

+

S

TRACHEOPHYTES

RHYNIOPHYTA

STEM ENATIONS

ZOSTEROPHYLLOPHYTA

**MICROPHYLLS
ENATION THEORY**

LYCOPODIOPHYTA

**PHYLOGENETIC
DEAD-END**

COMPLEX TELOMES

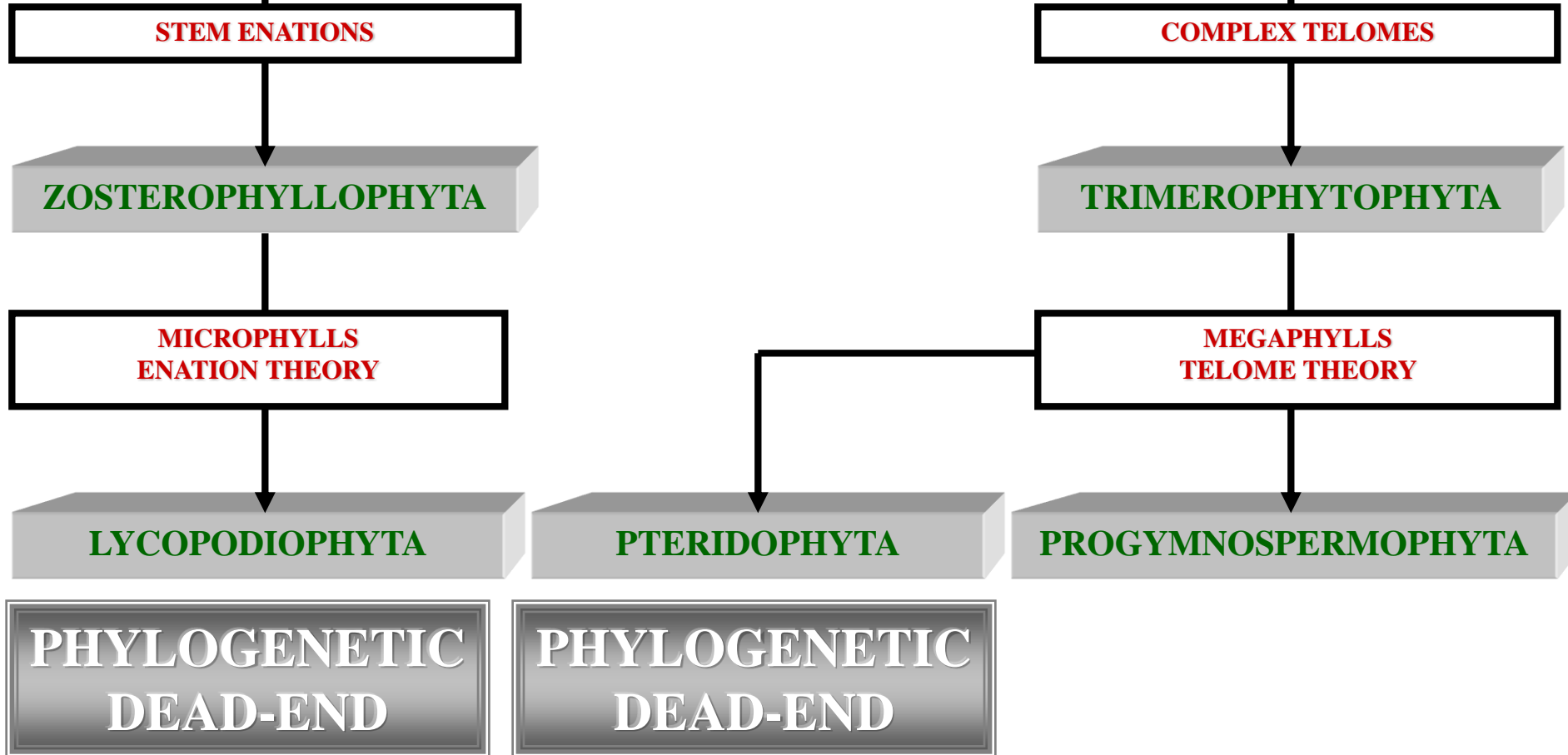
TRIMEROPHYTOPHYTA

**MEGAPHYLLS
TELOME THEORY**

PTERIDOPHYTA

**PHYLOGENETIC
DEAD-END**

PROGYMNOSPERMOPHYTA



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DEAD-END**

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TRIMEROPHYTOPHYTA

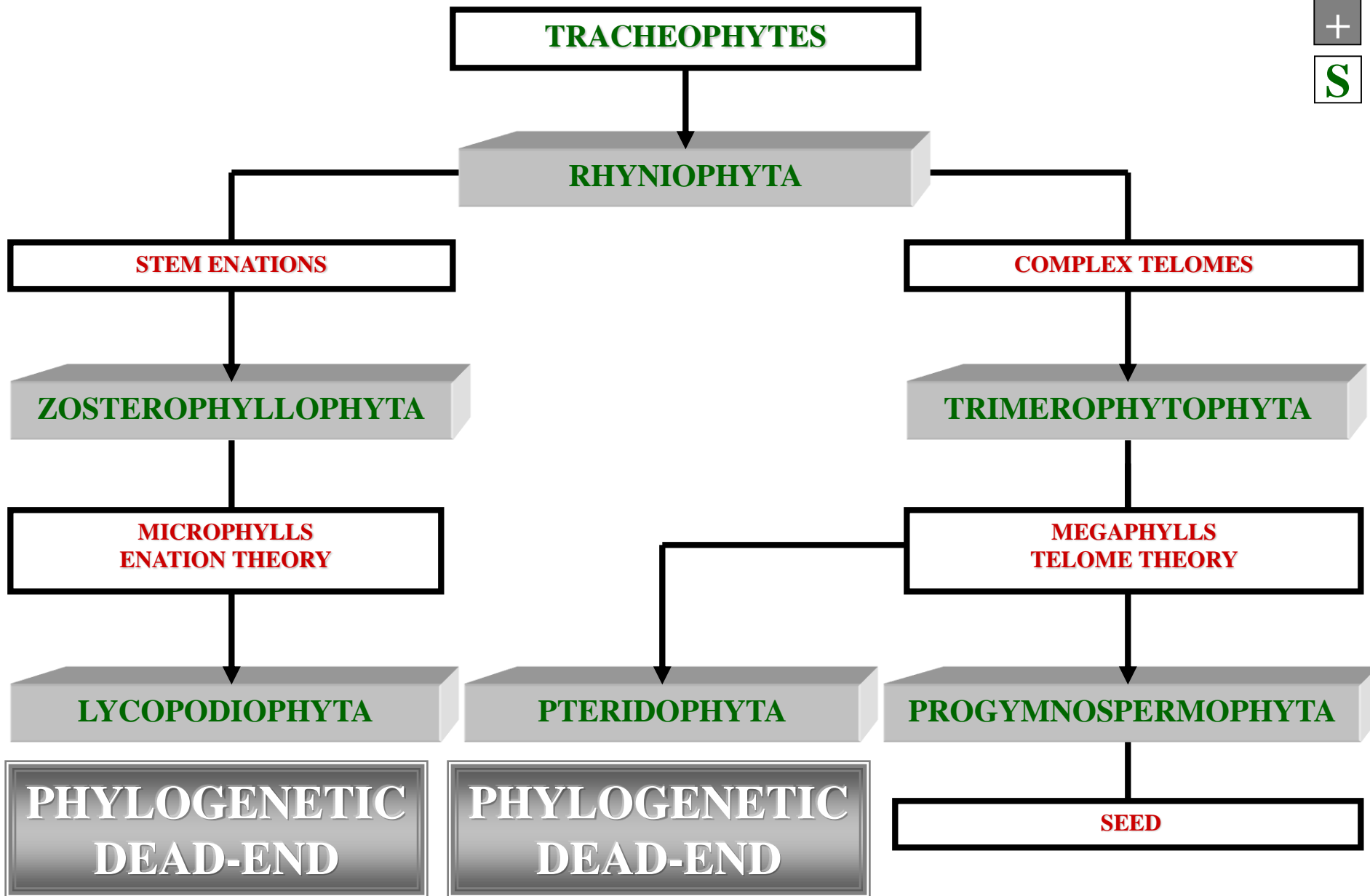
**MEGAPHYLLS
TELOME THEORY**

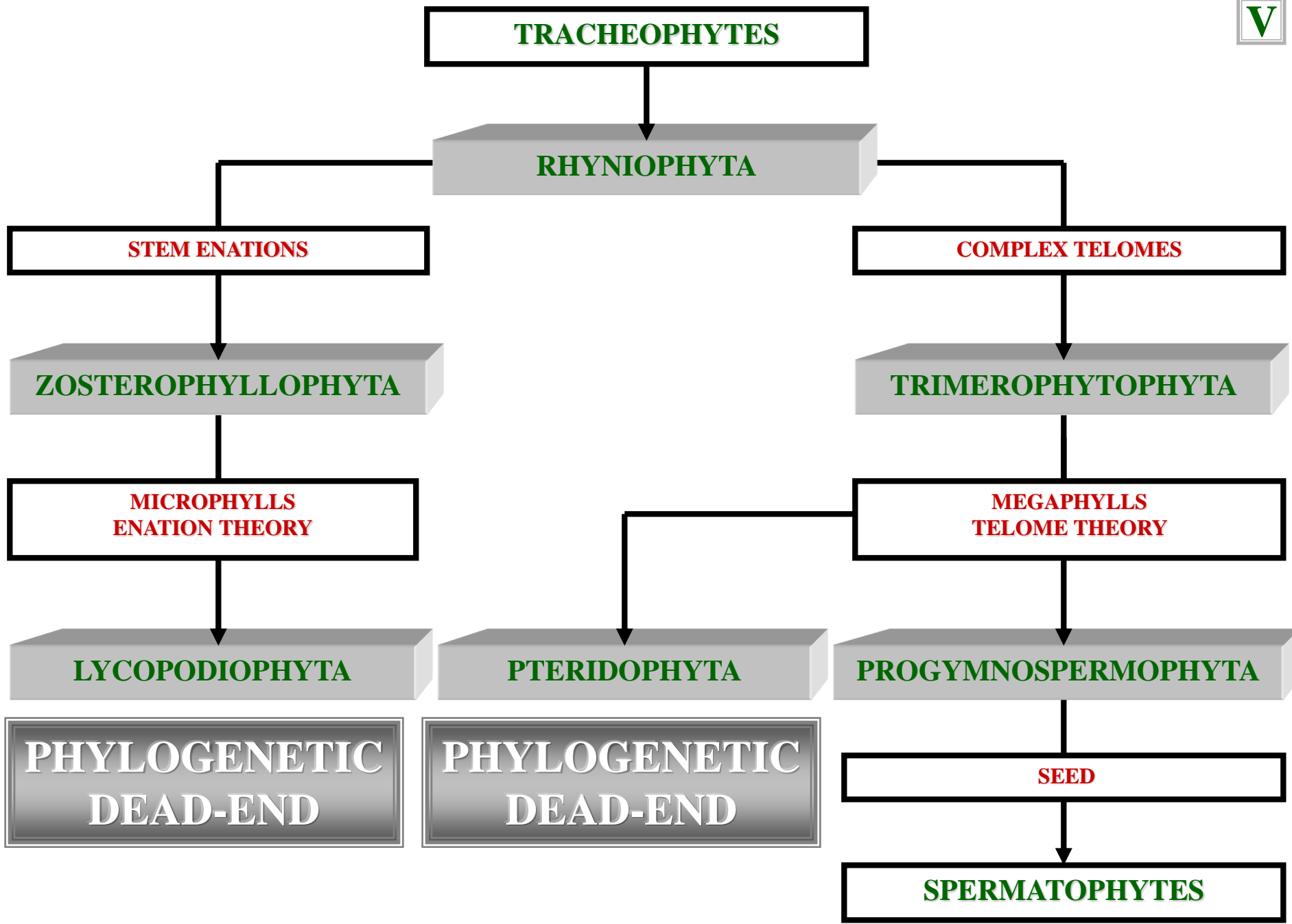
PTERIDOPHYTA

**PHYLOGENETIC
DEAD-END**

PROGYMNOSPERMOPHYTA

SEED







VASCULAR PLANT EVOLUTION



~360

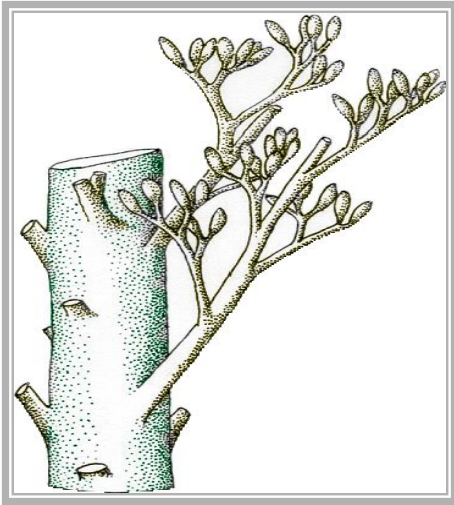
MILLION YEARS

A detailed digital reconstruction of a prehistoric landscape. The scene is dominated by large, lush green trees with fern-like foliage. In the foreground, a large, dark, scaly dinosaur is partially visible, standing near a body of water. The background shows rolling hills and mountains under a blue sky with light clouds. The overall atmosphere is that of a vibrant, ancient world.

~360 MILLION YEARS AGO

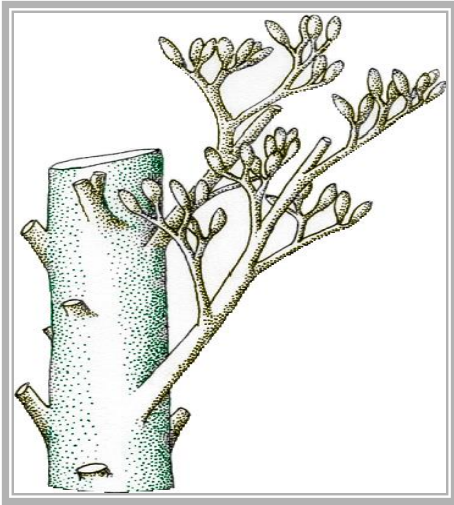
SPERMATOPHYTES EVOLVE

SPERMATOPHYTE EVOLUTION



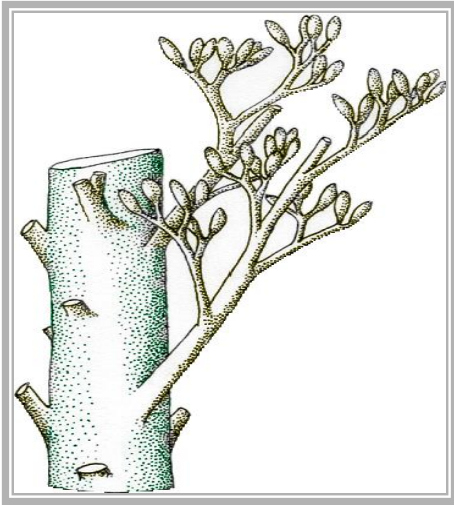
OOCAMPSA

SPERMATOPHYTE EVOLUTION

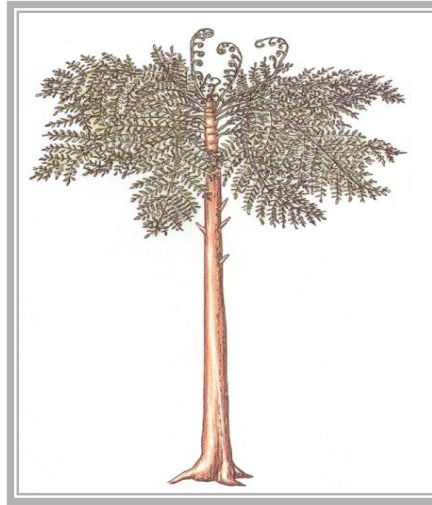


TRIMEROPHYTE

SPERMATOPHYTE EVOLUTION

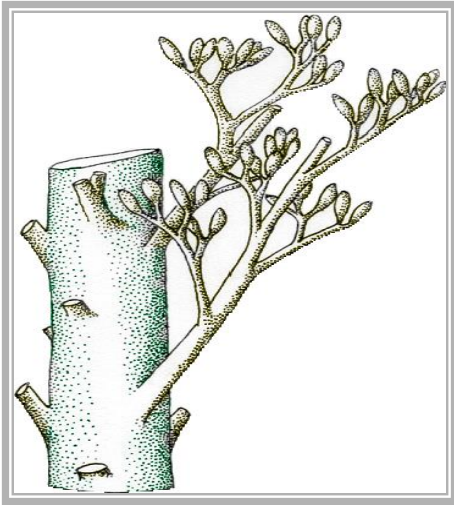


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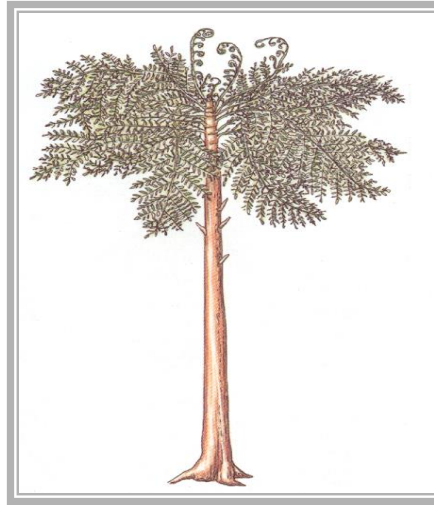


ANEUROPHYTON

SPERMATOPHYTE EVOLUTION

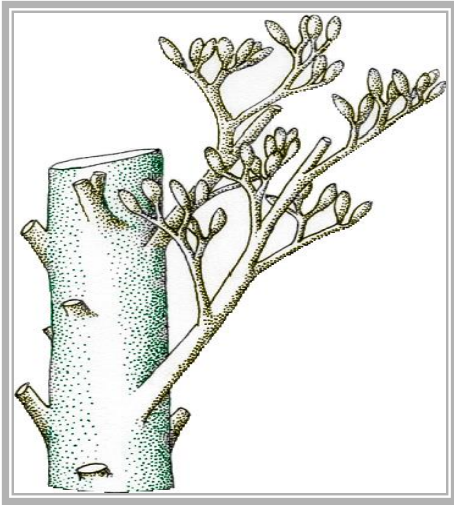


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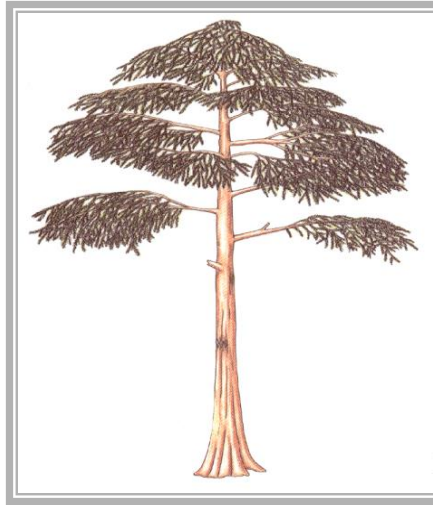


PROGYMNOSPERM

SPERMATOPHYTE EVOLUTION

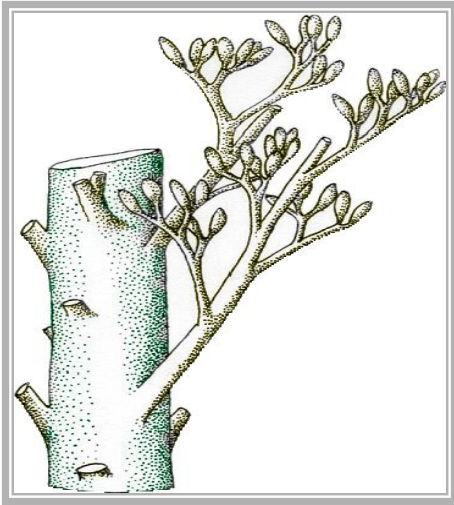


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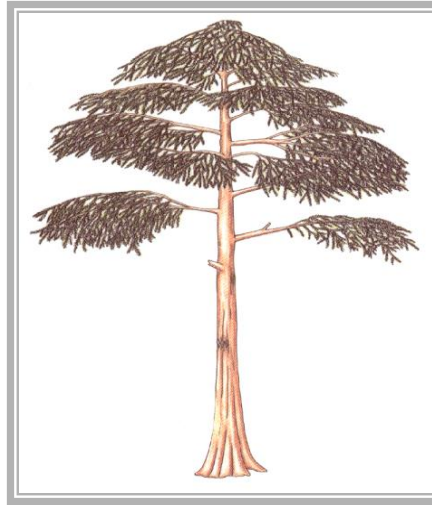


ARCHAEOPTERIS

SPERMATOPHYTE EVOLUTION

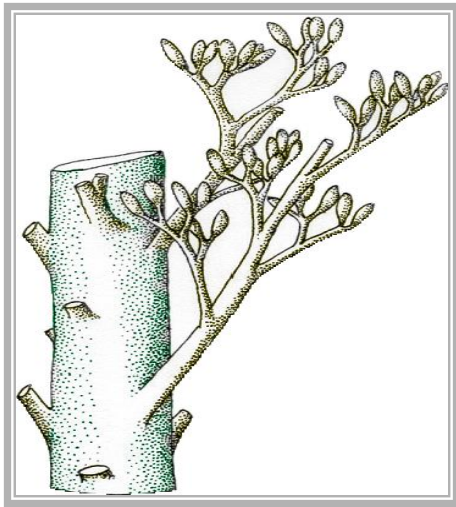


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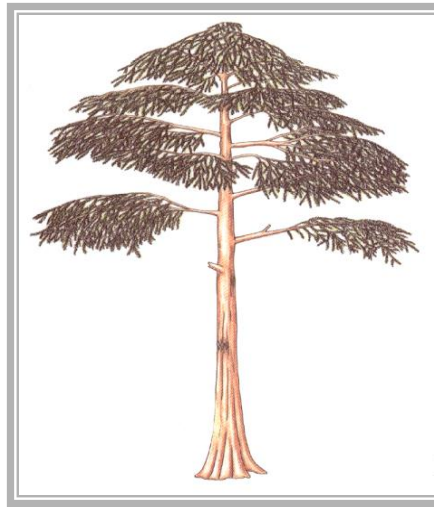


