Web Notes

Are not available on Learn@UW

There will be not links to the notes. To access them you must know the url.

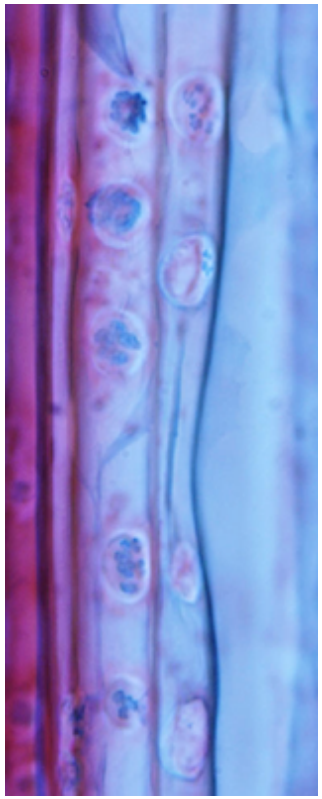
http://botit.botany.wisc.edu/Anatomy/

Web Resources on the Lab Site

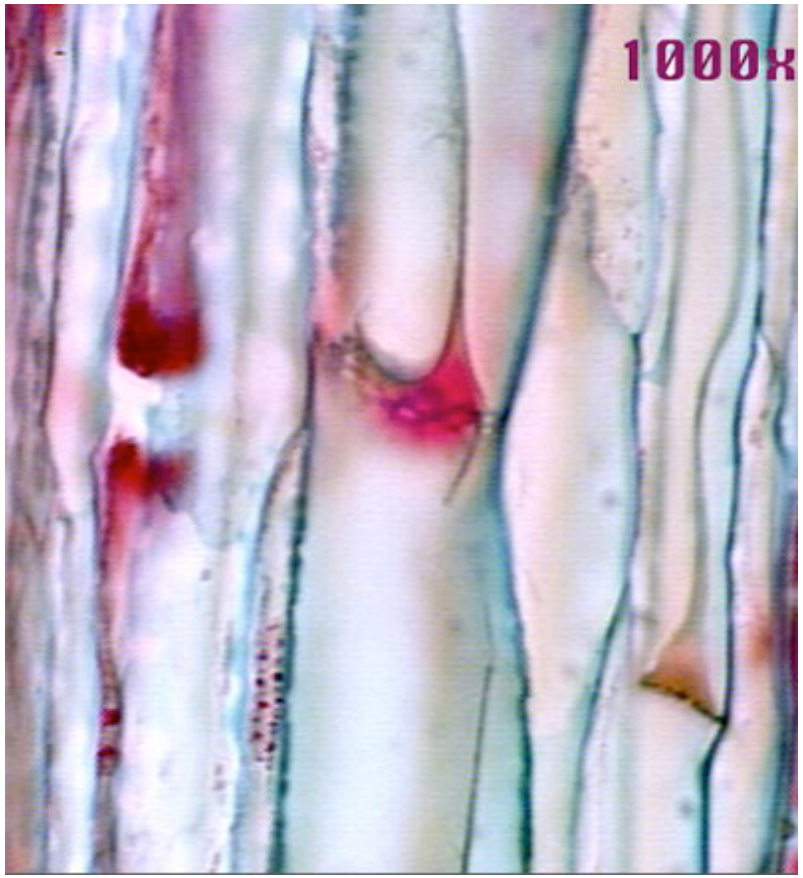
http://botit.botany.wisc.edu/Anatomy/Glossary

http://botit.botany.wisc.edu/botany_130/Laboratory.html

Phloem is a complex tissue that includes sieve elements



Sieve Cells
(Conifers)



Sieve-Tube Elements
(Angiosperms)

Sieve Elements Serve as a Conduit for the Movement of Photosynthate

This movement is based on a pressure gradient generated osmotically. To generate this gradient sugar must be loaded at the source and unloaded at the sink. Living membranes are necessary both to control the movement of sucrose and for the osmotic movement of the water into and out of the Sieve tubes.

Read about phloem transport in the text pp. 682 -685.

Sieve elements are greatly reduced.They lose their vacuole, nucleus, and most of the rest of their cellular structure as they mature.

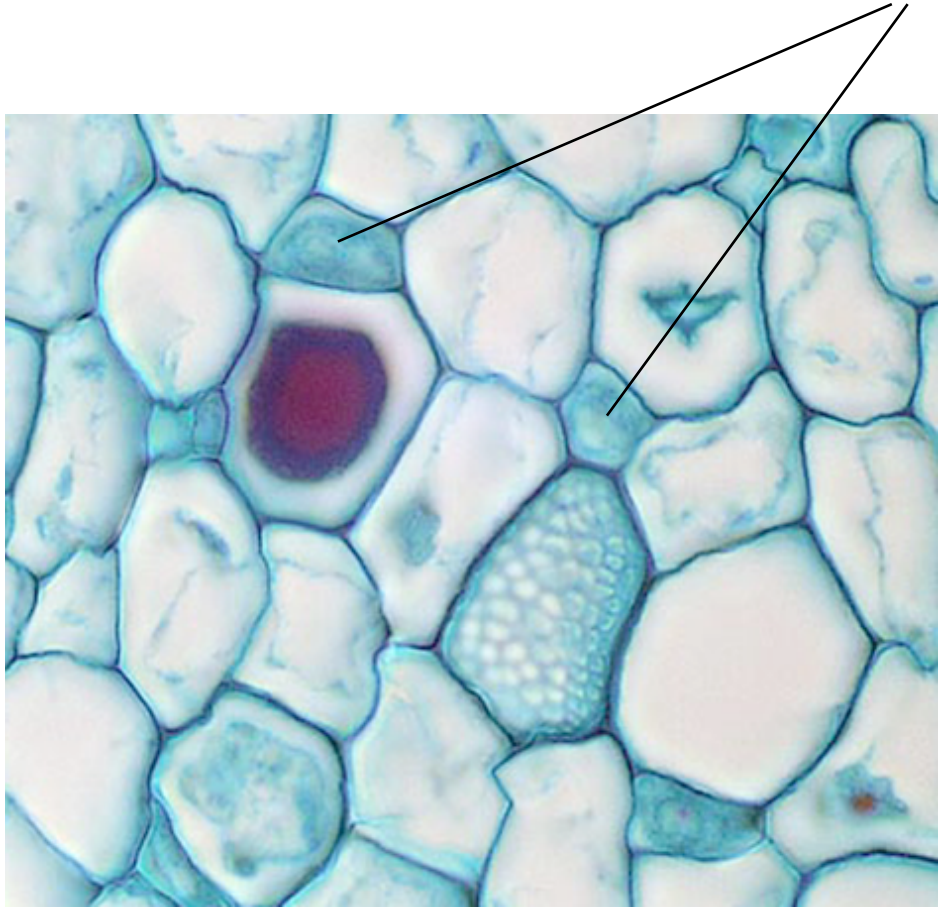
Adjacent sieve elements are interconnected by clusters of pores through which materials flow from one element to another.

Sieve-tube members are one type of sieve element.

They are found only in the flowering plants.

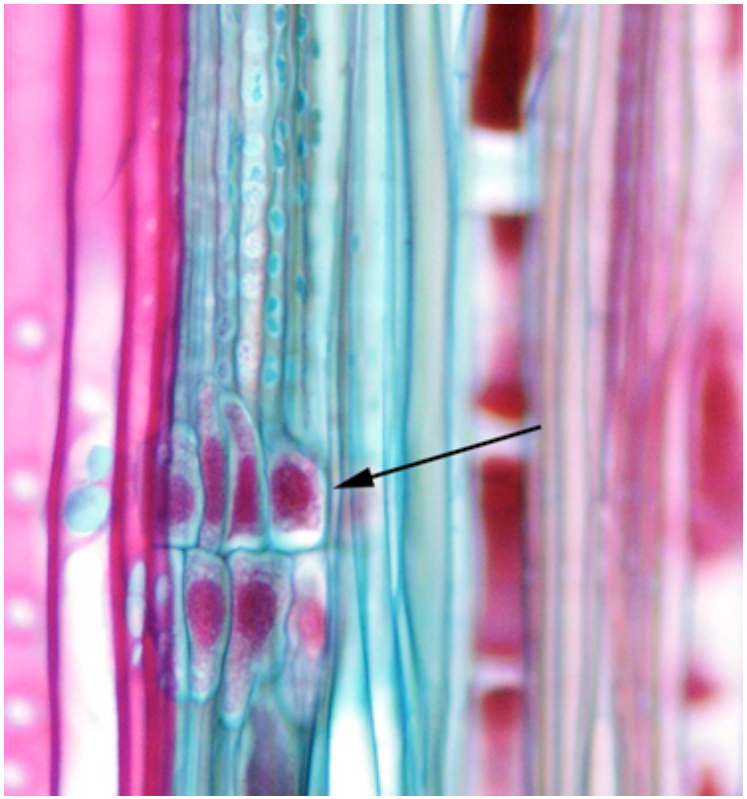
Sieve-Tube Members Have Sieve Plates

Sieve-Tube Members are Associated with Companion Cells



Gymnosperms have a different type of sieve element called a sieve cell

Associated with albuminous cells



Vascular Tissue System

Xylem

Always includes tracheary elements

Tracheids and/or vessel elements

May have

Parenchyma

Fibers

Other types we will not consider

Vascular Tissue System

Phloem Always has sieve elements

If **sieve-tube members** then also **companion cells**

If **sieve cells** then also **albuminous cells**

Some plants have sieve elements that are neither. In these cases, the cells are simply called **sieve elements**

May also have

Parenchyma cells

Fibers

Growth in Plants

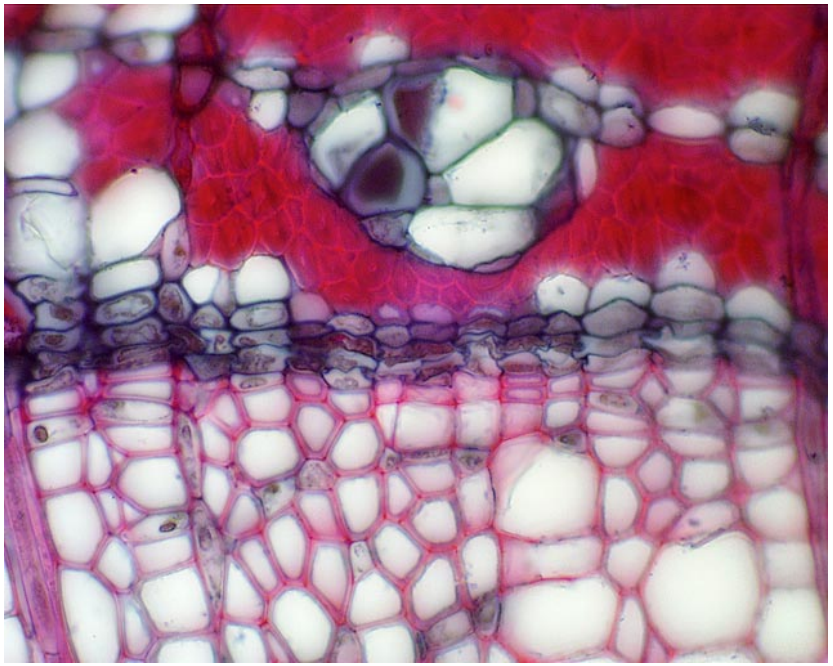
Growth is an irreversible increase in size. In plants, this is a function of cell division coupled with cell elongation

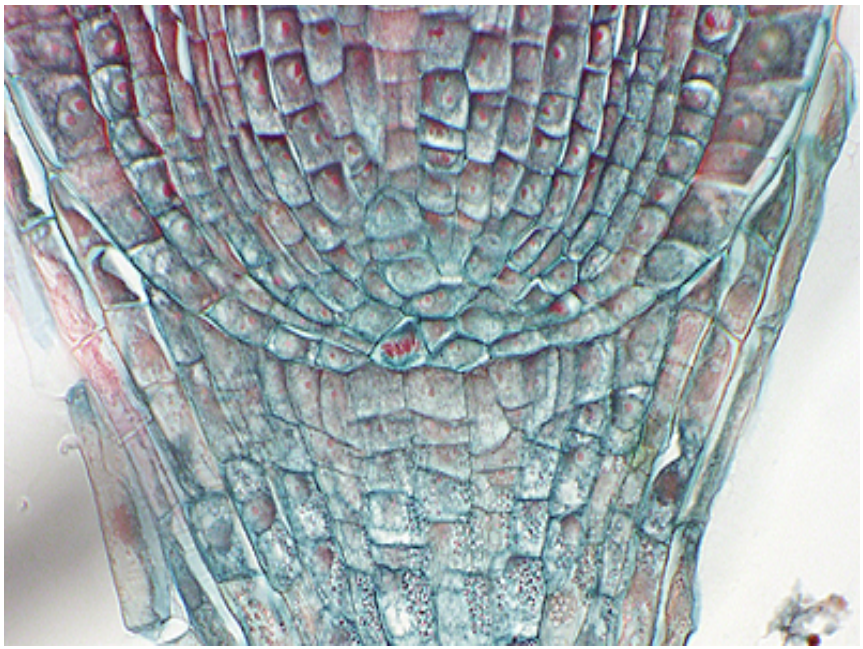
Primary growth elongates the axis of a plant

Secondary growth increases the girth of a plant

Meristems

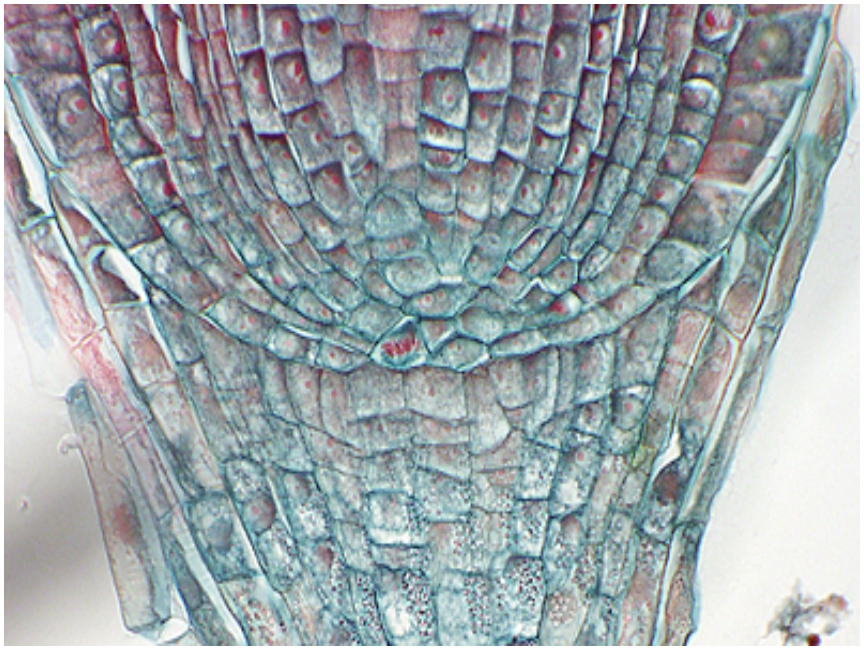
Cell division in plants is restricted to regions of parenchyma called meristems.



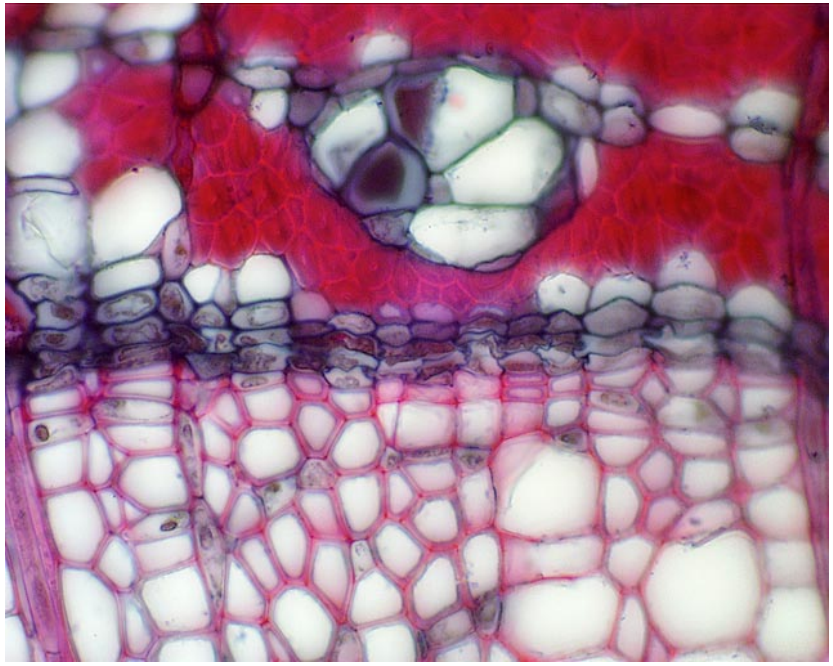


There are three types of meristems.

Apical Meristems.



Lateral Meristems.

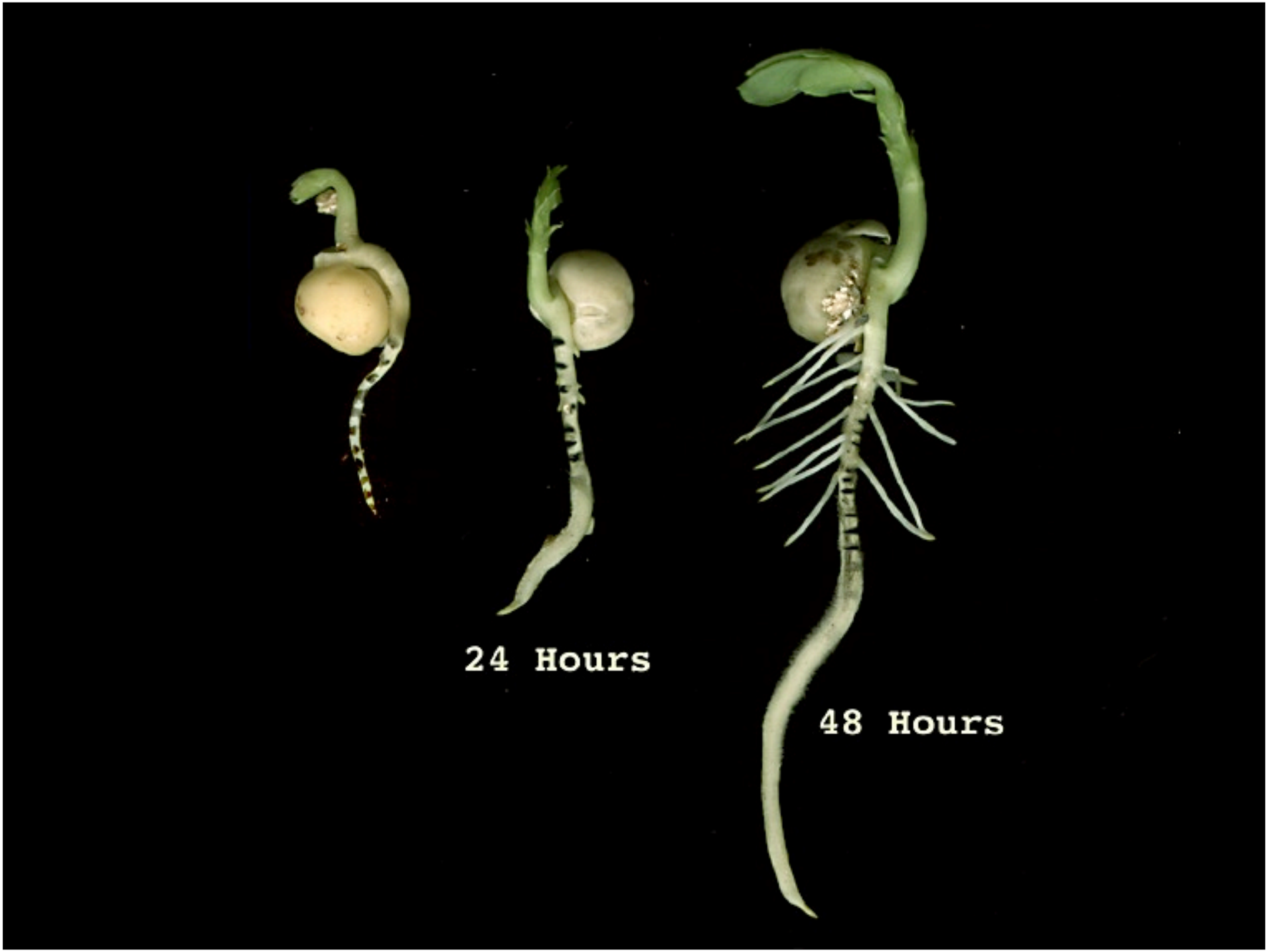


Intercalary Meristems.

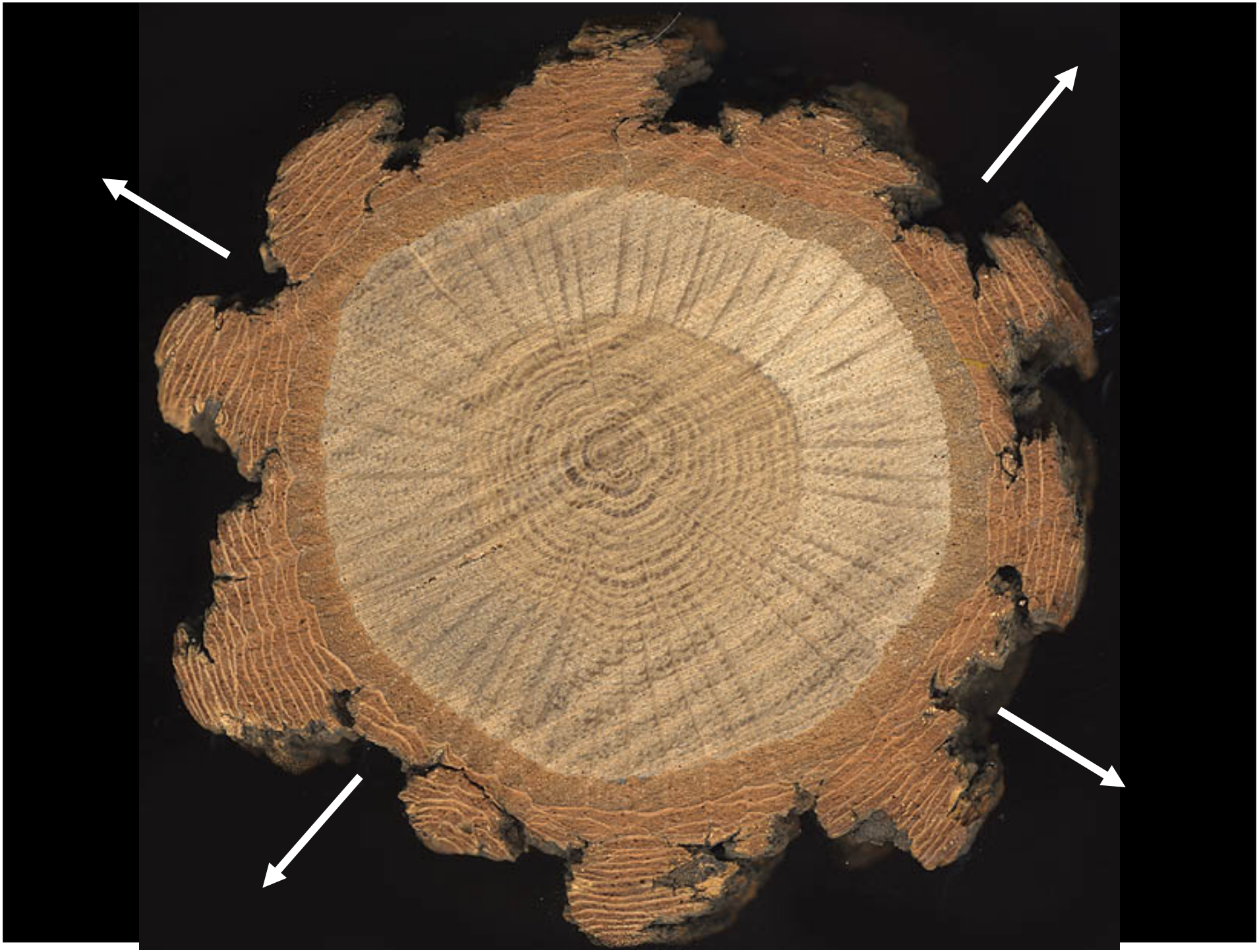
Why grass grows upward after it is mowed.

This is all we will say about these…….

Apical meristems extend the length of the plant body


24 Hours
48 Hours

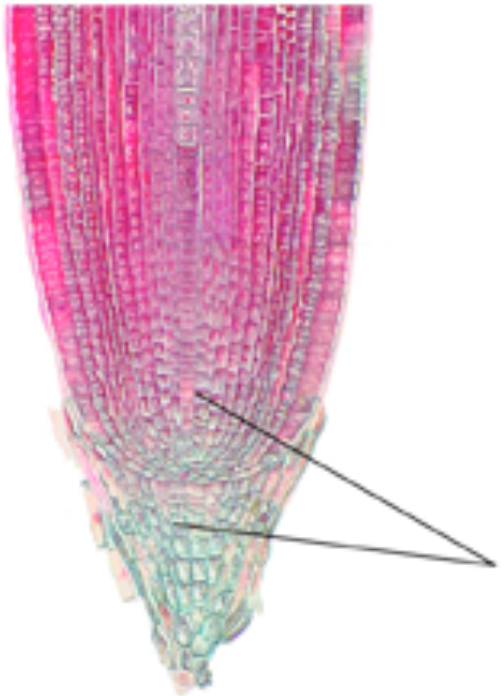
Lateral Meristems Increase the Girth of the Plant Body



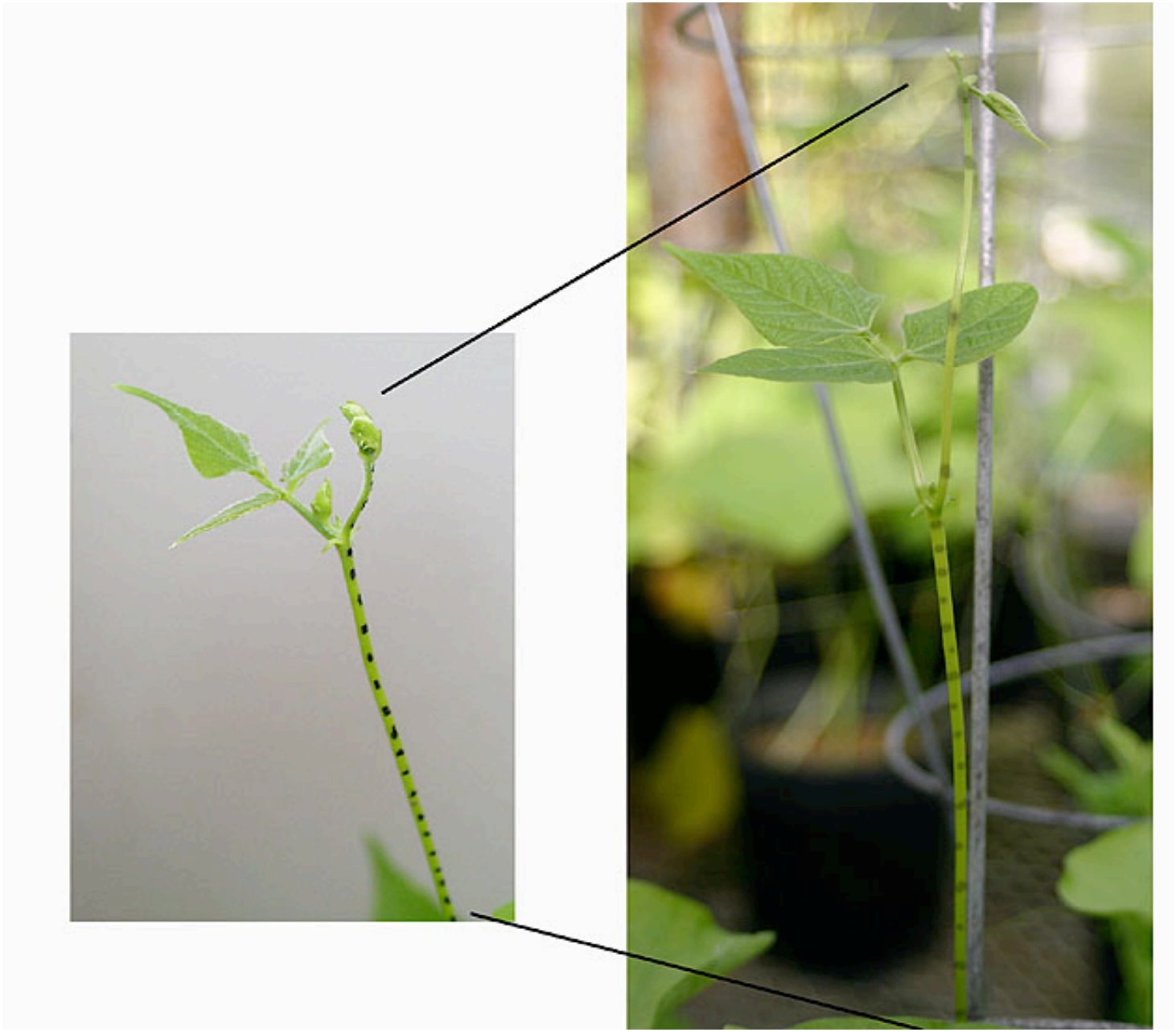
Primary Tissues

result from primary growth

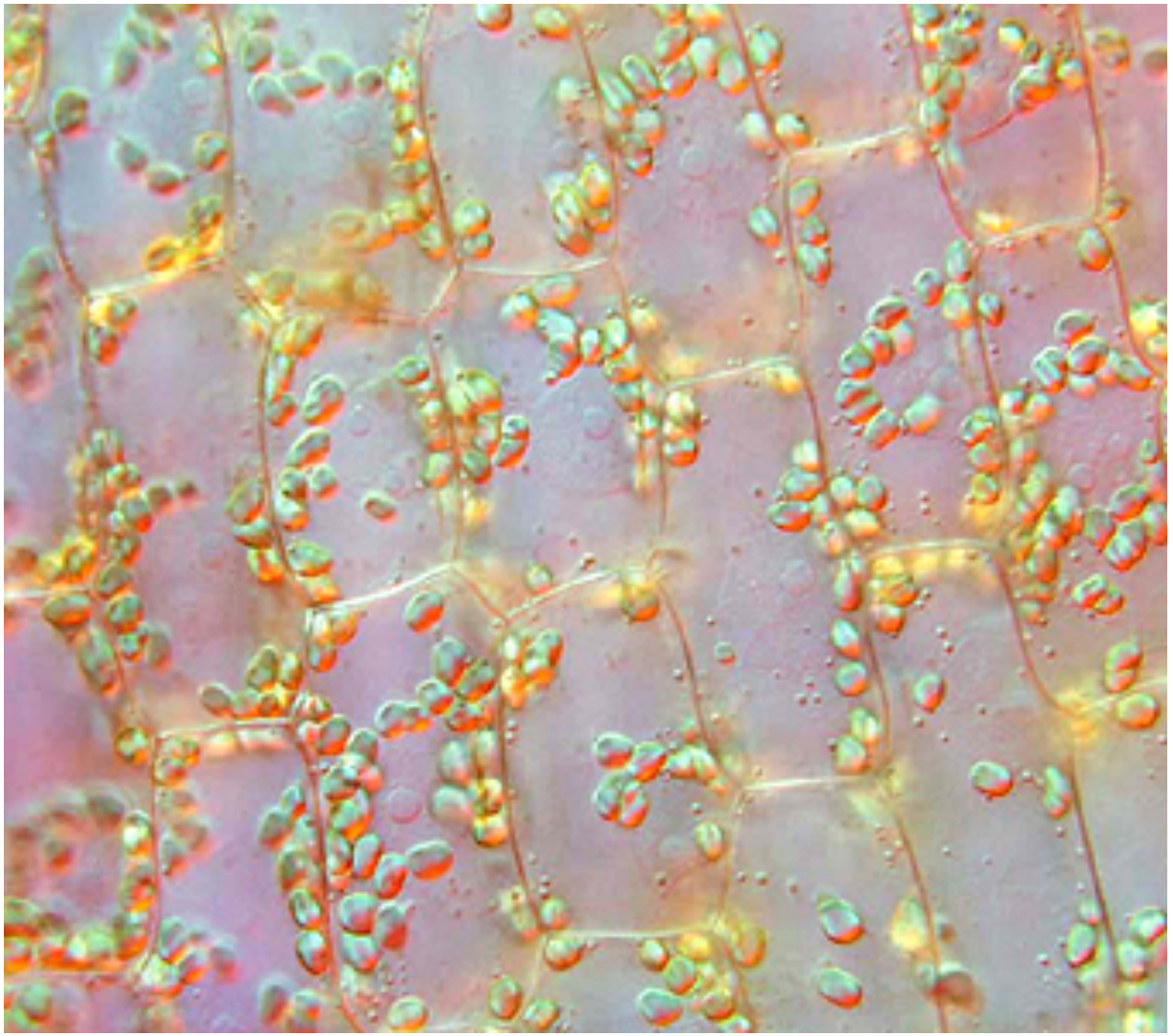
And are derived from apical meristems.



