University Center of Abdelhafid Boussouf Mila

COURS OF :

PLANT PHYSIOLOGY

2ND YEAR AGRONOMY

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INTRODUCTION

- Plant physiology: Plant physiology is the study of vital phenomena in plants. It studies the entire plant and its communities. It is the science concerned with processes and functions at cellular, sub- cellular and whole plant levels in response to environmental variables and growth, the responses of plants to changes in the environment and the growth and development that result from the responses is the study of the plant processes responsible for the growth, development, and production of economic yield by crop plants..

CHAPTER 01:
REMINDER OF THE BASIC CONCEPTS

- **Plan of chapter**

1.1. organisation of the plant body

1.2. plant cell organisation

1. ORGANISATION OF THE PLANT BODY

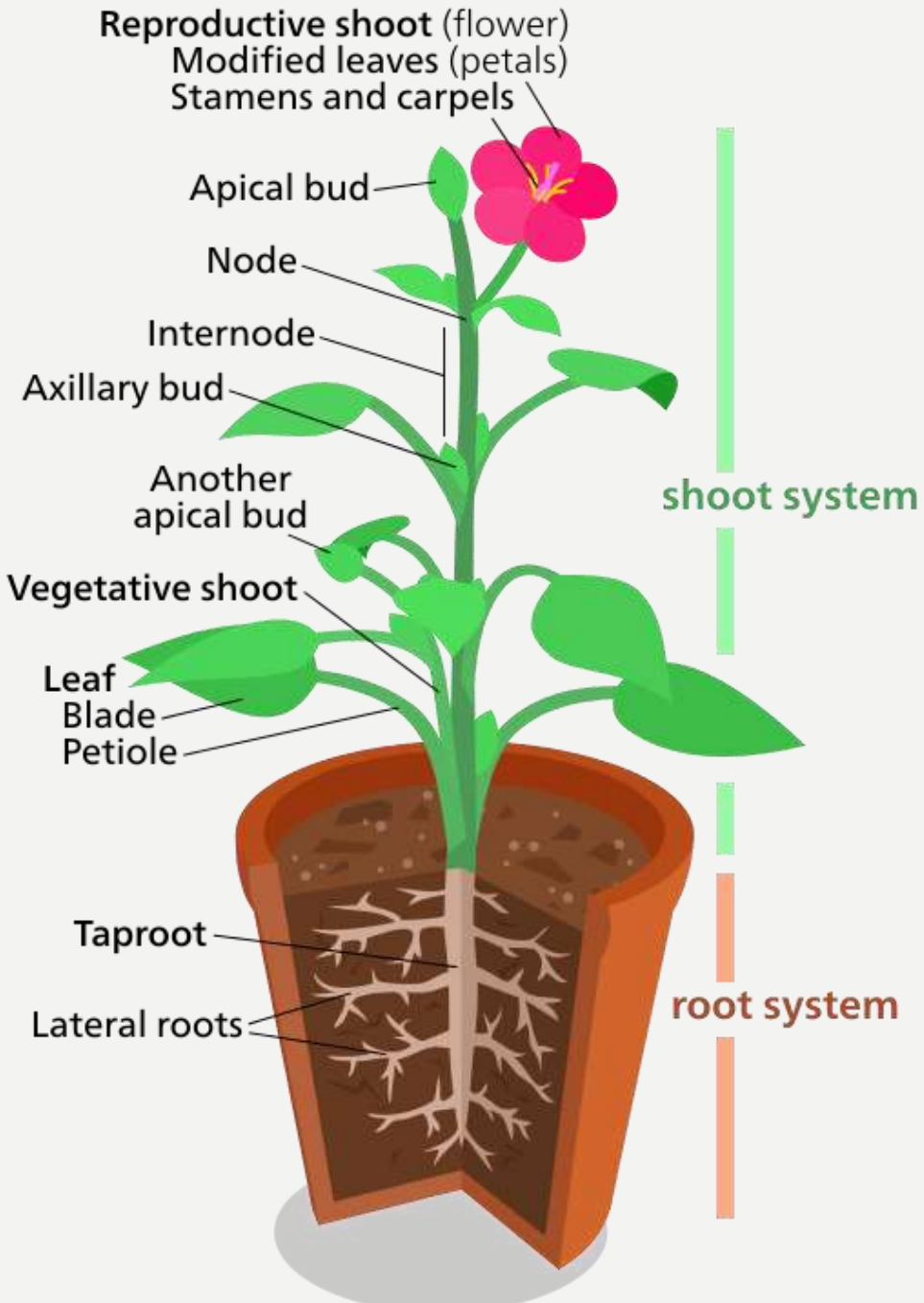
- Like animals, plants are multicellular eukaryotes whose bodies are composed of organs, tissues, and cells with highly specialized functions.
- **Tissues** are groups of similar cells that work together on a specific task.
- **Organs** are structures made up of two or more tissues organized to carry out a particular function, and groups of organs with related functions make up the different **organ systems**.