PROGYMNOSPERM

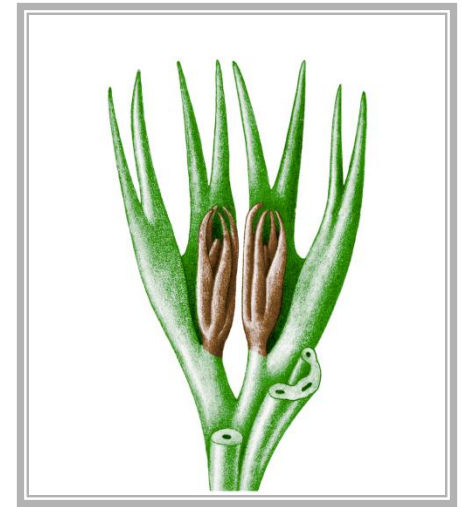
SPERMATOPHYTE EVOLUTION



TRIMEROPHYTE



PROGYMNOSPERM

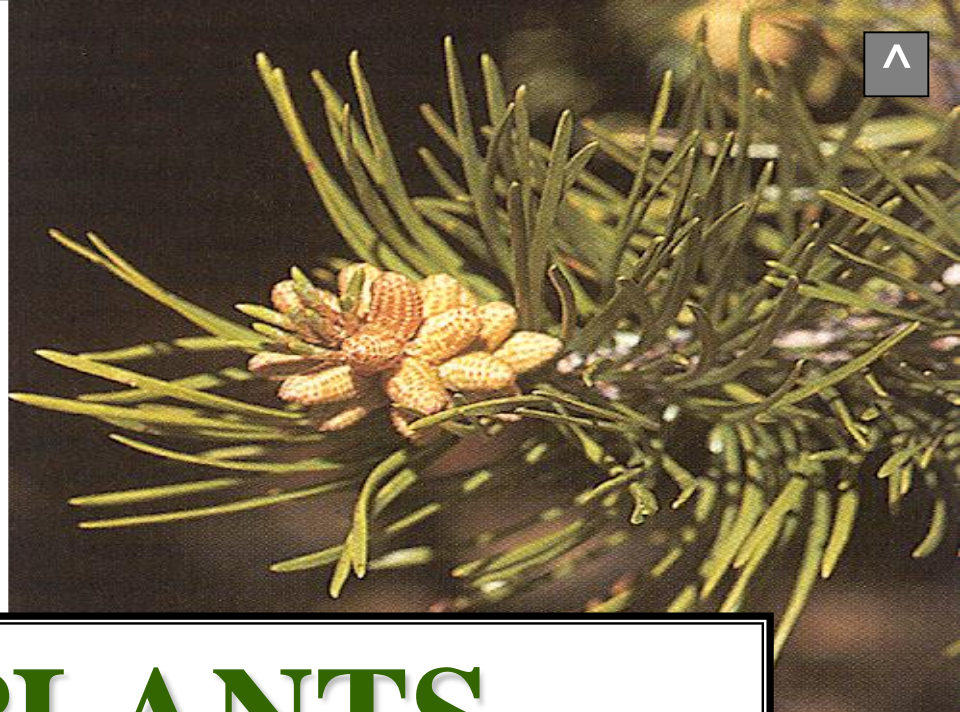


SPERMATOPHYTE



SPERMATOPHYTES

COMMON NAME



SEED PLANTS





DIVERSITY

~285,000 SPECIES

EARTH



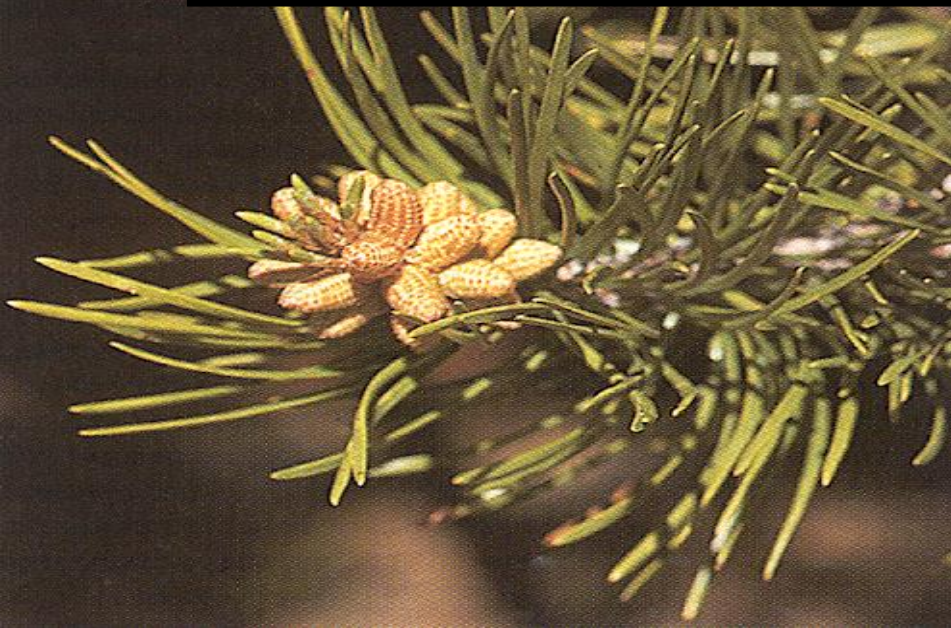
~300,000 SPECIES

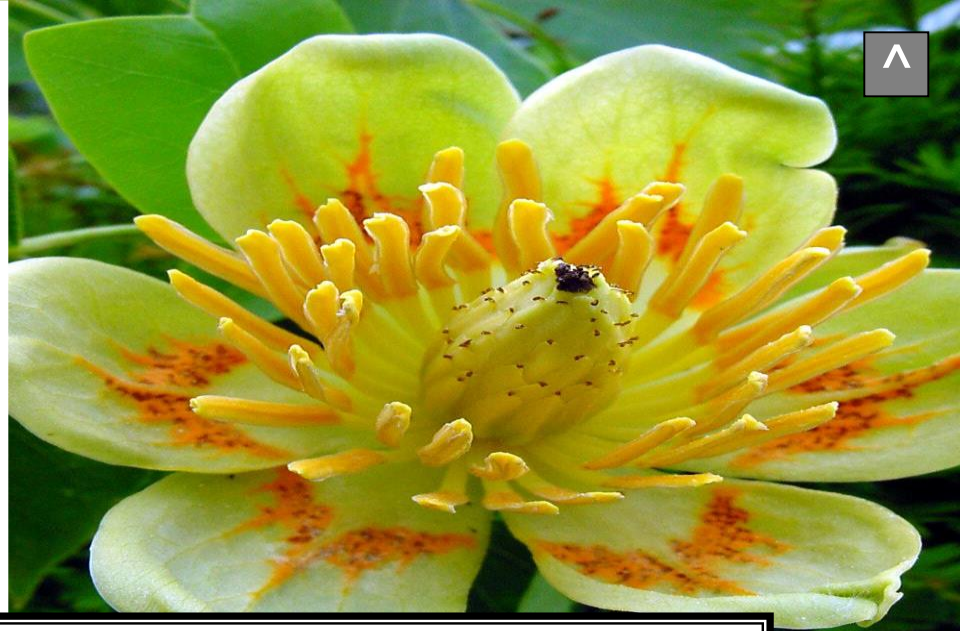
EARTH

SPERMATOPHYTE GRADES



GYMNOSPERMS





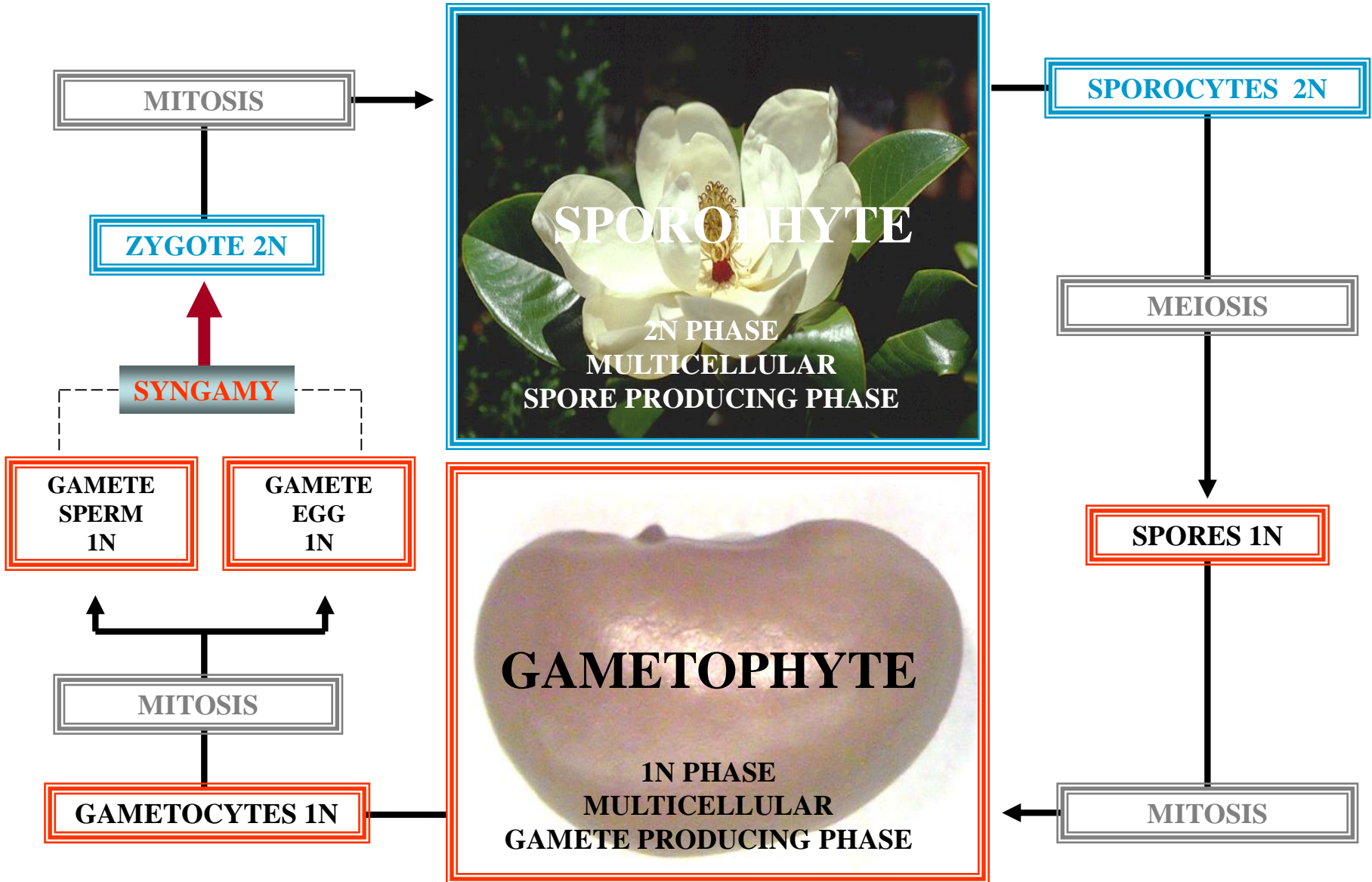
ANGIOSPERMS





GENERAL CHARACTERS

SPERMATOPHYTE LIFE CYCLE



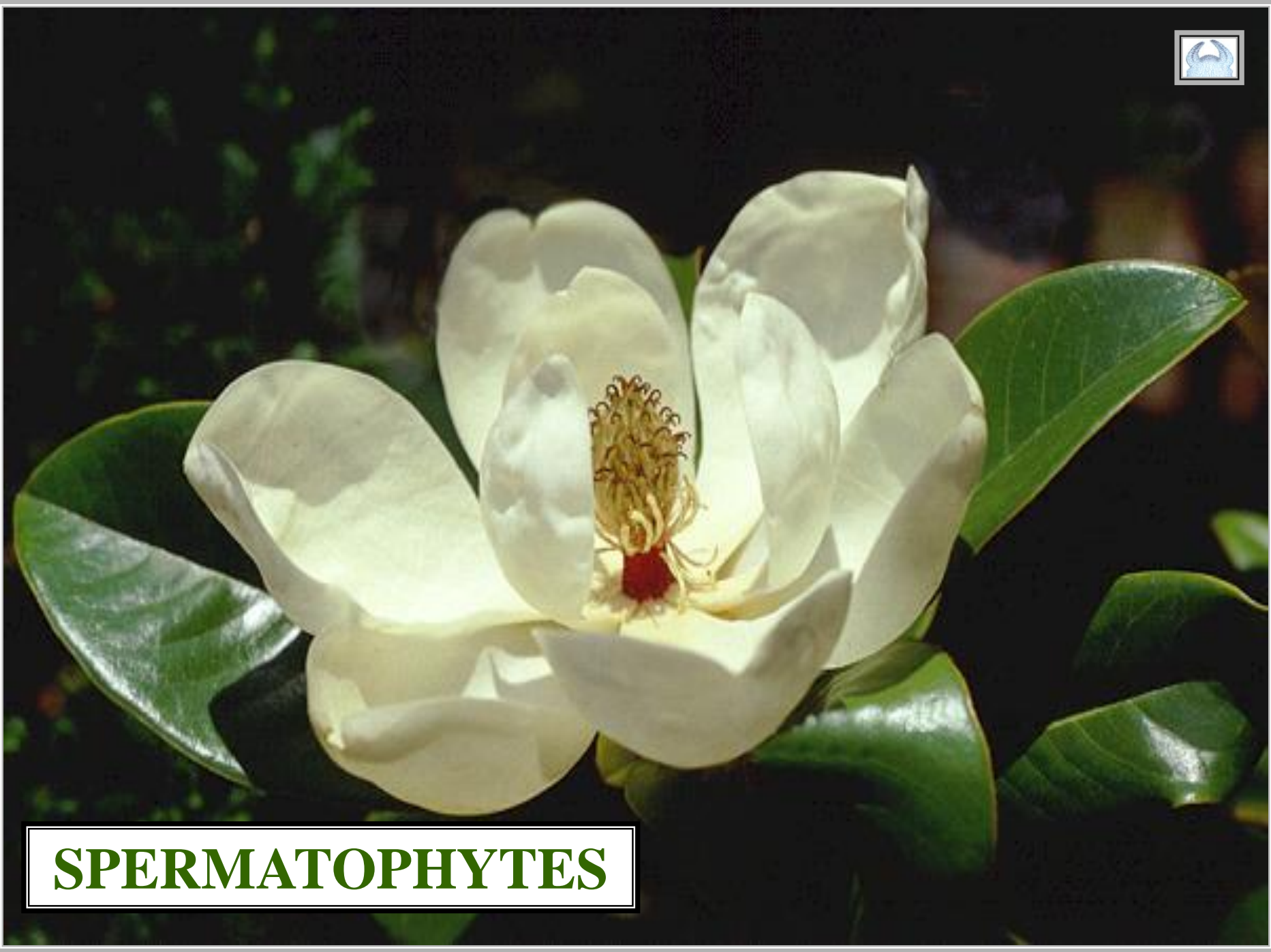


SPOROPHYTE CHARACTERS

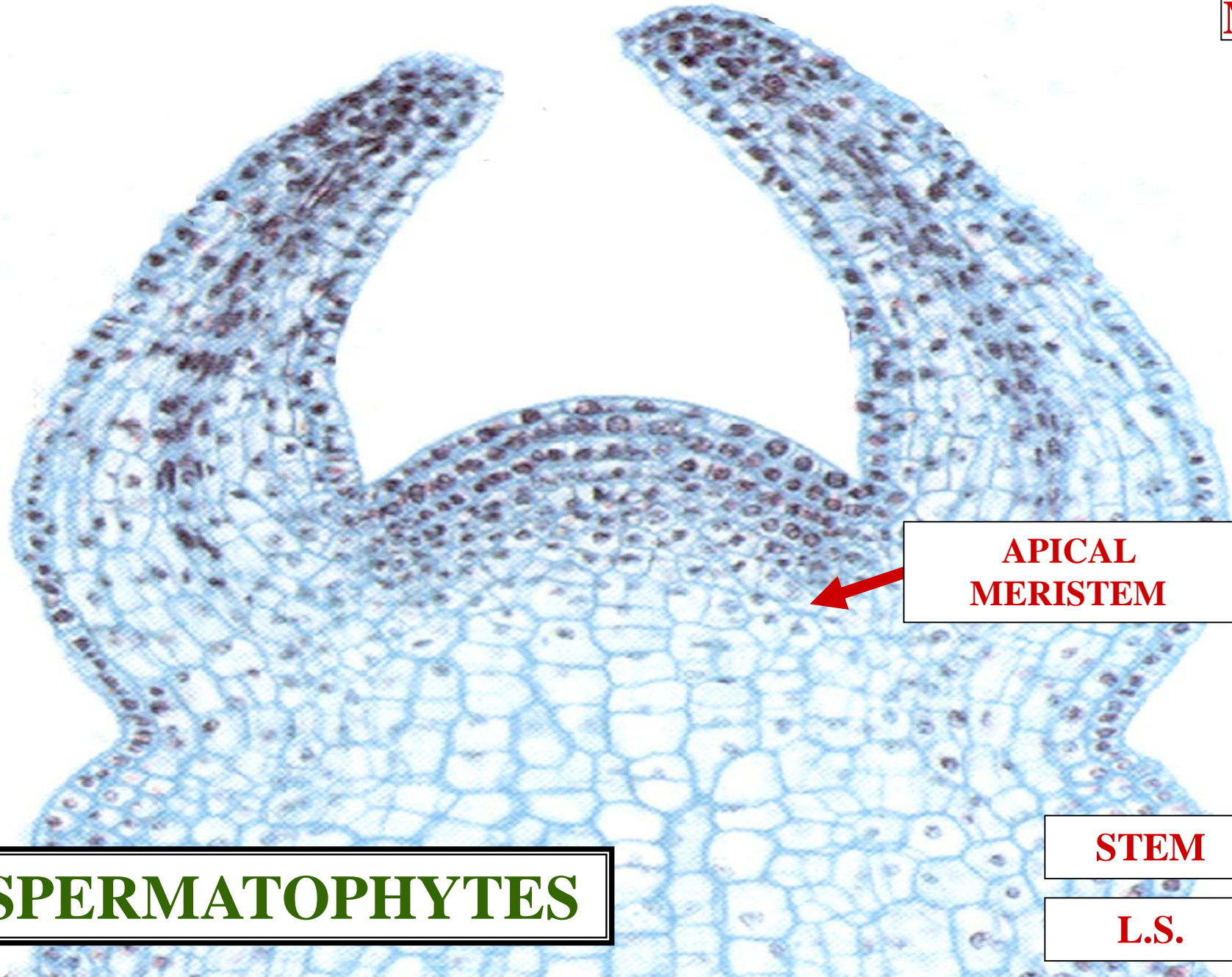
MERISTEM



APICAL MERISTEM



SPERMATOPHYTES

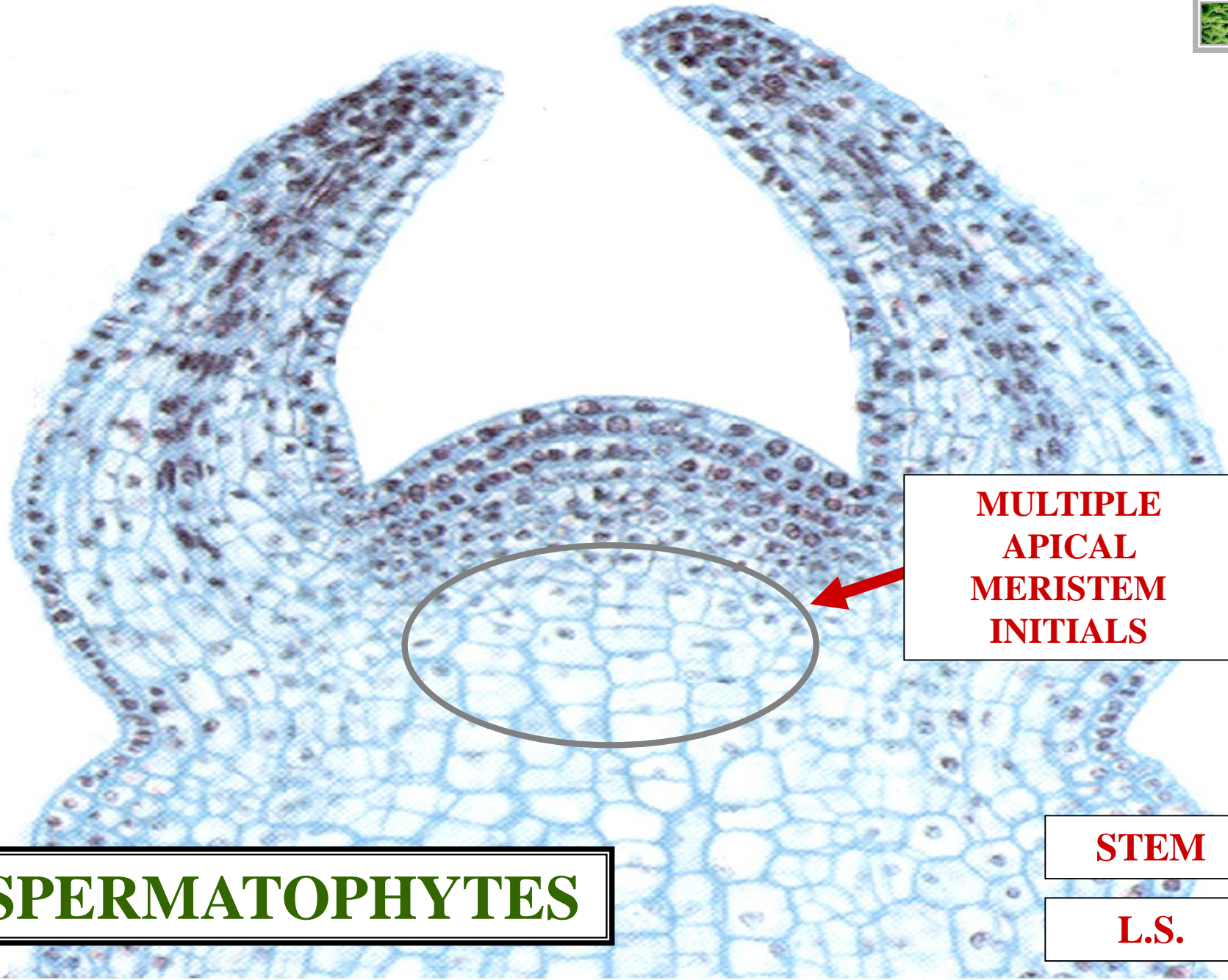


**APICAL
MERISTEM**

STEM

L.S.

