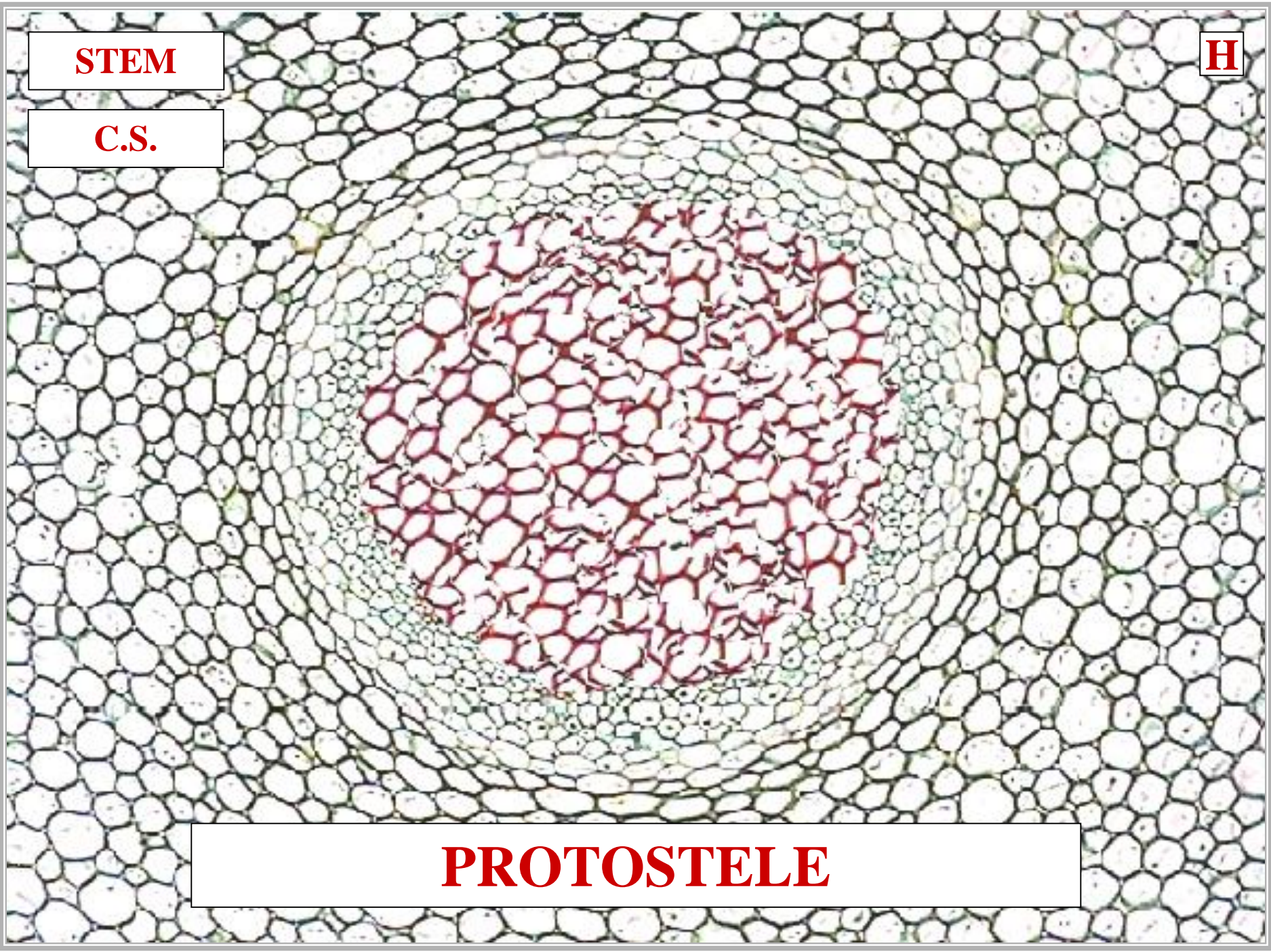


**STEM**

**C.S.**

**H**

**PROTOSTELE**



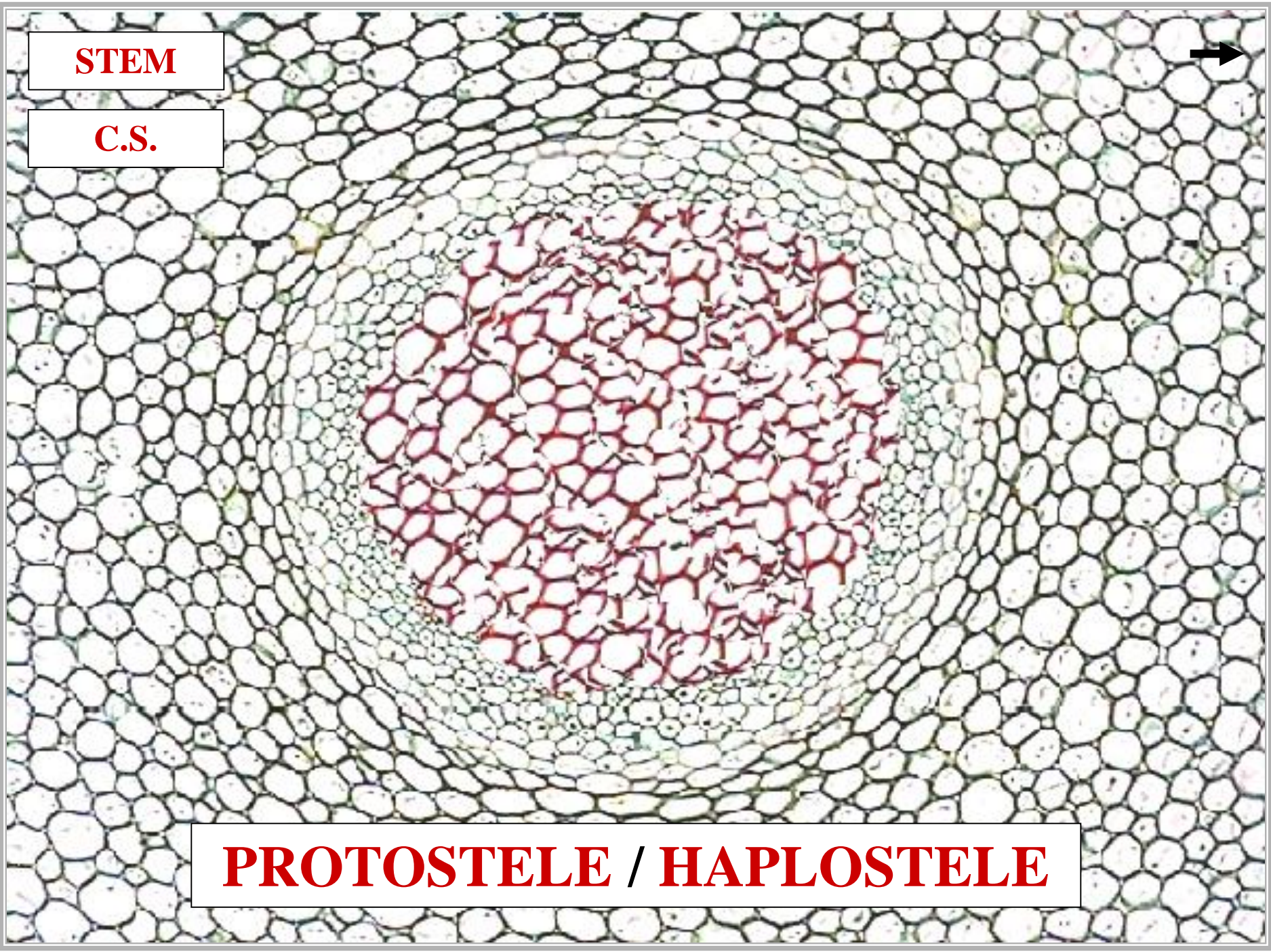


**STEM**

**C.S.**



**PROTOSTELE / HAPLOSTELE**



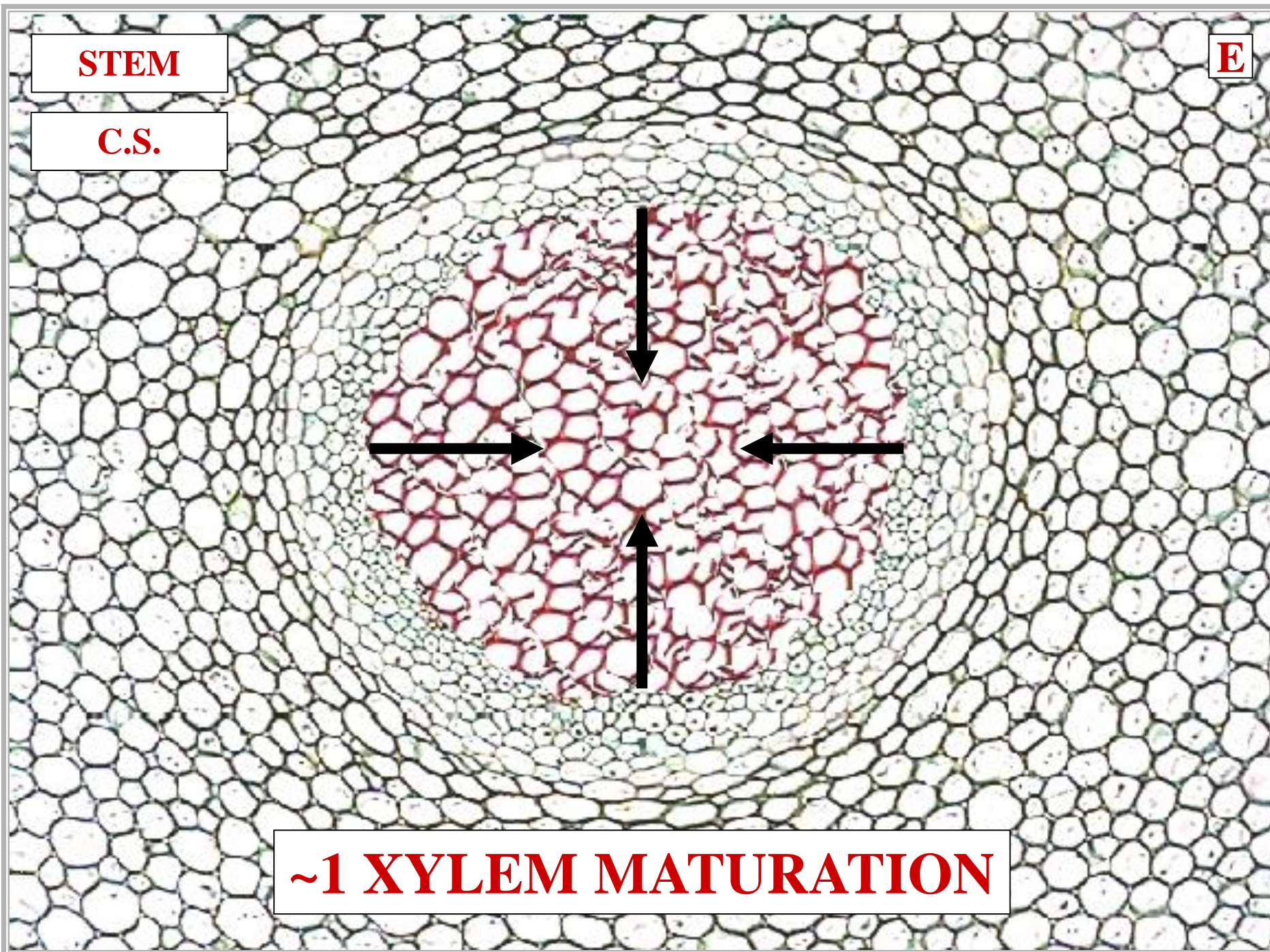


**STEM**

**C.S.**

**E**

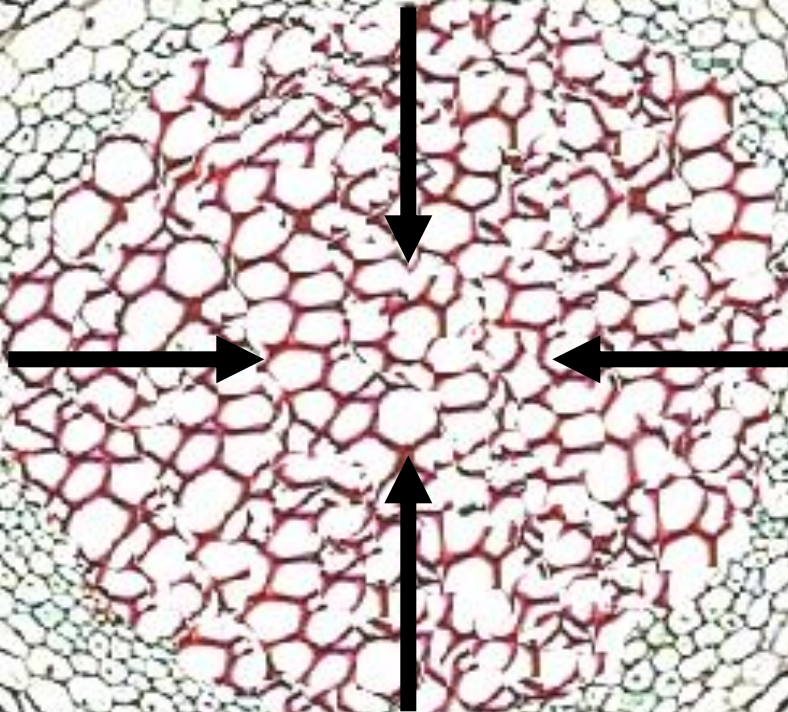
**~1 XYLEM MATURATION**





**STEM**

**C.S.**



**EXARCH**





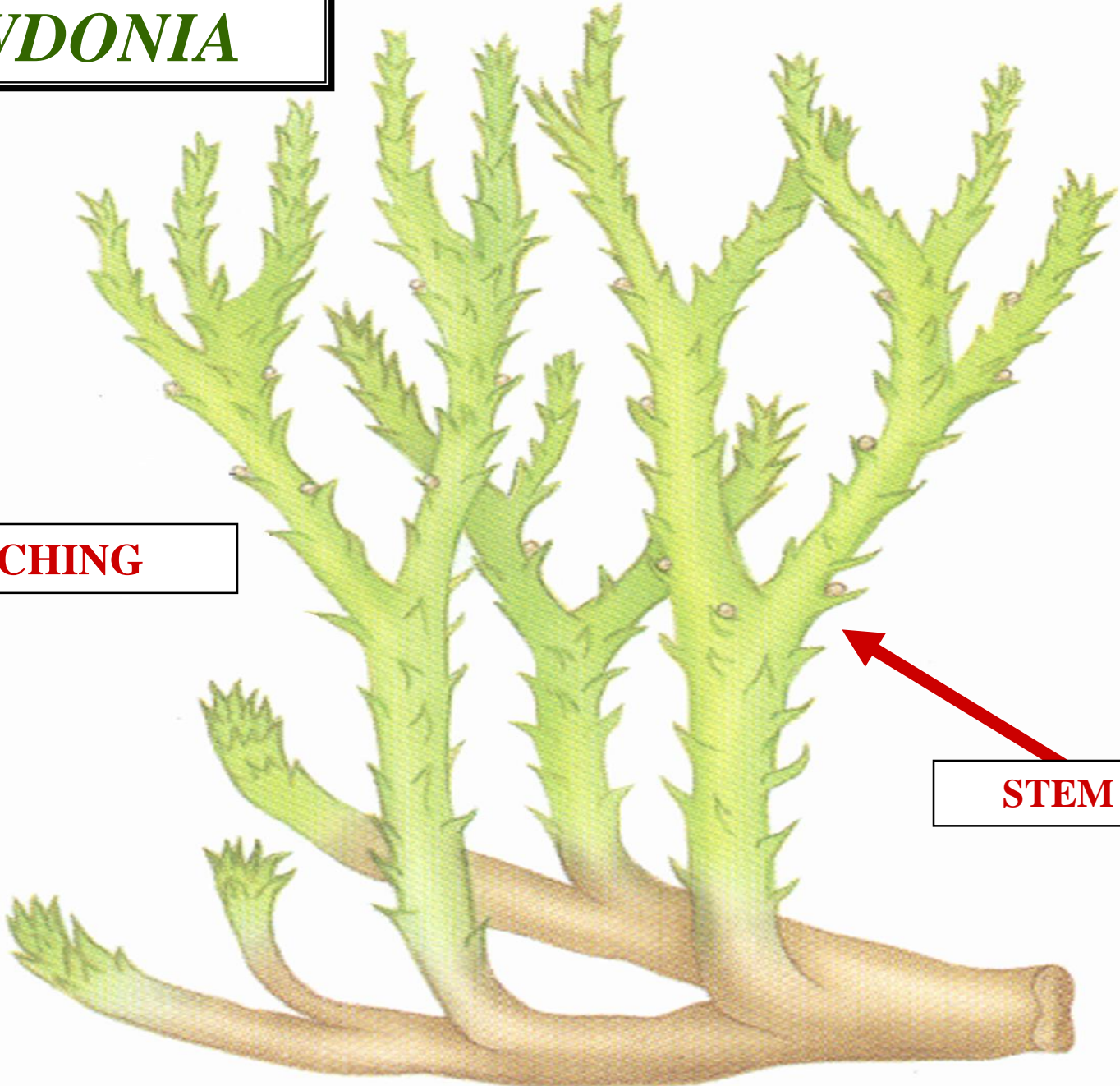
# STEM MORPHOLOGY



***SAWDONIA***

**BRANCHING**

**STEM**



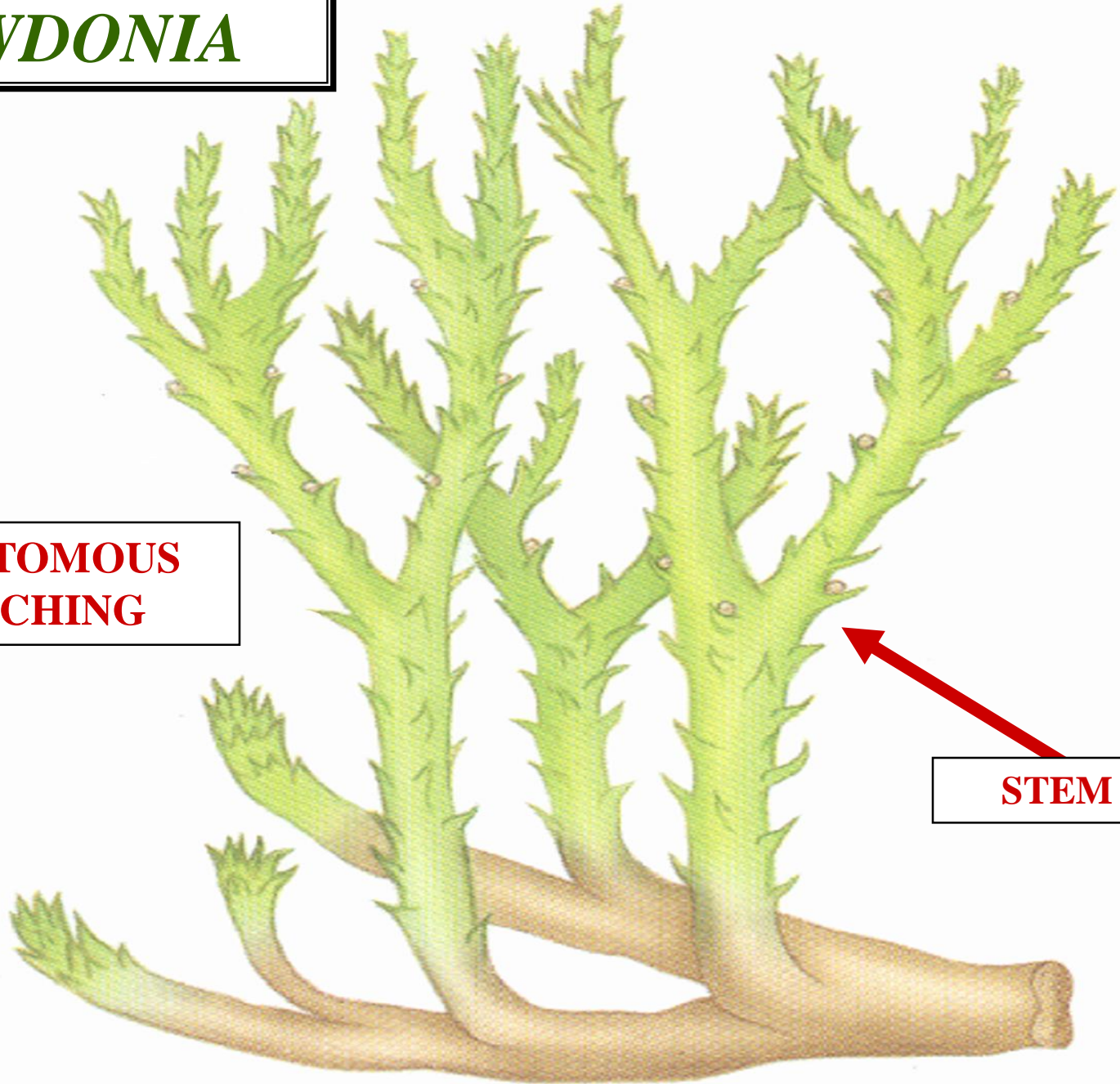


# *SAWDONIA*

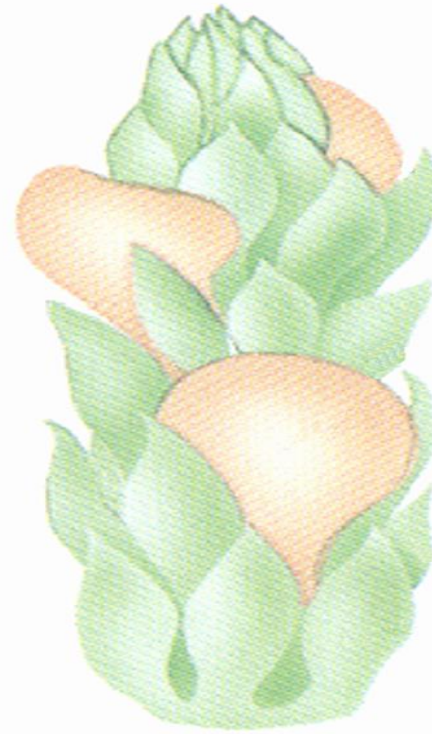
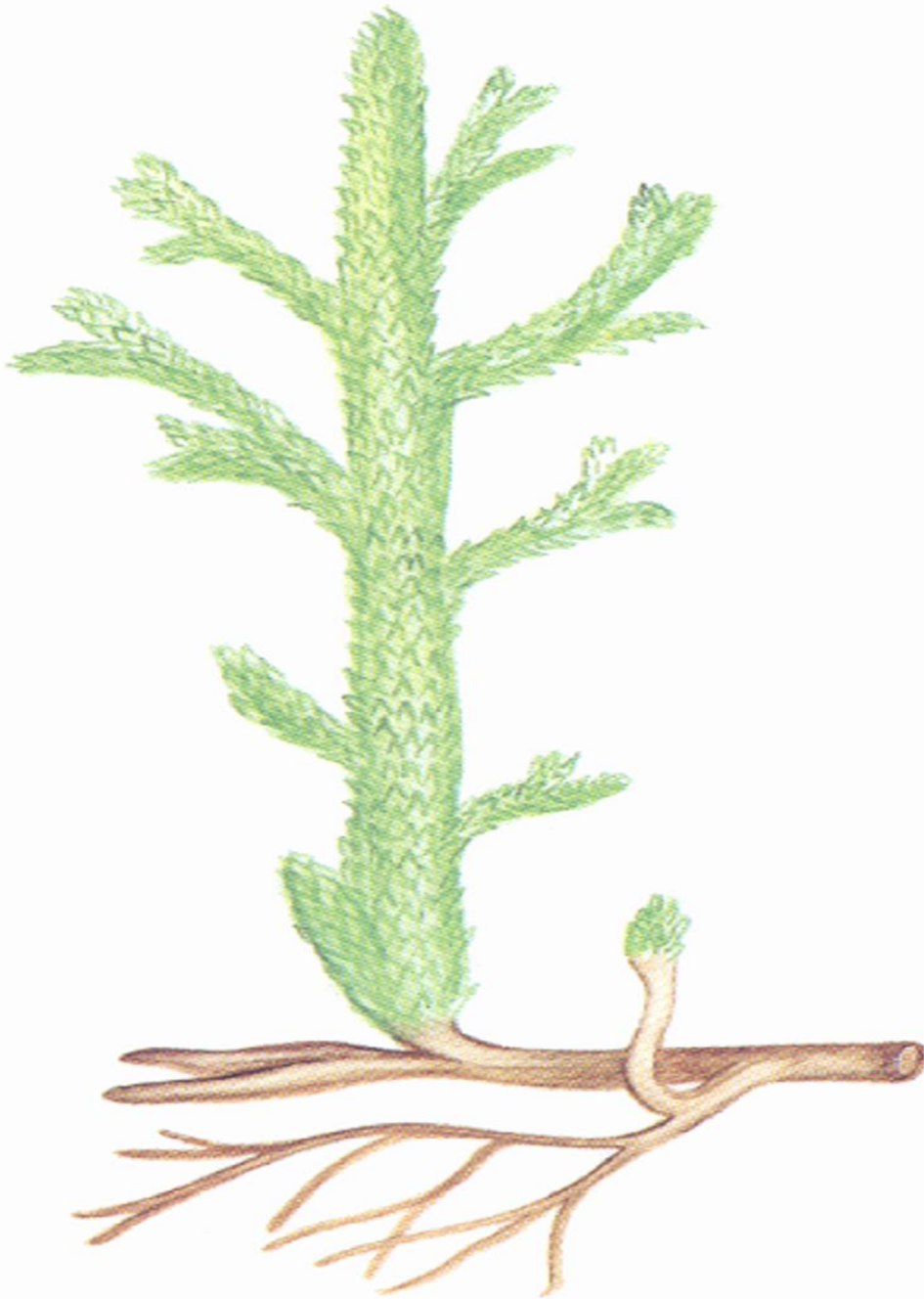
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**DICHOTOMOUS  
BRANCHING**

