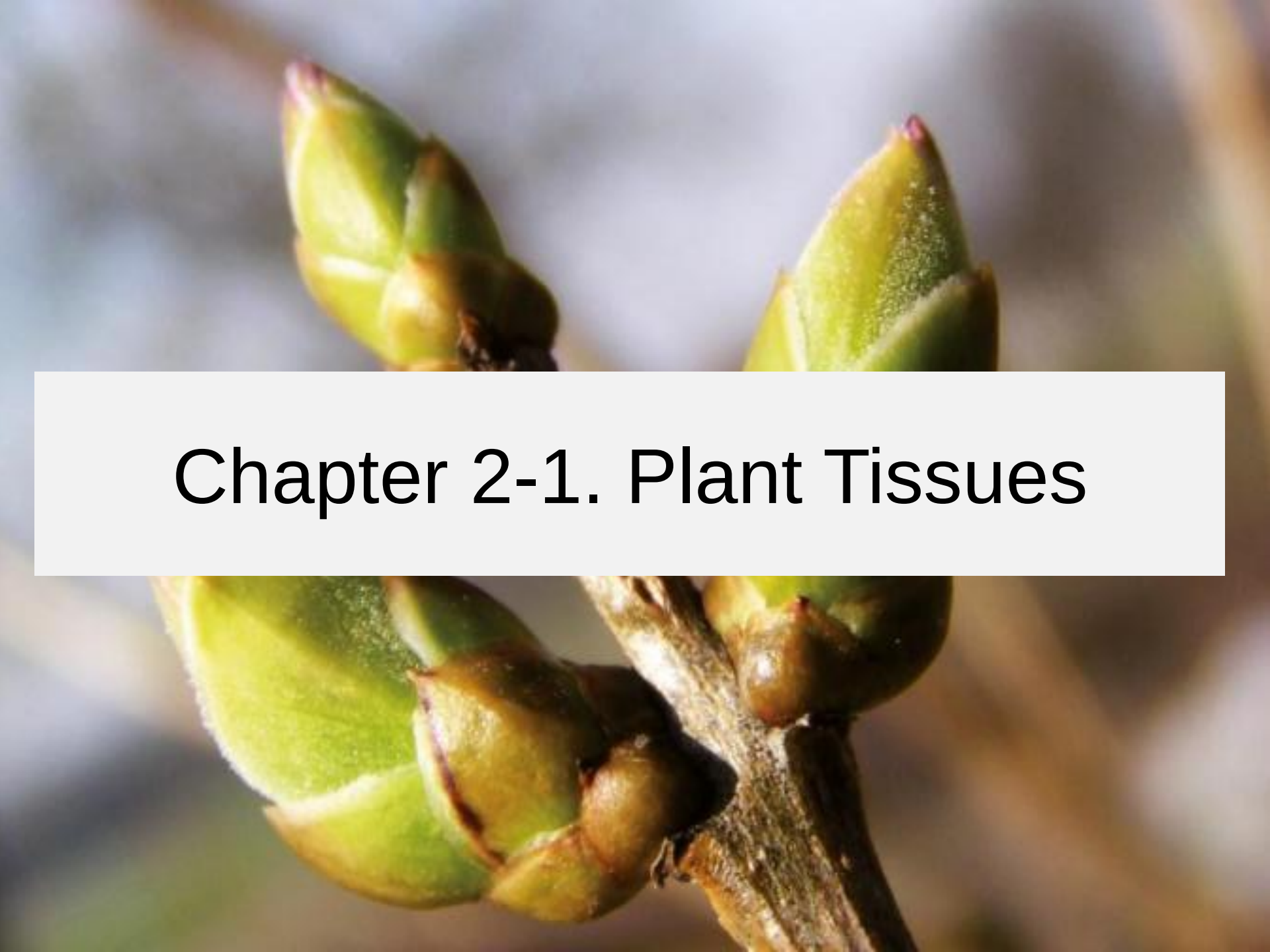
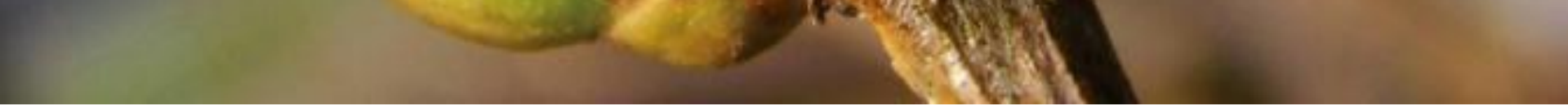


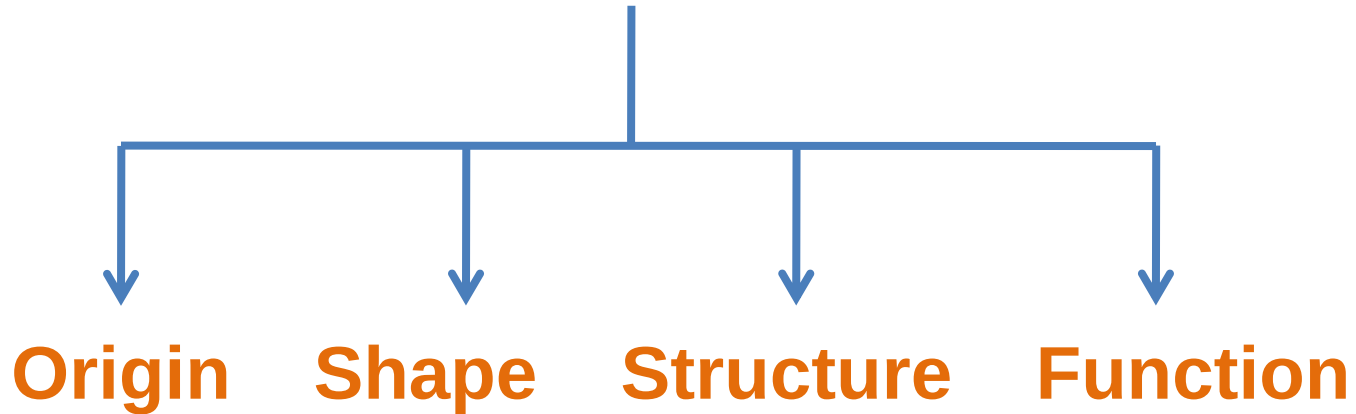
A close-up photograph of a plant stem with several green, pointed buds. The buds are in various stages of development, with some showing more green and others more brown. The stem is brown and textured. The background is blurred.

Chapter 2-1. Plant Tissues

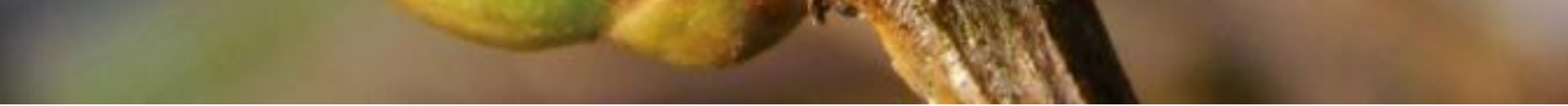


Histology is the study of tissues.

A **tissue** is a grouping of similar cells **having the same** :

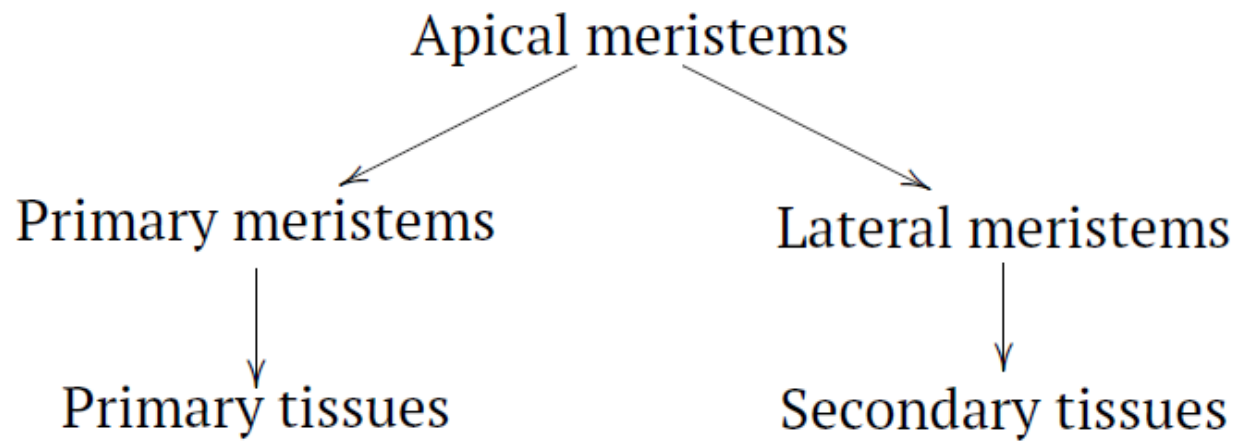


The **tissues** will form organs such as roots, stems, flowers, etc....etc.

