) 3

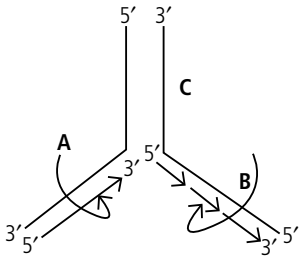
15. An anticodon of *t*RNA can recognise more than one codon of *m*RNA. It is
(a) Wobble base hypothesis
(b) gene flow hypothesis
(c) template hypothesis
(d) Richmond and Lang effect.

16. Which of the following is an initiation codon during protein formation?
(a) 3′ GUA 5′ (b) 3′ AUG 5′
(c) 5′ UAC 3′ (d) 3′ UAC 5′

17. Polymerisation rate of nucleotides in prokaryotes is _____ during replication of DNA.
(a) 200 bp per minute (b) 2000 bp per second
(c) 200 bp per hour (d) 2000 bp per day

18. Transcription refers to the
(a) transfer of genetic code of DNA to RNA
(b) formation of DNA from RNA
(c) formation of protein
(d) polymerisation of deoxyribonucleotides in cell-free system.

19. Identify A, B and C strands.



(a) A-Discontinuous strand, B-Continuous strand,C-Template strand
(b) A-Leading strand, B-Lagging strand, C-Parental strand
(c) A-5′ – 3′ strand, B-3′ – 5′ strand, C-Parental strand
(d) All of these

20. Which of the following is/are true regarding genetic code?
(i) 1st codon decoded was UUU coding for amino acid phenylalanine.
(ii) There are five punctuations and sixty one coding codons.
(iii) UAA, UGA and AUG are non-sense codons.
(iv) It is non-overlapping, colinear and ambiguous.
(v) Two codons decoded by Hargobind Khorana were UGU and GUG coding for amino acid cysteine and valine respectively.

ANSWERS *WHO AM I ...*

1.	*Haematococcus nivalis*	Pg. 15
2.	Pteridosperms	Pg. 20
3.	Microspheres	Pg. 57
4.	Oligocene	Pg. 66

MPP-8 CLASS XII ANSWER KEY

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

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

21. Which of the following is an incorrect statement?
(a) Chemically, adenine is 6 amino purine.
(b) Cytosine and adenine are purine bases.
(c) Two DNA strands are antiparallel due to hydrogen bonds holding them together.
(d) Pitch of dsDNA is 3.4 nm.

22. *m*RNA directs building of proteins through sequence of its
(a) exons (b) anticodons
(c) introns (d) codons.

23. To which factor, RNA polymerase binds transiently to terminate transcription?
(a) Sigma (b) Amber codon
(c) AUG (d) Rho

24. Which of the following is a wrong match?
(a) Rho factor – Terminates translation
(b) AUG – Initiates transcription
(c) Sigma factor – Initiates translation
(d) All of these

25. 'QB bacteriophage' has genetic material as
(a) ssRNA (b) dsDNA (c) dsRNA (d) ssDNA.

26. *E.coli* with dsDNA labelled with radioactive thymidine, allowed to replicate in simple nutrient medium for two generation. What will be the percentage of bacteria containing only non-radioactive DNA?
(a) 12.5% (b) 6.25% (c) 25% (d) 50%

27. During protein synthesis which of the following is true?
(a) Mn^{++} is required for completion of ribosome.
(b) 3′ of *m*RNA enter the ribosome.
(c) Main energy source used in elongation steps is GTP.
(d) EF-Ts helps in codon-anticodon recognition.

28. How many of the following statements are true?
(i) 6 turns of Z-DNA has 144 nucleotides.
(ii) Transposable elements were first discovered in maize.
(iii) Operon concept was given by Jacob and Monod while working on yeast.
(iv) Enzyme required for peptide chain synthesis is a ribozyme in bacteria and lies in 50S subunit.
(v) Small segment of RNA synthesised during replication of DNA is "Okazaki segment".
(a) 2 (b) 3 (c) 1 (d) 5

29. During translation, for formation of one peptide bond, how many phosphate bonds are used?
(a) 2 each from ATP and GTP
(b) 3 (c) 4 from GTP
(d) 2 + 1 + 1 + 1

30. Virus integrated into bacterial genome is commonly called
(a) virion (b) viroid
(c) virusoid (d) provirus.

31. Which of the following is wrongly matched?
(i) Virus – Has either DNA or RNA
(ii) Peplomer – Building block of envelope
(iii) Virus – Obligate intracellular parasite
(iv) Prong and Pins – Help in locomotion in bacteriophage
(v) Virus crystallised by – Stanley
(a) (ii), (iii) and (iv) (b) All except (i)
(c) (iv) only (d) (i), (ii) and (iv)

32. Feature of genetic code where many different codons, code for same amino acid is called
(a) deciphering of genetic code
(b) colinearity of genetic code
(c) degeneracy
(d) ambiguity.

33. Eukaryotic genome differs from prokaryotic genome in
(a) DNA is circular and single-stranded in prokaryotes
(b) IVS are present in eukaryotic DNA
(c) DNA is complexed with histones in prokaryotes
(d) DNA is not organised into operons in eukaryotes.

34. Virus mediate transfer of DNA from one bacterium to another is
(a) transduction (b) transformation
(c) transversion (d) translation.