1.1. PLANT MORPHOLOGY

- Seeded plants (angiosperms and gymnosperms) have two organ systems:

1. Shoot system; includes the organs such as leaves, buds, stems, and the reproductive parts of the plant (flowers and fruits). It absorbs the light needed for photosynthesis..

2. Root system; includes those parts of the plant below ground, such as the roots, tubers, and rhizomes. which supports the plants and absorbs water and minerals, is usually underground.



1.2. PLANT TISSUES

Plant Tissues

Meristematic Tissues

Apical meristematic tissues.

Lateral meristematic tissues.

Permanent Tissues

- Epidermal tissues.
- Ground tissues: Parenchyma tissues.
  Collenchyma tissues.
  Sclerenchyma tissues.
- Vascular tissues: Xylem tissues.
  Phloem tissues.

1. **Ground tissue system**: Provides support, photosynthesis and storage.
2. **Dermal tissue system**: Provides protection and gaseous exchange.
3. **Vascular tissue system**: Transports water and solutes over long distances within the plant.

Types of Permanent Tissues

Epidermal Tissues

- **The xylem** is made up of dead cells without **cytoplasm**
- This enables xylem to transport water and mineral salt to all parts of a plant.
- **Phloems** are made of companion cells and sieve tubes.
  - Made of living cells, which are the sieve tubes with the presence of cytoplasm.
  - phloems transport sugars produced from the photosynthesis from the leaves to storage organs such as roots, fruits and tubers.

Ground Tissues

- **Paracenchyma tissues** are the simplest living cells and do not undergo differentiation.
- **Collenchyma tissues** are made of living cells which mature into cells that are flexible.
- **Sclerenchyma tissues** consist of dead cells when they are matured.

Vascular Tissues

- **Epidermal tissues** layer is at the outermost surface of stems, leaves and roots of young plants.
- Epidermal cell walls which are exposed to the air have a waxy and waterproof layer called the **cuticle**.

Seeded plants have three organs: **roots**, **stems**, and **leaves**, and three tissue types: **ground tissue**, **vascular tissue**, and **dermal tissue**. *Each organ includes all three tissue types.* Each tissue is made up of different cell types, and the structure of each cell type influences the function of the tissue. We will go through each of the organs, tissues, and cell types in greater detail below.