Primary Plant Growth and Development

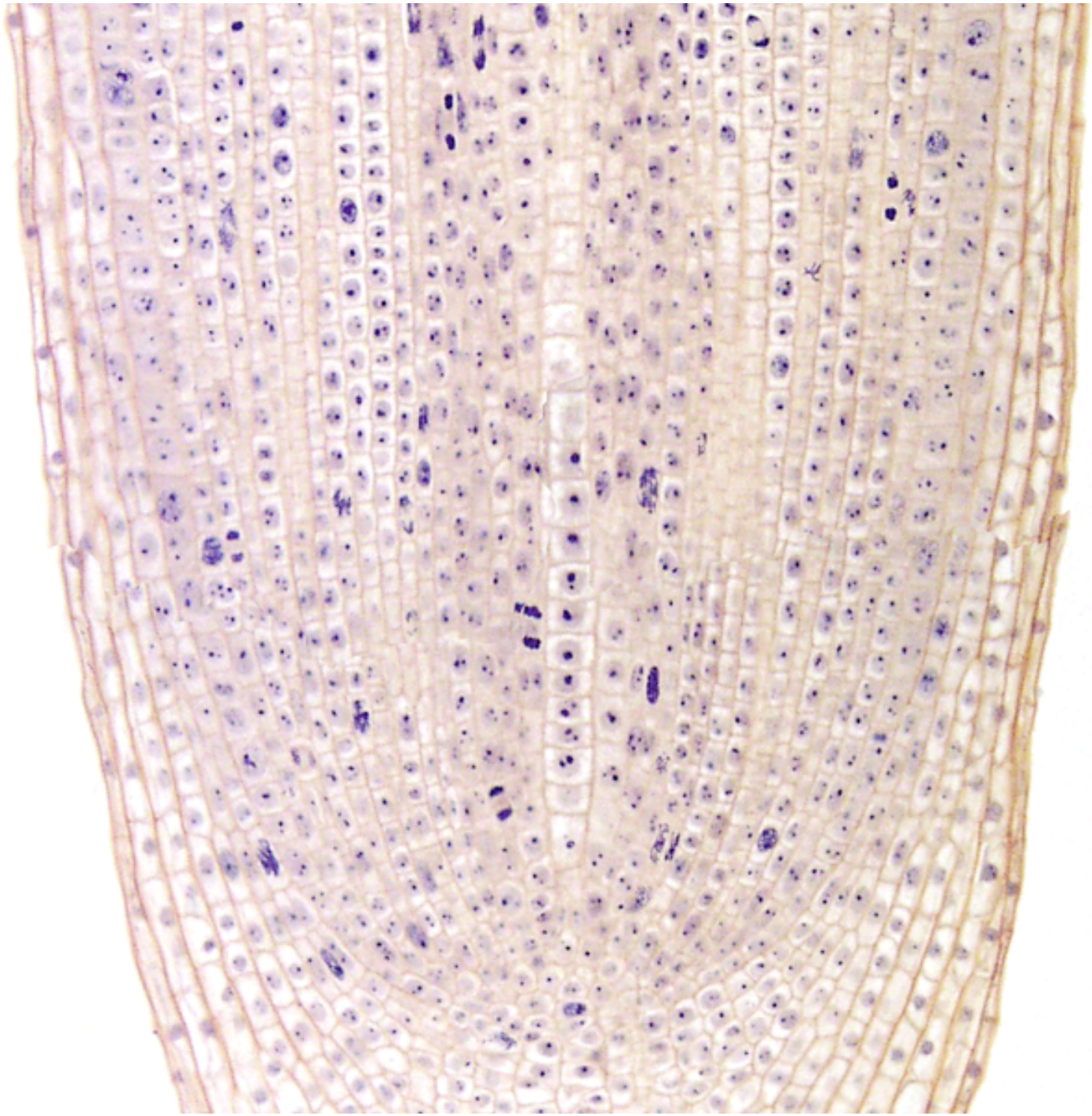


In mature tissues, cells are arrested in interphase



Primary growth is a product of

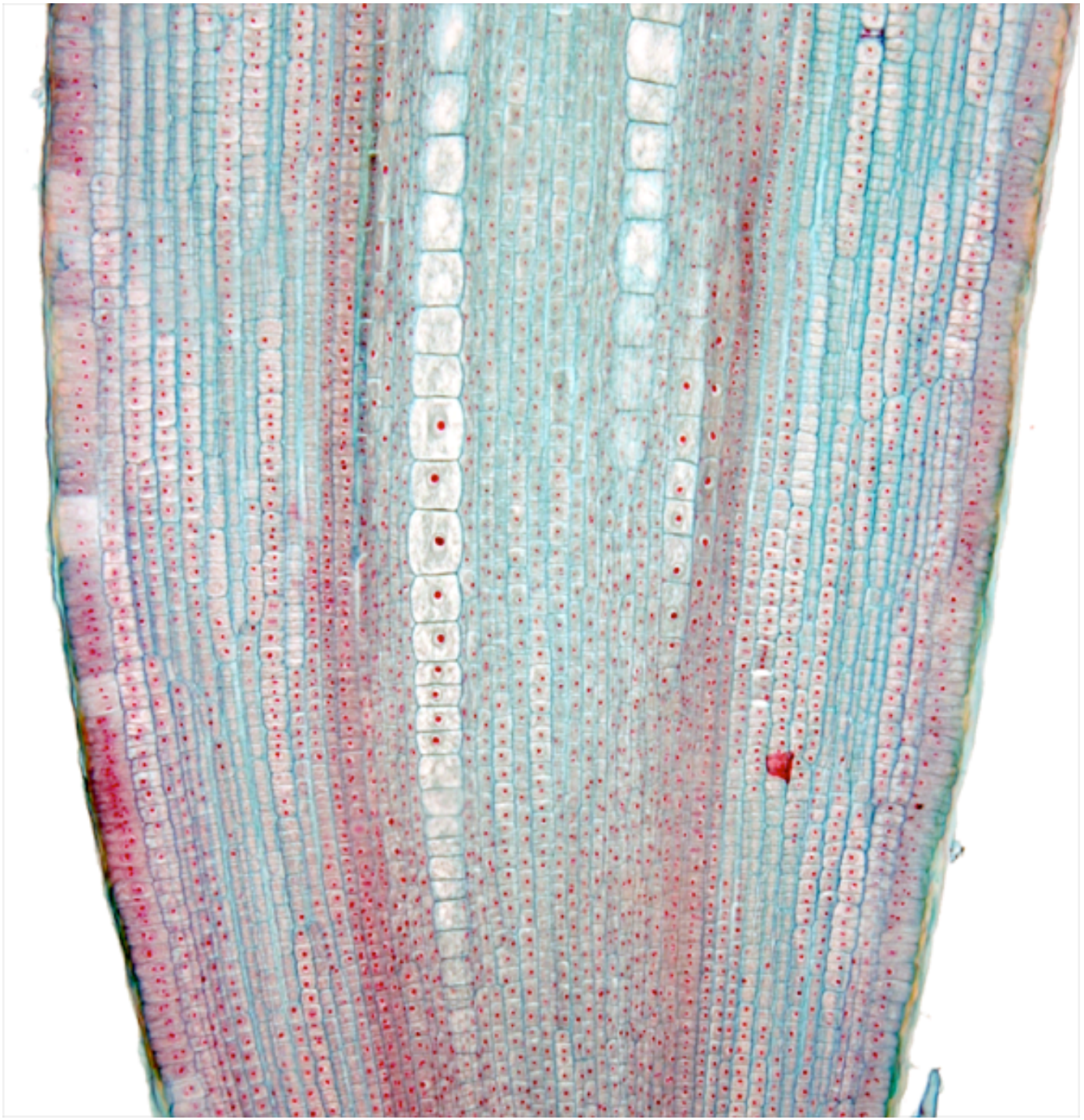
Cell division



Primary growth is a product of

Cell division

Cell elongation

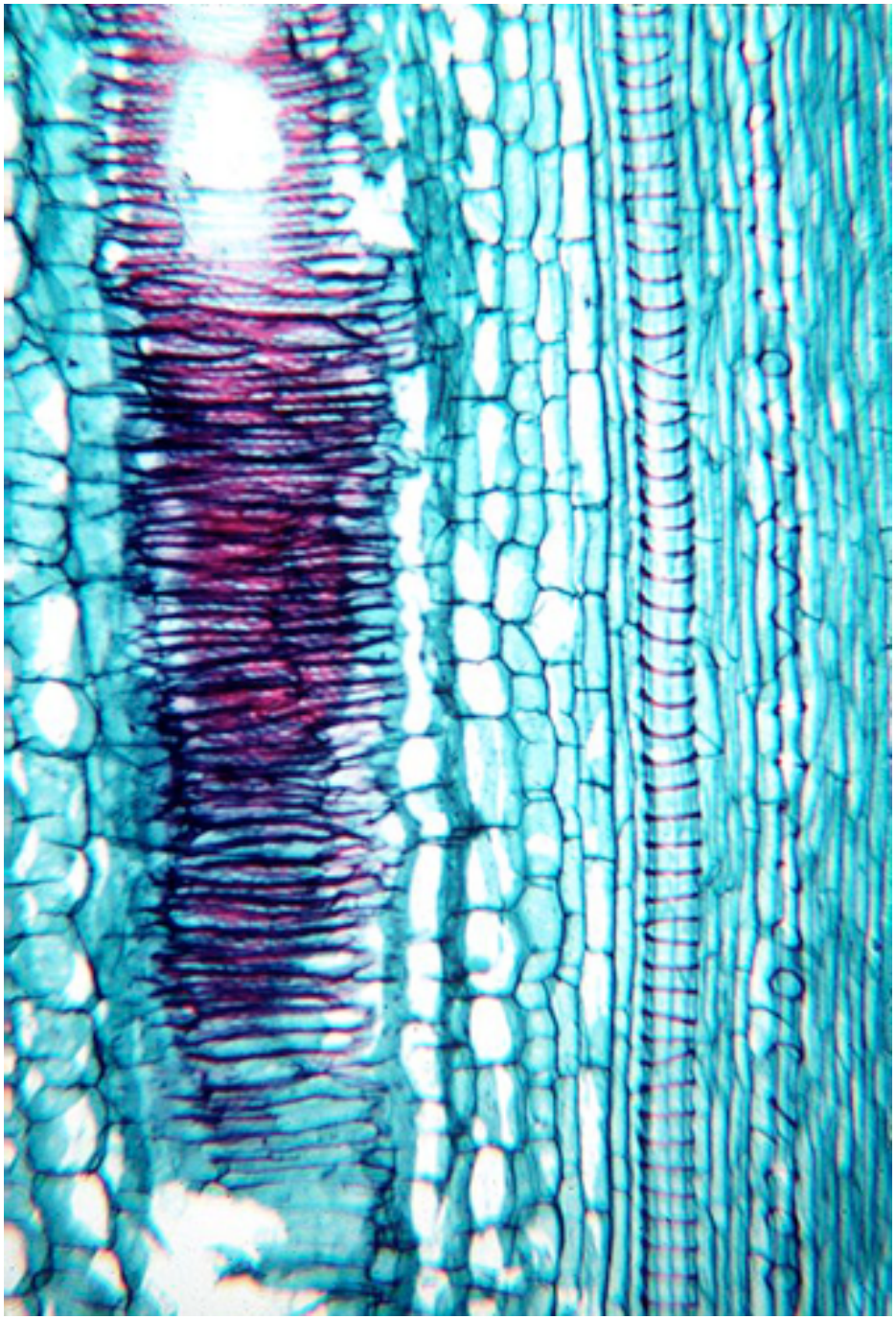


Primary growth is a product of

Cell division

Cell elongation

Ending with cell/tissue differentiation-maturation

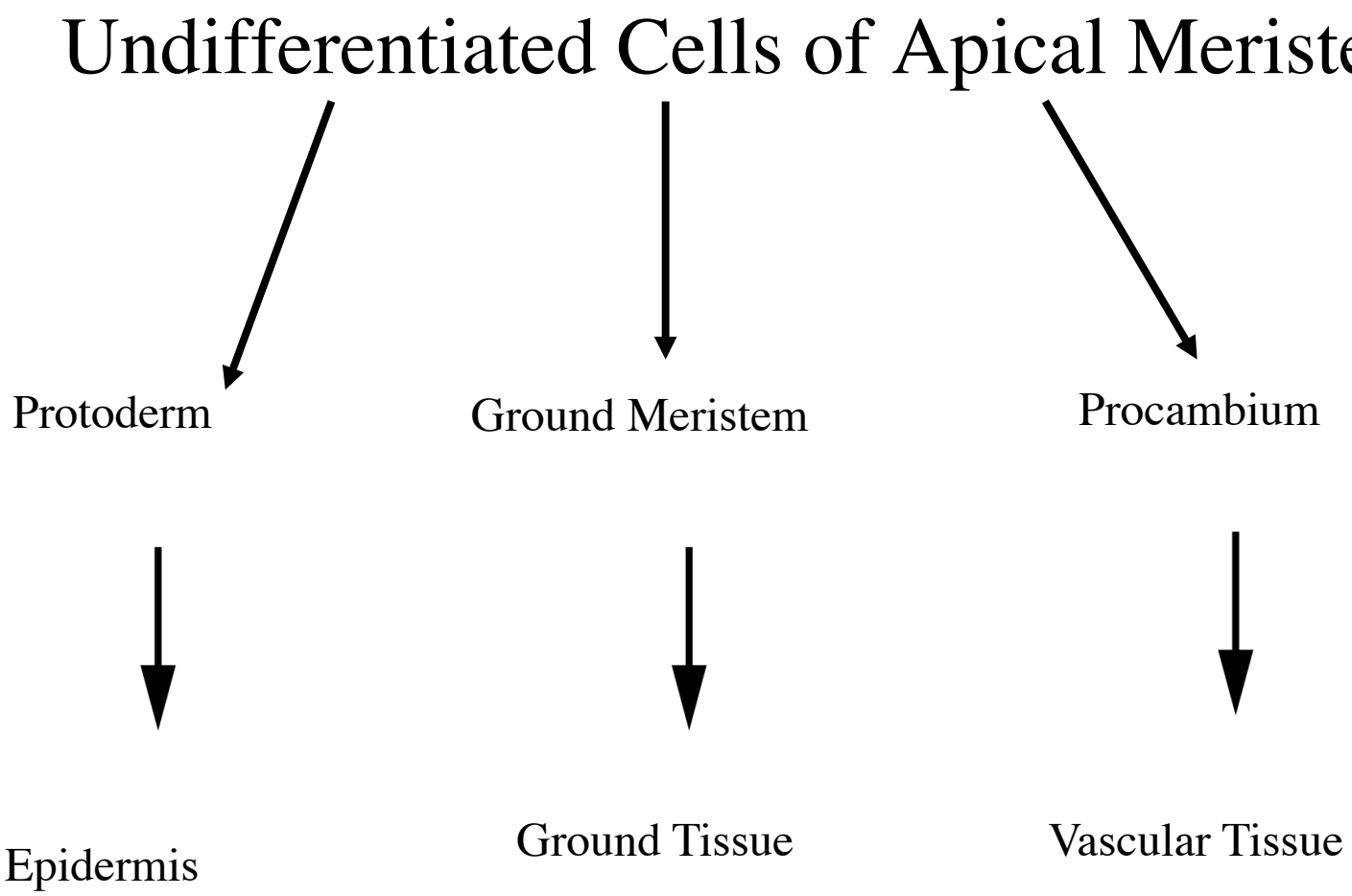


In primary growth, cell division isn't entirely restricted to the apical meristem proper. Cell division continues in the derived immature tissues behind the apical meristem. These tissues are called the primary meristematic tissues.

Protoderm matures to form the epidermis

Ground Meristem matures to form the ground tissue

Procambium matures to form the vascular tissue

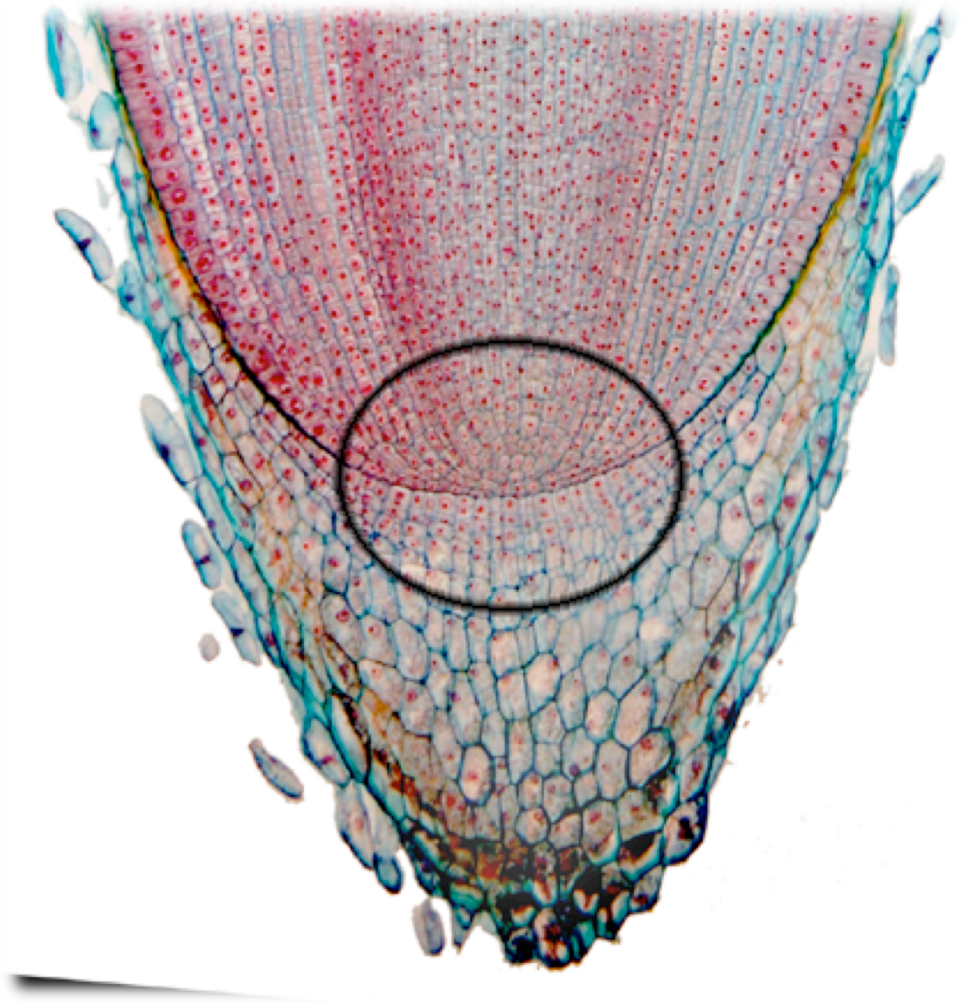

Undifferentiated Cells of Apical Meristem
Protoderm
Ground Meristem
Procambium
Epidermis
Ground Tissue
Vascular Tissue

Primary growth in the root

Simpler than in the shoot as there are no nodes or internodes

Always includes a root cap. The apical meristem of the root encompasses some of the area of the root cap