35. A collection of DNA fragments produced by restriction endonucleases representing, whole DNA from an organism is called
(a) gene bank (b) gene pool
(c) gene library (d) genoid.

36. Which of the following is true about processed *m*RNA?
(a) It has 3 UTRs present between 5′cap and initiation codon, inside exons and behind non-sense codon.
(b) It is polycistronic in eukaryotes.
(c) 1st base at 5′ is 7 mG.
(d) Smallest RNA molecule taking part in protein synthesis.

37. Which of the following is a true statement?
(a) Human genome has 16.5 million nucleosomes.
(b) 2-D shape of *t*RNA is 'inverted L'.
(c) Aminoacyl attachment site of *t*RNA is 5′ primer with base sequence CCA where amino acid attaches by phosphoester bond.
(d) One nucleosome has 150 bps + octamer of histones.

38. All the given statements are true, except.
(a) DNA is more stable than RNA because DNA contains 5 methyl uracil and deoxyribose.
(b) DNA replication is semi-conservative, bidirectional and semi-discontinuous.
(c) Taylor proved semi-conservative replication of DNA by working on *E.coli* bacteria.
(d) 'Klenow fragment' is a part of DNA polymerase I.

39. Which of the following is incorrect for operon concept?
(a) The sequence of structural gene in *lac* operon is ZYA where Z gene codes for hydrolytic enzyme.
(b) Allolactose turns it on by binding with repressor protein.
(c) It is an inducible operon and controls catabolic reactions.
(d) Operator gene receives RNA polymerase to switch it off.

40. How many of the following statements are true?
(i) snRNA is synthesised by RNA polymerase III.
(ii) Proteins are synthesised from C′ → N′.
(iii) To form 1st peptide bond 4GTP and 3ATP are required.
(iv) Frame shift mutations are most dangerous.
(v) 23S *r*RNA acts as a catalyst in eukaryotic ribosome.
(a) 3 (b) 2 (c) 4 (d) 5

41. Maximum possible transversion, which may take place in genetic code are
(a) 366 (b) 183
(c) 549 (d) in each codon 9 only.

42. Which of the following statements are false regarding 'Hershey and Chase' experiment, proving DNA is a genetic material?
(i) They made use of rats.
(ii) Bacteriophage used was T_4 with dsDNA.
(iii) Used radioisotope to label sulphur with ^{35}S in sulphur containing amino acids.
(iv) Technique used density gradient centrifugation.
(v) Phenomenon exploited was lytic cycle.
(a) (ii) and (iii) only (b) (iii) and (iv)
(c) (ii), (iii) and (iv) only (d) (i) and (ii)

43. "Sequence annotation" in human genome project refers to
(a) identification of only those genes that are expressed as RNA
(b) correlating, sequence of nucleotides already known for an organism, to their functions
(c) selection of base sequences not involved in protein synthesis
(d) both (a) and (b).

44. DNA is a polymer of nucleotides which are linked to each other by 3′ – 5′ phosphodiester bond. To prevent polymerisation of nucleotides, which of the following modifications would you choose?
(a) Replace purine with pyrimidines
(b) Remove/Replace 3′ OH group in deoxyribose
(c) Remove/Replace 2′ OH group with some other group in deoxyribose
(d) Both (b) and (c)

45. 'Base pair rise' in typical DNA molecule is
(a) 3.4 nm (b) 0.34 Å (c) 0.34 nm (d) 3.4 μm.

ANSWER KEY

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

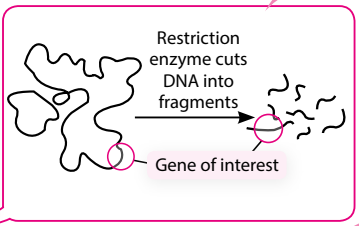
BIO-GRAM

Southern Blotting

Southern blotting is a technique that involves transfer of DNA fragments from an electrophoresis gel onto a membrane support, in such a way that DNA banding pattern present in the gel is reproduced on the membrane. During transfer, DNA becomes immobilised on the membrane and can be used as a substrate for hybridisation analysis with labelled DNA or RNA probes that specifically target individual restriction fragments in blotted DNA. This technique is named after its inventor Edwin Southern (1975). It involves the following steps:

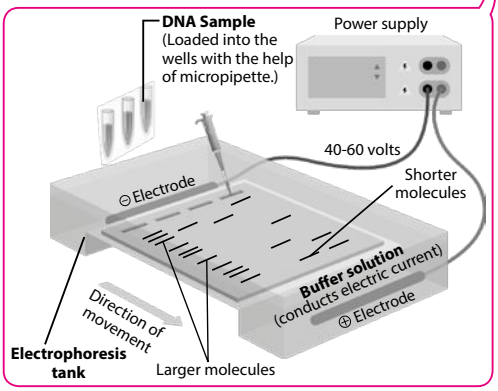
1 DNA Digestion

DNA containing gene of interest is extracted from cells with the help of enzymes and subjected to restriction digestion so as to obtain DNA fragments.