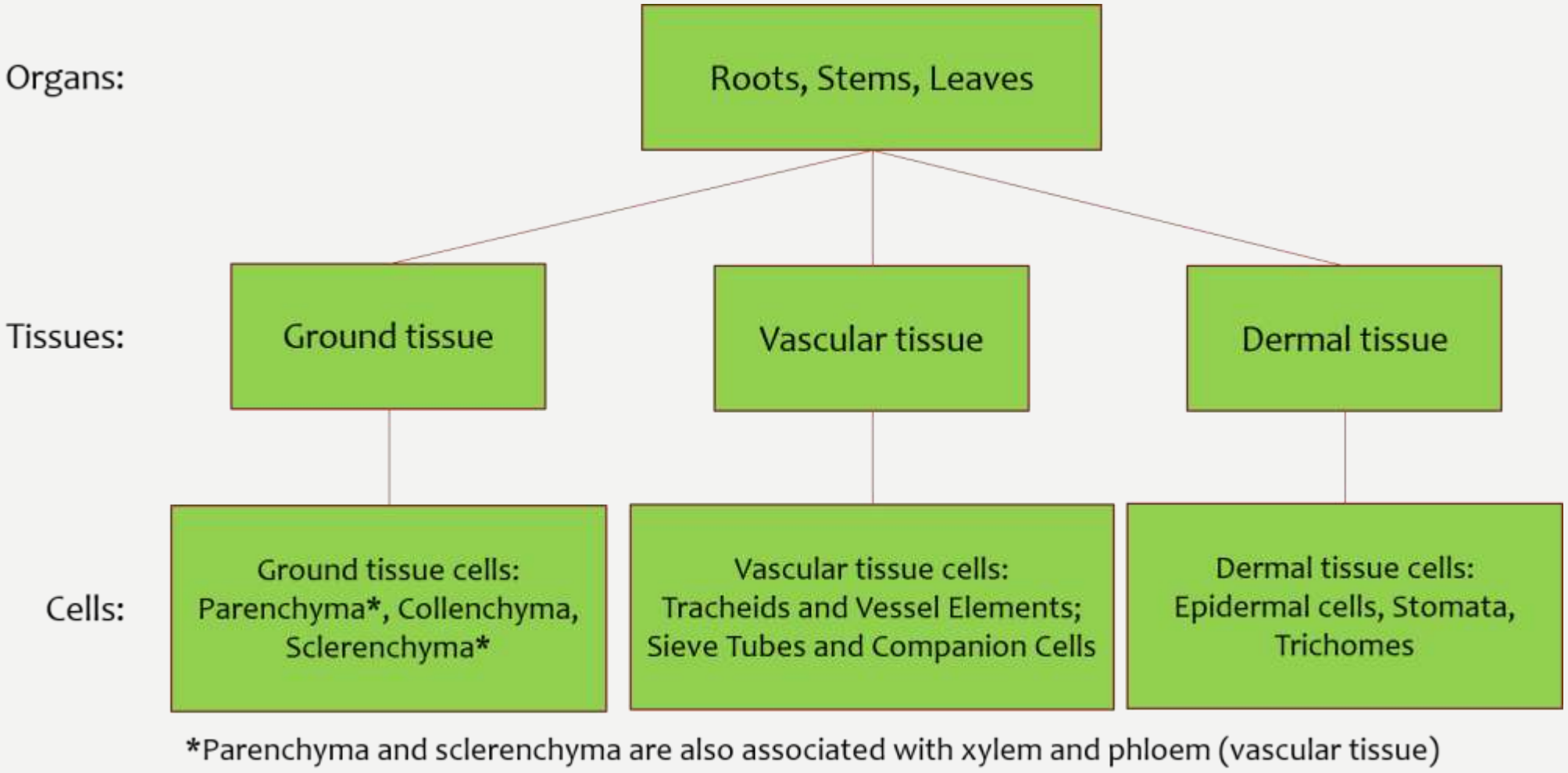
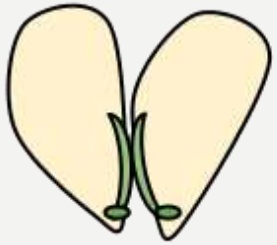
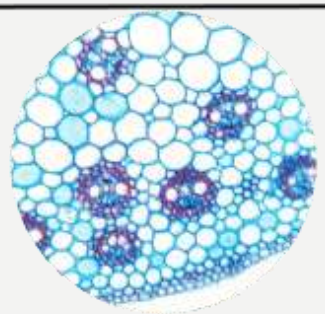
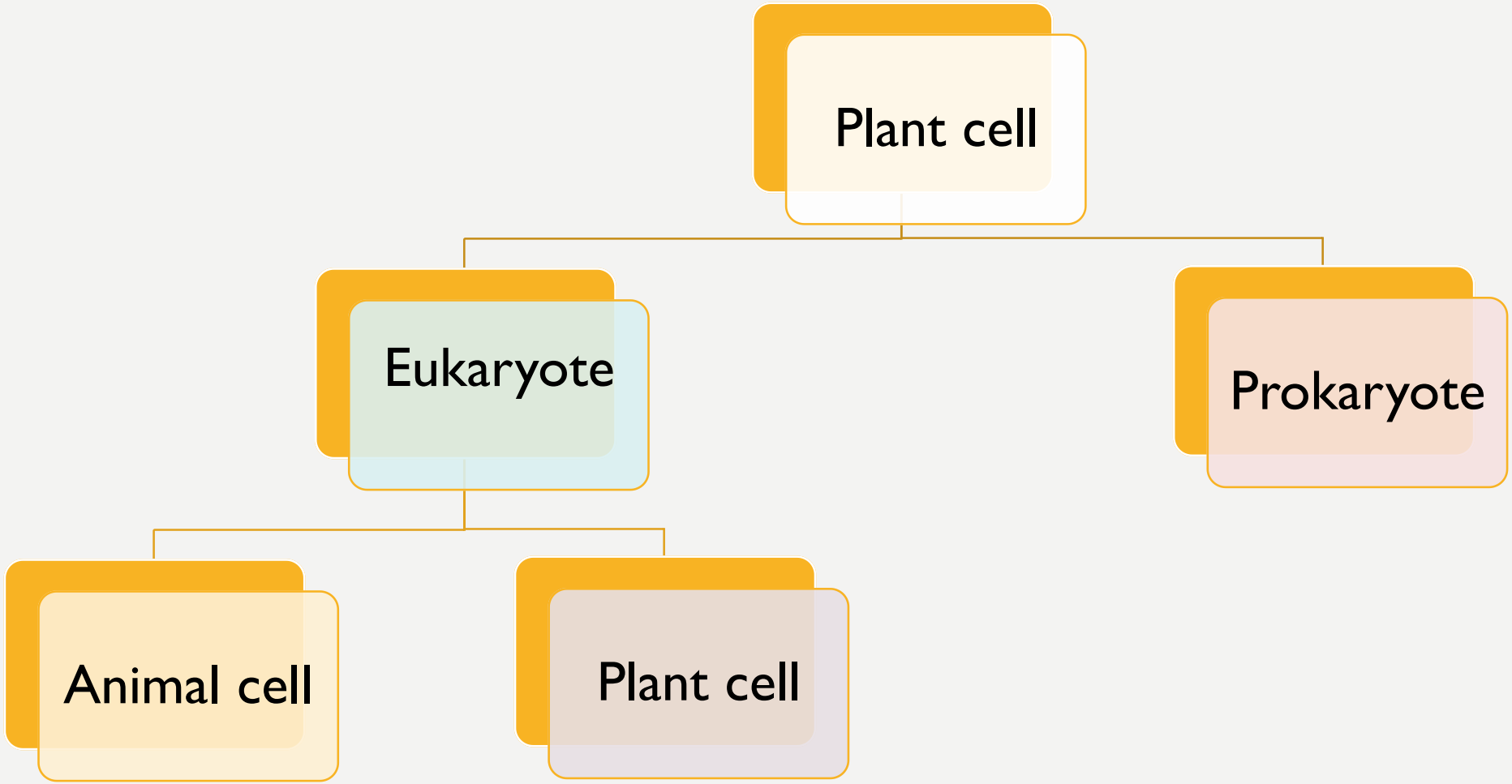


