Introduction to Plant Physiology

L2, Semester 4

Departments : - Marine and Continental Hydrobiology

- Agronomy – Plant Protection

January 2024

Définition of Plant physiology

Plant physiology is the science that studies how plants function to keep them alive. This science uses physical and chemical laws to explain how the plant uses light energy to synthetize organic molecules that form part of the complex structures that make up the plant. This science also studies the integration of chemical and physical processes in space and time (plant-environment interaction).

Plan of the course

INTRODUCTION: Reminder of the basic concepts

- Organisation of a plant
- Organisation of a plant cell

Part I. NUTRITION

1. Water nutrition (mechanisms of water absorption and movement);

2. Transpiration and water balance;

3. Mineral nutrition (macro and micro-elements);

4. Nitrogen nutrition (Nitrogen cycle, transport and assimilation of nitrates);

5. Carbon nutrition (photosynthesis).

Plan of the course

Part II. PLANT DEVELOPMENT

1. Seed formation;
2. Germination;
3. Growth;
4. Flowering;
5. Fruiting.

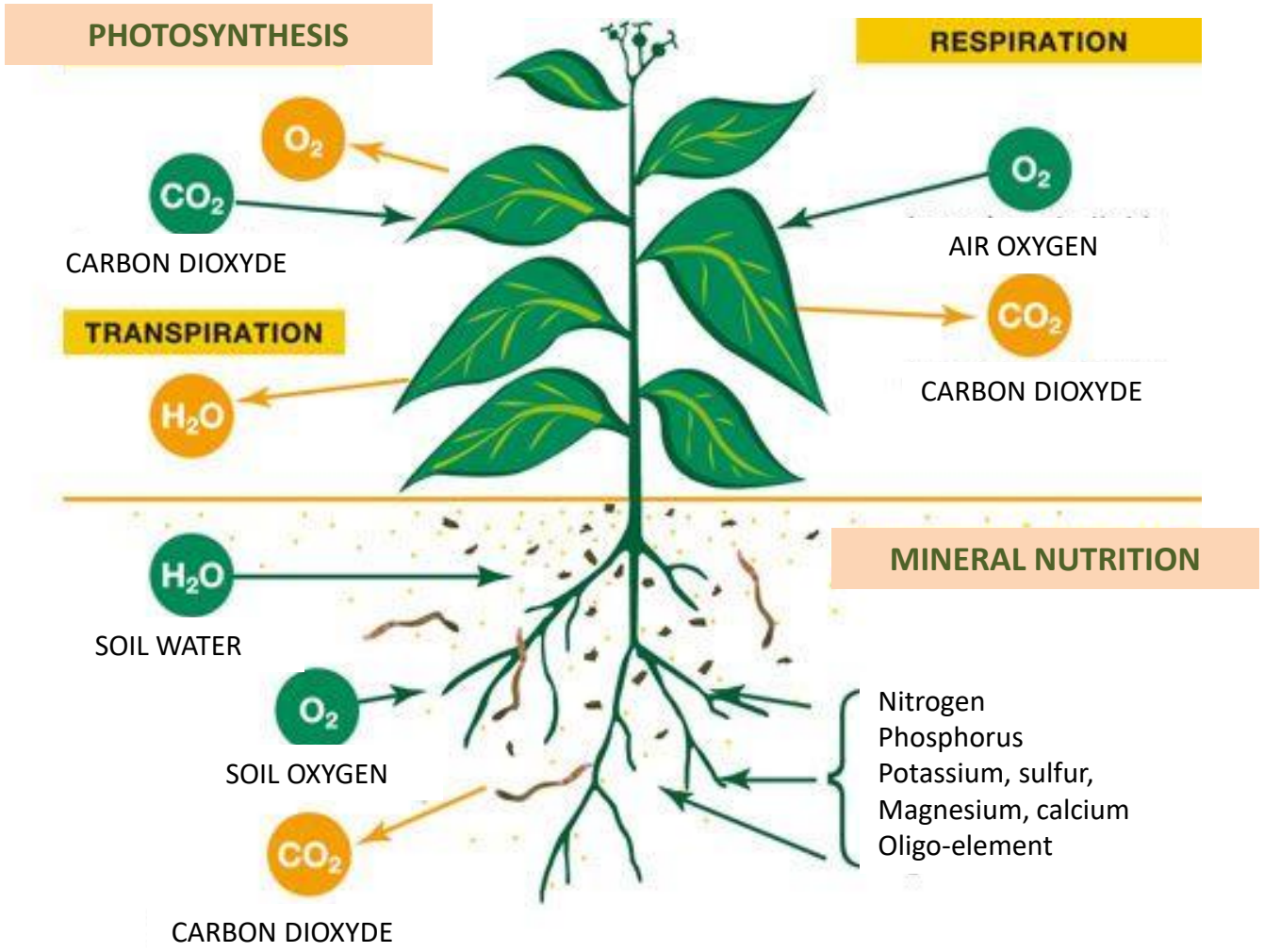
INTRODUCTION

A reminder of the basic concepts

- Organization of a plant;

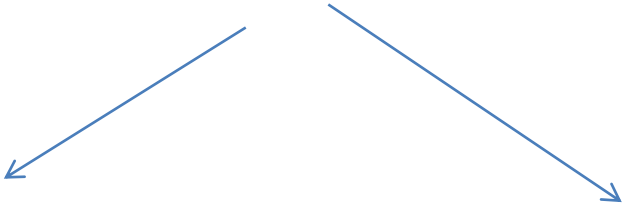
- Organization of a plant cell.

- Organisation of a plant



- The organisation of a plant cell

Plants are distinguished from other living organisms by 2 characteristics: The plant cell



- Surrounded by a **rigid wall** that forms the pericellular skeleton and is rich in carbohydrates.

- Highly developed biosynthesis capacity (**complete autotrophy**).

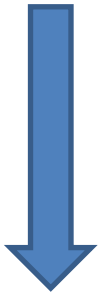
Some definitions

- **Autotrophy :** An organism is capable to synthetize its own organic matter from mineral elements. (ex. photosynthesis).

- **Heterotrophy :** Refers to species that take the organic substances they need from the external environment.

The fundamental unit of living organisms is the **cell**

Physiological functions of the **cell**



Insured by

- **Plastes;** responsible of <u>photosynthesis;</u>
- **Vacuoles;** play an important role in water absorption in the roots and in gas exchange in the leaves (opening and closing of stomata);
- **The skeletal wall;** gives the cell its shape.

The **plant cell** is an eukaryotic cell.