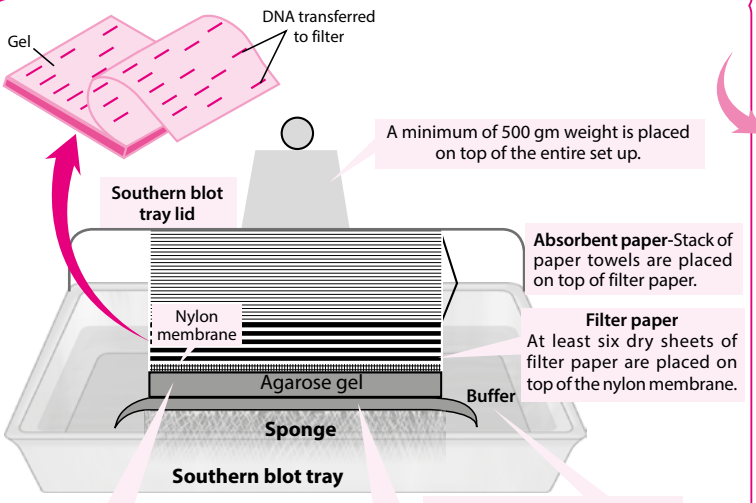
2 Separation of Fragments by Gel Electrophoresis

Fragmented DNA is typically electrophoresed on an agarose gel to separate them on the basis of their molecular weights. DNA size is determined by running the DNA ladders (or molecular weight markers) in the lane adjacent to the sample. By matching the distance covered by fragment and marker, the molecular weight and size of DNA fragment can be estimated.



3 Blotting

After electrophoresis, the DNA fragments in the gel are denatured for which it is soaked in about 0.5 M NaOH which separates dsDNA into ssDNA and then transferred onto positively charged nylon or nitrocellulose membrane. The traditional transfer of DNA is done overnight using an upward capillary transfer of DNA from an agarose gel onto a membrane and its subsequent immobilisation by UV irradiation (for nylon) or baking (for nitrocellulose).



Obtained from gel electrophoresis after separation of fragments and is carefully placed onto filter paper bridge.

Filter paper bridge Briefly soaked in buffer and placed across the support so that it hangs down into tray.

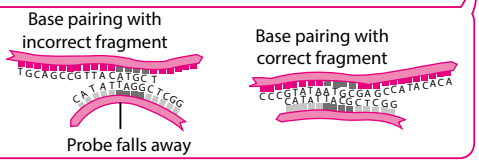
The buffer contains a strong alkali that denatures DNA. Denaturation facilitates the transfer and prepares the DNA for hybridisation by probe.

4 Prehybridisation of Southern blot

The nylon membrane is carefully removed from the setup and is incubated in a buffer for 15 minutes containing radioactively labelled probe. Labelled probe is a nucleic acid probe with sequence homologous to the target sequence under study, labelled with radioactivity, fluorescent dye or an enzyme that can generate a chemiluminescent signal when incubated with the appropriate substrate.

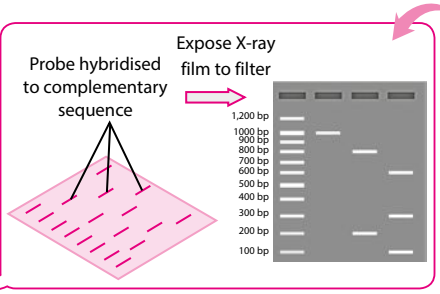
5 Hybridisation

Hybridisation is promoted when the labelled probe is incubated with the DNA fragments immobilised on the blot in a tube that is constantly rotated or in a sealed plastic bag that is placed on a shaker. Random collisions bring small regions of complementary sequences together to start the renaturation. Base pairing proceeds in a zipper-like fashion as flanking sequences are complementary; probe sticks even after washing. The unhybridised probe is removed by washing several times in buffer. Only the fully hybridised labelled probe molecules with sequences complementary to gene of interest remain bound.



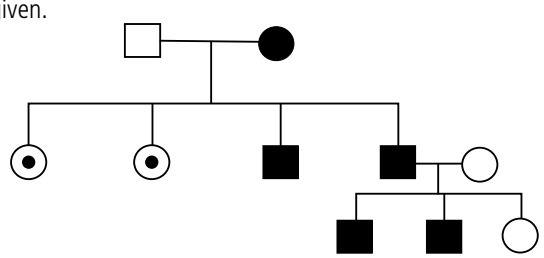
6 Detection

The labelled probe is detected using the method required for the type of label used. For example, radiolabelled probes may be detected using X-ray film or a phosphorimaging instrument.



BIOLOGY OLYMPIAD PROBLEMS

1. Pedigree analysis helps determine the pattern of inheritance of a trait among related individuals. One such pedigree is given.



Squares indicate males and circles females. Filled symbols indicate presence of trait while circles with a dot indicate carriers. The inheritance pattern shown in the given pedigree is

(a) X-linked recessive (b) autosomal recessive
(c) sex limited trait (d) sex influenced trait.

(INBO 2017)

2. Which one of the following plant traits is not associated with colonisation on land from aquatic habitat?

(a) Presence of apical meristems
(b) Absence of alternation of generations
(c) Formation of multicellular, dependent embryos
(d) Production of gametes within multicellular organs

(INBO 2017)

3. The nuclear membrane disappears during cell division. After completion of cell division, it re-appears during the interphase. Which of the following contributes towards formation of the nuclear membrane?

