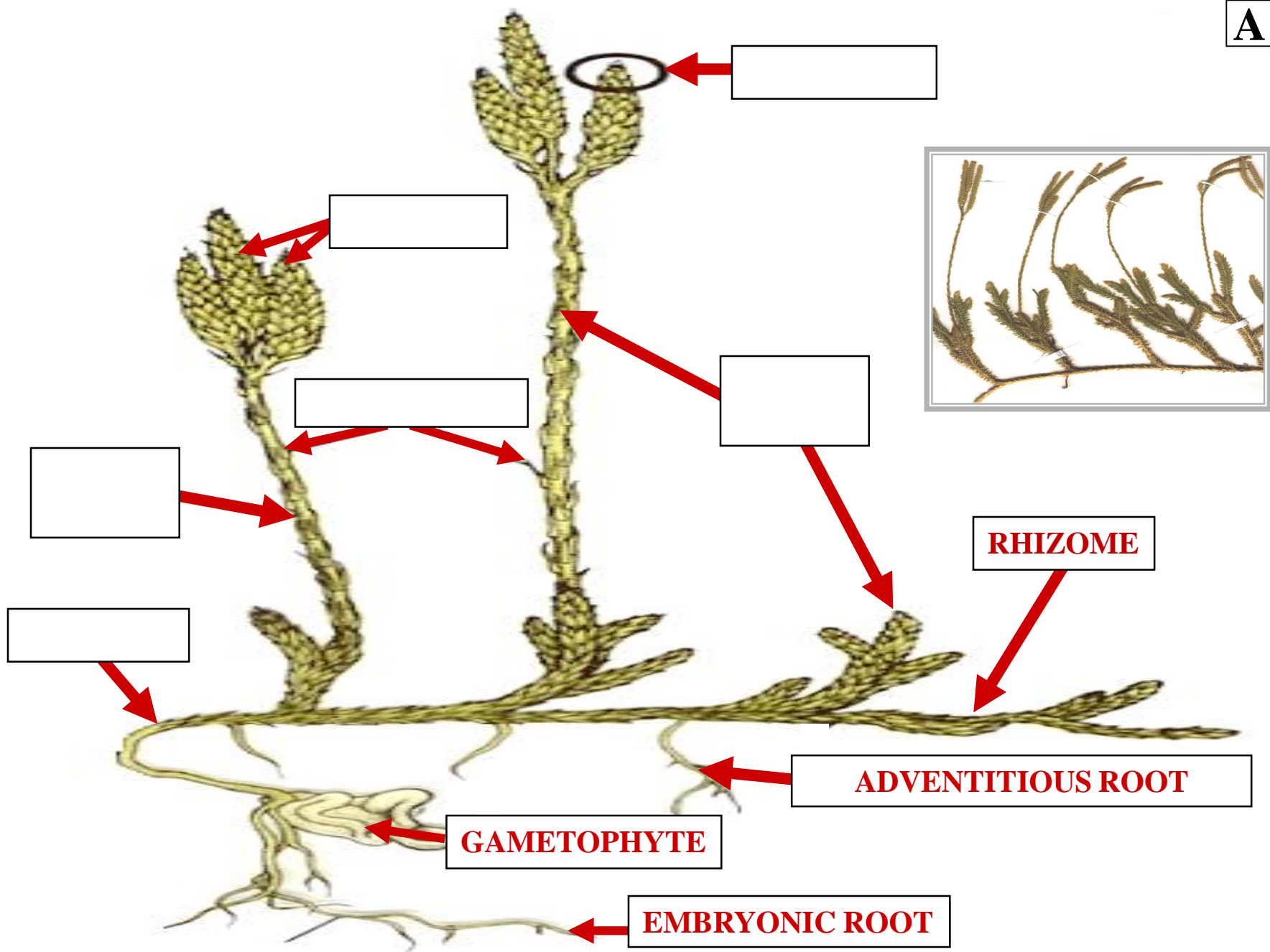


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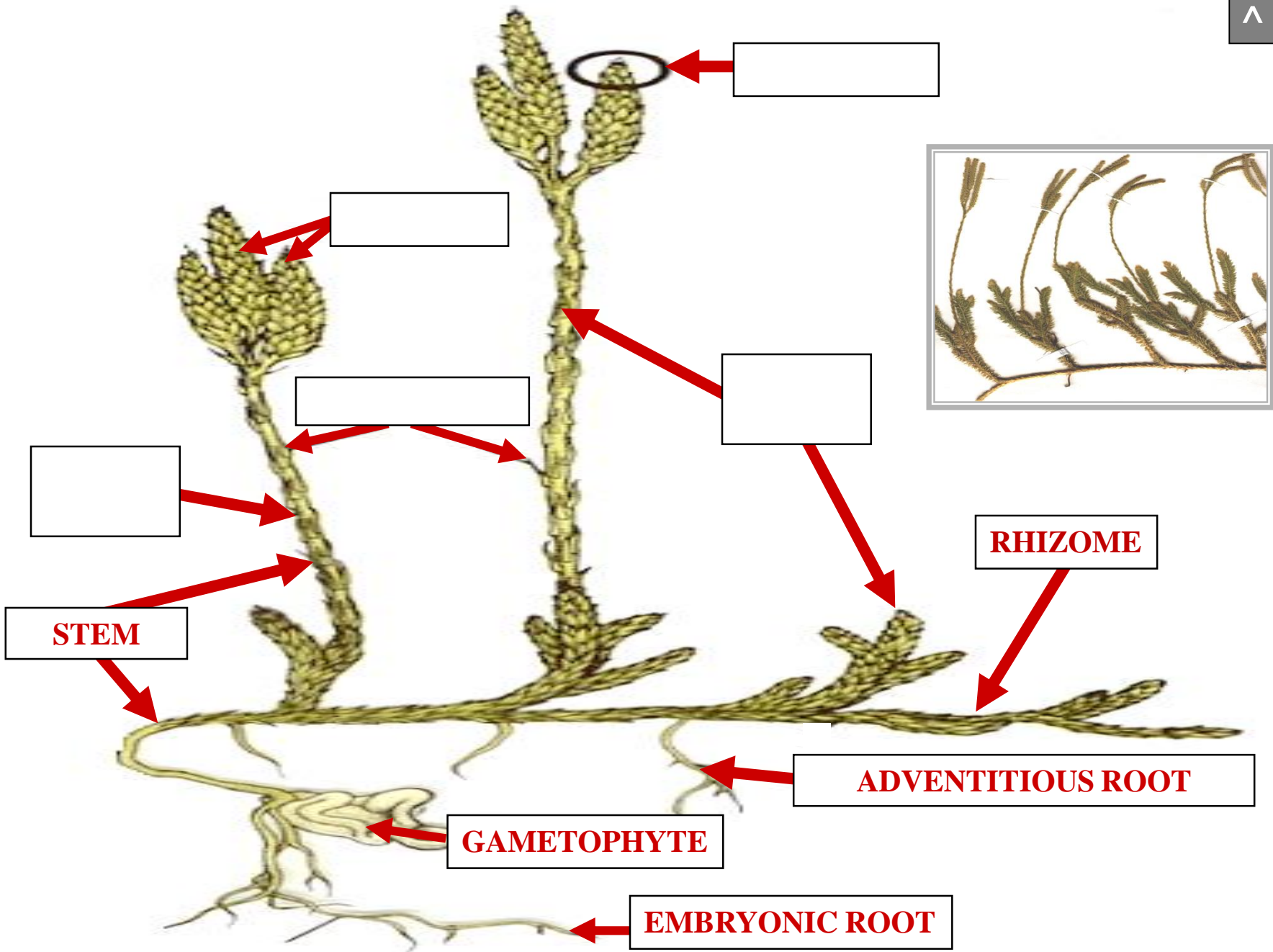
**ADVENTITIOUS  
ROOT**

# **ADVENTITIOUS ROOTS**



**NON-EMBRYONIC ROOT  
DERIVED FROM  
STEM**

**ADVENTITIOUS  
ROOTS**





**STEM**



# STEM ANATOMY

**C**

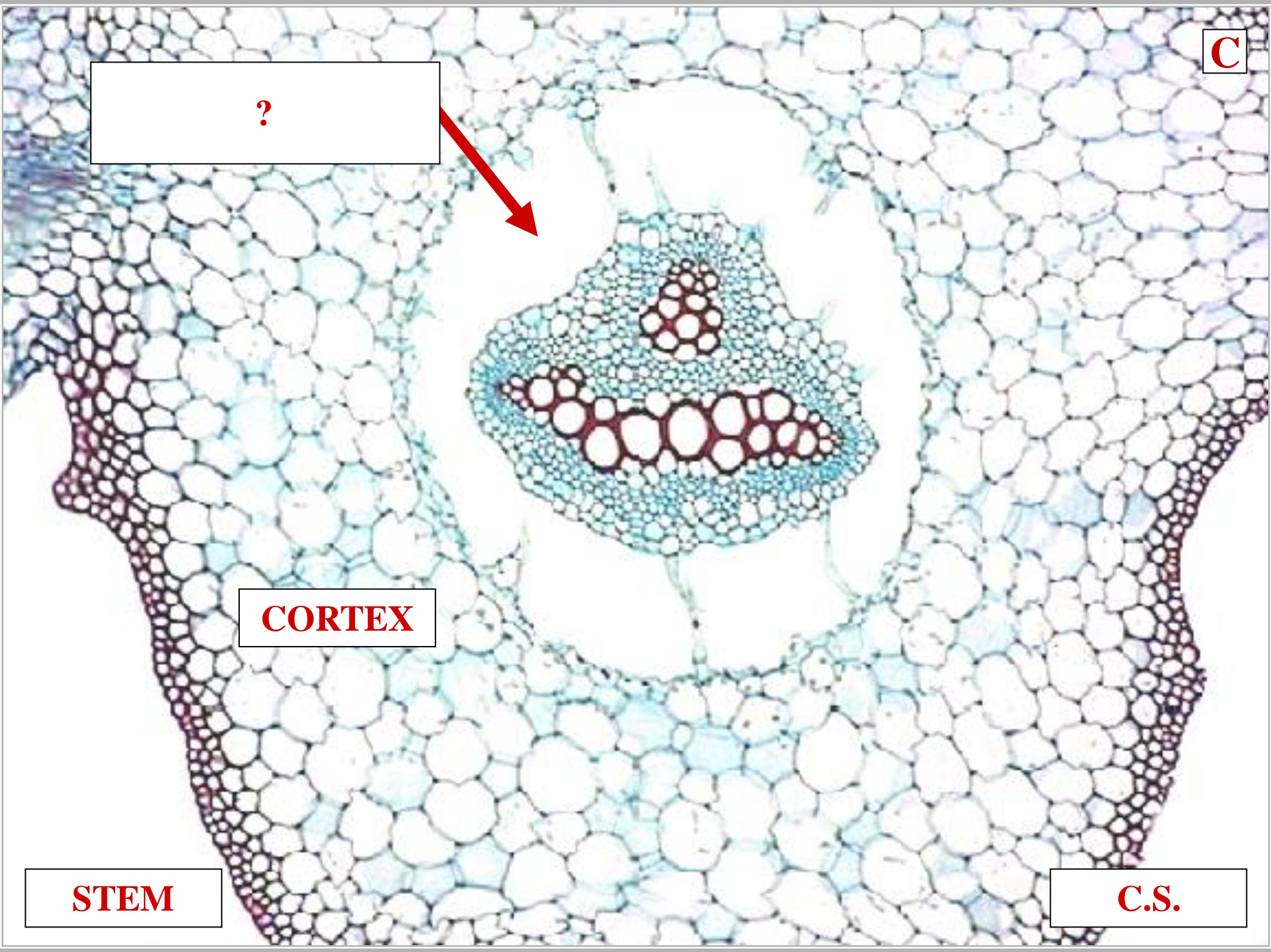
**?**



**CORTEX**

**STEM**

**C.S.**



**CORTICAL  
CAVITY**

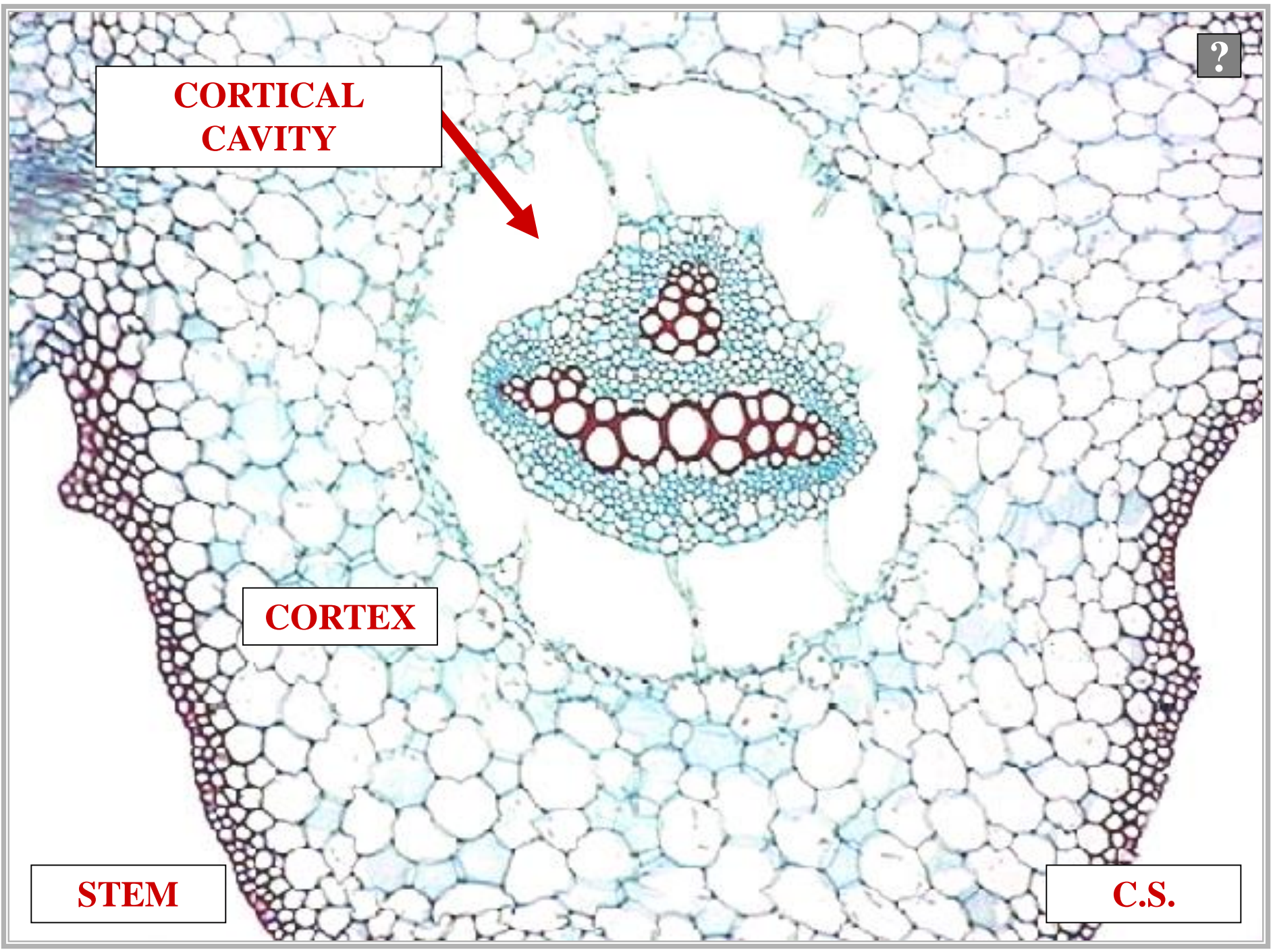


**CORTEX**

**STEM**

**C.S.**

?