SPERMATOPHYTES

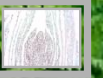


**MULTIPLE
APICAL
MERISTEM
INITIALS**

STEM

L.S.

SPERMATOPHYTES



PTERIDOPHYTES

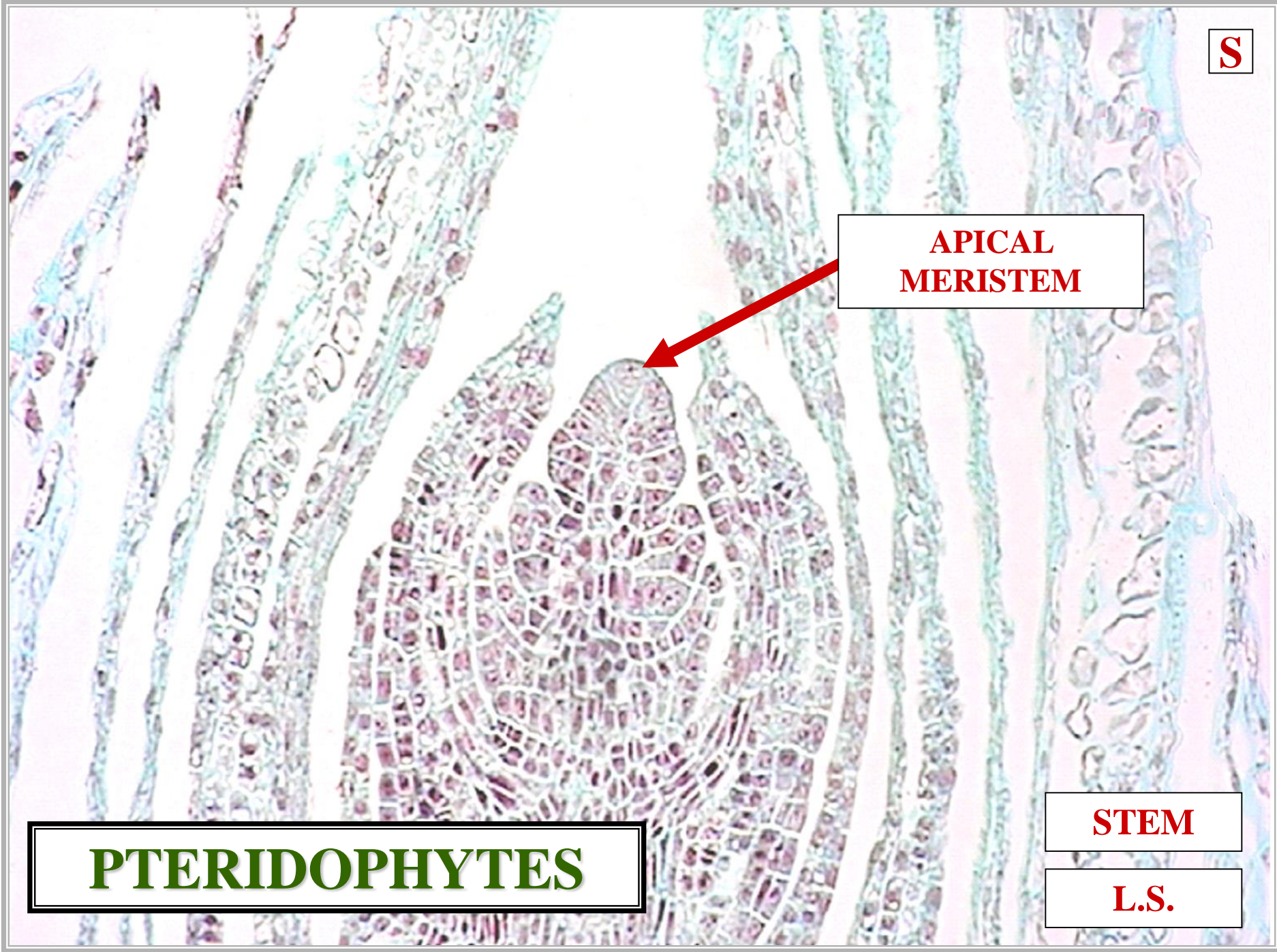
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**APICAL
MERISTEM**

STEM

L.S.

PTERIDOPHYTES



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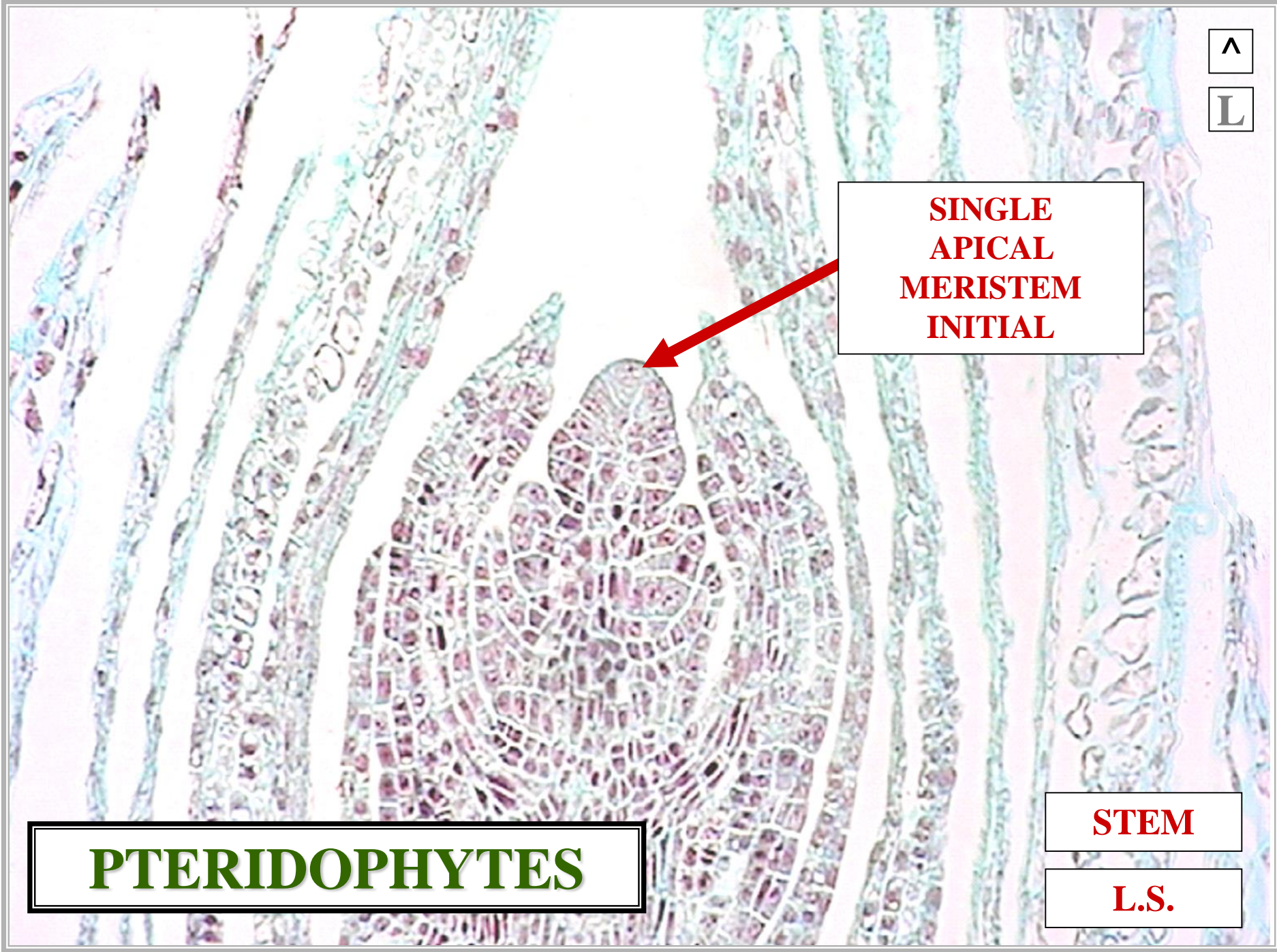
L

**SINGLE
APICAL
MERISTEM
INITIAL**

STEM

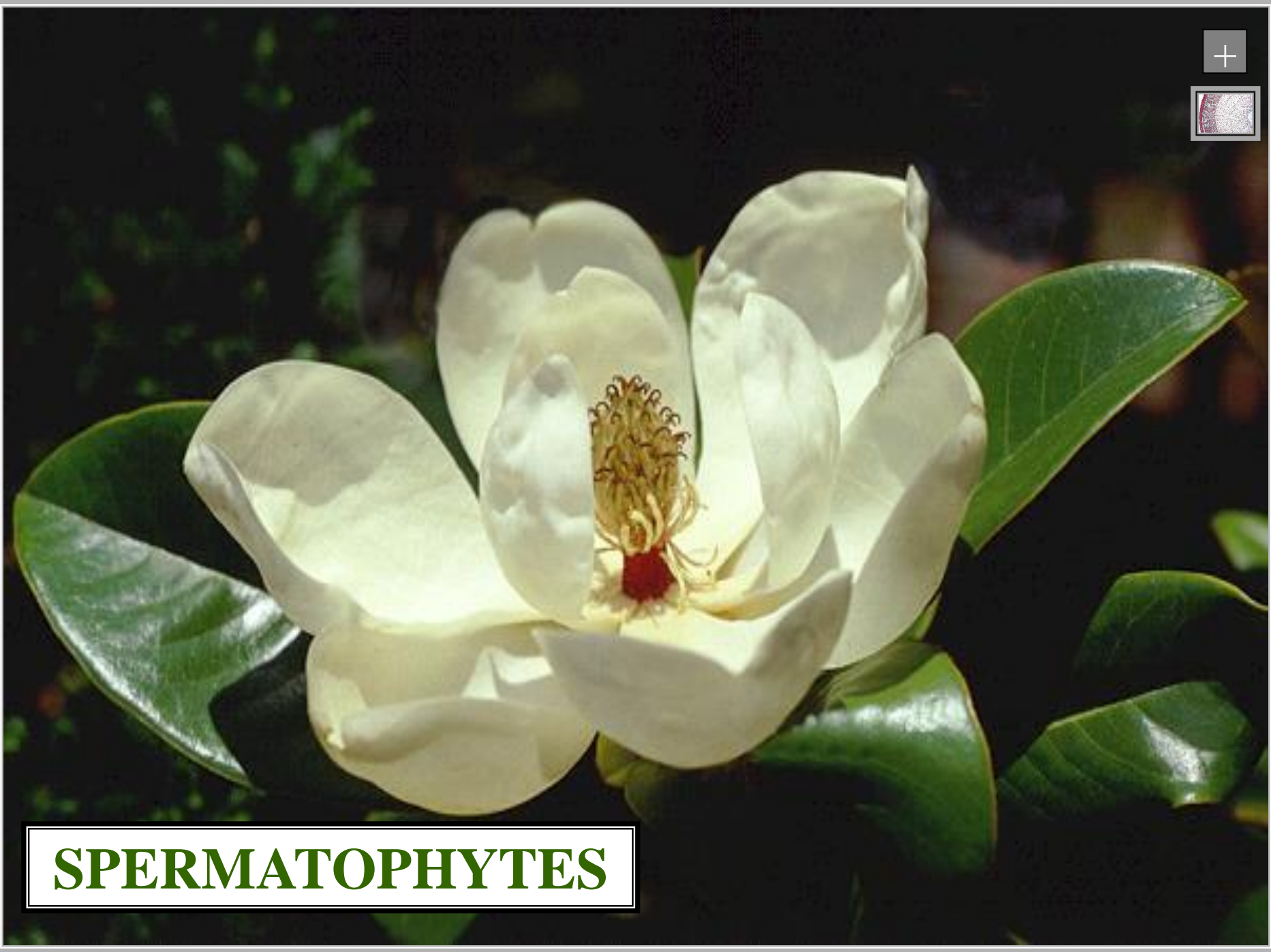
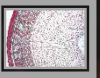
L.S.

PTERIDOPHYTES





LATERAL MERISTEM



SPERMATOPHYTES

**LATERAL
MERISTEM
PRESENT
OR
ABSENT**

STEM

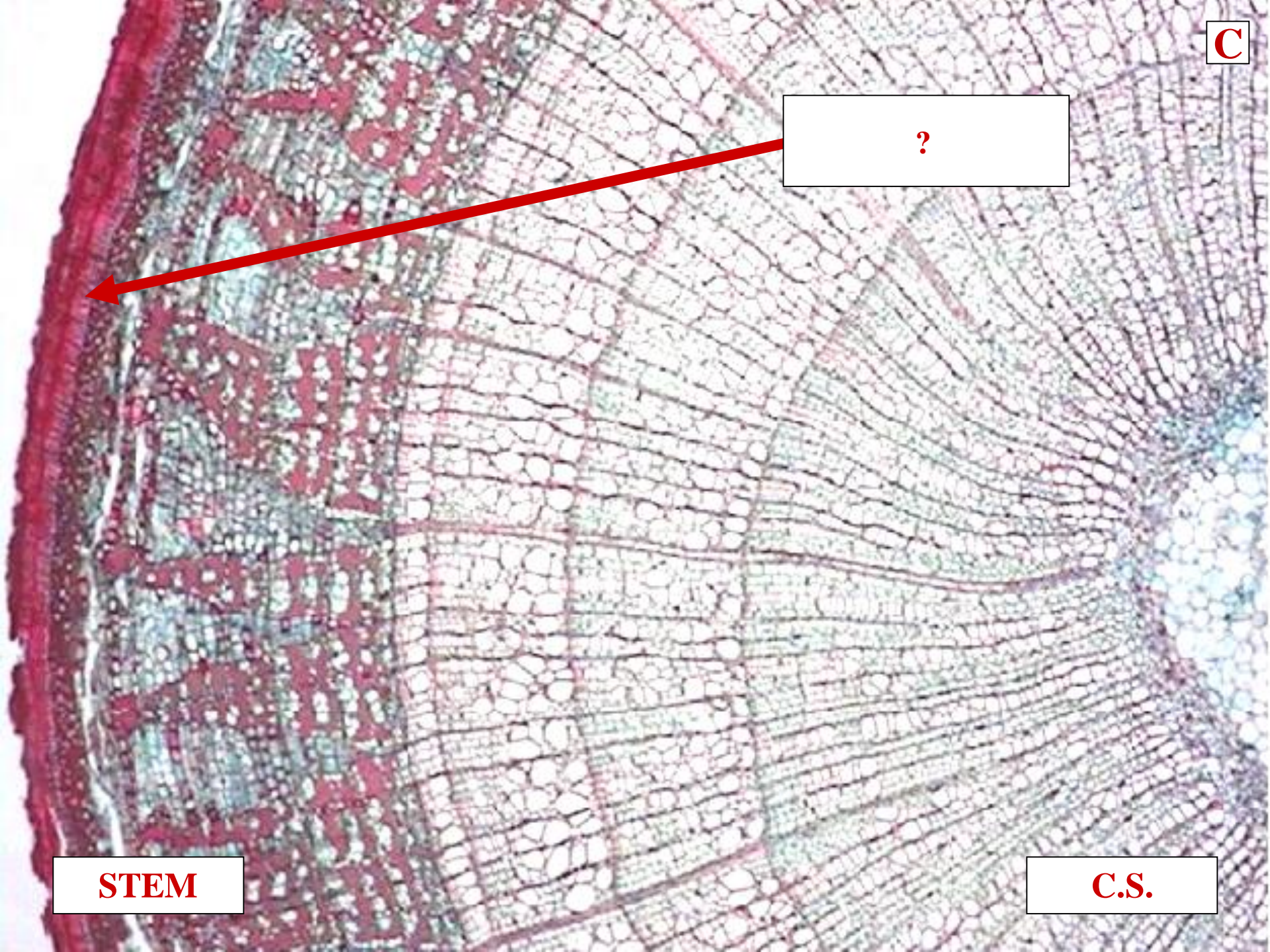
C.S.

C

?

STEM

C.S.



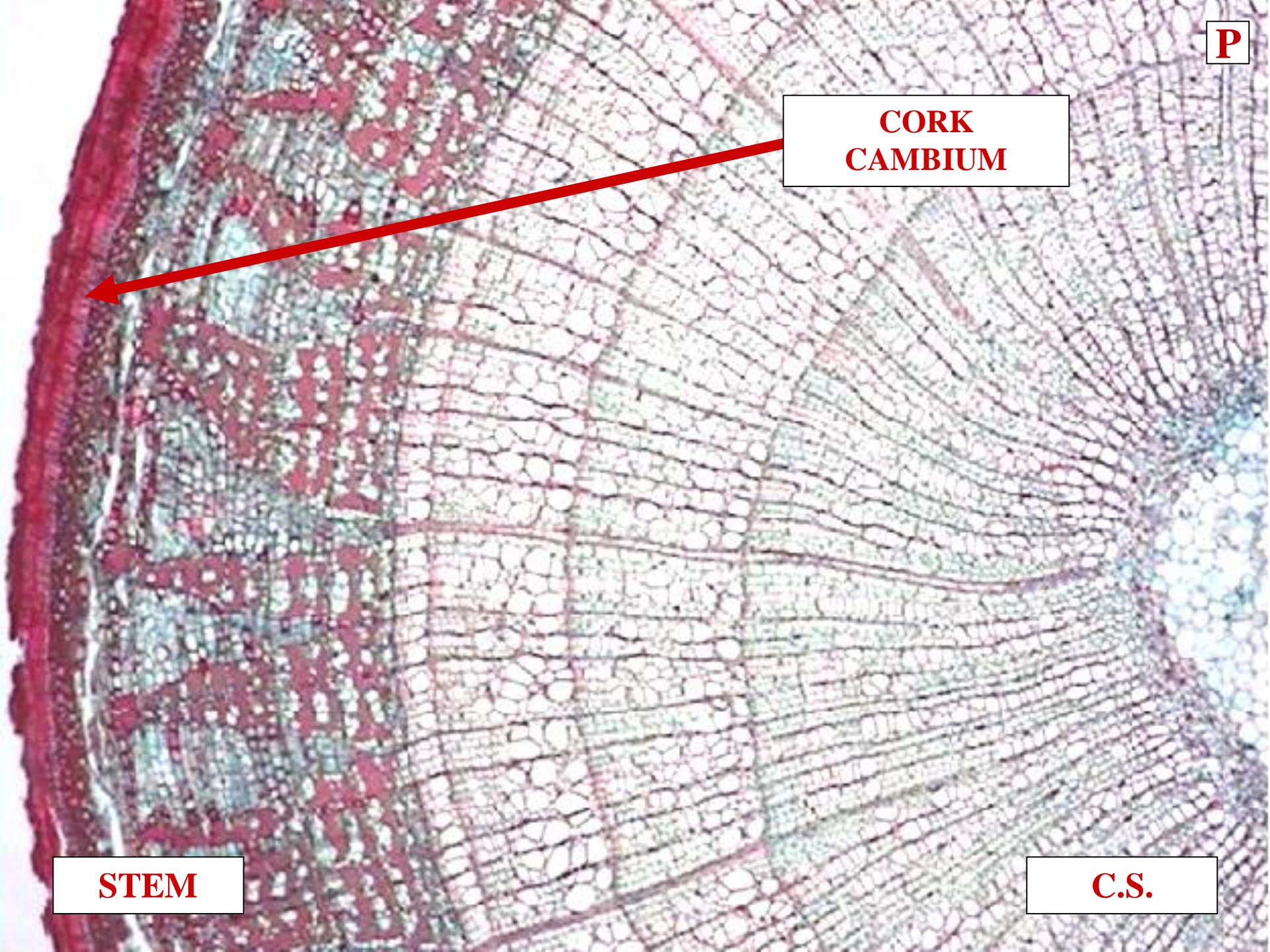
P

**CORK
CAMBIUM**



STEM

C.S.