**STEM**



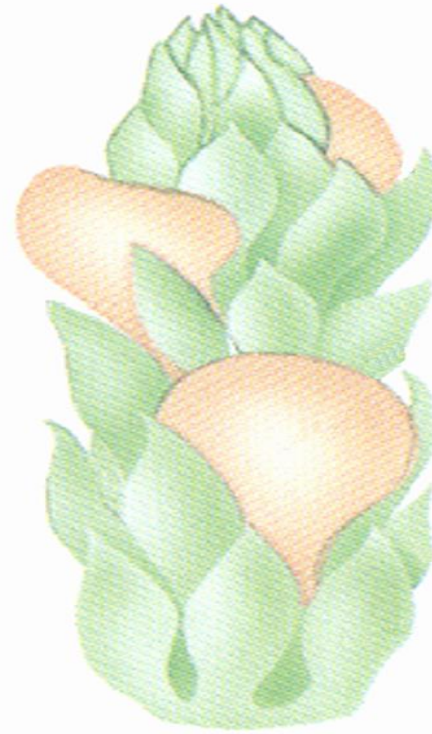
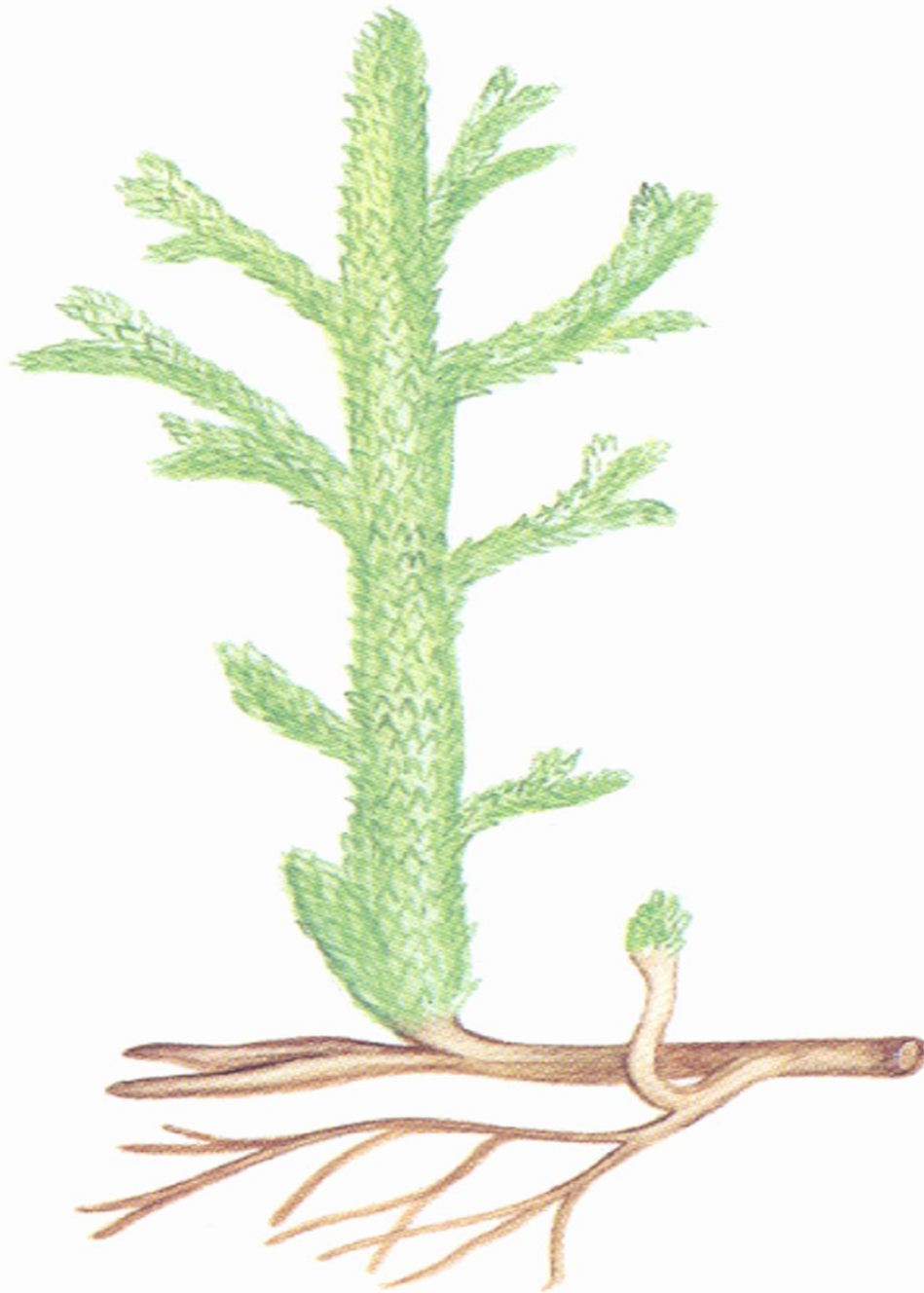




**BRANCHING**

***ASTEROXYLON***





?



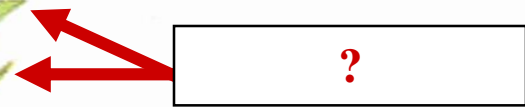
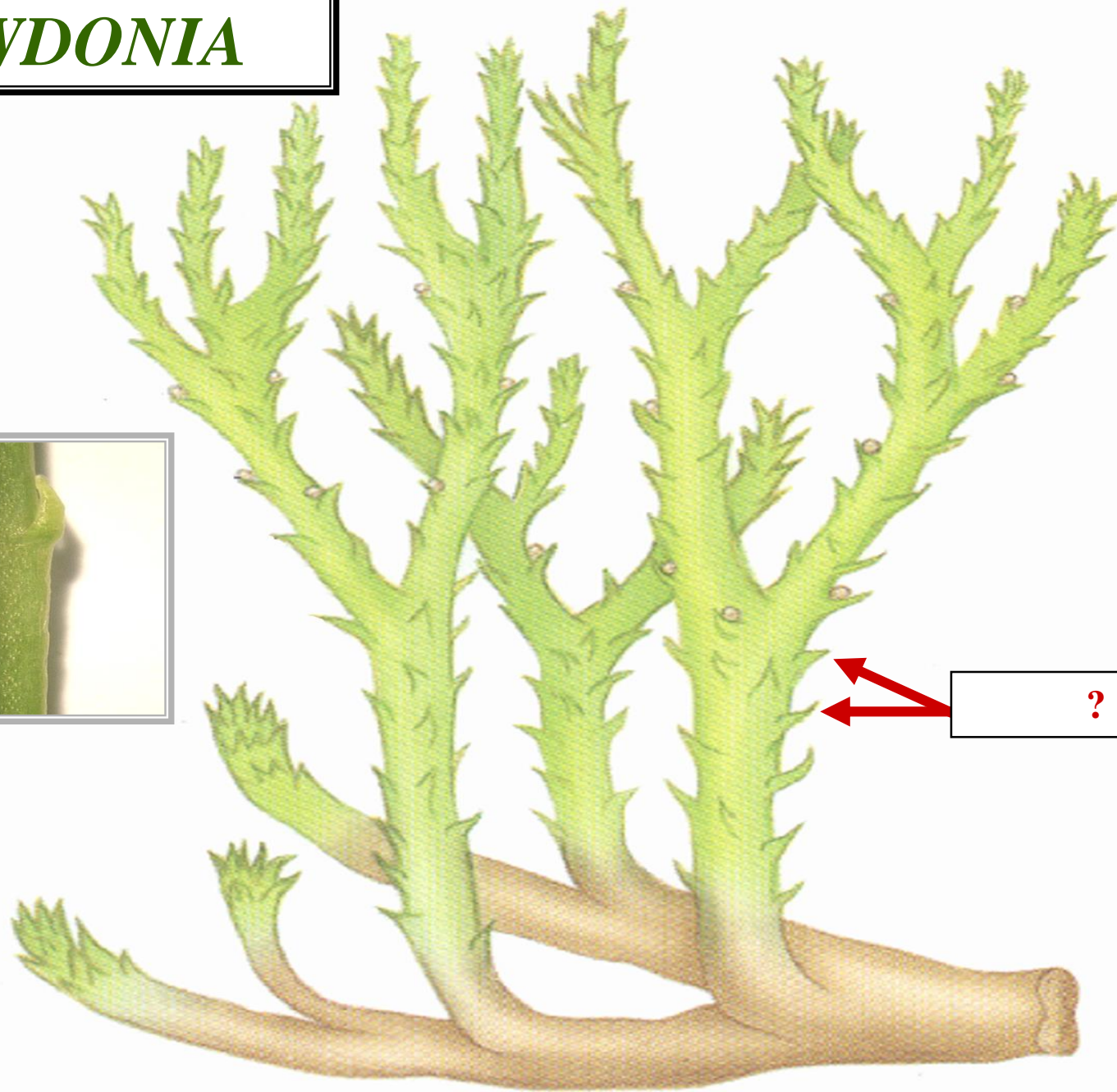
**MONOPODIAL  
BRANCHING**