Apical Meristem of the Root

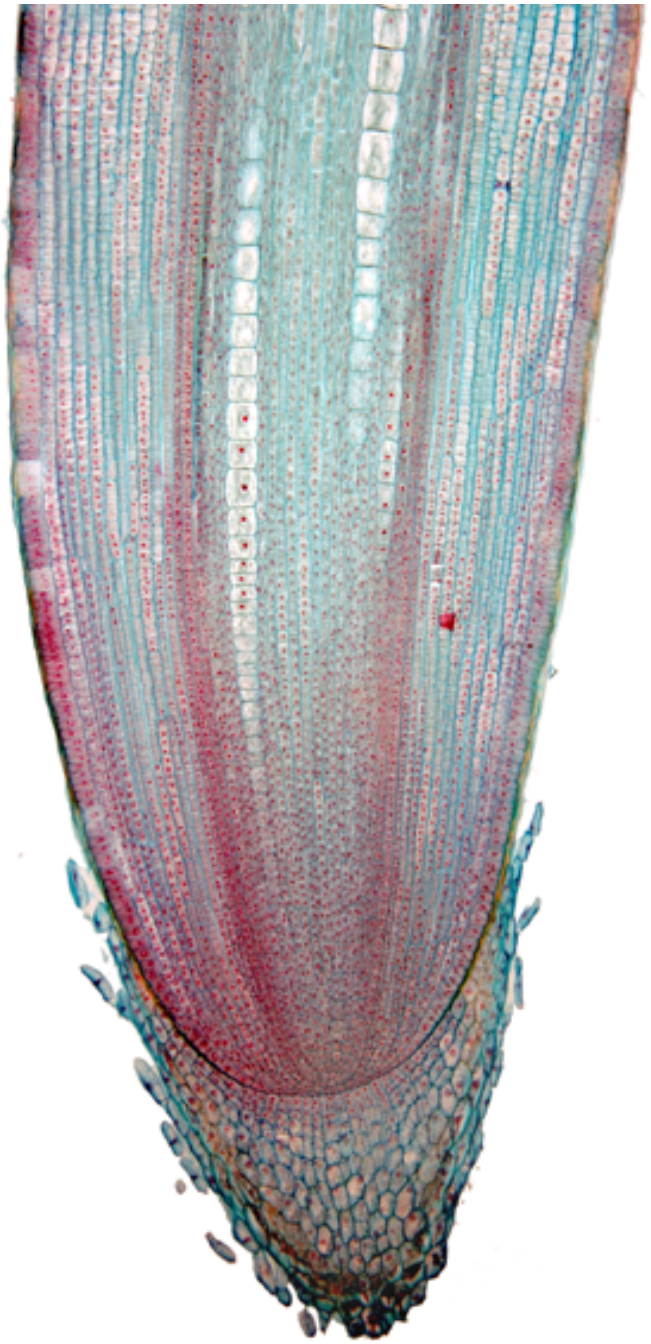


Regions of growth of a root

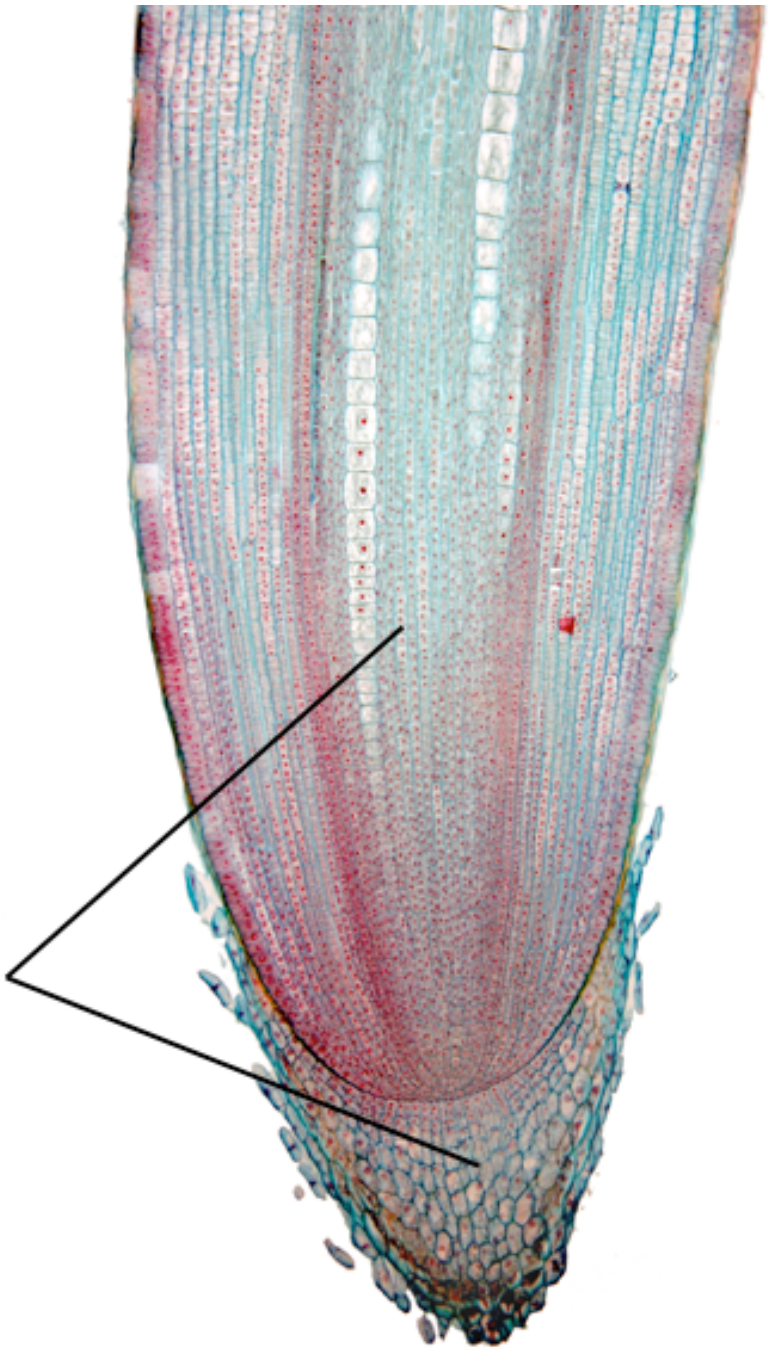
Region of cell division

Region of cell elongation

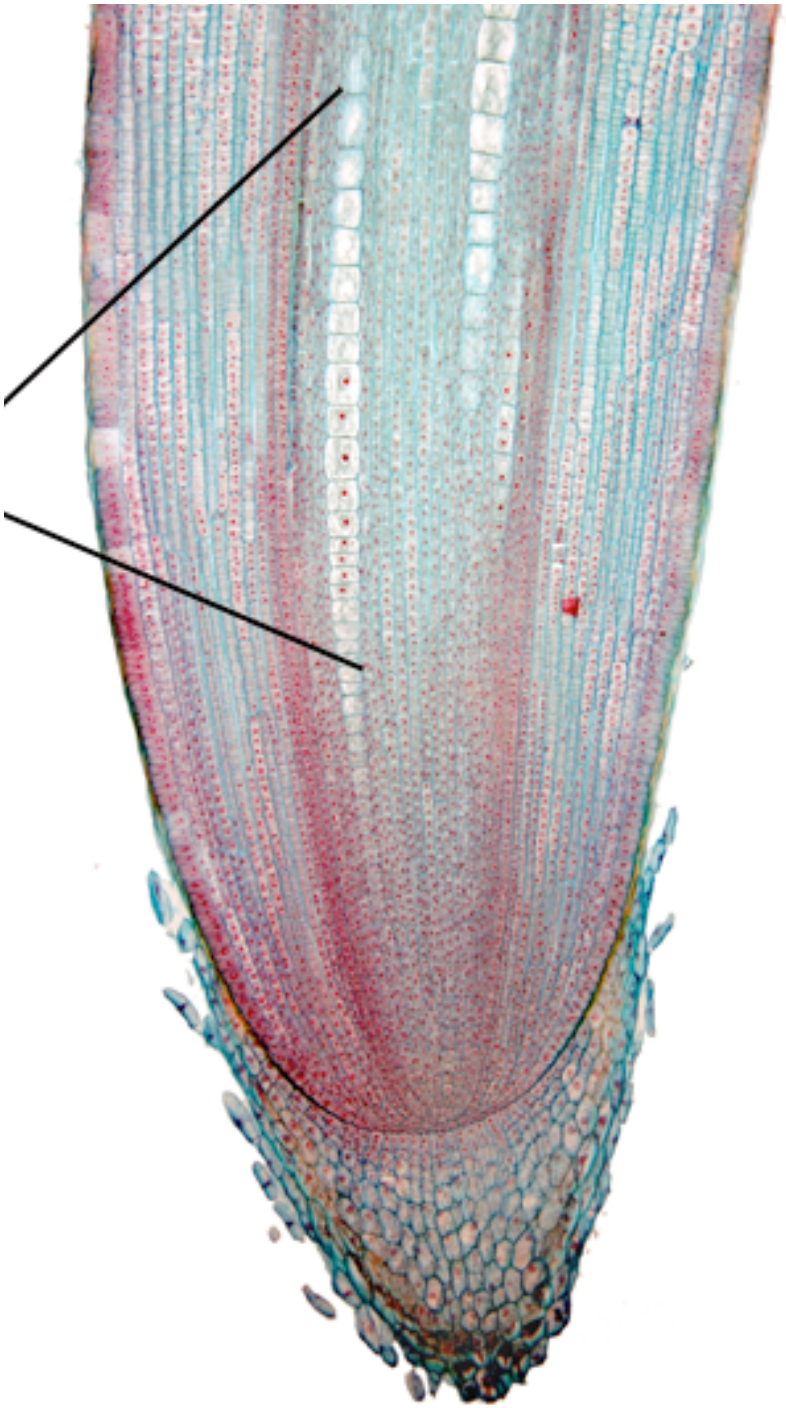
Region of maturation



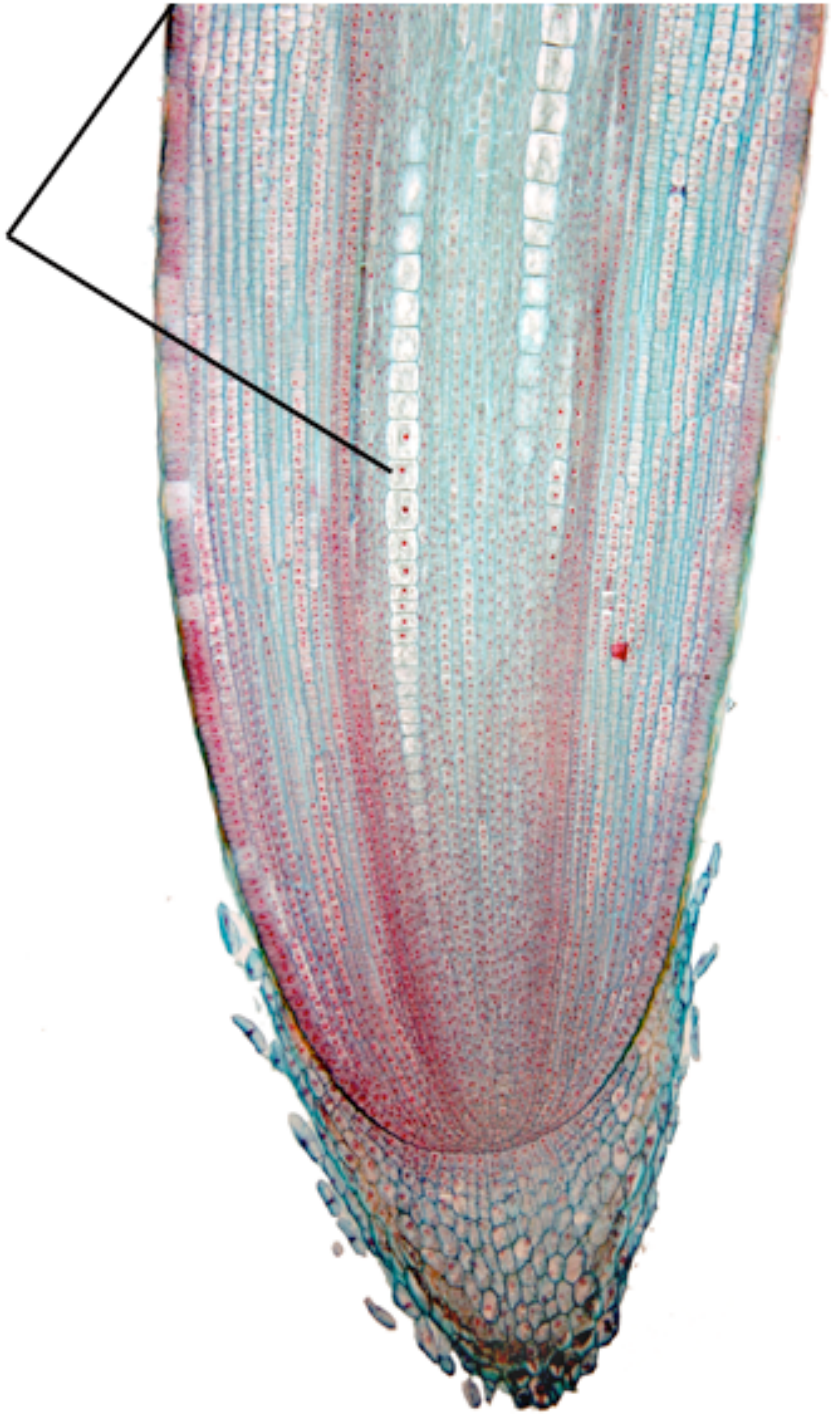
Region of cell division



Region of elongation



Region of Maturation

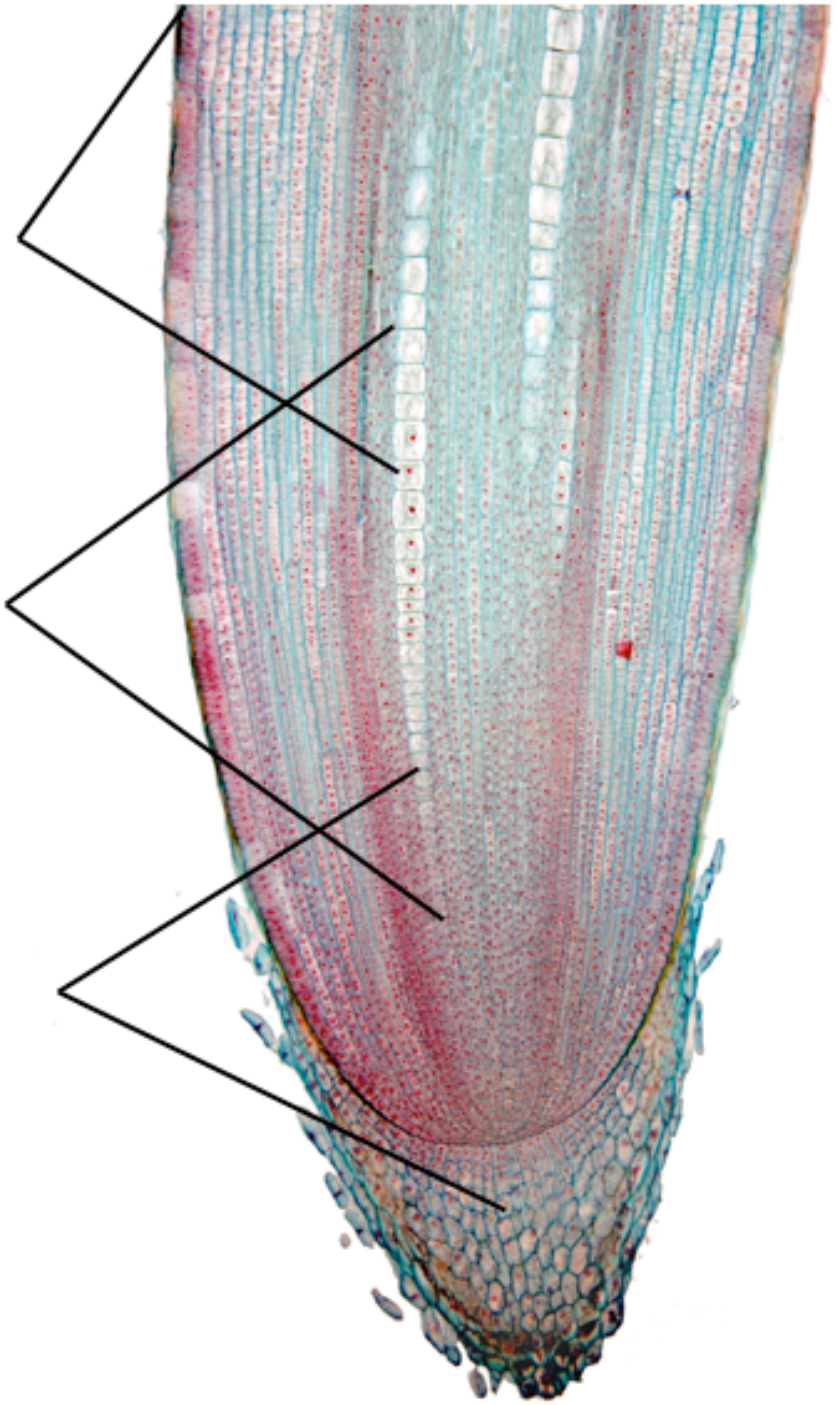


Regions

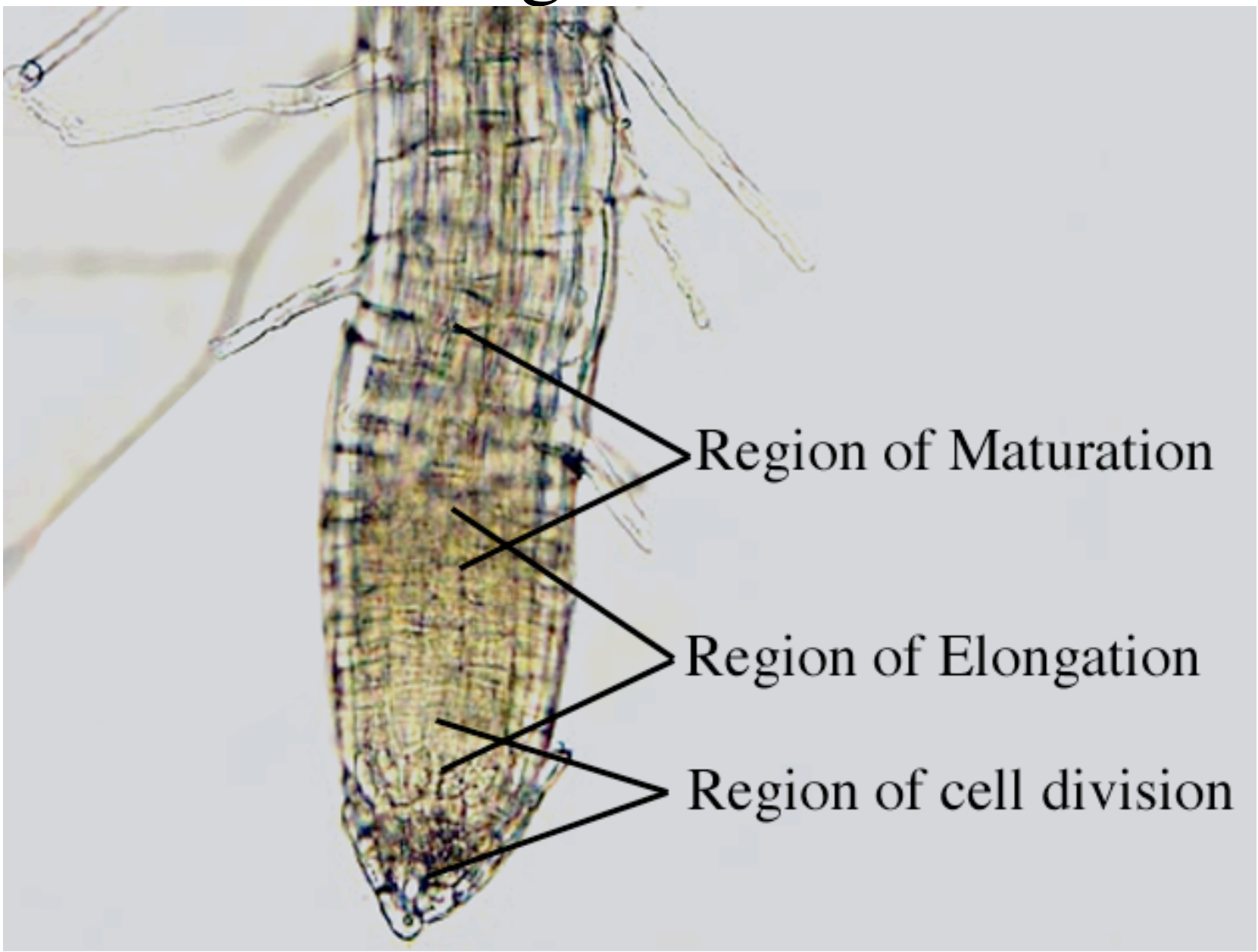
maturation

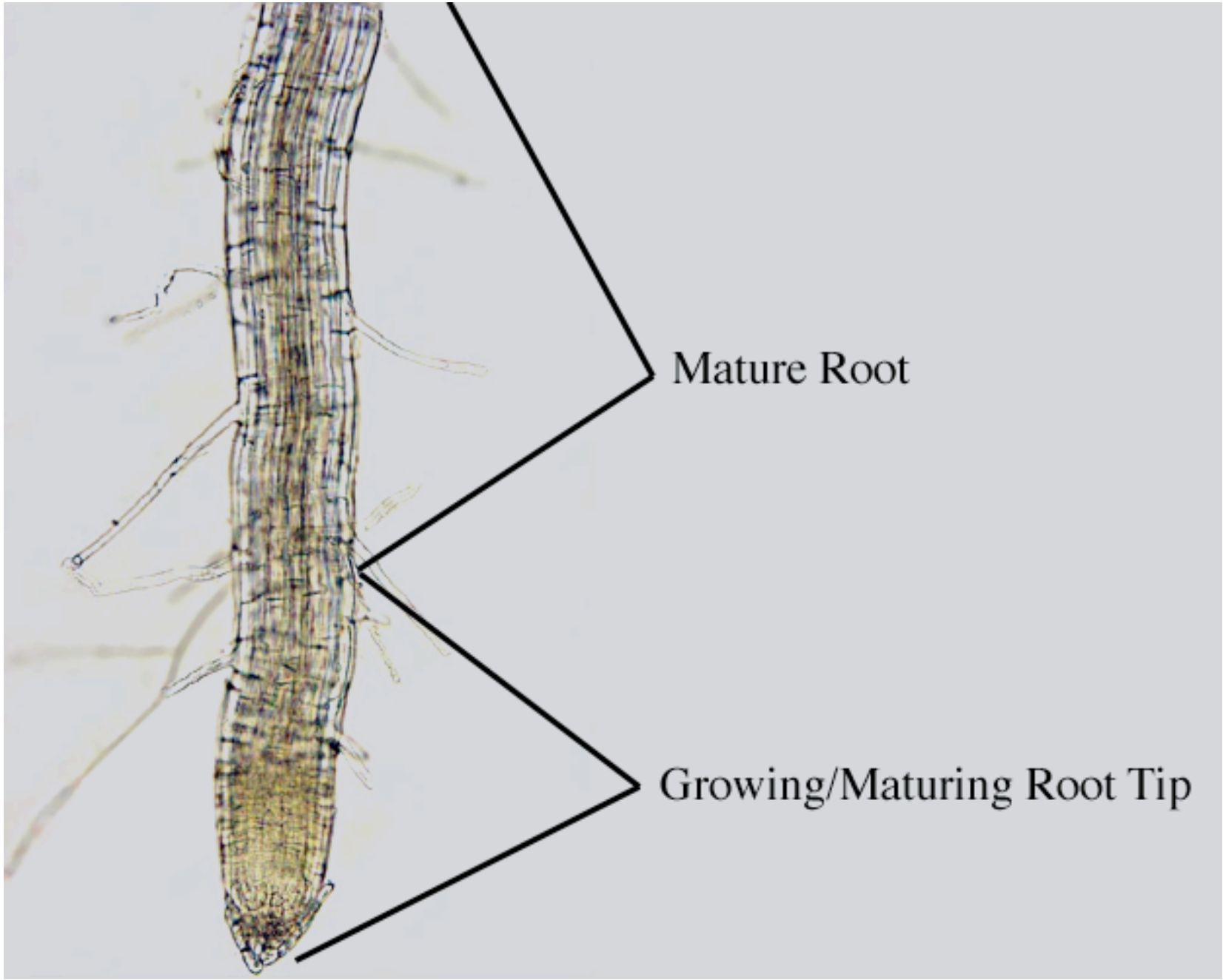
elongation

division



Regions


Region of Maturation
Region of Elongation
Region of cell division

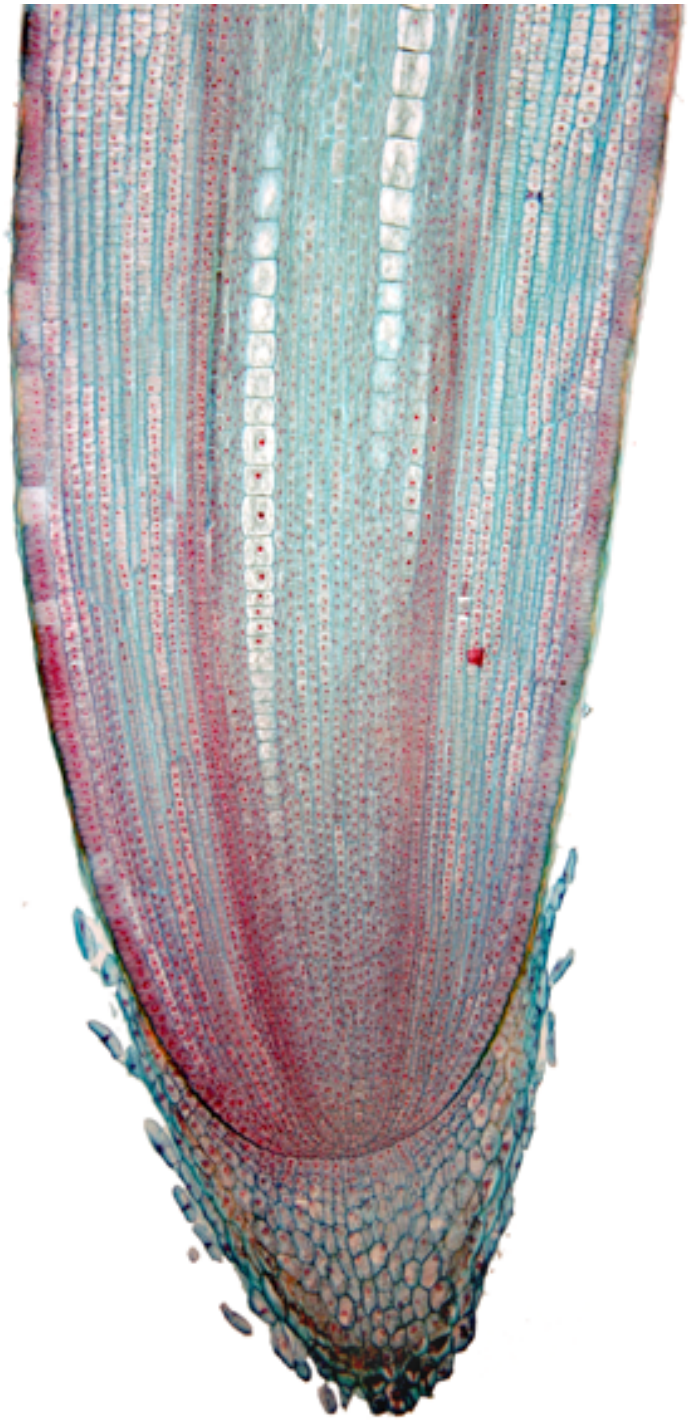

Mature Root
Growing/Maturing Root Tip

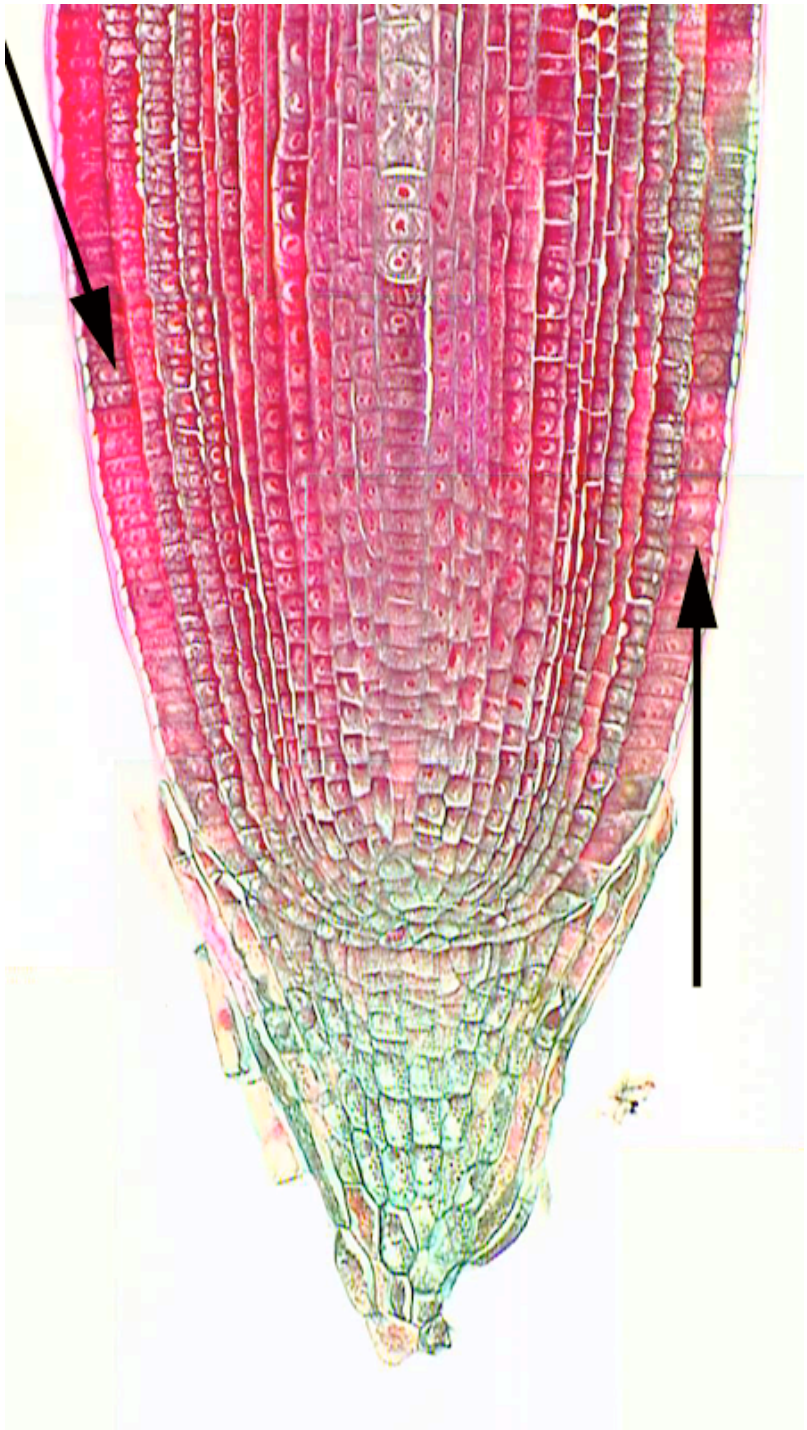
Primary Meristematic Meristems in a Root Tip

Protoderm = outer layer of cells

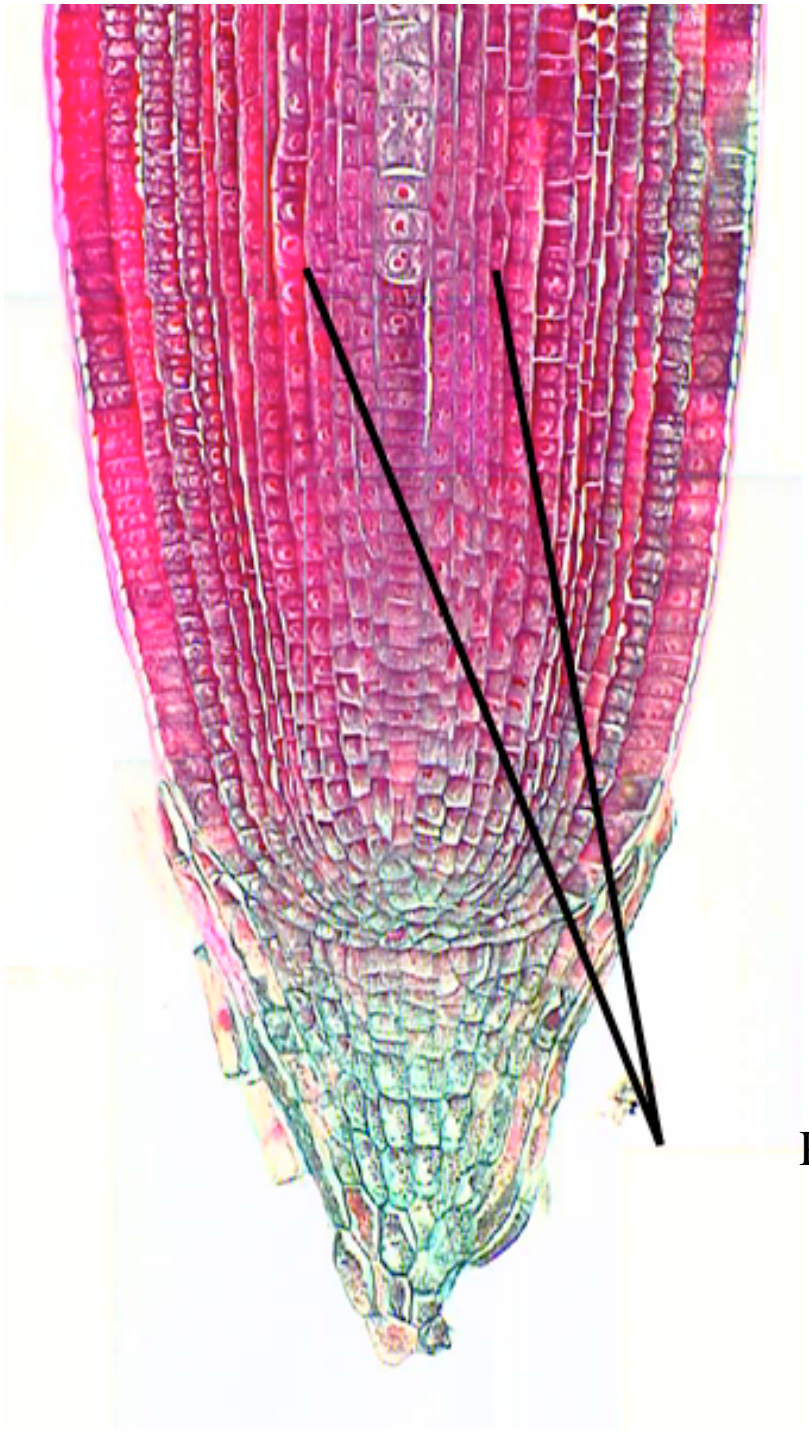
Procambium = inner core of cells

Ground Meristem = everything else

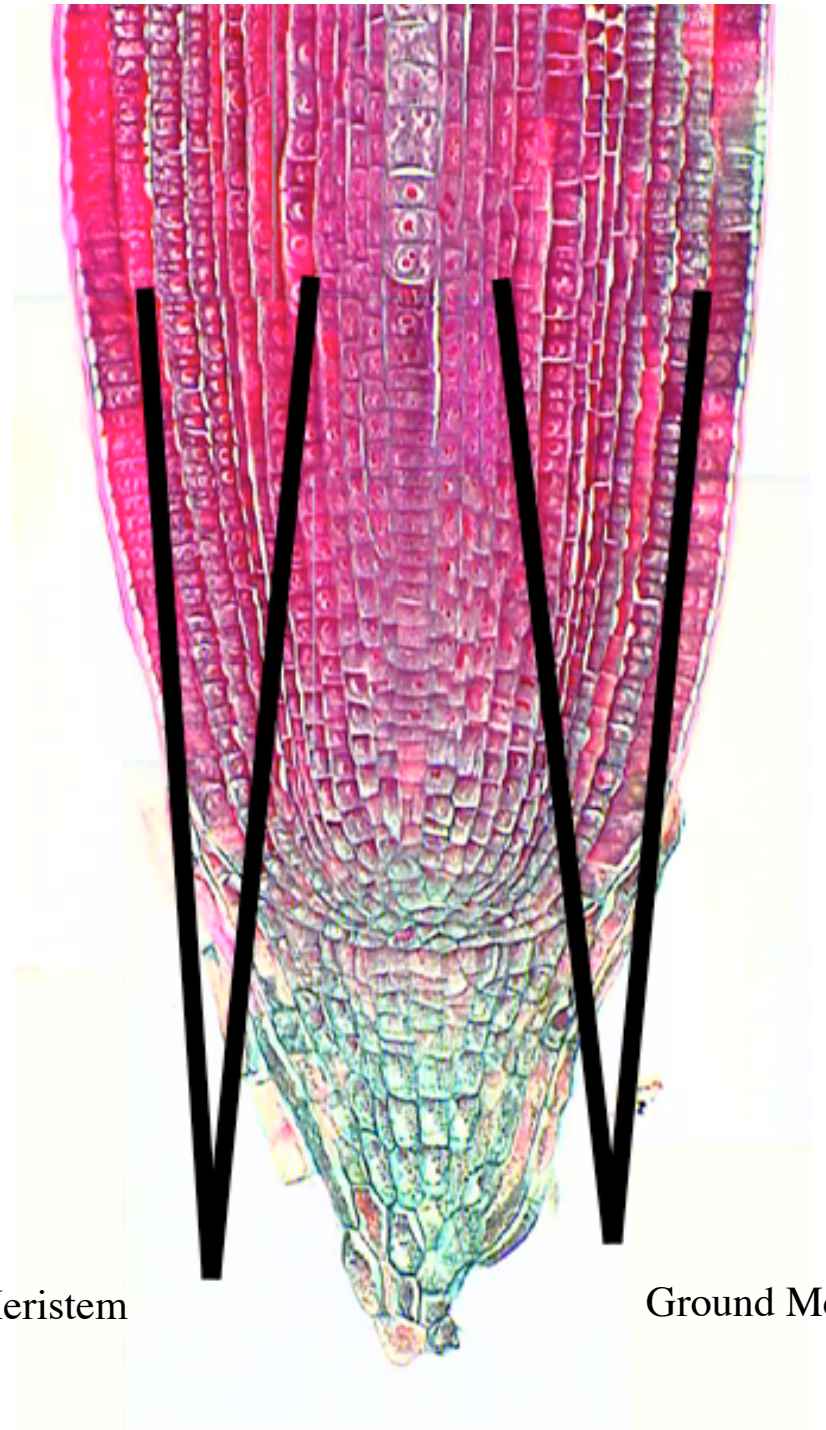




Protoderm



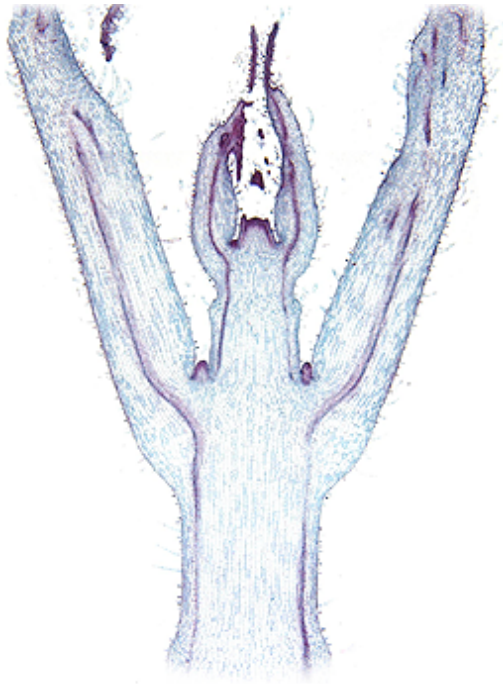
Procambium



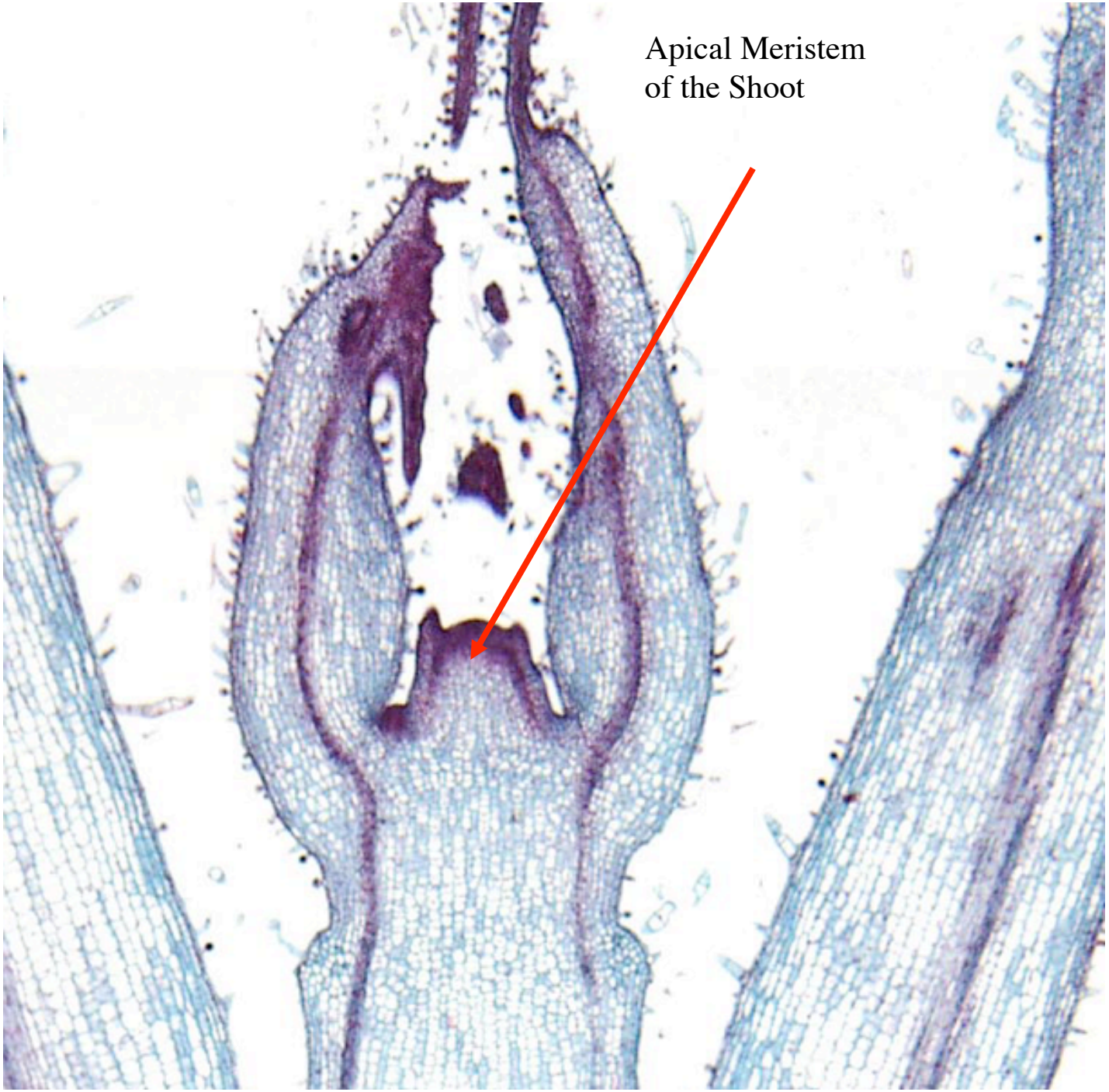
Ground Meristem

Ground Meristem

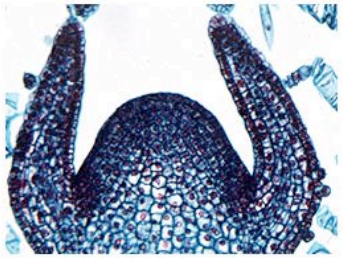
Primary Growth in the Shoot

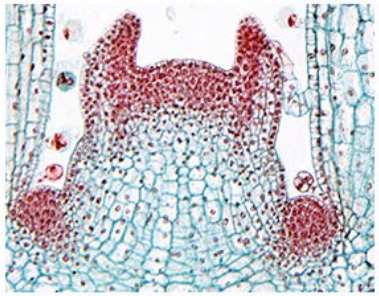


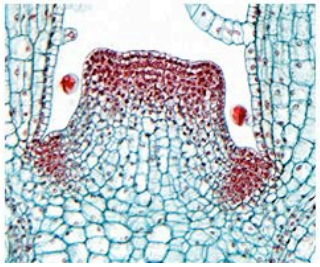
Is more complex because it generates both leaf and stem tissue along with the axillary buds at the internodes.


