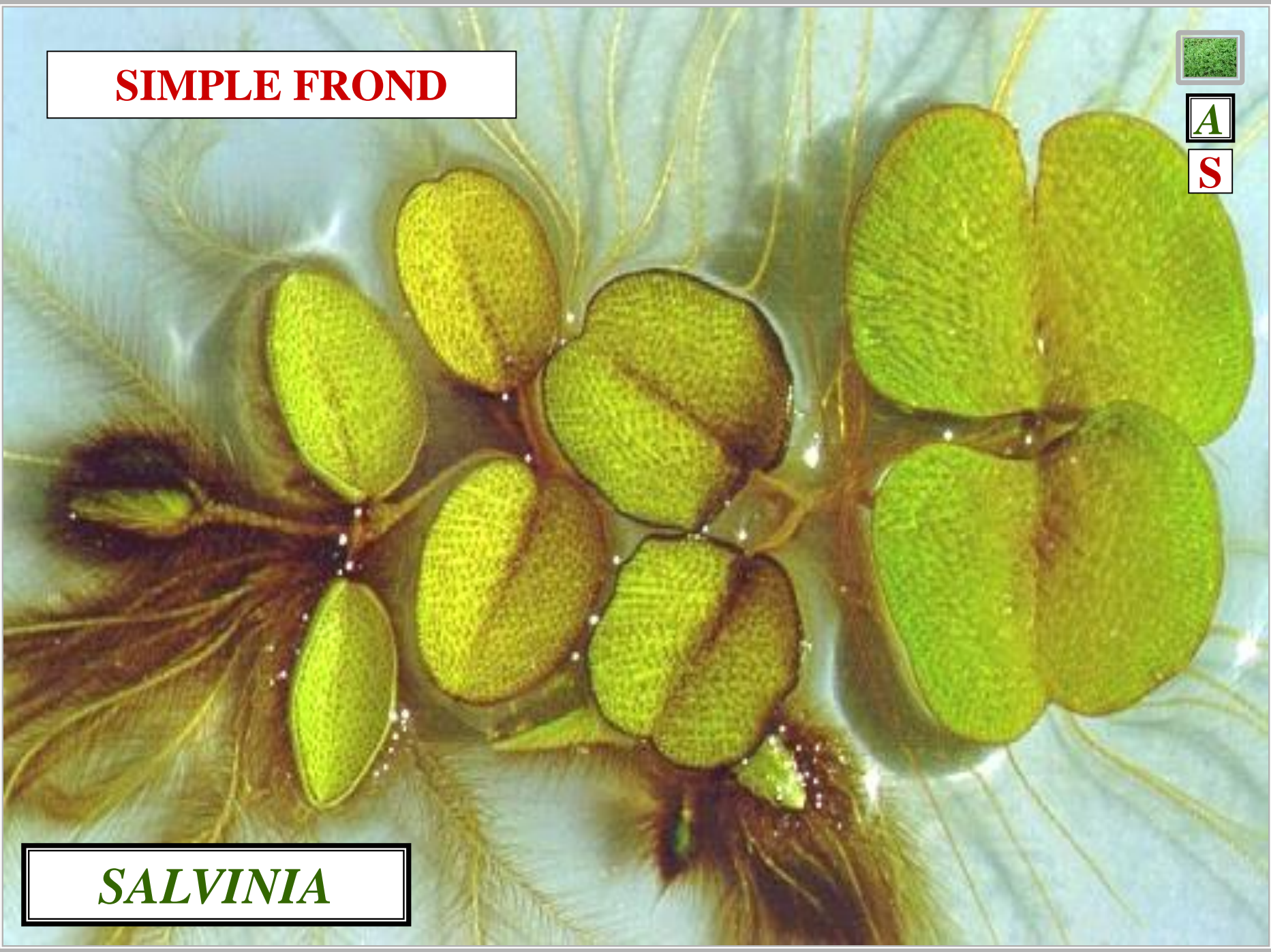




A

S

SIMPLE FROND



SALVINIA

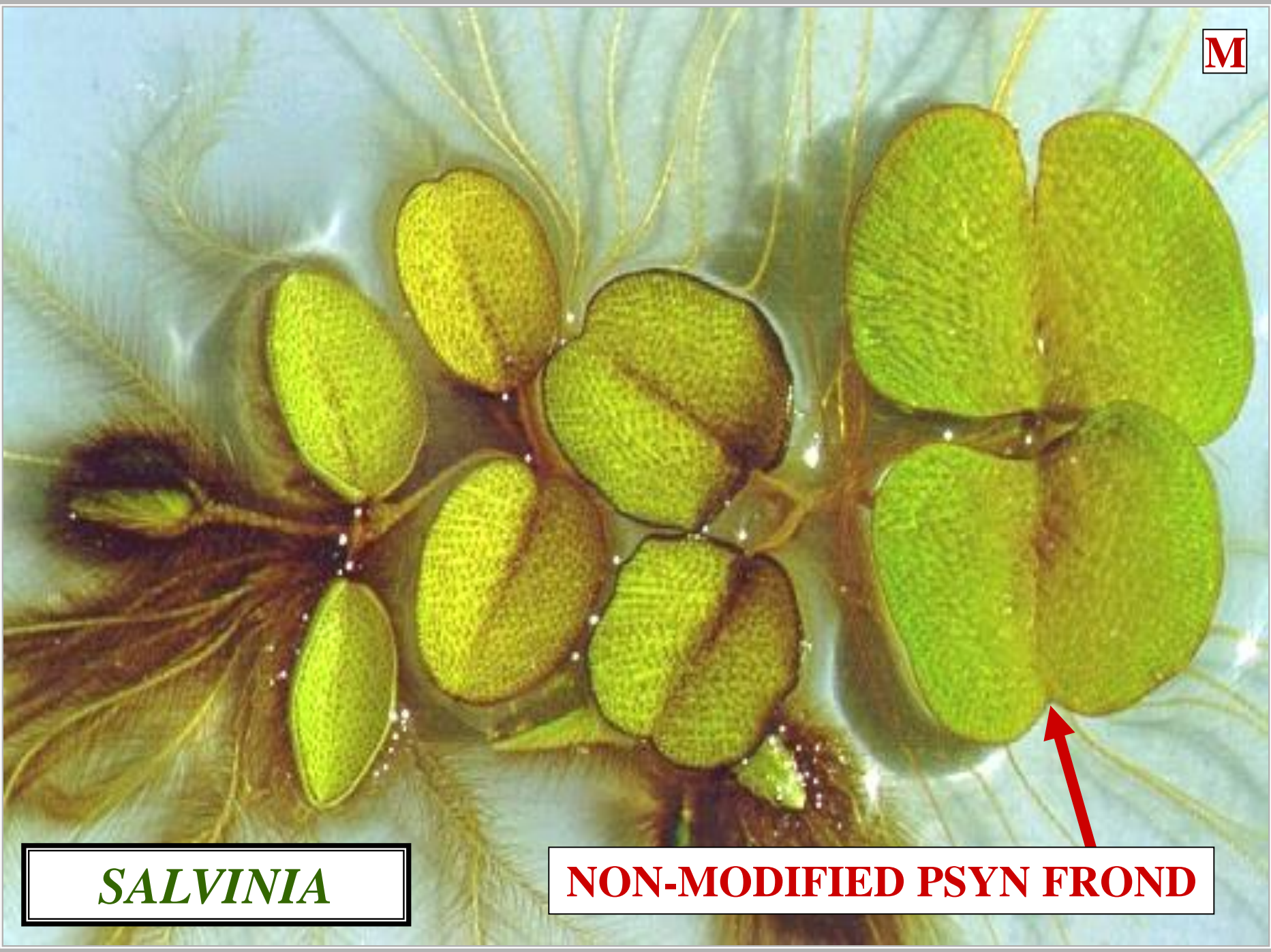


SIMPLE FROND

AZOLLA



MODIFIED SIMPLE FROND

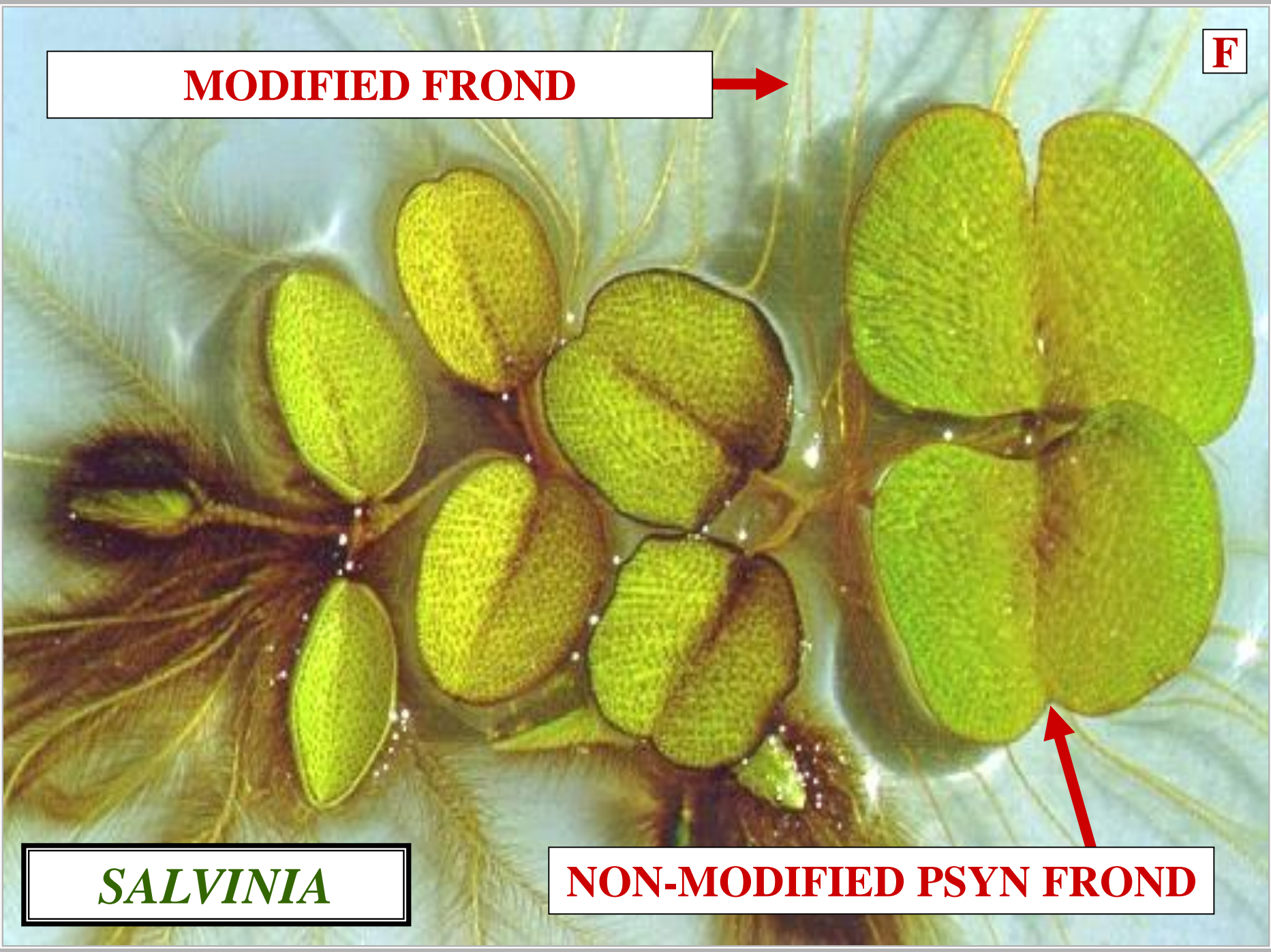


SALVINIA

NON-MODIFIED PSYN FROND

F

MODIFIED FROND



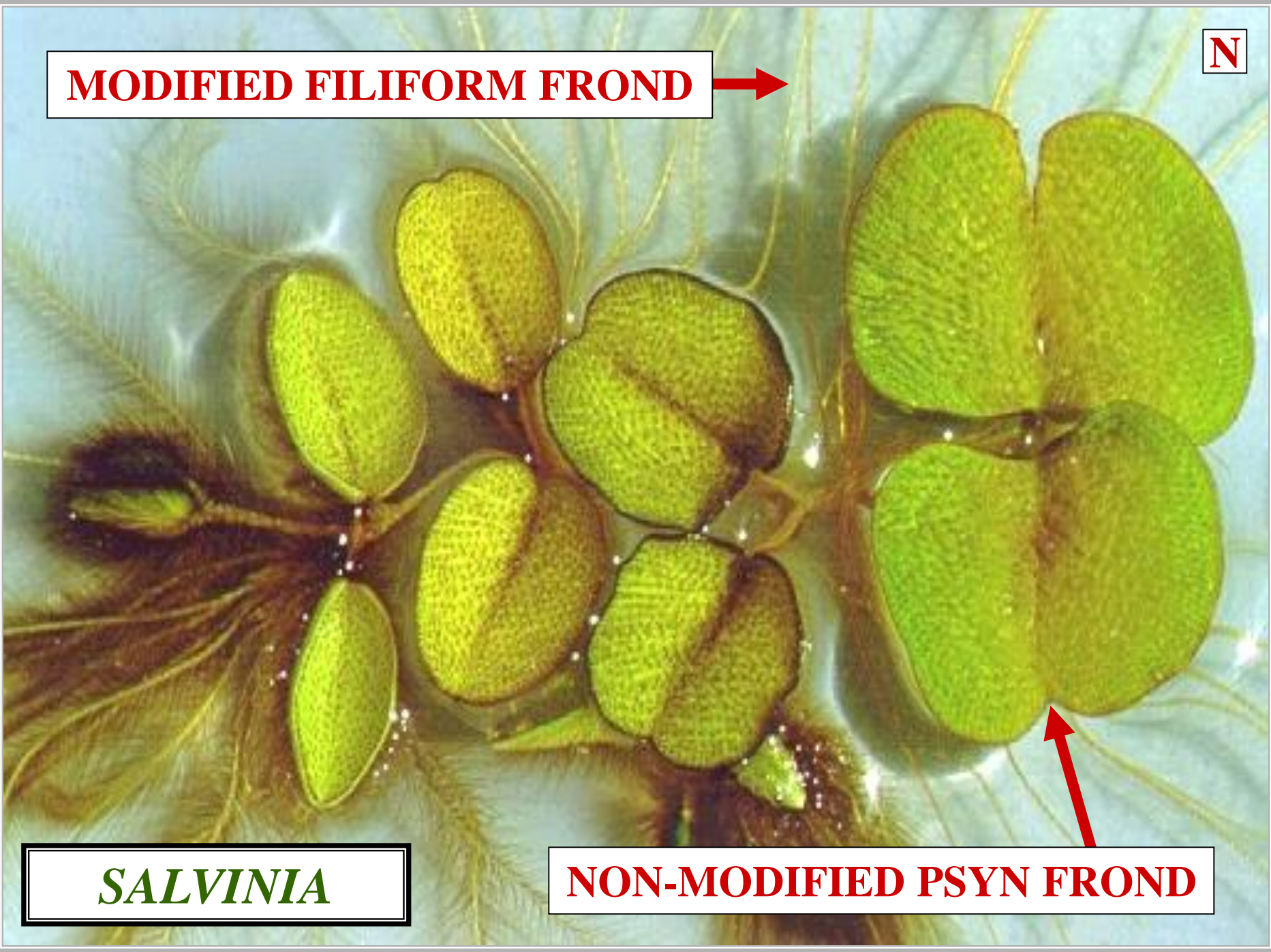
SALVINIA

