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UG TRB
BOTANY
2023-2024

UNIT-1

VIRUS, BACTERIA, PHYCOLOGY, MYCOLOGY

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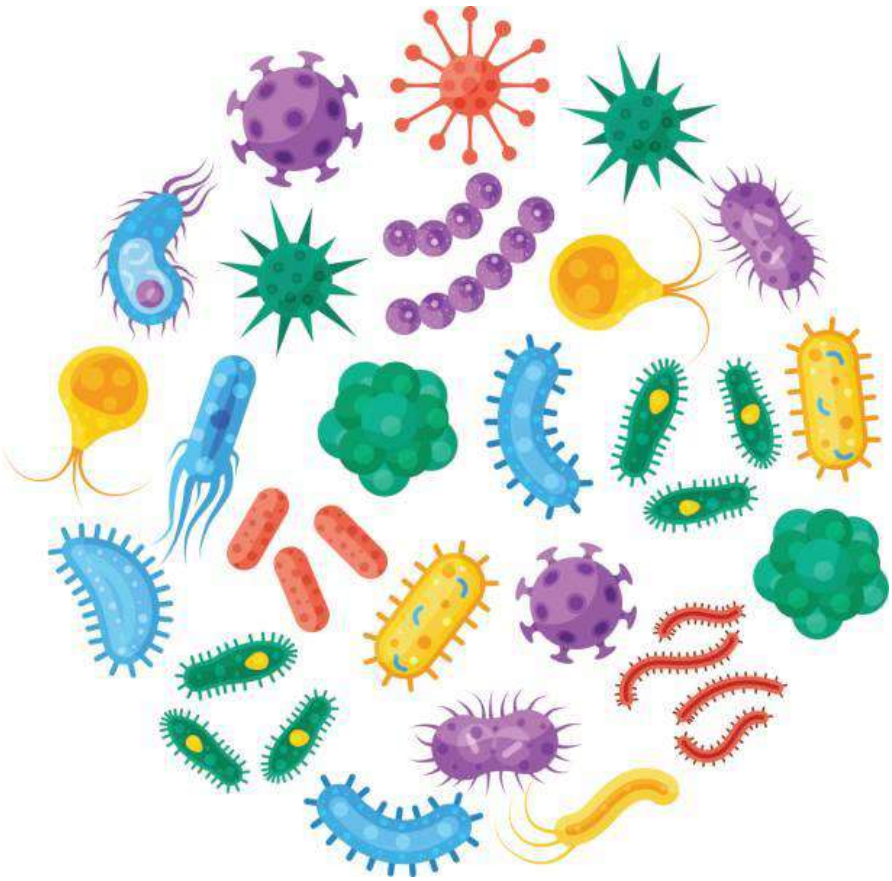
TEACHER'S CARE ACADEMY

KANCHIPURAM

BOTANY

UNIT - I

VIRUS, BACTERIA, PHYCOLOGY & MYCOLOGY



COMPETITIVE EXAM

For

UG TRB – 2023-24

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UG TRB BOTANY – 2023-24

UNIT 1 – VIRUS, BACTERIA, PHYCOLOGY & MYCOLOGY

1. VIRUS

1.1 INTRODUCTION:

- Viruses occupy the twilight zone that separates the 'living' from the 'non-living'. They do not have a cellular organization and contain only one type of nucleic acid, either DNA or RNA but never both. The medical importance of viruses lies in their ability to cause a very large number of human diseases. Viral diseases range from minor ailments like common cold to terrifying diseases like rabies and AIDS.

1.1.1 Concept of Viruses in relation to other Organisms:

- Viruses occupy the twilight zone that separates the 'living' from the 'non-living'. They do not have a cellular organization and contain only one type of nucleic acid, either DNA or RNA but never both. Viruses are obligate intracellular parasites. They lack the enzymes necessary for protein and nucleic acid synthesis. They are dependent for replication on the synthetic machinery of host cells. They multiply by a complex process and not by binary fission. They are unaffected by antibacterial antibiotics. Viruses cause a wide range of human diseases. They cause infections like common cold, chicken pox, measles, viral encephalitis, rabies and AIDS.

1.1.2 Virus History:

- The history of virology goes back to the late 19th century, when German anatomist Dr Jacob Henle (discoverer of Henle's loop) hypothesized the existence of infectious agent that were too small to be observed under light microscope. This idea fails to be accepted by the present scientific community in the absence of any direct evidence.

- At the same time three landmark discoveries came together that formed the founding stone of what we call today as medical science. The first discovery came from Louis Pasture (1822-1895) who gave the spontaneous generation theory from his famous swan-neck flask experiment. The second discovery came from Robert Koch (1843-1910), a student of Jacob Henle, who showed for first time that the anthrax and tuberculosis is caused by a bacillus, and finally Joseph Lister (1827-1912) gave the concept of sterility during the surgery and isolation of new organism.
- The history of viruses and the field of virology are broadly divided into three phases, namely discovery, early and modern. The discovery phase (1886-1913) In 1879, Adolf Mayer, a German scientist first observed the dark and light spot on infected leaves of tobacco plant and named it tobacco mosaic disease.
- Although he failed to describe the disease, he showed the infectious nature of the disease after inoculating the juice extract of diseased plant to a healthy one. The next step was taken by a Russian scientist Dimitri Ivanovsky in 1890, who demonstrated that sap of the leaves infected with tobacco mosaic disease retains its infectious property even after its filtration through a Chamberland filter.
- The third scientist who plays an important role in the development of the concept of viruses was MartinusBeijerinck (1851-1931), he extended the study done by Adolf Mayer and Dimitri Ivanofsky and showed that filterable agent form the infectious sap could be diluted and further regains its strength after replicating in the living host; he called it as “contagium vivumfluidum”. Loeffler and Frosch discovered the first animal virus, the foot and mouth disease virus in 1898 and subsequently Walter Reed and his team discovered the yellow fever virus, the first human virus from Cuba in1901.
- Poliovirus was discovered by Landsteiner and Popper in 1909 and two years later Rous discovered the solid tumor virus which he called Rous sarcoma virus. The early phase (1915-1955) In 1915, Frederick W. Twort discovered the phenomenon of transformation while working with the variants of vaccinia viruses, simultaneously Felix d’Herelle discovered bacteriophage and developed the assay to titrate the viruses by plaques. WendellStanley (1935) first crystallized the TMV and the first electron micrograph of the tobacco mosaic virus (TMV) was taken in 1939.
- In 1933 Shope described the first papillomavirus in rabbits. The vaccine against yellow fever was made in 1938 by Thieler and after 45 years of its discovery, polio virus vaccine was made by Salk in 1954. The modern phase (1960-present) During this phase scientists began to use viruses to understand the basic question of biology. The superhelical nature of polyoma virus DNA was first described by Weil and Vinograd while Dulbecco and Vogt showed its closed circular nature in 1963.

- In the same year Blumberg discovered the hepatitis B virus. Temin and Baltimore discovered the retroviral reverse transcriptase in 1970 while the first human immunodeficiency virus (HIV) was reported in 1983 by Gallo and Montagnier. The phenomenon of RNA splicing was discovered in Adenoviruses by Roberts, Sharp, Chow and Broker. In the year 2005 the complete genome sequence of 1918 influenza virus was done and in the same year hepatitis C virus was successfully propagated into the tissue culture. Many discoveries are done using viruses as a model.
- The transcription factor that binds to the promoter during the transcription was first discovered in SV40. The phenomenon of polyadenylation during the mRNA synthesis was first described in poxviruses while its presence was first reported in SV40. Many of our current understanding regarding the translational regulation has been studied in poliovirus. The oncogenes were first reported in Rous sarcoma virus. The p53, a tumor suppressor gene was first reported in SV40.

1.1.3 Discovery and Detection:

- Viruses were first discovered after the development of a porcelain filter, called the Chamberland-Pasteur filter, which could remove all bacteria visible in the microscope from any liquid sample.
- In 1886, Adolph Meyer demonstrated that a disease of tobacco plants, tobacco mosaic disease, could be transferred from a diseased plant to a healthy one via liquid plant extracts.
- In 1892, Dmitri Ivanowski showed that this disease could be transmitted in this way even after the Chamberland-Pasteur filter had removed all viable bacteria from the extract.
- Virions, single virus particles, are very small, about 20–250 nanometers in diameter. These individual virus particles are the infectious form of a virus outside the host cell.
- Unlike bacteria (which are about 100 times larger), we cannot see viruses with a light microscope, with the exception of some large virions of the poxvirus family.
- The surface structure of virions can be observed by both scanning and transmission electron microscopy, whereas the internal structures of the virus can only be observed in images from a transmission electron microscope.

Important discoveries

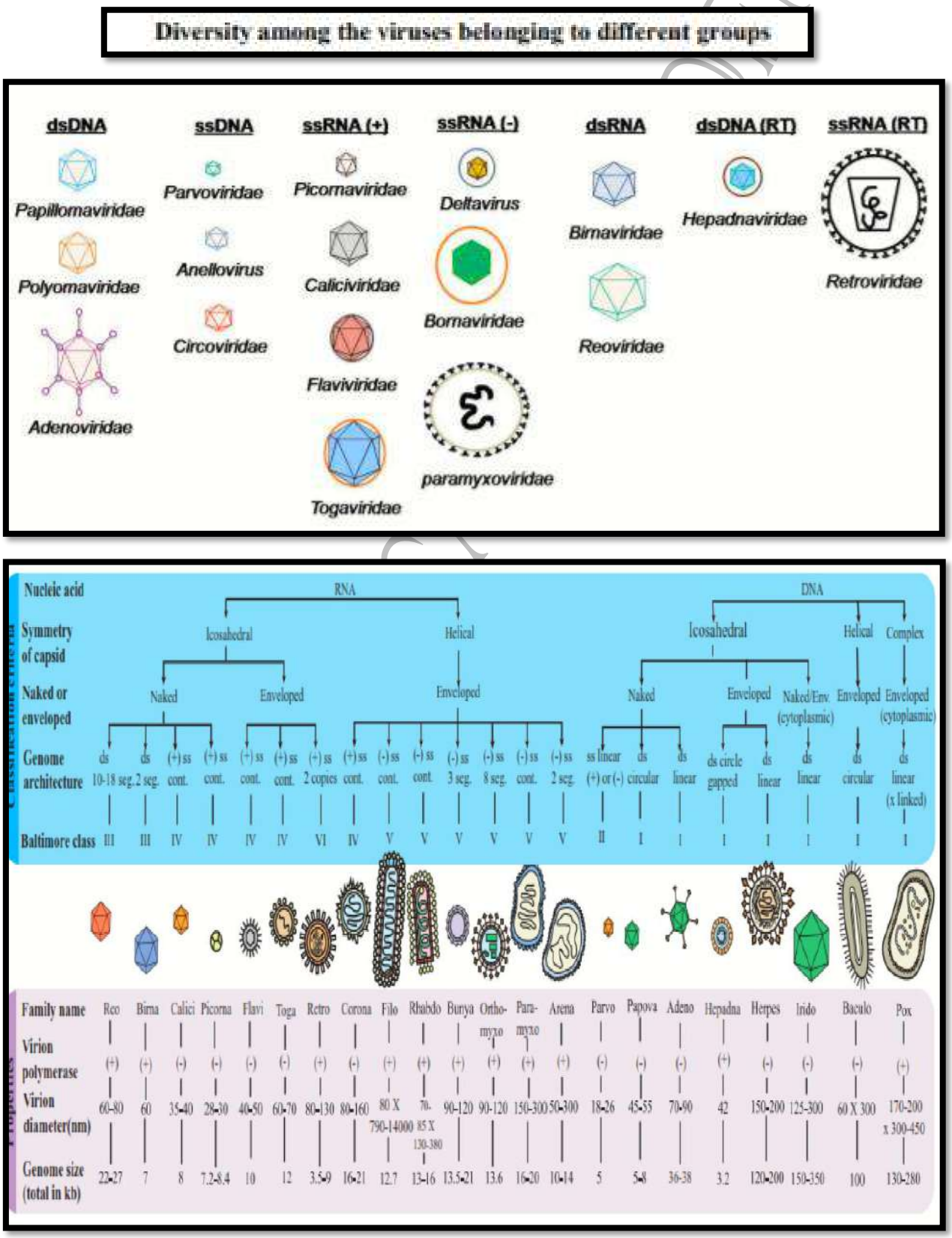
Date	Discovery
1796	Cowpox virus used to vaccinate against smallpox by Jenner.
1892	Description of filterable infectious agent (TMV) by Ivanovsky.
1898	Concept of the virus as a contagious living form by Beijerinck.
1901	First description of a yellow fever virus by Dr Reed and his team.
1909	Identification of poliovirus by Landsteiner and Popper.
1911	Discovery of Rous sarcoma virus.
1931	Virus propagation in embryonated chicken eggs by Woodruff and Goodpasture.
1933	Identification of rabbit papillomavirus.
1936	Induction of carcinomas in other species by rabbit papillomavirus by Rous and Beard.
1948	Poliovirus replication in cell culture by Enders, Weller, and Robbins.
1952	Transduction by Zinder and Lederberg.
1954	Polio vaccine development by Salk.
1958	Bacteriophage lambda regulation paradigm by Pardee, Jacob, and Monod.
1963	Discovery of hepatitis B virus by Blumberg.
1970	Discovery of reverse transcriptase by Temin and Baltimore.
1976	Retroviral oncogenes discovered by Bishop and Varmus.
1977	RNA splicing discovered in adenovirus.
1983	Description of human immunodeficiency virus (HIV) as causative agent of acquired immunodeficiency syndrome (AIDS) by Montagnier, Gallo)
1997	HAART treatment for AIDS.
2003	Severe acute respiratory syndrome (SARS) is caused by a novel coronavirus.
2005	Hepatitis C virus propagation in tissue culture by Chisari, Rice, and Wakita.
2005	1918 influenza virus genome sequencing.

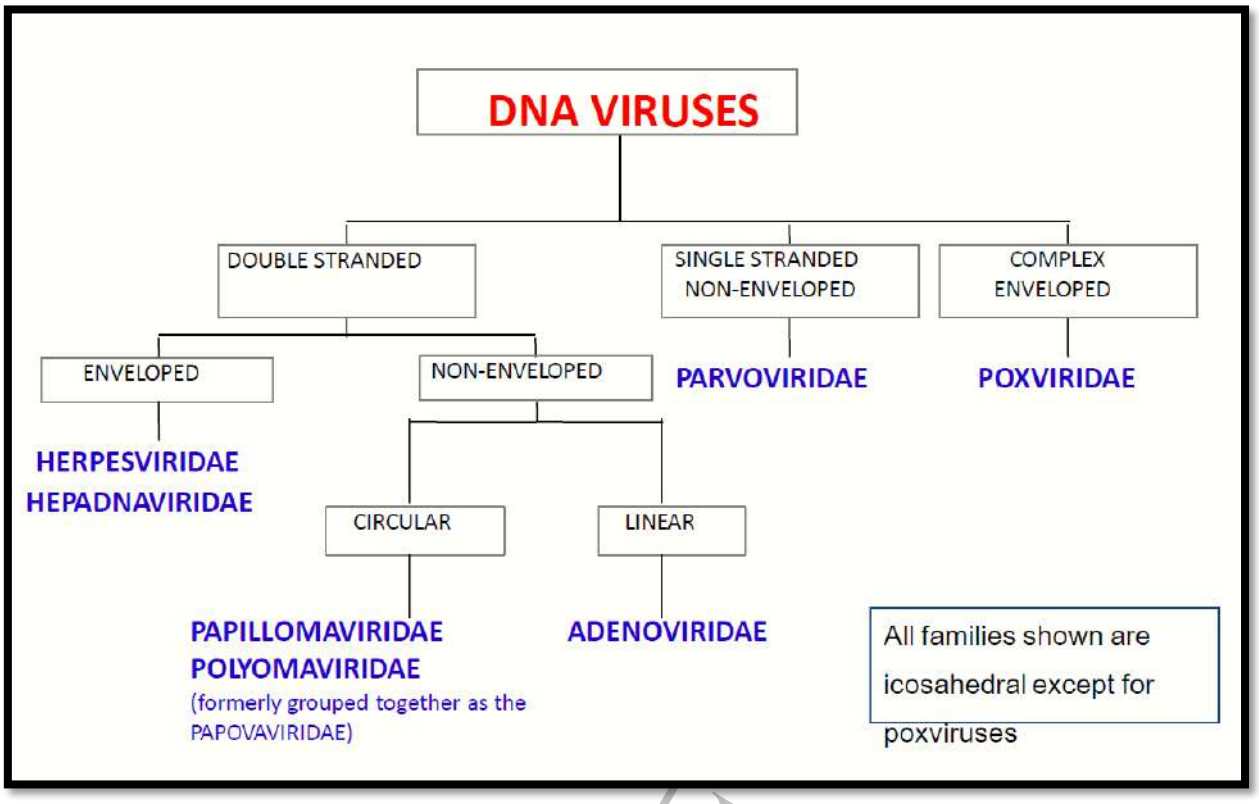
1.1.4 Classification and naming of viruses

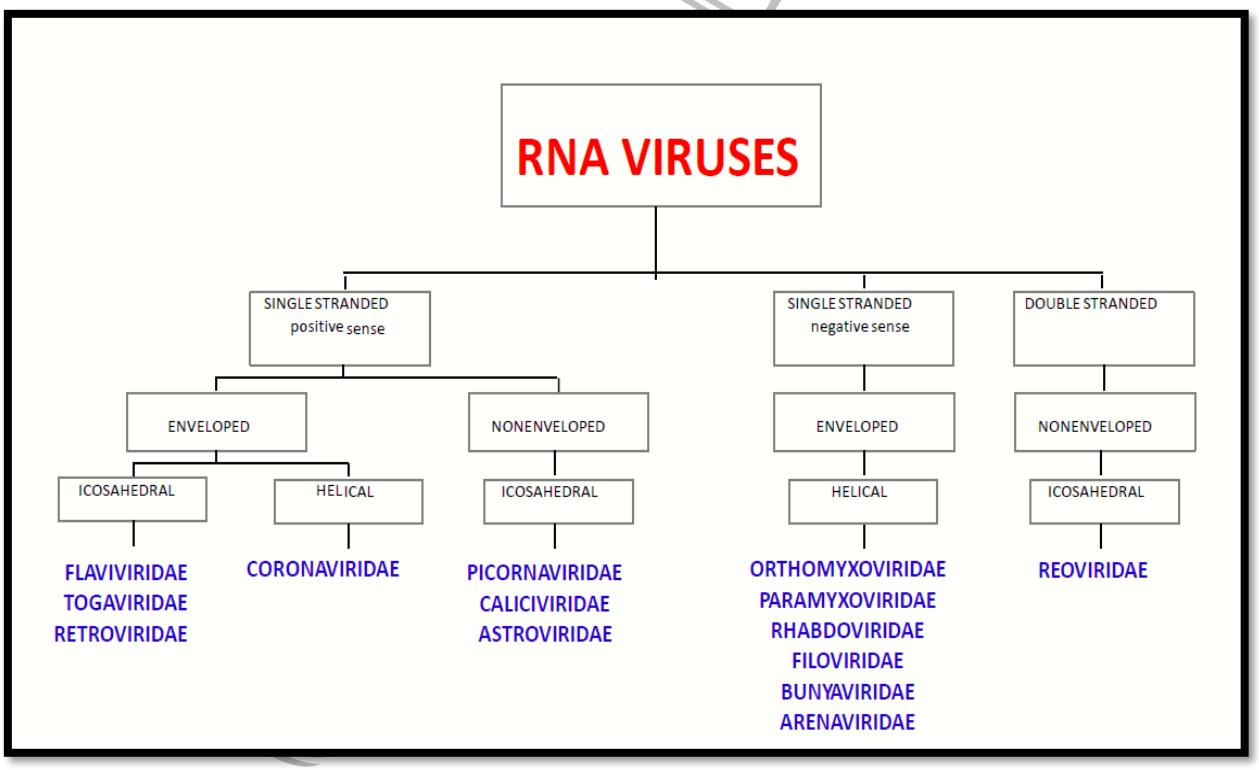
- Till about 1950 little was known of the basic properties of viruses. They werenamed haphazardly, based on the diseases they caused or on the place of theirisolation.
- They were grouped according to affinity to different systems or organsof the body (tropism). So, human viruses were classified as dermotropic, thatis those producing skin lesions (smallpox, chickenpox, measles), neurotropic, that is those affecting the nervous system (poliomyelitis, rabies), pneumotropic, that is those affecting the respiratory tract (influenza, common cold) andviscerotropic, that is those affecting visceral organs (hepatitis). Bawden (1941) made the pioneering suggestion that viral nomenclature and classificationshould be based on the properties of viruses and not upon host responses.
- Fromthe early 1950s, viruses began to be classified into groups based on theirphysiochemical and structural features. Nomenclature and classification are nowthe official responsibility of the International Committee on Taxonomy ofViruses (ICTV).

- Viruses are classified into two main divisions based on the type of nucleic acidthey possess: riboviruses contain RNA and deoxyriboviruses contain DNA.Further classification is based on other properties like strandedness of nucleicacid, symmetry of nucleic acid, presence of envelope, size and shape of virionand number of capsomeres.
- DNA viruses: A few medically important families of DNA viruses are
  - Herpesviridae,
  - Adenoviridae,
  - Hepadnaviridae,
  - Parvoviridae and
  - Papillomaviridae.
- The Herpesviridae family consists of enveloped double-stranded DNA viruseshaving an icosahedral capsid.
- Examples of this family are herpes simplex virusand varicella zoster virus. Herpes simplex virus causes skin lesions like herpeslabialis. It can also cause viral encephalitis. Parvoviridae consists of nonenvelopedsingle-stranded DNA viruses, for example Parvovirus B19.
- TheHepadnaviridae family includes Hepatitis B virus which is a partially doublestrandedDNA virus. Papillomaviridae family includes human papilloma viruswhich is responsible for causing skin warts.
- RNA viruses: Some medically important families of RNA viruses are –Picornaviridae, Orthomyxoviridae and Paramyxoviridae, Flaviviridae, Rhabdoviridae and Retroviridae.
- Members of the family Picornaviridaearesmall (20-30 nm), non-enveloped, icosahedral viruses with single-stranded RNAgenome. Examples include poliovirus and coxsackievirus. The viruses includedin Orthomyxoviridae are enveloped viruses carrying haemagglutinin and
- neuraminidase peplomers on the envelope. The genome consists of singlestrandedRNA in several (eight) pieces. Thus, they have a segmented genome.
- An example of this family is influenza virus. Flaviviridae consists of envelopedsingle-stranded RNA viruses. Examples include yellow fever virus, Japaneseencephalitis virus and dengue virus. The members of Retroviridae family areenveloped RNA viruses which have a special enzyme called ‘reverse transcriptase’.