(a) Spindle fibre proteins
(b) Cytoskeletal elements
(c) Endoplasmic reticulum
(d) Golgi bodies *(INBO 2016)*

4. In C_4 plants, dimorphism of chloroplasts is an adaptation to

(a) absorb light efficiently
(b) absorb light in blue-violet and red regions
(c) carry out cyclic and non-cyclic electron transfer
(d) minimise photorespiration. *(NSEB 2015-16)*

5. If the triplet base sequence for an amino acid in DNA is TTT, what will be the anticodon for it?

(a) UUU (b) AAA
(c) TTT (d) CCC *(NSEB 2015-16)*

6. Assuming that the number of chromosomes in the endosperm of a gymnosperm is 80, the number of chromosomes before and immediately after fertilisation in each of the following structures will be

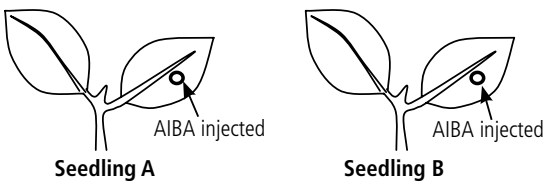
	Structures	Before fertilisation	After fertilisation
(a)	Integument	80	160
	Cells of archegonia	80	80
	Nucellus	160	160
(b)	Integument	80	80
	Cells of archegonia	40	40
	Nucellus	80	80
(c)	Integument	80	80
	Cells of archegonia	40	40
	Nucellus	40	120
(d)	Integument	160	160
	Cells of archegonia	80	80
	Nucellus	160	160

(INBO 2015)

7. Poonam noticed a total of 64 setae in 4 bunches in each segment of an annelid 'X' and 85 setae in a single ring in certain segments of the body of an annelid 'Y'. She should classify 'X' and 'Y' as

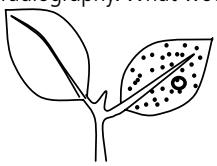
(a) oligochaetes
(b) polychaetes
(c) oligochaete and polychaete respectively
(d) polychaete and oligochaete respectively. *(INBO 2014)*

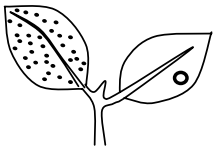
8. Cytokinins influence the movement of nutrients into leaves from other parts of the plant. This phenomenon is known as cytokinin-induced nutrient mobilisation. In an experiment with cucumber seedlings, the left cotyledon of a seedling A and right of seedling B were treated with 50 mM kinetin. The [^{14}C] amino iso-butyric acid (AIBA) was injected into the right cotyledon of each of these seedlings.

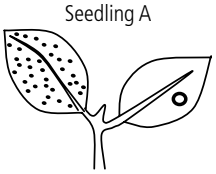


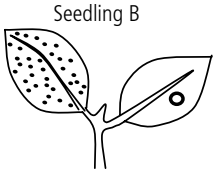
Seedling A **Seedling B**

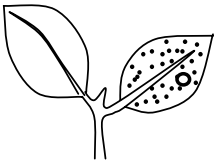
After few hours, the seedlings were subjected to autoradiography. What would be the result?

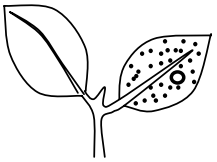
(a) 

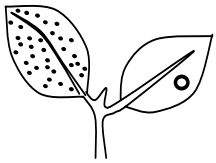


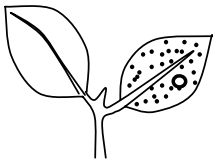
(b) 



(c) 



(d) 



(INBO 2014)

9. Which of the following pairs is mismatched?

(a) Spliceosome - Removal of introns
(b) Transposase - Insertion of DNA segments into DNA
(c) DNA polymerase - Makes a molecule of DNA from a DNA template
(d) RNA polymerase - Makes a molecule of RNA from an RNA template

(NSEB 2013-14)

10. In a plant, genes A, B and C control the flower colour, height and position of the flowers respectively. Study the following genotypes and corresponding phenotypes :

AA → red flower
aa → white flower
Aa → pink flower
B_ → tall plant
bb → dwarf plant
C_ → axillary flower and
cc → terminal flower

If AabbCC and aaBbCc are crossed, what proportion of plants would be tall, have pink and axillary flowers in the progeny?

(a) 25% (b) 50%
(c) 75% (d) 100% *(INBO 2013)*

SOLUTIONS

1. (d) : From the given pedigree analysis, it can be determined that the trait in concern is neither X-linked recessive nor only autosomal recessive (as should not have expressed itself in last generation). It cannot be sex limited as well because both male and female show the concerned trait. The trait therefore seems to be influenced by some factors. It can be sex influenced trait. Sex influenced traits are autosomal traits that are expressed based on the influence of the sex, in particular the sex hormones. Although these traits can be seen in both the sexes, the degree or frequency of the phenotypic expression varies according to the sex. For example baldness pattern in humans. The presence of hair as a character has 2 forms: baldness (B+) and full hair (B–). B+ is dominant in males but recessive in females and, hence, requires 2 B+ to cause baldness in females. In addition, the presence of testosterone levels influences the expression of baldness allele. Higher levels of testosterone hormone in males cause the baldness gene to be dominant while lower levels in females make it recessive. This trait is also called as male pattern baldness.

Genotype	Male	Female
B+B+	Bald	Bald
B+ B–	Bald	Full hair
B– B–	Full hair	Full hair

2. (b)

3. (c) : During telophase, the nuclear envelope reappears around chromatin and nucleoplasm. It is formed from either pieces of older nuclear envelope or endoplasmic reticulum. Therefore, ER contributes towards formation of nuclear envelope.

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.