NON-MODIFIED PSYN FROND



N

MODIFIED FILIFORM FROND →

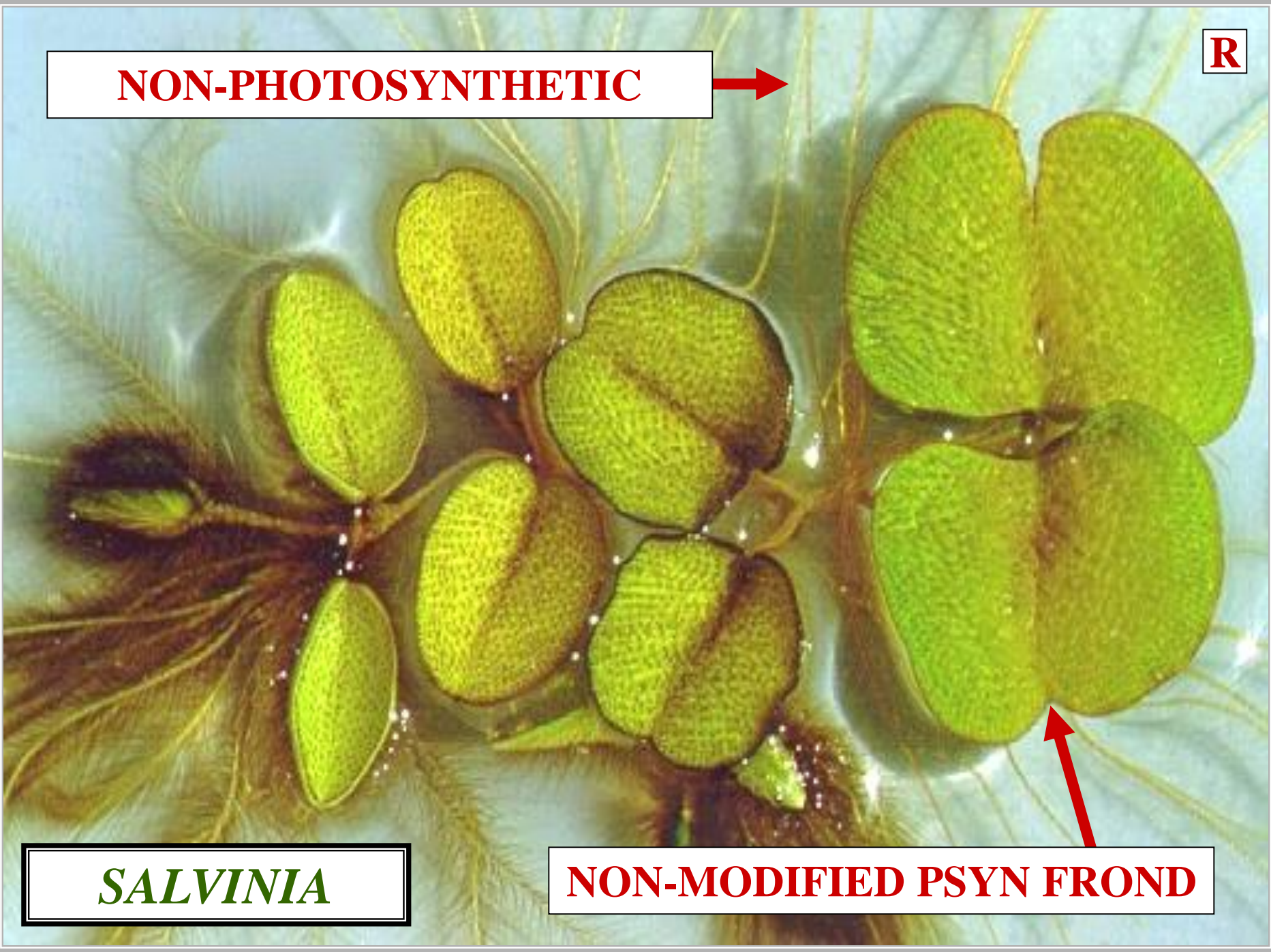


SALVINIA

NON-MODIFIED PSYN FROND ←

R

NON-PHOTOSYNTHETIC →



SALVINIA

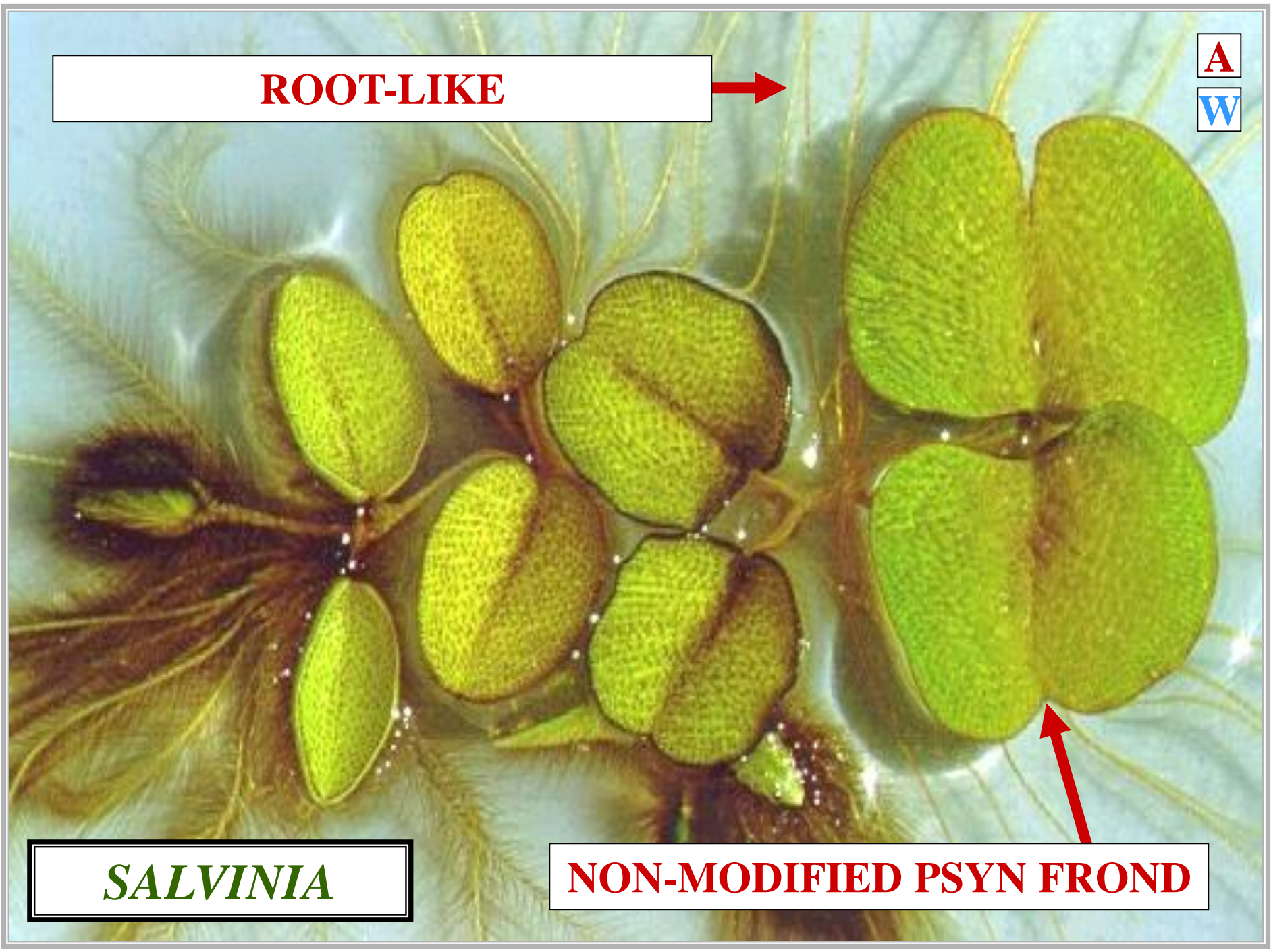
NON-MODIFIED PSYN FROND ←

ROOT-LIKE

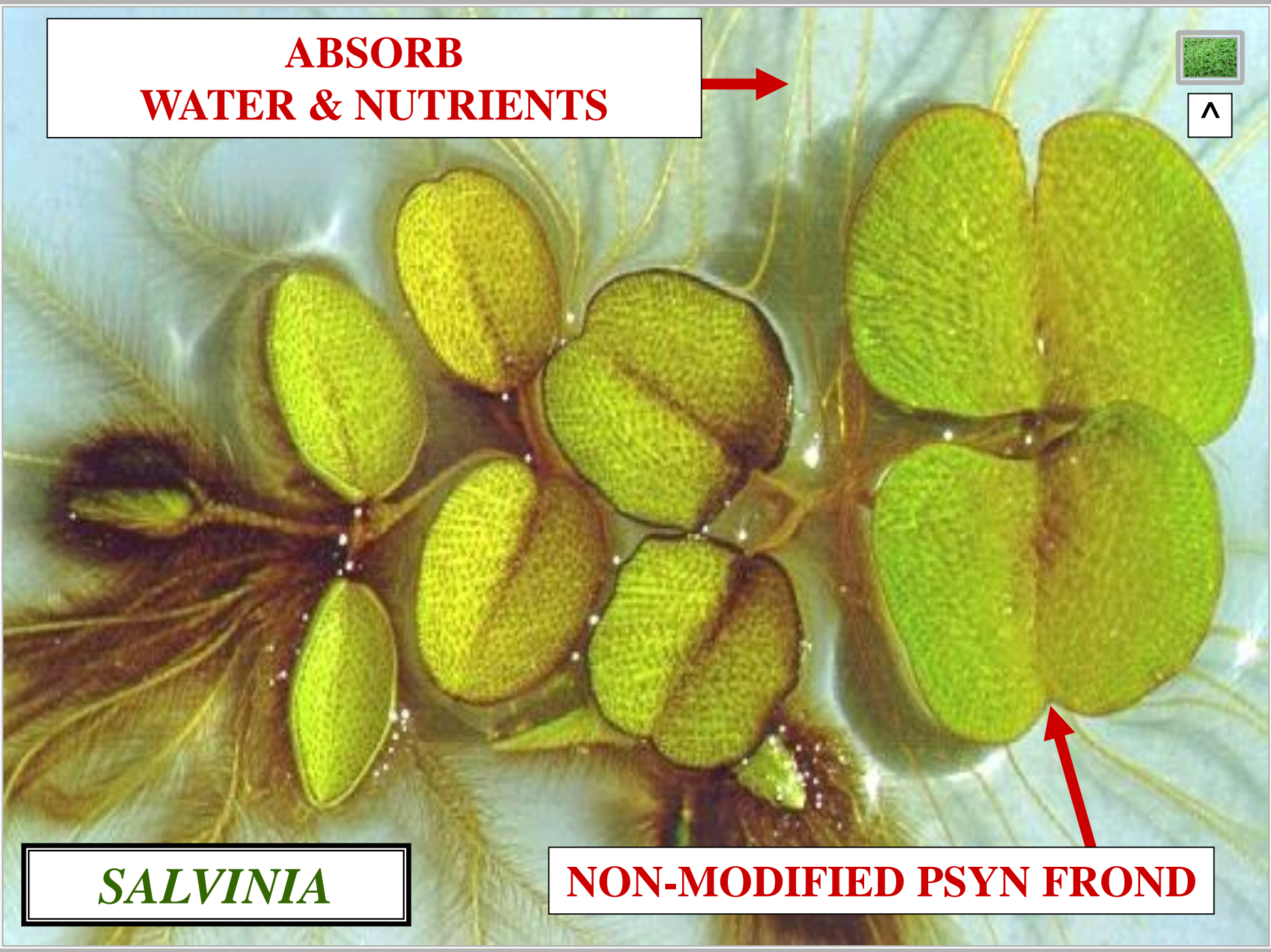
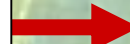