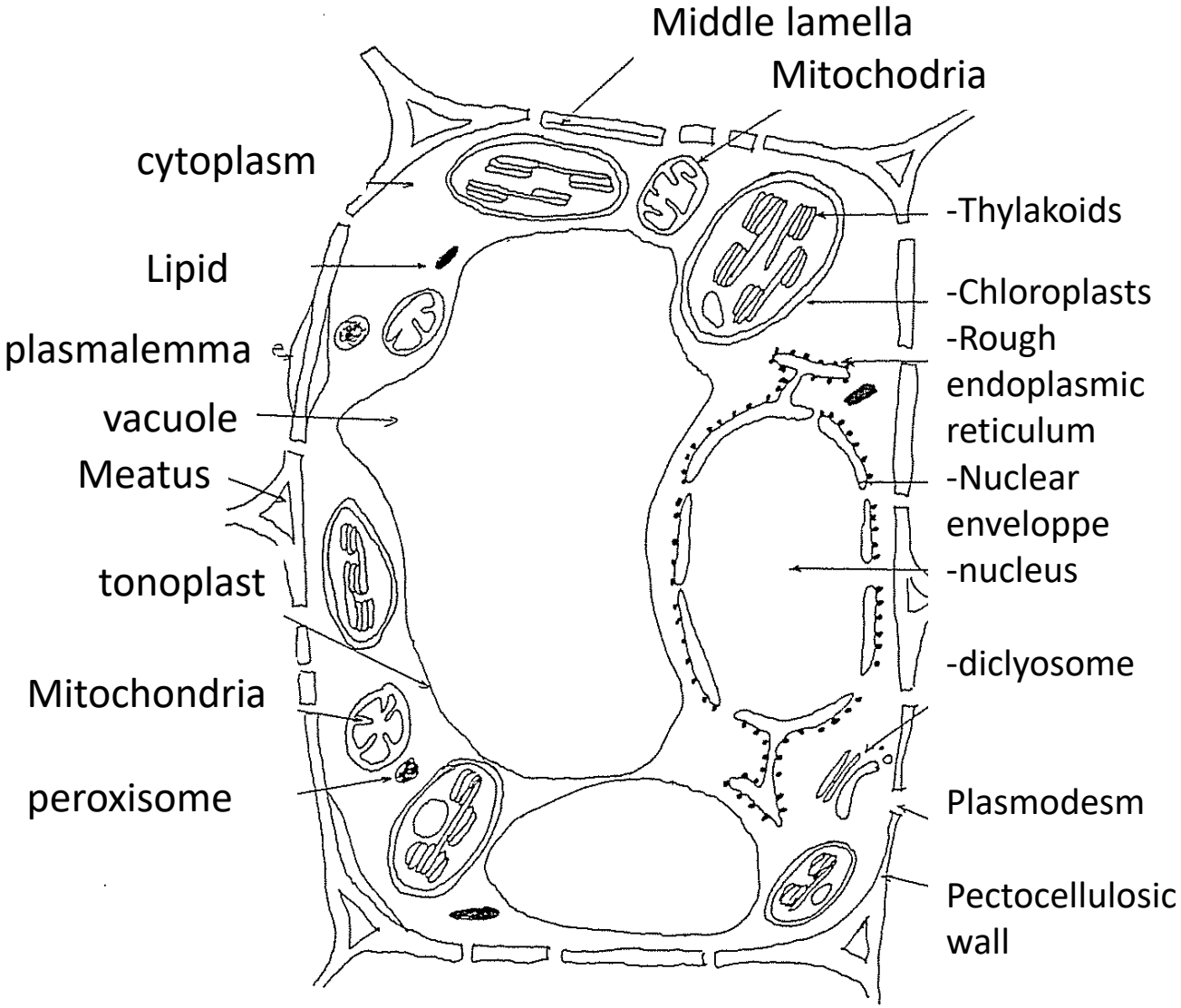


Fig. 1. Assimilating cell of the leaf parenchyma.
A meristematic cell has proplasts instead of chloroplasts and very small vacuoles

A typical example of a plant cell: **Leaf parenchyma cell**

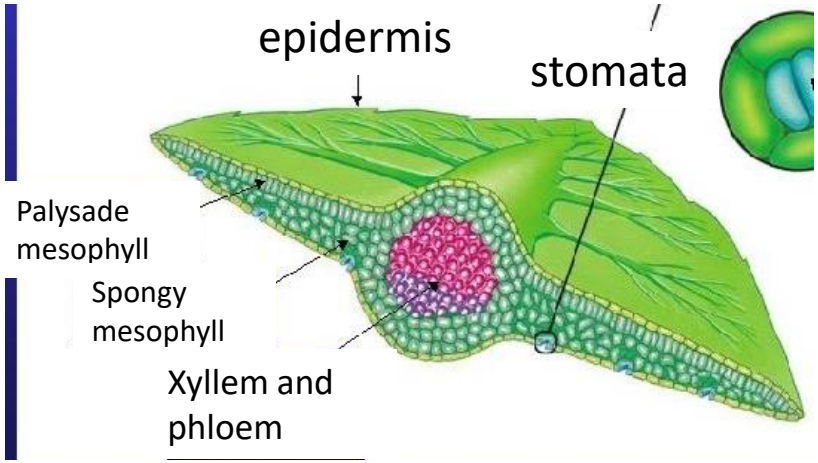


Fig 2. Cells of the leaf's palisade parenchyma.