T E P G D O R I A Y
H U L R N C S O I

Send your response at editor@mtg.in or post to us with complete address by 25th of every month to win exciting prizes. Winner's name will be published in next issue.

4. (d) : C_4 fixation is a photosynthetic process in some plants such as sugarcane, corn, etc., where oxygenase activity of enzyme RuBisCO in photorespiration is prevented. For this purpose, C_4 plants utilise their specific leaf anatomy where chloroplasts exist in both mesophyll and bundle sheath cells. The mesophyll cells incorporate CO_2 in a 4-C organic acid which is transported back to bundle sheath cells where normal C_3 pathway follows. In C_4 plants, RuBisCO is located only in bundle sheath cells where photosynthetic release of oxygen does not occur. Bundle sheath cells have a high intracellular concentration of CO_2 due to flow of C_4 acids and their decarboxylation to release CO_2. Hence, in C_4 plants RuBisCO functions purely as carboxylase, thus preventing photorespiration.

5. (a) : The sequence of anticodon for an amino acid is complementary to its *m*RNA sequence or codon. Therefore, the anticodon will be similar to the sequence of template strand of DNA, from which *m*RNA is transcribed, except that the thymine will be replaced by uracil so, if the triplet base sequence for an amino acid in DNA is TTT, its *m*RNA sequence will be AAA and the anticodon for it is UUU.

6. (d) : In gymnosperms, the endosperm is formed before fertilisation, hence is haploid. The integuments of ovule and nucellus are diploid structures while archegonia represents female gametophyte which is a haploid structure. So, if endosperm (n) has 80 chromosomes then, integument and nucellus (both diploid) will have 160 chromosomes and archegonia (n) will have 80 chromosomes.

7. (c) : Polychaetes, include annelids such as *Nereis*, having well developed paired paddle-like flap structures in each of their segments called parapodia. Each of these parapodia bear numerous bristle-like setae. While the oligochaete comprises of annelids having few setae as compared to polychaetes, *e.g.*, earthworm. Each segment of annelid bears a ring of tiny, curved, chitinous structures known as setae, which are embedded in skin, inside a setal sac. From the above description of two annelids, it can be thus, concluded that 'X' can be classified as oligochaete and 'Y' as polychaete.

8. (d) : Cytokinin *e.g.*, kinetin is known to mobilise and accumulate nutrients into leaves and cells from other parts of plants. In the given experiment, only the left cotyledon of seedling A and right cotyledon of seedling B are treated with kinetin, therefore, only these two cotyledons of both the seedlings would show accumulation of nutrients in them, *i.e.*, acts as nutrient sink. The radioactivity will be retained in those cotyledons in which kinetin was injected. This is because in seedling A, the labelled compound *i.e.*, [^{14}C] AIBA, will move toward the cytokinin application whereas in seedling B, since cytokinin is applied on the marker, *i.e.*, [^{14}C] AIBA, no movement is observed.

9. (d) : RNA polymerase is an enzyme which synthesises RNA from a DNA template. The process is called transcription.

10. (a) : A cross between AabbCC and aaBbCc will be:

Parents: AabbCC × aaBbCc

Gametes: AbC, abC × aBC, abC, aBc, abc

Progeny:

♀ \ ♂	AbC	abC
aBC	AaBbCC pink flower, tall plant, axillary flower	aaBbCC white flower, tall plant, axillary flower
abC	AabbCC pink flower, dwarf plant, axillary flower	aabbCC white flower, dwarf plant, axillary flower
aBc	AaBbCc pink flower, tall plant, axillary flower	aaBbCc white flower, tall plant, axillary flower
abc	AabbCc pink flower, dwarf plant, axillary flower	aabbCc white flower, dwarf plant, axillary flower

Phenotypic ratio is:

Pink flower tall plant axillary flowers		Pink flower dwarf plant axillary flowers		White flower tall plant axillary flowers		White flower dwarf plant axillary flowers
(2)		(2)		(2)		(2)
or 2/8	:	2/8	:	2/8	:	2/8

So, the proportion of tall plant having pink and axillary flower would be 25%.

