BOTANY-I

WORKBOOK(ENGLISHMEDIUM)

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PREFACE

"I hear and I forget – I see and I remember - I do and I understand – I think and I learn"

The Board of Intermediate Education, Andhra Pradesh, Vijayawada made an attempt to provide work books for the thirst time to the Intermediate students with relevant and authentic material with an aim to engage them in academic activity and to motivate them for self learning and self assessment.

These work books are tailored based on the concepts of "learning by doing" and "activity oriented approach" to sharpen the students in four core skills of learning – Understanding, Interpretation, Analysis and Application.

The endeavour is to provide ample scope to the students to understand the underlying concepts in each topic. The workbook enables the student to practice more and acquire the skills to apply the learned concept in any related context with critical and creative thinking. The inner motive is that the student should shift from the existing rote learning mechanism to the conceptual learning mechanism of the core concepts.

I am sure that these compendia are perfect tools in the hands of the students to face not only the Intermediate Public Examinations but also the other competitive Examinations.

My due appreciation to all the course writers who put in all their efforts in bringing out these work books in the desired modus.

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Secretary,
B.I.E., A.P., Vijayawada.

JUNIOR INTERMEDIATE WORK BOOK BOTANY

Unit -I Diversity in the Living World

Chapter 1 The Living World

Note to the students:

1. Please read the text book and go through the lines before you solve these small questions in the work book.

2. You may need to apply the Knowledge given in the chapter "Biotechnology: Principles and processes" to solve some questions.

3.Discuss the answers and solutions with your friends and your lecturer.

4.The key concept given above may give you some clues in solving the below questions.

Concepts of The Living World

1.1. WHAT IS 'LIVING'?

- Growth, reproduction, ability to sense environment and mount a suitable response come to our mind immediately as unique features of living organisms.
- One can add a few more features like metabolism, ability to self-replicate, self-organise, interact and emergence to this list.

Growth: All living organisms grow. Increase in mass and increase in number of individuals are twin characteristics of growth.

- In plants, this growth by cell division occurs continuously throughout their life span. In animals, this growth is seen only up to a certain age.
- In majority of higher animals and plants, growth and reproduction are mutually exclusive events.
- Non-living objects also grow if we take increase in body mass as a criterion for growth. In living organisms, growth is from inside.
- Growth, therefore, cannot be taken as a defining property of living organisms. A dead organism does not grow.

Reproduction: In multicellular organisms, reproduction refers to the production of progeny possessing features more or less similar to those of parents.

- When it comes to unicellular organisms like bacteria, unicellular algae or Amoeba, reproduction is synonymous with growth, i.e., increase in number of cells.

- Further, there are many organisms which do not reproduce (mules, sterile worker bees, infertile human couples, etc).
- Hence, reproduction also cannot be an all-inclusive defining characteristic of living organisms. Of course, no non-living object is capable of reproducing or replicating by itself.

Metabolism: All living organisms are made of chemicals. These chemicals changed into some other biomolecules. These conversions are chemical reactions or metabolic reactions.

- There are thousands of metabolic reactions occurring simultaneously inside all living organisms, be they unicellular or multicellular.
- All plants, animals, fungi and microbes exhibit metabolism. The sum total of all the chemical reactions occurring in our body is metabolism.
- No non-living object exhibits metabolism, So metabolism is a defining feature of all living organisms without exception. Hence, cellular organisation of the body is the defining feature of life forms.

Consciousness: Perhaps, the most obvious and technically complicated feature of all living organisms is this ability to sense their surroundings or environment and respond to these environmental stimuli which could be physical, chemical or biological.

- All organisms therefore, are 'aware' of their surroundings. Consciousness therefore, becomes the defining property of living organisms.
- Therefore, we can say that living organisms are self-replicating, evolving and self-regulating interactive systems capable of responding to external stimuli.

1.2 DIVERSITY IN THE LIVING WORLD

- If you look around you will see a large variety of living organisms, Each different kind of plant, animal or organism that you see, represents a species.
- The number of species that are known and described range between 1.7-1.8 million.

Identification-Nomenclature

- we know the plants and animals in our own area by their local names. These local names would vary from place to place, even within a country.
- Hence, there is a need to standardise the naming of living organisms such that a particular organism is known by the same name all over the world. This process is called nomenclature.

- Obviously, nomenclature or naming is only possible when the organism is described correctly and we know to what organism the name is attached to. This is identification.
- In order to facilitate the study, number of scientists have established procedures to assign a scientific name to each known organism.
- This is acceptable to biologists all over the world. For plants, scientific names are based on agreed principles and criteria, which are provided in International Code for Botanical Nomenclature (ICBN).
- Universal rules of nomenclature are as follows:

1. Biological names are generally in Latin and written in italics. They are Latinised or derived from Latin irrespective of their origin.
2. The first word in a biological name represents the genus while the second component denotes the specific epithet.
3. Both the words in a biological name, when handwritten, are separately underlined, or printed in italics to indicate their Latin origin.
4. The first word denoting the genus starts with a capital letter while the specific epithet starts with a small letter.

Ex: *Mangifera indica*. Name of the author appears after the specific epithet, i.e., at the end of the biological name and is written in an abbreviated form, e.g., ***Mangifera indica Linn***. It indicates that this species was first described by Linnaeus.

- Since it is nearly impossible to study all the living organisms, it is necessary to devise some means to make this possible. This process is classification.
- Classification is the process by which anything is grouped into convenient categories based on some easily observable characters.
- Hence, based on characteristics, all living organisms can be classified into different taxa. This process of classification is taxonomy.
- External and internal structure, along with the structure of cell, development process and ecological information of organisms are essential and form the basis of modern taxonomic studies.
- Hence, characterisation, identification, classification and nomenclature are the processes that are basic to taxonomy.

- Human beings were, since long, not only interested in knowing more about different kinds of organisms and their diversities, but also the relationships among them. This branch of study was referred to as systematics.
- The word systematics is derived from the Latin word 'systema' which means systematic arrangement of organisms.
- The scope of systematics was later enlarged to include identification, nomenclature and classification. Systematics takes into account evolutionary relationships between organisms.

1.3 TAXONOMIC CATEGORIES

- Classification is not a single step process but involves hierarchy of steps in which each step represents a rank or category.
- Each category, referred to as a unit of classification, in fact, represents a rank and is commonly termed as taxon.
- Each rank or taxon, in fact, represents a unit of classification.
- These taxonomic groups/ categories are distinct biological entities and not merely morphological aggregates.
- Taxonomical studies of all known organisms have led to the development of common categories such as kingdom, phylum or division (for plants), class, order, family, genus and species.

1.3.1. Species: Taxonomic studies consider a group of individual organisms with fundamental similarities as a species.

- One should be able to distinguish one species from the other closely related species based on the distinct morphological differences.
- Let us consider *Mangifera indica*, *Solanum tuberosum* (potato) and *Nicotiana tobacum* (tobacco) in this *indica*, *tuberosum* and *tobacco* represent the specific epithets.

1.3.2. Genus: Genus comprises a group of related species which has more characters in common in comparison to species of other genera. We can say that genera are aggregates of closely related species.

- For example, potato, tomato and brinjal are three different species but all belong to the genus *Solanum.*

1.3.3. Family: The next category, Family, has a group of related genera with still less number of similarities as compared to genus and species.

- For example, three different genera *Solanum*, *Nicotiana* and *Datura* are placed in the family Solanaceae

1.3.4 Order: Generally, order and other higher taxonomic categories are identified based on the aggregates of characters. The similar characters are less in number as compared to different genera included in a family.

- Plant families like Convolvulaceae, Solanaceae are included in the order Polymoniales mainly based on the floral characters.

1.3.5 Class: This category includes related orders.

- For example, orders like Malvales, Rosales and Polymoniales etc. are included in the class Dicotyledonae.

1.3.6 Division: Classes with a few similar characters are assigned to a higher category called Division.

- Classes like Dicotyledonae and Monocotyledonae with a few similar characters are assigned to a higher called division Spermatophyta (sub-division Angiospermae).

1.3.7 Kingdom: All plants belonging to various divisions are assigned to the highest category called Kingdom Plantae in the classification system of plants.

- Lower the taxa, more are the characteristics that the members within the taxon share. Higher the category, greater is the difficulty of determining the relationship to other taxa at the same level.

This table indicates the taxonomic categories of some common organisms

Common Name	Biological Name	Genus	Family	Order	Class	Phylum/ Division
Man	*Homo sapiens*	Homo	Hominidae	Primate	Mammalia	Chordata
Housefly	*Musca domestica*	Musca	Muscidae	Diptera	Insecta	Arthropoda
Mango	*Mangifera indica*	Mangifera	Anacardiaceae	Sapindales	Dicotyledonae	Angiospermae
Wheat	*Triticum aestivum*	Triticum	Poaceae	Poales	Monocotyledonae	Angiospermae

1.4. TAXONOMICAL AIDS

- Taxonomic studies of various species of plants, animals and other organisms are useful in agriculture, forestry, industry and in general in knowing our bio-resources and their diversity.
- These studies would require correct classification and identification of organisms. Identification of organisms requires intensive laboratory and field studies.

- The collection of actual specimens of plant and animal species is essential and is the prime source of taxonomic studies.

Some of these are explained to help you understand the usage of these aids.

1.4.1 Herbarium: Herbarium is a store house of collected plant specimens that are dried, pressed and preserved on sheets.

- Further, these sheets are arranged according to a universally accepted system of classification.
- These specimens, along with their descriptions on herbarium sheets, become a store house or repository for future use.

1.4.2 Botanical Gardens These specialised gardens have collections of living plants for reference.

- Plant species in these gardens are grown for identification purposes and each plant is labelled indicating its botanical/scientific name and its family.
- The famous botanical gardens are at Kew (England), Indian Botanical Garden, Howrah (India) and at National Botanical Research Institute, Lucknow (India).

1.4.3. Museum: Biological museums are generally set up in educational institutes such as schools and colleges.

- Museums have collections of preserved plant and animal specimens for study and reference.
- Specimens are preserved in the containers or jars in preservative solutions. Plant and animal specimens may also be preserved as dry specimens

1.4.4. Key: Key is another taxonomical aid used for identification of plants and animals based on the similarities and dissimilarities.

- The keys are based on the contrasting characters generally in a pair called couplet. It represents the choice made between two opposite options.
- Each statement in the key is called a lead.
- Separate taxonomic keys are required for each taxonomic category such as family, genus and species for identification purposes.
- Keys are generally analytical in nature.
- Flora, manuals, monographs and catalogues are some other means of recording descriptions.

I – Fill in the blanks using the words given below:

taxon, genus, given area, direct, England, classification,

principles, fundamental, paired, botanical garden

1. A unit of _____represents a rank is commonly termed as taxon.

2. A group of individual organisms with _____ similarities are called as species.

3. Collection of living plants for reference can be seen in _____.

4. _____contrasting characters in the key are called as couplet.

5. Monograph contains information on any _____.

6. Actual account of habitat and distribution of plants of a _____is found in the flora.

7. Group of related species are grouped under _____.

8. In _____method the plants are identified with the help of herbarium.

9. The _____ and criteria of naming of plants are provided in ICBN.

10. The Royal botanical garden is located in _____.

II – Read the following statement and tick the right answer.

11. In a scientific name second word stands for

Species epithet / Genus

12. Increase in the mass and number of individuals are twin characters of

Reproduction / Growth

13. In the scientific name *Mangifera indica L.* 'L' stands for

Latin / Linnaeus

14. Identification of organism can be done indirectly with the help of

Herbarium / Manual

15.Dicotyledone and monocotyledone are two classes assigned to

Spermatophyta / Primata

16. The sum total of all the chemical reactions occurring in the body of a living organism

Catabolism / Metabolism

17. Reproduction is synonym with growth is most common in

Unicellular organisms / Multicellular organisms

18. Linnaeus is associated with

Binomial Nomenclature / Taxonomic Hierarchy

19. Group of related genera are grouped under

Family / Order

20. Study of different kinds of organisms their diversities and also relationships among them is referred to as

Nomenclature / Systematics

III – Carefully observe the following statements. Denote whether they are True or False.

21. Identification is an important pre requisite in Taxonomy.

22. Biological names are generally in English and written in Italics.

23.Higher the category, greater difficulty of determining the relationship to other taxa at the same level.

24. Basic unit of classification is genus.

25. Systema naturae is a book written by Aristotle.

26. Convolvulaceae is the order name in Taxonomic Categories.

27. Separate taxonomic keys are required for each taxonomic category.

28. Drying, pressing and preservation are the processes involved in the preparation of Flora.

29. Plant families like Convolvulaceae, Solanaceae are included in the order Polymoniales.

30. Keys are generally analytical in nature.

IV – Match the items in Section A with the items in Section B.

Section A		Section B
31. Man	[ ]	a. Convolvulaceae
32. Genus	[ ]	b. Class
33. Triticum	[ ]	c. Sapindales
34. Insecta	[ ]	d. Lucknow
35. Monocotyledons	[ ]	e. Order
36. Family	[ ]	f. Primata
37. NBRI	[ ]	g. England
38. Mango	[ ]	h. Diptera
39. Poales	[ ]	i. vulgare
40. RBG	[ ]	j. Datura

V – After reading the text book try to answer these simple questions on your own in one word or a sentence.

41. Systematics:

42. Museum:

43. Flora:

44. Species:

45. Lead:

46.Taxon:

47. Manual:

48. Consciousness:

49. Herbarium:

50. Monograph:

VI – After reading the lesson try to explain the following questions in one or two sentences.

51. Key;

Ans: _____

52. Taxonomy:

Ans: _____

53. Metabolism:

Ans: _____

54. ICBN:

Ans: _____

55. Binomial nomenclature:

Ans: _____

56. Growth:

Ans: _____

57. Taxonomic hierarchy:

Ans: _____

58. Botanical Garden:

Ans: _____

59. Taxonomical Aids:

Ans: _____

60. Kingdom:

Ans: _____

VII – Multiple choice questions.

61. Potato and brinjal are two different species belong to the genus [ ]

a) *Nicotiana*

b) *Datura*

c) *Solanum*

d) *Mangifera*

62. The character shown by non-living things [ ]

a) Metabolism

b) Growth

c) Consciousness

d) Reproduction

63. The correct order of taxonomic hierarchical arrangement? [ ]

a) Family> Kingdom> Class> Genus

b) Kingdom> Family> Genus> Class

c) Genus> Family> Class> Kingdom

d) Class> Genus> Family> Kingdom

64. Which one of the following is not a taxonomic aid? [ ]

a) Key

b) Systematics

c) Herbarium

d) Museum

65. Binomial nomenclature was first introduced by

a) Gaspard Bauhin

b) Aristotle

c) De Candolle

d) Linnaeus

66. The first word of binomial nomenclature is _____and it is in the form of _____ respectively. [ ]

a) Genus, Noun

b) Species, Adjective

c) Genus, Adjective

d) Species, Noun

67. Kew in England is a location well-known for

a) Plant Herbarium

b) Botanical Garden

c) Botanical Laboratory

d) Botanical Park

68. Identify the correct literature of this scientific name

a) *Mangifera Indica L.*

b) *Mangifera indica.*

c) *mangifera Indica L.*

d) *Mangifera indica L.*

69. which of the following is a wrong combination?

a) International centre for plant identification - Kew

b) Basic unit of classification - Species

c) Collection of living plants for reference - Botanical Gardens

d) Direct identification of plant species - Keys in Flora

70. Choose the correct statements from the following:

i) The Latin word ‘systema’ means systematic arrangement of organism.

ii) All living phenomenon are due to underlying principles.

iii) Nomenclature is only possible when the organism is described correctly and accurately identified.

iv) Identification of organisms requires intensive laboratory and field studies.

v) Key represents the choice made between two parallel options.

vi) Metabolism is a defining feature of all living organisms.

a) i, ii, v, vi

b) i, iii, iv, vi

c) ii, iv, v, vi

d) ii, iii, iv, v

VII – Check if you can answer some questions from previous NEET (AIPMT) and EAMCET papers.

71. Nomenclature is governed by certain universal rules. Which one of the following is contrary to the rules of nomenclature? [NEET 2016 PHASE-1]

1) The names are written in Latin and are italicised

2) When written by and the names are to be underlined.

3) Biological names can be written in any language.

4) The first word in Biological name represents the genus name and the second is a specific epithet,

72. The label of a herbarium sheet does not carry information on [NEET 2016 PHASE-2]

1) date of collection

2) name of collector

3) local names

4) height of the plant

73. Match the column I with column II for housefly classification and select the correct option using the codes given below [NEET 2016 PHASE-2]

Column I	Column II
A. Family	i) Diptera
B. Order	ii) Arthropoda
C. Class	iii) Muscidae
D. Phylum	iv) Insecta

	A	B	C	D
1)	iii	i	iv	ii
2)	iii	ii	iv	i
3)	iv	iii	ii	i
4)	iv	ii	i	iii

74. Study the four statements (A-D) given below and select the two correct ones out of them

[NEET 2016 PHASE-2]

A. Definition of biological species was given by Ernst Mayr.

B. Photoperiod does not affect reproduction in plants.

C. Binomial nomenclature system was given by R.H.Whittaker.

D. In unicellular organisms, reproduction is synonymous with growth.

The two correct statements are

1) B and C

2) C and D

3) A and D

4) A and B

75. Match the items given in Column I with those in Column II and select the correct option given below: [NEET-2018]

Column I	Column II
a. Herbarium	i. It is a place having a collection of preserved plants and animals.
b. Key	ii. A list that enumerates methodically all the species found in an area with brief description aiding identification.
c. Museum	iii. Is a place where dried and pressed plant specimens mounted on sheets are kept.
d. Catalogue	iv. A booklet containing a list of characters and their alternates which are helpful in identification of various taxa.

	a	b	c	d
1)	ii	iv	iii	i
2)	iii	ii	i	iv
3)	i	iv	iii	ii
4)	iii	iv	i	ii

76. Select the correctly written scientific name of Mango which was first described by Carolus Linnaeus. [NEET-2019]

1) *Mangifera indica* Car. Linn.

2) *Mangifera indica* Linn.

3) *Mangifera indica*

4) *Mangifera Indica*

77. Study the following list: [EAMCET-2017]

List I	List II
A. Convolvulaceae	i. Dicotyledons

B. Rosales	ii. Arthropoda
C. Mangifera	iii. Anacardiaceae
D. Insecta	iv. Polymoniales
	v. Monocotyledons

The correct answer is:

	A	B	C	D
1)	iv	i	v	ii
2)	iv	i	iii	ii
3)	iv	i	v	iii
4)	iv	i	ii	iii

78. Choose the correct set of taxonomic words belong to the given statement.

[EAMCET-2019]

I - Taxonomic category showing individual organisms with fundamental similarities.

II - Taxonomic category with same hierarchical status.

a) dicotyledonae	b) domestica	c) indica
d) insecta	e) mangifera	f) sapiens
g) mammalia	h) Monocotyledons	i) vulgaris

Options:

	I	II
1)	b c f i	a d g h
2)	a b c h	b c e i
3)	a b e d	e f g h
4)	c d e f	g h i a

Answers for I to VII

1	classification	11	Species epithet	21	T	31	f
2	fundamental	12	growth	22	F	32	j
3	botanical garden	13	Linnaeus	23	T	33	i
4	paired	14	manual	24	F	34	h
5	taxon	15	spermatophyta	25	F	35	b
6	given area	16	metabolism	26	F	36	a
7	genus	17	unicellular organism	27	T	37	d
8	direct	18	binomial nomenclature	28	F	38	c
9	principles	19	family	29	T	39	e
10	England	20	systematics	30	T	40	g

41. The study of different kinds of organisms their diversities and also the relationship among them is referred to as Systematics.

42. Collection of preserved plant and animal specimens in containers or jars for study and reference is termed as Museum.

43. The actual account of habitat, distribution and systematic listing of plants of a given area is termed as Flora.

44. A group of individual organisms with fundamental similarities is called Species.

45. Each statement in the key is called a Lead.

46. Any unit or category in a taxonomic system is referred to as Taxon.

47. A small book specially designed for ready reference is a Manual.

48. The ability of organism to sense the surroundings is termed as Consciousness.

49. A store house of collected plant specimens that are dried, pressed and preserved on sheets is called as Herbarium.

50. A book containing information on any one taxon is called as Monograph.

51. A taxonomic aid used for identification of plants and animals based on the similarities and dissimilarities is termed as a Key.

52. Characterisation, identification, classification and nomenclature are the basic components of taxonomy.

53. The sum total of all the chemical reactions (anabolism and catabolism) occurring in the body of an organism is referred as Metabolism.

54. International Code for Botanical Nomenclature (ICBN), Which provide agreed principles and criteria for scientific naming of plants.

55. Providing name with two components (Generic and specific epithet) is Binomial Nomenclature.

56. A permanent and irreversible in the size of a living organism generally accompanied by a change in dry weight is called growth.

57. Classification involves hierarchy of steps in which each step represents a rank or category. All the taxonomic categories together constitute the taxonomic hierarchy.

58. The collection of living plants for reference and identification purpose is called Botanical Garden. Each plant is labelled indicating its botanical / scientific name and its family.

59. The collection of actual specimens of plants and animal species is essential and is the prime source of taxonomic studies. Biologists have established certain procedures and techniques to store and preserve the information as well as the specimens are termed as Taxonomical Aids.

60. All plants belonging to various divisions are assigned to the highest category called Kingdom.

61	c	62	b	63	c	64	b	65	d	66	a	67	b	68	d	69	d	70	b
71	3	72	4	73	1	74	1	75	4	76	2	77	2	78	1				

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UNIT – DIVERSITY IN LIVING WORLD

CHAPTER 2: BIOLOGICAL CLASSIFICATION

*Aristotle was the earliest to attempt a more scientific basis for classification. He used simple morphological characters to classify plants into trees. shrubs and herbs.

* In Linnaeus' time a Two Kingdom system of classification with Plantae and Animalia kingdoms was developed that included all plants and animals respectively.

* R.H. Whittaker (1969) proposed a Five Kingdom Classification. The kingdoms were named Monera, Protista, Fungi, Plantae and Animalia. The main criteria for classification used by him include cell structure, thallus organisation, mode of nutrition, reproduction and phylogenetic relationships.

*KINGDOM MONERA :All prokaryotes like Archaebacteria, Eubacteria. Mycoplasma and Actinomycetes etc. are included in Kingdom Monera,

* Archaebacteria :These are special Monerans since they live in some of the most harsh habitats such as extreme salty areas (halophiles), hot springs (thermoacidophiles) and marshy areas (methanogens).The cell wall does not contain peptidoglycan but contains pseudomurein. Methanogens are also present in the gut of several ruminant animals such as cows and buffaloes and they are responsible for the production of methane (biogas) from the dung of these animals.

*Eubacteria Bacteria are the most abundant micro-organisms. They occur almost everywhere. Bacteria are grouped under four categories based on their shape: the spherical coccus (pl.cocci), the rod shaped Bacillus (pl:bacilli). the comma shaped vibrium (pl:vibrio) and the spiral Spirillum (pl:spirilla)

* The cyanobacteria (also referred to as blue-green algae. They often form blooms in polluted water bodies. Some of these organisms can fix atmospheric nitrogen in specialised cells called heterocysts, e.g. Nostoc and Anabaena. The red colour of red sea is due to Trichodesmium erythrium present in it.

*The Mycoplasma are organisms that completely lack a cell wall and are pleomorphic. They are the smallest living cells known and can survive without oxygen. They cause witches broom inplants, pleuropneumonia in cattle and mycoplasmal urethritis in humans.

* The Actinomycetes are branched filamentous bacteria which form radiatingcolonies in culture. The cell wall contains mycolic acid. A number of antibiotics are produced by actinomycetous members especially the genus Streptomyces.

KINGDOM PROTISTA :All single-celled eukaryotes are placed under Protista, include Chrysophytes, Dinoflagellates, Euglenoids, Slime moulds and Protozoans. Members of Protista are primarily aquatic.

Chrysophytes :This group includes diatoms and golden algae (desmids). They are found in fresh water as well as in marine environments. They are microscopic and plankton. Most of them are photosynthetic. In diatoms the cell walls form two thin overlapping shells, epitheca over hypotheca which it together as in a soap box. The walls are embedded with silica and thus the walls are indestructible. Thus, diatoms have left behind large amount of cell wall deposits in their habitat.this accumulation over billions of years is referred to as 'diatomaceous earth' or kieselguhr. Being gritty,this soil is used in polishing, filtration of oils and syrups. Diatoms are the chief producers' in the ocean.

Dinoflagellates:These organisms are mostly marine and photosynthetic. They appear yellow, green, brown, blue or red depending on the main pigments present in their cells. The cell wall has stiff cellulose plates on the outer surface. The flagella produce spinning movements, so these protists are called whirling whips. Some marine dinoflagellates like Noctiluca show bioluminescence. Very often red dinoflagellates like Gonyaulax undergo such rapid multiplication that they make the sea appear red (red tides in Mediterranean sea). Toxins released by such large numbers may even kill other marine animals such as fishes.

Euglenoidsconsists of a photosensitive stigma or eye spot on the membrane of the reservoir. Though they are photosynthetic in the presence of sunlight. when deprived of sunlight they behave like heterotrophs by predation on other smaller organisms. Interestingly, the pigments of euglenoids are identical to those present in higher plants. Example: Euglena. The reproduction is by longitudinal binary fission and a palmella stage is found in Euglena.

Slime moulds are saprophytic protists. The multinucleated mass of protoplasm Is surrounded by a plasma membrane. The body moves along decaying twigs and leaves engulfing organic material.

Protozoans are heterotrophs and live as predators or parasites. There are four major groups of protozoans

Amoeboid protozoans: These organisms live in fresh water, sea water or moist soil. Ex.Entamoeba are parasites

Flagellated protozoans: The parasitic forms cause diseases such as sleeping sickness. Example: Trypanosoma.

Ciliated protozoans: Example: Paramecium

Sporozoans: The most Paramecium notorious is Plasmodium (malarial parasite) which causes malaria.