Fig. 1. The relationships between plant organs, tissues, and cell types

MONOCOT	DICOT
Single Cotyledon 	Two Cotyledon 
Long Narrow Leaf Parallel Veins 	Broad Leaf Network of Veins 
Vascular Bundles Scattered 	Vascular Bundles in a Ring 
Floral Parts in Multiples of 3 	Floral Parts in Multiples of 4 or 5 

1.2. ORGANISATION OF PLANT CELL



1. SYSTEMATICS

The classification of plant based on morphological, cytological and anatomic critaria.

Prokaryotic organisms :

Cyanophytes (Blue-green algae).

Eukaryotic organisms:

Thallophytes (sporocysts and gametocysts) (thallus)

Autotrophic thallophytes (Algae)

Heterotrophic thallophytes (fungi)

Cormophytes

Bryophytes Non-vascular cormophytes

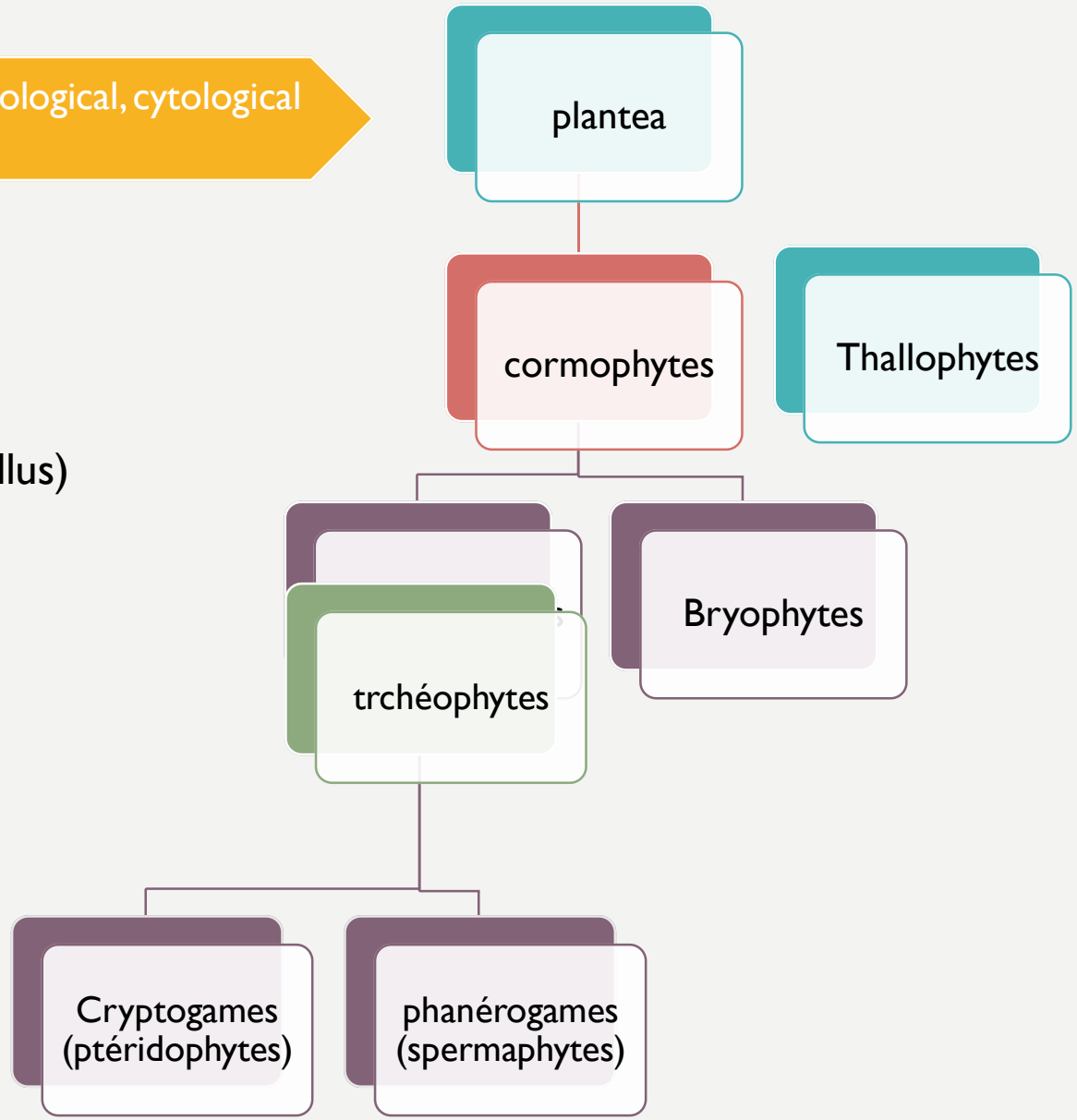
Trachéophytes vascular Cormophytes

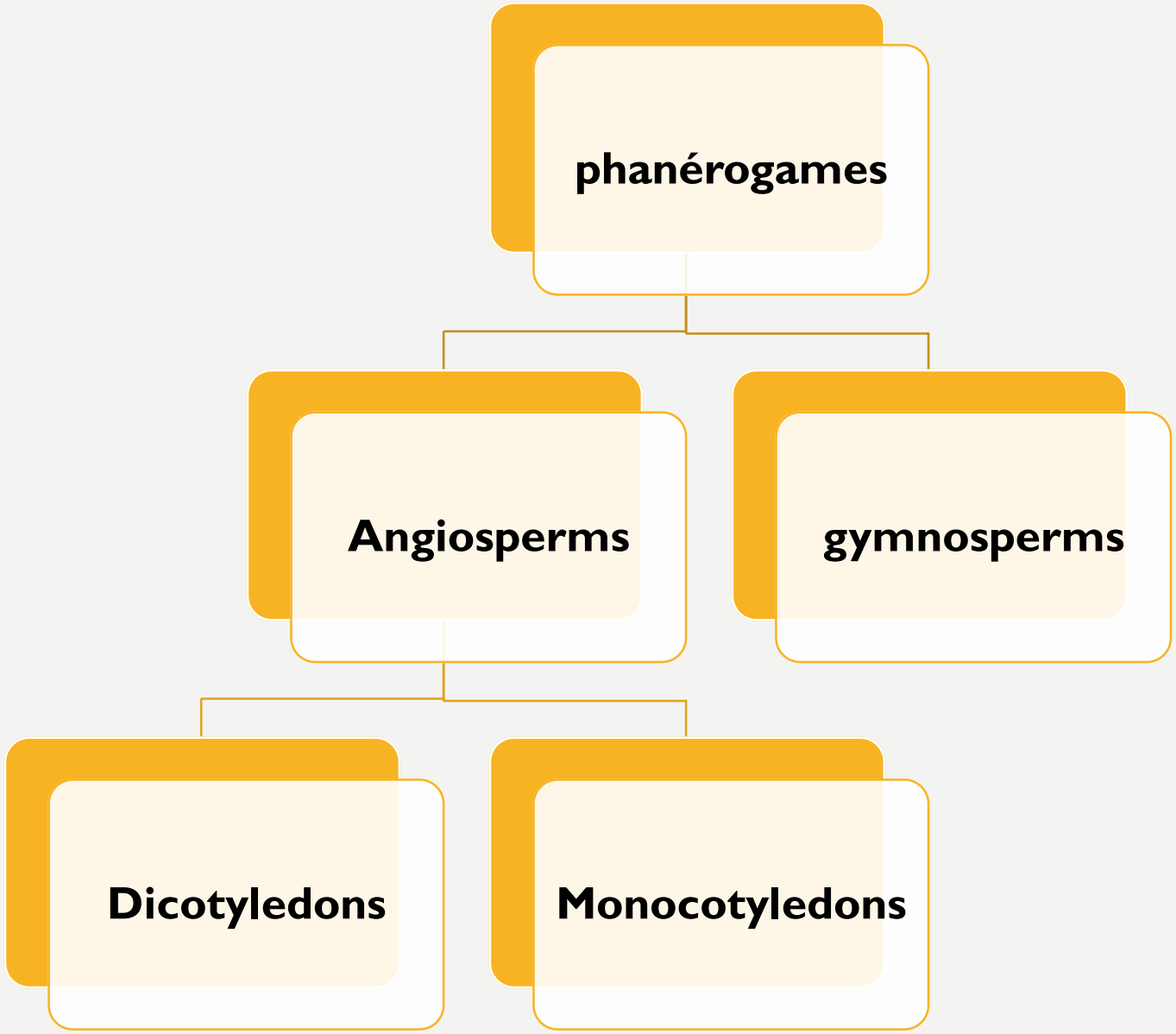
Pteridophytes (Cryptogams)