- This enzyme is an RNA dependent DNA polymerase. It is required in thesynthesis of DNA from RNA. An example of the Retroviridae family is HumanImmunodeficiency Virus (HIV) which causes AIDS (acquired immunodeficiencysyndrome). Based on the mechanism of replication, Baltimore (1970) categorisedvirusesinto seven categories. This is called the Baltimore classification.







1. Who is the father of Virology?

A) MartinusBeijerinck
B) Dmitri Ivanovsky
C) John Ellerman
D) Frederick Twort

2. What is Virology?

A) Virology is the study of bacteria
B) Virology is the study of viruses
C) Virology is the study of fungi
D) Virology is the study of algae

3. Who discovered viruses?

A) John Ellerman B) Frederick Twort
C) Dmitri Ivanovsky D) MartinusBeijerinck

4.Which of the following has responsibility for the assignment of new viruses to specific groupings?

A) ICC B) ICTV C) ITC D) RCM

5.Which of the following viruses are icosahedrons?

A) Filamentous virus B) Complex virus
C) Simple virus D) Isometric virus\\

6.The Baltimore classification was based on the importance of _____

A) DNA B) mRNA C) rRNA D) tRNA

7.Which of the following class contains all viruses that have dsDNA genomes?

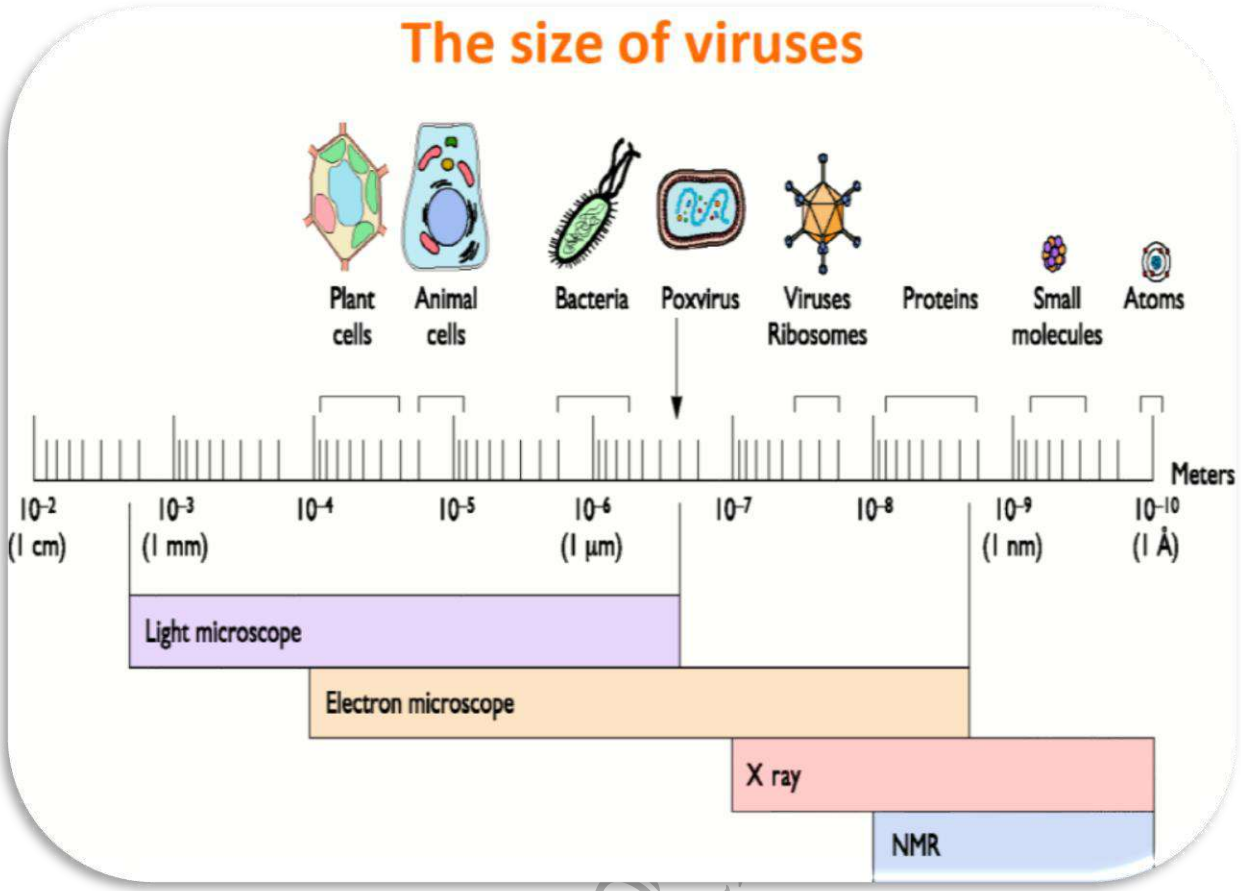
A) Class I B) Class II C) Class III D) Class IV

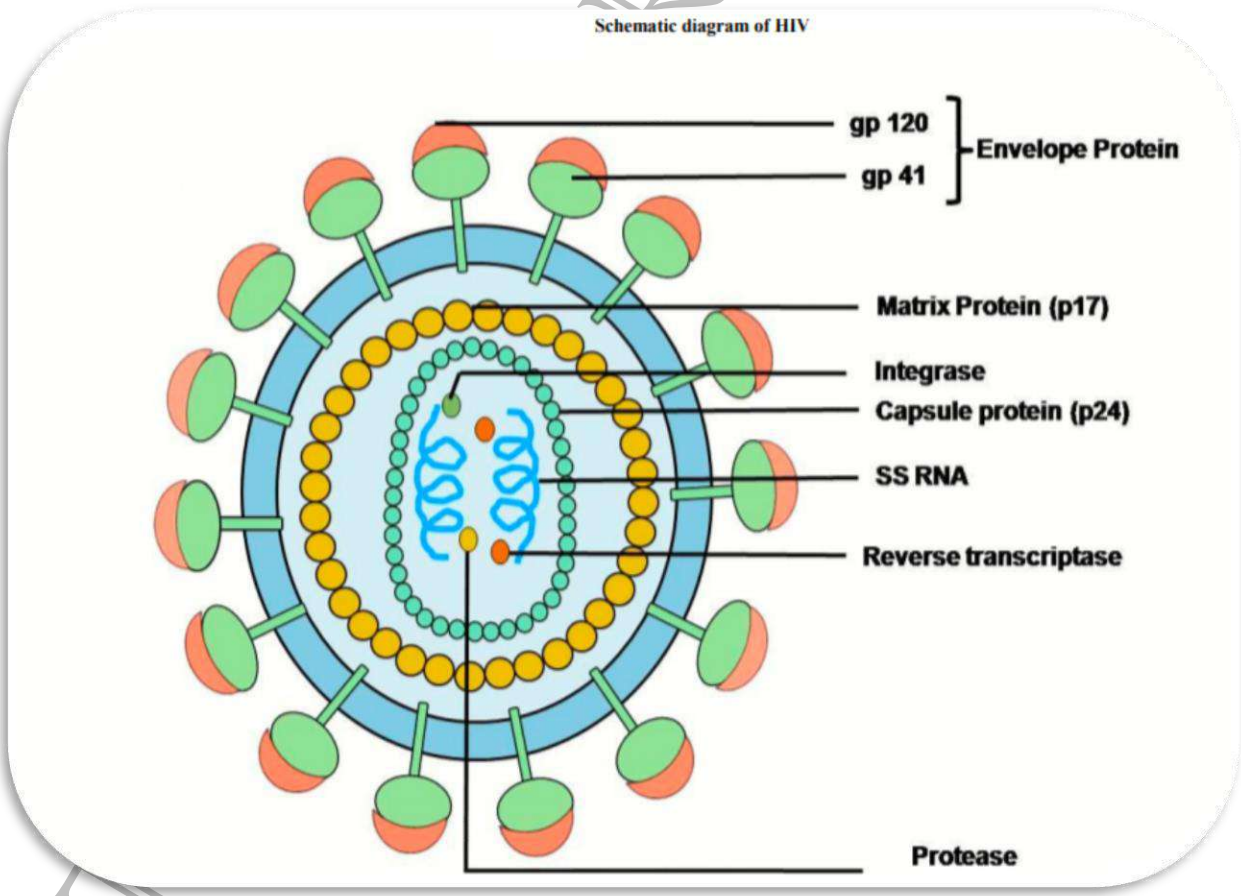
1.2 STRUCTURE OF VIRUSES:

1.2.1 Morphology of Viruses:

1. Size:

- The extracellular infectious virus particle is called virion. Viruses are much smaller than bacteria. They are too small to be seen under the light microscope. Some large viruses like the poxviruses can be seen under the light microscope when suitably stained.
- The viruses range in size from 20 nm to 300 nm. Poxviruses are one of the largest viruses and parvoviruses are one of the smallest viruses.
- The earliest method of estimating the size of virus particles was by passing them through collodion membrane filters of graded porosity.
- The average pore diameter of the finest filter that permitted passage of the virion gave an estimate of its size.
- With the development of the ultracentrifuge, a second method became available. From the rate of sedimentation of the virus in the ultracentrifuge, the particle size could be calculated using Stoke's law.
- The third and the most direct method of measuring virus size is electron microscopy. By this method, both the shape and size of virions can be studied.





- **Capsid**: the outer protein shell of a virus
- **Envelope**: an enclosing structure or cover, such as a membrane

- **Filamentous**: Having the form of threads or filaments
- **Isometric**: of, or being a geometric system of three equal axes lying at right angles to each other (especially in crystallography)
- **Capsomere**: Any of the individual protein subunits of a viral capsid
- **Icosahedral**: of, relating to, or having the shape of an icosahedrons

1.2.2 Structure, shape and symmetry:

- The virion consists essentially of a nucleic acid surrounded by a protein coat, the **capsid**. The capsid with the enclosed nucleic acid is called the **nucleocapsid**.
- The capsid protects the nucleic acid from harmful agents in the environment. It is composed of a large number of capsomers which form its morphological units.
- The chemical units of the capsid are polypeptide molecules which are arranged symmetrically. They form a shell around the nucleic acid.

1.2.3 Defective Viruses:

Defective viruses are those virus particles whose genome lacks a specific gene or genes due to either mutation or deletion.

- As a result, defective viruses are not capable of undergoing a productive life cycle in cells.
- However, if the cell infected with the defective virus is co-infected with a "helper virus", the gene product lacking in the defective one is complemented by the helper and defective virus can replicate.
- Interestingly, for some viruses, during infection a greater quantity of defective virionsis produced than infectious virions(as much as 100:1).
- The production of defective particles is a characteristic of some virus species and is believed to moderate the severity of the infection/disease in *vivo*.

1.2.4 Pseudovirions:

- Pseudovirions may be produced during viral replication when the host genome is fragmented.
- As a result of this process, host DNA fragments are incorporated in to the capsid instead of viral DNA.
- Thus,pseudo virions possess the viral capsid to which antibodies may bind and facilitate attachment and penetration into a hostcell, but they cannot replicate once

they have gained access to a host cell, as they have none of the essential viral genes for the process.

1.2.5 Prions:

- Prions are proteinaceousinfectious particles associated with transmissible spongiform encephalopathies (TSE) of humans and animals.
- TSEs include the Creutzfeldt-Jacob disease of humans, scrapieof sheep and bovine spongiform encephalopathy.
- At postmortem, the brain has large vacuoles in the cortex and cerebellum regions an thus priondiseases are called "spongiform encephalopathies". Closer examination of brain tissue reveals the accumulation of prion-protein associated fibrils and amyloidplaques.

1.2.6 Viroids:

- Viroids are naked, low-molecular weight nucleicacids that are extremely resistant to heat, ultraviolet,and ionizing radiation. These particles are composed exclusively of a single piece of circular, single stranded RNA that has some double-stranded regions.Viroids mainly cause plant diseases, such as potato spindle tuber disease.
- These diseases are characterized by loss of motor control, dementia, paralysis, wasting and eventually death.

1.2.7 Virusoids:

- Virusoids (also called satellite RNAs)are similar to viroids in that they are naked,low molecular weight nucleic acids that are extremely resistant to heat and ultraviolet and ionizing radiation.However,they depend on a helper virus for replication.Virusoids replicate in cytoplasm via RNA dependent RNA polymerase.

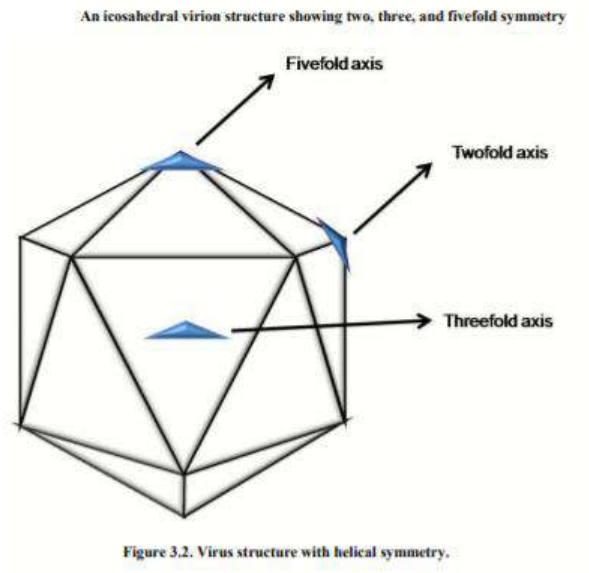
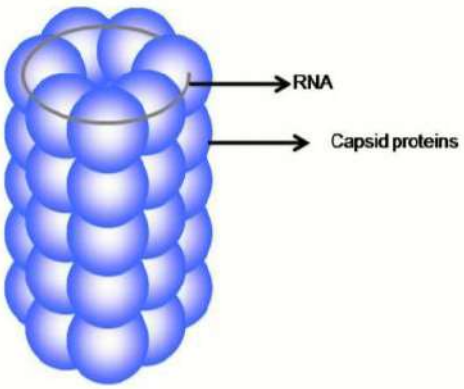


Figure 3.2. Virus structure with helical symmetry.



72) Carrageenan is used as a _____

A) emulsifier B) solidifying agent

C) binder D) emulsifier and binder

73) The famous Japanese dish sushi is made with the help of the red algae named ___

A) Nemalion B) Porphyra C) Chondrus D) Eucheuma

74) Asexual reproduction in Spirogyra

A) takes place by zoospore formation B) has not been recorded

C) takes place by hypnospore formation D) takes place by aplanospore formation

75) Agar-Agar is derived from

A) fungi B) algae C) bryophytes D) gymnosperms

76) The number of flagella produced by motile cells in

A) members of the Rhodophyta is greater than members of the Phaeophyta

B) members of the Phaeophyta is greater than members of the Rhodophyta

C) members of the Rhodophyta is exactly or approximately equal to members of the Phaeophyta

D) none of the above

77) Starch is an energy storage material characteristic of

A) chlorophyta B) chrysophyta C) phaeophyta D) rhodophyta

78) Heterocysts are found in

A) Nostoc B) Cystopus C) Ulothrix D) Aspergillus

79) What is the storage product of most algae?

A) Cellulose B) Glycogen C) Starch and oil D) Fat

80) In Ulothrix, reduction division takes place at the time of

A) germination of zygote B) formation of spores

C) formation of gametes D) formation of zoospores

81) Agar, which is the solidifying agent in many bacterial culture media, is part of the cell wall of

A) chlorophyta B) chrysophyta C) pyrrophyta D) rhodophyta

82) Number of flagella produced by motile cells in

A) members of the phaeophytais greater than members of the Oomycota

B) members of the Oomycotais greater than members of the Phaeophyta

C) members of the Phaeophyta is approximately equal to members of the Oomycota

D) none of the above

83) Characteristics used to place algae into divisions include all of the following except

A) form of storage material

B) flagella number and location

C) accessor pigments used in photosynthesis

D) all of the above

84) Which of the following is correct?

A) All members of photolithotrophic autotrophs are also members of algae, but not all members of algae are members of photolithotrophic autotrophs

B) All members of algae are also members of photolithotrophic autotrophs, but not all members of photolithotrophic autotrophs are members of algae

C) All members of photolithotrophic autotrophs are members of algae, and all members of algae are members of photolithotrophic autotrophs

D) No member of photolithotrophic autotrophs is a member of algae

85) Zooxanthellae are algal symbiont that live within coral reef animals. These algae belong to

A) chlorophyta B) chrysophyta C) pyrrophyta D) rhodophyta

86) Algae is a nonvalid taxinomic term that refers to

A) eukaryotic organisms that have chlorophyll a and produce O2

B) well developed cellular structure including a conducting system

C) Both (A) and (B) D) none of the above

87) Filaments of Ulothrix are

A) branched B) unbranched C) brick-shaped D) girdle-shaped

88) Which is a rich source of protein?

A) Nostoc B) Anabaena C) Spirulitia D) Oscillatoria

89) Red colour of the red algae is due to

A) y-phycocyanin B) Xanthophyll C) Carotene D) y-phycoerythrin

90) Algae are classified into 6 groups, technically known as

A) categories B) divisions C) genera D) domains

91) Cyanobacteria name has been given to

A) Mycoplasma B) Myxophyceae C) Myxomycetes D) Schizomycetes

92) Spirogyra differs from moss-protonema in having

A) pyrenoids B) branched filaments

C) discoid chloroplasts D) rhizoidal branches

93) Simplest type of reproduction in plants is found in

A) Ulothrix B) Nostoc C) Chlamydomonas D) Spirogyra

94) Parasitic alga is

A) Cephaleuros B) Ulothrix C) Spirogyra D) Chlamydomonas

95) The algae Chlamydomonas demonstrates a complex life cycle that switches between haploid and diploid forms. This life cycle is called

A) the sexual-asexual exchange B) the transposition cycle

C) an alternation of generations D) algal transformation

96) The _____ is the vegetative body of algae.

A) mycelium

B) pseudoplasmodium

C) is scattered the least by smoke or fog

D) thallus

97) Which algal division never produces motile, flagellated cells among any of its members?

A) Chlorophyta B) Chrysophyta C) Phaeophyta D) Rhodophyta

98) Chlamydomonas and Volvox are similar because

A) they both are motile

B) they are members of the Chlorophyta

C) Both (A) and (B)

D) none of these

99) All algae possess

A) nuclei B) chloroplasts

C) Both (A) and (B) D) none of these

100) Bioluminescence is a phenomenon associated with

A) chrysophyta B) phaeophyta C) pyrrophyta D) chlorophyta

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UNIT-2

LICHENOLOGY, BRYOLOGY, PTERIDOLOGY

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UNIT - II

LICHENOLOGY

COMPETITIVE EXAM

For

UG TRB – 2023-24

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UNIT - II

1. LICHENOLOGY:

❖ The term 'Lichen' was used for the first time by Theophrastus (the father of Botany, 371-284 B.C.) to denote a superficial growth on the tree barks. Lichen has been defined as 'a stable selfsupporting association of a phycobiont and mycobiont' in 1989 edition of the 'Dictionary of the Fungi'. Lichen is not a single organism but a small group of curious plants. It is a symbiotic association between a fungus and algae or cyanobacteria. Cyanobacteria are sometimes referred to as 'blue-green algae', though they are quite distinct from the algae. The fungal partner may be referred to as the Mycobiont (Mykes= fungus, bios=life). The non-fungal partner contains chlorophyll and is called the phycobiont (Phykos= alga, bios= life). The lichen symbiosis is thought to be a mutualism, since both the fungi and the photosynthetic partners benefit.

1.1. GENERAL CHARACTERISTICS -STRUCTURE:

- In lichen, the mycobiont produces a thallus, which houses the photobiont. There are three major morphological types of thalli: foliose, fruticose and crustose.

1.1.1 Colour:

- Lichens show many colours such as green, yellow, orange, white, grey etc. The colouration is due to the pigmentation of algal component in the lichens. In some lichens, a special pigment called usnic acid is present which give lichens a variety of colours. In the absence of special pigments, lichens are generally bright green to olive grey when it is wet and grey or grayish-green to brown when dry. In high moisture surroundings, lichens appear greener because the water absorbed fungal mater become more transparent and as a result the green colour algal pigments

get exposed. Colours vary due to genetics, age and on the angle of exposure to light

1.1.2 Internal Structure of Lichen:

- Internally the thallus is composed of fungal and algal components. Such type of thallus is called consortium. On the basis of internal structure of thallus, the lichens are divided into two groups, namely, heteromerous and homoiomerous lichens

(a) Structure of Heteromerous Lichen:

- Thalli or most foliose and fruticose lichens are differentiated into several layers of tissues, and therefore known a heteromerous. A transverse section of the heteromerous lichen can be divided into following distinct zone-

i) Upper cortex:

- It forms the upper surface of the thallus. It is thick and protective in nature and consists of fungal hyphae. The compactly interwoven hyphae produce a tissue like layer (Plectenchyma and Pseudoparenchyma) called the upper cortex. The intercellular spaces are absent, if present, they are filled with gelatinous substances. In some species of foliose lichens this layer is interruptions or areas are called breathing pores and serve for aerations. In addition to these certain other structures are also present for gaseous exchange. These are known as cyphellae.

ii) Algal zone or gonidial layer:

- It is a zone below the upper cortex. This layer consists of loosely interwoven hyphae intermingled with algal cells. This algal zone is the photosynthetic region of the lichen. This layer is also known as gonidial layer because of the earlier concept that these cells are having reproductive function.

iii) Medulla:

- It is the central core of the thallus and is composed of loosely arranged fungal hyphae with intercellular spaces. The hyphae run in all directions. Usually, the wall of the fungal hyphae is thick and strong.