KINGDOM FUNGI :The fungi constitute a unique kingdom of heterotrophic organisms. They show Some unicellular fungi. e.g.. yeast are used to make bread and beer. Other fungi cause diseases in plants and animals: wheat rust-causing Puccinia is an important example. Some are the source of antibiotics, e.g.. Penicillium. The common edible mushroom and toadstools are also fungi. White spots seen on mustard leaves are due to a parasitic fungus (Albugo).

With the exception of yeasts which are unicellular, fungi are filamentous. Their bodies consist of long, slender thread-like structures called hyphae. The network of hyphae is known as mycelium. Some hyphae are continuous tubes with multinucleated cytoplasm - these are called coenocytic hyphae. Others have septae or cross walls in their hyphae. The cell walls of fungi are composed of chitin and polysaccharides. The reserve food material is glycogen and oll.

The morphology of the mycelium, mode of spore formation and fruiting bodies form the basis for the division of the kingdom into various classes viz. Phycomycetes, Ascomycetes, Basidiomycetes and Deuteromycetes.

Members of phycomycetes are also called algal fungi. The mycelium is aseptate and coenocytic. Some common examples are Mucor (Figure 2.6a). Rhizopus (the bread mould) and Albugo (the parasitic fungi on mustard).

Ascomycetes commonly known as sac-fungi, the ascomycetes are unicellular, e.g.. yeast (Saccharomyces) or multicellular.eg.. Penicillium. They are saprophytic, decomposers. parasitic or coprophilous (growing on dung). Mycelium is branched and septate. The asexual spores are conidia produced exogenously on the special hyphae called conidiophores. Conidia on germination produce mycelium. During sexual reproduction a dikaryotic phase with ascogenous hyphae is formed. Sexual spores are called ascospores which are produced endogenously in sac like asci (singular ascus), Karyogamy and meiosis occur in asci. These asci are arranged in different types of fruiting bodies called ascocarps. The globose ascocarp without opening is called cleistothecium. The flask shaped ascocarp with an apical opening is called perithecium and cup or saucer shaped ascocarp is called apothecium. Some examples are Aspergillus , Claviceps. Penicillium andNeurospora. Neurospora is used extensively in biochemical and genetic work. Manymembers like morels and truffles are edible and are considered delicacies.

BasidiomycetesCommonly known forms of basidiomycetes are mushrooms, bracket fungi or puffballs. They are commonly known as club fungi. e.g., rusts and smuts. The basidia are arranged in fruiting bodies called basidiocarps. Some common members areAgaricus (mushroom) . Ustilago (smut). Puccinia (rust fungus), Polyporus (bracket fungus). Lycoperdon (puffball).

Deuteromycetes Commonly known as imperfect fungi because only the asexual or vegetative

phases of these fungi are known Some examples are Alternaria, (early blight) Colletotrichum (redrot) and Trichoderma.

KINGDOM PLANTAEincludes all eukaryotic chlorophyll-containing organisms commonly called plants. Plantae includes algae, bryophytes, pteridophytes, gymnosperms and angiosperms.

2.5 KINGDOM ANIMALIAThis kingdom is characterised by heterotrophic multicellular and their cells lack cell walls. They directly or indirectly depend on plants for food.

SIx KINGDOM CLASSIFICATION :Carl Woese proposed six kingdom classification. He replaced kingdom Monera with two distinct kingdoms. Bacteria and Archaea.

Thus the six kingdoms include Bacteria, Archaebacteria, Protista, Fungi, Plantae and Animalia.

VIRUSES, VIROIDS, PRIONS AND LICHENS

In the five kingdom classification of Whittaker there is no mention of lichens and some unicellular organisms like viruses, viroids and prions.

VirusesThese did not find a place in classification since they are not truly living'.

Lichens :Lichens are symbiotic associations i.e. mutually useful associations, between algae and fungi The algal component is known as phycobiont and fungal component as mycobiont. Lichens are very good pollution indicators - they do not grow in polluted areas.

-00000000000-

Fill in the blanks:

1. The scientist who classified plants into herbs, shrubs and tress _____
2. Two kingdom system of classification was developed by _____
3. Five kingdom classification is proposed by _____
4. In which kingdom the prokaryotic organisms were placed in five kingdom classification _____
5. The cell wall of archaebacteria contains _____
6. Methanogens are present in the gut of ruminant animals such as cows and buffaloes and they are responsible for the production of _____
7. Organisms which form bloom in the polluted water _____
8. Use of Heterocyst in nostoc and anabaena _____
9. The red color of red sea is due to _____

10. The disease caused my mycoplasmas in plants _____

11. Examples of chrysophytes _____

12. The cell walls of diatoms embedded with _____

13. The cell walls of diatoms form two thin overlapping shells, upper shell is called _____

14. The cell of actinomycetes contain _____ acid

15. Accumulation of diatoms cell walls over billions of years is referred as _____

Earth.

16. Name the Protista which is called as whirling whips _____

17. Name the fungi used to make bread and beer _____

18. Members of phycomycetes are known as _____ fungi.

19. Name the class in which sac-fungi are placed _____

20. Name the class in which bracket fungi puffballs are placed _____

II. Choose the correct answer

21. 5 Kingdoms in R.HWhittaker classification

A. Monera, Protista, Fungi, plants, Animalia.

B. Monera, plants, animalia, viruses, Euglenoids.

C. Protista, Animalia, chrysophytes, Plants, Slimemoulds.

D. Plants, Animalia, Euglenoids, protozoans, Fungi.

22. Criteria of Whittaker classification

A. Cell structure, thallus organization

B. Mode of nutrition, Reproduction.

C.phylogenetic relationships.

D. All of the above

23. Eubacteria occur in

A. Soil

B. Air

C. Everywhere

D. Deserts and deep oceans

24. The disease not caused by mycoplasmas

A. Witches broom

B. Pleuropneumonia in cattle

C. Mycoplasmal urethritis in man

D. Tetanus

25. Which of the following does not belong to Protista kingdom

A. Desmids

B. Noctiluca

C. Euglena

D. None of the above

26. Choose the organisms belong to Monera kingdom

A. Noctiluca

B. Trochodesmium

C. Paramaecium

D. Amoeba

27. Name the fungi belong to phycomycetes class

A. Mucar
B. Rhizopus
C. Albugo
D. All of the above

28. Name the fungi belong to Ascomycetes

A. Claviceps, penicillium
B. Morelsm truffles
C. Neurospora, aspergillus
D. All of the above

29. Whittaker not mentioned the following in his classification

A. Virus
B. Viroid
C. Prion
D. All of the above

30. Algae component in lichens

A. Mycobiont
B. Phycobiont
C. Bryophyte
D. Pteriodophyte

31. Fungal component in lichens

A. Pteridophyte
B. Byrophyte
C. Mycobiont

D. Phycobiont

32. Six kingdom classification proposed by

A. Aristotle
B. Mendal
C. Linnaeus
D. Carl woese

III. Match the following

33.

1) Bacteria	a) Chitin
2) Plants	b) Psuedomurein
3) Archaebacteria	c) peptidoglycan
4) Fungi	d) Cellulose

A. 1 – c 2 - d 3 - b 4- a
B. 1 – d 2 – a 3 – b 4 – c
C. 1 – a 2 – b 3 – c 4 – d
D. 1 – b 2 – c 3 – a 4 – d

34.

1) Monera	a) Basidiomycetes
2) Protista	b) Byrophytes
3) Fungi	c) Eubacteria
4) Plants	d) chrysophytes

A. 1 – a 2 - b 3 - c 4- d
B. 1 – c 2 – a 3 – b 4 – d
C. 1 – c 2 – d 3 – a 4 – b
D. 1 – c 2 – b 3 – a 4 – c

35.

1) Archaebacteria a) Antibiotics production
2) Eubacteriab) Methane gas production
3) Mycoplasmas c) Pleuropneumonia in cattle
4) Actinomycetes d) citrus cancer

A. 1 – d 2 - c 3 - b4- a
B. 1 – b 2 – d 3 – c 4 – a
C. 1 – d 2 – a 3 – b 4 – c
D. 1 – b 2 – a 3 – c 4 – d

36.

1) Chrysophytes a) Noctiluca, Goniolux
2) Dinoflagellates b) Trypanosoma
3) Euglenoids c) Diatoms, Desmids
4) Protozoans d) Euglena.

A. 1 – a 2 - b 3 - d 4- c
B. 1 – c 2 – d 3 – b 4 – a
C. 1 – b 2 – c 3 – d 4 – a
D. 1 – c 2 – a 3 – d4 – b

37.

1. Dinoflagellates a) Kieselguhr
2. Chrysophytes b) Malaria
3. Euglenoids c) Bioluminescence
4. Protozoans d) photosensitive stigma

A. 1 – a 2 - b 3 - d 4 - c
B. 1 – c 2 – d 3 – b 4 – a
C. 1 – b 2 – c 3 – d 4 – a

D. 1 – c 2 – a 3 – d 4 – b

38.

1) phycomycetes	a) Agarics
2) ascomycetes	b) Rhizopus
3) Basidiomycetes	c) Trichoderma
4) Deuteromycetes	d) Penicillium

A. 1 – d 2 - b 3 - c 4- a

B. 1 – b 2 – d 3 – a 4 – a

C. 1 – a 2 – b 3 – c 4 – d

D. 1 – c 2 – a 3 – d 4 – b

39.

1) Agarics	a) Rust fungi
2) Puccinia	b) Bracket fungi
3) Ustilago	c) puff ball
4) Polyporus	d) smut fungi
5) Lycoperdon	e)Mushroom

A. 1 – e 2 - d 3 - a4- b 5 - c

B. 1 – e 2 – b 3 – c4 – a 5 - d

C. 1 – e 2 – a 3 – d4 – b 5 - c

D. 1 – c 2 – d 3 – b 4 – a 5 - e

40.

1) Cleistothcium	a) cup shaped ascocarp

2) Perithecium b) globose ascocarp

3) Apothecium c) flash shaped ascocarp

A. 1 – a 2 - b 3 - c

B. 1 – c 2 – a 3 – b

C. 1 – b 2 – c 3 – a

ANSWERS

1. Aristotle 2. Linnaeus 3. R.H.Whittaker 4. Monera 5.Pseudomurein

6. Methane (Bio-gas) 7. Cyanobacteria 8. Nitrogen Fixation 9.Trichodesmiumerythrium

10.Witches broom 11. Diatoms & Desmids 12. Silica 13. Epitheca

14. Mycolic 15. Diatomaceous earth 16. Dinoflagellates 17. Yeast

18. Algal 19. Ascomycetes 20. Basidiomycetes.

21-A	22-D	23-C	24-D	25-D
26-B	27-D	28-D	29-D	30-B
31-C	32-D	33-A	34-C	35-B
36-D	37-C	38-B	39-C	40-C

UNIT 1 DIVERSITY IN LIVING ORGANISMS

CHAPTER 3: SCIENCE OF PLANTS – BOTANY

The study of living organisms is called Biology. In Greeklanguage 'BIOS means life and LOGOS means discourse.

Biology in relation to plants is generally called PlantScience but particularly emerged as 'Botany. In Greek language, 'Bous' refers to cattle and 'Bouskein' to cattle feed. In course of time 'Bouskein' gave rise to 'Butane' which gave birth to the present widely used title 'Botany.

DEVELOPMENT

Egyptians and Assyrians (4000 B.C)recorded information related to crop plants and fruit trees in the form of pictures (Hieroglyphics). During 1300 B.C Parasara in his book "Krishi Parasaram', the oldest book on agriculture, dealt about agriculture and about weeds. He also wrote another book 'Vrikshayurveda' and described differenttypes of forests, external and internal characters of plants including medicinal plants.

Theophrastus (340 B.C), regarded as 'Father of Botany described the external and internal characters of some 500 plants in his book de Historia Plantarum.

herbalists identified and described medicinal plants in their books called herbals. Gaspard Bauhin published the description and Identification of 6000 plants introducing Binomial Nomenclature for the first time.

the discovery of the cell by Robert Hooke (1665 who published the book 'Micrographia'

study of bacterial cell for the first time in living condition by Anton Van Leeuwenhoek'

anatomical study of plant tissues by Nehemiah Grew & Marcello Malpighi and discovery of sexual reproduction in plants by Camerarius.

Carolus Von Linnaeus popularised the Binomial Nomenclature System and also proposed the sexual system of classification. Stephen Hales observed for the first time conduction of water through xylem by root pressure and Joseph Priestley discovered the absorption of toxic gases and release of pure gas by green plants.

Hybridization experiments on Pea plants conducted by Gregor Johann Mendelmarked the beginning of Genetics. He introduced the laws of inheritance) and became popular as the 'Father of Genetics.

Ecological studies began with the works of Haeckel and others. Different types of plant classification were proposed by the famous Taxonomists, de Candolle, Endlicher, Bentham and Hooker.

Charles Darwin put forward the Theory of evolution'.Buchner discovered the enzyme zymase in yeast cells.

Mutations in plants by Hugo de Vries (1901); role of chromosomes in heredity by Sutton and Boveri

Double helical structure of DNA by Watson and Crick , discovery of the genetic nature of RNA by Frankel Conrat : artificial synthesis of the gene by H.G. Khorana; technique of plant tissue culture by Hanning, Shimakura, Skoog, White, Nitsch, Maheswari. Electron microscope was invented by Knoll and Ruska .

Identification of auxins by F.W. Went ; discovery of citric acid cycle, also called Tricarboxylic acid (TCA) cycle by Hans Krebs . crystallization of the enzyme urease by J.B. Sumner, understanding the mechanism of light reaction of photosynthesis by Robert Hill, Ruben, Arnon, Emerson and others.

Discovery of the C3-pathway of Carbon assimilation by Melvin Calvin, Benson and Bassham and

C4 pathway by Hatch and Slack . Indian Scientist Prof. V.S. Rama Das and his students also made significant contributions to C4 photosynthesis.

Scientists like Wodehouse, P.K.K. Nair, C.G.K. Ramanujam developed the science of pollen namely Palynology and modern taxonomists viz. Bessey, Rendle, Hutchinson, Takhtajan, Cronquist have proposed the phylogenetic classification.

Knowledge of Plant Physiology, for example, the role of minerals in plant nutrition is useful in rational usage of chemical fertilizers and control of mineral deficiencies to improve agricultural productivity. Similarly, the knowledge on the role of plant hormones in plant growth and development is highly significant to improve agriculture and horticulture through herbicidal control of weeds, breaking of seed dormancy, enhancement of shelf life period of leafy vegetables like spinach. artificial ripening of fruits like apple, banana and watermelon and rooting of stem cuttings for vegetative propagation.

Studies on many other plants víz. Amica. Cinchona. Neem. Datura, Digitalis. Rauwolfia, Withania, Ocimum, Belladonna. Aloe etc., having medicinal value are also important to explore them for human health care.

Production of antibiotics (Penicillin). bioinsecticides, single cell proteins (Spirulina. Chlorella) . Fuels like coal, coke, gasoline, petrol etc. are past formed products of fossil plants.bio-diesel is also produced from petro-plants, such as Jatropha and Pongamia which are rich in hydrocarbons. , usage of biofertilizers (Azolla, Nostoc, Anabaena. Rhizobium etc.) to avoid soil and water pollution caused by chemical fertilizers and prevention of soil erosion by sand binding plants. Usage of algae (Chlorella) as food for astronauts in space research programmes and extraction of iodine, agar agar etc., from several sea weeds.

BRANCHES of Botany: Morphology deals with the study and description of different organs of a plant. It is a fundamental requisite for classification of plants. It can be divided into two parts.

External Morphology is the study and description of external characters of plant organs like root, stem, leaf, flower, fruit and seed etc.

Internal Morphology is the study of internal structure of organs. It has two branches.

Histology is the study of different tissues present in the plant body.

Anatomy deals with the study of gross internal details of plant organs like root, stem, leaf, flower etc.

Cytology or Cell Biology is the study of structure and functions of cell and cell organelles and their multiplication.

Embryology deals with the study of development of male and femalegametophytes, formation of gametes, process of fertilization, development ofembryo, endosperm and seed.

Palynology is the study of the development, structure and all other aspects related to microspores or pollen grains.

Taxonomy or Systematic Botany deals with the identification, nomenclature and classification of plants into related groups on the basis Of information obtained from different fields of Botany.

Physiology deals with the study of different vital activities of plants like absorption of water and minerals, photosynthesis, respiration, nitrogen metabolism. growth

Plant Ecology is the study of reciprocal relationship between the plants and the environment in which they are living.

Palaeobotany deals with the study of fossil plants. It helps us in understandingthe course of evolution in plants.

Genetics deals with all aspects related inheritance, mutation etc. to genes such as their structure, synthesis,

Phytogeography is the study of geographical distribution of plants in the past and present.

Plant pathology is the study of causes, symptoms and methods of control ofplant diseases.

Phycology is the study of all aspects related to algae which are chlorophyllous and autotrophic thallophytes.

Mycology deals with the study of fungi which are non-chlorophyllus heterotrophic thallophytes.

Lichenology is the study of lichens which are a special group of plants in which

algal member and a fungal member live together as symbionts.

Bryology is the study of bryophytes (amphibians of plant kingdom).

Pteridology is the study related to pteridophytes. also known as vascular cryptogams.

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UNIT 1 DIVERSITY IN LIVING ORGANISMS

CHAPTER 3: SCIENCE OF PLANTS – BOTANY

Fill in the blanks

1. The study of living organisms is called _____.
2. In Greek language 'Bios' means _____ and LOGOS means _____
3. Biology in relation to plants is called _____
4. In Greek language 'BIOS' refers to _____ and bouskein to _____
5. During 1300 B.C books written by parasara are _____and _____
6. Father of Botany _____, the book written by him is _____
7. Name the scientist who introduced Binomial nomenclature first time _____
8. Cell was discovered by _____. He published the book named _____
9. Name the Indian scientist who made significant contribution to C4photosynthesis

   _____
10. Branch of botany that deals with the fossil plants is _____
11. The branch of botany that deals with special group of plants in which algal member and a fungal member live together as symbionts _____
12. Study of amphibians of plant kingdom_____
13. Study related to vascular cryptogams _____
14. Study of Chlorophyllous and autotrophic thallophytes _____
15. Study of non-chloropyllous heterotrophic thallophytes _____
16. Study of reciprocal relationship between the plants and the environment _____

17. Name the branch of botany deals with identification, nomenclature and classification of plants into groups _____

18. The study of development of male and female gametophytes, formation of gamates, process of fertilization, development of embryo, endosperm and seed is _____

19. The study of gene such as their structure synthesis, inheritance and mutation are _____

20. Study and description of different organs of a plant is _____

Choose the correct answer

21. Egyptians recorded information related to crop plants and fruit trees in the form of pictures is

    A. Micrographia

    B. Hieroglyphics

    C. Species plantaram

    D. Historia planatrum.

22. During the Renaissance period of 16^{th}, 17^{th} centuries described medicinal plants in books named

    A. Pomology

    B. Anthology

C. Genetics

D. Herbals

23. Plant classifications not proposed by

A. De candolle

B. Robert Hook

C. Endlicher

D. Bentham and Hooker

24. Modern taxonomists who proposed the phylogenetic classification during the 20^{th} century

A. Hutchinson

B. Bessy and Rendle

C. Takhtajan, Cronquist

D. All of the above

25. Name the algae used as food for astronauts in space research programs

A. Chlorella

B. Nostoc

C. Pongamia

D. None of the above

26. Name the petroplants rich in hydrocarbons

A. Azolla

B. Nostoc, Anabaena

C. Rhizobium

D. Jetropa, Pongamia

27. Bio-fertilizers

A. Azolla

B. Nostoc, Anabaena

C. Rhizobium

D. All the above

28. Products of fossils

A. Coal, Coke

B. Gasoline

C. Petrol

D. All of the above

29. Role of minerals in plants nutrition is useful in usage of fertilizers, control of minerals deficiencies to improve agricultural productivity is done by knowing the knowledge

A. Phycology

B. Plant physiology

C. Plant taxonomy

D. Palaeobotany

30. Plants used for human health care are

A. Arnica, Cinchona

B. Neem, Datura, Ocimum

C. Digitalis, Rawwoljia

D. All the above

Match the following

31. 1.Stephen Hales a) Theory of Evolution
    2. Haeckel b) Release of pure gas by plants
    3. Joseph priestly c) Conduction of water through xylem by root pressure
    4. Darwin d) Ecological studies

A. 1-c 2-d 3-b 4-a

B. 1-a 2-c 3-b 4-d

C. 1-d 2-a 3-c 4-b

D. 1-b 2-d 3-c 4-a

32. 1. Leeuwenhoek a) Sexual reproduction in plants
    2. Marcello Malpighi b) Popularized the binomial nomenclature
    3. Camerarius c) Study of living bacteria cell
    4. Linnaeus d) Anatomical study of plant tissues

A. 1-c 2-a 3-d 4-b

B. 1-C 2-d 3-a 4-d

C. 1-a 2-b 3-c 4-d

D. 1-b 2-a 3-d 4-c

33. 1. Hugo de vries a) Double helical structure of DNA

2. Frankel conrat b) Role of chromosomes in heredity

3.Sutton and boveri c) Mutations

4.Watson and crick d) Genetic nature of R.N.A

A. 1-a 2-c 3-d 4-b

B. 1-c 2-d 3-b 4-a

C. 1-b 2-c 3-d 4-a

D. 1-c 2-b 3-a 4-d

34. 1. H.G Khorana a) Tissue culture

2. Maheshwari b) Auxins

3.Knoll and Ruska c) Artificial synthesis of gene

4.Went d) Electron microscope

5. Mendel e) Laws of inheritance

A. 1-b 2-c 3-d 4-a 5-e

B. 1-c 2-a 3-e 4-b 5-c

C. 1-a 2-b 3-e 4-d 5-c

D. 1-c 2-a 3-d 4-b 5-e

35. 1. Hans Krebs a) light reaction of photosynthesis

2. Calvinb) c4 pathway

3.Robert Hill c) citric acid cycle in respiration

4.Hatch-slack d) C3-pathway of carbon assimilation

A. 1-d 2-a 3-b 4-c

B. 1-b 2-c 3-a 4-d

C. 1-c 2-d 3-a 4-b

D. 1-a 2-b 3-c 4-d

36. 1. Antibiotic a) spirulina, chlorella

2.Single cell proteins b) Iodine, agar-agar

3. sea weeds c) Penicillin

4. Petro plants d) Jatropa, Pongamia

A. 1-a 2-b 3-c 4-d

B. 1-c 2-a 3-b 4-d

C. 1-b 2-c 3-a 4-d

D. 1-a 2-c 3-d 4-b

ANSWERS

1.Biology 2. Life,Discourse 3. Plant science (Botany) 4. Cattle,Cattle feed

5.Krishiparasaram, Vrikshayurveda 6. Theophrastus, de Historia plantaram

7.Gaspard Bauhin 8. Robert Hooke , Micrographia 9. V.S.Rama Das 10. Paleobotany

11.Lichenology 12. Bryology 13. Pteridology 14. Phycology 15. Mycology

16. Plant Ecology 17. Taxonomy 18.Embryology 19.Genetics 20. Morphology

21-B	22-D	23-B	24-D	25-A
26-D	27-D	28-D	29-B	30-D
31-A	32-B	33-B	34-D	35-C
36-B				

Chapter-4: PLANT KINGDOM

Key points of Plant kingdom

- The plant Kingdom contains all **eukaryotic, multicellular organisms**. The plant kingdom can be divided into two groups. **i. cryptogams ii. Phanerogams**.
- Algae, Bryophytes and Pteridophytes are **cryptogams** or **non-flowering plants** while Gymnosperms and Angiosperms are **Phanerogams** or **flowering plants**, also called **spermatophytes** (seed bearing plants).

  In this chapter, we will study the general characters of **Algae**, **Bryophytes**, **Pteridophytes**, **Gymnosperms** and **Angiosperms**.

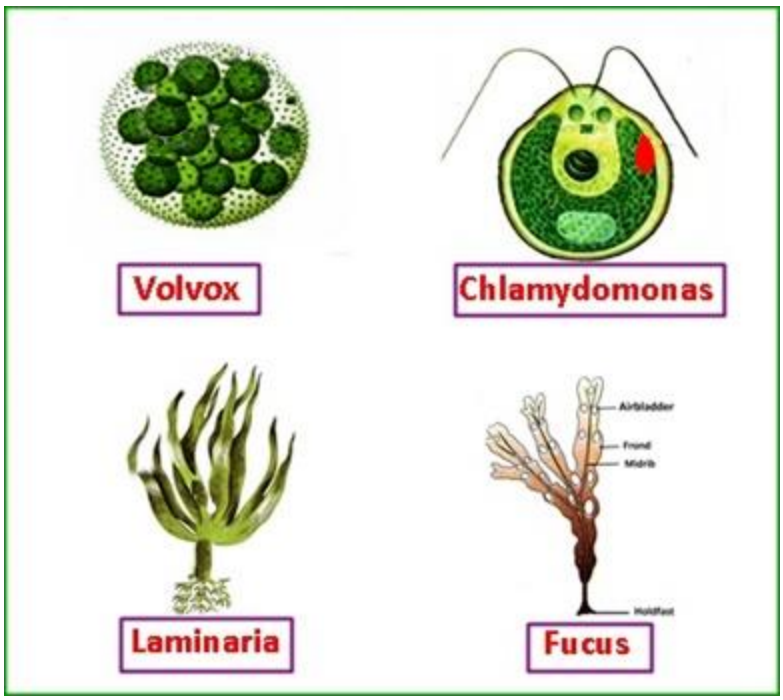
ALGAE

- Algae are simple, chlorophyll bearing and photosynthetic non-vascular plants.
- **Linnaeus** (1754) first coined the term algae. The study of algae is called **Phycology** or **Algalogy**. **F.E. Fritsch** is known as 'Father of Algalogy' and his student **M.O.P. Iyangar** is known as the 'Father of Modern Algalogy of India'.