***ASTEROXYLON***



# *SAWDONIA*

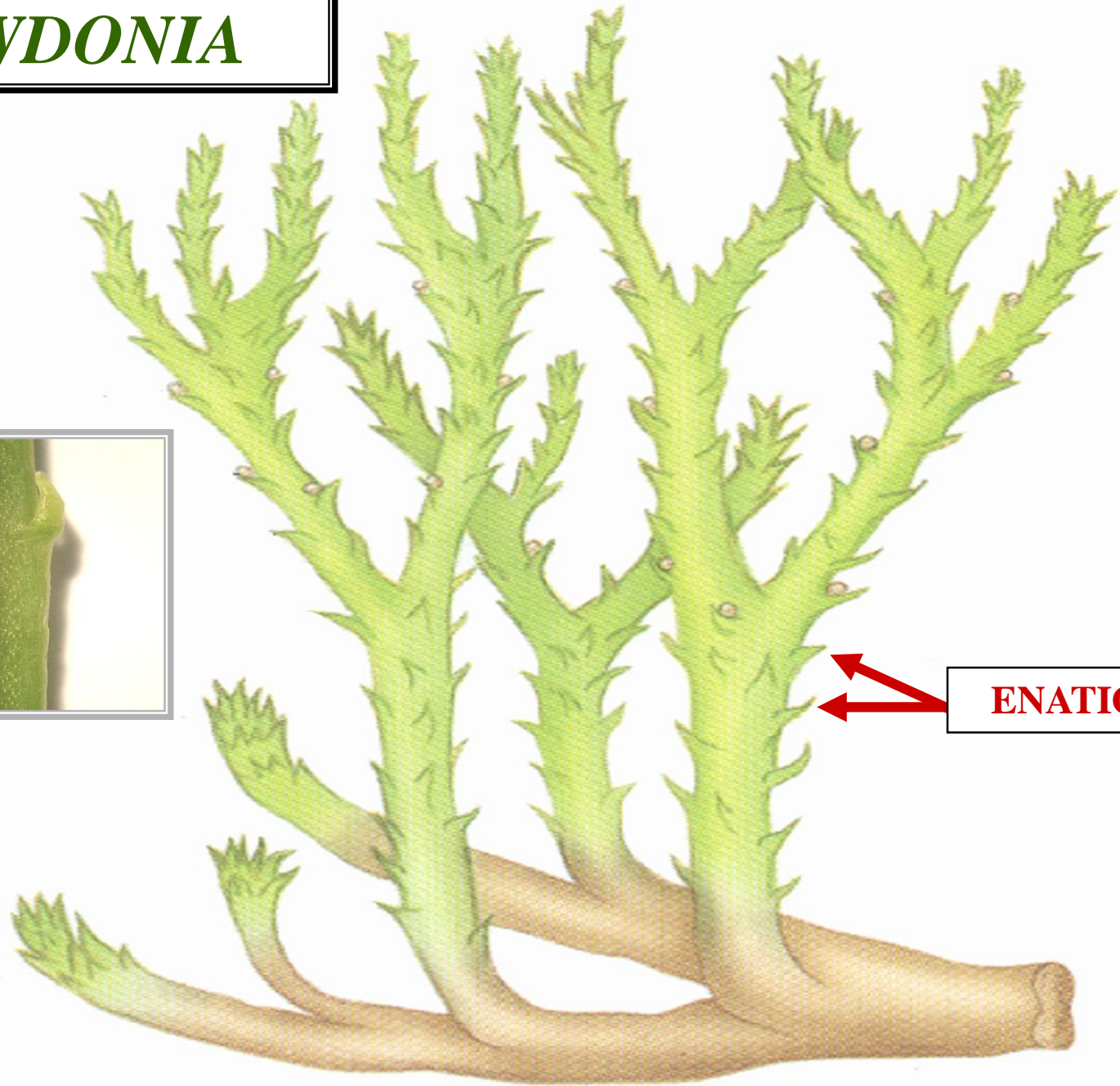
E





# *SAWDONIA*

+/-

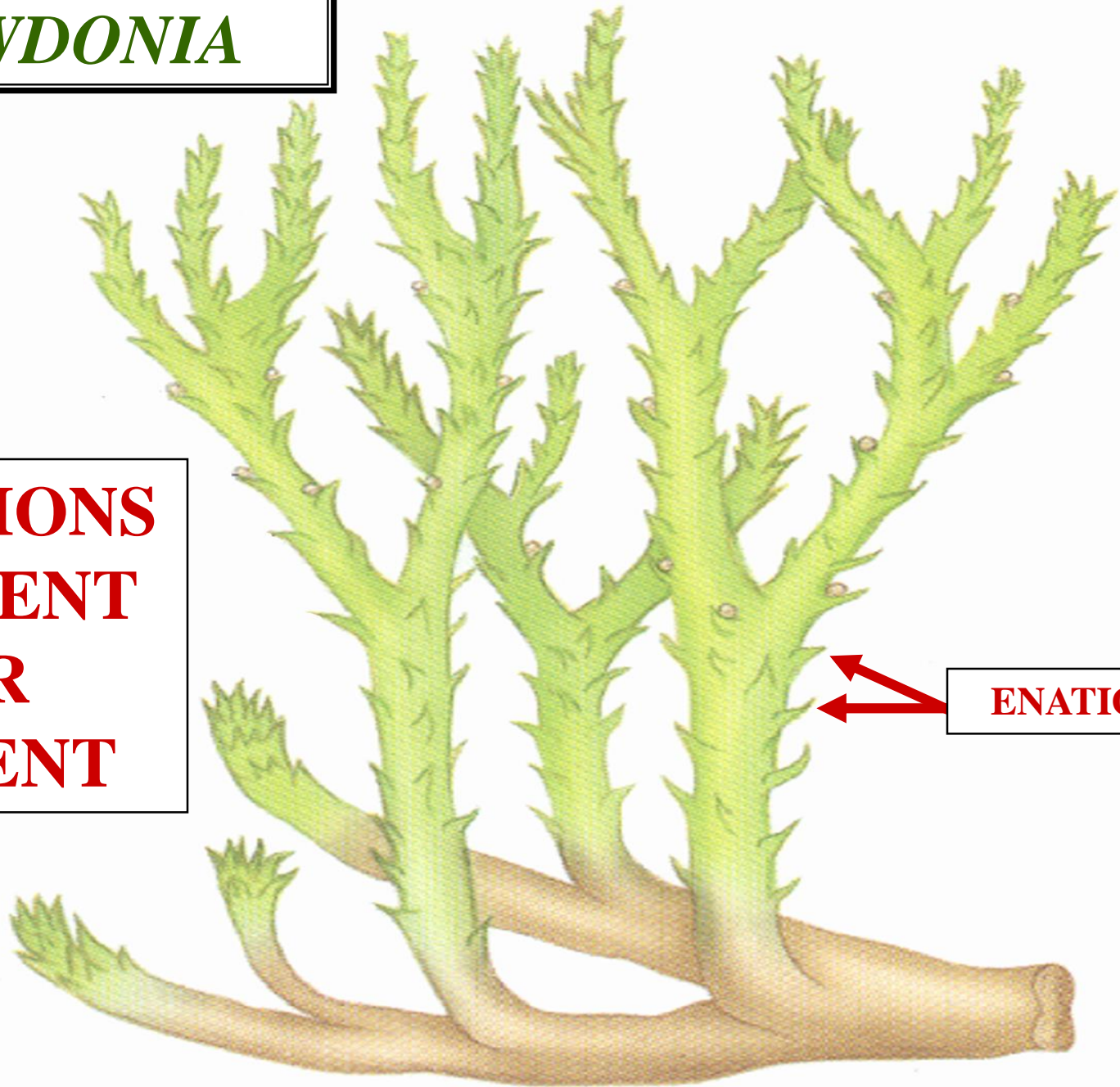


ENATIONS

# *SAWDONIA*



**ENATIONS  
PRESENT  
OR  
ABSENT**

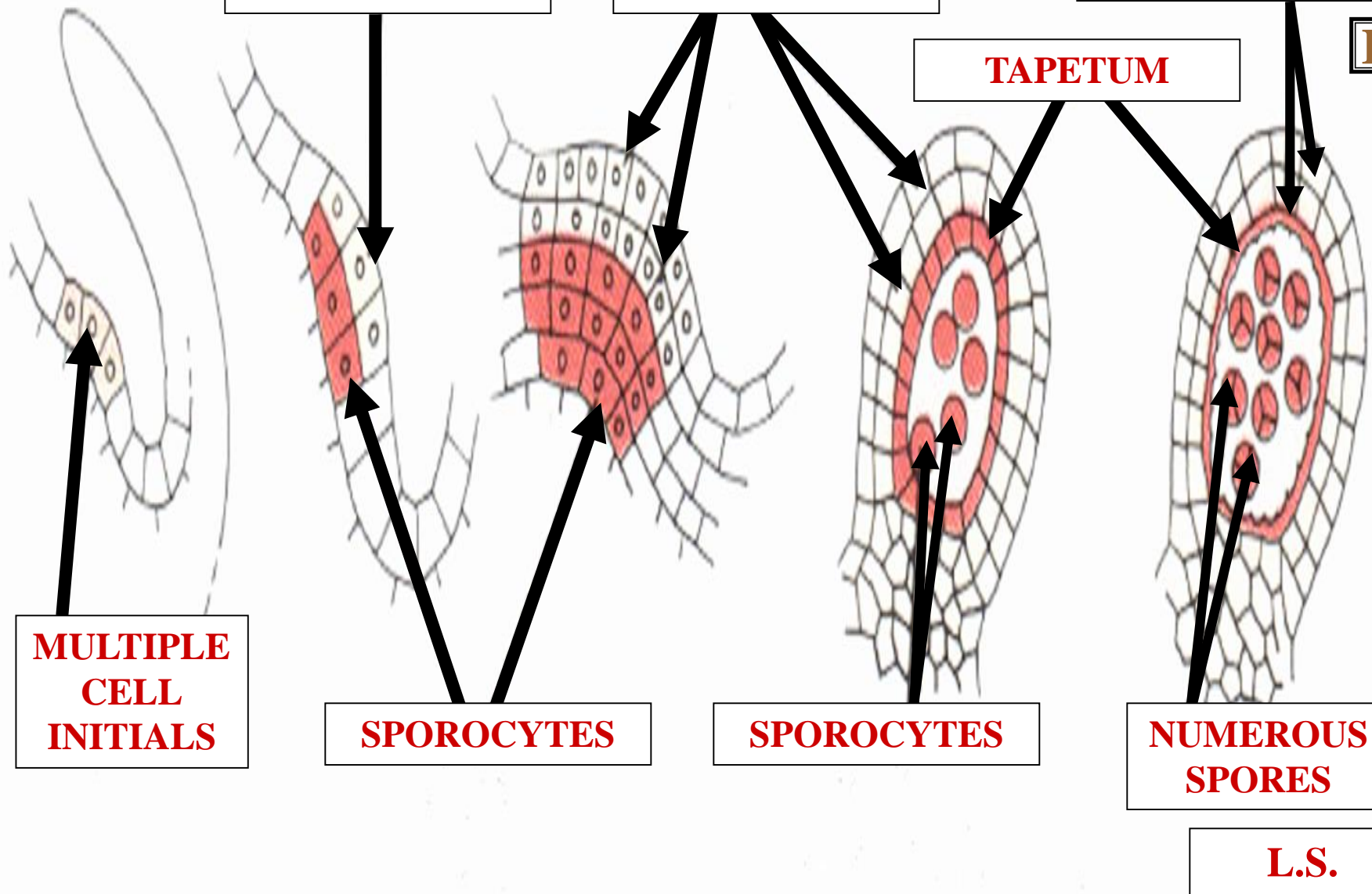


**ENATIONS**

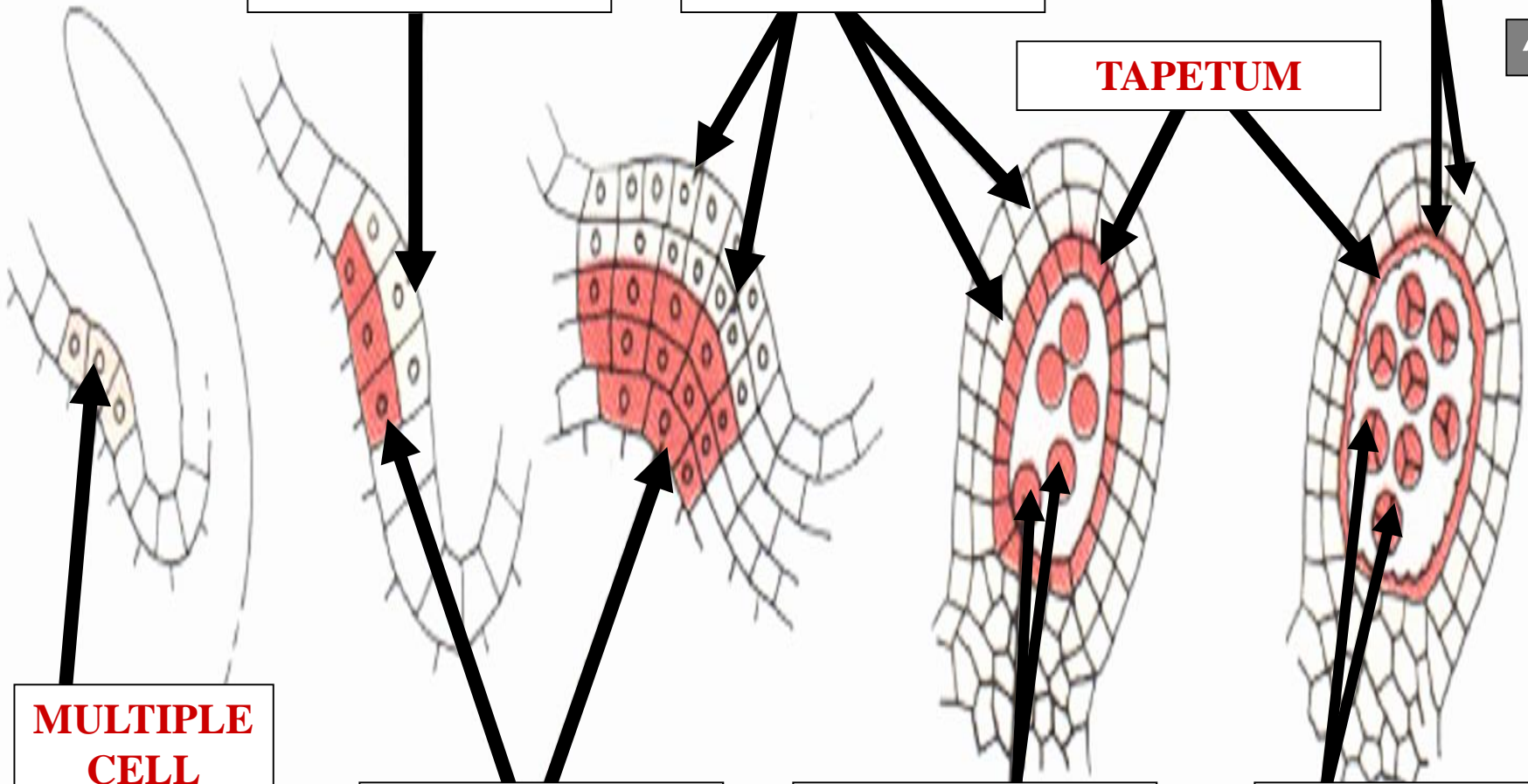




# SPORANGIUM







**WALL CELLS**

**WALL CELLS**

**LARGE SIZE**

**THICK WALL**



**TAPETUM**

**MULTIPLE  
CELL  
INITIALS**

**SPOROCYTES**

**SPOROCYTES**

**NUMEROUS  
SPORES**

**EUSPORANGIUM**

**L.S.**

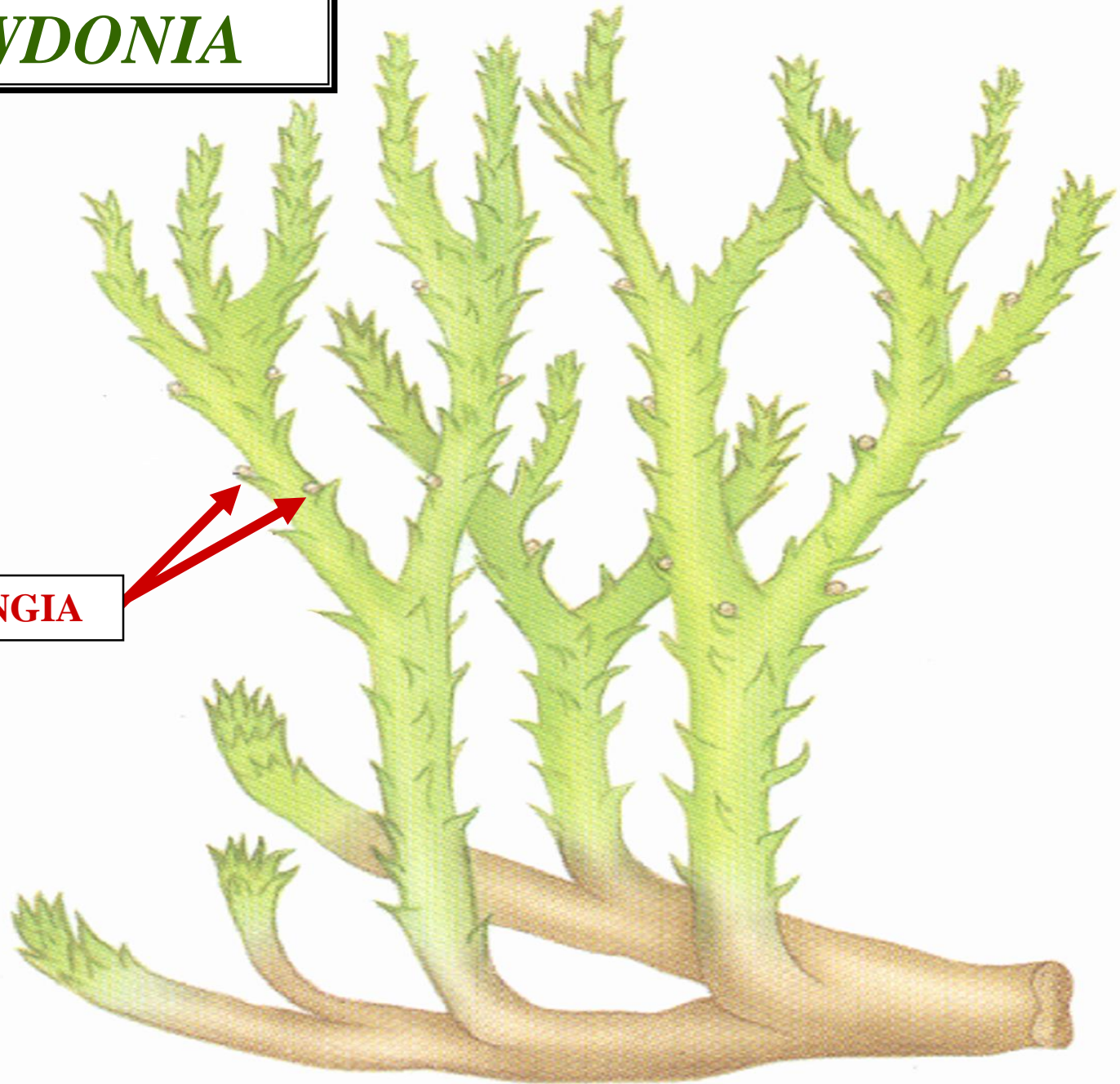


# SPORANGIUM POSITION



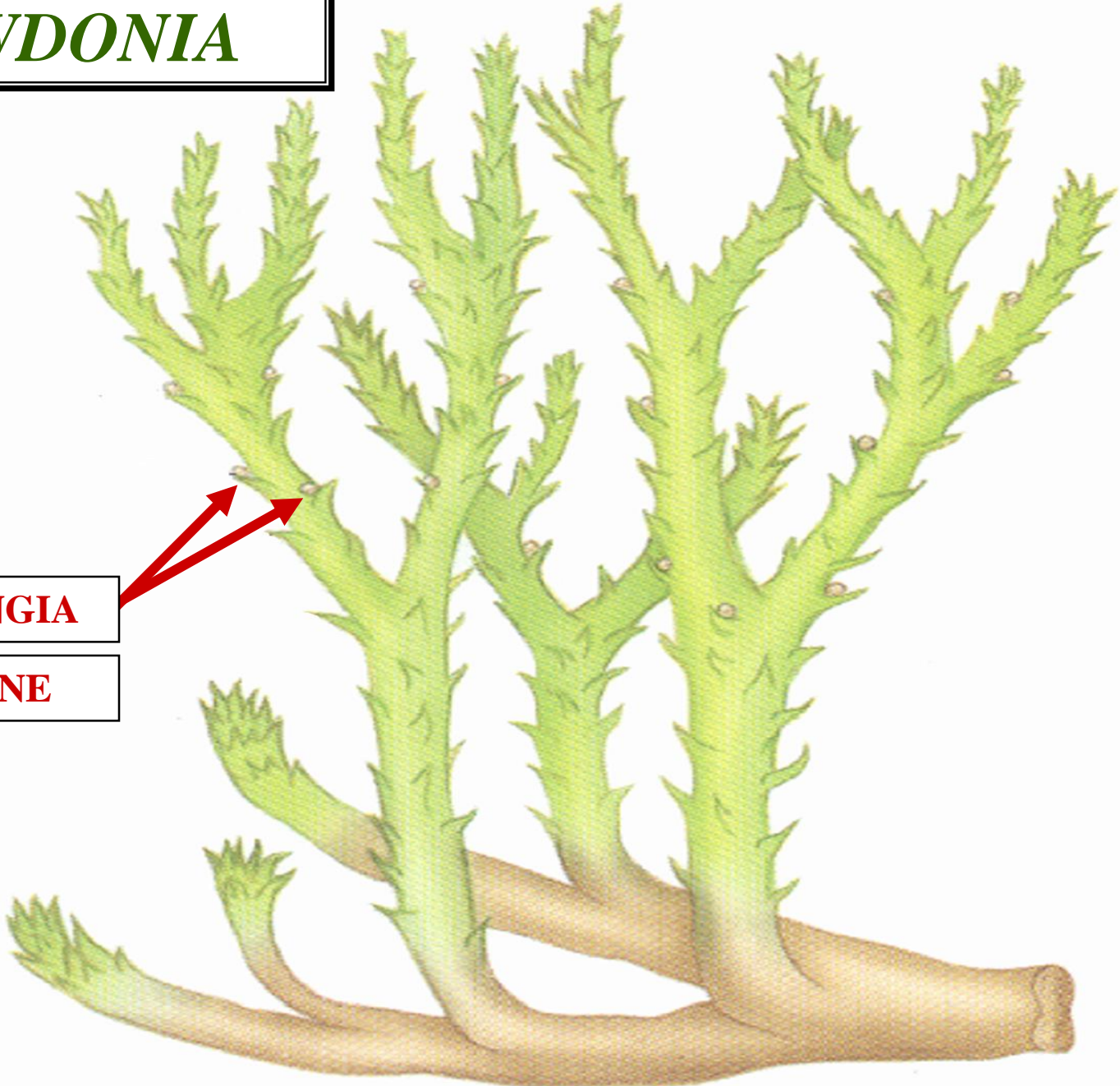
# *SAWDONIA*

C



**SPORANGIA**

**SAWDONIA**

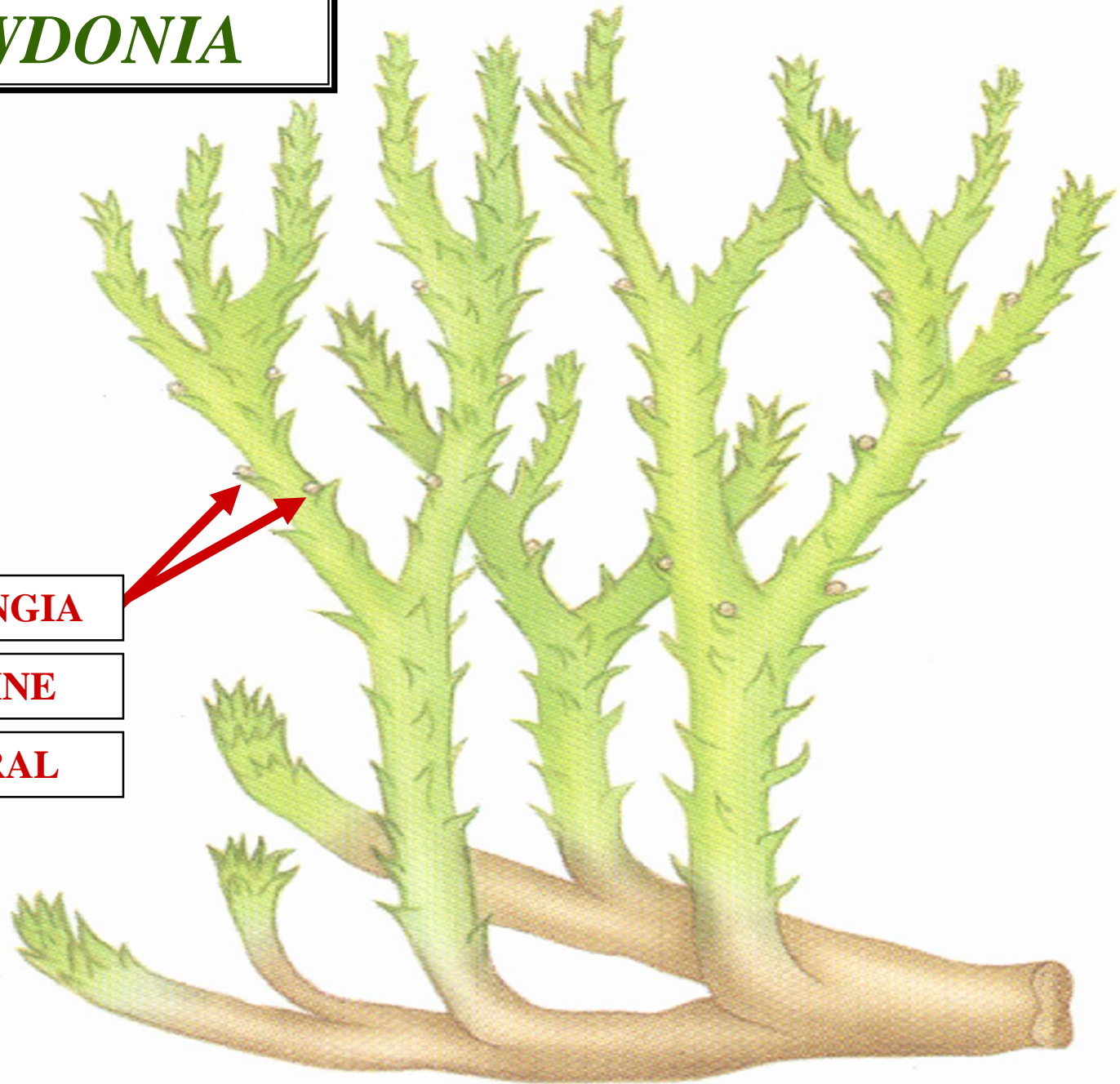


**SPORANGIA**

**CAULINE**



# *SAWDONIA*



**SPORANGIA**

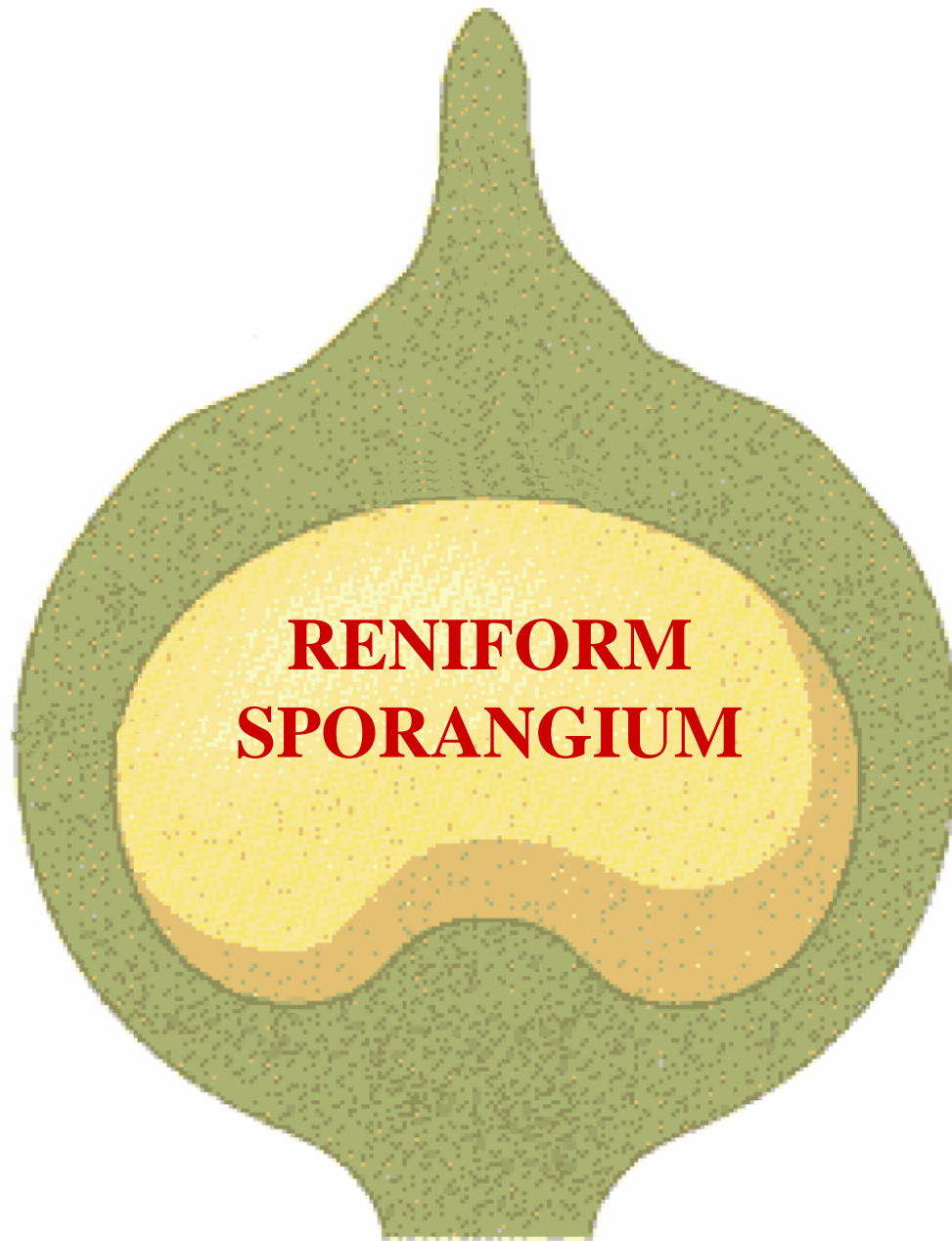
**CAULINE**

**LATERAL**



# SPORANGIUM SHAPE





**RENIFORM  
SPORANGIUM**

**RENIFORM**



**RENIFORM  
SPORANGIUM**



**KIDNEY SHAPED  
SPORANGIUM**

**RENIFORM  
SPORANGIUM**



**SPORANGIUM  
KIDNEY SHAPE**

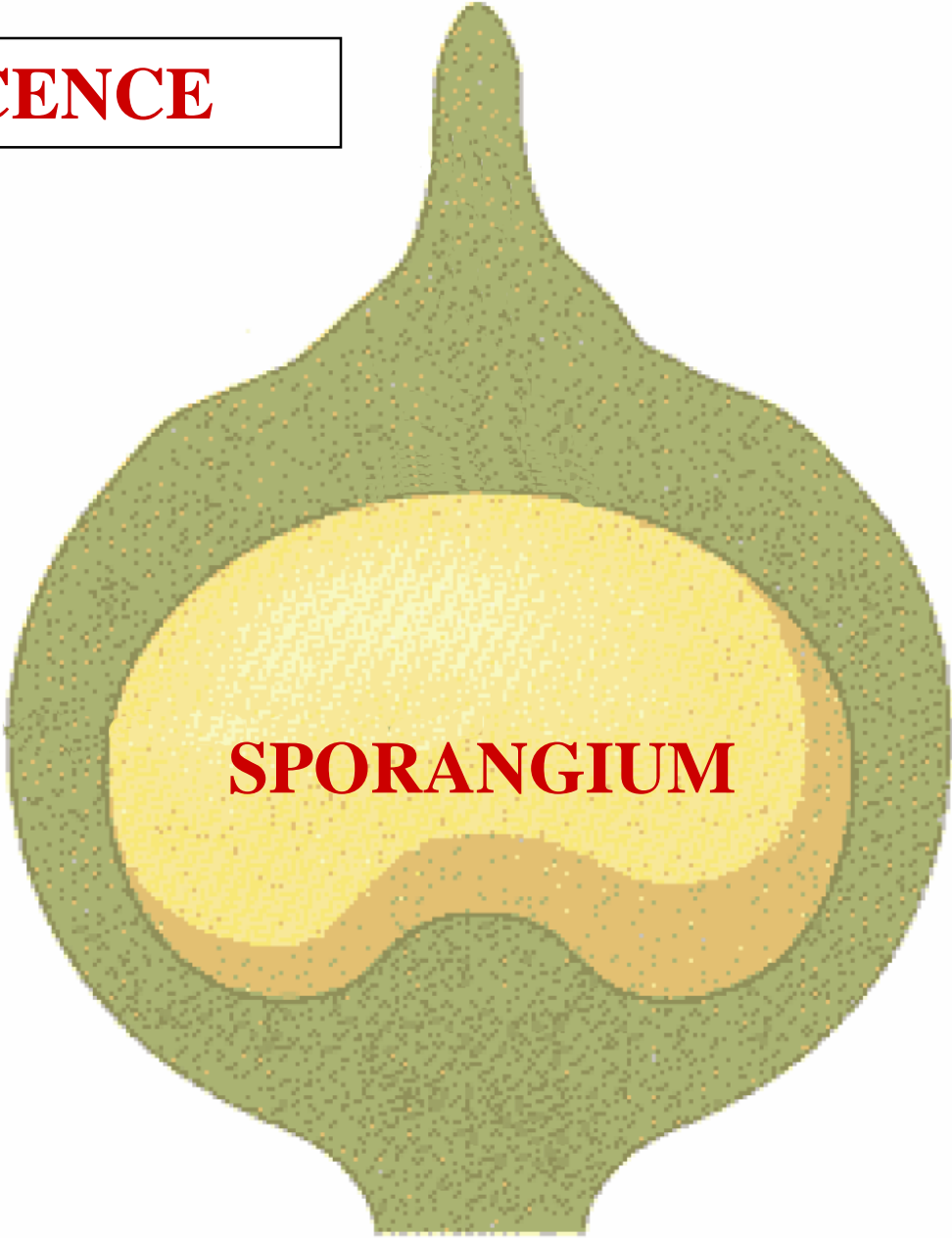
**SPOROPHYLL**



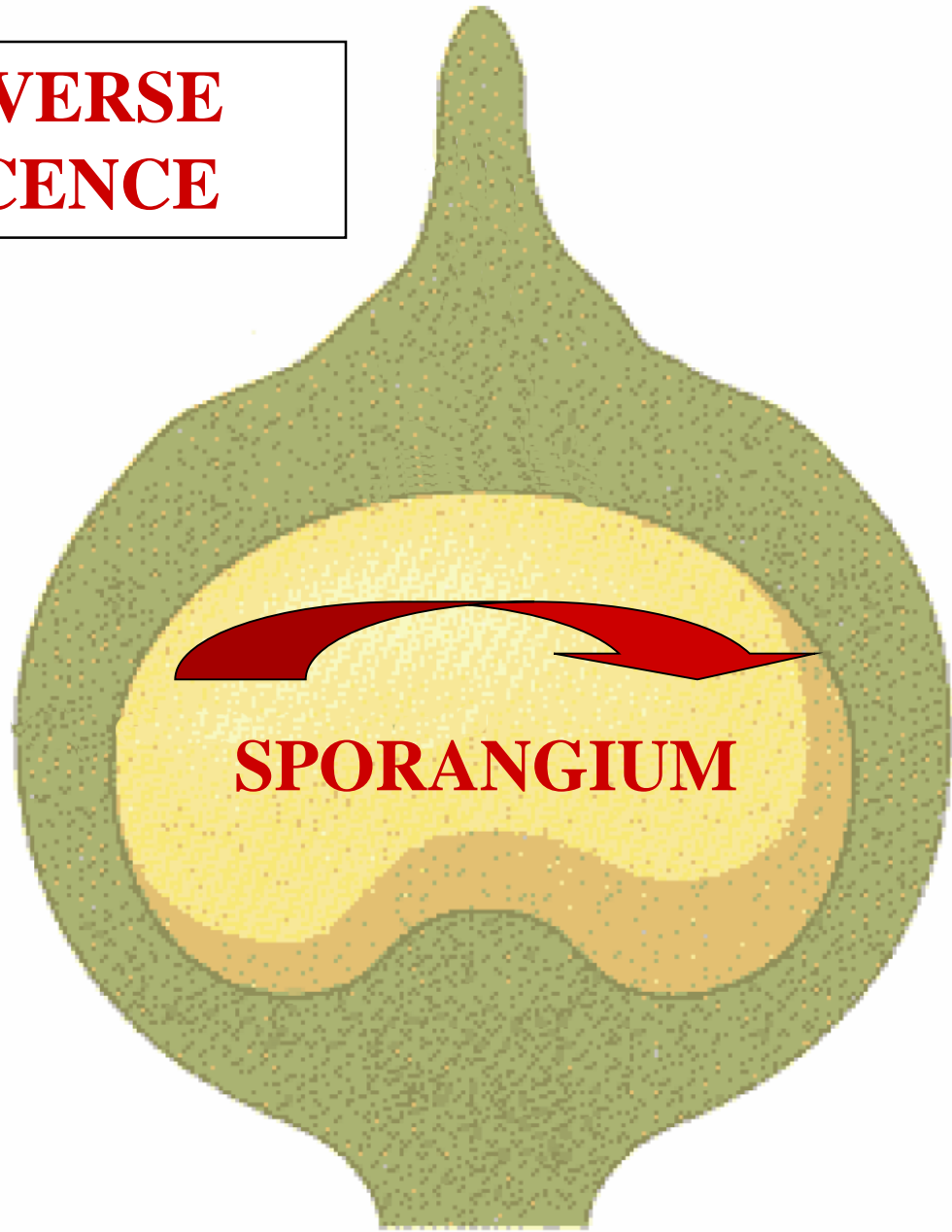