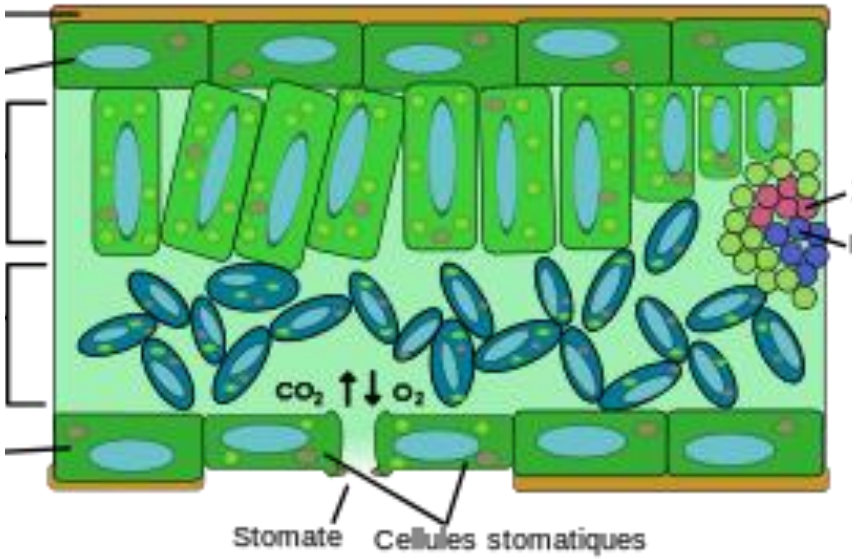
-Cuticule

-Upper epidermis

-palissade parenchyma

-spongy parenchyma

-lower epidermis



Vascular tissu :
-xyllem
-phloem

The cell of the palisade parenchyma contains: A true nucleus, separated from the cytoplasm by a nuclear envelope (double membrane).