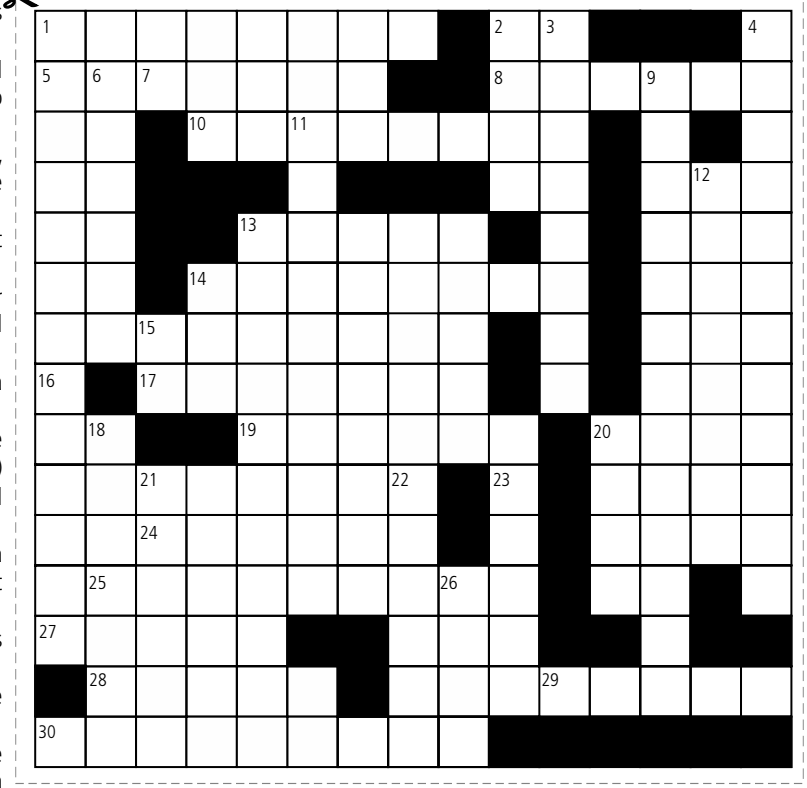
MPP-8 CLASS XI ANSWER KEY

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

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.

Cut Here



ACROSS

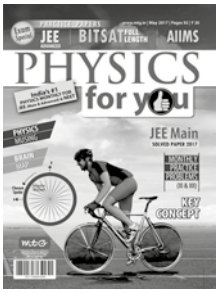
1. A process that involves the fusion of gametes produced by the same parent. (8)
7. The position of a species within an ecological community that includes physical environment to which it has adapted. (5)
8. Fungus used for the treatment of migraine, enlarged prostate gland and uterine haemorrhage after child birth. (5)
10. The type of muscle that contracts to bend a limb at a joint. (6)
13. A series of acidic dyes used with haematoxylin for colouring tissue smears and sections of animal tissues. (5)
14. The flora and fauna occurring at the bottom of a sea or lake. (7)
15. A slit-like aperture that opens the pharynx into the larynx and serves as the space for vocal cords. (7)
17. A compound widely used by scientists to study cell physiology of islets of Langerhans. (7)
19. The red variety of sea onion that produces a radicide which does not have any harmful effect on animals. (6)
21. Phycocolloid extracted from *Laminaria* and used as an emulsifying agent. (5)
24. A fixed position that is occupied by a gene or one of its allele on a chromosome. (5)
25. The procedure of removal of bitterness from the leaves of tea, tobacco, coffee beans and cocoa with the help of *Bacillus megaterium*. (6)
27. Chitinous, short external bristles produced by the epidermal cells of earthworm that are used to grip the soil. (5)
28. A microelement that helps in transport of carbohydrates through phloem and synthesis of proteins and nucleic acids. (5)
29. The scientist who discovered a simple method of cell division "amitosis" in 1855. (5)
30. The most abundant protein of the animal world. (8)

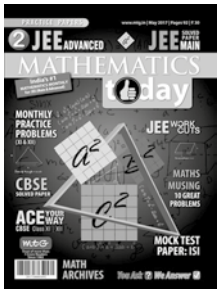
DOWN

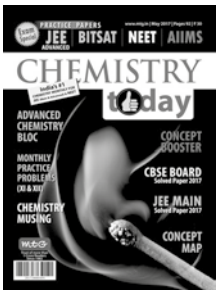
2. A dark brown debris formed from moss and marshy plants and used as fuel and manure. (4)
3. A hard sharp protective outgrowth of stem or leaves that lacks vascular bundles. (8)
4. A condition in which more than one embryo develop in a seed. (12)
5. The broad, protective zone of tissue lying between epidermis and endodermis in stem. (6)
6. The upper lip in the mouthparts of cockroach that holds food particles during feeding. (6)
9. The larval form that is characteristic of *Ophiuroidea*. (12)
11. A functional coding sequence that codes for part or all of the gene product and is expressed in processed RNA. (4)
12. A carotenoid pigment that imparts red colour to tomatoes and chillies. (8)
16. The rhythmic throbbing of arteries produced by the regular contractions of the heart. (5)
18. A taxonomical aid used in identifying organisms by selecting and eliminating from a list of characters. (3)
20. A plant disease characterised by black fungal spores in the cereal crops. (4)
22. The modern horse that arose in Pleistocene epoch about ten lakh years ago in North America. (5)
23. Sterile hybrid offspring obtained when female ass is crossed with stallion. (5)
26. A disease characterised by accumulation of uric acid crystals in synovial joints. (4)

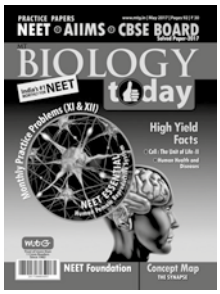
☺☺

Now, save up to Rs 2,020*









Subscribe to MTG magazines today.

Our 2017 offers are here. Pick the combo best suited for your needs. Fill-in the Subscription Form at the bottom and mail it to us today. If in a rush, log on to www.mtg.in now to subscribe online.

*On cover price of ₹ 30/- each.

For JEE (Main & Advanced), NEET, AIIMS AND JIPMER

About MTG's Magazines

Perfect for students who like to prepare at a steady pace, MTG's magazines-Physics For You, Chemistry Today, Mathematics Today & Biology Today-ensure you practice bit by bit, month by month, to build all-round command over key subjects. Did you know these magazines are the only source for solved test papers of all national and state level engineering and medical college entrance exams?

Trust of over 1 Crore readers since 1982.