Apical Meristem
of the Shoot

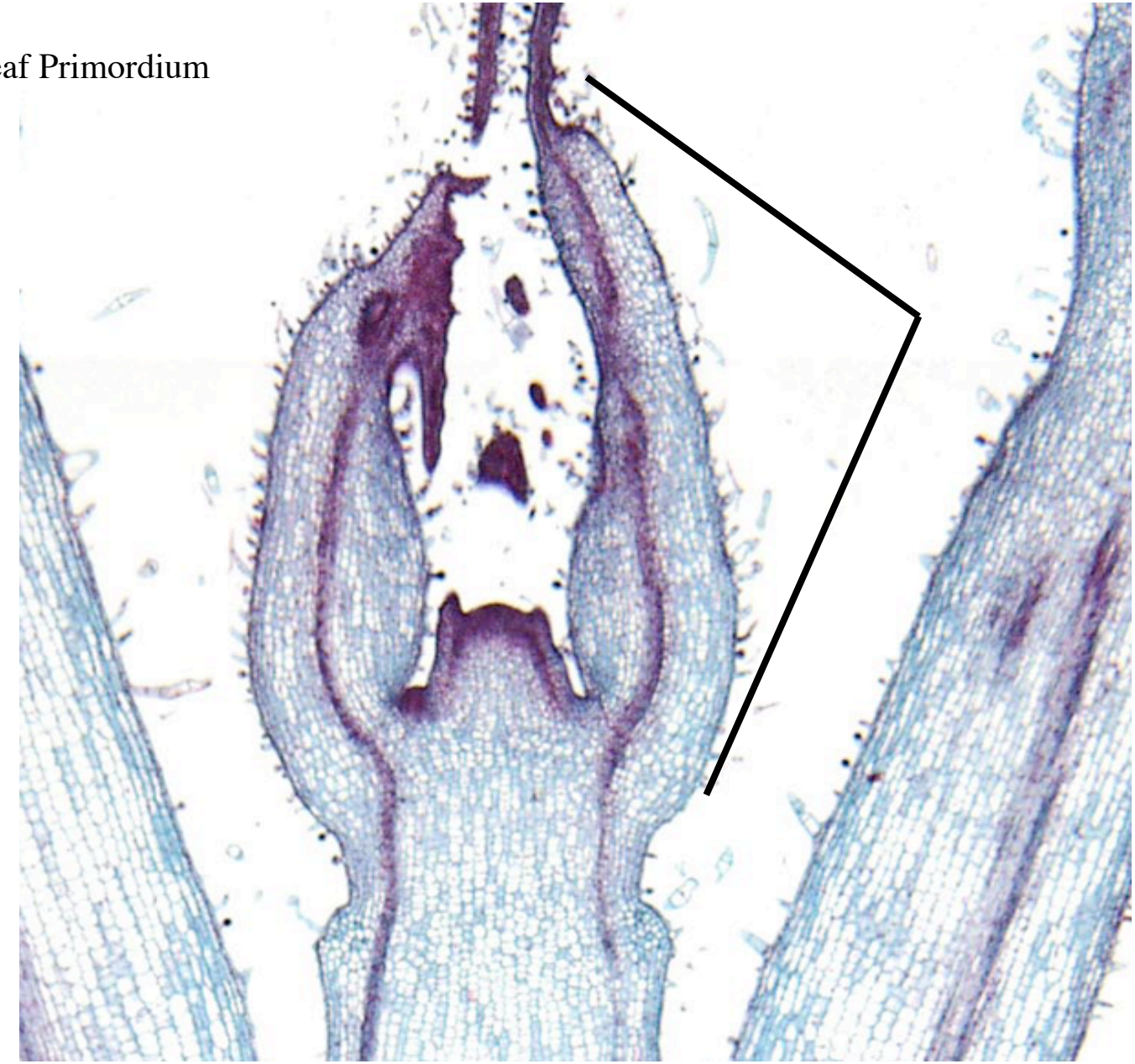
Apical meristem of the Shoot is more complex than that of the root.

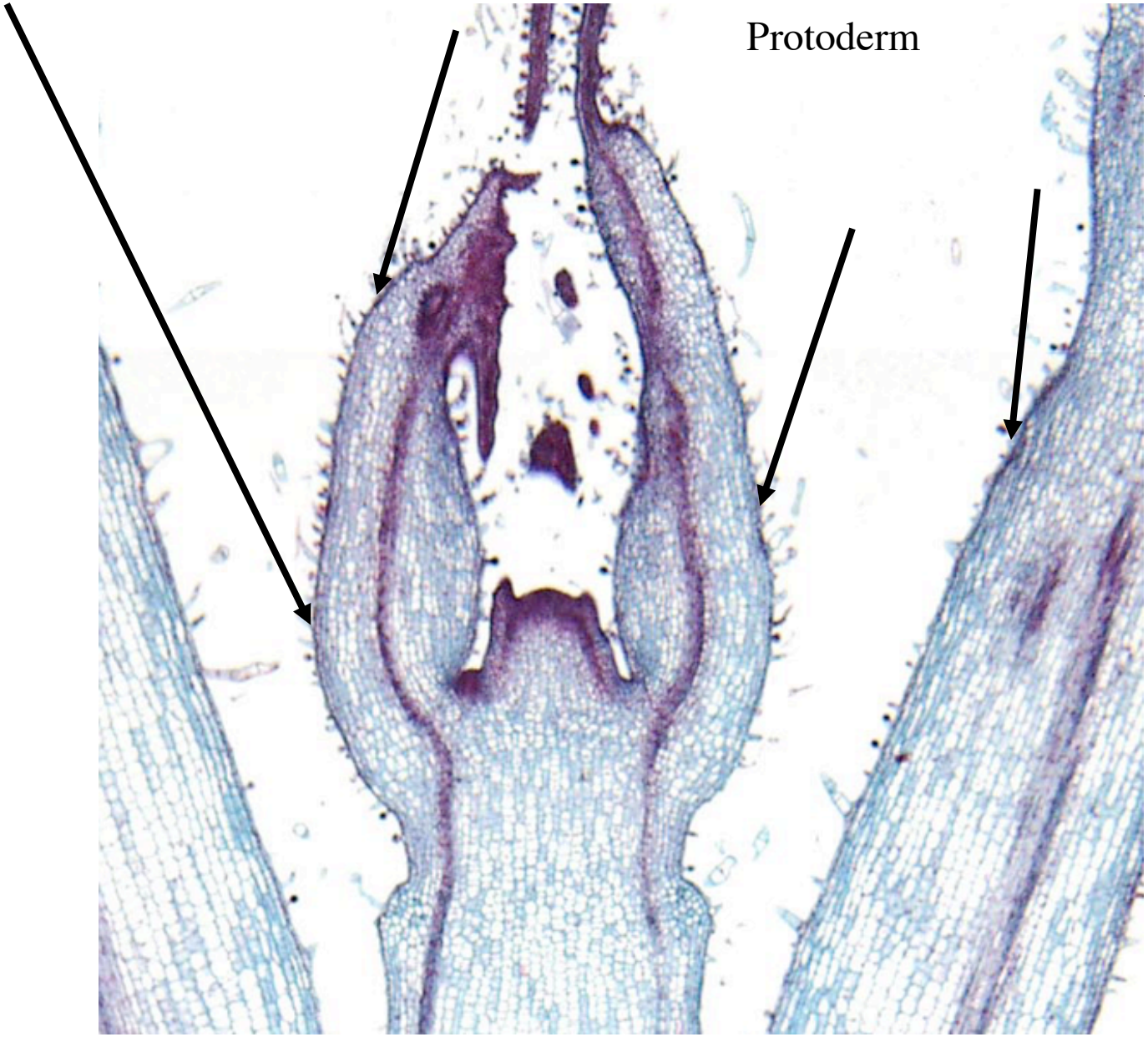




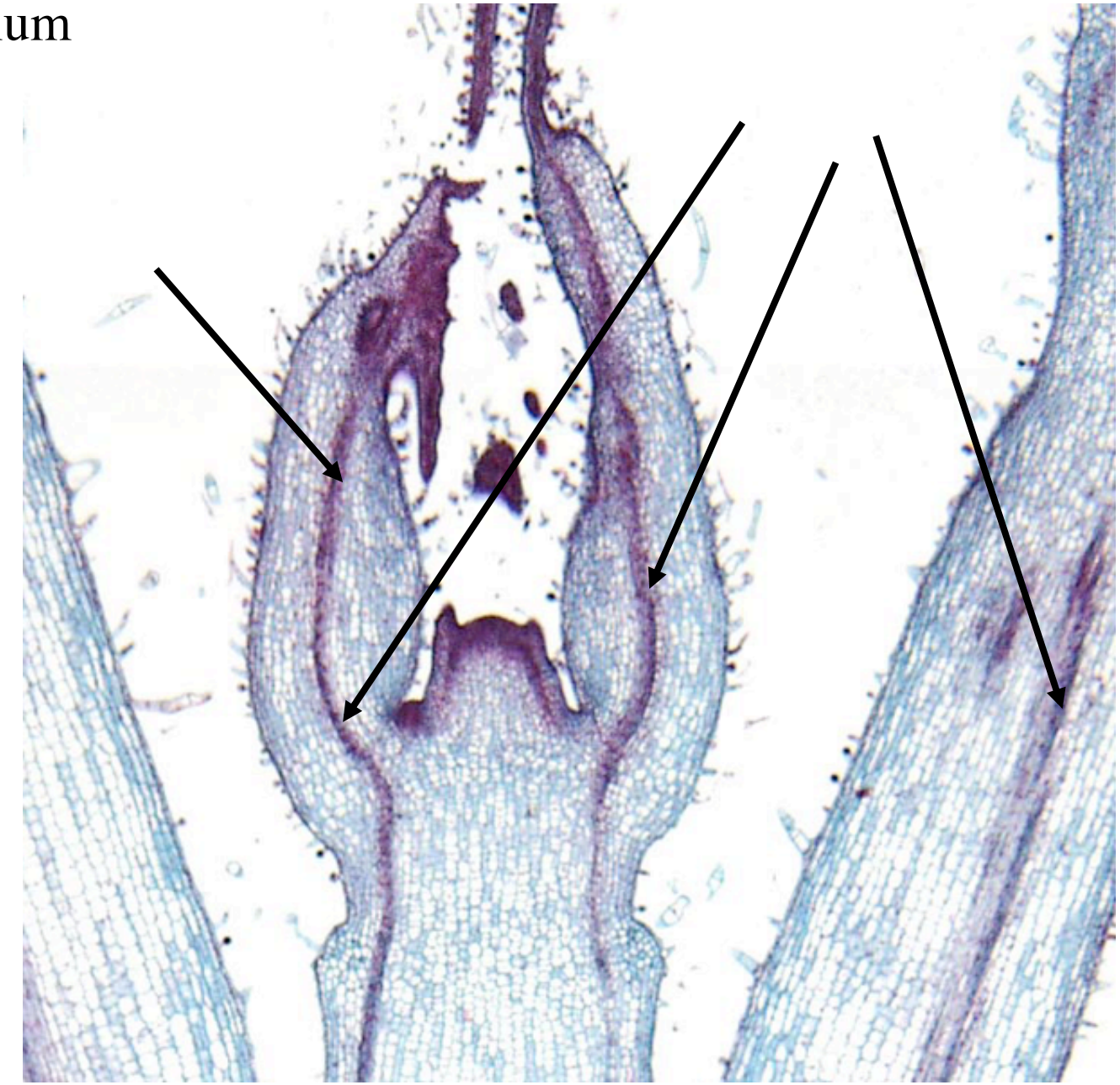


Leaf Primordium

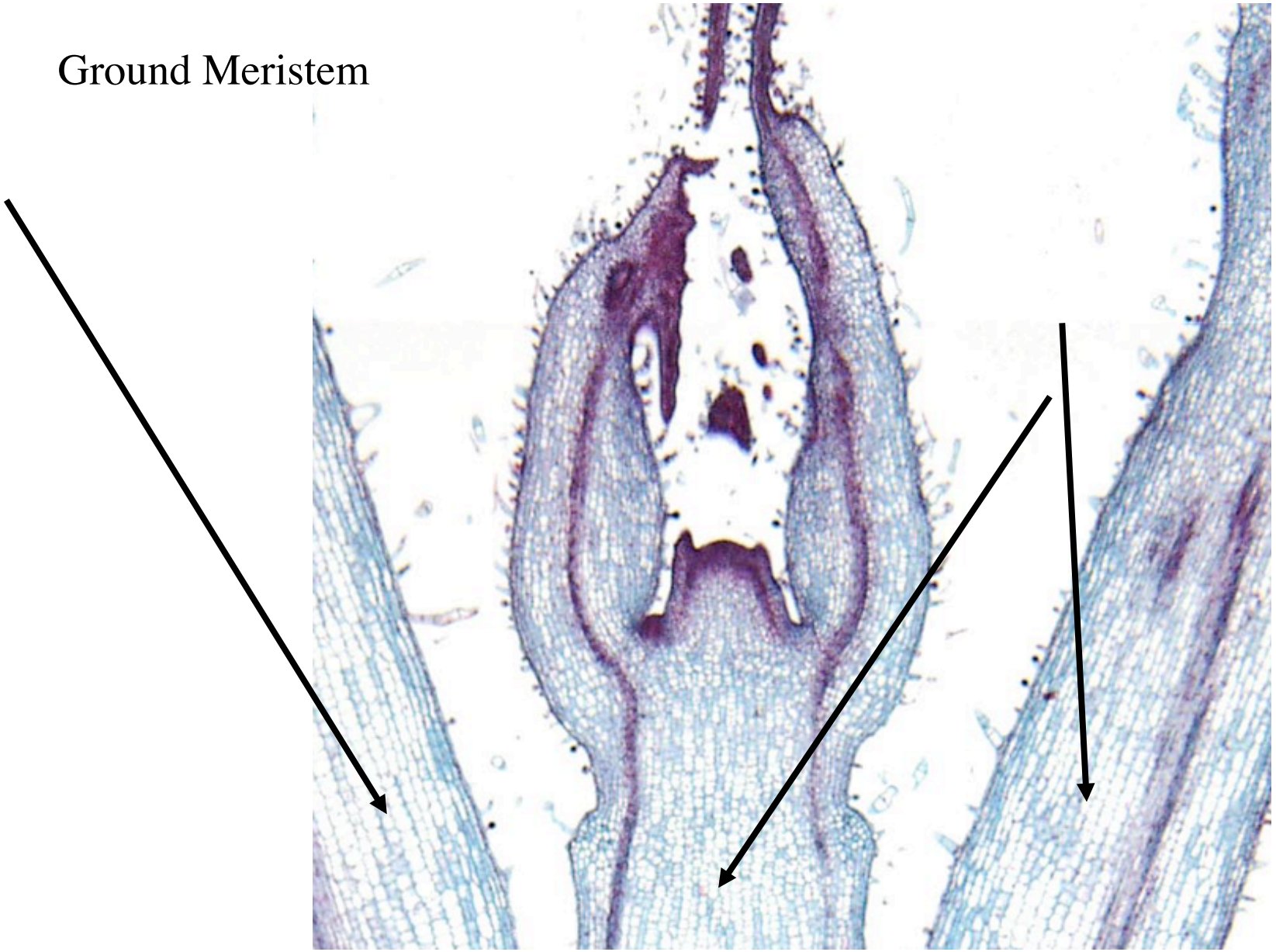


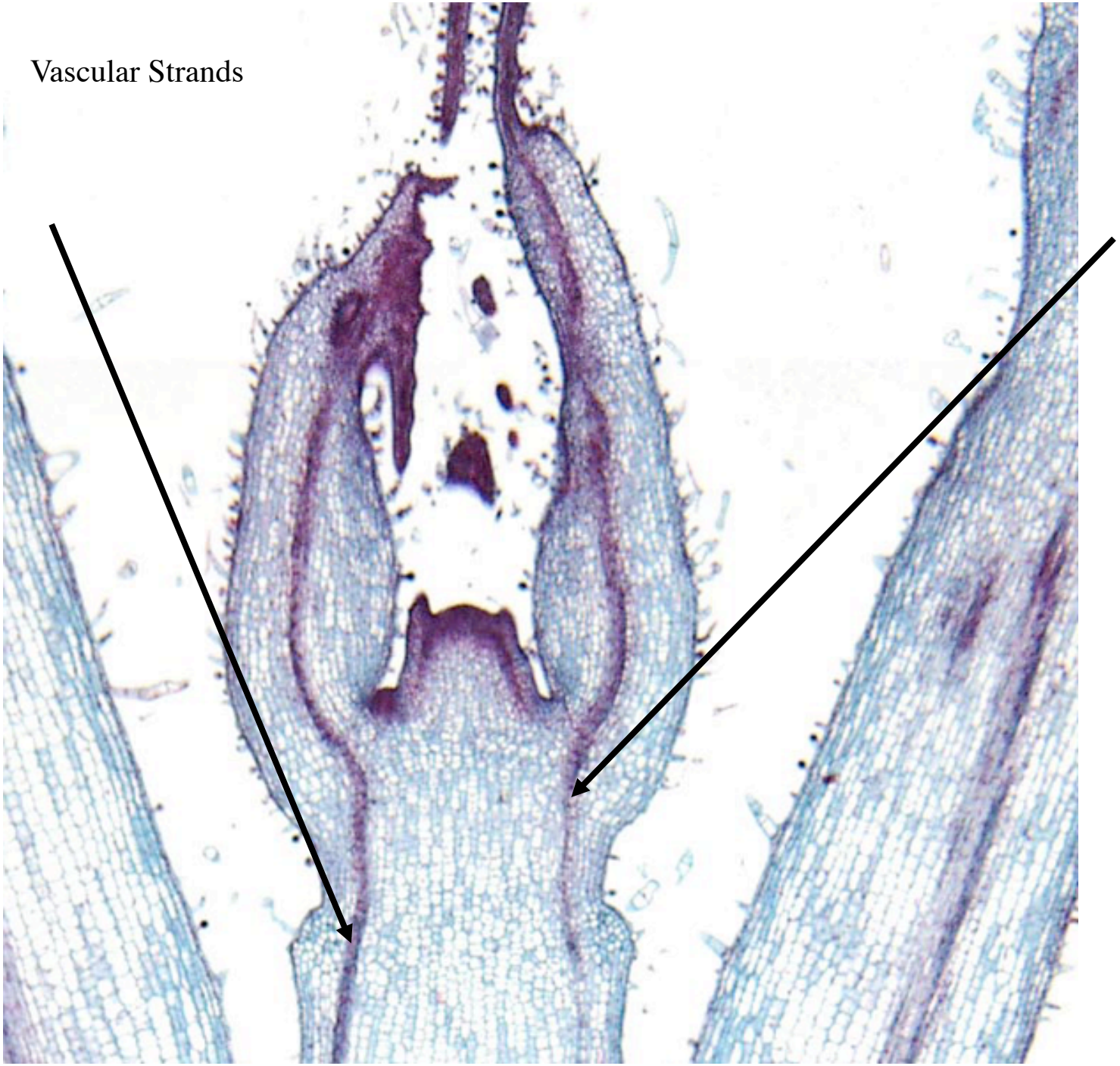

Protoderm

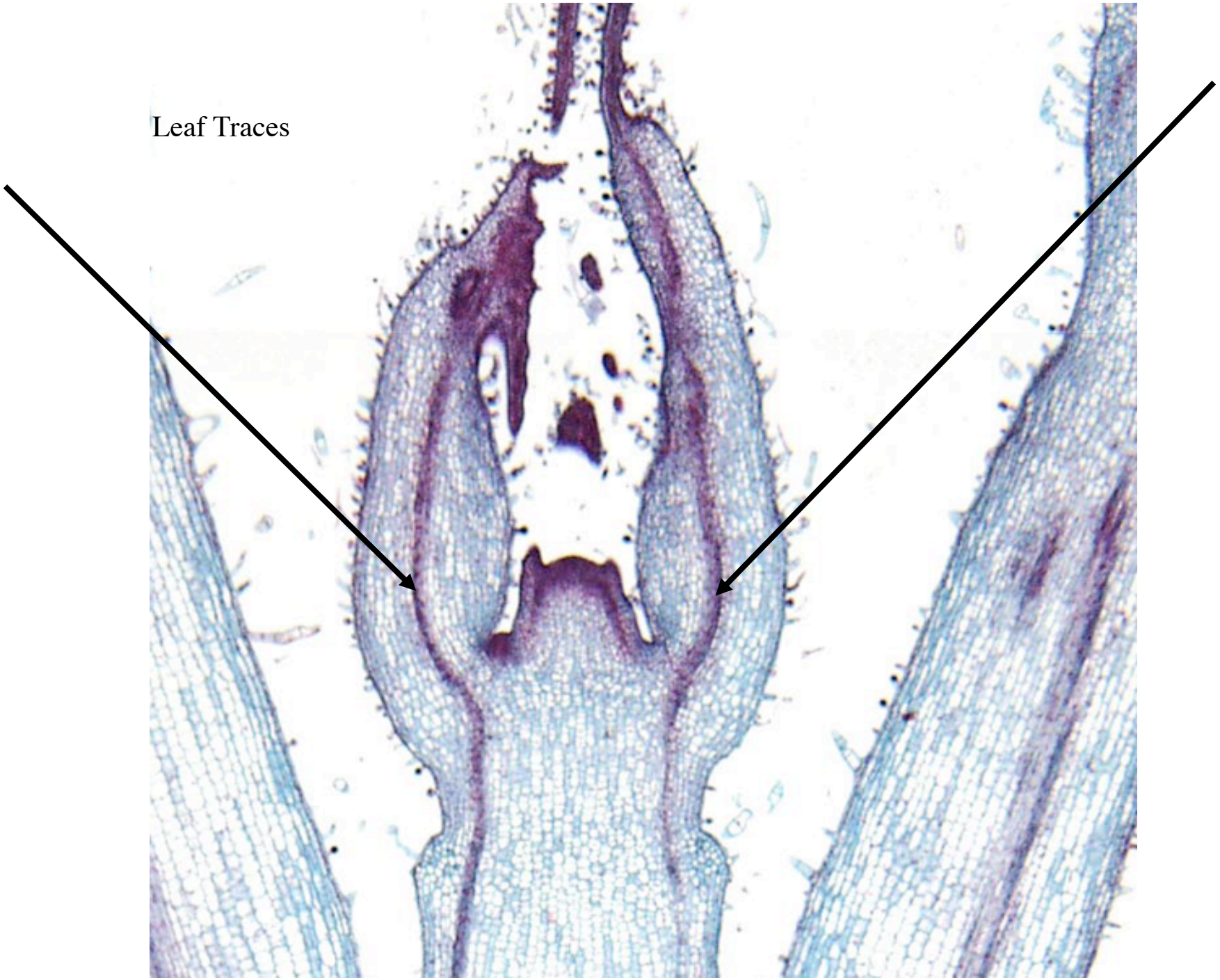
Procambium



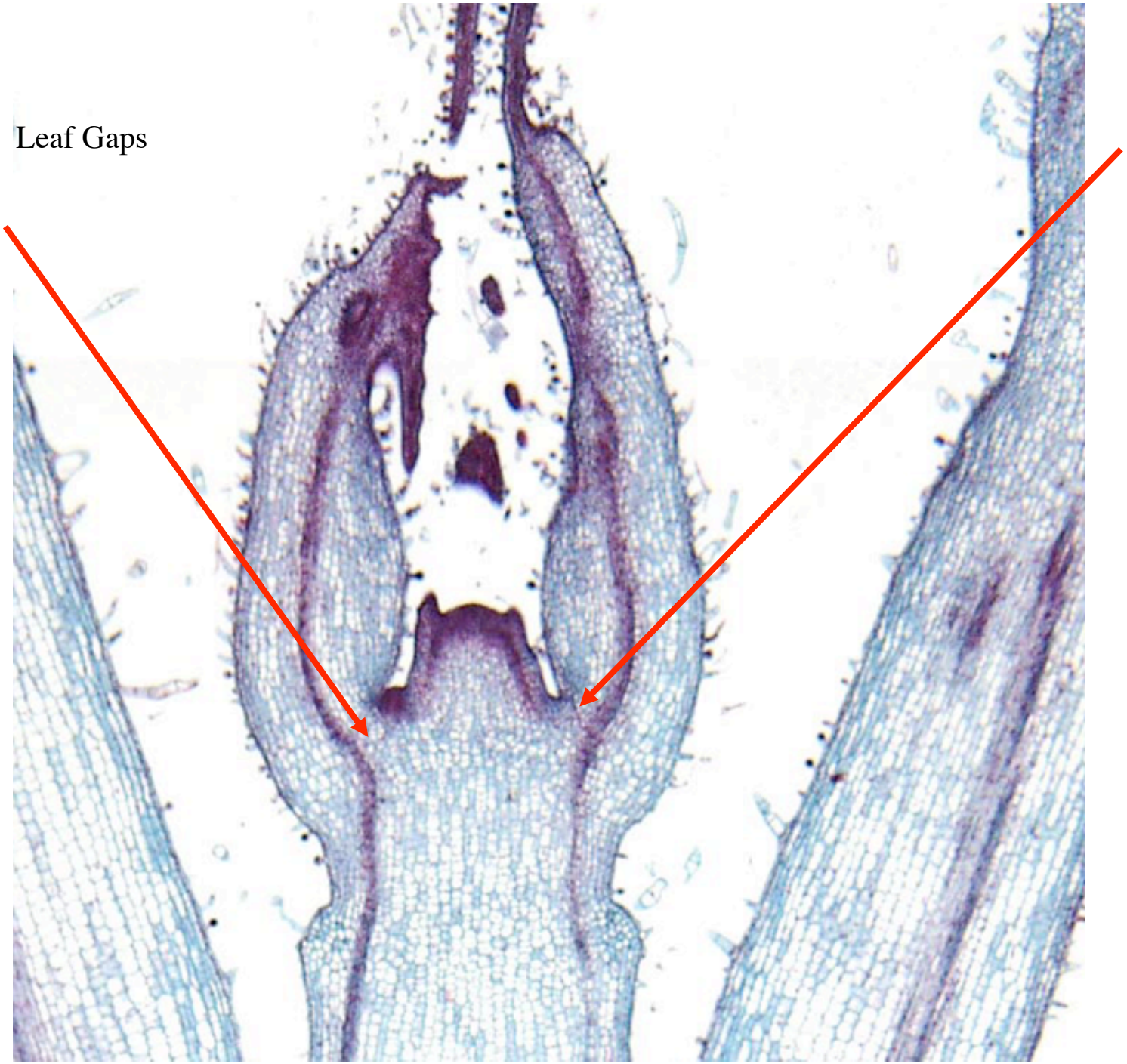
Ground Meristem



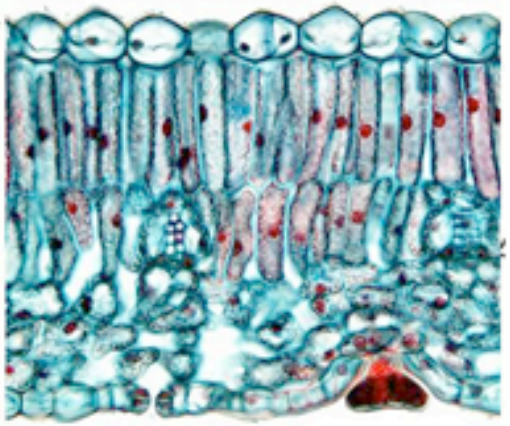

Vascular Strands


Leaf Traces

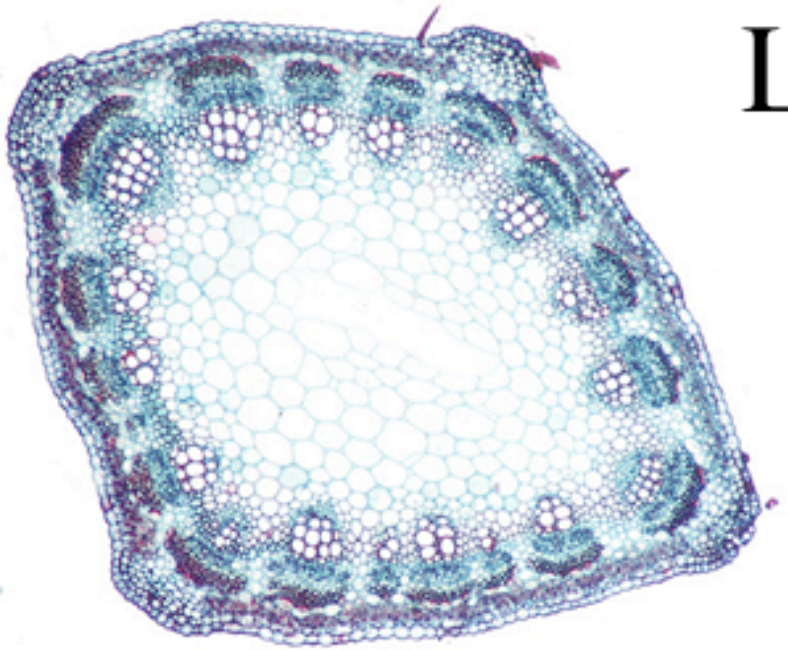
Leaf Gaps



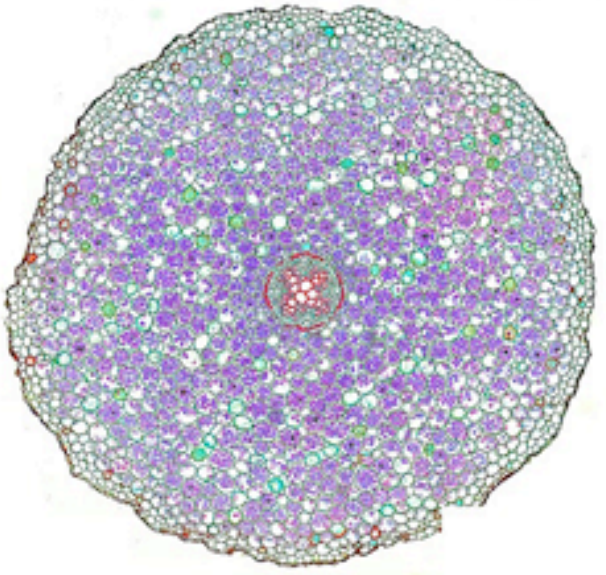
Not surprisingly, the differences in the tissue organization between the root, stem, and leaf of The plant body at the end of primary growth is related to their function.