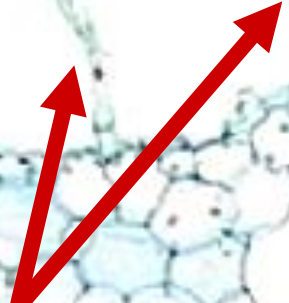
**T**

**CORTICAL  
CAVITY**



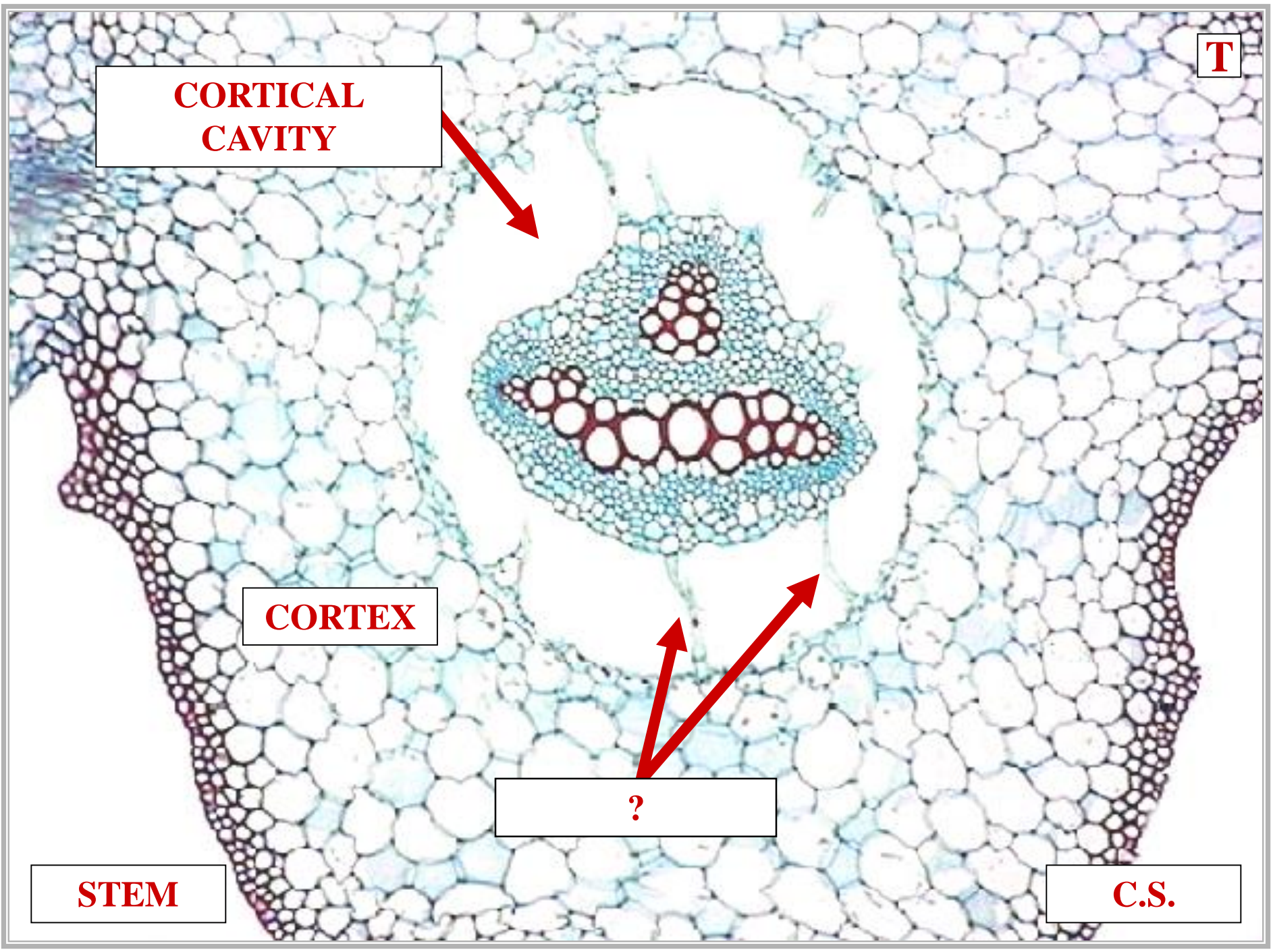
**CORTEX**

**?**



**STEM**

**C.S.**



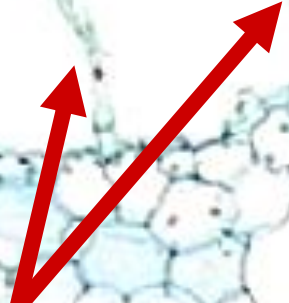
+/-

**CORTICAL  
CAVITY**



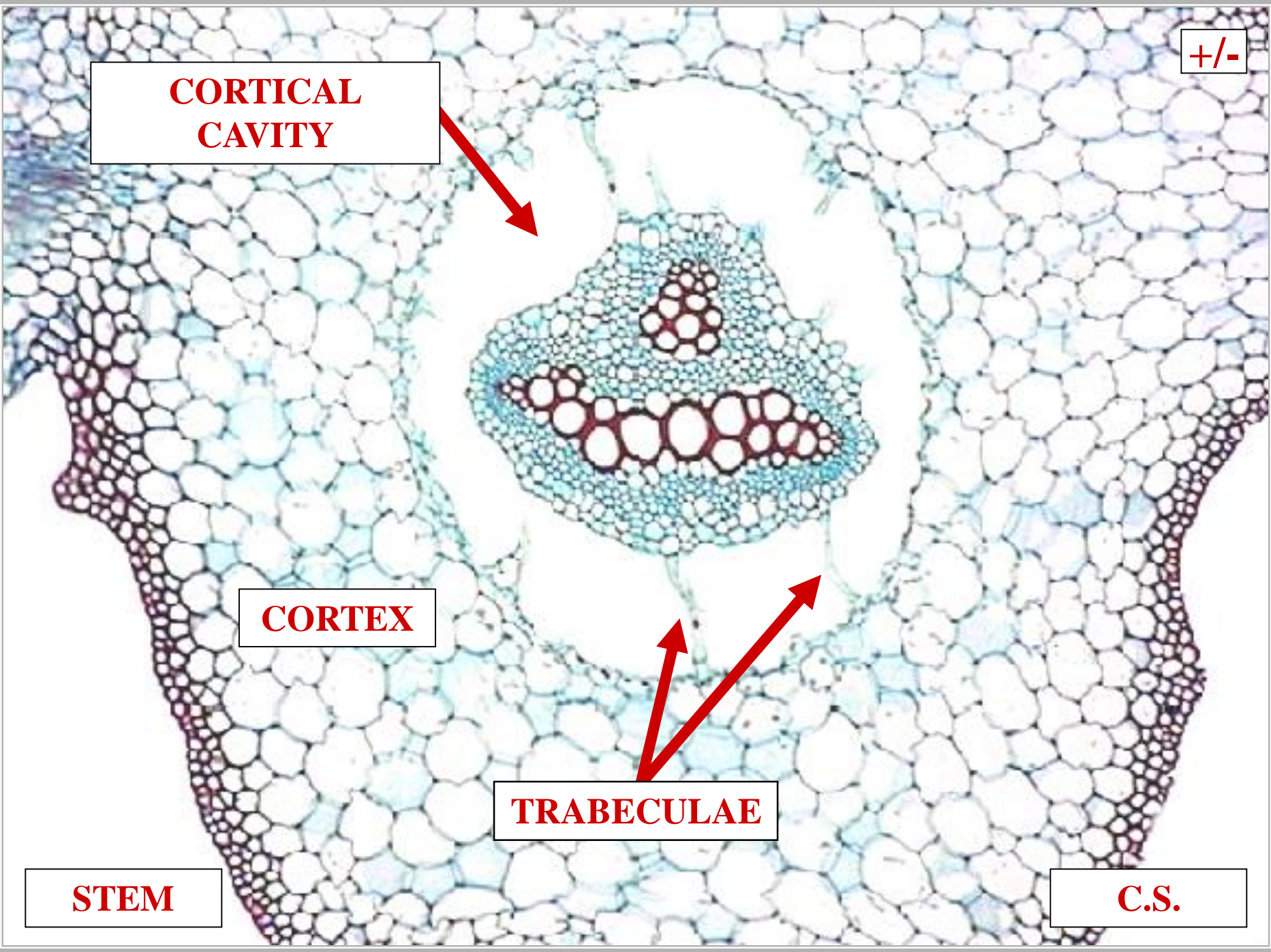
**CORTEX**

**TRABECULAE**



**STEM**

**C.S.**



**T**

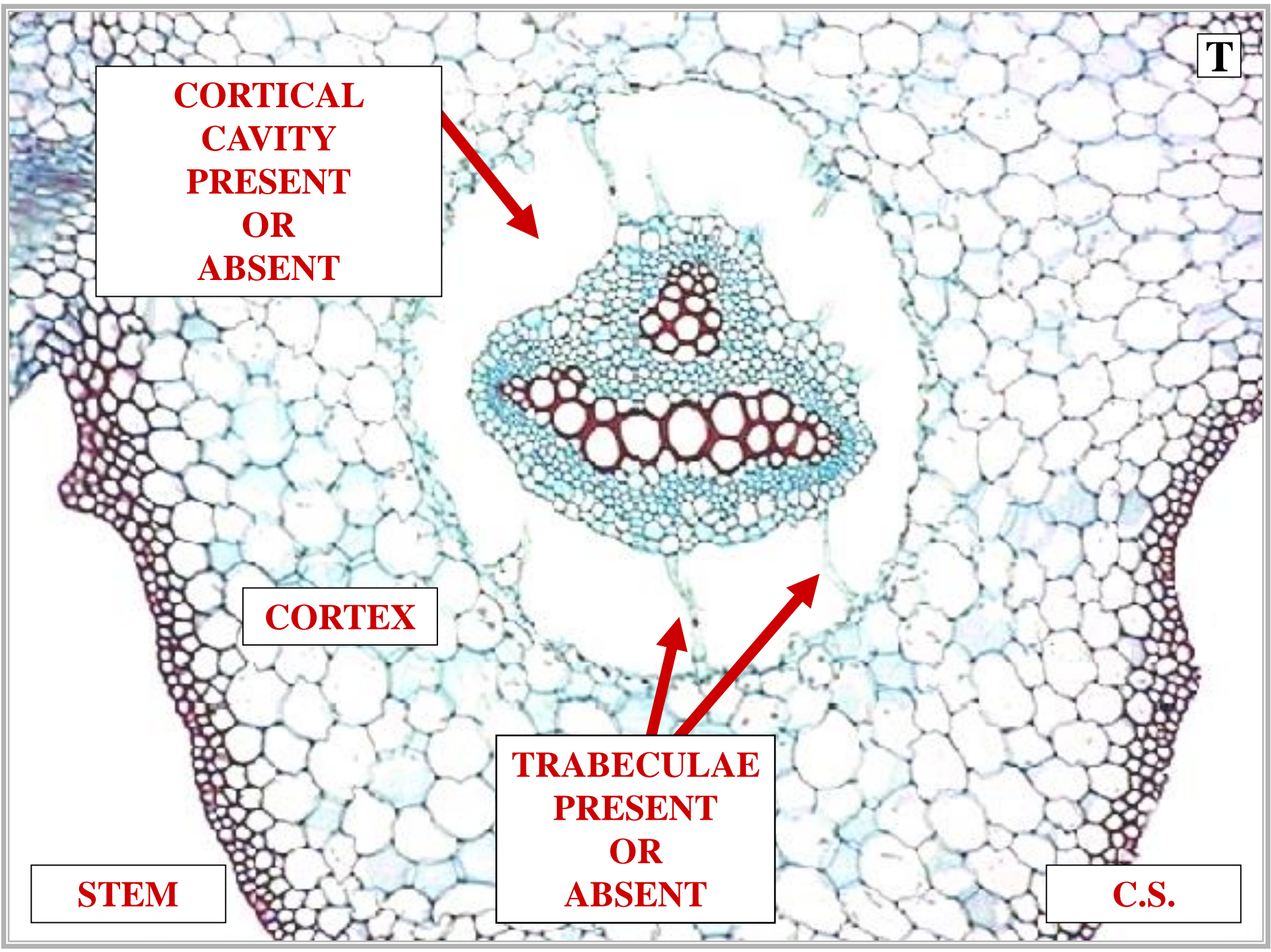
**CORTICAL  
CAVITY  
PRESENT  
OR  
ABSENT**