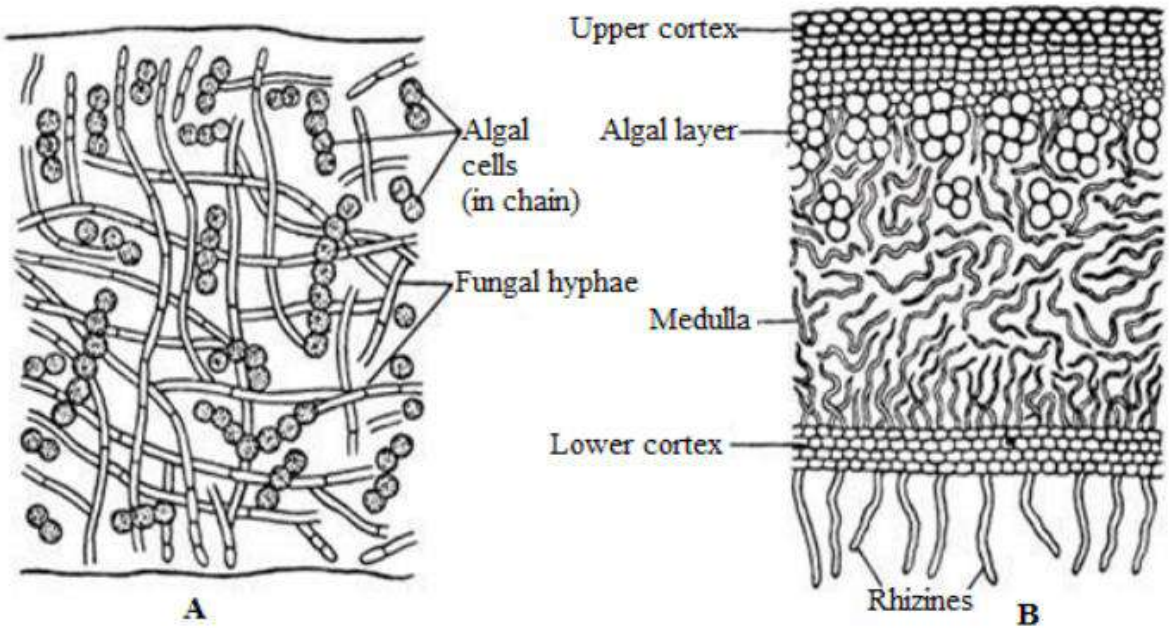
iv) Lower cortex:

- The lower cortex is below medulla. It is formed by fungal component and made up of compact hyphae. They may be parallel to perpendicular to the surface to the surface of the thallus. Thje bundle of hyphae (rhizinae) arise

from the lower surface and penetrate the substratum functioning as anchoraging and absorbing organs. In some lichens, the lower cortex is absent. e.g., Lobaria, Pulmonaira and is replaced with a sheet of hyphae forming hypothallus.

(b) Homoiomerous Lichens:

- In some lichens for example, Collema and Leptogium, the thallus shows a simple structure. It consists of a loosely interwoven mass of fungal hyphae with algal cells equally distributed through a gelatinous matrix. Thalli of such lichens are not differentiated into layers of tissues and therefore, known as homoiomerous.



Internal structure of lichen thallus, A-Homoiomerous thallus, B-Heteromerous thallus

1.The fungal portion in Lichens is known as _____

A) Mycobiant B) Phycobiant C) Capsobiant D) Deuterobiant

2.This is a crutose lichen

A) Peltigera B) Usnea C) Rhizocarpon D) None of the above

3.Most of the scientists deem the algal-fungal relationship in lichens as helotism. Helotism is a

A) master-master relationship B) master-slave relationship
C) a kind of mutualism D) a kind of symbiotic association

4.This lichen is pioneer in xerosere

A) fruticose lichen B) foliose lichen C) crustose lichen D) leprose lichen

5.This about lichens is incorrect

A) Lichens are indicators of pollution

B) They grow rapidly about 2cm every day

C) Some species are eaten by reindeers

D) They have symbiotic relationship between alga and fungus

6.The lichens are

A) Slow gowing, long lived B) Fast growing, long lived

C) Fast growing, short lived D) Slow growing, short lived

7.A common phycobiot in lichen is

A) Trebouxia B) Cetraria C) Microcystis D) Oegogonium

8.Which of the following is a crustose lichen

A) Usnea B) Peltigera C) Soredia D) Rhizocarpon

9.Lichen are formed by the association of

A) Ascomycetes only, with algae only

B) Ascomycetes or basidiomycetes with algae or cyanobacteria

C) Basidiomycetes only with algae or cyanobacteria

D) Ascomycetes only, with algae only

1.2. THALLUS ORGANIZATION:

1.2.1 Anatomy of the Lichen Thallus:

The vegetative structures which are associated with the lichen thallus are

(i) Breathing pores:

- These are localized openings which develop in the upper cortex. In some lichens, e.g., Parmelia, the upper cortex is interrupted by some openings, called breathing pores. The breathing pores serve for aeration and helps in respiration.

(ii) Cyphellae:

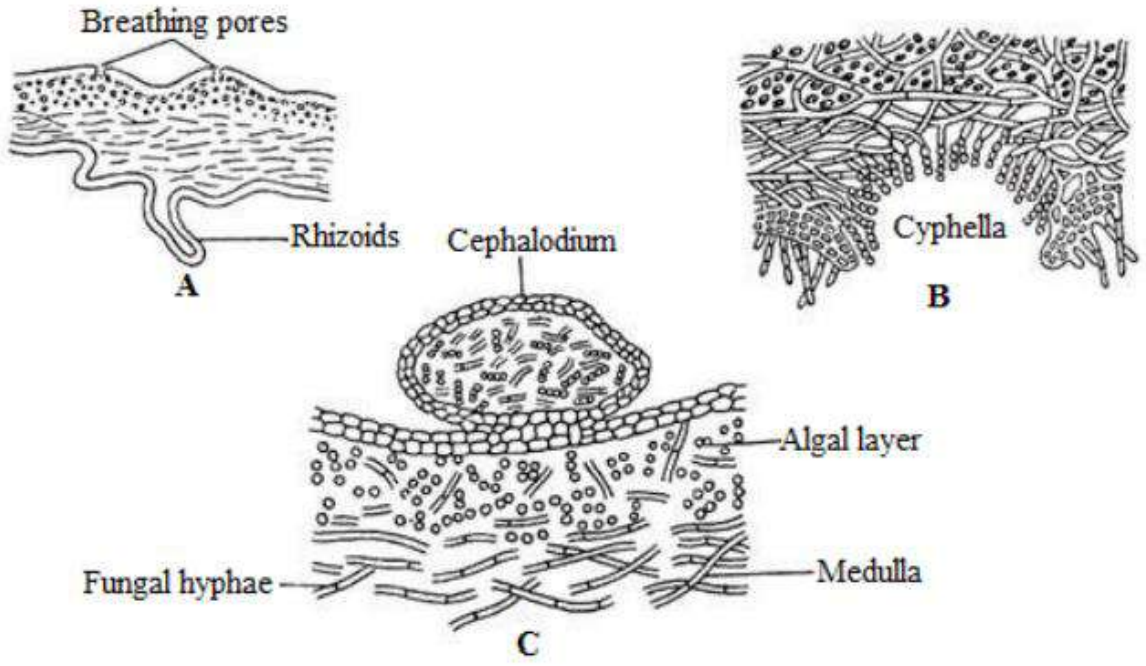
- They occur on the lower surface of the thallus quite commonly in the genus Stricta. If seen with naked eyes these structures appear as cup-like white spots but under the microscope they appear as small, hollow, circular, white cavities. From these cavities medulla is exposed and hyphae protrude out. If these cavities are of a definite form with a distinct border, these are called cyphellae. (The function of these structures is to allow free passage of air to the algal cells.(or their function is aeration.)

(iii) Cephalodia:

- Cephalodia are small, dark-coloured, hard, gall-like structures found in some species of lichens that contain cyanobacterial symbionts. Cephalodia can occur within the tissues of the lichen, or on its upper or lower surface e.g., Peltigera aphthosa, Lobaria, Pulmonaria etc. They contain fungal hyphae of the same type as the mother thallus, but the algal elements are always different. They probably help in retaining the moisture.

(iv) Isidia (Singular "Isidium"):

- Isidium is a vegetative reproductive structure present on the surface of the lichen thallus consisting of both fungal hyphae and algal cells. Isidia are fragile structures and may break off and be distributed by wind, animals, and splashing raindrops. They consist of an external cortical layer and an internal algal layer. In terms of structure, isidia may vary in form in different lichen species as- Cylindrical, warty, cigar shaped, clavate (clubshaped), Scale shaped, coralloid (coral-shaped), rod-shaped etc



Structures of lichen thallus: (A)-Breathing pores, B-Cyphella, C-Cephalodium

1) The specialized structure present in the thallus of lichen that help in nitrogen fixation is

A) Cyphellae B) Isidia C) cephalodia D) soredia

2) A prothallus is

A) a structure in pteridophytes formed before the thallus develops

B) a gametophyte free living structure formed in pteridophytes

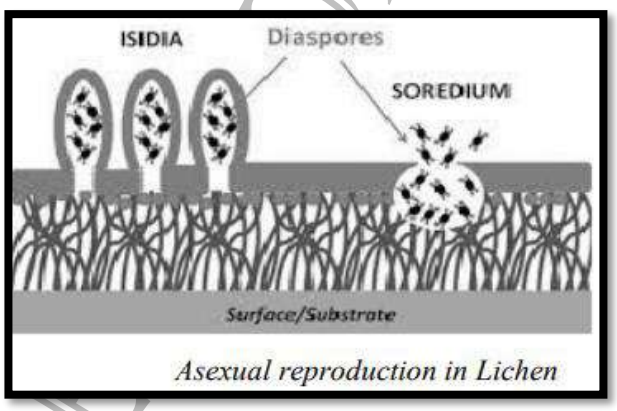
C) a sporophytic free living structure formed in pteridophytes

D) a primitive structure formed afer fertilization in pteridophytes

3) A lichen having much branched system of cylindrical or ribbon like branches but a small thallus is called as

A) foliose lichen B) fruticose lichen C) crustos lichen D) thallose lichen

1.3. REPRODUCTION IN LICHEN:



- Most lichens reproduce asexually; when conditions are favourable they simply expand across the surface of the rock or tree. In dry conditions they become crumbly and small pieces break off and are dispersed by the wind. The fungal part of many lichens also sometimes reproduces sexually to produce spores. These spores must meet up with an algal partner in order to form a new lichen.

1.3.1 Vegetative and Asexual Reproduction:

It takes place by following methods

(i) By Fragmentation:

- It takes place by death and decay of older parts of the thallus produce smaller pieces which give rise to new thallus. This occurs more frequently in pendant thallus e.g., Ramalina reticulata. The new thallus being genetically identical to the thallus from which the fragement came.

(ii) Isidia:

- Isidia are tiny, simple, branched, spiny, elongated out growth from the thallus and contains both photobiont and mycobiont cells covered by the cortical layer of thallus. Each detached isidium may develop into a new thallus under favorable conditions. Common example is Peltigera sp.

(iii) Soredia:

- These are small, minute, powdery granules or bud-like out growth present usually over the upper surface or edges of the thalli of many species of lichens. Each

soredium consists of few algal cells surrounded by fungal hyphae Soredia detaches from the thallus and are carried away by wind. Falling on suitable substrate, it germinates and gives rise to new thallus. e.g., Parmedia.

1.3.2 Sexual Reproduction:

- In lichens only the fungal partner may reproduce sexually. The sexually reproducing lichens are either ascomycetes or basidiomycetes. Ascomycetes produce their sexual propagules (called ascospores) within microscopic organs called asci and basidiomycetes produce their sexual propagules (called basidiospores) on microscopic organs called basidia. Often ascospores or basidiospores are simply called spores. A very small number of lichens have the fungal part which belongs to the basidiomycetes. The fungal component of most of the lichens belongs to the class Ascomycetes, which produce spores in a sac-shaped container, the ascus. The male reproductive organ is called spermogonium and the female is called as carpogonium or ascogonium.

The Male Sex Organs:

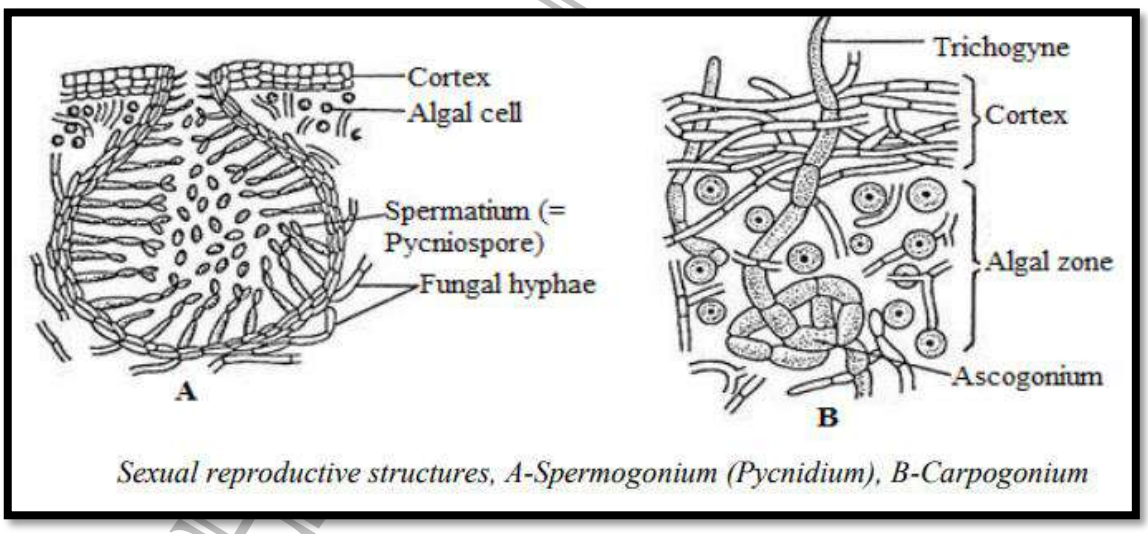
- The male sex organ is known as spermogonia. In some species of lichens, the pycnidia-like structures function as spermogonia. The spermogonia develop in flaskshaped cavities on the upper surface of the thallus. It opens to the exterior by small pore, an ostiole. A number of hyphae develop from the walls of the cavity. Few of them are sterile and others are fertile. The fertile ones produce the non-motile male cells called spermatia. These nonmotile cells develop continuously from the tips of the fertile branches. The spermtaia are set free in a slimy mass through ostiole.

The female Sex Organs:

- The female sex organs are known as carpogonium. The carpogonium develops fron hyphae deep in the algal layer. It consists of two portions, the upper straight portion is called trichogyne and the lower coiled portion is called ascogonium (oogonium). The ascogonium lies deep in the medullary region of the thallus. The terminal portion of the trichogyne ends in a long cell, which projects beyond the surface of the thallus and has a gelatinous cell wall. It is multicellular and the cells are uninucleate or multinucleate in some species. The basal cell of the ascogonium is fertile.

Fertilization:

- A spore called conidium is released from a pycnidia structure. Pycinidia are flasklike structures embedded in the thallus of the lichen. Conidia can act as "spermatia" in sexual reproduction of the lichen. The spermatia are functional male gametes. The spermatium spore finds its way to a tiny thread (trichogyne) on a surface of lichen and attaches itself. The conidia and the trichogyne both are haploid. The growing trichogyne comes in contact with spermatia. The intervening walls between the spermatium and the trichogyne dissolve at the point of contact. The male nucleus gradually passes downward to the oogonium, where it fuses with the female nucleus. The actual migration of the male nuclei down the trichogyne has not yet been observed, but it is assumed. Fused cell produces ascogenous hyphae within which develop 8 ascospores and asci. The hymenium is made up of Asci and Paraphysis. The fruiting body may be either apothecia e.g., Parmelia and Physcia or Perithecia e.g., Peltigera.
- Sexual reproduction results in the formation of apothecia or perithecia. In lichens, fruiting bodies are of following two types:



Sexual reproductive structures, A-Spermogonium (Pycnidium), B-Carpogonium

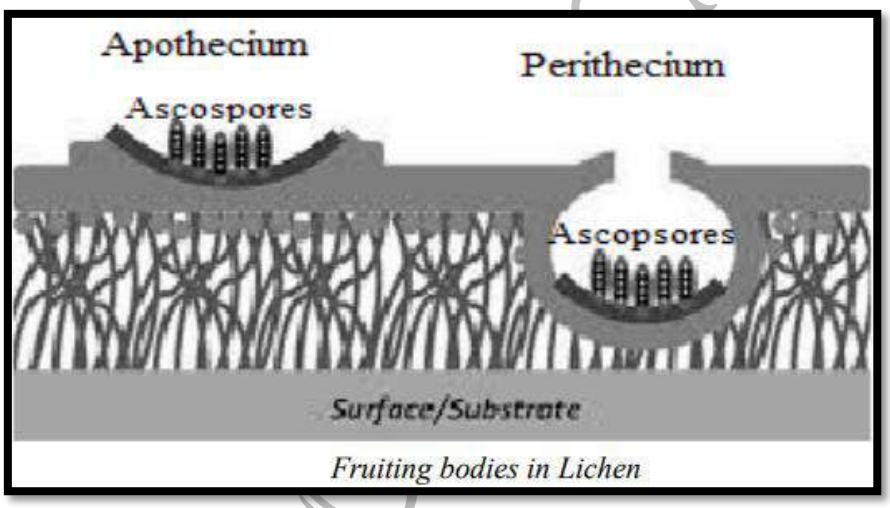
(i) Apothecia:

- The most commonly seen sexual reproduction structures are apothecia. These are typically circular and disc-like or cup-like though there are also species in which the apothecial surface bulges outward. They may be of the same colour as the thallus or strikingly different and vary in diameter from under a millimetre to over two centimetres, depending on species. The structure of the apothecium chiefly consists of three parts: hymenium, Hypothecium, and excipulum. The apothecium has a layer of exposed spore-producing cells called asci. The asci

are present in the hymenium layer. The hymenium, composed of sac-like asci and sterile, hair-like fungal hyphae known as paraphyses. Asci and paraphyses form a thin inner lining, which is called as hymenial layer. Each ascus contains eight ascospores. The asci are freely exposed at maturity.

(ii) Perithecia:

- Perithecia are generally flask-shaped frutiting bodies in certain ascomycetous fungi that contain the ascospores. Depending on the species perithecia may develop totally on the lichen thallus or embedded in the thallus. It looks like a small black dots on the surface of lichen. At maturity a small opening at the top, called an “ostiole”, allows the ascospores to escape.



Fruiting bodies in Lichen

1. Zygote of spirogyra produces four haploid nuclei in which

A) One functional B) Resolution occur

C) Maginication occur D) Resolving power present

2. Branched conidiophores are present in

A) Rhizopus B) Penicillium C) Ustilago D) Aspergillus

3. Sexual reproduction in spirogyra is morphologically characterized by

A) Oogamy B) Anisogamy C) Isogamy D) Isogamy and oogamy both

1.4. OCCURRENCE OF LICHEN:

- Lichen is a group of tiny plants that looks like moss and grows on the surface of things such as rocks, trees, and walls. Lichens grow relatively slowly. Growth rate depends both on the species and on the environmental conditions around it. The smaller encrusting lichens may grow as little as 1mm a year. Large forms may grow

up to 1 cm per year. Lichens occur from sea level to alpine peaks and from the hot deserts of the world to the cold Arctic and Antarctic. Lichens can grow in locations impossible for most plants, such as bare rock, walls, roofs, sterile soil and sand etc. Based on the substratum on which the lichens are growing, lichens are of following types:

- **Muscicolour lichens:** Lichens growing along with mosses. e.g., Cladonia.
- **Follicolous lichens:** Lichens growing on the surface of leaves. e.g., Calicium.
- **Terricolous lichens:** Lichens growing on the surface of soil, in hot climate with sufficient rain and dry summer (terrestrial) e.g., Cladonia, Florekeana, Lecidea, Collema etc.
- **Saxicolous lichens:** Lichens growing on the surface of rocks and stones in cold climate. e.g., Dermatocarpon, Xanthoria, Verrucaria etc.
- **Corticolous lichens:** Lichens growing on the surface of barks of trees mainly in the subtropical and tropical regions. e.g., Parmelia, Usnea, Grpahis.
- **Lignicolous:** Grow directly on wood. e.g., Calicium etc.
- **Marine Lichens:** Grow on siliceous rocky shores of Sea e.g., Verrucaria, Caloplaca etc.
- **Fresh water lichens:** Grow on hard siliceous rocks in fresh water. e.g., Epheba, Hymenelia etc.

1. Earliest settelers on barren land and rocks are

A) Mosses B) Lichens C) Fern D) None

2. Lichens are not found

A) In big cities B) Arctic region C) In villages D) On bark rocks

1.5. CLASSIFICATION OF LICHEN:

1.5.1 Lichens are Classified on the Basis of Growth Forms:

1) Crustose Lichens (Encrusting Lichens):

- These lichens occur as thin or thick crust over soil, rocks or tree barks. These are very closely adhered to the substratum on which they are present and it is difficult to remove them from substratum. Fruiting bodies are present on the upper surface, common examples are Ochrolechia, Graphis scripta, Rhizocarpon, etc.

2) Foliose Lichens (Leafy lichens):

- These lichens have a flat, expanded, leaf like thallus (generally grayish or brownish in colour) which spread out in a horizontal layer over the surface. They are attached to the substratum by rhizoid like outgrowth called the rhizines and can be easily dismantled without damaging the substrates. Common examples are Physcia, Parmelia, Gyrophora, etc.

3) Fruticose Lichens (Shrubby Lichens):

- These are the upright or hanging lichens. These lichens have a thallus that is branched and bushy and can hand from the substrate. It may be erect or pendant. These are flat, cylindrical, or ribbon like, well branched and resemble with little shrubs. These lichens are attached only at the base by a flat disc and can be removes from the surface by hand. e.g., Cladonia rangiferina, Usnea barbata etc.

There Are Few Intermediate Categories of Growth Forms Such As:

4) Leprose Lichens:

- A leprose lichen is a lichen with a powdery or granular surface. In leprose lichens the thallus surface is composed of granules containing algal cells and fungal hyphae. Leprose lichens lack an outer “skin”, or cortex. Leprose lichens have no inner or outer cortex. They sometimes have a weak kind of medulla. e.g., Leparia incana.

5) Squamulose lichens:

- Squamulose lichens are a group of lichens that are scale-like. They are somewhere in between the foliose lichens (flat leaf-like) and the fruticose lichens (erect growing). In Squamulose lichens, the thallus is composed of usually small, flat, usually massed, often overlapping scales- ‘squamules’. If they are raised from the substrate and appear leafy, the lichen may appear to be foliose lichen, but the underside does not have a “skin” (cortex), as foliose lichens do e.g., Normandina pulchella.

