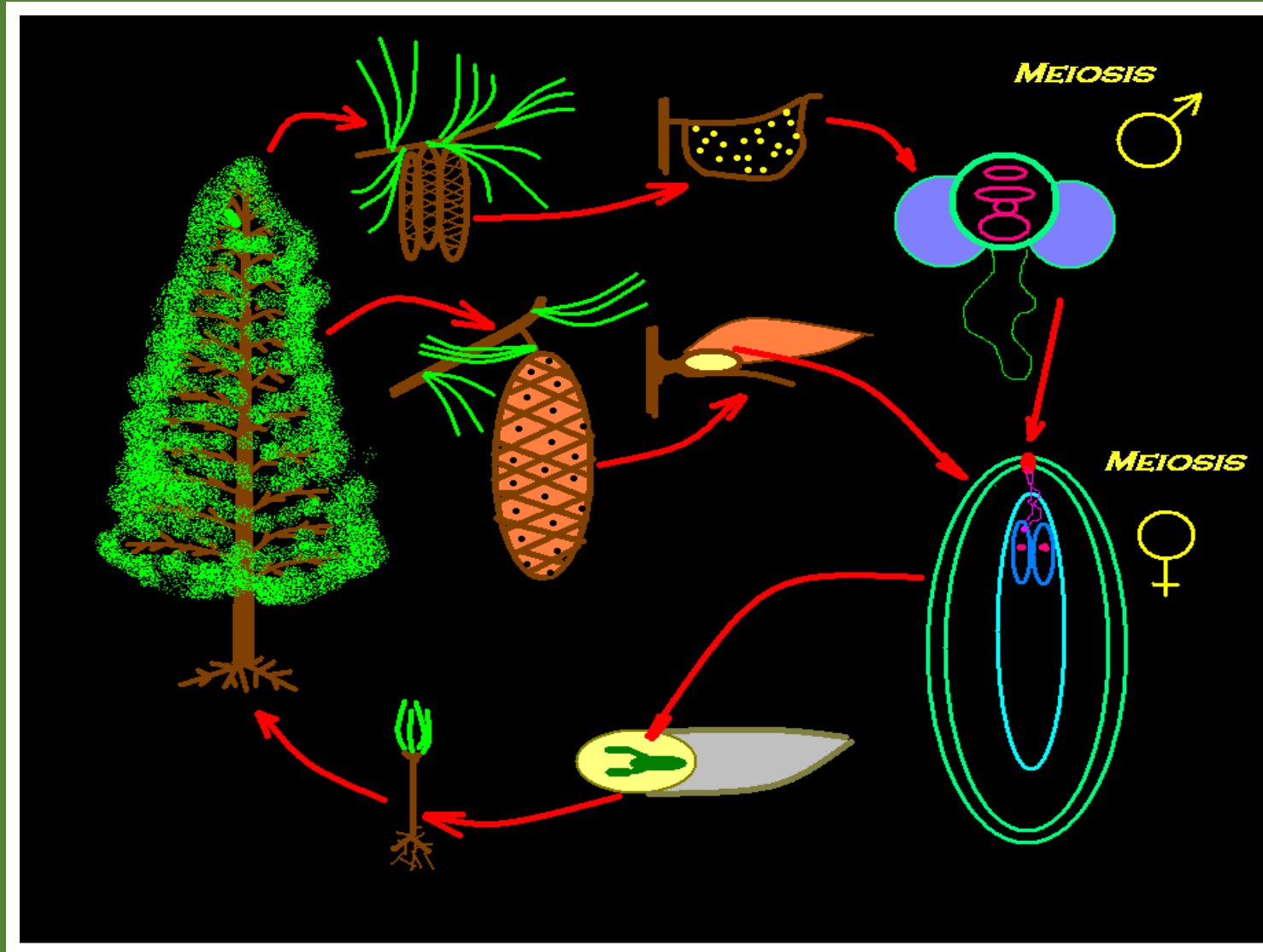


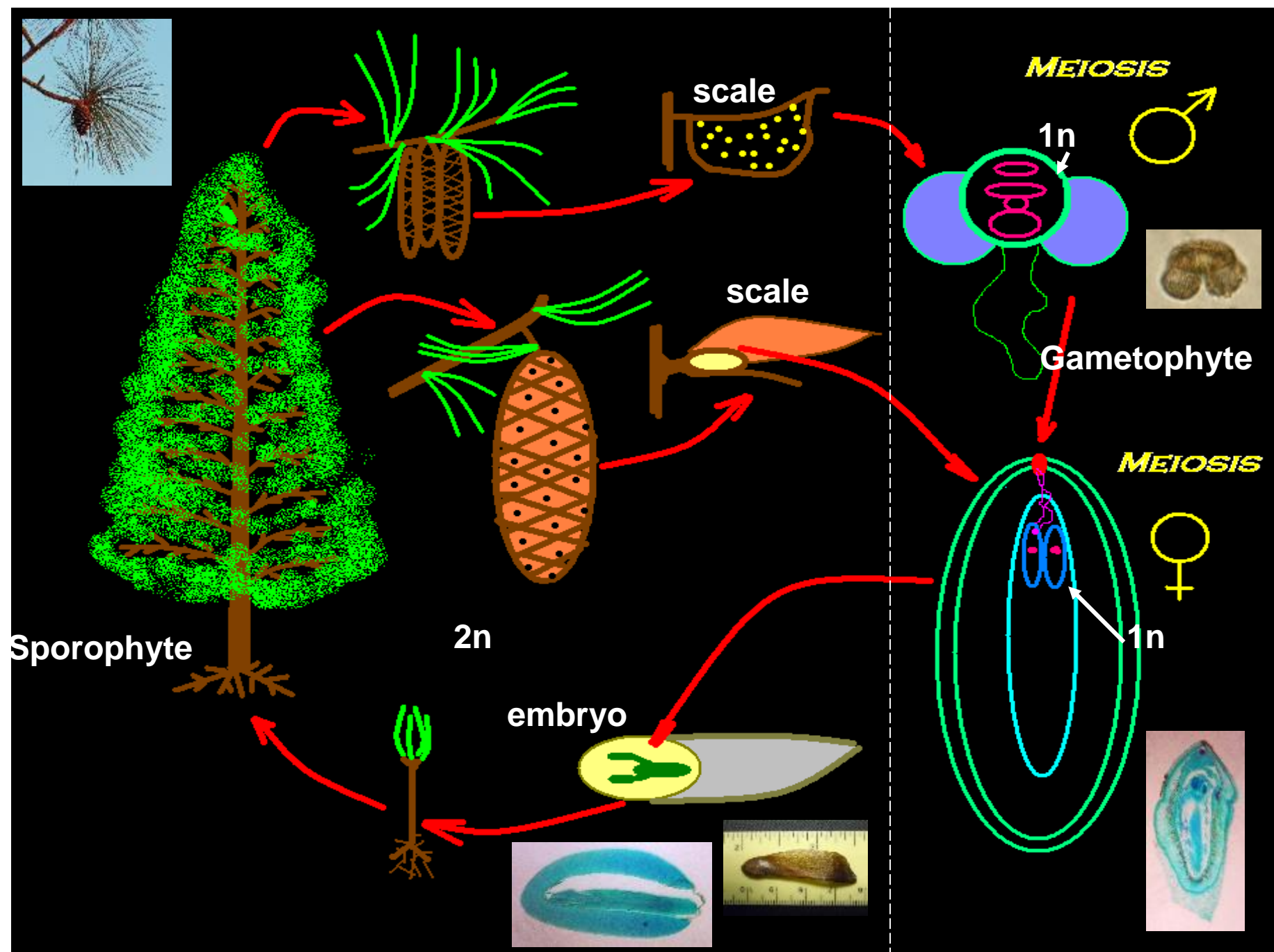
Conifers & some other Gymnosperms



Gymnosperm:
Conifer

Pine Reproduction & Life Cycle







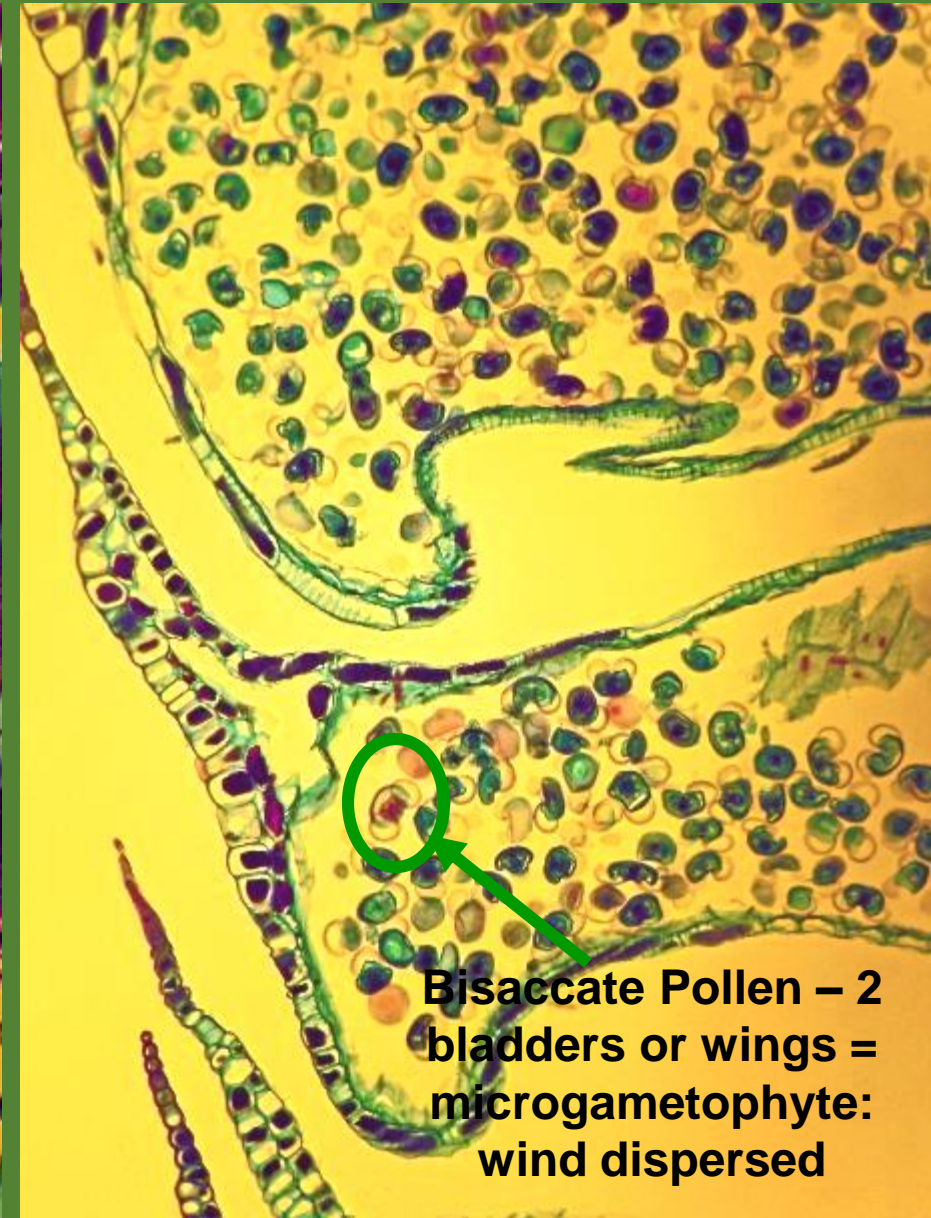
Male (microgametophyte strobili) cones release Pollen

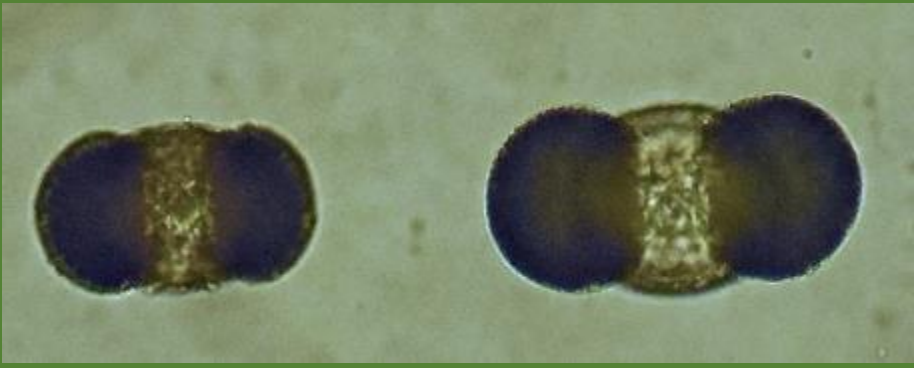


Center
column
of cone

Male Cone with microgametophytes
developing in a sac at base of each
scale

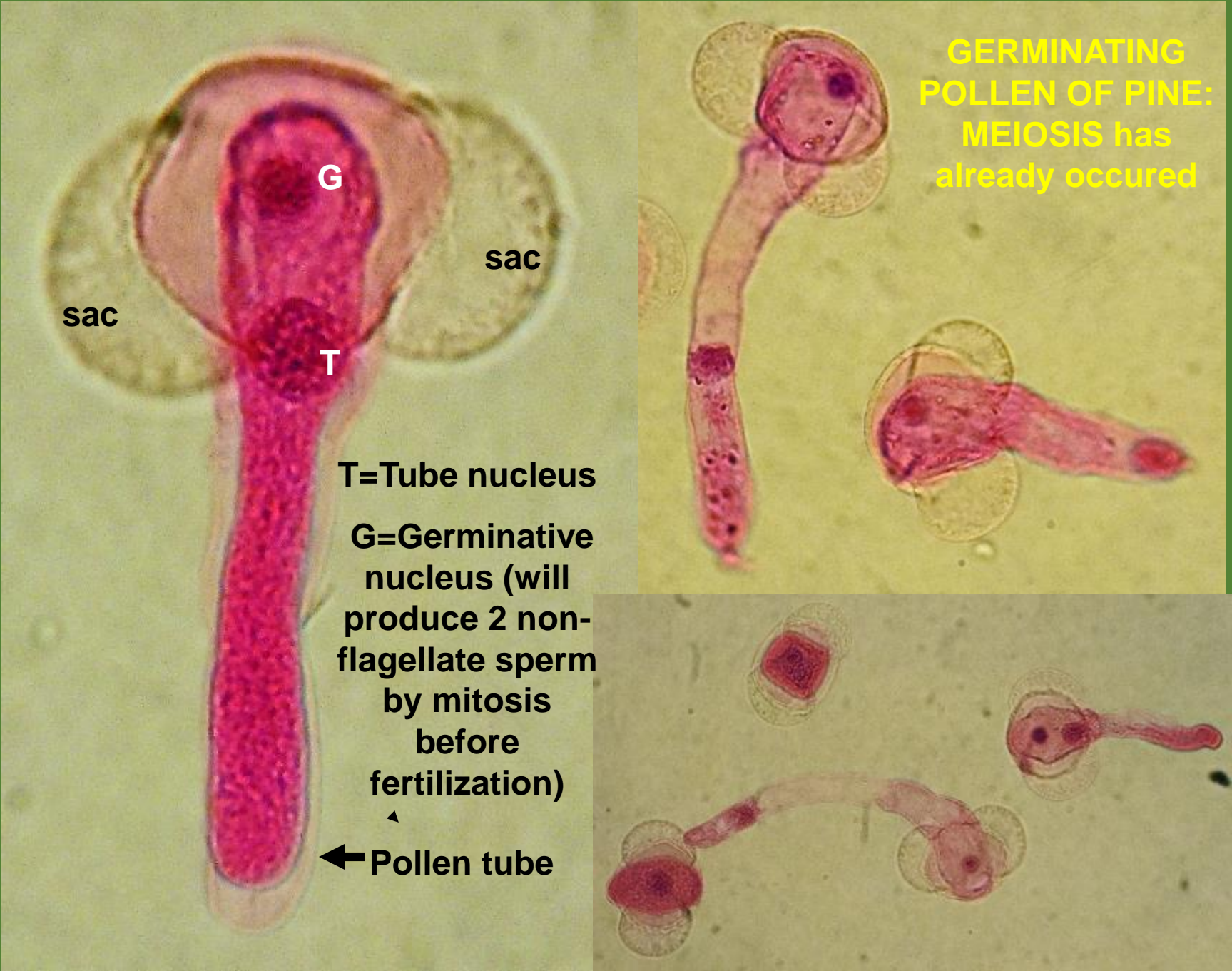






**Bisaccate Pollen – 2
bladders or wings**





**GERMINATING
POLLEN OF PINE:
MEIOSIS has
already occurred**

sac

G

sac

T

T=Tube nucleus

**G=Germinative
nucleus (will
produce 2 non-
flagellate sperm
by mitosis
before
fertilization)**

← Pollen tube



New 1st year female
cone on top of new
stem annual growth

End of 1st year



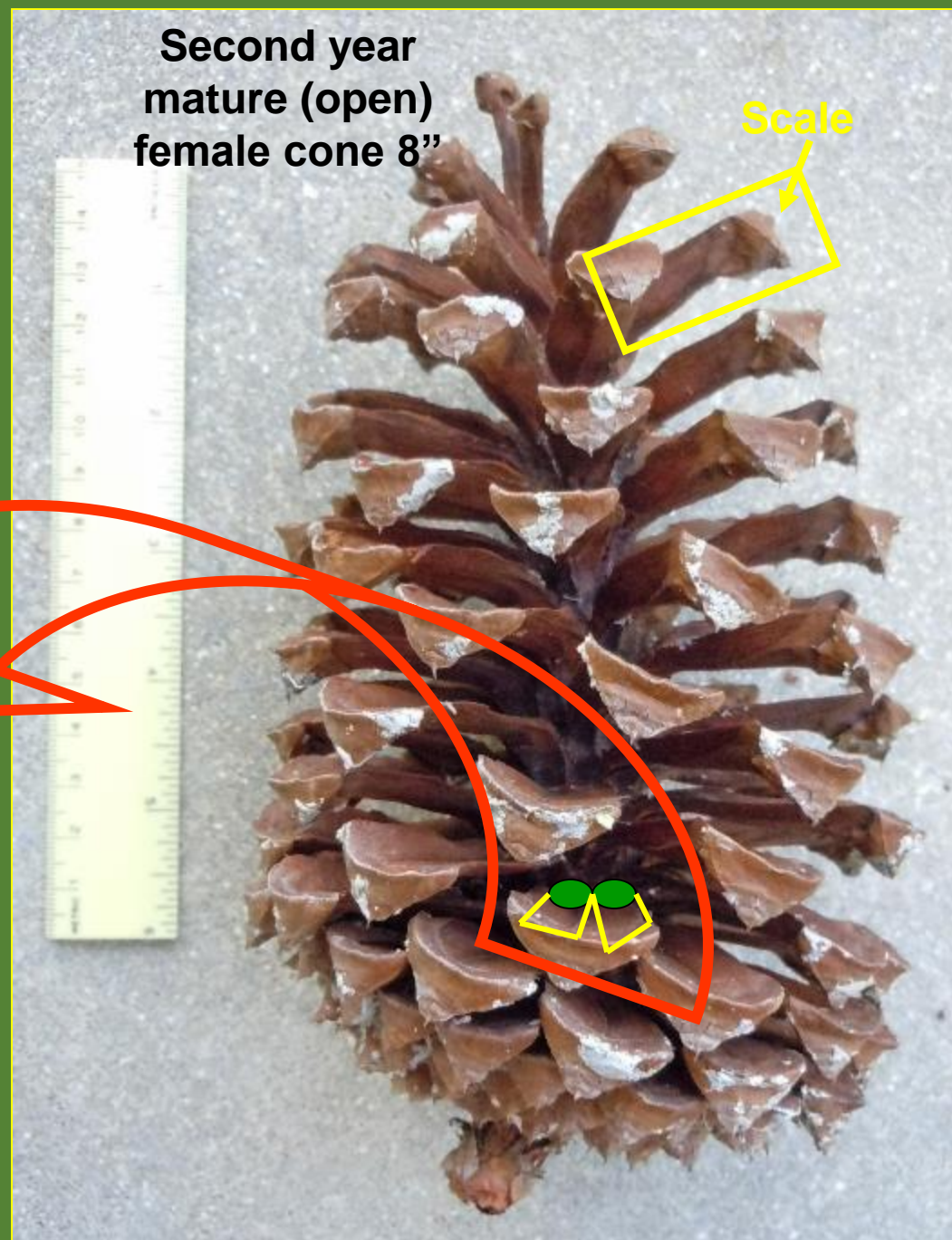
**Female
Cone
(Stobilus)
(Female
Gametophyte
bearing)**