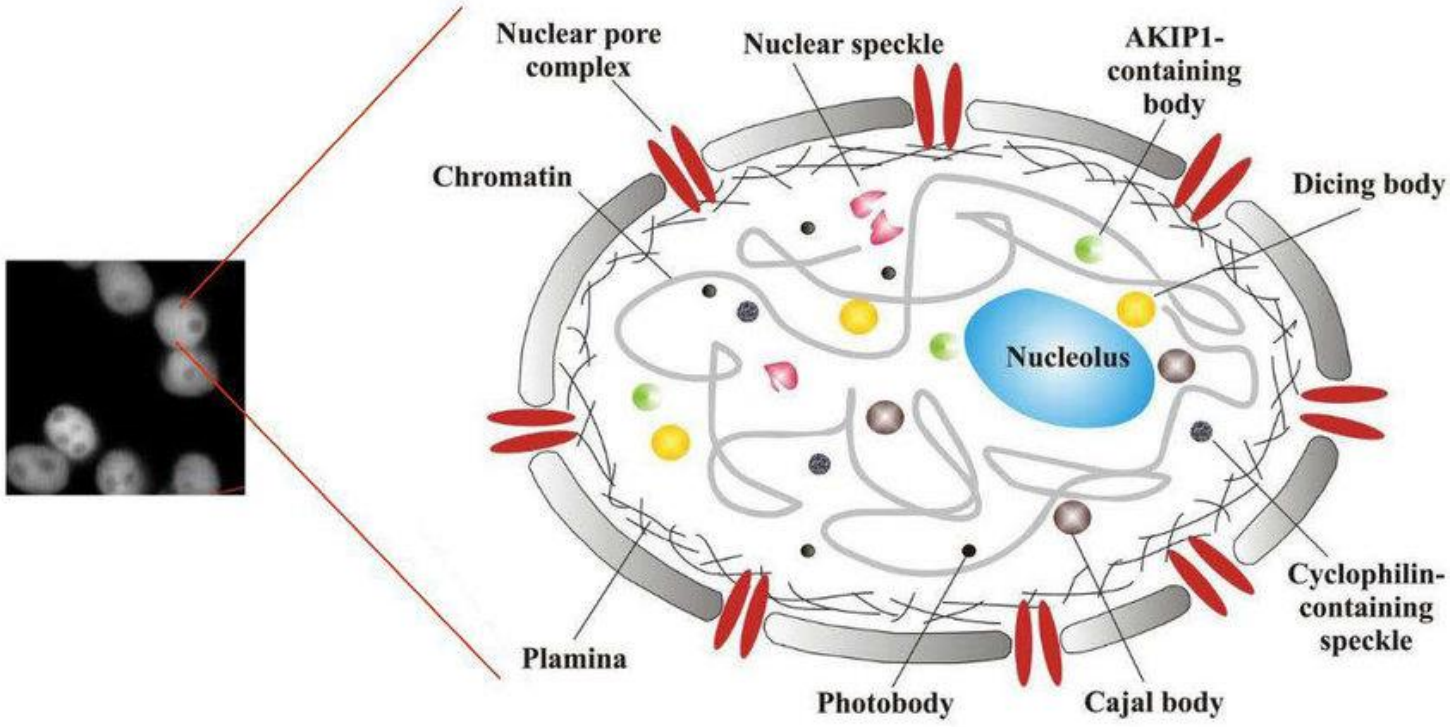


Fig 3. Diagram of a nucleus

- An **outer plasma** membrane (plasmalemma) which is pressed against a skeletal (or pectocellulosic) wall which acts as a support.

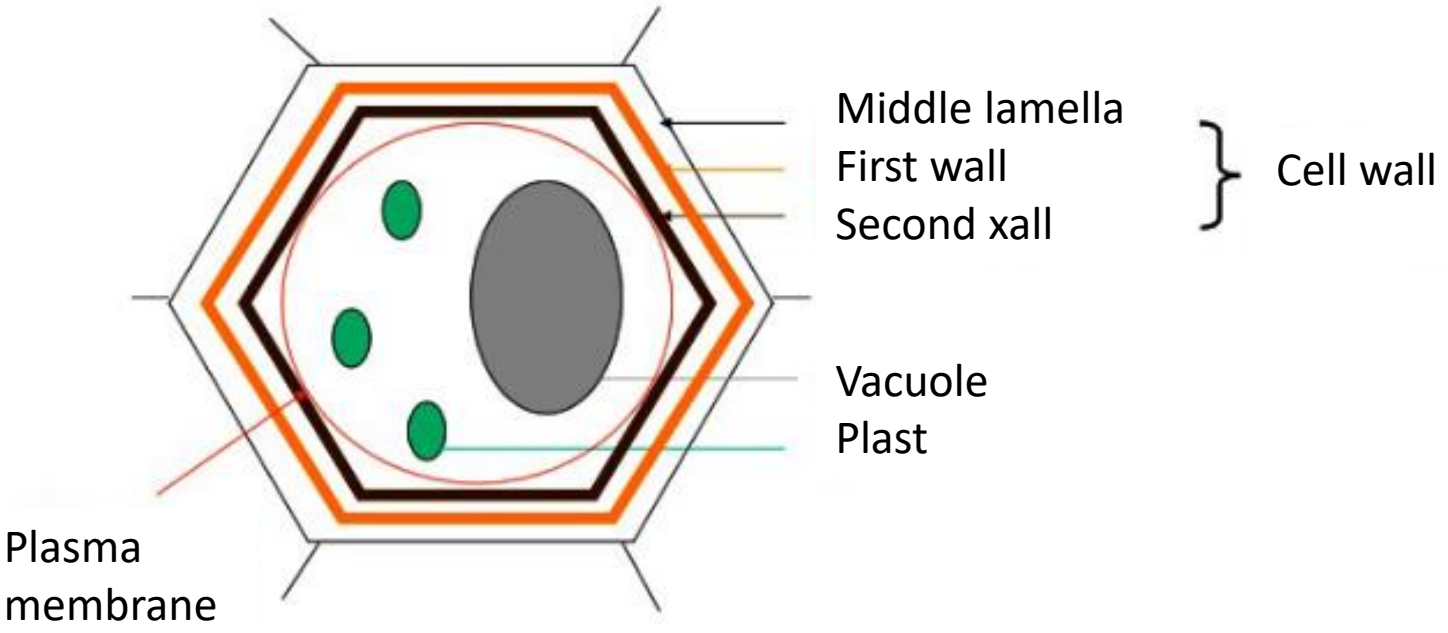


Fig 4. Plant cell: the plasma membrane (Plasmalemma)