Spermaphytes (Phanerogams)

Gymnosperms With naked ovum

Angiosperms An ovum hidden in ovary




phanérogames
Angiosperms
gymnosperms
Dicotyledons
Monocotyledons

1. CELL MEMBRANE

- A thin membrane, the plasma membrane, surrounds each cell.
- The cell membrane (plasma membrane), which defines the boundaries of the cytoplasm or cell organ, also known as the cytoplasmic membrane, it is a membrane found in all cells, which divides the cell's interior from the external environment.
- It surrounds a cell and consists of a lipid bilayer with embedded proteins. It is selectively permeable to molecules and ions,, and controls the motion of substances.
- Membranes are composed of approximately half phospholipid and half protein, with a small amount of sterols, another form of lipid. The phospholipids and sterols provide a flexible, continuous and hydrophobic called the **phospholipid bilayer.**

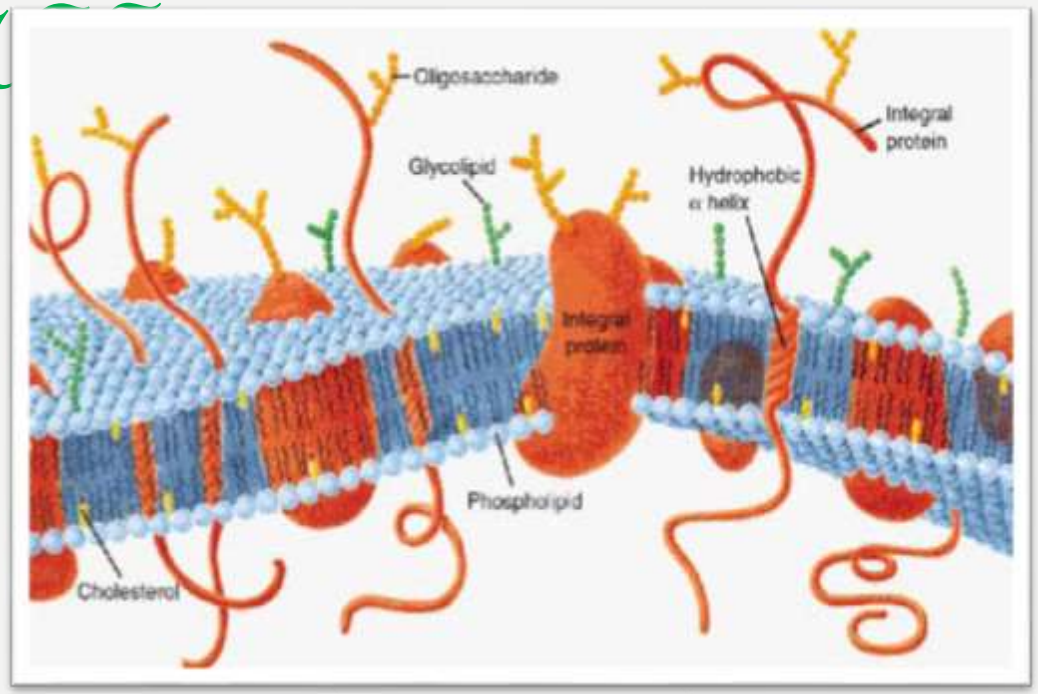


Figure : A model of the plasma membrane, showing the phospholipids bilayer, sterols, and various types of proteins floating in the bilayer.