- Practice steadily, paced month by month, with very-similar & model test papers
- Self-assessment tests for you to evaluate your readiness and confidence for the big exams
- Content put together by a team comprising experts and members from MTG's well-experienced Editorial Board
- Stay up-to-date with important information such as examination dates, trends & changes in syllabi
- All-round skill enhancement – confidence-building exercises, new studying techniques, time management, even advice from past JEE/NEET toppers
- **Bonus:** Exposure to competition at a global level, with questions from Intl. Olympiads & Contests

SUBSCRIPTION FORM

Please accept my subscription to:

Note: Magazines are despatched by Book-Post on 4th of every month (each magazine separately).

☑ *Tick the appropriate box.*

Best Offer

PCMB combo

☐ 1 yr: ₹ 1,000 *(save ₹ 440)* ☐ 2 yr: ₹ 1,800 *(save ₹ 1,080)* ☐ 3 yr: ₹ 2,300 *(save ₹ 2,020)*

PCM combo

☐ 1 yr: ₹ 900 *(save ₹ 180)* ☐ 2 yr: ₹ 1,500 *(save ₹ 660)* ☐ 3 yr: ₹ 1,900 *(save ₹ 1,340)*

PCB combo

☐ 1 yr: ₹ 900 *(save ₹ 180)* ☐ 2 yr: ₹ 1,500 *(save ₹ 660)* ☐ 3 yr: ₹ 1,900 *(save ₹ 1,340)*

Individual magazines

☐ Physics ☐ Chemistry ☐ Mathematics ☐ Biology

☐ 1 yr: ₹ 330 *(save ₹ 30)* ☐ 2 yr: ₹ 600 *(save ₹ 120)* ☐ 3 yr: ₹ 775 *(save ₹ 305)*

Enclose Demand Draft favouring **MTG Learning Media (P) Ltd**,payable at New Delhi. You can also pay via Money Orders. Mail this Subscription Form to Subscription Dept., **MTG Learning Media (P) Ltd**, Plot 99, Sector 44, Gurgaon – 122 003 (HR).

Want the magazines by courier; **add** the courier charges given below:

☐ 1 yr: ₹ 240 ☐ 2 yr: ₹ 450 ☐ 3 yr: ₹ 600

☑ *Tick the appropriate box.*

☐ Student Class XI ☐ XII ☐ ☐ Teacher ☐ Library ☐ Coaching

Name:_____

Complete Postal Address:_____

Pin Code ☐☐☐☐☐☐ Mobile # ☐☐☐☐☐☐☐☐☐☐

Other Phone # 0 ☐☐☐☐☐☐☐☐☐☐

Email _____

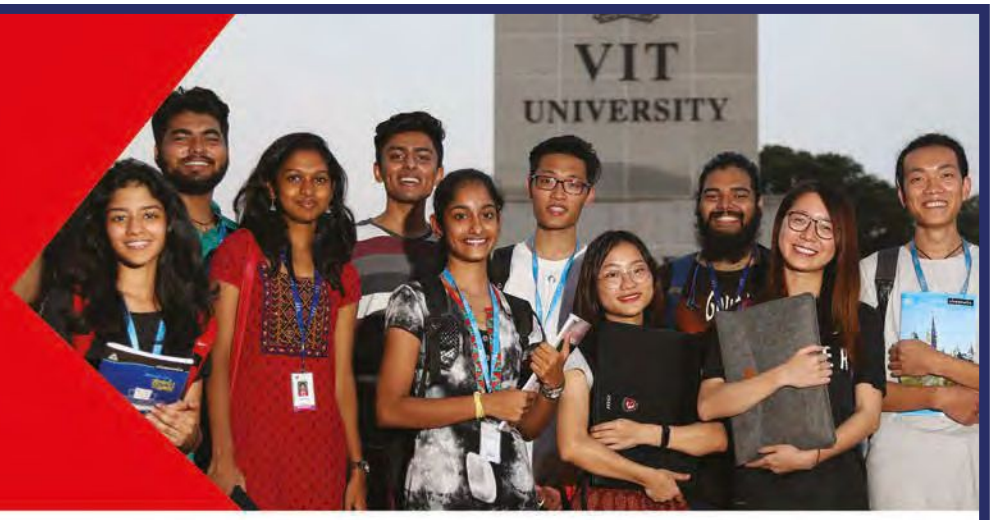
E-mail *subscription@mtg.in*. Visit *www.mtg.in* to subscribe online. **Call (0)8800255334/5 for more info.**

VIT®

READY. STEADY.

VITEEE

EXPERIENCE EDUCATION THAT'S AT PAR WITH TOP UNIVERSITIES ABROAD



VITEEE 2018

4th April to 15th April (Computer Based Test)

Applications are invited for B.Tech Programmes

Biotech., Bioengg., Chemical, Civil, CSE, CSE (Specialisation in Digital Forensics & Cyber security), CSE (Bioinfo.), CSE (Data Analytics), CSE (Gaming Tech.), CSE (Information Security), CSE (Networks & Security), ECE, ECE (Biomedical), ECE (Embedded Systems), ECE (IOT), ECE (Sensors & Wearable Tech.), ECE (VLSI) , EEE, EIE, Electronics & Computer Engg., IT, Mech., Mech (Auto), Mech. (Energy), Production & Industrial Engg., B.Des.Ind.Design

To apply online and to get details like eligibility and fee, please visit www.vit.ac.in

LAST DATE FOR SUBMISSION: 28th FEBRUARY 2018
ONLINE APPLICATION FEE: ₹1150

International Transfer Programme (ITP)