**CORTEX**

**TRABECULAE  
PRESENT  
OR  
ABSENT**

**STEM**

**C.S.**



**TRABECULAE**



# TRABECULAE

CORTEX CELLS  
THROUGH CORTICAL  
CAVITY TO STELE

TRABECULAE

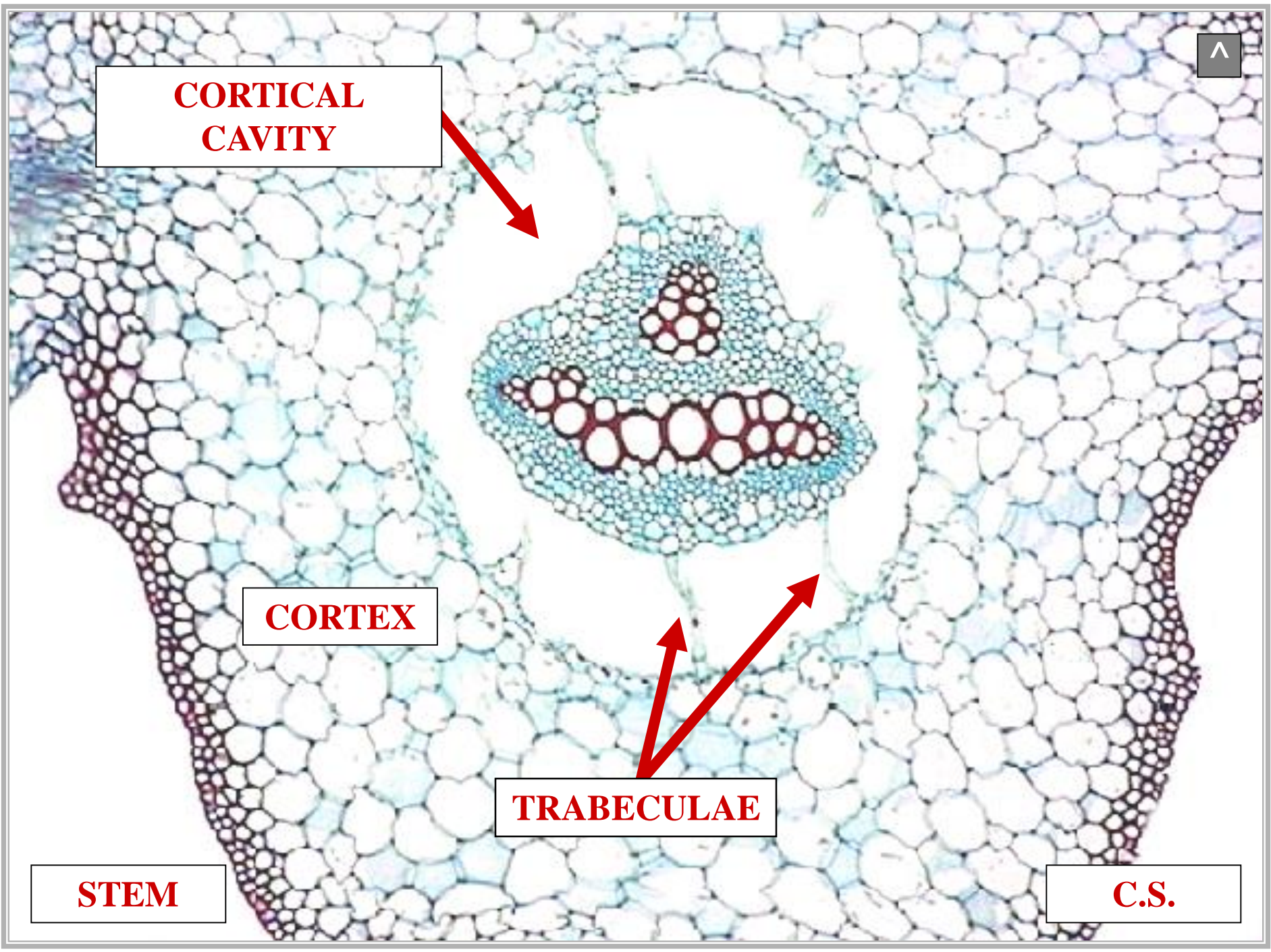
**CORTICAL  
CAVITY**

**CORTEX**

**TRABECULAE**

**STEM**

**C.S.**



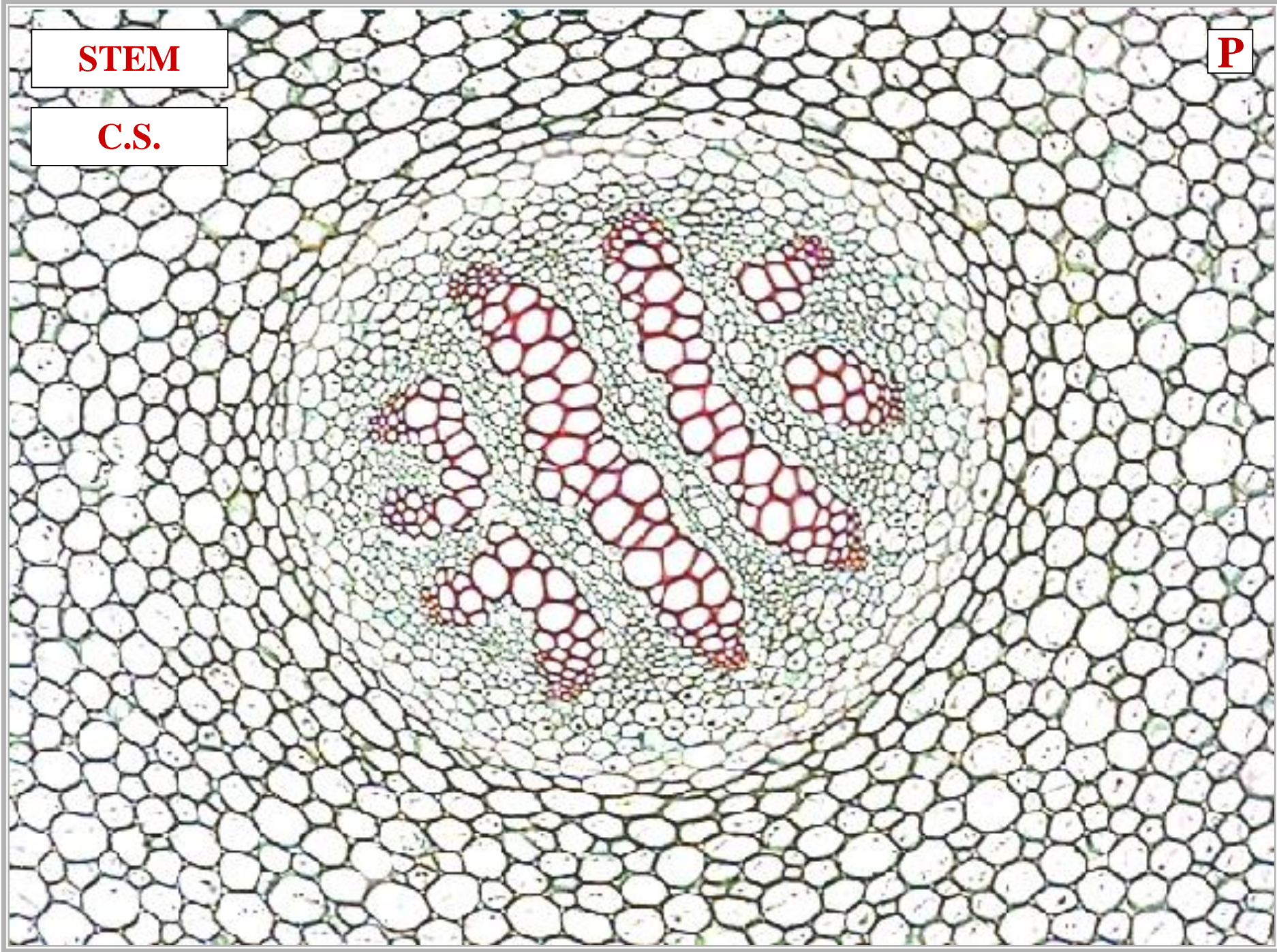


# STEM STELE

**STEM**

**C.S.**

**P**



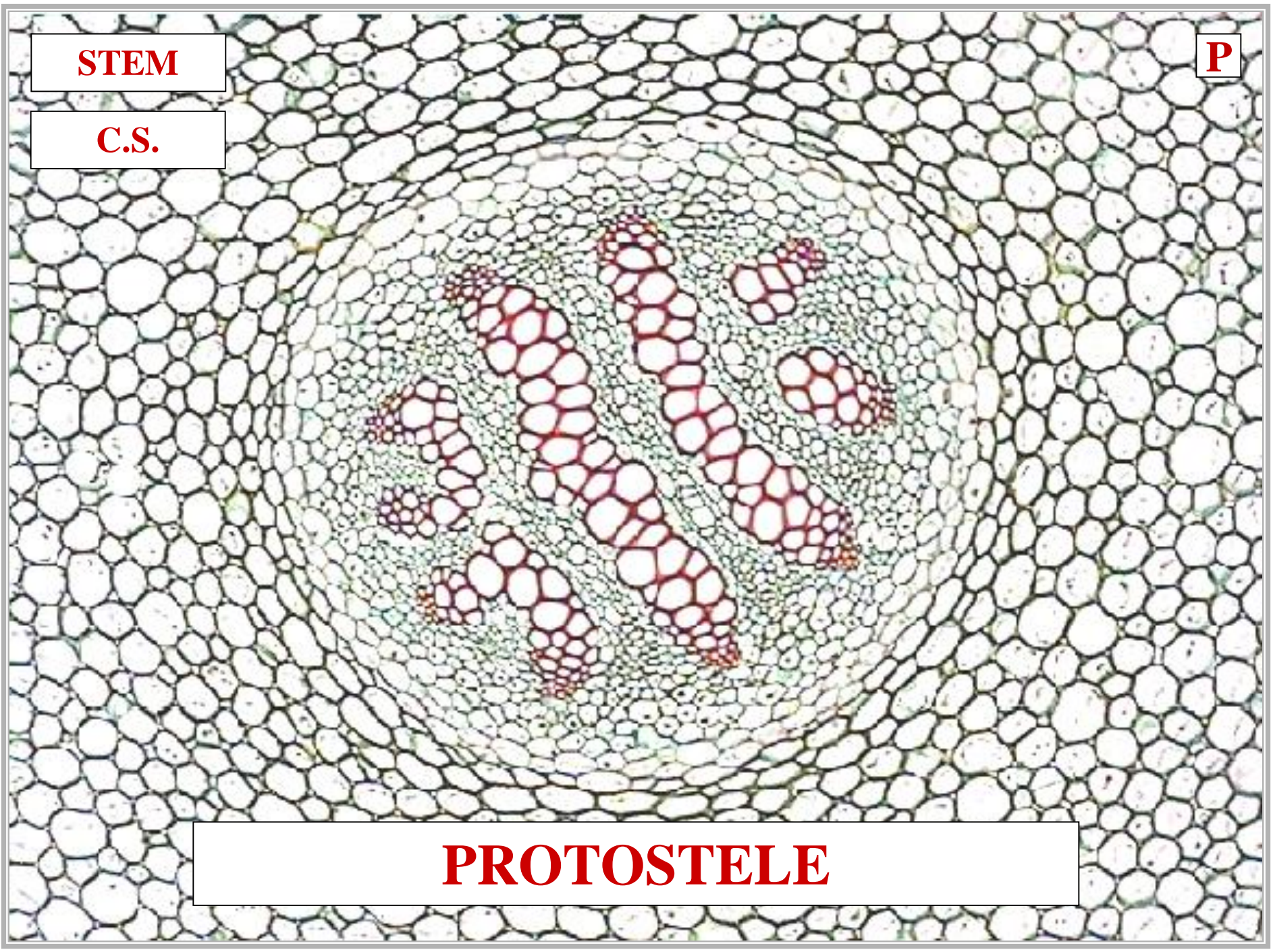


**STEM**

**C.S.**

**P**

**PROTOSTELE**

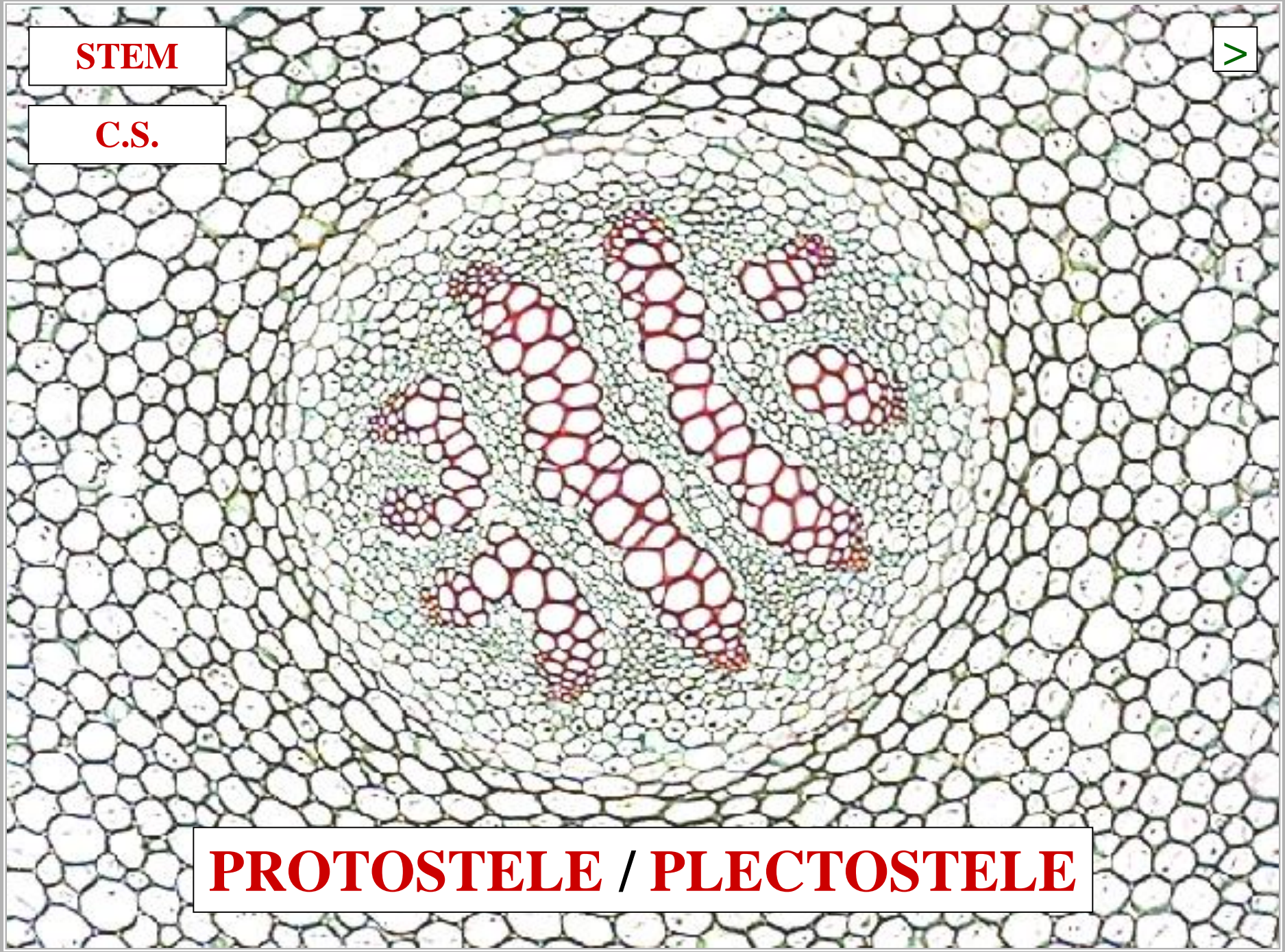


**STEM**

**C.S.**



**PROTOSTELE / PLECTOSTELE**



**STEM**

**C.S.**



**PLECTOSTELE / DIAGNOSTIC**

# RHIZOME

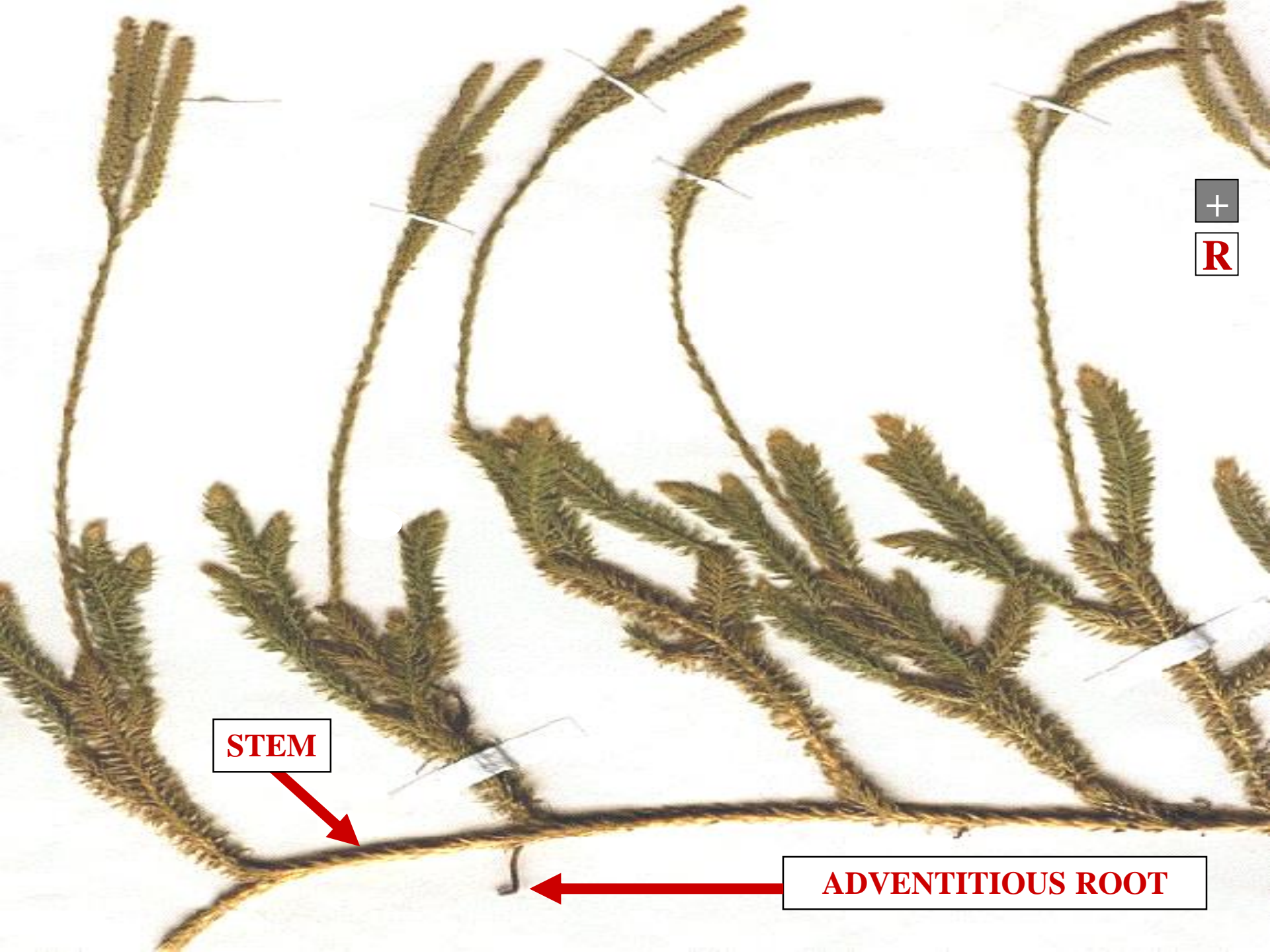
**RHIZOME**



**RHIZOME**

**UNDERGROUND  
STEM**

**RHIZOME**

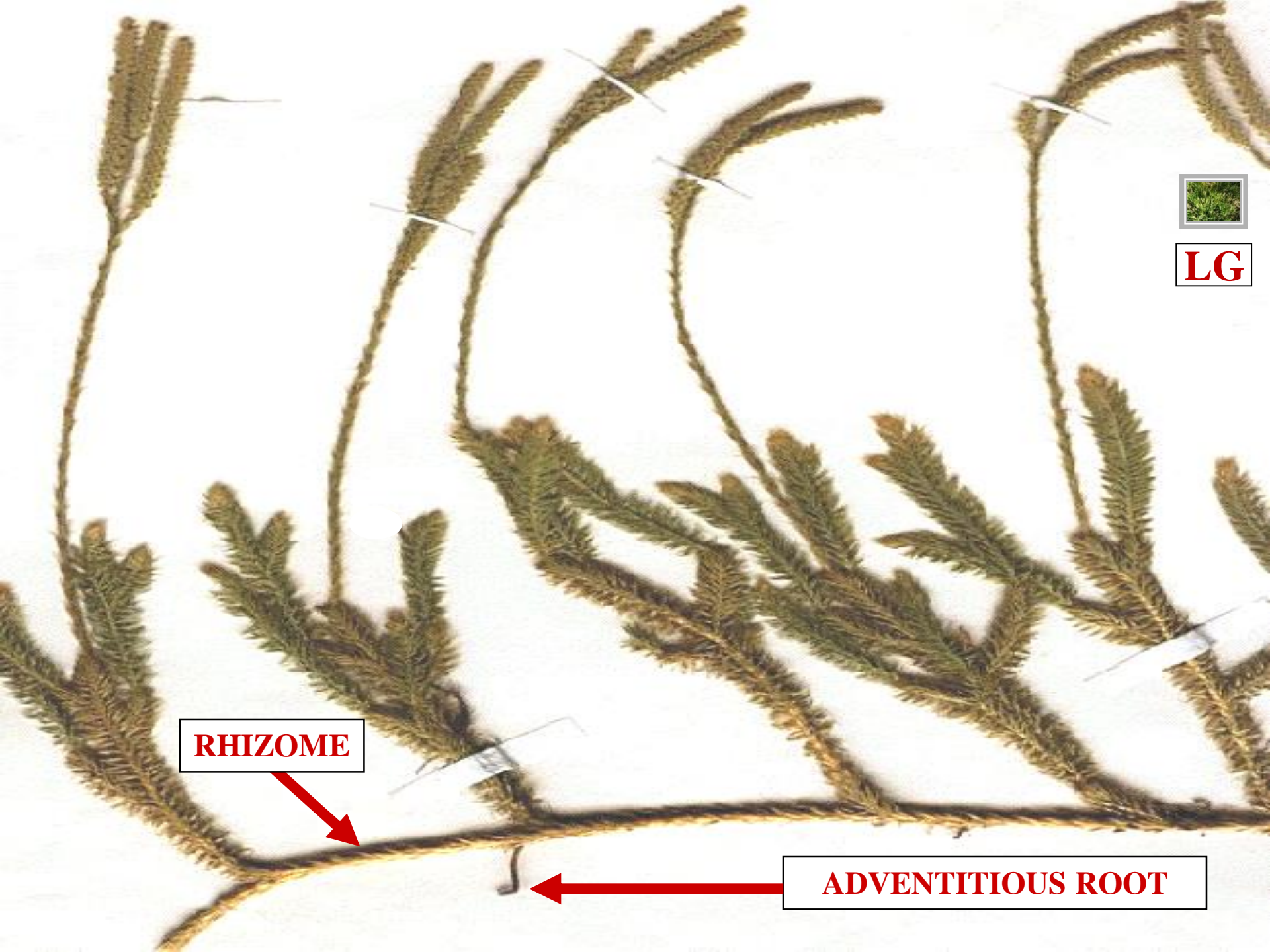


+

R

**STEM**

**ADVENTITIOUS ROOT**



**RHIZOME**

**ADVENTITIOUS ROOT**



**LG**

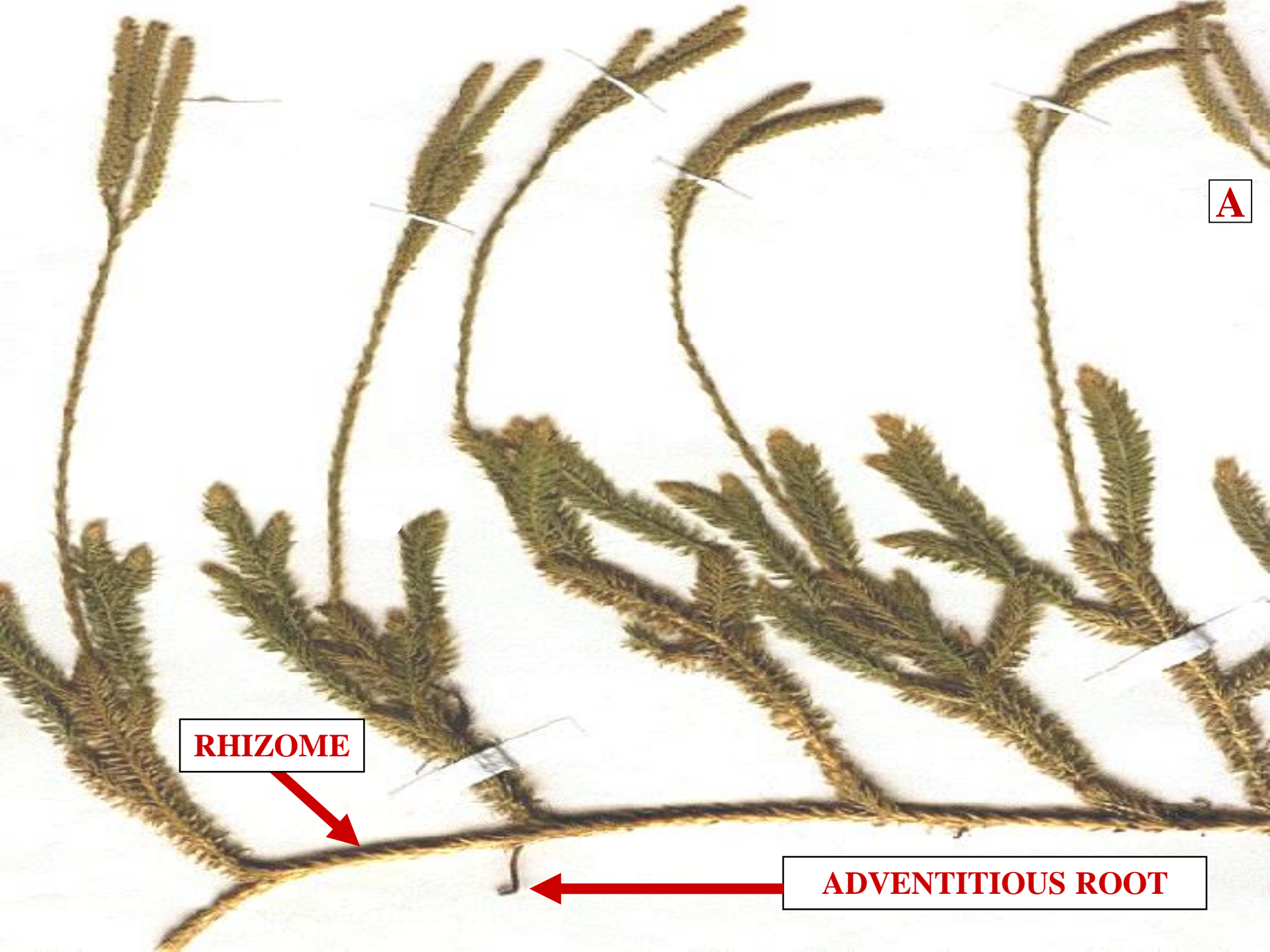


**RHIZOME EXTENSIVE  
LATERAL GROWTH**





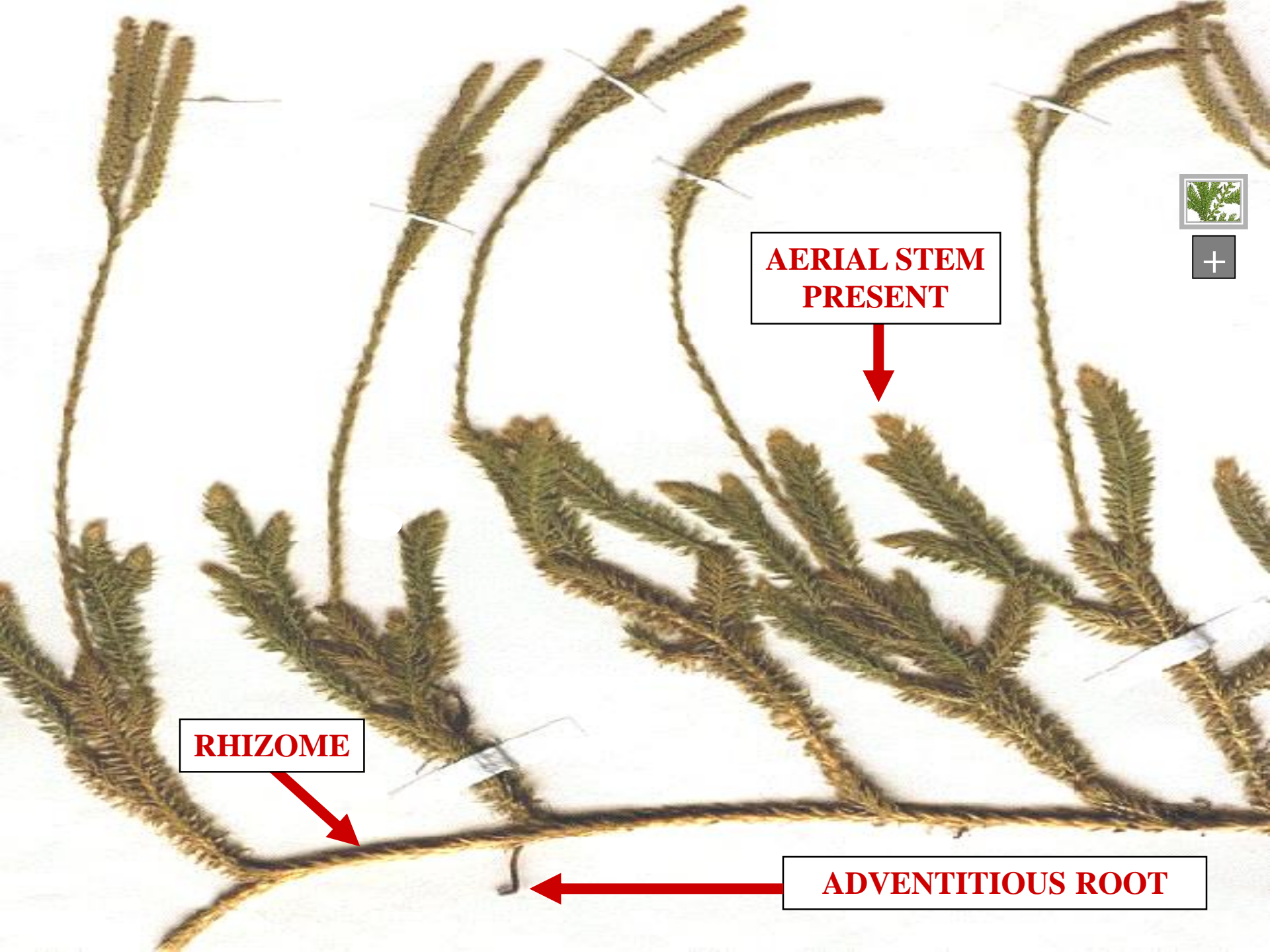
