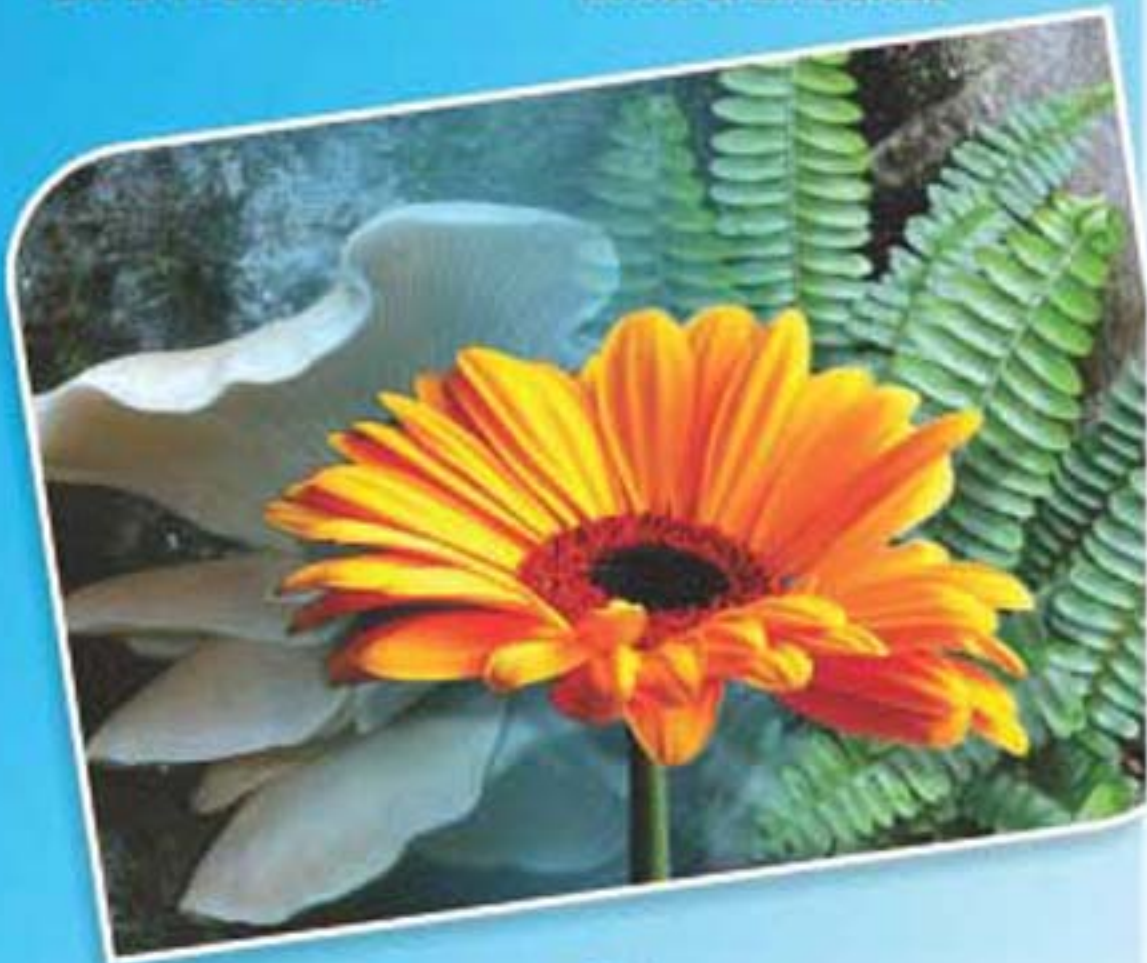


F.Y.B.Sc. : Botany : Paper-I & II : Term-I

FUNDAMENTALS OF BOTANY
PLANT DIVERSITY AND INDUSTRIAL BOTANY

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A Book Of

FUNDAMENTALS OF BOTANY

PLANT DIVERSITY AND INDUSTRIAL BOTANY

For
F.Y.B.Sc. Botany, Term I : Paper – I & II
As Per New Revised Syllabus, June 2013

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Preface ...