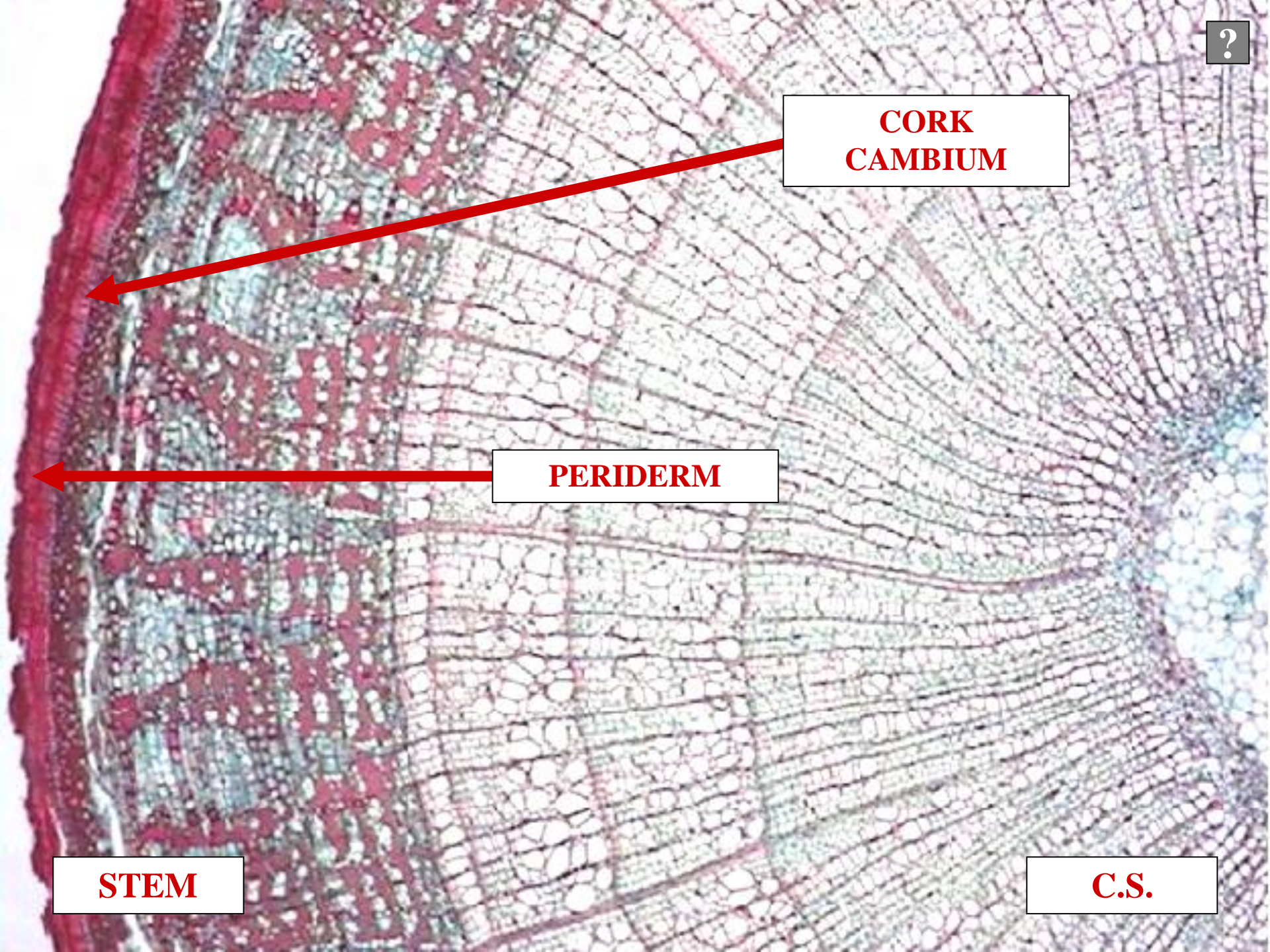
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**CORK
CAMBIUM**

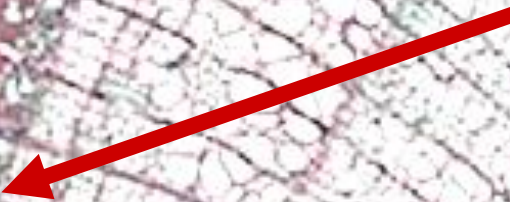
PERIDERM

STEM

C.S.

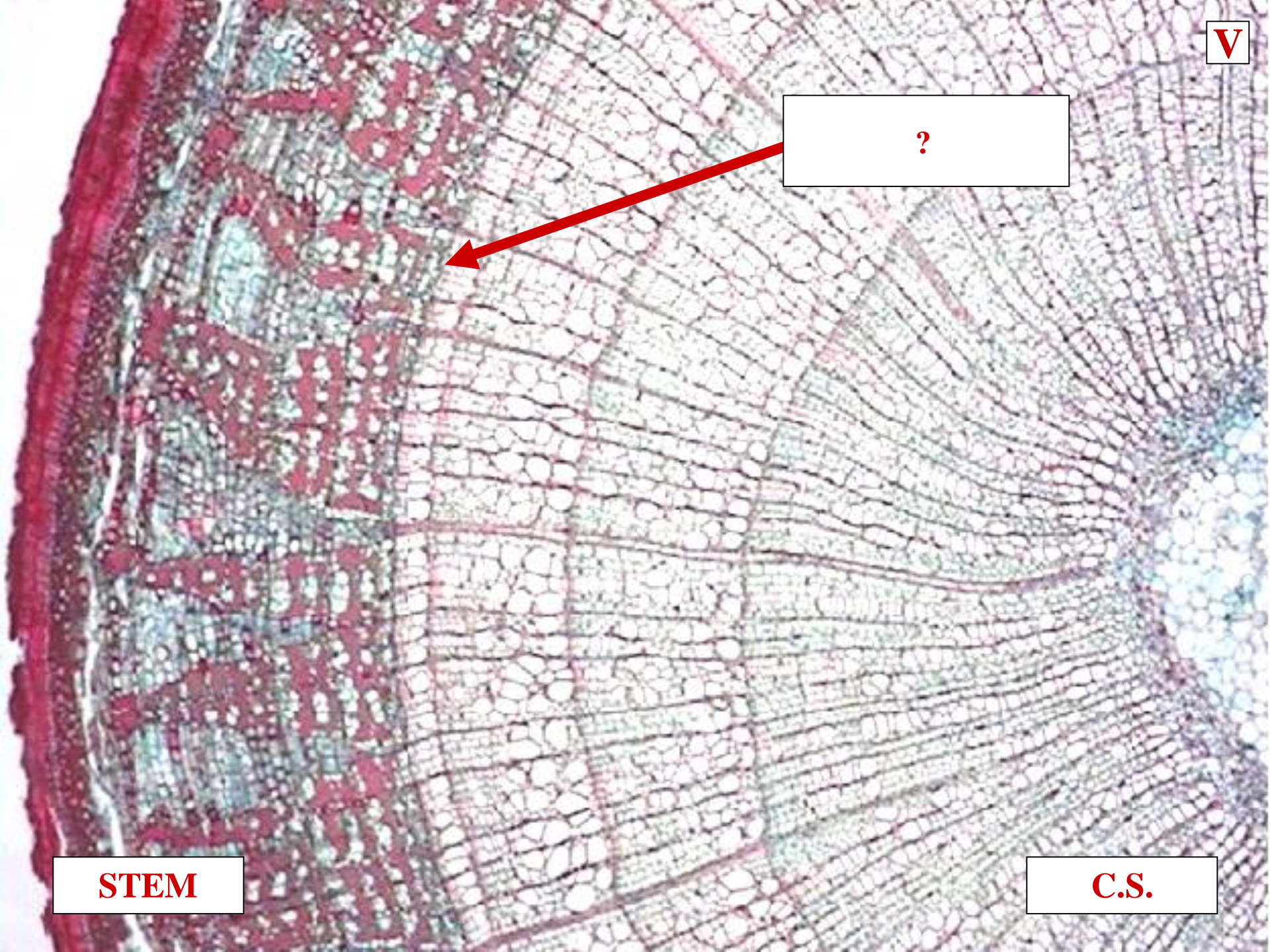


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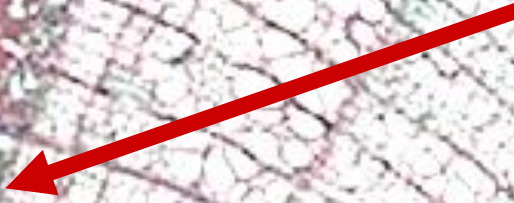
STEM

C.S.



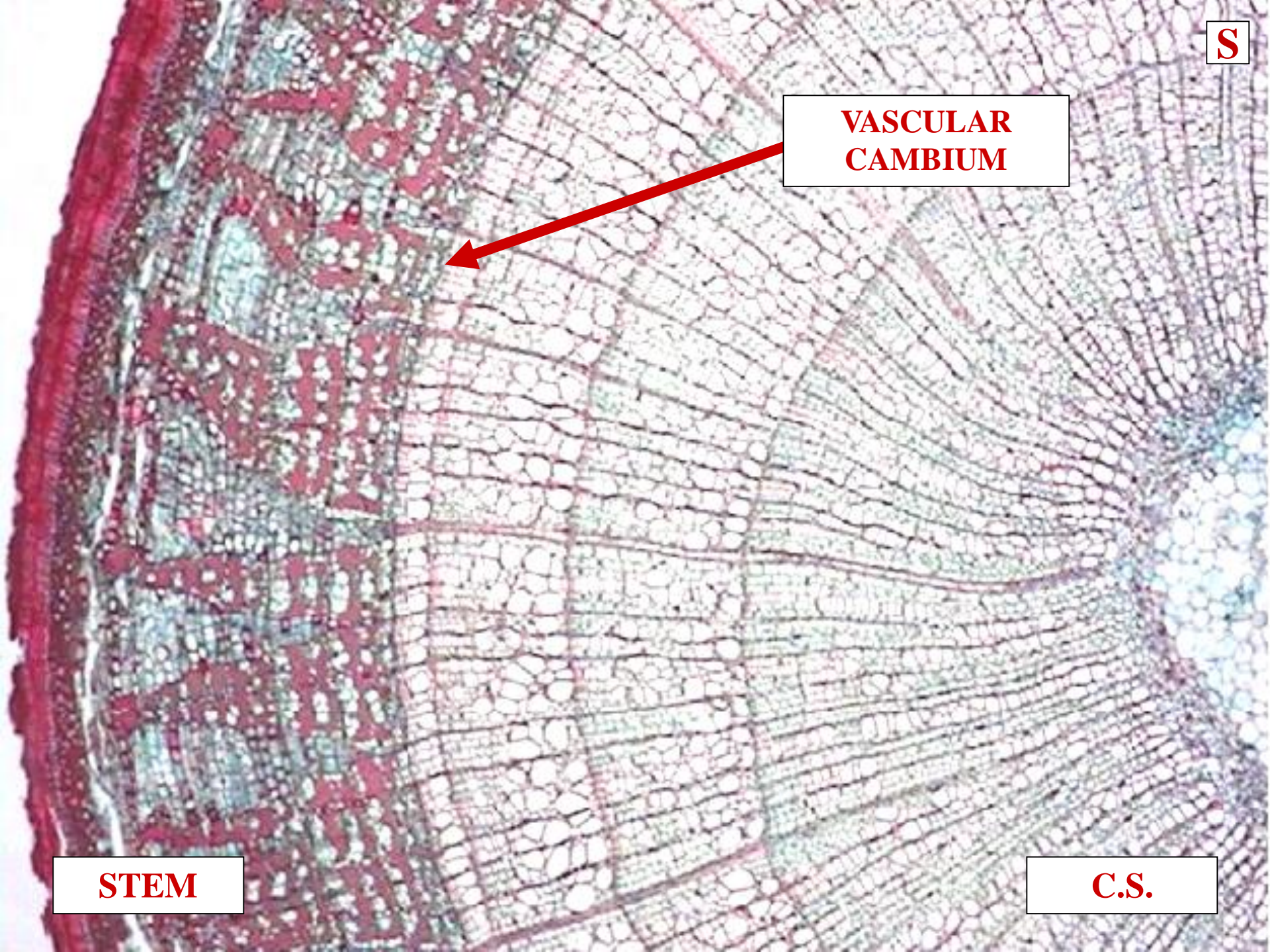
S

**VASCULAR
CAMBIUM**



STEM

C.S.



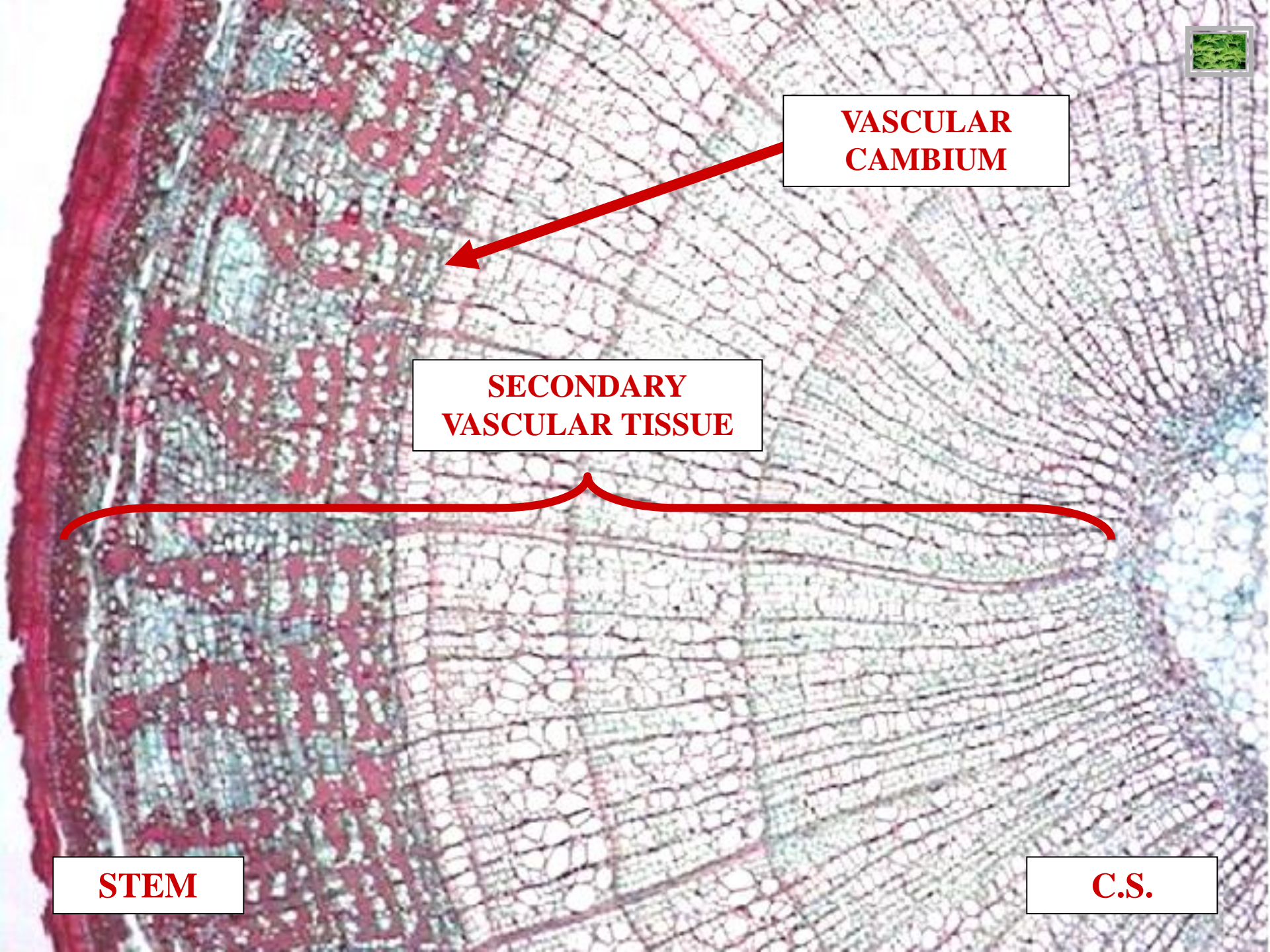


**VASCULAR
CAMBIUM**

**SECONDARY
VASCULAR TISSUE**

STEM

C.S.



LATERAL MERISTEMS

PTERIDOPHYTES

LATERAL MERISTEMS: ABSENT

PTERIDOPHYTES

SECONDARY GROWTH

PTERIDOPHYTES



SECONDARY GROWTH: ABSENT

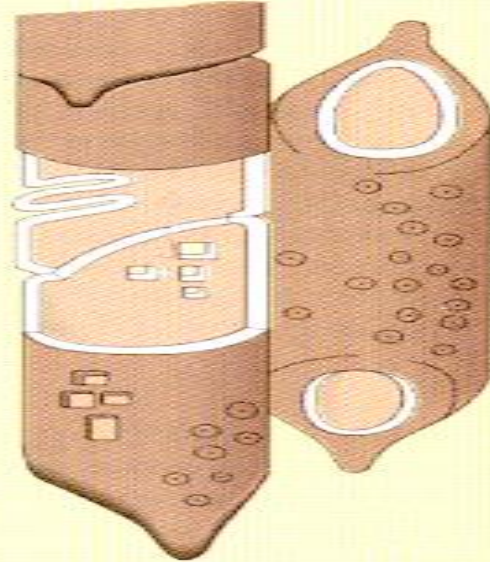
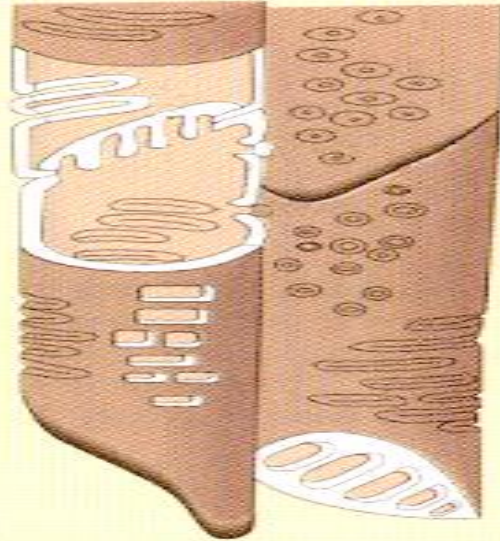
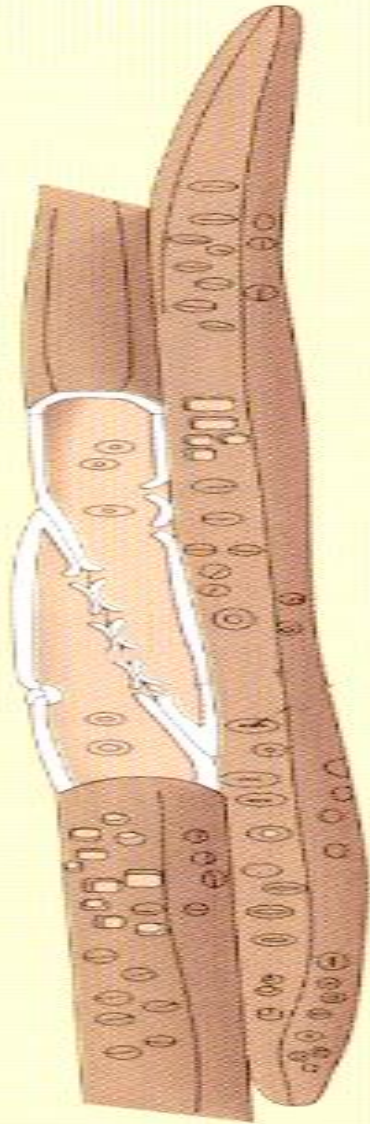
PTERIDOPHYTES



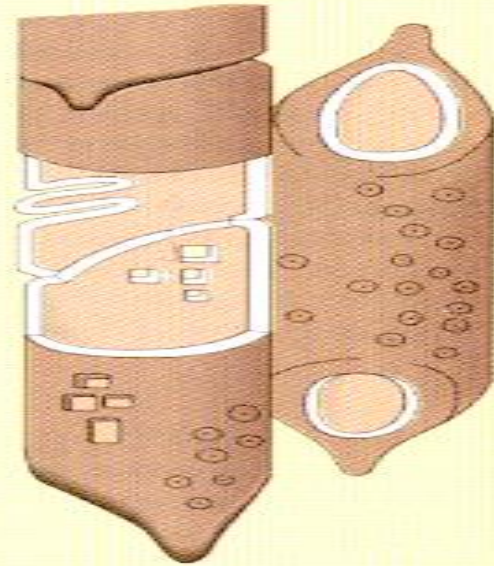
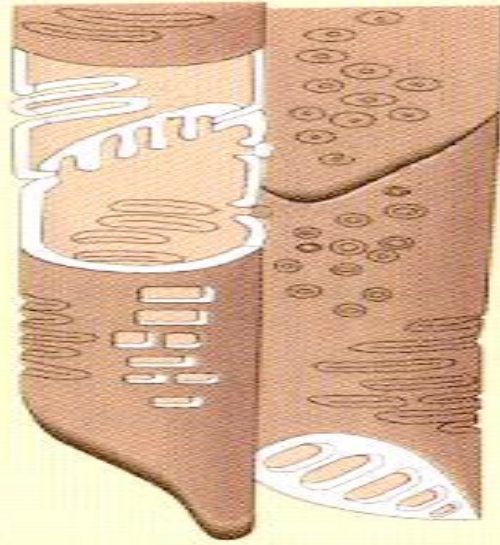
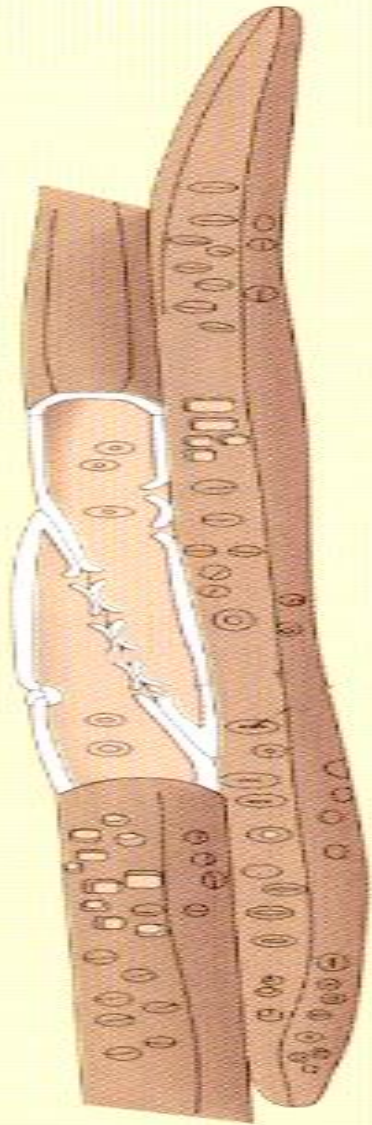
VASCULAR TISSUE



XYLEM



XYLEM CELLS



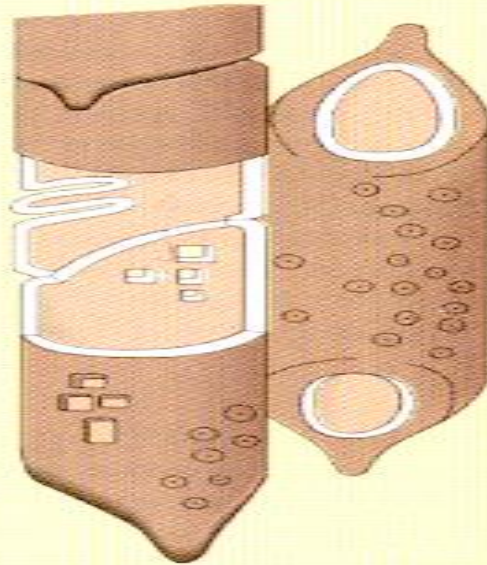
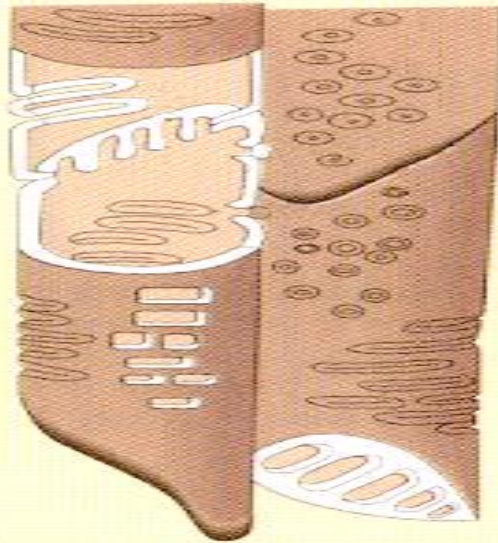
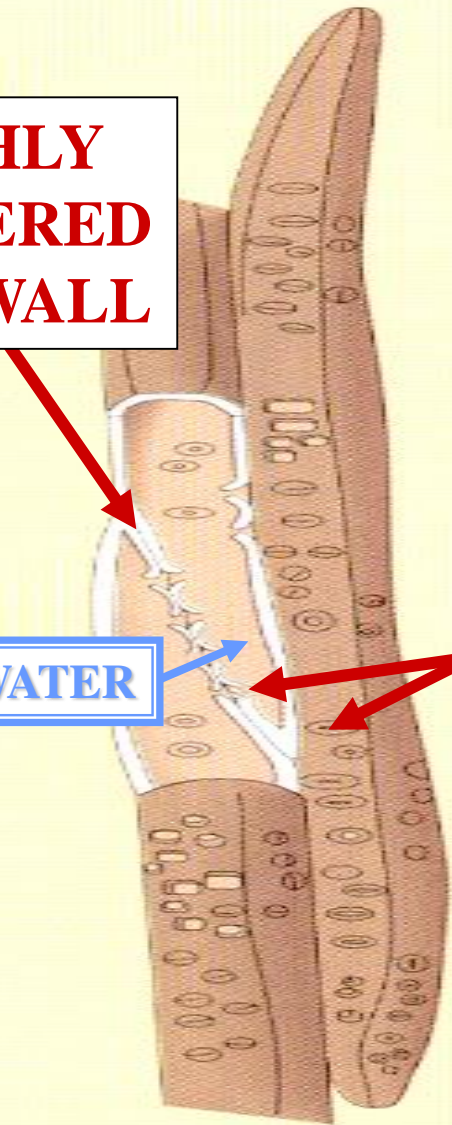
TRACHEARY ELEMENTS

**HIGHLY
TAPPED
END WALL**

WATER

PITS

?