SALVINIA

NON-MODIFIED PSYN FROND



**ABSORB
WATER & NUTRIENTS**

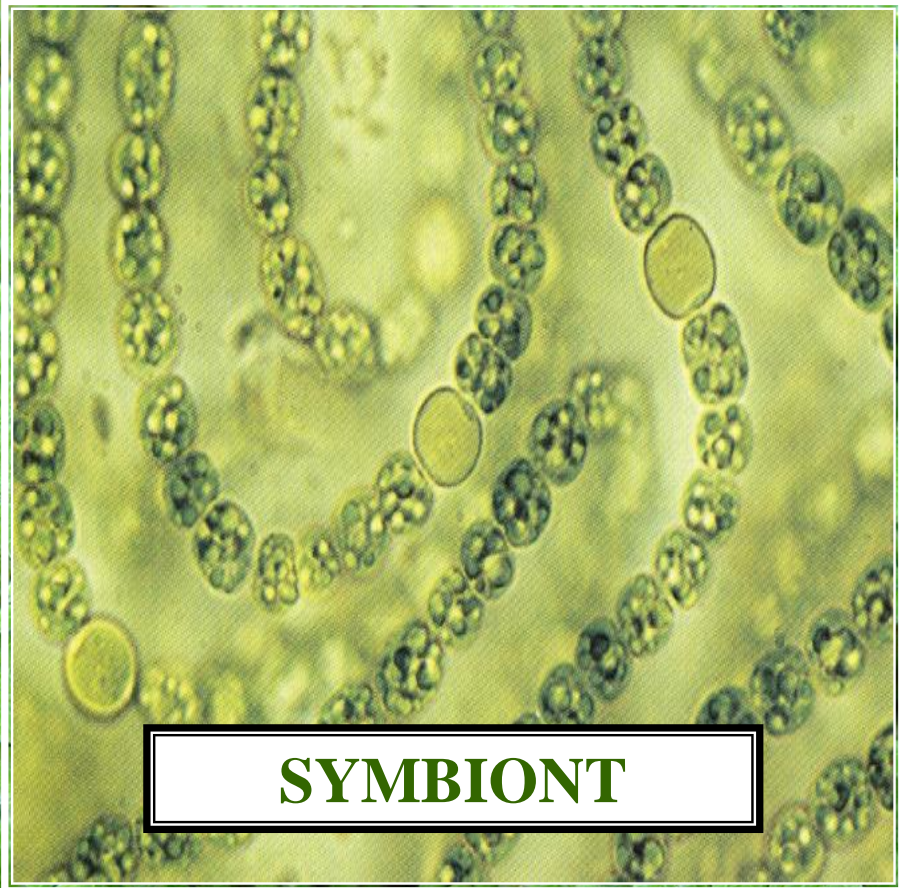


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NON-MODIFIED PSYN FROND



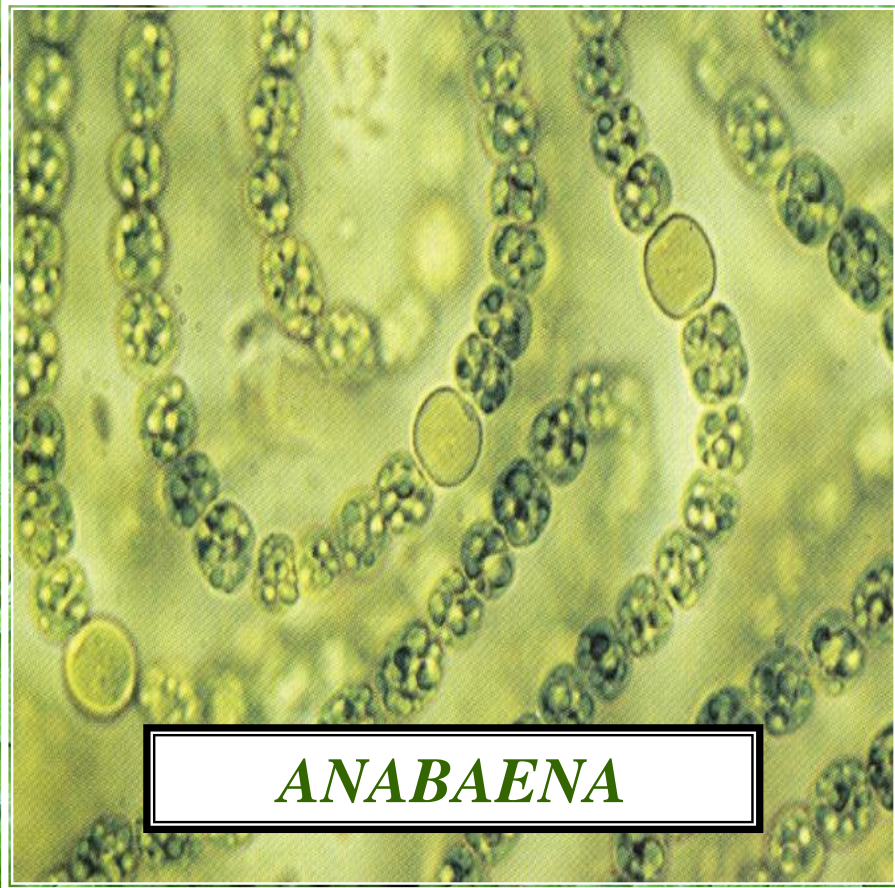
AZOLLA



SYMBIONT

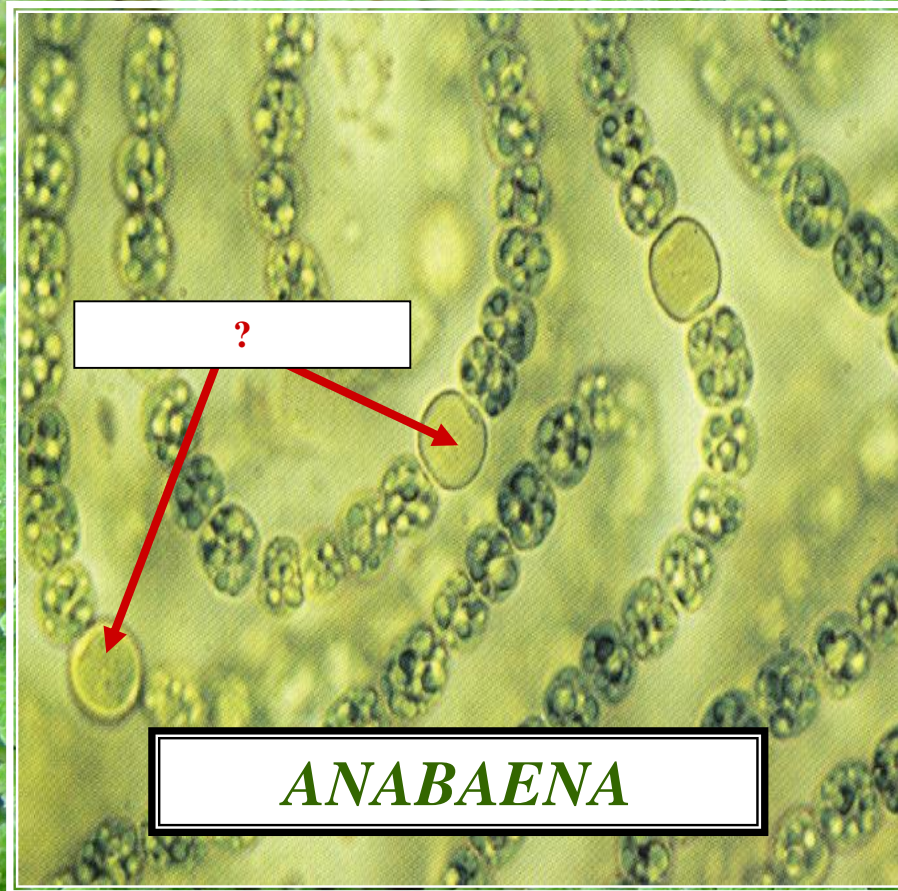
AZOLLA

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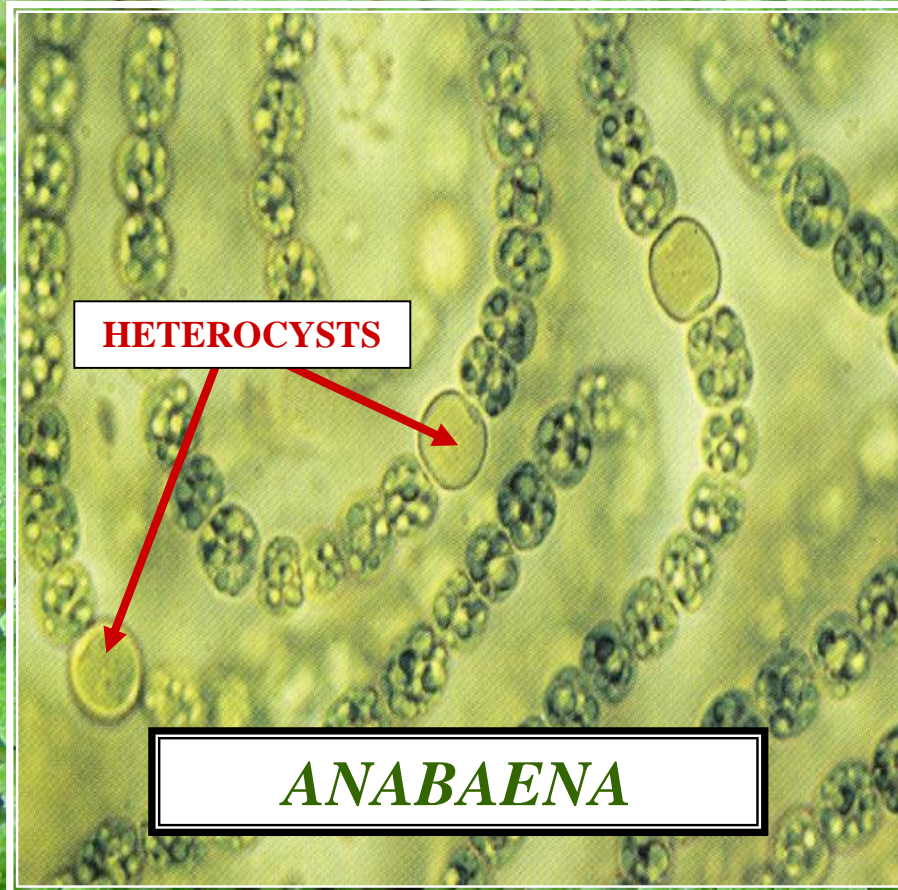


ANABAENA

AZOLLA



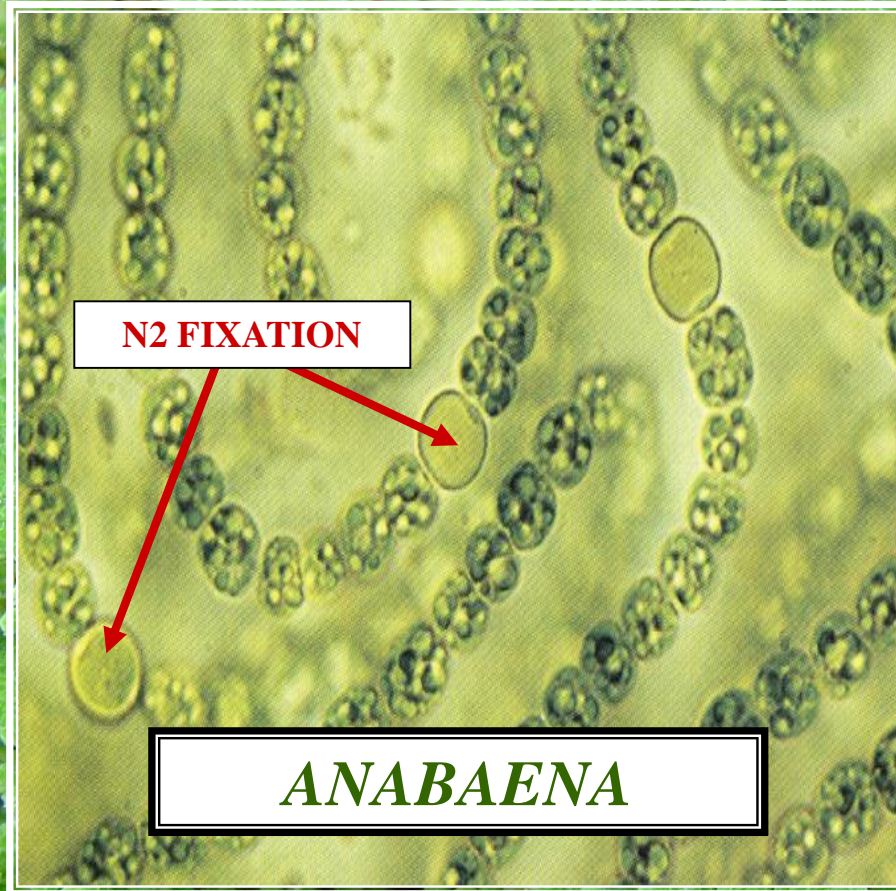
AZOLLA



HETEROCYSTS

ANABAENA

AZOLLA



N₂ FIXATION

ANABAENA

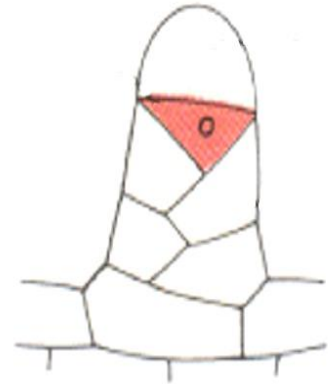
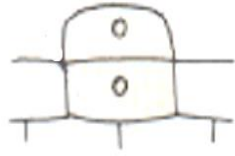
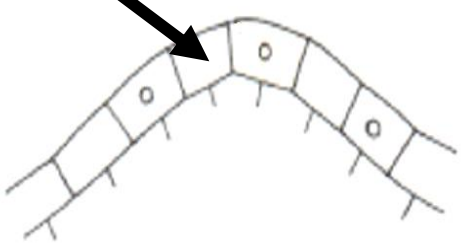
AZOLLA