The subject of Botany is gaining ground and has come into limelight because of the globalisation. Plant resources have become crucial for the sustainable development of any country, hence indepth basic and applied knowledge of this subject is of prime importance.

We, the authors, are therefore pleased to publish this Botany text book for F.Y.B.Sc. students. This text book is written according to new syllabus of **F.Y.B.Sc. Botany** for the academic year 2013-2014. It includes 1st Term of Paper I and Paper II. The title of **Paper I** is **Fundamentals of Botany (Plant Diversity)** and **Paper II** is **Industrial Botany**. We are thankful to all the students and teachers from affiliated colleges of Pune University for giving an overwhelming response to our previous text books of Botany.

The contents of this book will also satisfy the quest of knowledge of a layman for plant diversity and industrial botany. Both these papers will help our students and teachers to strive for excellence. This book is very illustrative and useful for all students. Plant diversity includes topics like Introduction, General Characters, and Outline Classification of Algae, Fungi, Lichens, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms. The most important facet of this book is points to remember and exercises given at the end of each chapter. It will be most useful and popular amongst students and teachers.

Industrial Botany includes topics such as introduction to various industries like Floriculture, Plant Nursery, Plant Tissue Culture, Agriculture and Mushroom. The authors have taken great efforts to justify the topics included in this paper. We have also duly acknowledged the literature referred to. We are grateful to our most popular publisher Shri Dineshbhai Furia of Nirali Prakashan. We are also thankful to Mr. Jignesh Furia for providing us this opportunity. We would also like to thank the supporting staff which includes Rama Raghu, Sarita Soman, Prachi Sawant, Neha Deshpande of Nirali Prakashan for their timely help. Some valuable suggestions and comments for the enhancement and improvement of the text will be highly appreciated.

Syllabus ...

PAPER – I

Term – I: PLANT DIVERSITY (36 Lectures)

1. Introduction

- General outline of plant kingdom, Introduction to plant diversity with reference to following groups: Cryptogams: Thallophyta (Algae, Fungi, Lichens, and Bacteria), Bryophyta and Pteridophyta, Phanerogams: Gymnosperms & Angiosperms. **3L**

2. Algae

- General characters, Outline classification according to G.M. Smith (1955) up to classes with reasons. Life cycle of *Spirogyra*. **6L**

3. Fungi

- General characters, Outline classification according to G.M. Smith (1955) up to classes with reasons. Life cycle of *Cystopus (Albugo)*. **5L**

4. Lichens

- General characters, Nature of Association, Types of Lichens on the basis of thallus morphology, Economic importance of lichens. **3L**

5. Bryophytes

- General characters, Outline classification according to G.M. Smith (1955) up to classes with reasons. Life cycle of *Riccia*. **5L**

6. Pteridophytes

- General characters, Outline classification according to G.M. Smith (1955) up to classes with reasons. Life cycle of *Nephrolepis*. **6L**

7. Gymnosperms

- General characters, Outline classification according to Chamberlain (1934) up to classes with reasons. Life cycle of *Cycas*. **5L**

8. Angiosperms

- General characters, Causes of evolutionary success of Angiosperms, comparative account of monocotyledons and dicotyledons. **3L**

(Note: Development of sex organs not expected, for all the above mentioned life cycles)

PAPER- II

Term – I: INDUSTRIAL BOTANY (36 Lectures)

1. Introduction to Industrial Botany

2L

- Concept of Industrial Botany.

- **Plant resources and industries:** Food, fodder, fibers, medicines, timber, dyes, gum, tannins. (Two examples of each resource and the relevant industries with which they are associated).

2. Floriculture Industry **8L**

- Introduction to floriculture.
- Important floricultural crops, open cultivation practices, harvesting and marketing of Tuberose.
- **Greenhouse technology:** Concept, advantages and limitations.
- Cultivation practices (greenhouse technology), harvesting and marketing of Rose and Gerbera.