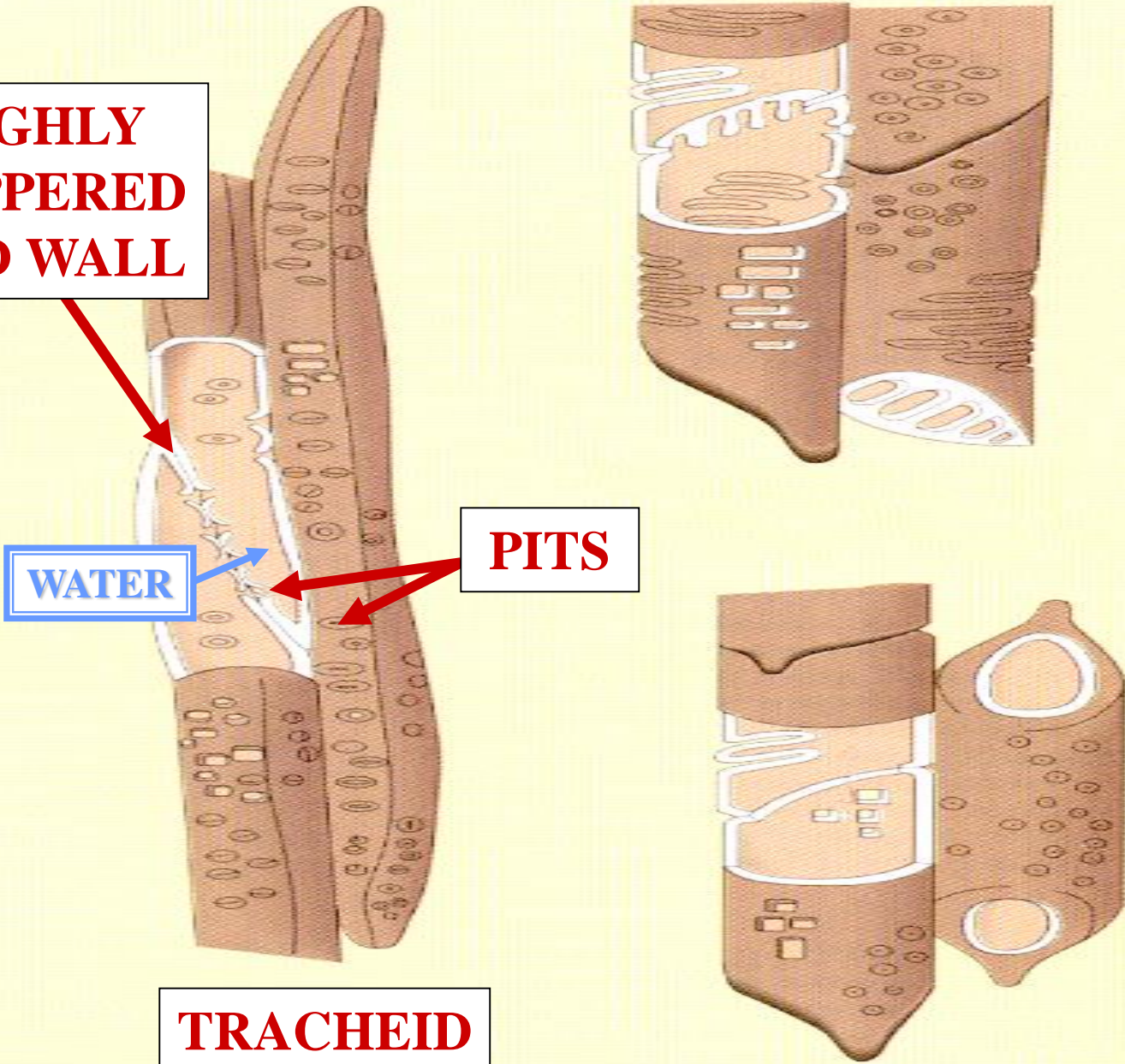


**HIGHLY
TAPPED
END WALL**

WATER

PITS

TRACHEID



**HIGHLY
TAPPED
END WALL**

**LESS
TAPPED
END WALL**

?

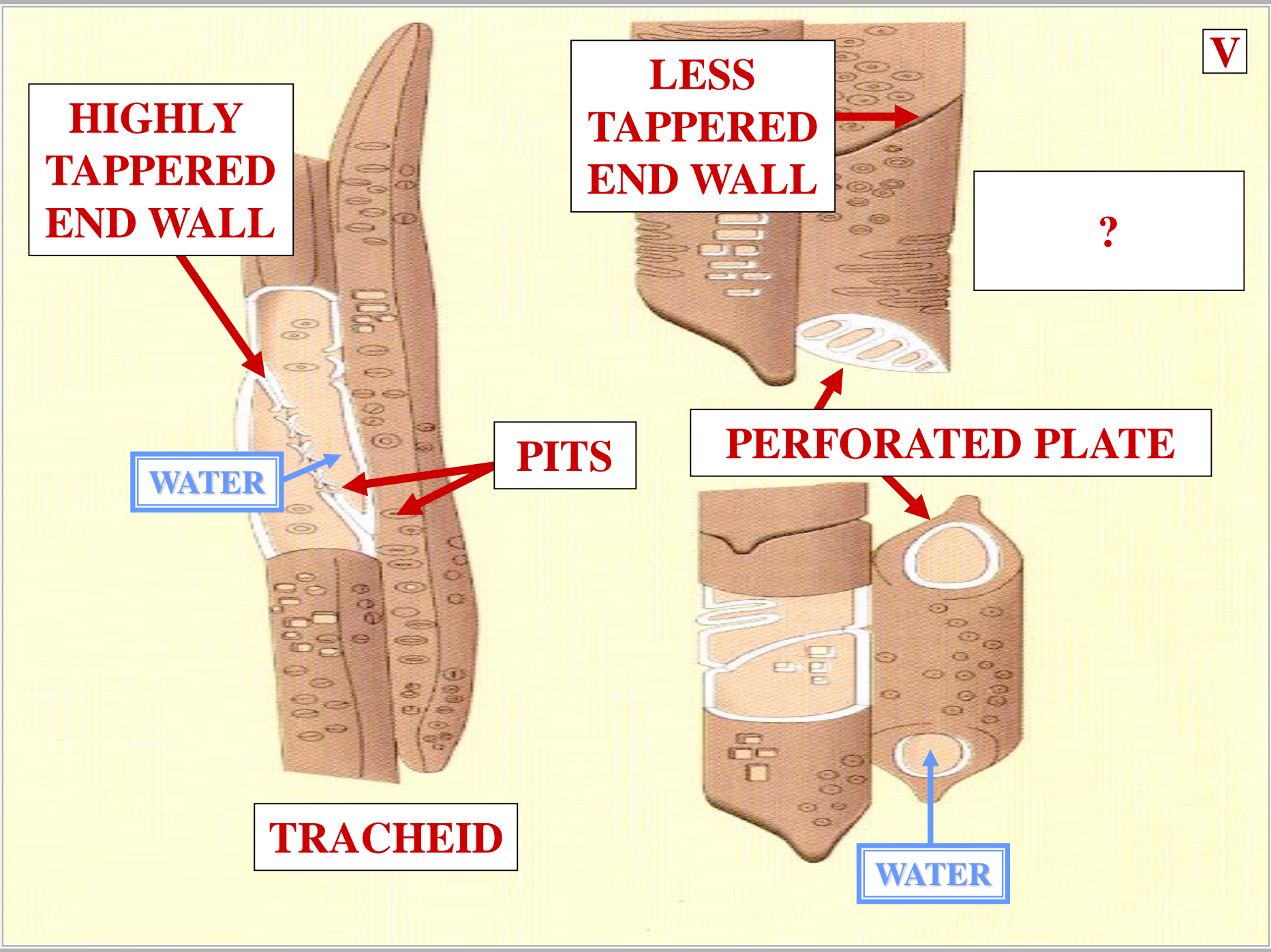
WATER

PITS

PERFORATED PLATE

TRACHEID

WATER





**HIGHLY
TAPPED
END WALL**

**LESS
TAPPED
END WALL**

**VESSEL
MEMBER**

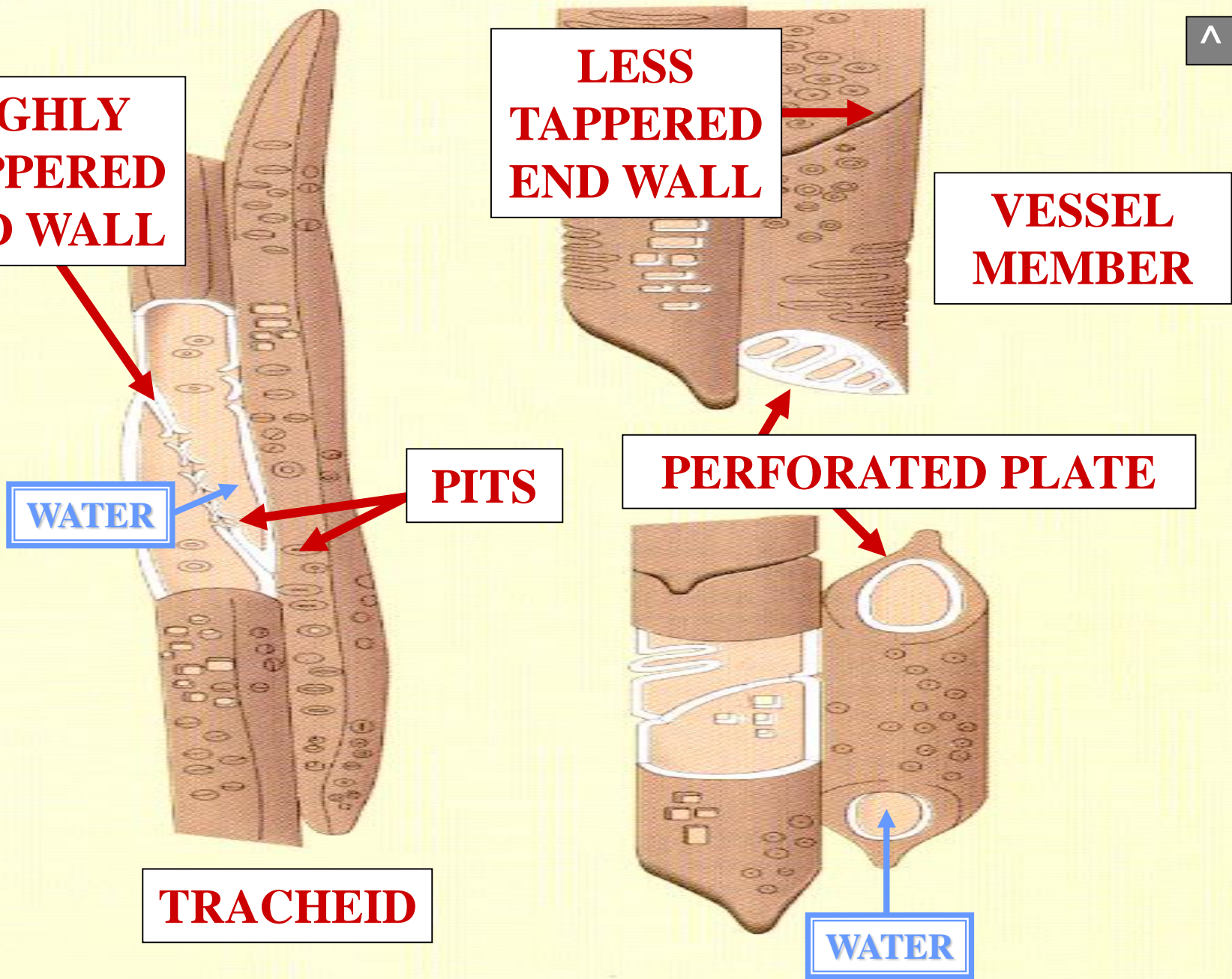
WATER

PITS

**PERFORATED
PLATE**

TRACHEID

WATER





GYMNOSPERMS

T



GYMNOSPERMS

A close-up photograph of a pine cone, showing its textured, brown, scaly surface. The pine cone is surrounded by numerous long, thin, green needles that are slightly curved and have a fine texture. The background is dark and out of focus.

TRACHEIDS

GYMNOSPERMS



ANGIOSPERMS

T

V



ANGIOSPERMS



TRACHEIDS & VESSEL MEMBERS

ANGIOSPERMS



PHLOEM

NUCLEUS

SE

SUGAR

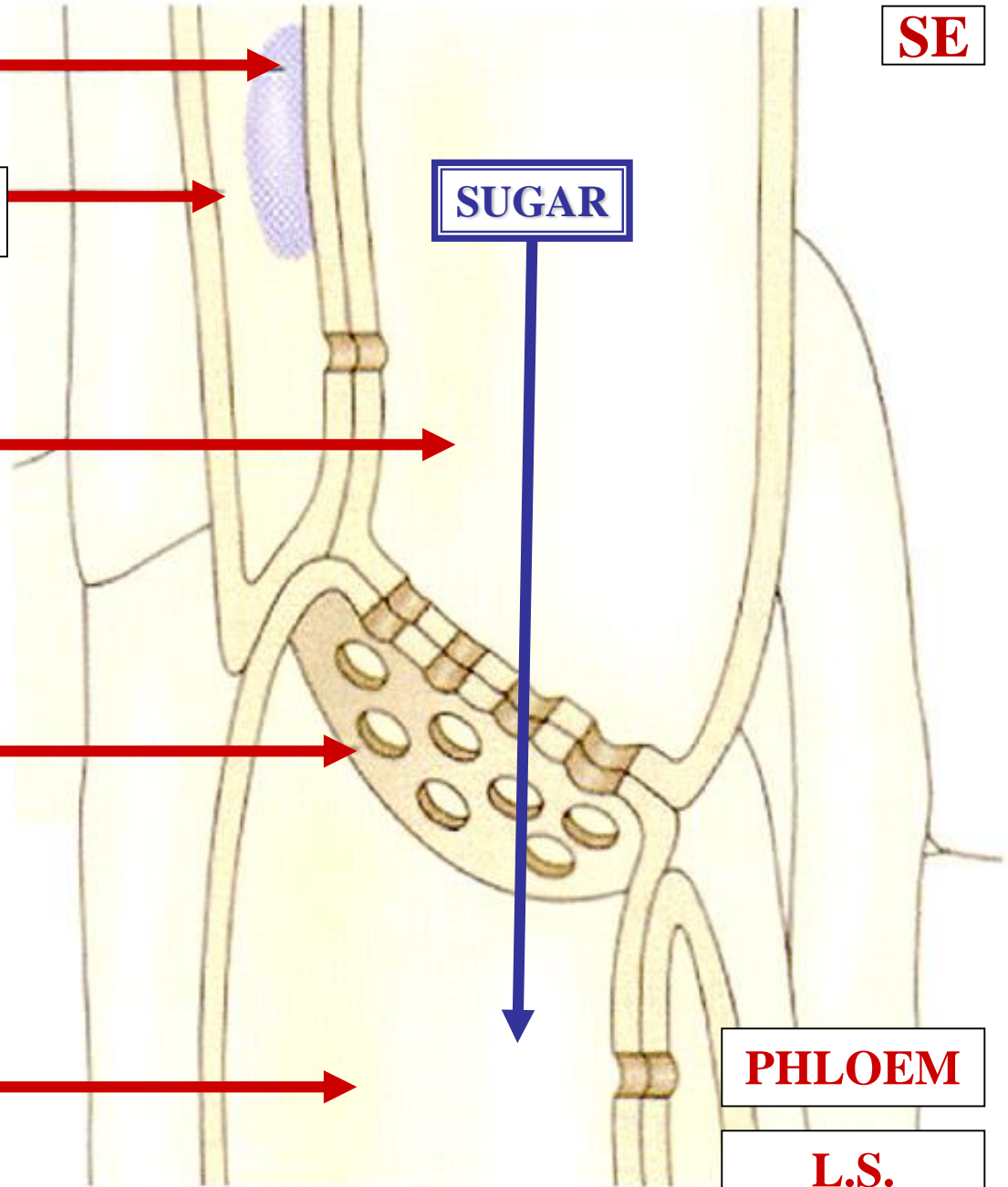
PHLOEM CELL

END WALL

PHLOEM CELL

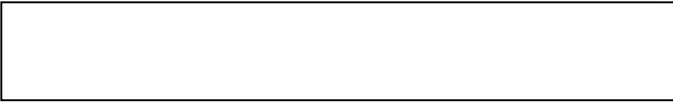
PHLOEM

L.S.



?

NUCLEUS



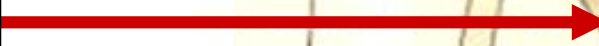
SUGAR



SIEVE ELEMENTS



END WALL

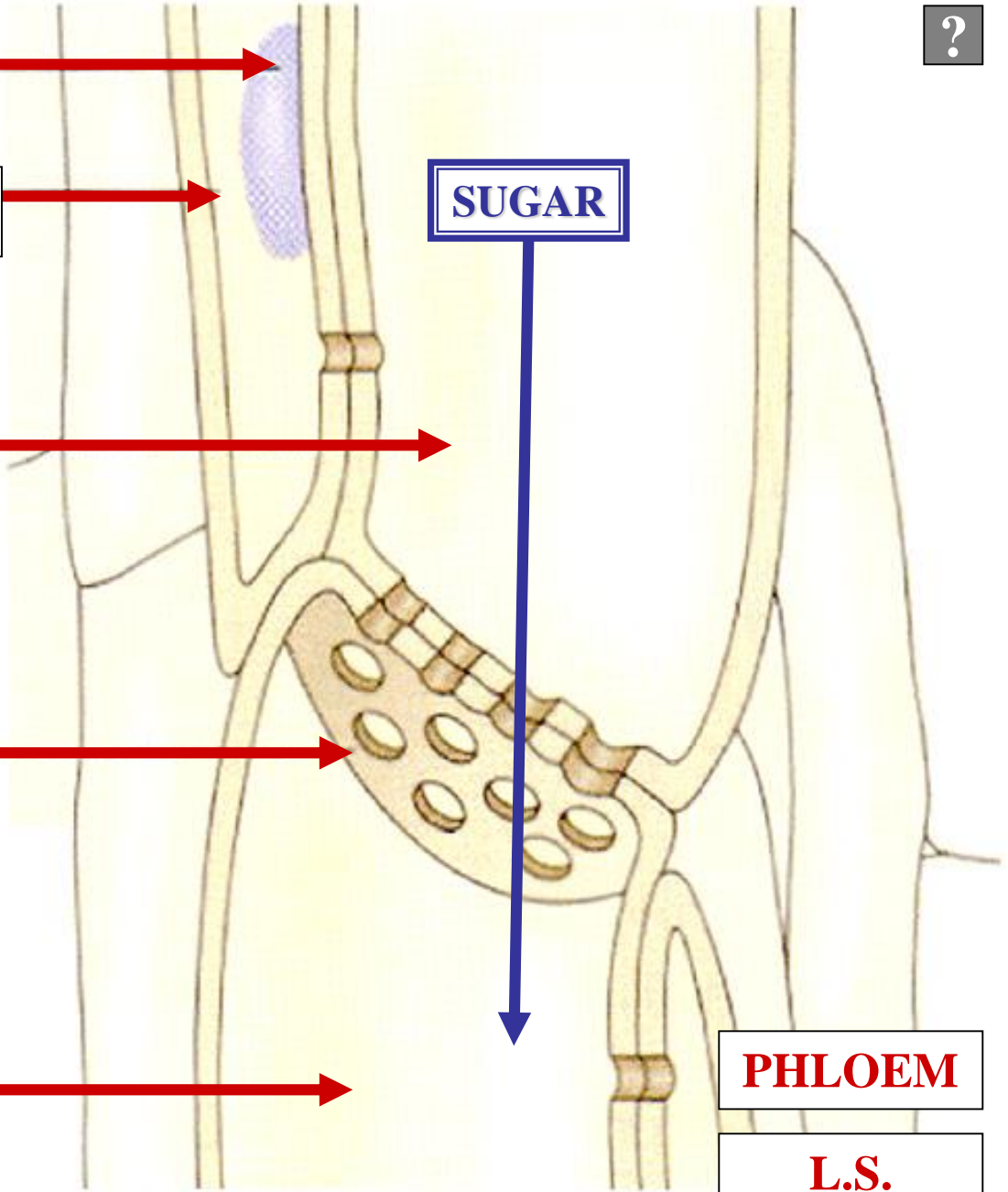


SIEVE ELEMENTS



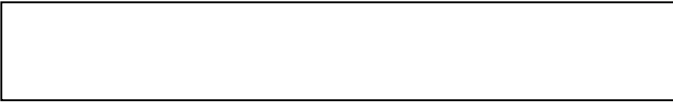
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L.S.