Cell membrane lipids provide flexibility to the membrane structure while membrane proteins help to move molecules across the membrane

2.CELL WALL

- Cell wall is the characteristic feature of the plant cells which is completely absent in animal cell
- A **cell wall** is a structural layer surrounding some types of cells, just outside the cell membrane. It can be tough, flexible, and sometimes rigid. It provides the cell with both structural support and protection, and also acts as a filtering mechanism.

- The primary cell wall of land plants is composed of the polysaccharides cellulose, hemicelluloses and pectin. Often, other polymers such as lignin, suberin or cutin are anchored to or embedded in plant cell walls.

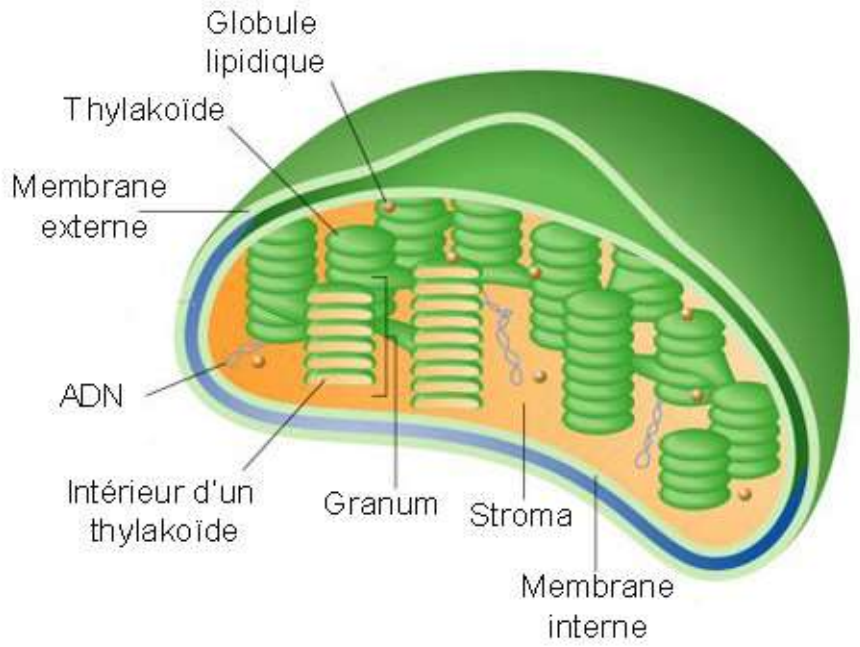
- The walls of plant cells must have sufficient tensile strength to withstand internal osmotic pressures that result from the difference in solute concentration between the cell interior and external solutions. Plant cell walls vary from 0.1 to several μm in thickness.

3. PLASTES

- Plant cells have two specialized organelles that a provide the energy: plastids and mitochondria.
- **Plastids Convert Light Energy to Chemical Energy**
- Plastids are complex organelles found in every living plant cell. One cell may have 20 to 50 plastids, each 2 to 10 μm in diameter.
- Characteristically, they are surrounded by a double membrane. They contain DNA and ribosomes, a full protein-synthesizing system similar but not identical to the one in the nucleus and cytoplasm. Some of the proteins of the plastid are made by this system; other are made in the cytoplasm and are transported into the plastid across its outer membranes.

Many cells in leaves contain plastids called **chloroplasts.** Chloroplasts contain an elaborate array of membranes, the **thylakoids. Incorporated in the thylakoid** membranes are proteins that bind the green compound **chlorophyll.**

It is this compound that gives green plant tissues their color. Surrounding the thylakoids is a thick solution of enzymes, the **stroma. Together, the proteins in the thylakoids and** the stromal enzymes perform photosynthesis, during which light energy is converted to chemical energy. These plastids can also store carbohydrates, the products of photosynthesis, in the form of starch grains.



Amyloplasts: colourless plasts, they are the place of synthesis and storage of starch. They are found, for example, in the reserve parenchyma of the potato tuber.

The chromoplasts: plasts colored yellow or red orange by carotenoid pigments giving their color to plant organs (yellow flower of arnica, red fruit of tomato, orange root of carrot...)