3. Plant Nursery Industry **8L**

- Concept and types of nurseries: ornamental plant nursery, fruit plant nursery, medicinal plant nursery, vegetable plant nursery, orchid nursery, forest nursery (with reference to infrastructure required, outputs, commercial applications and profitability).
- Propagation methods: Seed propagation, natural vegetative propagation and artificial vegetative propagation (Cutting: Stem, Layering: Air layering, Grafting: Stone grafting and Approach grafting, Budding: T- budding).

4. Plant Tissue Culture Industry **6L**

- Concept of tissue culture.
- **Culture techniques:** Types of explants, preparation of media, methods of sterilization, inoculation techniques, incubation and hardening.
- Commercial significance

5. Agri Industries **8L**

- **Organic farming:** Concept, need of organic farming, types of organic fertilizers, advantages and limitations.
- **Seed industries:** Importance of seed industries, seed production, seed processing and seed marketing with reference to cotton. Major seed industries and corporations of India.

6. Mushroom Industries **4L**

- **Mushroom cultivation:** Plant resources, cultivation practices of oyster mushroom, uses of mushrooms, value added products, commercial significance.





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6. Pteridophytes	6.1 - 6.20
7. Gymnosperms	7.1 - 7.20
8. Angiosperms	8.1 - 8.6

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2. Floriculture Industry	2.1 - 2.28
3. Plant Nursery Industry	3.1 - 3.34
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Chapter 1...

Introduction

Contents ...

- 1.1 Introduction
 - 1.2 General Outline of Plant Kingdom
 - 1.3 Cryptogams and Phanerogams
 - Points to Remember
 - Exercises
-

1.1 Introduction

"Biological diversity is the variety of life forms ... at all levels of biological systems (i.e., molecular, organismic, population, species and ecosystem). The 1992, United Nations Earth Summit defined "biological diversity" as *"the variability among living organisms from all sources, including, 'inter alia', terrestrial, marine, and other aquatic ecosystems, and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems.* This definition is used in the United Nations Convention on Biological Diversity. The textbook definition is *"variation of life at all levels of biological organization.* Genetically, biodiversity can be defined as *"the diversity of alleles, genes, and organisms and the study of processes such as mutation and gene transfer that drive evolution".*

Measuring diversity at one level in a group of organisms may not precisely correspond to diversity at other levels.

"Biodiversity" is most commonly used to replace the more clearly defined and long established terms, species diversity and species richness. Biologists most often define biodiversity as the "totality of genes, species, and ecosystems of a region". An advantage of this definition is that it seems to describe most circumstances and presents a unified view of the traditional three levels at which biological variety has been identified:

- species diversity
- ecosystem diversity
- genetic diversity

The concept of biodiversity breaks down into three major factors, all of which are interwoven: First is the concept of genetic diversity. This refers to the variation of genes

within a single species and can be further broken down into two components: genetic variations within distinct populations of the same species, and genetic variations within a population.

Next is the concept of species diversity. We consider the varieties of species within a region. There are two main measures to assess this: the first is species "richness" or the number of species, both plant and animal, that inhabit an area; the second is the more precise "taxonomic diversity," which takes into account the relationships between species in addition to their numbers.

The third factor, and the overarching one, is ecosystem diversity. Since the boundaries between various biological communities are highly fluid, this is the most difficult factor to measure accurately, yet it may very well be the most important, since this is where changes that affect all life occur. Climate change, often caused by things like global warming, is among the greatest threats to ecosystem diversity.

Biological diversity includes the variety of ecosystems, and their patterns. It also includes their linkages across regional landscapes. There is a hierarchy of the parts and processes of biological diversity that is, admittedly, artificial. This hierarchy also has a distinct human context (i.e., things are seen in the context of how useful they are to humans). Still, it provides a focus for the concept of biodiversity, which is so infinitely varied that any lens taken to it must be narrowly focused compared to the full spectrum of both the topic and human needs.