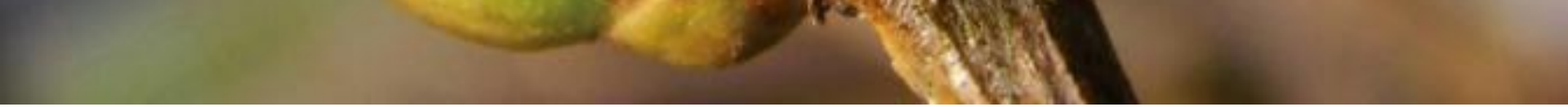


Different types of plant tissues

1. The primary and secondary tissues ;
2. Les tissus de revêtement primaires ;
3. Les tissus conducteurs primaires
4. Les parenchymes ;
5. Les tissus de soutien (colenchyma and sclerenchyma) ;
6. Les tissus sécréteurs.



Meristems and tissues

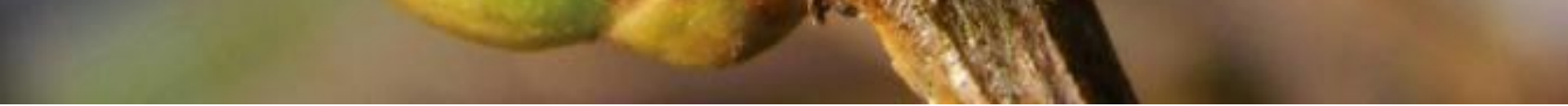


- Definition of a **meristem**

A **meristem** is a plant tissue composed of a group of **undifferentiated cells** with high **mitotic activity**, responsible for the indefinite growth of the plant..

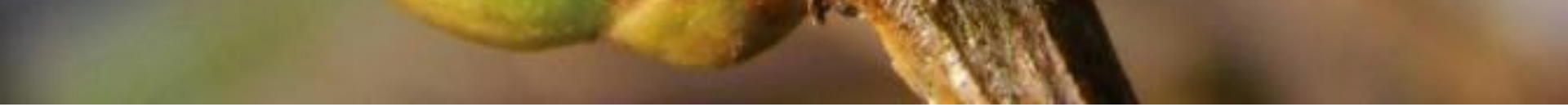
Etymology

From the ancient Greek meristos = **divided**



The primary and secondary plant tissues

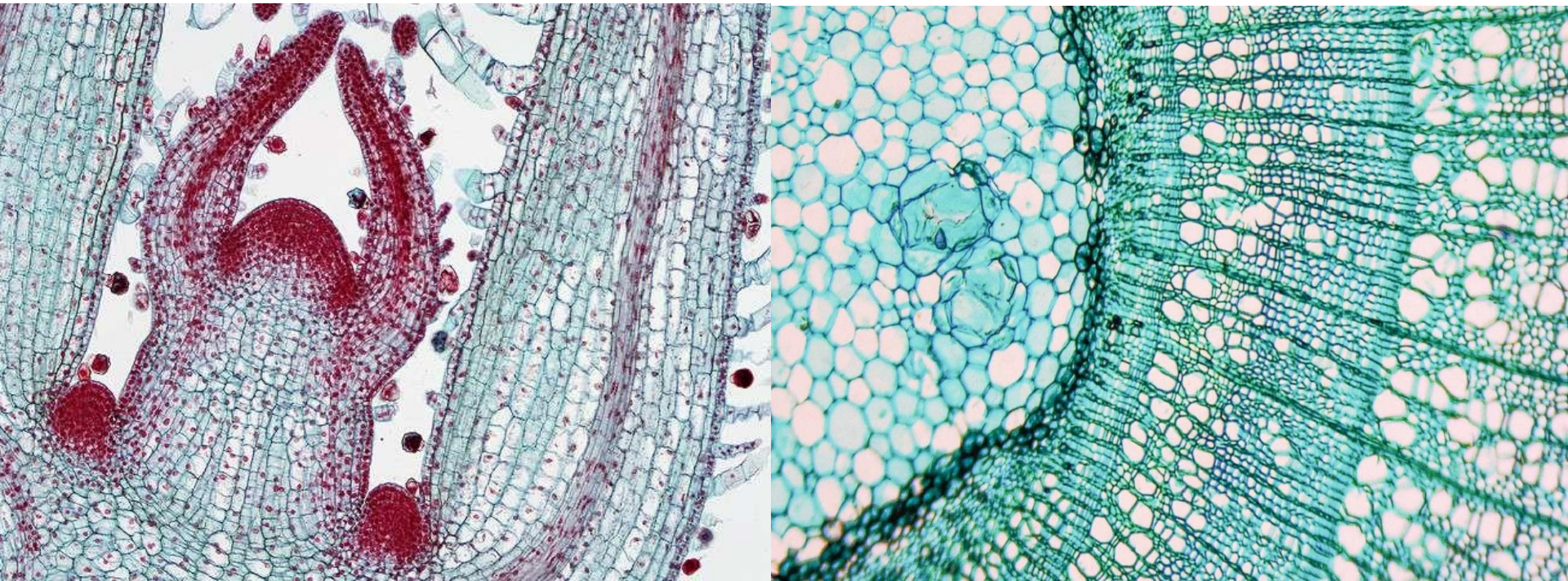
- The **primary tissues** assure **longitudinal** growth, allowing stems and roots **elongation** and **branch**;
- The **secondary tissues** ensure that the plant grows **thicker**, allowing the stems and roots to **increase in diameter**.



Primary and secondary tissues are distinguished from one another by:

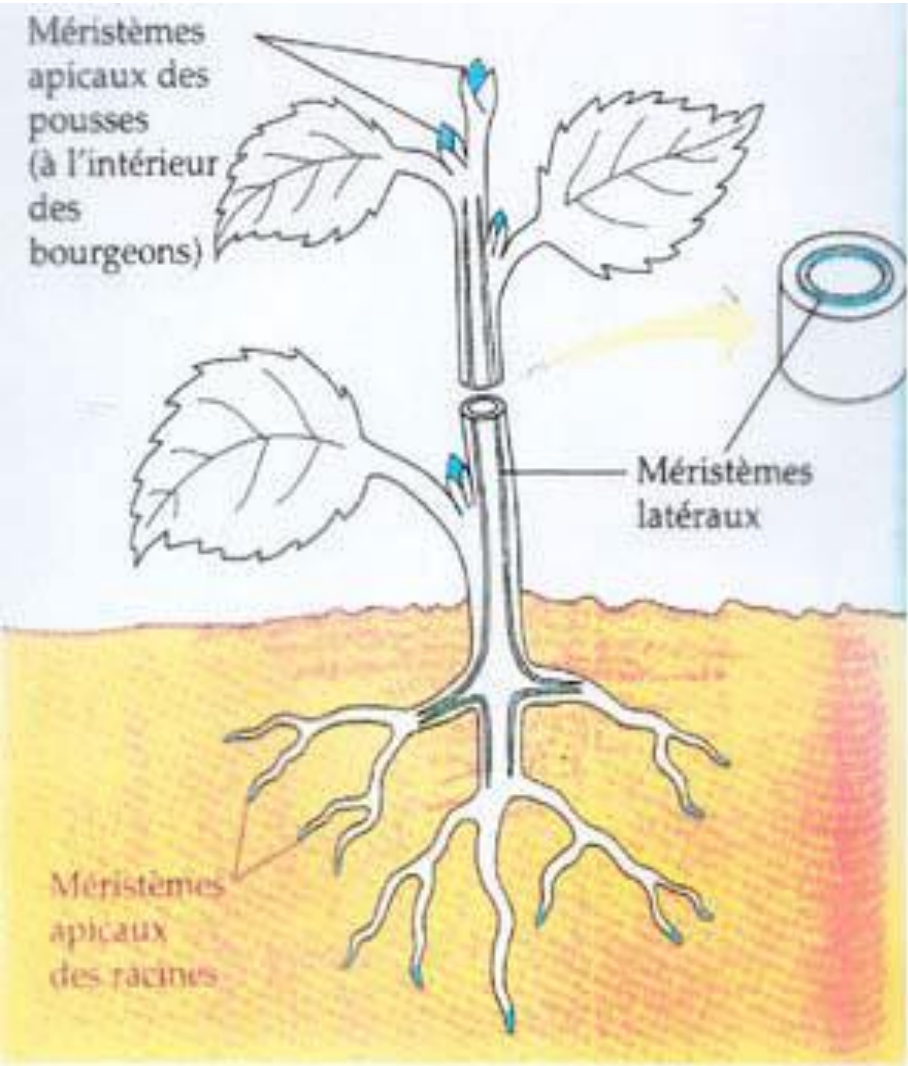
- Their **location** in the plant ;
- Their **cytological characteristics** and ;
- Their **role in tissue and organ formation**.