- An **external skeleton** of the skeletal wall which is built up from the plasmalemma due to the enzymatic action of cellulose synthetase: this enzymatic action assembles the glucose molecules one by one (on the cytoplasm side) and unwinds a chain of Cellbiose on the outside, which spontaneously aggregates with other chains to form a cellulose microfibril, which is a basic component of the skeletal wall.

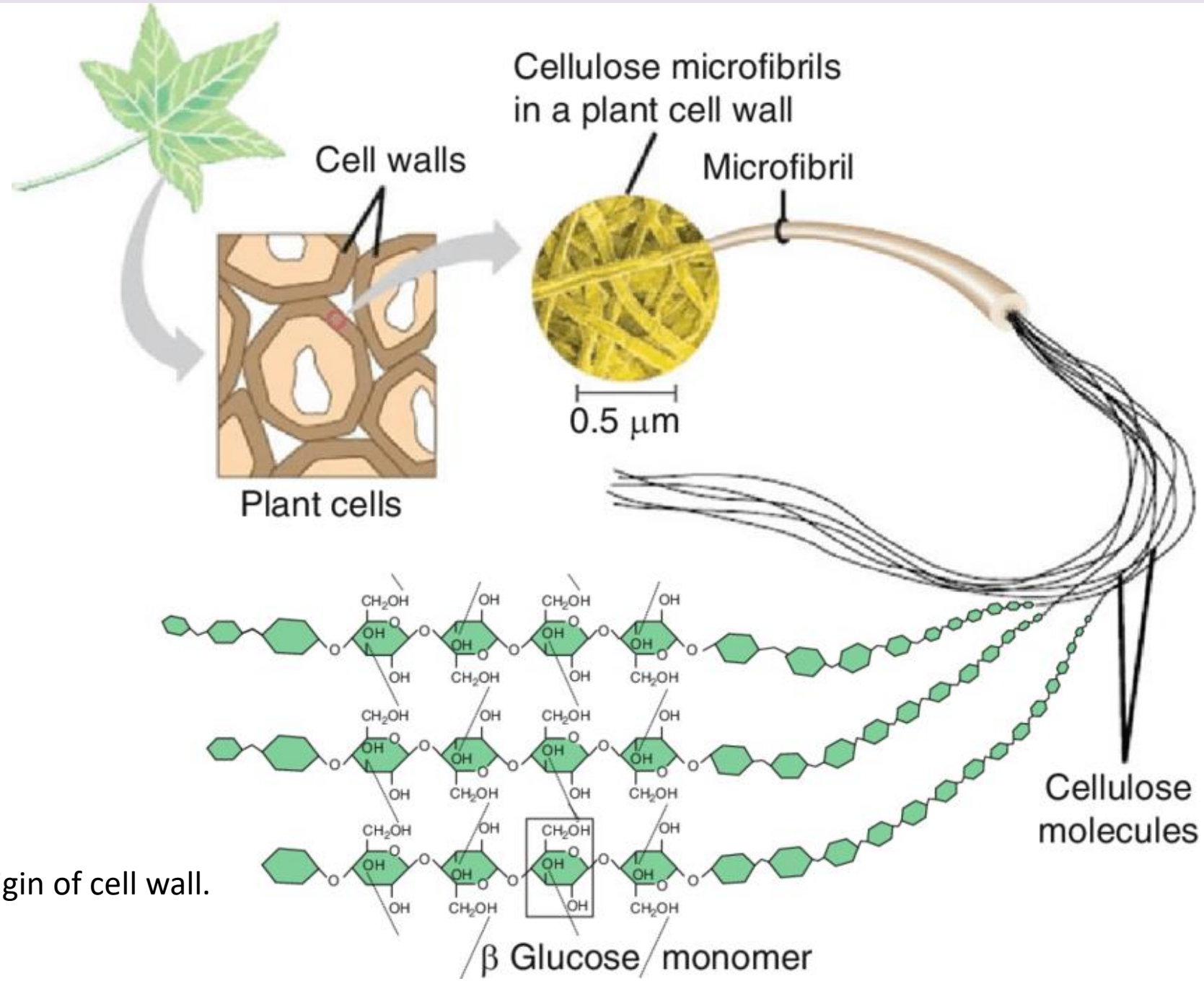


Fig 5. Origin of cell wall.