- Algae are cosmopolitan in distribution. They occur in a wide variety of habitats – fresh, brackish and marine waters, in or on the soils, tree trunks, snow, hot springs etc.,
- Vegetative body of algae is **thalloid**. It is not differentiated into root, stem and leaves, Plant body is relatively simple **unicellular** (e.g: *Chlamydomonas*) or multicellular. Multi cellular thallus may be **colonial** (e.g: *Volvox)*, **dendroid** (tree-like) or **filamentous** type (e.g: *Spirogyra*).
- The cell wall consists of cellulose and other carbohydrates.
- Photosynthetic pigments like chlorophylls (a, b, c, d and e), carotenoids and phycobilins are present.
- Algae may be either autotrophic or heterotrophic. The heterotrophic algae may also be parasitic or saprophytic.
- Reserve food is in the form of **starch** (in chlorophyceae), **oil** (in xanthophyceae), **laminarin** and **mannitol** (in phaeophyceae), **floridian starch** (in Rhodophyceae).
- A number of algae (*Chlorella, Nostoc, Scytonema and Gleocapsa*) enter into a mutually beneficial symbiotic association with fungi to form **lichens**.
- Certain marine brown and red algae produce large amounts of hydrocolloids e.g: **Algin** (brown algae) and **carrageen** (red algae) which are used commercially. **Agar**, one of the commercial products obtained from ***gelidium*** and ***gracilaria*** is used to grow microbes and preparations of ice creams and jellies. Iodine is extracted from kelps like ***Laminaria***. ***Chlorella*** and ***spirullina*** are unicellular algae and are used as food supplements even by space travellers.

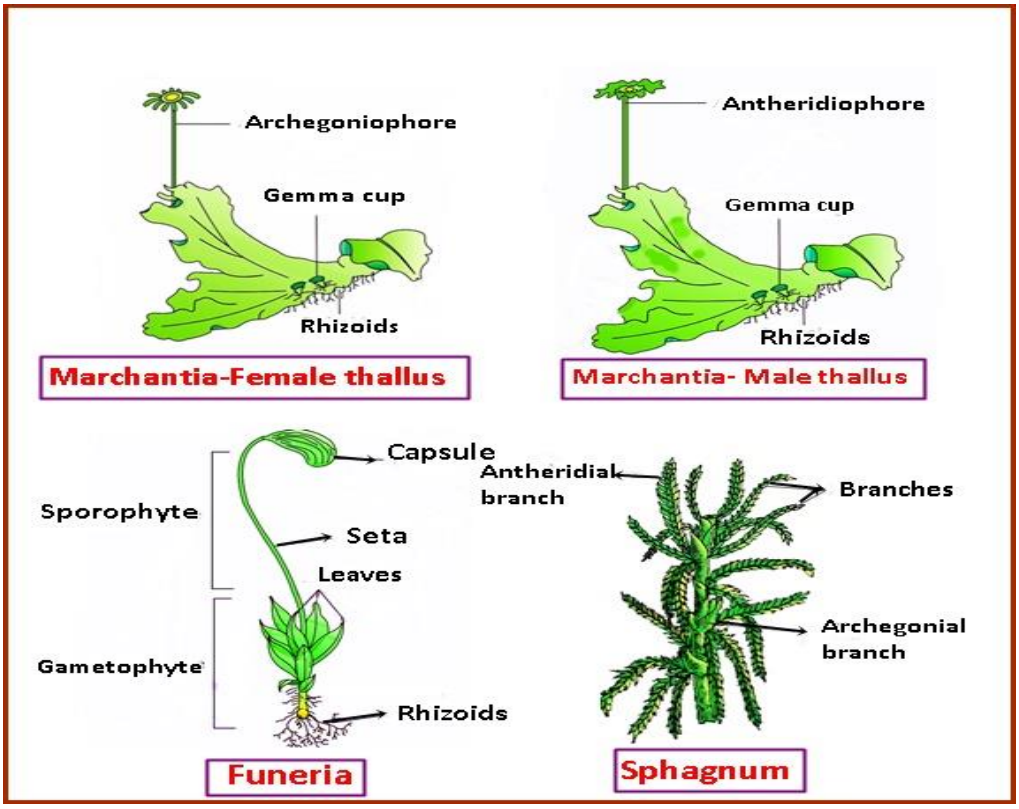
- Algae reproduce by vegetative, asexual and sexual methods.
- Vegetative reproduction is by fragmentation. Each fragment develops into a thallus. e.g: *Spirogyra*.
- Asexual reproduction takes place by the formation of motile zoospores or non-motile aplanospores. e.g: *Chlamydomonas*.
- Sexual reproduction takes place by the fusion of two gametes. Sexual reproduction may be isogamous, anisogamous and oogamous.

- The life cycle has distinct haploid and diploid phases exhibiting phenomenon of alternation of generations.
- Based on the pigment colour, nature of stored food material and cell organization, algae are divided into three main classes
- **Chlorophyceae** (**green-algae**): Ex- Volvox, Chlamydomonas, Chara, Spirogyra and Ulothrix.
- **Phaeophyceae (brown-algae)**: Ex- Ectocarpus, Laminaria, Sargassum, Fucus
- **Rhodophyceae** (**red-algae**): Ex- Polysiphonia, Porphyra, Gracilaria and Gelidium



BRYOPHYTES

- Bryophytes (Gr. **Bryon**: moss; **phyton**: plant) are small, herbaceous plants that grow closely packed together in mats, cushions on rocks, soil or as epiphytes on the trunks and leaves of forest trees.
- They are terrestrial but require water for sexual reproduction. Hence they are called **"Amphibians of plant kingdom"**.
- Bryophytes are archegoniate, embryophytic and atracheophtic cryptogams.
- The study of bryophytes is called **Bryology**. **Hedwig** is called 'Father of Bryology' and **Shivram kashyap** is called as 'Father of Indian Bryology'.



- Bryophytes are the primitive land plants and usually occur in damp, humid and shaded localities.
- The plant body of bryophytes is leafy or thalloid. A thalloid plant body lack true root stem and leaves. It is prostrate or erect and attached to the substratum by unicellular or multicellular rhizoids.
- The mosses (e.g: ***Funaria***) possess root - like rhizoids, leaf-like phylloids and stem-like cauloids.
- The plant body consists of parenchymatous tissue.
- The thallus - like plant body of bryophytes bears the gametes. For this reason it is called the gametophyte plant.
- Vascular tissues (xylem and phloem) are absent.
- Vegetative reproduction in bryophytes takes place by fragmentation, tuber formation and gemma formation.
- Sexual reproduction is of oogamous type.
- Sex organs in bryophytes are **multicellular**, **jacketed** and **stalked.** The male sex organ is called **antheridium**. They produce biflagellate antherozoids. The female sex organ is called **archegonium**. It is flask – shaped and produces a single egg.
- Both kinds of sex organs may be developed on the same individual or on distinct plants. The former are called monoecious and the later called dioecious.
- Fertilization occurs when the sex organs are matured. Moisture is essential for the maturing of the sex organs and also for the movements of the sperms towards the archegonia.

- The antherozoids are released into water where they come in contact with archegonium. An antherozoid fuses with the egg to produce the zygote. This is called **zooidogamous oogamy.**
- Zygote divides and develops into an embryo with in archegonia. Later, embryo develops into sporophyte.
- In some bryophytes (e.g: ***Marchantia, Funaria***) the sporophyte differentiate into three separate regions; the enlarged foot, the seta and capsule.
- The sporophyte is dependent partly or wholly on the gametophyte plant for its nutrition.

Gemma

Gemmas are green, multicellular vegetatively reproducing bodies. They are produced in gemma cups. After falling on suitable substratum each gemma give rise to a new plant.

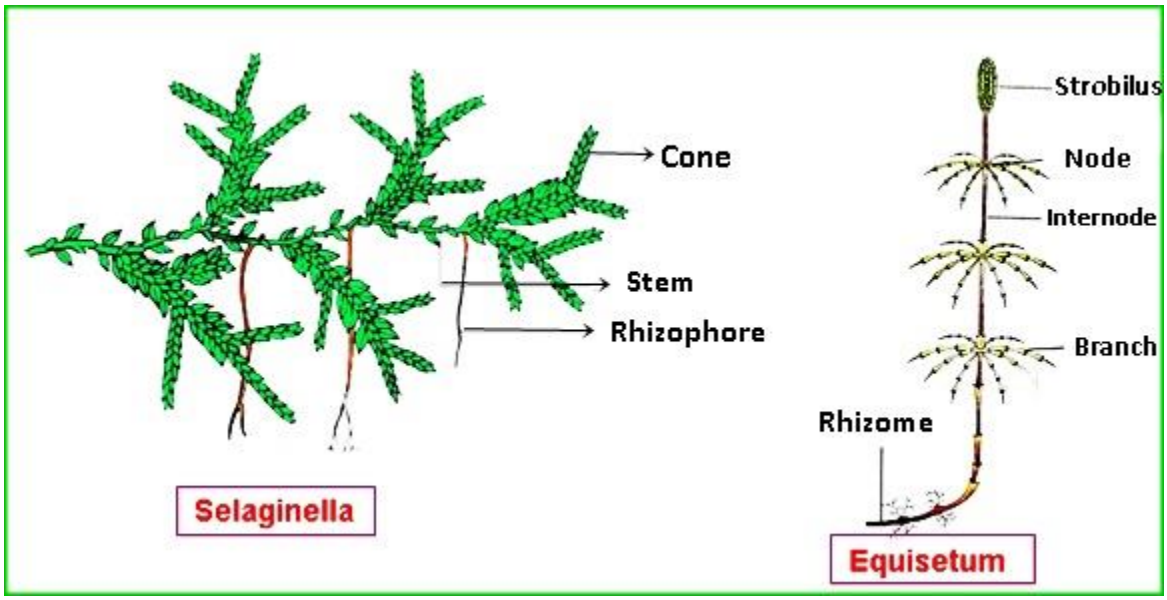
- All bryophytes are **homosporous**. After liberation, the spores germinate to produce a **protonema** which in turn, gives rise to adult gametophyte.
- Based on the structure of plant body and the method of sexual reproduction, bryophytes are divided into three classes.

- **Hepaticopsida** (Liver worts) – e.g: *Marchantia*
- **Anthocerotopsida** (Hornworts) – e.g: *Anthoceros*
- **Bryopsida** (Mosses) – e.g: *Funaria*

PTERIDOPHYTES

- Pteridophytes (Gr. **Pteron** = Feather; **phyton** = plant) constitute the most primitive seedless vascular plants that reproduce by means of spores. Hence, they are known as **'vascular cryptogams'**. **Haeckel** (1866) called these groups of plants as 'Pteridophytes' because of their pinnate or feather like fronds (leaves).
- Like reptiles (first true land animals that evolved after amphibians) they are considered as the first true land plants that evolved after bryophytes. Hence, Pteridophytes are sometime called **"Botanical snakes"** or **"snakes of plant kingdom"**.
- The study of Pteridophytes is called **'Pteridology'**.
- Pteridophytes are the first true land plants.
- Pteridophytes are basically terrestrial plants grow in moist shady cool places.
- The sporophyte is the dominant plant body which is differentiated into roots, stem and leaves. Gametophyte is a small, simple **prothallus**.
- Primary root is short lived and is replaced by adventitious roots.
- Stem is herbaceous or woody and branched.
- Leaves may be **microphyllous** (e.g*: Lycopodium, Selaginella*) or **megaphyllous** (e.g: Ferns). The leaves bearing sporangia are called sporophylls. In some cases sporophylls are in compact structures called cones or strobilus (e.g: *Selaginella, Equisetum*).

- Vascular tissues present throughout the sporophyte except in reproductive parts and in gametophyte. Xylem consists of tracheids (vessels and fibers absent). Phloem consists of sieve cells only.



- The sporophyte produces meiospores inside sporangia. The development of sporangia may be **eusporangiate** (from a group of cells, e.g: *Selaginella, Equisetum*) or **Leptosporangiate** (from a single cell, e.g: *Azolla, Marsilea*.)
- The sporophyte may be **homosporous** (e.g: *Pteris*) or **heterosporous** (e.g: *Selagenella*, Marsilea). In heterosporous forms, two types of spores are developed i.e., microspores and megaspores. Microspores and megaspores are produced in microsporangia and megasporangia respectively.
- The spore germinates into an inconspicuous free-living, photosynthetic thalloid gametophyte called **prothallus**.
- The microspores on germination produce male gametophyte (male prothallus) on which, sperms are produced. The megaspores produce the female gametophytes (female prothallus) on which eggs are formed.
- The gametophytes develop sex organs like **antheridia** (male sex organs) and **archegonia** (female sex organs) both sex organs are developed on the ventral surface of the prothallus.
- Fertilization required water for transfer of antherozoids to the egg of archegonium.
- Fusion between an egg cell and an antherozoid results in the formation of a zygote. The zygote develops directly by mitotic divisions into the sporophyte.
- The sporophytic (diploid) and gametophytic (haploid) phases alternate with one another and thus atternation of generations is fully perceivable.
- The Pteridophytes are divided into four classes

1. **Psilopsida** - e.g *: Psilotum*
2. **Lycopsida** - e.g : *Selagenella, Lycopodium*
3. **Sphenopsida** - e.g : *Equisetum*
4. **Pteropsida** - e.g : *Pteris*

GYMNOSPERMS

- Gymnosperms (Gr. **Gymno** = naked; **sperma** = seed) are most ancient and a history of the fossil records indicates that they once formed a predominant part of the earth's vegetation.
- Gymnosperms form a small group of plant kingdom, and are represented by only about 70 genera and 725 species. The word gymnosperm was first used by **Theophrastus**, one of the Aristotle's pupils.

Gymnosperms have no flowers or fruits and have naked seeds on the surface of scales or leaves.

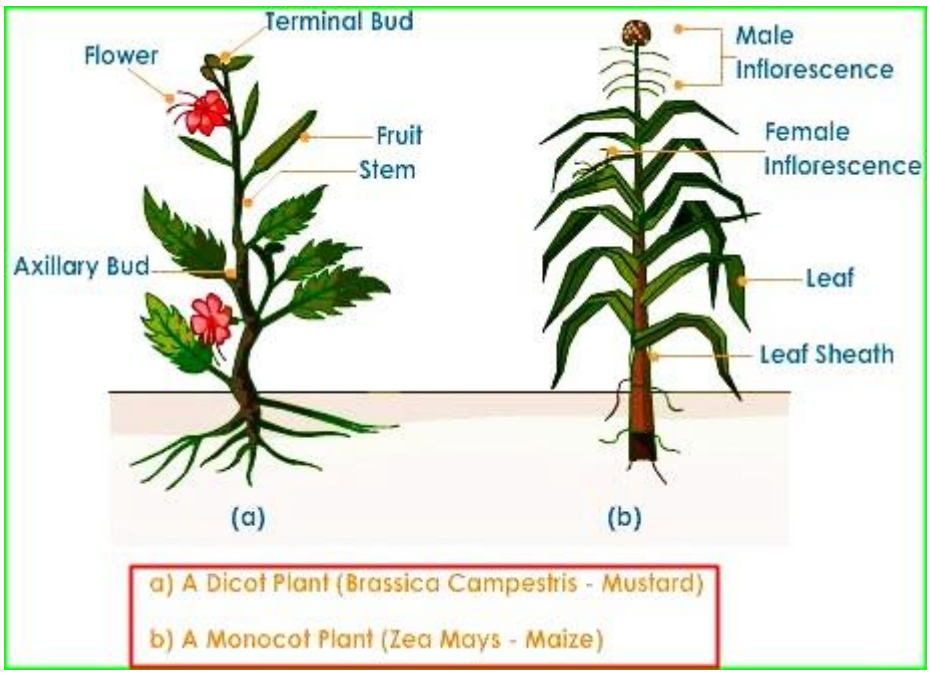
- Gymnosperms are mostly woody, evergreen, perennials with shrubby or tree- like habit. The plants show xerophytic characters.
- Gymnosperms are embryophytic, tracheophytic, archegoniate, Phaenerogams.
- Some of the gymnosperms attain a height up to 100 meters, e.g: *Sequoia sempervirens* (nearly 112 meters, the tallest living tree). The smallest gymnosperm is *Zamia pygmaea*, a cycad. *Ginkgo* is considered to be a living fossil.
- The roots are generally tap roots. Roots in some genera have fungal association in the form of **mycorrhizae** (*Pinus*). While in some others (*Cycas*) having small specialized roots called **coralloid roots**. These are associated with nitrogen fixing cyanobacteria (*Nostoc and Anabaena*).
- Stems are unbranched (*Cycas*) or branched (*Pinus*). The vascular bundles are conjoint, collateral, open and endarch. They are usually arranged in ring.
- The leaves may be foliage or scaly. They are large and pinnately compound as in cycas or small needlelike as in pinus. Leaves are spirally arranged.
- Cambium is present in stems and the plants show secondary growth.
- **Resin canals** occur in the leaves of all conifers. **Mucilage ducts** are in cycads while **latex tubes** are present in Gnetum.

- The reproductive structures are unisexual and aggregated in compact cones, in which a number of microsporophylls or megasporophylls are arranged on an elongated axis. The microsporophyll may be broad or peltate bearing microsporangia. The megasporophylls are foliar bearing naked ovules.
- The ovules are not enclosed inside the ovary. Instead, they are born naked on the leafy sporophylls. Due to absence of ovary, the true fruits are lacking.
- The pollination is direct. Gymnosperms are **wind – pollinated.**
- The pollen tube carrying the male gametes grows towards archegonia in the ovule and discharges the contents near the mouth of the archegonia. This is called **siphonogamous oogamy**.
- The endosperm is formed before fertilization.
- Embryo is formed inside the ovule. The ovule gets transformed into seed. Polyembryony is exhibited by many members of gymnosperms.
- Gymnosperms are divided into three classes-**Cycadopsida** (Cycas), **Coniferopsida** (Pinus) and **Gnetopsida** (Gnetum).

ANGIOSPERMS

- Angiosperms (Gr. **Angios** = closed; **sperma** = seed) are an exceptionally large group of plants occurring in wide range of habitats.
- The most prominent features of angiosperms are the ability to flower and produce fruits. In angiosperms, the seeds are enclosed in fruits. Based on the number of cotyledons in the seed, angiosperms are divided into two classes.

1. **Dicotyledons –** seeds having two cotyledons. e.g: Groundnut, pea.
2. **Monocotyledons –** Seeds having one cotyledon. e.g: Maize, rice



- Angiosperms are able to grow in a variety of habitats. They can grow as trees, shrubs, bushes as well as herbs.
- Plant body is well differentiated into root, stem and leaves.

- The root system of these plants is tap root or adventious type.
- The stem may be aerial, sub-aerial and underground.
- Vascular tissues like xylem and phloem are well developed.
- The leaf is considered as the flattened, lateral outgrowth of the stem or the branch, arising from node and having bud in its axil.
- The flowers are one of the most differentiating features of angiosperms. They are the reproductive structures of angiosperms. The male sex organs in a flower are the stamens. The female sex organ in a flower is the pistil or the carpel. Pistil consists of an ovary enclosing one to many ovules.
- The pollen grains after dispersal from the anther are carried by wind (anemophily) or water (hydrophily) or various other biotic agencies like animals (zoophily) to the stigma of a pistil. This is termed as pollination.
- The pollen grains germinate on the stigma and the pollen tubes grow through the tissue of stigma and style and reach the ovule. The pollen tubes entre the embryo sac where two male gametes are discharged. One of the male gametes fuses with the egg cell to form zygote (**syngamy**).The other male gamete fuses with the diploid secondary nucleus to produce the triploid primary endosperm nucleus (PEN). This is called **triple fusion.**

Double fertilization : **First male gamete + egg → Zygote**
Second male gamete + two polar nuclei → endosperm

- Because of the involvement of two fusions, this event is termed as **double fertilization.**
- The zygote develops into an embryo and the PEN develops into endosperm which provides nutrition to the developing embryo.
- After fertilization the ovary develop into **fruit** and ovules develop into **seeds.**

-o0o-

Fill in the blanks with suitable answer

1. At least a half of the total carbon dioxide fixation on the earth is carried out by _____through photosynthesis.
2. The vegetative cells of brown algae have a cellulosic wall usually covered on the outside by a gelatinous coating of _____
3. A group of algae grows in cold marine water regions and has algin in its cell walls, reserve food material is in the form of laminarin. This algal group belongs to _____class.
4. A plant shows thallus level of organisation. It shows rhizoids and is haploid. It needs water to complete its life cycle because the male gametes are motile. That plant belongs to_____ group.
5. In most green algae, pyrenoids represent the protein storage bodies located in _____.
6. In bryophytes water is necessary for the movement of _____during fertilization.
7. In pteridophytes, Heterospory leads to the development of_____.
8. In pteridophytes, the spore germinates into an inconspicuous free-living, photosynthetic thalloid gametophyte called _____.
9. Plants which produce seed, has a vascular tissue but lack flowers and fruits are _____.
10. A plant has fibrous root system, parallel venation and consisting one cotyledon within seed. That plant belongs to _____class.
11. The ovules are not enclosed inside the ovary. Instead, they are born naked on the leafy sporophylls. Due to absence of ovary, the true fruits are lacking. These characters belongs to_____.
12. The pollen grains after dispersal from the anther are carried by wind or water or various other biotic agencies like animals to the stigma of a pistil. This is termed as _____.
13. _____are green, multicellular, asexual buds, which develop in small receptacle cups located on the thalli.
14. The predominant stage of the life cycle of a moss is the gaetophyte which consists of two stages. The first stage is the _____stage, which develops directly from a spore.
15. Coralloid roots of cycas are meant for_____.

Answer True or False

S.NO	Statement	True/ False
1	Majority of the red algae are marine with greater concentrations found in warmer areas.	
2	The plant body of bryophytes is more differentiated than that of algae	
3	The sex organs in bryophytes are multicellular	
4	The double fertilization, an event not unique to angiosperms	
5	The dicotyledons are characterized by seeds having two cotyledons	
6	Gymnosperms are embryophytic, tracheophytic, archegoniate, Phaenerogams.	
7	Sex organs in bryophytes are unicellular, jacketed and stalked.	
8	**Agar**, one of the commercial product obtained from red algae	
9	*Pinus* having small specialized roots called **coralloid roots**.	
10	Most gymnosperms are wind-pollinated, except cycads.	
11	Pteridophytes are the first true land plants.	
12	The plant Kingdom contains all **eukaryotic, multicellular organisms**.	
13	In bryophytes, main plant body is sporophyte.	
14	Plant body of algae is well differentiated into root, stem and leaves.	
15	***Chlorella***, an unicellular alga used as food supplements for space travellers.	