Oleoplasts: plasts for the storage of lipid substances

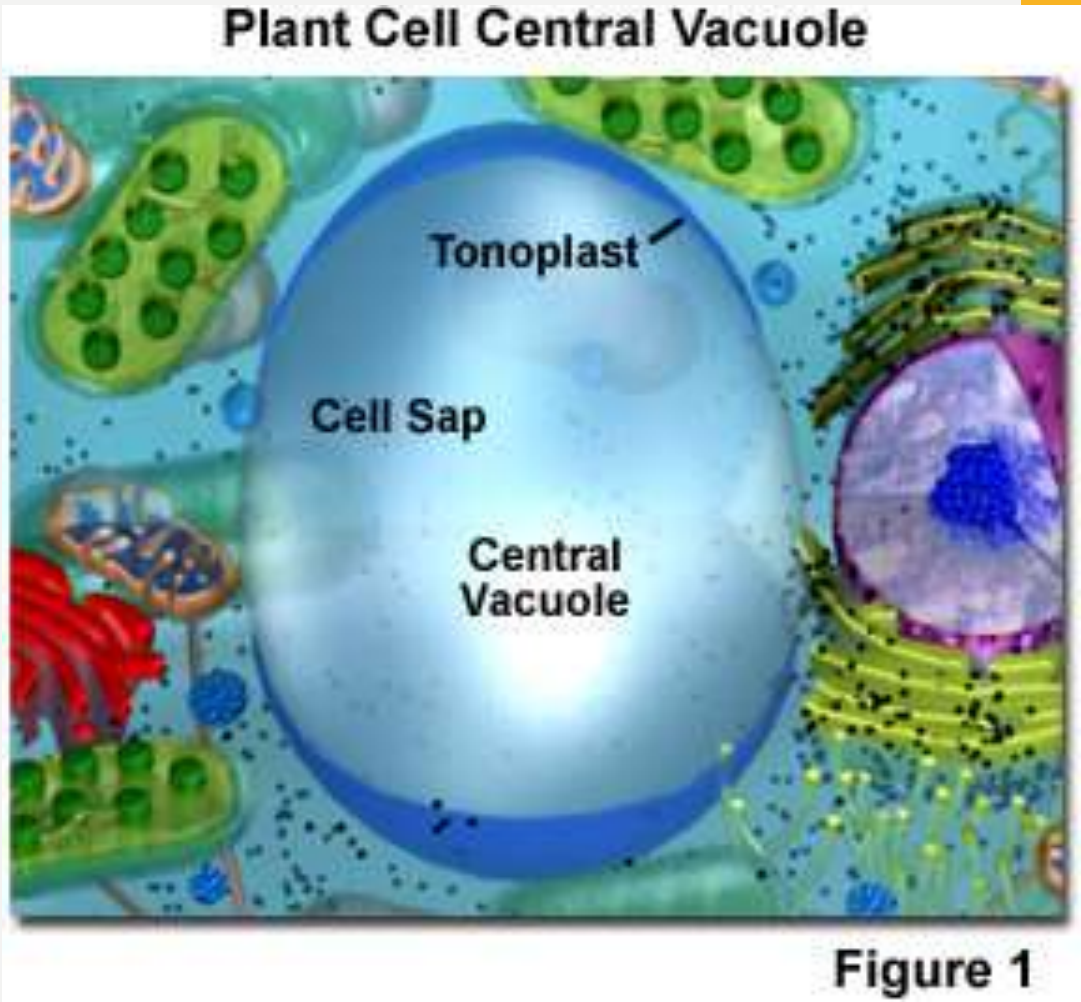
Proteoplasts: plasts for the storage of proteins

4. VACUOLE

- The vacuoles of plant cells are multifunctional organelles that are central to cellular strategies of plant development.
- They are lytic compartments, function as reservoirs for ions and metabolites, including pigments, and are crucial to processes of detoxification and general cell homeostasis.
- They are involved in cellular responses to environmental and biotic factors that provoke stress.
- In the vegetative organs of the plant, they act in combination with the cell wall to generate turgor, the driving force for hydraulic stiffness and growth.
- In seeds and specialized storage tissues, they serve as sites for storing reserve proteins and soluble carbohydrates.
- In this way, vacuoles serve physical and metabolic functions that are essential to plant life.

- Vacuoles are membrane-bound sacs within the cytoplasm of a cell that function in several different ways.

- In mature plant cells, vacuoles tend to be very large and are extremely important in providing structural support, as well as serving functions such as storage, waste disposal, protection, and growth.



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