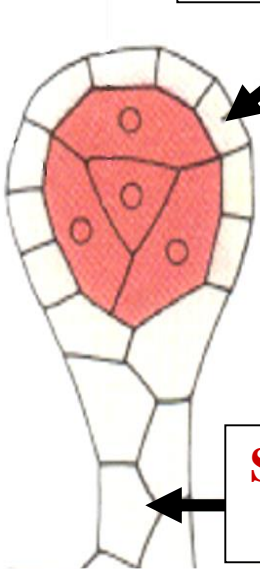


SPORANGIUM

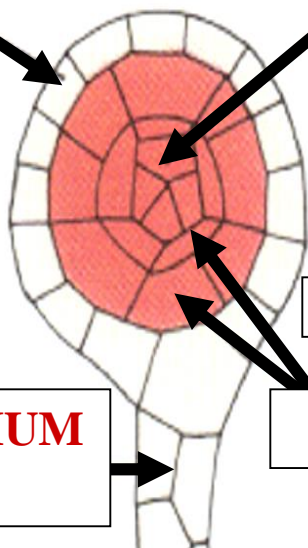
CELL INITIAL



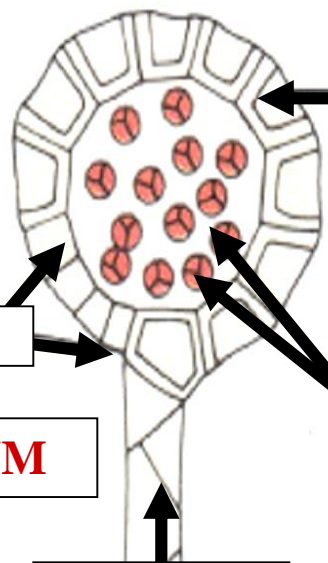
SPORANGIUM WALL



SPOROCYTES



SMALL SIZE



ANNULUS

THIN WALL

FEW SPORES

STOMIUM

TAPETUM

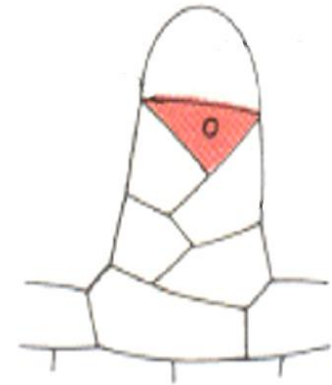
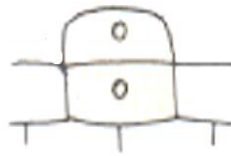
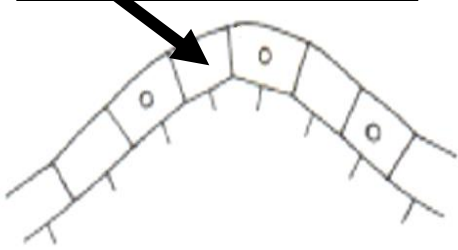
SPORANGIUM STALK

STALK

L.S.



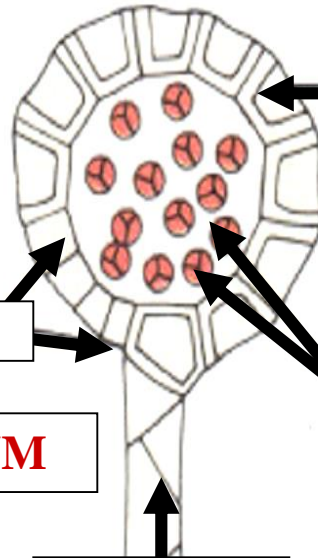
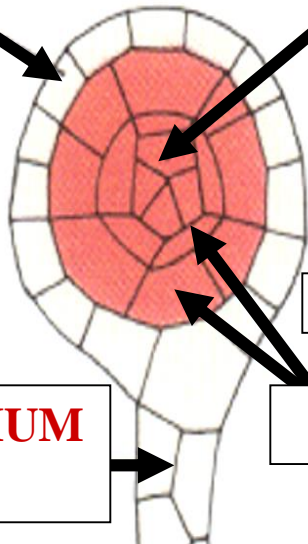
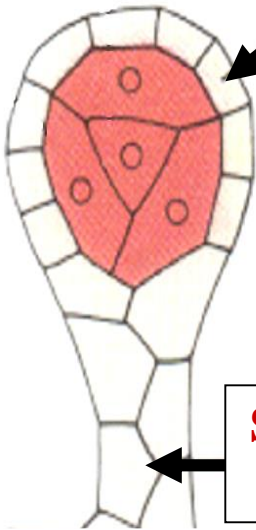
CELL INITIAL



SPORANGIUM WALL

SPOROCYTES

SMALL SIZE



ANNULUS

THIN WALL

FEW SPORES

STOMIUM

TAPETUM

SPORANGIUM STALK

STALK

LEPTOSPORANGIUM

L.S.



F

SPORANGIUM POSITION

FOLIAR SPORANGIUM



S

F

AZOLLA

FOLIAR SPORANGIUM

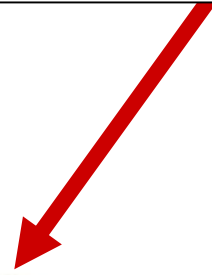


?

SALVINIA

L.S.

?



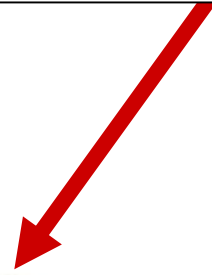
S

SALVINIA



L.S.

SPOROCARP



SALVINIA



SPOROCARP

SPOROCARP

SALVINIALES

SPOROCARP



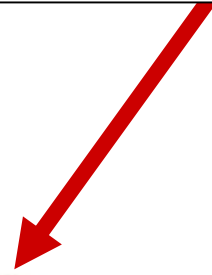
MODIFIED INDUSIUM

SALVINIALES

SPOROCARP

L.S.

SPOROCARP



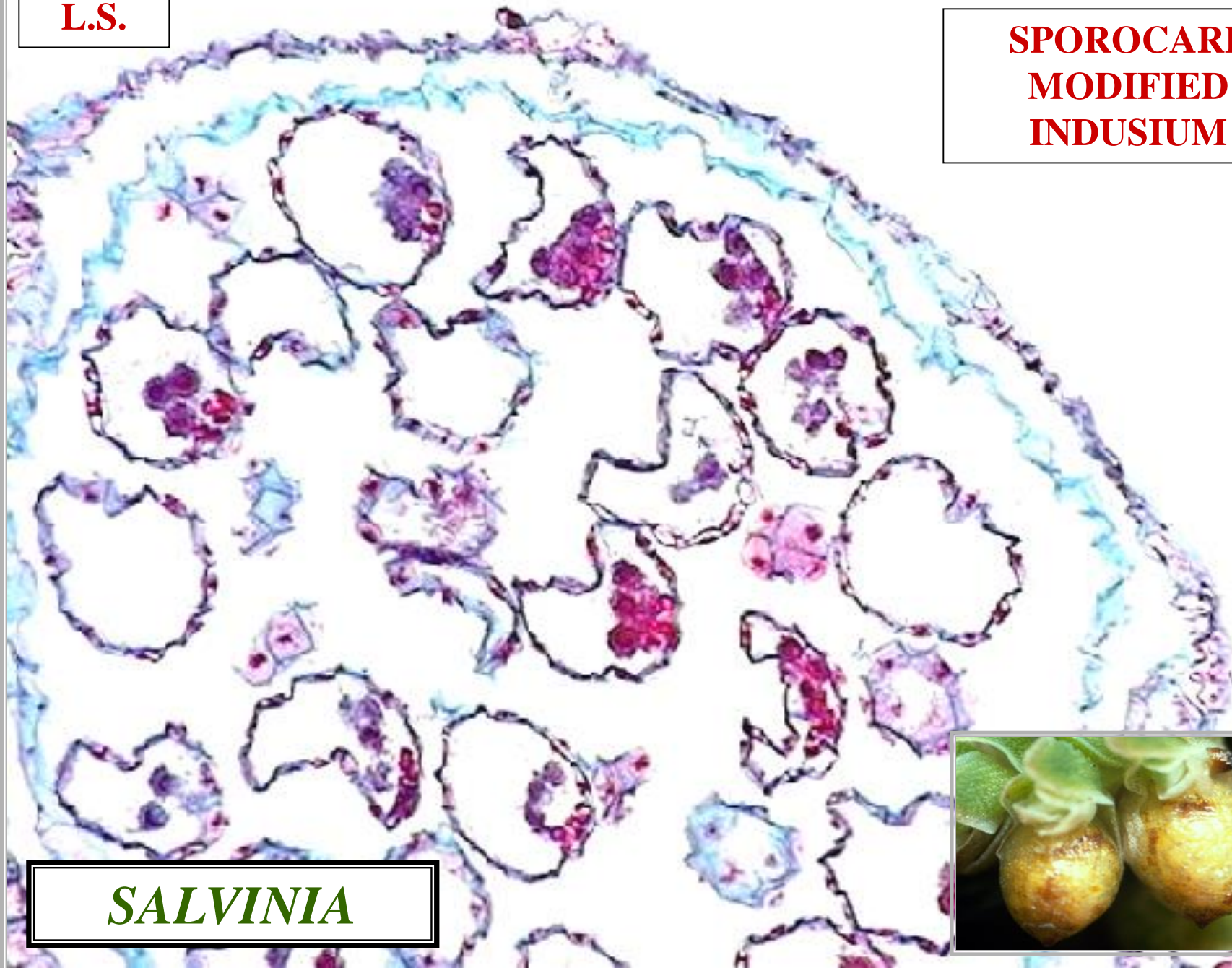
I

SALVINIA



L.S.

**SPOROCARP
MODIFIED
INDUSIUM**



SALVINIA





SALVINIA

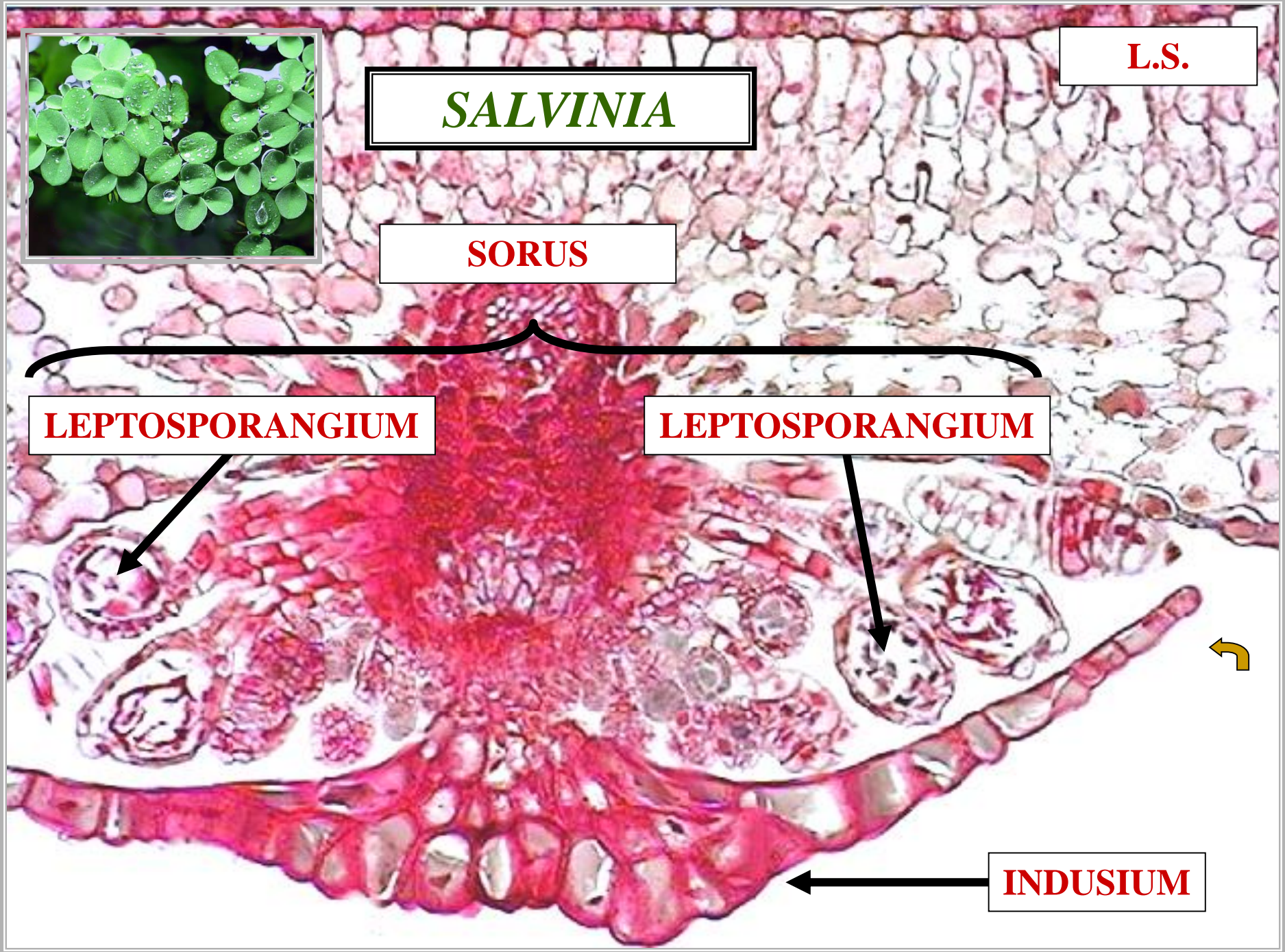
L.S.