Multiple Choice Questions: (LEVEL-1)

1.The branch of Botany dealing with algae is known as			
a. Mycology	b. Microbiology	c. Phenology	d. Phycology
2. **Flagellated and similar size gametes are found in**			
a. *Spirogyra*	b. *Volvox*	c. *Chlamydomonas*	d. *Fucus*
3. Fusion between one large, non-motile female gamete and a smaller, motile male gamete is termed as			
a. Isogamy	b. Anisogamy	c. Oogamy	d. Syngamy
4. Which of the following is autotrophic			
a. Protozoa	b. Fungi	c. Viruses	d. Algae
5. **Motile flagellated asexual spores are called as**			
a. Zygospores	b. Aplanospores	c. Tetraspores	d. Zoospores
6. **A group of autotrophic plants kept under thallophyta is**			
a. Algae	b. Fungi	c. Gymnosperms	d. Both a and b
7. Sexual reproduction in *spirogyra* is morphologically characterised by			
a. Oogamy	b. Anisogamy	c. Isogamy	d. Both a and b
8. At least a half of the total Co_2 fixation on the earth is carried out through photosynthesis by			
a. Algae	b. Bryophytes	c. Gymnosperms	d. Angiosperms
9. Agar, one of the commercial products obtained from			
a. *Gelidium*	b. *Gracilaria*	c. *Sargassum*	d. Both a&b
10. 'Algin' is a hydrocolloid obtained from			
a. Red algae	b. Green algae	c. Brown algae	d. Blue-green algae
11. 'Carrageen' is a hydrocolloid obtained from			
a. Green algae	b. Brown algae	c. Blue-Green algae	d. Red algae
12. The simplest of green plants are			
a. Algae	b. Fungi	c. Gymnosperms	d. Angiosperms
13. The members of chlorophyceae are commonly called as			
a. Red algae	b. Brown algae	c. Blue-green algae	d. Green algae
14. Which of the following pigments are found in green algae			
a Chl.a, Chl.b	b. Chl.a, Chl.d	c. Chl.c, Chl.d	d. Chl.b, Chl.d

15. Plant body in chlorophyceae members are			
a Unicellular	b. Colonial	c. Filamentous	d. All of these
16. Most of the chlorophyceae members have one or more protein storage bodies called			
a. Oil droplets	b. Starch bodies	c. Pyrenoids	d. All of these
17. Pyrenoids are the centre of the formation of			
a. Fat	b. Starch	c. Oil	d. Protein
18. Cup-shaped chloroplast is present in			
a. *Chlamydomonas*	b. *Spirogyra*	c. *Ulothrix*	d. *Chara*
19. The members of phaeophyceae are commonly called as			
a. Red algae	b. Blue-Green algae	c. Green algae	d. Brown algae
20. Which one of the following pigment is found in all algae?			
a. Chl.a	b. Chl.b	c. Chl.c	d. Chl.d
21. In which one of the following classes of algae the reserve food is stored in the form of laminarin or mannital?			
a. Chlorophyceae	b. Rhodophyceae	c. Phaeophyceae	d. Xanthophyceae
22. Brown algae are characterised by the pigment			
a. Phycocyanin	b. Phycoerythrin	c. Fucoxanthin	d. Haematochrome
23. Agar – agar is obtained from			
a. *Gelidium*	b. *Chara*	c. *Fucus*	d. All of these
24. The giant kelps belong to class			
a. Phaeophyceae	b. Chlorophyceae	c. Rhodophyceae	d. Xanthophyceae
25. Which of the following is principal pigment in phaeophyceae?			
a. Phycoerythrin	b. Fucoxanthin	c. Phycocyanin	d. Xanthophyll
26. Majority of the red algae are marine with greater concentrations found in			
a. Low depth areas	b. Warmer areas	c. Cold areas	d. Both a and b
27. Red algae reproduce a sexually by			
a. Motile zoospores	b. Ciliated zoospores	c. Non-motile spores	d. Clamydospores
28. The main plant body of the bryophyte is			
a. Haploid	b. Diploid	c. Triploid	d. Both a and b
29. Which of the following group is called as 'amphibians of the plant kingdom'?			
a. Gymnosperms	b. Bryophytes	c. Pteridophytes	d. Angiosperms
30. Gametophytic generation is dominant in			
a. Pteridophyta	b. Gymnosperms	c. Bryophyta	d. Angiosperms

31. In which of the following the sporophyte is attached to the gametophyte?			
a. Algae	b. Fungi	c. Bryophytes	d. Pteridophytes
32. Gemmae are vegetative reproductive bodies of			
a. Algae	b. Fungi	c. Pteridophytes	d. Bryophytes
33. In which part reduction division takes place in moss plant?			
a. Antheridium	b. Archegonium	c. Capsule	d. Gemma
34. The spore in case of moss on immediate germination gives rise to			
a. Sporophyte	b. Prothallus	c. Thallus	d. Protonema
35. The female sex organs in bryophytes are called			
a. Antheridia	b. Arechegonia	c. Oogonia	d. Ascogonia
36. Which of the following moss plant produce peat?			
a. *sphagnum*	b. *Funaria*	c. *Polytrichum*	d. All of these
37. Seed habit originated in			
a. Pteridophytes	b. Bryophytes	c. Algae	d. Fungi
38. Prothallus of fern produces			
a. Spores	b. Gametes	c. Both Spores and gametes	d. None of these
39. The leaves in pteridophyta are			
a. Microphylls	b. Macrophylls	c. Sporophylls	d. Both a and b
40. In pteridophytes a spore germinates to produce			
a. Sporophyte	b. Gametophyte	c. Sporophyll	d. Sporangium
41. The nacked seeded plants are			
a. Gymnosperms	b. Angiosperms	c. Bryophytes	d. Pteridophyts
42. Coralloid roots of *cycas* are meant for			
a. Co_2 fixation	b. Photosynthesis	c. Absorption	d. N_2 fixation
43. Which of the following has mycorrhiza?			
a. *Pinus*	b. *Cycas*	c. *Ginkgo*	d. *Sequoia*
44. Longest plants of the world belong to			
a. Pteridophytes	b. Gymnosperms	c. Dicots	d. Monocots
45. Which one of the following is Classified on the basis of cotyledons?			
a. Thallophytes	b. Gymnosperms	c. Angiosperms	d. Pteridophyte
46. Angiosperms differ from Gymnosperms in having			
a. Broad leaves	b. Tracheids	c. Fruits	d. Cotyledons
47. Haplo – diplontic life cycle is found in			
a. Bryophytes	b. Pteridophytes	c. Most fungi	d. Both a and b

48. Most algal genera are			
a. Haplontic	b. Diplontic	c. Haplo-biontic	d. Both b and c
49. Which kind of life-cycle pattern is exhibited by Ectocarpus and Polysiphonia?			
a. Haplo-diplontic	b. Diplo-biontic	c. Haplontic	d. Diplontic
50. Diplontic life cycle is found in			
a. Ecotocoscpus	b. Polysiphonia	c. Spirogyra	d. Fucus

Multiple Choice Questions: (LEVEL-2)

51. Which of the following algal members are unicellular, rich in proteins and are used as food supplements even by space travellers?	
a. *Nostoc and chlorella* b. *Gelidium and Gracilaria*	c. *Chlorella and spirulina* d. *Spirullina and Laminaria*
52. Green algae usually have a rigid cell wall made of an inner layer of _____ and an outer layer of _____	
a. Pectose, Cellulose b. Cellulose, Pectose	c. Pectose, Hemicellulose d. Hemicellulose, Cellulose
53. Which of the following members does not belong to green algae?	
a. *Chlamuydomonas, Volvox* b. *Ulothrix, Spirogyra*	c. *Fucus, Sargassum* d. All of these
54. A sexual reproduction in most brown algae is by biflagellate zoospores that are _____	
a. Pear shaped, two unequal lateral flagella b. Pear shaped, two equal lateral flagella	c. Pear shaped, two unequal apical flagella d. Pear shaped, two equal apical flagella
55. Which of the following does not belong to brown algae?	
a. *Ectocarpus, Fucus* *b. Laminaria, Dictyota*	c. *Sargassum, Laminaria* d. *Gelidium, Batrachospermum*

56. Which one of the following statement is in correct with respect to red algae?

a. Majority of the red algae are marine with greater concentrations found in warmer areas

b. They occur in both well – lighted regions close to the surface of water and also at great depths in oceans

c. The food is stored as floridean starch which is very similar to amylopectin and glycogen in structure

d. The red thalli of most of the red algae are unicellular

57. The sporophytic phase of mosses consisting of

a. Foot and capsule
b. Foot, seta and capsule
c. Capsule only
d. Spore sac only

58. Prothallus represents the

a. Sporophytic phase in *funaria*
b. Sporophytic phase in a fern
c. Gametophytic phase in a fern
d. Gametophytic phase in *marchantia*

59. Pteridophytes differ from Bryophytes in having

a. Independent gametophyte and sporophyte
b. Sporophyte dependent on Gametophyte
c. Gametophyte dependent on sporophyte
d. Absence of gametophyte

60.The heterosporous pteridophytes are

a. Pteris and selaginella
b. Lycopodium and Equisetum
c. Selaginella and Adiontum
d. Selaginella and Salvinia

61. In Gymnosperms, the ovule is nacked bacause

a. Ovary wall is absent
b. Perianth is absent
c. Integuments are absent
Nucellus is absent

62. Which of the following statement is not true for Gymnosperms?

a. Leaves are compound
b. They are homosporous
c. Nacked seeds are formed
d. The roots are generally tap roots

63. If seed is defined as an ovule modified as a result of fertilization, one may expect to find seed in

a. Gymnosperms only
b. Angiosperms only
c. All vascular plants
d. Phanerogams

64. Angiosperm differ from the Gymnosperms

a. in having compound leaves
b. being evergreen
c. in having ovules enclosed in ovary
d. being smaller in size

65. In flowering plants meiosis occur at the time of	
a. germination of seed b. formation of ovules	c. formation of pollen grains d. formation of root primordia
66. Which is the most logical sequence with reference to life cycle of angiosperms?	
a. Germination, endosperm formation, seed dispersal, double fertilization b. Pollination, fertilization, seed formation, germination c. Germination, endosperm formation, double fertilization, seed dispersal d. Pollination, fertilization, germination, seed formation	
67. The embryo sac of an Angiosperm is made up of	
a. 8 cells and 7 nuclei b. 7 cells and 7 nuclei	c. 7 cells and 8 nuclei d. 7 cells and 6 nuclei
68. Pollen grains represent	
a. Male gametophyte b. Female gametophyte	c. Male sporophyte d. Female sporophyte
69. The diploid sporophyte is the dominant, photosynthetic, independent phase of the plant. The gametophytic phase is represented by the single to few – celled haploid gameophyte. This kind of life cycle is termed as	
a. Haplontic b. Diplontic	c. Diplo-biontic d. Both a and b
70. In Bryophytes	
a. Gametophytes are dependant upon sporophyte b. Sporophytes are dependent upon gametophytes c. Sporophytic and gametophytic generation are independent d. Sporophyte in itself complete the life- cycle	

Match the following type Questions (LEVEL-3)

71. Match column – I with column – II and select the correct option from the codes given below.

	Column – I		Column – II
A.	Algae	1.	Prothallus
B.	Bryophytes	2.	Corolloid roots
C.	Gymnosperms	3.	Pyrenoids
D.	Pteridophytes	4.	Gemma

a. A – 3, B – 2, C – 4, D – 1
b. A – 4, B – 3, C – 1, D – 2
c. A – 3, B – 4, C – 2, D – 1
d. A – 4, B – 3, C – 1, D – 2

72. Match column – I with column – II and choose the correct answer

	Column – I		Column – II
A.	Gymnosperms	1.	*Pteris*
B.	Algae	2.	*Marchantia*
C.	Pteridophytes	3.	*Cycas*
D.	Bryophytes	4.	*Spirullina*

a. A – 3, B – 4, C – 1, D – 2
b. A – 2, B – 3, C – 4, D – 1
c. A – 3, B – 4, C – 2, D – 1
d. A – 2, B – 3, C – 4, D – 1

73. Match column – I with column – II and select the correct option from the codes given below.

	Column – I		Column – II
A.	Psilopsida	1.	*Adiantum*
B.	Pteropsida	2.	*Lycopodium*
C.	Lycopsida	3.	*Psilotum*
D.	Sphenopsida	4.	*Equisetum*

a. A – 3, B – 1, C – 4, D – 2
b. A – 4, B – 3, C – 2, D – 1
c. A – 3, B – 1, C – 2, D – 4
d. A – 4, B – 3, C – 1, D – 2

74. Match column – I with column – II and select the correct option

	Column – I		Column – II
A.	Algin	1.	Iodine
B.	Kelps	2.	Fuel
C.	Peat	3.	Used to grow microbes
D.	Agar	4.	Hydro colloid

a. A – 3, B – 2, C – 1, D – 4
b. A – 4, B – 1, C – 2, D – 3
c. A – 3, B – 1, C – 2, D – 4
d. A – 4, B – 2, C – 1, D – 3

75. Match the plant structures given in the column-I with their plants given in the column-II

	Column – I		Column – II
A.	Prothallus	1	Bryophytes
B.	Microsporophyll	2	Pteridophytes
C.	Protonema	3	Angiosperms
D.	PEN	4	Gymnosperms

a. A–3, B–1, C–4, D–2
b. A–4, B–3, C–1, D–2
c. A–2, B–4, C–3, D–1
d. A–2, B–4, C–1, D–3

76. Match the words of column – I with that of column – II and choose the correct answer given below

	Column – I		Column – II
A.	Algae	1	Gymnosperms
B.	*Marchantia*	2	Pond scum
C.	*Spirogyra*	3	Autotrophic
D.	*Gnetum*	4	Liver worts

a. A–3, B–2, C–4, D–1
b. A–4, B–3, C–1, D–2
c. A–3, B–4, C–2, D–1
d. A–2, B–4, C–4, D–3

77. Match the organism in Column A with the contents in Column B

	Column – A		Column – B
A.	*Gracilaria*	1.	Biflagellate zoospores
B.	*Ectocarpus*	2.	Elaters
C.	*Marchantia*	3.	Biflagellate antherozoids
D.	*Cycas*	4.	Carpogonium
		5.	Multiflagelltated male gametes

a. A – 1, B – 4, C – 3, D – 5
b. A – 4, B – 1, C – 2, D – 5
c. A – 4, B – 2, C – 3, D – 1
d. A – 4, B – 5, C – 2, D – 1

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

	Column-I		Column-II
A.	Proteins	1	*Porphyra, Sargassum*
B.	Carrageen	2	Red algae
C.	Algin	3	*Chlorella, Spirullina*
D.	Food	4	Brown algae

a. A – 3, B – 4, C –2), D –1
b. A – 1, B – 2, C –4, D – 3
c. A – 1, B –4, C –2, D – 3
d. A – 3, B – 2, C – 4, D –1

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

	Column-I		Column-II
A.	Chlorophyceae	1	*Fucus*
B.	Rhodophyceae	2	*Porphyra*
C.	Phaeo Phyceae	3	*Chara*

a. A – 3, B –1, C – 2
b. A – 2, B –3, C – 1
c. A – 3, B –2, C – 1
d. A – 2, B – 3, C –1

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

Column – I		Column – II	
A.	Psilopsida	1	*Seluginella*
B.	Lycopsida	2	*Adiantum*
C.	Sphenopsida	3	*Equisetum*
D.	Pteropsida	4	*Psilotum*

a. A – 4, B-3, C-1, D-2
b. A – 4, B-2, C-1, D-3
c. A – 4, B-1, C-2, D-3
d. A – 4, B-1, C-3), D-2

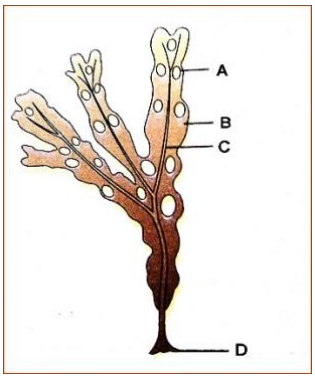
Diagram based Questions (LEVEL-4)

81. The algae shown in figure is

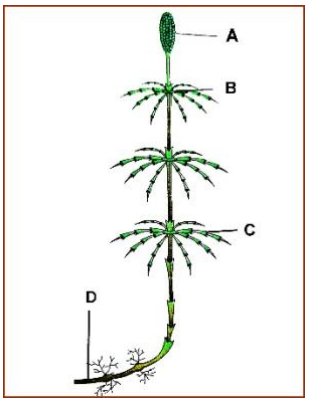
a. *Spirogyra*
b. *Chlamydomonas*
c. *Chara*
d. *Ulothrix*

82. Select the option that correctly identifies A, B, C and D in the given figure of Fucus

a. A – Air bladder, B – Frond, C – Midrib, D – Holdfast
b. A – Air bladder, B – Midrib, C – Frond, D – Holdfast
c. A – Holdfast, B – Frond, C – Midrib, D – Air bladder
d. A – Holdfast, B – Midrib, C – Frond, D – Air bladder



83. Identify the parts marked as A,B,C and D in the given figure of *Equisetum* Plant and select the correct option.



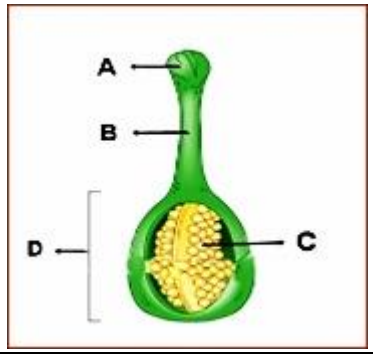
a. A – Strobilus, B – Branch, C - Node, D – Rhizome

b. A – Strobilus, B – Node, C - Branch, D – Rhizome

c. A – Strobilus, B – Branch, C - Rhizome, D – Node

d. A – Strobilus, B – Rhizome, C - Branch, D – Node

84. Select the option that correctly identified A, B, C and D in the given picture of gynoecium.



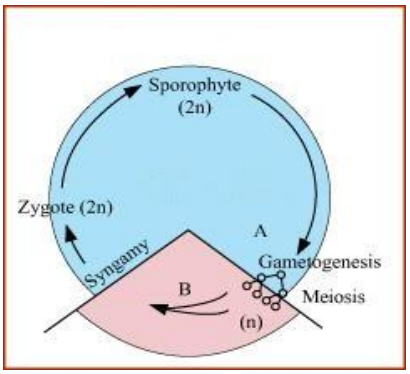
a. A – style, B - Stigma, C – Ovary, D – Ovule

b. A – Stigma, B – Style, C – Ovary, D – Ovule

c. A – Style, B – Stigma, C – Ovule, D – Ovary

d. A – Stigma, B – Style, C – Ovule, D – Ovary

85. Which kind of life-cycle is observed in the given figure



a. Haplontic

b. Diplontic

c. Haplo-diplontic

d. Diplo-biontic

86. Identify the gymnosperm plant given in the picture. Which is called as "Living Fossil".

a. *Cycas beddomi*

b. *Gnetum ula*

c. *Ginkgo biloba*

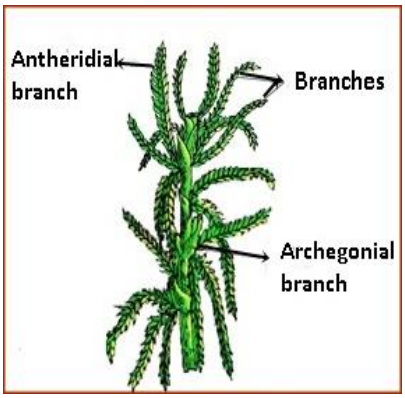
d. *Pinus sylvestris*

87. The alga shown in the figure belong to the class

a. Phaeophyceae
b. Chlorophyceae
c. Rhodophyceae
d. Cyanophyceae

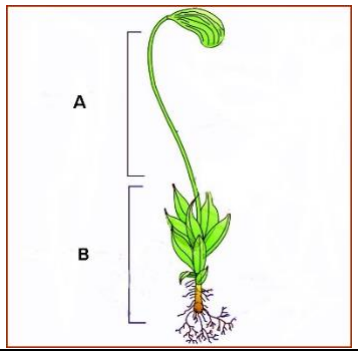
88. Which of the following options correctly identifies the plant shown in the figure and the group it belongs to?

a. *Funaria*- Moss
b. *Selaginella*- Pteridiphyte
c. *Sphagnum*- Liverwort
d. *Sphagnum*- Moss



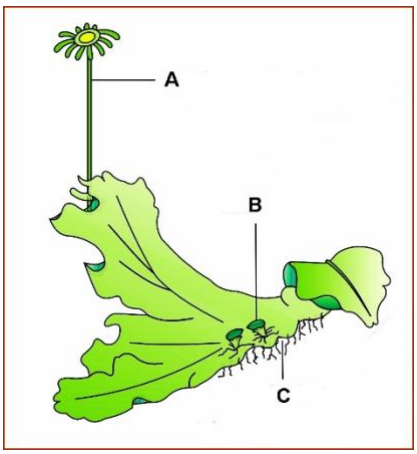
89. Select the option that correctly identifies A and B in the given figure

	A	B
a.	Sporophyte	Gametophyte
b.	Gametophyte	Sporophyte
c.	Female shoot	Male shoot
d.	Male shoot	Female shoot



90. Identify A, B, C in the given figure of female thallus of *Marchantia*.

	A	B	C
a.	Antheridiophore	Gemma cup	Rhizoids
b.	Antheridiophore	Rhizoids	Gemma cup
c.	Archegoniophore	Gemma cup	Rhizoids
d.	Archegoniophore	Rhizoids	Gemma cup



ASSERTION AND REASON TYPE QUESTIONS (LEVEL-5)

Directions: In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as:

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

(1) Assertion: Ginkgo biloba is living fossil.
Reason : Organism which have persisted and remain unchanged for the past for the past several million years while their relatives disappeared.

(2) Assertion: Gymnosperms do not produce fruit.
Reason : Ovules of gymnosperms are enclosed within the ovaries.

(3) Assertion: Only red algae are able to flourish at the great depth of sea.
Reason : Red algae has the pigment r-phycoerythrin.

(4) Assertion: Chlorella could be utilized to keep the air in space vehicles.
Reason : The space travellers feed on *Chlorella* soup.

(5) Assertion: The bryophytes exist in two phases-gametophyte and sporophyte.
Reason : The sporophyte is nutritionally independent.

(6) Assertion: The plant body of bryophyte is called gametophyte.
Reason : The plant body of bryophyte bears gamets.

(7) Assertion: Pteridophytes are sometimes called as **"Snakes of plant kingdom"**.
Reason : Like reptiles they are considered as the first true land plants.

(8) Assertion: The sex organs in the bryophytes are jacketed.
Reason : Bryophytes are called as **"Amphibians of plant kingdom"**.

(9) Assertion: In angiosperms, each cell of the embryosac is hapoid.
Reason : In angiosperms, embryosac formation is preceded by meiosis.

10. Assertion: Spores in mosses are contained within the capsule.
Reason : Spores are formed by mitotic division in mosses.

ANSWER KEY

Fill in the blanks

1. Algae	6. Antherozoids	11. Gymnosperms
2. Algin	7. Seed habit	12. Pollination
3. Phaeophyceae	8. Prothallus	13. Gemma
4. Bryophyte	9. Gymnosperms	14.Protonema
5. Chloroplast	10.Monocotyledon	15. Nitrogen fixation

True or False

Note: Correct statements are given in the brackets	
1	**True**
2	**True**
3	**True**
4	**False (**The double fertilization, an event is unique to angiosperms **)**
5	**True**
6	**True**
7	**False (**Sex organs in bryophytes are multi cellular, jacketed and stalked)
8	**True**
9	**False (***Cycas* having small specialized roots called **coralloid roots)**
10	**True**
11	**True**
12	**True**
13	**False** (In bryophytes, main plant body is gametophyte)
14	**False (**Plant body of algae is thalloid. It is not differentiated into root, stem and leaves**)**
15	**True**

Multiple Choice Questions (LEVEL-1)

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

Multiple Choice Questions (LEVEL-2)

51	**c**	**52**	**a**	**53**	**c**	**54**	**a**	**55**	**d**	**56**	**d**	**57**	**b**	**58**	**b**	**59**	**a**	**60**	**d**
61	**a**	**62**	**b**	**63**	**c**	**64**	**c**	**65**	**c**	**66**	**b**	**67**	**c**	**68**	**a**	**69**	**b**	**70**	**b**

Match the following type Questions (LEVEL-3)

71	c	72	a	73	c	74	b	75	d
76	c	77	b	78	c	79	c	80	a

Diagram based Questions (LEVEL-4)

81	b	82	a	83	b	84	d	85	b
86	c	87	b	88	d	89	a	90	c

Assertion and Reason Type Questions (LEVEL-5)

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

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JUNIOR INTERMEDIATE WORK BOOK
BOTANY

UNIT – II STRUCTURAL ORGANISATION OF PLANTS – MORPHOLOGY
CHAPTER – 5 MORPHOLOGY OF FLOWERING PLANTS

Key concepts of Morphology of flowering plants

- Theophrastus is considered as the "Father of Botany".
- *Historia Plantarum* (Enquiry into plants) and *Causae Plantarum* (on the causes of plants) were written by Theophrastus.
- The underground part of the flowering plant is root system – **positive geotropism.**
- The portion above the ground is the shoot system - **positive phototropism.**

The root

- After the seed germinates the radicle elongates into the soil and forms primary root.
- In dicot plants the primary root grows into a tap root with lateral roots and root hair – **Tap root system**
- In monocot plants the primary root is short lived and replaced by many fibrous roots – **Fibrous root system**
- In some plants roots arise from parts other than radicle to form adventitious roots – Ex: *Monstera* and Banyan (*Ficus bhengalensis*)
- Functions of root: 1. Absorption of water and minerals
  2. Anchorage to the plant
  3. Store reserve food
  4. synthesis of some growth regulators
- Regions of the root – 1. Root cap 2. Region of meristematic activity 3. Region of elongation 4. Region of maturation.
- Root hair arise from the region of maturation and absorb water and minerals from the soil.

Root modifications

- A permanent change in the structure of the root to perform special or additional functions is called a root modification.
- Types of root modifications:
  1. **Storage roots**: The roots store food materials and become swollen -tuberous roots Ex: carrot, turnip, (dicot roots)
     Asparagus (fibrous roots)
     Sweet potato (adventitious roots)

2. **Prop roots or pillar roots**: These roots arise from the horizontal branches in big trees and grow downwards to give additional mechanical support to the plant. Ex: Banyan
3. **Stilt roots**: These roots arise from the lower nodes of the stem and give additional support to the plant. Ex: Maize and sugarcane
4. **Pneumatophores /Respiratory roots**: In mangrove plants some roots come out of the soil vertically upwards and bear pores called pneumathodes which help in getting oxygen (respiration). These roots are called pneumatophores. Ex: Rhizophora, Avicinnea
5. **Velamen roots**: In some epiphytes the adventitious roots absorb moisture from the atmosphere. These roots are called velamen roots. Ex: Vanda
6. **Haustoria roots**: In some parasitic plants the roots are modified into haustoria which help in absorption of water only or water along with nutrients from the host. They are called haustoria.
   Ex: *Viscum* (partial stem parasite – draws only water and minerals from the xylem only host stem)
   Striga (partial root parasite – draws only water from the xylem of the host root)
   Cuscuta (complete stem parasite – draws water and food from both xylem and phloem of the host stem)
   Rafflesia (complete root parasite – draws water and food from both xylem and phloem of the host root)
7. **Nodular roots:** In some plants the bacteria like Rhizobium fix atmospheric nitrogen by forming nodules in the roots. Such roots are called nodular roots. Ex: Members of Fabaceae – *Pisum sativum*
8. **Photosynthetic roots**: In some plants the roots are chlorophyllous and perform photosynthesis. Ex: *Taeniophyllum*

The stem

- Stem is the central axis of the shoot system that bears branches, leaves, flowers and fruits.
- It is developed from plumule of the germinating seed.
- It bears nodes and internodes, buds etc.
- The region where leaves are borne is called a node.
- The portion between two nodes is called an internode.
- Based on the position the buds may be axillary or terminal.
- Functions of the stem:
  1. Spread out branches bearing leaves, flowers and fruits
  2. Conducts water, minerals and photosynthates

Stem modifications

- A permanent change in the structure of the stem to perform special or additional functions is called a stem modification. There are three categories of stem modifications.
    1. Underground stem modifications
    2. Aerial stem modifications
    3. Sub-aerial stem modifications
- **Underground stem modifications** store food, help in perennation, vegetative propagation and provide protection from grazing animals

1) **Stem tuber**: The tip of the underground stem stores food and swells up. Potato
2) **Rhizome**: It grows horizontally inside the soil and bears nodes and internodes, scale leaves and buds. Ex: *Zingiber*
3) **Corm:** It grows vertically inside the soil and bears nodes and internodes, scale leaves buds etc. Ex: *Amorphophallus* and *Colocasia*
4) **Bulb**: It is condensed stem inside the soil, surrounded by scale leaves storing food. Ex: onion.