# AERIAL STEM



A

**RHIZOME**

**ADVENTITIOUS ROOT**



**AERIAL STEM  
PRESENT**



**RHIZOME**



**ADVENTITIOUS ROOT**

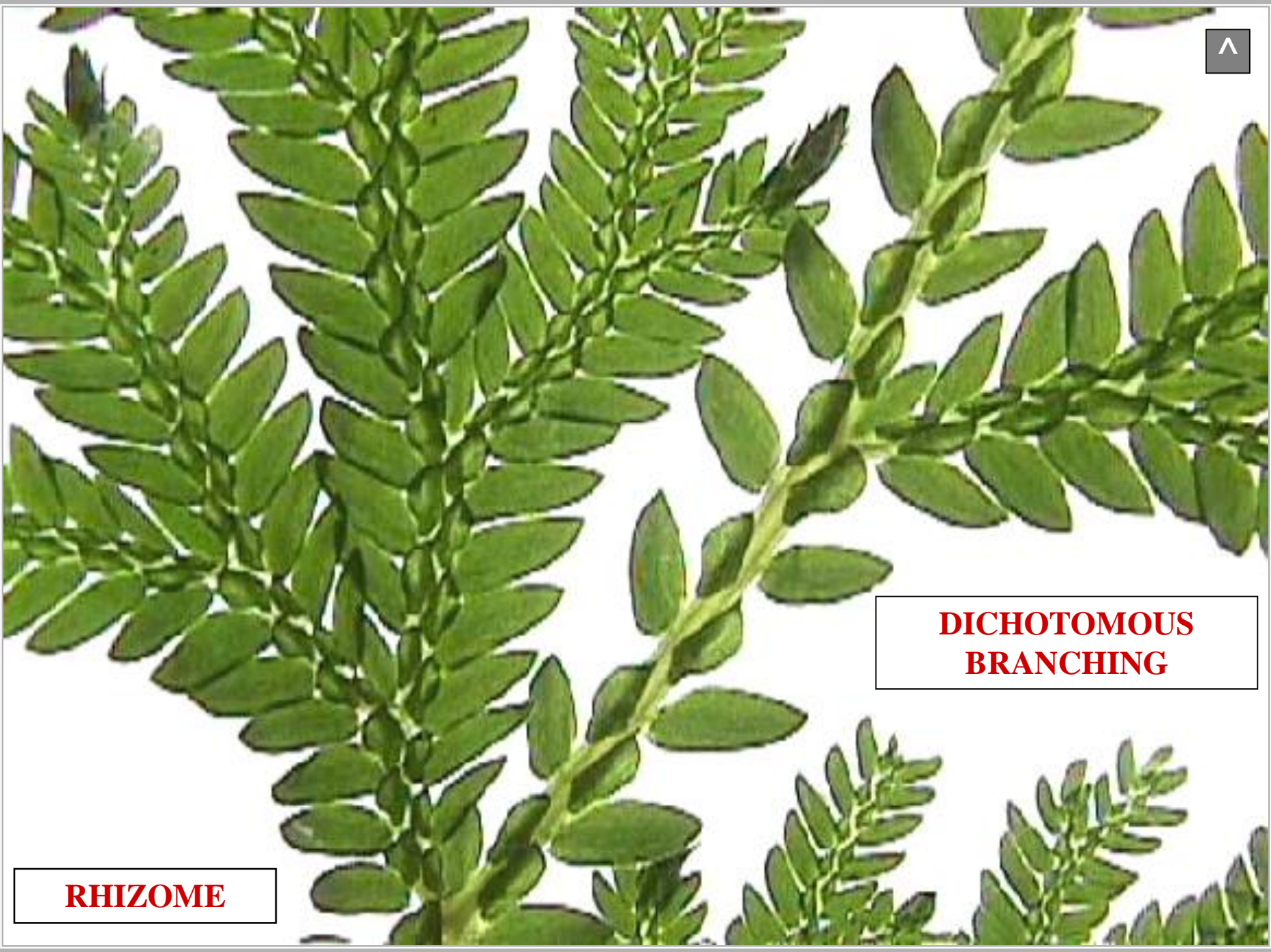


**DB**



**AERIAL STEM  
BRANCHING**

**RHIZOME**



**DICHOTOMOUS  
BRANCHING**

**RHIZOME**



**LEAF**

L

+

**LYCOPODIOPHYTA**







**LYCOPHYTES**

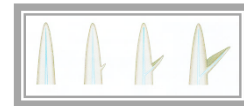
**LYCOPODIOPHYTA**



**MICROPHYLLS**

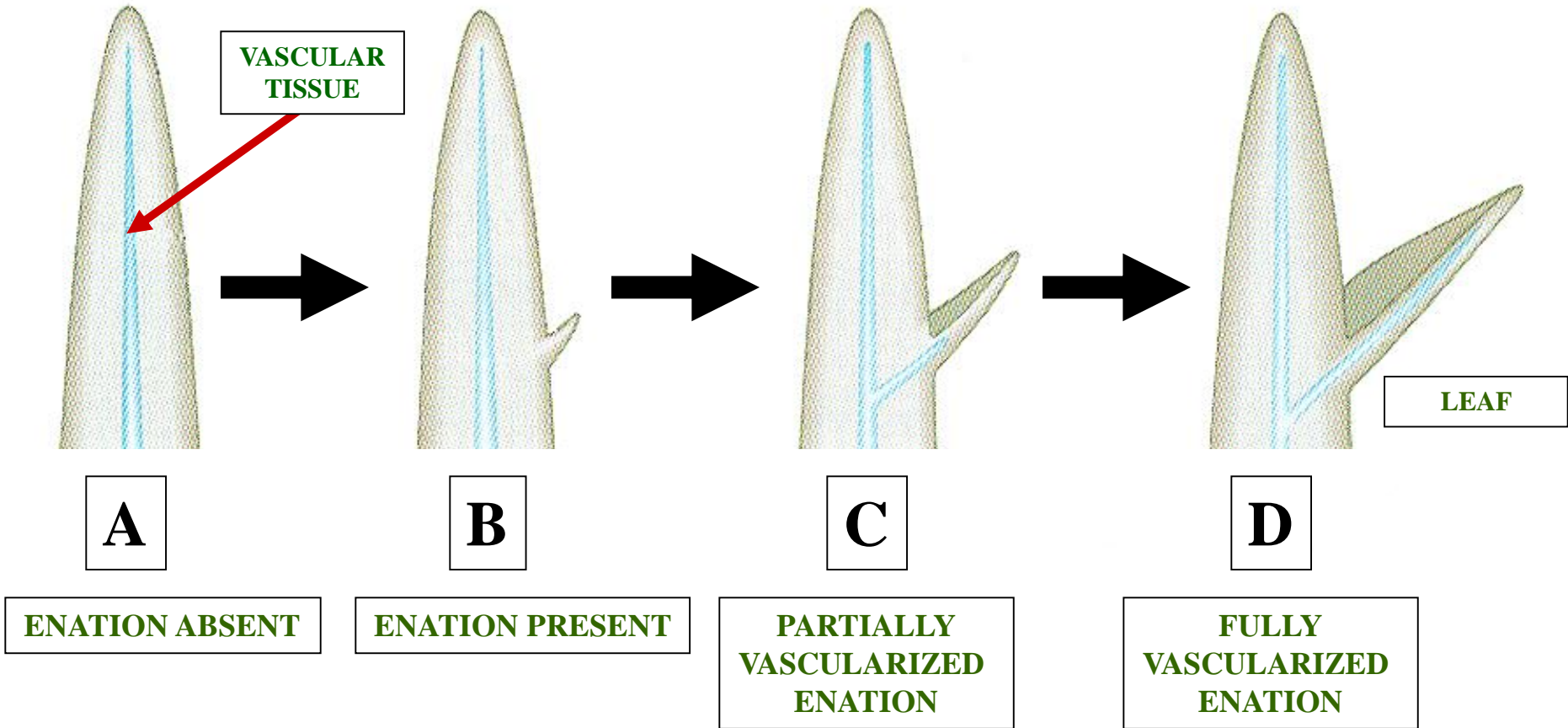
**LYCOPHYTES**

**LYCOPODIOPHYTA**



# LEAF EVOLUTION

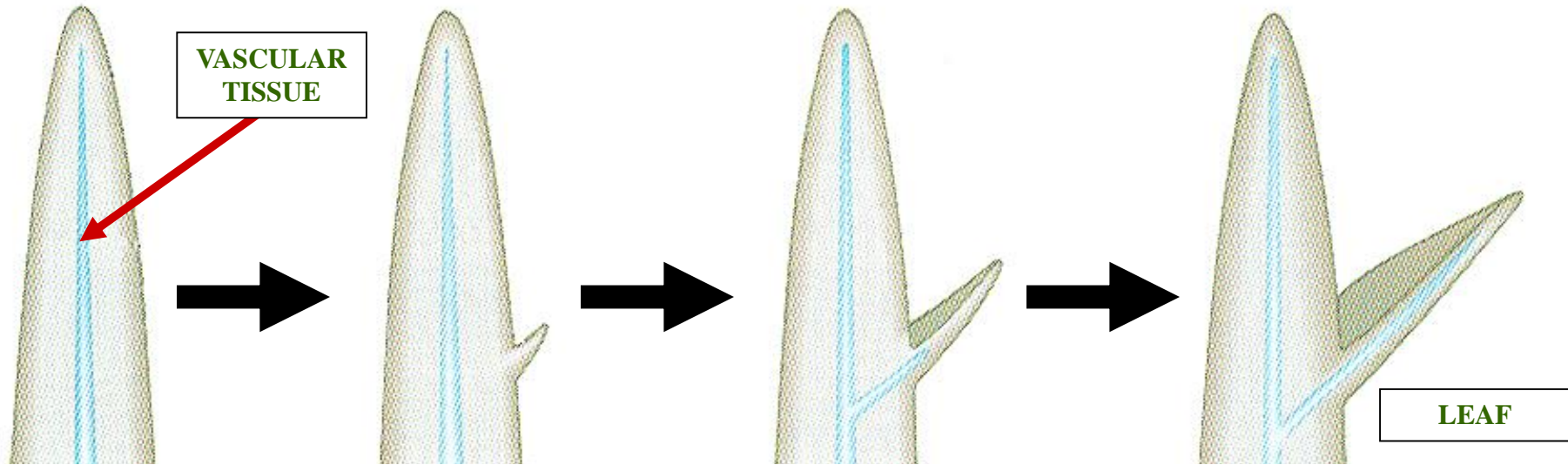
# THEORY



➔ = TIME

# MICROPHYLL

# ENATION THEORY



**A**

**B**

**C**

**D**

ENATION ABSENT

ENATION PRESENT

PARTIALLY  
VASCULARIZED  
ENATION

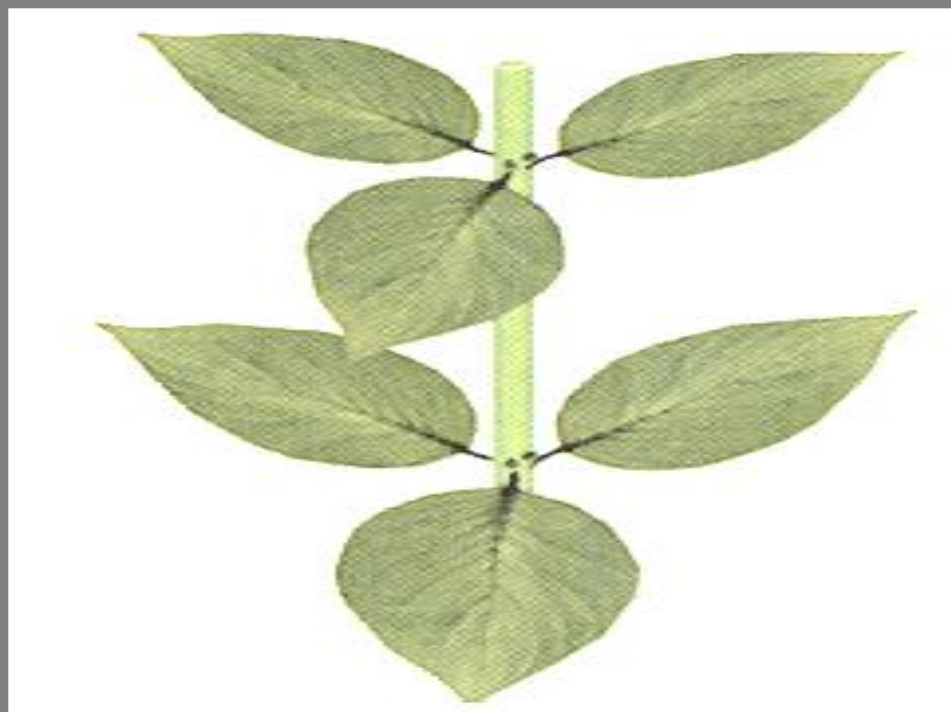
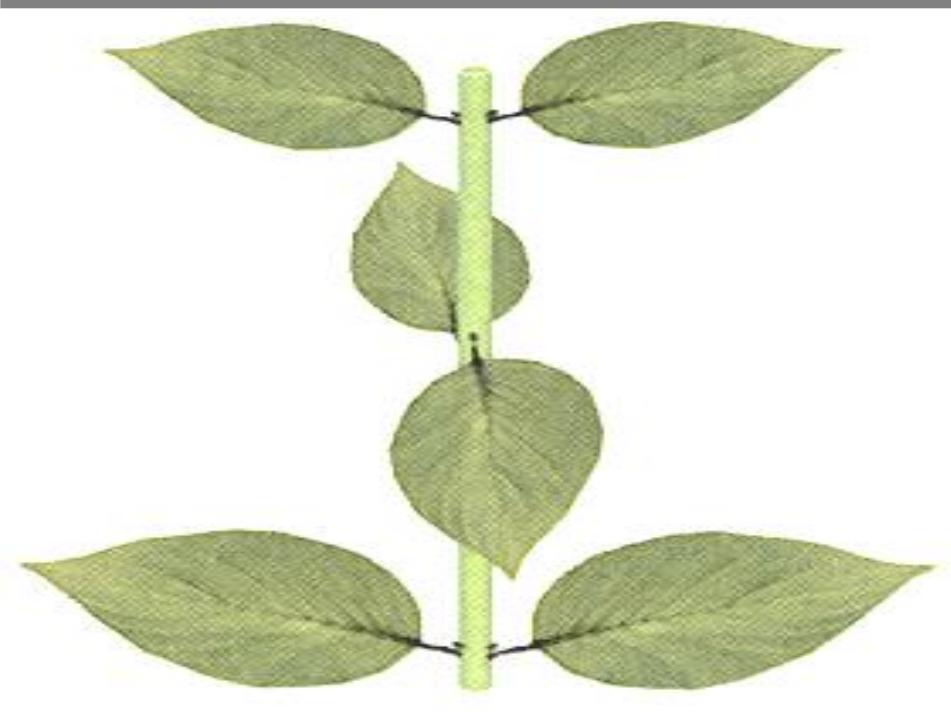
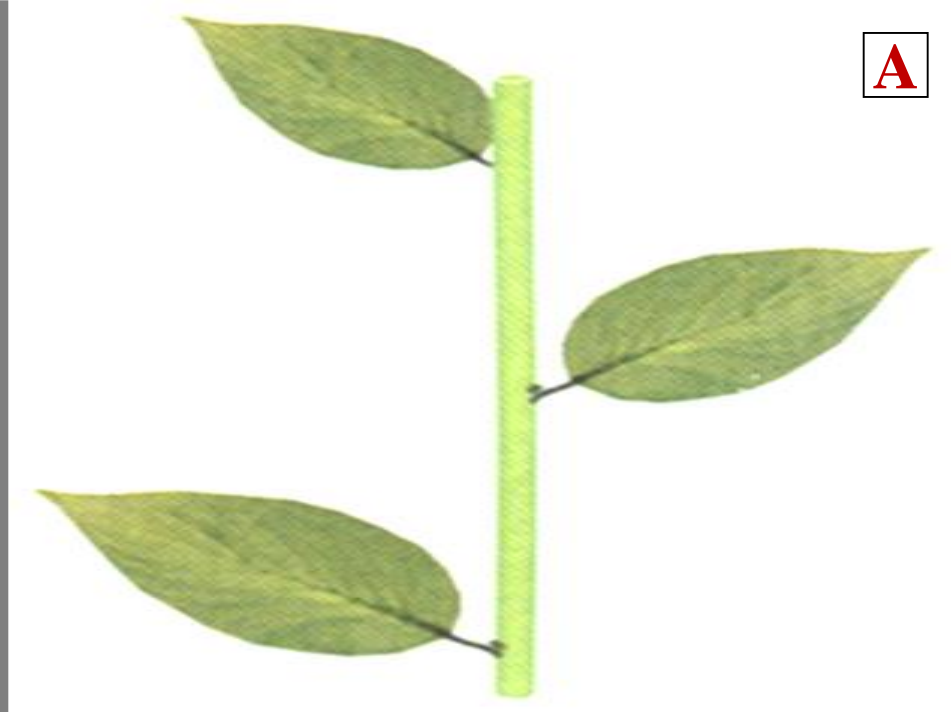
FULLY  
VASCULARIZED  
ENATION

➔ = TIME

# MICROPHYLL



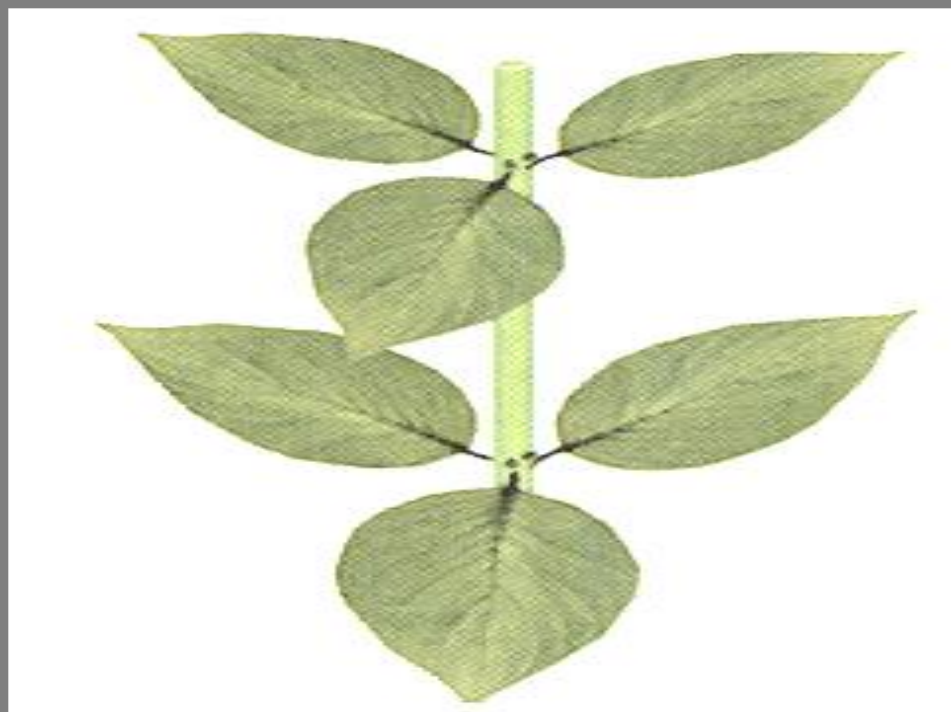
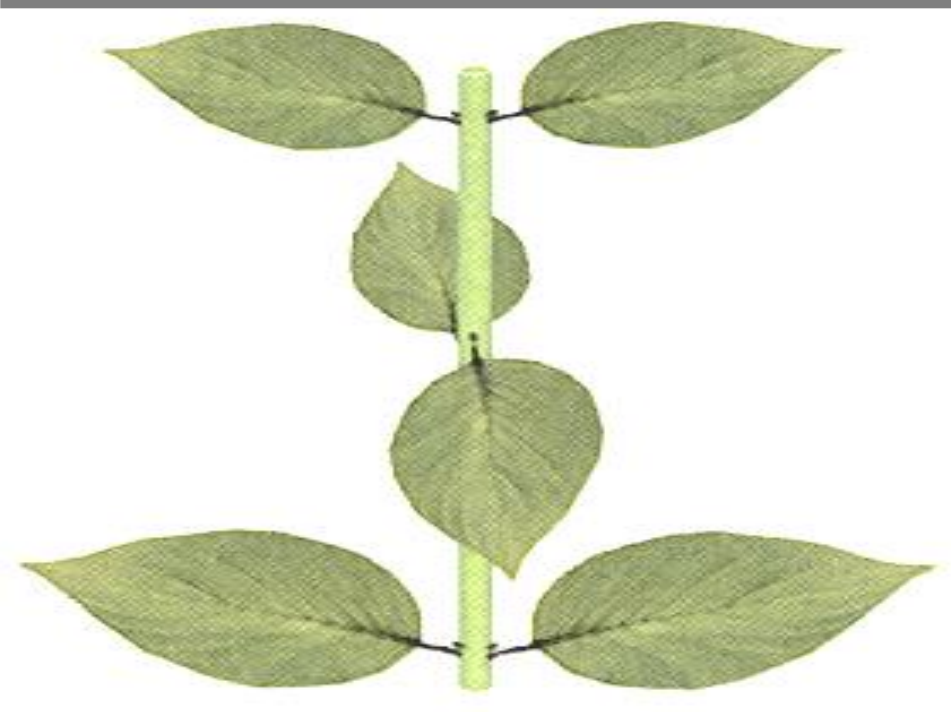
# LEAF PHYLLOTAXY