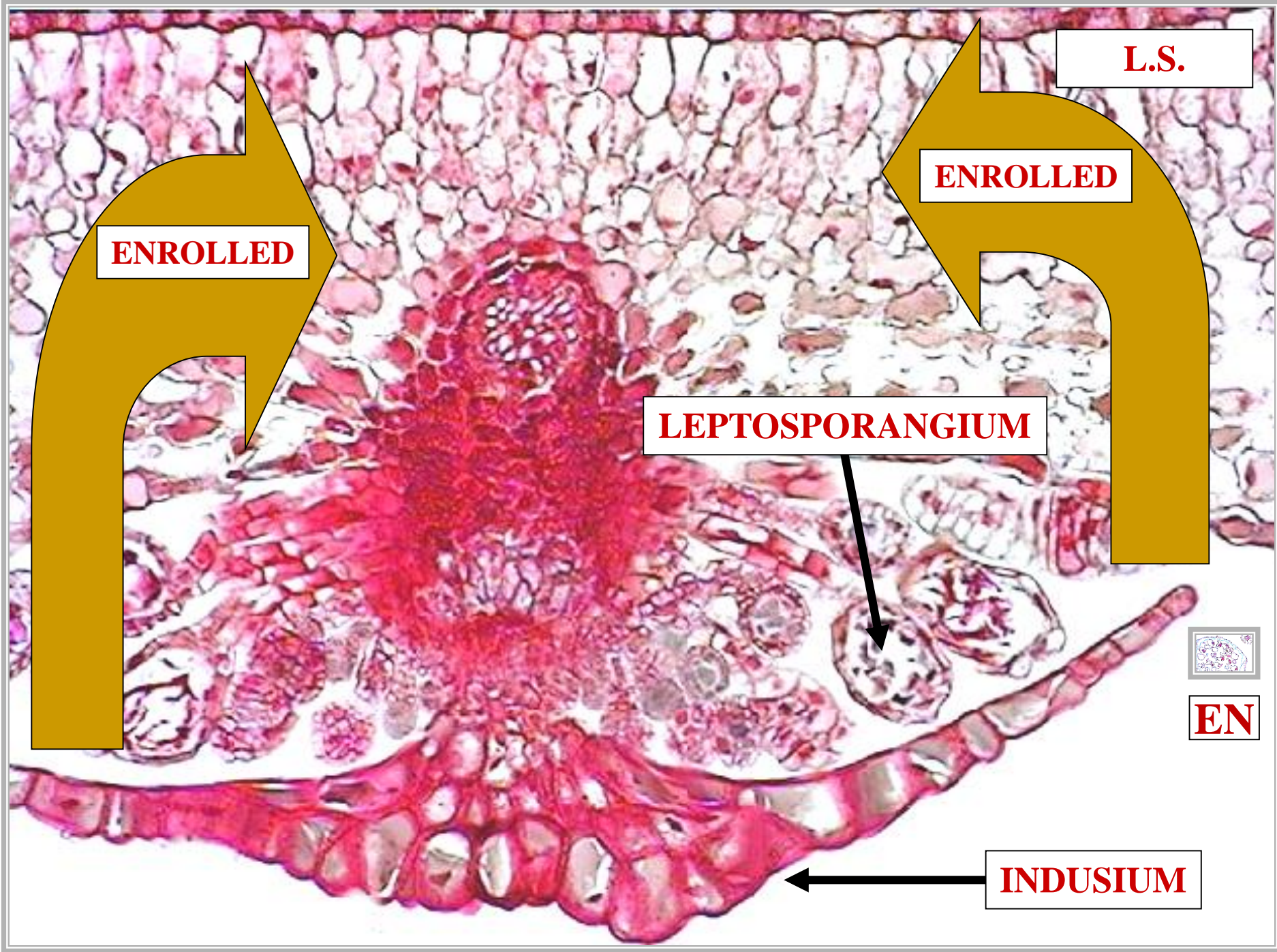
SORUS

LEPTOSPORANGIUM

LEPTOSPORANGIUM

INDUSIUM



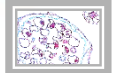


L.S.

ENROLLED

ENROLLED

LEPTOSPORANGIUM

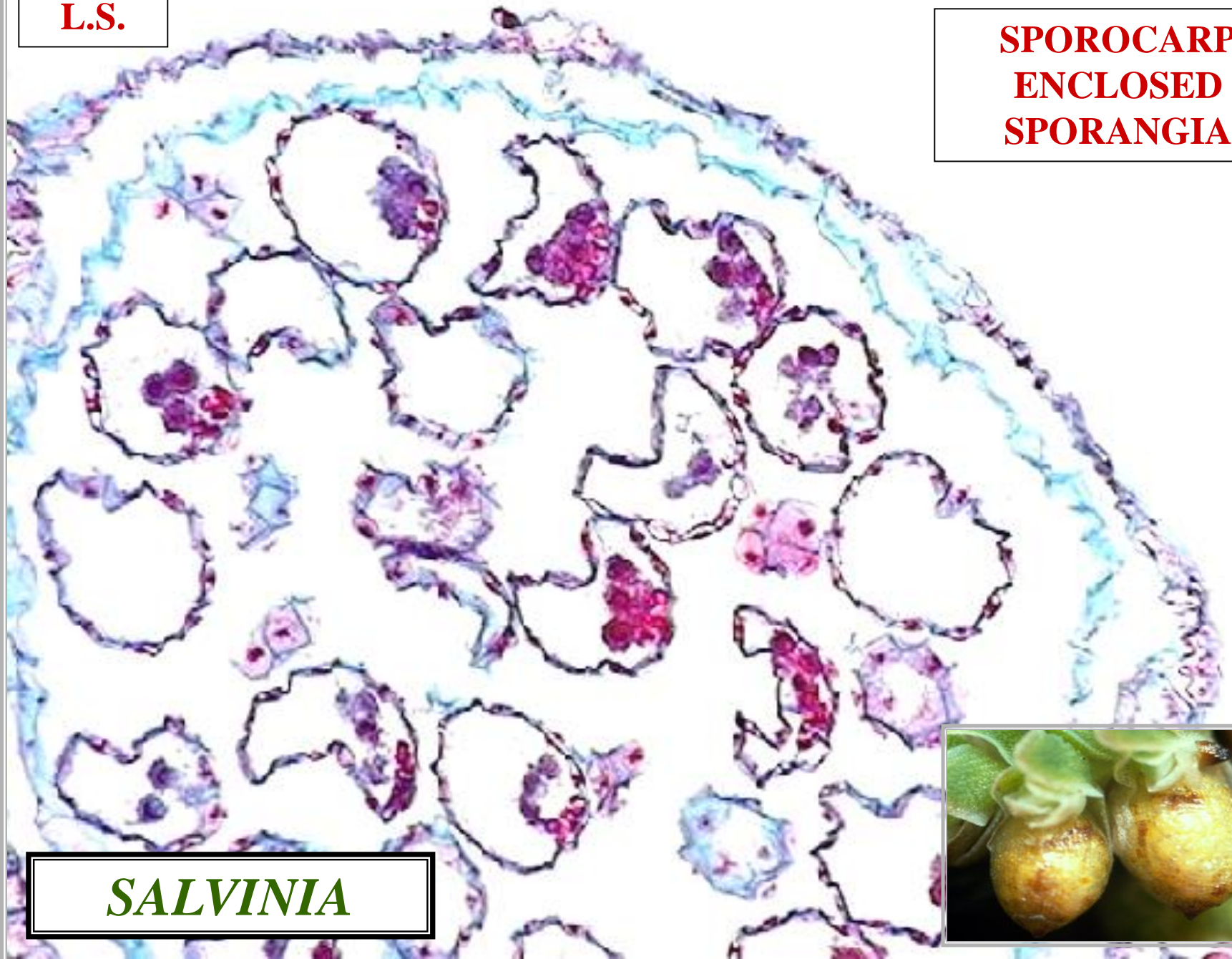


EN

INDUSIUM

L.S.

**SPOROCARP
ENCLOSED
SPORANGIA**

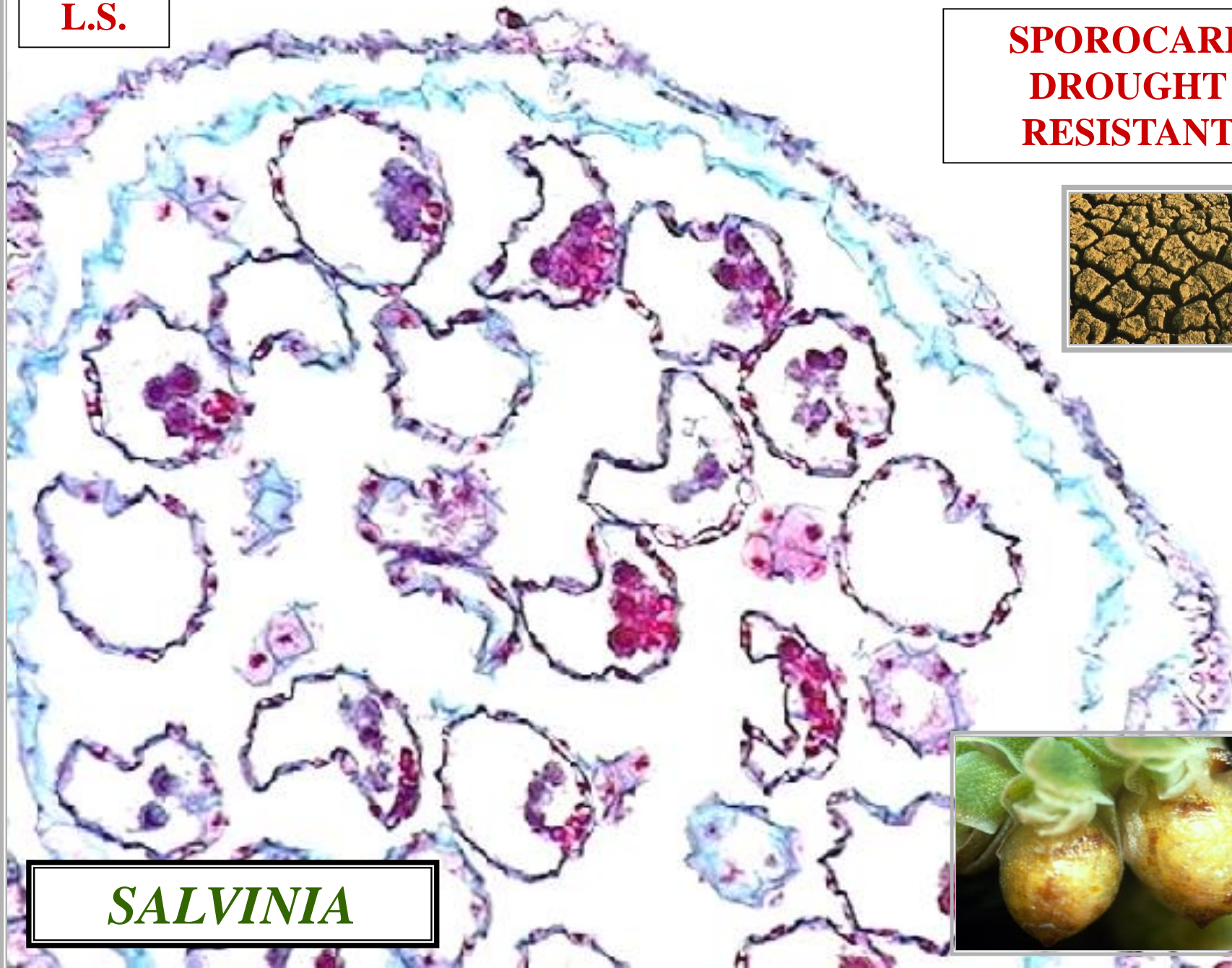


SALVINIA



L.S.

**SPOROCARP
DROUGHT
RESISTANT**



SALVINIA

L.S.

SPOROCARP
“GERMINATES”



SALVINIA





SPOROCARP STRUCTURE

L.S.