- **Aerial stem modifications:**
    1) **Stem tendrils**: Thin, long, slender and spirally coiled structures that develop from axillary buds (cucumber, pumpkin, water melon) or terminal buds (grapevine) help in climbing.
    2) **Thorns:** Woody, straight and pointed structures help in protection from grazing animals. Ex: Citrus and *Bougainvillea*
    3) **Phylloclades:** Fleshy, green, photosynthetic, leaf like stems are called phylloclades. They may be flat (*Opuntia*), cylindrical (*Euphorbia*) or needle like (*Casuarina*)
    4) **Cladophylls:** The branches of limited growth that are modified to perform photosynthesis. Ex: *Asparagus*
    5) **Bulbils:** The vegetative buds store food and also help in vegetative reproduction. Ex: *Dioscorea* and *Agave*
- **Sub-aerial stem modifications** – help in vegetative propagation
    1) **Runners:** The stems grow horizontally on the soil or under the soil, spread their roots at every node and form new plants when older parts die. Ex: Grasses, Strawberry, Oxalis
    2) **Stolon:** Slender branch that grows from the base of the stem grows aerially, arches downward and produce adventitious roots. Ex: Nerium and Jasmine
    3) **Offset:** A lateral branch of one internode length bears rosette of leaves at each node and tuft of balancing roots from the base of the discoid stem. Ex: *Pistia* and *Eichhornia*
    4) **Suckers:** Some lateral branches arise from the underground part of the stem, grow horizontally and then upward to produce leafy shoots. Ex: Banana, Pineapple and *Chrysanthemum*

The leaf

- Most important vegetative organs for photosynthesis
- The leaf consists of a leaf base, petiole and lamina
- Monocots have a sheathing leaf base that covers the stem
- Pulvinous (swollen) leaf base is seen in some leguminous plants
- The green expanded blade like photosynthetic region of the leaf is lamina – shows venation, margin and apex

  Venation- The arrangement of veins and veinlets in the lamina
  Reticulate venation : veins and veinlets form a network. Dicots
  Parallel venation: veins run parallel to each other. Monocots

  Types of leaves:
  Simple leaf: The lamina is entire and not broken into leaflets
  Compound leaf: The lamina is dissected into small leaflets.
  1. **Pinnately compound leaf**: Leaflets are arranged on either sides of the common axis (rachis). Ex: Neem
  2. **Palmately compound leaf**: Leaflets are attached to the tip of the petiole. Ex: *Bombax ceiba* (silk cotton)

Phyllotaxy

- The pattern of arrangement of leaves on the stems and leaves is called phyllotaxy. 3 types:
  1. **Alternate phyllotaxy**: Single leaf at each node. Ex: *Hibiscus rosa-sinensis*, mustard and sun flower
  2. **Opposite phyllotaxy**: A pair of leaves at each node opposite to each other. Ex: *Calotropis*, Guava
  3. **Whorled** phyllotaxy: More than two leaves forming a whorl at each node. Ex: *Nerium* and *Alstonia*

Leaf modifications

- A permanent change in the structure of the leaf to perform additional or special function.
  1. **Leaf tendrils**: Whole leaf or a part of it may be modified into a thin, long, wiry, slender and coiled structure to help in climbing. Ex: *Pisum sativum*
  2. **Spine**: The leaf modifies into sharp structure to reduce transpiration and help in defence. Ex: *Opuntia*
  3. **Phyllode**: Expanded, green petioles that perform photosynthesis. Ex: Australian acacia
  4. **Insectivorous leaves**: leaf is modified into a trap like structure to trap insects or animals. Ex: *Nepenthes*, *Dionea*
  5. **Reproductive leaves**: epiphyllous buds are borne on the margins of leaves – help in vegetative reproduction. Ex: *Bryophyllum*

The inflorescence

- The arrangement of flowers on the floral axis is called an inflorescence.
- Inflorescences are three major types: Racemose, Cymose and Special

Racemose inflorescence	Cymose inflorescence
The main axis continues to grow indefinitely	The main axis shows limited growth
Main axis does not terminate in a flower	Main axis terminates in a flower
Flowers are produced in acropetal manner	Flowers are produced in basipetal manner
Flowers are numerous	Flowers are few in number

Types of racemose inflorescences

- Raceme, Corymb, Umbel, spike, spadix and head are Racemose types
- Simple inflorescences are unbranched
- Compound inflorescences are branched
- **Simple raceme** is unbranched Ex: *Crotalaria* (Compound raceme - *Mangifera*)
- In **simple corymb** all flowers are brought to same height due to varied lengths of pedicels Ex: *Cassia* (compound corymb – Cauliflower)
- Flowers appear to have arisen from the same point in **umbel** Ex: Onion (compound umbel – carrot)
- A whorl of bracts covers the umbel inflorescence called **'involucre'**.
- Acropetal arrangement of **sessile** flowers o the penduncle is called **spike.** Ex: ***Achyranthes*** (compound spike – grasses, rice etc of ***poaceae***)
- **Spadix** shows sessile unisexual and neuter flowers arranged in acropetal succession protected by a modified bract called **spathe**. Ex: ***Colocasia*** (compound spadix – ***Musa*** and ***Cocos***)
- **Head inflorescence** shows unisexual and bisexual sessile flowers arranged centripetally on condensed peduncle. Ex: Asteraceae members ***Tridax, sunflower*** etc

Types of cymose inflorescences

- **Solitary cyme** – bears a single flower on unbranched peduncle. Ex: ***Hibiscus*** and ***Datura***
- **Cymule or simple cyme** – three flowers arranged on unbranched peduncle in basipetal manner. Ex: ***Bougainvillea*** and ***Jasmine***
- **Monochasial cyme -** peduncle branched with one branch each time with flowers in basipetal manner. Ex: ***Hamelia*** and ***Solanum***
- **Dichasial cyme –** peduncle branched with two branches each time with flowers in basipetal manner. Ex: ***Ipomoea***

- **Polychasial cyme –** peduncle branched with more than two branches each time with flowers in basipetal manner. Ex: ***Nerium***
- **Special inflorescences**

1. **Verticellaster**
2. **Cyathium**
3. **Hypanthodium**

- **Verticellaster:** starts as a dichasial cyme and turns into monochasial cyme forming a false whorl around the node. Ex: ***Leucas, Leonitis*** (Lamiaceae)
- **Cyathium:** Naked (achlamydeous), stalked and unisexual flowers arranged in cymose manner inside a cup like involucre of bracts. Many male flowers are arranged around a single tricarpellary female flower in monochasial pattern. Ex: ***Euphorbia*** (Euphorbiaceae)
- **Hypanthodium:** unisexual flowers are arranged in a deep cup like fleshy peduncle. Male flowers near the opening, female flowers at the bottom and sterile gall flowers in between. After fertilization the whole inflorescence become a fruit – fig or syconus.
- Insect called ***Blastophaga*** lays eggs in gall flowers.

The flower

- Flower is the reproductive unit meant for sexual reproduction in angiosperms.
- The stalk or pedicel of the flower has a swollen end called thalamus or receptacle.
- Calyx, corolla, androecium and gynoecium arise on the thalamus.
- Calyx and corolla are called accessory organs, androecium and gynoecium called reproductive organs.
- Perianth – calyx and corolla are not distinct. Ex: Lily, Onion etc.
- Bisexual flower – has both androecium and gynoecium
- Unisexual flower – has any one. Male flower – has andoecium only and female flower has gynoecium only
- **Symmetry of a flower**
    1. **Actinomorphic :** the flower has radial symmetry – can be cut into two equal radial halves in any radial plane through the centre. Ex: *Datura*, Chillie, Mustard etc
    2. **Zygomorphic:** the flower is cut into two similar halves only in one vertical plane. Ex: Pea, Gulmohar, beans, *Cassia*
    3. **Asymmetric flower:** cannot be cut into two similar halves in any vertical plane passing through the centre. Ex: *Canna.*
- **Types of flowers based on the position of the ovary**
    1. **Hypogynous flower**: The ovary is superior and all the flowers parts are situated below it. Ex: Mustard, china rose and brinjal.

2. **Perigynous flower**: the ovary is half inferior or half superior and the floral parts are located on the rim of the thalamus. Ex: plum, peach, rose etc.
3. **Epigynous flower**: The ovary is inferior and the flower parts arise above the level of the ovary. Ex: Guava, cucumber, ray florets of sunflower etc.

Parts of a flower – calyx and corolla

- Calyx: green - sepals – united (gamosepalous), free (polysepalous)
- Corolla: coloured – petals – united (gamopetalous), free (polypetalous)
- Shapes of corolla
    1. Tubular – disc florets of Asteraceae
    2. Funnel shaped – Datura
    3. Bi-lipped – Ocimum
    4. Wheel shaped – Brinjal
    5. Bell shaled – Tecoma
- **Aestivation:** The mode of arrangement of sepals or petals in floral bud.
    1. **Valvate aestivation**: Sepals or petals of each whorl touch each other without overlapping. Ex: *Calotropis*
    2. **Twisted aestivation**: one margin of the petal overlaps that of the next one. Ex: China rose, lady's finger, cotton
    3. **Imbricate aestivation**: margins of sepals or petals overlap one another but not in a particular direction. Ex: Gulmohar, *Cassia*
    4. **Vexillary or papilionaceous aestivation**: the largest standard petal overlaps the two lateral petals (wings) which in turn overlap the two smallest keel petals. Ex: Pea or bean flowers

Parts of a flower – Androecium and gynoecium

- **Androecium** – whorl of stamens – male reproductive organ
- Each stamen has a stalk or filament and an anther
- Anther may be bilobed or dithecous or monothecous
- Pollen grains are produced in the anthers.
- **Staminode**: sterile stamen (does not produce pollengrains)
- **Epipetalous:** stamens attached to petals . Ex: Brinjal
- **Epiphyllous**: Stamens attached to perianth members (tepals) Ex: Lily
- **Polyandrous**: Stamens are free
- **Monadelphou**s: stamens are united into a single bundle. Ex: China rose
- **Diadelphous:** stamens are united into two bundles. Ex: Pea
- **Polyadelphous**: stamens are united into more than two bundles. Ex: Citrus

Gynoecium – whorl of carpels – female reproductive organ

- Each carpel has three parts – ovary, style and stigma
- If the carpels are more than one but free – apocarpous Ex: Lotus and rose

- If the carpels are more than one but fused – syncarpous Ex: mustard and tomato
- Ovary has ovules on the placenta
- After fertilization ovary develops into a fruit and ovules develop into seeds
- **Placentation** – the arrangement of ovules within the ovary
    1. **Marginal**: placenta forms a ridge along the ventral suture of the ovary and ovules are born on this ridge in two rows. Ex: Pea
    2. **Axile:** ovules are attached to the central axis in a multilocular ovary with septa. Ex: Tomato, lemon etc
    3. **Parietal:** Ovules develop on the inner wall of the ovary. Ex: Mustard, Argemone (false septum is formed)
    4. **Free central**: ovules are formed on the central axis without septa. Ex: *Dianthus, Primrose*
    5. **Basal:** Placenta develops at the base of the ovary and a single ovule is attached to it. Ex: Sunflower and marigold

FRUITS

- **Fruit** is a mature or ripened ovary after fertilization
- A fruit formed without fertilization is seed less – **parthenocarpic fruit**. Ex: Banana
- Fruit consists of a fruit wall (pericarp) and seeds.
- The pericarp may be fleshy or dry.
- A fleshy pericarp is differentiated into outer epicarp, middle mesocarp and inner endocarp.
- The fruits in which the thalamus and pedicel also contribute to fruit formation along with ovary are called **False fruits.** Ex: apple, cashew, strawberry
- The fruits that develop only from ovary are **True fruits**.
- The true fruits may be classified into fleshy and dry fruits based on the nature of the pericarp.

Fleshy fruits

- The fruit wall is fleshy and divisible into epicarp, mesocarp and endocarp.
    1. **Drupe:** It develops from a monocarpellary superior ovary and is one seeded. The epicarp is thin, mesocarp is flesh edible or fibrous and inner endocarp is hard and stony. Ex: Mango, Coconut
    2. **Berry:** It develops from bi or multicarpellary syncarpous gynoecium. The mesocarp and endocarp are fused to form pulp, seeds are hard. Ex: Guava, grapes, guava

3. **Pepo:** It develops from a tricarpellary, unilocular inferior ovary. The epicarp is like a rind, mesocarp is fleshy and endocarp is smooth. Ex: Cucumber.
4. **Hesperidium:** It develops from multicarpellary, syncarpous, multilocular, superior ovary. The epicarp is leathery with many volatile oil glands, papery mesocarp and endocarp with may juicy hair. Ex: Citrus
5. **Pome:** It develops from bi or multicarpellary gynoecium with inferior ovary. The endocarp is cartilaginous. Epi and mesocarps are fleshy surrounded by fleshy thalamus. Ex: Apple.

- **Dry fruits**
  The pericarp is dry or non-fleshy
- **Dehiscent fruits**- they break open to liberate the seeds
  1. **Legume:** The fruit dehisces dorsiventrally into two halves Ex: pea and beans
  2. **Capsule:** It dehisces in different ways to liberate the seeds Ex: Cotton, Datura
- **Indehiscent fruits** – They remain unopened and liberate the seeds after disintegration of pericarp. They are usually single seeded.
  1. **Caryopsis:** The pericarp and seed coat are fused together. Ex: grasses
  2. **Nut:** It develops from multicarpellary, syncarpous, unilocular ovary and the pericarp is stony. Ex: Cashew
  3. **Cypsela:** It is a single seeded fruit characterized by persistent pappus like calyx. Ex: *Tridax*
- **Schizocarpic fruits -**The fruit splits into one seeded bits called mericarps. Ex: *Acacia*
- **Aggregate fruits -**The carpels are many, free and each develops into a fruitlet to form a bunch of fruitlets. Ex: custard apple (*Annona squamosa*)
- **Composite fruit** – the entire inflorescence develops into a fruit. Ex: Jack fruit and pineapple.

THE SEED

- **Ovules** develop into seeds after fertilization
- A seed has a seed coat and an embryo.
- The embryo has an embryonal axis and one or two cotyledons.

I – Fill in the blanks using the words given under

Alstonia, lamiaceae, Theophrastus, seed coat, pneumatophores, root, parietal, aggregate fruits, apple, Monadelphous, *Cocos*, parthenocarpic, cypsela, underground stem corm, sucker, racemose, mericarps, Hypanthodium, spines, spathe

1. ……. is regarded as the father of botany.
2. The negatively phototropic part of the plant is ……
3. Mangrove plant Rhizophora shows …… roots.
4. The Amorphophallus or elephant foot yam is a …….. modification called …….
5. Whorl of leaves are found in ……..
6. In pine apple the sub aerial stem is modified into a ……..
7. The main axis continues to grow in a …… inflorescence.
8. The modified bract in a spadix inflorescence is called ……
9. ……..help in reducing the rate of transpiration.
10. Gall flowers are found in the ……. Inflorescence.
11. …….stamens are found in china rose.
12. Verticellaster inflorescence is characteristic of the family ……..
13. Thin epicarp, fleshy mesocarp and stony endocarp are seen in ……..
14. Banana is an example of ……fruit.
15. True and false fruits are present together in ……
16. Pappus is found in the fruit …….
17. In schizocarpic fruits the one seeded bits are called ……
18. Bunch of fruitlets are found in ……..
19. Ovules develop on inner walls of the ovary in …….placentation.
20. A seed is made up of an embryo and ……..

II– Read the following statements and tick the right answer.

21.	Two small lateral appendages present below the leaf base are called	bracts / stipules
22.	In rose flower the ovary is	Inferior/half inferior
23.	Petioles are modified in Australian acacia as	Phyllode /phylloclade
24.	In Dionea (venus fly trap) the trap is formed by	Stem / leaf
25.	The roots that arise from the aerial branches in Monstera are	Prop roots/ stilt roots
26.	The roots that perform photosynthesis are found in	*Avicinnea / Taeniophyllum*
27.	A root parasite with haustorial roots	*Loranthus / Rafflesia*
28.	Cladophylls are seen in	*Asparagus / Casuarina*
29.	Pulvinous leaf base is characteristic of the family	Asteraceae / Leguminosae

30.	Palmately compound leaf is seen in	Neem / silk cotton
31.	Leaf tendrils are observed in	Cassia / peas
32.	The inflorescence in rice and graminae is	Spike / spadix
33.	Achlymadeous flowers are found in	Cyathium / Hypanthodium
34.	Blastophaga lays eggs in	Neuter flowers / gall flowers
35.	In mustard the symmetry of flower is	Actinomorphic / zygomorphic
36.	Epipetalous stamens are found in	Brinjal / groundnut
37.	Endocarp forms juicy hair in	Drupe / hesperidium
38.	In Datura the fruit is	Legume / capsule
39.	Aggregate fruit is found in	Pine apple / custard apple
40.	Jack fruit is	Aggregate fruit / composite fruit

III – Carefully observe the following statements. Denote whether they are true or false.

41.	In Ipomea the flowers are arranged in dichasial cyme manner.	True / false
42.	Cyathium is a character of lamiaceae.	True / false
43.	Flowers are borne in basipetal manner in a umbel.	True / false
44.	Involucre of bracts is seen in umbel and cyathium.	True / false
45.	Stem is the positively phototropic part of the plant.	True / false
46.	The roots that arise from parts of the plant other than radicle are fibrous roots.	True / false
47.	Sugarcane has stilt roots to give additional support.	True / false
48.	Turnip is a type of storage root.	True / false
49.	Stem develops from the radicle of the embryo.	True / false
50.	Curcuma (turmeric) is a modified stem called bulb.	True / false
51.	Perennation is common in aerial and subaerial stems but not in underground stems.	True / false
52.	Axillary buds are modified into tendrils in cucumbers.	True / false

53.	Monocots show parallel venation in their leaves.	True / false
54.	Hibiscus has alternate phyllotaxy.	True / false
55.	Epiphyllous buds are seen in neem.	True / false
56.	Canna exhibits zygomorphic symmetry in its flower.	True / false
57.	Vexillary aestivation is seen in peas and beans.	True / false
58.	Legume dehisces along its dorsiventral valves into two halves.	True / false
59.	Castor fruit is schizocarpic.	True / false
60.	The pericarp is stony in a nut	True / false

IV - Match the items in section A with the items in Section B

61.	A	B	
1.	Rhizome	a. Potato	
2.	Corm	*b. Zingiber*	
3.	Stem tuber	c. Onion	
4.	Bulb	*d. Colacasia*	
5.	Bulbil	*e. Dioscorea*	

62.	A	B	
1.	Tendril	a. Bryophyllum	
2.	Spine	b. Onion	
3.	Phyllode	c. Peas	
4.	Epiphyllous bud	d. Opuntia	
5.	Storage leaf bases	e. Australian acacia	

63.	A	B	
1.	Colacasia	a. Spike	
2.	Crotalaria	b. hypanthodium	
3.	Achyranthes	c. Head	

4.	Tridax	d. Simple raceme	
5.	Ficus	e. Spadix	

64.	A	B	
1.	Marginal placentation	a. Marigold	
2.	Axile placentation	b. Peas and beans	
3.	Parietal placentation	c. Lemon	
4.	Free central placentation	d. Argemone	
5.	Basal placentation	e. Dianthus	

65.	A	B	
1.	False fruit	a. Cashew	
2.	Parthenocarpic fruit	b. Cotton	
3.	Caryopsis	c. Apple	
4.	Nut	d. Paddy	
5.	Capsule	e. Banana	

V-After reading the text book try to answer these simple questions on your own in one word or a sentence.

66. Region of meristematic activity is very delicate in the root . Hence it is protected by

……..

67. You have observed in your kitchen garden that the fenugreek plant is having number of nodules on it. What is the bacterium that is present inside to fix nitrogen?

..…….

68. Mangrove plants have low availability of oxygen to their roots. How do they help themselves?

…….

69. How do velamen roots help the epiphyte?

……..

70. Which root modifications are suited best to protect themselves from grazing

animals and also undergo perennation?
……

71. The branches of limited growth that perform photosynthesis are ……..
72. A lateral branch of one internode length in Eichhornia is called ……
73. Presence of two leaves at each node in Calotropis is called ……..
74. In a inflorescence all the flowers are brought to the same height due to varied lengths of petioles. It is called ……
75. In Chrysanthemum the florets are borne on the condensed peduncle in centripetal manner. What type of inflorescence is it? ……..

VI- After reading the lesson try to answer these questions in one or two sentences each

76. While you are passing by a garden you find that roots are hanging down from the horizontal branches of a huge banyan tree. Are they fibrous roots or adventitious roots? Give the reasons.
……
……
……
77. A farmer harvested his sweet potato in the end of second year. He found that the yield was very low. Can you give the reason why?
……
……
……
78. You observed that a chillie plant in your pot died due to water logging in the pot. What is the reason? Which plants have the mechanism to overcome this problem?
……
……
……
79. In *Hibiscus* there is only one leaf at each node, in *Calotropis* there are two leaves at each node opposite to each other, in Nerium each node has more than two leaves. Why? What is the specific purpose of such arrangement in plants?
……
……
……

80. Beetle leaf plant has a weak stem. But it manages to get sunlight by climbing up on a support. What type of modification do you find in this plant?

……
……
……

81. A plant living in a forest is deprived of certain nutrients. It has special leaves to trap insects. How does eating insects help the plant? What do you call such plants?

……
……
……

82. In a plant flowers are very small and assembled into compact groups on the condensed peduncle. On keen observation they are distinguished into two types, the disc florets (bisexual) and ray florets (unisexual). What do you call such an inflorescence? To which type does it belong to? Mention two examples.

……
……
……

83. On a huge peepal tree you find beautiful orange red fruit like structures. On opening them you observe that there are small male, female and gall flowers inside with a small opening called orifice. Can you identify the inflorescence? What type of fruit does it transform to? Which part of the inflorescence is modified into deep cup like fleshy structure?

……
……
……

84. You have cut open a flower and observed that the ovary is deeply seated below and the thalamus is completely fused with it. On the rim of the thalamus the sepals, petals and stamens are attached. What is the position of the ovary in this flower and what do you call such a flower as? Give an example.

……
……

85. In a flower there is a big standard petal which overlaps two lateral petals called wings, these two wing petals in turn overlap two small fused petals called keel petals. On opening the keel petals, you find both androecium and gynoecium inside. What is the kind of aestivation called? In which family you find it? Give two examples.