6) **Filamentous Lichens:**

- Filamentous lichen is a lichen that has a growth form like a mass of thin, stringy, non-branching hairs or filaments of the alga (Trentepohlia or trichome-forming cyanobacteria). These lichens are generally darker in colour and unlike most other

lichen growth forms, the filaments of fungus do not determine the shape. e.g., Cystocoleus, Ephebe, Coenogonium, Racodium etc.

7) Gelatinous Lichens:

- Gelatinous lichens are lichens in which the phycobiont (the principal symbiont) is a cyanobacterium. In gelatinous lichens the cyanobacteria produce a polysaccharide that absorbs and retains water. They become gelatinous when wet and brittle when dry.

8) Dimorphic lichens:

- In dimorphic lichens single characters of both foliose/ Squamulose and fruticose lichens. The squamulose and fruticose lichens. The squamules are the primary thallus, which bears erect body of fructicose lichen, the secondary thallus.

9) Placodioid:

- A placodioid lichen is a crustose lichen (the thallus is generally crustose) with a growth form that radiates out from a center, sometimes peeling up at the ends of the radial arms to have a leafy form, but without a cortex on the underside, like a foliose lichen. Some placodioid species can be confused with foliose species, e.g., Crustose- Placodioid species of caloplaca, especially C. flavescens, can resemble the foliose Xanthoria elegans, but the latter has true foliose lobes with a lower cortex

1.5.2 On the Basis of Nature of Fungal Componenet:

❖ The fungal partner mainly belongs to ascomycetes apart from basidiomycetes and rarely deuteromycetes. On the basis of the nature of fungal components, lichens are divided to three classes-

(i) Ascolichens:

- In this, the fungal component belongs to Ascomycetes. Sexual reproduction of Ascolichens is similar to those of Ascomycotina. They produce ascus with ascospores after sexual reproduction. Majority of lichens (more than 95% of the lichens) are Ascolichens. Such lichens are further divided into two sub groups:

  (a) Gynocarpeae: In which fruiting body (i.e. ascocarp) is apothecium. e.g., Parmelia.

  (b) Pyrenocarpeae: In which the ascocarp is perithicium type. e.g., Dermatocarpon.

(ii) Basidiolichens:

- In this, fungal component belongs to basidiomycetes. e.g., Dictonema, Corella. Sexual reproduction is similar to those of Basidiomycotina. They produce Basidia and Basidiospores during sexual reproduction. Only very few lichen (4 genera reported so far) belongs to Basidiolichen.

(iii) Deuterolichens:

- Deuterolichens are also known as lichen imperfectii. The fungal partners belong to Deuteromycotina division of fungi. These lichens lack sexual reproduction or should say that lichens with sterile thalli are constituted by this group. e.g., Lepraria, Leprocaulo, Crysothrix.

1) A common phycobiont in lichens are

A) Cetraria B) Microcystis C) Trebouxia D) Oedogonium

2.Reindeer moss is a lichen known as

A) Usnea B) Rocella C) Cladonia D) Parmelia

3. Lichen reproduce vegetatively by

A) Fragmentation B) Soredia C) Isidia D) All of these

4. Most lichens are

A) Homoiomerous B) Heteromerous C) Both D) None of these

5. Lichens growing on rocks are called

A) Corticoles B) Saxicoles C) Lignicoles D) Tericoles

6. The symbiotic association of fungi and algae is called

A) Lichen B) Mycorrhiza C) Rhizome D) Endomycorrhiza

1.6. ECONOMIC AND ECOLOGICAL IMPORTANCE:

1.6.1 Economic Importance:

Lichens are very important economically. Some are given below

1.6.1.1 As a Source of Food:

- Certain species of lichens are valuable sources of food. The edible lichens are harvested and dried for human consumption or as fodder for animals. They are rich in polysaccharides. Some vitamins, and certain enzymes. Cetraria islandica (Iceland moss) is taken as food in Norway, Sweden, Iceland, Scandinavian countries etc.

60. In homosporus species germination of spore is.

A) Exosporic B) Endosporic C) Mesosporic D) Episporic

61. Homosporusspeices are.

A) Monoecious B) Hermephrodites C) Dioecious D) Both (A) and (B)

62. Apical pole give rise to.

A) Root B) Shoot C) Leaves D) All of above

63. Star shaped xylem is character of.

A) Haplostele B) Actinostele C) Plectostele D) Protostele

64. Stele with pith in the centre is called.

A) Protostele B) Siphonostele C) Actinostele D) Plectostele

65. Invasion of pith occurs through the leaf gap?

A) Intra-steler origin of pith B) Extra-steler origin of pith

C) nvasion D) All of above

66. Siphonostele which is perforated at the place of origin of leaf trace is called.

A) Protostele B) Siphonostele C) Actinostele D) Solenostele

67. Each separate vascular strand in dictyostele is called

A) Plectostele B) Meristele C) Polystele D) Eustele

68. Anatomically shoot and root in Rhynia are.

A) Different B) Identical C) Both a and b D) None of above

69. Rhynia lacks.

A) Root B) Stem C) Leaves D) All of above

70. Horizontal stem in Rhynia is connected with soil through.

A) Rhizome B) Rhizoids C) Root hairs D) Roots

71. Rhynia was evolved in.

A) Carboniferous period B) Devonian period

C) Jurrasic period D) Palazioc period

72. Zosterophyllum has sporangium.

A) Single B) Clusters C) Both (A) and (B) D) None of above

73. Oldest representatives of Rhyniophyta belongs to genus.

A) Zosterophyllum B) Cooksonia C) Psilophyta D) All of above

74. First vascular plant was evolved.

A) 400 million years ago B) 400 billion years ago

C) 4 million year ago D) None of above

75. Psilotum belongs to class.

A) Psilotophyta B) Psilopsida C) Psilotopsida D) Psilotales

76. Common name of Psilotum is.

A) Fern B) Whisk Fern C) Horse tail D) Club moss

77. Psiltum is found in.

A) Saline soil B) Loamy soil C) Humus rich soil D) Silty soil

77. Sporangium of Psilotum is called?

A) Triads B) Synangium C) Sori D) Both (A) and (B)

78. In Psilotum stomata are present in.

A) Leaves B) Stem C) Roots D) Both (A) and (B)

79. In stele of Psilotum all components are present except.

A) Pericycle B) Pith C) Endodermis D) Both (A) and (B)

80. In rhizome of psilotum epidermis is.

A) Conspicuous B) Inconspicuous C) Thick D) Thin

81. Spores in fern are produced by.

A) Sexual B) Asexual C) Mitosis D) Binary fission

82. Synangium in Psilotum is.

A) Sessile B) Petiolated C) Stalked D) All of above

83. Synangium in Psilotum is.

A) Ramal B) Cauline C) Both (A) and (B) D) None of above

84. Gametophyte in Psilotum take nutrition from.

A) Synthesize its own food B) Take it from sporophyte

C) From dead organic matter D) Hetrotrophic mode

85. One or two peripheral layers persist for the nourishment of the developing spores. These nourishing cells form:

A) Elators B) Sopores C) Jacket D) tapetum.

86. Match gametophyte with one of the followings:

A) Prothellus B) Thallus C) Cone D) Strobilus

87. Selaginella belongs to division

A) Lycopsida B) Pteropsida C) Psilopsida D) Sphenopsida

88. Hone tails are:

A) Lycopsida B) Pteropsida C) Psilopsida D) Sphenopsida

89. Marsilea belongs:

A) Lycopsida B) Ptcropsida C) Psilopsida D) Sphenopsida

90. Which of the followings is fern?

A) Psilopsida B) Pteropsida C) Lycopsida D) Sphenopsida

91. Which of the followings is most primitive division?

A) Lycopsida B) Pteropsida C) Psilopsida D) Sphenopsida

92. Club mosses are:

A) Lycopsida B) Pteropsida C) Psilopsida D) Sphenopsida

93. The protostele in which xylem core is Smooth and rounded is:

A) Haplostele B) Actinostlele C) Plectostele D) Siphonostele

94. The protostele in which xylem core is star like is called:

A) Haplostele B) Actinostlele C) Plectostele D) Siphonostele

95. The siphonostele in–which two cylinders of vascular tissue are present in the stele is:

A) Haplostele B) Actinostlele C) Plectostele D) Polycyclic

96. In Xylem in which protoxylem is lying in the middle of Metaxylem is:

A) Exarcsh B) Mesarch C) Endarch D) Diarch

97. The stele in which xylem forms several plates is:

A) Haplostele B) Actinostlele C) Plectostele D) Polycyclic

98. The xylem in which protoxylem is lying on the periphery of metaxylem is:

A) Exarch B) Mesarch C) Endarclt D) Diarch

99. The triad of sporangia is called:

A) hirers B) synangium C) Jacket D) tapetum

100. The primary androgonial cell divides to produces a mass of:

A) Androgonial B) androcytes C) Antherozold D) None

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UNIT-3

GYMNOSPERMS, PALEOBOTANY, EVOLUTION.

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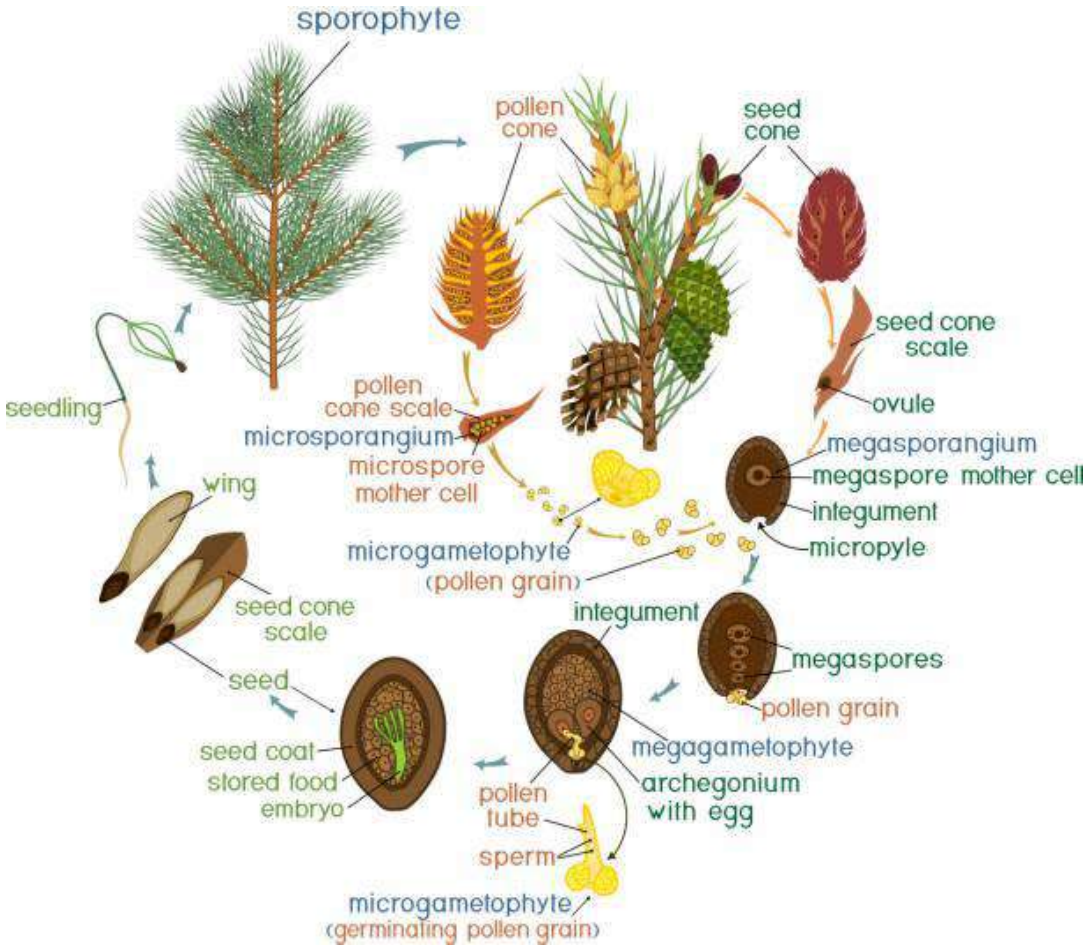
UNIT - III - GYMNOSPERM



COMPETITIVE EXAM

For

UG TRB – 2023-24

INDEX

UG TRB BOTANY – 2023-24

UNIT - III

1.GYMNOSPERM

1.1. GENERAL CHARACTERS OF GYMNOSPERMS:

- Gymnosperms represent a primitive group of seed belaring plants (Spermatophytes) in which the seeds are naked i.e. they are not covered by the fruit wall as in Angiosperms (The word Gymnos means naked and spermos means seed). This is because in Gymnosperms the ovules are exposed and they are not covered by ovary. The ovules are borne directly on open carpellary leaves called megasporophylls and hence they are naked and they develop into naked seeds after fertilization.
- Gymnosperms were most abundant during the Mesozoic era (225 million years) ago. The living Gymnosperms include middle –sized or tall trees and shrubs and number approximately 70 genera and 900 species distributed in tropical and temperature regions. Most of them are conifers mostly evergreen, with needle like leaves. The roots are generally tap-roots, but mycorrhizic and coralloid roots are known in some genera (Pinus, Cycas). The stems are aerial, erect unbranched (Cycas, Zamia) or branched (Pinus, Cedrus etc).
- In some genera (Pinus) the branches may be of two types: (1) The long shoots; and (2) the dwarf shoots that bear at their apices, bundles or clusters of green leaves and are collectively known as spur. Both the microphyllous (small and scale like) and the megaphyllous (large and well-developed) leaves are known among the gymnosperms. The venation may be reticulate (Gnetum), parallel (Welwitschia) or even dichotomons (Ginkgo).

- The secondary wood in the Gymnosperms may be (1) Manoxylic or (ii) Pyconxylic. The manoxylic wood is found in cycadophyta and is porous, soft and more Parenchymatous in nature. It has wide medullary rays and is useless commercially. The pycnoxylic wood is characteristic or coniferophyta and is compact and has narrow medullary rays. It is of great commercial use. The xylem lacks wood vessels (except in Ephedra, Welwitschia and Gnetum), where as phloem is devoid of companion cells.
- The sporophyte bears two types of fertile leaves, the microsporophyll that produces microspores and megasporophyll that produces megaspores. The microspores on germination develop into male gametophytes and megaspore develops into female gametophyte.
- Mostly the spores are grouped into compact cones or strobili. The plant body is the sporophyte (diploid) mostly a tree with well developed roots, stem and leaves. Ovules are naked. Pollination is mostly by wind (anemophilous). Fertilization involves only one fusion. Seeds are naked and not embedded in fruit.

1.1.1 Distribution :

- The modern gymnosperms are commonly grouped under four orders : The Cycadales, the Ginkgoales, the Coniferales and the Gnetales. The Ginkgoales and the Cycadales include living members that have a long fossil history and can be regarded as 'Living fossils'. Ginkgoales in the past (early Mesozoic) were represented by widely distributed group of plants, but now the order is represented by a single species Ginkgo biloba. Similary cycads flourished well during the Mesozoic and are now represented by nine well-defined genera that are confined to limitted areas in the tropical and subtropical countries of the world. The Coniferales form the most conspicuous order of the living Gymnosperms include the most familiar and economically important plants like Pinus, Cedrus, Abies, Juniperus, Cupressus, Thuja etc. Some of them are the world's tallest and long-lived plants, eg., Sequoia gigantea lives for 4000 years and grows very tall. The conifers are cosmopolitan and widely distributed throughout the northern and southern hemispheres of the globe and form extensive forests.
- The Gnetales are represented by three living genera e.g., Gnetum, Ephedra and Welwitschia. The last named genus is monotypic and is represented by Welwitschia mirabilis in some deserts in South-West Africa. Gnetum (40 species) and Ephedra (30-40 species) include many species that are distributed in tropical and temperate

regions of Asia, Africa and South America. The living Gymnosperms include 22 genera that are monotypic.

1.1.2 Phylogeny:

- The Gymnosperms arose in the Paleozoic, alominated the world during the Mesozoic the age of the dinosaurs, and the earlier members of the group have become extinct today. The Paleozoic groups Cycadofilicales and Cordaitales represent the historical background of Gymnosperms. The Cycadofilicales are so fern like in every features except their seeds, that their derivation from some ancient fern stock (called provisionally Primofilices) is as certain as phylogenetic connections can be. The origin of the Cordaitales, therefore, presents two alternatives: either they arose independently from the same ancient fern stock, or they were differentiated from the Cycadofilicales very early. The Gymnosperms began with Cycadofilicales more ancient than any yet known; that Cordaitales branched off from Cycaodofilicales earlier than our present records, and that the two groups constituted the extensive Gymnosperm flora of the Carboniferous.
- This Paleozoic display of Gymnosperms was succeeded by a Mesozoic display, in which at least four groups are recognized. From the Cycadofilicales there arose the Mesozoic Bennettitales and the cycadales; and from the Cordaitales the Mesozoic Ginkgoales and coniferales were derived. The relation of the Bennettitales to the Cycadales is not so clear; either the two groups were differentiated from a common stock that arose from the Cycadofilicales and confined into the Mesozoic. In the Gymnosperm flora of today, therefore, the Cycadales, although relatively a modern group, are the nearest representatives of the PaleozoicCycadofilicales.
- The Ginkgoales and Coniferales have both been traced into late and independent paleozoic connection with the Cordaitales, and were welldisplayed during Mesozoic. The Ginkgoales, while widely distributed during the Mesozoic, apparently were never a large group. The Coniferales, on the other hand, began that extensive differentiation during the Mesozoic which has resulted in six recognized tripes in our present flora. Among these tribes the earliest to be recognized are the Abietineae and the Araucarineae.
- The Taxodineae and Cupressineae, and possibly the Taxineae, arising from the Mesozoic Abietineae; and the Podocarpineae possibly arising from the Mesozoic Araucarineae.

- The connections of the Gentales are altogether obscure, and every openion as to their origin must be regarded as very tentative. Evidence seems to be accumulating that they may have been derived from Cupressineae, or at least that they are closely related to that tribe in origin.

1. Which of the followings is correct for vascular bundle of gymnosperms?

A) Stele B) Exarch

C) Collateral D) Conjoint

2. Secondary growth occurs by the activity of:

A) Phloem B) Xylem

C) Cambium D) Bark

3. Which of the followings is absent in the xylem of gymnosperms?

A) Trachieds B) Parenchyma

C) Fibers D) Vessels

4. Bark is produced by the activity of:

A) Phloem B) Xylem

C) Cambium D) Phellogen

5. Generative cell represents the reduced:

A) Antheridium B) Archegonium

C) Oogonium C) Antherozoids

6. The unutilized prothalial cell becomes:

A) Endosperm B) Archegonium

C) Oogonium C) Antherozoids

1.2. CLASSIFICATION OF GYMNOSPERM:

SPORNE CLASSIFICATION OF GYMNOSPERMS:

- Fossil plants presents problem to the taxonomist, but living plants are classified based on the totality of characters. But for fossil plants, it is most convenient to have a separate classification for stem, leaves, and seeds and so on. Sporne has adapted Engler's method of classification.

lasses	Orders	Families	Examples
1.Cycadopsida	1.Pteridopermles*	1.Lyginopteridacea	*Lygnopteris*
		2.Meulosaceae	*Medullosa*
		3.Calamopityceae	*Calamopitys*
		4.Glossopteridaceac	*Glossopteris*
		5.Peltaspermaceae	*Lepidopteris*
		6.Corystospermaceae	*Xylopteris*
		7.Caytoniaceae	*Caytonia*
	2.Bennettitales*	1.Williamsoniaceae	*1.Williamsonia*
		2.Wielandiellaceae	*2.Wielandiella*
		3.Cycadeoideaceae	*3.Cycadeoidea*
	3.Pentoxylales*	1.Pentoxylaceae	*1.Pentoxylon*
	4.Cycadales	1.Cycadaceae	*1.Cycas*
		2.Nilssoniaceae	*2.Nilssonia*
2.Coniferopsida	1.Cordaitales*	1.Erytophytaceae	*1.Erytophyton*
		2.Cordaitaceae	*2.Cordaites*
		3.Poroxylaceae	*3.Poroxylon*
	2.Coniferales	1.Lebachiaceae	*1.Lebachia*
		2.Voltziaceae	*2.Voltziopsis*
		3.Palissyaceae	*3.Palissya*
		4.Pinaceae	*4.Pinus*
		5.Taxodiaceae	*5.Taxodium*
		6.Cupressaceae	*6.Cupressus*
		7.Podocarpaceae	*7.Podocarpus*
		8.Cephalotaxaceae	*8.Cephalotaxs*
		9.Araucariaceae	*9.Araucaria*

	3.Taxales	1.Taxaceae	*1.Taxus*
	4.Ginkgoales	1.Trichopityaceae	*1.Trichopitys*
		2.Ginkgoaceae	*2.Ginkgo*
3.Gnetopsida	1. Gnetales	1.Gnetaceae	*1.Gnetum*
		2.Welwitschiaceae	*2.Welwitschia*
		3.Ephedraceae	*3.Ephedra*

Order1. Pteridospermales:

- Plants with relatively slender stems. Primary xylem mesarch (rarely exarch) in the form of a solid or a medullated protostele or reduced to circum-medullary strands. Sometimes polystelic. Secondary wood limited in amount, manoxylic and composed of trachieds with multiseriate piting, especially on the radial walls. Leaves mostly large and fern-like, often many times pinnate. Ovule and seed borne either on the frond or on a specially modified frond (megasporophyll) which is not part of a cone.

Order 2. Bennettitales:

- Stem with wide pith, stout and pachycaulic or relatively slender and forking. Leaves compound (rarely simple) with open (rarely closed) venation. Stomata syndetocheilic. Reproductive organs in hermaphrodite or unisexual 'flowers', protected by numerous bracts. Ovules stalked, very numerous, scattered over a conical, cylindrical or dome shaped receptacle, along with interseminal scales, more or less uinted at the distal end to form a shield, through which the micropyles protruded. Seeds with two cotyledons. Pollen bearing organs in a whorl, free or united, pinnate or entire, with numerous microsporangia, usually in capsules.

Order3. Pentoxylales:

- Fossil plants, habit unknown, but probably shrubs or very small trees. Long and short shoots, the latter bearing reproductive organs terminally and spirally arranged leaves. Stems- polystelic. Wood rays uniseriate. Leaves thick, simple, lanceolate. Venation open (anastomoses very rare). Female organs like stalked mulberries; seeds sessile, united by fleshy outer layer or integument. Male organs consisting of a whorl of branched sporangiophores, fused basally into a disc.