**O**

**ALTERNATE**



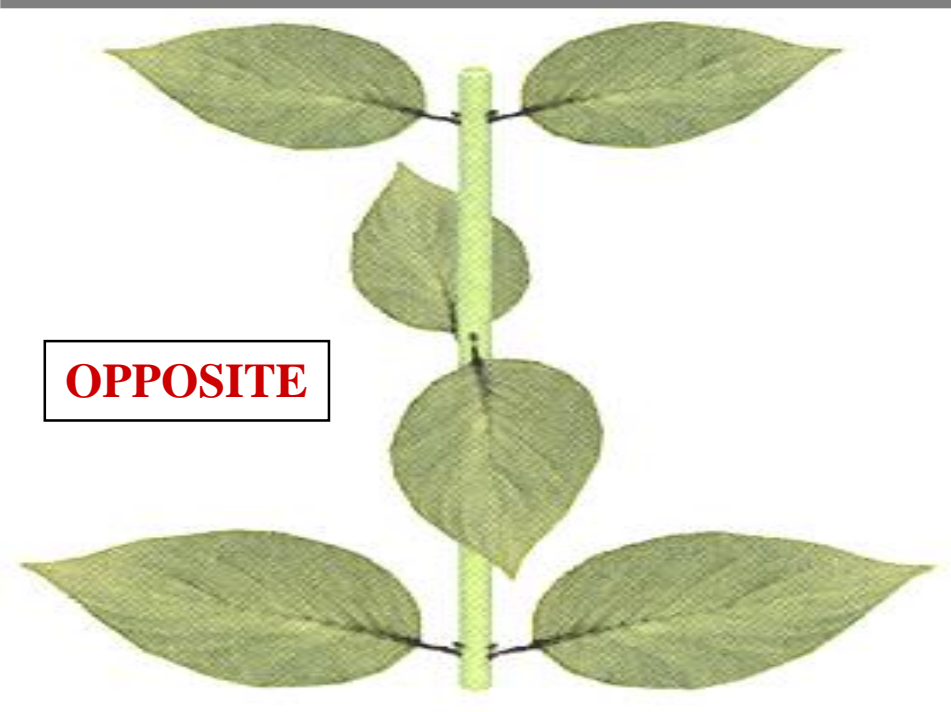




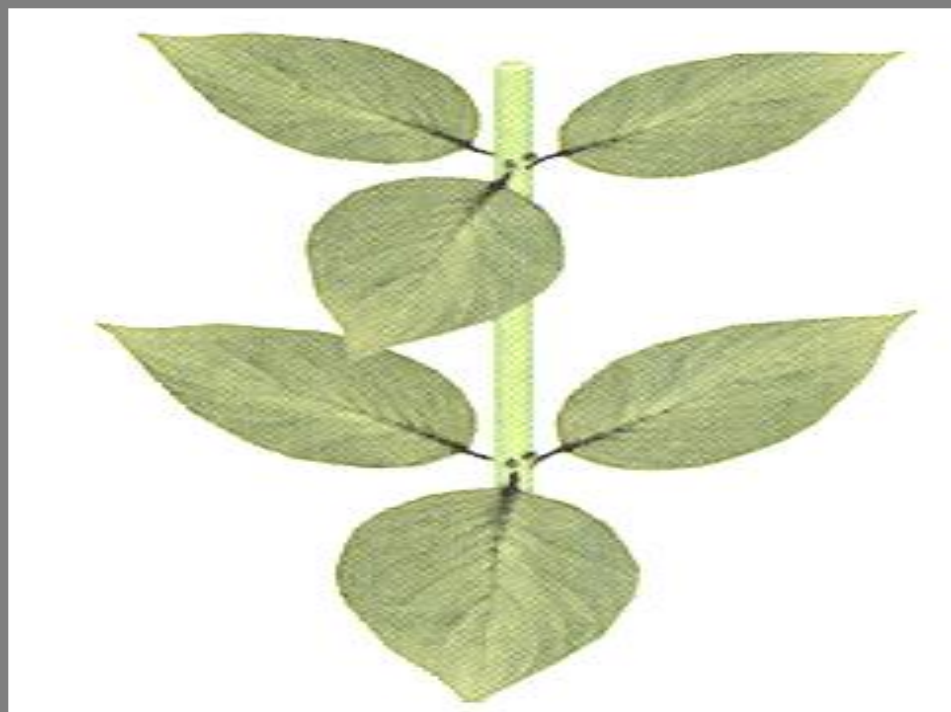
**LYCOPHYTES**



**ALTERNATE**

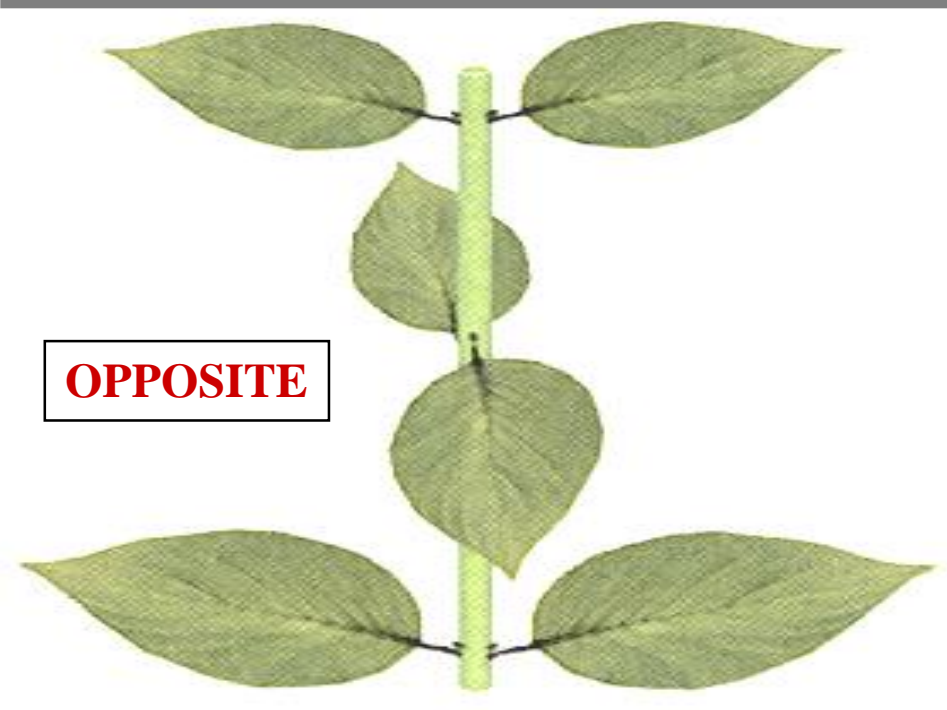
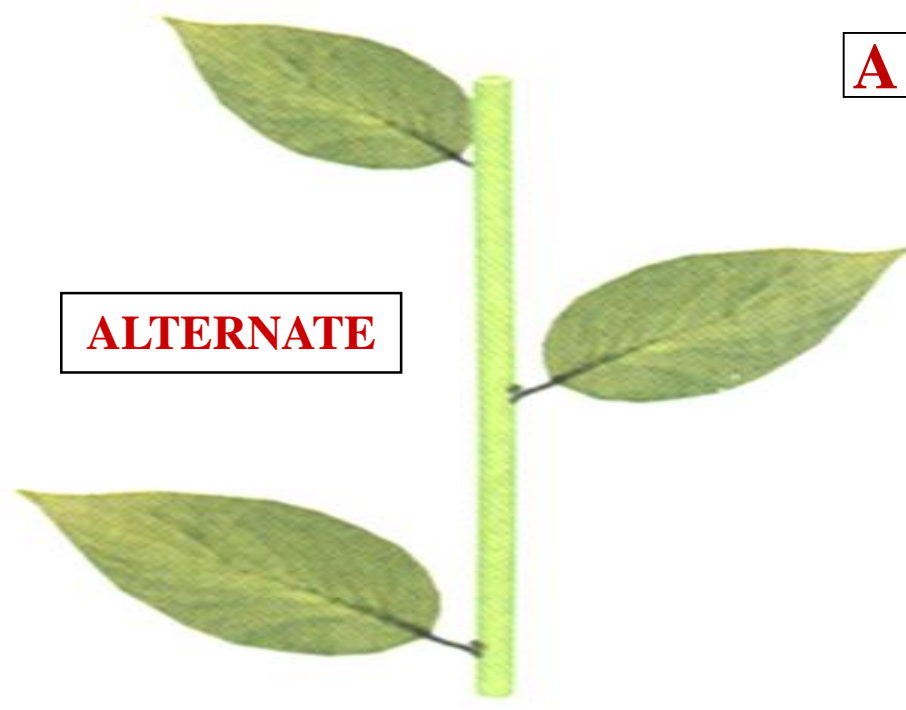