Table 1.1: Diversity of major groups of plants and microorganisms in India

Sr. No.	Plant groups	Number of species described in World	Number of species described in India	Percentage of India to the world	Number of endemic species	%
1.	Virus/Bacteria	8,050	850	10.6	-	-
2.	Algae	40,000	7,175	17.9	1925	26.8
3.	Fungi	72,000	14,500	20.1	3500	24.0
4.	Lichens	13,500	2223	16.4	527	23.7
5.	Bryophytes	14,500	2,500	17.2	629	25.1
6.	Pteridophytes	10,000	1,200	12.0	193	16.0
7.	Gymnosperms	650	67	10.3	7	14.9
8.	Angiosperms	2,50,000	17,527	7.0	6200	35.3

Understanding the concept of biodiversity should be a high priority for everyone, since we cannot preserve it if we don't understand it, and not preserving it will ultimately affect the lives of all of us. One of the best ways of understanding the very broad concept of biodiversity is reading the various definitions used by scientists, philosophers, environmentalists, and others.

In terms of plant diversity, India ranks tenth in the world and fourth in Asia. With over 45,500 plant species, India represents nearly 11% of the world's known floral diversity. As elsewhere in the world, many organisms especially in lower groups such as bacteria, fungi, algae, lichens and bryophytes are yet to be described and remote geographical areas are to be comprehensively explored. The richness of Indian plant species as compared to the world is shown in Table 1.1.

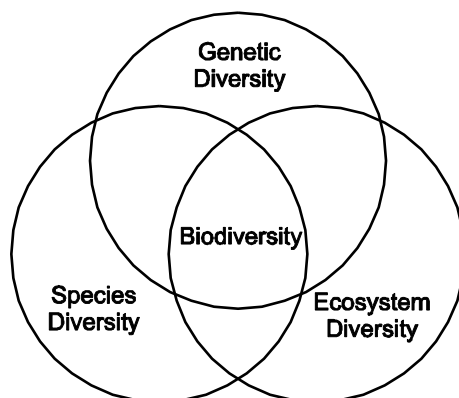


Fig. 1.1: Biodiversity

Algae are represented by over 7,175 species in 666 genera. They are found in a variety of habitats ranging from aquatic (both fresh water and marine) to terrestrial. Chlorophyceae with 4,495 species is the largest family followed by Cyanophyceae (1,453 species) and Bacillariophyceae (516 species).

India has 14,500 species of fungi in 2,300 genera and 250 families with maximum diversity in the Western Ghats followed by the Eastern Himalayas and the Western Himalayas. Deuteromycetes with 900 genera and 6000 species (40 %) is the largest group of Indian mycoflora, followed by Ascomycetes [680 genera / 3500 species (25 %)] and Basidiomycetes [520 genera/3400 species (23 %)]. *Cercospora* with 707 species is the largest genus of Indian fungi followed by *Puccinia* (328 species) and *Phyllosticta* (280 species). About 3500 species are endemic to the country.

Lichens representing symbiotic association of fungi and algae, constitute a dominant component of epiphytic and saxicolous vegetation (growing on or among rocks), and comprise 2,223 species in 283 genera and 72 families. Western Ghats are the richest region with 800 species (38%) followed by Eastern Himalayas with 759 species (37%) and Western

Himalayas with 550 species (27%). Families such as - Parmeliaceae, Graphidaceae, Physciaceae, Usneaceae, Cladoniaceae, and genera like *Parmelia*, *Graphina*, *Usnea*, *Graphis* and *Lecanora* are among the dominant families and genera of Indian lichens. About 23% species, mainly belonging to genera *Graphina*, *Trypethelium*, *Graphis* and *Poring*, are endemic to India. Andaman and Nicobar Islands (24%), Western Ghats (20%) and Eastern Himalayas (18%) show high percentage of endemic species.

Bryophytes represented by 2500 species are the second largest group of green plants in India distributed largely in Eastern Himalayas, North-eastern India, Western Himalayas and the Western Ghats. Mosses constitute the major component of Indian bryoflora with 1576 species followed by liverworts and hornworts (924 species). Lejeuneaceae (155 species) is the largest family followed by Pottiaceae (129), Dicranaceae (119), Bryaceae (98) and Sematophyllaceae (92 species). *Fissidens* (67 species) is the largest genus followed by *Plagiochila* (65) and *Frullania* (63). Nineteen genera and 629 species are endemic to India.