Order4. Cycadales:

- Woody plants with stems unbranched or with occasional adventitious branching. Manoxylic. Mucilage canals in pith and cortex. Some genera with additional co-axial vascular cylinders. Leaves large, pinnate (rarely bi-pinnate). Leaf trace diploxylic (except in Nilssoniaceae). Dioecious. Reproductive organs in cones (except female *Cycas*) cones terminal or lateral. Megasporophylls with sterile tips and 8-2 orthotropus ovules. Seeds large. Microsporophyll scale-like or peltate with pollen-sacs on the abaxial side. Sperms with spiral band or flagella.

Order 5. Cordaitales*

- Mostly tall trees with slender trunks and a crown of branches. Primary wood scanty. Secondary wood mostly pycnoxylic. Leaves spirally arranged, simple, up to 1 meter long, grass like or paddle-shaped, with parallel venation. Cones compound, unisexual, consisting of a main axis with bracts subtending secondary fertile shoots bearing sterile and fertile appeanages. Female fertile appendages with one to four ovules. Male fertile appendages with four to six terminal pollen sacs. Seeds bilateral.

Order 6. Coniferales:

- Branching woody plants, often with long and short shoots. Secondary wood pycnoxylic, made up of tracheids with large uniseriate (rarely multiseriate) pits on the radial walls, and small wood rays. Resin canals in leaves, cortex and (sometimes) in wood. Leaves spirally arranged form opposite, rarely whorled, needle- like or scale-like, rarely broad. Reproductive organs unisexual cones. Female cones fundamentally compound; a main axis with infinite to few bract scales each subtending, or fused with one ovuliferous scale bearing infinite to 2 ovules (rarely one). Male cones simple, usually with many scale-like microsorophylls with 2 to infinite fused or free pollen sacs. Embryo with two to infinite cotyledons.

Order 7. Taxales:

- Profusely branching, evergreen shrubs or small trees, with spirally arranged small linear leaves. Wood pyconxylic, tracheids with abundant tertiary spirals, no resin canals in wood or leaves. Ovules solitary, arillate, terminating a dwarf shoot, with decussate bracts microsporangiophores in small cones, scale-like or peltate, with two to eight pollen sacs. Embryo with two cotyledons.

Order 8. Ginkgoales:

- Branching trees with long and short shoots (except in the earliest fossil members). Wood- pycnosylic. Leaves leathery, strap-shaped or fan shaped, often deeply divided, with dichotomous venation. Ovules two to ten, terminal on axillary branching or almost unbranched, axes. Seeds large, with fleshy outer layer and stony middle layer. Male organs axiallary, unbranched, catkin-like, bearing micro sporangiophores each with two to twelve pendulous microsporangia. Sperm with spiral band of flagella.

Order 9. Gnetales:

- Woody plants; trees, shrubs, lianes or stumpy turnip-like plants with stem partly below ground. Leaves opposite or whorled, simple, broadly elliptic or strap shaped or reduced to minute scales. Secondary wood with vessels. 'Flowers' unisexual and normally dioecious (except some Gnetum sp.). Flowers organized into compound strobili or 'infolorescence'. Female flowers with a single erect ovule, the nucellus of which is surrounded by two to three enveloped, the micropyle projecting as a long tube. Male flowers with a perianth and antherophores with one to eight synangia. Fertilization by means of a pollen-tube with two male nuclei. Embryo with two cotyledons.

1. Which of the following is incorrect?

A) Phanerogams contain specialized reproductive organ and don't follow cryptogamae

B) Phanerogams are classified as Gymnosperms and Angiosperms based on the type of seed they produce

C) Gymnosperms have covered seeds and Angiosperms have naked seeds

D) Angiosperms bear fruit whereas Gymnosperms don't

2. Which among the following are incorrect?

A) Gymnosperms are fruitless plants that are mostly found in hilly areas

B) Gymnosperms are perennial, evergreen and woody trees

C) Gymnosperms have needle-shaped leaves that are well-adapted to withstand extreme weather conditions

D) Gymnosperms are also termed as hard wood trees

3. Which among the following are incorrect?

A) Microsporophylls are spirally arranged to form Strobili to form a cone shaped structures called microsporangiate

B) Microsporangiate is also called as male strobili because they contain microspores that form male gametophyte

C) Gametophytes can't exist independently i.e. free living

D) Microsporangiate and macrosporangiate exists within the same plant

4. Which among the following is incorrect?

A) Some Gymnosperms have algal association in their roots and it is termed as mycorrhiza

B) Leaves of Gymnosperms can be either simple/ compound

C) Gymnosperms have either branched/unbranched stems

D) The roots in Pinus exist in the form of mycorrhiza

1.3. STRUCTURE OF GYMNOSPERM:

- The gymnospoerms (gymnos-naked; sperma-seed) are naked seeded plants.
- The group includes about 70 genera and 725 living species. Besides it includes a large number of extinct fossil plants.

1. Habit:

- They are represented by the plant bodies which are diploid (sporophyte). They are perennials of usually arboreal evergreens (*Sequoia* up to 125 meters height and 30 meters girth), shrubby habits, or rarely climbers (Gnetales) occurring mostly under xerophytic conditions of life. No herbs are seen.

2. Roots:

- The radicle forms the tap root. The tap root system is exarch and diarch to polyarch. The tap roots may contain fungus (mycorrhiza) or algal cells (coralloid root of *cycas*).

3. Stem:

- Stems are tall erect. In some it is underground tuberous- *Zamia pygmia.* Tht stem is generally branched. But it is unbranched in cycas. Mostly they are woody. They bear characteristic leaf scars.

- In some genera (*Pinus*) two types of branches are seen: Long shoots and dwarf shoots that bear at their apices a clusters of green leaves collectively known as spur.
- Majority of the gymnosperms are monostelic with distinct pith, though a few may be polystelic.
- Vascular tissue is well developed. Stem possess collateral, endarch and open vascular bundles. Due to the presence and activity of cambium, secondary growth is present.
- Xylem consists of xylem parenchyma and trachieds. The trachieds are homoxylous with bordered pits in their radial walls. Vessels or wood fibres are absent except in Gnetales.
- Phloem consists of sieve tubes, phloem parenchyma and sometimes fibres. Companion cells are absent. Resin ducts are abundant.
- The secondary wood may be either manoxylic or pycnoxylic.
- The manoxylic wood is without any commercial value; it is soft and relatively thinly distributed with very wide rays made of parenchyma cells. *E. g*., Cycadales.
- The pycnoxylic wood is of much commercial importance, as it forms the most important constituent of the total timber output of the world. This type of wood is dense, compact and possesses very narrow wood-rays. *E. g.,* Coniferales.

4. Leaves:

- Leaves are mono or dimorphic.
- If dimorphic, two widely different types of leaf are found- the microphyll and megaphyll.
- Microphyll are usually small, deciduous leaves with only one or two veins; but sometimes rather larger leaves with parallel venation are also meant by the same. In *Pinus* they are needle like.
- Megaphyll is meant to relatively larger type of cutinized leaves with a fern-like branching and having branched veins. They may be pinnately compound as in *Cycas*.
- Leaves are mostly evergreen and possess resin passages (Pinus), or lacks resin passage (e.g., Gnetales) and posses' latex tubes.

- Usually the leaves are arranged in a spiral manner except in Cupressaceae and Gnetales where their arrangement is cyclic(*Cedrus*) or opposite decussate (*Gnetum, Weltitschia, Ephedra*). Forking of rachis and that of leaflets is seen in *Cycas circinalis*.
- The venation may be reticulate (*Gnetum*), parallel (*Welwitschia*) or even dichotomous (*Ginkgo*).
- The leaves of conifers and cycads possess a transfusion tissue.
- Stomata may be syndetocheilic or haplocheilic. The stomata may be on both surface (*Ginkgo biloba*) and on lower epidermis alone (*Cycas, Taxus).*
- The mesophyll may (Cydacs, *Gnetum*) or may not (*Pinus*) be distinguished into palisade and spongy parenchyma.
- Leaves may be triangular (*Pinus roxburghii*), semi circular (*Pinus sylvestris*), circular (*Pinus monophylla*) and bifacial (*Cycas, Gnetum*).

1. 'Saccus' term is used for

A) exine of pollen grains of Pinus B) intine of pollen grains of Pinus

C) Wings of pollen grains of Pinus D) Wings of seeds of Pinus

2. Flowers and cones are similar because

A) both assist seed dispersal

B) both are responsible in attracting insects to pollinate

C) both are shoy and bright

D) both are reproductive structures

3. An autotrophic, prokaryotic, nitrogen fixing symbiont is present in

A) Cicer B) Cycas C) Sequoia D) Pinus

4. Pick the pair that is incorrectly matched

A) Cycas – coralloid roots B) Abies – wood tar, wood gas

C) Pinus – Mycorrhizal roots D) Sequoia – Red wood tree

5. This serves as a connecting link between the angiosperms and gymnosperms

A) Gnetales B) Coniferales C) Ginkgoales D) Cycadales

83. Which of the following statements is true?

A) Ground water percolation can hinder mineralization of bone

B) Bones usually contain organic as well as inorganic molecules

C) Jellyfish can become fossils as their body contains hard parts

D) None of the above

84. Which of the following can be inferred from studying the fossilized skeletons of animals?

A) Pathologies B) Life expectancy

C) Growth pattern D) All of the above

85. Paleoanthropology is the study of _____

A) Fossils of early birds and their ancestors

B) Fossils of early humans and their ancestors

C) Fossils of early fish and its descendants

D) Fossils of early reptiles and its descendants

86. A holotype is a _____

A) A single physical example of an organism known to have been used when the species was described

B) A term used to describe special type of bones found exclusively in birds

C) A recently formed fossil specimen

D) None of the above

87. Radiocarbon dating can help find the age range of biological specimens no older than:

A) 50,000 years B) 100,000 years C) 500,000 years D) 1,000,000 years

88. The scientific study of the structure of bones, skeletal elements and microbone morphology is called:

A) Osteology B) Herpetology C) Entomology D) None of the above

89. Atoms of AA decay to atoms of BB with a half-life of 100,000 years. If there are 20,000 atoms of AA to begin with (and 0 atoms of BB), how long will it take for there to be 2,500 atoms of AA?

A) 100,000 yrs B) 200,000 yrs C) 300,000 yrs D) 400,000 yrs

90.In the past there were (more or less) atoms of radioactive Uranium?

A) Less B) More C) No wat to tell D) high

91. Which of the following represents the longest time period

A) Precambrian B) Paleozoic C) Mesozoic D) Cenozoic

92. The Paleozoic does not include the

A) Ordovician B) Jurassic C) Mississippian D) Permian

93. The _____ was an era dominated by the dinosaurs

A) Precambian B) Paleozoic C) Mesozoic D) Cenozoic

94. The boundaries between _____ seem to coincide with major changes in the life forms present on Earth.

A) Precambrian B) System C) Eras D) Epochs

95. Radiometric age is often referred to as _____ age.

A) Total B) Absolute C) Historic D) Geologic

96. The principal of original horizontality states that _____ .

A) Most rocks in the Earth's crust are layered horizontally

B) Igneous rocks form essentially horizontal layers

C) Metamorphic gradients are essentially horizontal before deformation

D) Sediments are deposited as essentially horizontal layers

97. Microscopic granules of silicon dioxide that enter a plant's cells and take their shape are called

A) Phytoliths B) Middens C) fission tracks D) pollen

98.During in which geological period did the earth become oxygen rich?

A) Orosirian period B) Ediacaran period

C) Devonian period D) Ordovcian period

99.The first green plants and fungi appeared on land during which period.

A) Ediacaran period B) Devonian period

C) Orosirian peiod D) Ordovcian period

100.Flowering plants first appeared during which period?

A) Jurassic peiod B) Carboniferous period

C) Cretaceous period D) Stone period

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UNIT - III

GYMNOSPERM

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UNIT-4

ANGIOSPERM - MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY

Your Success is Our Goal....

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UNIT - IV

ANGIOSPERM - MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY

COMPETITIVE EXAM

For

UG TRB – 2023-24

TEACHER'S CARE ACADEMY, KANCHIPURAM

TNPSC-TRB- COMPUTER SCIENCE -TET COACHING CENTER

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B.Off 3: Vijiyaraghavachariar Memorial Hall(Opp to Sundar Lodge), Salem

Trichy : 76399 67359 **Salem : 93602 68118**

UG TRB 2023 - 2024

BOTANY

UNIT - 4

ANGIOSPERM - MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY

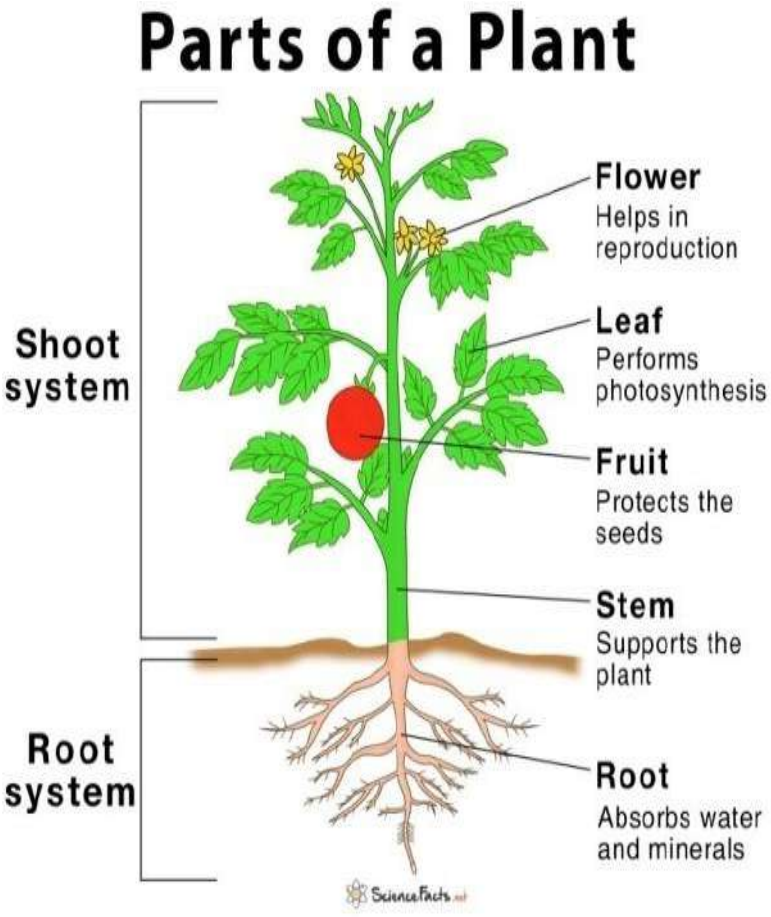
1.ANGIOSPERM MORPHOLOGY

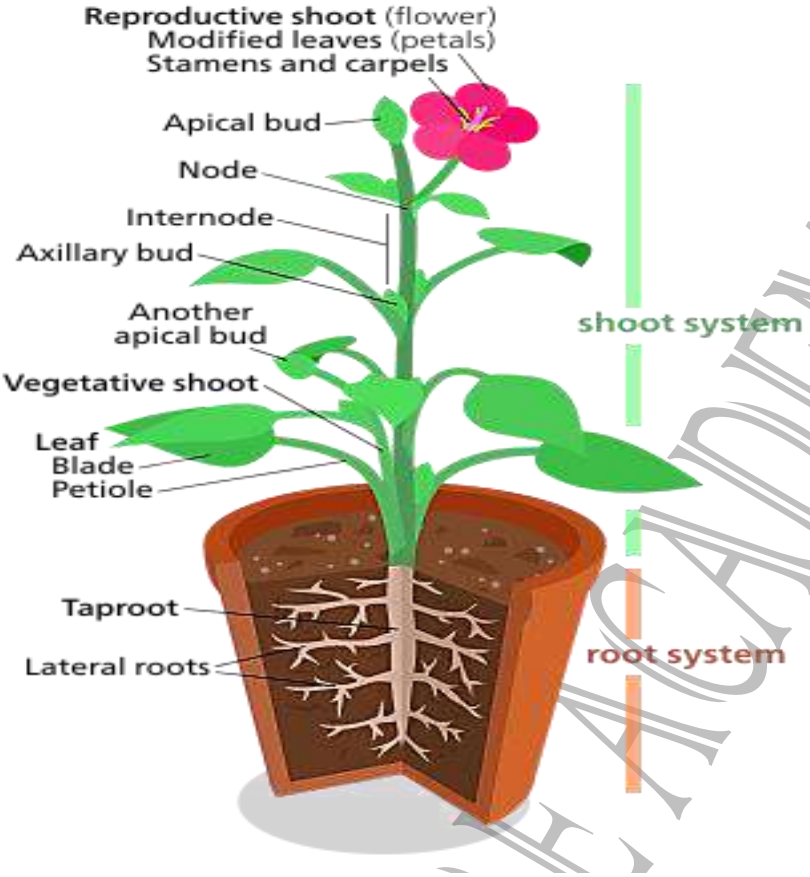
1.1 PLANT BODY PARTS:

- **The basic parts of most land plants are roots, stems, leaves and flowers, fruits and seeds**
- **The plant body consists of a number of organs**
- **The three main parts are: the roots, the leaves and the stem (fundamental)**
- Each part has a set of jobs to do keep the plant healthy
- The roots absorb water and minerals from the soil and anchor the plant in the ground.
- The stem supports the plant above ground and carries the water and minerals to the leaves

PLANT BODY PARTS: (COMMON)

SHOOT, ROOT, LEAVES, FLOWERS, FRUITS AND SEEDS





1. Which among the following is incorrect about the root?

   A) Radicle grows to form a primary root inside the soil

   B) From the primary roots grows the secondary roots from lateral surfaces

   C) Most of the monocotyledons adopt tap root system

   D) Adventitious roots are present in Banyan tree

2. The word morphology means _____

   A) Study of structure B) Study of bones

   C) Study of change D) Study of skin

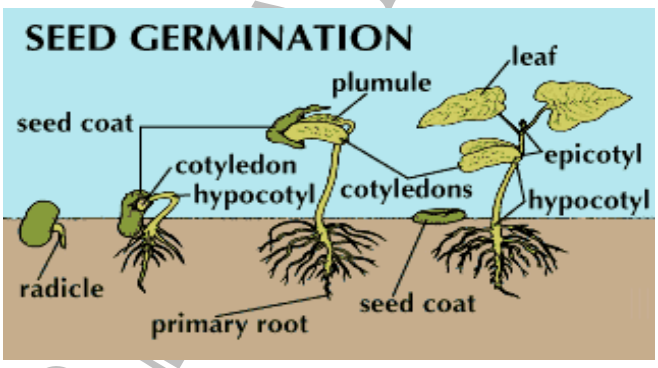
1.2 ROOT SYSTEM

- **The underground part of the main axis of a plant is known as root**
- **Root has no nodes, internodes and flower buds**
- **The root is subterranean and positively geotropic**
- **It is endogenous in origin**
- Its primary function are anchorage of the plant, absorption of water and minerals from the soil and its provides the stems and leaves

- The structure of the root consists of the root cap, apical meristem, epidermis, root hairs and root cap
- **In vascular plants, the roots are the organs of a plant that typically lie below the surface of the soil**
- **Roots can also be aerial or aerating that is growing up above the ground or especially above water**
- The primary root or radicle is the first organ to appear when a seed germination

Characters:

- **They are colourless and cylindrical structures**
- **They lack nodes, internodes, leaves and buds**
- Root is positively geotrophic, negatively phototrophic and positively hydrotrophic



1.2.1 Root Parts:

1. Root cap:

- It is a type of tissue at the tip of a plant root and it is also called calyptra

2. Root hairs:

- Each of a large number of enlarged microscopic outgrowths from the outer layer of cells in root and it absorbing moisture and nutrients from the soil
- Root hairs are always intercellular.

1.2.2 TYPES OF ROOT SYSTEM:

1. Primary or Tap Root system:

- **A tap root system always develops from the radicle and grows faster**
- **It is usually underground and is positively geotrophic**
- **The taproot system is characteristic or most the dicotyledonous plants and gymnosperms**
- It is extensively develops and occupies a very large and deep area in soil

- Its help for absorption of water, minerals and for a firm anchorage of the plant in the ground
- A straight growing vertically downwards with many smaller lateral root hairs
- The secondary and tertiary root grow form primary roots

2. Adventitious Root system:

- **Adventitious roots are that from any non root tissue and are produced both during normal development and in response to stress conditions such as flooding, nutrient depletion and wounding**
- **It almost all the monocotyledons including the cereals, the main root system is the adventitious root**
- **It may be underground or aerial**
- This root is short lived and the root arise from any part of the plant except the radicle
- Functions such as mechanical support, anchorage, storage of food, viral functions etc.

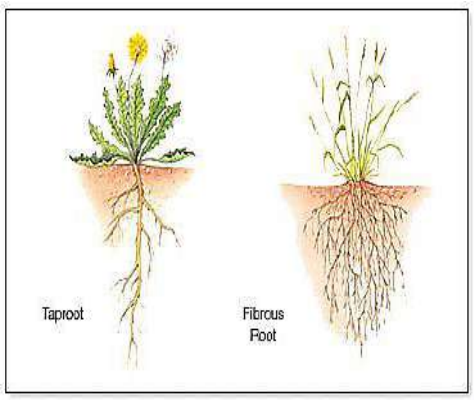
3. Aerial Roots:

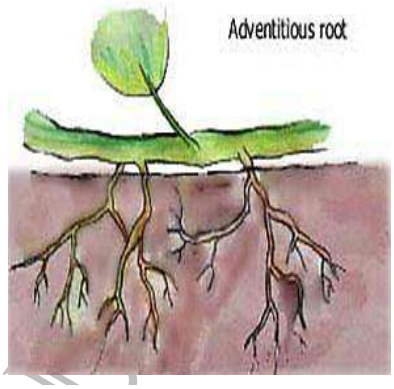
- **A root that develops from a location on a plant above the surface of the earth or water, as from a stem.**
- They are above the ground the plants and they are found in diverse plant species, including epiphytes such as orchids, tropical coastal swaps trees such as Mangroves, etc.
- Some type of aerial roots also absorb moisture and nutrients from soil

4. Fibrous Roots:

- **This system forms a dense network of roots that is closer to the soil surface**
- **It is found only in monocots**
- **It is usually formed by thin with root hairs**
- **Example: Grasses, wheat, rice, carrot**
- Their function is mainly absorption of nutrient and water from soil
- They have same length and same size.