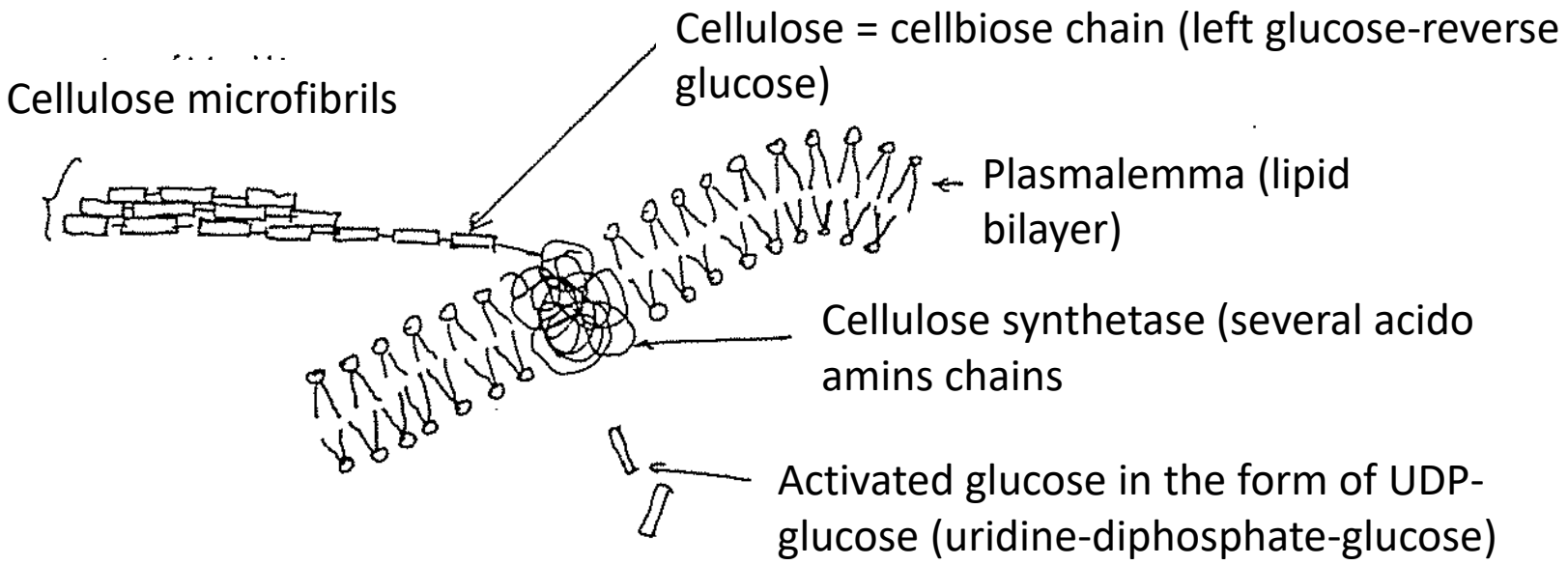


Fig 6. Weaving of cellulose by displacement of the enzyme cellulose synthetase (CS) within the plasmalemma:
-enzymatic polymerisation of cellbiose chains
-spontaneous association of microfibril chains

- **Plasts** : The plant cell is characterized by the presence of plastids, or more precisely chloroplasts, which carry out photosynthesis (transformation of light energy).