VIT offers students the choice to study the first two years at VIT University and the next two in the following universities abroad & get their degree

United States of America: • Purdue University • State University of New York (SUNY) • Rochester Institute of Technology (RIT) • University of Massachusetts (UMass) **United Kingdom:** • Queen Mary University of London **Australia:** • Australian National University • Deakin University • Queensland University of Technology • Royal Melbourne Institute of Technology (RMIT) • Curtin University

Opportunities Unlimited

VIT offers students, opportunity to get placed in companies with regular, dream (5L CTC & above), Superdream (10L CTC & above) offers. In 2016-17, 427 companies came for placement to VIT, which itself is a record, of which 45+ were Super Dream Companies. Recruiting companies include:

•Microsoft	•Amazon	•Maruti	•ABB	•Deloitte
•Deshaw	•Paypal	•Hyundai	•L & T	•Morgan Stanley
•Oracle	•Visa	•Mahindra	•ITC	•KPMG
•SAP	•Cisco	•Honda	•Shapoorji	•JP Morgan
•Vmware	•Barclays	•TVS Motors	•Johnson Controls	•PWC

nirf NATIONAL INSTITUTIONAL RANKING FRAMEWORK

Ranked as 13th best engineering institution in India by NIRF, MHRD, GOI, for 2 consecutive years in 2016 & 2017

FFCS™ FULLY FLEXIBLE CREDIT SYSTEM

- Option to Change Branch
- Opportunity to graduate with a double major
- Choice of major and minor programmes
- Degree with honours

GET THE VIT EDGE

- National Record in Slot 1 companies recruitment for 9 years in a row
- Record 7943 job offers from Slot 1 companies (Accenture, Cognizant, Infosys, TCS, Wipro) at VIT University for the year 2016
- Excellent international internship and placement opportunities

Advantage VIT

- Curriculum for Applied Learning (CAL)™
- Project Based Learning (PBL)
- Opportunity for Semester Abroad Programme
- One module of every subject handled by Industry experts
- 35,000 students from 60 countries
- 110 student clubs and chapters
- More than 170 Adjunct Professors from reputed universities abroad

International Accreditations

- ABET, US, http://www.abet.org has accredited 14 B.Tech Programs at VIT Vellore & Chennai Campus
- 3 cycles of NAAC accreditation completed
- Awarded 'A' grade for last two consecutive cycles
- First University in India to get QS 4 Stars Rating

Offline application forms can be obtained: • From the designated branches of Post Offices on cash payment of ₹1200/- (list available on our website) •By handing over a DD for ₹1200/- drawn in favour of VIT University, payable at Vellore. Applications also available in VIT Chennai, VIT Bhopal & VIT AP.

For enquiries contact us on our helpline number
+91-416-330 5555
For more details visit **www.vit.ac.in**
VITUniversity VIT_Univ

VIT® VELLORE CHENNAI
www.vit.ac.in

VIT® BHOPAL
www.vitbhopal.ac.in

VIT® AP
www.vitap.ac.in

VIT - A Place to learn; A Chance to grow

Registered R.N.I. No. 71810/1999 *Published on 1st of every month* Postal Regd. No. DL-SW-1/4046/15-17
Lic. No. U(SW)-32/2015-2017 to post without prepayment of postage N.D.P.S.O.N.D-1 on 1-2nd same month

A SCHOLARSHIP OPPORTUNITY

THAT YOU CAN'T AFFORD TO MISS

Aakash TALENT QUEST
For Crash Courses / Test Series Courses 2018

A UNIQUE OPPORTUNITY TO HELP YOU FULFIL YOUR DREAMS

For Class XII Studying / Passed Students

GET UP TO 100% SCHOLARSHIP*

Every day is a new opportunity and every opportunity a new chance. Aakash brings ATQ, a fantastic opportunity for those students who believe they can & they will. It is a chance to prove their potential and build a better tomorrow. With ATQ, students can win scholarships up to 100% in Short Term Courses for 2018 such as Crash Courses / Test Series Courses & cash awards. It provides a platform to students nationwide who have been waiting for the right opportunity to embark on a successful journey ahead.

*Terms & Conditions apply.

Date of Examination: **24th December, 2017 (Sunday)**

Exam Fee: ₹ **300/-**

Test Centres: **All Aakash Centres**

Paytm
Pay Fees on Paytm!
Scan code in Paytm App

Last Date of receiving duly filled enrollment form by post / by hand / through online - **17th December, 2017** (Sunday) and with late fee - **19th December, 2017** (Tuesday)

Download Enrollment Form from our website: **www.aakash.ac.in** or **www.myatq.in** The result shall be displayed on our website.

Aakash
Medical | IIT-JEE | Foundations
(Divisions of Aakash Educational Services Pvt. Ltd.)

www.myatq.in | www.aakash.ac.in TOLL FREE: **1800-180-2727** GIVE A MISSED CALL: **9599280605** SMS Aakash to **53030**

Registered Office : Aakash Tower, 8, Pusa Road, New Delhi-110005. **Ph.:** (011) 47623456 | **E-mail:** atq@aesl.in | iitjee@aesl.in | medical@aesl.in

instagram.com/aakasheducation facebook.com/aakasheducation youtube.com/AakashEducation twitter.com/aakash_twitted aakashinstitute.blogspot.com