Leaf



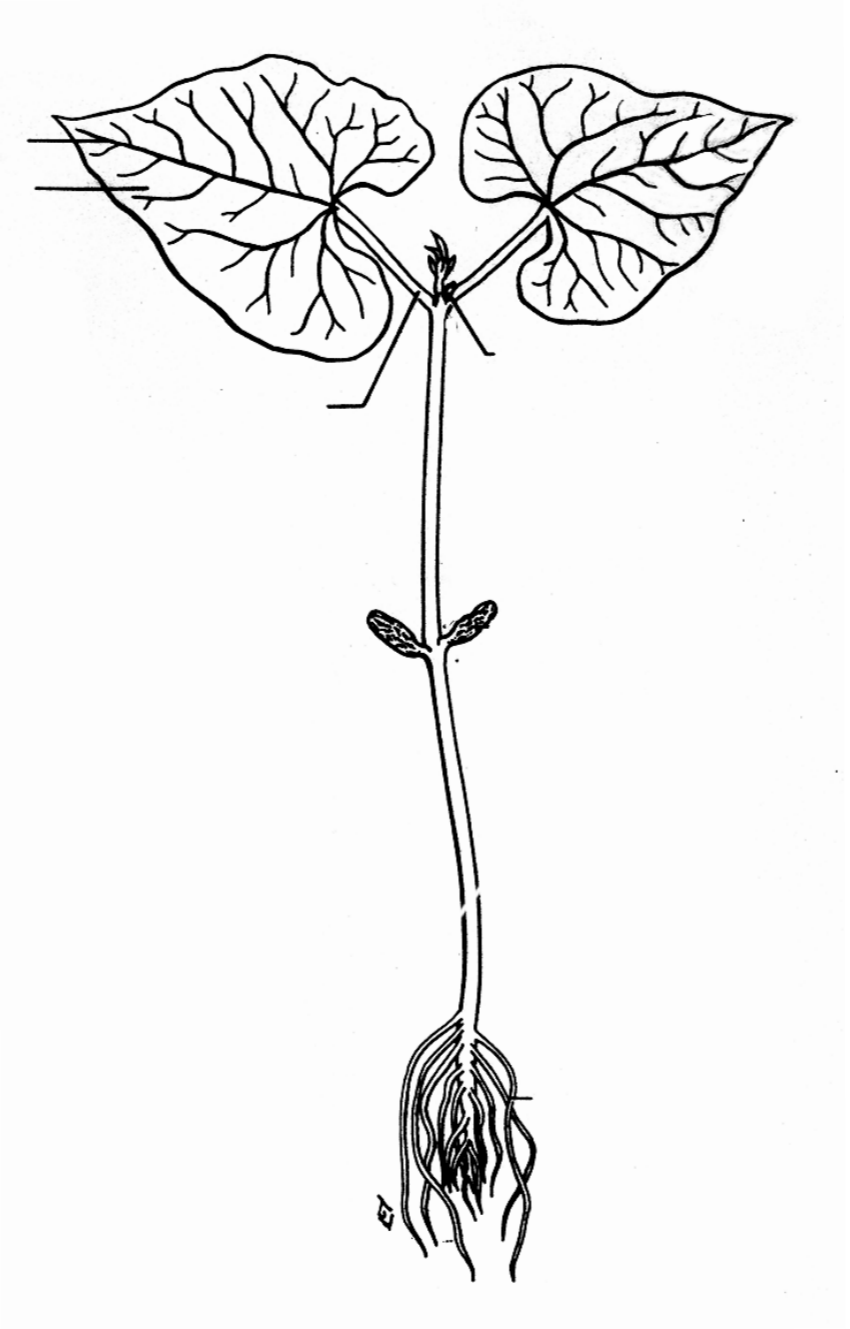
Stem



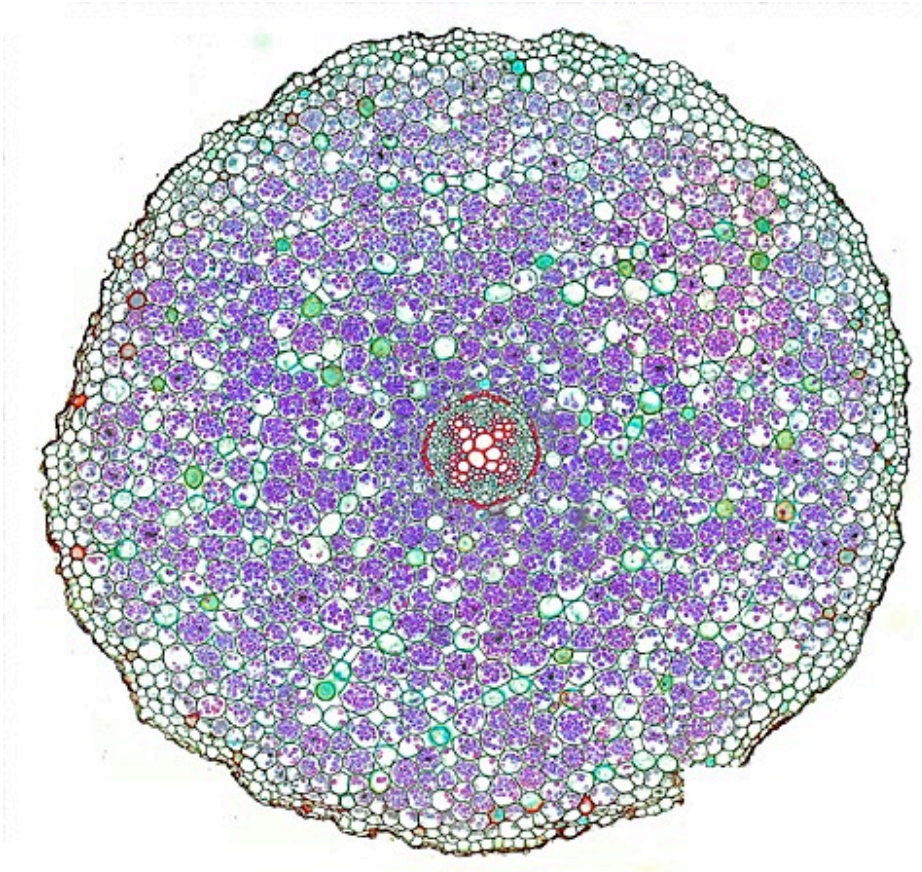
Root

The environmental pressures to which the root is subject is reflected in its anatomy. These are

Anchorage



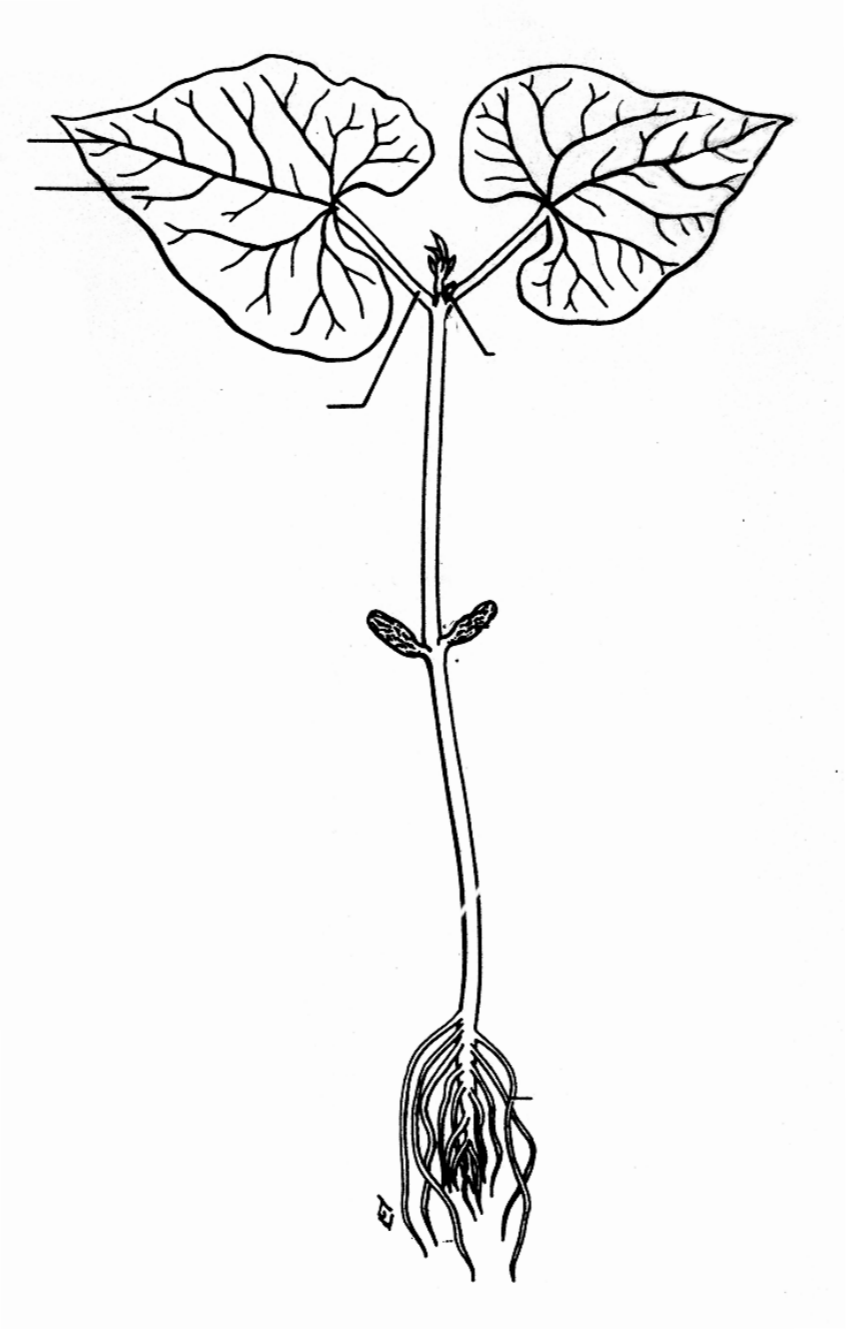
Vascular tissue forms a cylinder inside of the root



Basic root functions:

Anchorage

Absorption



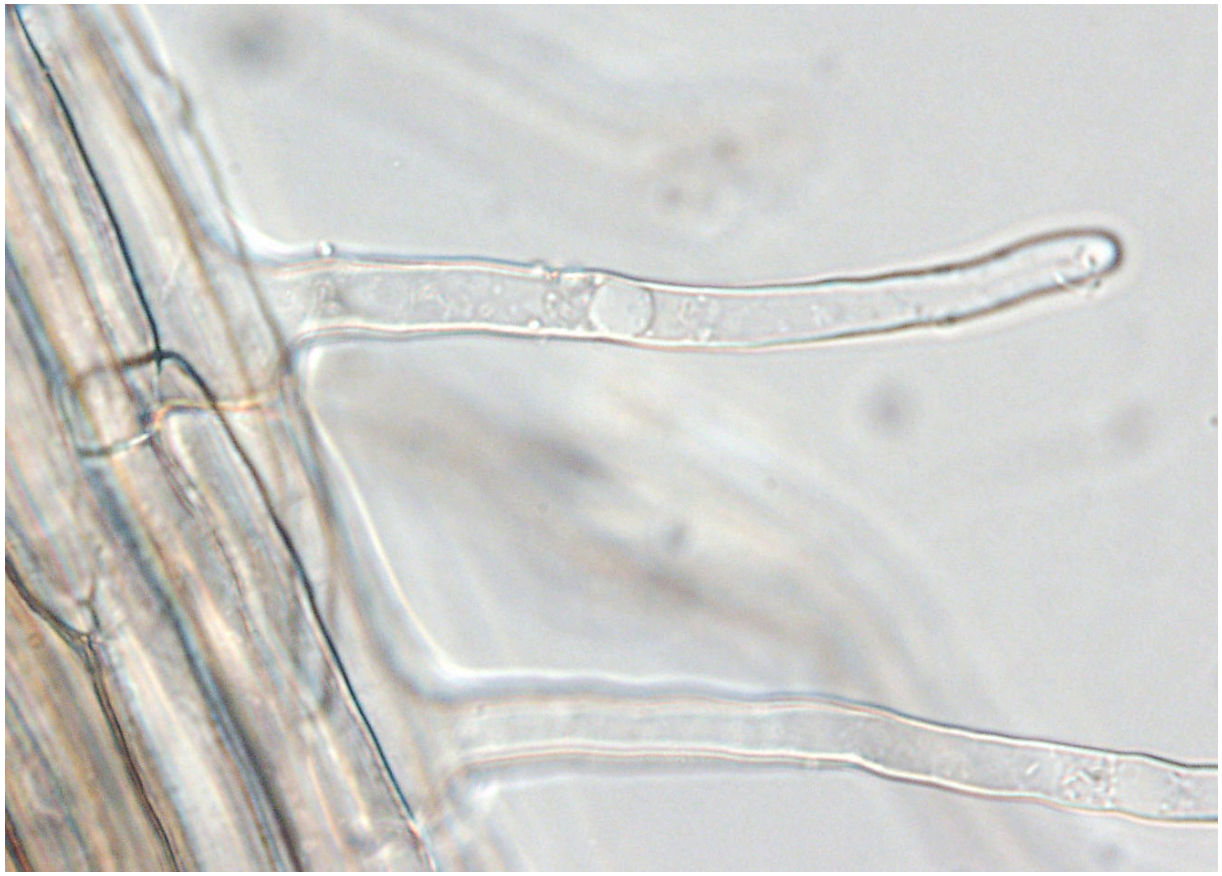
The root epidermis must allow for the movement of water and minerals, hence, does not have a cuticle, hence, does not have stomata with guard cells.

Dermal Tissue of the Root

No cuticle

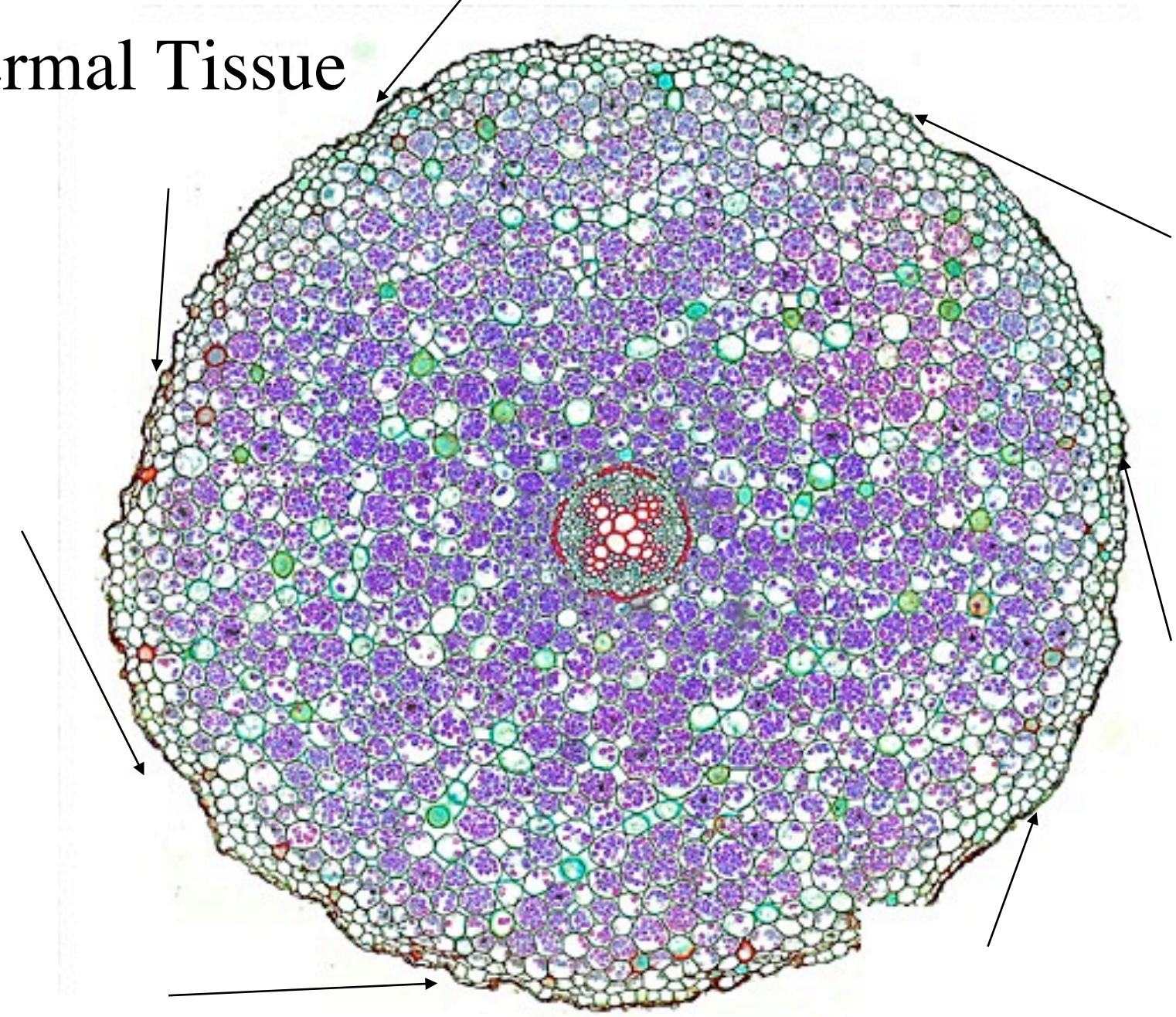
No stomata

Root hairs are extensions of individual epidermal cells that increases the surface area for absorbing water and nutrients.

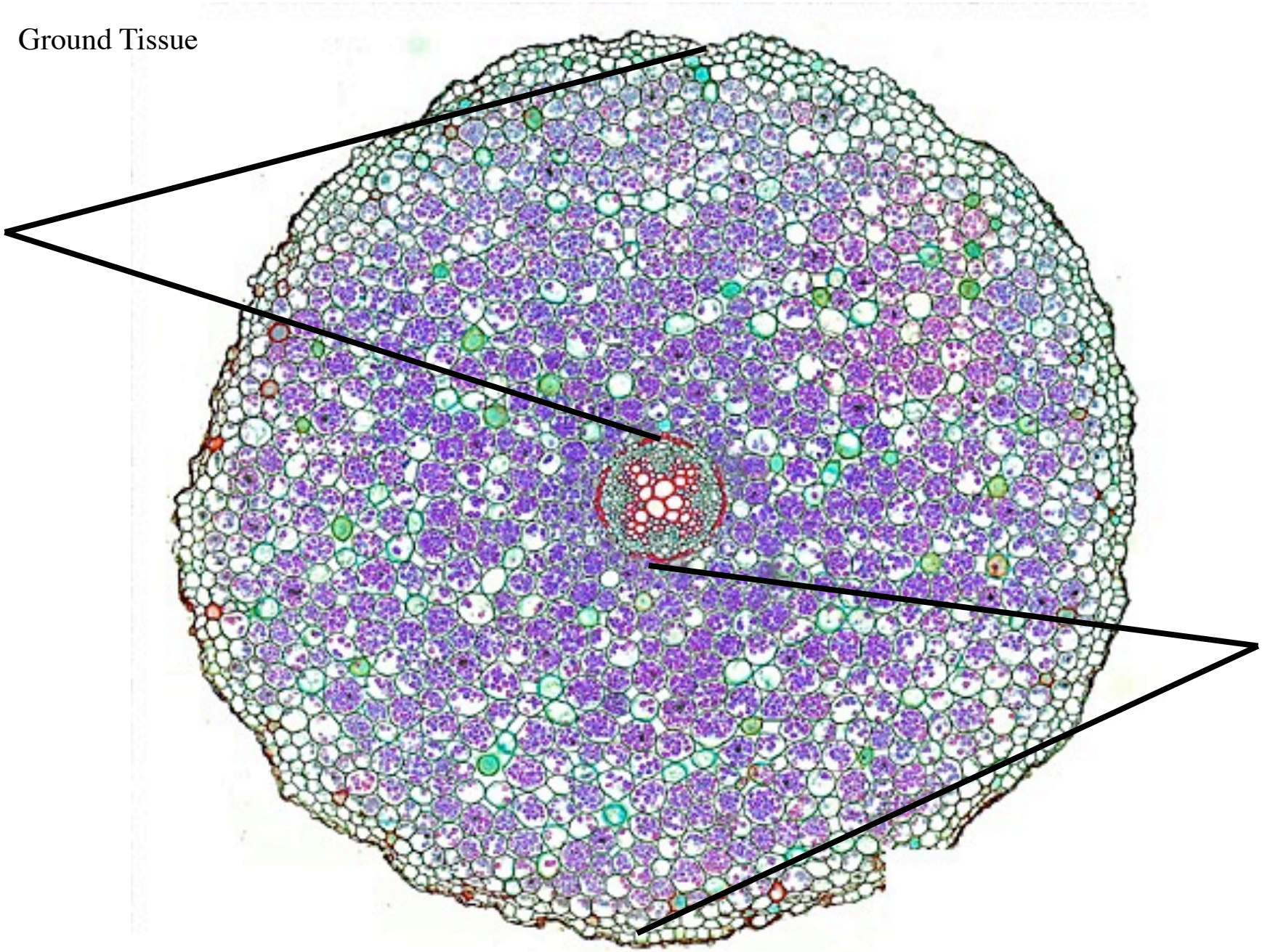


Root hairs are simply extensions of basal epidermal cells.

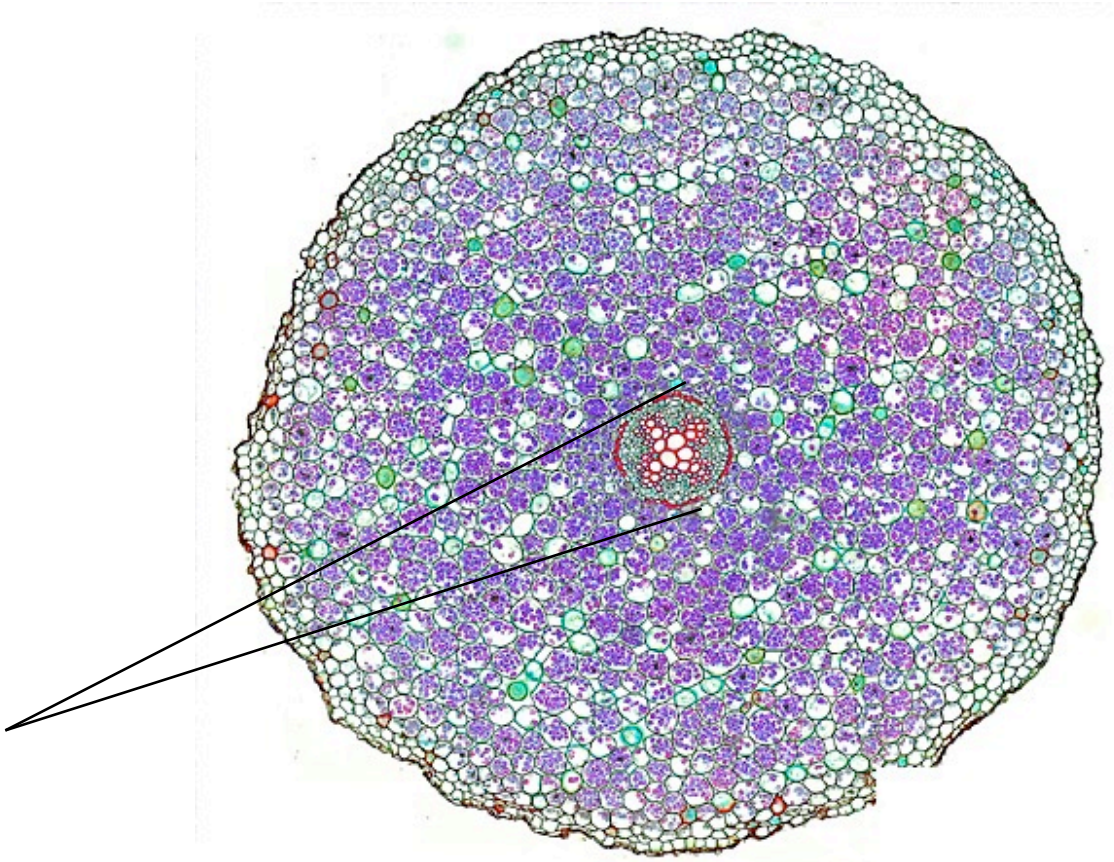
Dermal Tissue



Ground Tissue

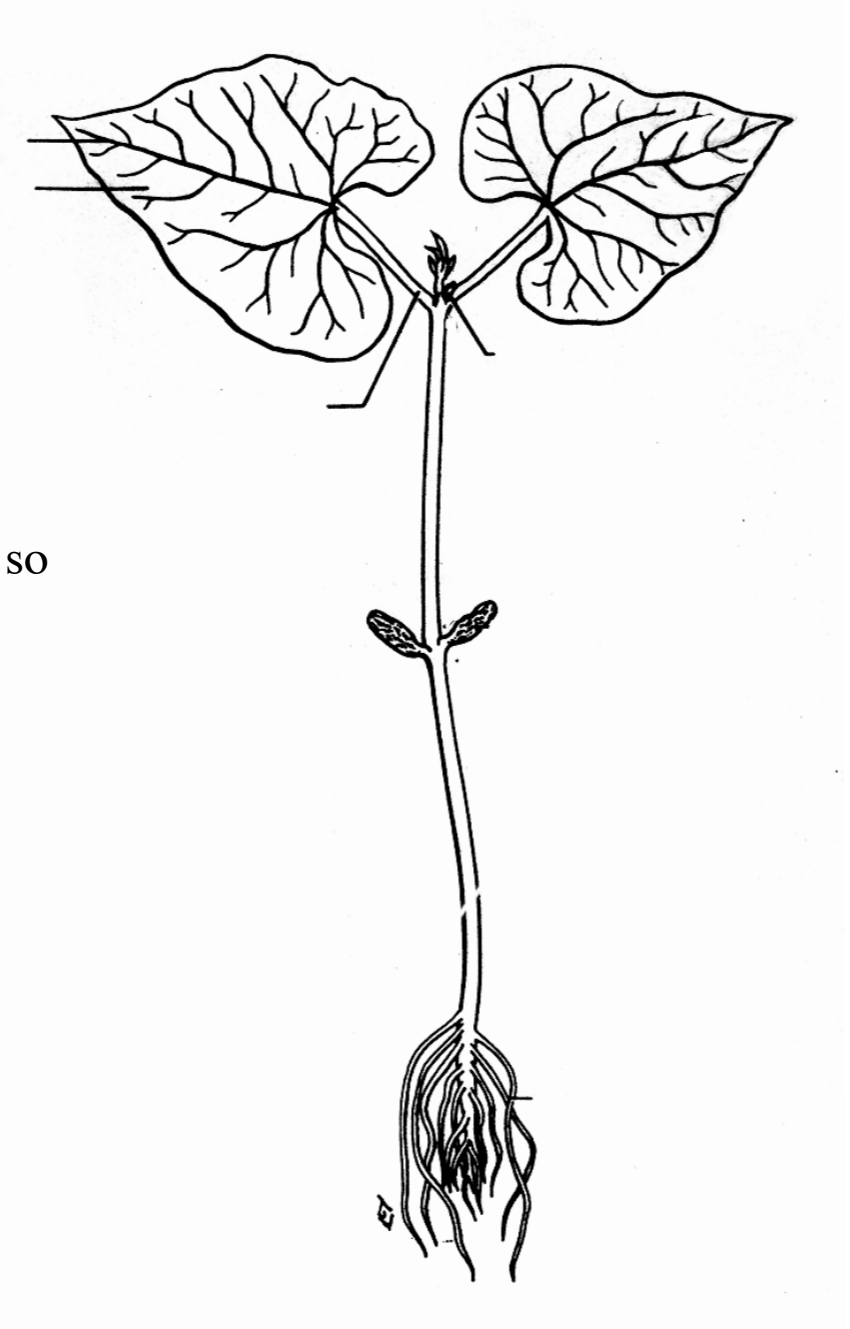


Vascular Tissue



In the shoot, axillary buds form
New branches.