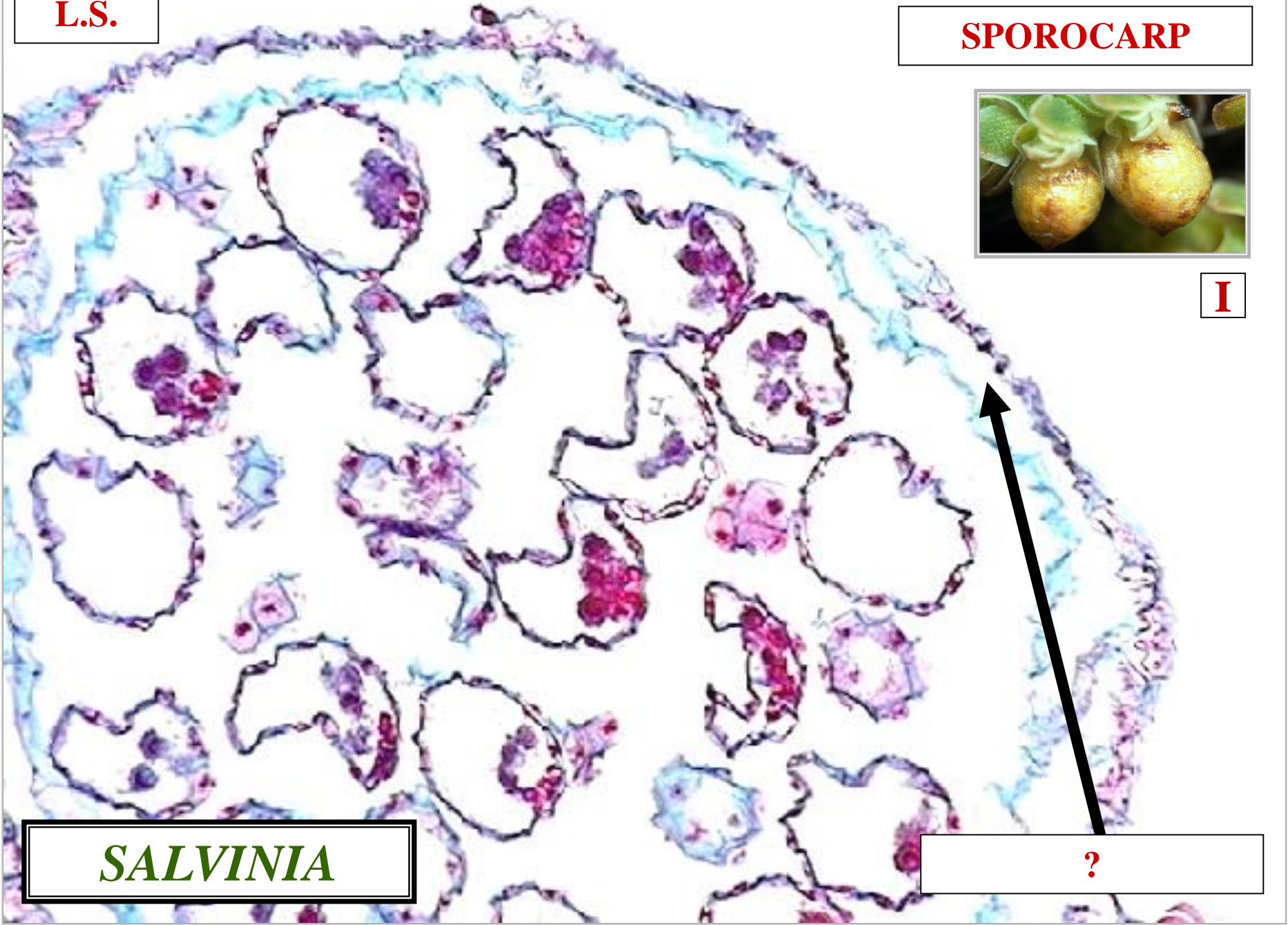
SPOROCARP



I

SALVINIA

?



L.S.

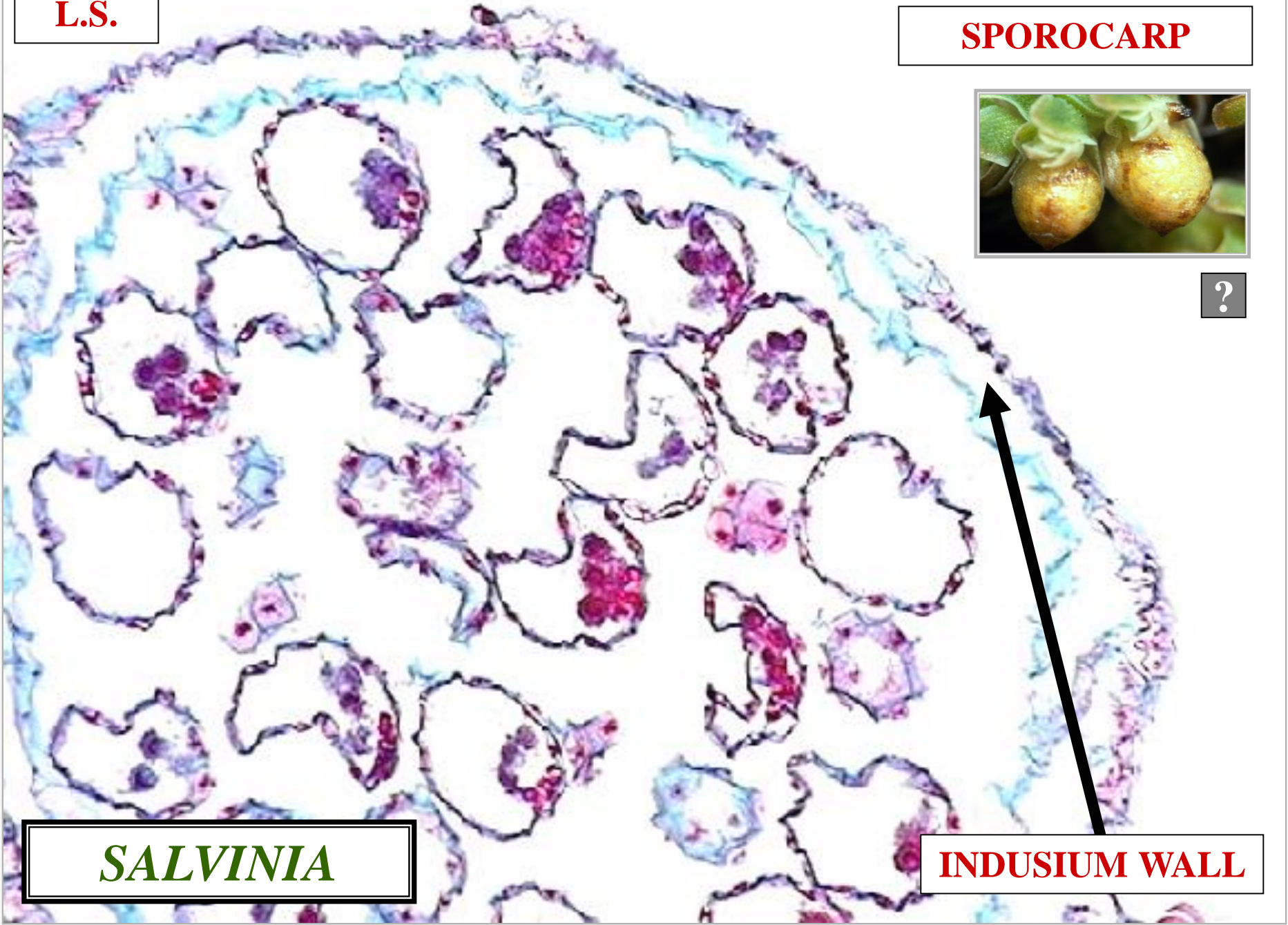
SPOROCARP



?

SALVINIA

INDUSIUM WALL



L.S.

SPOROCARP

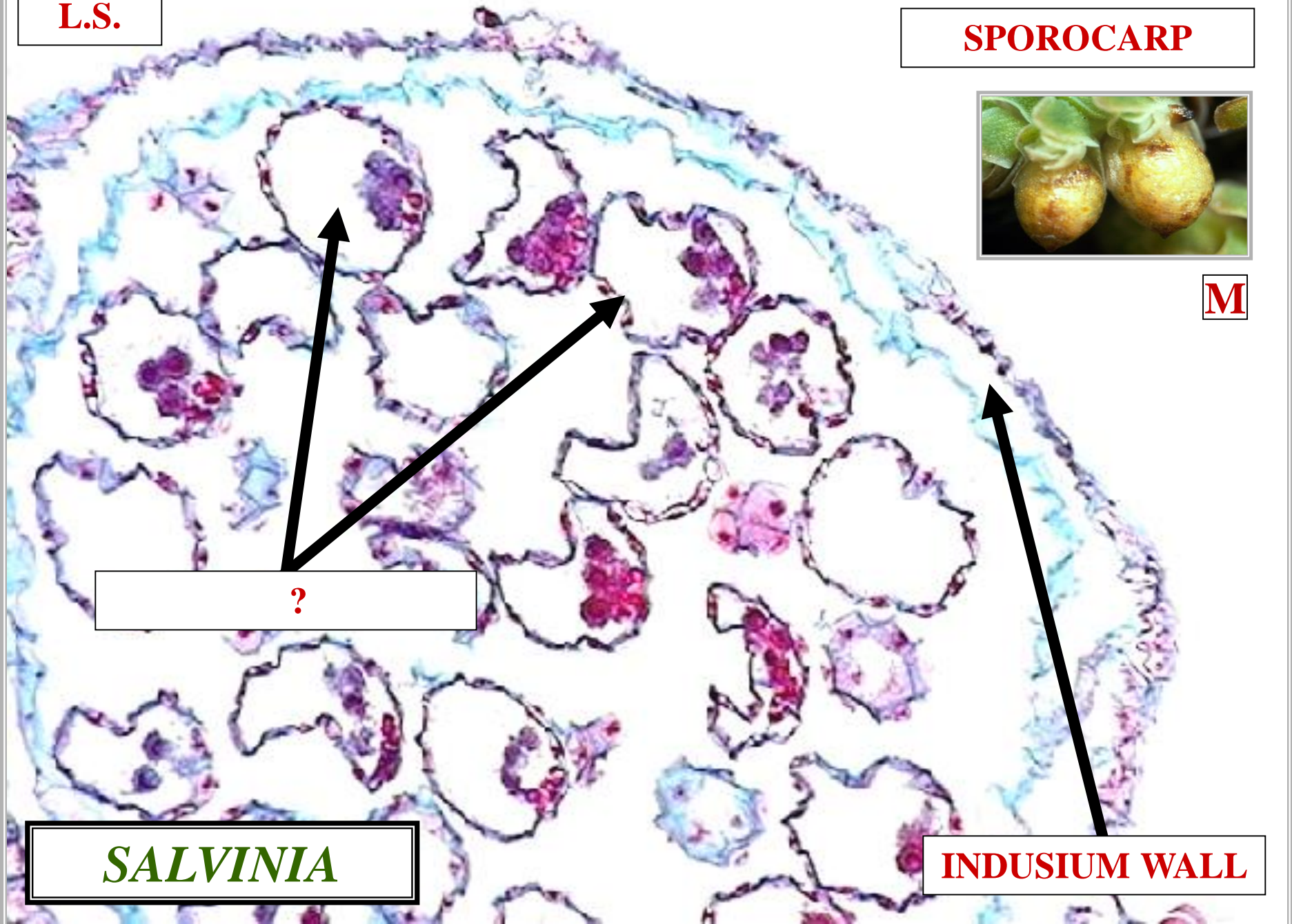


M

?

SALVINIA

INDUSIUM WALL



L.S.

SPOROCARP

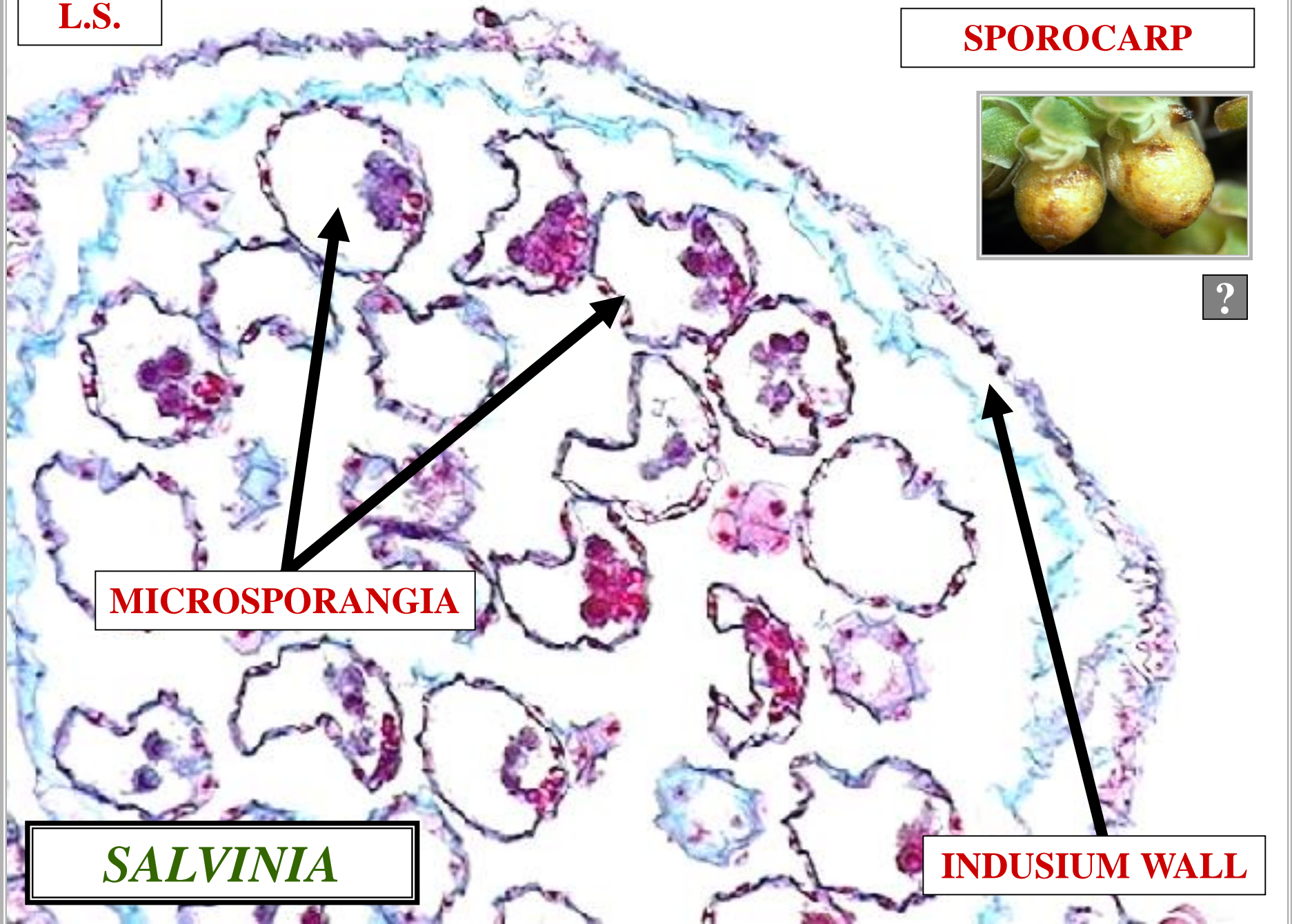


?