**Winged seed -
2 per Scale**



**Second year
mature (open)
female cone 8"**

Scale



**Young Female cone with ovules
on inner part of scales**

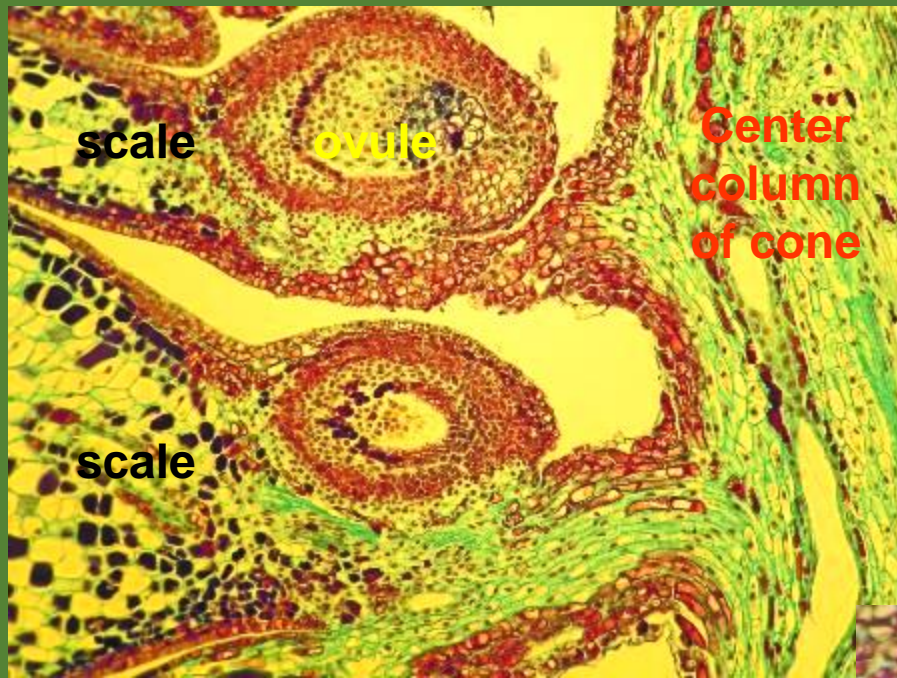


**2 months
old**

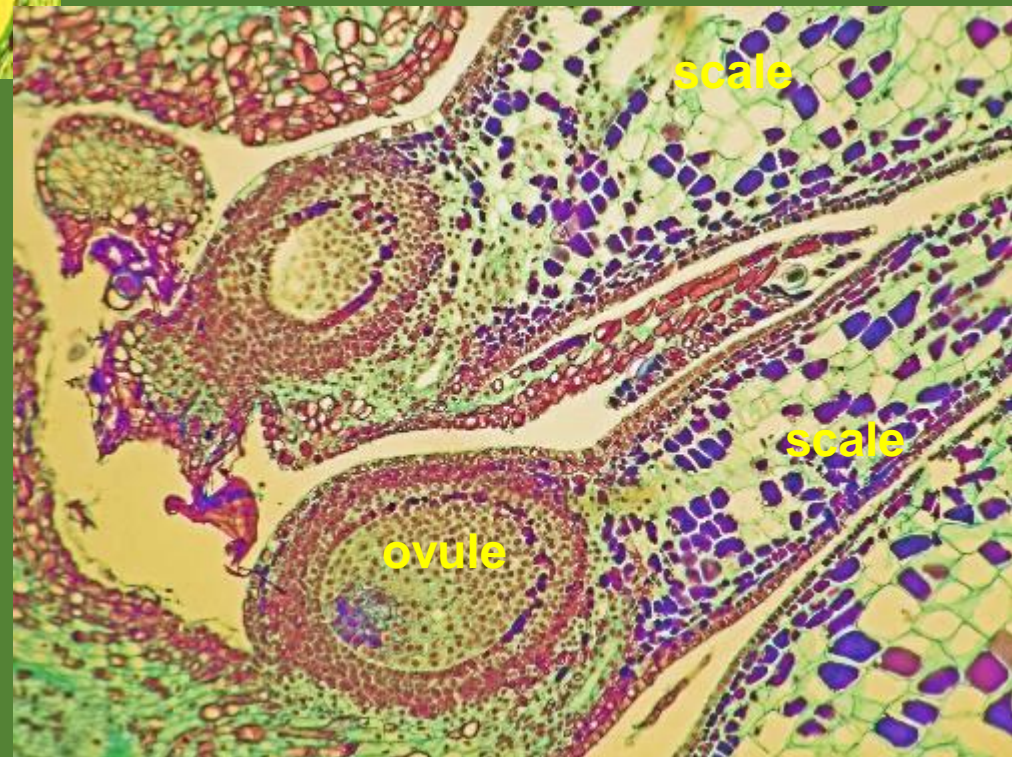
**Longitudinal section of
young female cone
showing scales & ovules**

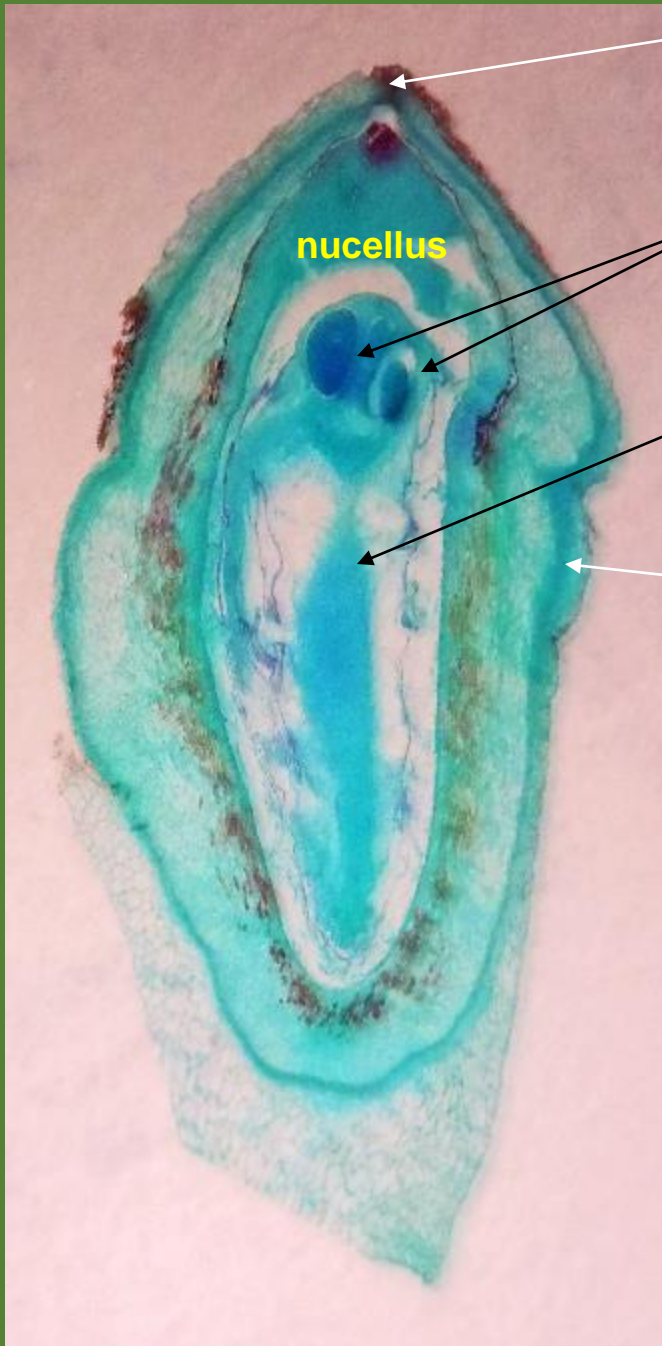


**2 years old &
open**



Longitudinal section of young female cone showing scales & ovules: closer view





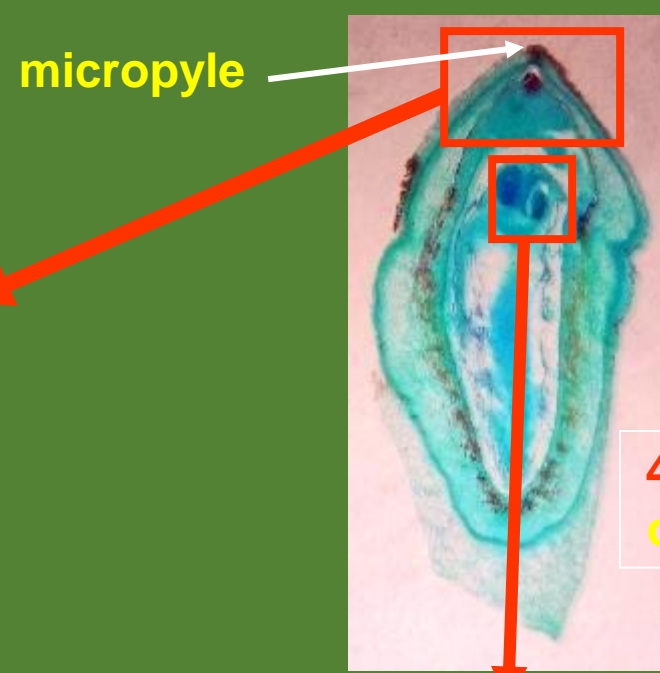
Micropyle through which pollen tube enters

2 1n Archegonia w/ egg inside each and surrounded by nucellus = female Gametophyte

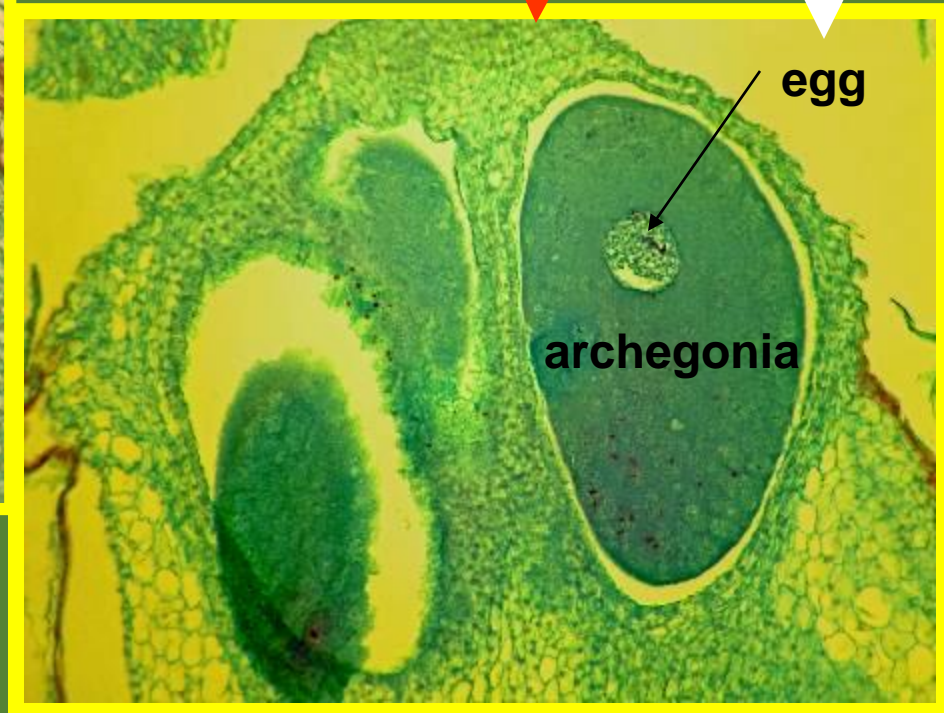
Integument becomes seed coat

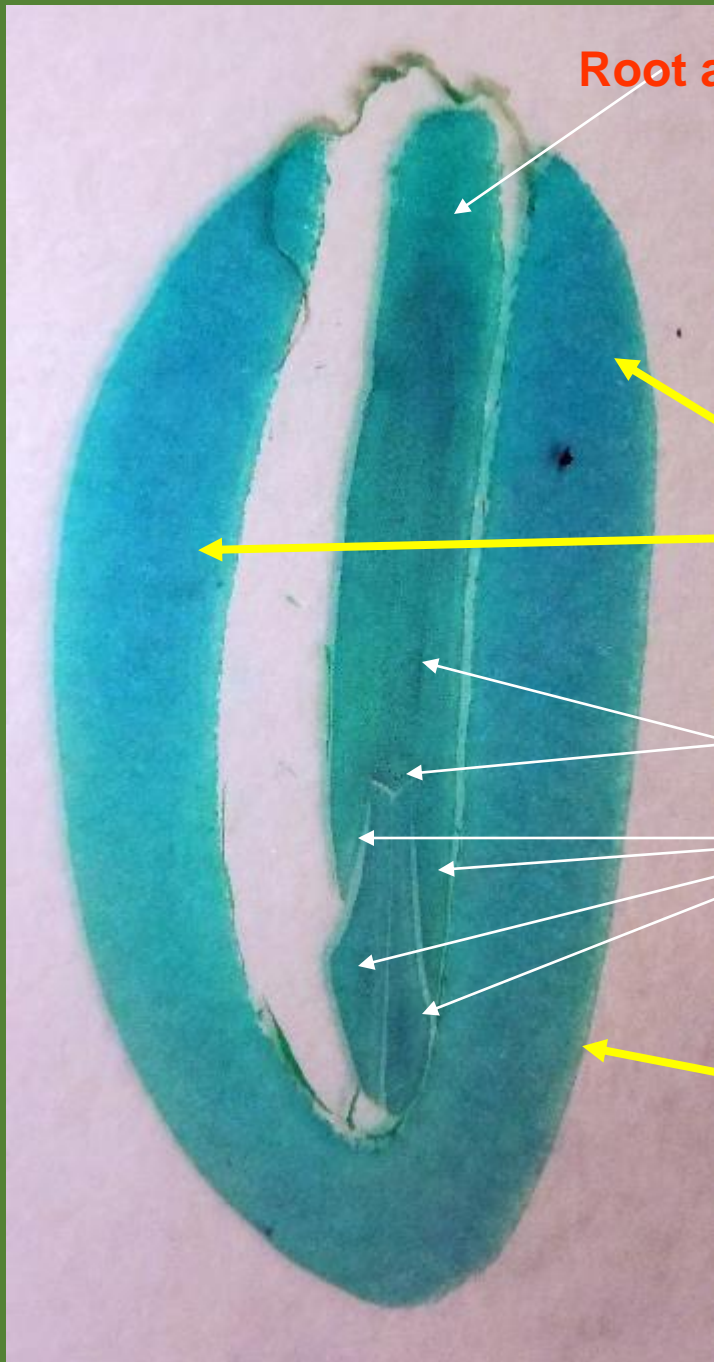


Pollen tube digesting way to archegonia (12-15 months)



4 1n nuclei, 3 die=MEIOSIS





Root apex

Embryo in seed with seed coat & wing removed

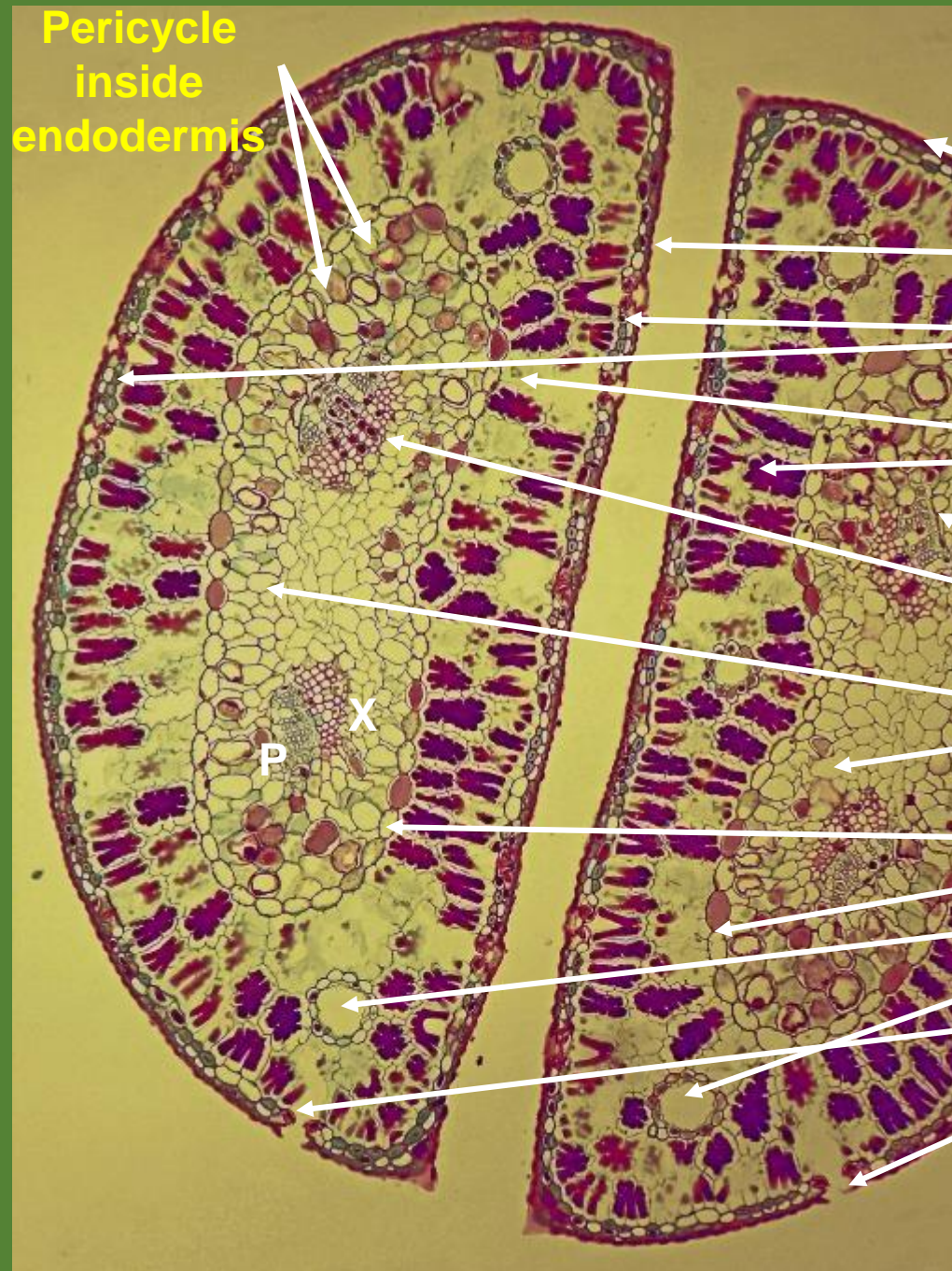
Hi fat, nutty food = 'pignoli nuts'

Gametophyte (1n)

Embryo (2n) note shoot apex, hypocotyl & cotyledons-several



LEAVES ('NEEDLES')



Epidermis

Hypodermis
(sclerenchyma)