**OPPOSITE**





**A**



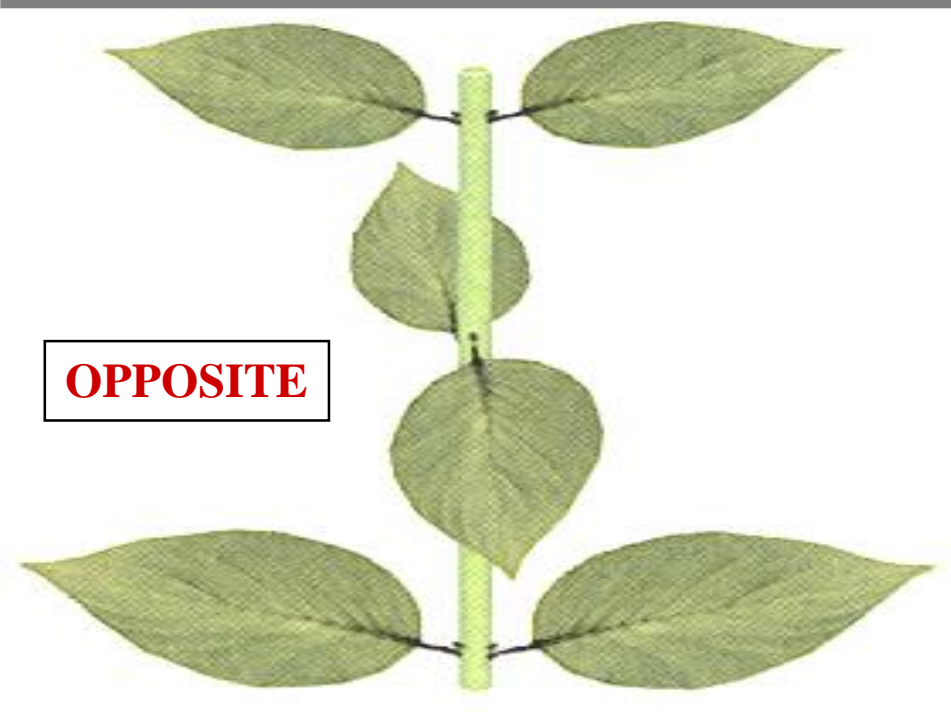


**ALTERNATE**

**LYCOPHYTES**



**ALTERNATE**



**OPPOSITE**



**WHORLED**



# LEAF MORPHOLOGY

**ISOPHYLLOUS  
LEAVES**

**VS**

**ANISOPHYLLOUS  
LEAVES**

# **ISOPHYLLOUS LEAVES**

# ISOPHYLLOUS LEAVES



## 1 MORPHOLOGICAL FORM

# ISOPHYLLOUS LEAVES

**ISOPHYLLOUS LEAVES**





# **ANISOPHYLLOUS LEAVES**

# **ANISOPHYLLOUS LEAVES**



## **2 MORPHOLOGICAL FORMS**

# **ANISOPHYLLOUS LEAVES**

L

+

**ANISOPHYLLOUS LEAVES**

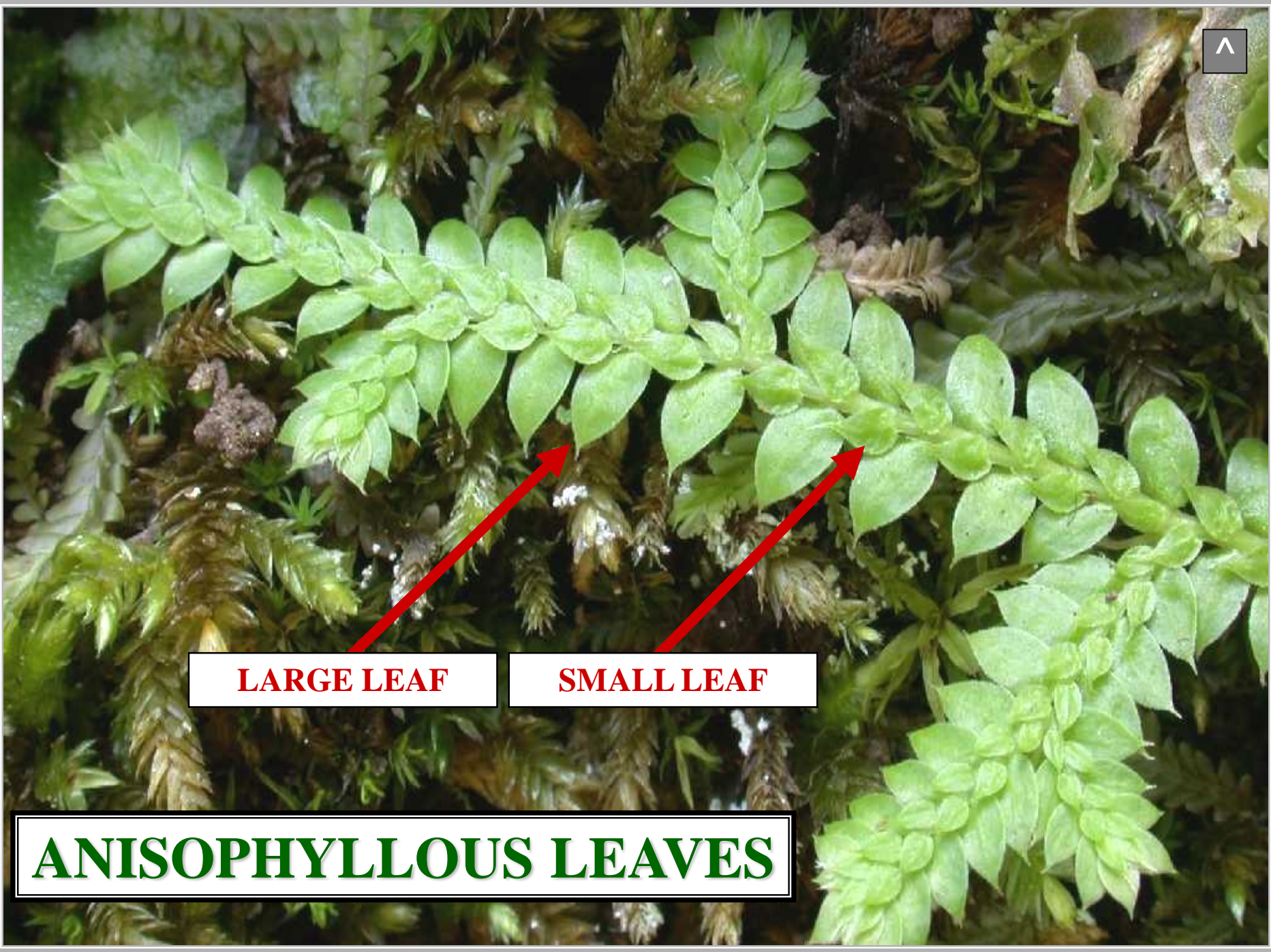


S



LARGE LEAF

**ANISOPHYLLOUS LEAVES**



**LARGE LEAF**

**SMALL LEAF**

**ANISOPHYLLOUS LEAVES**

# LIGULE

**LIGULE**

**LIGULE**



**SMALL TONGUE-LIKE  
LEAF OUTGROWTH**

**LIGULE**



# LIGULE



SMALL TONGUE-LIKE  
LEAF OUTGROWTH

---

FUNCTION UNKNOWN

LIGULE

# LIGULE



SMALL TONGUE-LIKE  
LEAF OUTGROWTH

---

FUNCTION UNKNOWN

---

PRESENT OR ABSENT

LIGULE

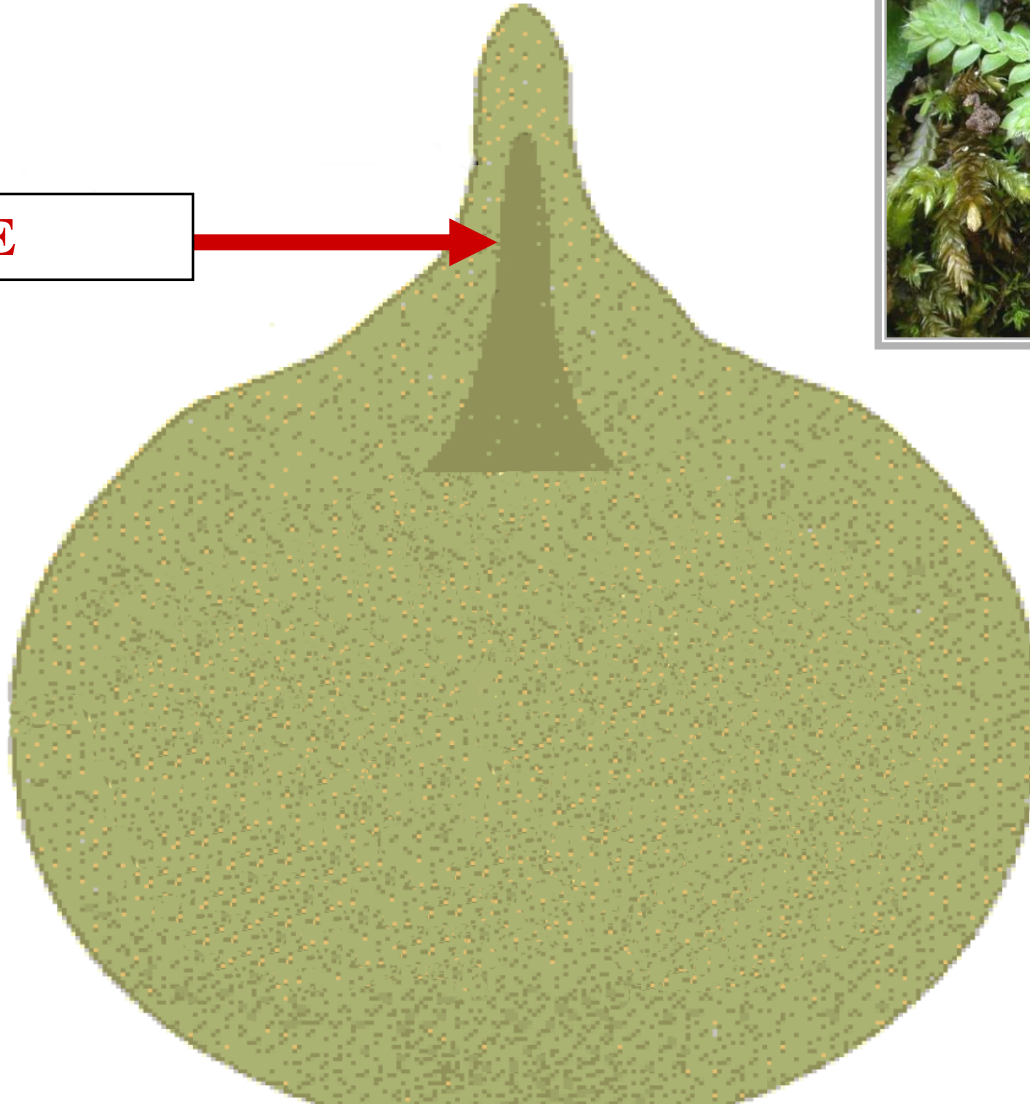
**LIGULE**



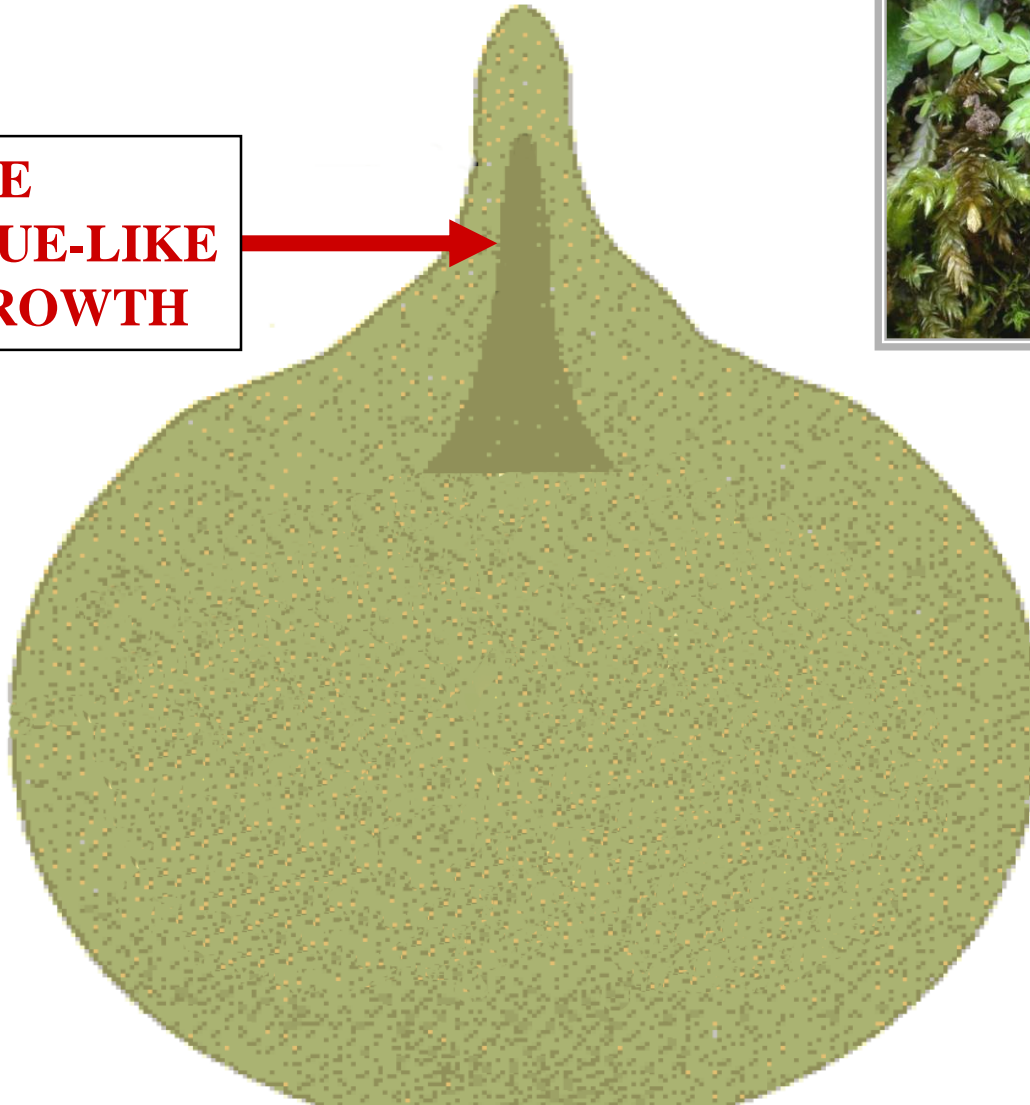
**S**

+

**MICROPHYLL**



**LIGULE**  
**SMALL TONGUE-LIKE**  
**LEAF OUTGROWTH**



**MICROPHYLL**

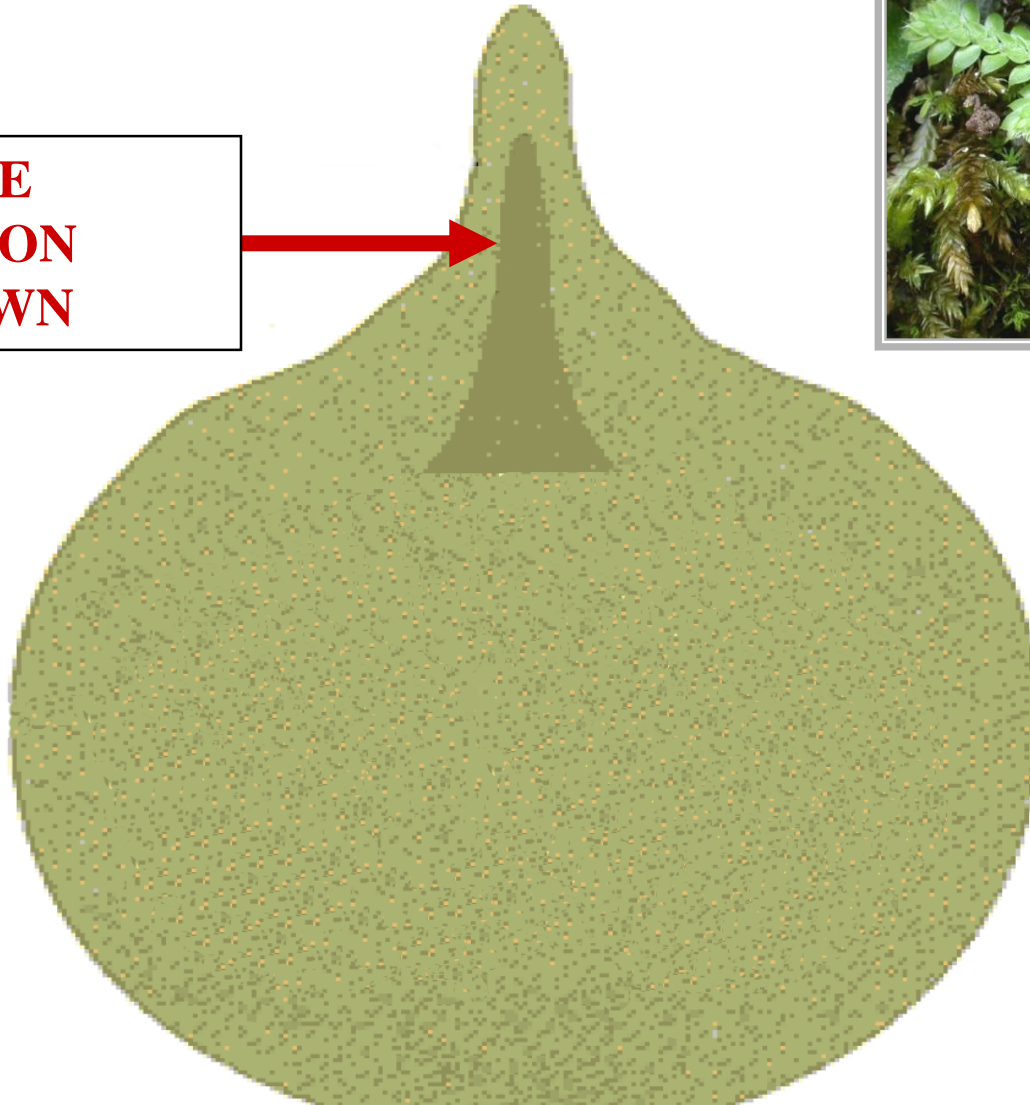


**F**

**LIGULE  
FUNCTION  
UNKNOWN**

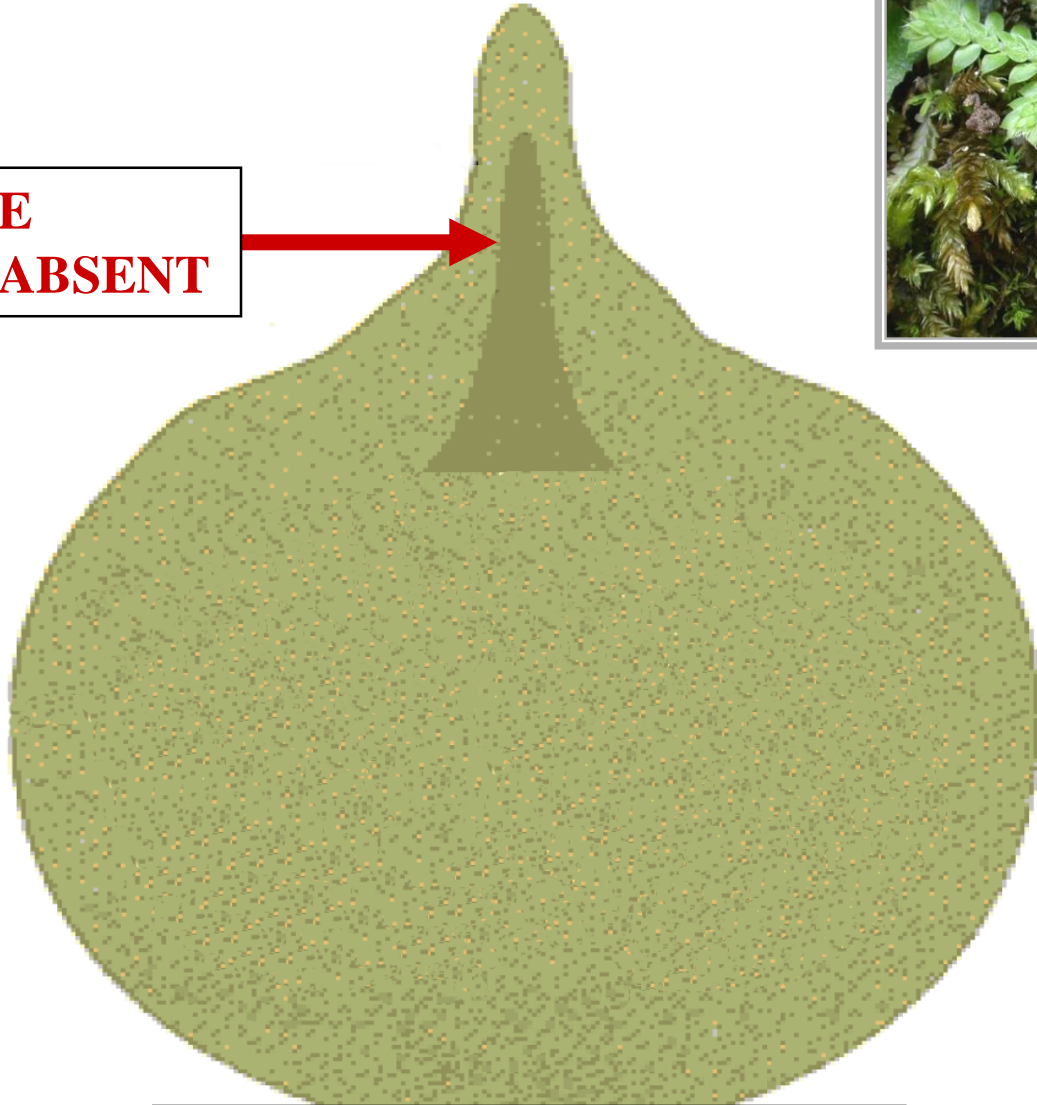


**+/-**



**MICROPHYLL**

**LIGULE  
PRESENT OR ABSENT**



**MICROPHYLL**



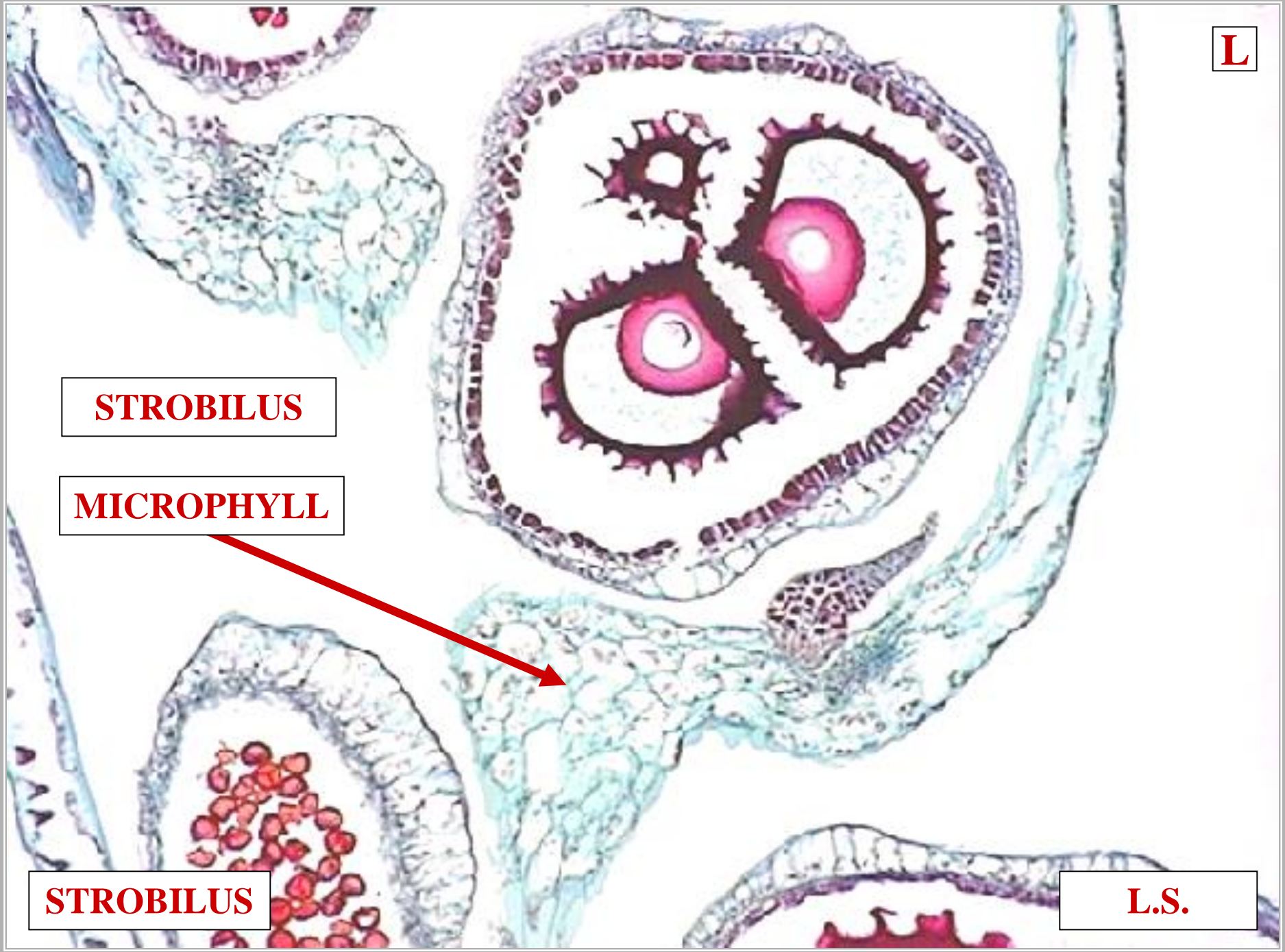
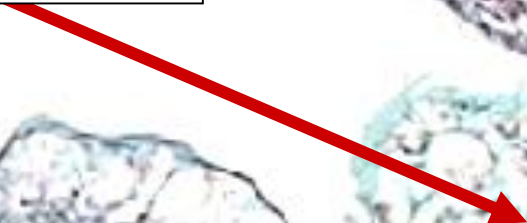
**L**