MICROSPORANGIA

SALVINIA

INDUSIUM WALL



L.S.

SPOROCARP



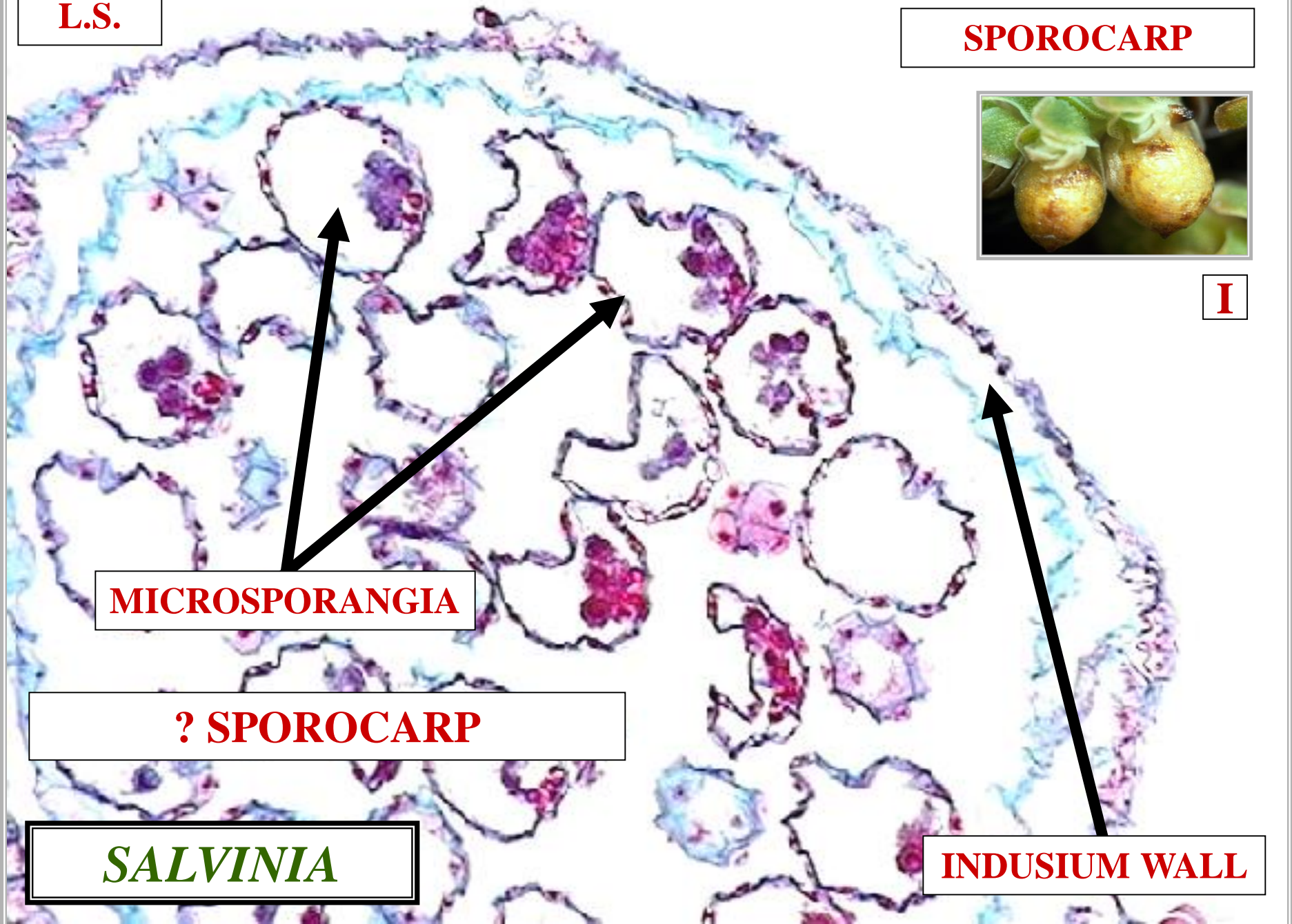
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MICROSPORANGIA

? SPOROCARP

SALVINIA

INDUSIUM WALL



L.S.

SPOROCARP



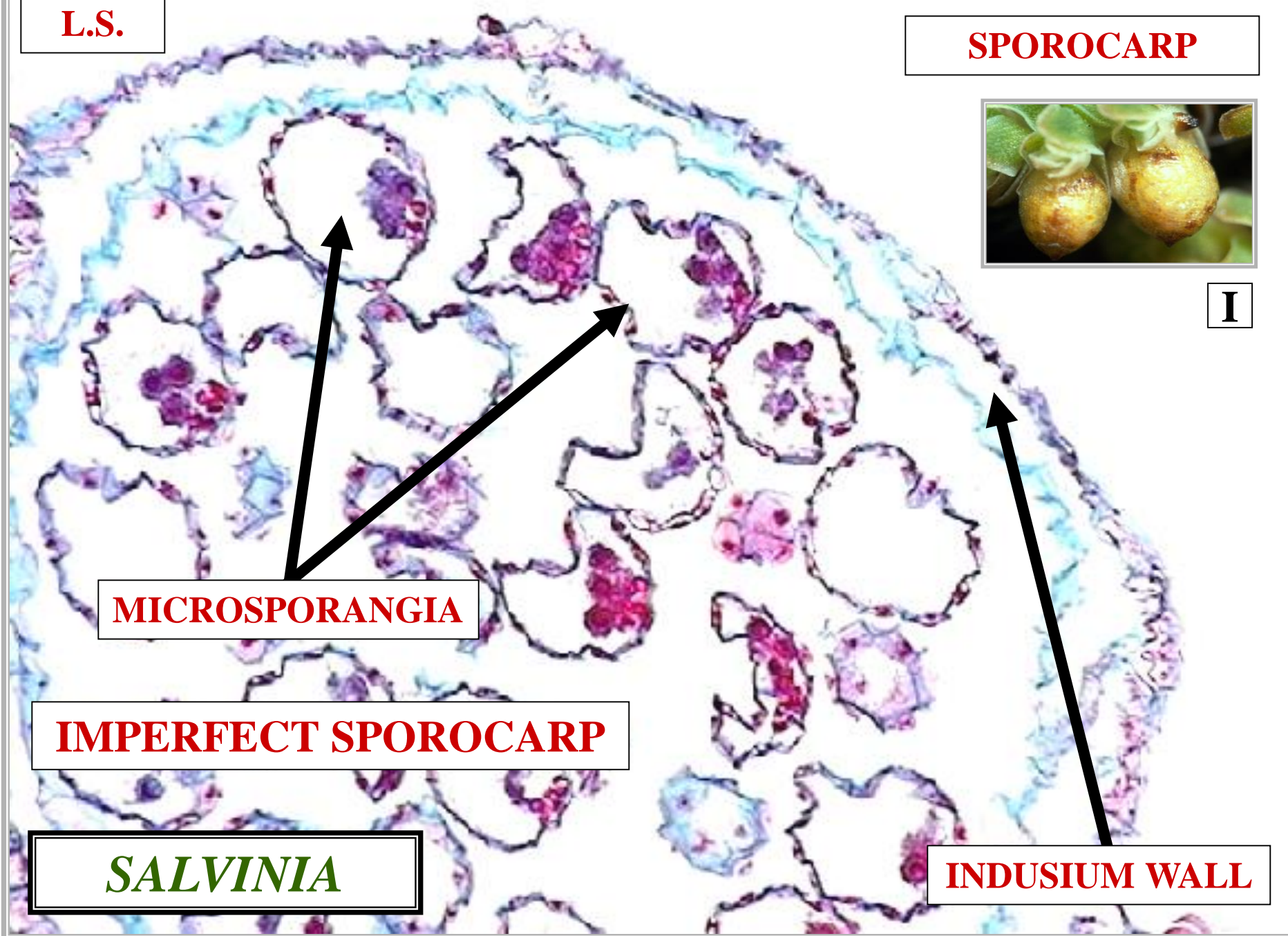
I

MICROSPORANGIA

IMPERFECT SPOROCARP

SALVINIA

INDUSIUM WALL



**IMPERFECT
SPOROCARP**

SALVINIALES
IMPERFECT SPOROCARP

EITHER
MICROSPORANGIA
OR
MEGASPORANGIA
NOT BOTH

SALINIALES
IMPERFECT SPOROCARP



SPOROCARP MODIFIED PINNA



AB

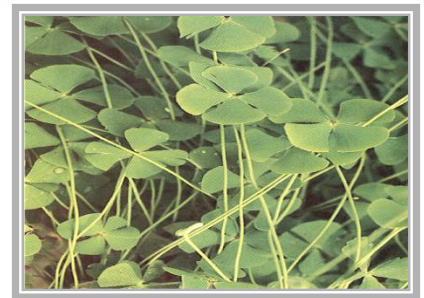


SOROPHORE

SPOROCARP

SPORANGIA

MARSILEA



AB



SPOROCARP MODIFIED PINNA

SOROPHORE ABSENT

SPOROCARP



SPORANGIA

SALVINIA



SPOROCARP MODIFIED PINNA

SOROPHORE ABSENT

SPOROCARP

SPORANGIA



AZOLLA



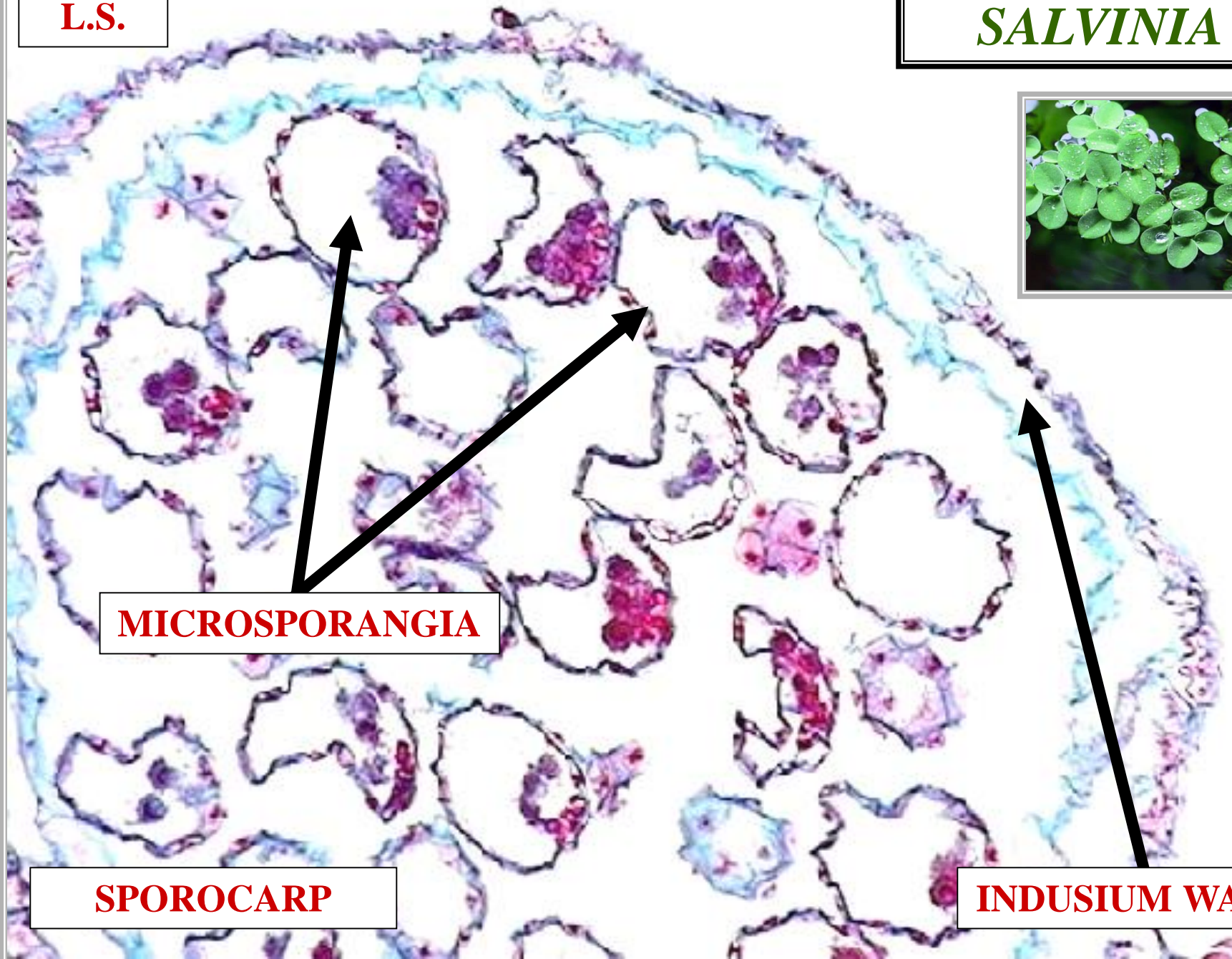
SPORE HABIT

L.S.