# SPORANGIUM DEHISCENCE

**DEHISCENCE**



**TRANSVERSE  
DEHISCENCE**

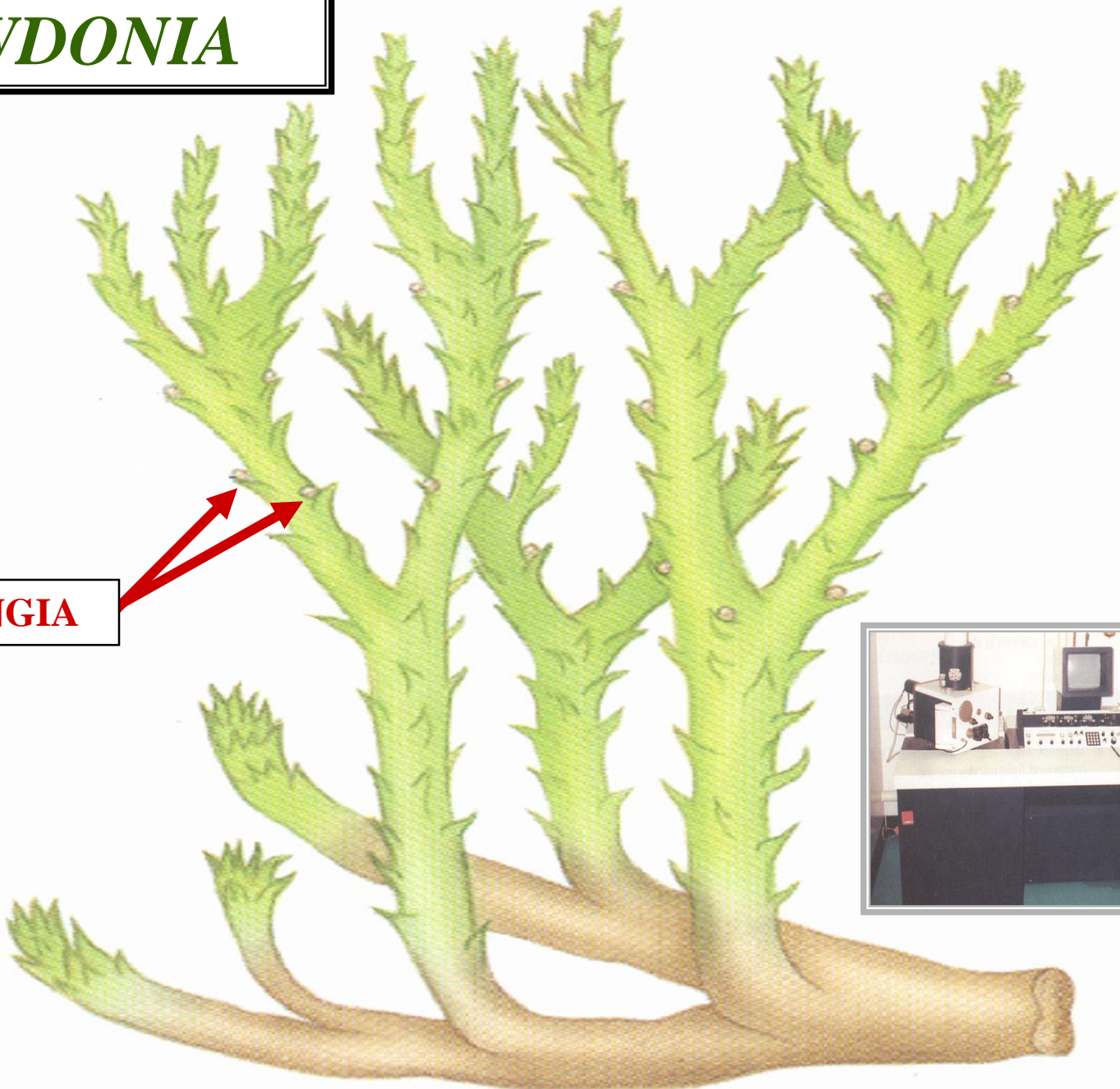




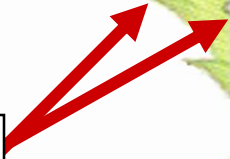


# REPRODUCTION

# *SAWDONIA*



**SPORANGIA**



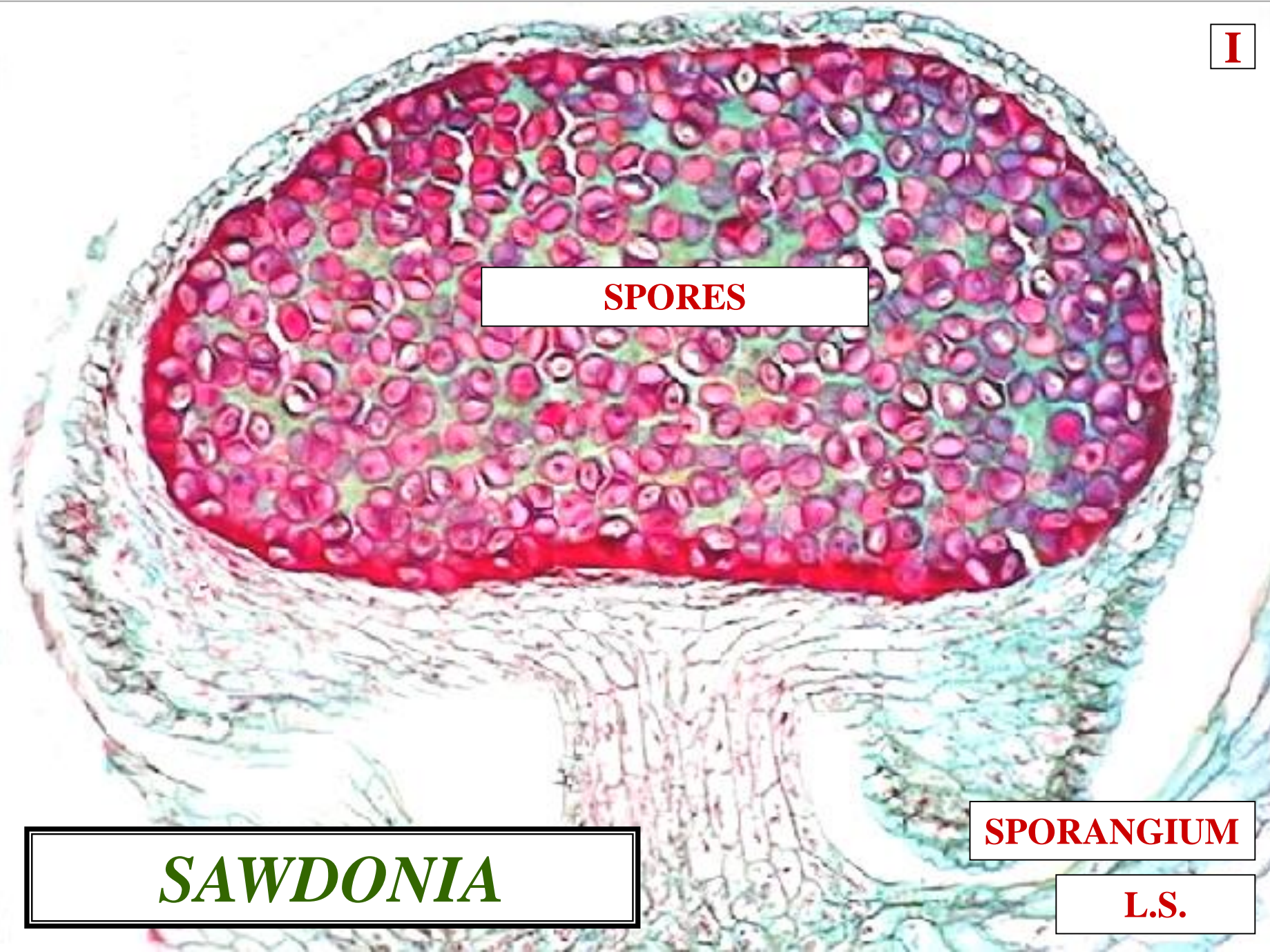
I

**SPORES**

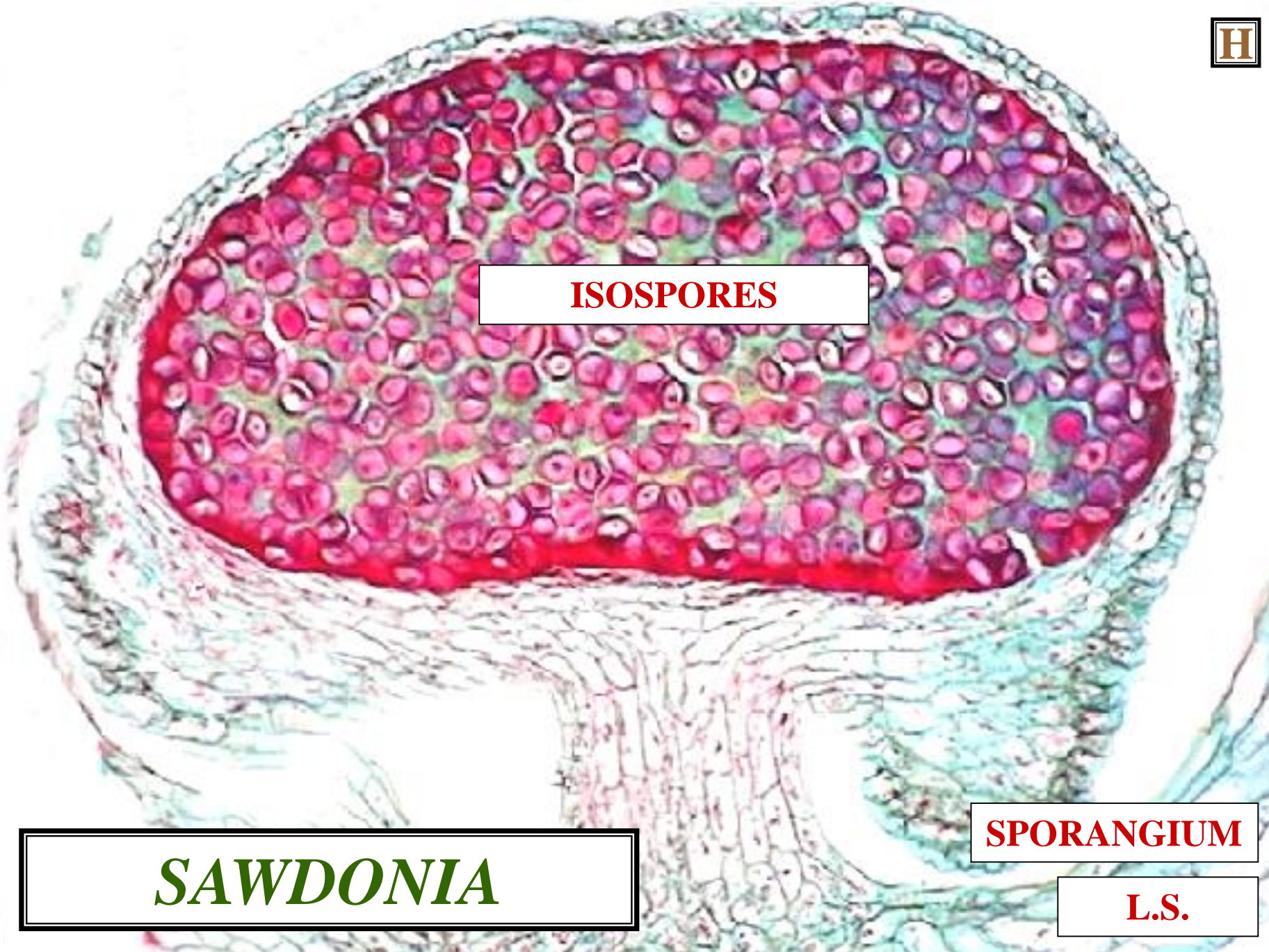
***SAWDONIA***

**SPORANGIUM**

**L.S.**







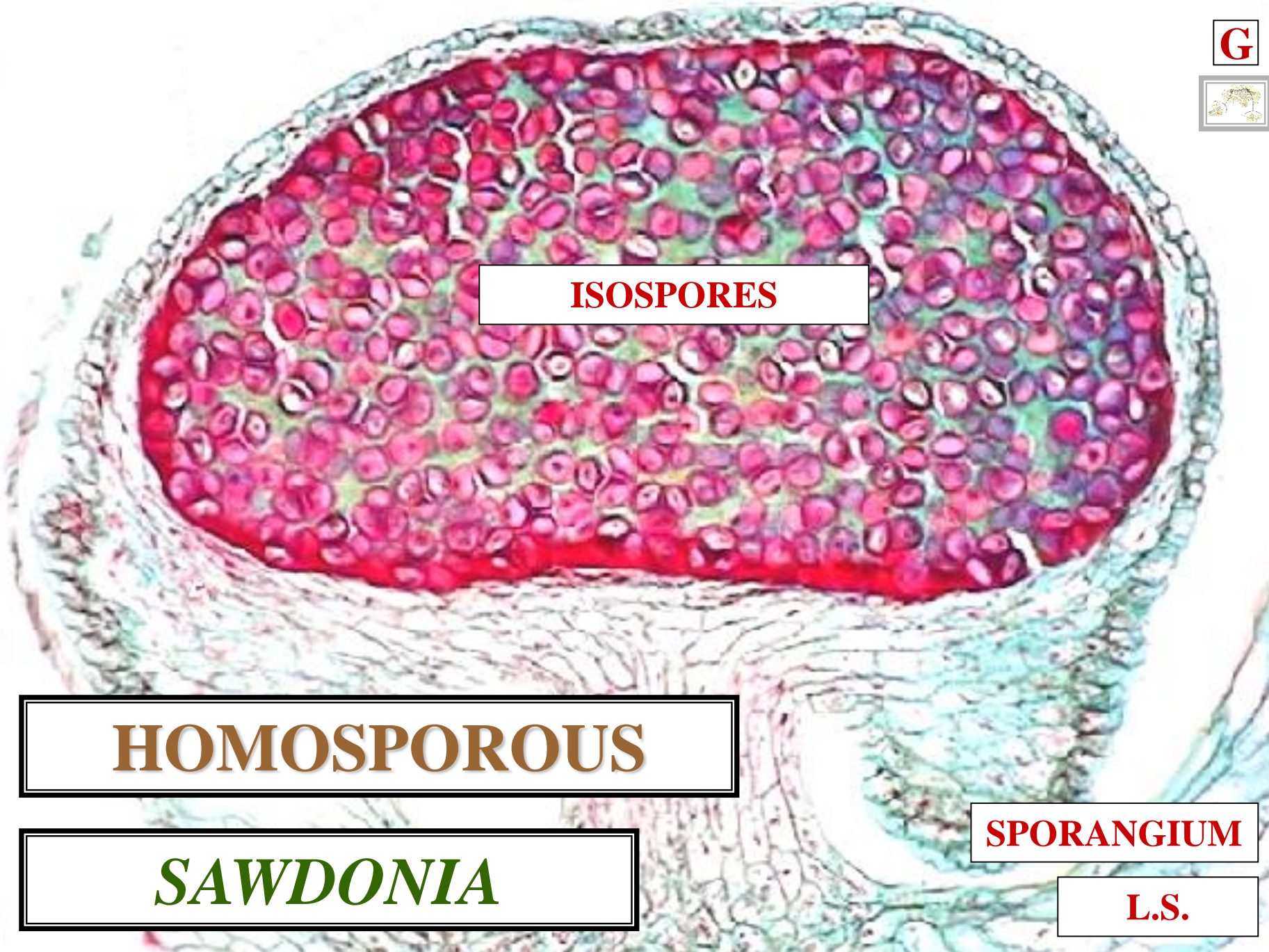
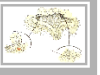
**ISOSPORES**

***SAWDONIA***

**SPORANGIUM**

**L.S.**





**ISOSPORES**

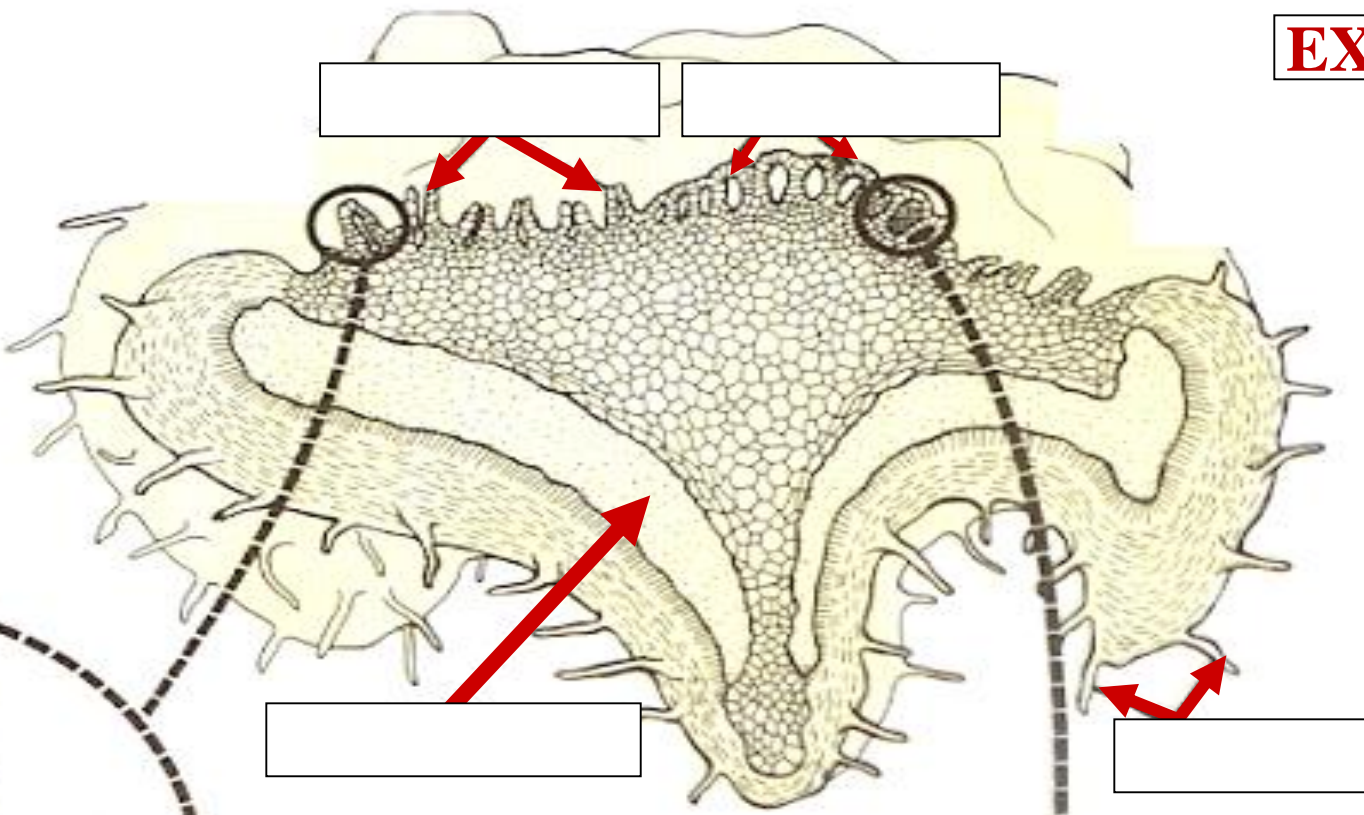
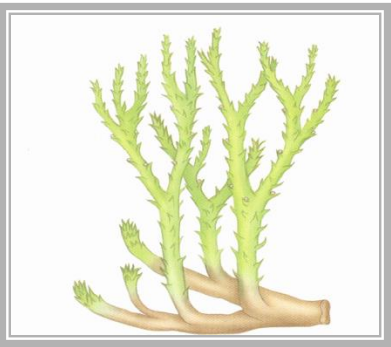
**HOMOSPOROUS**

***SAWDONIA***

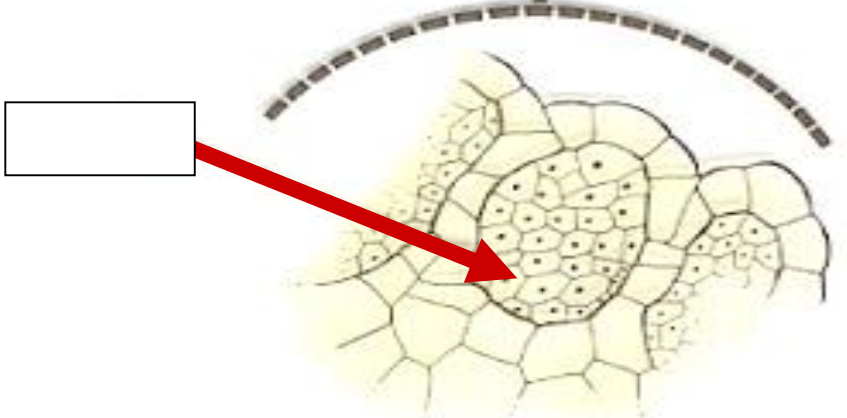
**SPORANGIUM**

**L.S.**

**EX**



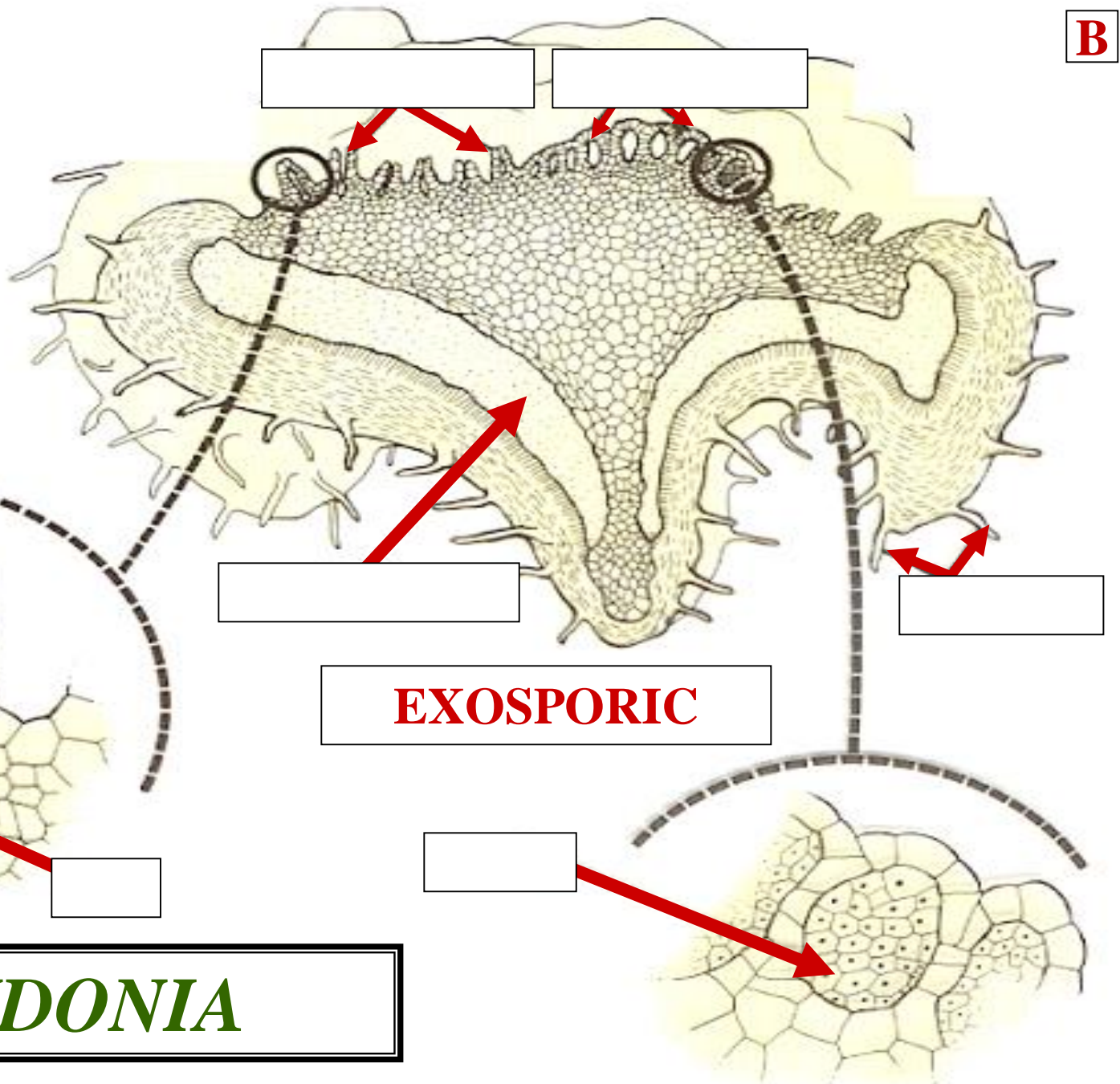
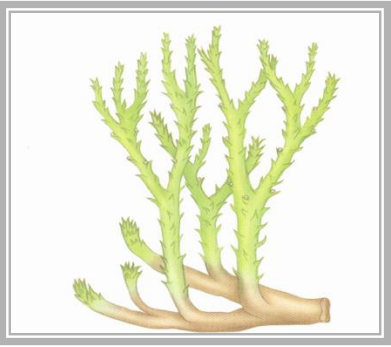
**GAMETOPHYTE**



***SAWDONIA***

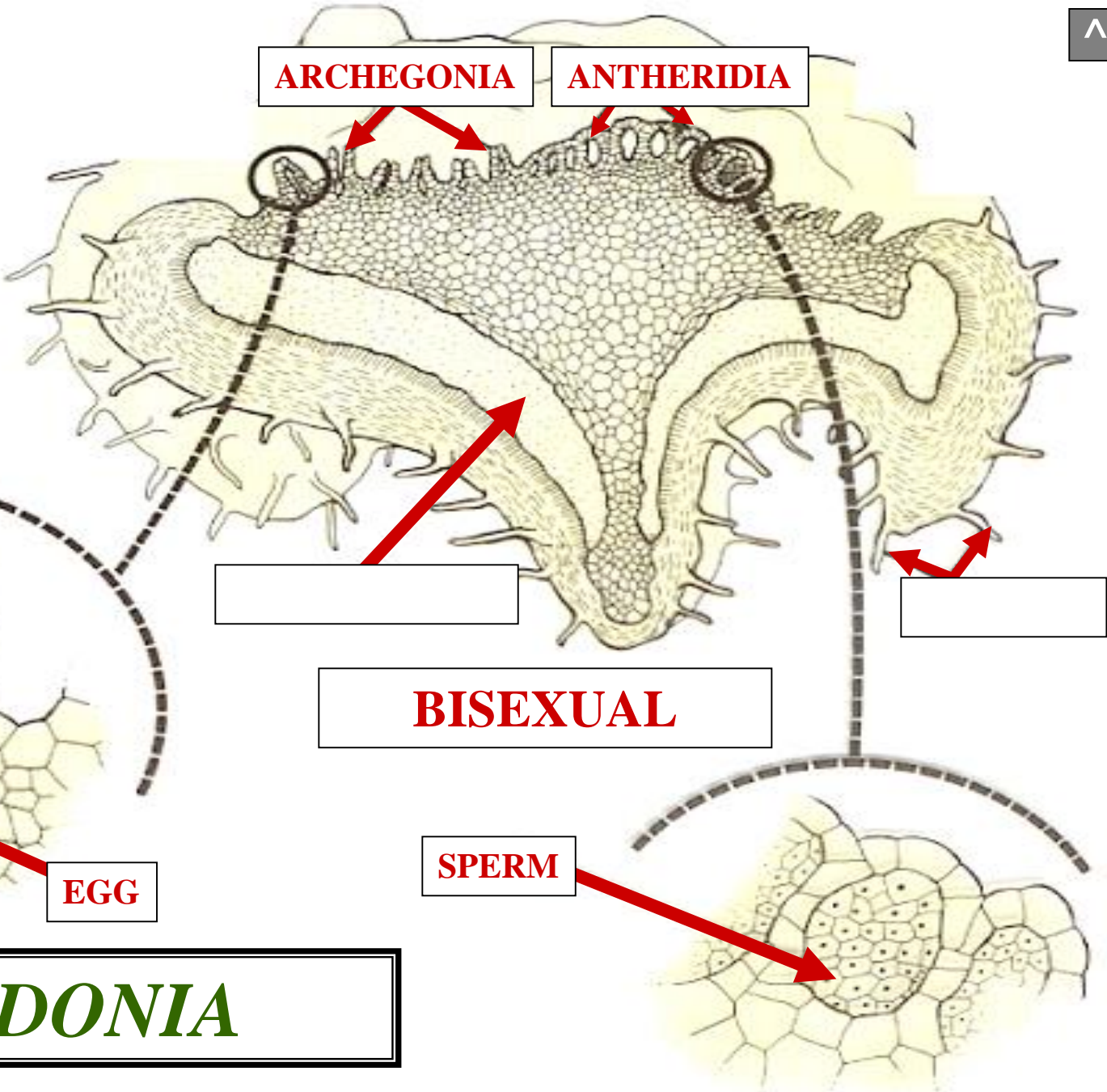
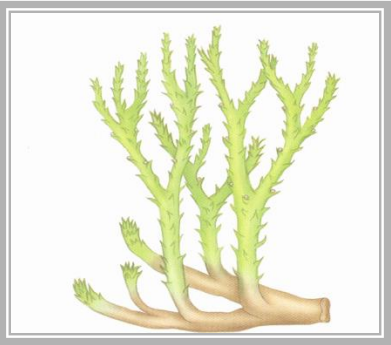


**B**



**EXOSPORIC**

***SAWDONIA***



ARCHEGONIA

ANTHERIDIA

[Empty box]

[Empty box]

BISEXUAL

EGG

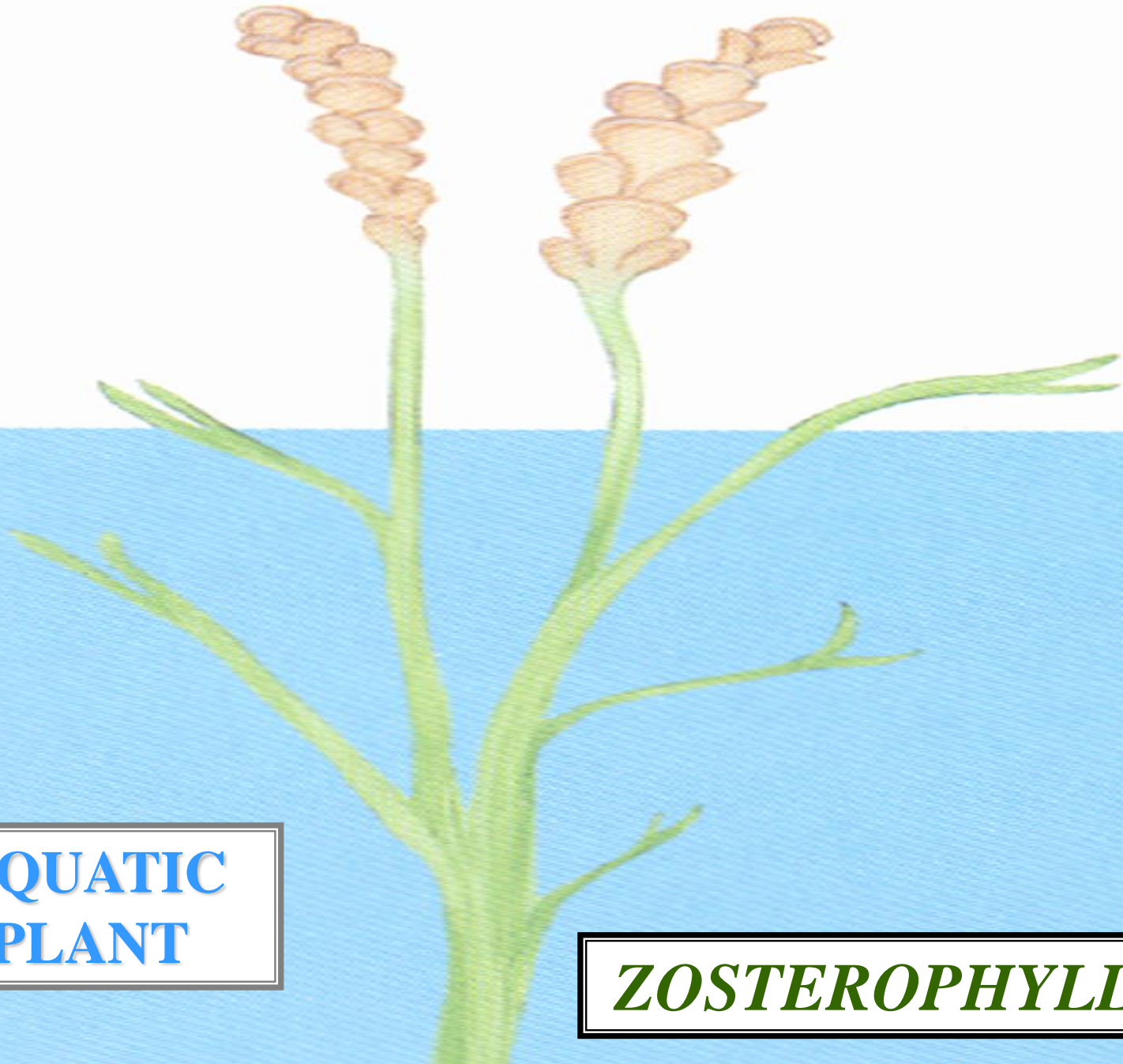
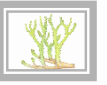
SPERM