Mesophyll w/
chloroplasts

sunken stomata

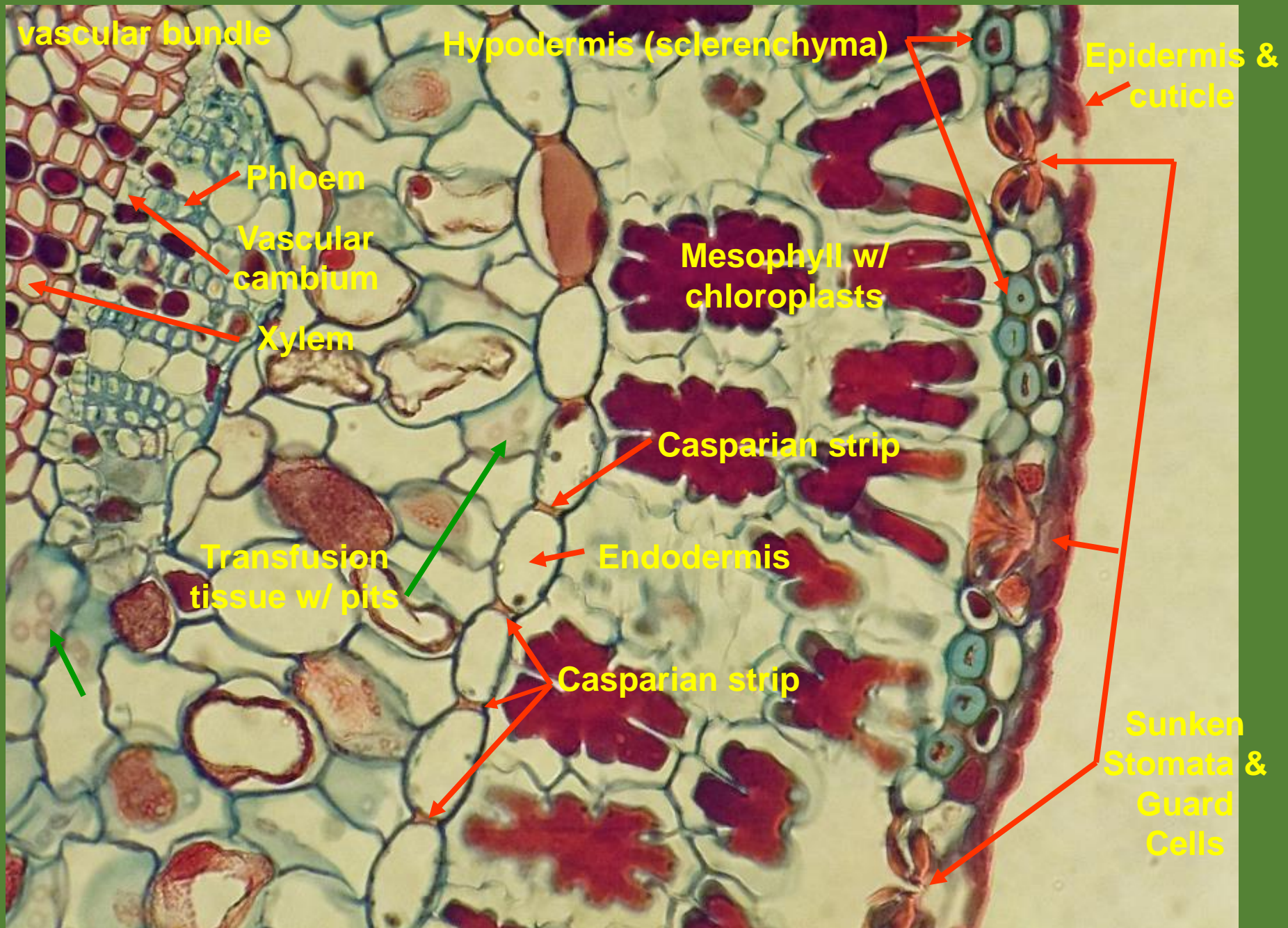
2 vascular bundles

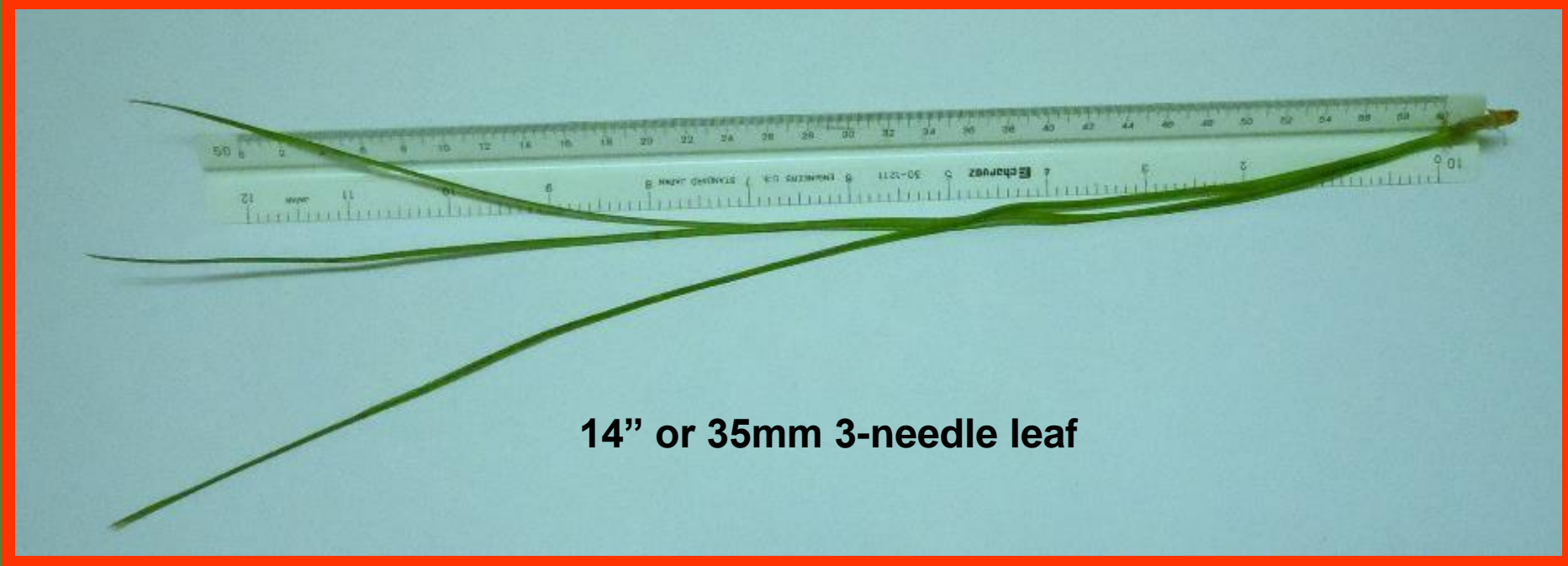
Transfusion tissue w/
bordered pits

Endodermis

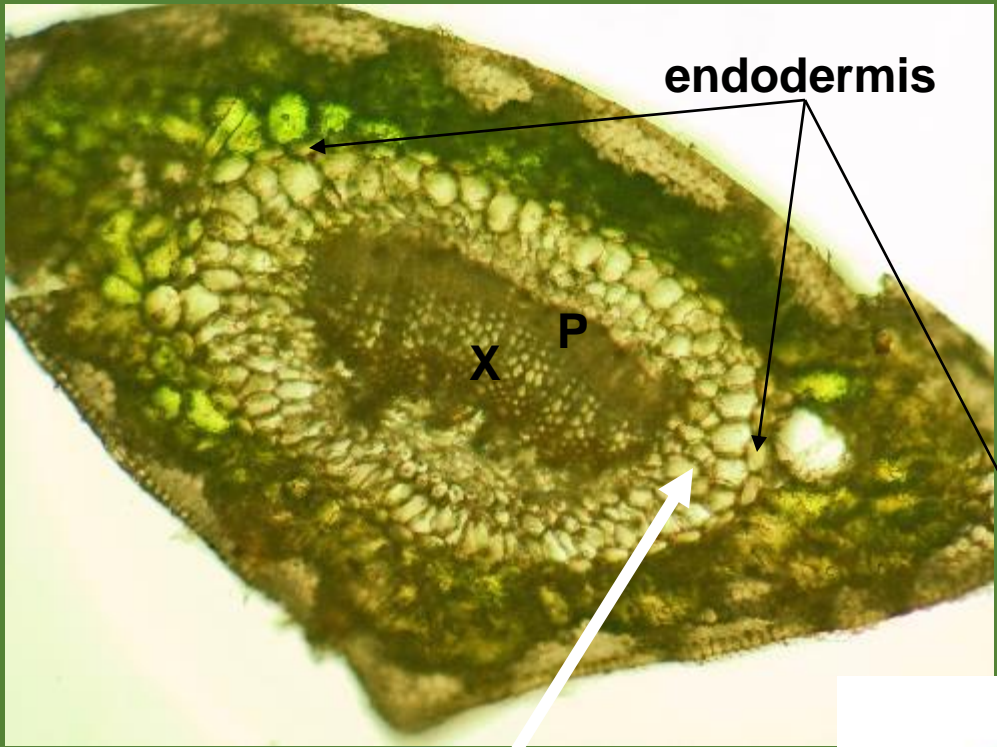
Resin Ducts

Stomata





14" or 35mm 3-needle leaf

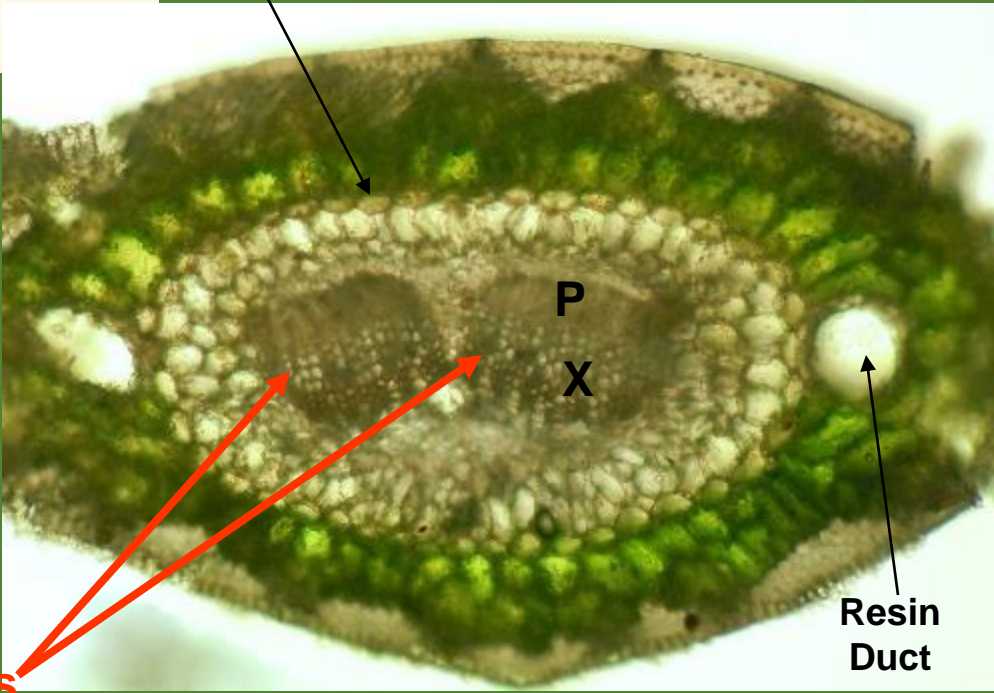


endodermis

X P

'Transfusion
Tissue'
surrounding
Vascular
bundles inside
endodermis

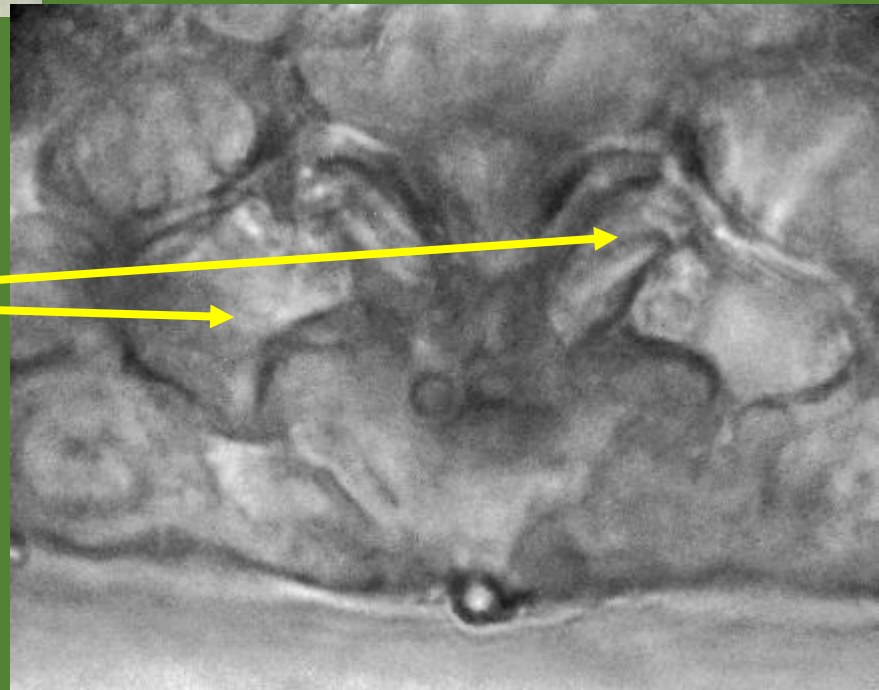
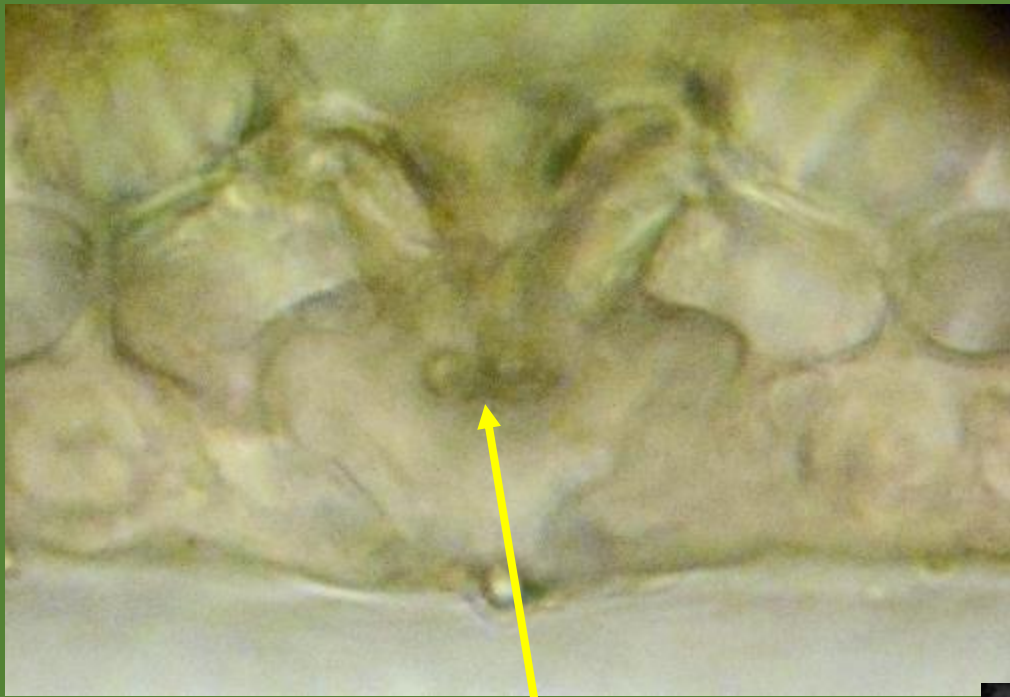
Pine 'needles' are the
leaves of pine trees:
hand sections of
Pinus australis the
longleaf pine;
needles in 3's, big 8"
- 10" cones: drought
resistant adaptations