1. The primary tissues (apical meristems of **roots and stems**)

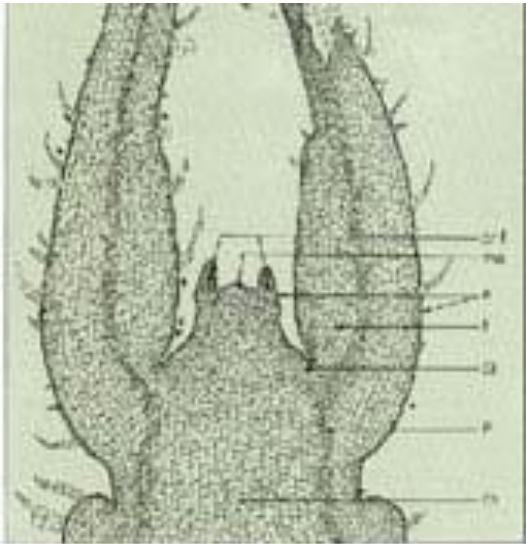


Primary meristems

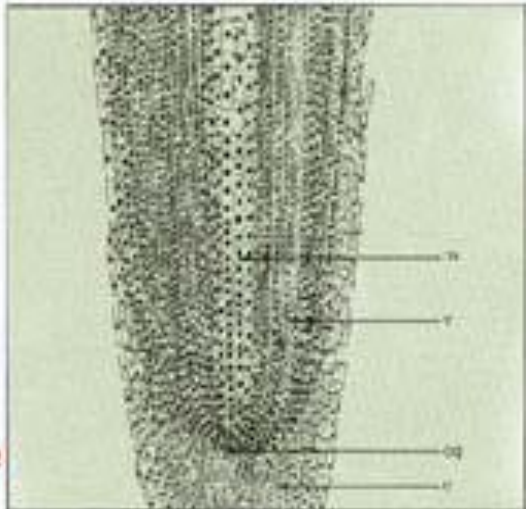
- Localisation of primary meristems



Stem or apical meristem



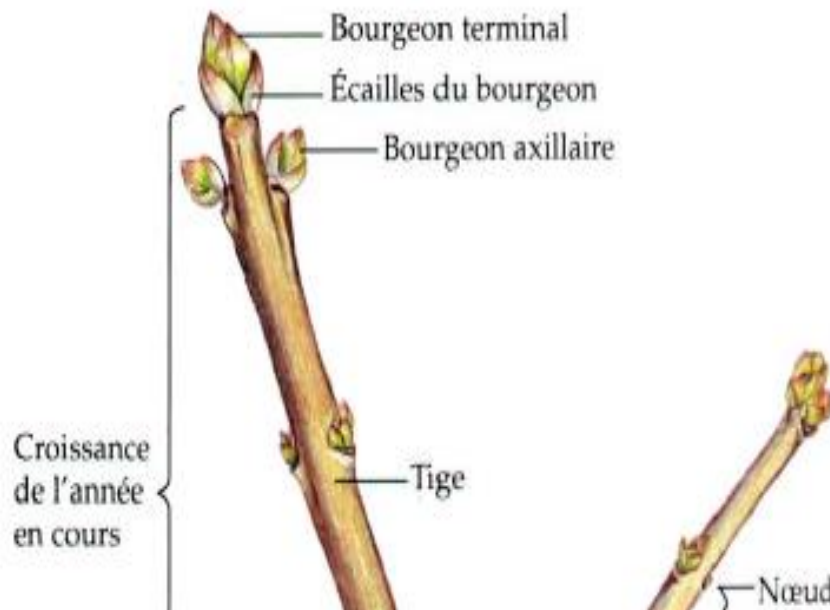
Root meristem



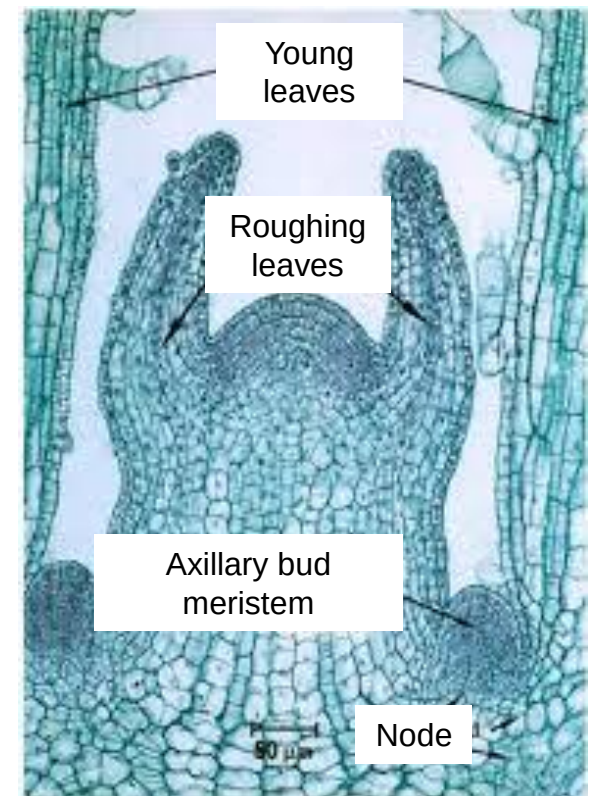
- Cytological characteristics of primary meristems

Localization	At the tips of stems and roots
Role	Ensure length growth
Cells	Small and isodiametric
Nucleus	Spherical, large in the center of the cell and very rich in chromatin
Cytoplasm	Dense and abundant
Vacuoles	Numerous and very small, highly concentrated content.
Wall	Pectocellulosic wall
Plasts	Undifferentiated plasts
Lipidic inclusions	Small number