India has about 1200 species of pteridophytes under 204 genera. While species of *Marsilea*, *Azolla* and *Salvinia* grow in aquatic habitats, those of *Acrostichum* occur in mangrove ecosystems. The north-eastern region (including Eastern Himalayas) is rich in pteridophytic diversity with about 845 species, followed by South India (including Eastern and Western Ghats) with 345 species and north India (including Western Himalayas) with 340 species. About 17% of the species are endemic to India. The families such as Polypodiaceae (137 species), Dryopteridaceae (125 species), Athyriaceae (97 species), Thelypteridaceae (83 species), Selaginellaceae (62 species), and genera like *Selaginella* (62 species), *Asplenium* (45 species) and *Polystichum* (45 species) are some of the dominant families and genera of the pteridophytic flora of Indian region.

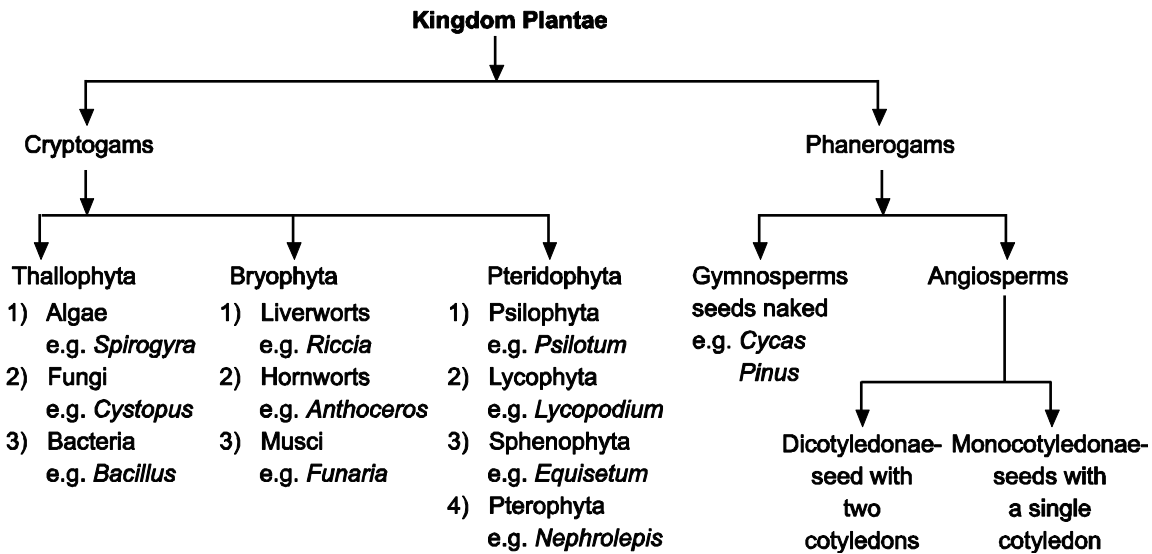
India has about 17,527 species of angiosperms or flowering plants (more than 7% of the world's known flowering plants) in 247 families and 2984 genera. The dominant families with more than 500 species are Poaceae-1291; Orchidaceae-1229; Leguminosae-1225; Asteraceae-892; Rubiaceae-616; Cyperaceae-545; Euphorbiaceae-527; and Acanthaceae-510.

Gymnosperms are represented by about 67 species. Pinaceae (6 genera and 15 species) is the largest family, followed by Cupressaceae (13 genera and 13 species), Ephedraceae (1 genus, 7 species) and Gnetaceae (1 genus and 5 species). The species of *Gnetum* and *Cycas* are mostly confined to North Eastern region.