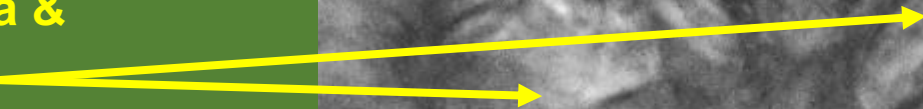
P
X

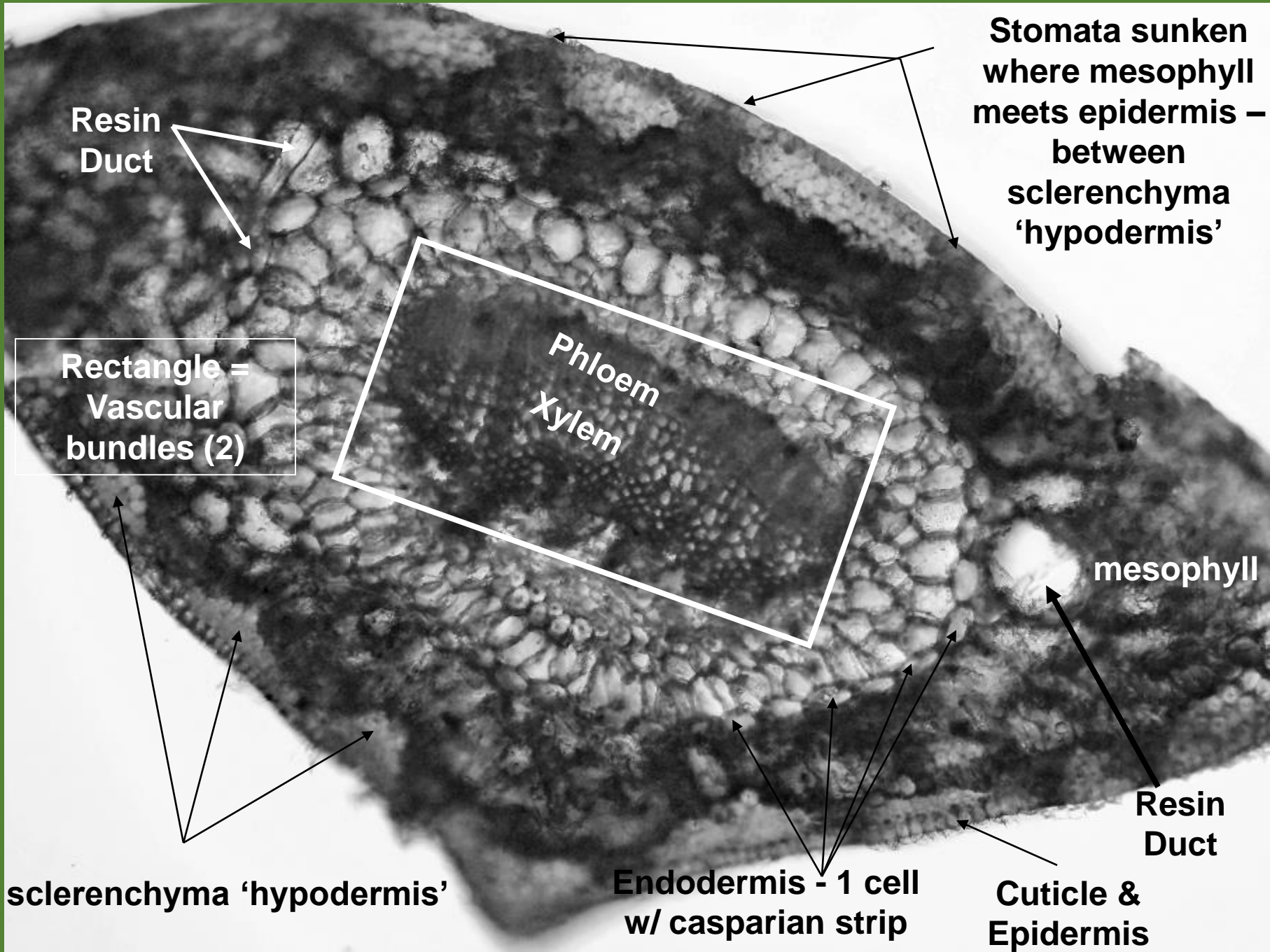
Resin
Duct

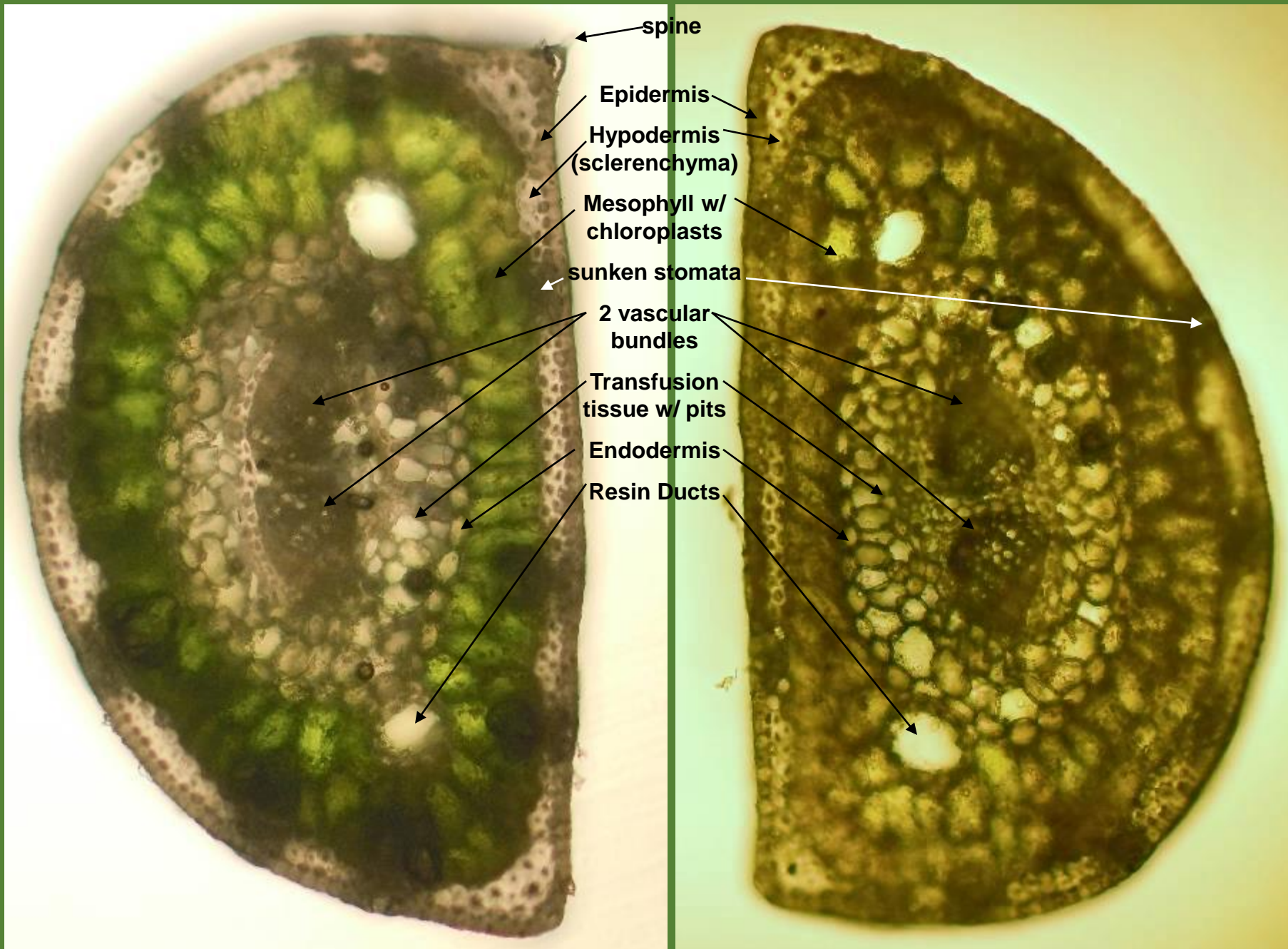
Vascular Bundles



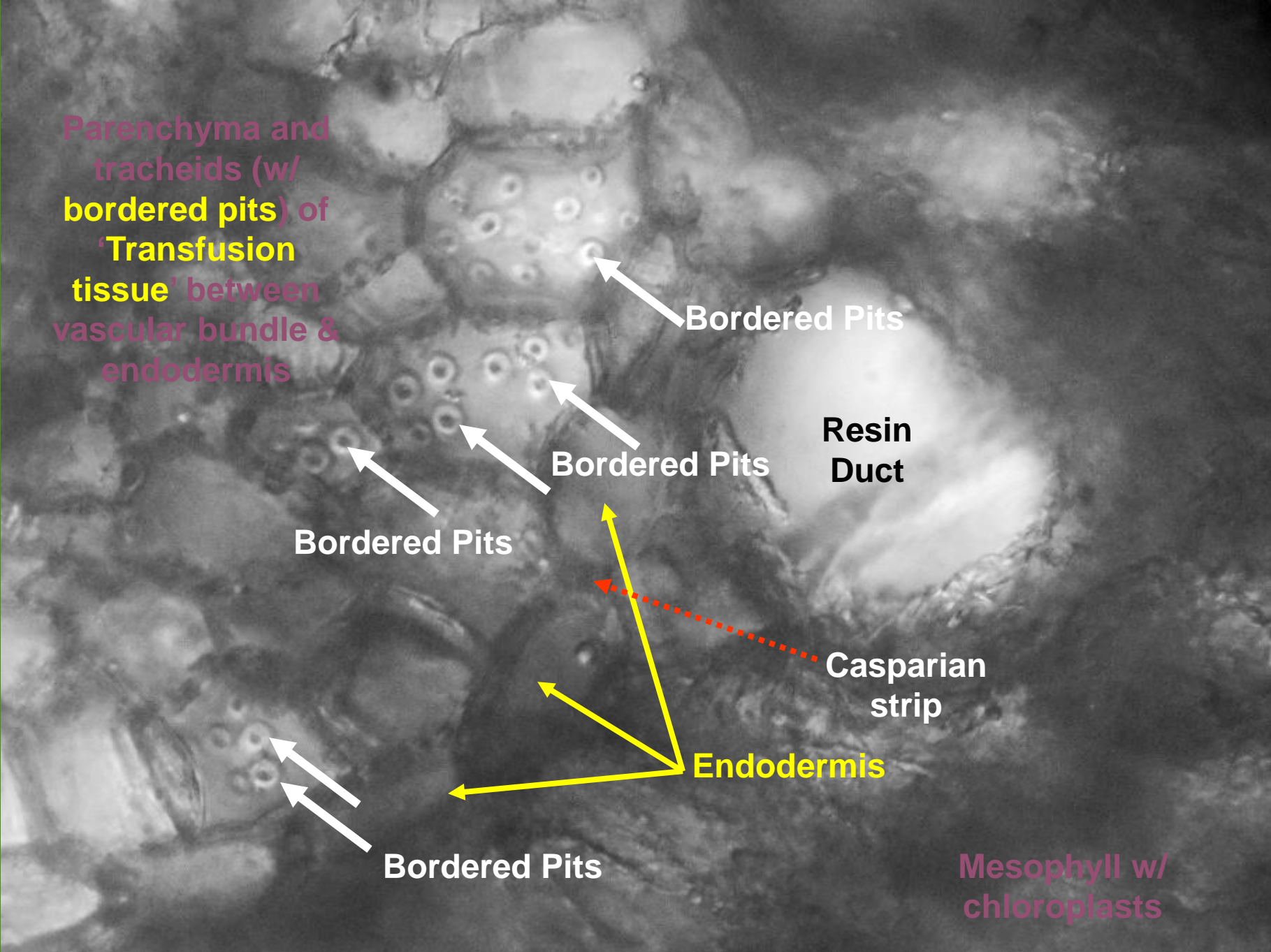
**Sunken Stomata &
Guard Cells**



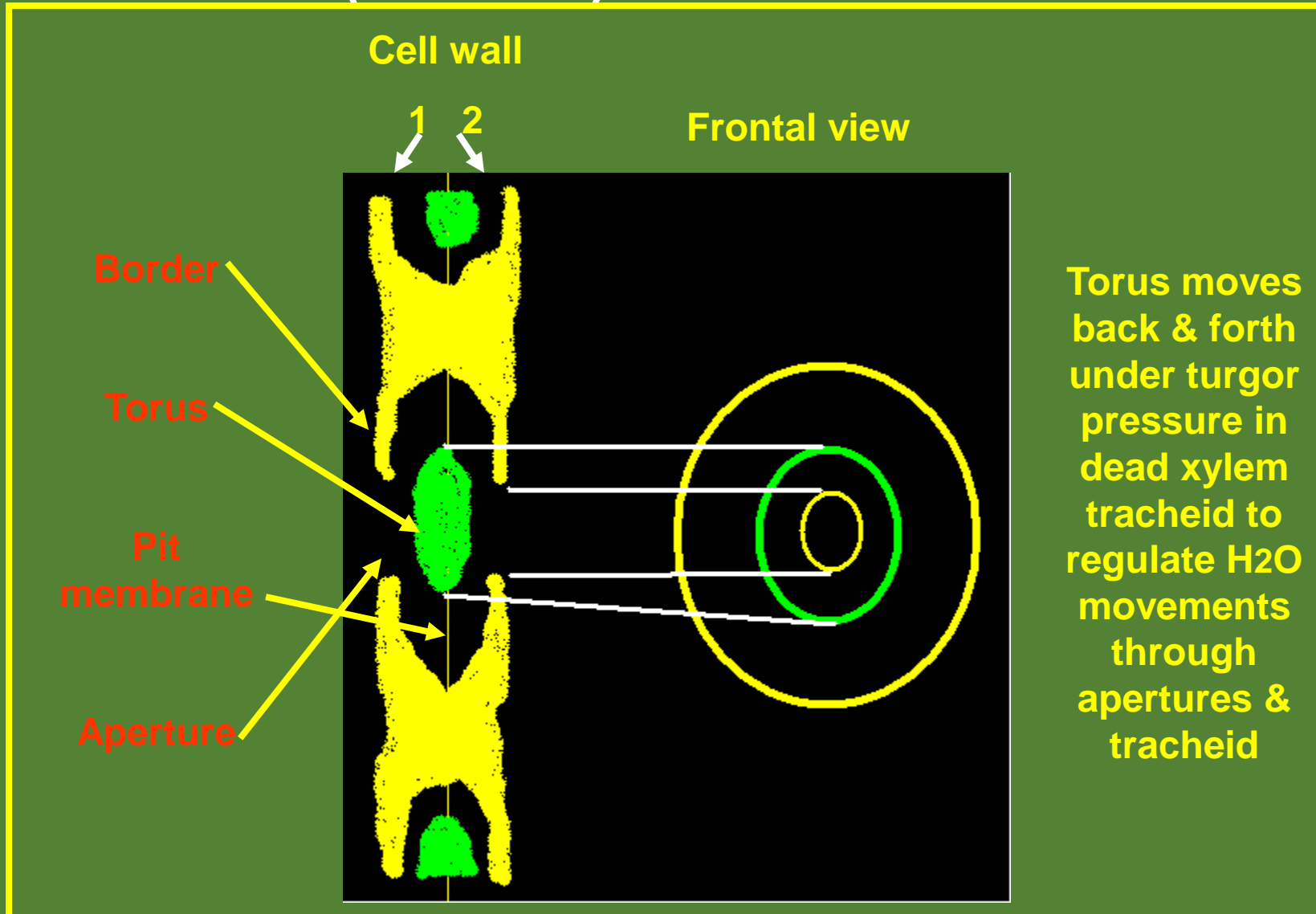


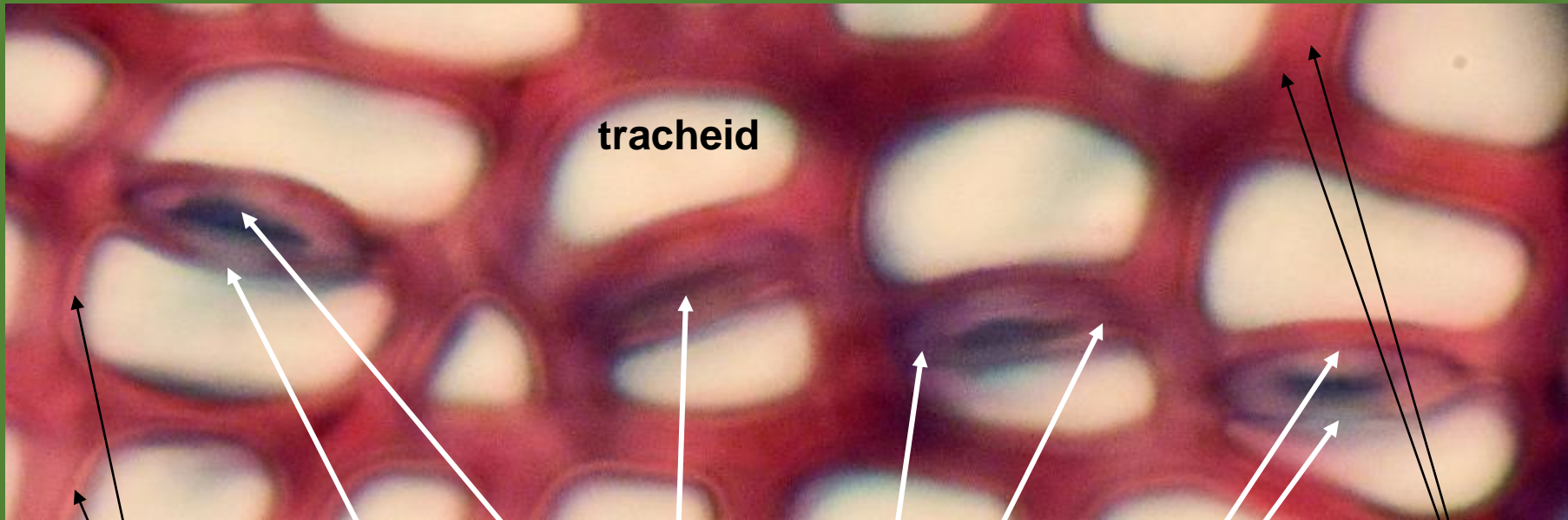


Hand section of 2-needle pine leaves



BORDERED PITS in transfusion tissue & xylem (tracheids) of wood in stem





tracheid

Secondary cell wall

Torus

Primary cell wall

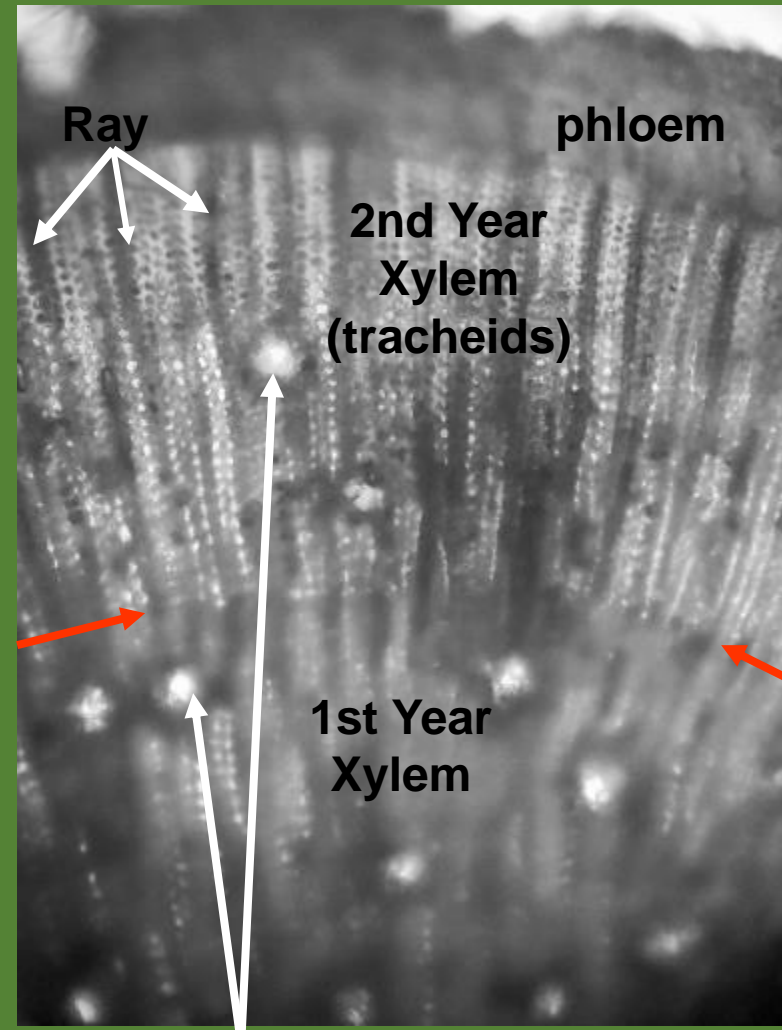
Pit membrane (middle lamella)

Secondary XYLEM made of Tracheids: showing Bordered Pits in pine stem wood cross section

Aperture



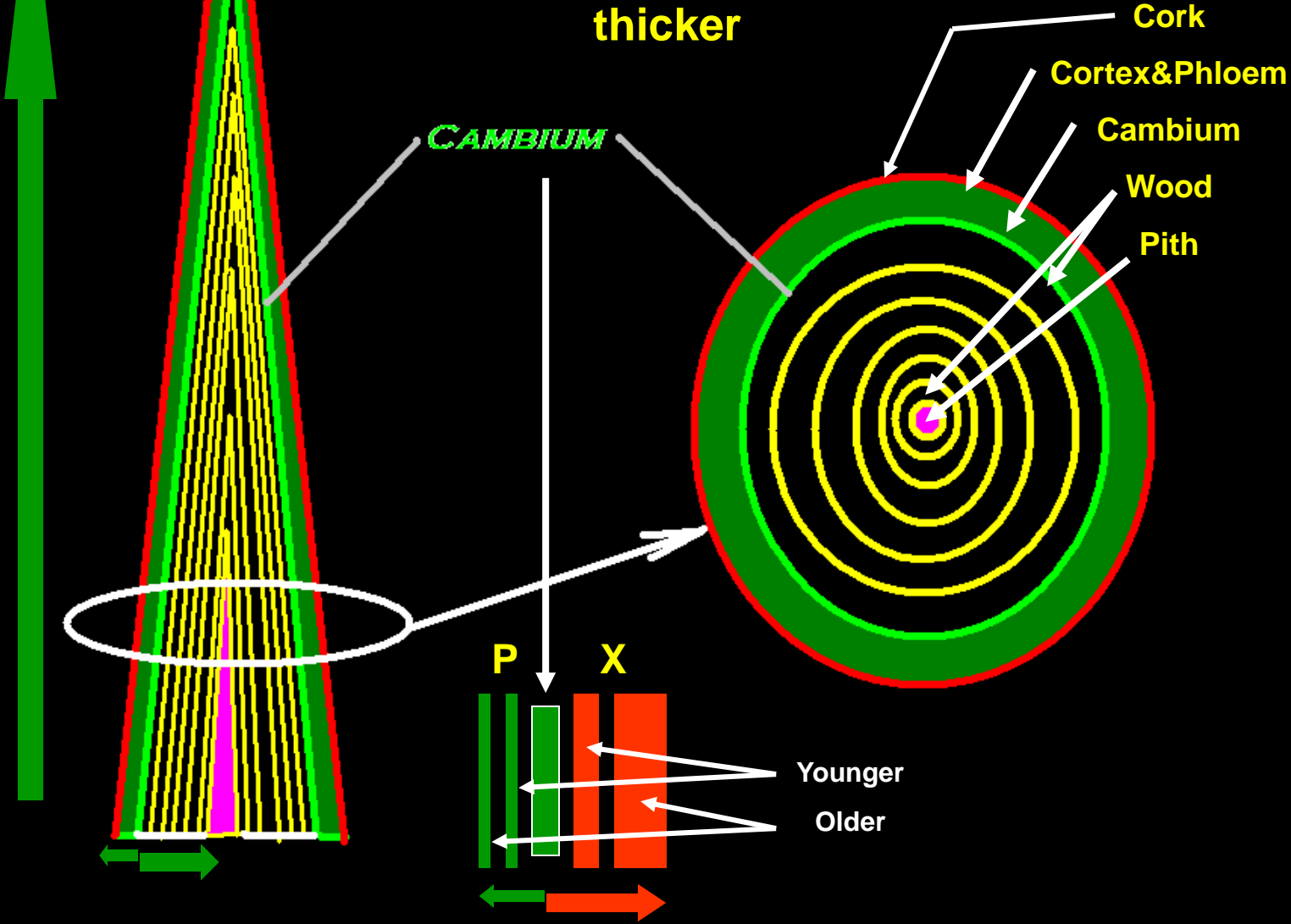
STEMS

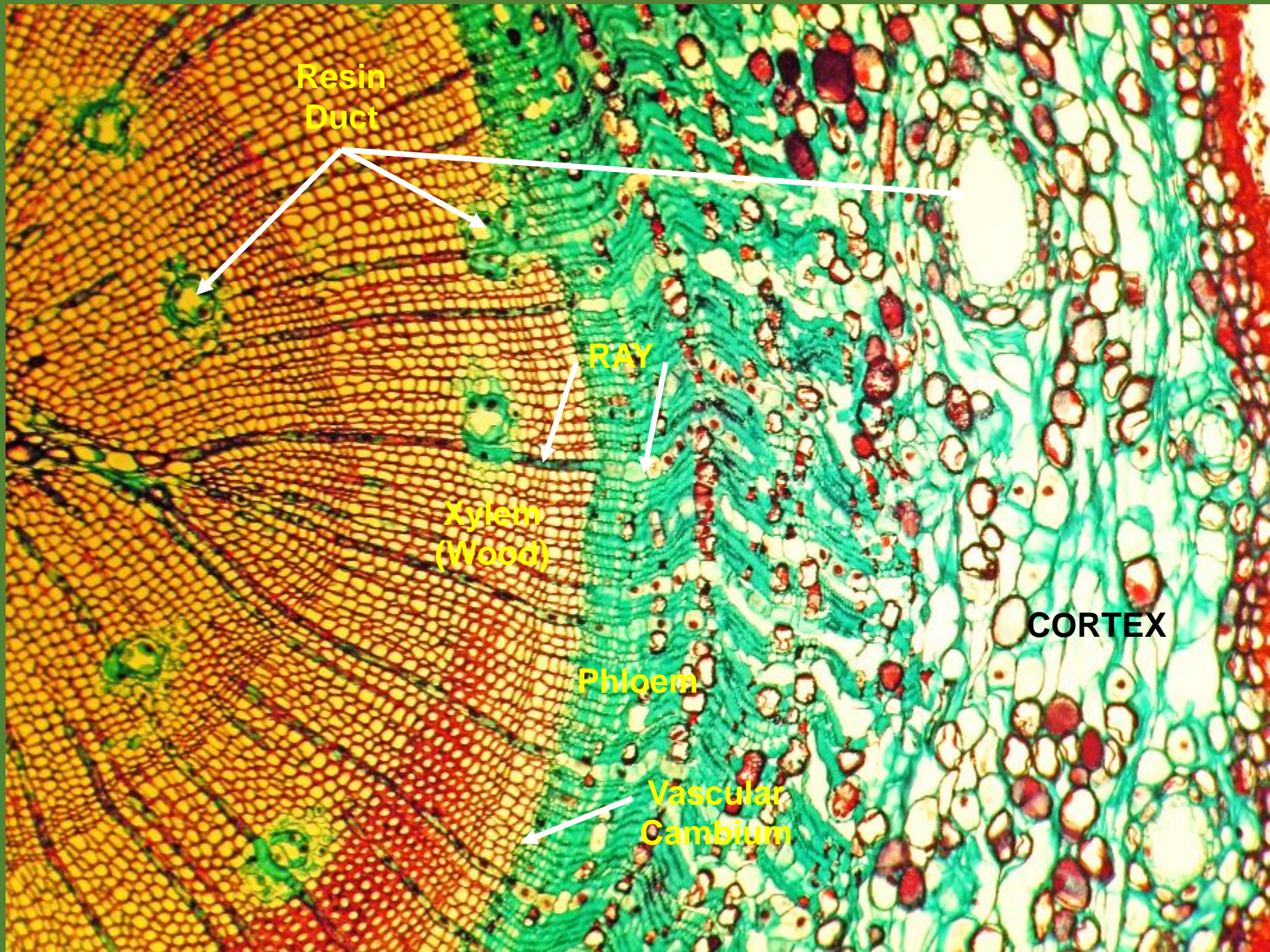


Resin ducts

2 yr. stem

Stem Growth: from Cambium out as phloem;etc. and cambium in as xylem, so stem grows longer and thicker





Resin
Duct

RAY

Xylem
(Wood)

Phloem

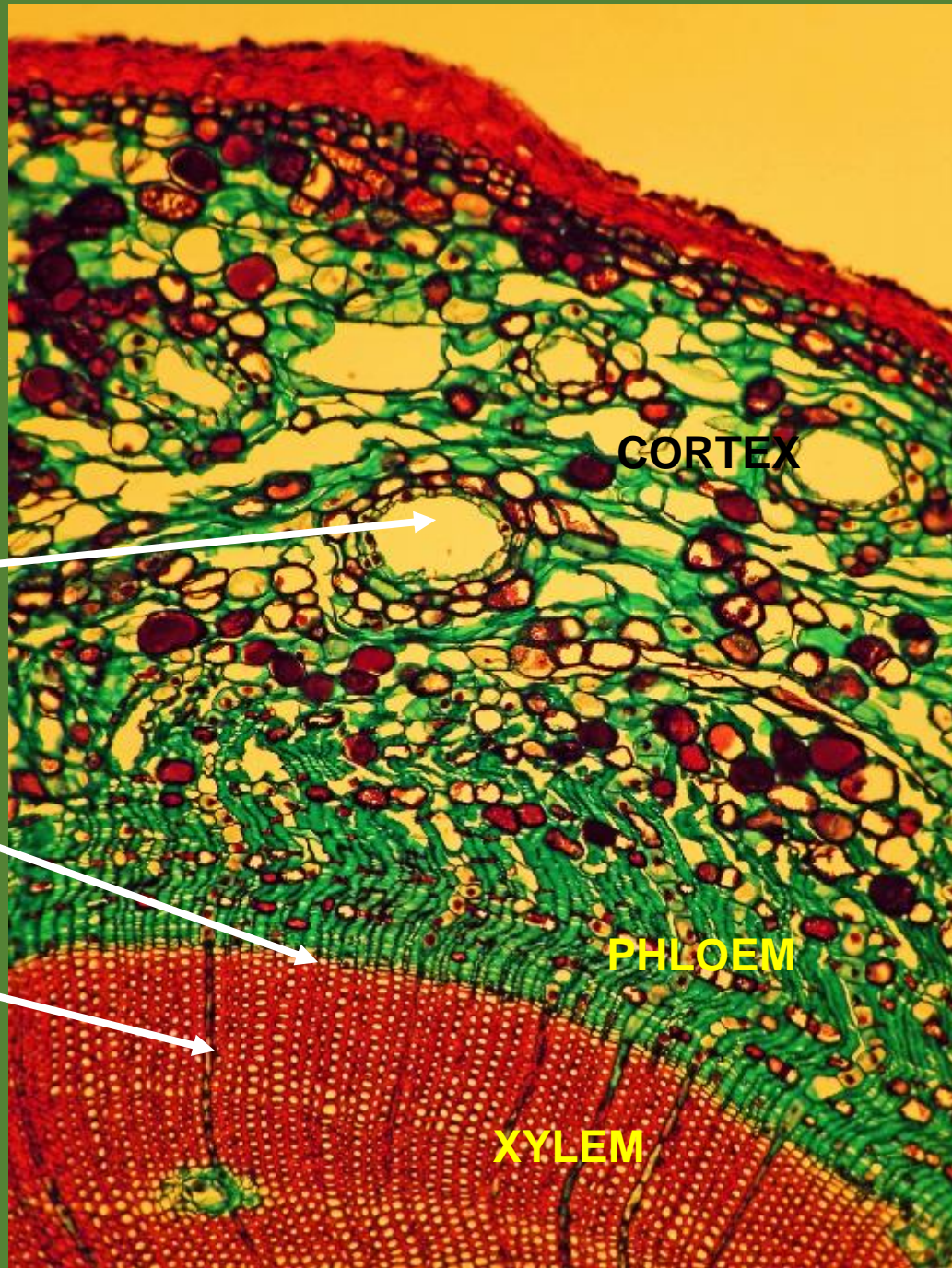
Vascular
Cambium

CORTEX

Xylem conducts water *UP*
from root to leaves:



Phloem conducts food
(Glucose/Starch) *DOWN* from
leaves towards root



CORTEX

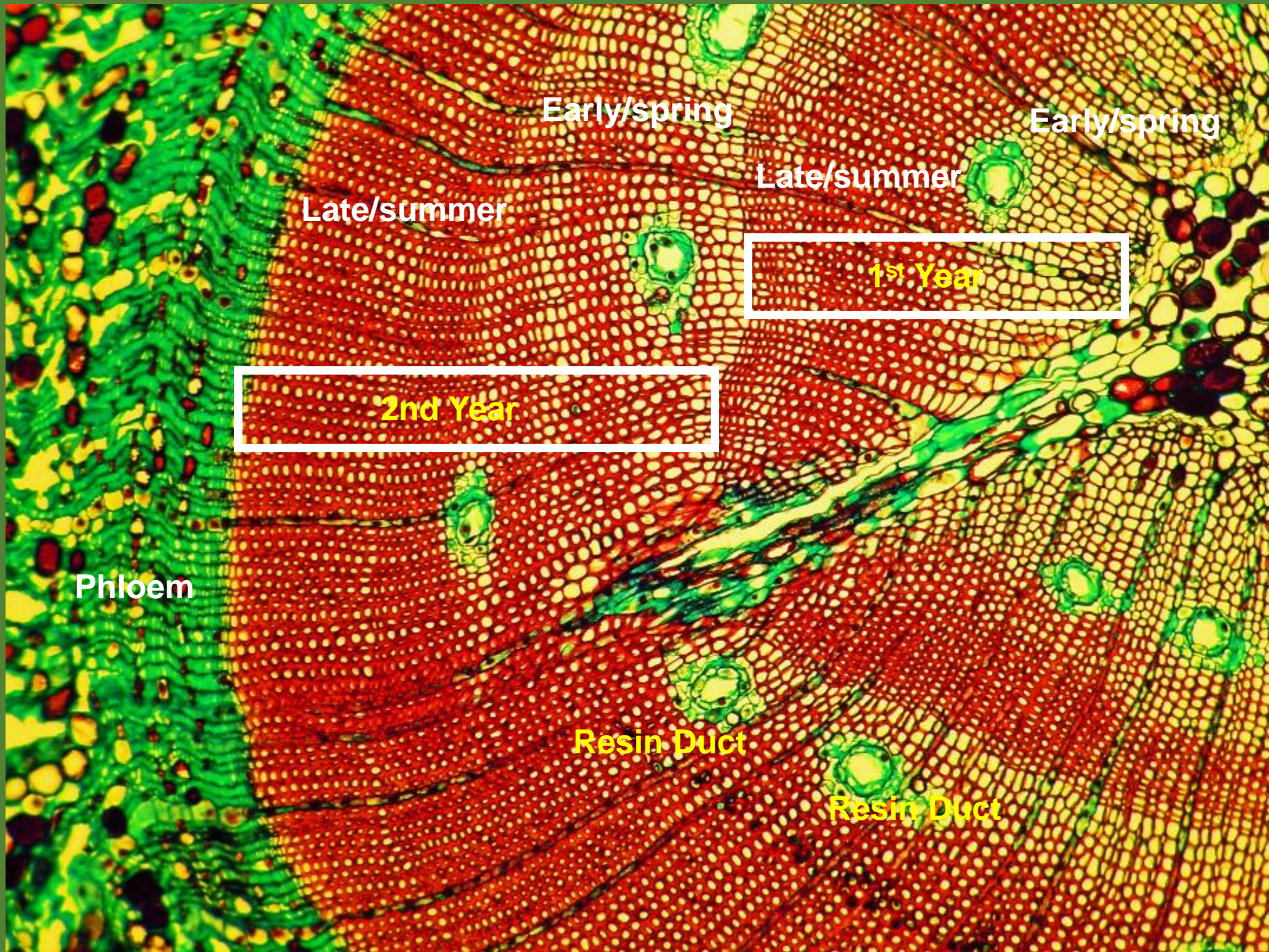
Resin Duct

**Vascular
Cambium**

RAY

PHLOEM

XYLEM



PERIDERM

Epidermis & cuticle

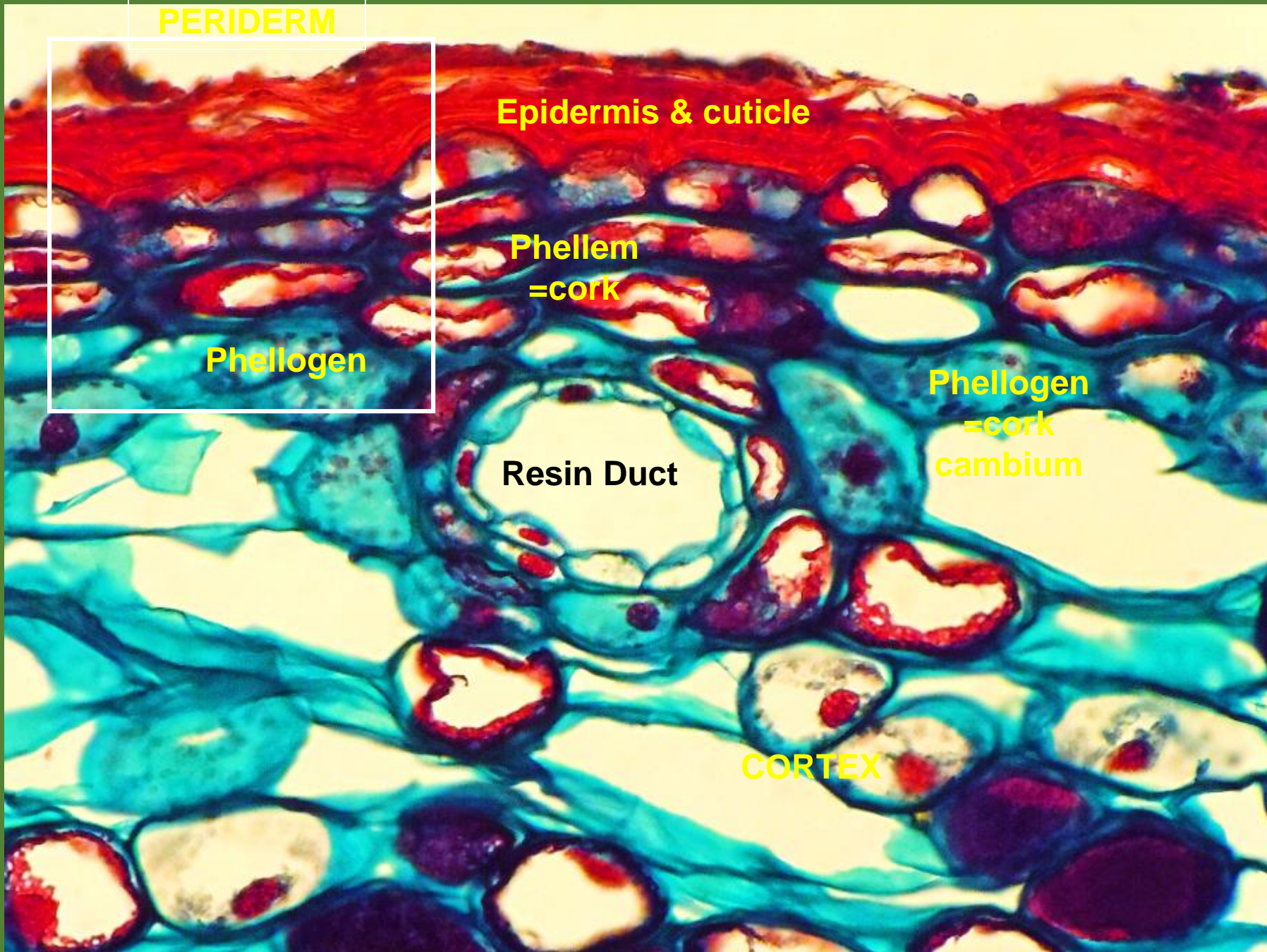
**Phellem
=cork**

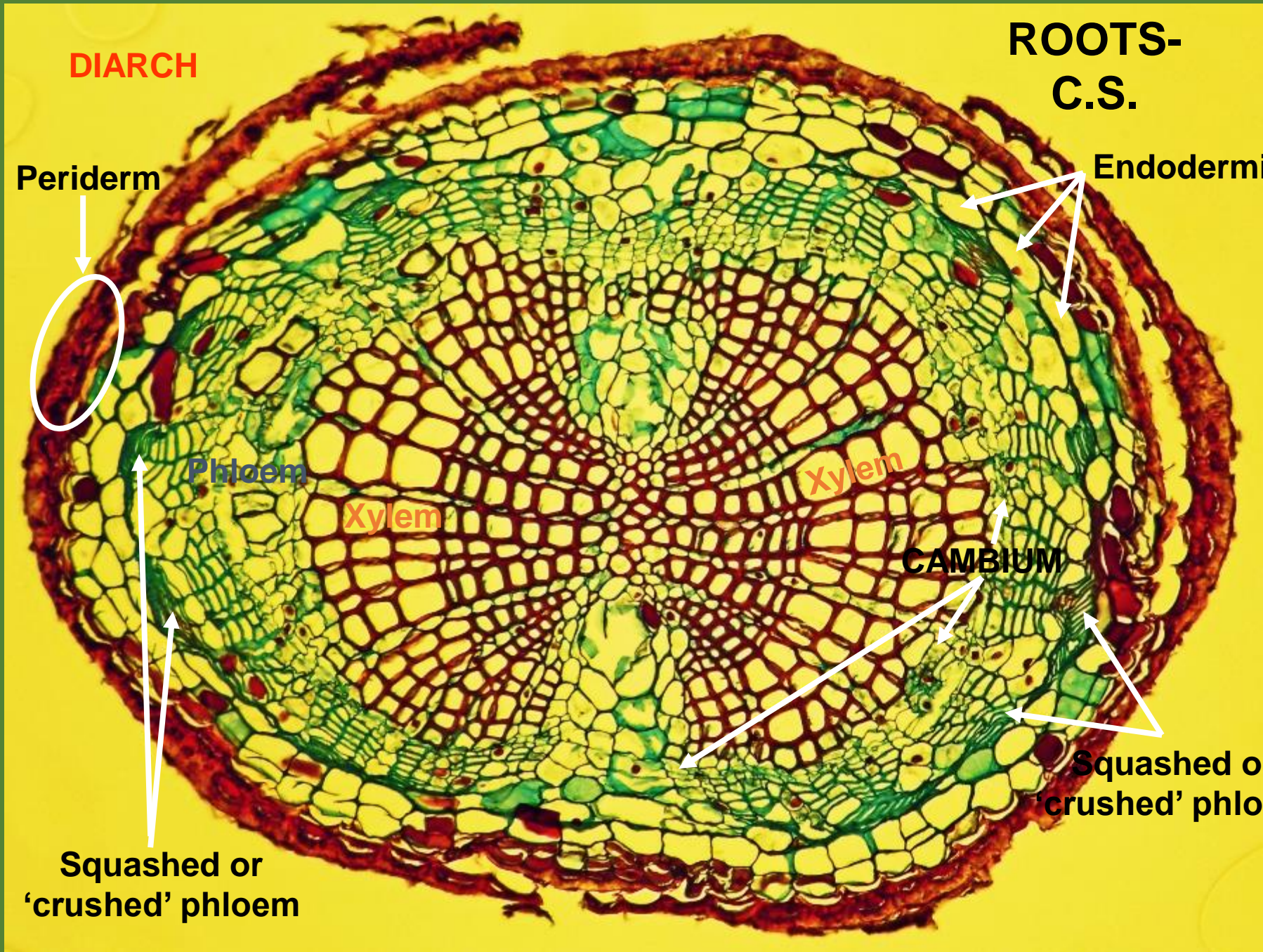
Phellogen

**Phellogen
=cork
cambium**

Resin Duct

CORTEX





DIARCH

**ROOTS-
C.S.**

Periderm

Endodermis

Phloem

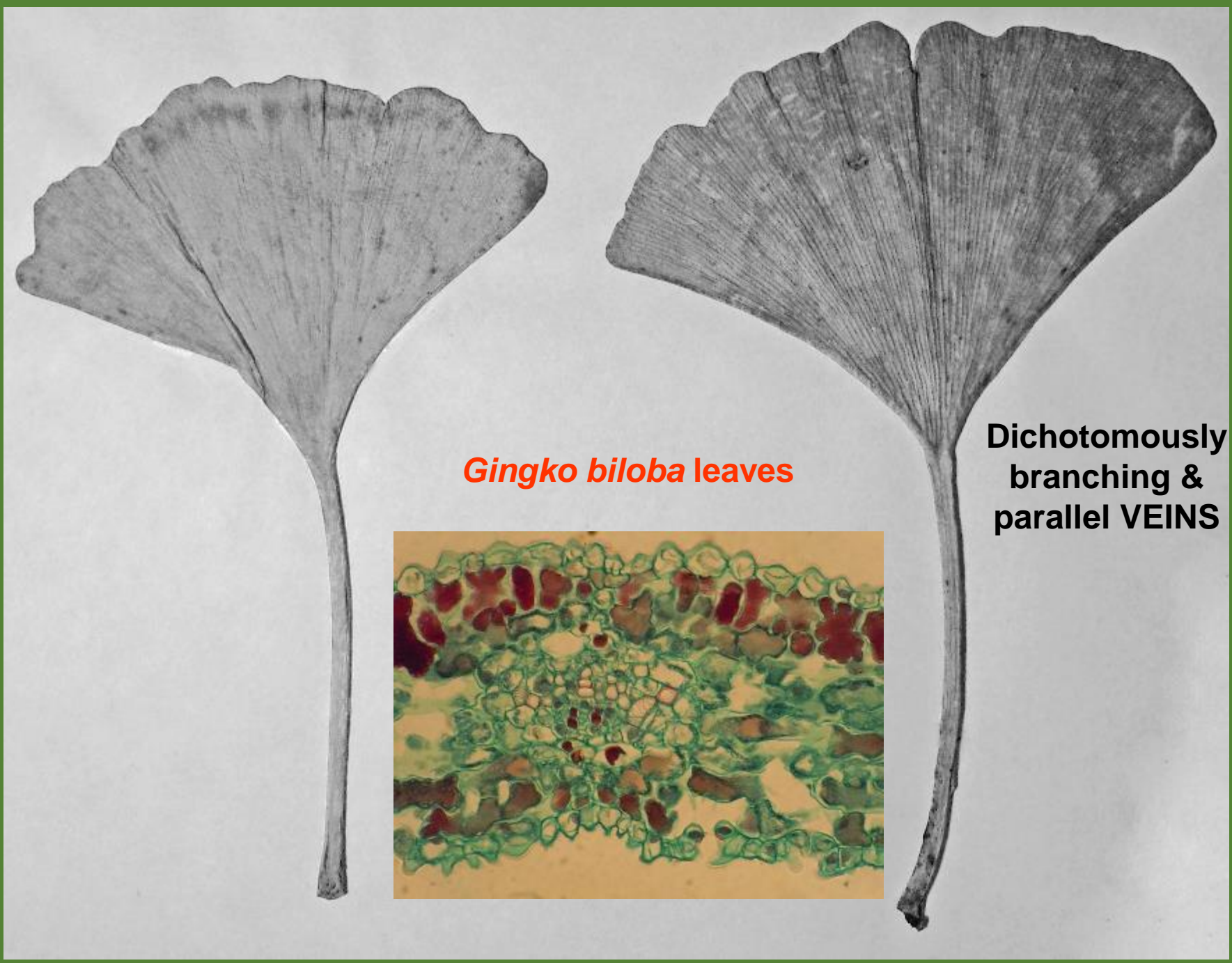
Xylem

Xylem

CAMBIUM

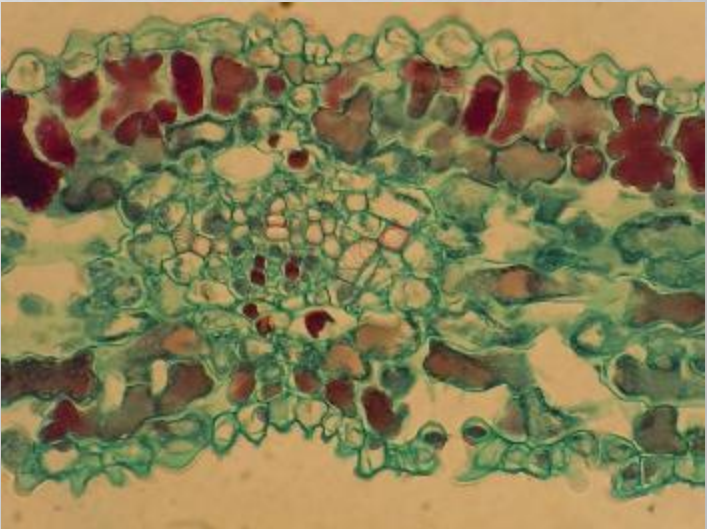
**Squashed or
'crushed' phloem**

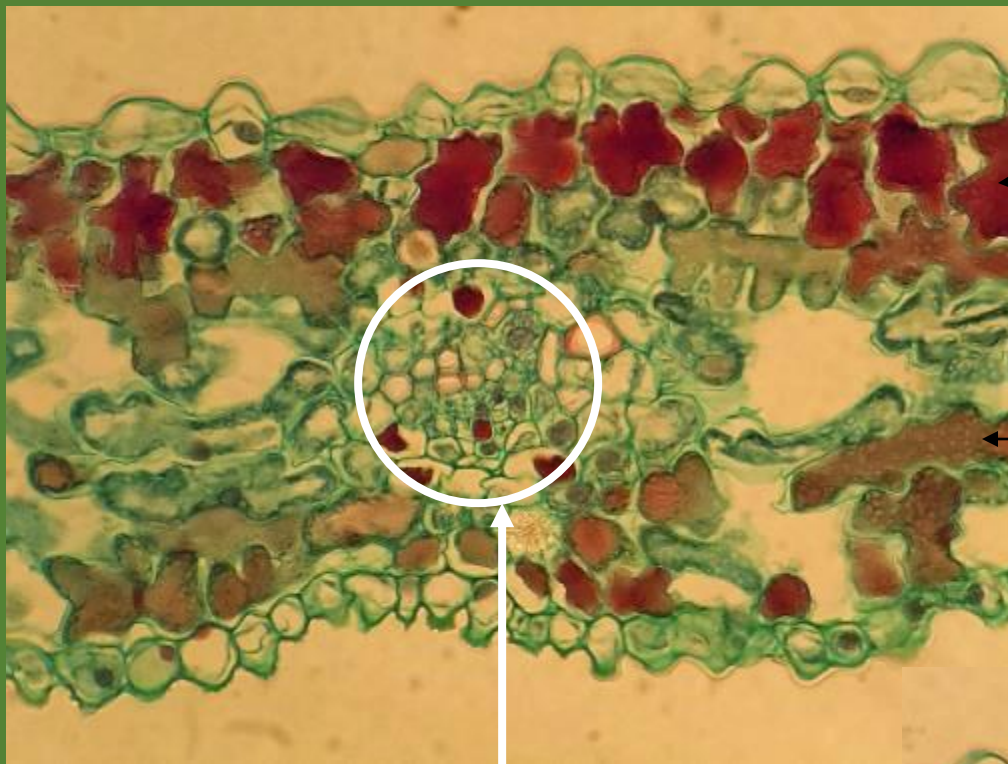
**Squashed or
'crushed' phloem**



Ginkgo biloba leaves

Dichotomously
branching &
parallel VEINS





Palisades

Mesophyll

Spongy

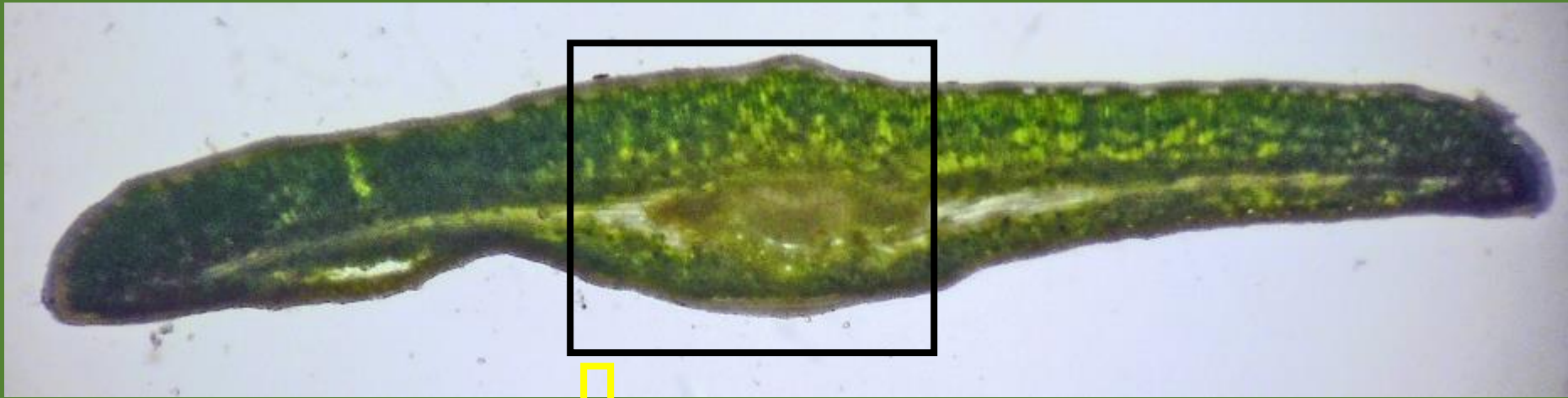
Vascular bundle - VEIN

Gingko biloba leaves

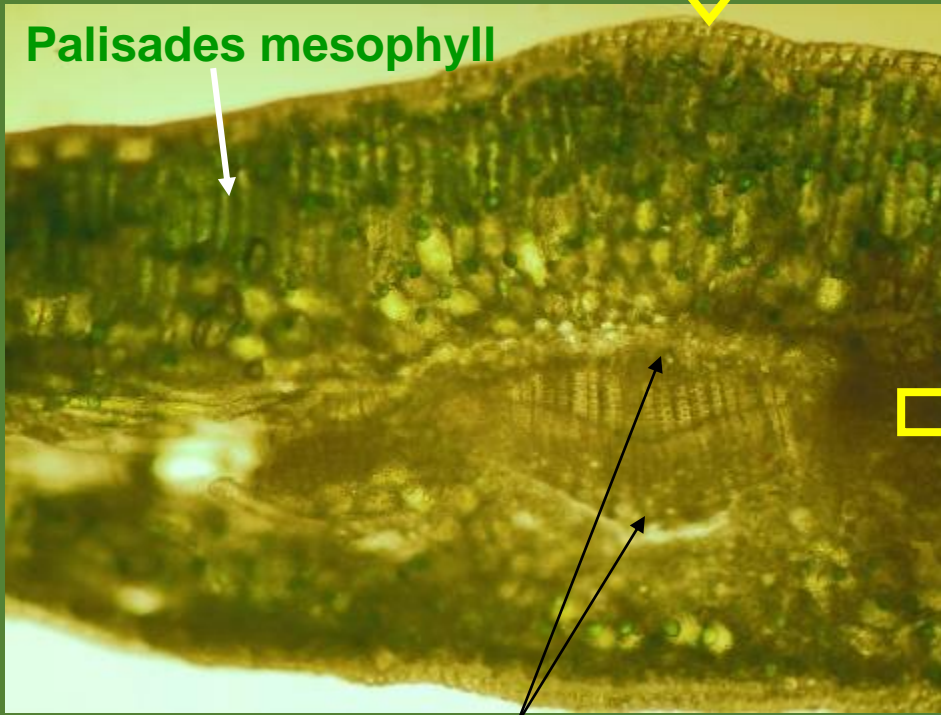


Resin duct

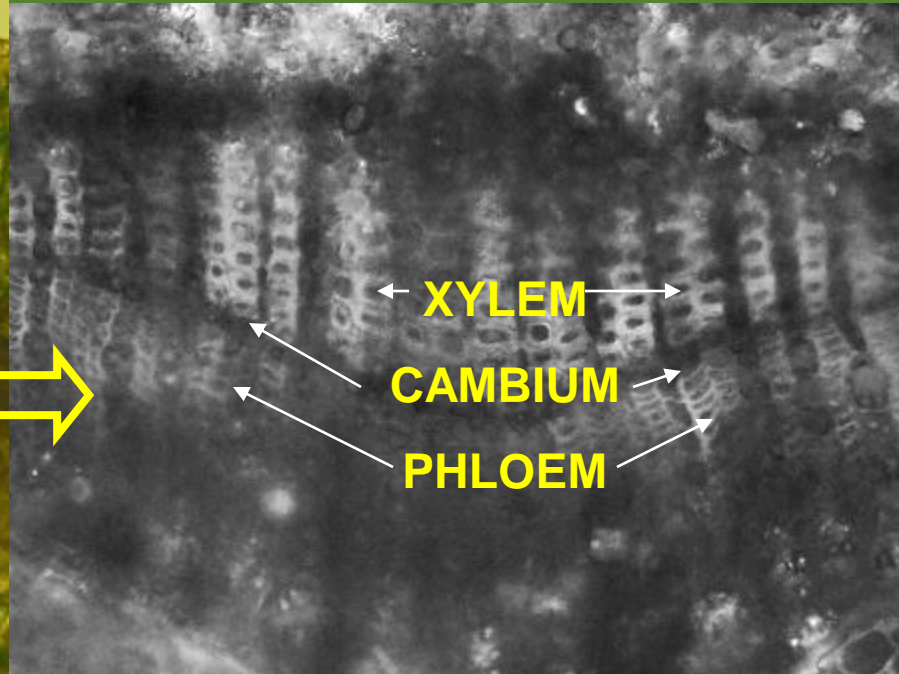
stoma



Podocarpus



Palisades mesophyll



XYLEM

CAMBIUM

PHLOEM

Vascular bundle



Cypress