……
……
……

Multiple choice questions (LEVEL - I)

1. The book Historia Plantarum is written by			
1) Aristotle	2) Robert Hooke	3) Theophrastus	4) George Bentham
2. The fibrous root that stores food			
1. Turnip	2. sweet potato	3. ground nut	4. Asparagus
3. *Viscum* and *Loranthus* are			
1.Partial stem parasites	2. complete stem parasites	3. partial root parasites	4.complete root parasites
4. The horizontal underground stem that stores food in turmeric is a			
1. Rhizome	2. corm	3.stem tuber	4. bulb
5. Potato is a modified			
1. aerial stem	2. underground stem	3.sub-aerial stem	4.root modification
6.Fleshy cylindrical phylloclade is found in			
1. Opuntia	2. Casuarina	3.Euphorbia	4.Asparagus
7. The horizontal underground branches that come out obliquely upwards giving rise to leafy shoots are			
1.stolons	2.suckers	3.offsets	4.runners
8.Neem plant shows the following type of leaves			
1. pinnately compound leaf	2. palmately compound leaf	3. decompound leaf	4. whorled leaf
9.The arrangement of leaves in sunflower is			
1. opposite	2. alternate	3.whorled	4.mosaic
10.The racemose type of inflorescence found in Cassia and cauliflower is			
1. simple raceme	2. corymb	3.umbel	4.spike
11.Spathe is present in			
1.Musa	2.Cocos	3.Colocasia	4. All the three
12.Unisexual and bisexual florets are present centripetally in			
1. spike	2.spadix	3.umbel	4. head
13.In a hypogynous flower the ovary is			
1. superior	2. half superior	3. inferior	4. half inferior
14. Bi-lipped corolla is found in			
1. Datura	2. Ocimum	3. Peas	4. all the three
15.The placentation in Marigold is			
1. free central	2. parietal	3. marginal	4. None of these
16. In apple the false fruit develops from			

1. pedicel	2.thalamus	3. peduncle	4. calyx
17. The fruit with leathery epicarp having volatile oil glands			
1. pome	2. pepo	3. hesperidium	4. berry
18. A single seeded dry fruit with a stony pericarp is			
1. cypsela	2. nut	3.caryopsis	4. drupe
19.Bunch of fruitlets is a characteristic feature of			
1. aggregate fruits	2. composite fruits	3. compound fruit	4. complex fruit
20.The fleshy fruit that develops from a tricarpellary unilocular ovary with parietal placentation is			
1. pome	2.pepo	3.berry	4.drupe

Multiple choice questions (LEVEL – II)

1.Which of the following is true regarding velamen roots a. They are found in epiphytes b. They help in absorption of moisture c. They help in attachment d. They are adventitious roots			
1.abc	2.bcd	3.acd	4.abd
2.Choose the correct order of regions in a root tip from bottom upwards a. Region of maturation-region of elongation-region of meristematic activity b. Region of elongation-region of maturation-region of meristematic activity c. Region of meristematic activity-region of elongation-region of maturation d. Region of meristematic activity-region of maturation-region of elongation			
1.a	2.b	3.c	4.d
3.Which of the following is not true regarding underground stem modification			
1. stores food	2.perennation	3.vegetative propagation	4. none of these
4.Woody and straight thorns are found in			
1. Citrus and Bougainvillea	2. Citrus and Opuntia	3. Bougainvillea and Opuntia	4.Opuntia and Dioscorea
5.Floral buds store food and form bulbils in			
1. Dioscorea	2. Agave	3.Dioscorea and Agave	4.None of these
6.Runners are seen in			
1. Oxalis	2. grasses	3. Strawberry	4. All of these

7.Layering is a means on vegetative propagation in some plants based on the principle of			
1. Runners	2. Suckers	3. Stolons	4. Offsets
8.An offset shows a. one internode length lateral branch b. bears rosette of leaves c. Tuft of balancing roots d. Discoid stem			
1. abc only	2. acd only	3.bcd only	4.abcd
9. Vegetative propagation is a common character of			
1. All underground stem modifications and all sub aerial stem modifications	2. All aerial stem modifications and underground stem modifications	3. All underground stem modifications and some subaerial stem modifications	4. Some underground stem modifications and some subaerial stem modifications
10. The plant which shows root, stem and leaf modifications			
1. carrot	2.sweet potato	3. potato	4. Asparagus
11.Identify the wrong statement regarding umbel inflorescence			
1. The peduncle is condensed	2.Flowers appear to have arisen from the same point	3.Show varied lengths of pedicels	4. Involucre of bracts is present
12. Centripetally arranged unisexual and bisexual sessile flowers on a condensed peduncle are seen in the family			
1. Asteraceae	2.Poaceae	3.Lamiaceae	4. Euphorbiaceae
13.Special type of inflorescence is not found in			
1.Euphorbiaceae	2.poaceae	3.Lamiaceae	4. All of the above
14.The inflorescence that begins as a dichasial cyme and turns into monochasial cyme forming a false whorl around the node is seen in			
1. Cyathium	2.Head	3.Verticellaster	4. Hypanthodium
15.The fruit which has a dry fruit wall but does not dehisce and breaks into one seeded bits to liberate the seeds is			
1. Indehiscent fruit	2. Schizocarpic fruit	3. Aggregate fruits	4. All the three

Multiple choice questions (LEVEL- III)

1. Match Column-I with Column-II and select the correct option from the codes given below

Column-I	**Column-II**
A. Root cap	1. Region of maturation
B. Root hair	2. Region of elongation
C. Cell enlargement	3. Region of absorption
D. Cell differentiation	4. Calyptra

a. A=3, B=4, C=1, D=2
b. A=3, B=1, C=4, D=2
c. A=4, B=3, C=2, D=1
d. A=4, B=2, C=3, D=1

2. Match Column-I with Column-II and select the correct option from the codes given below

Column-I	**Column-II**
A. Prop roots	1. *Avicennia*
B. Stilt roots	2. *Cuscuta*
C. Pneumatophores	3. Banyan
D. Haustorial roots	4. Sugarcane

a. A=3, B=4, C=1, D=2
b. A=3, B=1, C=4, D=2
c. A=4, B=3, C=2, D=1
d. A=4, B=2, C=3, D=1

3. Match Column-I with Column-II and select the correct option from the codes given below

Column-I	**Column-II**
A. Nodular roots	1. Absorption of moisture
B. Velamen roots	2. Chlorophyllous
C. Tuberous roots	3. Nitrogen fixation
D. Photosynthetic roots	4. Food stored

a. A=3, B=4, C=1, D=2
b. A=3, B=1, C=4, D=2
c. A=4, B=3, C=2, D=1
d. A=4, B=2, C=3, D=1

4. Match Column-I with Column-II and select the correct option from the codes given below

Column-I	**Column-II**
A. Zaminkhand	1. Bulb
B. Potato	2. Stem tuber
C. Curcuma	3. Rhizome
D. Lilly	4. Corm

a. A=3, B=4, C=1, D=2
b. A=3, B=1, C=4, D=2
c. A=4, B=3, C=2, D=1
d. A=4, B=2, C=3, D=1

5. Match Column-I with Column-II and select the correct option from the codes given below

Column-I	Column-II
A. Stem tendril	1. Asparagus
B Cladophyll	2. Agave
C Phylloclade	3. Pumpkin
D Bulbil	4. Casuarina

a. A=3, B=4, C=1, D=2
b. A=3, B=1, C=4, D=2
c. A=4, B=3, C=2, D=1
d. A=4, B=2, C=3, D=1

6. Match Column-I with Column-II and select the correct option from the codes given below

Column-I	Column-II
A. Sucker	1. Strawberry
B. Stolon	2. Eichhornia
C. Offset	3. Nerium
D. Runner	4. Banana

a. A=3, B=4, C=1, D=2
b. A=3, B=1, C=4, D=2
c. A=4, B=3, C=2, D=1
d. A=4, B=2, C=3, D=1

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

Column-I	Column-II
A. Spine	1. Pisum
B. Leaf tendril	2. Dionea
C. Phyllode	3. Cacti
D. Trap leaf	4. Acacia

a. A=3, B=4, C=1, D=2
b. A=3, B=1, C=4, D=2
c. A=4, B=3, C=2, D=1
d. A=4, B=2, C=3, D=1

8. Match Column-I with Column-II and select the correct option from the codes given below

Column-I	Column-II
A. Simple raceme	1. Colocasia
B. Compound umbel	2. Oryza
C. Simple spadix	3. Crotalaria
D. Compound spike	4. Carrot

a. A=3, B=4, C=1, D=2
b. A=3, B=1, C=4, D=2
c. A=4, B=3, C=2, D=1
d. A=4, B=2, C=3, D=1

9. Match Column-I with Column-II and select the correct option from the codes given below

Column-I	Column-II
A. Solitary cyme	1. *Solanum*
B. Dichasial cyme	2. *Ipomea*
C. PolyChasial cyme	3. *Nerium*
D. Monochasial cyme	4. *Hibiscus*

a. A=3, B=4, C=1, D=2
b. A=3, B=1, C=4, D=2
c. A=4, B=3, C=2, D=1
d. A=4, B=2, C=3, D=1

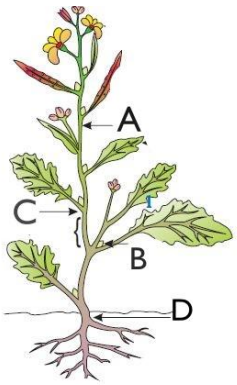
10. Match Column-I with Column-II and select the correct option from the codes given below

Column-I	Column-II
A. Valvate aestivation	1. Petals in beans
B. Vexillary aestivation	2. Petals of lady's finger
C. Imbricate aestivation	3. Sepals of Calotropis
D. Twisted aestivation	4. Cassia

a. A=3, B=4, C=1, D=2
b. A=3, B=1, C=4, D=2
c. A=4, B=3, C=2, D=1
d. A=4, B=2, C=3, D=1

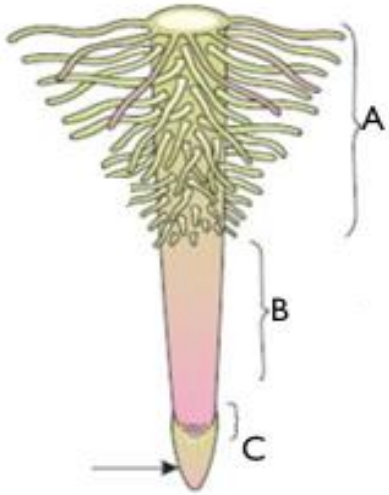
Multiple choice questions (LEVEL IV)

1. Identify the parts in the given diagram



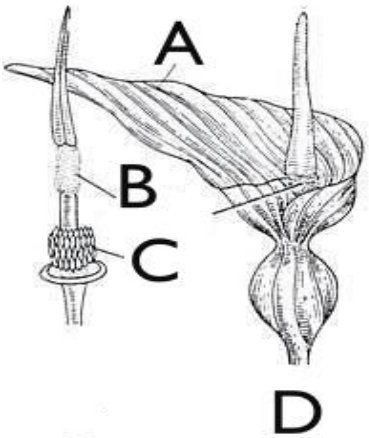
a. A-internode , B-node , C- axillary bud, D- tap root
b. A-node, B-terminal bud, C- node, D- tap root
c. A-node, B- axillary bud, C- internode, D-tap root
d. A- internode,B-lateral branch, C-node, D- lateral root

2. Identify the different regions of the root tip from top to bottom in the picture



a. A- Region of maturation, B-region of elongation, C-region of meristematic activity
b. A-Region of elongation, B-region of maturation, C-region of meristematic activity
c. A- Region of meristematic activity, B-region of elongation, C-region of maturation
d. A-Region of meristematic activity, B-region of maturation, C-region of elongation

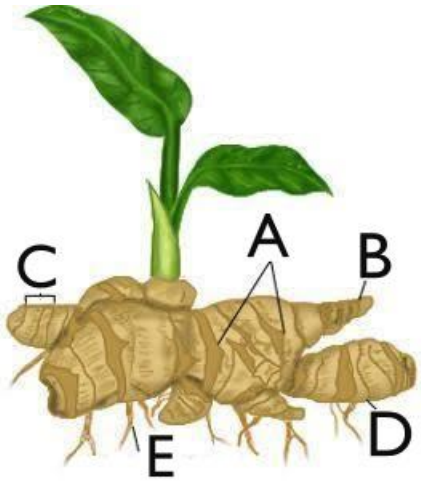
3. Identify the inflorescence and its parts in the below diagram



a. A- Spadix, B- Male flowers, C- Female flowers, D-Spathe
b. B-Spadix, B- Female flowers, C-Male flowers, D-Spathe

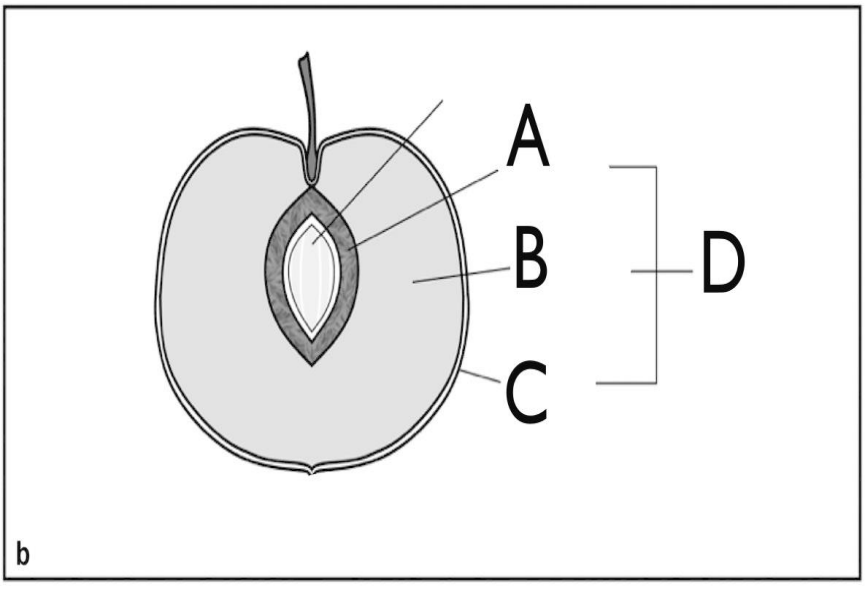
c. A-Spathe, B-Male flowers, C-Female flowers, D-Spadix
d. A-Spathe, B-Spadix, C-Male flowers, D-Female flowers

4. Identify the regions of given Rhizome – *Zingiber officinalis.*



a. A-Scale leaves, B-terminal bud, C-Internode, D-Node, E- Adventitious roots
b. A-Node, B-Internode, C- Scale leaves, D-adventitious roots, E- terminal bud
c. A- Scale leaves, B-terminal bud, C- Node, D-internode, E-Adventitious roots
d. A-Internode, B-Node, C-adventitious roots, D-scale leaves, E- terminal bud

5. Identify the regions in the fruit pome



a. A- Epicarp, B-Mesocarp, C-Pericarp, D- Endocarp
b. A-Endocarp, B- Epicarp, C-pericarp, D- Epicarp
c. A-Endocarp, B- Mesocarp, C- Epicarp, D-Pericarp
d. A-Pericarp, B-Endocarp, C-Mesocarp, D- Epicarp

Multiple choice questions – (Level V)

Directions: In the following questions, a statement of assertion is followed by a statement of reason.
Mark the correct choice as:
(a) If both (A) and (R) are true and (R) is the correct explanation of assertion
(b) If both (A) and (R) are true but (R) is not the correct explanation of (A)
(c) If (A) is true, but (R) is false
(d) If (A) and (R) are false

1. Assertion: Pneumatophores help in respiration
   Reason: Vivipary is seen in mangrove plants which live in swamps.
2. Assertion: In some plants like Opuntia the leaves are modified into spines.
   Reason: Phylloclade helps in photosynthesis.
3. Assertion: Eichhornia bears offsets with rosette of leaves and tuft of roots.
   Reason: Eichhornia has an aerial stem modification.
4. Assertion: In cymose inflorescence main axis terminates in a flower.
   Reason: The main axis continues to grow in cymose.
5. Assertion: Cassia has zygomorphic flowers.
   Reason: Flower in Cassia cannot be cut into two similar halves.
6. Assertion: Mustard plant shows inferior ovary.
   Reason: The flower in mustard is epigynous.
7. Assertion: Lotus and Rose have apocarpous condition.
   Reason: The carpels are more than one and free in lotus and rose.
8. Assertion: Mustard and Argemone shows parietal placentation.
   Reason: In parietal placentation the ovules are attached to the axis in multilocular ovary.
9. Assertion: Drupe fruit has a stony epicarp.
   Reason: Drupe is seen in cashew nut.
10. Assertion: Aggregate fruit is found in custard apple.
    Reason: In custard apple whole inflorescence transforms into a fruit.

Key – Chapter – 5 Morphology of flowering plants

1.	**Theophrastus**	**21.**	**Stipules**	**41.**	**True**
2.	**Root**	**22.**	**Half inferior**	**42.**	**False**
3.	**Pneumatophores**	**23.**	**Phyllodes**	**43.**	**False**
4.	**Underground stem corm**	**24.**	**Leaf**	**44.**	**True**
5.	**Alstonia**	**25.**	**Stilt roots**	**45.**	**True**
6.	**Sucker**	**26.**	**Taeniophyllum**	**46.**	**False**
7.	**Racemose**	**27.**	**Rafflesia**	**47.**	**True**
8.	**Spathe**	**28.**	**Asparagus**	**48.**	**True**
9.	**Spines**	**29.**	**Leguminosae**	**49.**	**False**
10.	**Hypanthodium**	**30.**	**Silk cotton**	**50.**	**False**
11.	**Monadelphous**	**31.**	**Peas**	**51.**	**False**
12.	**Laminaceae**	**32.**	**Spike**	**52.**	**True**
13.	**Cocos**	**33.**	**Cyathium**	**53.**	**True**
14.	**Parthenocarpic**	**34.**	**Gall flowers**	**54.**	**True**
15.	**Apple**	**35.**	**Actinomorphic**	**55.**	**False**
16.	**Cypsela**	**36.**	**Brinjal**	**56.**	**False**
17.	**Mericarps**	**37.**	**Hesperidium**	**57.**	**True**
18.	**Aggregate fruits**	**38.**	**Capsule**	**58.**	**True**
19.	**Parietal placentation**	**39.**	**Custard apple**	**59.**	**True**
20.	**Seed coat**	**40.**	**Composite fruit**	**60.**	**True**

	1	**2**	**3**	**4**	**5**
61.	**b**	**d**	**a**	**c**	**e**
62.	**c**	**d**	**e**	**a**	**b**
63.	**e**	**d**	**a**	**c**	**b**
64.	**b**	**c**	**d**	**e**	**a**
65.	**c**	**e**	**d**	**a**	**b**
66.	**Root cap or calyptra**				
67.	**Rhizobium**				
68.	**By producing pneumatophores**				
69.	**They absorb moisture from the atmosphere**				
70.	**Underground**				
71.	**Cladophylls Ex: Asparagus**				
72.	**Offset**				
73.	**Opposite phyllotaxy**				
74.	**Corymb**				
75.	**Head / Capitulum**				

Note: For questions from 76 to 85 the students should be motivated to write answers on their own by analysing the contents and have a discussion with their subject lecturer.

Multiple choice questions – key

L- I		L-II		L -III		L-IV		L-V	
1.	3	1.	4	1.	c	1.	c	1.	b
2.	4	2.	3	2.	a	2.	a	2.	a
3.	1	3.	4	3.	b	3.	c	3.	c
4.	1	4.	1	4.	d	4.	a	4.	c
5.	2	5.	2	5.	b	5.	c	5.	c
6.	3	6.	4	6.	c			6.	d
7.	2	7.	3	7.	b			7.	a
8.	1	8.	4	8.	a			8.	c
9.	2	9.	1	9.	d			9.	d
10.	2	10.	4	10.	b			10.	c
11.	4	11.	3						
12.	4	12.	1						
13.	1	13.	2						
14.	2	14.	3						
15.	4	15.	2						
16.	2								
17.	3								
18.	2								
19.	1								
20.	2								

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JUNIOR INTERMEDIATE WORK BOOK

BOTANY

Unit -IV Plant Systematics

Chapter 8 Taxonomy of Angiosperms

Note to the students:

1. Please read the text book and go through the lines before you solve these small questions in the work book.

2. You may need to apply the Knowledge given in the chapter "Biotechnology: Principles and processes" to solve some questions.

3.Discuss the answers and solutions with your friends and your lecturer.

4.The key concept given above may give you some clues in solving the below questions.

Concepts of Taxonomy of Angiosperms

- It is not easy to study understand and record all heterogeneous group of plants individually, but yet possible using specific approach called taxonomy.
- The term Taxonomy was coined by **A.P.de Candolle** in 1813.
- Taxonomy purely based on the description of morphological characteristics is called **Alpha Taxonomy.**
- In recent times, we have advanced to **Omega Taxonomy** In which information from other sources, te, Embryology Cytology. Palynology. Phytochemistry, Serology etc. also form criteria apart from morphological features.
- Taxonomy includes four baste components utz, characterization, identification, nomenclature and classification.

8.1 SYSTEMS, TYPES OF CLASSIFICATION

- Classification of plants refers to grouping plants based on their structural similarities and interrelationships.

- Different systems or classifications have developed gradually over period and in tune with the advances that have taken place in other branch Botany as well as in allied sciences.
- Based on the criteria followed for classifier all the systems proposed from the beginning are grouped under three type artificial, natural and phylogenetic.

Artificial system: It is the earliest system of plant classification based only gross superficial morphological characters such as habit, colour, number and shape of leaves etc.

In this system only one or a few characters were selected arbitrarily and plants were arranged into groups according to such characters.

This system did not indicate the natural relationship that exists among the individuals forming a group.

- **Theophrastus** (370 to 285 BC) classified plants into 3 groups based on the habit as (i) herbs (ii)shrubs and (iii) trees in his book **'Historia Plantarum'.** and
- **Linnaeus** (1754) classified plants into 24 groups on the basis of number, length and union of stamens and of carpels (sexual characters) In his book **"Species Plantarum"**.
- They gave equal importance vegetative and sexual characteristics.

Natural System: In this system of classification, all the important, mostly morphology characters were taken into consideration and plants were classified accordingly.

Usually, the floral characters were given greater importance since they are more conserved and do not change due to the effect of environment.

However, characters of evolutionary importance were not considered.

- **Bentham & Hooker's** (1802-1893) system of classification of plants as proposed in book **"Genera Plantarum"** is a Natural System of Classification.

- They grouped flowering plants into 202 natural orders now called as families. Of these 165 orders belong to Dicotyledons, 3 to Gymnosperms and 34 belong to monocotyledonae.

Phylogenetic System: The classifications of post-Darwinian period united evolutionary trends in plants and so they are considered as phylogenetic system.

- In a phylogenetic system, primitive and advanced characters are recognized.
- The system proposed by **Engler and Prantl** in the book **"Die Naturlichen Planzenfamilien"** (1887-1893), and
- **J.Hutchinson** (1954) in his book **"Families of Flowering Plants"** are examples for phylogenetic system.

Other Types

Numerical taxonomy uses mathematical methods to evaluate observable differences and similarities between taxonomic groups. Each character is given equal importance and al same time hundreds of characters can be considered.

Cytotaxonomy: A branch of taxonomy that uses the cytological characters lke chromosome number, structure in solving taxonomic problems.

Chemotaxonomy: A branch of taxonomy that uses the phytochemical data to the problems of taxonomy.

8.2 SEM-TECHNICAL DESCRIPTION OF A TYPICAL FLOWERING

- The plant is described beginning with its habit, habitat, vegetative characters (roots, stem and leaves) and then floral characters (inflorescence, flower and its parts) followed by fruit.

- After describing various parts of a plant, floral diagram and a floral formula are presented. The formula is represented by some symbols of floral parts.
- A Floral diagram provides information about the number of parts their arrangement and the relation they have with one another.

8.3 DESCRIPTION SOME IMPORTANT FAMILIES

8. 3.1 FABACEAE: This family was earlier called as Papilionoidea, a sub-family of Leguminosae in Bentham and Hooker's system of classification. It comprises about 8500 species under 450 genera.

- Tap root system with nodular roots (containing *Rhizobia* - the nitrogen fixing bacteria)
- Stipulate, base pulvinate, simple or pinnate compound leaf.
- Zygomorphic, complete, bisexual, perigynous flowers and cup shaped thalamus.
- Odd sepal anterior with papilionaceous corolla consisting of a large posterior (standard), two lateral (wings), two anterior fused petals and vexillary aestivation.
- Stamens 10 Diadelphous [(9) +1] or Monadelphous.
- Monocarpellary, unilocular, half-superior ovary with many ovules with marginal placentation.
- Flowers are entomophilous-cross pollination with Piston mechanism.
- Fruit mostly legume or pod and geocarpic in *Arachis*.

Economic Importance: Many plants belonging to the family are good sources of

- Proteins: Pulses like Red gram, Black gram etc.,
- Edible oils: Soyabean, Groundnut.
- Vegetables: Pods of Bean, Soyabean: seeds of Garden pea, Groundnut and leaves of Menthi.

- Timber: Red sanders, Indian Rose wood.
- Fiber: Sun hemp.
- Blue dye: *Indigofera tinctoria.*
- Yellow dye: *Butea monosperma.*
- Medicine: *Derris indica.*
- Fodder: *Crotalaria, Phaseolus.*
- Green manure: *Sesbania, Tephrosia.*

8.3.2 SOLANACEAE: It is commonly called as the potato family and includes about 2200 species belonging to 85 genera.

- Plants are mostly herbs.
- Bicollateral vascular bundles are common in the stem.
- Petiole adnate to the stem.
- Actinomorphic, pentamerous and hypogynous flowers.
- Persistent calyx in *Solanum* and *Capsicum.*
- Epipetalous stamens.
- Bicarpellary, syncarpous, superior ovary, placenta swollen with many ovules on axile placentation. Carpels are arranged obliquely at 45º.
- Fruits are Berry (*Capsicum, Solanum, Lycopersicon*) or capsule (*Datura, Nicotiana*).

Economic Importance: Many plants belonging to this family are sources of

- vegetables: Tomato, Brinjal and Potato.
- Spicy: chilli.
- Medicine: Belladonna and Ashwagandha.
- Ornamentals: Petunia, Night queen and Day king.
- Produce chemical substances of medicinal value: Makoi or Kamanchi.

- An alkaloid nicotine is obtained from Tobacco and leaves are used in making cigarettes.

8.3.3 LILIACEAE: This family is commonly called the Lily family' and is a typical representative of monocotyledonous plants. It Includes about 254 genera with 4075 species.

- Mostly perennial herbs with underground stems such as bulbs, corms, rhizomes.
- Adventitious roots, fasciculated and tuberous.
- Simple leaves with parallel venation or exceptionally reticulate in *Smilax.*
- Actinomorphic, trimerous and hypogynous flowers.
- Homo chlamydeous perianth.
- Tricarpellary, syncarpous: ovary superior with axile placentation.
- Fruit is usually capsule.
- Seeds are monocotyledonous.

Economic Importance: Many plants belonging to this family are

Good ornamentals: Tulip, *Lilium, Asparagus, Gloriosa*.

Source of medicine: *Aloe, Smilax, Gloriosa, Scilla.*

Vegetables: *Allium cepa, Asparagus*.

Spice: *Allium sativum*.

Colchicine*: Colchicum autumnale*.

I – Fill in the blanks using the words given below:

Fabaceae, Environment, Menthi, Anterior, Piston, Dicotyledonae,

Solanaceae, Ovary, Linnaeus, Liliaceae

1. _____ gave equal importance to vegetative and sexual characters.

2. _____ was divided three subclasses namely Polypetalae. Gamopetalae and Monochlamydae.

3. Gynoecium being in the centre represented by a diagram of T.S. of _____.

4. _____ was earlier called as Papilionoideae.

5. Cross pollination in Fabaceae is called as _____ mechanism.

6. Leaves and seeds of _____are economically important.

7. Petiole adnate to the stem in _____ family.

8. _____ is a typical representative of monocotyledonous plants.

9. In Fabaceae odd sepal is _____in position.

10. Vegetative characters are not stable as they get effected by _____.

II – Read the following statement and tick the right answer.

11. The term Taxonomy was coined by

A.P.de Candolle / J. Hutchinson

12. The phylogenetic systems with evolutionary trends are of

Earlier period / Post Darwinian period

13. The bract represents which side of the flower

Posterior side / Anterior side

14. *Rhizobium* – the nitrogen fixing bacterium are present in

Nodular roots / Fasciculated roots

15. Which plant is known as flame of the forest?

Indigofera tinctoria / *Butea monosperma*

16. The earlier classifications of plants were on their

Economic use / Medicinal use

17. In *Arachis hypogaea* the legume fruit is

Dehiscent / Indehiscent

18. In Solanaceae placenta is swollen with many ovules on

Axile placentation / Marginal placentation

19. Terminal solitary cymose inflorescence and Capsule fruit are seen in the genus

Solanum / *Datura*

20. Homochlamydous flowers are seen in

Liliaceae / Fabaceae

III – Carefully observe the following statements. Denote whether they are True or False.

21. In natural system of classification characters of evolutionary importance were considered.

22. The latest phylogenetic classification is Angiospermic phylogenetic Group system.

23. Floral formula shows cohesion and adhesion of the floral parts.

24. Papilionaceous corolla shows vexillary or descendingly imbricate aestivation.

25. *Tephrosia* and *Sesbania* are used for timber and fiber.