**STROBILUS**

**MICROPHYLL**

**STROBILUS**

**L.S.**





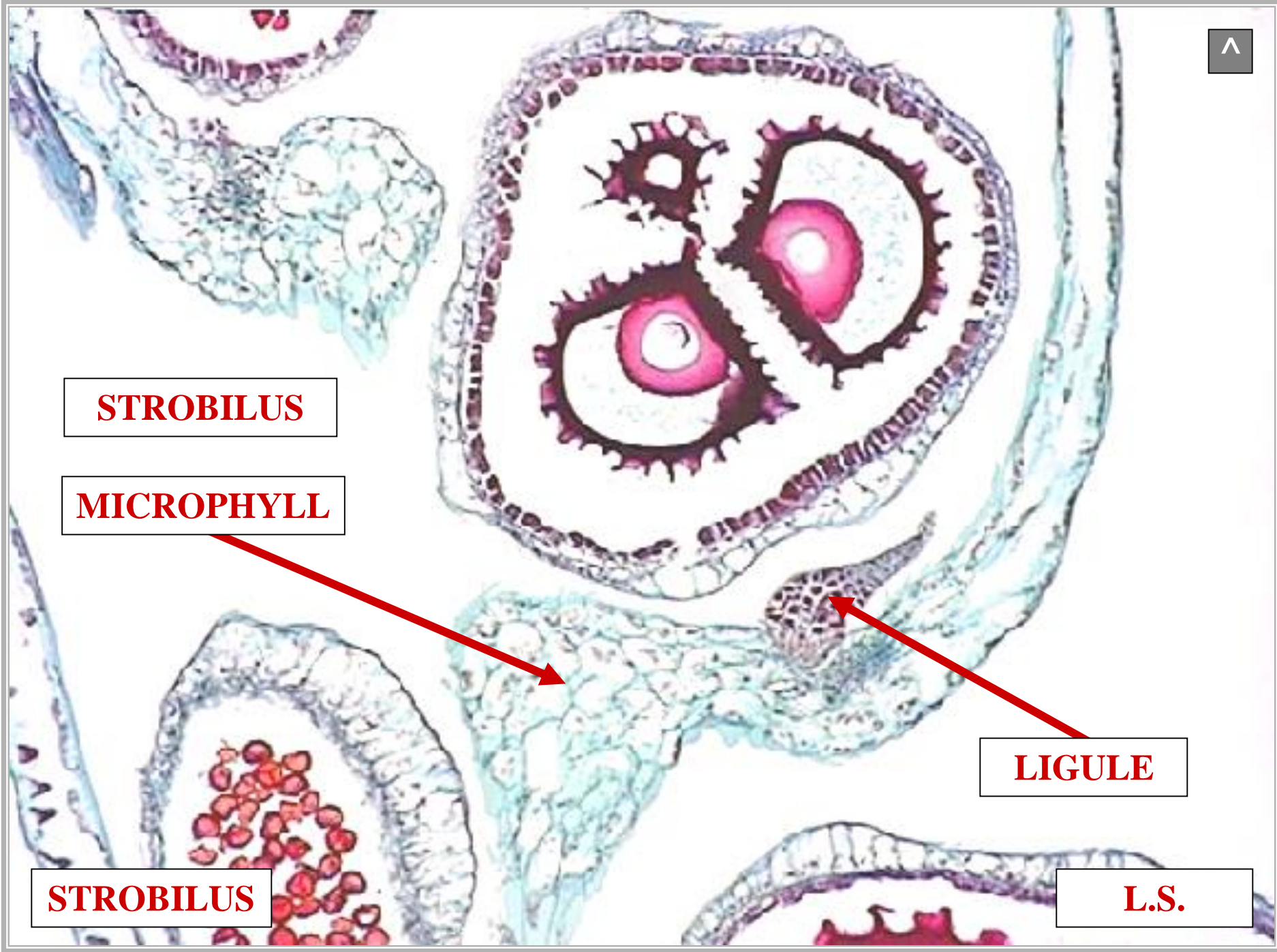
**STROBILUS**

**MICROPHYLL**

**LIGULE**

**STROBILUS**

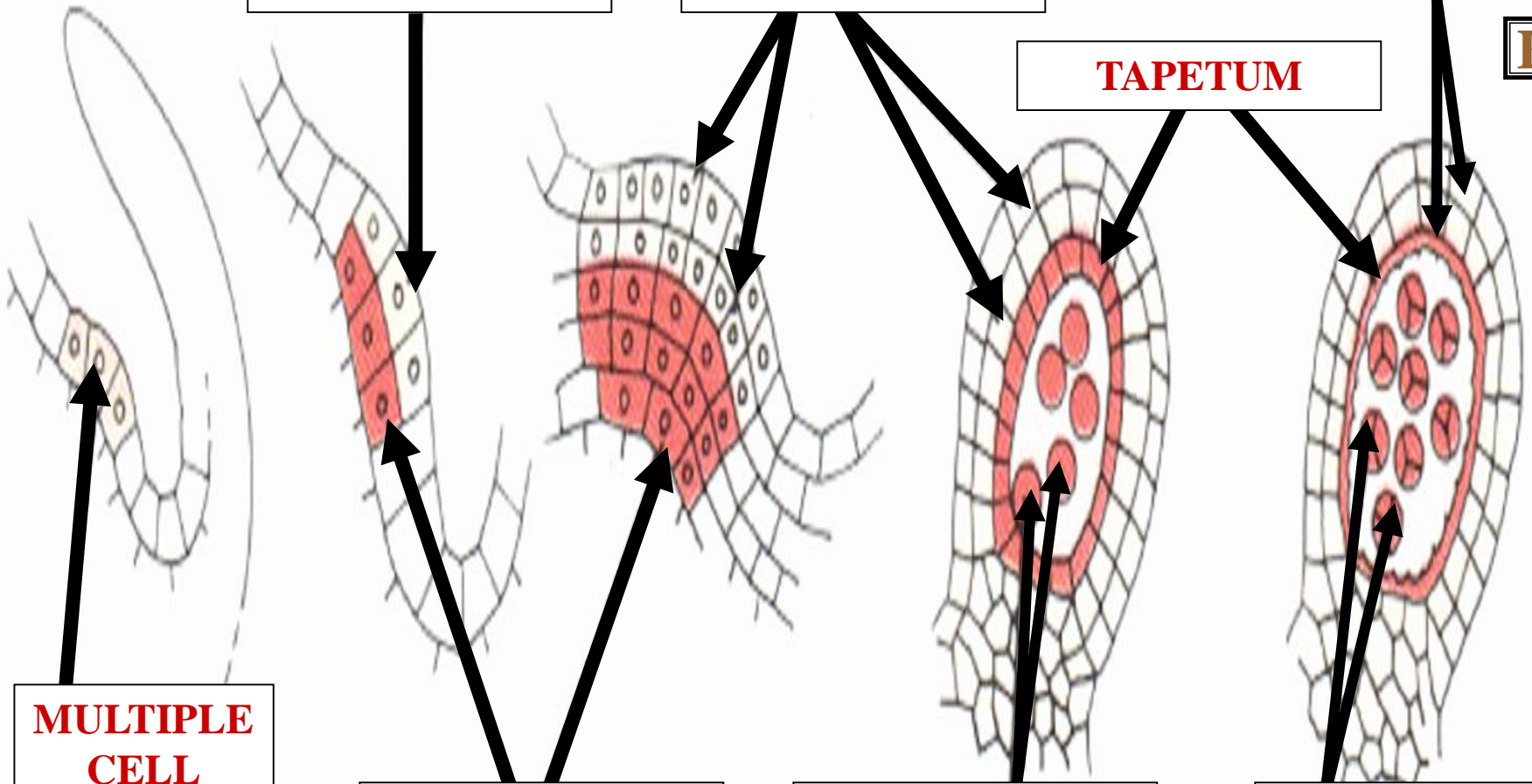
**L.S.**







# SPORANGIUM



**WALL CELLS**

**WALL CELLS**

**LARGE SIZE**

**THICK WALL**

**E**

**TAPETUM**

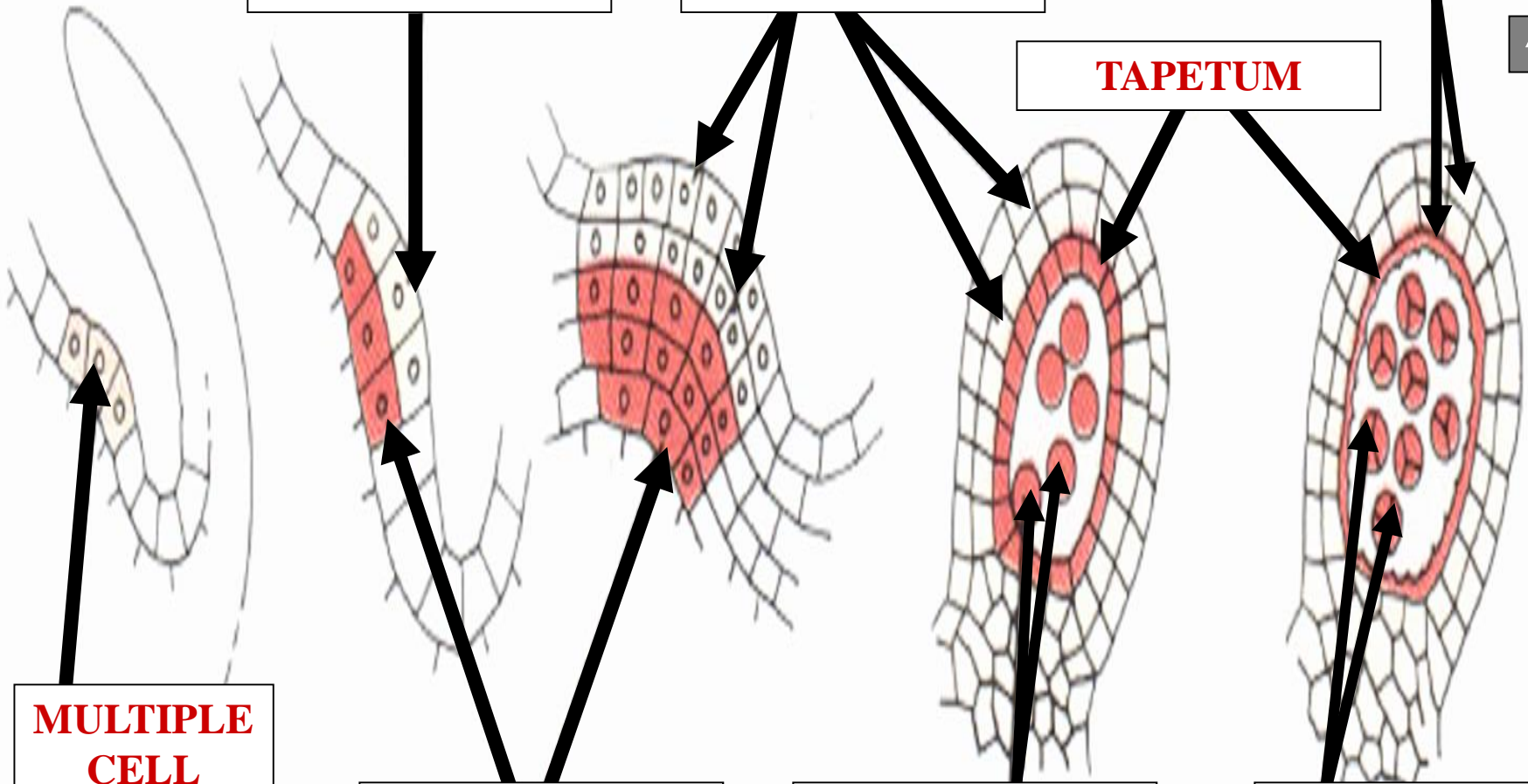
**MULTIPLE  
CELL  
INITIALS**

**SPOROCTYES**

**SPOROCTYES**

**NUMEROUS  
SPORES**

**L.S.**



**WALL CELLS**

**WALL CELLS**

**LARGE SIZE**

**THICK WALL**



**TAPETUM**

**MULTIPLE  
CELL  
INITIALS**

**SPOROCTES**

**SPOROCTES**

**NUMEROUS  
SPORES**

**EUSPORANGIUM**

**L.S.**



# SPORANGIUM SHAPE



**SPORANGIUM  
KIDNEY SHAPE**

**SPOROPHYLL**



**SPORANGIUM  
RENIFORM**

**SPOROPHYLL**

**RENIFORM**

**SPORANGIUM SHAPE**  
**RENIFORM**



**KIDNEY SHAPED**

**SPORANGIUM SHAPE**  
**RENIFORM**





**SPORANGIUM  
RENIFORM**

**SPOROPHYLL**



# SPORANGIUM POSITION



**SPORANGIUM**

**LEAF**



**LEAF**

**FOLIAR**

**FOLIAR  
SPORANGIUM**



**LEAF DERIVED  
SPORANGIUM**

**FOLIAR  
SPORANGIUM**



**FOLIAR  
SPORANGIUM  
ADAXIAL SURFACE**

**SPOROPHYLL**

**ADAXIAL SURFACE**

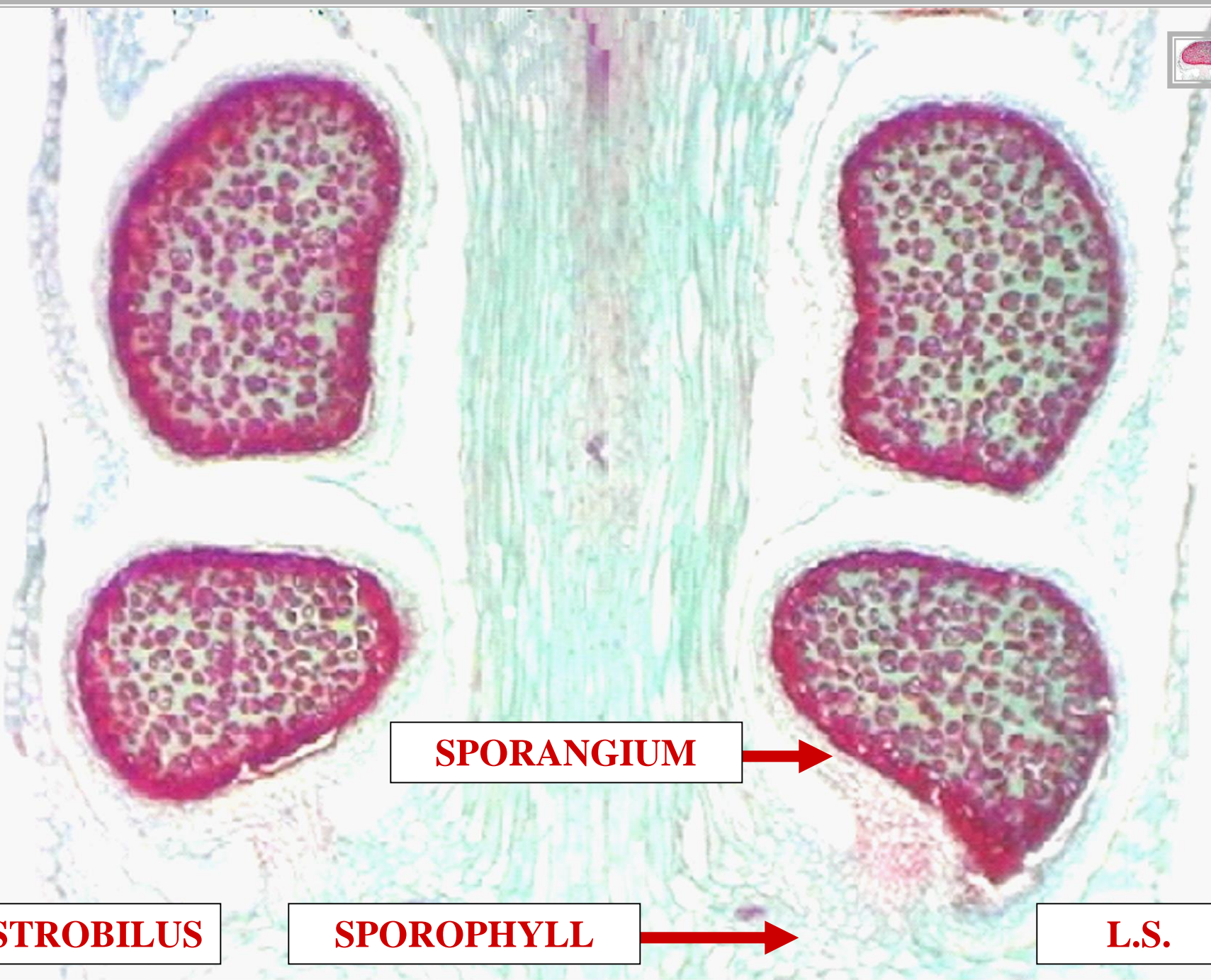




**ADAXIAL  
SPORANGIUM**

**UPPER  
SPOROPHYLL  
SURFACE**

**ADAXIAL  
SPORANGIUM**

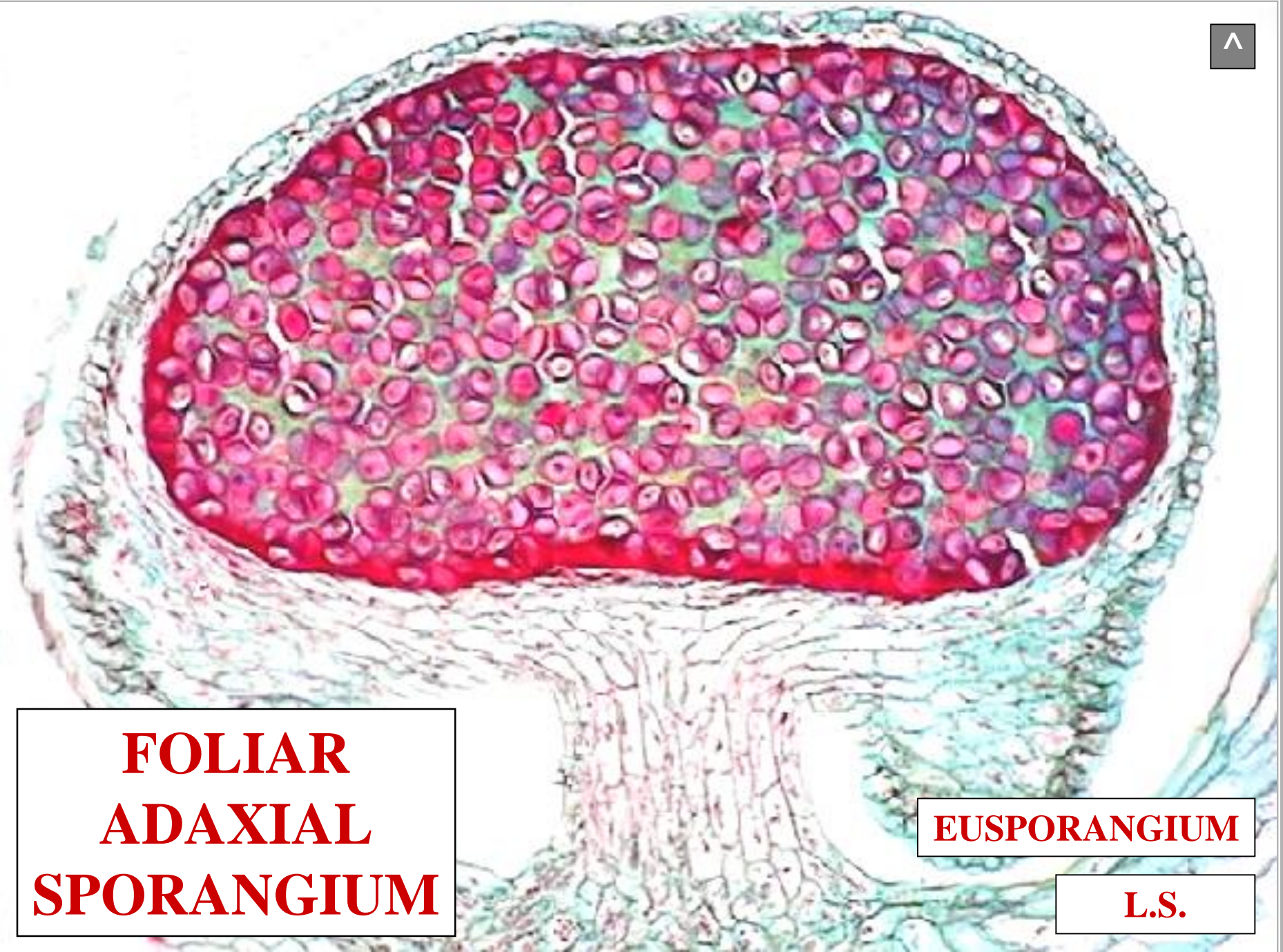