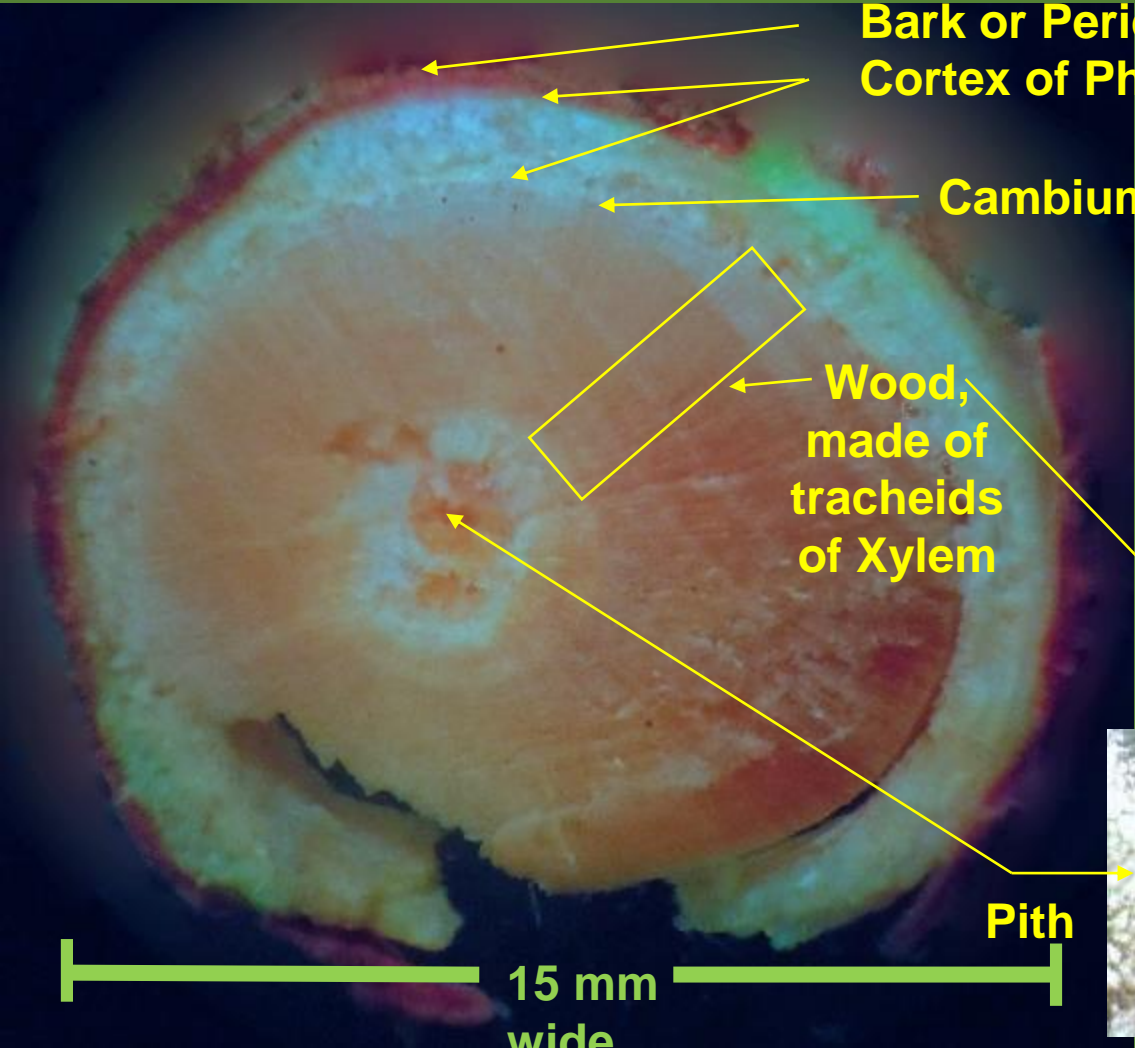
Araucaria heterophylla

Histology of Norfolk Pine/ 'Monkey Puzzle' Tree Stem

Araucaria: Gymnosperm –
Ancient Conifer (Triassic to
Recent)

All hand-cut sections
with razor blade

Cross section



**Bark or Periderm (red from tannins)
Cortex of Phloem**

Cambium

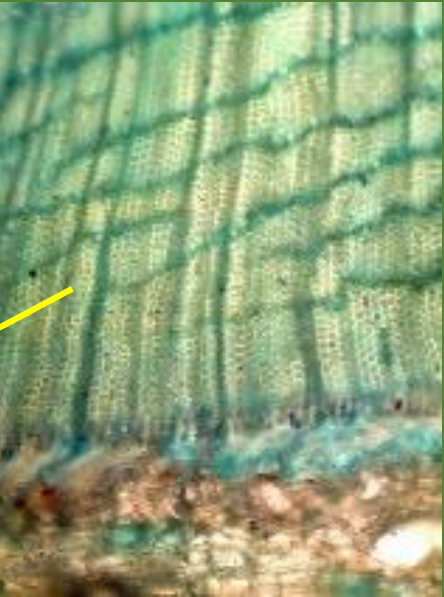
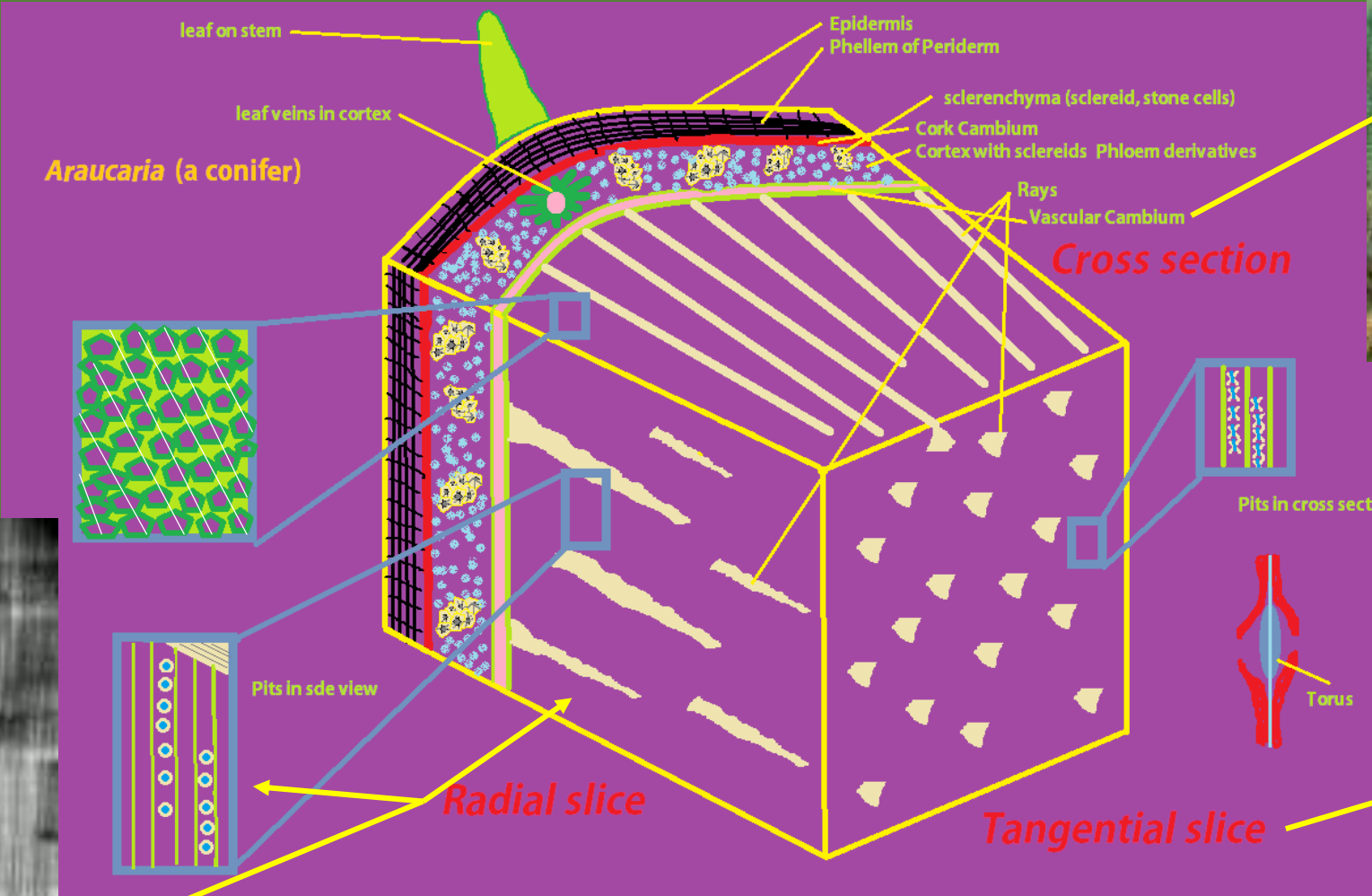
**Wood,
made of
tracheids
of Xylem**

Pith

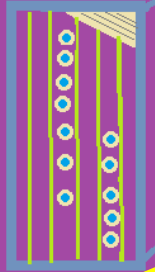
**15 mm
wide**



**Small stem of
Araucaria: the
'monkey puzzle' tree
or Norfolk Pine of
Australia & South
America- a pine tree
or Conifer-
Gymnosperm**



§ No vessel elements



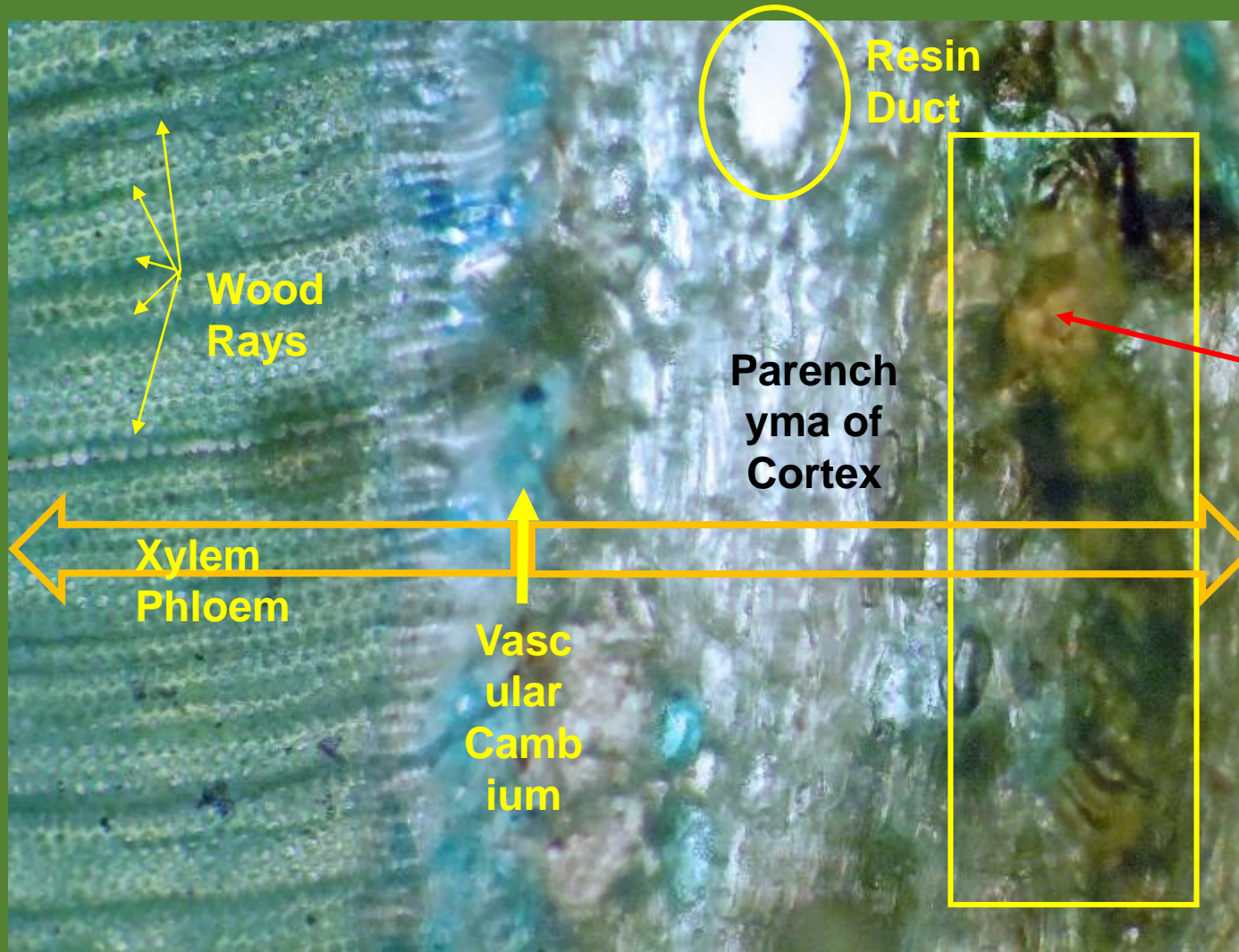
Radial slice



Pits in cross section

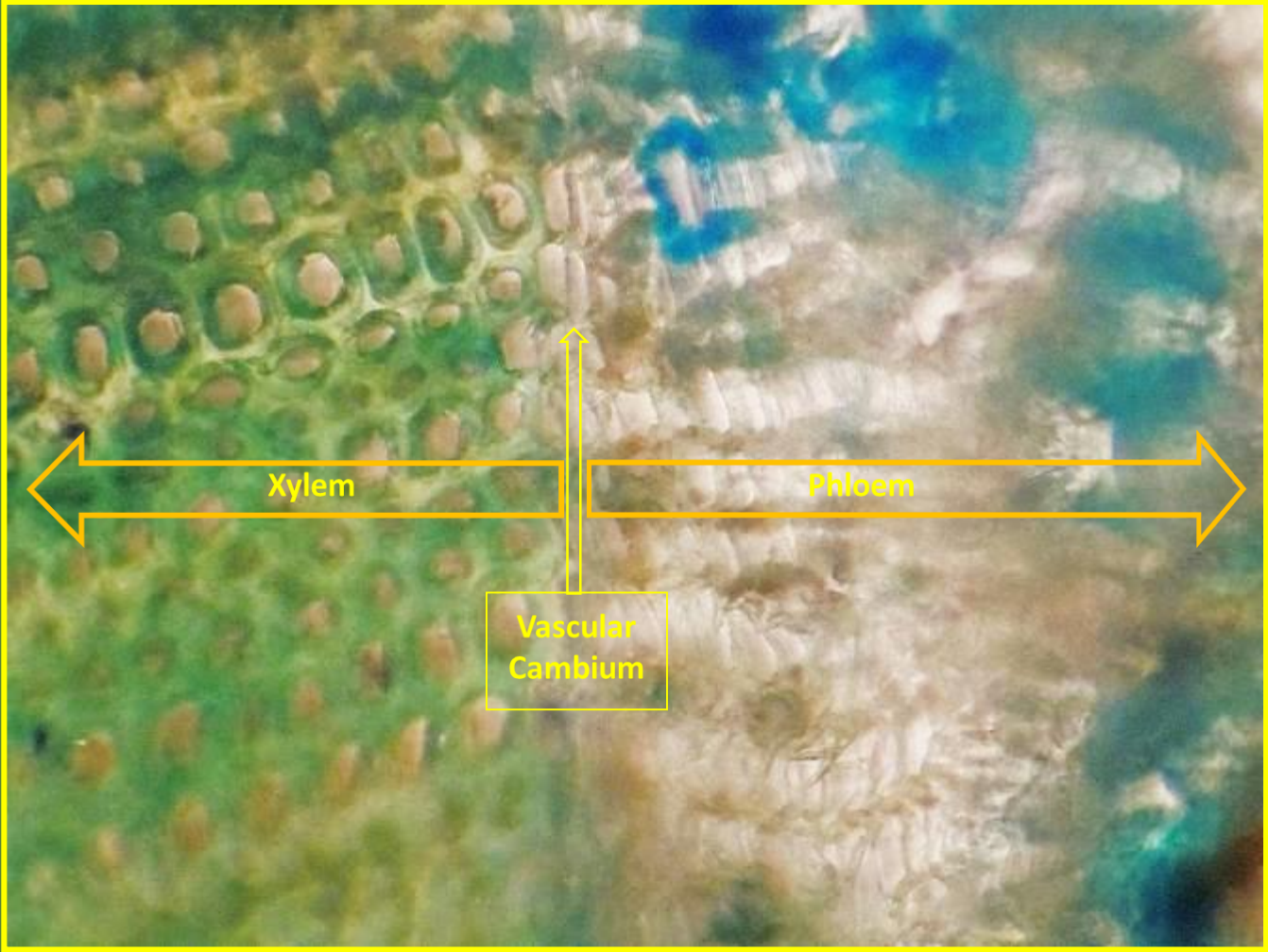


Tangential slice



**Stone cells of
modified Phloem
fibers
(Sclerenchyma)**

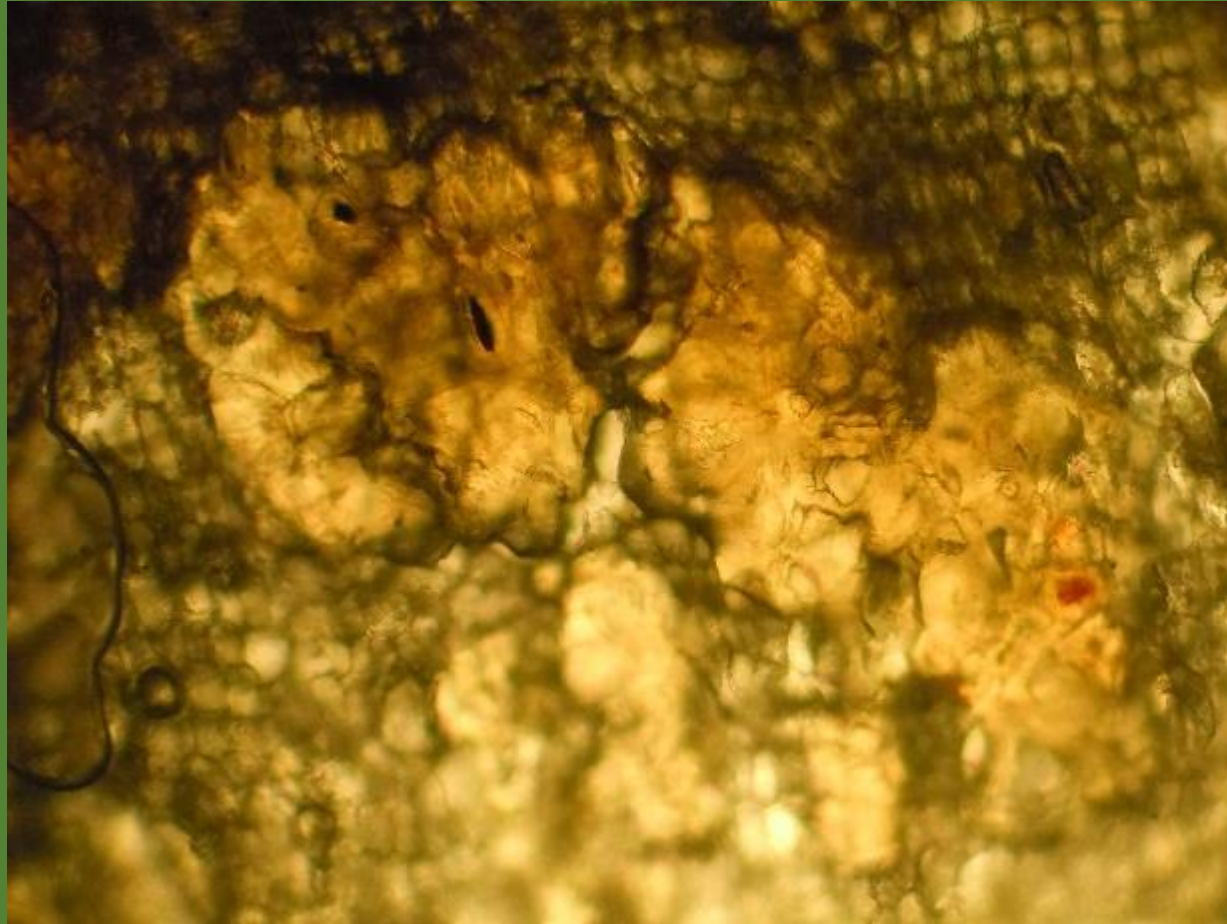




**3 secondary Xylem cells
with thick cell walls for
conducting water from
roots up stem = wood
tracheids (cross section)**