26. Sepals are not persistent in *Solanum* and *Capsicum*.

27. Protogynous condition is seen in Solanaceae and Liliaceae.

28. Lilliaceae is commonly called as the Lilly family.

29. *Pisum* and *Lathyrus* are the genera of Fabaceae showing Cross pollination.

30. In Bentham and Hooker's classification Monocotyledonae is a class was divided into 7 cohorts.

IV – Match the items in Section A with the items in Section B.

Section A		Section B
31. Liliaceae	[ ]	a. *Rhizobium*
32. Standard petal	[ ]	b. Reticulate venation
33. *Ruscus*	[ ]	c. Tendril
34. Potato family	[ ]	d. Alkaloid
35. *Smilax*	[ ]	e. Monocotyledon
36. Inferae	[ ]	f. Phylogenetic system
37. Nicotine	[ ]	g. Papilionaceous corolla
38. Nodular roots	[ ]	h. Cladophyll
39. Engler & Plantl	[ ]	i. Series
40. *Gloriosa*	[ ]	j. Solanaceae

V – After reading the text book try to answer these simple questions on your own in one word or a sentence.

41. Alpha Taxonomy:

42. Taxonomy:

43. Artificial System of classification:

44. Phylogenetic System of classification:

45. Geocarpic fruit:

VI – After reading the lesson try to explain the following questions in one or two sentences.

46. Omega Taxonomy

Ans: _____

47. Natural System of classification

Ans: _____

48. Numerical Taxonomy

Ans: _____

49. Papilionaceous corolla

Ans: _____

50. Flora Diagram

Ans: _____

VII – Multiple choice questions.

51. The floral formula cannot provide information about [ ]

a) Placentation of the ovary

b) Actinomorphic / Zygomorphic condition

c) Epipetalous condition

d) Position of the ovary

52. Axillary inflorescence, persistent calyx and protogynous condition is seen in this plant [ ]

a) *Solanum*

b) *Datura*

c) *Capsicum*

d) *Asparagus*

53. Character of the stem not seen in the family Solanaceae [ ]

a) Bicollateral vascular bundles

b) Adnation with the petiole

c) Climbers with the help of tendrils

d) Underground stem tubers

54. Which of the following is wrongly matched plant and its product [ ]

a) *Colchicum autumnale* - Colchicine

b) *Nicotiana tobacum* - Nicotine

c) *Indigofera tinctoria* - Blue dye

d) *Pterocarpus santalinus* - Yellow dye

55. Which of the following is not a character of Fabaceae family [ ]

a) Pulvinus leaf base

b) Piston mechanism

c) Epipetalous condition

d) Papilionaceous corolla

56. Which of the following plant doesn't have underground modified parts [ ]

a) *Allium cepa*

b) *Solanum tuberosum*

c) *Asparagus racemosus*

d) *Datura metel*

57. Type of fruit present in Asparagus, Capsicum, Lycopersicon and Solanum[ ]

a) Berry

b) Legume

c) Drupe

d) Capsule

58. Which of the following plants are not used for vegetable purpose [ ]

a) Soyabean and Groundnut

b) Sun hemp and *Crotalaria*

c) *Allium cepa* and *Asparagus*

d) Tomato and Potato

59. Identify the characters shown by *Arachis* from the following list [ ]

i. Nodular roots

ii. Papilionaceous corolla

iii. Diadelphous stamen

iv. Indehiscent legume fruit

v. Geocarpic fruit

vi. A good source of protein

a) i, ii, iv, v

b) ii, iii, v, vi

c) i, iii, iv, v

d) ii, iv, v, vi

60. Pick out the Character not exhibited by Allium [ ]

a) Umbel inflorescence

b) Protogynous condition

c) Polyembryony

d) Underground bulb

61. Identify unique monocotyledonous characters of family Liliaceae [ ]

i. Adventitious roots

ii. Parallel venation

iii. Umbel inflorescence

iv. Trimerous flowers

v. Valvate aestivation

vi. Monocotyledonous seed

a) i, iii, v, vi

b) ii, iv, v, vi

c) i, ii, iv, vi

d) ii, iii, v, vi

62. Find the pair which is not correctly matched [ ]

a) Proteins - Red gram

b) Oils - Ground nut

c) Fodder - *Crotalaria*

d) Vegetables - *Sesbania*

63. Match the following Authors and the books written by them [ ]

Author	Name of the book
A. Theophrastus	i. Families of flowering plants
B. Bentham & Hooker	ii. Species Plantarum
C. J. Hutchinson	iii. Historia Plantarum
D. Linnaeus	iv. Genera Plantarum

Options:

a) A-iii, B-i, C-iv, D-ii

b) A-iii, B-iv, C-i, D-ii

c) A-ii, B-iv, C-iii, D-i

d) A-ii, B-i, C-iii, D-iv

64. Identify the pair not used as medicine [ ]

a) Belladona and Kamanchi

b) *Smilax* and *Scilla*

c) *Derris* and *Gloriosa*

d) *Sesbania* and *Tephrosia*

65. Carefully observe the diagram and find irrelevant statement [ ]

a) Ebracteate

b) Tetramerous perianth

c) Stamens are 4 in number

d) Bicarpellary ovary

66. Observe the floral diagram and identify its family [ ]

a) Fabaceae

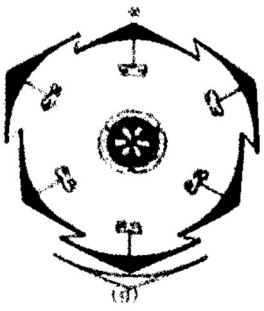
b) Solanaceae

c) Brassicaceae

d) Liliaceae

67. Identify the characters shown in this floral diagram [ ]

A. Bracteate



B. Homochlamydeous

C. Twisted aestivation

D. Stamens are six in number

E. Tricarpellary ovary

F. marginal placentation

a) A, C, E, F

b) B, D, E. F

c) B, C, D, E

d) A, B. D, E

68. Observe the diagram and identify irrelevant word. [ ]

a) Polypetalous

b) Papilionaceous

c) Gamopetalous

d) Unequal petals

69. Explain the given symbols of floral formula – Br, %, $C_{5,}$ $\underline{G}$ [ ]

a) Bracteate, Actinomorphic, Calyx 5 and free, Superior ovary

b) Bracteolate, Actinomorphic, Calyx 5and united, Gynoecium superior

c) Bracteate, Zygomorphic, Corolla 5 and free, Superior ovary

d) Bracteolate, Zygomorphic, Corolla 5 and united, Gynoecium superior

70. Match the following [ ]

A) *Allium*	i) Cladophyll	1) Reticulate venation
B) *Asparagus*	ii) Tendril climber	2) Umbel inflorescence
C) *Smilax*	iii) Bulb	3) Fasciculated roots

Choose the correct options

	A	B	C
a)	iii, 2	i, 3	ii, 1
b)	iii, 2	ii, 1	i, 3
c)	i, 1	ii, 3	iii, 2
d)	ii, 2	iii, 1	i, 2

VIII– Check if you can answer some questions from previous NEET (AIPMT) and EAMCET papers.

71. Assertion(A): In Angiospermic phylogenetic group system, the arrangement of plants show progressive or retrogressive characters.

Reason (R): Evolutionary trends are the basis for phylogenetic system of classification. `

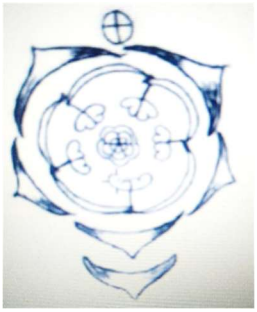
Optiions:

1) (A) is true, (R) is true and (R) is correct explanation of (A).
2) (A) and (R) are true but (R) is not correct explanation of (A).
3) (A) is true, (R) is false.
4) (A) is false, (R) is true.

72. Find the correct description of the flower in general and 1st and 3rd whorlflower based on the diagram illustrated above. [EAMCET-2017]

Options:

1) Bracteate, ebracteolate, pentamerous, bisexual, gamosepalous, Twisted aestivation, stamens 5, epipetalous



2) Ebracteate, ebracteolate, pentamerous, bisexual, polysepalous, imbricate aestivation, stamens 5, epiphyllous

3) Ebracteate, ebracteolate, pentamerous, bisexual, gamosepalous, valvate aestivation, stamens 5, monodelphous

4) Bracteate, ebracteolate, pentamerous, bisexual, polysepalous, imbricate aestivation, stamens 5, epipetalous

73. Study the following list [EAMCET-2018]

List-I	List-II
A) Blue dye	I) *Belladona*
B) Yellow dye	II) *Ruscus*
C) Medicine	III) *Indigofera*
D) Edible oil	IV) Soyabean
	V) *Butea*

The correct answer:

	A	B	C	D
1)	V	III	II	IV
2)	III	I	V	II
3)	III	V	I	IV

4) III II I IV

74. Find the correct floral formula from the given floral description [EAMCET-2018]

Bracteate, ebracteolate, pentamerous, bisexual, actinomorphic, sepals 5, polysepalous, imbricate aestivation, petals 5, gamopetalous, twisted aestivation, stamens 5, epipetalous, pentacarpellary, syncarpus, superior ovary with axile placentation.

Options:

1) Br, ebrl, (+), ♀, K_5, $\overline{C_5}$, A_5, G $_{(5)}$

2) Br, brl, (+), ♀, K_5, C_5, A_5, G $_{(5)}$

3) Br, brl, %, ♀, $K_{(5)}$, C_5, A_5, G $_{(5)}$

4) Br, ebrl, (+) ♀, K_5, $C_{(5)}$, A_5, G $_{(5)}$

75. Choose the correct combination [EAMCET-2019]

List-I	List-II	List-III
1) Raceme	i) Cup shaped thalamus	I) *Derris indica*
2) Mathematical model	ii) Codes	II) Use of computers
3) Trimerous	iii) Species plantarum	III)Artificial Systems
4) Historia plantarum	iv) Capsule	IV) *Allium*

The correct answer is

Options:

1) A, D

2) B, D

3) A, C

4) A, B

76. Choose the correct set of plants showing the following features [EAMCET-2019]

A) Medicinally important plantand a tendrillar climber with unisexual flowers

B) Spice yielding pplant with cymose inflorescence, persistant calyx, unilocular ovary

C) Oil seed plant with monadelphous stamens, unilocular ovary and indehiscent pod

Options:

1) *Ruscus, Capsicum, Derris*

2) *Smilax, Solanum, Arachis*

3) *Asparagus, Capsicum, Arachis*

4) *Smilax, Capsicum, Arachis*

77.Match the following. [EAMCET-2019]

List-I	List-II	List-III
A) Radical leaves	i) Anterior odd sepal	I) Protandrous
B) Exstipulate leaf	ii) Artificial system of classification	II) Persistant Calyx
C)Monocarpellary Unilocular gynoecium	iii) *Allium*	III) Geocarpy
D) Species plantarum	iv) Solid or hollow stem	IV) Linnaeus

Options:

A B C D

1) iii, I iv, II i, III ii, IV

2) iv, I iii, II i, III ii, IV

3) iii, II iv, III i, I ii, IV

4) iii, I iv, III i, II ii, IV

Answers for I to VIII

1	Linnaeus	11	A.P.de Candolle	21	F	31	e
2	Dicotyledonae	12	Post Darwinian period	22	T	32	g
3	Ovary	13	Anterior side	23	T	33	h
4	Fabaceae	14	Nodular roots	24	T	34	j
5	Piston	15	*Butea monosperma*	25	F	35	b
6	Menthi	16	Economic use	26	F	36	i
7	Solanaceae	17	Indehiscent	27	T	37	d
8	Liliaceae	18	Axile placentation	28	T	38	a
9	Anterior	19	*Datura*	29	F	39	f
10	Environment	20	Liliaceae	30	F	40	c

41.Taxonomy purely based on the description of morphological characteristics is known as Alpha Taxonomy.

42.Taxonomy is a branch of botany including characterization, identification, nomenclature and classification.

43. A system of classification based on a few easily comparable morphological characters is called as Artificial System of Classification.

44. A system of classification based on genetic and evolutionary relationships among the taxa is called as Phylogenetic System of Classification.

45. A fruit developed inside the soil is known as Geocarpic fruit.

46. Taxonomy based on information from other branches such as Embryology, Cytology, Phytochemistry, Palynology etc., in addition to morphological characters is known as Omega Taxonomy.

47. A system of classification in which plants are grouped on the basis of their natural relationships taking into consideration all possible morphological characters is called as Natural System of Classification.

48. A branch of taxonomy that uses mathematical methods to evaluate observable differences and similarities between taxonomic groups is called as Numerical Taxonomy.

49. A unique feature of family Fabaceae having 5 unequal polypetalous petals consisting of a large posterior petal (standard), two laterals (wings), two anterior fused petals (keel) with vexillary aestivation is known as Papilionaceous corolla.

50. A diagram representing the number of parts of flower, the structure, arrangement, aestivation, adhesion, cohesion and position with respect to the mother axis is referred as Floral Diagram.

51	d	52	a	53	c	54	d	55	c	56	d	57	a	58	b	59	a	60	b
61	c	62	d	63	b	64	d	65	c	66	a	67	d	68	c	69	c	70	a
71	1	72	4	73	3	74	4	75	4	76	4	77	1						

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CELL CYCLE

* The growth and reproduction of all organisms depend on the division and engagement of cells
* The mechanisms of division and multiplication of cells together constitute cell reproduction

Cell Cycle:

* It is the life period of a cell during which a cell synthesizes DNA (replication) grows in size and divides into two daughter cells.
* Cell growth (cytoplasmic increase) is a continuous process but DNA synthesis occurs only at a specific stage
* Duration of cell cycle varies from organism and also from cell type to cell type
* Duration of a typical eukaryotic cell cycle (e.g. human cell) is about 24 hours. In Yeasts, it is only about 90 minutes

Phases of cell cycle:

* Cell cycle includes 2 basic phases: **Interphase & M Phase**

Interphase (resting phase)

* It is the phase between two successive M phase
* In this phase, cell growth and DNA synthesis occur
* It lasts more than 95% of the duration of cell cycle

Interphase has 3 phases

* G_1 phase (Gap 1 or Anterphase): First growth phase. It is the interval between mitosis and DNA replication

Main events:

* Continuous growth of cell
* Cell becomes metabolically active
* Prepares machinery for the DNA replication
* Synthesizes RNA and proteins

(Synthetic) phase:

* It is the longest phase
* DNA replication takes place
* The amount of DNA per cell doubles. However, there is ~~not~~ no increase in the chromosome number
* The animal cells, replication begins in the nucleus, and the centriole duplicates in the cytoplasm.

Phase (Gap 2):

* Second growth phase. Cell growth continues
* Synthesis of RNA and proteins continues
* Cell is prepared for mitosis

t Phase (Mitosis phase)

* It represents the actual cell division (mitosis)
* In human cell cycle, it lasts for only about an hour
* M phase includes karyokinesis (nuclear division) and cytokinesis (division of cytoplasm)
* Some cells do not show division. E.g. heart cells
* Many other cells divide only occasionally to replace damaged or dead cells
* The cells that do not divide further exit G_1 phase end enter an inactive stage called quiescent stage (G_0). Such cells remain metabolically active but do not proliferate

Mitosis:

* It is the cell division occurring in somatic cells

* It is also called as equational division as the number of chromosomes in the parent and progeny cells is same
* Mitosis is generally seen in diploid cells. However, in some lower plants and some social insects also occurs in haploid cells
* It involves major reorganization of all cell components.

The karyokinesis of mitosis has 4 stages: Prophase, metaphase, Anaphase & Telophase

Prophase

It is the longest phase in mitosis

Early Prophase:

* The tangled chromatin fibres condense to chromosomes
* The nucleolus is seen attached to the chromosome at the nucleolar organizer

Late Prophase:

* Each chromosome splits into two chromatids attached together at the centromere.
* Condensation of chromosomes continues.
* In animal cells, the centrioles move to opposite poles. They radiate out astral rays (mictotubular fibrels). Astral rays along with its centriole pair is called aster. The 2 asters move to opposite poles and start spindle formation
* The nuclear envelope, nucleolus, Golgi complexes and endoplasmic reticulum disappear.
* Spindle fibres originate from microtubular proteins (tubulin)

Metaphase

* The nuclear envelope completely disintegrates. Hence the chromosomes spread through the cytoplasm of the cell
* Chromosome condensation is completed. They can be observed and studied easily under the microscope. They will have two sister chromatids
* Chromosomes come to lie at the equator. The plane of alignment of the chromosomes at metaphase is called the metaphase plate.
* The spindle fibres from both poles are connected to chromatids by their kinetochores in the centromere

Anaphase

* It is the shortest phase in the mitosis
* Centromere of each chromosome divides longitudinally resulting in the formation of two daughter chromatids (chromosomes of the future daughter nuclei)
* As the spindle fibres contract the chromatids move from the equator to the opposite poles

Telophase

* Chromosomes cluster at opposite poles and uncoil into chromatin fibres
* Nuclear envelope assembles around the chromatin fibres. Thus 2 daughter nuclei are formed
* Nucleolus, Golgi complex and ER reappear
* The spindle fibres disappear

Cytokinesis

* It is the division of cytoplasm resulting the formation of 2 daughter cells. It starts when telophase is in progress
* Cytokinesis in animal cell: Here, a cleavage furrow is appeared in the plasma membrane. It gradually depends and joins in the centre dividing the cytoplasm into two
* Cytokinesis in plant cell: It is different from the cytokinesis in animal cells due to the preserve cell wall. In plant cells, the vesicles formed from Golgi bodies accumulate at the equator. It grow outward

and meets the lateral walls. They fuse together to form the cell – plate. It separates the 2 daughter cells. Later, the cell plate becomes the middle lamella

* During cytokinesis, organelles like mitochondria and plastids get distributed between the daughter cells
* In some organisms karyokinesis is not followed by cytokinesis. As a result, multinucleate condition (syncytium) arises. E.g liquid endosperm in coconut

Significance of Mitosis

* It produces diploid daughter cells with identical genome
* It helps to retain the same chromosome number in all somatic cells
* It helps in the body growth of multicellular organisms. Mitosis in the meristematic tissues helps in a continuous growth of plants throughout the life
* It restores the nucleo – cytoplasmic ratio that disturbed due to cell growth
* It helps in cell repair & replacement. E.g. cells of the upper layer of the epidermis, lining of the gut & blood cells

Meiosis

* It is the division of diploid germ cells that reduces the chromosome number by half resulting in the production of haploid daughter cells (gametes)
* It occurs during gametogenesis
* It ensures the production of haploid phase in the life cycle of sexually reproducing organisms whereas fertilization restores the diploid phase

Key features of meiosis

* It involves two cycles called meiosis I & meiosis II but only a single cycle of DNA replication
* It involves pairing of homologous chromosomes and recombination between them
* Meiosis 1 begins after replication of parental chromosomes to form identical sister chromatids the S phase
* 4 haploid cells are formed at the end of meiosis II

Meiosis I	Meiosis II
Prophase I	Prophase II
Metaphase I	Metaphse II
Anaphase I	Anaphase II
Telophase I	Telophase II

Meiosis I

Prophase I:

* It is the typically longer and more complex
* It includes 5 phases based on chromosomal behavior
  Leptotene, Zygotene, Pachytene, Diplotene & Diakinesis
* Leptotene (Leptonema): Chromatin fibres become long slender chromosomes. Nucleus enlarges
* Zygotene (Zygonema): Chromosomes become more condensed. Similar chromosomes start pairing together (synapsis) with the help of a complex structure called synaptonemal complex The paired chromosomes are called homologous chromosomes. Each pair of homologous chromosomes is called a bivalent

* **Pachytene (Pachynema):** Comparatively longer phase, Bivalent chromosomes split into similar chromatids. This stage is called tetrads. This is characterized by the appearance of recombination nodules at which crossing over occurs. Crossing over is the exchange of genetic material between non – sister chromatids of two homolog ous chromosomes with the help of an enzyme, recombinase. It leads to recombination of genetic material on the homologous chromosomes. Recombinantion is completed by the end of pachytene
* **Diplotene (Diplonema):** Dissolution of the synaptonemal complex occurs. The recomb homologous chromosomes of the bivalents separate from each other except at the sites of crossovers. These X – shaped structures are called chiasmata. In oocytes of some vertebrates, diplotene can last for months or years
* **Diakinesis:** Terminalisation of chiasmata. Chromosomes are condensed. The meiotic spindle fibres originate from the poles to prepare the homologous chromosomes for separation. Nucleolus & nuclear envelope disappear.

Metaphase I: Spindle formation is completed. The chromosomes align on the equatorial plate. The microtubules from the spindle attach to the pair of homologous chromosomes

Anaphase I: The homologous chromosomes separate, while sister chromatids remain associated at their centromeres

Telophase I: The nuclear membrane and nucleolus reappear and 2 haploid daughter nuclei are formed this is called diad. After this cytokinesis may or may not occur. After a short interphase, it is followed by meiosis II. This short stage between the two meiotic division is called interkinesis. DNA replication does not occur in this phase

Meiosis II: It resembles the mitosis. It has the following phases

Prophase II: It is initiated immediately after cytokinesis. The chromosomes again become compact. Nucleolus and nuclear membrane disappear in both nuclei

Metaphase II: The chromosomes align at the equator and the microtubules from opposite poles of the spindle get attached to the kinetochores of sister chromatids

Anaphase II: It begins with the simultaneous splitting of the centromere of each chromosomes (which was holding the sister chromatids together), allowing them to move toward opposite poles of the cell

Telophase II: The two groups of chromosomes once again get enclosed by a nuclear envelope, cytokinesis follows resulting in the formation of tetrad of cells i.e., 4 haploid daughter cells

Significance of meiosis

* It conserves the chromosome number of each species
* it causes genetic variation (due to crossing over) in the population of organisms. It is important for evolvution.

2. FILL IN THE BLANKS

1. DNA replication takes place in _____
2. G_0 stage is also called _____
3. Spindle fibres are made up of _____ proteins

4. Centrioles are only present in _____
5. The disappearance of nuclear membrane takes place in _____
6. The formation of equational plate in _____ stage of mitosis
7. The type of cytokinesis in plants cells is _____
8. The _____ type of cell division reduce chromosome number half of the parental ce
9. Crossing over takes place in _____ stage of prophase – I
10. The chromosomal segregation takes place in _____ stage of meiosis
11. Terminalisation takes place in _____ stage of prophase – I
12. The chromatids are move toward opposite poles in _____ stage of mitosis
13. The gap period between meiosis – I and meiosis – II is ____
14. The number of daughter cells are formed in meiosis are ____
15. The centriolar division takes place in _____ stage of animal cells

3. TRUE OR FALSE

1. Interphase is the longest phase in cell cycle
2. In G_0 cell is metalobically inactive phase
3. Movement of centrioles towards opposite poles takes place in metaphase
4. Chromatids are appear V.I, L, I shapes in anaphase
5. The reappearance of nuclear membrane and nucleolus takes place in anaphase of mitosis
6. The pairing of homologous chromosomes takes place in diplotene
7. The pachytene stage is longest and complicated stage in meiosis
8. Synapsis takes place in zygotene of meiosis
9. Genetic recombinations are takes place through meiosis
10. Plastids are involved in cytokinesis of plant cells

4. OBJECTIVE TYPE QUESTIONS

1. ……. Is the process by which new cells are formed from pre – existing cells
   Choose an appropriate option to fill the blank
   1) Cell division
   2) Cell growth
   3) Cell elongation
   4) None of these
2. The phase between two successive M – Phase is called
   1) S – phase
   2) G_1 – phase
   3) G_2 – phase
   4) Interphase
3. In which phase of the cell cycle, DNA content gets doubled?
   1) interphase
   2) Anaphase
   3) Prophase
   4) Telophase
4. What change would occur in DNA content, during S – phase?
   1) No change

2) The amount of DNA per cell doubles
3) The amount of DNA per cell increase four folds
4) The amount of DNA per cell decreases

5. In animals, …. A …. Is only seen in diploid somatic cells. Against this, the plants can show … B … in both haploid and diploid
Fill in the blanks with an appropriate option
1) A – Meiotic cell division; B – Mitotic cell division
2) A – Meiotic – cell division; B – Meiotic cell division
3) A – Mitotic cell division; B – Mitotic cell division
4) A – Mitotic cell division; B – Meiotic cell division

6. Mature nerve cells are incapable of cell division. These cell are probably considered in
1) G_2 – phase
2) S – phase
3) Mitosis
4) G_0 – phase

7. The second check point in cell cycle occurs at
1) $G_0 – G_1$
2) $G_1 – G_2$
3) G_1 – S
4) G_2 – M

8. Which of the following type of cell cycle is known as equational division?
1) Amitosis
2) Mitosis
3) Meiosis
4) None of the above

9. In which stage of cell initiation of condensation of chromosome takes place?
1) Anaphase
2) Metaphase
3) Telophase
4) Prophase

10. Mitosis usually results in the
1) production of diploid daughter cells
2) growth of multicellular organisms
3) cell repair
4) All the above

11. Which of the following stage of mitosis follows the S and G_2 – phases of interphase?
1) Prophase
2) Metaphase
3) Anaphase
4) Telophase

12. What type of cell division takes place in the functional megaspore initially in angiosperms?
1) homotypic Haemotypic without cytokinesis
2) Reductional without cytokinesis
3) Somatic followed by cytokinesis
4) Meiotic followed by cytokinesis

13. Mitosis is a process by which eukaryotic cells

1) grow
2) get specialized in structure
3) multiply
4) expose the genes

14. At the end of meiosis – II, number of haploid cells formed are
1) two
2) four
3) eight
4) None of these

15. Meiosis occurs in organism during
1) vegetative reproduction
2) sexual reproduction
3) Both 1 and 2
4) None of these

16. Diakinesis is marked by
1) terminalisation of chiasmata
2) degeneration of nucleolus
3) chiasmata shift towards chromosome ends
4) All of the above