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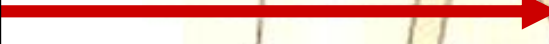
NUCLEUS



SUGAR

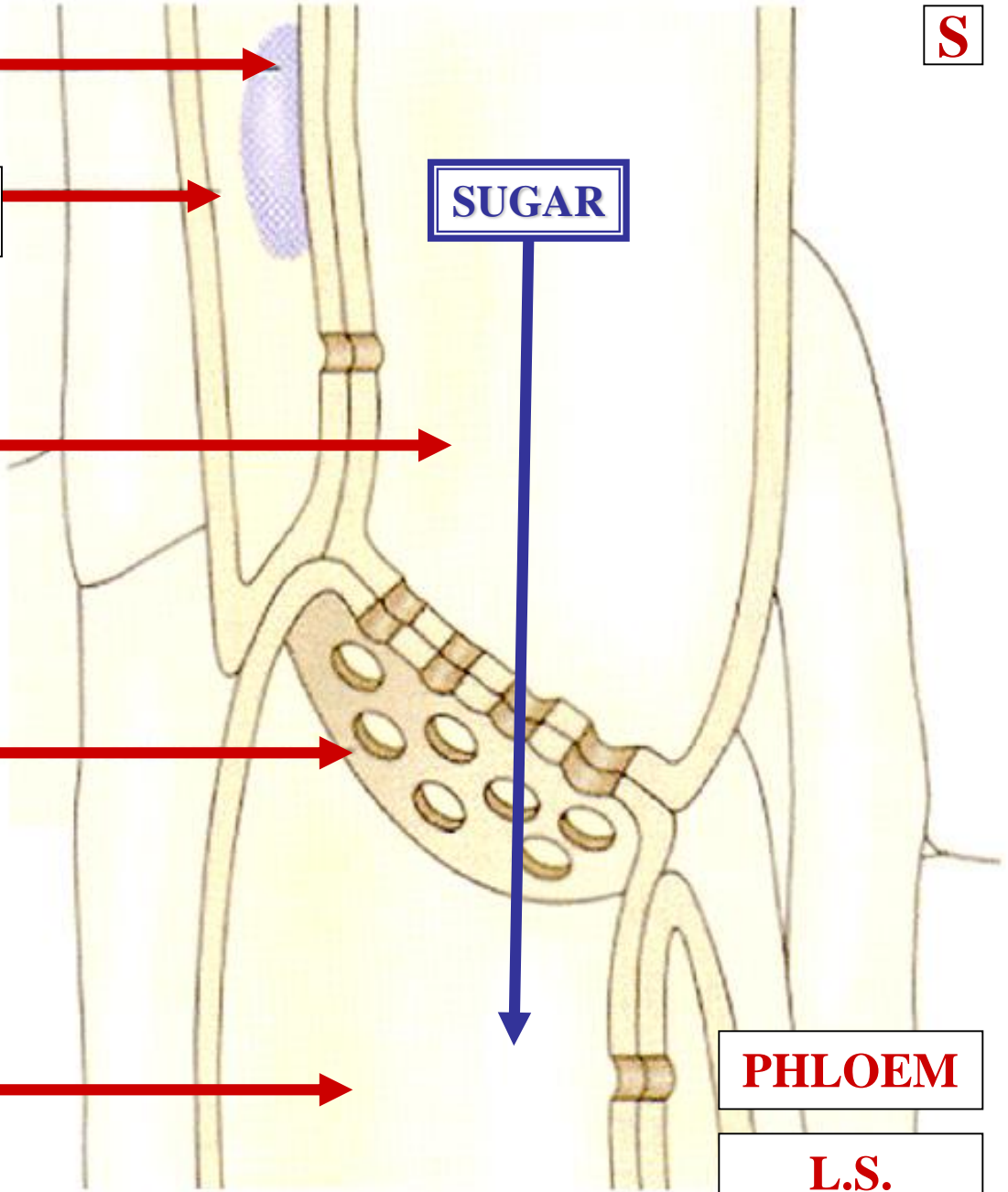


**SIEVE AREA
SMALL PORES**



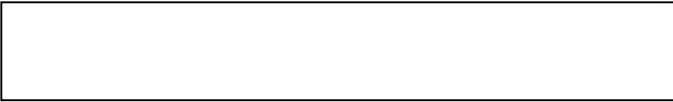
PHLOEM

L.S.





NUCLEUS



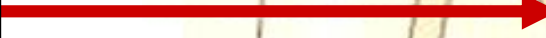
SUGAR



SIEVE CELL



**SIEVE AREA
SMALL PORES**

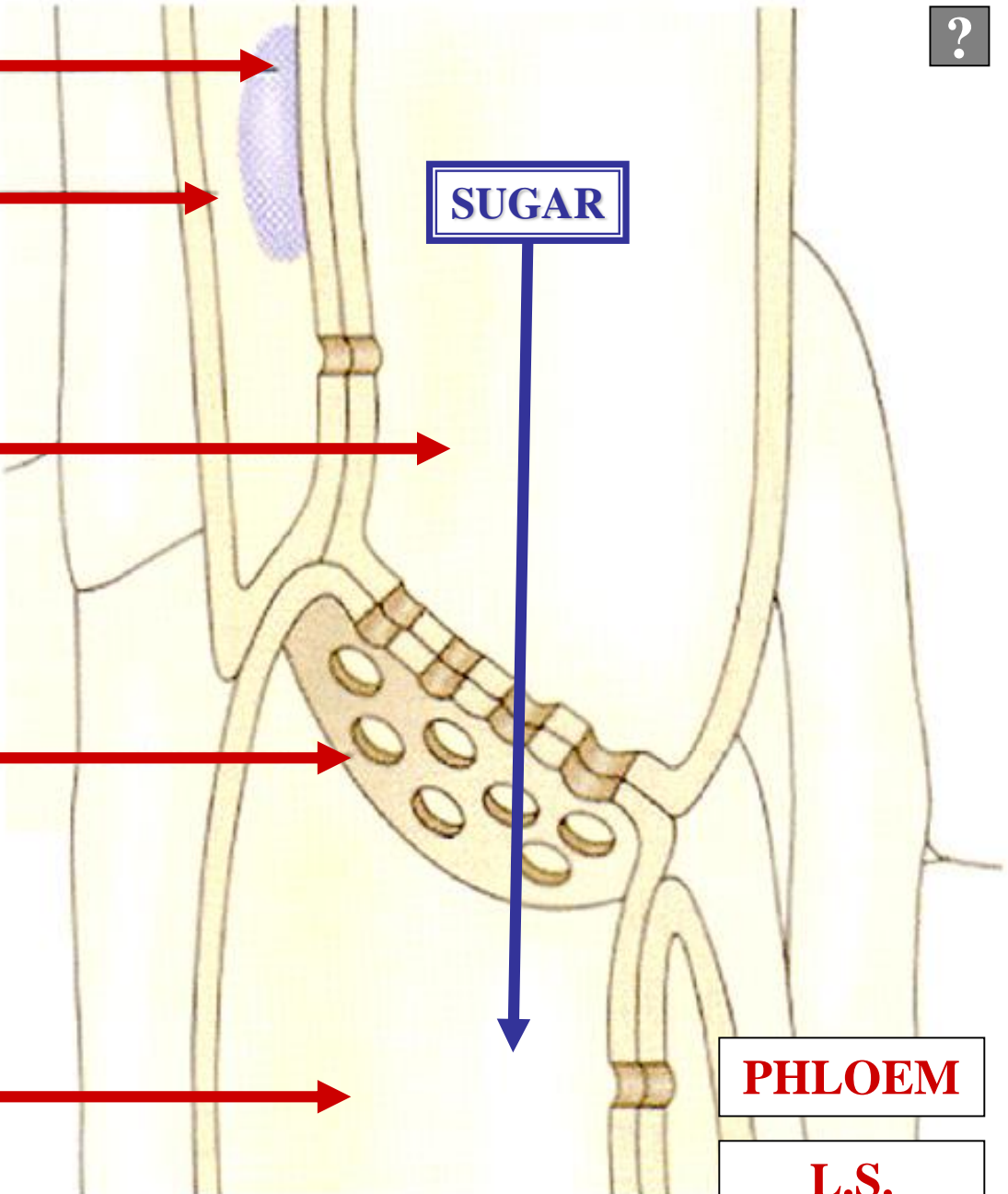


SIEVE CELL



PHLOEM

L.S.

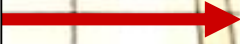


A

NUCLEUS



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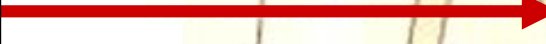
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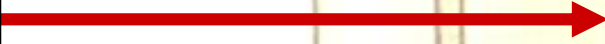
SIEVE CELL



**SIEVE AREA
SMALL PORES**

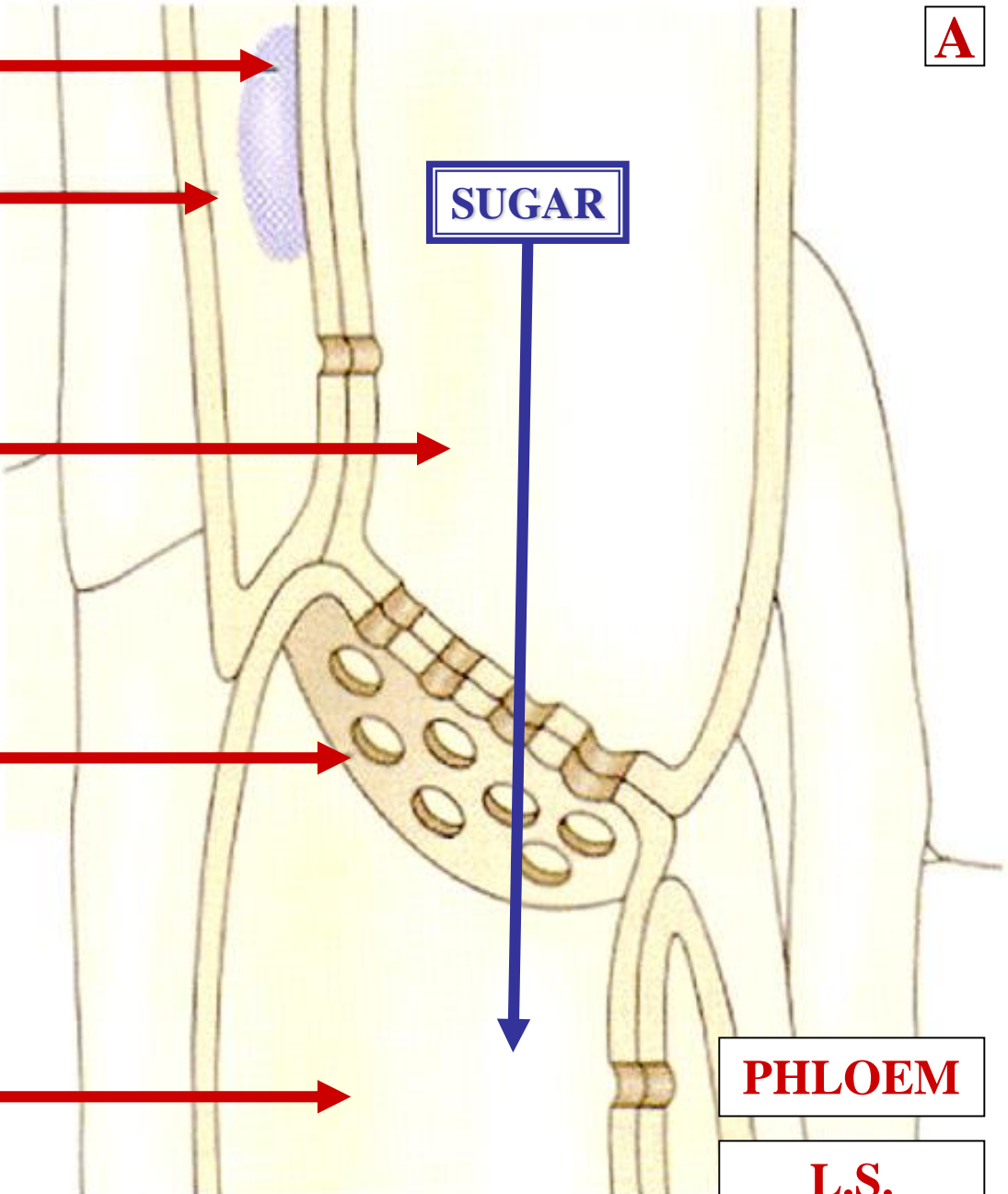


SIEVE CELL



PHLOEM

L.S.





NUCLEUS



ALBUMINOUS CELL



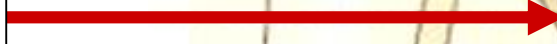
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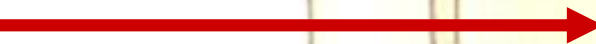
SIEVE CELL



**SIEVE AREA
SMALL PORES**

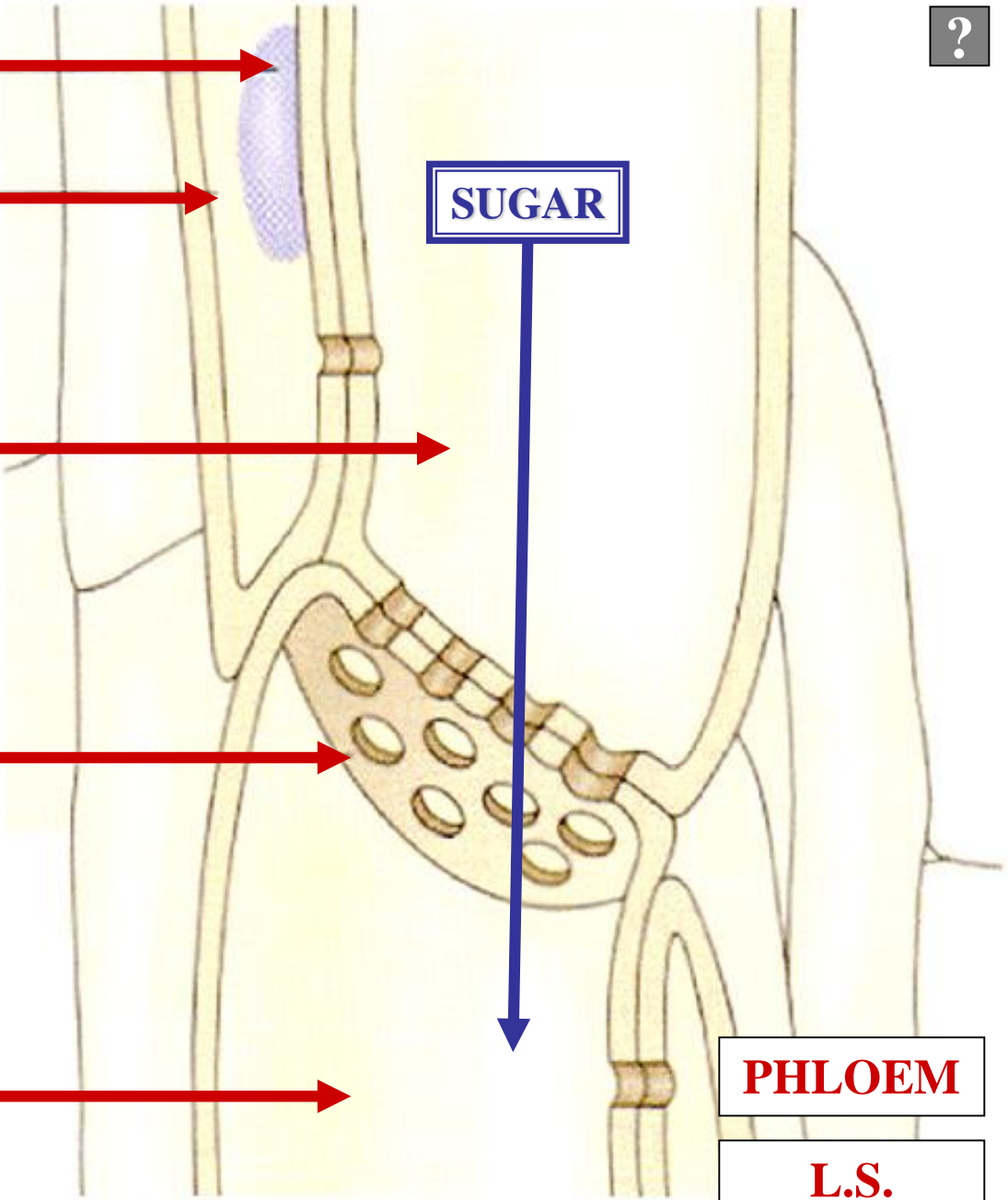


SIEVE CELL



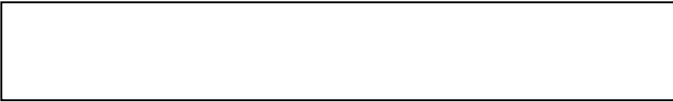
PHLOEM

L.S.



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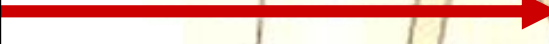
NUCLEUS



SUGAR

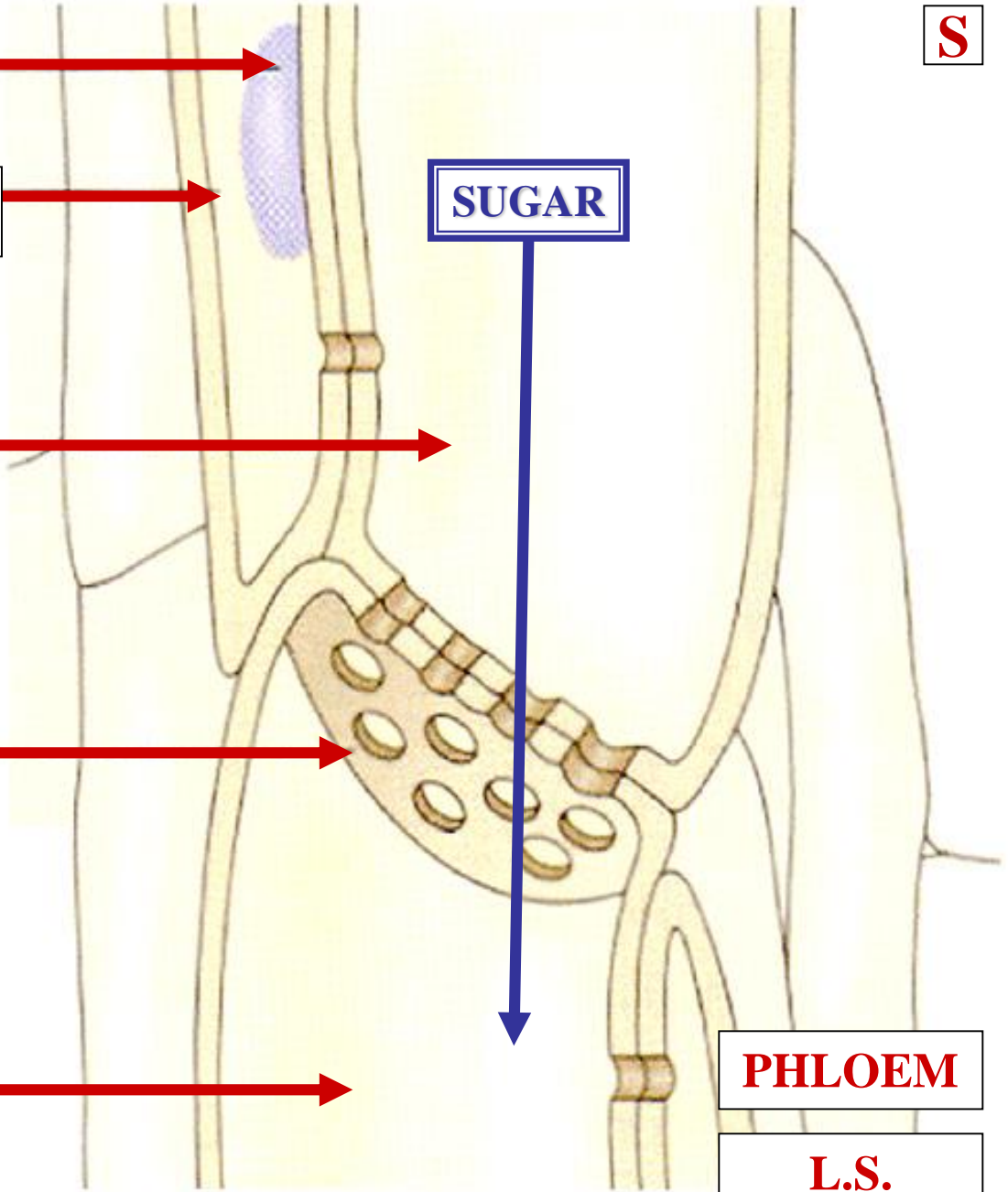


**SIEVE PLATE
LARGE PORES**



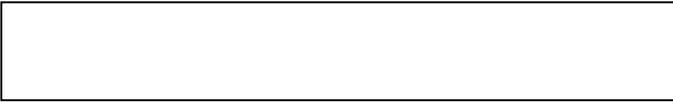
PHLOEM

L.S.