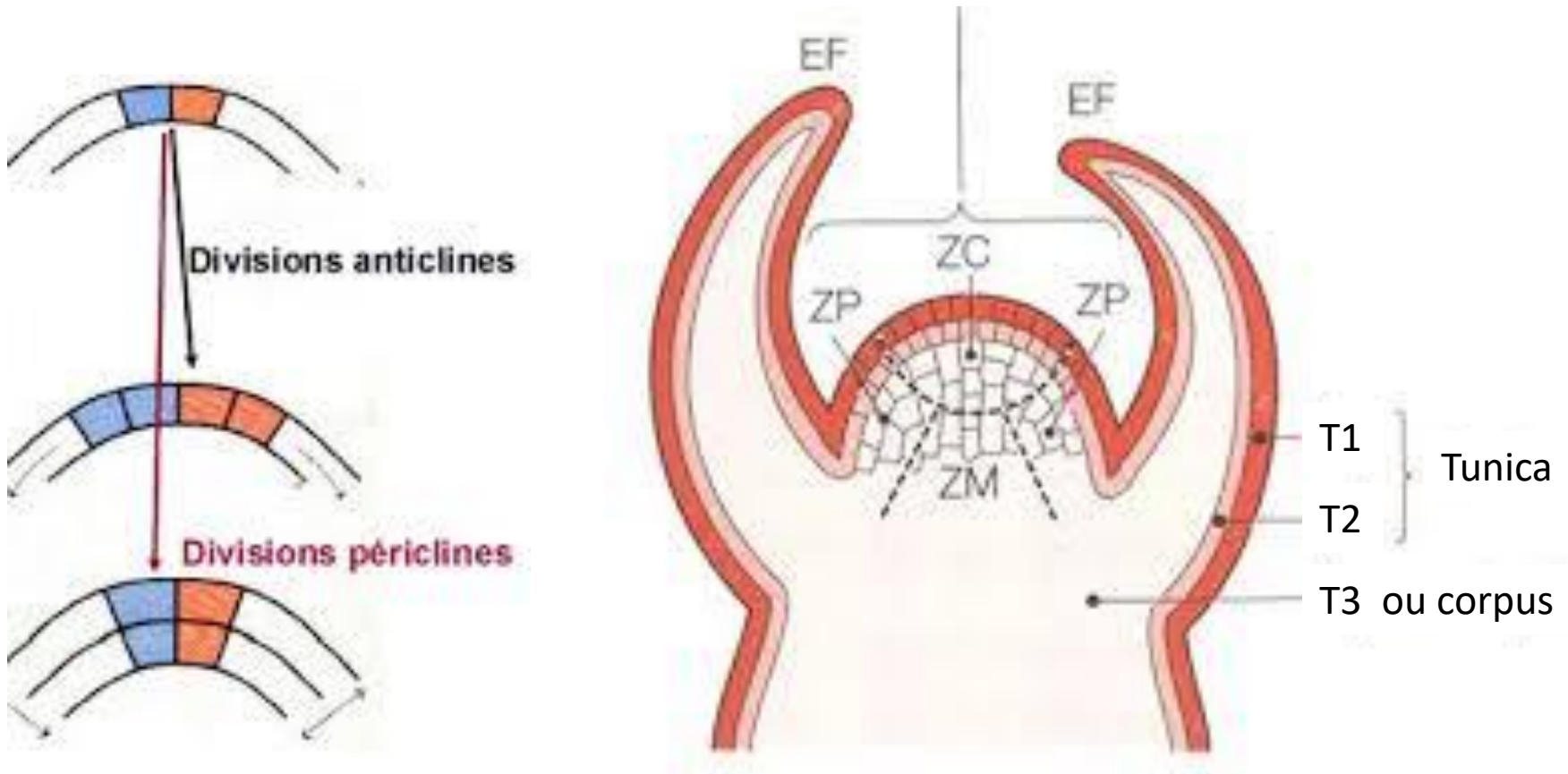
1. The stem meristem



Meristematic zones on a longitudinal section of a bud (cauline meristem)



The main zones of the cauline apex



Periclinal division: All the new walls are arranged parallel to each other.

Anticline division: The walls which divide the cells successively are perpendicular to each other, but only two directions in space accommodate the new cells formed. The result is a tissue, a single-layer cell layer that spreads out in a single plane.

The central section of the cauline meristem reveals the existence of 3 regions :

1. An axial zone (Zc) : two superficial layers, the tunicas **T1 and T2** and the corpus:

Tunica T1: around the meristem, distinguished by an anticlinal division (partitions perpendicular to the surface), forms the epidermis.

Tunica T2: initiates the leaves and corpus, and gives rise to the central tissues of the stem and leaves. Mitosis occurs in all directions.

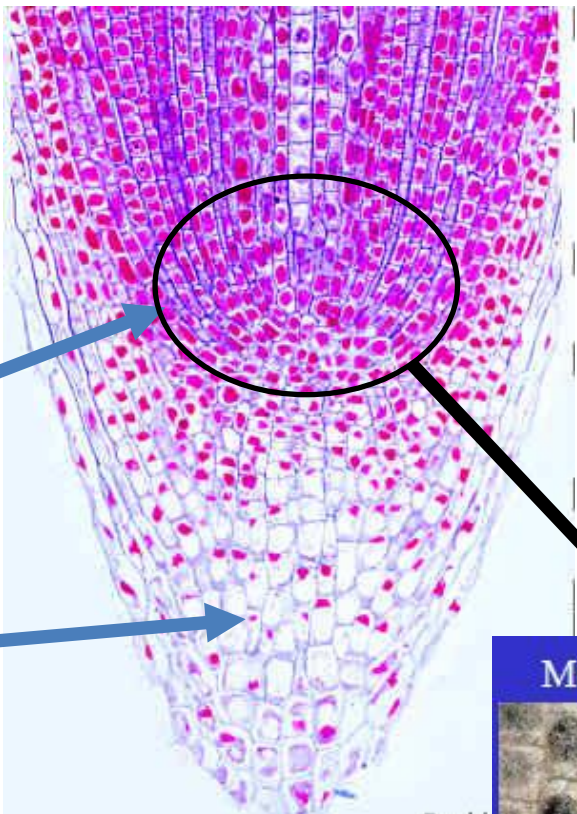
2. A lateral zone (ZP) : The part on the right corresponds to the appearance of a leaf, EF. Periclinal division.

3. A medullary meristem, Zm. Mitosis is infrequent, formation of stacked rows of cells at the origin of the central medulla, M.

2. Root meristems

Root meristems

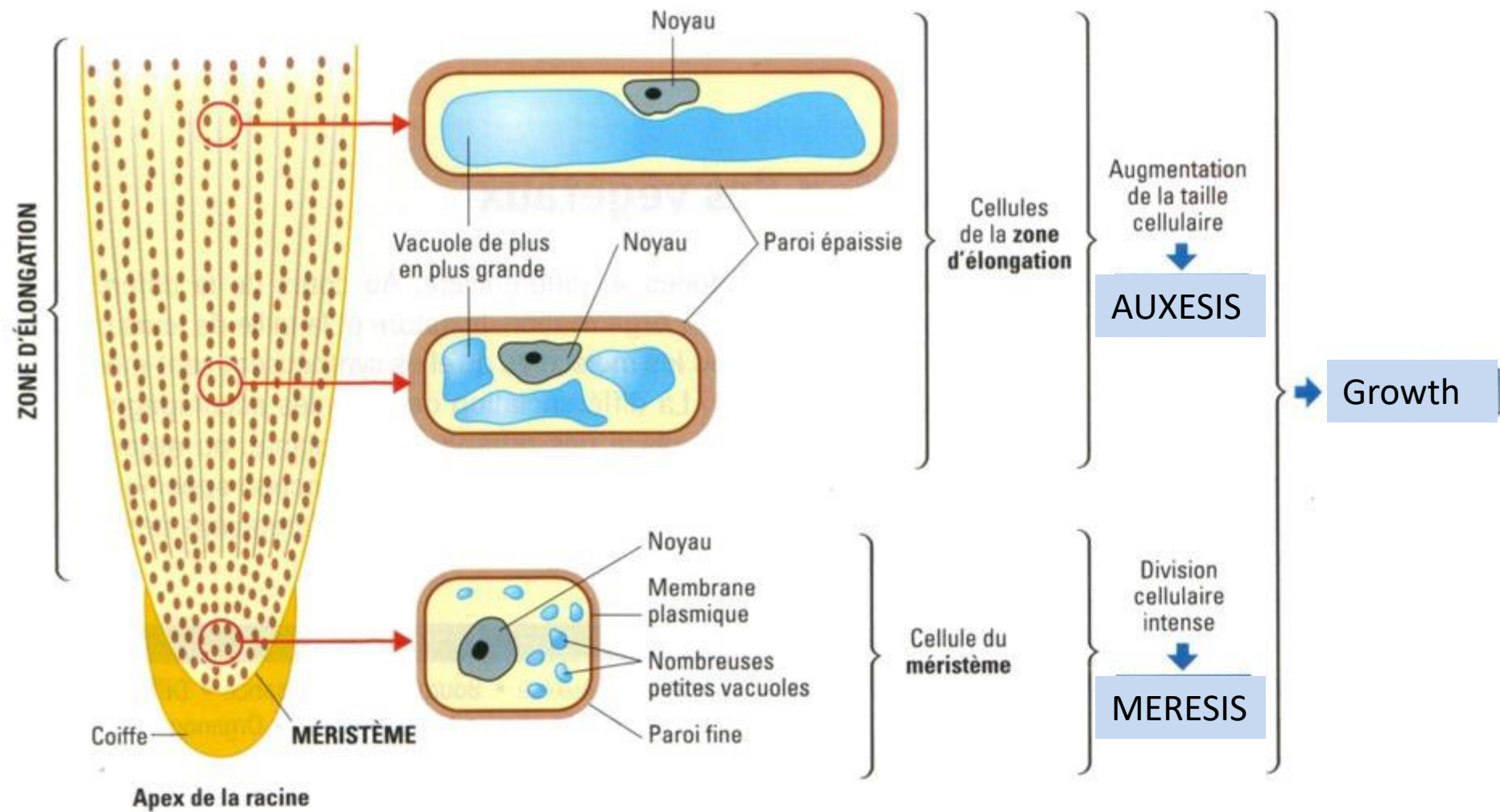
Cap of the root



Longitudinal section of a root

Les méristèmes primaires

- Example the root growth (cell differentiation)