TYPES OF ROOTS





1. Which among the following is incorrect about adventitious root system?

   A) Adventitious roots when buried in soil grows into new roots

   B) These roots provide additional anchoring to a plant

   C) These are the roots that grow from parts that are other than the radicle

   D) Adventitious roots are present in Turnip

2. Which among the following is an incorrect statement about root?

   A) The root is covered at the end by a thimble like structure called root cap

   B) Meristematic tissue helps in the growth of plants

   C) Mersistematic cells when mature forms the so called growing cells

   D) Root hairs increase the surface area which helps in increasing the levels of water absorption

3. Which among the following is incorrect about the modifications in roots?

   A) Roots undergo modifications to perform conduction of water and minerals

   B) Prop roots help in anchoring banyan tree to the ground

   C) Pneumatophores are present in maize and sugar cane that help them to respire easily

   D) Tap roots in turnip and carrot store food in their roots

4. Which among the following is incorrect about shoot system?

   A) The portion of a plant that grows above the soil is called shoot system

   B) Aerial roots are a part of shoot system

   C) Shoot system comprises of leaves, branches, flowers and fruits

   D) The shoot system develops from plumule

5. Which among the following is incorrect about tap root and fibrous root?

A) Tap root grows deep into the soil

B) Fibrous root grows laterally

C) In fibrous root system, one primary root and more than one secondary root is Present

D) Most of the dicotyledons adopt tap root system

6. Which among the following is incorrect about root system in carrot?

A) In carrot, roots are edible

B) They adopt fibrous root system

C) Turnip and beetroot also adopt the same type of root system

D) In this root system, one primary root present grows deep into soil and many secondary roots grow along the sides of the primary roots

1.3 ROOT MODIFICATION

Definition:

- In some plants, the **roots change their shape and get modified**

1.3.1. TAP ROOT MODIFICATION

1.3.1.1 STORAGE ROOTS (TUBEROUS ROOTS)

- In some plants, the primary taproots are modified for storing reserve food materials
- They are usually swollen and assume various forms

1. Conical:

- It is **Conical; swollen root** is broad at the above, tapers below and giving a shape of cone.
- Eg. Carrot (Daucus carota)

2. Fusiform:

- It is **Spindle shaped, broad at the centre** and tapers both upwards and downwards.
- Eg. Radish (Raphanus sativum)

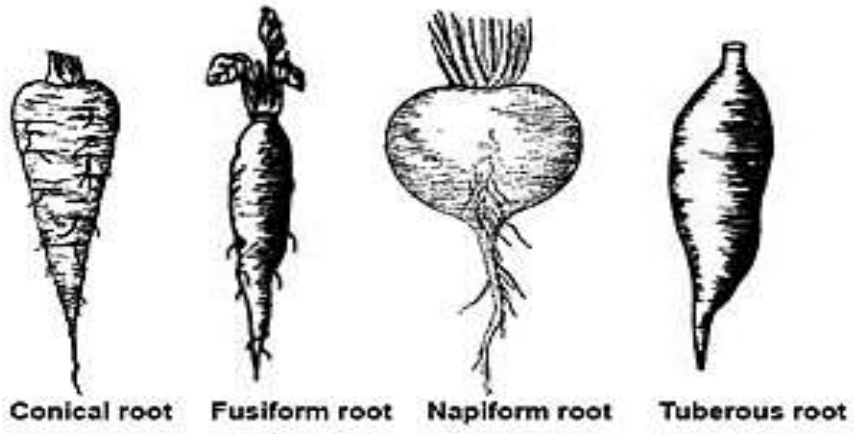
3. Napiform:

- The roots is **Nearly globular or spherical in shape**

- The basal portion is much swollen a tapers at the apex. Eg. Turnip (Brassica rapa), Sugar beet

4. Tuberous roots:

- They have no specific shape and they **appear thick and fleshy.** Eg. Dahlia.



1.3.2 MODIFICATION OF FIBROUS ROOTS

1.3.2.1 FOR STORAGE FOOD

1. Simple tuberous roots:

- They are **Swollen and do not assume any shape** Eg.Sweet potato

2. Nodulose roots:

- It is the fibrous root modification for food storage
- They are **Single beads and they become swollen at the tip**
- They have a definite shape Eg.Ginger

3. Fasiculated tuberous roots:

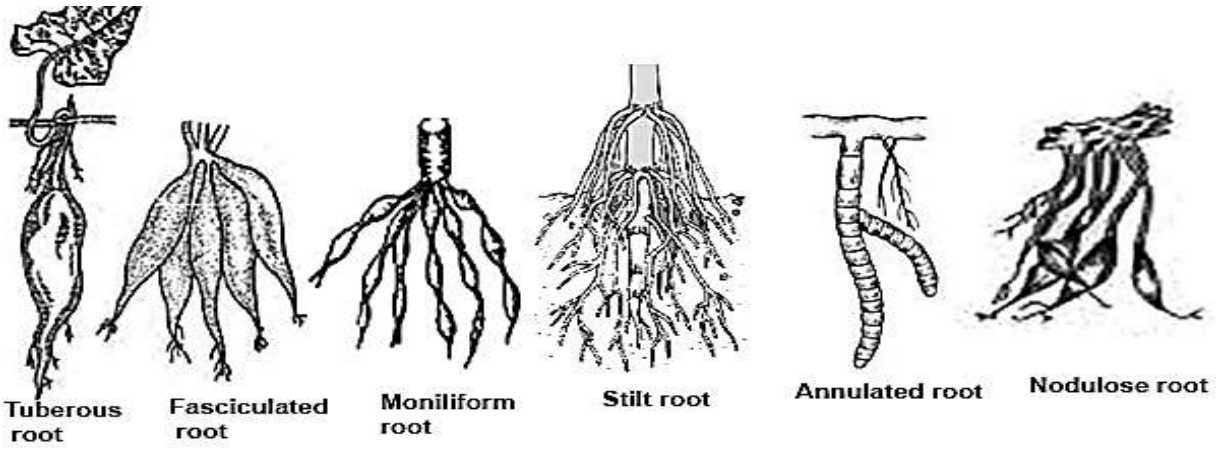
- **It is the cluster** of fibrous root modification for food storage
- They have a definite shape Eg. Sweet potato, Dahlia.

4. Moniliform roots:

- It is the fibrous root modification for food storage
- They are **Swollen up at intervals to give a beaded appearance**. Eg. Grasses

5. Annulated roots:

- It has an **Appearance of ring-like discs** placed one over the other Eg.lepecae (Cephaelis)
- It is a disc-like fibrous root modifications to store food material



1.3.3 ADVENTITIOUS ROOT MODIFICATION

1.3.3.1 FOR SUPPORT

1. Prop roots:

- These roots develop form the branches of the tree and **hang downwards**
- They penetrates into the ground thereby supporting the tree
- They are aerial and **they are pillar-like** and they give support to the huge tree
- Eg. Roots of the banyan tree

2. Slit roots:

- They are aerial **which develops from basal nodes of the stem**
- They are Provides mechanical support to the plants Eg. Roots of the sugarcane

3. Climbing roots:

- They are aerial and they arise from the nodes of the stem
- Its **help for climbing**. Eg. Pothos, Piper nigrum

4. Buttress roots:

- They are **Plank-like,** flat, broad aerial roots, **which spring from vertically elongated basal part of the stem which spread in different directions in the soil**. Eg.Salmalia, Ficus.Etc.

BUTTRESS ROOTS **PROP ROOTS** **SLIT ROOTS** **CLIMBING ROOTS**

1.3.4 ROOT MODIFICATION FOR SPECIAL FUNCTION

1. Epiphytic roots or Velamen roots:

- **These roots are aerial hanging and they are aerial root modification and these possess a special spongy-like tissue known as Velamen Eg. Vanda**
- Velamen absorbs and stores moisture from the air since these plants do not have direct contact with the soil and this root helps fix the plant and supporting branch

2. Respiratory roots or Pheumatophores:

- **These are aerial roots which are negatively geotrophic. Eg. Aviennia, Rihizophora,etc**
- **These root are found in mangroves plants, which grows in saline marshes**
- **Root have specialized structure called Pheumatophores** are minute aperture called lenticels through which exchange of gases take place

3. Parasitic or Haustorial roots:

- **Parasitic roots are aerial roots live in parasitic plant to suck food material from the host** and these roots serve to absorb water, nutrients. **Eg. Cuscuta**

4. Floating roots:

- **Floating roots are aerial root modification produced in hydrophytes** to provides buoyancy **Eg.Jussieua**

5. Balancing roots:

- These roots aerial root modification which are produced clusters and balance the plant while floating in water **Eg. Eichchornia (floating hydrophytes)**

6. Photosynthetic roots or Assimilatory roots:

- These are also known as photosynthesis roots. These when exposed to the sun develop chlorophyll and **manufacture food material and these roots become greenish**. Eg.Tinospora

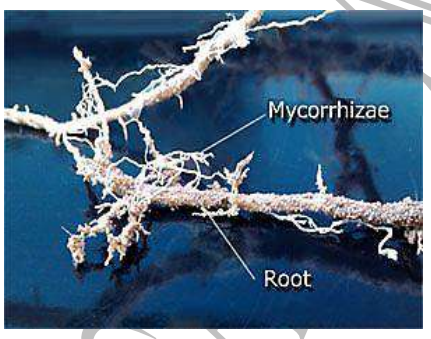
7. Mycorrhizal roots:

- **The symbiotic association of a fungus with higher plant root is called Mycorrhizal roots**
- The fungus absorbs moisture and nutrients from the soil for the plant and plant in turn produce organic food to it. Eg. Pinus (gymnosperm)

8. Reproduction Roots:

- In some plants such as sweet potato, the **adventitious roots give rise to buds** which develop into leafy shoots. This produce buds to help in vegetative propagation Eg. Guava, Milligtonia

PICTURES



1. Which of the following is an edible modified root?

(A) Potato (B) Sweet potato (C) Groundnut (D) both (a) and (b)

2. Clinging roots are found in

(A) Podostemon (B) Orchid (C) Trapa (D) Screwpine

3. Where do you find velamen?

(A) in roots of screwpine (B) in aerial roots of orchids

(C) in leaves of Ficus (D) in aerial and terrestrial roots of orchids

4. Which of the following has buttress roots?

(A) Banyan (B) Sorghum (C) Pandanus (D) Terminalia

5. Roots of which of the following plants contains an oxidising agent?

(A) Soybean (B) Radish (C) Mustard (D) Carrot

6. Roots developing from a part of the plant other than radicle are called

(A) Fibrous (B) Adventitious (C) Epicaulous (D) Epiphyllous

1.4 SHOOT SYSTEM:

- **SHOOT SYSTEM= LEAVES+ STEMS+ FLOWER**
- **Shoot or stem hold the leaves and flowers in plants**
- **Stems contain the plumbling that carries nutrients to different parts of the parts**
- **Shoot system consists of stem, branches, leaves and flowers**
- The shoot system which is above ground consisting of supporting stems, photosynthetic leaves and reproductive flowers
- The shoot system conduction of mineral solutions from the root to the leaves and of prepared food from the leaf to the different parts goes on through the xylem and the phloem
- First stem of a plant develops from part of a seed embryo called epicotyls

Shoot system function:

- **Photosynthesis, Reproduction, Storage, Transport, Hormones**

1.4.1 PARTS OF SHOOT SYSTEM

1.4.1.1. VEGETATIVE SHOOT:

It refers to the stem, leaves and growing tips of the plant shoot buds, nodes and internodes

1.STEM:

- **Stems are usually above ground, but there are some plants that have stems underground, such as bulbs or tubers**
- Stems are generally round like a stick and may be herbaceous or woody
- Stem is a main body or stalk of a plant and typically rising above ground but occasionally subterranean
- The stem of the plant connects the roots to the leaves in plants

STEM SYSTEM

- **The Shoot System represents the aerial part of the plants**
- It is the part of the plant that lies above the ground and Few stems are also found underground, so they are considers to stem modification
- **It consists of stem, branches, leaves and flowers**

- **It develops from the plumule of the embryo**
- **The aerial part of the main axis of a plant is the stem**
- **It grows against gravitational force and so it is negatively geotrophic**
- The stem has nodes, internodes, bears buds and stem hairs
- The main function of stems to support and elevation of leaves, fruits and flowers

STEM TYPES

- Based on their location with represent to the ground, there are three types of stems
- **Aerial stem, Underground stem and Sub aerial stem**

1. Aerial Stem:

- **A Stem with an erect or vertical growth habit above the ground**

2. Uuderground Stem

- **Underground Stems are modified plants that derive from Stem tissue but exist under the soil surface**

3. Sub Aerial Stem

- **Sub Aerial stems are the stems grow just above the ground**

Stem Consist of Some Parts:

1.Buds:

- **It is a small protuberance or round structure**
- A compact growth on a plant that develops into a leaf, flower and shoot

2.Apical buds:

- **The apical buds are otherwise called terminal buds**
- **The apical bud of a plant is the primary growing point located at the apex (tip) of the stem**
- Apical bud release a hormone called Auxin (IAA) or that can inhibit the growth of lateral bud.
- This phenomenon is termed as apical dominance

3.Axillary buds:

- **Axillary buds are otherwise called lateral buds**
- The axillary buds arise from the leaf node of the stem
- Hence both terminal and axillary buds arise from the apex (apical meristem) of the stem

4.Buds function:

- Buds arise from meristem tissue shoot.
- Each bud has the potential to form shoots and may be specialized in producing either vegetative shoots (stems, branches and leaves) (axillary buds) and reproduction shoots (apical buds)

5.Nodes:

- **A point in a network or diagram at which lines or pathways interest or branch**
- **Node are the points on a stem where the buds, leaves and branching twigs originate**
- They are crucial spots on the plant where important healing, structural support and biological processes. The number of leaves that appear at a node depends on the species

6.Internodes:

- **The intervals on the stem between the nodes are called internodes**
- The function of an internodes is to link the nodes of a plant together
- This allows food, hormones and water to be distributed throughout the nodes of the plant
- The internodes are easily visible on a plant

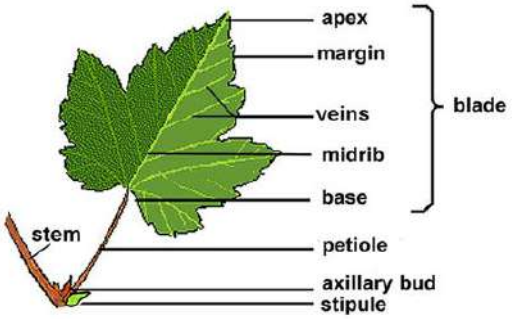
Stem Function:

- It helping to transport absorbed water and minerals to different parts of the plants
- It also help to transport the products of photosynthesis (sugars) from the leaves to the rest of the plant

2.LEAVES:

- **The leaf-singular (plural-leaves) is the principal appendage of the vascular plant stem**
- **It is usually borne above ground and in general, leaves are thin, flat organs**
- **The leaves and stem together form the shoot system of the plant**
- **It is an expanded structure, usually green of vascular plants, characteristically consisting of a blade like expansion attached to a stem and functioning for photosynthesis and transpiration**

- Leaves are typically comprised of a distinct upper and lower surface, stomata for gas exchange, waxy coating, hairs and venation, petiole, blade
- A leaf part is attached to it by a stem or stalk
- Three basic types of leaf arrangements found in trees and shrubs are alternate, opposite and whorled



- **The leaves are collectively referred to as foliage**
- It developing from a node and having a bud in its axils

A. PARTS OF LEAVES

1.Venation:

- **The arrangement of veins in a leaf is called the venation pattern**
- **Monocots have parallel venation while dicots have reticulate venation**
- **The veins are composed of xylem and phloem**
- The vein xylem transports water from the petiole and the phloem transports sugars out of the leaf to the rest of the plants

2.Petiole:

- **The petiole is long, thin stalk that attaches the leaf blade to the stem**
- This gives a characteristic foliage arrangements to the plant

3.Blade:

- **The leaf blade or lamina consists of a central tissue called the mesophyll surrounded on either side by upper and lower epidermis**
- The blade collects sunlight and its main function are photosynthesis and gas exchange

4. Leaf base (Hypopodium):

- **The leaf bases if the slightly expanded area where the leaf attaches to the stem**
- It protects the young axillary bud

5. Leaf margin:

- **The leaf margin is the boundary area extending along the edge of the leaf**

- There are lots of different types of leaf margins that are important for plant identification

6.Midrib:

- The central and usually the most prominent vein of a leaf
- It is a thick, linear structure that runs along the length of a plant thallus or lamina
- It provides support to the leaf

7.Stipules:

- A small leaf-like appendage to a leaf
- Typically it borne in pairs at the base of the leaf stalk
- Common on dicotyledons and some monocotyledons plants display stipule like structures
- Leaves with stipules are called stipulate and the leaves without stipules are called exstipulate leaves
- Its protect the emerging leaf or bud

8.Stomata parts:

- **It is a pore found in the epidermis of leaves and some stems and other organs**
- **The main function is regulating water movement through transpiration**
- They control water loss and gas exchange by opening and closing
- In general, stomata open by day time and close at night time

Function of leaves:

- The main function of a leaf is to produce food for the plant by photosynthesis
- Its protect vegetative and floral buds
- **Gas exchange** : the exchange of oxygen and carbon-dioxide in the leaf occurs through posses pores called stomata
- **Transpiration**: is a process where water evaporates through openings in the leaves of plants called stomata and the function of transpiration is to keep plants cool and deliver water all over the plant

1.4.1.2. REPRODUCTION SHOOTS:

- Reproduction shoot system over time form its formation to the mature structure
- **Reproduction shoots to form flowers. So it is also called flowering shoot**

A. FLOWERS:

- **A flower sometimes known as a bloom or blossom is the reproductive structure found in flowering plants and the flower is a special part of the plant**
- In all plants, a flower is usually its most colorful part
- Flower are responsible for seed development and reproduction
- This involves the fertilization process; the ovary of the flower develops into fruit containing seeds
- **A typical Angiosperm families flower consists of four different sets of parts: the calyx, the corolla, the Androecium and the Gynoecium (Essential whorls)**
- Flower may be defined as a modifies shoot meant essentially for the reproductive of plant
- Flower usually develops as a branch from a bud

Flower parts:

A. Calyx (sepals):

- **The green structures are called sepals and together or collectively the sepals are called the calyx**
- They serve to protect the flower and it prevents from it drying out of the flower
- **It many flowers, sepals are modified in various ways or even completely missing**
- **Singular (calyx) and Plural (Calyces)**
- The sepals surround the petals and the reproductive tissue organs inside the flower and protect them harsh environment conditions

B.Corolla: (Petals):

- **The petals of a flower, typically forming a whorl within the sepals and enclosing the reproductive organs and Petals are modified leaves**
- **Together or collectively the petals of a flower are called corolla**
- The petals of the corolla are designed to aid in pollination and therefore, increase the chance of successful reproduction of the flower
- **They are often brightly colored or usually shaped to attract pollinators (such as butterflies, bees and bats)**

C. Androecium:

- **The stamens of a flower are collectively called Androecium**
- It is male reproductive part of the flower

Stamen:

- Each stamen consists of a filament and an anther

Anther:

- A part of a stamen the produces and contains pollen and is usually borne on a stalk

Filament:

- The filament is a long, thin structure and anchors the anther to the bottom
- This gives support to the anther

D. Gynoecium:

- **The female part of the flower, consisting of one or more carpels (Megasporophyll) which carries the female gametes or ovules within ovary**
- Gynoecium is the innermost whorl of a flower
- It is typically surround by the pollen-producing reproductive organs
- **Gynoecium is also refers as carpel or pistil** which primarily consist of three structures, namely stigma, style and ovary

Stigma:

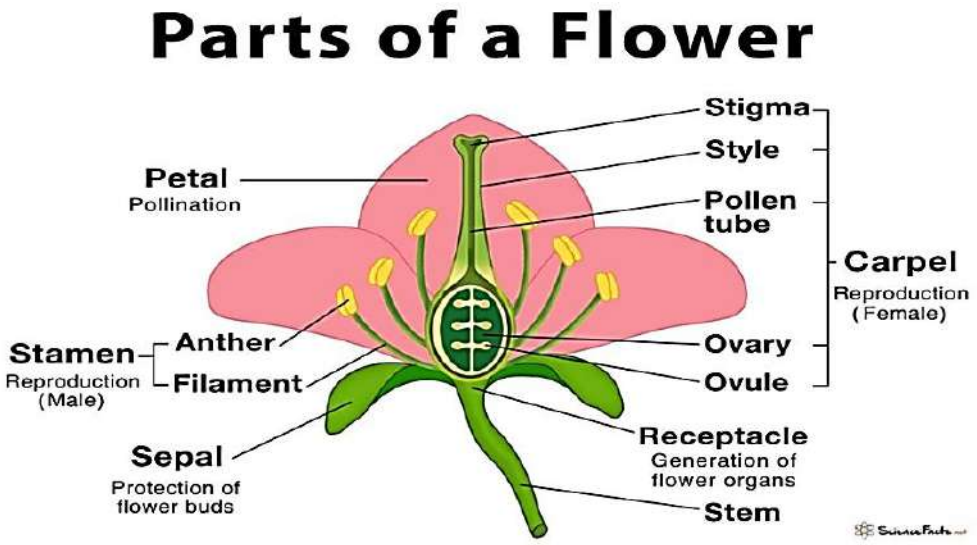
- The part of the pistil where pollen germinates and it receives pollen

Style:

- It is a long, slender, stalk that connects the stigma and the ovary
- It is a sticky platform where pollen is disposal

Ovary:

- Enlarged basal portion of the pistil
- It is the female organ of a flower
- The ovary contains ovules which develops into seeds upon fertilization
- The ovary itself will mature into a fruit, either dry or fleshy enclosing the seeds



E. Fruits:

- **Fruit is the seed-bearing structure in flowering plants**
- A fruit is defined as the fertilized and ripened ovary with one or more seeds
- After pollination and fertilization, carpels develop into the fruit

F. Seed:

- **It is a part of seed plants which can grow into a new plant**
- Seed is embryonic plant enclosed in a protective outer covering