**SPORANGIUM** →

**STROBILUS**

**SPOROPHYLL** →

**L.S.**



**FOLIAR  
ADAXIAL  
SPORANGIUM**

**EUSPORANGIUM**

**L.S.**



# SPORE HABIT

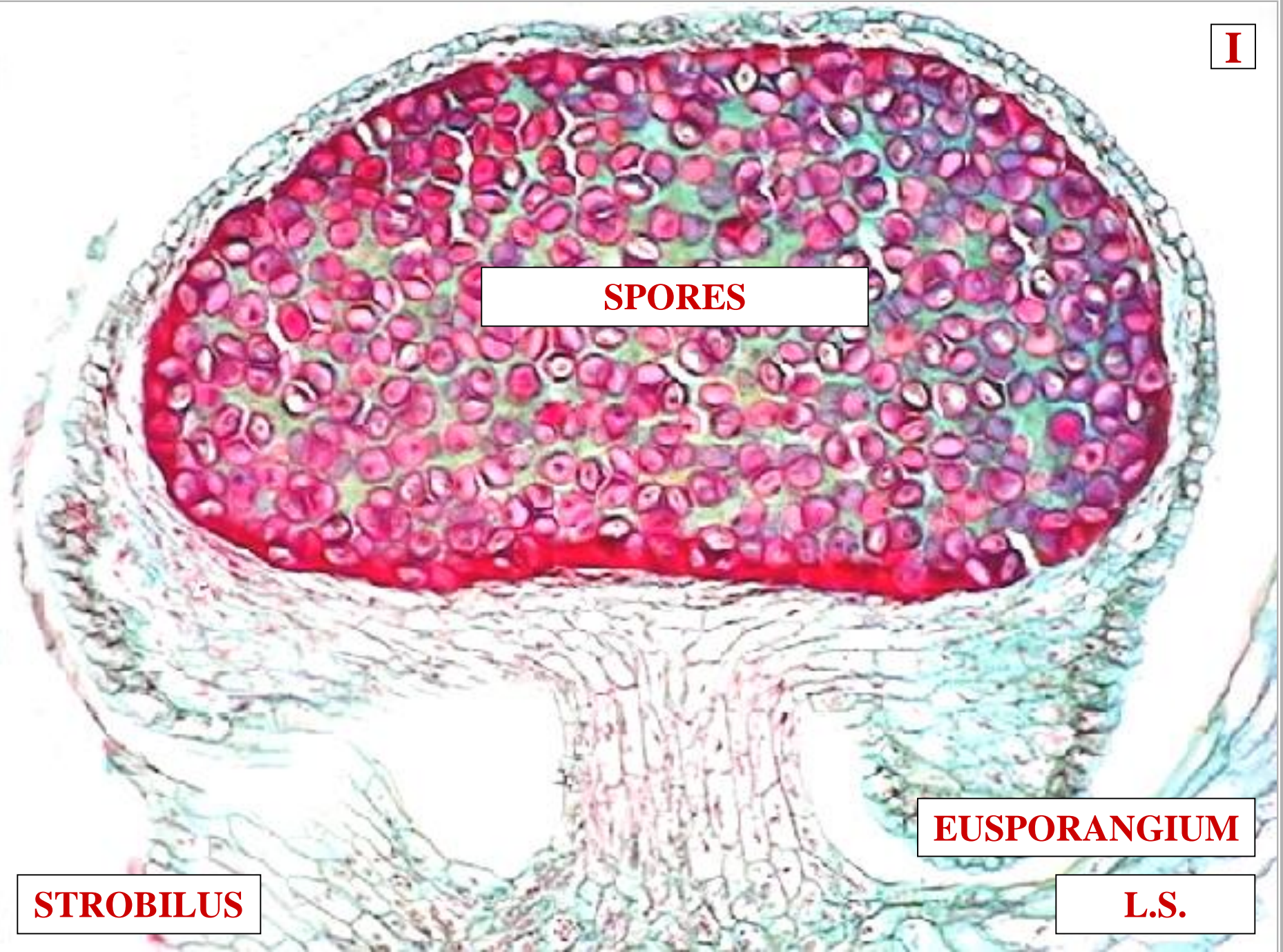
**I**

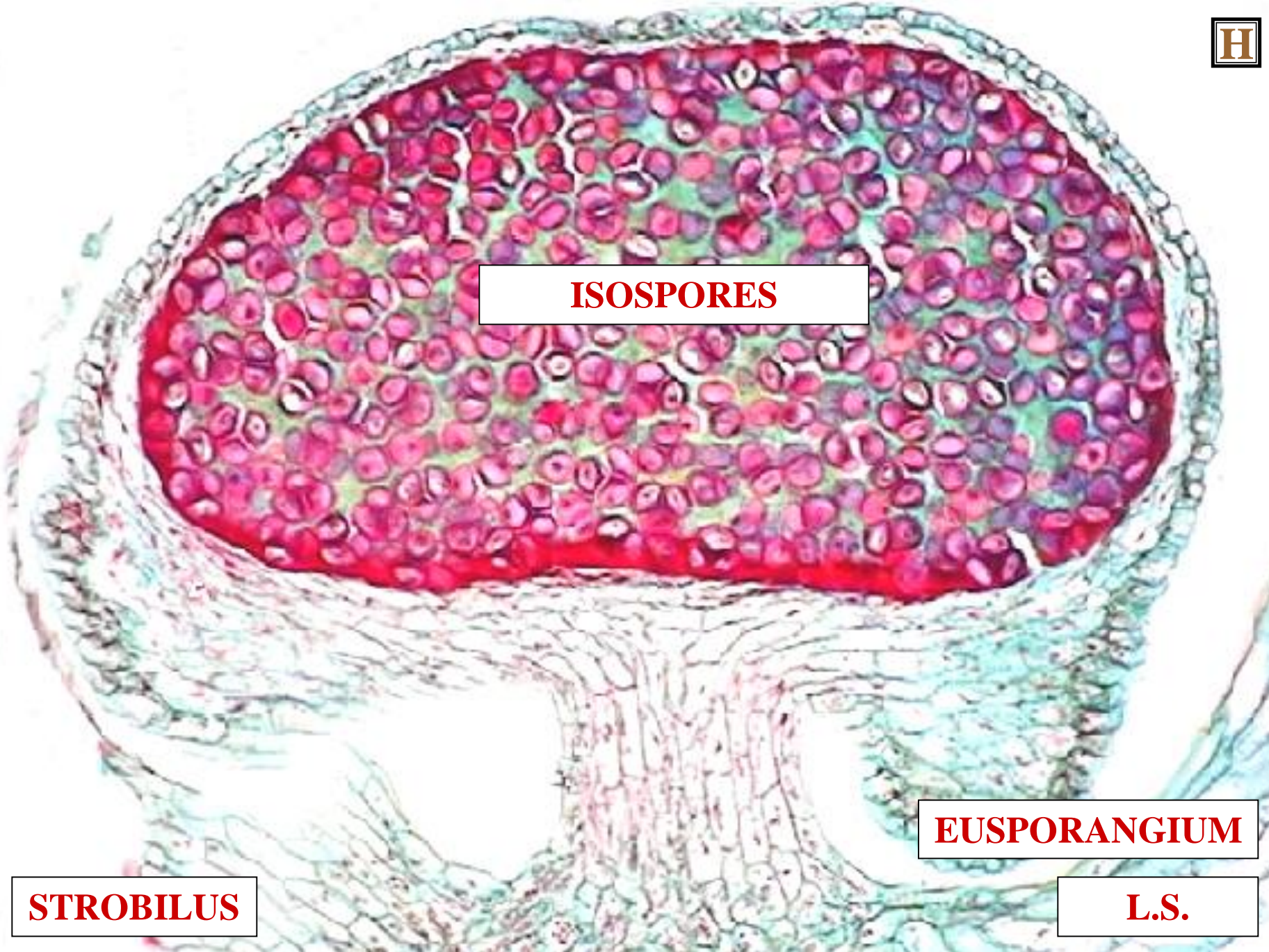
**SPORES**

**EUSPORANGIUM**

**STROBILUS**

**L.S.**





**ISOSPORES**

**EUSPORANGIUM**

**STROBILUS**

**L.S.**

<

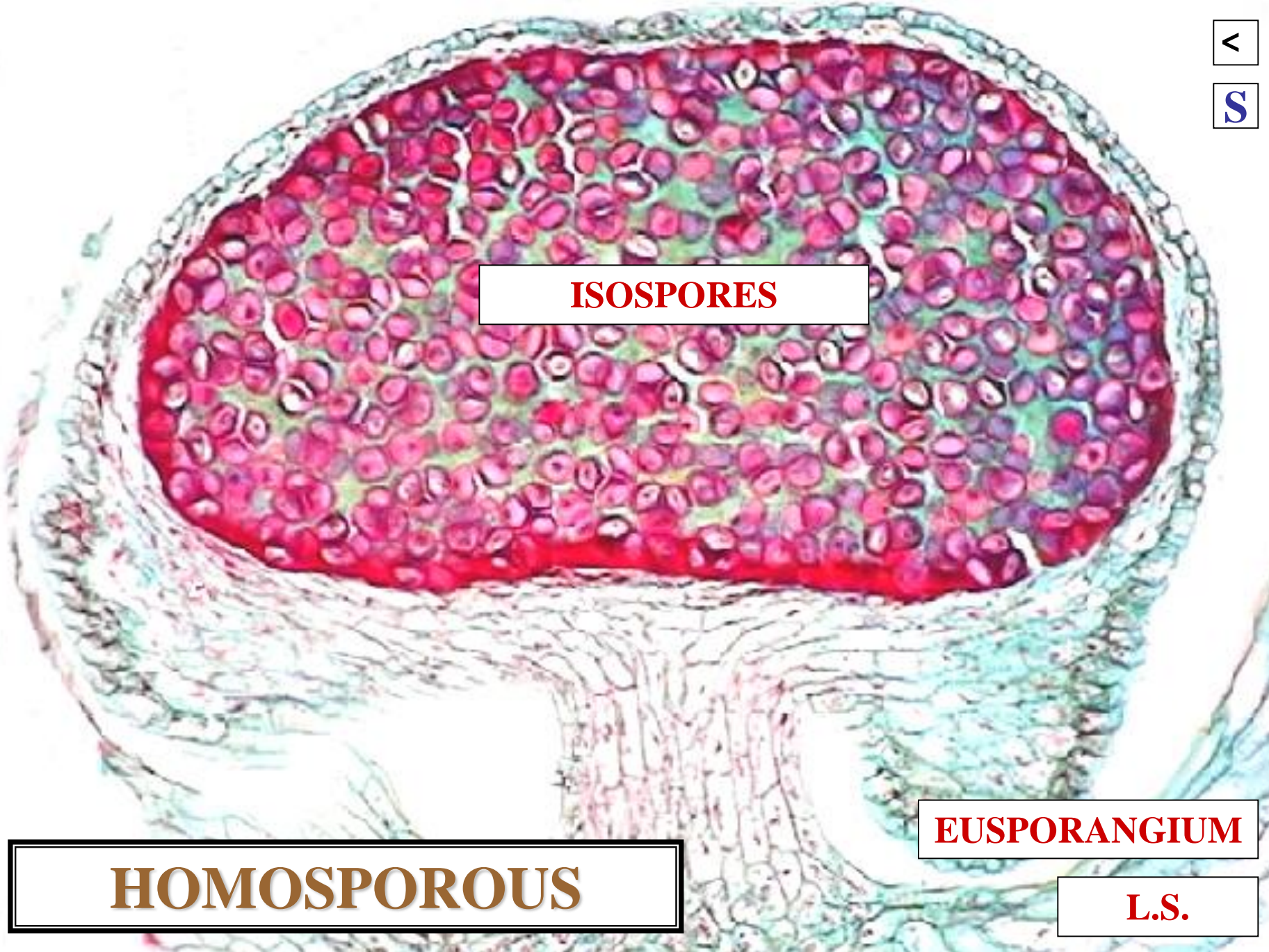
S

**ISOSPORES**

**EUSPORANGIUM**

**HOMOSPOROUS**

**L.S.**





# SPORE HABIT



M

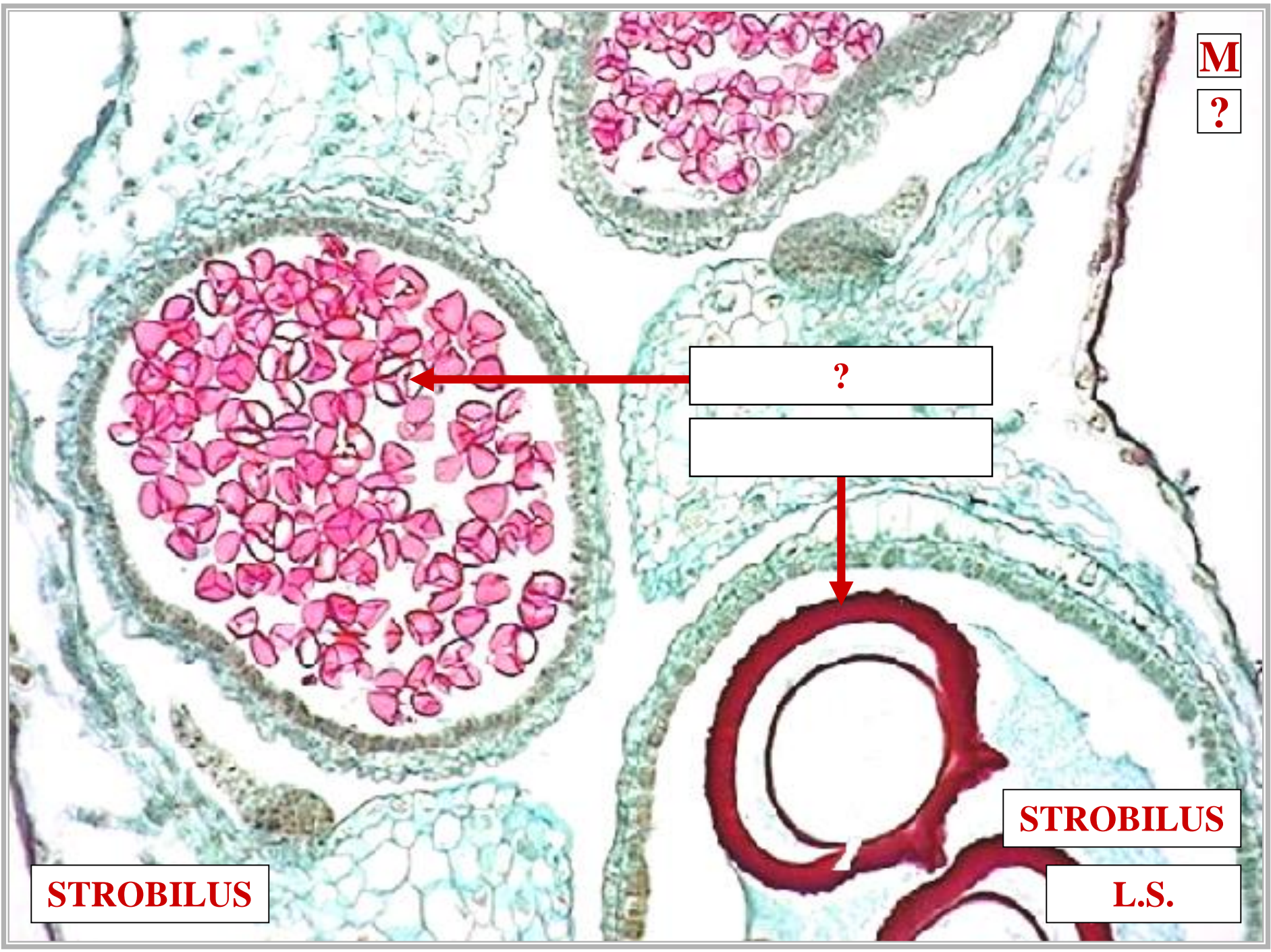
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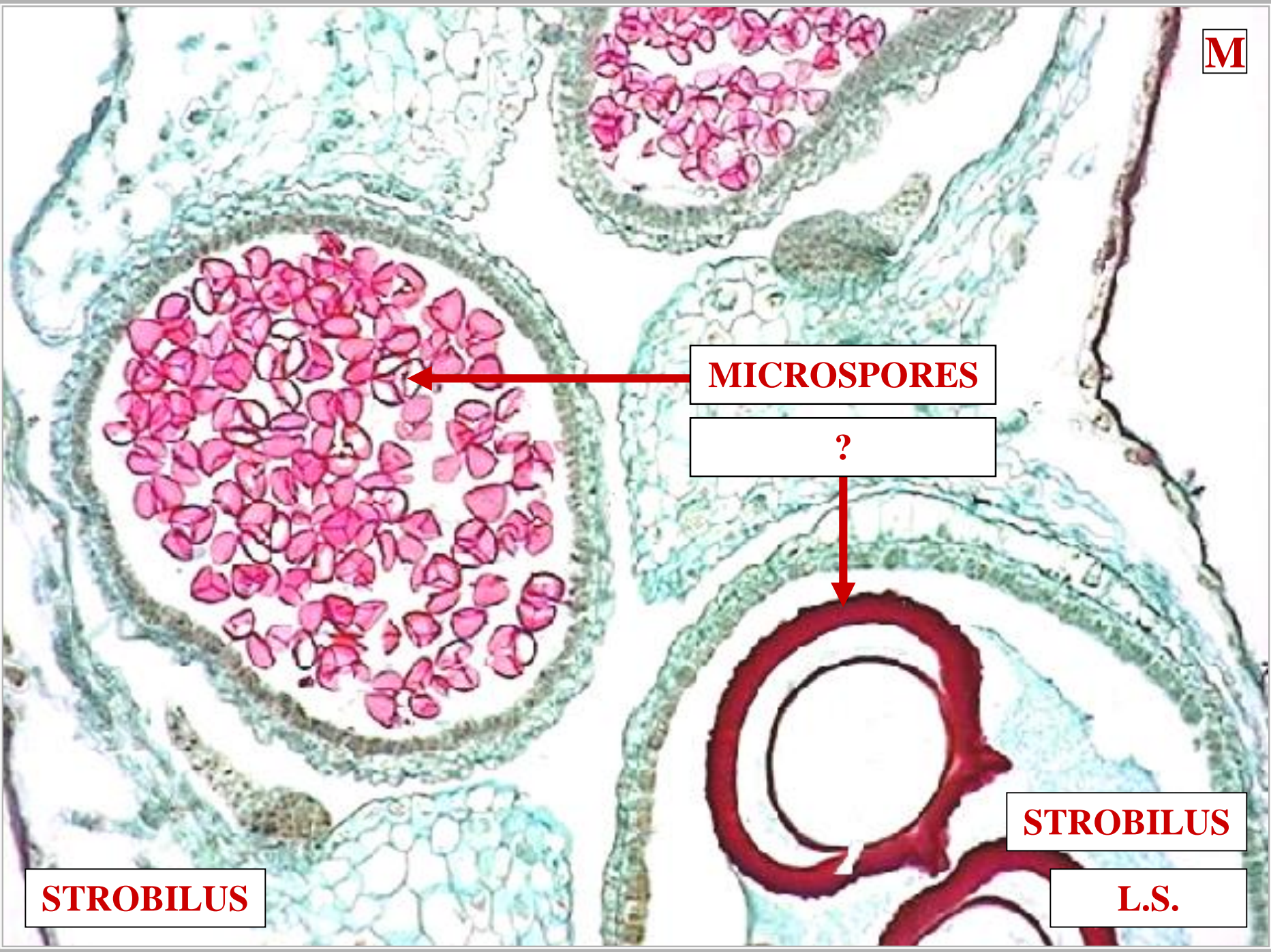
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STROBILUS

STROBILUS

L.S.





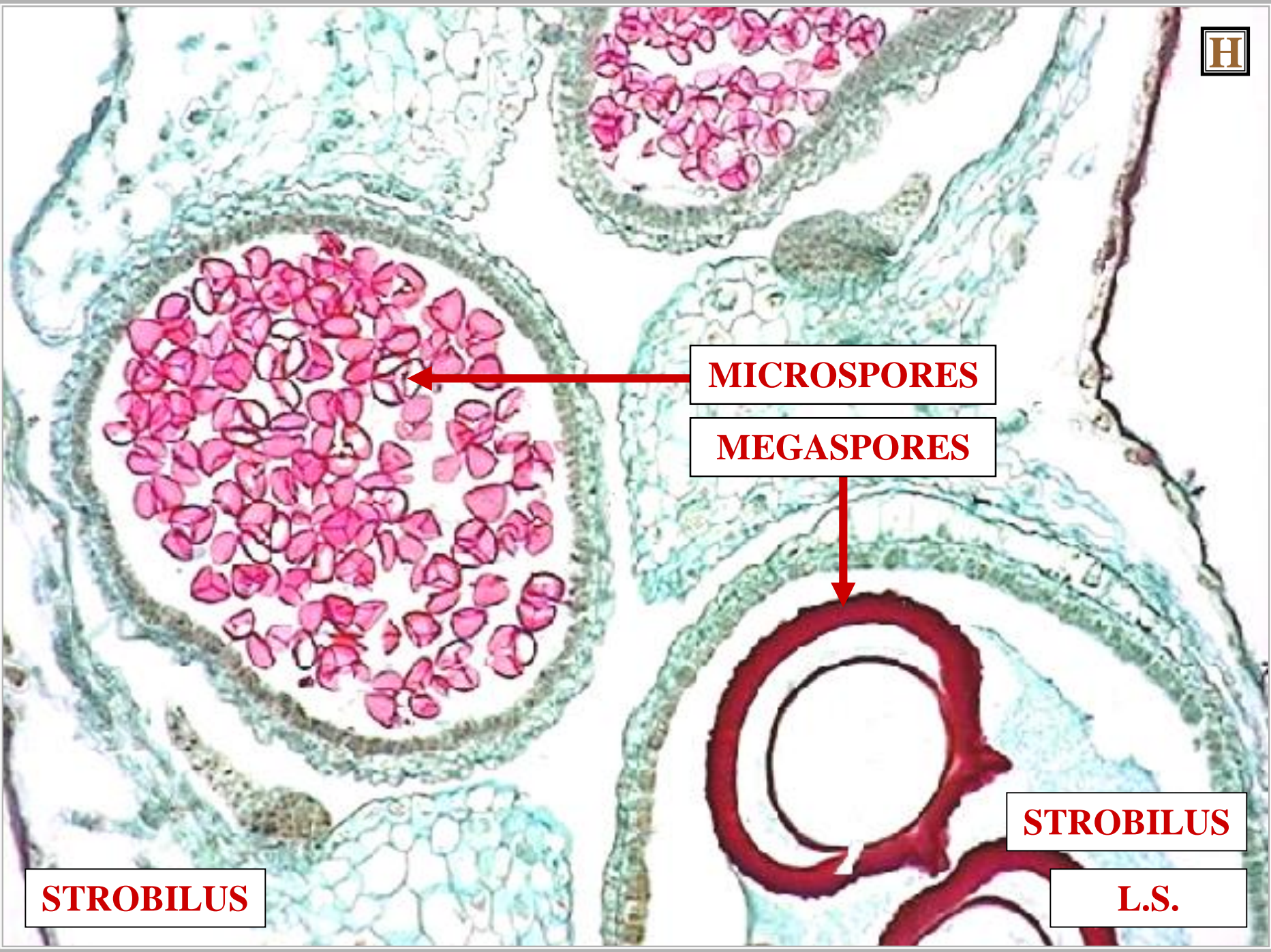
**MICROSPORES**

**?**

**STROBILUS**

**STROBILUS**

**L.S.**



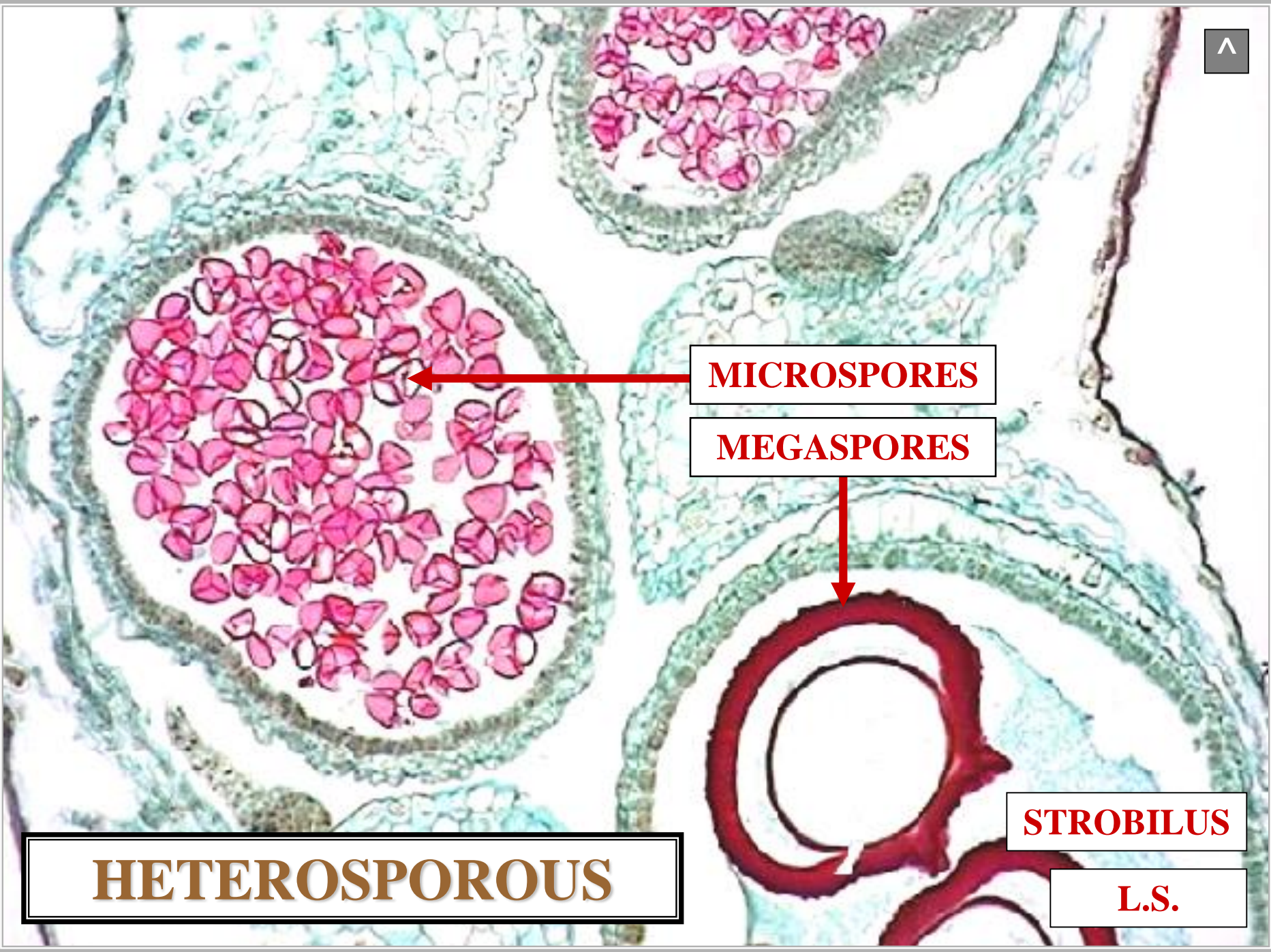
**MICROSPORES**

**MEGASPORES**

**STROBILUS**

**STROBILUS**

**L.S.**



**MICROSPORES**

**MEGASPORES**

**STROBILUS**

**HETEROSPOROUS**

**L.S.**

# STROBILUS

**STROBILUS**



**STROBILIUS**

**SPOROPHYLL  
AGGREGATE**

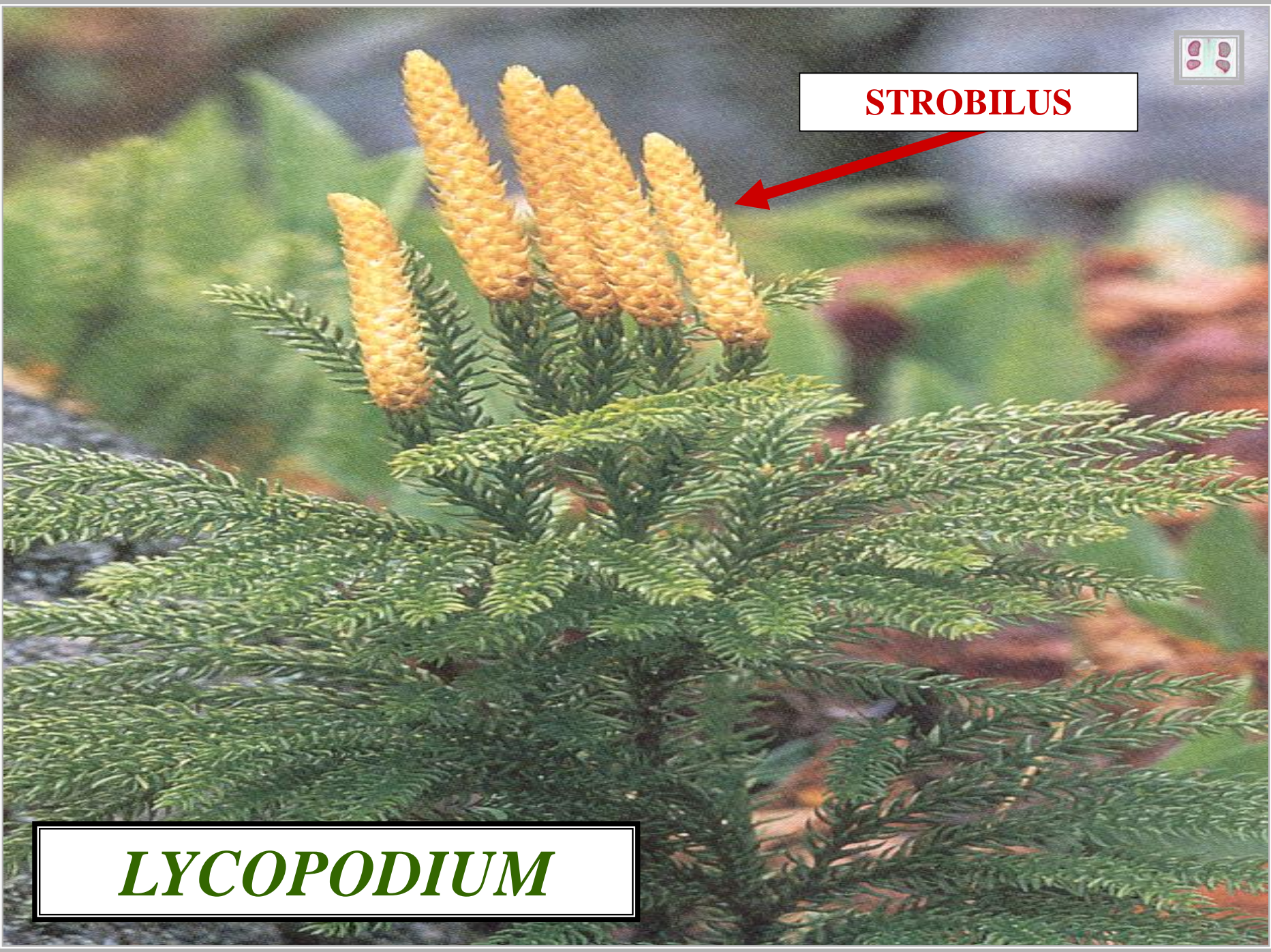
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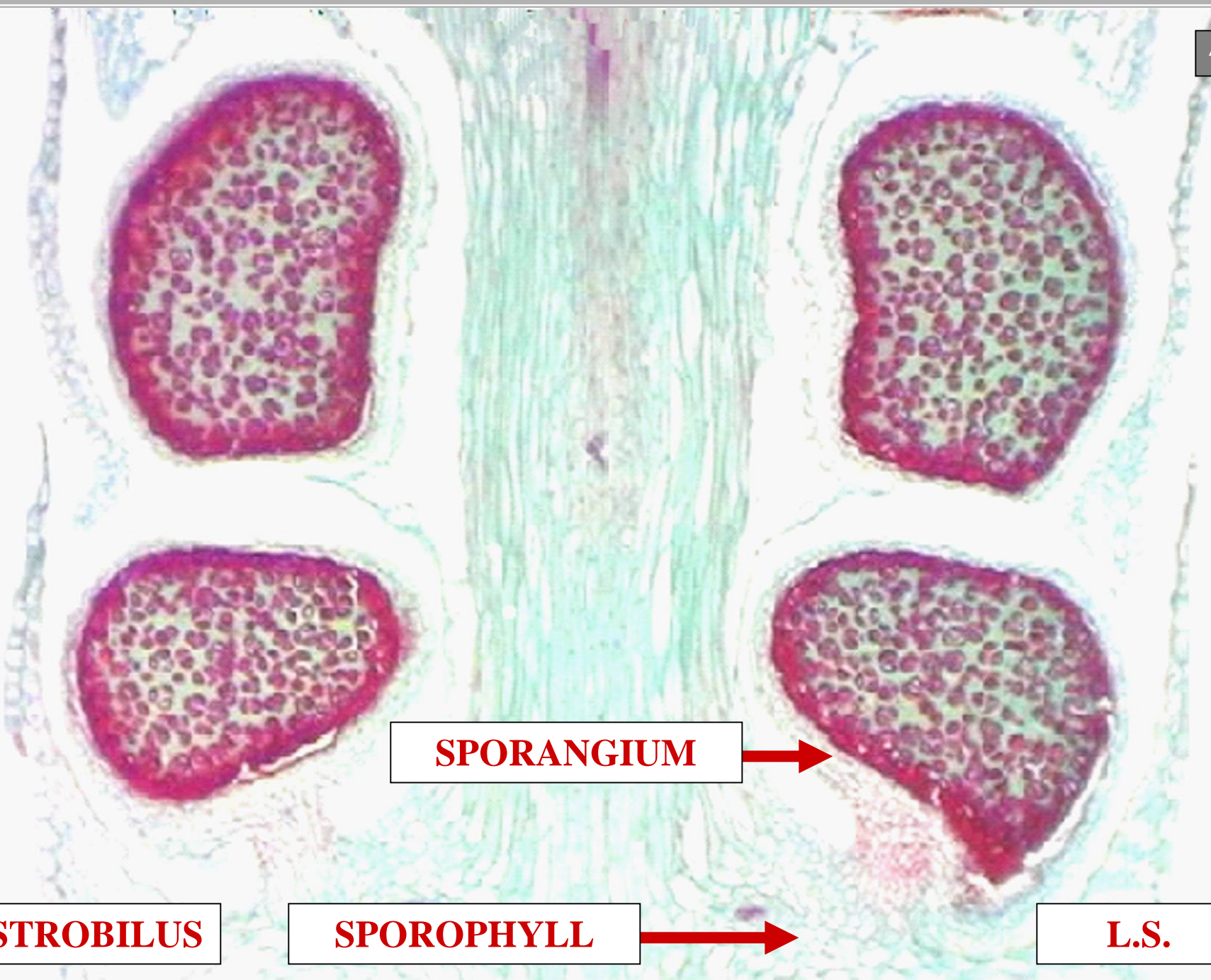
**STROBILUS**



***LYCOPODIUM***







**STROBILUS**

**SPOROPHYLL**

**SPORANGIUM**

**L.S.**

# SPOROPHYLL

**SPOROPHYLL**



**SPOROPHYLL**

**LEAF  
BEARING  
SPORANGIUM**

**SPOROPHYLL**