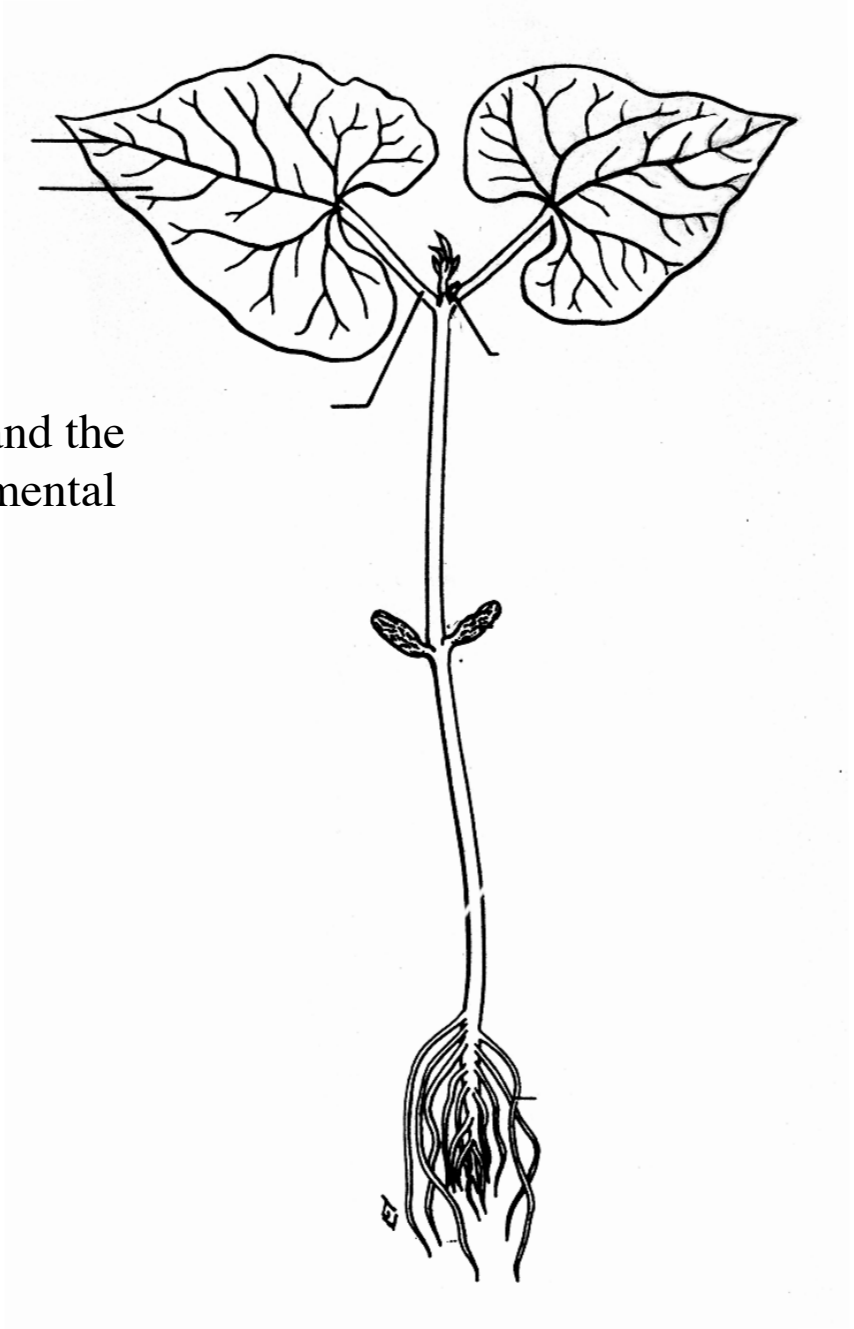
The root has no nodes and no axillary buds, so
how does branching originate in roots?



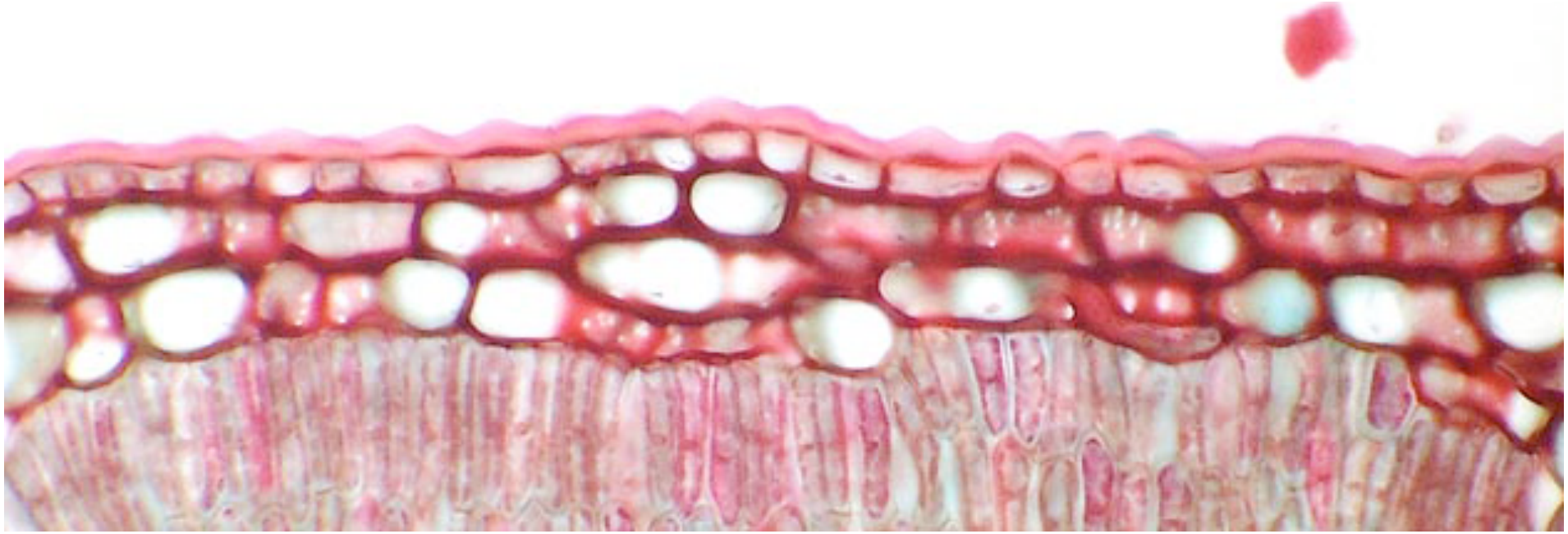
Branching occurs from within the root from a tissue layer called the pericycle.

Shoot System

The shoot system is composed of the stem and the leaf. These are subject to different environmental imperatives, and this is reflected in their anatomy.



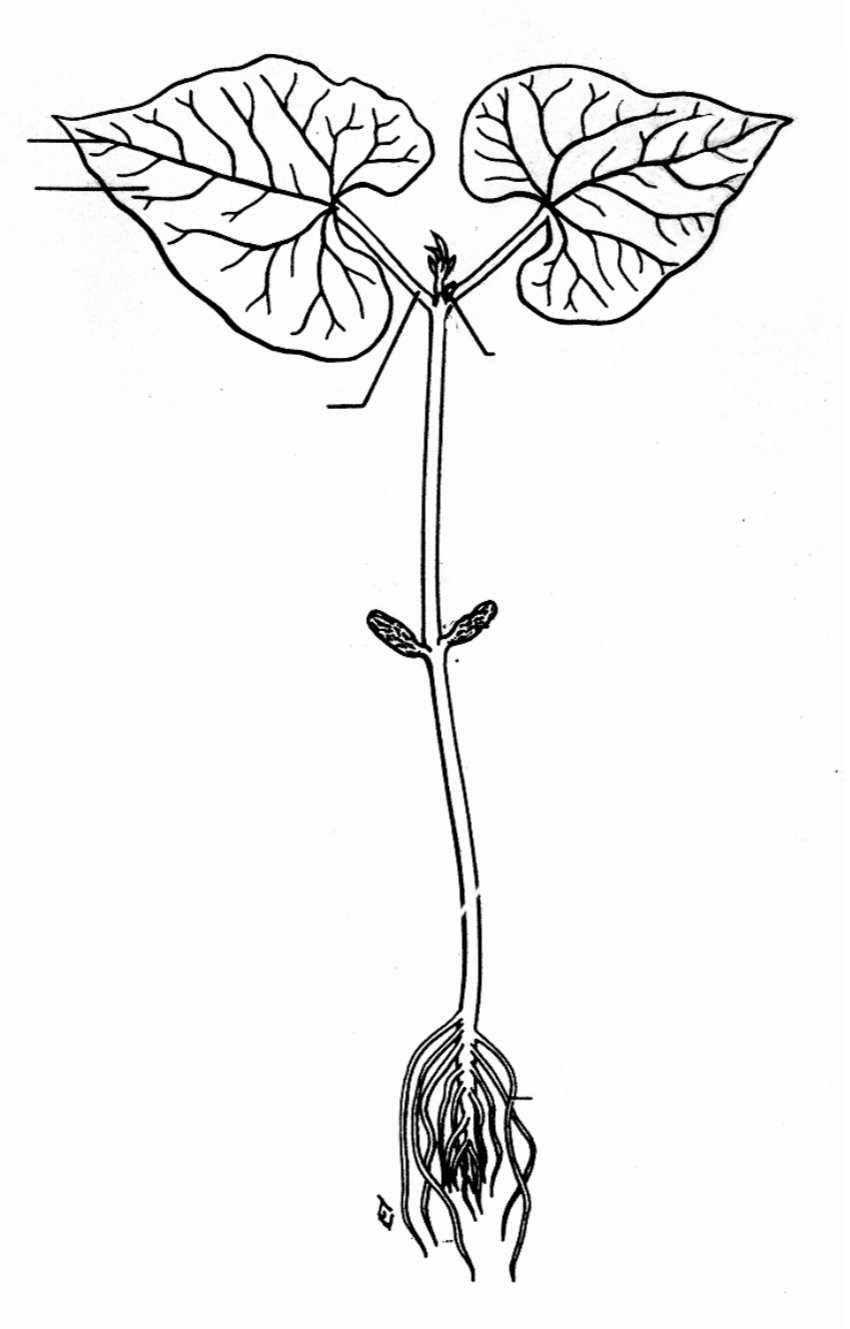
The epidermis of the shoot is associated with a cuticle …….

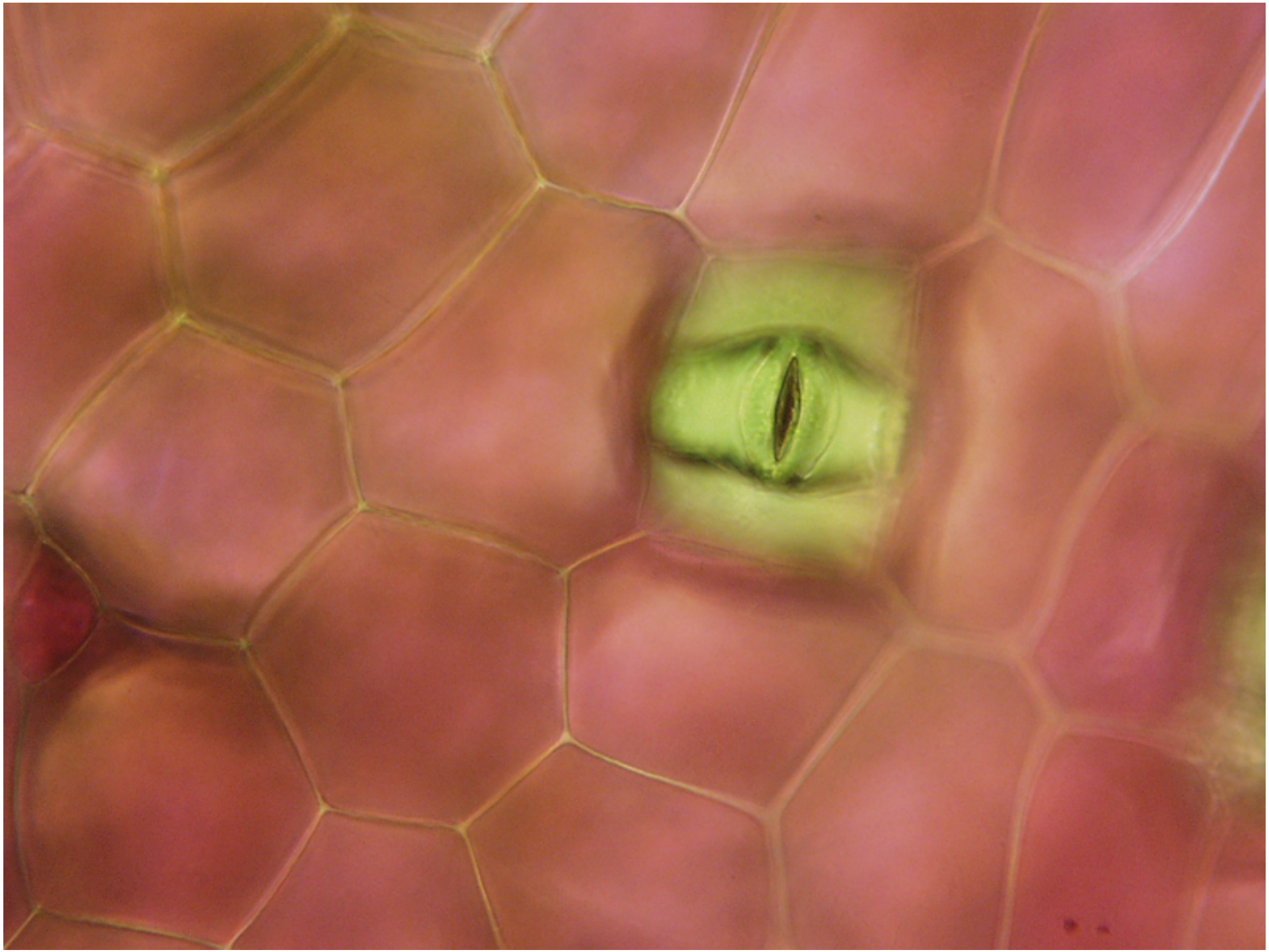


Shoot System

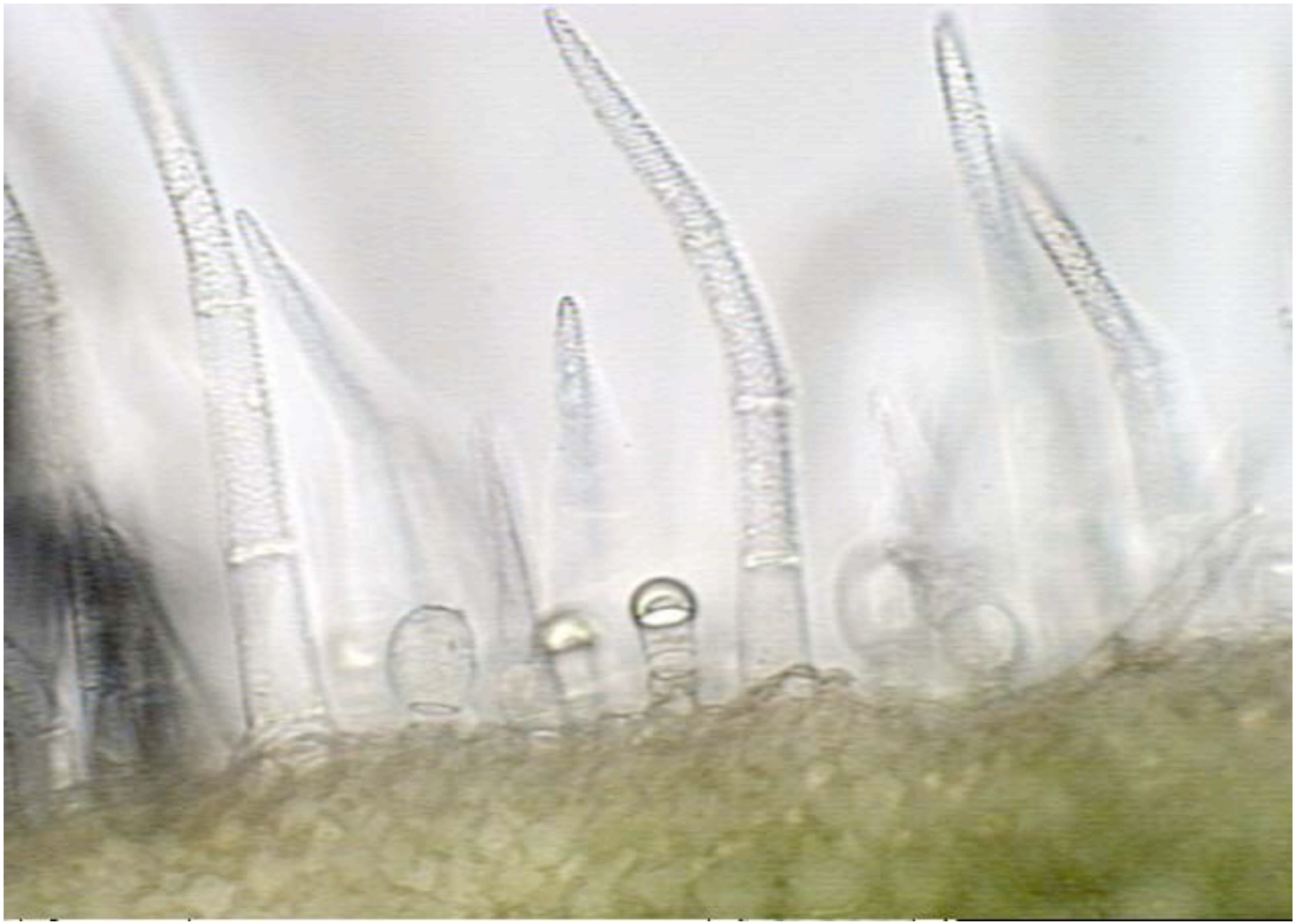
Epidermis is associated with a cuticle

and stomata

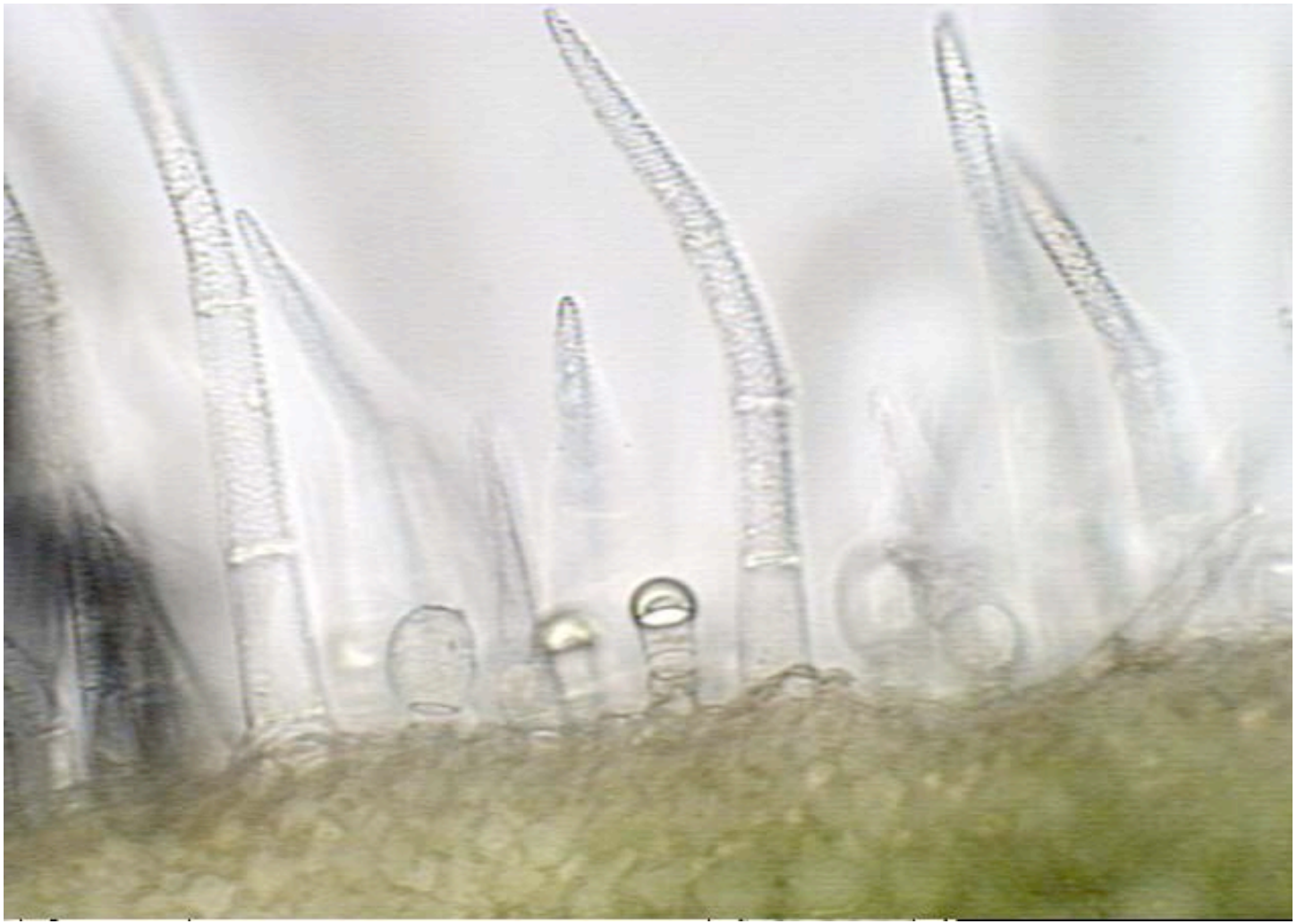




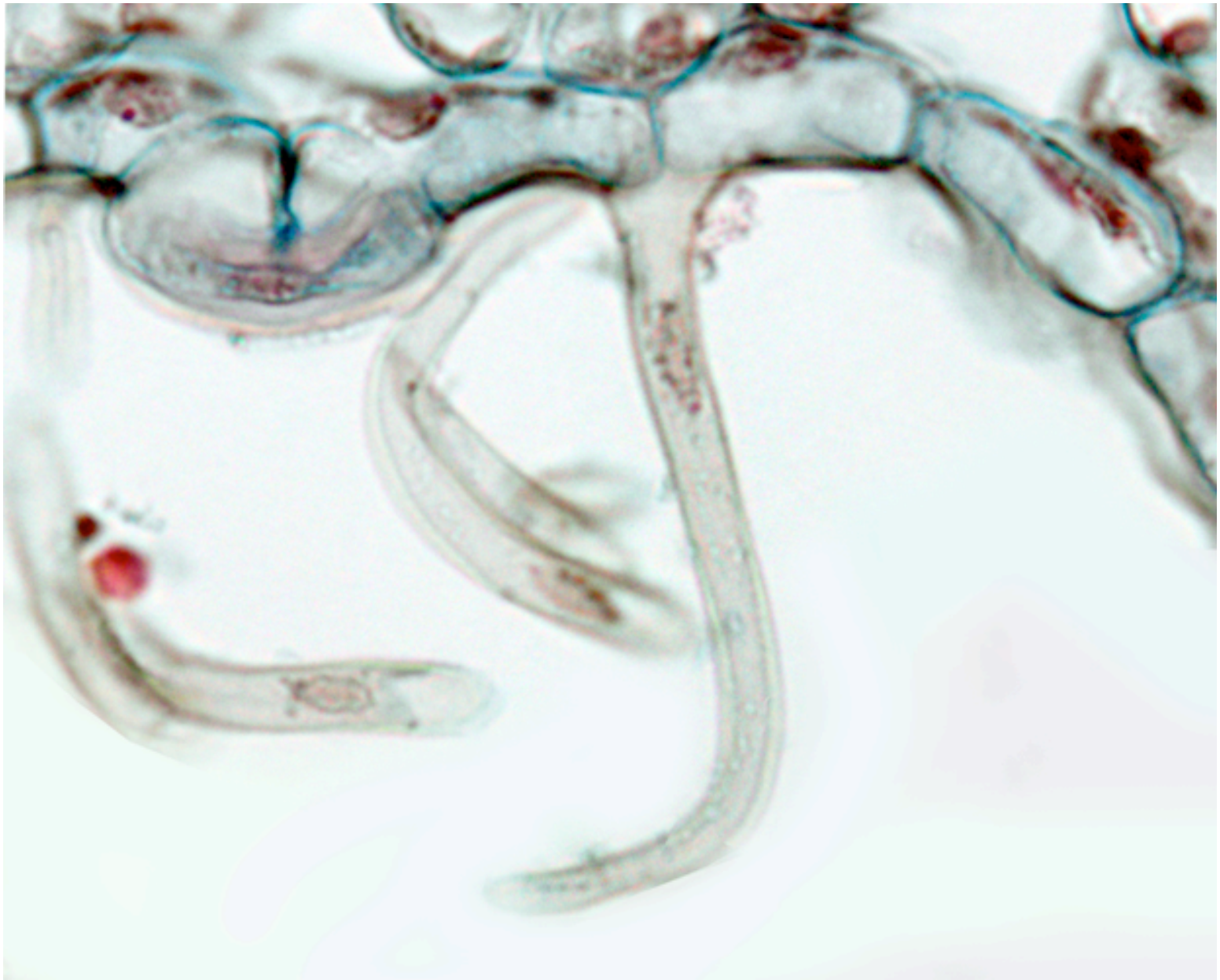
The Epidermis of the shoot is also associated with cellular structures attached to the basal epidermal cells called trichomes



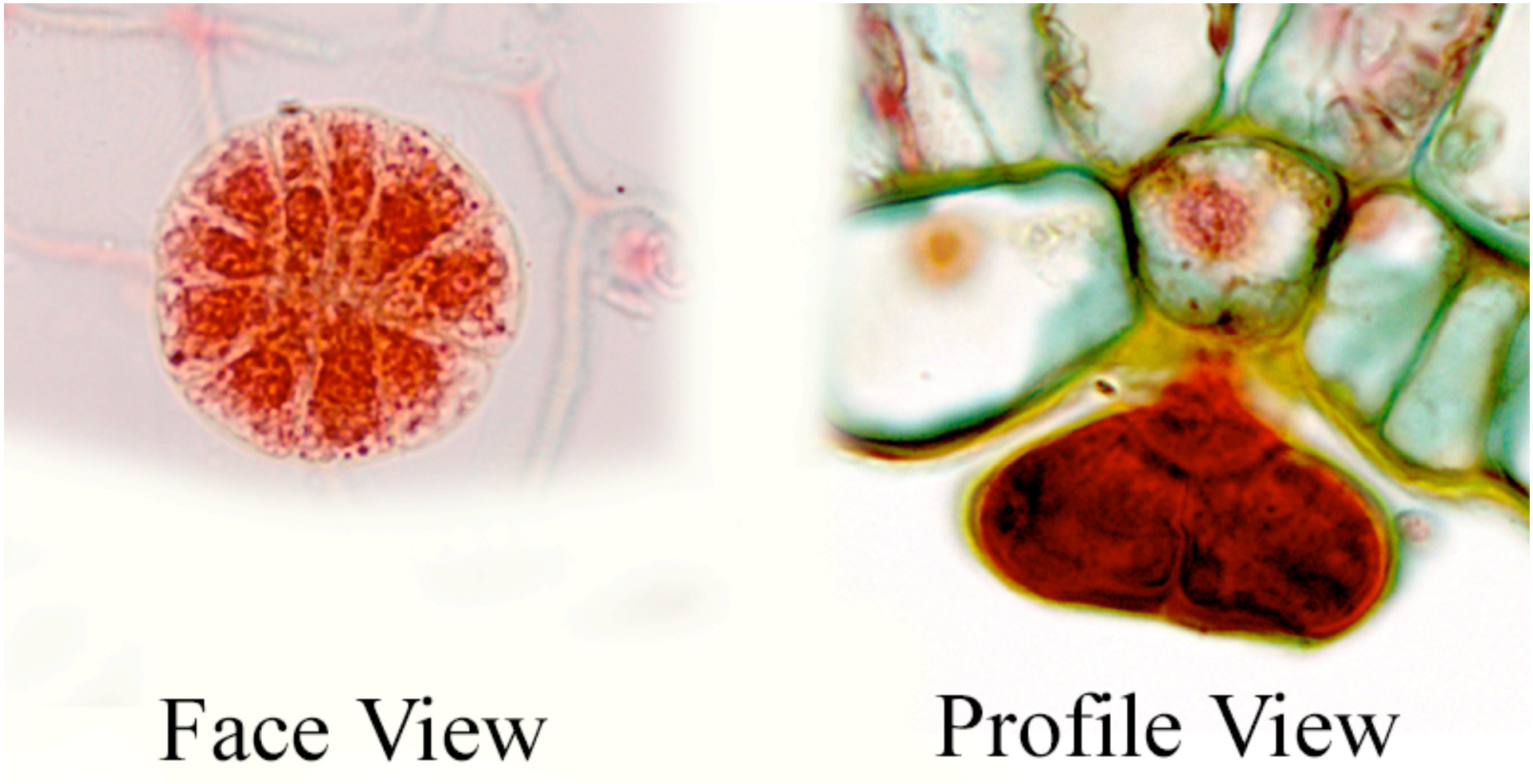
These trichomes of *Coleus* are multicellular and help defend the plant…..

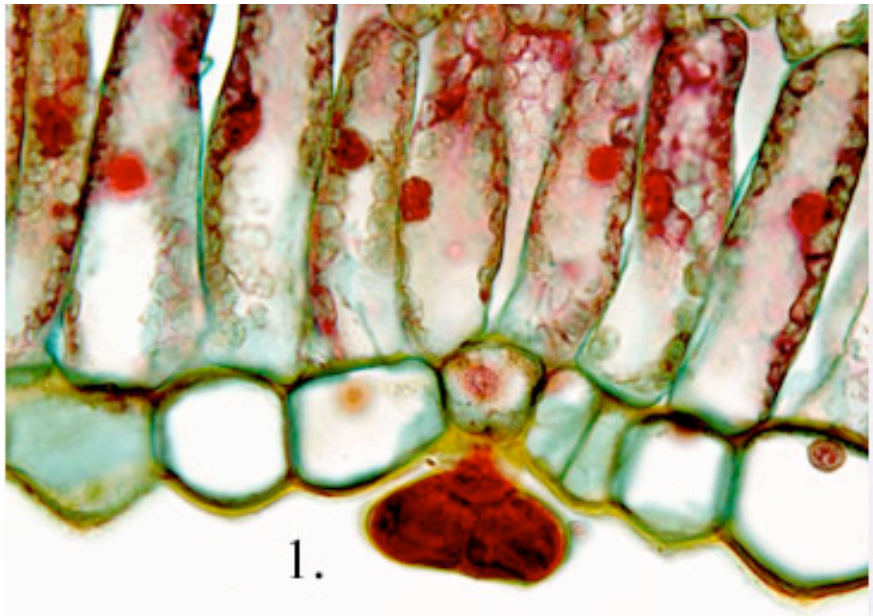


These trichomes of *Nerium* are unicellular and help retain water by generating a stagnant layer of air across the epidermis



These trichomes of *Syringa* are multicellular. They are peltate. These excrete substances to the surface such as volitile oils.