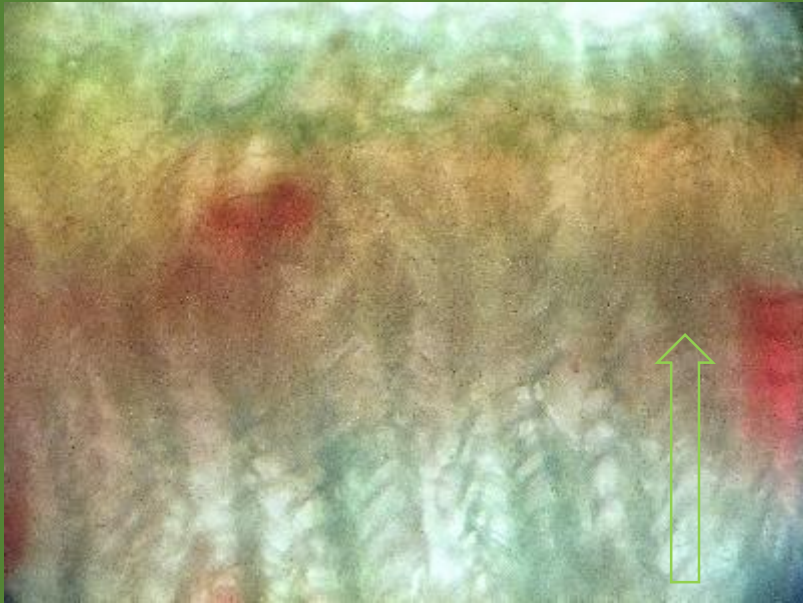
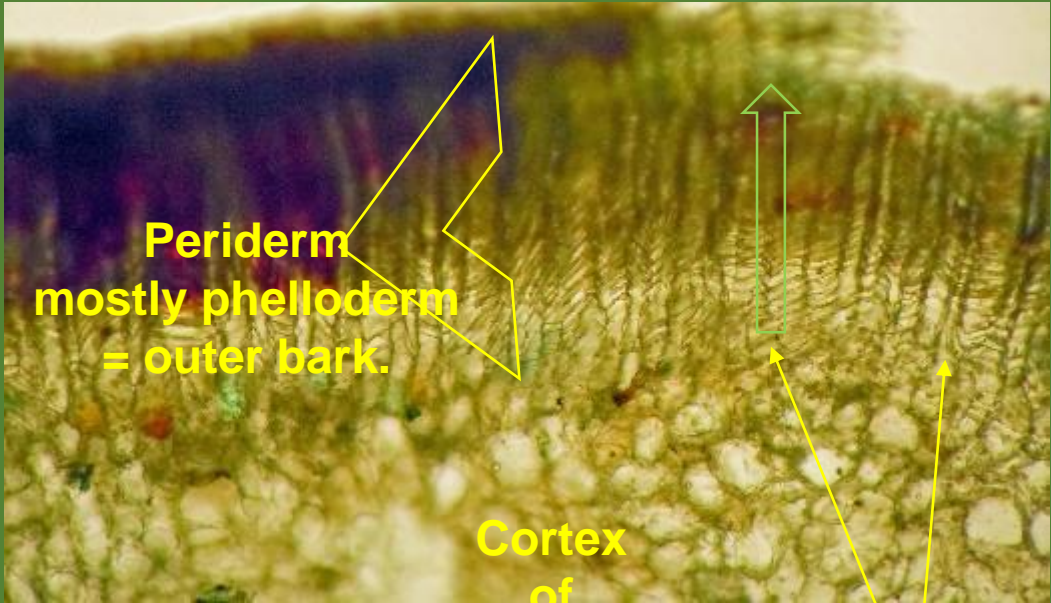


**Cross
section**

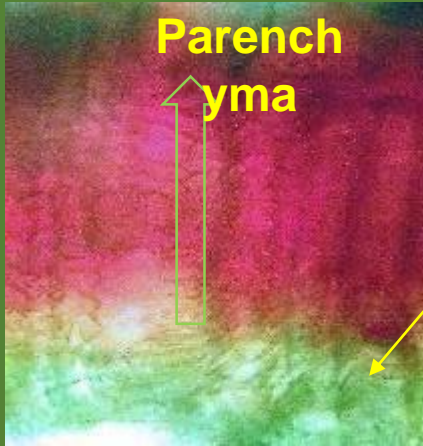


**Stone
cells of
modified
Phloem
fibers in
Cortex**

**Cross
sectio
n**

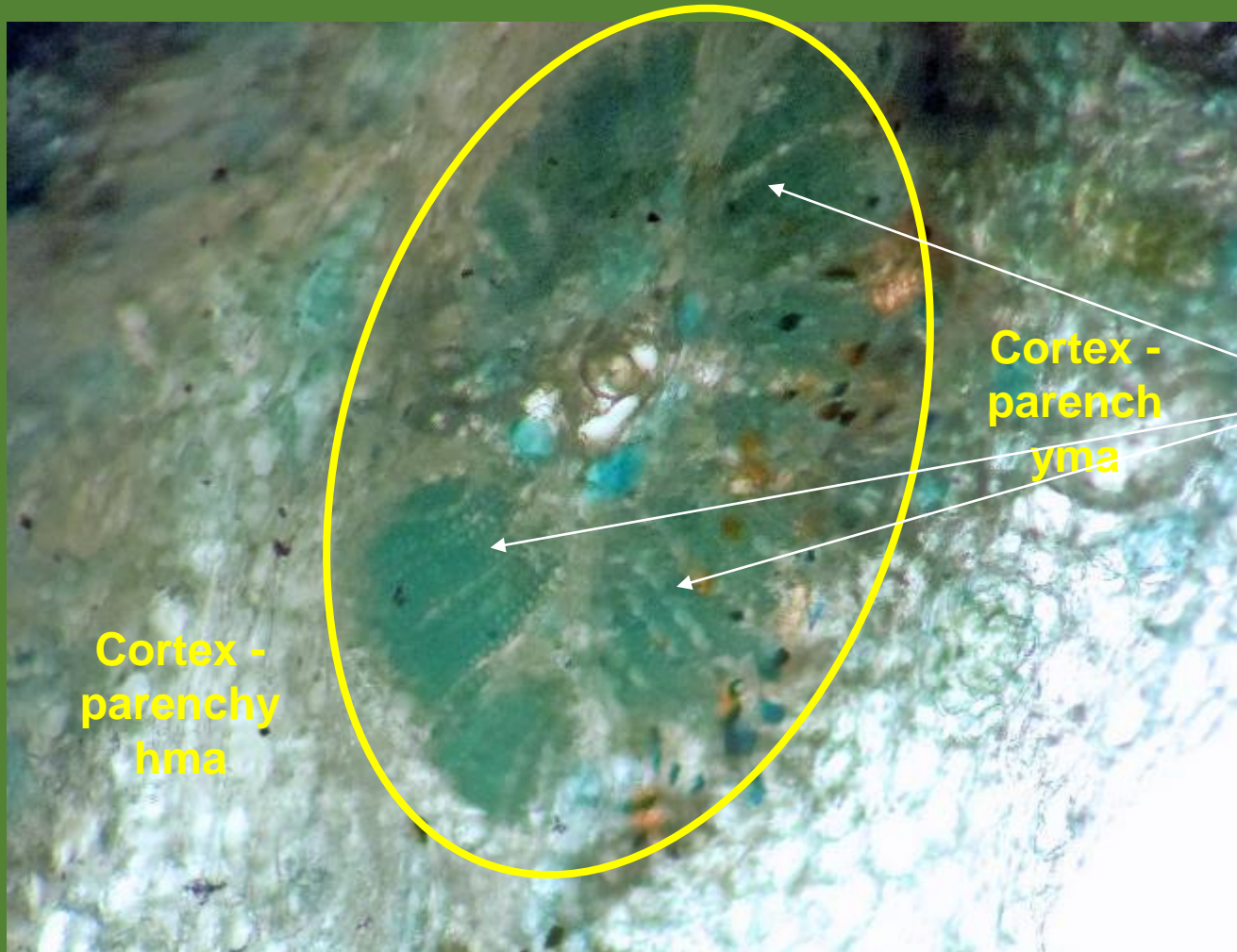


Cross
section
n



Cork Cambium

Periderm or bark
(colored red by
Tannins) is produced
by the Cork Cambium
(Phellogen) & the cells
are stacked and
squashed as
Phelloderm

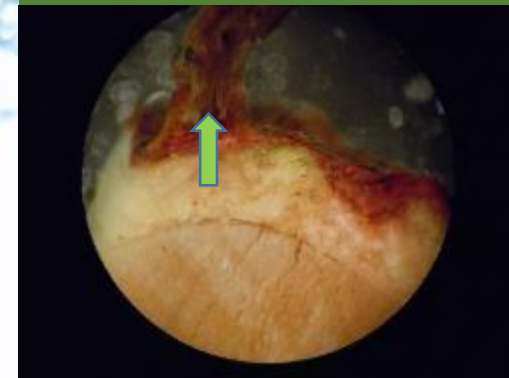


Cortex -
parenchy
hma

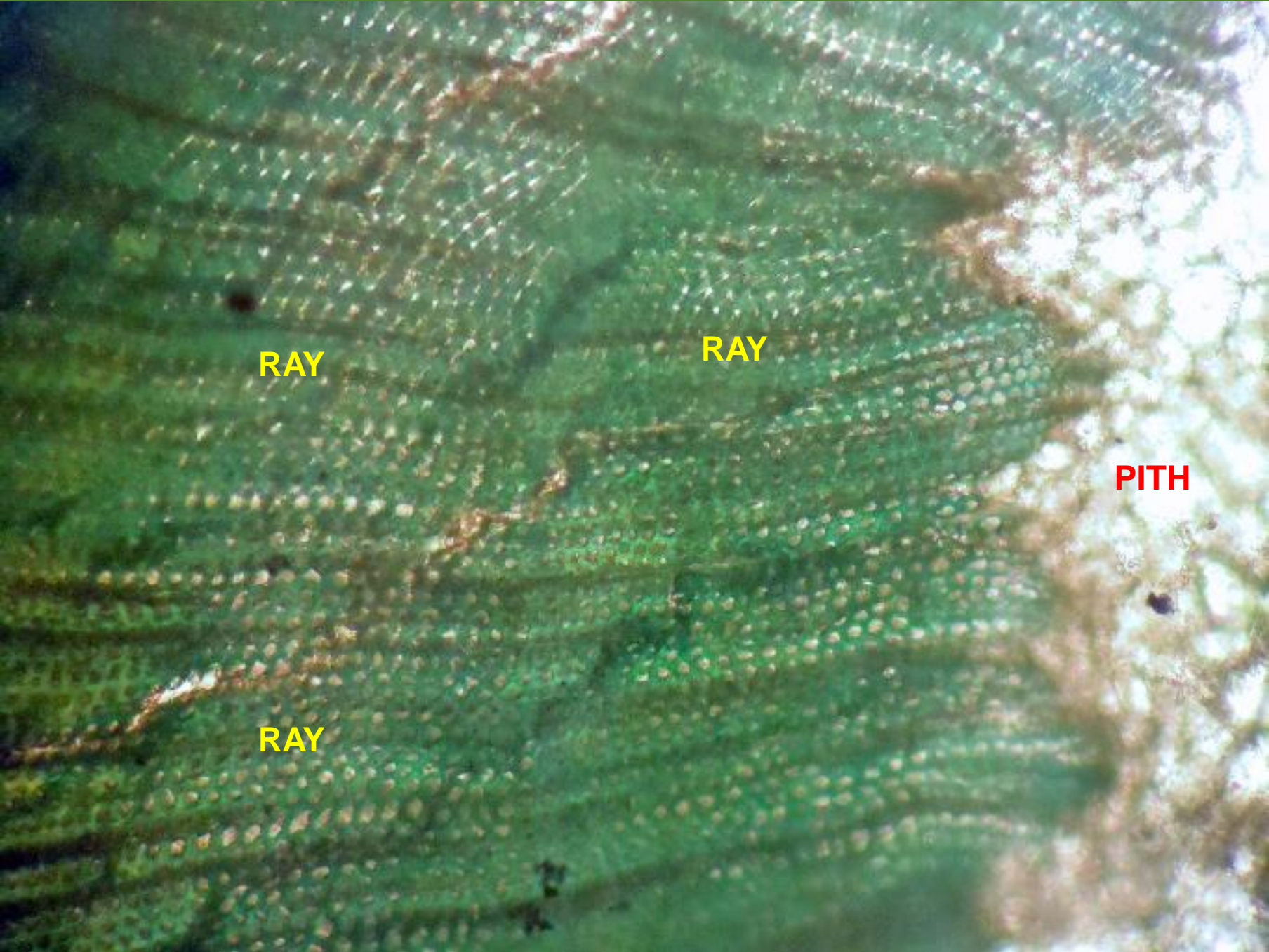
Cortex -
parench
yma

Cross
section

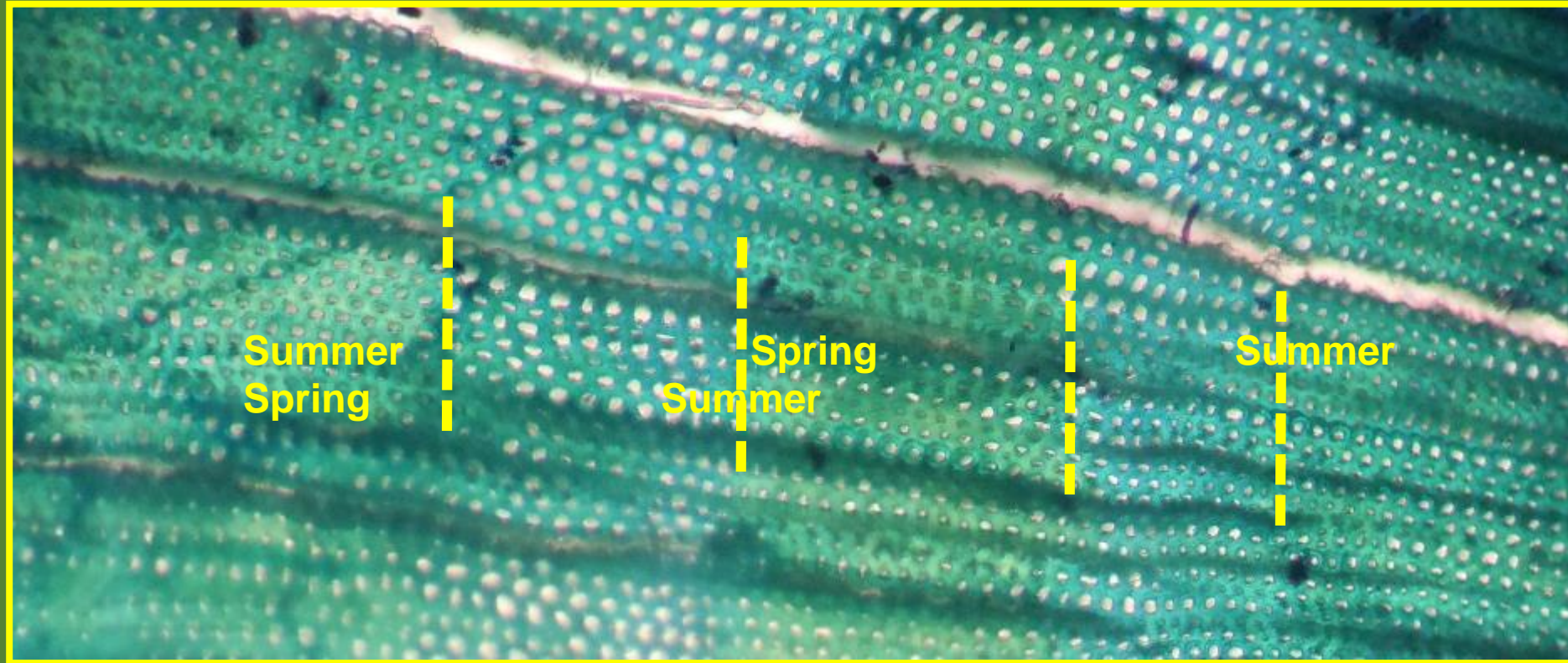
Leaf trace of
Xylem in Cortex
of 2dary Phloem

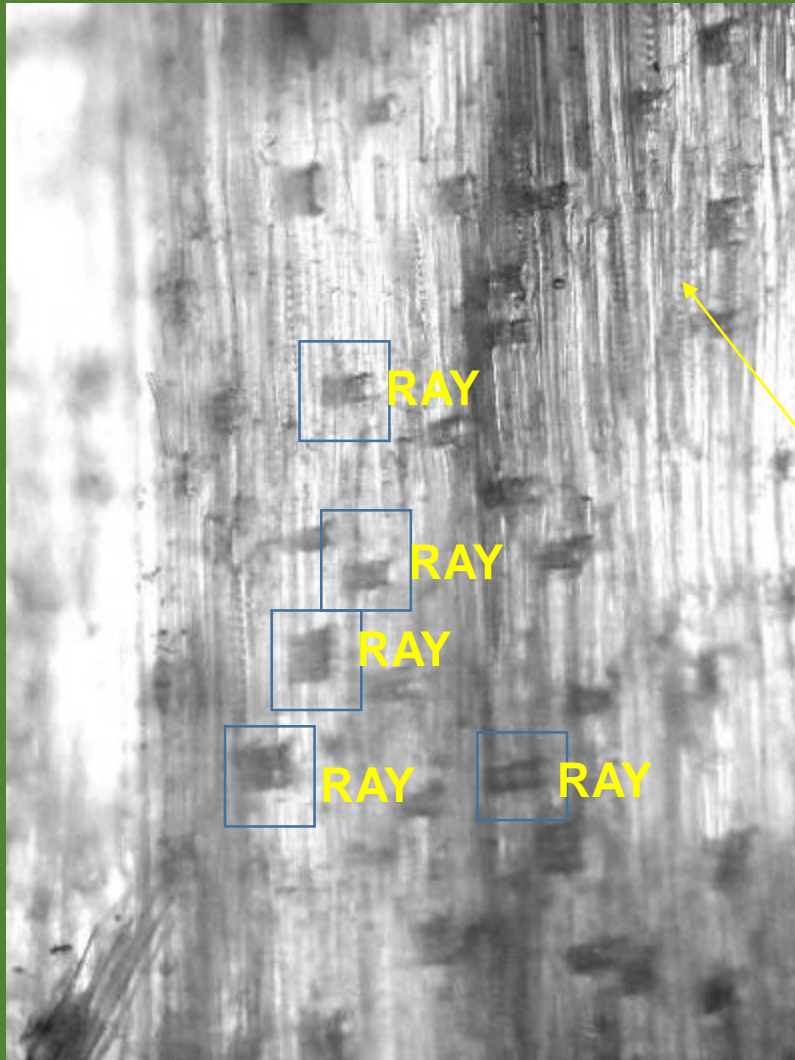


Cross section

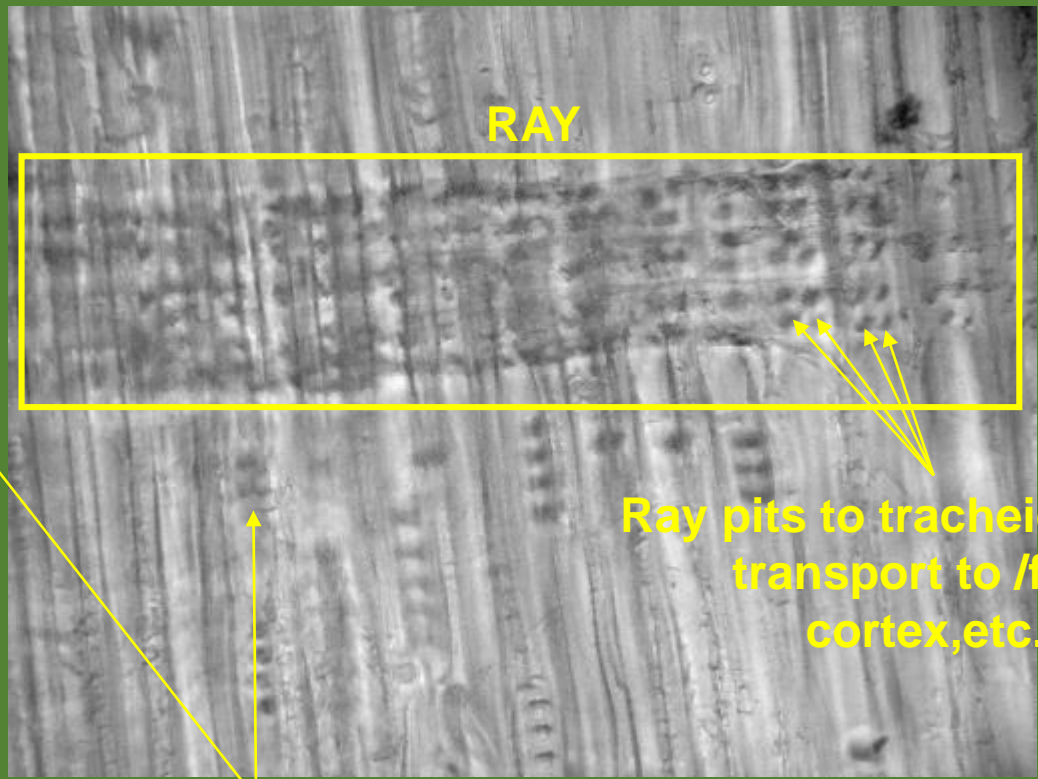


Annular growth rings (2.5
years shown)





Tangential Section



Ray pits to tracheids (water transport to /from cortex, etc.)