1. Which among the following is incorrect about stem?

A) It is initially greenish and turns woody gradually

B) A stem bears leaves, flowers, buds and fruits etc. and grows vertically erect

C) Both the shoot and stem refers to the same part of a plant

D) Aerial axis of a grown plant is called a stem

2. Which among the following statements is incorrect about stem?

A) The region of stem where buds arise is called a node

B) The region between two consecutive nodes is called inter-node

C) Stem helps in conduction of water and nutrients between root and shoot

D) Stem system includes fruits, flowers, buds and leaves etc

85. Which among the following is incorrect about fruits?

a) Seedless fruits are formed if fertilization fails to takes place

b) In pineapple, ovary is the edible part

c) In pear, both ovary and thalamus are edible

d) In coconut, endocarp is the edible part

86. Which among the following is incorrect about seed?

a) A seed mainly contains a seed coat and an embryo

b) Embryo contains cotyledons, radicle and plumule

c) Embryo also contains endosperm that reserves nutrition for the embryo

d) Radicle grows into the shoot and the plumule forms the root system

87. Which among the following is incorrect about seeds based on the presence of the endosperm?

a) Endosperm is usually absorbed and digested by the developing embryo

b) Seeds that lack endosperm at maturity are called non-endospermic seeds

c) Seeds that contain endosperm are called endospermic seeds

d) In endospermic seeds, embryo gets absorbed and digested even before the seed gets detached from the plant

88. Phenetic classification is based on

(a) Observable characteristics of existing entities

(b) The ancestral lineage of existing organisms

(c) Dendrograms based on DNA characteristics

(d) Sexual characteristics

89. Difference between the natural system of plant classification and artificial system of classification is

(a) Considers only one vegetative character

(b) Considers all the similarities between plants

(c) Considers only one floral character

(d) All of the above

90. This system of classification was used by Linnaeus

(a) Phylogenetic system (b) Natural system

(c) Artificial system (d) Asexual system

91. Pick the right sequence of taxonomic categories

(a) division-class-family-tribe-order-genus-species

(b) division-class-family-order-tribe-genus-species

(c) division-class-order-family-tribe-genus-species

(d) division-order-class-family-genus-tribe-species

92. 'New Systematics' term was coined by

(a) Linnaeus (b) Bentham and Hooker

(c) A.P. de Candolle (d) Juliane Huxley

93. The document that includes all the information related to a particular genus or plant family is termed as:

A. Monograph B. Record C. Revision D. Plant Module

94. Systematic Biology is the term used to refer:

A. Phenetics + Plant Taxonomy B. Phylogenetic + Biology

C. Systematics + Plant Taxonomy D. Dendrogram + Biology

95. Who was the first-ever philosopher to classify living organisms?

A. Whittaker B. Aristotle C. Linnaeus D. Charles Darwin

96.Taxon is-

a) A taxonomic unit b) A species

c) A taxonomic group of any rank d) A genus

97. The National Botanical Research Institute is located at

a) Dehradun b) Delhi c) Gangtok d) Lucknow

98. Which year marked birth of modern system of biological nomenclature?

a)1753 b)1857 c)1757 d)1854

99. Level of taxonomic study concerned with the biological aspects of taxa, including intraspecific populations, speciation, evolutionary rates and trends

a) alpha taxonomy b) beta taxonomy

c) gamma taxonomy d) theta taxonomy

100. Binomials with identical genus name and specific epithet are called

a) Homonym b) Tautonym c) Basionym d) Synonym

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UNIT - IV

ANGIOSPERM - MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY

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UNIT-5

ANATOMY AND EMBRYOLOGY

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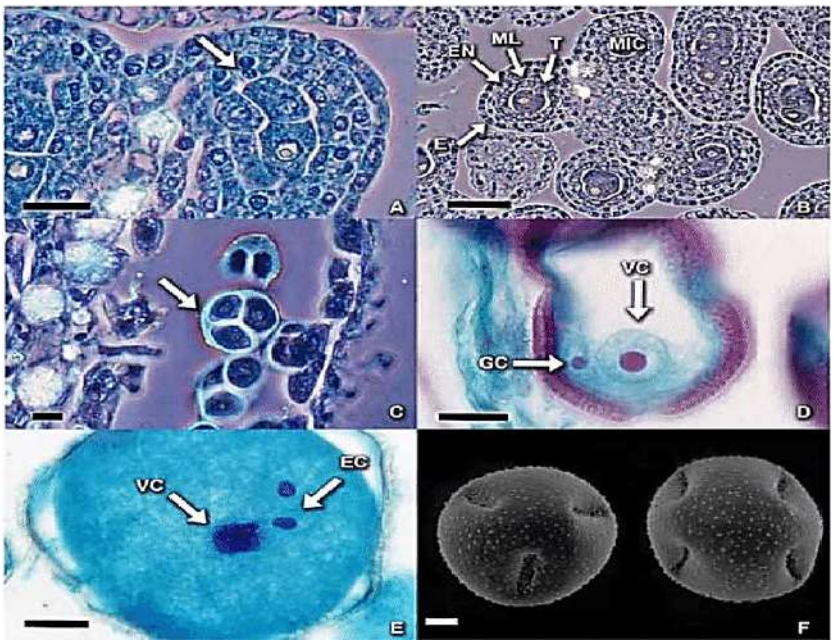
UNIT - V

ANATOMY AND EMBROYOLOGY



COMPETITIVE EXAM

For

UG TRB – 2023-24

TEACHER'S CARE ACADEMY, KANCHIPURAM

TNPSC-TRB- COMPUTER SCIENCE -TET COACHING CENTER

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BOTANY

UNIT - 5

ANATOMY AND EMBRYOLOGY

UNIT V

1.ANATOMY

1.1 MERISTEM

- All living organisms are made up of basic units known as cells. The individual cells are grouped to form tissues which perform a specific function. The cells have distinctive shapes, wall characteristics and show specific physiological properties. Depending upon the organization of cells, tissues have been categorized into different types. In this unit you will study about different types of tissues found in plants. Some cells develop specialized structures, some carry out limited functions while the others carry out multiple functions. Cells mainly participate in growth, cell division and differentiation. The detailed information about function of various tissues with emphasis on their role in plant growth will be provided to you in this unit.
- Meristematic tissue or meristems, as they are also called are tissues that have the ability to enlarge, stretch and differentiate into other types of cells as they mature. The cells of this tissue are generally young and immature, with the power of continuous division.
- Meristematic cells are all living cells. The meristematic cells can be oval or rounded or polygonal in shape. They have a large nucleus with no vacuoles. Intercellular space between cells is absent. The cells are also small in size but have a high capacity of cell division.
- Depending on the occurrence of the meristematic tissue on the plant body, we can classify the meristems into three types. They are:

  1.Apical Meristems: These meristems are located on the tip of the root, stem, etc. They help in the growth of the root system as well as the shoot system. The various cell divisions along with the cellular enlargement help in the growth of the stem above the ground and the growth of the root below the ground.

  2. Intercalary Meristems: The intercalary meristems are located at the internodes or the base of the leaves. The intercalary meristems help in increasing the length of the internode. This is usually seen in monocotyledonous plants.

  3.Lateral Meristems: The lateral meristems are present on the lateral side of the stem and root of a plant. These meristems help in increasing the thickness of the plants. The vascular cambium and the cork cambium are good examples of a lateral meristematic tissue.

1.1.1 ORGANIZATION OF MERISTEMS

- A meristem is the tissue in most plants containing undifferentiated cells (meristematic cells), found in zones of the plant where growth can take place. Meristematic cells give rise to various organs of a plant and are responsible for growth. Differentiated plant cells generally cannot divide or produce cells of a different type. Meristematic cells are incompletely or not at all differentiated, and are capable of continued cellular division. Therefore, cell division in the meristem is required to provide new cells for expansion and differentiation of tissues and initiation of new organs, providing the basic structure of the plant body. Furthermore, the cells are small and protoplasm fills the cell completely. The vacuoles are extremely small. The cytoplasm does not contain differentiated plastids (chloroplasts or chromoplasts), although they are present in rudimentary form (proplastids). Meristematic cells are packed closely together without intercellular cavities. The cell wall is a very thin primary cell wall as well as some are thick in some plants. Maintenance of the cells requires a balance between two antagonistic processes: organ initiation and stem cell population renewal. There are three types of meristematic tissues: apical (at the tips), intercalary (in the middle) and lateral (at the sides). At the meristem summit, there is a small group of slowly dividing cells, which is commonly called the central zone. Cells of this zone have a stem cell function and are essential for meristem maintenance. The proliferation and growth rates at the meristem summit usually differ considerably from those at the periphery.
- The term meristem was first used in 1858 by Carl Wilhelm von Nägeli (1817–1891) in his book (Beiträge zur Wissenschaftlichen Botanik) (‘Contributions to Scientific Botany’). It is derived from the Greek word merizein, meaning to divide, in recognition of its inherent function.
- Plants have meristematic tissue in several locations. Both roots and shoots have meristematic tissue at their tips called apical meristems that are responsible for the lengthening of roots and shoots. The shoot apical meristem is formed during embryonic development, but after germination gives rise to the stem, leaves, and flowers. The root apical meristem is also formed during development, but during germination gives rise to the root system. Cell division and cell elongation in the apical meristem is called primary growth and results in an increase in plant height and root length. Increasing root length enables the plant to tap into the water and mineral resources of a new region or layer of soil. Increasing shoot length makes the plant taller, thus allowing it better access to sunlight for photosynthesis.
- Many types of plants also increase the diameter of their roots and stems throughout their lifetime. This type of growth is called secondary growth and is the product of

lateral meristem. Lateral meristem is called the vascular cambium in many of the plants in which it is found. Secondary growth gives a plant added stability that allows for the plant to grow taller. Lastly, some plants have intercalary meristem. These are areas of plants that help in the regeneration of parts of the plant that have been damaged by predators or the environment. Intercalary meristems produce growth at the base of grass blades, for instance.

- Meristematic tissues are found in many locations, including near the tips of roots and stems (apical meristems), in the buds and nodes of stems, in the cambium between the xylem and phloem in dicotyledonous trees and shrubs, under the epidermis of dicotyledonous trees and shrubs (cork cambium), and in the pericycle of roots, producing branch roots. The two types of meristems are primary meristems and secondary meristems.

On the basis of the development, tissues have been classified into two groups:

- ✓ Meristematic Tissue, Permanent Tissue

1.Meristematic Tissue:

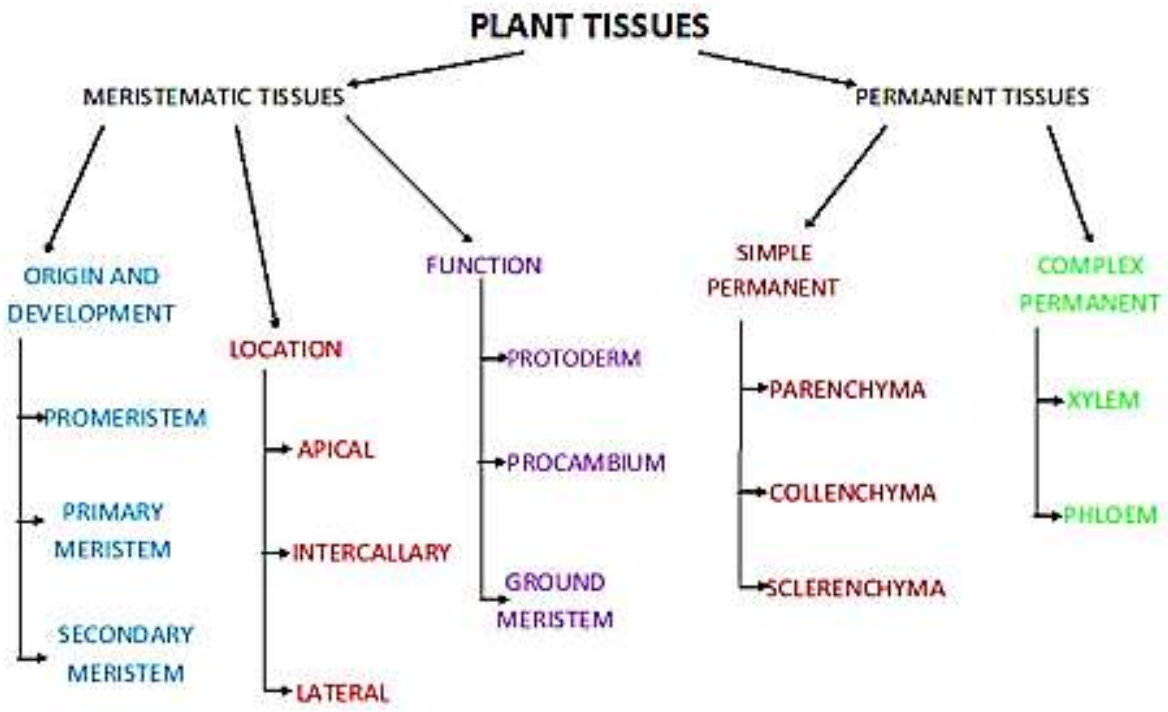
- It consists of a group of cells that divide continuously and the daughter cells differentiate into the permanent tissue. The cells of the meristematic tissue have the capability to divide indefinitely. The cells are isodiametric in shape. They have thin cellulosic wall with dense cytoplasm and large nucleus. Vacuoles are either absent or if present are very few in number except the cambial cells which show vacuolation. They are tightly packed without any intercellular spaces. Plastids occur in the form of proplastids. Mitochondria and endoplasmic reticulum are not well developed. They have very high metabolic rate.

2.Permanent Tissue:

- The cells of this tissue have lost their ability of division. They are thin or thick walled, living or dead, with well-developed intercellular spaces and cell organelles.

1.1.2 CLASSIFICATION OF MERISTEM

- The meristem can be classified on the basis of origin, plane of division, function and position in the plant body.



1.1.2.1 Meristem on the Basis of Origin

Following are the meristems based on the origin:

- Primordial Meristem, Primary Meristem, Secondary Meristem

1.Primordial Meristem:

- The undifferentiated group of cells is termed as promeristem. It is also known as primordial meristem or embryonic meristem. The cells are thin walled isodiametric cells with dense cytoplasm and large nuclei. Promeristem differentiates into primary meristem.

2. Primary Meristem:

Primary meristem originates from the promeristem and differentiates into the permanent tissue. It forms the fundamental parts of the plant and persists throughout the life of plant. The main primary meristems are root apical and shoot apical meristem. It also occurs at the tip of the leaf and forms the abaxial and adaxial surface of the leaf which encloses mesophyll and vascular tissues. The primary tissue of the plant such as epidermis, cortex, xylem, phloem, pith all are the derivatives of primary meristem. After the differentiation some permanent cells regain the capability of division and this is known as dedifferentiation.

3.Secondary Meristem:

This meristem develops from the permanent tissue which has undergone the dedifferentiation. New tissues are added to dermal and epidermal tissue system. It is

usually developed either at the time of emergency or to effect secondary growth. Cork cambium and vascular cambium are the examples of secondary meristem. Vascular cambium produces secondary xylem towards inner side and secondary phloem towards outer side. Cork cambium also known as phellogen, produces cork (phellem) towards outer side and secondary cortex (phelloderm) towards inner side. Phellem, Phellogen and Phelloderm constitutes the periderm which is protective in nature.

1.1.2.2 Meristem Based on the Function

Following are the meristems based on the function:

- ✓ Protoderm, Procambium, Ground Meristem

1.Protoderm:

- It is the outermost layer of young growing regions which develops into the epidermis. It is protective in nature and forms the part of dermal tissue system. Stomata, trichomes and all glandular hairs develop from the protoderm.

2.Procambium:

- It consists of narrow, elongated meristematic cells which develop into primary vascular tissue. The cells are densely cytoplasmic and consist of large nucleus. In stem, the cells of procambium develop primary xylem towards inner side and primary phloem towards outer side. In dicotyledons stem, a portion of procambium remains between primary xylem and primary phloem and later differentiates into cambium, which forms open collateral vascular bundles.

3.Ground Meristem:

- It consists of large thin walled cells which later on differentiate into hypodermis, cortex, pericycle, pith and medullary rays.
- Mesophyll cells of leaf and additional procambial bundles also derive from the ground meristem.

1.1.2.3 Meristem Based on the Position

Following are the meristems based on the position

- ✓ Apical Meristem, Intercalary Meristem, Lateral Meristem

1.Apical Meristem:

- It is present at the apex of root and apex of main and lateral shoots. Apical meristem is the growing point of shoot and forms leaves and branches. Flowers

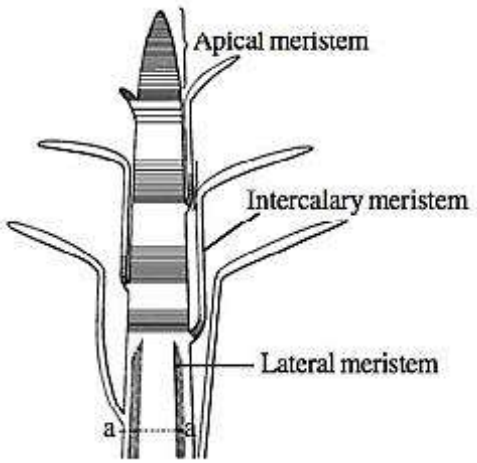
also differentiate from apical meristem. It is responsible for increasing the length of root and shoot.

2.Intercalary Meristem:

- The meristem which is present between the regions of permanent tissues is known as intercalary meristem. It is present at the base of internode of grasses.

3.Lateral Meristem:

- It is located parallel to the long axis of root and shoot and predominantly divide periclinally. They are responsible for increasing the diameter and form secondary permanent tissue. Vascular cambium and cork cambium are the examples of lateral meristem.



1.1.2.4 Meristem Based on the Division

Following are the meristems based on the division:

- ✓ Rib or File Meristem, Plate Meristem, Mass Meristem

1.Rib or File Meristem:

This meristem divide at the right angles to the longitudinal axis of the plant organ, and therefore parallel files of cells are formed. For example, cortex and pith of root and stem.

2.Plate Meristem: It consists of parallel layer of cells which divide anti-clinally and bring intercalary growth. This meristem is present in leaf and increases the surface area without increasing the number of mesophyll layers.

3.Mass Meristem: The cells of this meristem divide in all possible planes therefore, the tissue increases in volume. For example, embryo and endosperm.

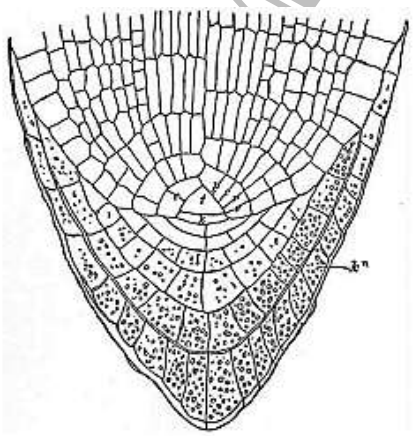
1.1.3 THEORIES OF ROOT APICAL MERISTEM

The cells forming the apical meristem of primary root are densely cytoplasmic with large nuclei. They undergo active division and all the permanent tissues of the root are derived from the root apical meristem. The position of root apical meristem is sub-terminal as terminal position is occupied by a root-cap. The meristem that generates root cap is known as calyptrogen.

There are mainly three theories to explain the root apex of vascular plants, i.e., as follows:

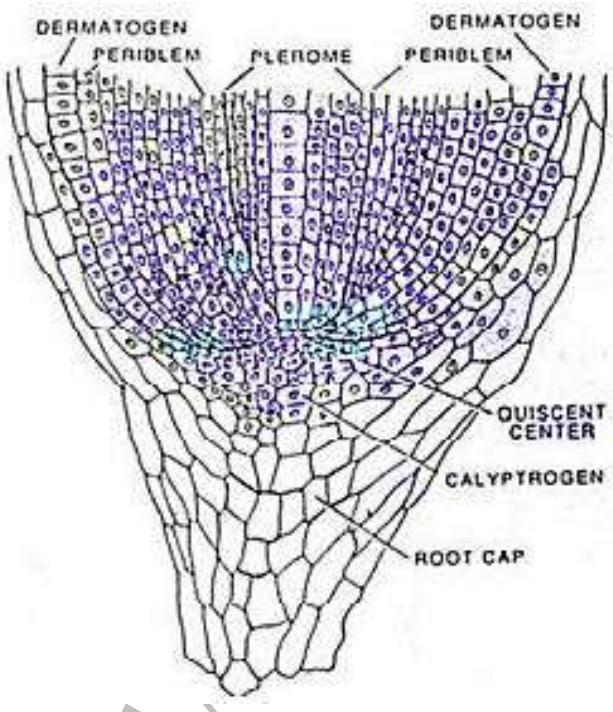
Apical Cell Theory, Histogen Theory, Korper–Kappe Theory

I. Apical Cell Theory:



- This theory was proposed by Nageli. According to this theory, there is a single apical tetrahedral cell which gives rise to all the tissues of the root.
- The root cap is derived from the base of the apical cell and all other tissues like epidermis, cortex and vascular cylinder originate from the upper three sides of apical cell. This theory is restricted to the vascular cryptogams only because in flowering plants a group of the initial cells has been observed in the root apical meristem.

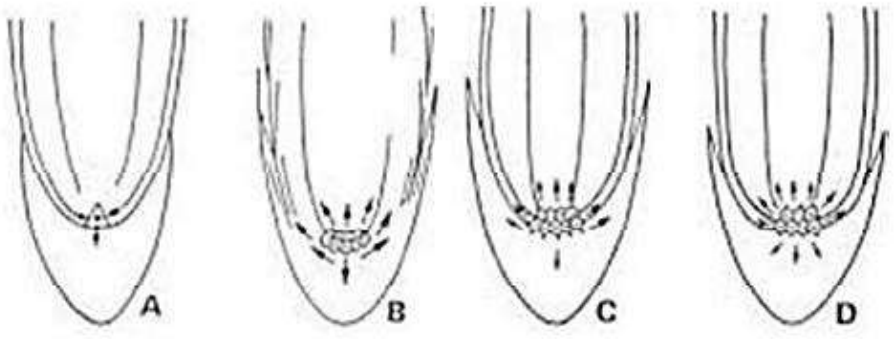
II. Histogen Theory:



- On the basis of cellular configuration, Schuepp divided the root apical meristem into four types :
- Type A: All the permanent tissues of root are derived from a single apical cell. It is present in all vascular cryptogams.
- Type B: There are two separate groups of initials. Vascular cylinder is derived from one group and epidermis, cortex and root cap originates from other group. It is common in gymnosperms.