17. In which of the following stages of the cell cycle chromosome number becomes half?
1) Metaphase – I
2) Anaphase – I
3) Prophase – I
4) Metaphase – II

18. Which of the following stage is responsible for the appearance of Lampbrush chromosomes?
1) Meiotic prophase
2) Mitotic prophase
3) Mitotic anaphase
4) Mitotic metaphase

19. The stage between two meiotic division is called
1) interphase
2) cytokinesis
3) interkinesis
4) karyokinesis

20. Meiosis can be observed in
1) tapetal cells
2) megaspores
3) microspores
4) spore mother cells

21. [redacted] In animals this phase is present in
1) leptotene
2) pachytene
3) diplotene
4) zygotene

22. Genetic recombination is due to
1) fertilization and meiosis

2) mitosis and meiosis
3) fertilization and mitosis
4) None of these

23. In which phase of cell cycle, proteins for spindle fibres are synthesized?
1) G_1 – phase
2) G_2 – phase
3) S – phase
4) Anaphase

24. In which phase of the cell cycle, the most cytogenic activities takes place?
1) Interphase
2) Telophase
3) Prophase
4) Anaphase

25. A cell plate is laid down during
1) cytokinesis
2) karyokinesis
3) interphase
4) None of these

26. Crossing over is also an enzyme mediated process and the enzyme involved is called
1) ligase
2) polymerase
3) recombinase
4) endonuclease

27. During mitosis, number of chromosomes
1) gets changed
2) remains the same
3) gets changed if cell is mature
4) gets changed if cell is immature

28. Synaptonemal complex is formed during
1) pachytene
2) zygotene
3) leptotene
4) diplotene

29. The spindle microtubules are polar in nature. What is their orientation?
1) Positive and negative, both ends orients towards the equator
2) Positive and orients towards the poles
3) Negative ends orients towards the poles
4) Positive and negative, both ends orients towards the poles

30. Chiasma shows the sites of
1) spindle formation
2) synapsis
3) crossing over
4) chromosome condensation

31. In a cell cycle, crossing over occurs at
1) single strand stage
2) two strand stage

3) four strand stage
4) eight strand stage

32. G_0 – phase is
1) the phase after G_2 – phase, in which nucleus divides
2) the phase after M – phase, in which daughter cell enters the new cell cycle
3) the phase of arrest of cell cycle and the onset of differentiation
4) All of the above

33. When dividing cells are examined under a light microscope, chromosomes become visible in
1) interphase
2) S – phase
3) prophase
4) G_1 – phase

34. DNA replicates
1) twice in each cell cycle
2) only once in each cell cycle
3) once in mitotic cell cycle, once in meiotic – I (reductional division) and once in meiotic – II (equational division)
4) None of the above

35. Which among the following proteins is found in the spindle fibres of a cell?
1) Tubulin
2) Albumin
3) Mucin
4) Haemoglobin

36. In a cell cycle, which structures serves as the site of attachment of spindle fibres?
1) Chromosome
2) Histone
3) Chromonemeta
4) Kinetochore

37. Karyokinesis refers to the division of
1) the cytoplasm
2) the nucleus
3) cytoplasm and nucleus
4) all constituents of the cell

38. In the process of mitotic division during interphase, chromosome material remains in the form of very loosely coiled threads called
1) chromosome
2) chromatin
3) chromatid
4) microtubules

39. After the separation of centromeres during mitosis, the chromatids move towards opposite pole of the spindle. Name the term used for these chromatids.
1) Daughter chromosomes
2) Kinetochores
3) Half spindels
4) Centrosomes

40. In meiosis, the chromosome number

1) reduces by half
2) increase by twice
3) increase by four times
4) reduces by one fourth

41. Significance of meiosis lies in
1) reduction of chromosome number to one – half
2) maintaining consistency of chromosome number during sexual reproduction
3) production of genetic variability
4) All of the above

42. Longest phase of meiosis is
1) Prophase – I
2) Prophase – II
3) Anaphase – I
4) Metaphase – II

43. Meiosis occurs in which of the following cells?
1) Sperm cells
2) Unicellular organisms
3) Liver cells
4) All of these

44. Which of the following stage of meiosis is responsible for deciding genetic constitution of gametes?
1) Metaphase – II
2) Anaphase – II
3) Metaphase – I
4) Anaphase – I

45. Meiosis in a plant cell occurs when there is a change from
1) sporophyte to gametophyte
2) gametophyte to sporophyte
3) gametophyte to gametophyte
4) sporophyte to sporophyte

46. Which of the following event distinguishes prophase – I of meiosis from prophase of mitosis?
1) Nuclear membrane breaks down
2) Chromosomes become visible
3) Homologous chromosomes pair up
4) Spindle forms

47. Which type of cell division helps in regeneration of cells?
1) Mitosis
2) Amitosis
3) Meiosis
4) Karyokinesis

48. The division of the cytoplasm is termed as
1) karyokinesis
2) mitosis
3) cytokinesis
4) meiosis

49. In which of the following phase of cell cycle, mitotic division got arrested?
1) G_2 – phase

2) G_0 – phase
3) S – phase
4) M – phase

50. Which is synthesized in G_1 – phase of cell cycle?
1) DNA polymerase
2) Histones
3) Nuclear DNA
4) Tubulin protein

5. MATCHING TYPE QUESTIONS

1. Match the following columns

Column – I	Column – II
A. Separation of daughter chromosomes	1. Interphase
B. Division of cytoplasm	2. Karyokinesis
C. Phase between two successive M – phases	3. S – phase
D. Synthesis phase	4. Cytokinesis

1) A – 2, B – 3, C – 1, D – 4
2) A – 4, B – 1, C – 3, D – 2
3) A – 2, B – 4, C – 1, D – 3
4) A – 4, B – 2, C – 3, D – 1

2. Match the following columns

Column – I	Column – II
A. Chromosomes in matching pairs	1. metaphase plate
B. In mitosis, each chromosomes copied and	2. homologous
C. Precursor for cell wall formation that represents the middle lamella between the walls of two adjacent cells is called	3. Cell plate
D. The plane of alignment of the chromosomes at metaphase is referred to as the	4. cell divides to give two daughter cells

1) A – 2, B – 4, C – 3, D – 1
2) A – 4, B – 3, C – 1, D – 2
3) A – 1, B – 4, C – 2, D – 3
4) A – 3, B – 2, C – 4, D – 1

3. Match the following columns

Column – I	**Column – II**
A. Terminalisation	1. Metaphase – I
B. Histone synthesis	2. Anaphase – I

C. Disjunction	3. Diakinesis
D. Interkinesis	4. Meiosis – II
E. Double equatorial plate	5. S – phase

1) A – 5, B – 2, C – 1, D – 3, E – 4
2) A – 3, B – 5, C – 4, D – 2, E – 1
3) A – 2, B – 5, C – 4, D – 1, E – 3
4) A – 3, B – 5, C – 2, D – 4, E – 1

4. Match the following columns

Column – I	**Column – II**
A. G_1	1. DNA replication
B. G_0	2. Protein synthesis
C. S	3. Cell metabolically active
D. G_2	4. Quiescent stage

1) A – 2, B – 4, C – 1, D – 3
2) A – 4, B – 3, C – 2, D – 1
3) A – 1, B – 2, C – 3, D – 4
4) A – 2, B – 3, C – 1, D – 4

5. Match the following columns

Column – I	Column – II
A. Prophase	1. Reappearance of nucleolus
B. Metaphase	2. Equational plate
C. Anaphase	3. Division of centrioles
D. Telophase	4. Disappearance of nucleolus

1) A – 4, B – 2, C – 3, D – 1
2) A – 1, B – 2, C – 3, D – 4
3) A – 2, B – 4, C – 1, D – 3
4) A – 2, B – 1, C – 4, D – 3

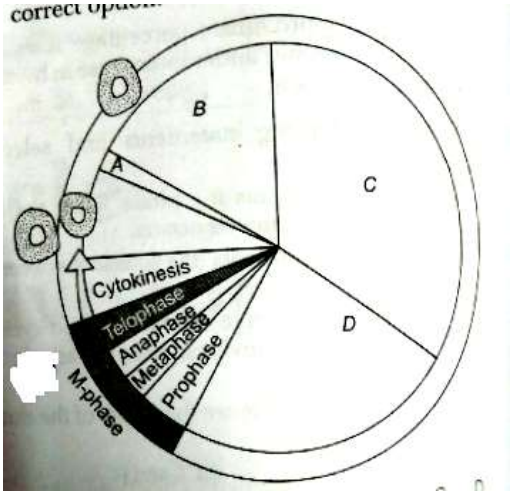
6. Match the following columns

Column – I	Column – II
A. Zygotene	1. Separation of chromosomes
B. Paelytene	2. Recombinase
C. Diplotine	3. Synapsis
D. Diakinesis	4. Ferminatlisation

1) A – 3, B – 2, C – 4, D – 1
2) A – 3, B – 2, C – 1, D – 4
3) A – 1, B – 2, C – 4, D – 3
4) A – 2, B – 3, C – 4, D – 1

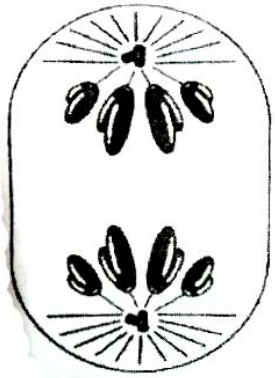
6. DIAGRAM BASED QUESTIONS

1. Given diagram represents the events occurring in cell cycle. Identify A, B, C and D and select the correct option



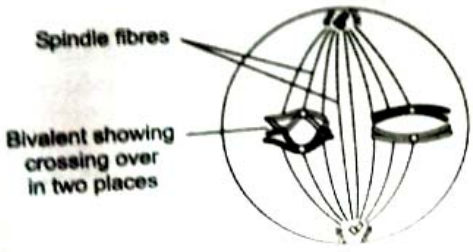
1) A – G_0, B – G_1, C – S, D – G_2
2) A – G_1, B – G_0, C – S, D – G_2
3) A – S, B – G_0, C – G_1, D – G_2
4) A – G_1, B – S, C – G_2, D – G_0

2. Given diagram indicates which of the following phase of mitosis? Choose the correct option



1) Interphase
2) Prophase
3) Metaphase
4) Anaphase

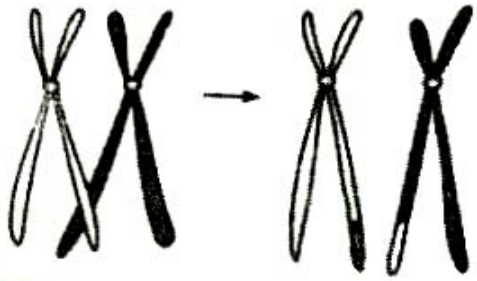
3. Identify the diagram and name the phase of meiosis carefully.



1) Telophase – I
2) Anaphase – I

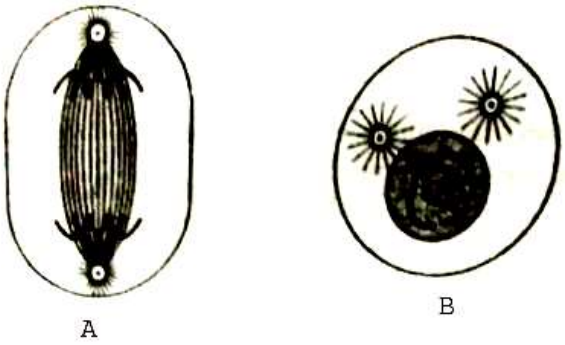
3) Metaphase – I
4) Prophase – I

4. The given figure is the representation of a certain event at a particular stage of a type of cell division. Identify the stage and choose the correct option?



1) Prophase – I during meiosis
2) Prophase – II during meiosis
3) Prophase of mitosis
4) Both prophase and metaphase of mitosis

5. Identify what does A and B represent respectively and choose the correct option



1) A – Metaphase, B – Telophase
2) A – Telophase, B – Metaphase
3) A – Late anaphase, B – Prophase
4) A – Prophase, B - Anaphase

7. ASSERTION REASON TYPE

1. A: G_0 phase is also called quiescent stage
   R: cell exist from G_1 and enter into temporarily resting phase
2. A: Reappearance of nuclear membrane takes place in prophase of mitosis
   R: Reappearance of nuclear membrane takes place in telophase
3. A: Genetic recombination's leads to genetic variations in organisms
   R: Crossing over takes place in pachytene stage of prophase I
4. A: Chromosomal number reduced to half in anaphase – I
   R: Chromotids are move opposite poles in anaphase - I

Instructions to AR type :
1 . A and R are true R is correct explanation of A
2 . A and R are true R is not correct explanation of A
3 . A is true R is false
4 . A is false R is true

KEY SHEET

2. FILL IN THE BLANKS

1. S Phase
2. Quiescent stage
3. Tubulin
4. Aninal cell
5) Prophase
6) Metaphase
7) Cell plate
8) Meiosis
9) Pachytene
10) Anaphase – I
11) Diakinesis
12) Anaphase
13) Interkinesis
14) 4
15) S - phase

3. TRUE OR FALSE

1) T	2) F	3) F	4) T	5) T	6) F	7) T	8) T	9) T	10) F

4. OBJECTIVE TYPE QUESTIONS

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

5. MATCHING TYPE QUESTIONS

1)	2)	3)	4) 1	5) 1	6) 2	7)	8)	9)	10)

6. DIAGRAM BASED QUESTIONS

1)	2)	3)	4)	5)	6)	7)	8)	9)	10)

7. ASSERTION AND REASON

Objective

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

Matching

1)3 2)1 3)4 4)1 5)1 6)2

Diagram based questions

1)1 2)4 3)3 4)1 5)3

Assertion Reason type

1)1 2)4 3)1 4)1

UNIT - VII

CHAPTER -13 - PLANT ECOLOGY

ECOLOGICAL ADAPTATIONS, SUCCESSION AND ECOLOGICAL SERVICES

- Ramdeo Misra is revered as the Father of ecology in India.
- Ecology deals with interactions among organisms and between organisms and its physical environment.
- Ecology is basically concerned with four levels of biological organisations - organisms, populations, communities and biomes.
- In this unit a concise account of plant communities and their ecological adaptations, succession and services provided by ecosystems for the benefit of mankind called Ecological Services.

Plant communities Ecological Adaptations

Adaptations is any attribute of the organism (morphological physiological, behavioural) that enables the organism to survive and reproduce in its habitat. Many adaptations have evolved over a long evolutionary time and are genetically fixed.

- In the absence of an external source of water, the opuntia plant is capable of meeting all its water requirements through its succulent par (in which water is stored in the form of mucilage.
- Many desert plants have a thick cuticle on their leaf surfaces and their stomata arranged in deep pits to minimise water loss through transpiration. They also have special photo synthetic pathway (CAM) that enables their stomata to remain closed during day time.
- Some desert plants like opuntia have no leaves - they are red to spines and the photosynthetic functions is taken over by the flatten

Halophytes : Some land plants that can tolerate the salinities of the sea are called Halophytes.

Eg. Rhizophora

Heliophytes : Plants grow in direct sunlight are called heliophytes

Sciophytes : Plants grow in shady places are called Sciophytes.

"Eugen Warming", Danish Botanist classified plant communities into three major ecological groups based on dependence and relation of plants to water. They are

1. Hydrophytes 2. Mesophytes 3, Xerophytes

Hydrophytes : Plants that grow in water or in very wet places are called hydrophytes. These are further subdivided into 5 categories according to their mode of living in water.

(i) **Free floating hydrophytes :** These have no contact with soil and thus found freely on water surface .

Eg pistia, Lemna , Salvinia

(ii) **Rooted hydrophytes with floating leaves :** Roots of these are fixed to substratum but their long petiolated leaves keep then floating on water surface .

Eg. Nymphaea, Victoria regia

(iii) **Submerged suspended hydrophytes :** These have contact only with water being completely submerged and not rooted in the mud.

Eg. Hydrilla and Utricularia.

(iv) Submerged rooted hydrophytes : These are completely submerged in water and attached to substratum by their root system .

Eg. Valisnaria

(v) Amphibious plants : These have live partly in water and partly in air Eg. Sagittaria, Typha and Limnophila

13.2.2. Ecological adaptations in hydrophytes :

Morphological and anatomical characteristics are mostly common to all hydrophytes, but may differ only in some.

Morphological adaptations in Hydrophytes :

(i) Roots may be absent or poorly developed. In some plants submerged leaves

compensate for roots.

(ii) Root caps are absent. But in amphibious plants roots with distinct root caps are present. In pistia root caps replaced by root pockets.

(iii) stem is long, slender and flexible.

(iv) leaves are thin, long, ribbon shaped or linear or finely dissected.

(v) Floating leaves are large and flat with their upper surfaces coated with wax.

Anatomical adaptations in hydrophytes :

1. Cuticle absent in hydrophytes. In submerged parts of plants it may be present in the form of fine film on surface of parts exposed to atmosphere.
2. The epidermis consists of thin walled cells and perform absorption and assimilation as the cells contain chloroplast.
3. Aerenchyma present . It is useful for gaseous exchange and buoyan
4. Mechanical tissues are poorly developed.
5. Xylem reduced
6. Stomata absent . But in Nymphaea – epistomatous (stomata present in upper epidermis only)

Mesphytes : Mesophytes are plants that are normally grown in habited where water is neither scarce not abundant.

Eg. Wheat, maize, barely, peas or sugar cane or species in grass land

terminal and temperate forests are all mesophytes.

These plants grow in habitats deficient on water supply and are generally classified into 3 categories.

Ephemerals : They complete their life cycle within a very short period. These are annuals, mostly found in arid regions.

Eg. Tribulus

Succulents : These absorb large quantities of water during rainy season and store in different plant parts usually in the form of mucilage. As a result plant parts like

Stem Eg : Opuntia

Leaf Eg : Aloe

Root Eg : Asparagus becomes fleshy or succulent

The stored water is sparingly used during dry period.

Non – succulents : These are perennial plants, can withstand prolonged period of drought .

Eg. Casuerina

Ecological Adaptations :

Morphological Adaptations in xerophytes :

(1) Roots are long with extensive branching spread over wide areas

(2) Root hairs and root caps are very well developed.

(3) Stems are usually covered by hairs and or waxy coatings.

(4) Stems are usually covered by hairs and or waxy coatings.

(5) Leaves are very much reduced, small scale like and sometimes modified into spines to reduce the roots of transpiration.

Anatomical Adaptations in Xerophytes :

(i) Epidermis is covered with thick cuticle to reduce the rate of transpiration.

(ii) Epidermal cells may have silica crystals.

(iii) Epidermis may be multilayered.

(iv) Stomata are hypo stomatous and sunken in some plants.

(v) Mechanical tissues are relatively well developed

(vi) Vascular tissues are relatively well developed.

PLANT SUCCESSION

All communities composition and structure constantly change in response to the changing environmental conditions. This change is orderly and sequential, parallel with the changes in the physical environment.

These changes lead finally to a community that is in near equilibrium with the environment and that is called climax community. The gradual and fairly predictable change in the species composition of a given area is called ecological succession.

Primary Succession :

The species that invade a bare area are called pioneer species.

In primary succession on rocks these are usually lichens which are able to secrete acids to dissolve rock, helping in weathering and soil formation.

These later pave way to some very small plants like bryophytes, which are able to take hold in the small amount of soil. They are, with time, succeeded by bigger plants and after several more stages . Ultimately a stable climax forest community is formed.

The climax community remains stable as long as the environment unchanged. With time the xerophyte converted into mesophyte one.

In this the species that invade depend on the condition of the soil, availability of water in the environment as also the seeds or other propagules present. Since soil is already there, the rate of succession is much faster, hence climax is also reached more quickly.

Primary succession is very slow process taking may be thousands of years for the climax to be reached. Another important fact to understand that all succession whether taking place in water or on land proceeds to a similar climax community- Thermesic.

13. 4 Ecological Services / Eco system Services

- Supporting services
- Provisioning Services
- Regulating Services
- Cultural Services

Ecosystem Services – Pollination

Pollinations play a significant role in the production of more crops in the world. The most important pollinator for agricultural purposes is the honey bee.

- Measures to protect pollinators.

Ecosystem Services : Carbon Fixation :

Carbon fixation has an obvious indirect economic values that can be estimated by taking account of alternative method of fixing carbon.

Many countries have established (or) are developing a certain tax system to reduce emissions of the green house gases especially to cut down Carbon and CO in atmosphere. This can be achieved by afforestation, an effective measure to prevent global warming.

Eco System Service – Oxygen release :

One acre of trees annually consume the amount of Carbon equivalent to that produced by driving an average car for 26,000 miles . That same acre of trees also produces enough CO_2 for 18 people to breathe for a year.

"The plants – The lungs of the world taking in many billions of tons of carbon di oxide from the atmosphere and through their photosynthesis, "exhaling" atmospheric O_2 that we breathe .

The cultural services can be exemplified by conservation of plant biodiversity and creating a natural beauty through local gardens.

I. Fill in the blanks :

Fill the following sentences with suitable words.

A.G. Tansley, Environment, Plant succession, H. Recter ecosystem, Community, Hydrilla, Utricularia, Ceraphyllum , Victoria regia, Scales and Spines, Eugen Warming, Hydrophytes, Mesophytes, Xerophytes.

1. The term Ecology was coined by _____
2. The term Ecosystem was coined by _____
3. The process of same area being colonised by different groups of communities one after another is known as _____
4. _____is always dynamic and is the cause of natural selection.
5. An aggregate of all the populations of a given area is called a _____
6. The interaction between the abiotic and biotic components is called _____
7. Based on water relation _____classified plant communities into _____, _____ and _____
8. Roots are totally absent in _____, _____ and _____.

9. Largest simple leaves are in the form of plates are found in _____

10. Leaves are modified into _____ and _____in xerophytes.

MULTIPLE CHOICE QUESTIONS

11. Water storage tissues is present in

    1. Opuntia 2. Casuarina 3. Nerium 4. Avicennia

12. A free floating hydrophytes with bladdery petioles .

    1. Lemne 2. Pistra 3. Eichhornia 4. Azolla

13. Development of succulency with the presence of mucilage is a xerophytic adaptation in

    1. Nerium 2. Zizyphus 3. Calotropis 4. Aloe

14. One of the following is an amphibious plant

    1. Typha 2. Azolla 3. Hydrilla 4. Nelumbo

15. Plants growing in marshy areas at the mouths of rivers are called

    1. Lithophytes 2. Limnophytes 3. Mangrooves 4. Trophophytes

16. A group of similar individuals belonging to same species is

    1. Population 2. Community 3. Ecosystem 4. Biome

17. True xerophytes are :

    1. Drought enduring plants 2. Non – succulents

    3.Succulents 4. Ephemerals.

18. Mechanical tissues are poorly developed in hydrophytes but selerids are found in :

1. Nymphaea 2. Hydrilla 3. Potamogoton 4. Vallisnaria

19. The complex of several communities living in a climate is called

1. Biosphere 2. Population 3. Ecosystem 4. Biome

20. Knowledge of Ecology is of great help in

1. Controlling soil erosion 2. Reforestation
3. Water management 4. All the above

After reading the lesson try to explain the following very short answer questions in one or two sentences each

21. Climax stage is achieved quickly in secondary succession as compared to primary succession . Why ?

---

22. Among bryophytes, lichens and ferns which one is a pioneer species in a xeric succession ?

---

23. Give any two examples of xerarch succession.

---

24. Name the type of land plants that can tolerate the salinities of the sea.

---

25. Define heliphytes and sciophytes. Name a plant from your locality that is either heliophyte and sciophyte.

---

26. Define population and community

---

27. Define communities ? Who classified plant communities into hydrophytes , mesophytes and xerophytes ?

---

28. Hydrophytes show reduced xylem. Why ?

---

29. What are the lungs of the world ?

---

30. Give an example for Ephemerals ?

IV. Match the words /sentences

Match the terms in column A with suitable terms in Column B

Column A		**Column B**
31. Ramdeo Misra	( )	(a) Victoria
32. Succulents store water in the form of	( )	(b) Limnophila
33. Pistra	( )	(c) Nymphaea
34. Aerinchyma	( )	(d) Xerophytes
35. Sunken stomata	( )	(e)Father of Ecology
36. Non – succulents	( )	(f) Mucilage
37. Epistomatous	( )	(g) Root pockets

38. Amphibious plants	( )	(h) Hydrophytes
39. Largest leaf	( )	(i) Nerium
40. Cuticle	( )	(j) Reduces transpiration

ANSWERS

Key to I

1. H. Reiter
2. Tansely- Plant succession
3. D
4. Environment
5. Community
6. Ecosystem
7. Warming,hydrophytes, Mesophytes, xerophytes
8. Hydrilla, Utricularia, Ceratophyllum
9. Victoria regia
10. Scales or spines

II. Multiple Choice Questions

11. 1 (opuntia)
12. 3 (Eichhornia)
13. 4 (Aloe)
14. 1 (Typha)
15. 3 (Mangrooves)
16. 1 (population)
17. 2 (Non- succulents)
18. 1 (Wymphaea)
19. 1 (Biome)
20. 4 (All the above)

21. Some soil or sediment is present in secondary succession. So climax stage also reached quickly than primary succession.
22. Lichens are pioneer species.
23. Crustose Lichens : Lichenora,

    Foliose Lichens : Paramelia Dermatocarpon

    Mosses : Funaria
24. **Halophytes .** Eg. Rhizophora
25. **Heliphytes :** Plants grow in direct sunlight Eg. Tridax

    Sciophytes : Plants grow in shady places . Eg. Mosses, Fermi
26. **Population :** A group of similar individuals belonging to the found in an area is called population.
27. **Communities :** An assemblage of all the populations belonging to different species occurring in an area is called Community.
    - Eugen Warming
28. All parts of plant body absorbs water . So hydrophytes show reduced xylem.
29. Plants and planktons.
30. Tribulus

IV. 31. E

32. f

33. g

34. h

35. d

36. I

37. c

38. b

39. a

40. j