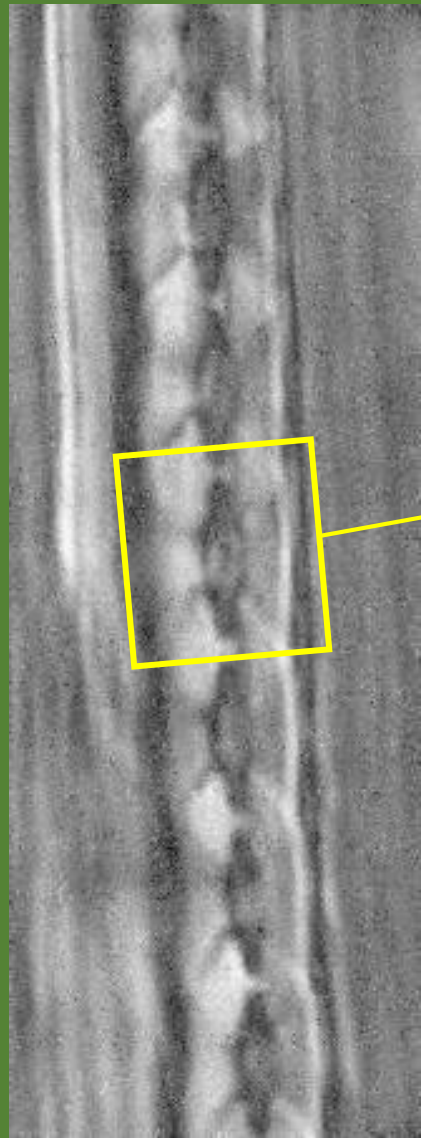
Radial Section

Vertical Xylem Tracheids, many with pits (no vessel elements in conifer wood)

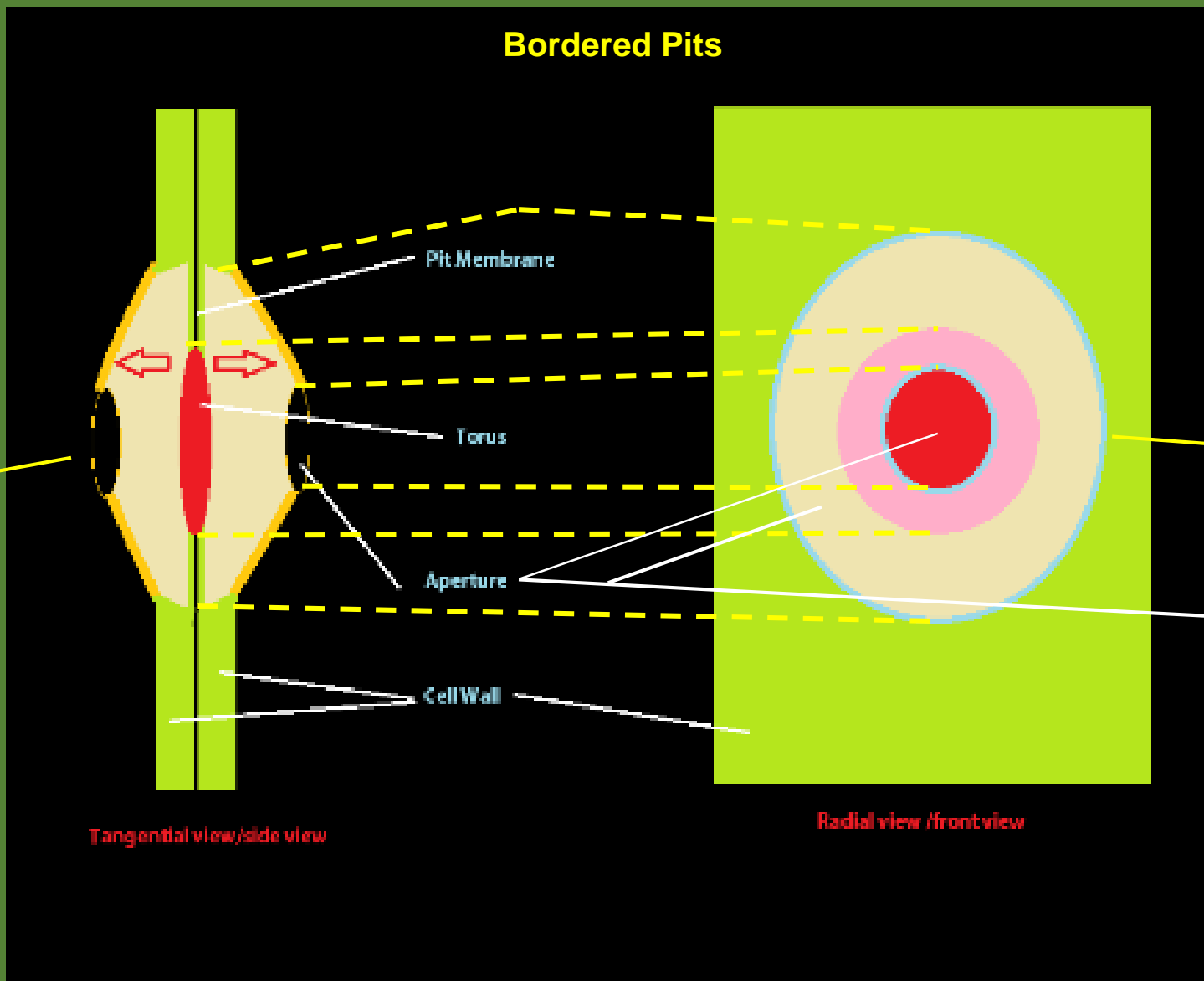


**Cs of ray in
tangential section**

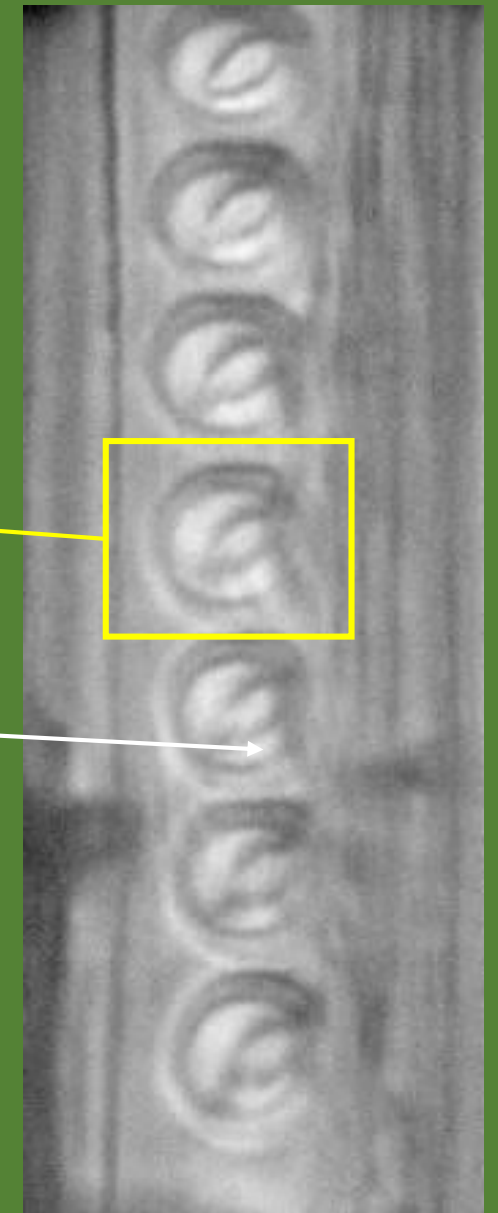
Tangential section



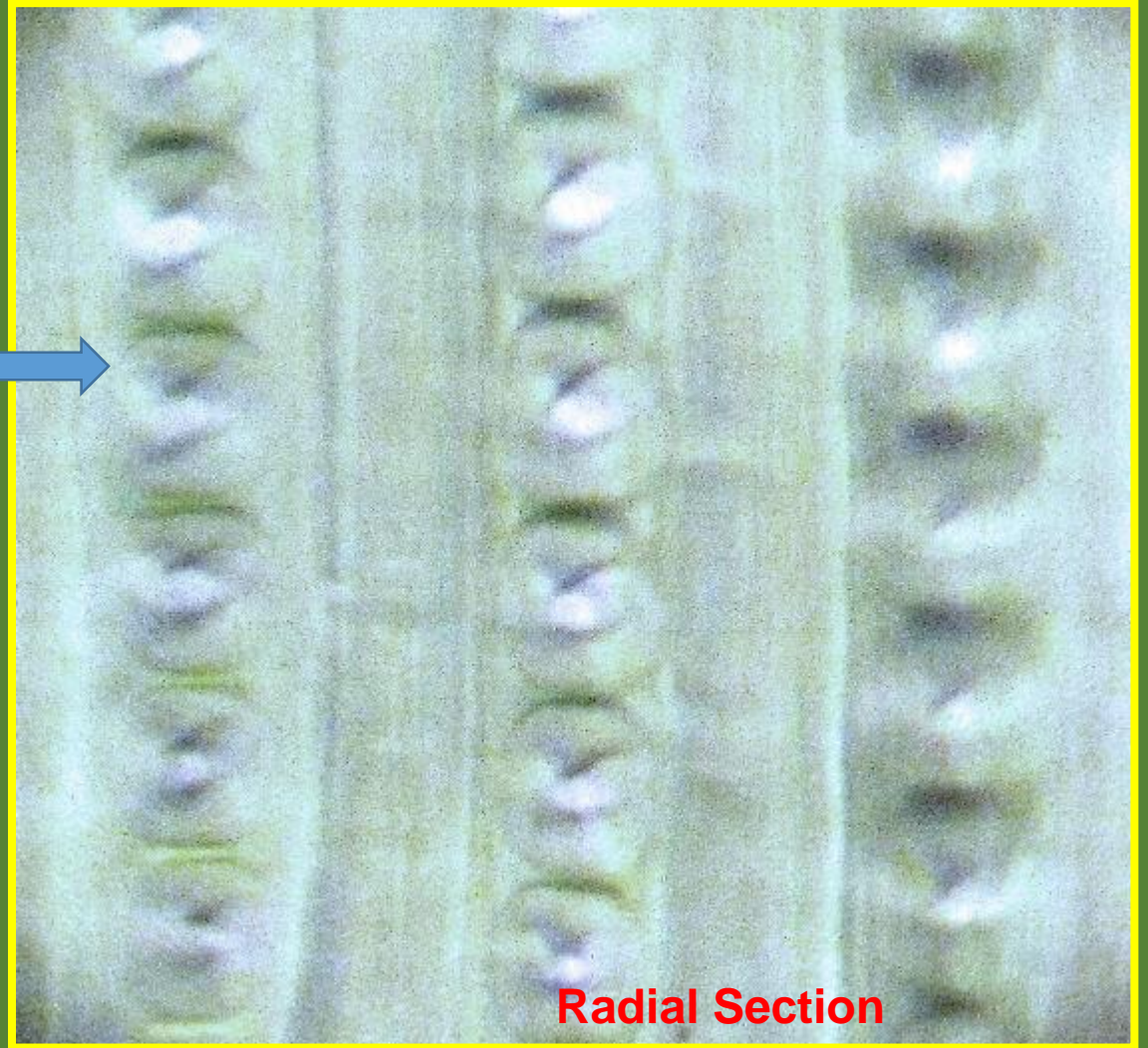
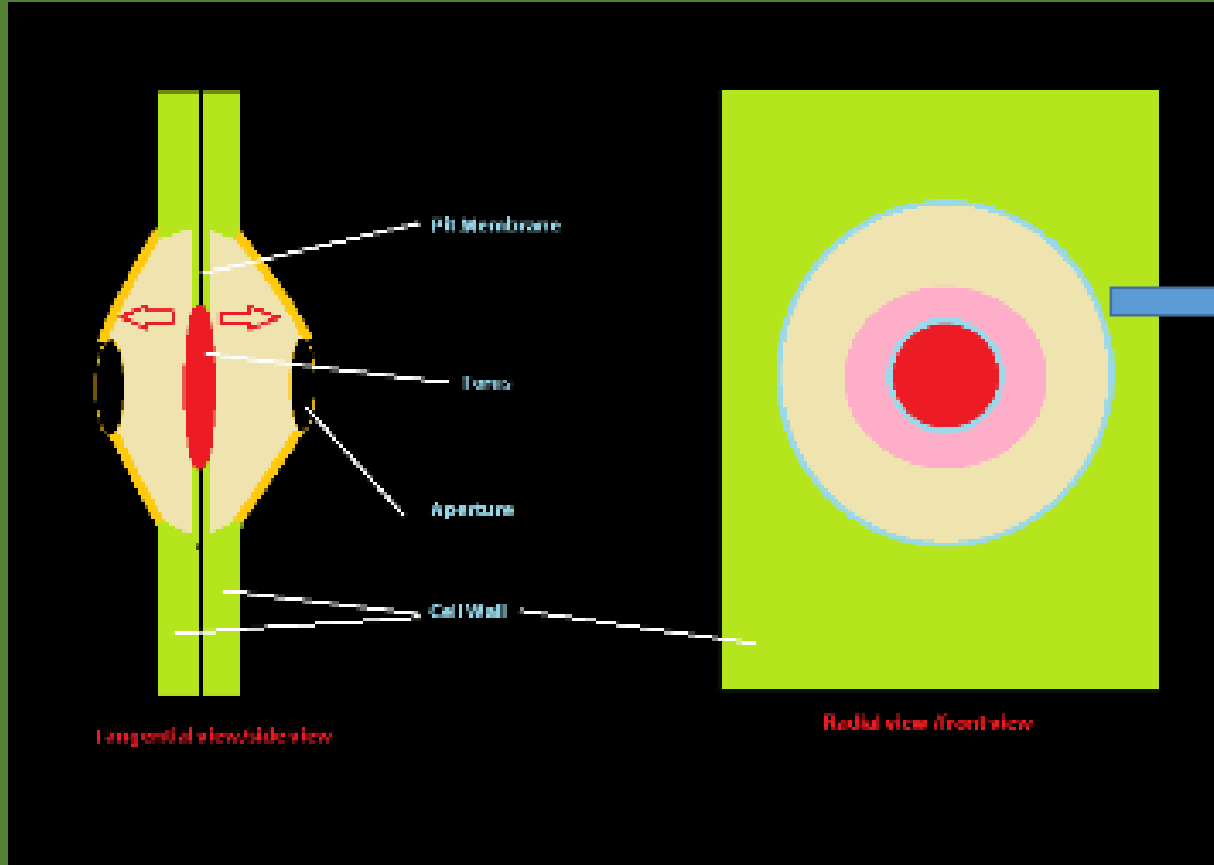
Tangential section



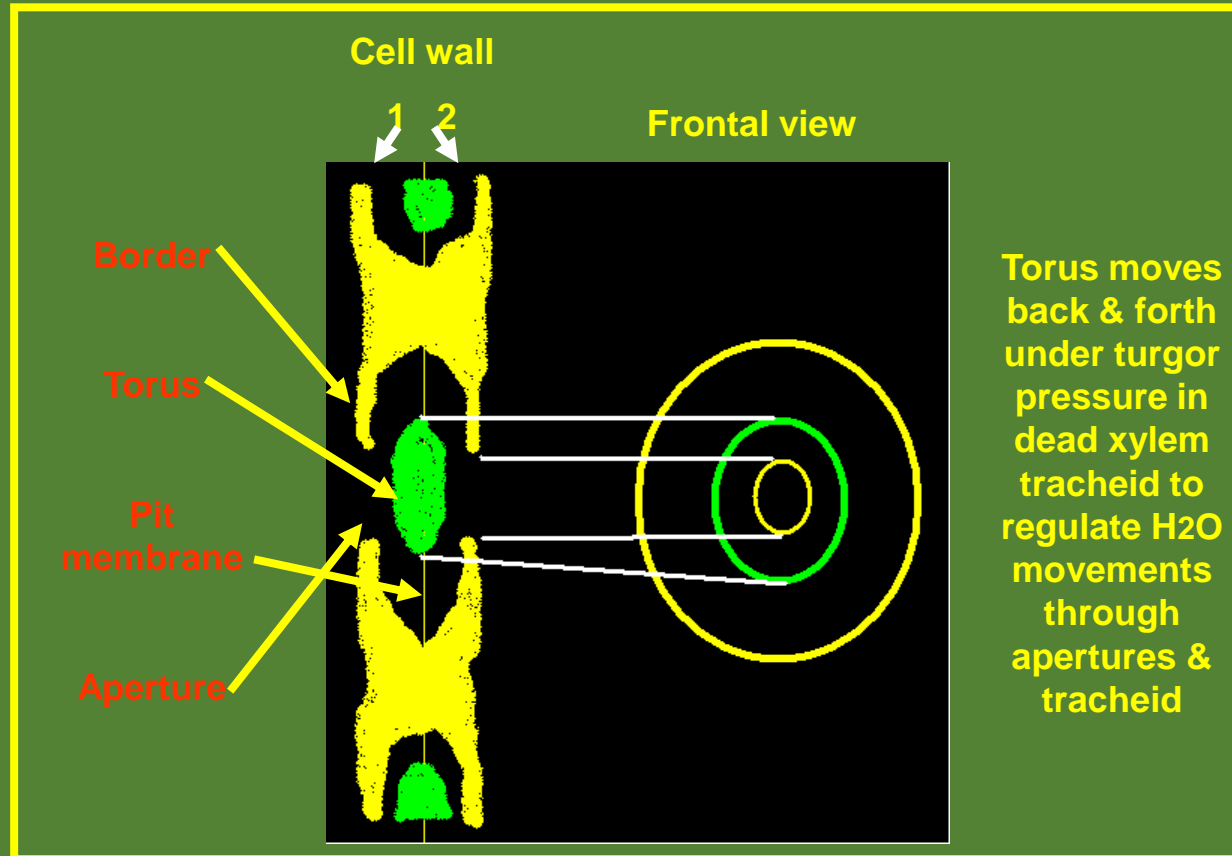
Torus and membrane move back-and-forth with turgor pressure to allow water to pass to other tracheids



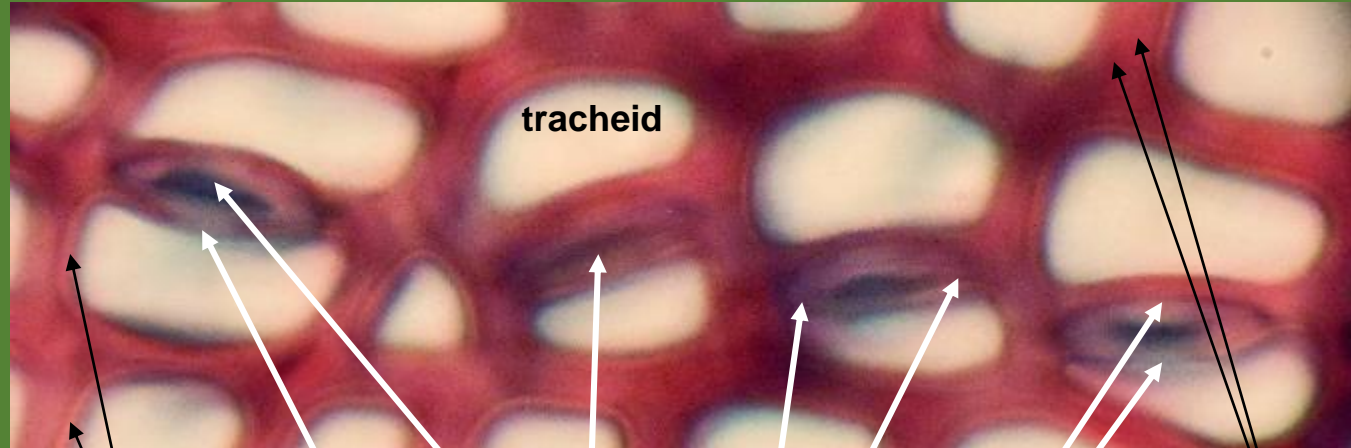
Radial Section



BORDERED PITS in transfusion tissue & xylem (tracheids) of wood in stem



Cross section



tracheid

Secondary cell wall

Torus

Primary cell wall

Pit membrane (middle lamella)

Secondary XYLEM made of Tracheids: showing **Bordered Pits** in pine stem wood cross section

Aperture

**Spiral leaf
arrangement**