- Role of the primary meristems

1- Histogenic function

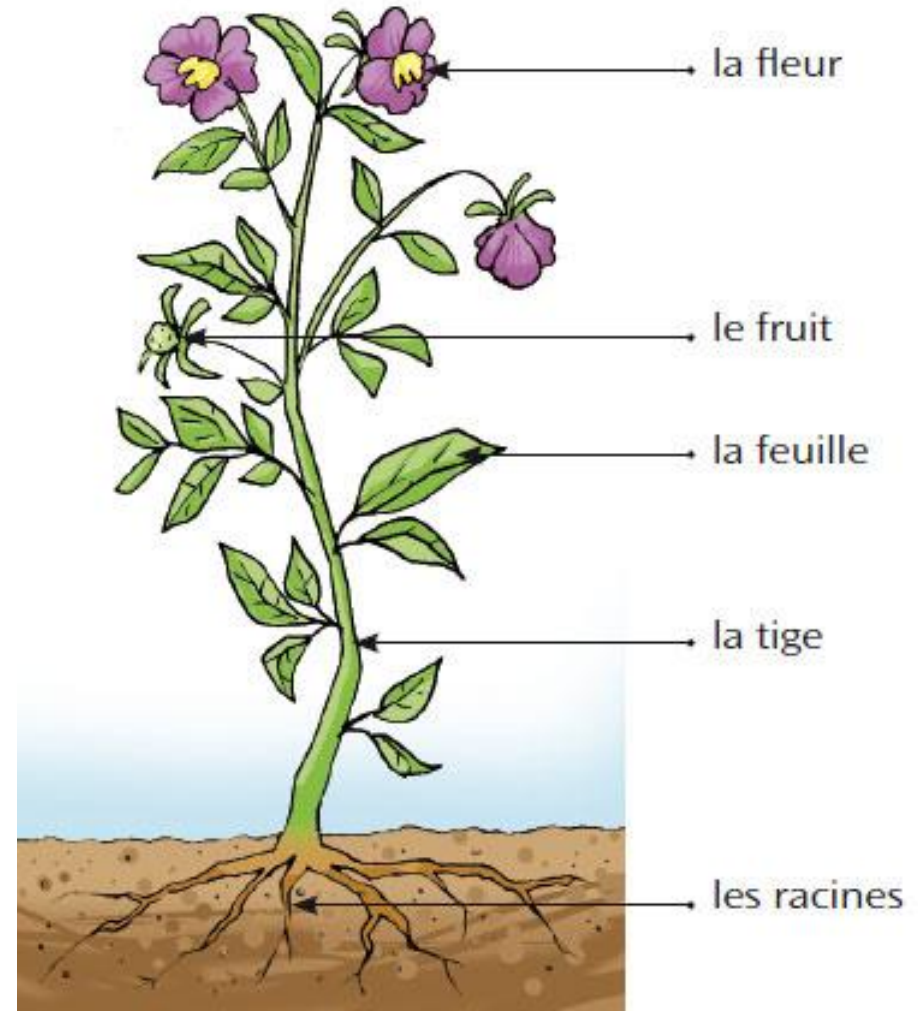
Intense divisions (mitosis) of meristematic cells produce new primary tissues such as **epidermis, **collenchyma**, **phloem**, etc.**

Each meristem cell produces two new cells by mitosis.



2- Organogenic function

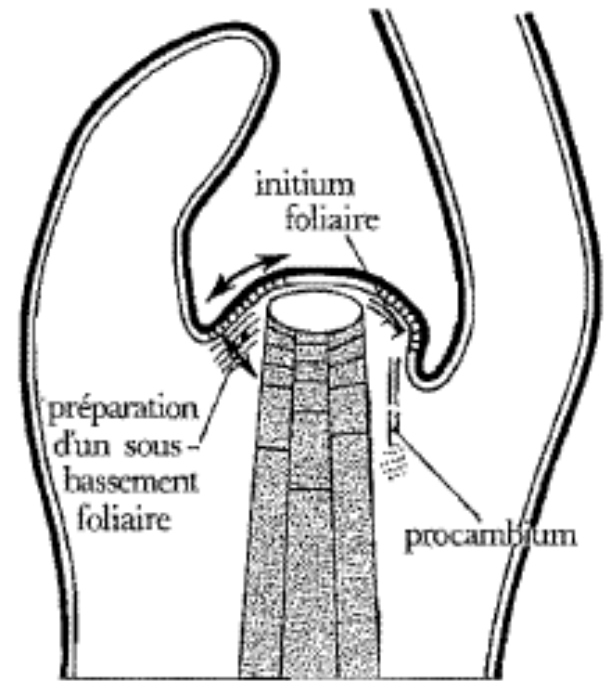
The various primary tissues obtained will give rise to new organs: **stem, root, leaves and flower.**



Example organogenesis of the leaves

1- The leaf initium

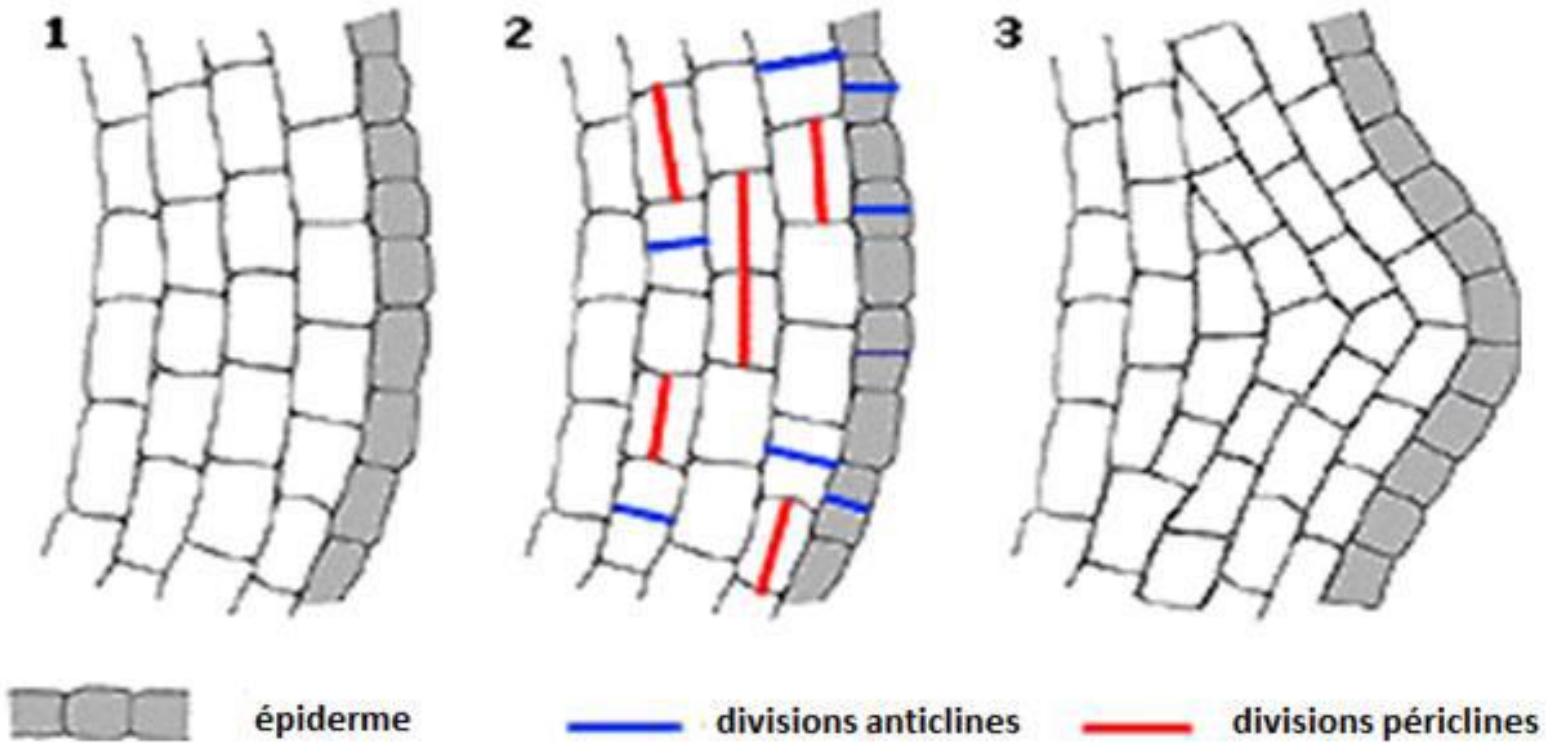
The initium is raised by sub-epidermal divisions of the primary meristem.