1.2 General Outline of Plant Kingdom

The Kingdom Plantae includes all chlorophyllous organisms. They have a distinct cellulosic cell wall. Plant body may be microscopic or large. The plant body of higher plants is well developed and is differentiated into root, stem and leaves. It shows various tissue

systems. Sexual reproductive organs are well developed. On the basis of thallus structure or plant body, mode of nutrition and nature of reproduction, kingdom Plantae is divided into two divisions i.e. Cryptogams and Phanerogams. The outline of the classification of kingdom Plantae is as follows.



Five Kingdom System

A more recent and well accepted system of classification of living organisms is proposed by Whittaker (1969). He classified living organisms into five kingdoms based on

- 1) The complexity of cell structure i.e. prokaryote or eukaryote.
- 2) The complexity of thallus, i.e. unicellular or multi-cellular
- 3) The mode of nutrition i.e. autotrophs or heterotrophs.

The five kingdoms of the living world are Monera, Protista, Plantae, Fungi and Animalia according to evolutionary sequence.

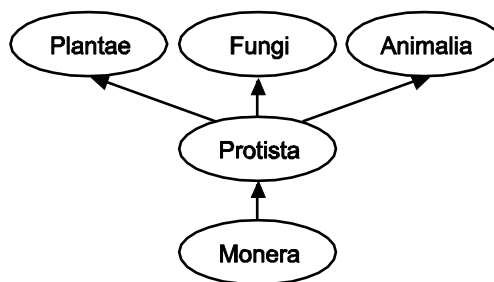
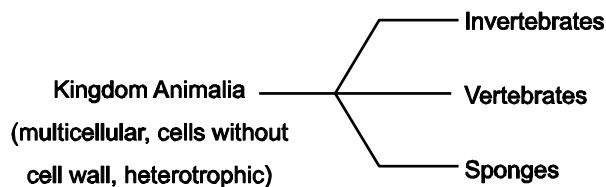
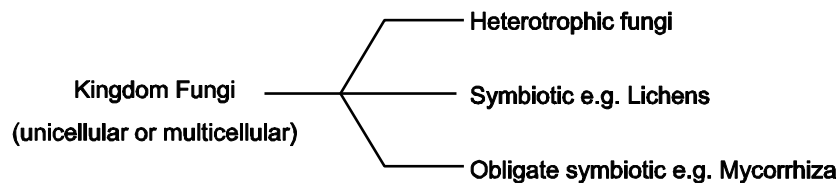
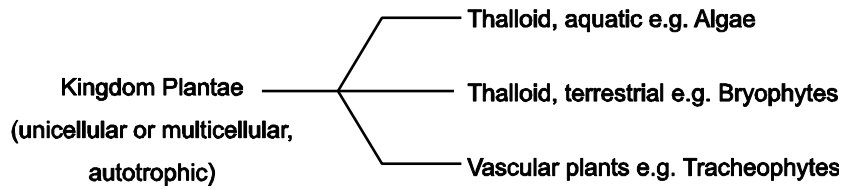
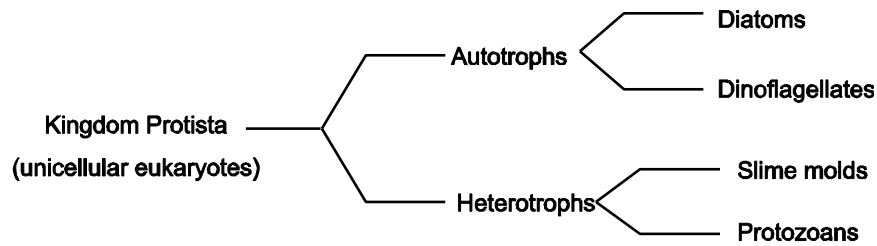
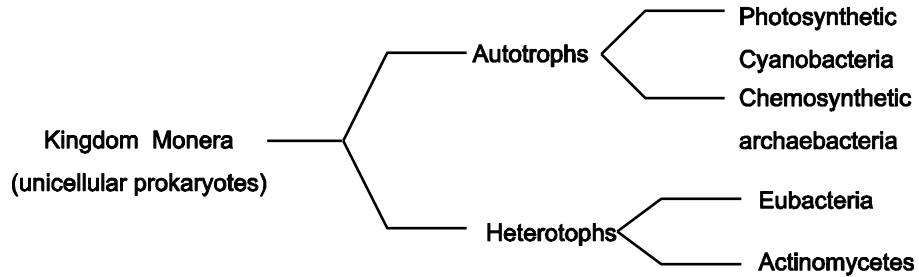


Fig. 1.2: Five kingdom classification

Key for five kingdoms of the living world.