**SAWDONIA**



# REPRESENTATIVE GENERA

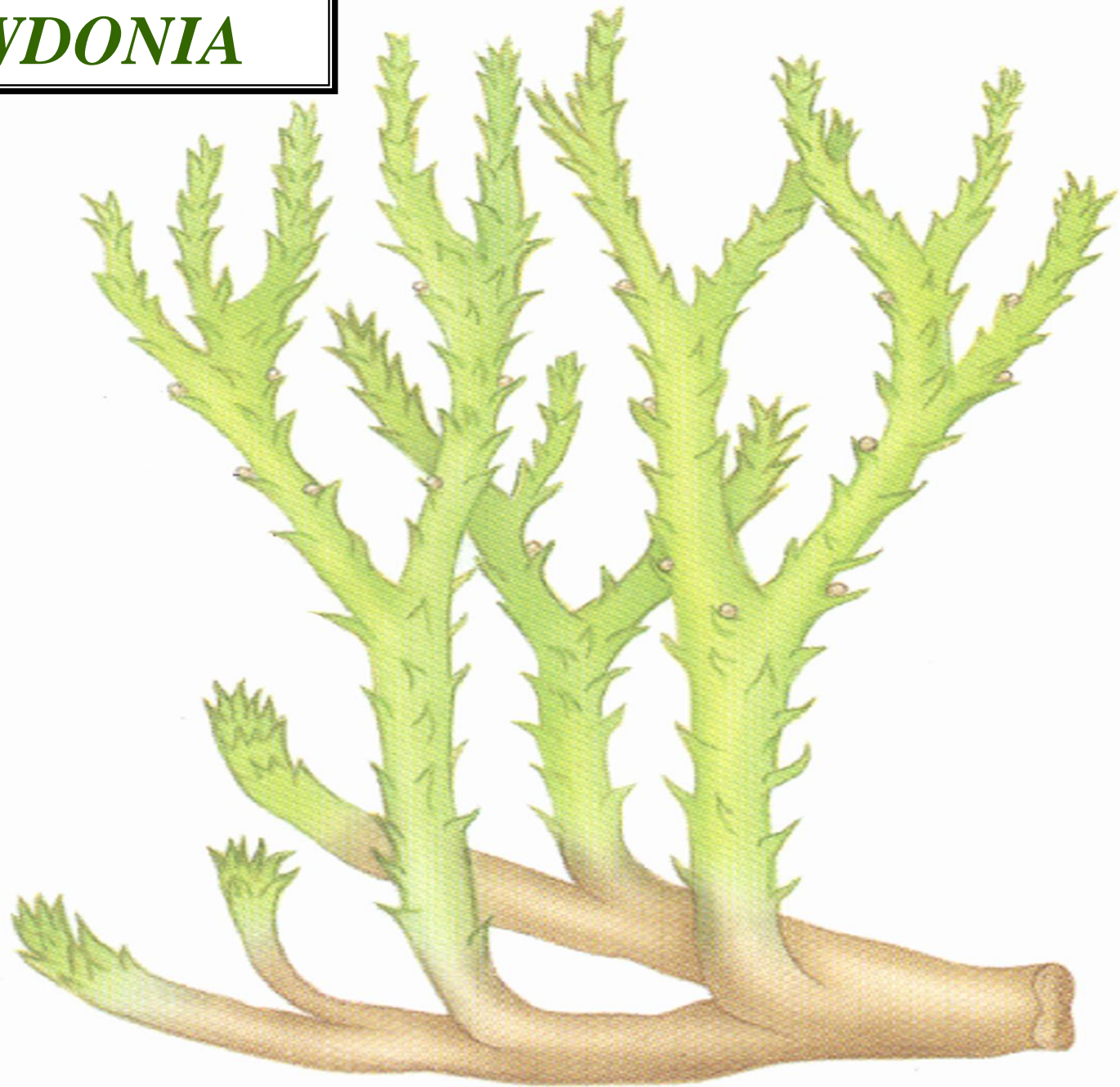


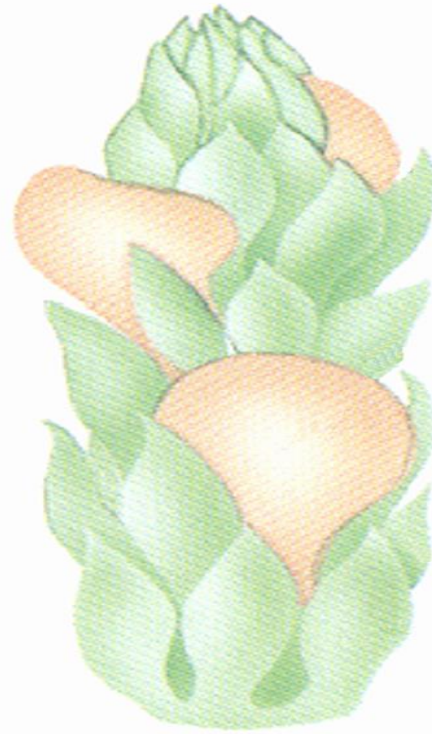
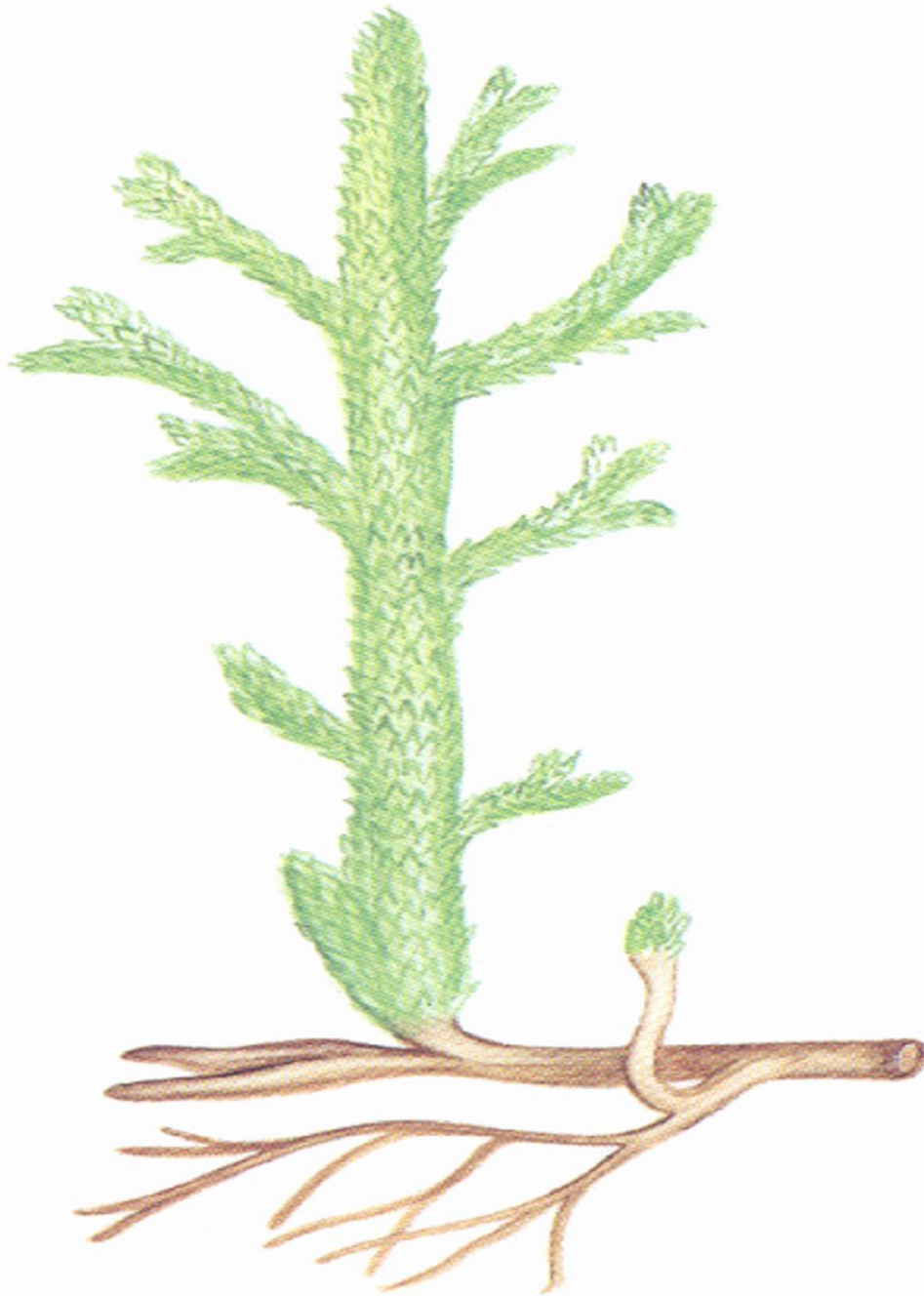


**AQUATIC  
PLANT**

***ZOSTEROPHYLLUM***

# *SAWDONIA*





***ASTEROXYLON***



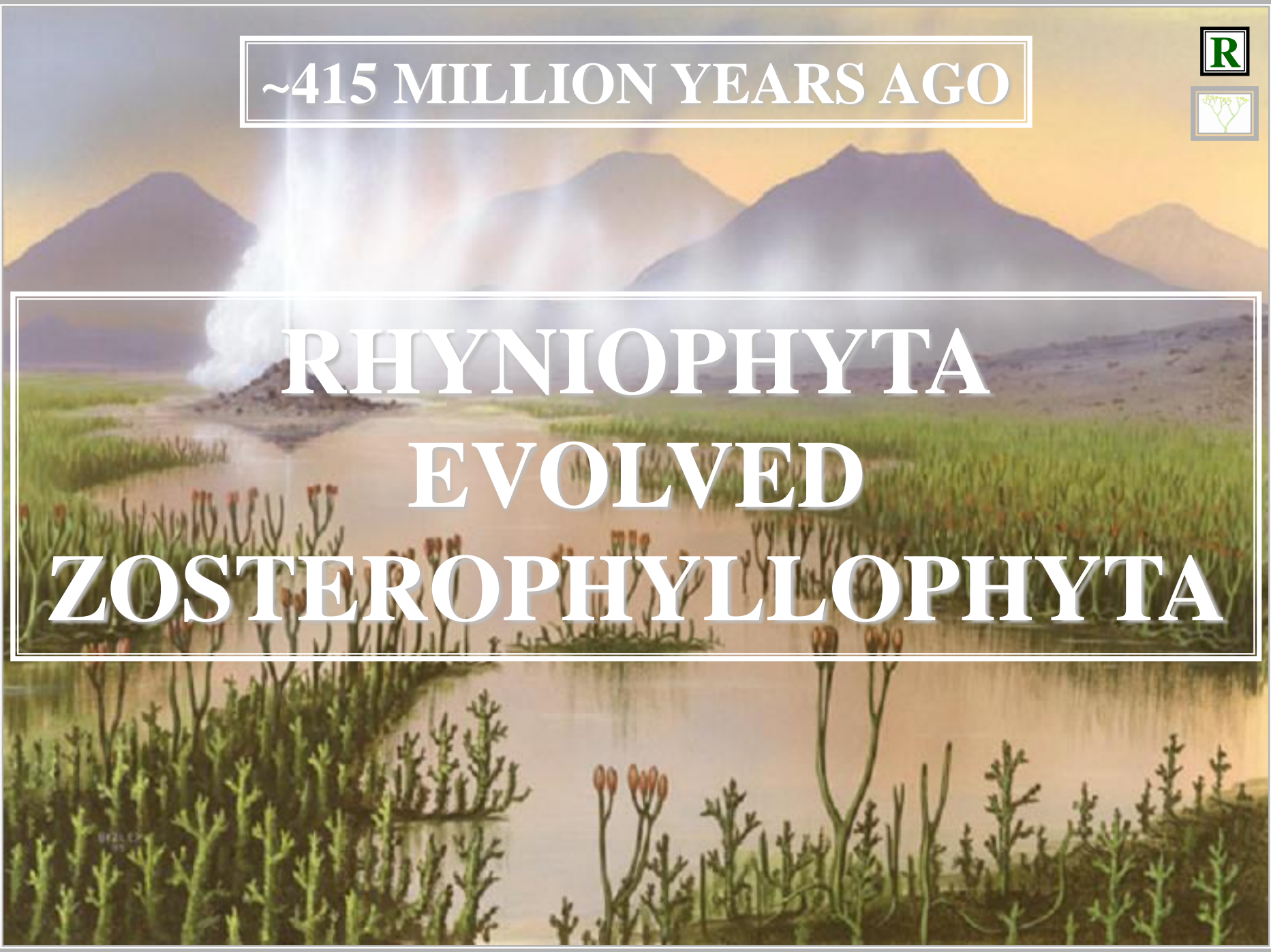
# PHYLOGENETIC RELATIONSHIP

~415 MILLION YEARS AGO

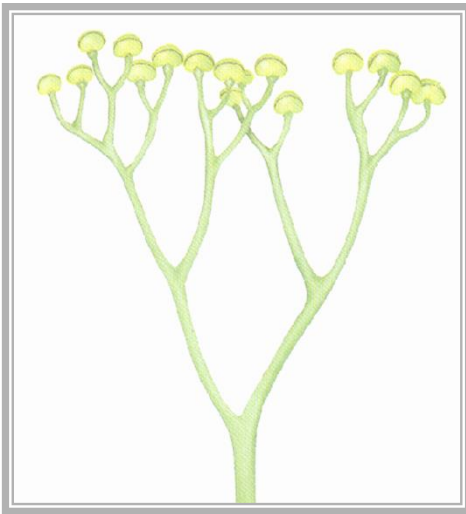
R



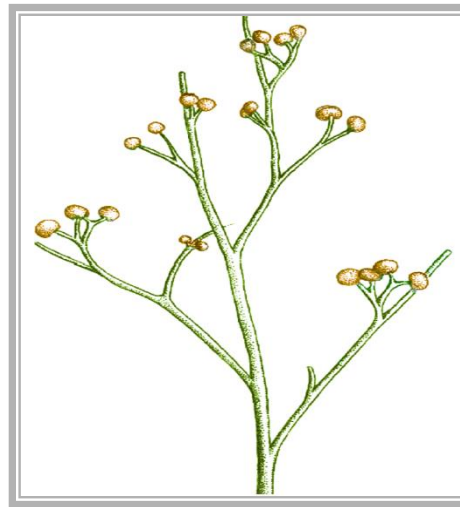
**RHYNIOPHYTA  
EVOLVED  
ZOSTEROPHYLLOPHYTA**