Les méristèmes primaires

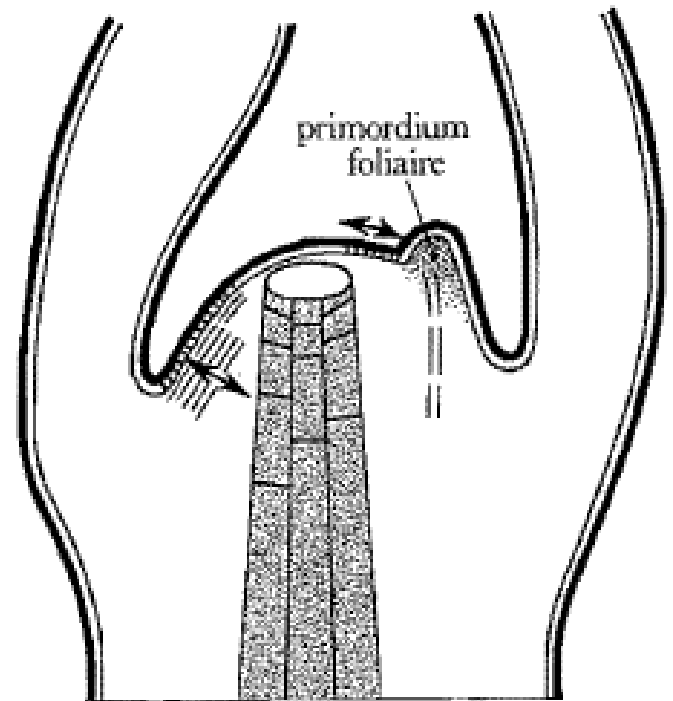
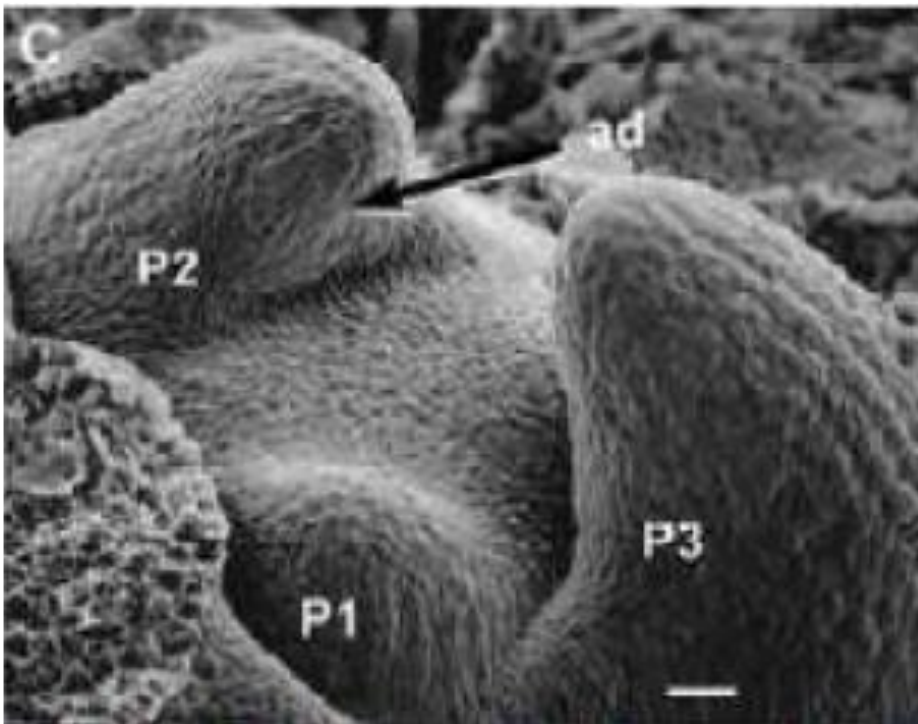
Formation of the leaf : Initium leaf steps

Starting of the primordium leaf steps



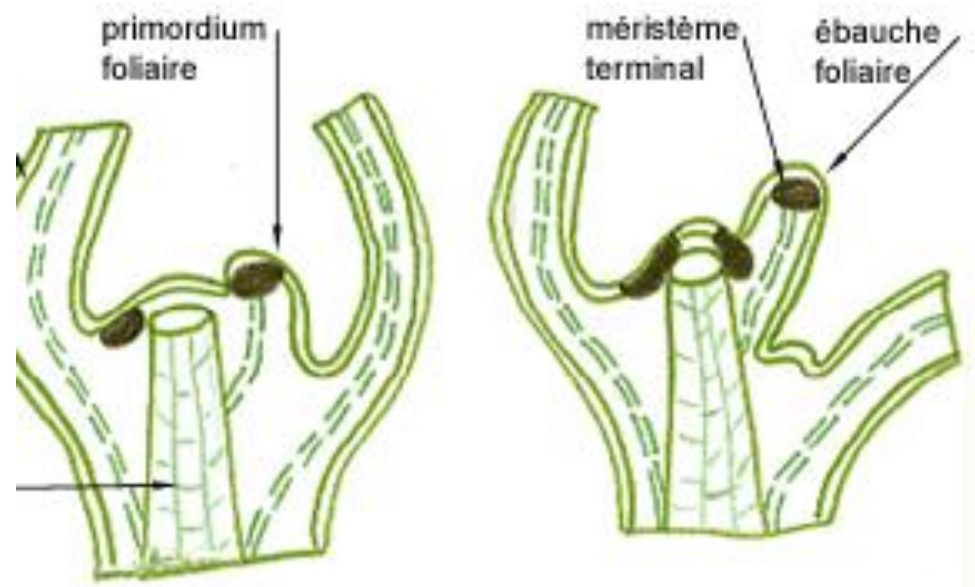
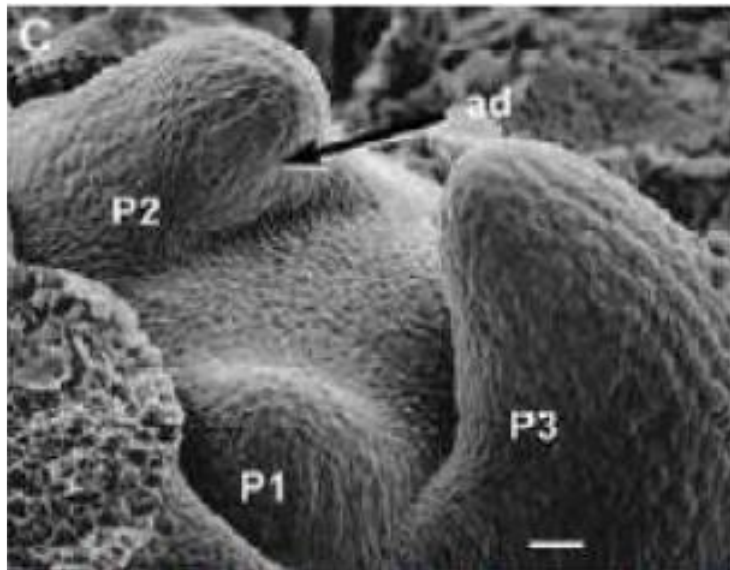
2. Primordium of the leaf

Appearance of a **protuberance** (the result of meristem divisions at the initium stage) which is the primordium of the new leaf (P1).