Trichomes

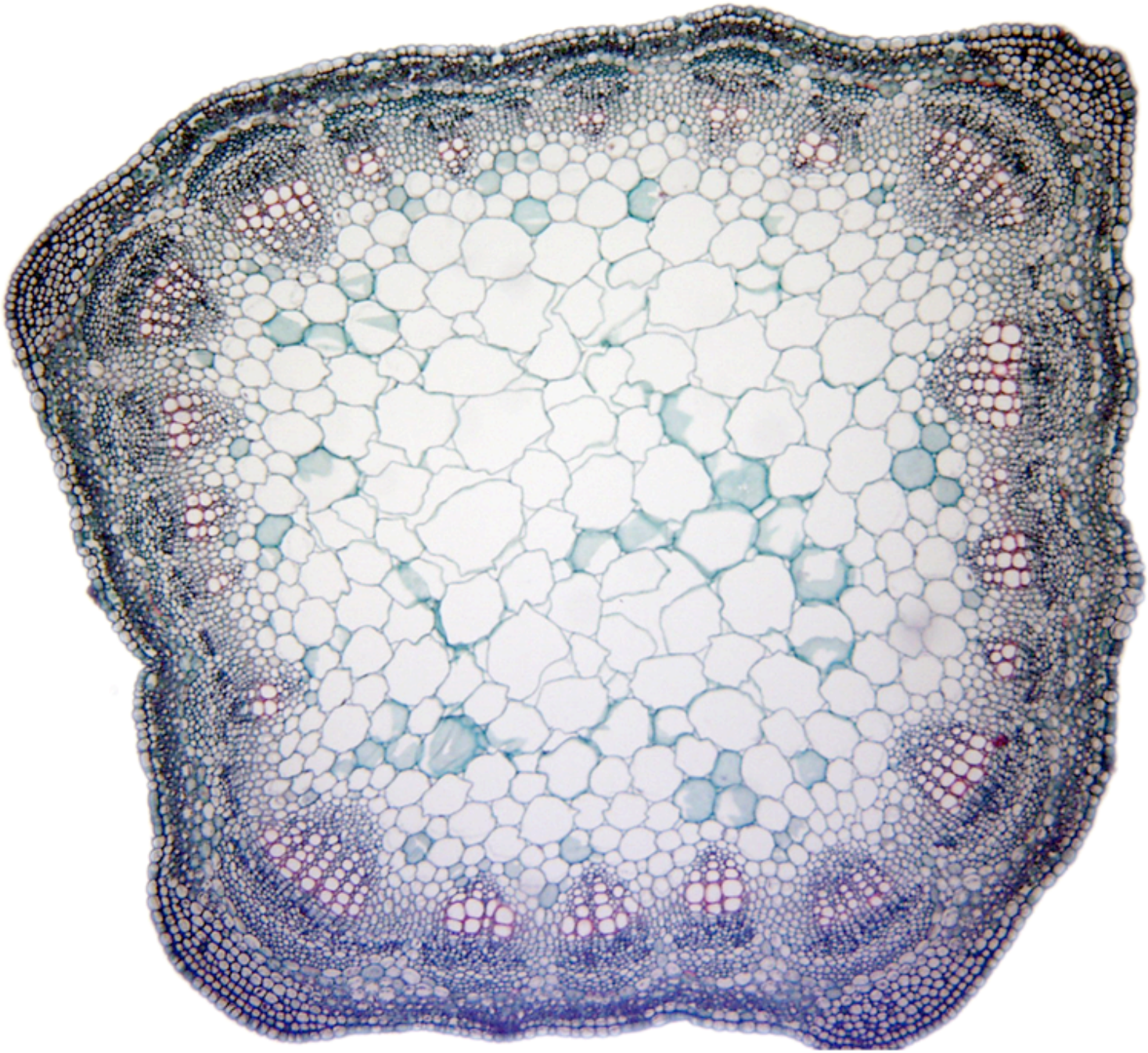
1. Peltate trichome of lilac.

2. Multicellular trichomes of *Coleus*

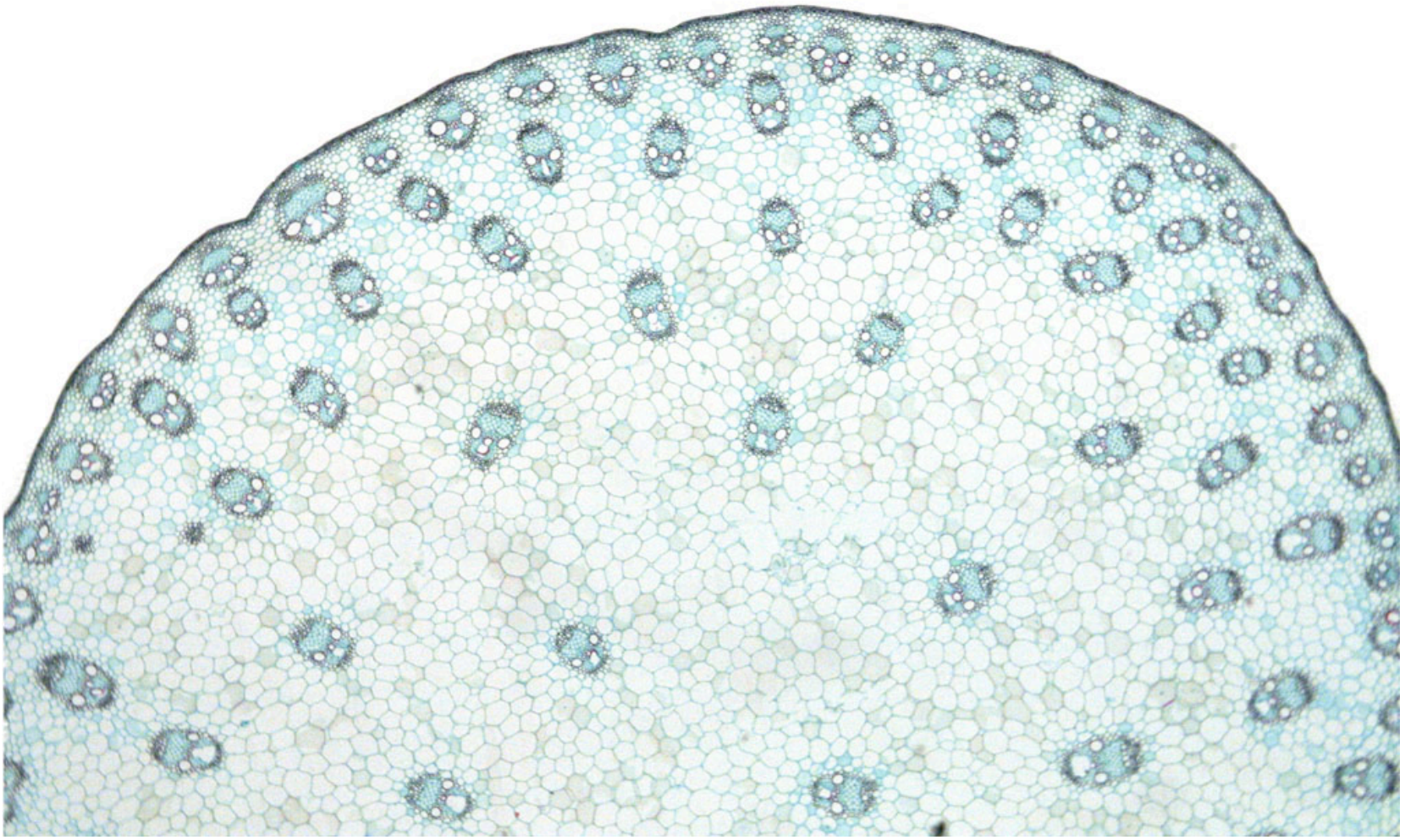
3. Unicellualr trichome of *Nerium*

Unlike in roots, the vascular tissue of the shoot is not restricted to one mass in the center.

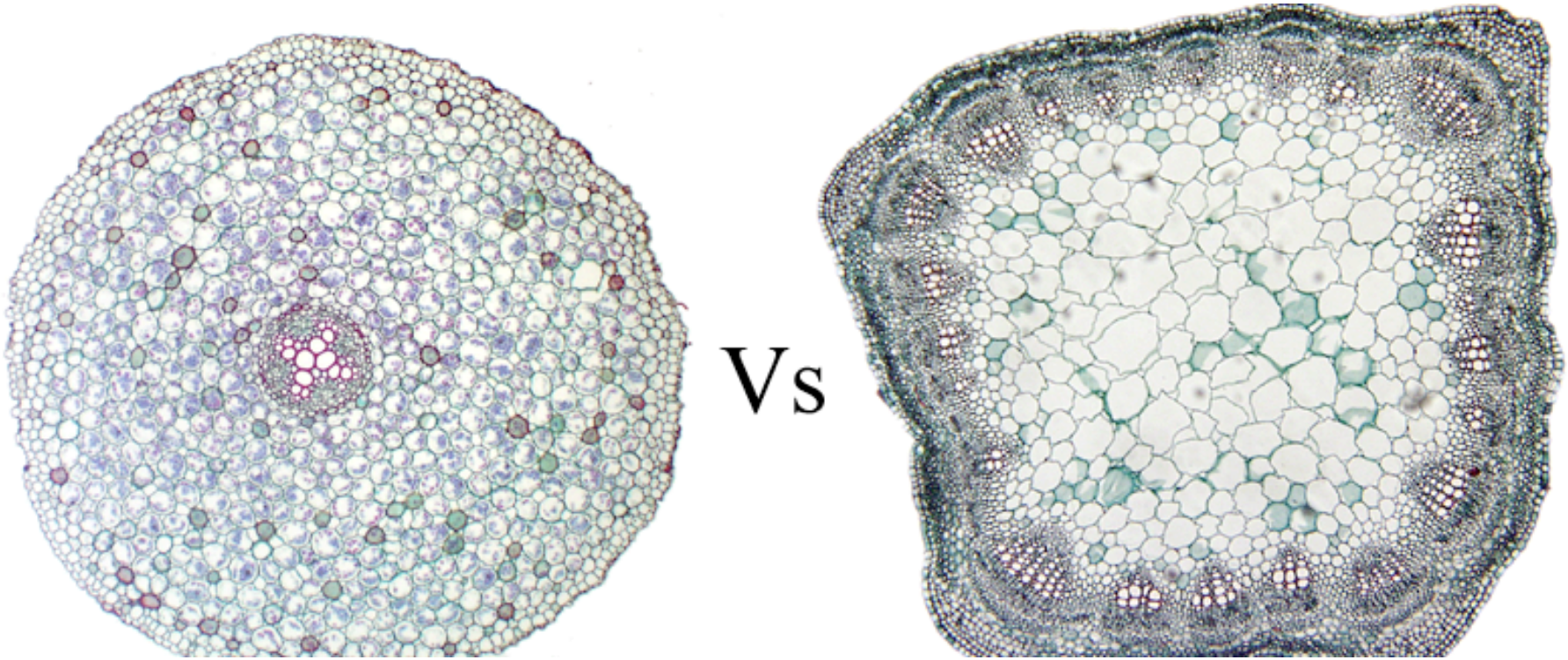
In dicot (= Eudicot) stems the vascular tissue is arranged in a ring of vascular bundles embedded in the ground tissue.



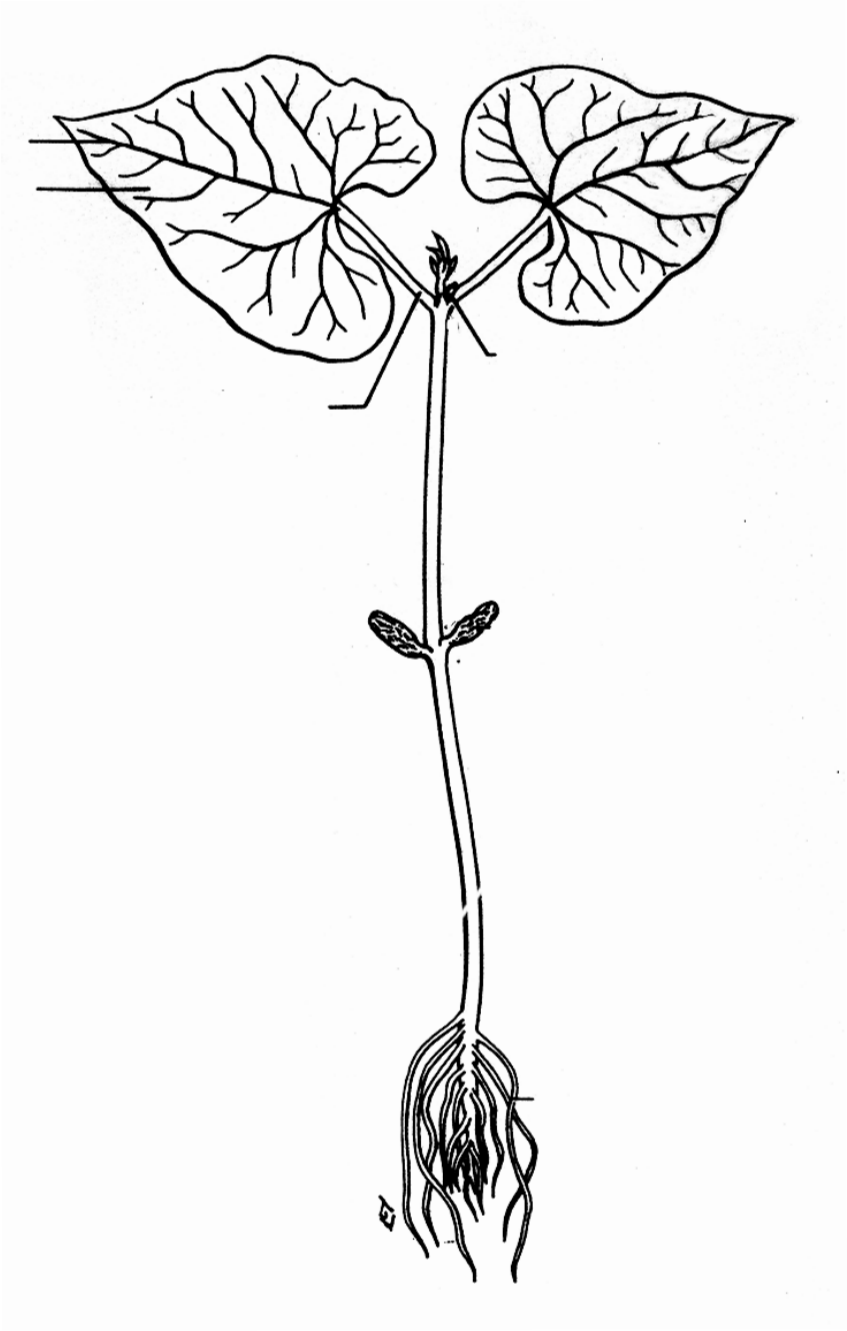
In monocot stems the vascular tissue is scattered throughout the ground tissue.



How does the internal organization of the vascular tissue between the root and stem reflect the different environmental stresses to which each is subject?



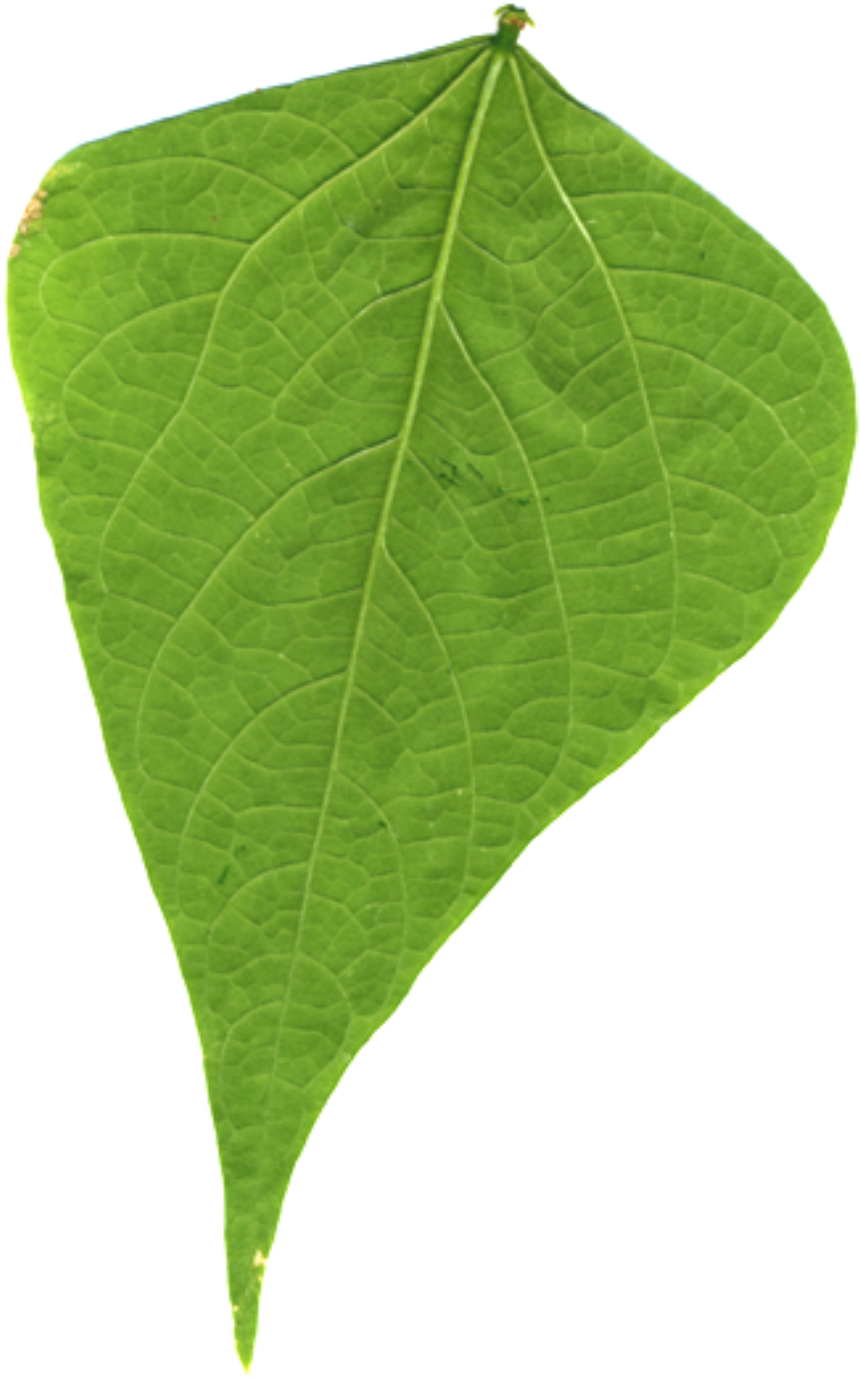
The basic function of the leaf is
Photosynthesis



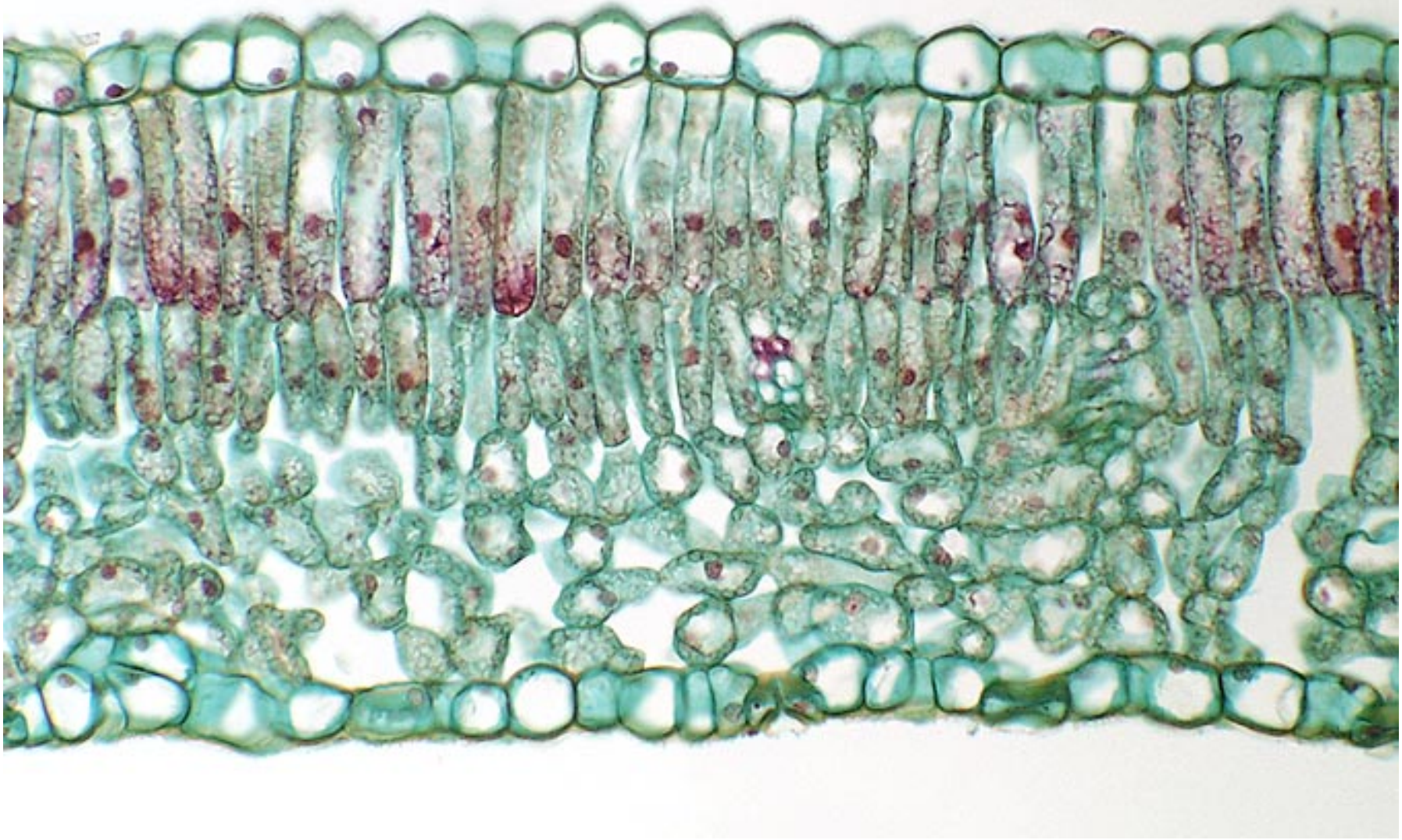
A thin flat structure optimizes the materials used to construct the leaf

No cell in the leaf is far from the outside this facilitates diffusion of gasses in and out of the leaf

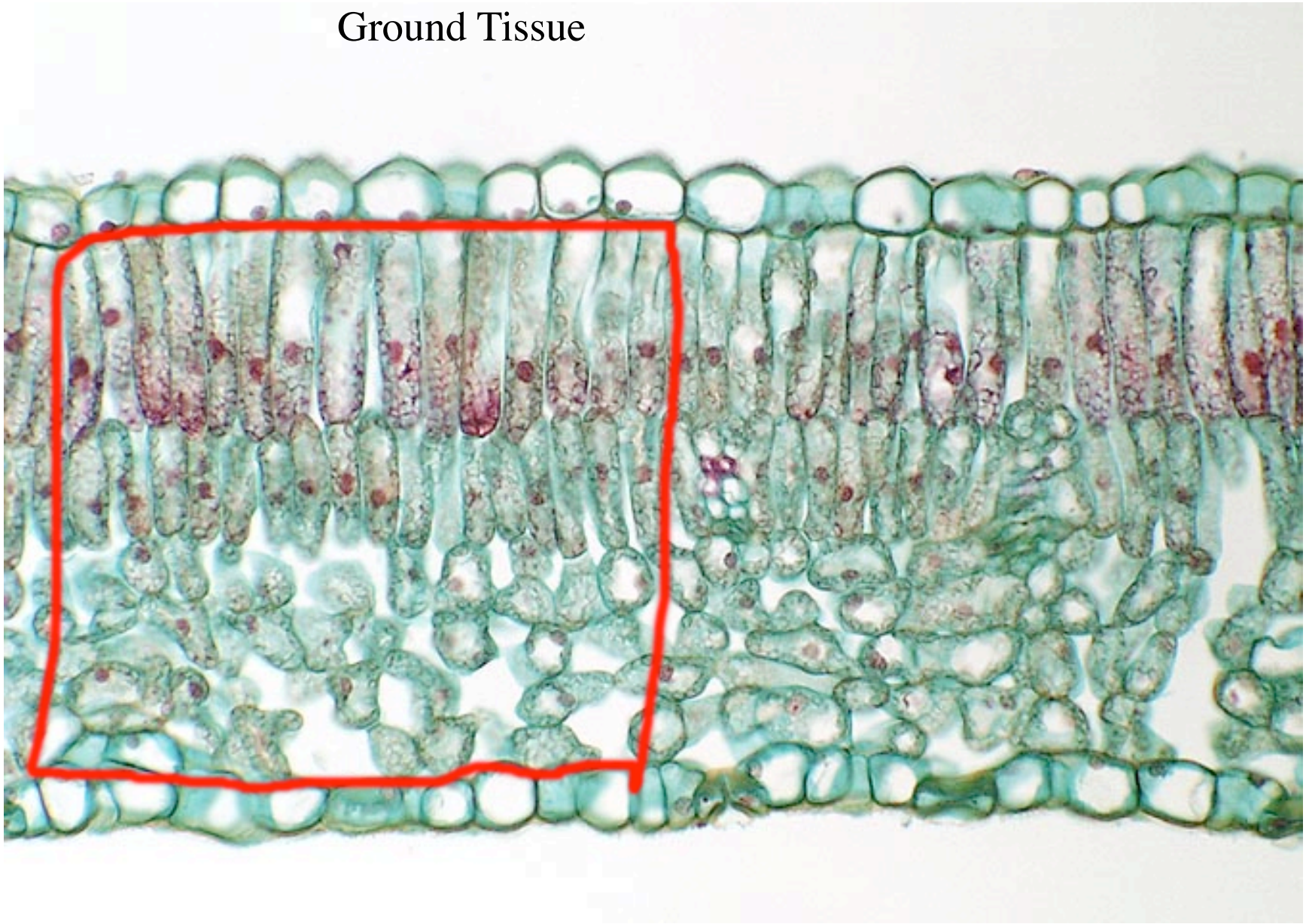
You get maximum surface area to Intercept light for the materials used.