NUCLEUS



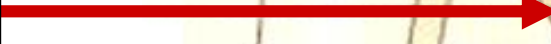
SUGAR



SIEVE MEMBER



**SIEVE PLATE
LARGE PORES**

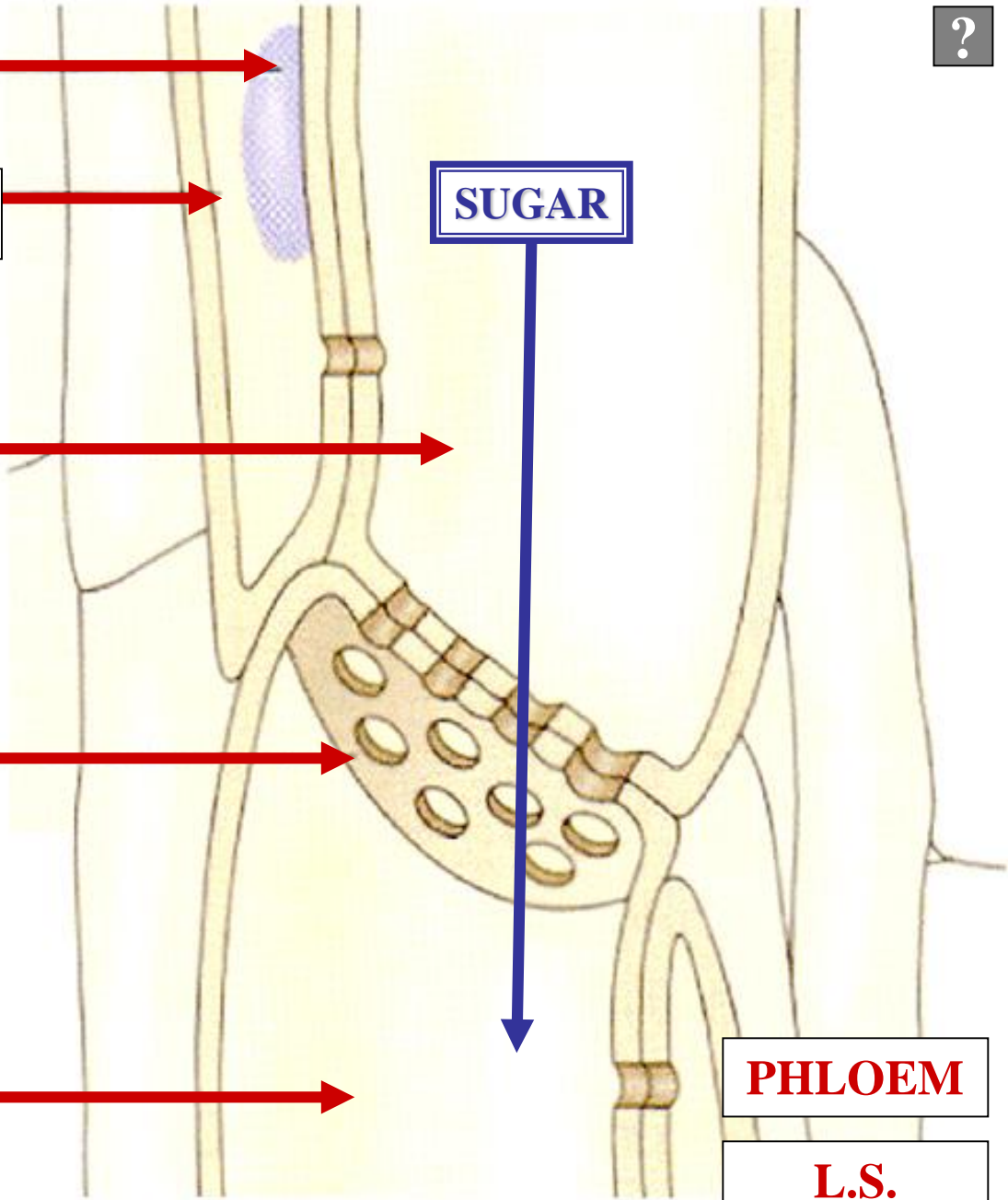


SIEVE MEMBER



PHLOEM

L.S.

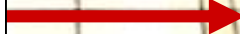


C

NUCLEUS



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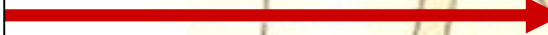
SUGAR



SIEVE MEMBER



**SIEVE PLATE
LARGE PORES**

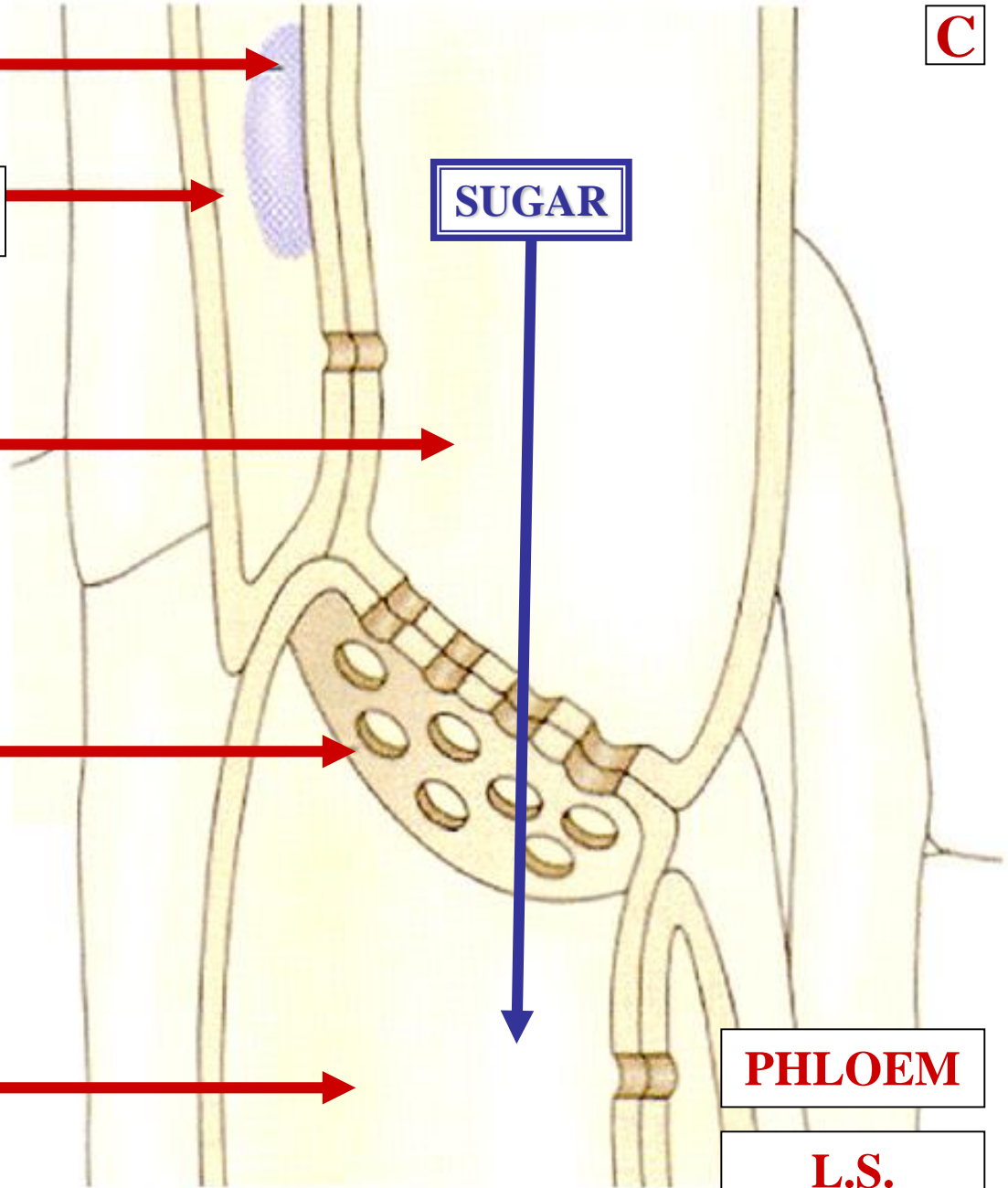


SIEVE MEMBER



PHLOEM

L.S.

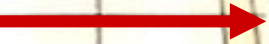




NUCLEUS



CAMPANION CELL



SUGAR



SIEVE MEMBER



**SIEVE PLATE
LARGE PORES**

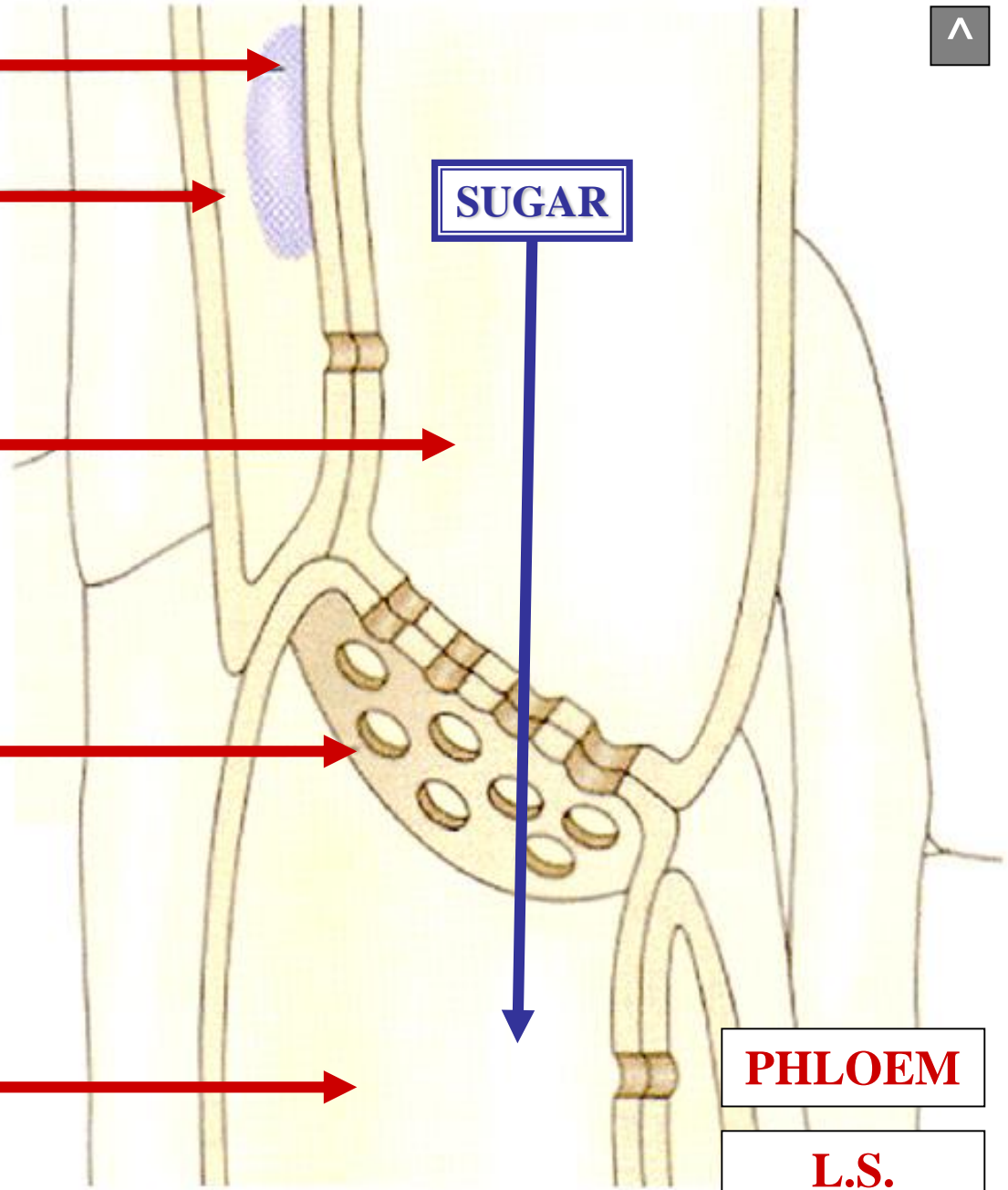


SIEVE MEMBER



PHLOEM

L.S.