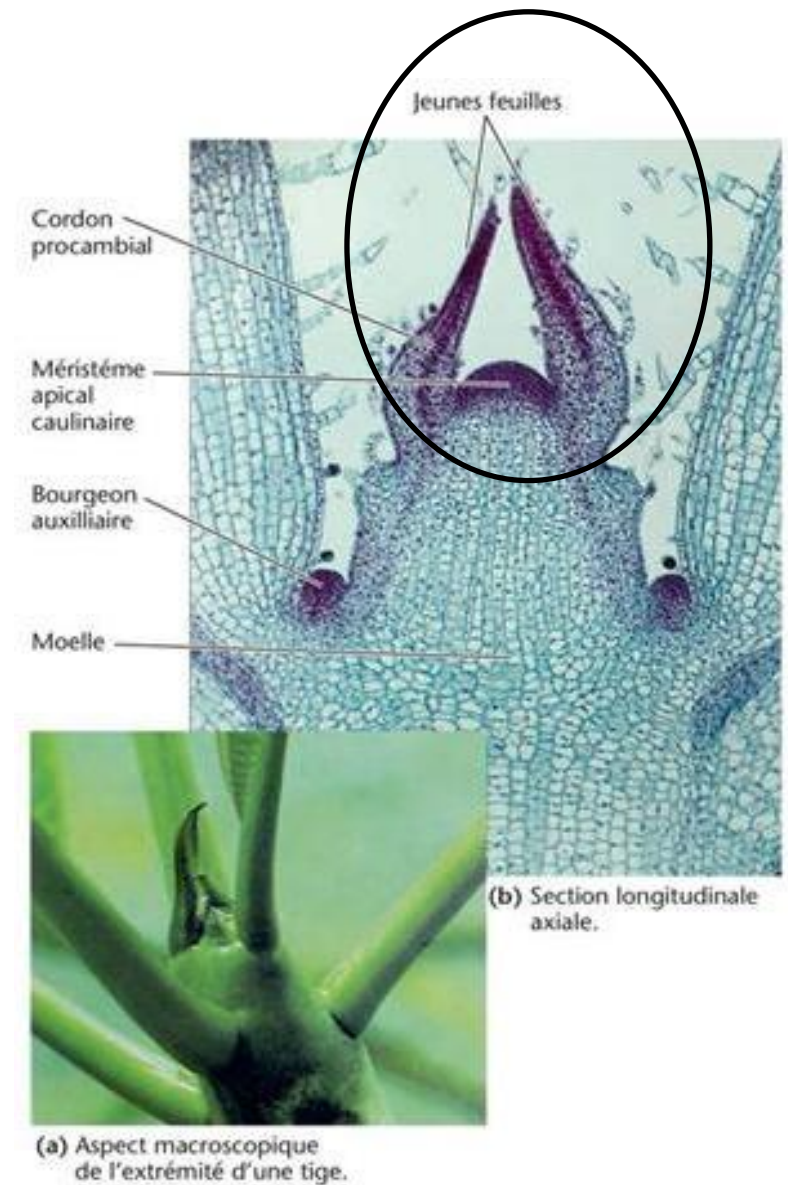
3. Leaf starting

The leaf primordium will continue to grow as a result of the divisions, which will continue until a starting leaf (P2) appears.



4. Leaf initiation and the entire leaf

The leaf blade continues to grow and divide to form a leaf.



The cellular differentiation

The cellular differentiation

The cells resulting from the division of meristematic cells gradually transform into adult tissue.

During this transformation, known as **cellular differentiation**, the cells acquire:

- a shape
- structure and
- function characteristic of each tissue type.

The cellular differentiation

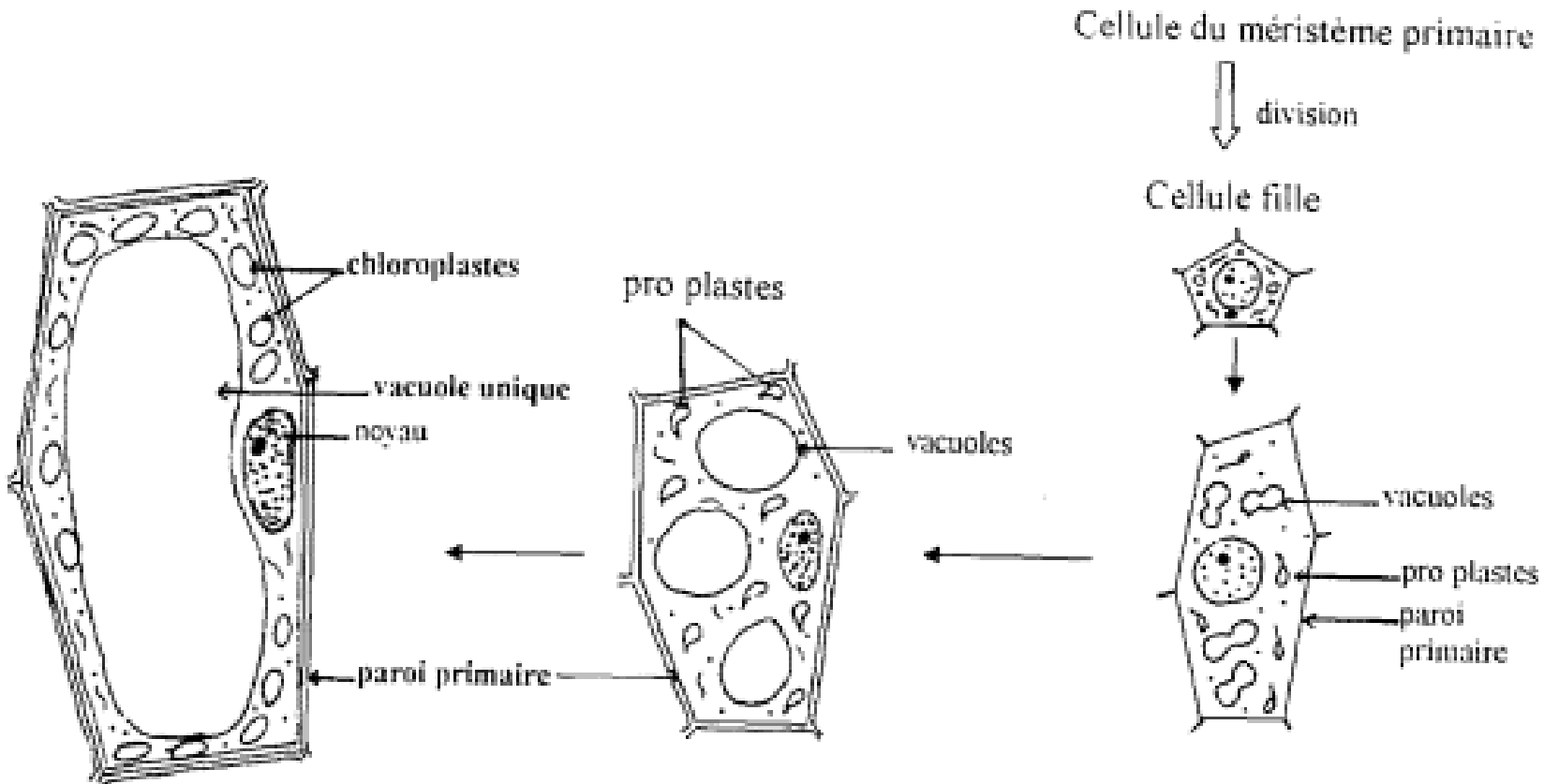
The stages of cellular differentiation are :

Cell elongation, which is responsible for the growth in length of the stem and root.

Significant development of the vacuolar apparatus,

- Transformation of proplasts into chloroplasts,
- Adaptation to photosynthesis,
- Thickening of the pectocellulose wall.
- Loss of the ability to divide,

Example of meristematic cells which will differentiate into chlorophyllian cells



Différenciation d'une cellule jeune en cellule chlorophyllienne

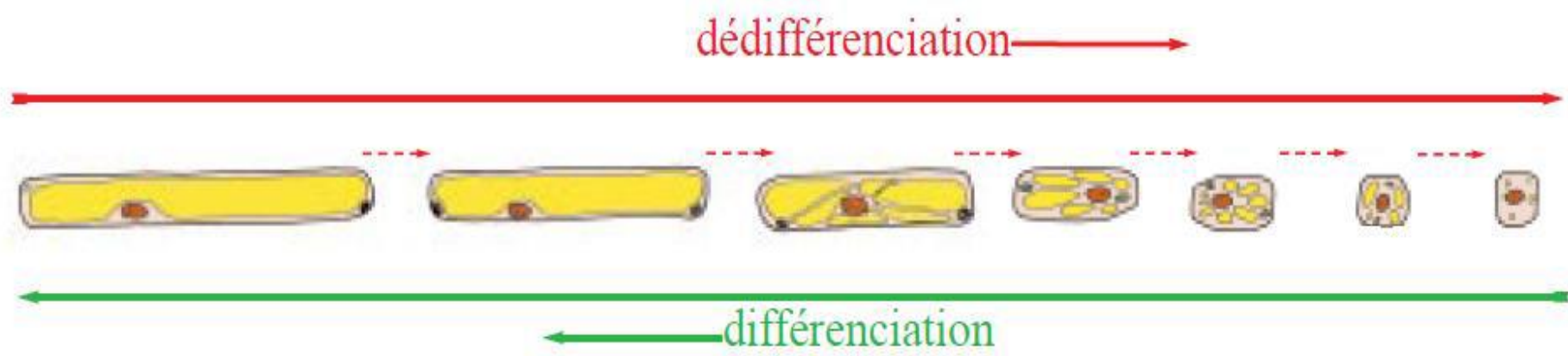
Cellular dedifferentiation

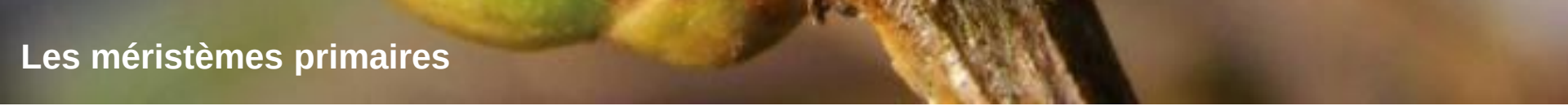
Cellular dedifferentiation

Some differentiated plant cells can dedifferentiate, i.e. they can return to their meristematic state and regain the ability to be divided.