1.3 Cryptogams and Phanerogams

A) CRYPTOGAMS

I) Thallophyta

a. Algae

1. The members of algae are prokaryotic or eukaryotic, chlorophyllous, thalloid organisms.
2. They mostly grow in an aquatic habitat (fresh and marine) or on moist soil.
3. Plant body is known as thallus.

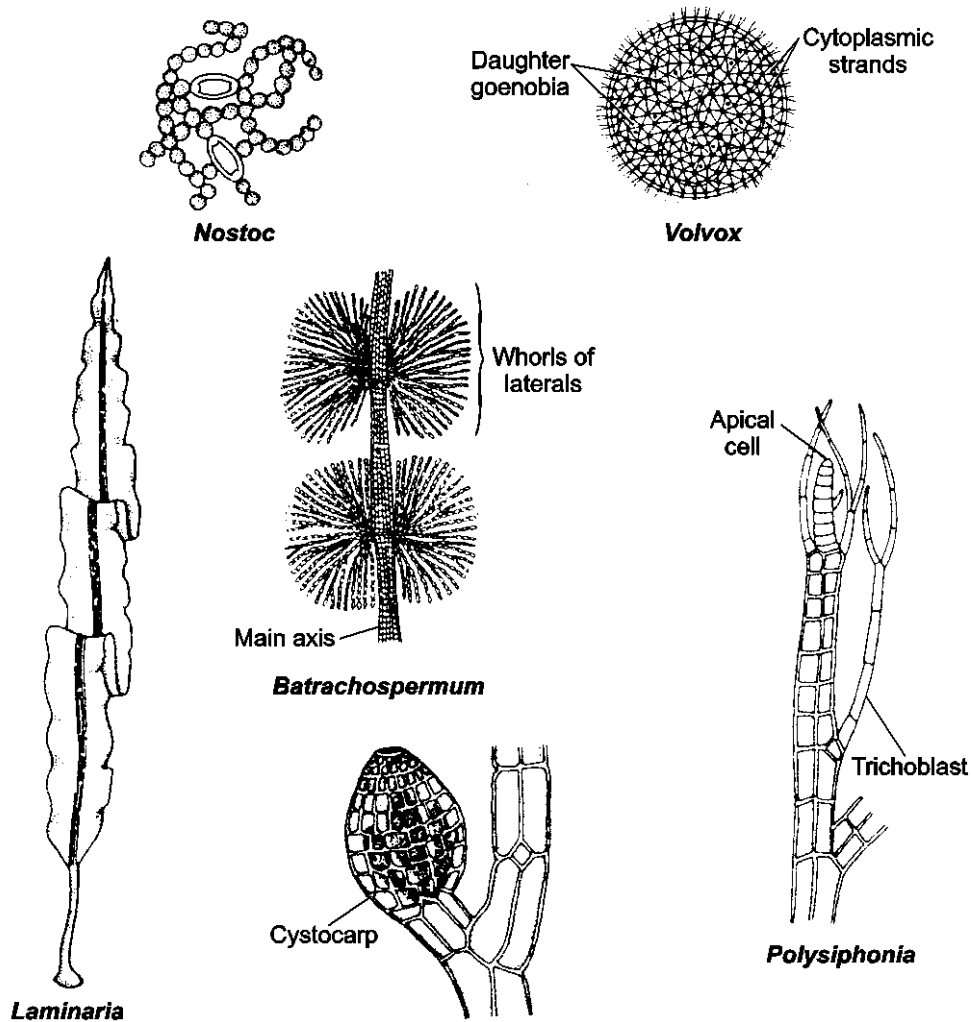


Fig. 1.3: Algae

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