GYMNOSPERMS

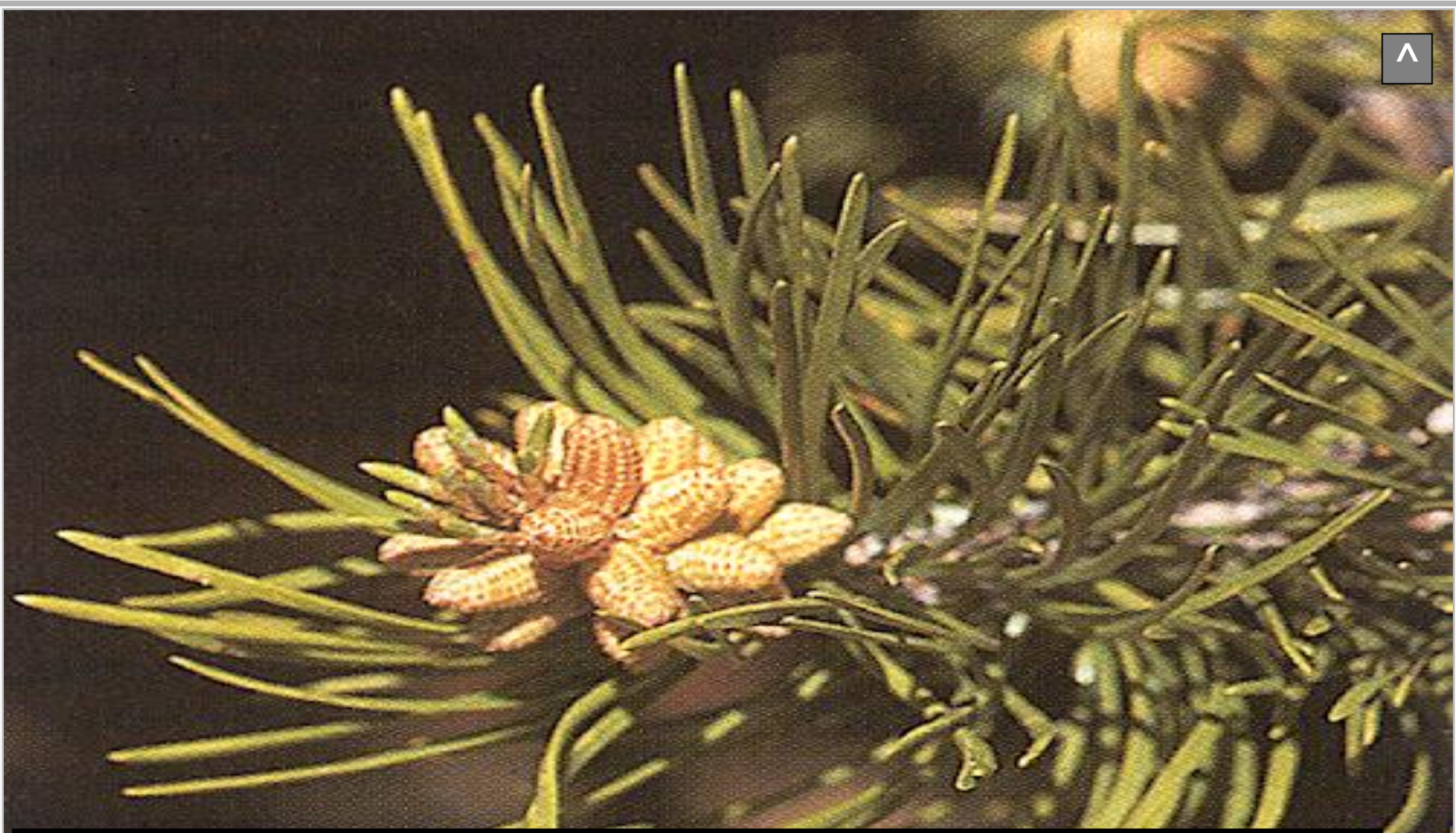


GYMNOSPERMS



SIEVE CELLS

GYMNOSPERMS



SIEVE CELLS & ALBUMINOUS CELLS

GYMNOSPERMS



ANGIOSPERMS



ANGIOSPERMS



SIEVE MEMBERS

ANGIOSPERMS



SIEVE MEMBERS & COMPANION CELLS

ANGIOSPERMS



**SIEVE MEMBERS
AND
COMPANION CELLS
DIAGNOSTIC
ANGIOSPERM
CHARACTERS**



ROOT



ROOT STELE



G

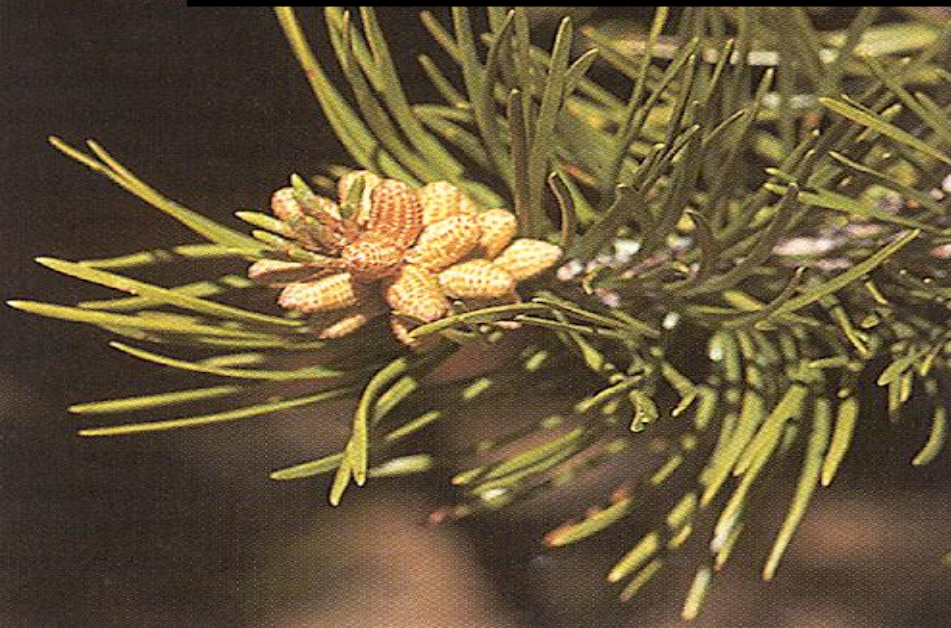
GYMNOSPERMS & DICOTS



D



GYMNOSPERMS

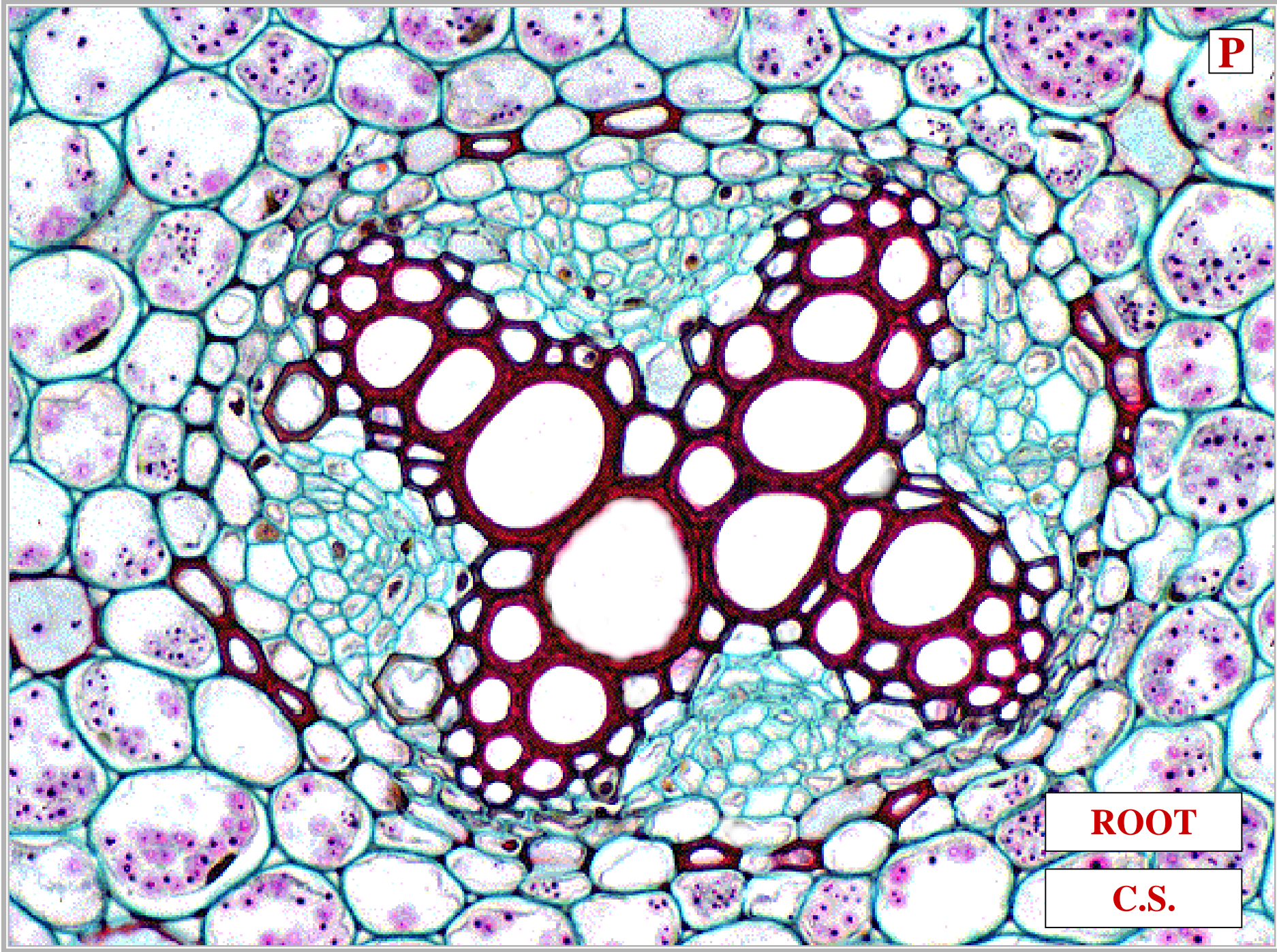




DICOTS



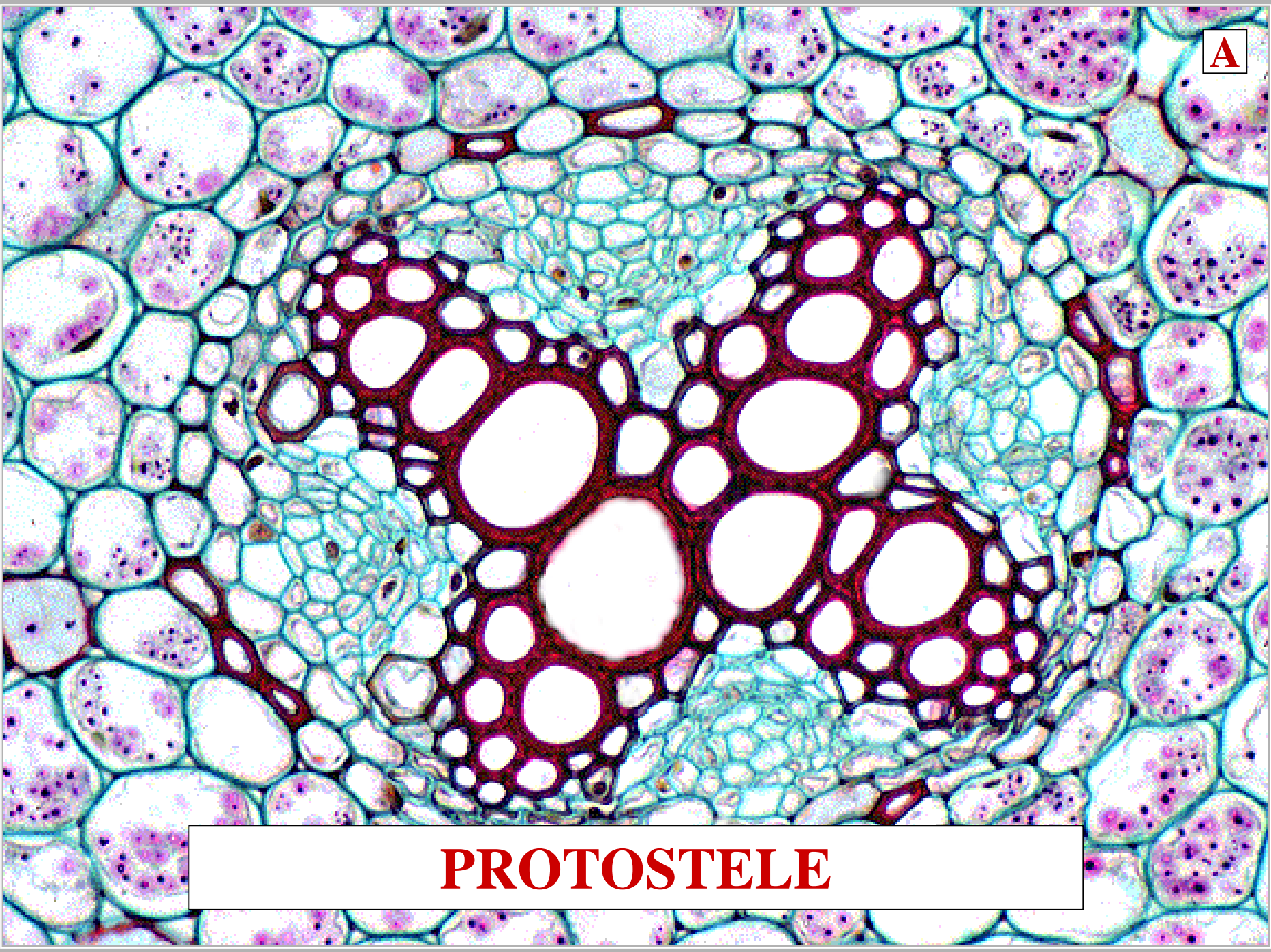
P



ROOT

C.S.

A



PROTOSTELE

A light micrograph of a plant stem cross-section. The vascular bundles are arranged in a ring, with each bundle containing a central protoxylem lacuna. The bundles are arranged in a pattern where the primary xylem is surrounded by secondary xylem, which is in turn surrounded by secondary phloem and primary phloem. The arrangement of the bundles is actinostele. The cells are stained with a blue-green dye, and the nuclei are stained purple. A small black square with a white upward-pointing arrow is located in the top right corner.

PROTOSTELE / ACTINOSTELE



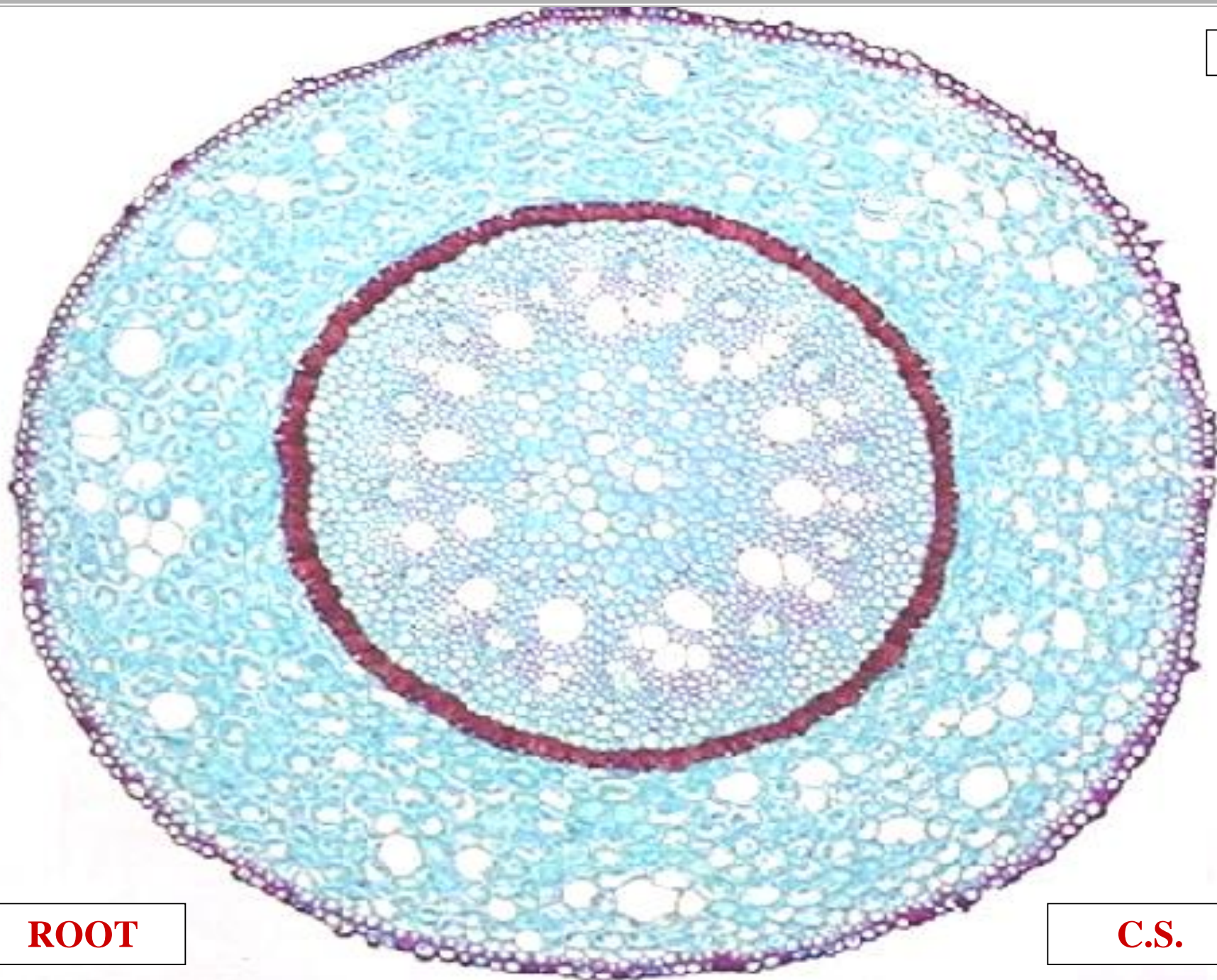
MONOCOTS



MONOCOTS

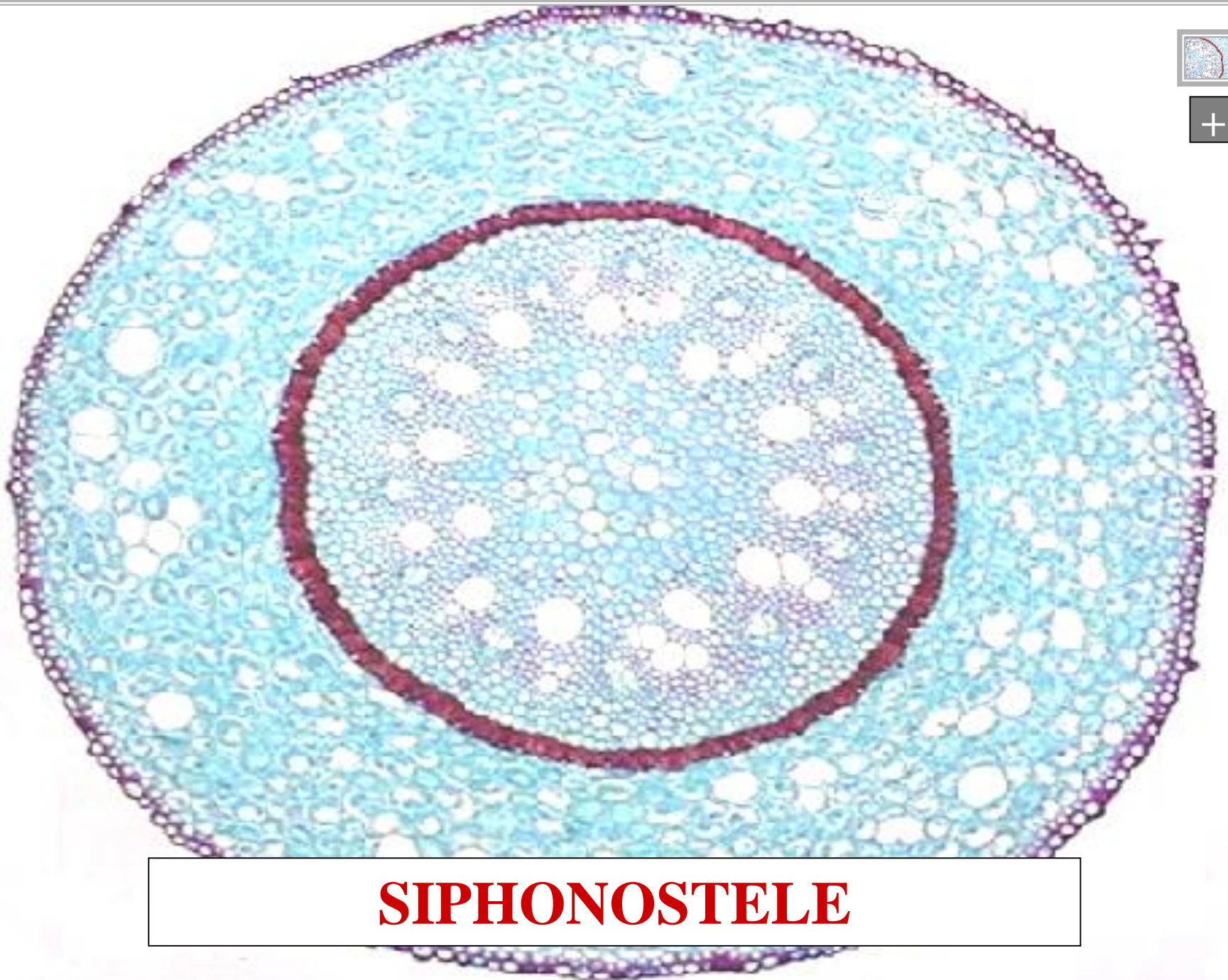


S



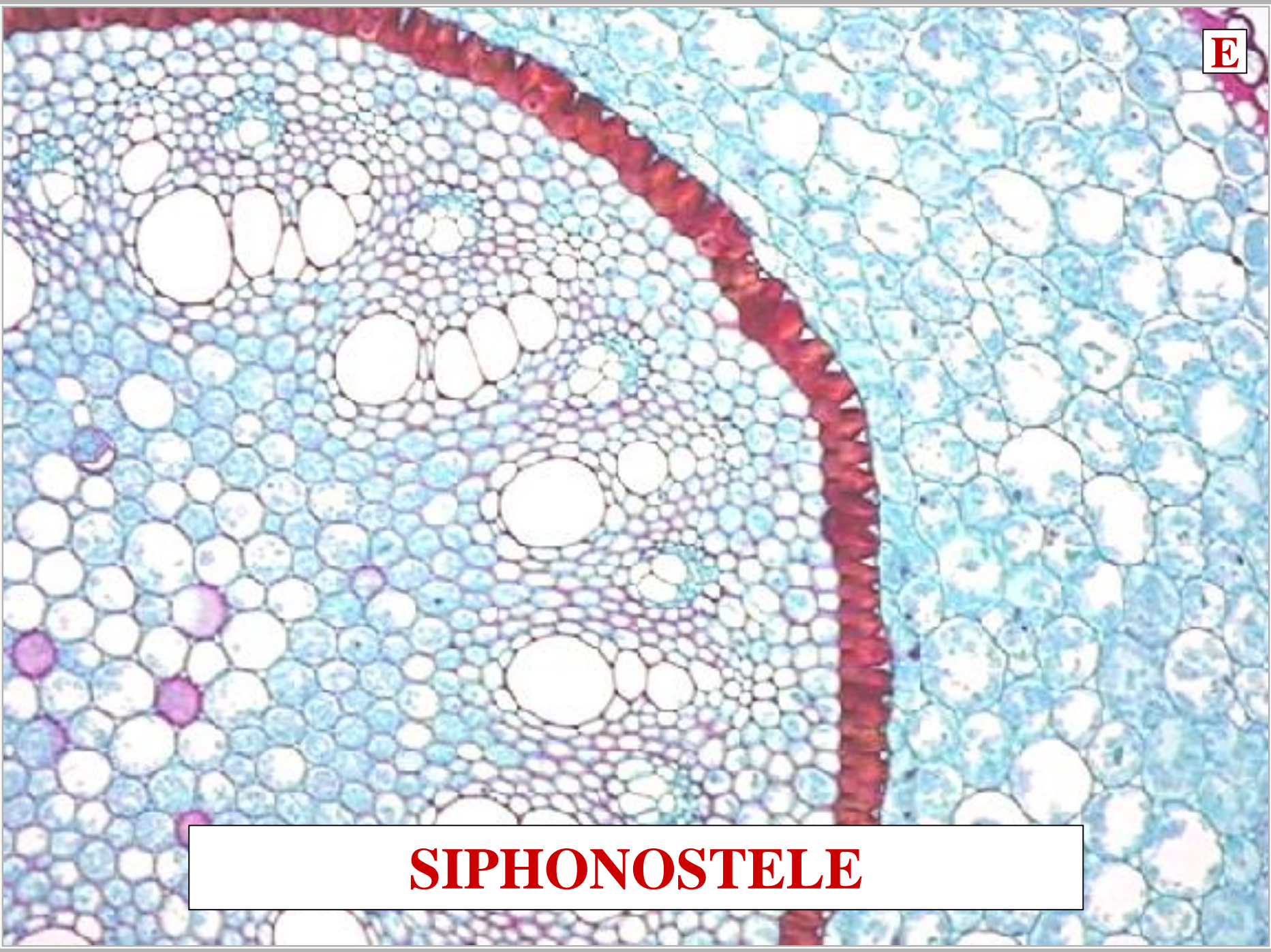
ROOT

C.S.

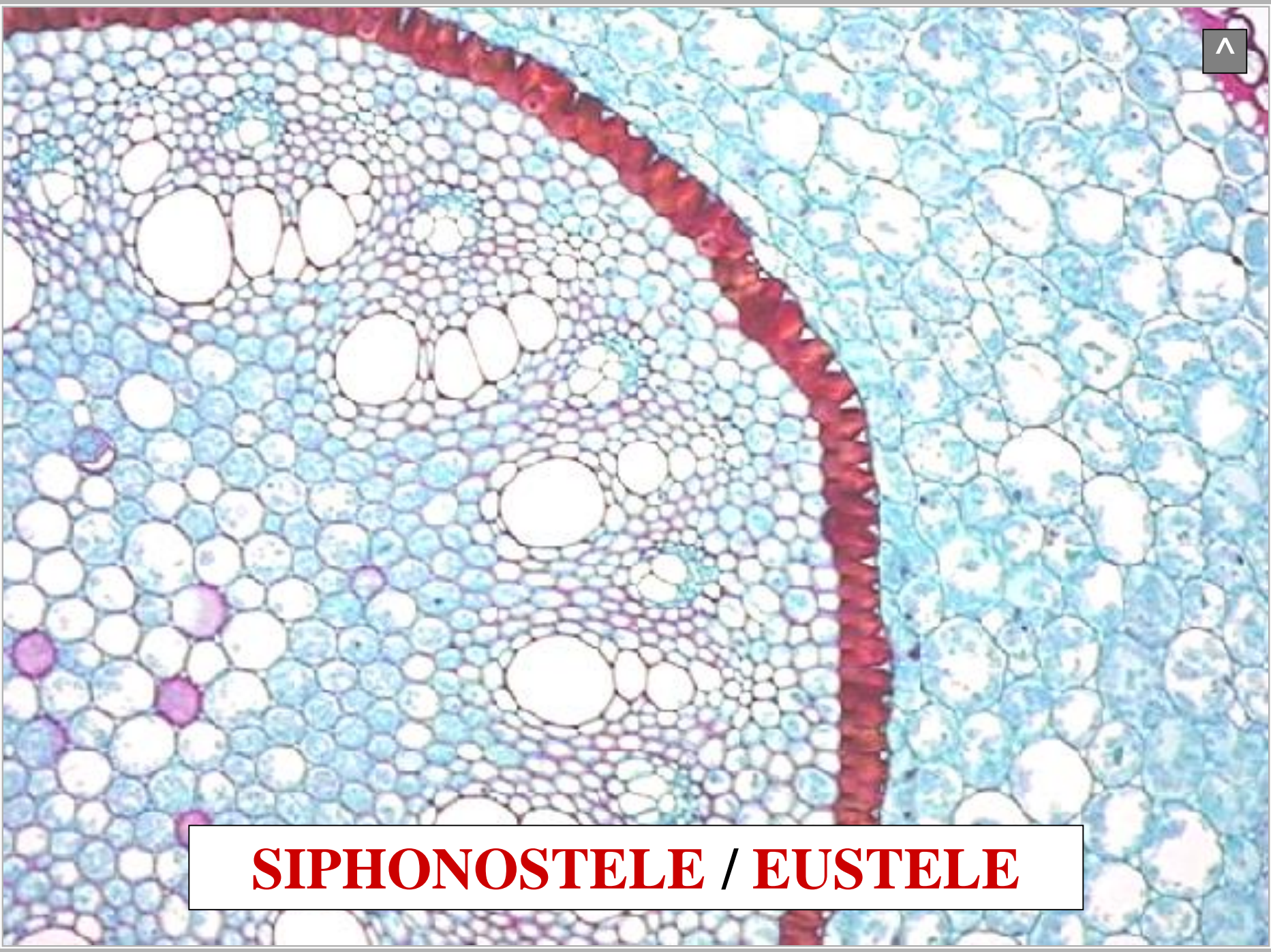


SIPHONOSTELE

E



SIPHONOSTELE



SIPHONOSTELE / EUSTELE



STEM



STEM STELE



G

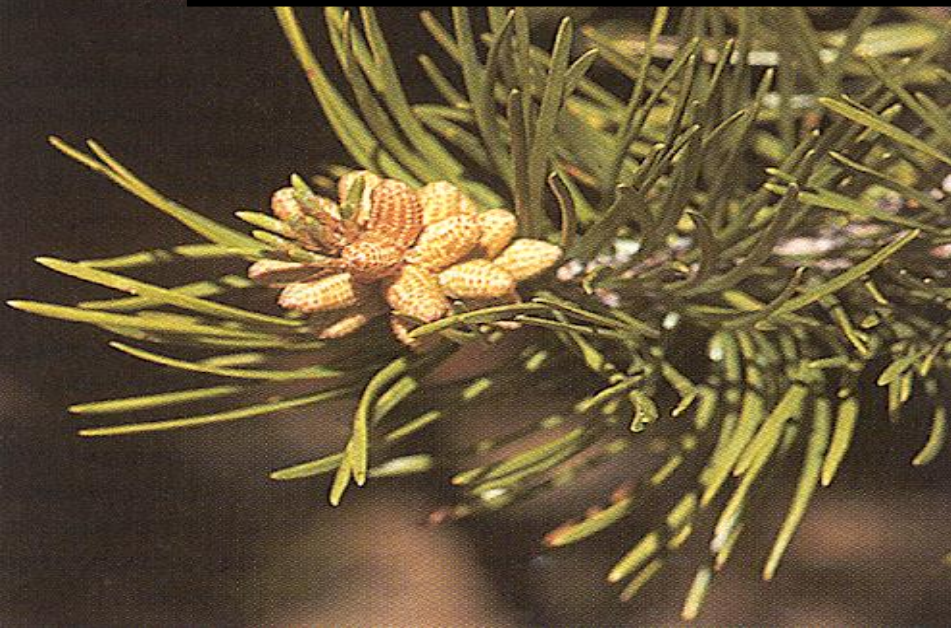
GYMNOSPERMS & DICOTS



D



GYMNOSPERMS





DICOTS