Type C: There are poorly individualized initials which give rise to root cap, cortex and vascular cylinder. It is present in dicotyledons.

Type D: In this type, there are three separate groups of initials. One group forms root cap, epidermis and cortex derive from other group and vascular cylinder originates from separate group. This type is common in monocotyledons.



Organization of Root Apical Meristem

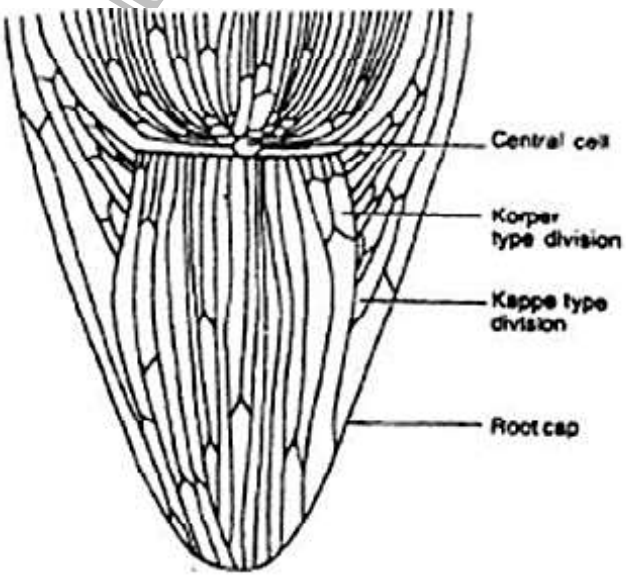
Guttenberg also divided the root apical meristem into two types

- ✓ Enclosed Type, Open Type

Enclosed Type: The initials of the various tissues lie closer to the central cells. Cortex and vascular cylinder have separate initials. Root cap and protoderm may have common or separate initials.

Open Type: In this type, the initials of various tissues are at some distance from the cemtral cells. Only vascular cylinder originates from separate initial and all other tissues have common origin.

III. Korper–Kappe Theory:



- This theory was proposed by Schuepp (1917). According to this theory, the cells at the root apex divide in two planes. First, a cell divides into two by a transverse division and then one of the daughter cells divides by a longitudinal division and therefore, a T shaped structure is formed. It is also known as T division.
- On this basis, root apical meristem has been divided into two distinct zones, Korper (cap) and Kappe (body). In the inner region, the second division occurs in upper daughter cell and therefore, inverted T shaped structure is formed and it is known as Korper (cap).
- In the outer region, the second division occurs in lower daughter cell and straight T shaped structure is formed, known as Kappe (body). The central region of root cap is known as columella where the cells are arranged in longitudinal files.

- These cells divide rarely. The korper-kappe theory of root apex is similar with tunica-corpus theory of shoot apical meristem as both are based on the plane of cell division.

Quiescent Centre

- In the root tip of Zea, Clowes observed a central cup like hemispherical region between the root cap and active meristematic zone. The cells of this zone have less amount of DNA, RNA and protein and these cells also show very low mitotic activity. They do not actively synthesize DNA. The cell organelles are also less in numbers. They have few mitochondria, less endoplasmic reticulum, small dictyosomes, nuclei and nucleoli. This zone was termed as quiescent centre (Refer Figure 1.7). Later on, the existence of quiescent zone has been observed in the root tips of many plants. When the cells of this zone are exposed to X-rays, the meristematic cells stop dividing and the cells of quiescent centre become active. It is because the cells of quiescent centre are more resistant to the radiations than actively dividing cells.
- Therefore, quiescent centre is regarded as central mother cells that form promeristem of the apex. It provides a reservoir of diploid cells when the root tip is damaged. It is also considered the site of hormone synthesis.

1.1.4 THEORIES OF SHOOT APICAL MERISTEM

- Shoot apical meristem is more complicated than root apical meristem and it shows the differences in the following aspect:
- Shoot apical meristem is terminal in position whereas root apical meristem is sub-terminal as root cap occupies the terminal position. Shoot apical meristem produces cells toward the axis but root apical meristem produces cells toward the axis as well as away from the axis to initiate the root cap. Shoot apex shows the rhythmic changes in shape and size before and after the initiation of leaf primordium. It widens considerably before leaf initiation and again becomes narrow after leaf initiation. Root apical meristem does not show any kind of rhythmic changes in shape and size. Shoot apical meristem is associated with the formation of lateral appendages (branches), but in root the lateral organs (lateral roots) are formed behind the root apical meristem. Theories of Shoot Apical Meristem
- Several theories have been proposed to describe the organization of shoot apical meristem:
    - ✓ Apical Cell Theor, Histogen Theory, Tunica-Corpus Theory

1.Apical Cell Theory:

- This theory was proposed by Nageli. According to this theory, there is a single apical tetrahedral cell in the shoot apex and it is considered the 'structural and functional unit' of apical meristem. The single apical cell divides to give rise to all the tissues of the shoot (Refer Figure 1.8). This theory is restricted to the vascular cryptogams only. In flowering plants a group of the initial cells has been observed in the root apical meristem and therefore this theory was discarded.

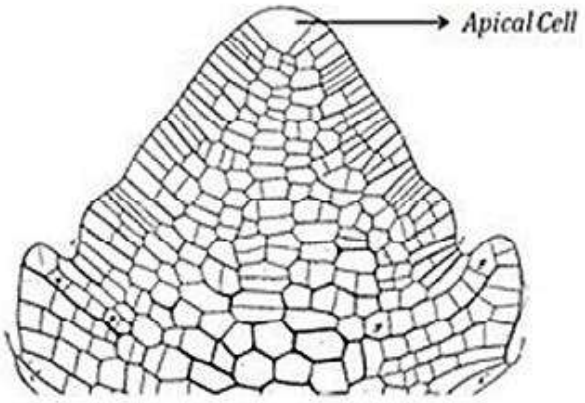
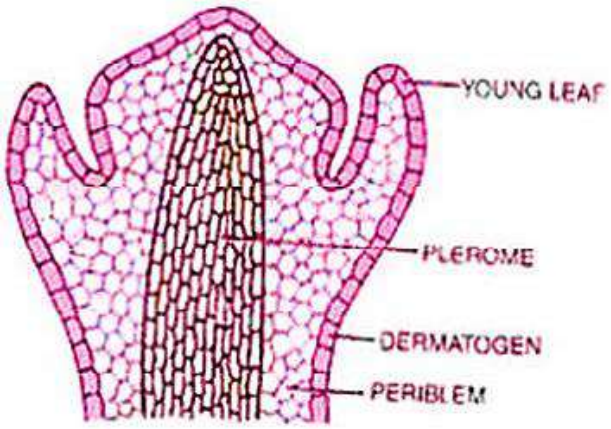


Diagram Showing the Shoot Apex with a Single Apical Cell

2.Histogen Theory:



- This theory was advocated by Hanstein. According to this theory, there are three distinct meristematic zones which arise from the independent initial of the apical mersitem. These layers are termed as histogens. The outermost histogen is known as dermatogen, middle one periblem and the inner most plerome. Epidermis originates from dermatogen, cortex from periblem and vascular cylinder from plerome. This theory was not accepted as these layers are not specific in their functions. In gymnosperms and angiosperms, it was not possible to make clear distinction between periblem and plerome. Haberlandt suggested protoderm, ground meristem and procambium for these three histogens.

3.Tunica-Corpus Theory:

- Tunica-corpus theory was proposed by Schmidt (1924). This theory was based on the plane of cell division in the apex. According to this theory, there are two distinct layers in the shoot apex of angiosperms. These two distinct zones were termed as tunica and corpus. The outer zone consisting of one or more layers of regularly arranged cells known as tunica in which only anticlinal division (perpendicular to the surface) occurs.

- Therefore, tunica develops as a layer but does not increase in thickness. In a same species, variations in the number of tunica layers have been observed in the different stages of development of shoot apex. These variations may be due to the plastochron periodicity. Usually tunica gives rise to epidermis. The inner zone of shoot apex is known as corpus, which is covered by tunica. Here, the cells divide in all possible planes.
- Therefore, shoot apex increases in volume. Corpus gives rise to cortex and vascular tissue. In some grasses like maize, periclinal divisions have also been observed. Therefore, some scientists consider that tunica should include only those layers in which only anticlinal divisions occur. The other layers of tunica in which cells divide by periclinal division, they should be termed as corpus. To accommodate these fluctuations in tunica and corpus, Popham and Chan (1950) suggested mantlecore hypothesis.
- They divided shoot apex into two zones but not on the basis of cell division. Mantle included all the outer layers of the apex and tunica was restricted only to those layers which divide anticlinally. The inner mass of cells covered by mantle termed as core. Both of these layers have separate set of initials which are adjacent with one another at the tip of the apex. These cells can be easily identified by their larger size and more vacuolation. The shoot apex of most of the gymnosperms does not exhibit tunica-corpus organization as their shoot apex does not have a surface layer which divides anticlinally.
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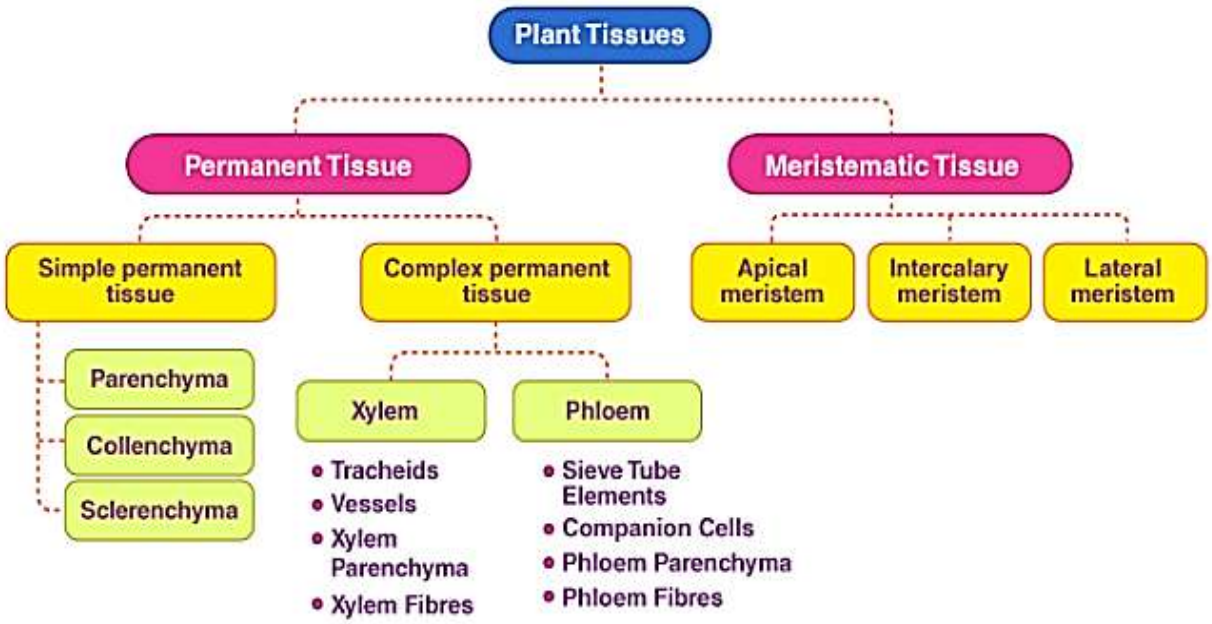
Types of Shoot Apex

- Newman (1965) gave this concept, and according to this there is nothing like a group of permanent initial cells in the shoot apex, instead there is a sequence of meristematic cells and it is known as continuing meristematic residue. He classified shoot apex into three types.

Monoplex Type:

- It is found in vascular cryptogams and ferns; here the shoot apex is denoted by one or more cells which divide by walls parallel to the inclined walls in the stem.
- Simplex Type: It is found in gymnosperms; it consists of one or more initial cells arranged in a single layer; these cells divide anticlinally and periclinally.
- Duplex Type: It is found in the shoot apex of angiosperms; it consists of atleast two successive layers of cells; the cells of surface layer divide anticlinally and that of inner layer divide in more than one plane.



Question of the following:

1): ____ is a group of organized cells with a common origin, similar or different structure and function.

a) Cell b) Tissue c) Organelle d) None of these

2): The group of plant cell which is in active state of division is known as ____

a) Meristematic tissue b) Permanent tissue

c) Special tissue d) Rhomboid tissue

3): _____type of meristematic is present at the shoot apex and it can be found at the leaf apices of developing leaves.

a) Intercalary meristem b) Lateral meristem

c) Apical meristem d) All of these

4): _____ is a type of meristematic tissue which remain embedded within the permanent tissue mainly between two nodes.

a) Permanent tissue b) Lateral meristem

c) Apical meristem d) Intercalary meristem

5): _____ are lateral meristem and primary cambium which remains within the vascular bundles forming the secondary xylem and phloem.

a) Fasicular cambium b) Cork cambium

c) Phellogen cambium d) None of them

6):Which of the following part of meristematic tissue forms primary meristem ___

a) Secondary meristem b) Primary meristem

c) Promeristem d) Interfascicular cambium

7: The secondary meristem origin of meristematic tissue found in vascular region in the form of _____

a) Phellogen cambium b) Cork cambium

c) Fasicular cambium d) Interfascicular cambium

8): _____ is the outermost layer of meristematic where radical division forms epidermal tissue in root.

a) Procambium b) Protoderm

c) Fundamental meristem d) Ground meristem

9): In the plane of division of meristematic tissue _____ type is the cell division takes place in one plane.

a) Plate meristem b) Rib meristem c) Mass meristem d) None of them

10): _____ Is the plane of division where cell division takes place in two plane.

a) Mass meristem b) Ground meristem

c) Plate meristem d) Rib meristem

1.2 TYPES OF TISSUES

- Plant body comprises of several types of tissues, now you are going to study about different types of tissues. Fahn defined tissues as 'complex of cells of common origin'. Tissue comprise of group of cells which may possess a common structure or may perform a common function.

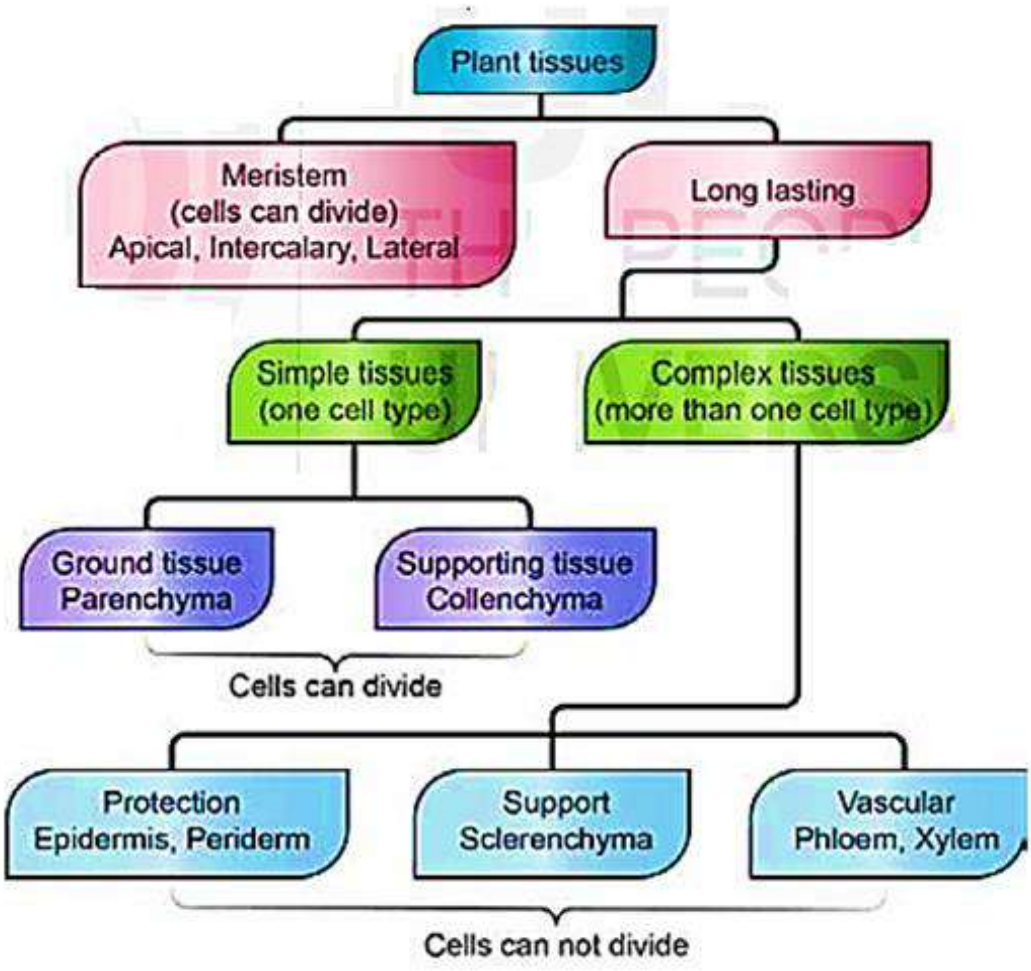
Tissues are classified basically into two types :

- ✓ Simple, Complex

Simple tissues-

- The tissues which consist of similar type of cells are referred as simple tissues. They appear to be homogeneous. These include parenchyma, collenchyma and sclerenchyma.
- Complex tissues- The tissues which consist of more than one type of cells are referred as complex tissues. These include xylem and phloem.
- Based on the stage of development of the plant body, the tissues are also classified into **two types :**

1) Meristematic tissue; and 2) Permanent tissue



68. A diploid female plant and a tetraploid male plant are crossed. The policy of endosperm shall be

(a) tetraploid (b) triploid (c) diploid (d) pentaploid.

69. Which ones produce androgenic haploids in anther cultures?

(a) anther wall (b) tapetal layer of anther wall

(c) connective tissue (d) young pollen grains.

70. Male gametophyte of angiosperms/monocots is

(a) microsporangium (b) nucellus (c) microspore (d) stamen.

71. Female gametophyte of angiosperms is represented by

(a) ovule (b) megaspore mother cell

(c) embryo sac (d) nucellus.

72. Sperm and egg nuclei fuse due to

(a) base pairing of their DNA and RNA

(b) formation of hydrogen bonds

(c) mutual attraction due to differences in electrical charges

(d) attraction of their protoplasts.

73. Entry of pollen tube through micropyle is

(a) chalazogamy (b) mesogamy (c) porogamy (d) pseudogamy

74. Cellular totipotency was demonstrated by

(a) Theodore Schwann (b) A.V. Leeuwenhoek

(c) F.C. Steward (d) Robert Hooke.

75. Pollination occurs in

(a) bryophytes and angiosperms (b) pteridophytes and angiosperms

(c) angiosperms and gymnosperms (d) angiosperms and fungi.

76. Embryo sac occurs in

(a) embryo (b) axis part of embryo

(c) ovule (d) endosperm.

77. Which of the following pair have haploid structures?

(a) nucellus and antipodal cells

(b) antipodal cells and egg cell

(c) antipodal cells and megaspore mother cell

(d) nucellus and primary endosperm nucleus

78. Point out the odd one

(a) nucellus (b) embryo sac (c) micropyle (d) pollen grain

79. Syngamy means

(a) fusion of gametes (b) fusion of cytoplasms

(c) fusion of two similar spores (d) fusion of two dissimilar spores.

80. Double fertilization is fusion of

(a) two eggs

(b) two eggs and polar nuclei with pollen nuclei

(c) one male gamete with egg and other with synergid

(d) one male gamete with egg and other with secondary nucleus.

81. Meiosis is best observed in dividing

(a) cells of apical meristem (b) cells of lateral meristem

(c) microspores and anther wall (d) microsporocytes.

82. A population of genetically identical individuals, obtained from asexual reproduction is

(a) callus (b) clone (c) deme (d) aggregate.

83. Study of formation, growth and development of new individual from an egg is

(a) apomixis (b) embryology (c) embryogeny (d) cytology.

84. Ovule is straight with funiculus, embryo sac, chalaza and micropyle lying on one straight line. It is

(a) orthotropous (b) anatropous (c) campylotropous (d) amphitropous.

85. Double fertilization is characteristic of

(a) angiosperms (b) anatropous (c) gymnosperms (d) bryophytes.

86. Number of meiotic divisions required to produce 200/400 seeds of pea would be

(a) 200/400 (b) 400/800 (c) 300/600 (d) 250/500.

87. Embryo sac represents

(a) megaspore (b) megagametophyte

(c) megasporophyll (d) megagamete.

88. When pollen of a flower is transferred to the stigma of another flower of the same plant, the pollination is referred to as

(a) autogamy (b) geitonogamy (c) xenogamy (d) allogamy.

89. The polyembryony commonly occurs in

(a) tomato (b) potato (c) Citrus (d) turmeric.

90. In an angiosperm, how many microspore mother cells are required to produce 100 pollen grains?

(a) 75 (b) 100 (c) 25 (d) 50.

91. The anthesis is a phenomenon, which refers to

(a) development of anthers (b) opening of flower bud

(c) stigma receptors (d) all of these.

92. If there are 4 cells in anthers, what will be the number of pollen grains?

(a) 16 (b) 12 (c) 8 (d) 4.

93. The role of double fertilization in angiosperms is to produce

(a) cotyledons (b) endocarp (c) endosperm (d) hormones.

94. If an angiospermic male plant is diploid and female plant tetraploid, the policy level of endosperm will be

(a) tetraploid (b) pentaploid (c) haploid (d) triploid.

95. The embryo in sunflower has

(a) two cotyledons (b) many cotyledons

(c) no cotyledon (d) one cotyledon.

96.. An interesting modification of flower shape for insect pollination occurs in some orchids in which a male insect mistakes the pattern on the orchid flower for the female species anr1 tries to copulate with it, thereby pollinating the flower. This phenomenon is called

(a) pseudopollination (b) pseudoparthenocarpy

(c) mimicry (d) pseudocopulation.

97. Type of placentation in which ovary is syncarpous unilocular and ovules are on sutures is called

(a) marginal placentation (b) superficial placentation

(c) apical placentation (d) parietal placentation.

98. The endosperm of gymnosperm is

(a) diploid (b) polyploid (c) triploid (d) haploid.

99. Eight nucleated embryo sac is

(a) only monosporic (b) only bisporic

(c) only tetrasporic (d) any of these formed during the double

100. Endosperm is fertilization by

(a) two polar nuclei and one male gamete

(b) one polar nuclei and one male gamete

(c) ovum and male gamete

(d) two polar nuclei and two male gametes.

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