We call this phenomenon cellular dedifferentiation.

Cellular dedifferentiation



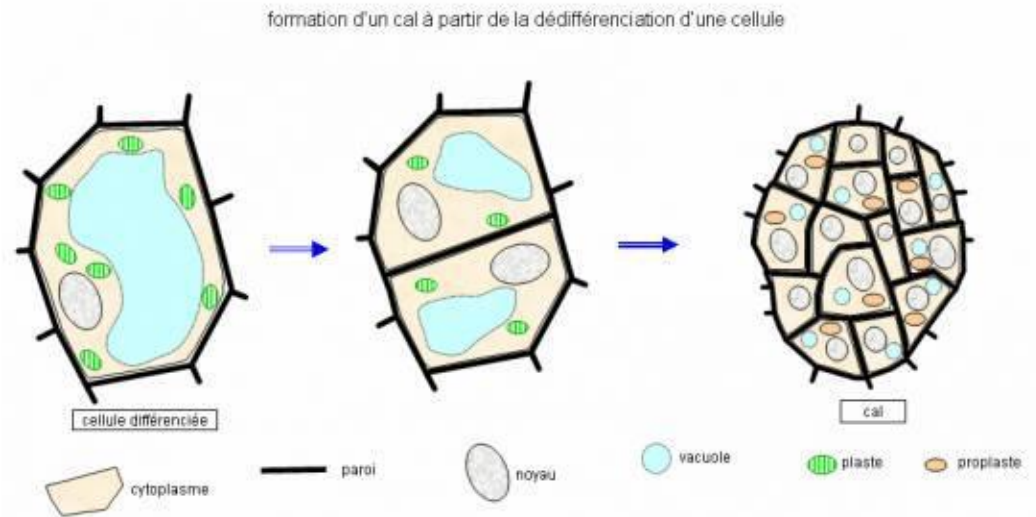


Some examples of
cellular dedifferentiation

Callus formation

When an organ is injured, the parenchyma cells dedifferentiate and give rise to meristematic cells which divide actively.

Then differentiate to renew the damaged tissue.



Cellular dedifferentiation

Cutting (Bouturage)

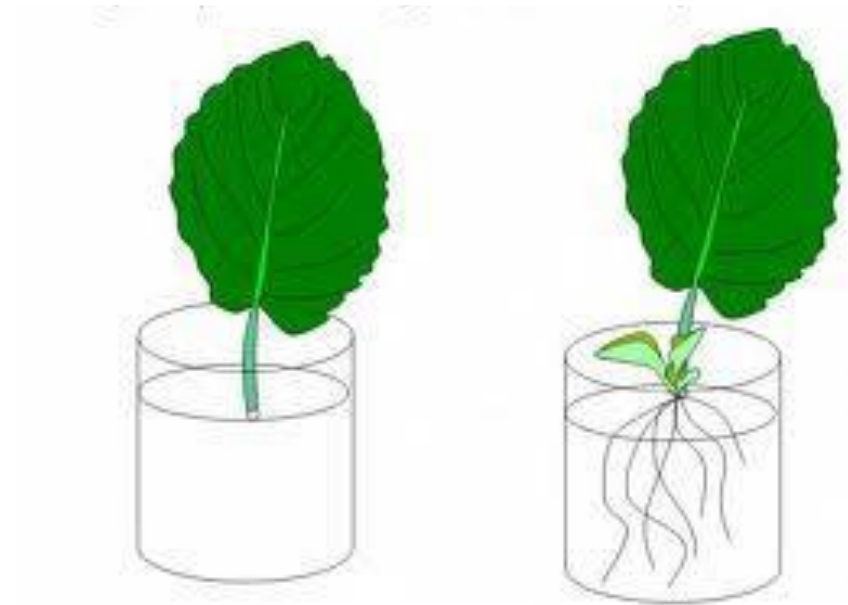
Fragment of a plant that is detached and rooted to produce a new individual.



Cellular dedifferentiation

Cutting

If we immerse a cutting, i.e. a piece of twig (bouture), in a glass of water, roots will appear after a few days.



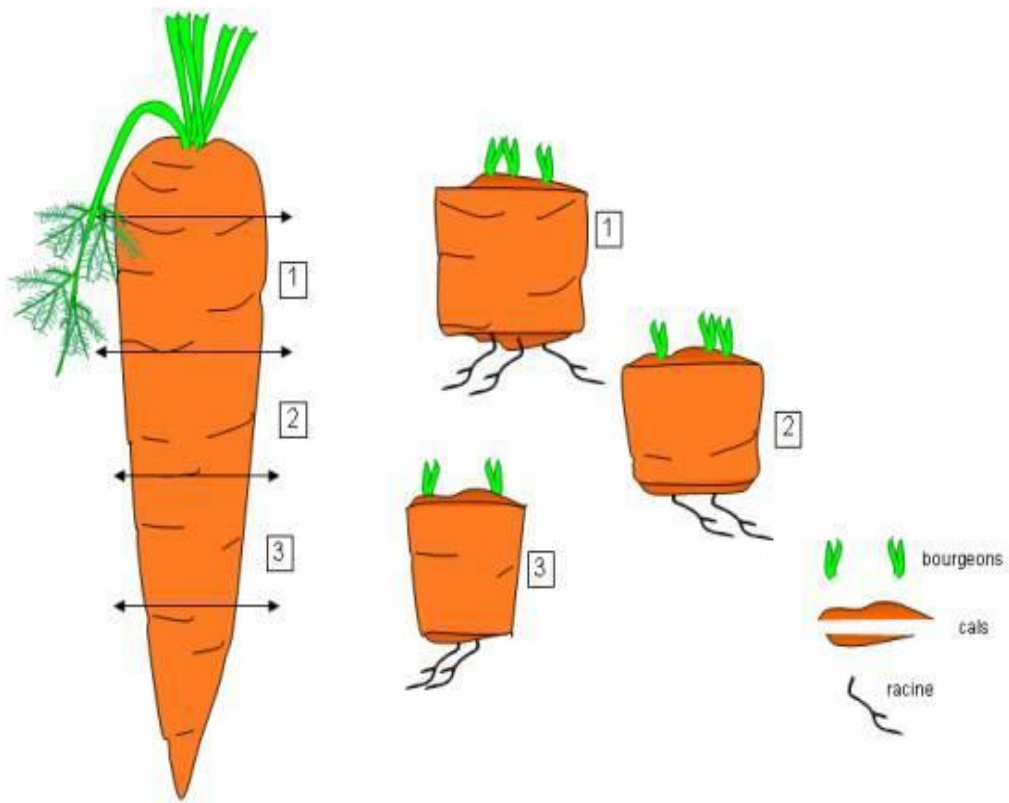
Cellular dedifferentiation

The stem parenchyma cells have therefore dedifferentiated, giving rise to meristematic cells. These cells then divide actively and differentiate into adult tissue to form the roots.

The *in vitro* culture

Plant in vitro culture techniques are based on the totipotency of plant cells taken from any organ of a plant. These cells have the ability to regenerate a complete individual identical to the mother plant. In nature, this property (of regenerating an individual) is expressed through cuttings.

The *in vitro* culture



Some of the advantages of in vitro culture

In vitro cultivation allows :

- Obtain virus-free plants;
- Save time through rapid mass production at any time of year;
- Reduce production costs (low staffing levels);
- Rejuvenate plants.