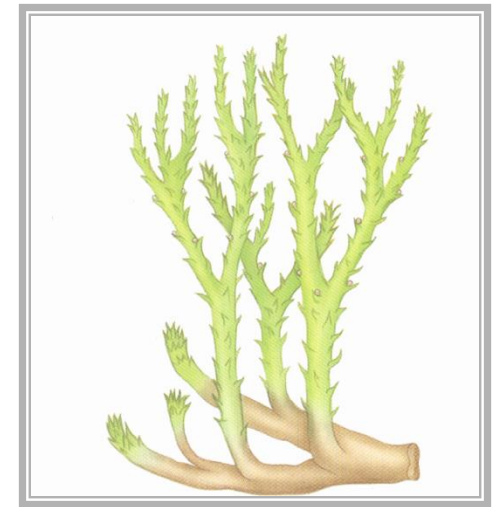
# ZOSTEROPHYTE EVOLUTION



**RHYNIOPHYTE**



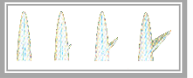
**RENALIA**



**ZOSTEROPHYTE**



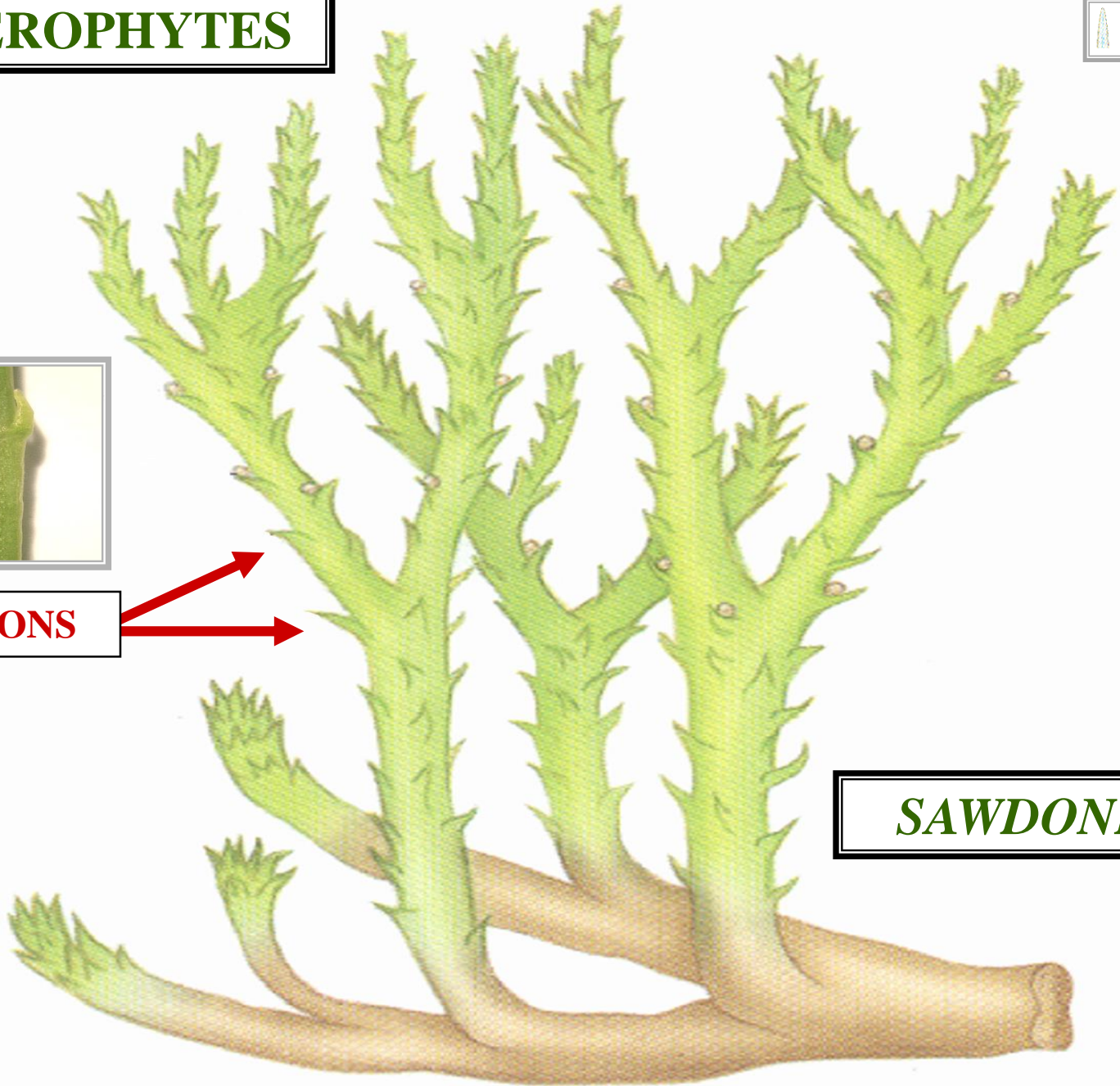
# ZOSTEROPHYTES



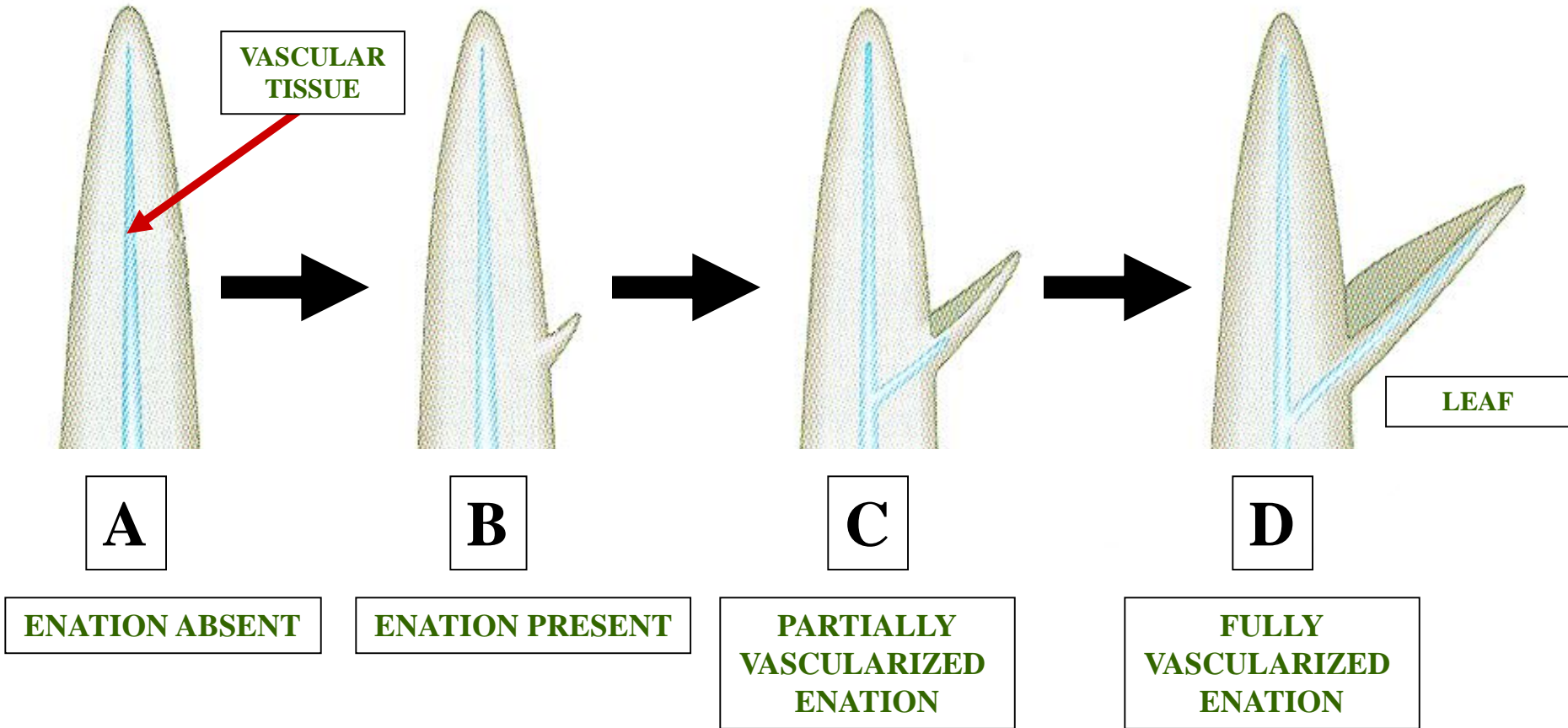
**ENATIONS**



***SAWDONIA***

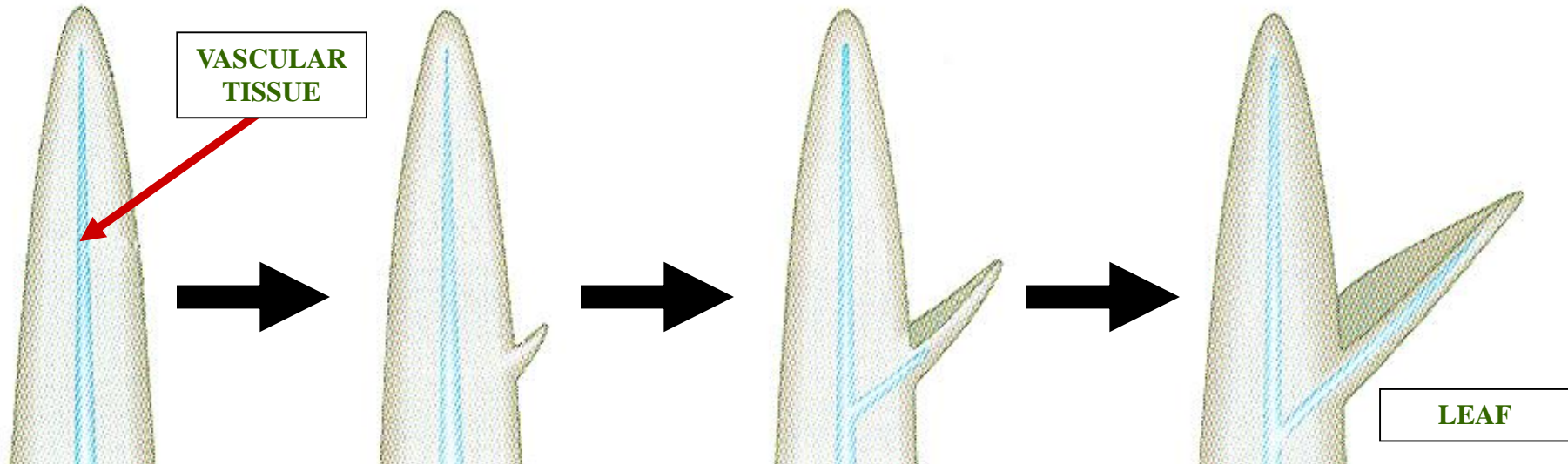


# THEORY



**→ = TIME**

# ENATION THEORY



A

B

C

D

ENATION ABSENT

ENATION PRESENT

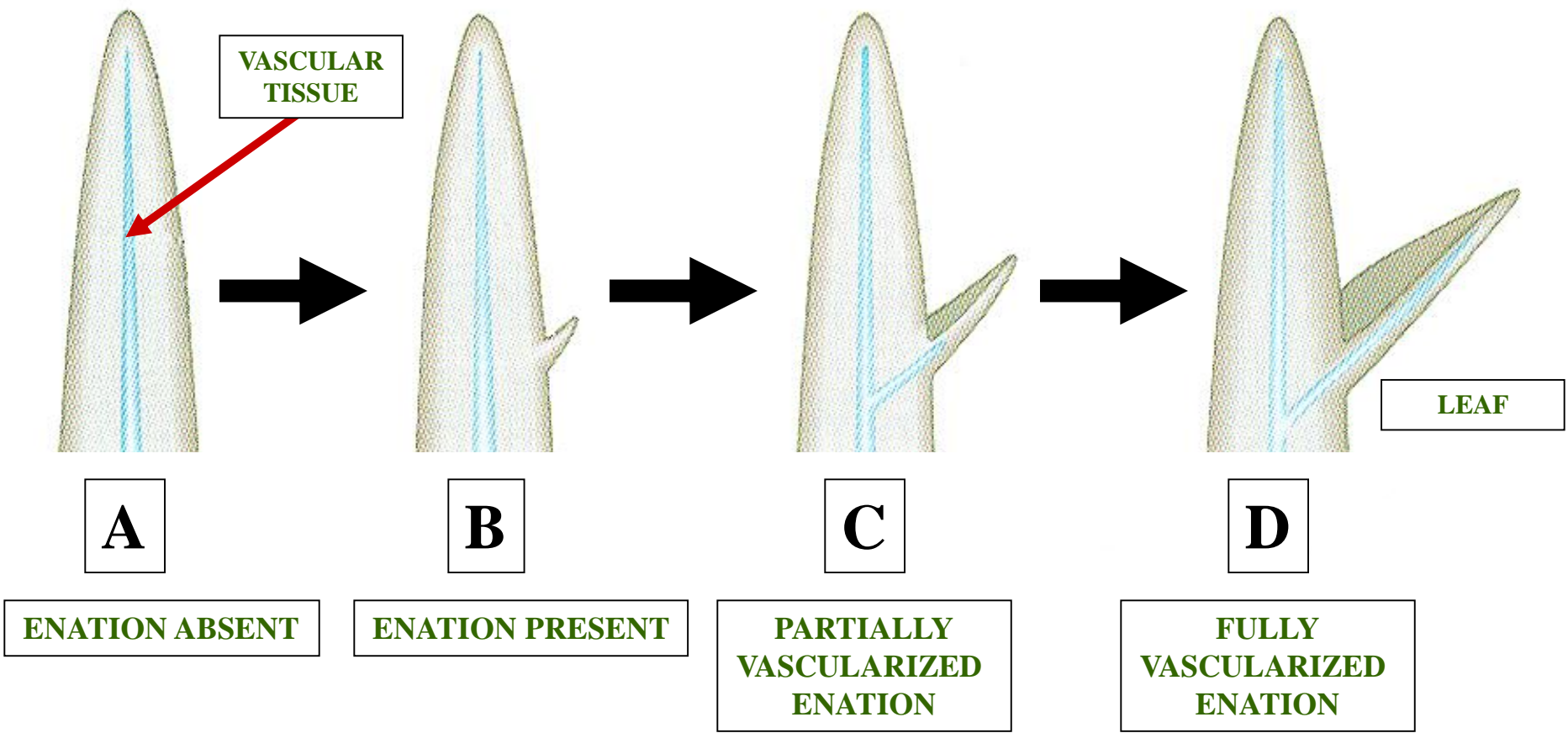
PARTIALLY  
VASCULARIZED  
ENATION

FULLY  
VASCULARIZED  
ENATION

➔ = TIME



# MICROPHYLL



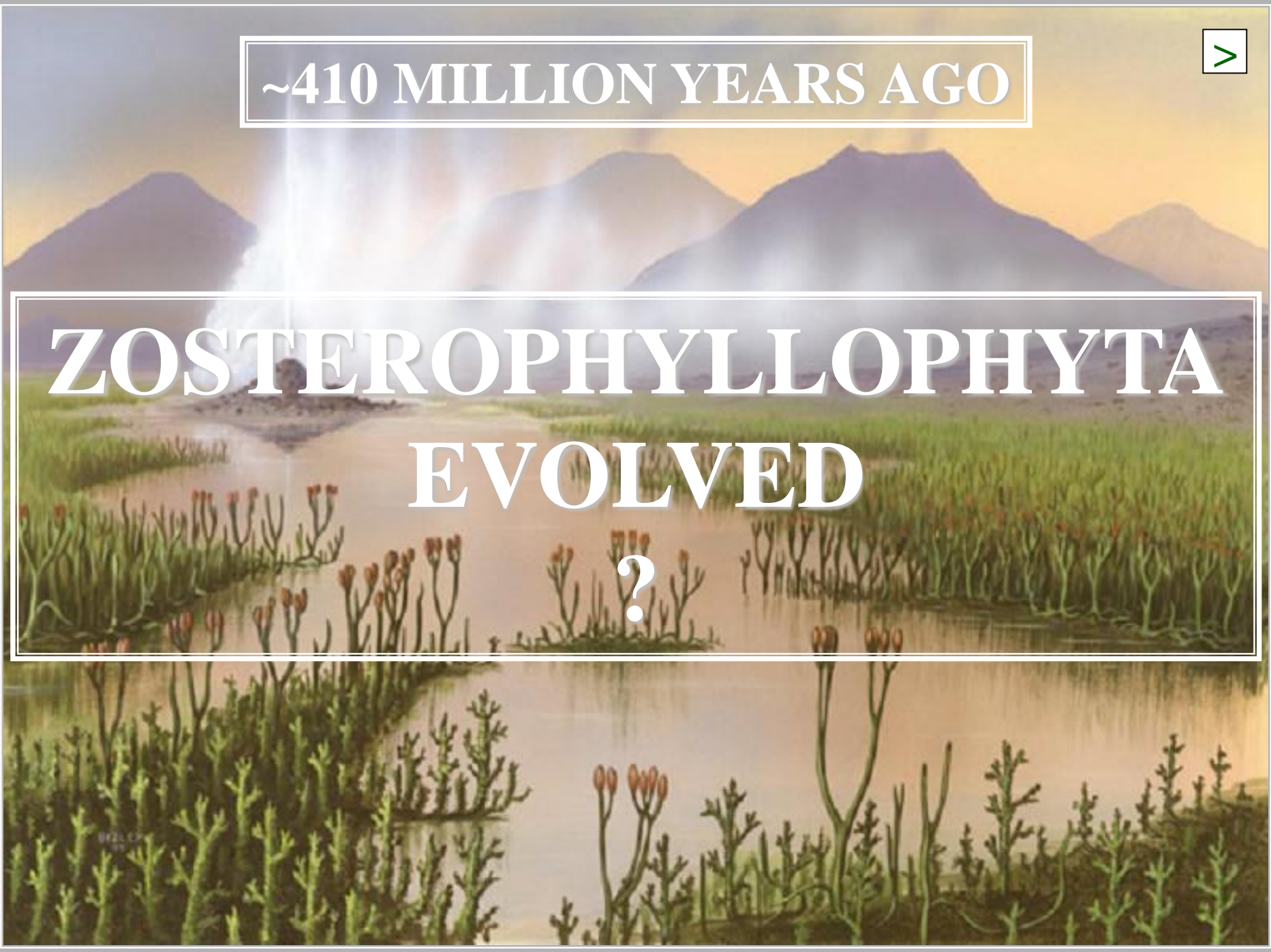
**→ = TIME**

~410 MILLION YEARS AGO



# ZOSTEROPHYLLOPHYTA EVOLVED

?





~410 MILLION YEARS AGO

V

ZOSTEROPHYLLOPHYTA  
EVOLVED  
LYCOPODIOPHYTA

9/21/07





# VASCULAR PLANT EVOLUTION



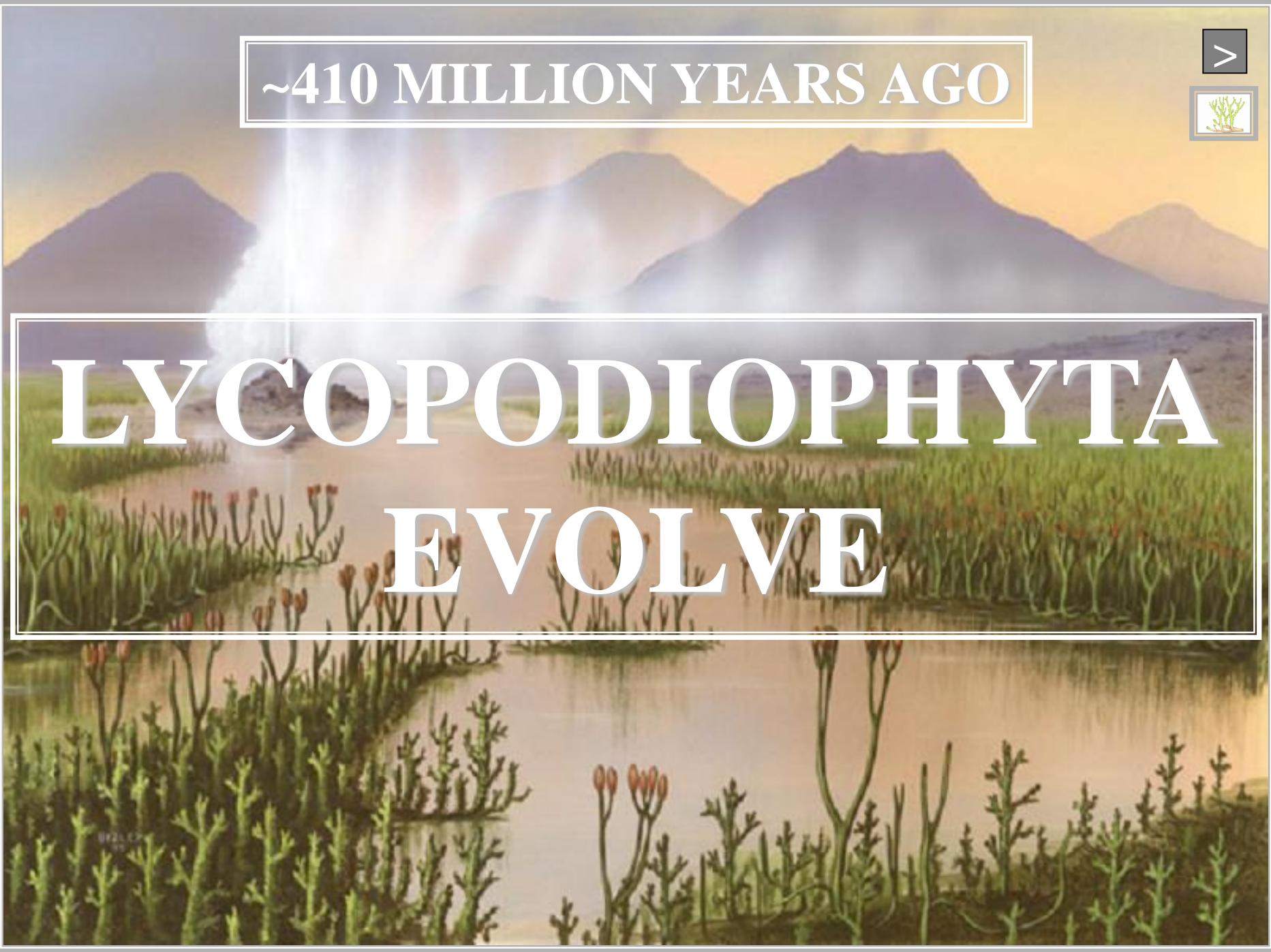
**~410**

**MILLION YEARS**

~410 MILLION YEARS AGO

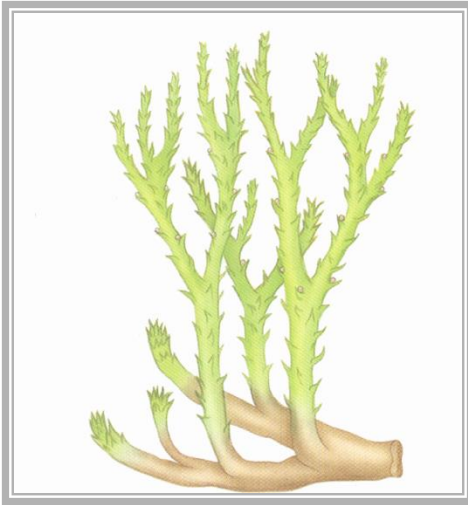


# LYCOPODIOPHYTA EVOLVE



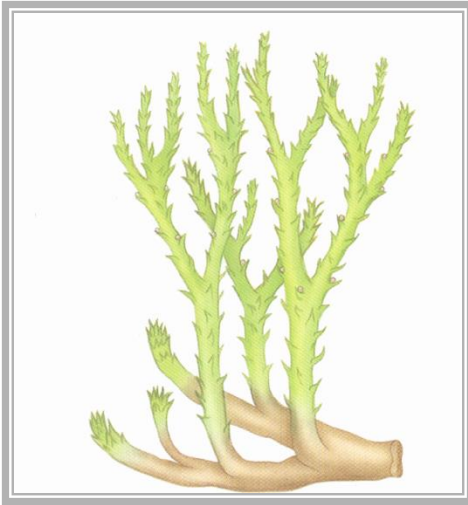


# LYCOPHYTE EVOLUTION



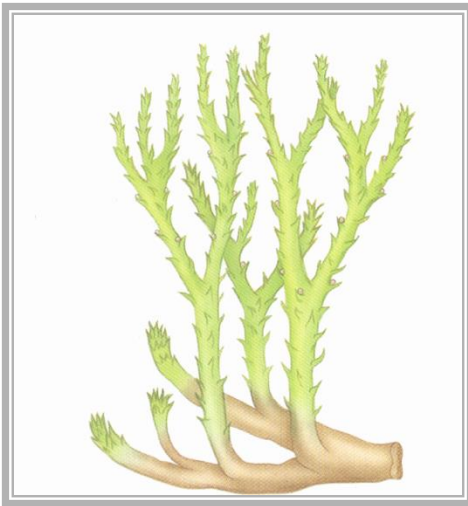
*SAWDONIA*

# LYCOPHYTE EVOLUTION

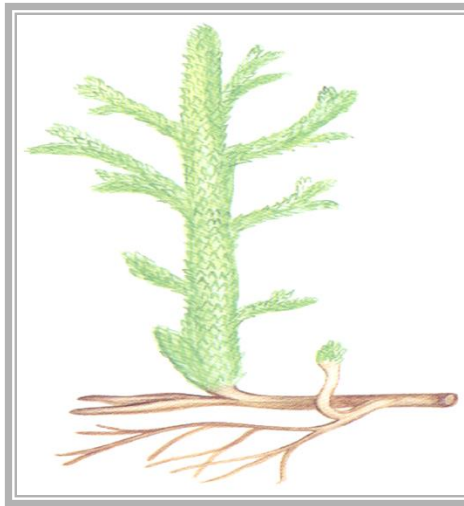


**ZOSTEROPHYTE**

# LYCOPHYTE EVOLUTION



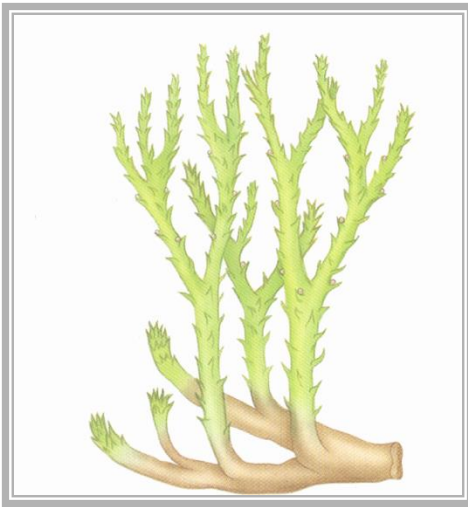
**ZOSTEROPHYTE**



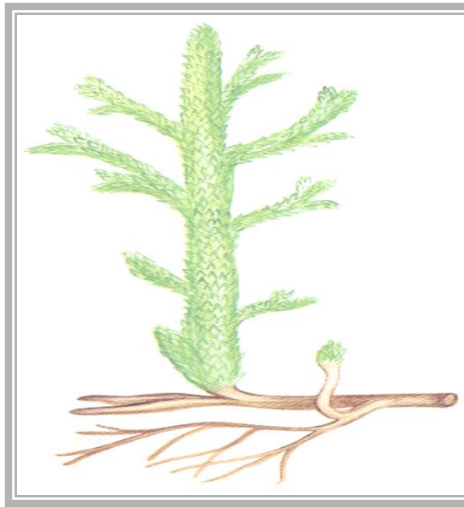
**ASTEROXYLON**



# LYCOPHYTE EVOLUTION

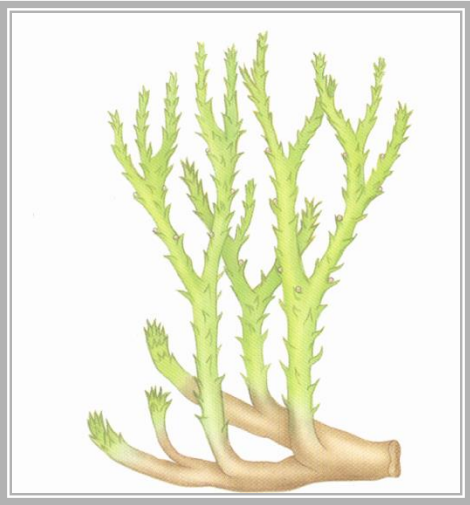


**ZOSTEROPHYTE**

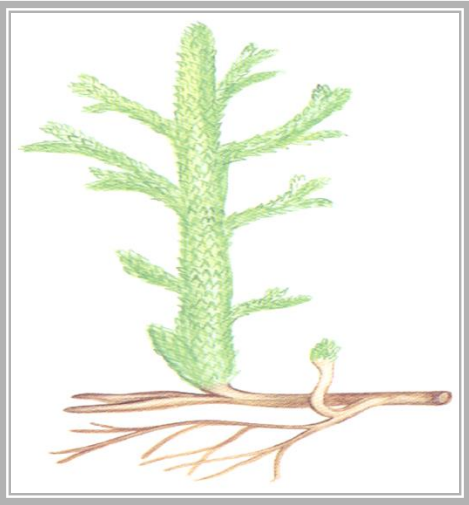


**ZOSTEROPHYTE**

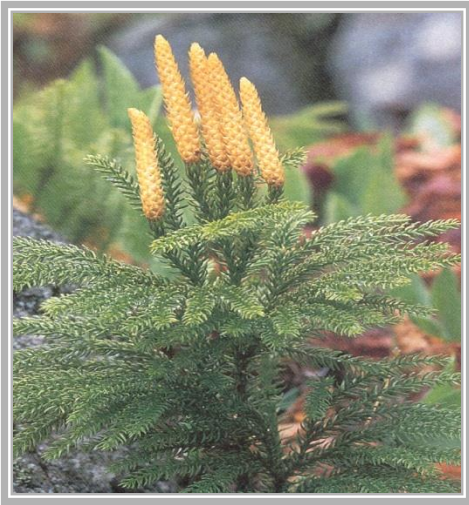
# LYCOPHYTE EVOLUTION



**ZOSTEROPHYTE**



**ZOSTEROPHYTE**



**LYCOPHYTE**



**EXTANT  
PHYLUM**

**PHYLUM  
LYCOPODIOPHYTA**

**EXTANT  
PHYLUM**



# SYNONYMS



**LYCOPHYTA**

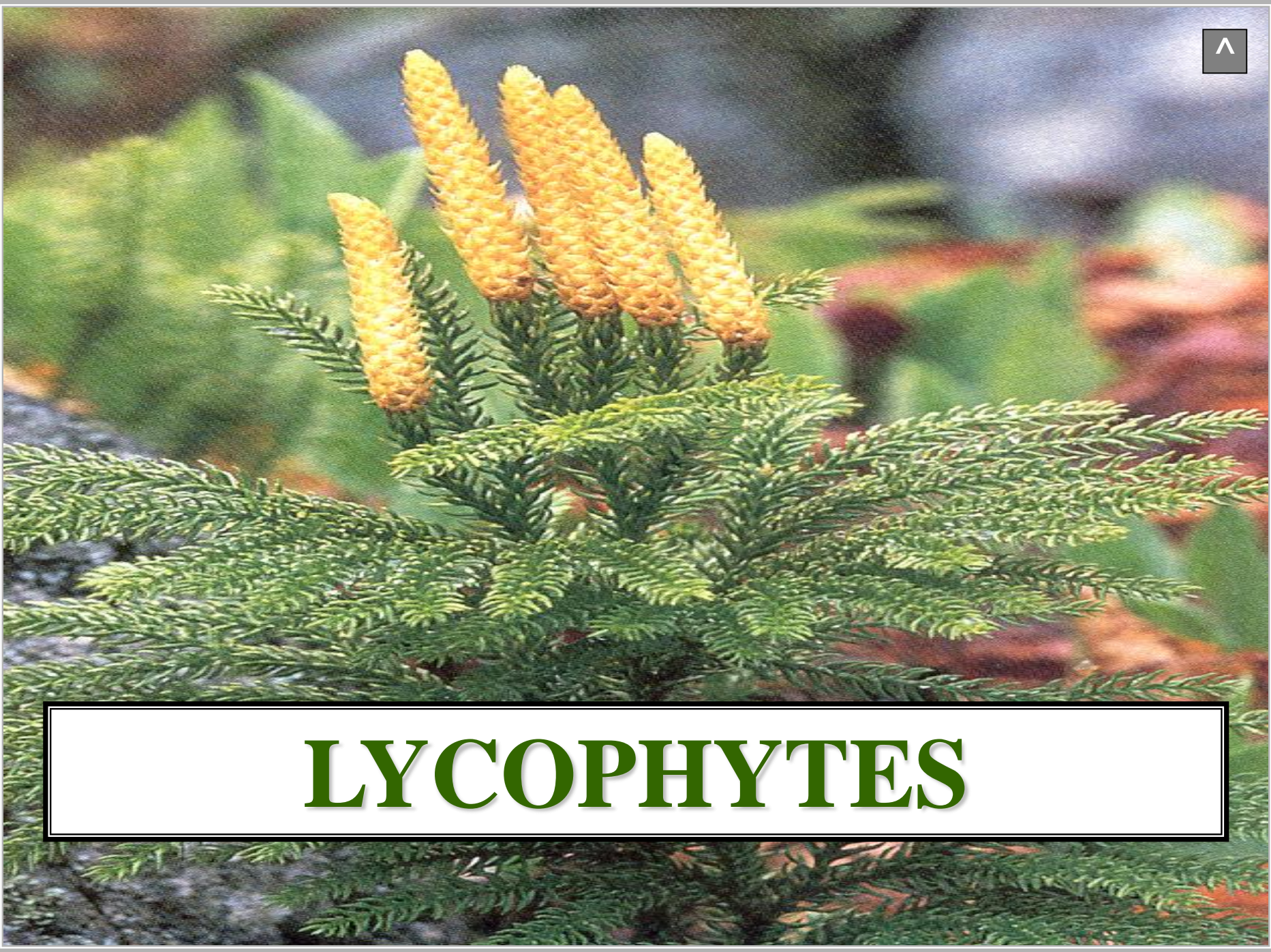


A close-up photograph of a plant's reproductive structures. The image shows several upright, yellowish, cone-shaped microphylls (strobili) emerging from a cluster of green, needle-like leaves. The background is blurred, showing more green foliage and some reddish-brown ground.

# MICROPHYLLOPHYTA



# COMMON NAME



# LYCOPHYTES



# DIVERSITY



**~1,200 SPECIES**

**EARTH**





**~15 GENERA**

**EARTH**





**LYCOPODIOPHYTA**  
**MINOR**  
**COMPONENT**  
**EXTANT FLORA**

**EARTH**

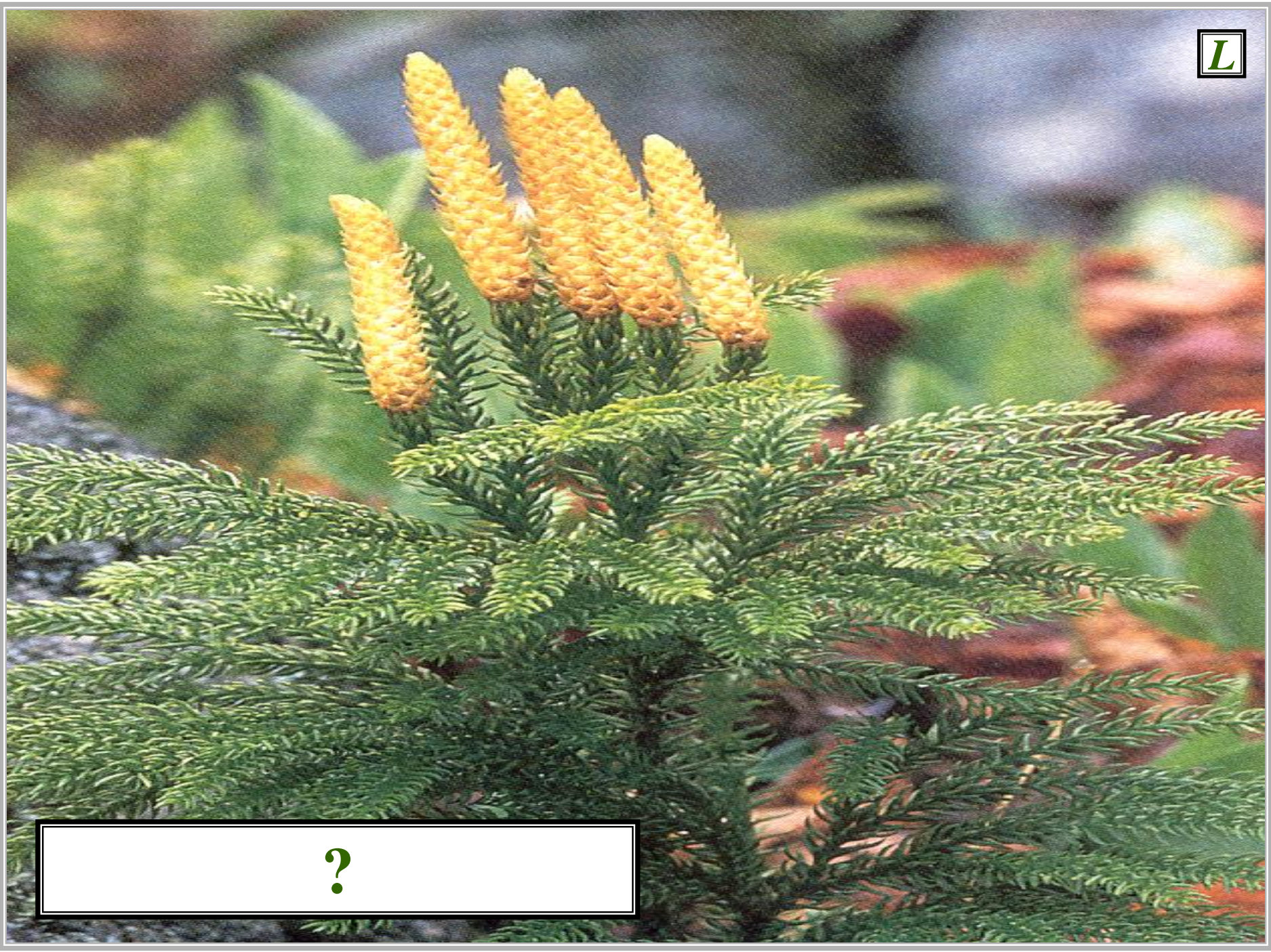




# REPRESENTATIVE GENERA

L

?







***LYCOPODIUM***



S

?







***SELAGINELLA***

# **DISTRIBUTION**



T

**TEMPERATE**

**EARTH**



A satellite view of Earth showing the tropical region. The image displays the Earth's curvature, with the blue oceans and white clouds of the tropics. A large white rectangular box with a black border is centered horizontally across the middle of the image, containing the word "TROPICAL" in a bold, black, serif font.

**TROPICAL**

A satellite view of Earth showing the tropical region. The image displays the Earth's curvature, with the blue oceans and white clouds of the tropics. A large white rectangular box with a black border is centered horizontally across the middle of the image, containing the word "TROPICAL" in a bold, black, serif font. Below this, a smaller white rectangular box with a black border is centered horizontally, containing the word "EARTH" in a bold, blue, serif font.