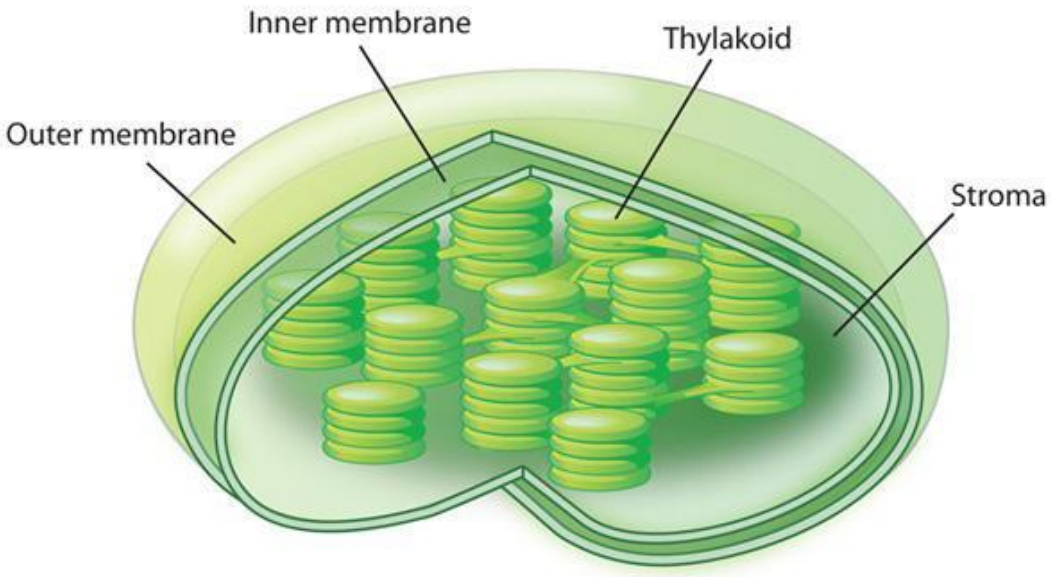


Fig 7. Diagram of a chloroplast

- A **vacuole**: in the plant cell, the development of vacuoles makes it possible to increase cell volume enormously at minimal metabolic reaction. The vacuole contains water and mineral salts.

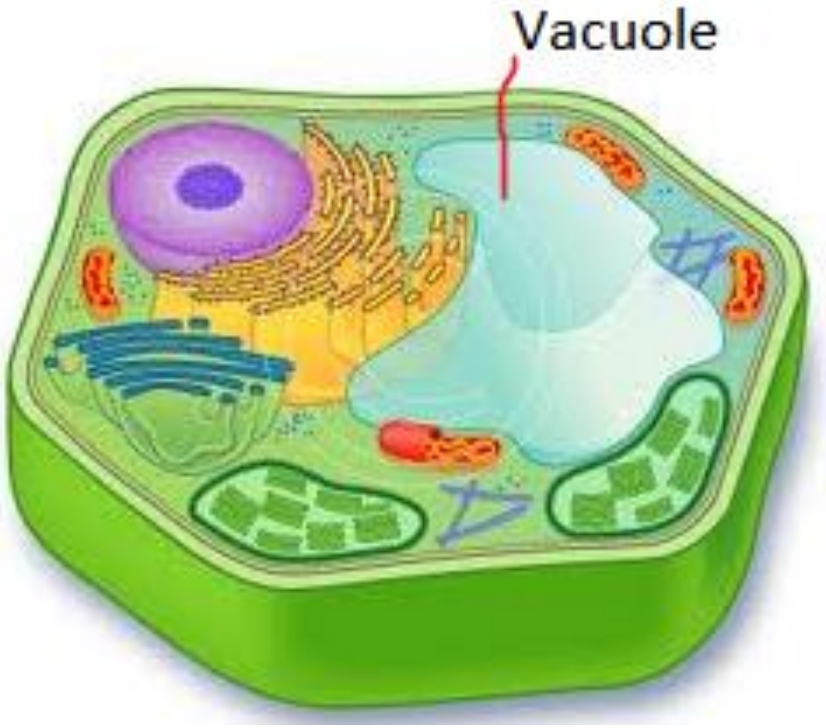


Fig 8. A vacuole