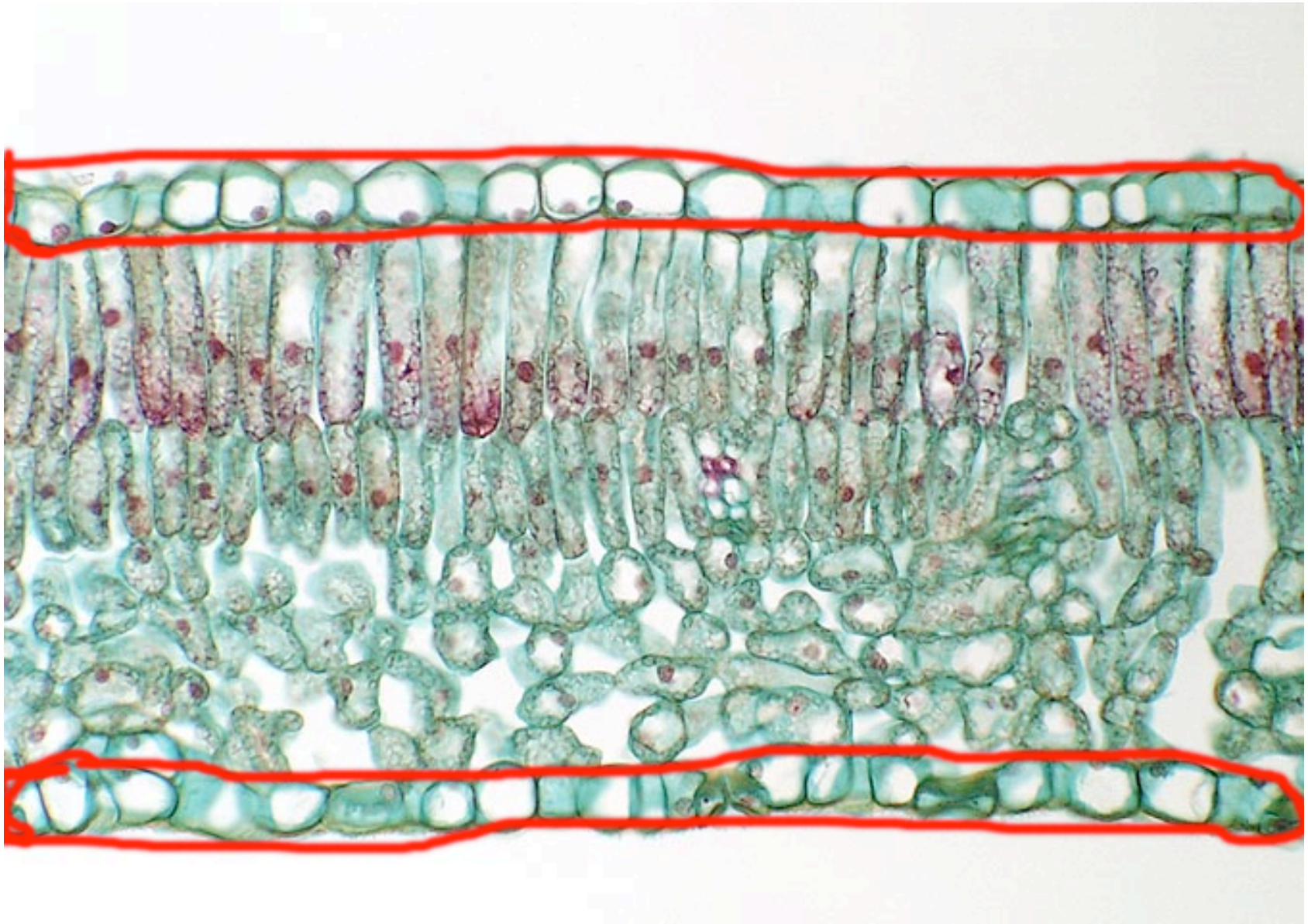
Cross section of lilac leaf



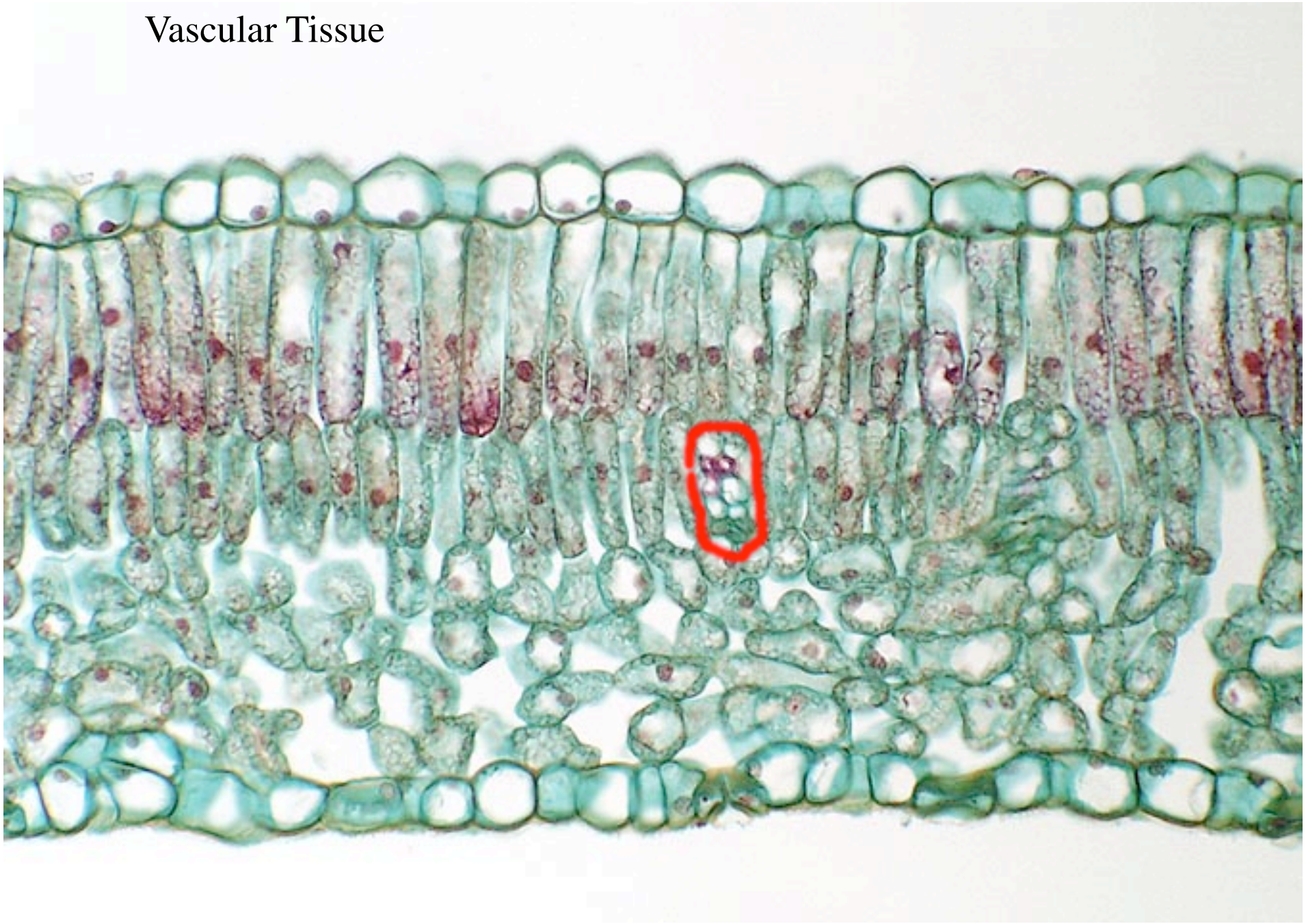
Ground Tissue

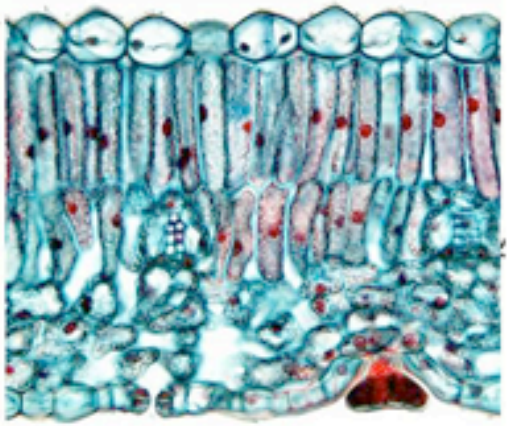


Dermal Tissue

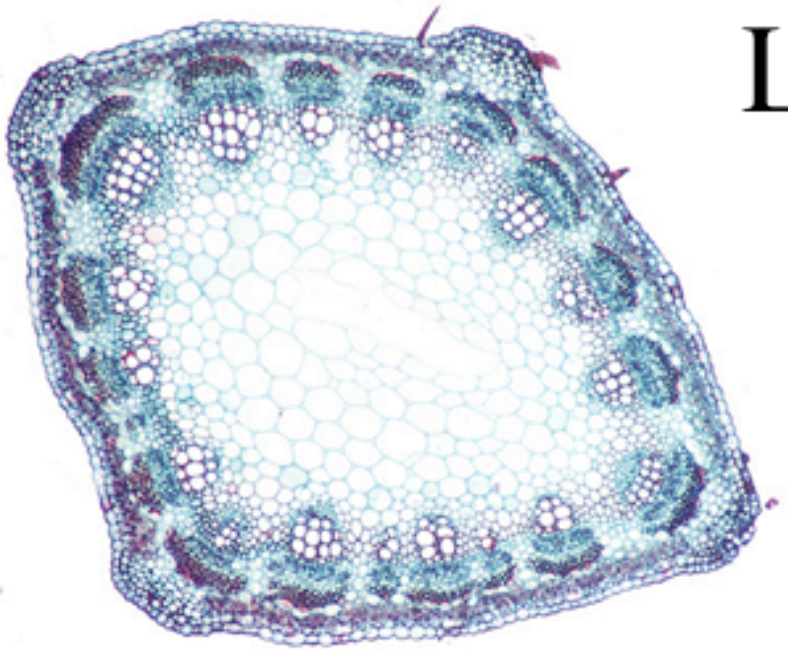


Vascular Tissue

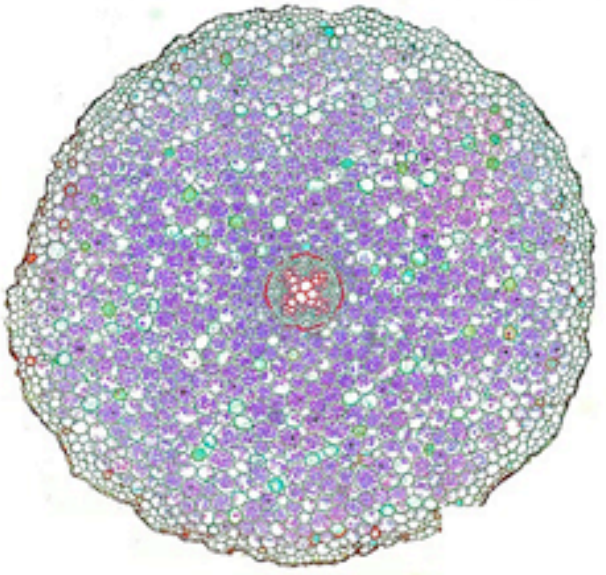




Leaf

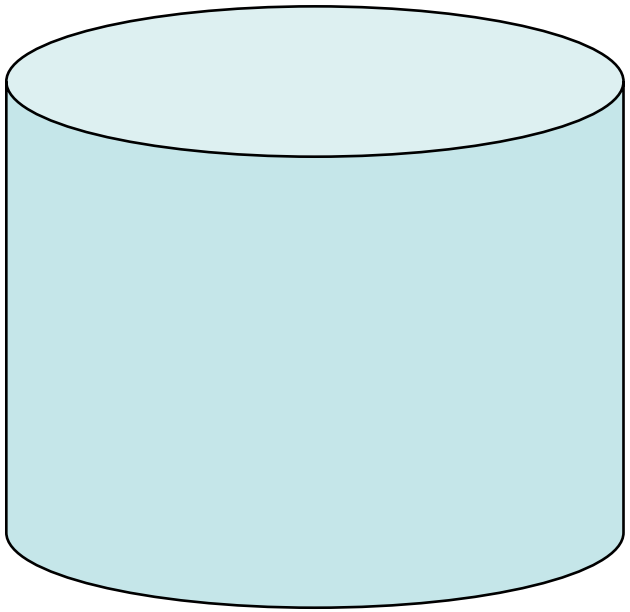


Stem

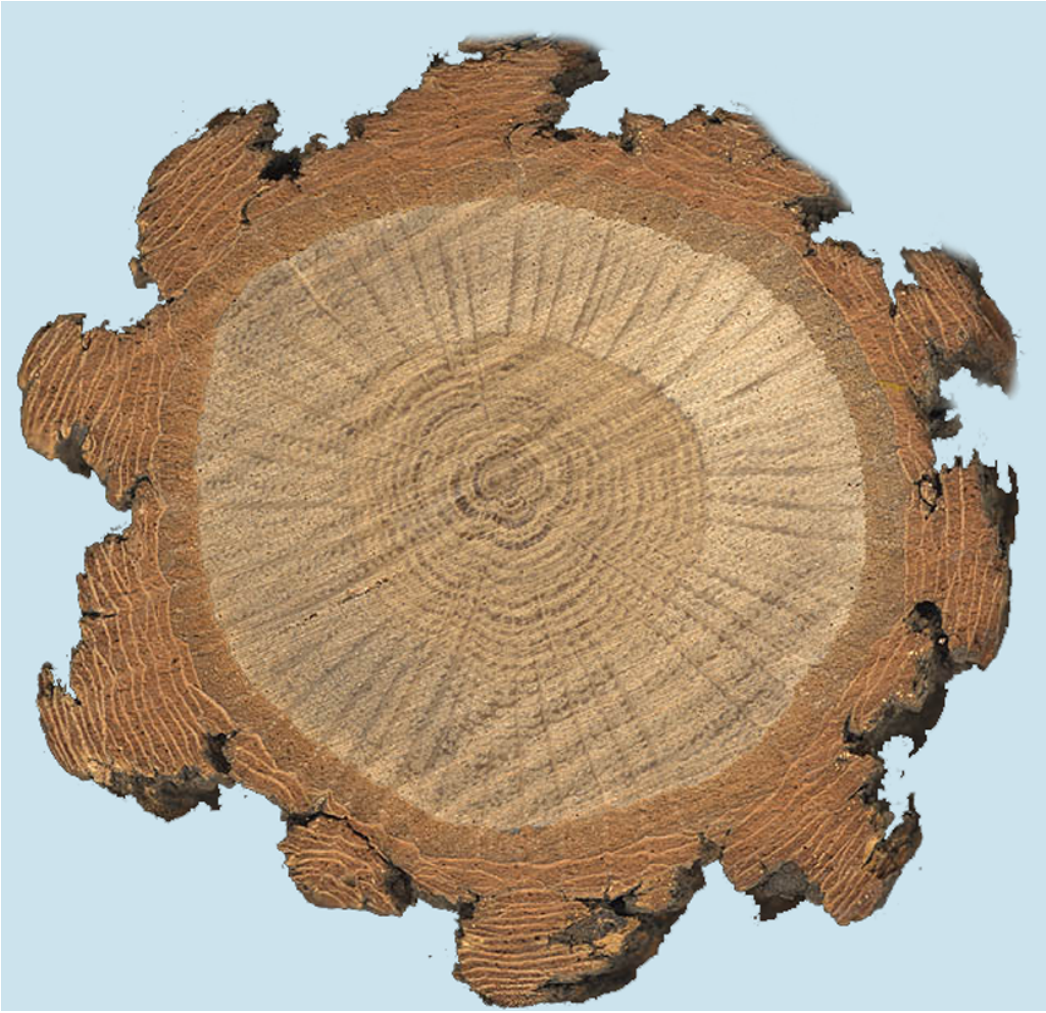


Root

Secondary Tissues are Derived from Lateral Meristems Called Cambia

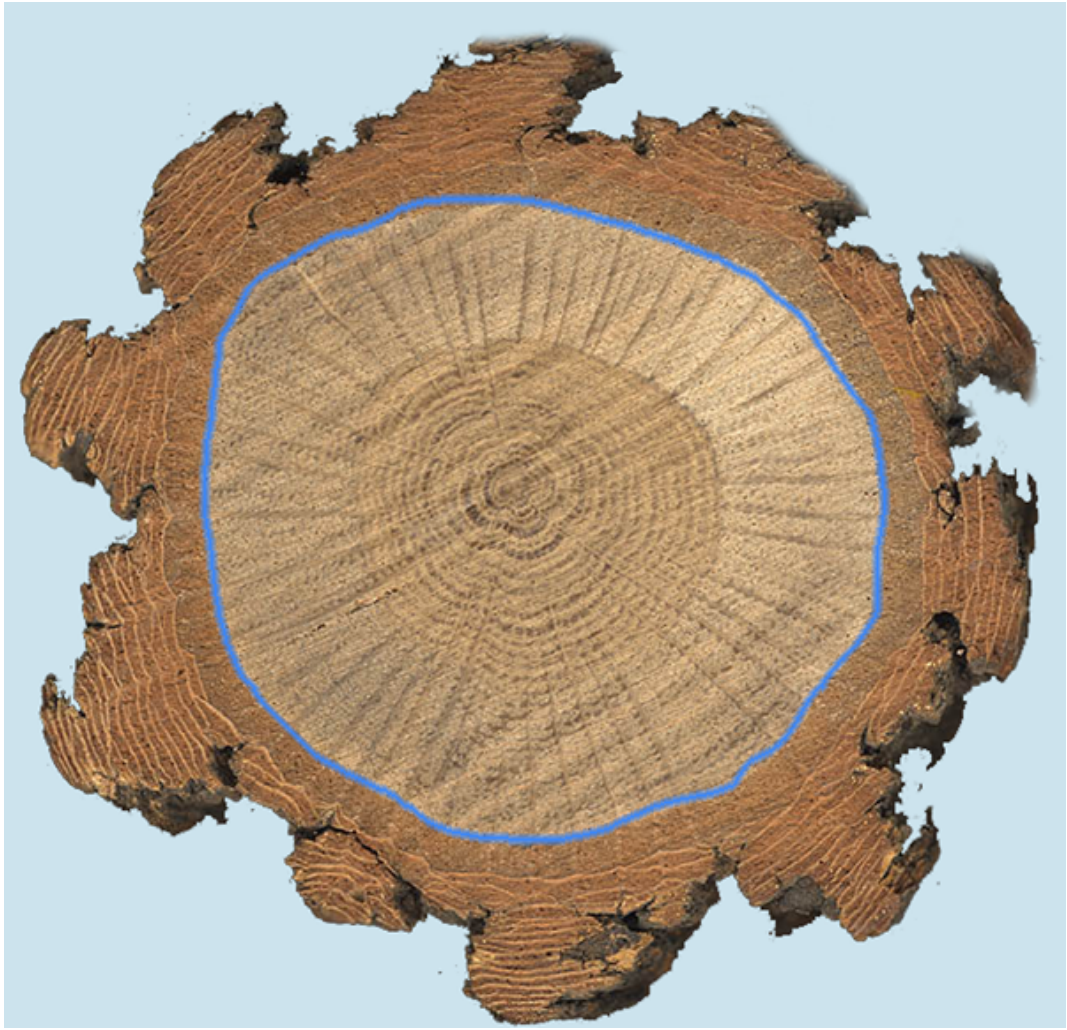


Except for the pith and some primary xylem bordering the pith, this is all secondary tissue

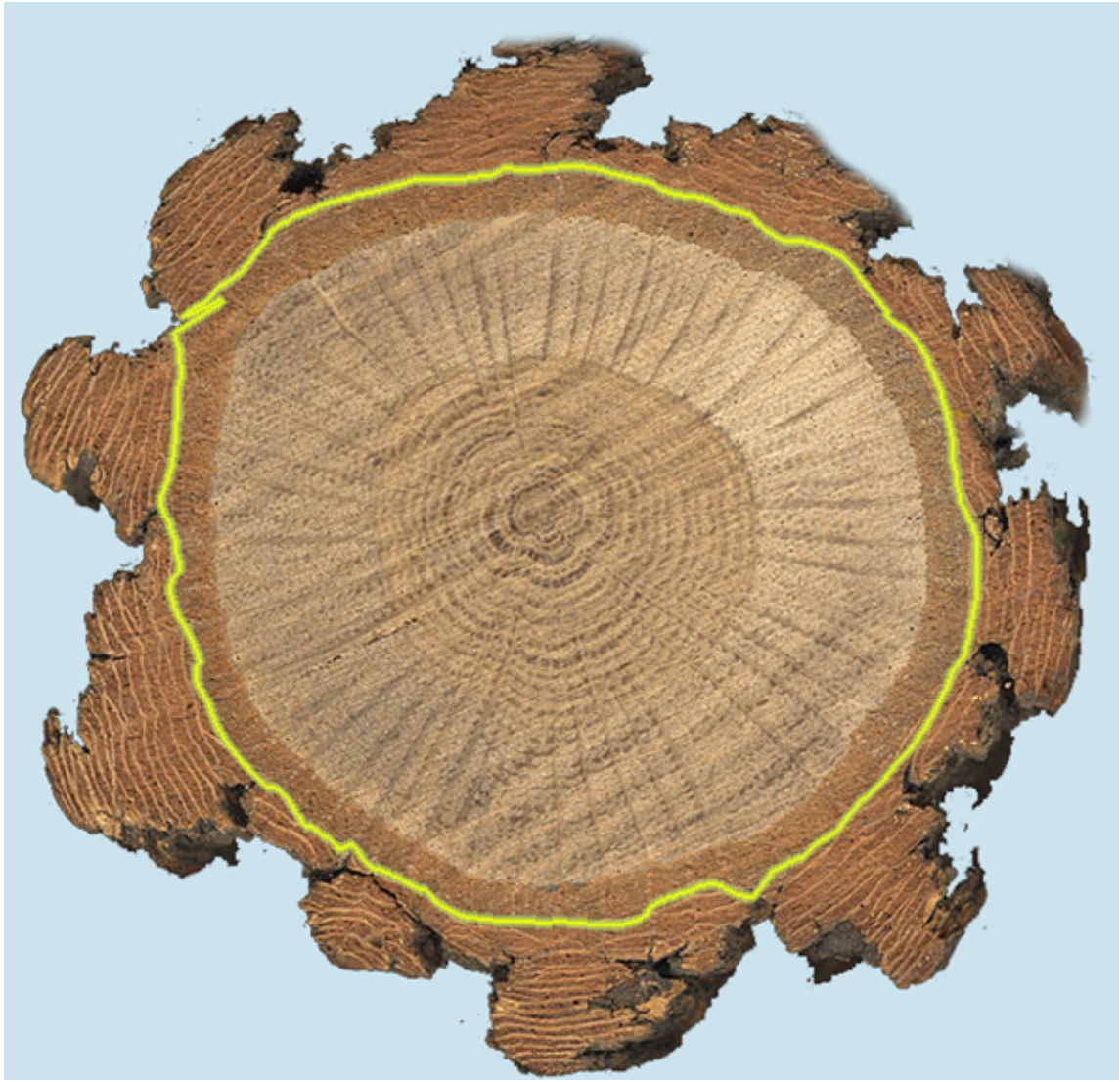


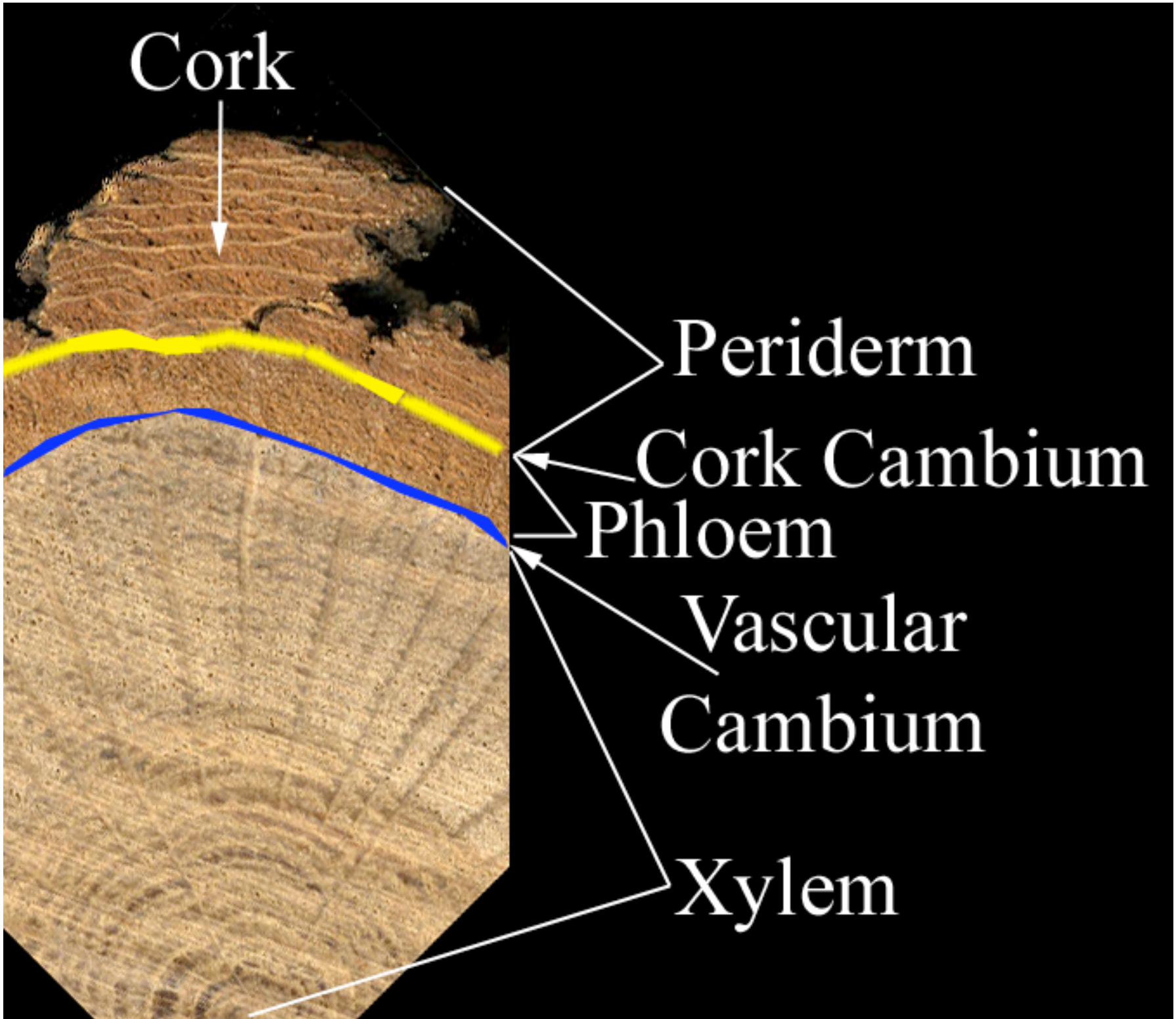
Secondary growth produces vascular tissue and dermal tissue, but not ground tissue.

The Vascular Cambium Produces Xylem to the Inside and Phloem to the Outside

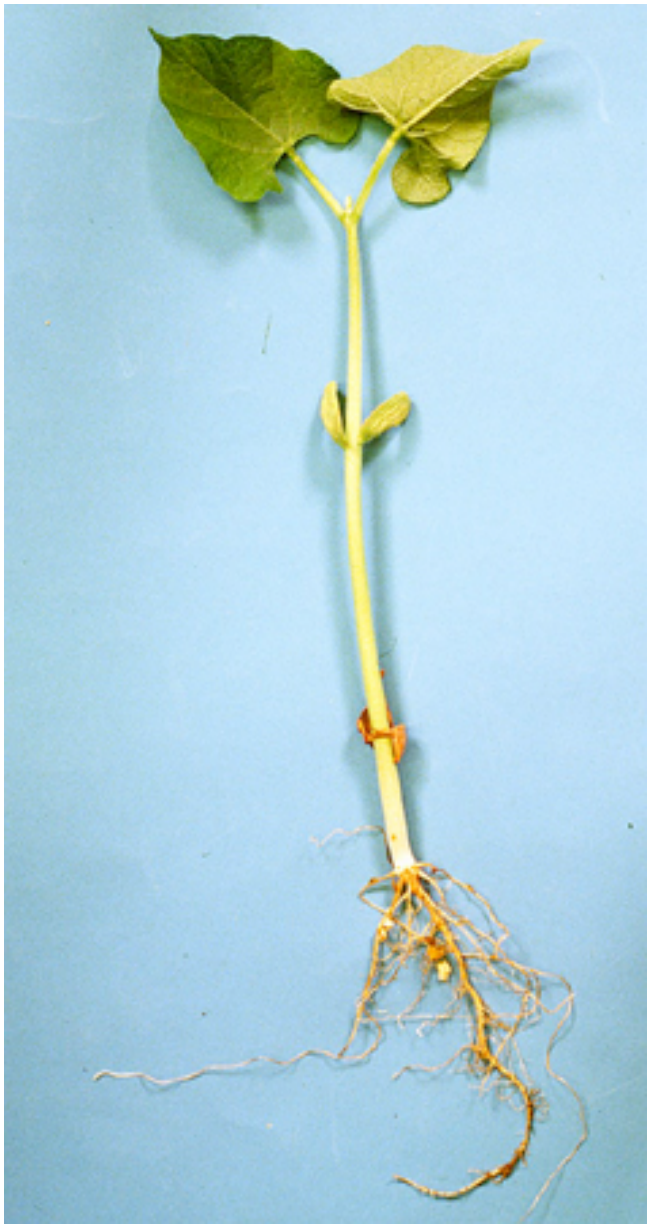


The Cork Cambium Produces Dermal Tissue (cork) to the Outside

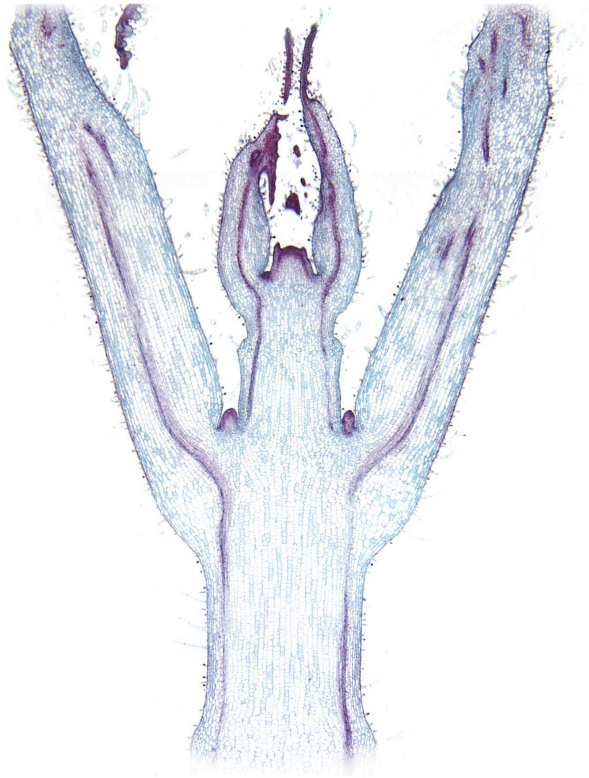



Cork
Periderm
Cork Cambium
Phloem
Vascular
Cambium
Xylem

Science of Plant Structure



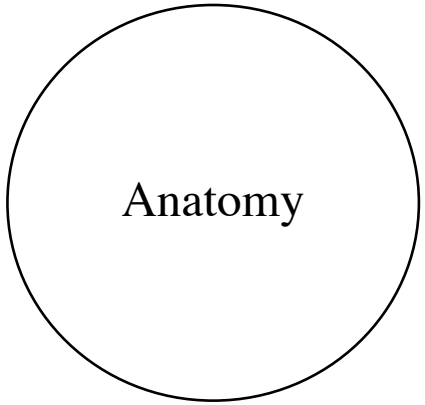
Plant Morphology deals with the external structure of plants



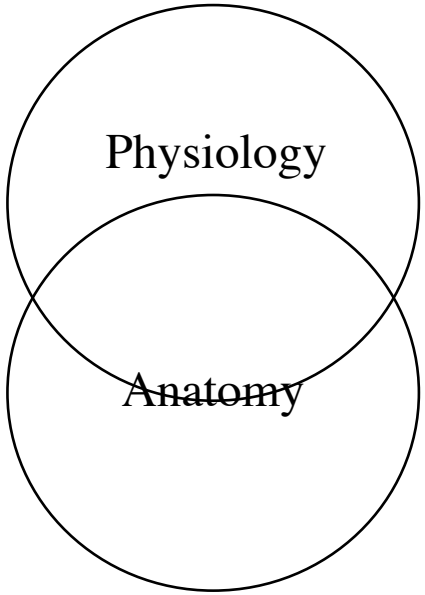
Plant anatomy deals with the internal structure of plants

Plant anatomy is embedded into the fabric of the discipline of botany

Anatomy is the study of how cells and tissues are organized in plants.



Plant Physiology is the study of the processes and functions associated with life.



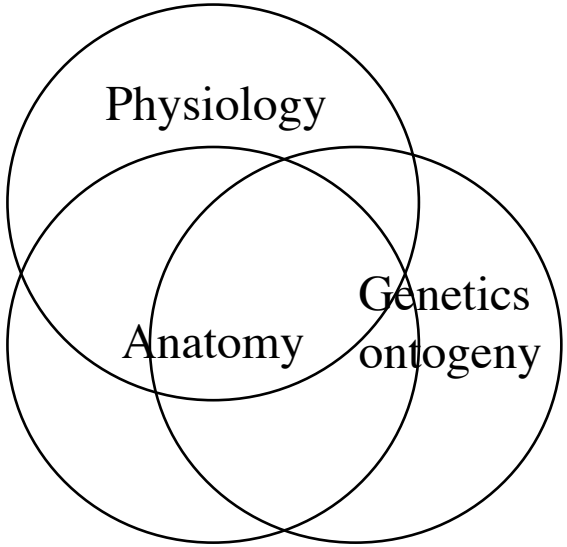
How form relates to function.

Genetics/Ontogeny

How genetic information is expressed in plant structure.

How the expression of genetic information is timed to generate a coherent organism.

How the expression of genetic information is influenced by the environment.

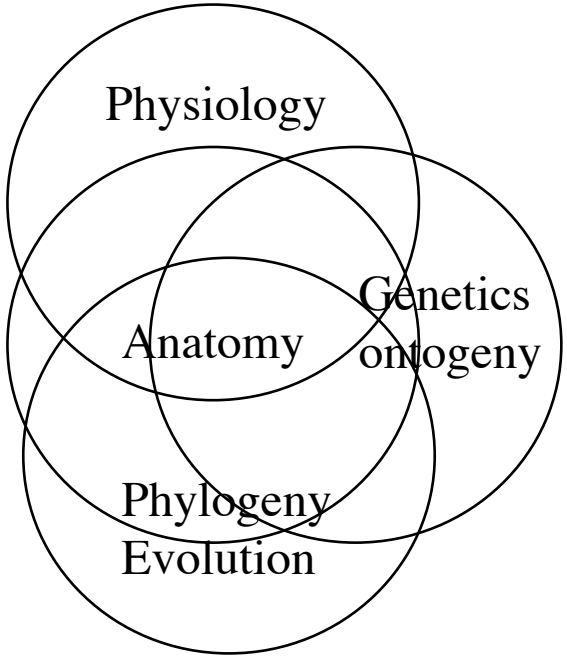


Phylogeny/Evolution

What structures are analogous?

What structures are homologous?

What does this tell us about the tree of life?



Ecology

How does structure/function relate to where a plant lives, and what a plant does in ecosystems?