**EARTH**



A high-resolution satellite image of Earth from space, showing the Western Hemisphere. The top half shows the Americas, with North America in shades of brown and orange, and South America in green and brown. The bottom half shows the Atlantic and Pacific Oceans, with prominent white and gray cloud patterns, including large cyclones. The Earth's curvature is visible against the black background of space.

# **DOMINATELY TROPICAL**

**EARTH**

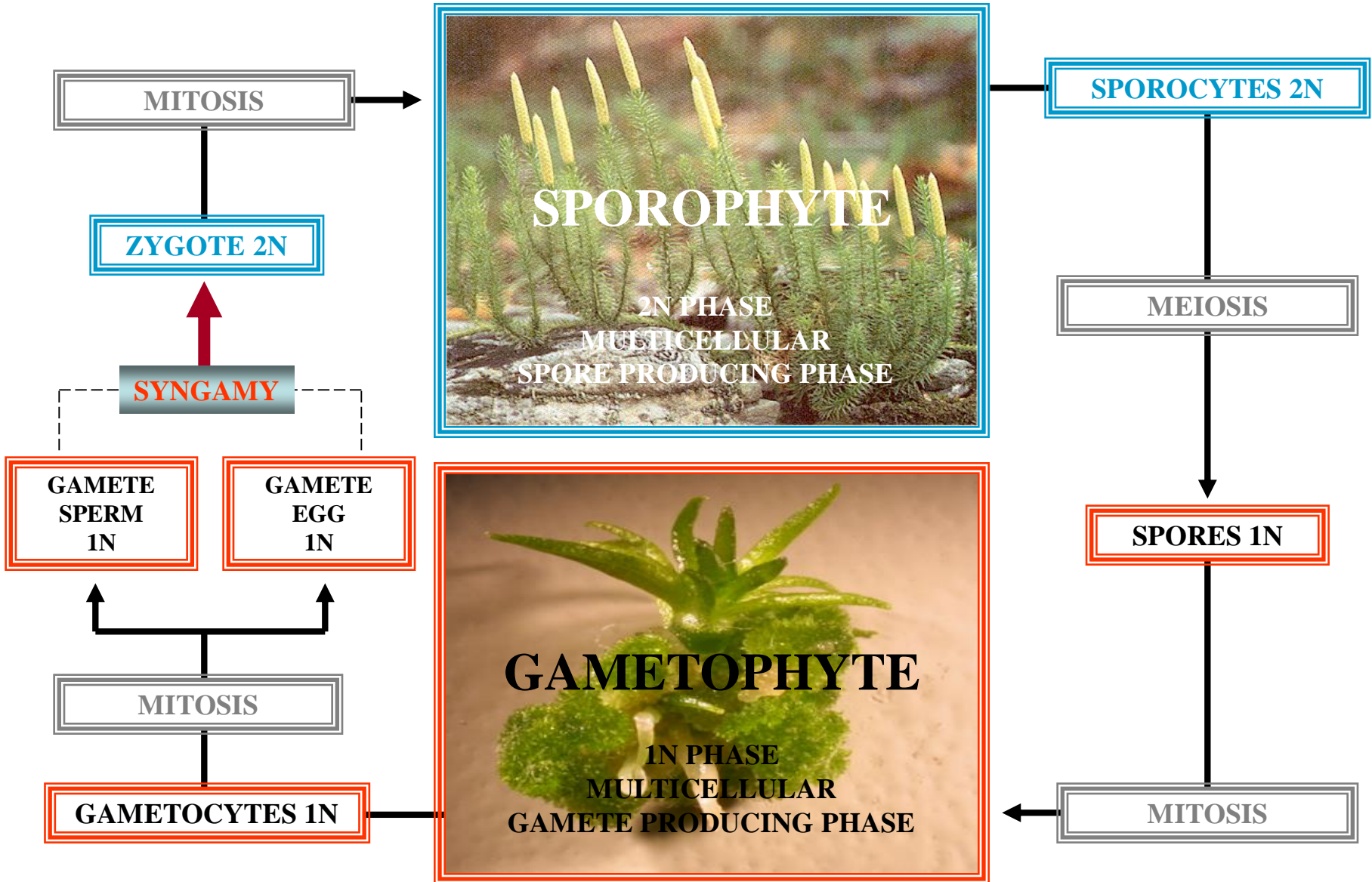




# GENERAL CHARACTERS

# LYCOPODIOPHYTA

## LIFE CYCLE



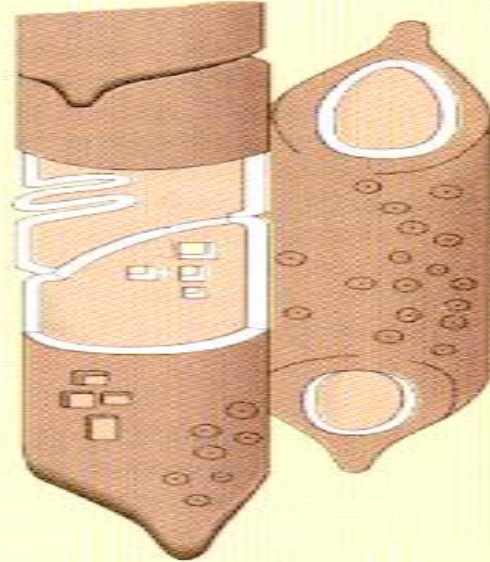
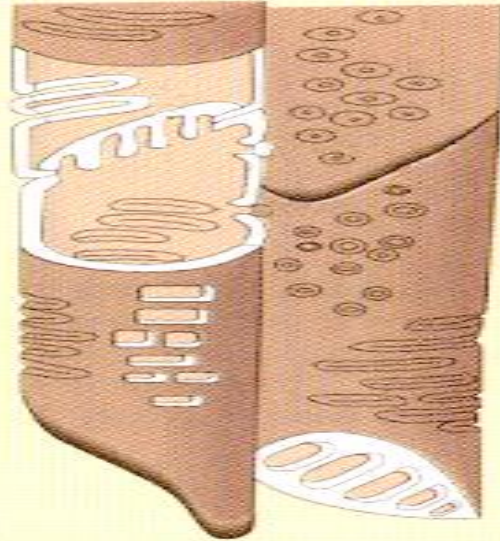
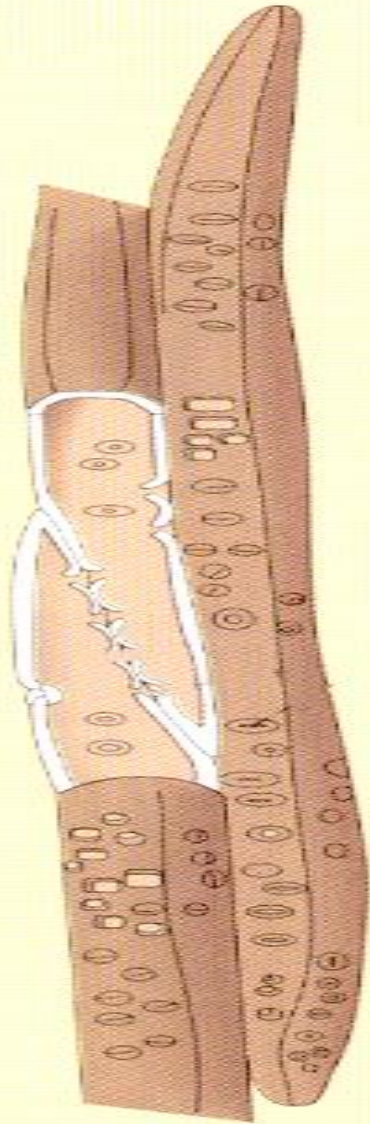




# SPOROPHYTE CHARACTERS

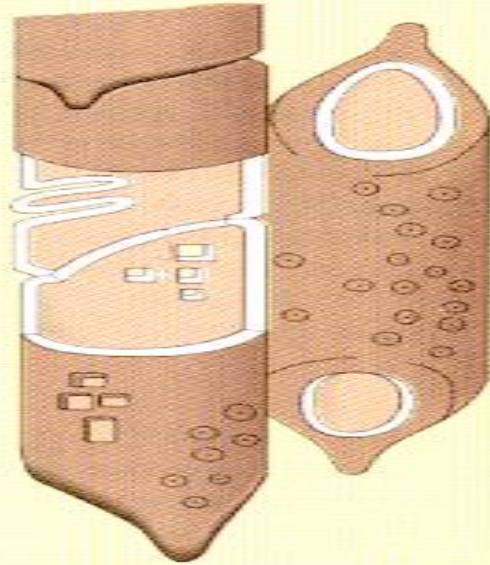
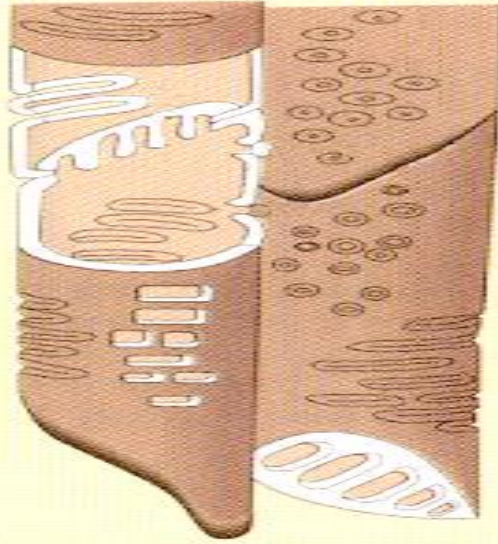
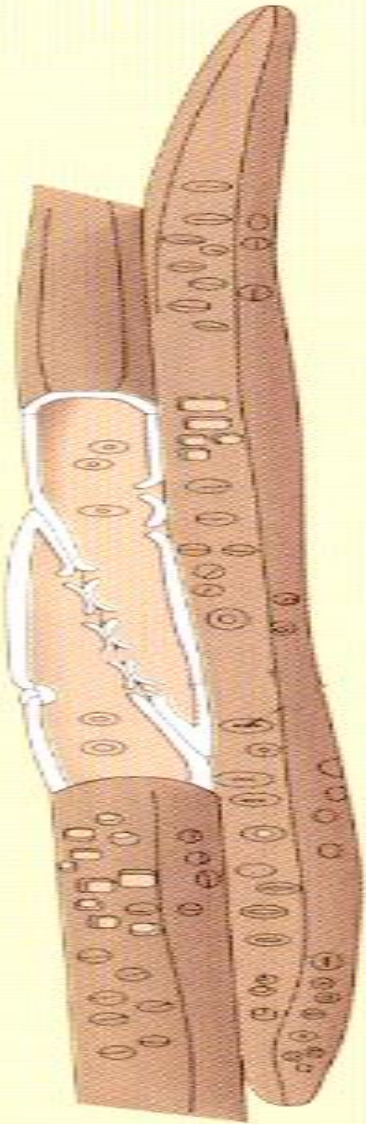


# XYLEM



**XYLEM CELLS**





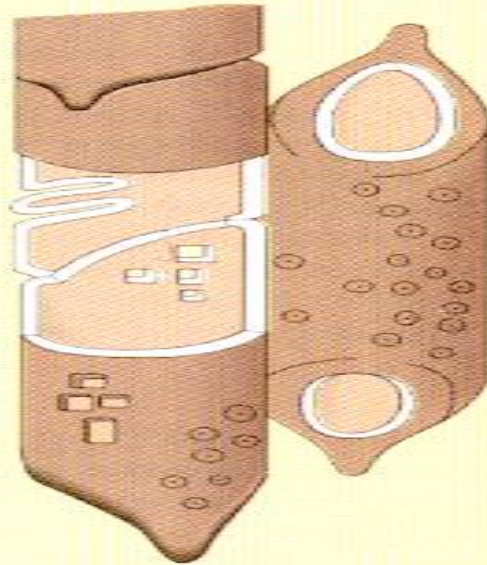
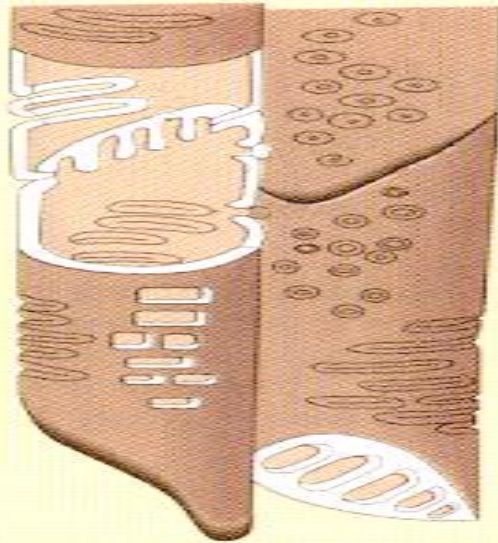
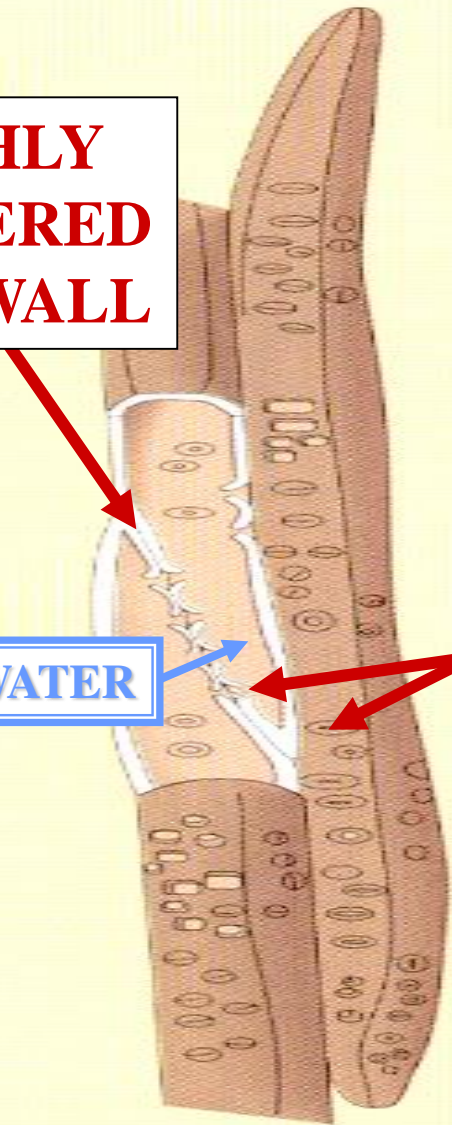
**TRACHEARY ELEMENTS**

**HIGHLY  
TAPPED  
END WALL**

**WATER**

**PITS**

**?**



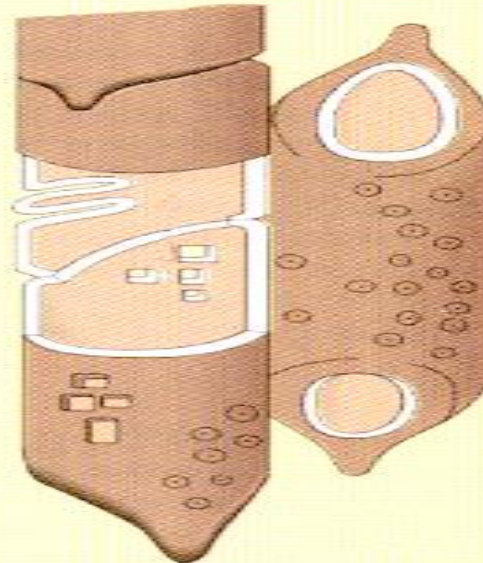
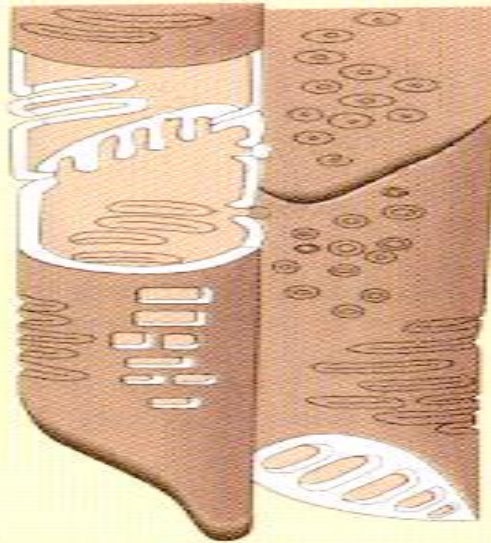
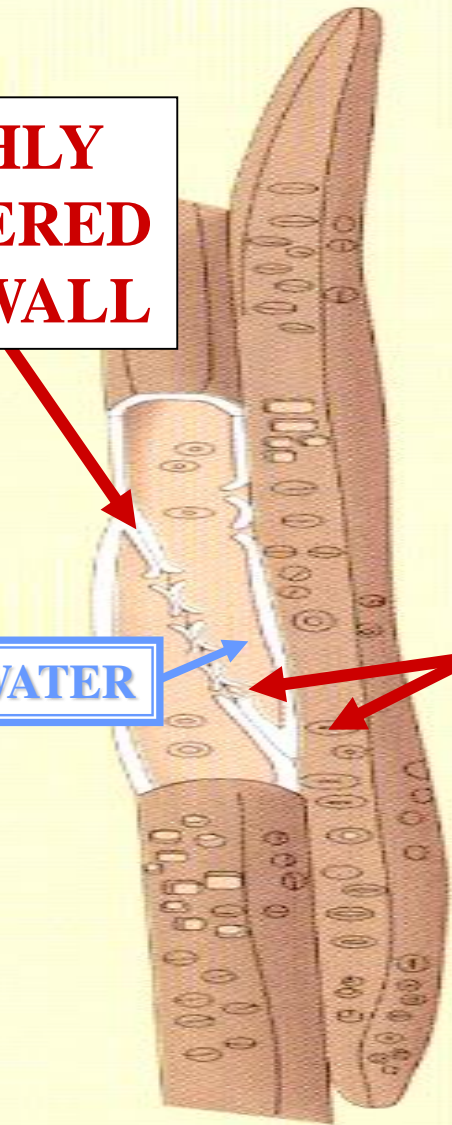


**HIGHLY  
TAPPED  
END WALL**

**WATER**

**PITS**

**TRACHEID**





**HIGHLY  
TAPPED  
END WALL**

**LESS  
TAPPED  
END WALL**

?

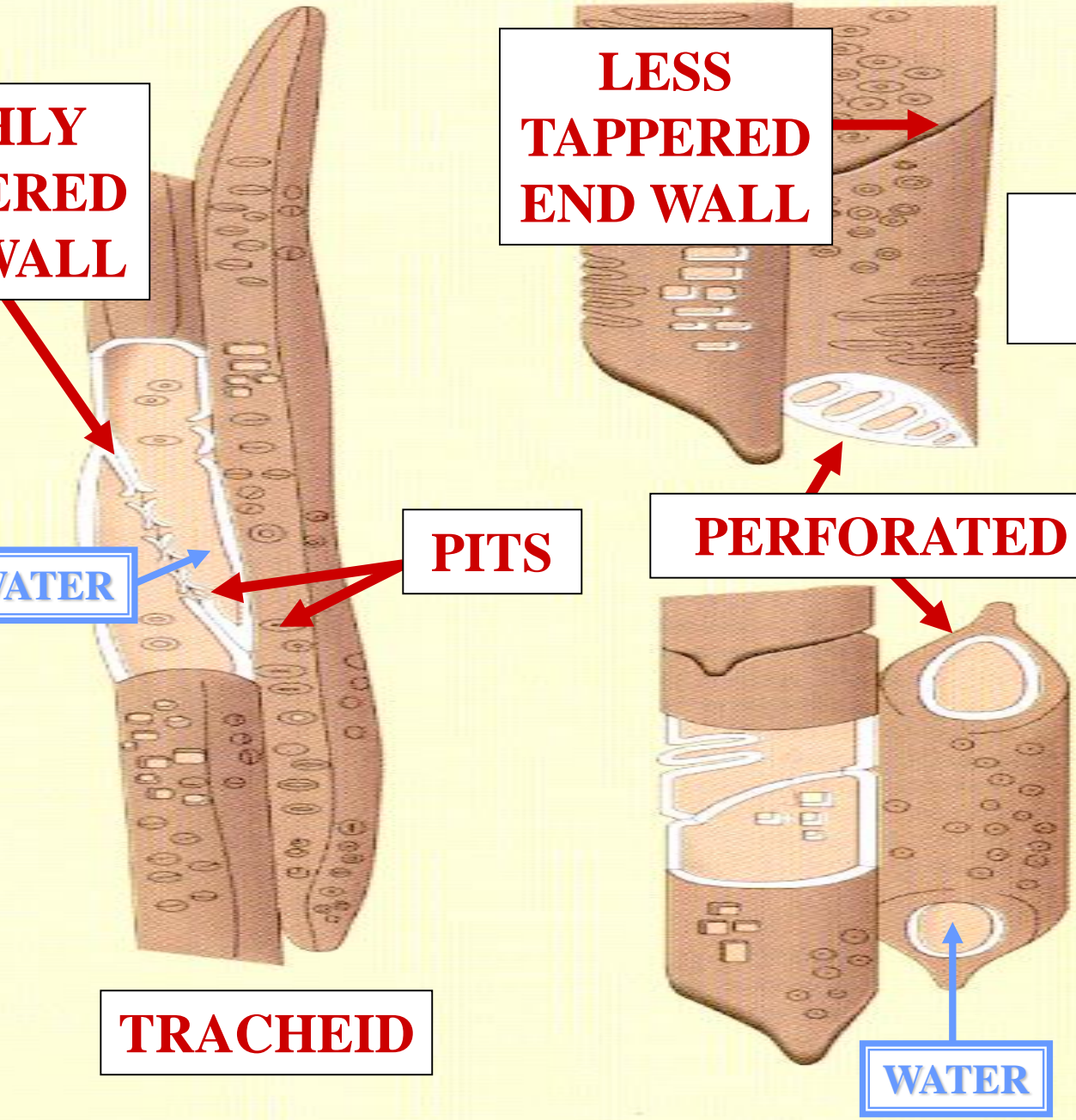
**WATER**

**PITS**

**PERFORATED PLATE**

**TRACHEID**

**WATER**





**T**

**HIGHLY  
TAPPED  
END WALL**

**LESS  
TAPPED  
END WALL**

**VESSEL  
MEMBER**

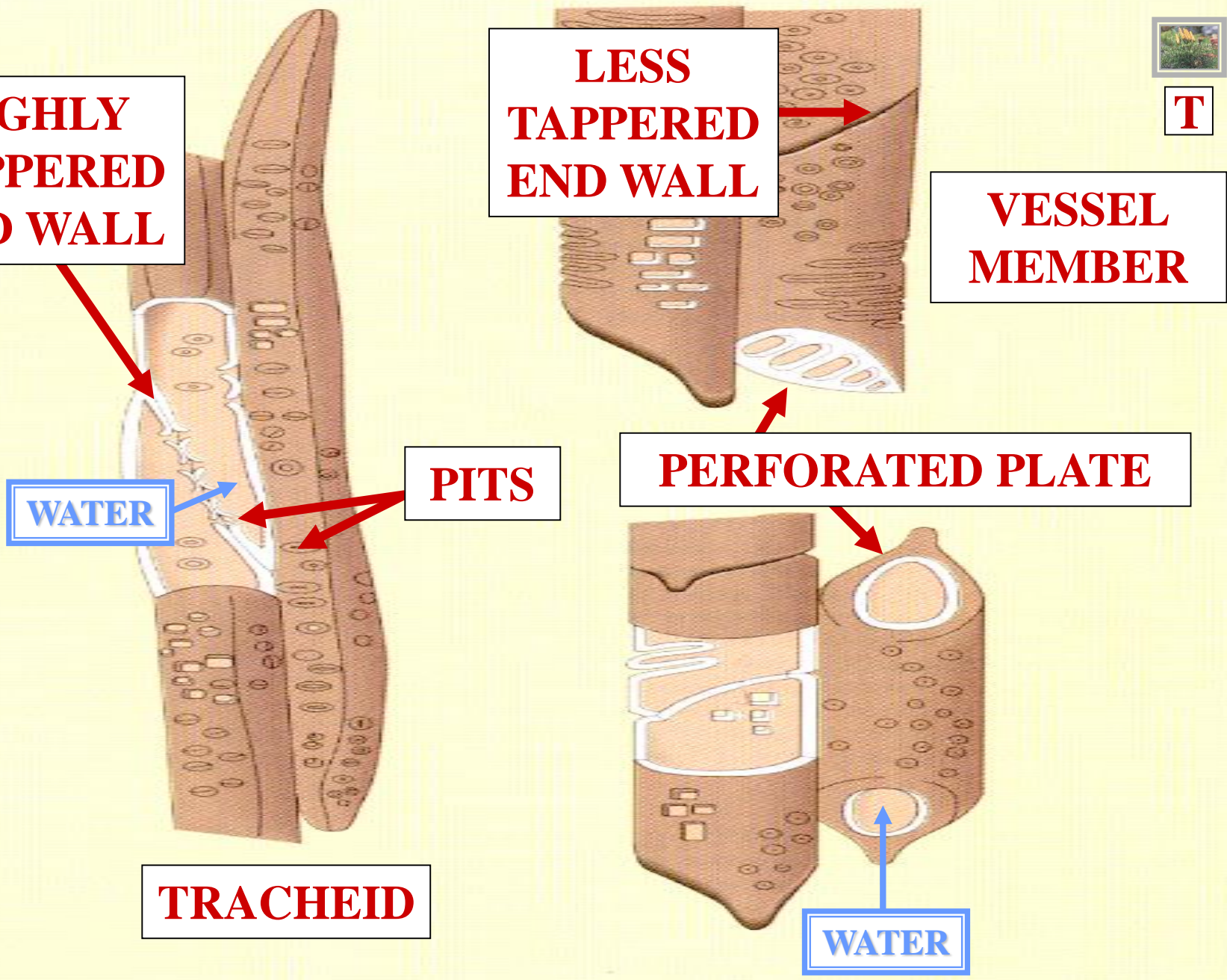
**WATER**

**PITS**

**PERFORATED PLATE**

**TRACHEID**

**WATER**







**T**

**V**

**TRACHEIDS**

*LYCOPODIUM*





**TRACHEIDS  
&  
VESSEL MEMBERS**

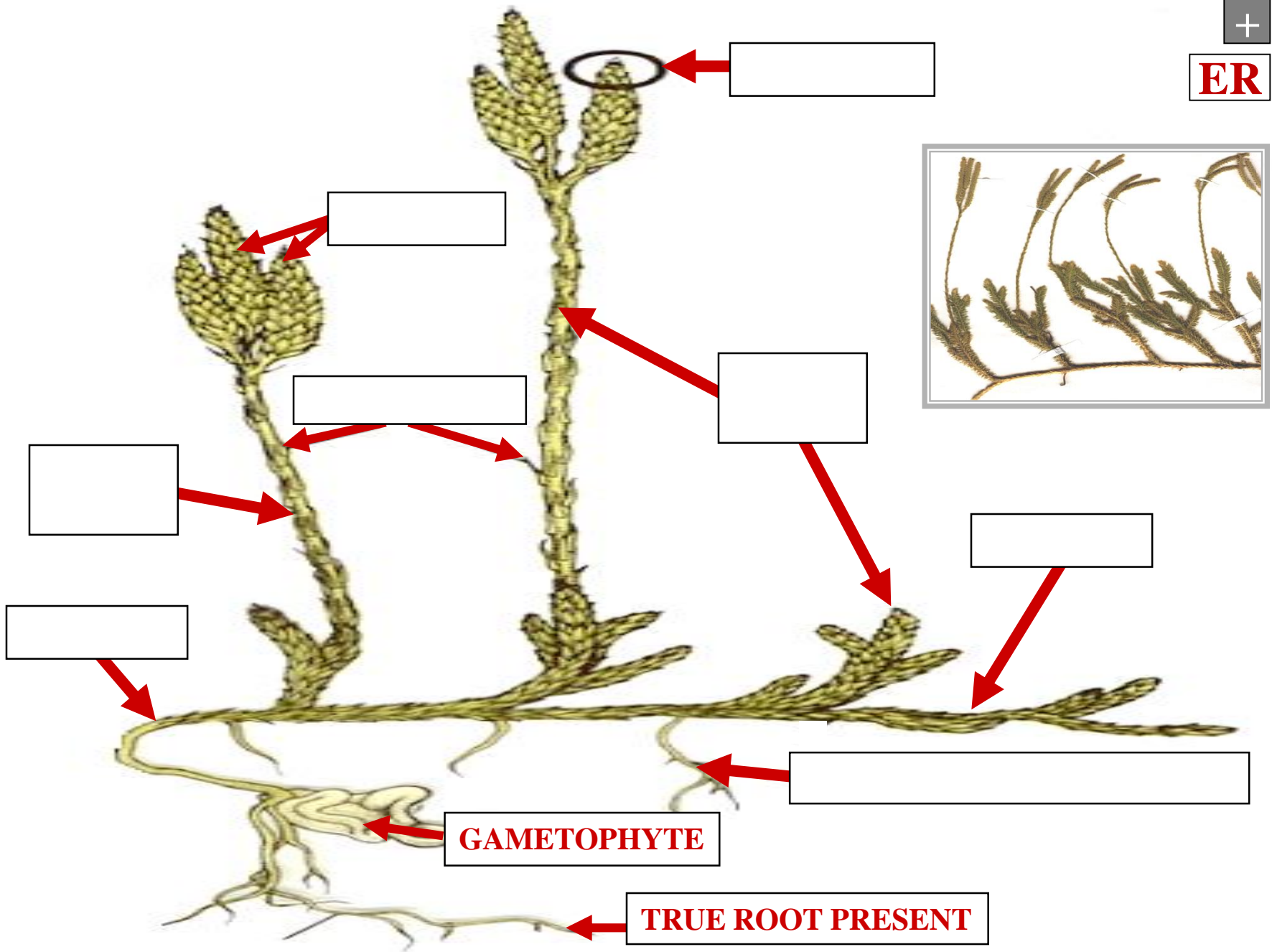
***SELAGINELLA***



**ROOT**



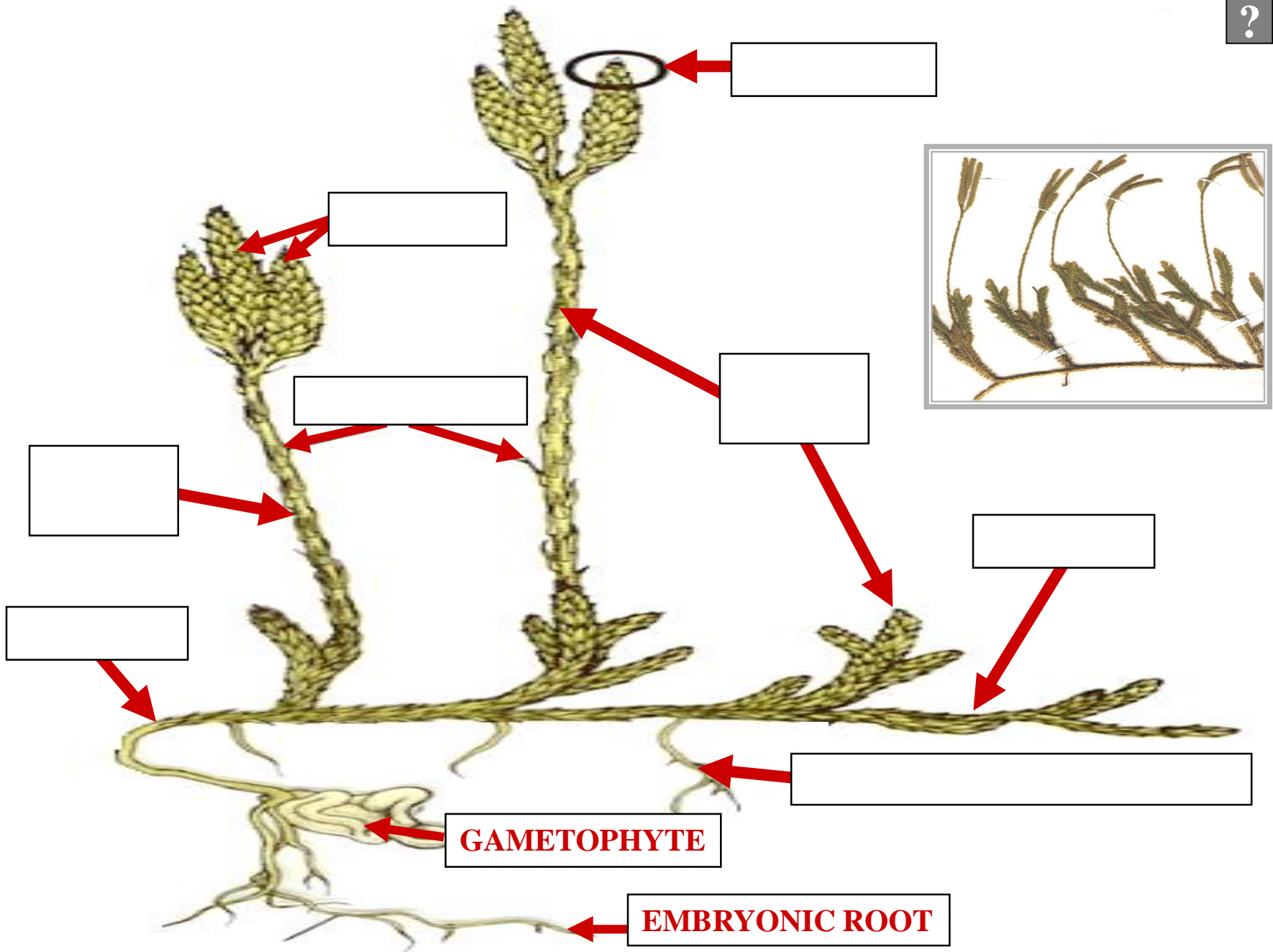
**ER**



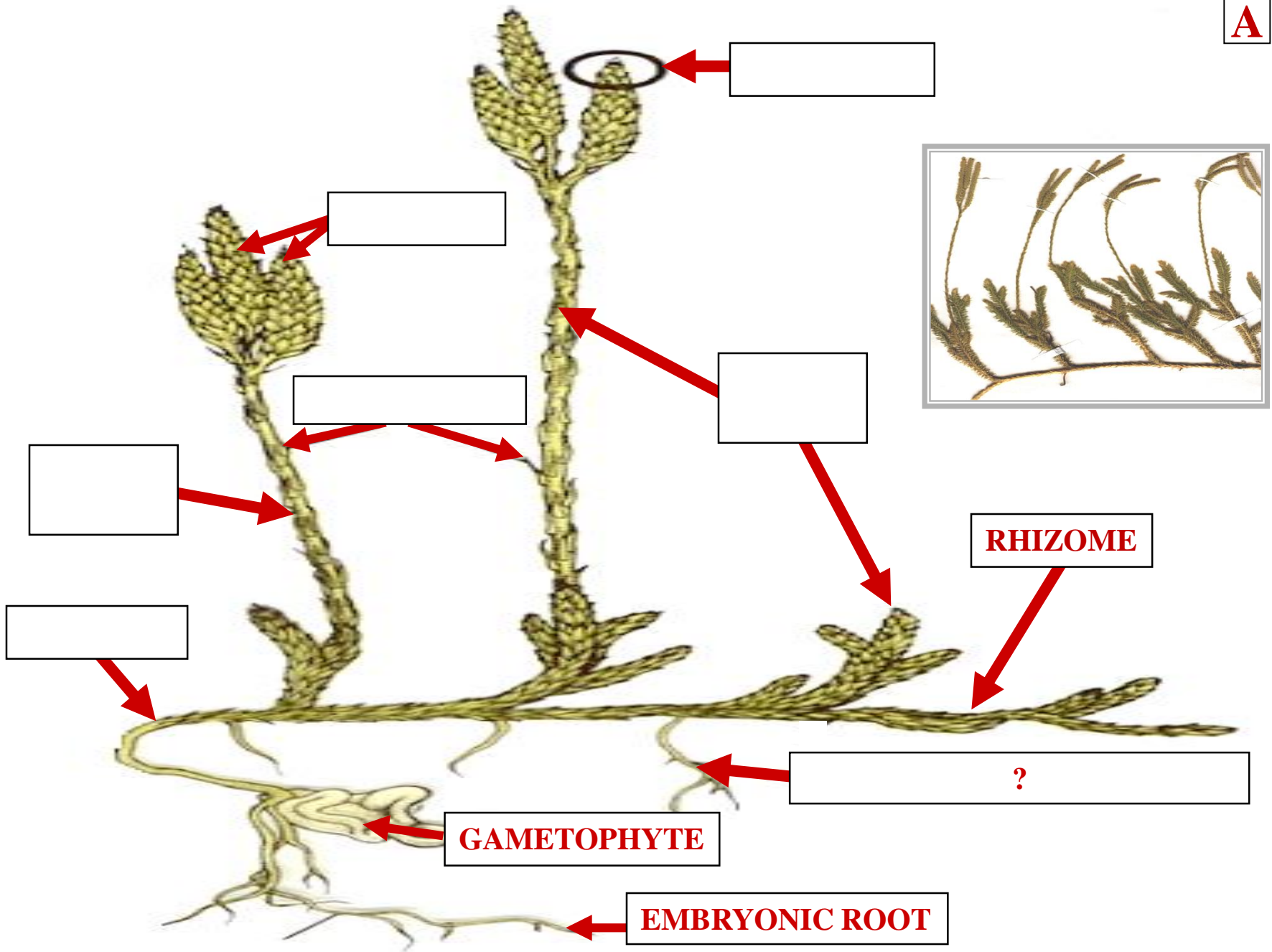
**GAMETOPHYTE**

**TRUE ROOT PRESENT**





A



[Empty box]

[Empty box]

[Empty box]

[Empty box]

[Empty box]

**RHIZOME**

[Empty box]

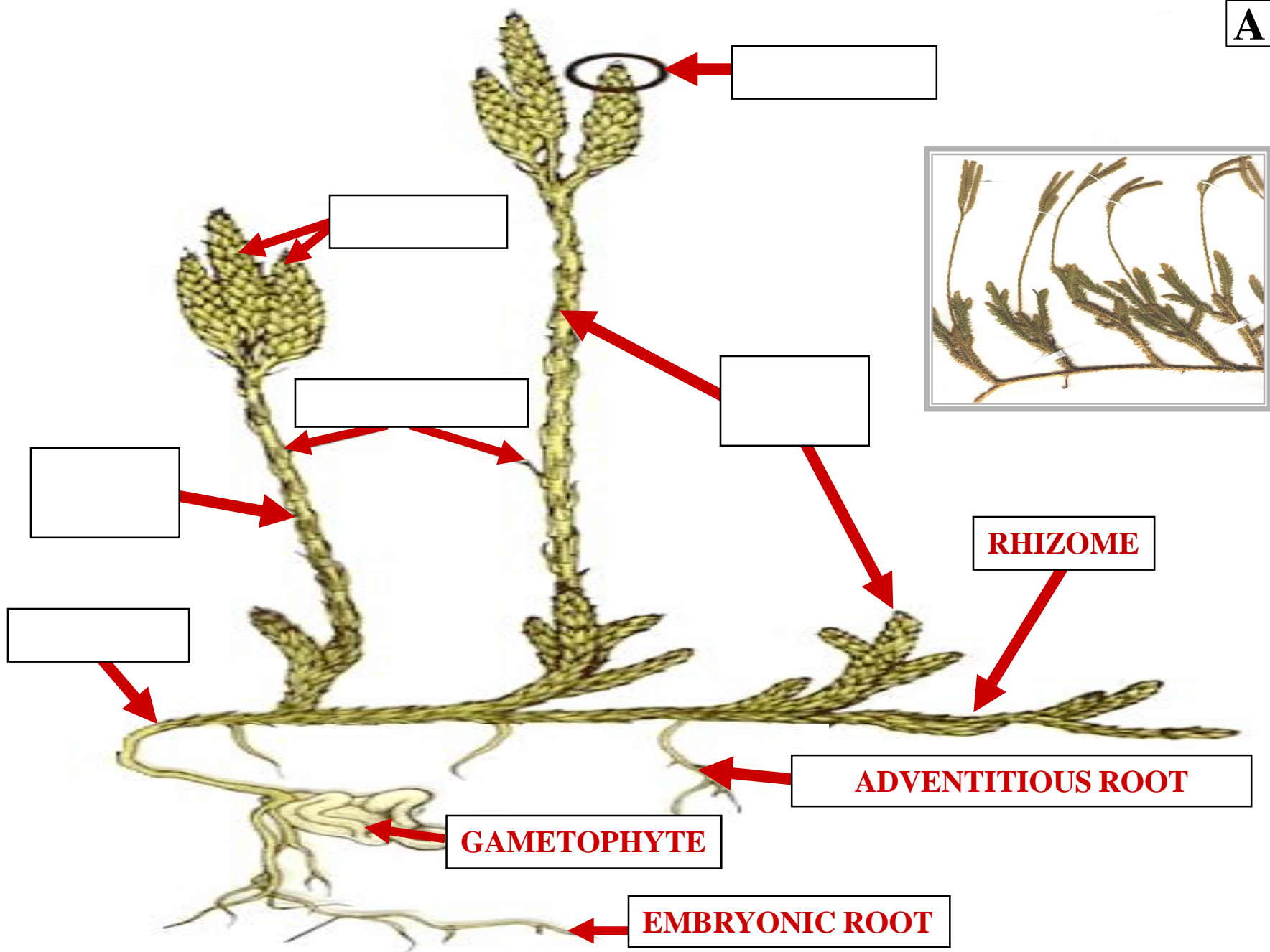
[Empty box with ?]

**GAMETOPHYTE**

**EMBRYONIC ROOT**



A





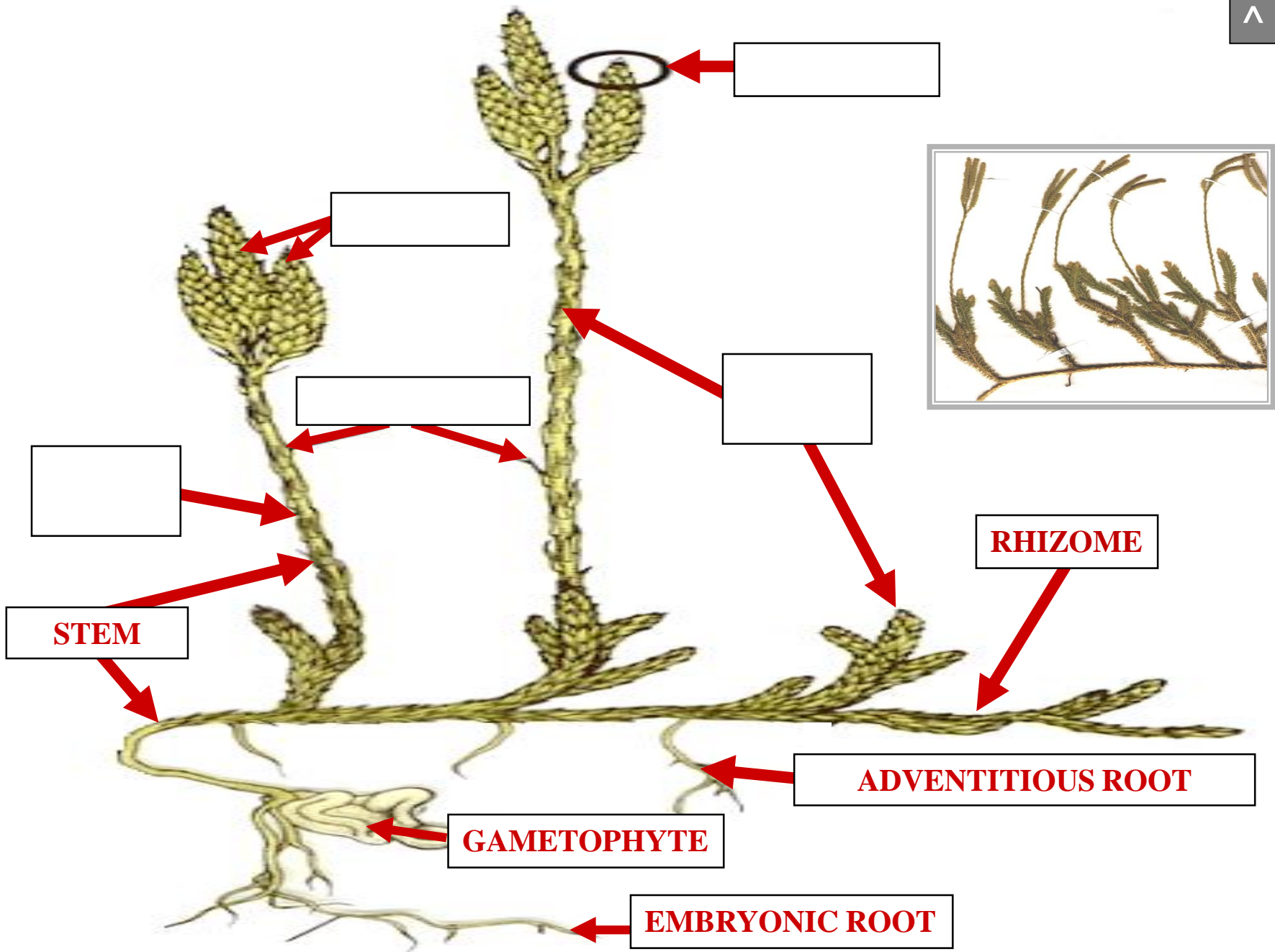
**ADVENTITIOUS  
ROOT**

# **ADVENTITIOUS ROOTS**



**NON-EMBRYONIC ROOT  
DERIVED FROM  
STEM**

**ADVENTITIOUS  
ROOTS**







**STEM**



# STEM ANATOMY

**C**

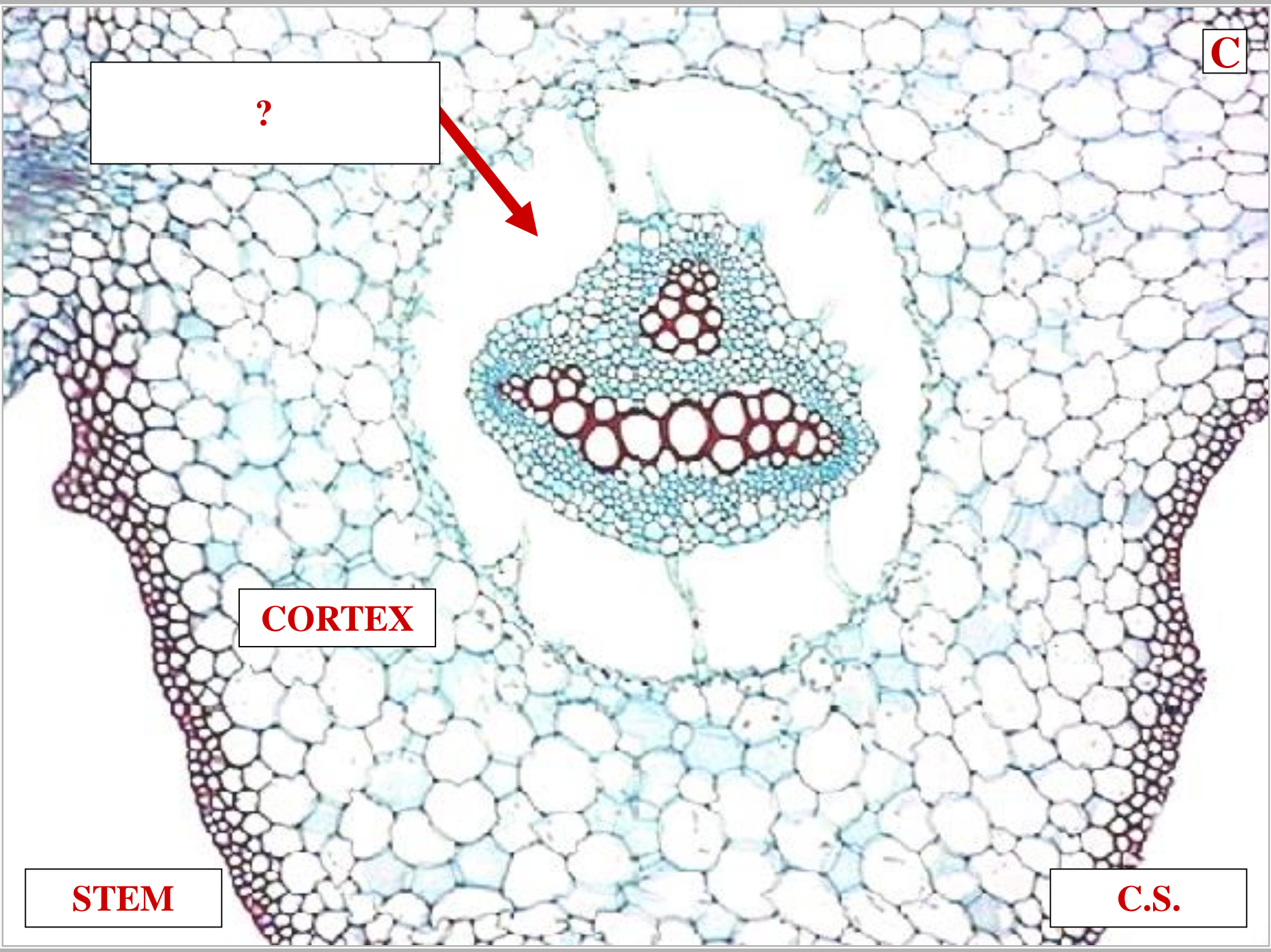
**?**



**CORTEX**

**STEM**

**C.S.**





?

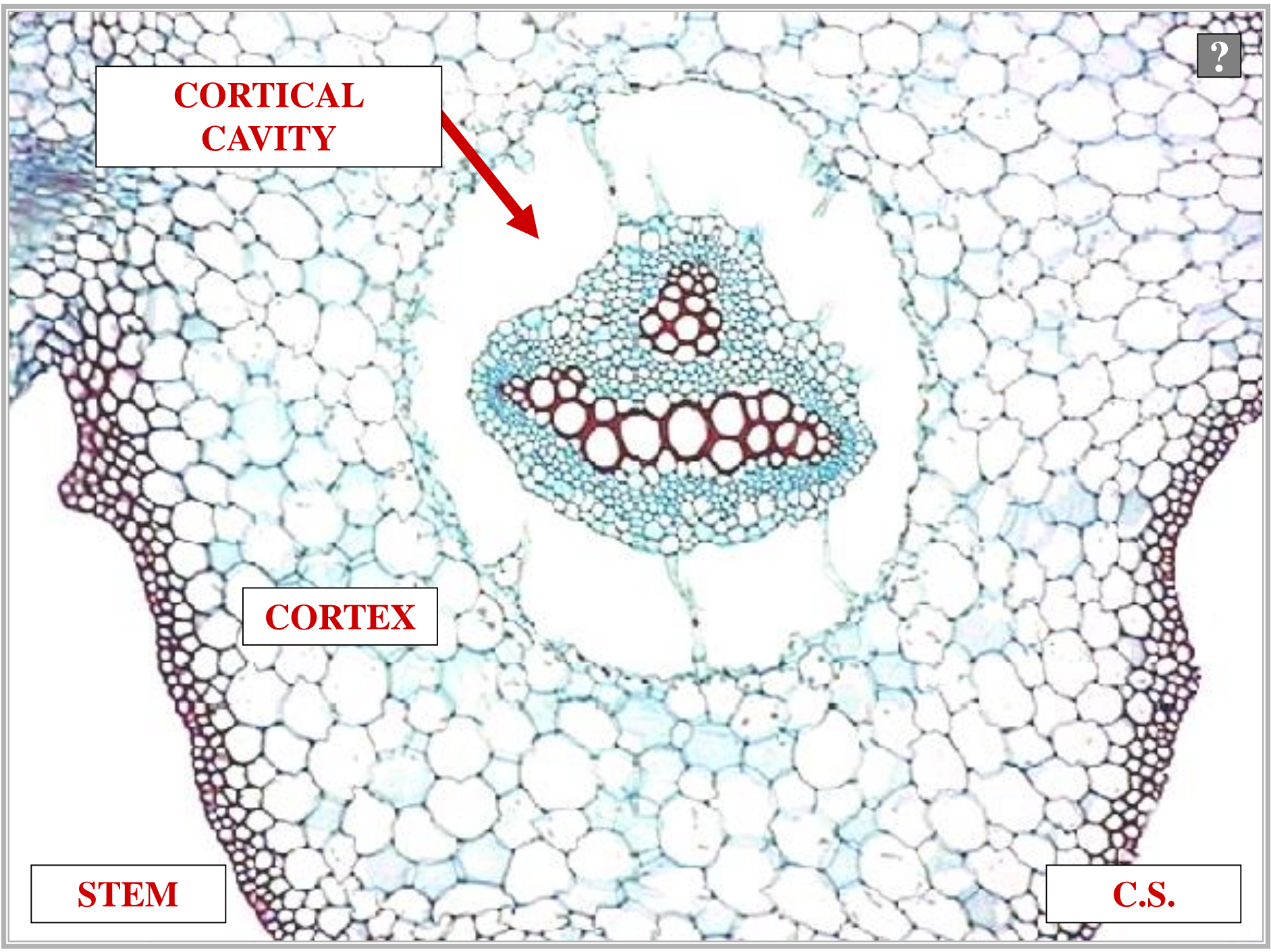
**CORTICAL  
CAVITY**



**CORTEX**

**STEM**

**C.S.**





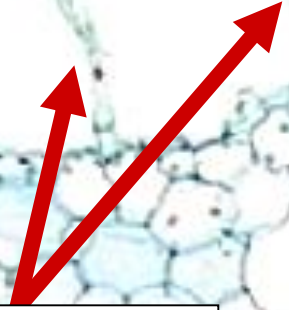
**T**

**CORTICAL  
CAVITY**



**CORTEX**

**?**



**STEM**

**C.S.**