SALVINIA



M



MICROSPORANGIA

SPOROCARP

INDUSIUM WALL

L.S.

SALVINIA

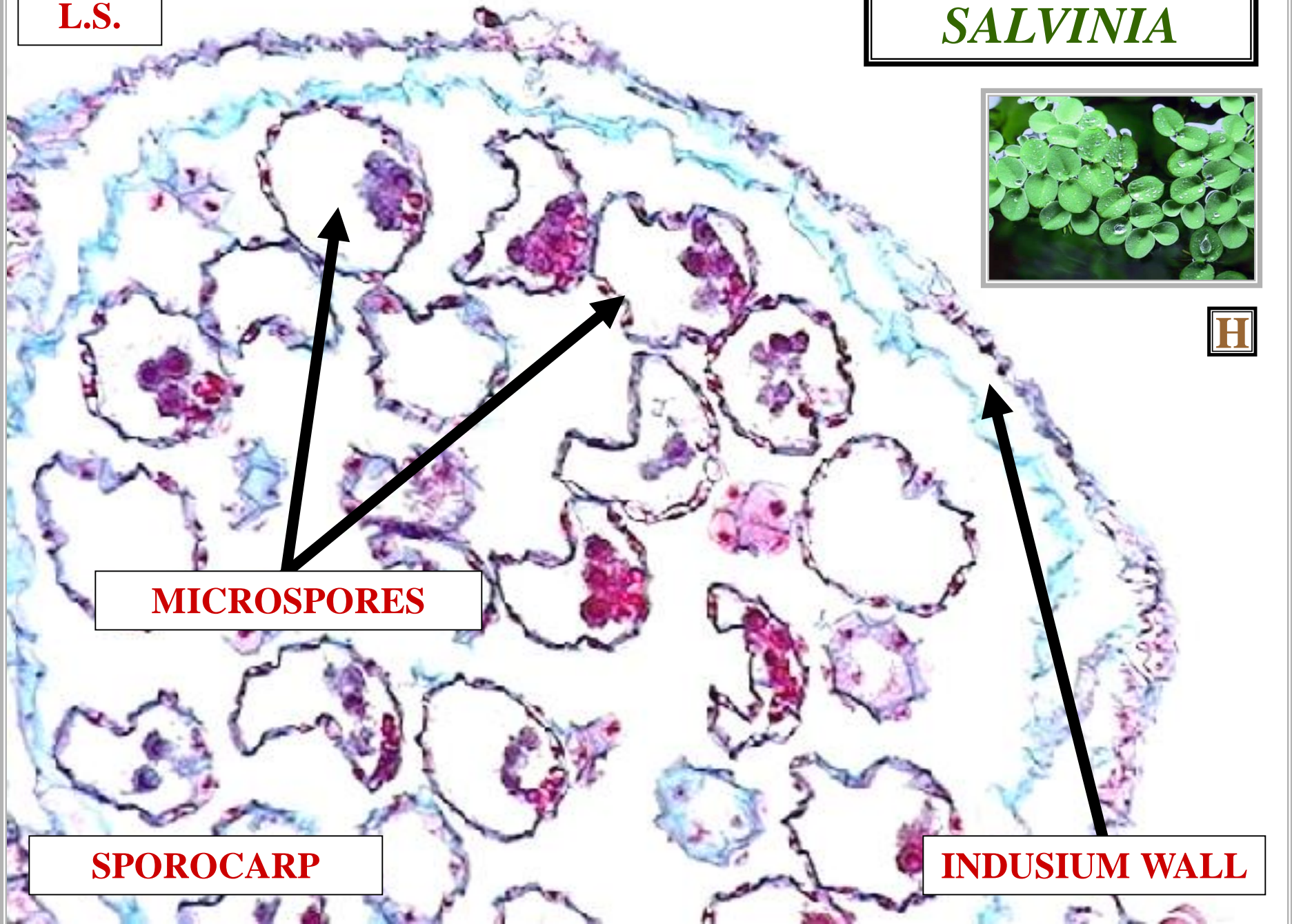


H

MICROSPORES

SPOROCARP

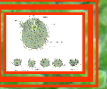
INDUSIUM WALL





HETEROSPOROUS

SALVINIA



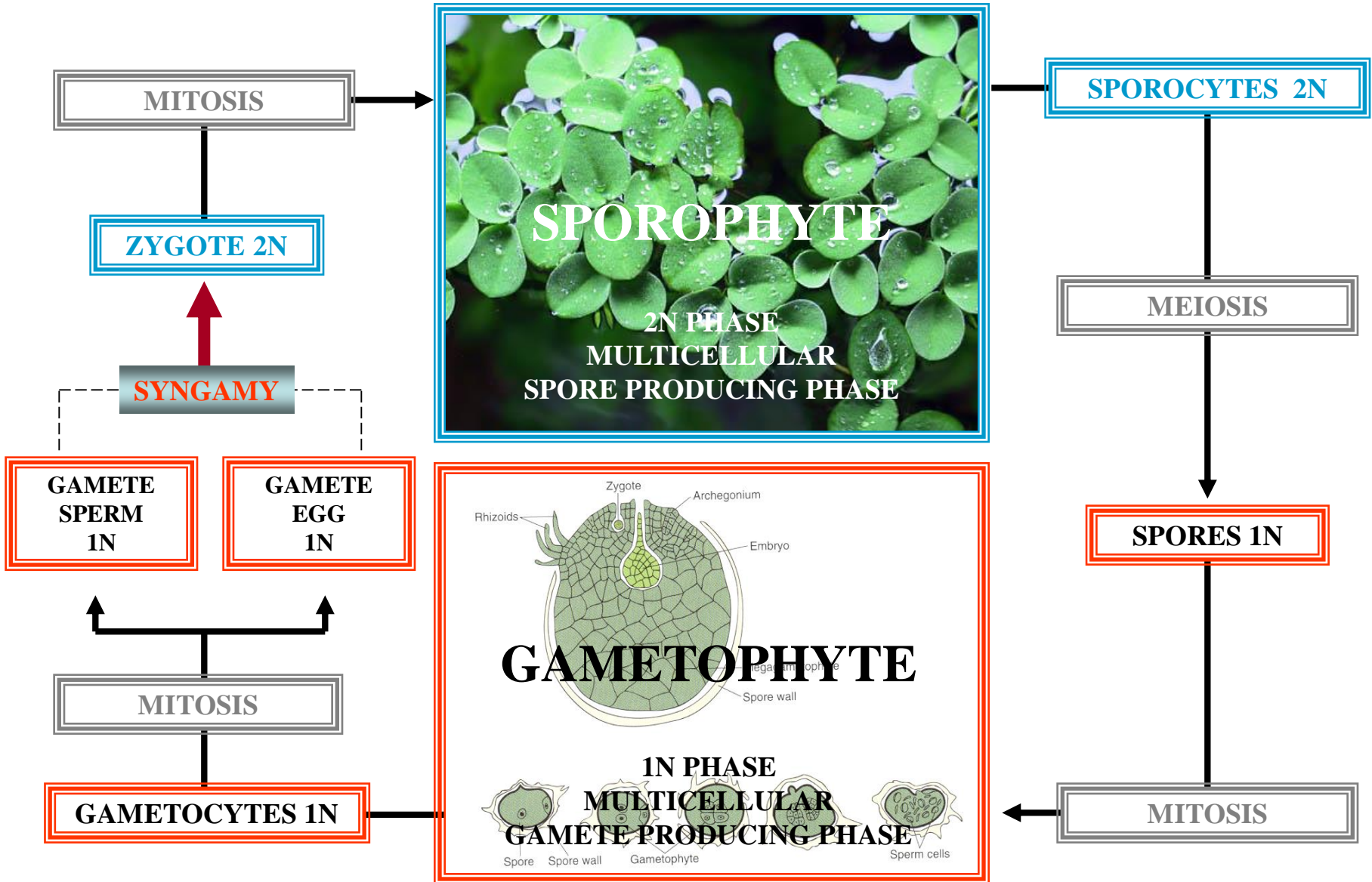
HETEROSPOROUS

AZOLLA



SALVINIALES

LIFE CYCLE



GAMETOPHYTE CHARACTERS



**GAMETOPHYTE
CHARACTERS
IDENTICAL
MARSILEALES**

PTERIDOPHYTA CLASSIFICATION

END
LECTURE
MATERIAL
2ND EXAM



VASCULAR PLANT EVOLUTION

VASCULAR PLANT EVOLUTION SUMMARY

FORMAL TAXON

DEFINING CHARACTER

NON-FORMAL TAXON

→ = EVOLVED

QUESTION

**HOW OLD
IS THE UNIVERSE?**

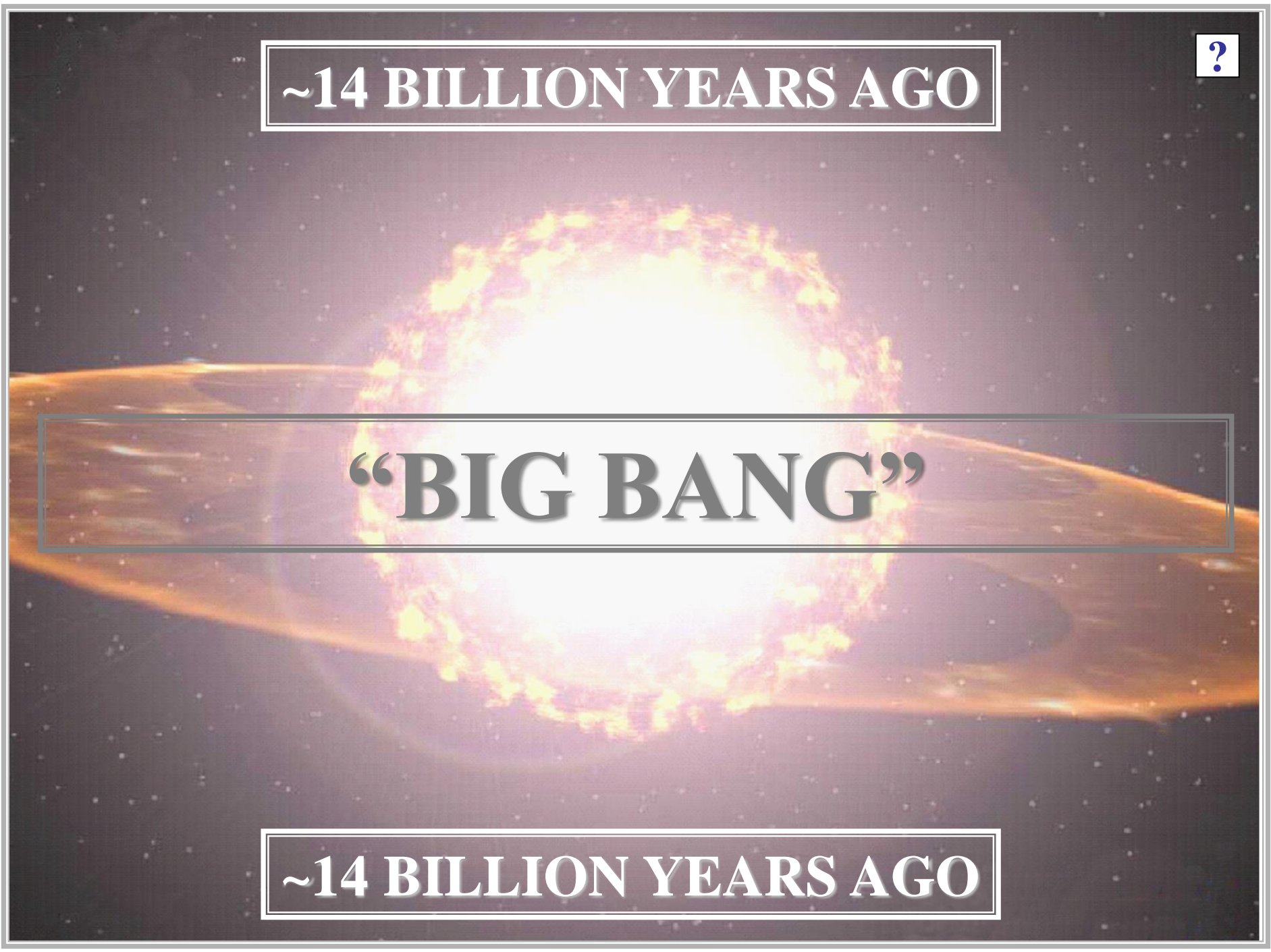
QUESTION



~14 BILLION YEARS AGO

“BIG BANG”

~14 BILLION YEARS AGO



QUESTION

HOW OLD IS OUR STAR?

QUESTION

~5 BILLION YEARS AGO

?

SUN / STAR

~5 BILLION YEARS AGO



QUESTION

HOW OLD IS THE EARTH?

QUESTION

~4.5 BILLION YEARS AGO

?

EARTH

~4.5 BILLION YEARS AGO



QUESTION

HOW OLD IS LIFE?

QUESTION

A black and white electron micrograph showing several rod-shaped, textured structures, likely early life forms, against a light background. The structures are elongated and have a granular, porous appearance. One large rod is oriented diagonally from the top left towards the bottom right. Other smaller rods are scattered around it.

~3.5 BILLION YEARS AGO



FIRST CELLS

~3.5 BILLION YEARS AGO

1ST CELLS

PROKARYOTE CELLS

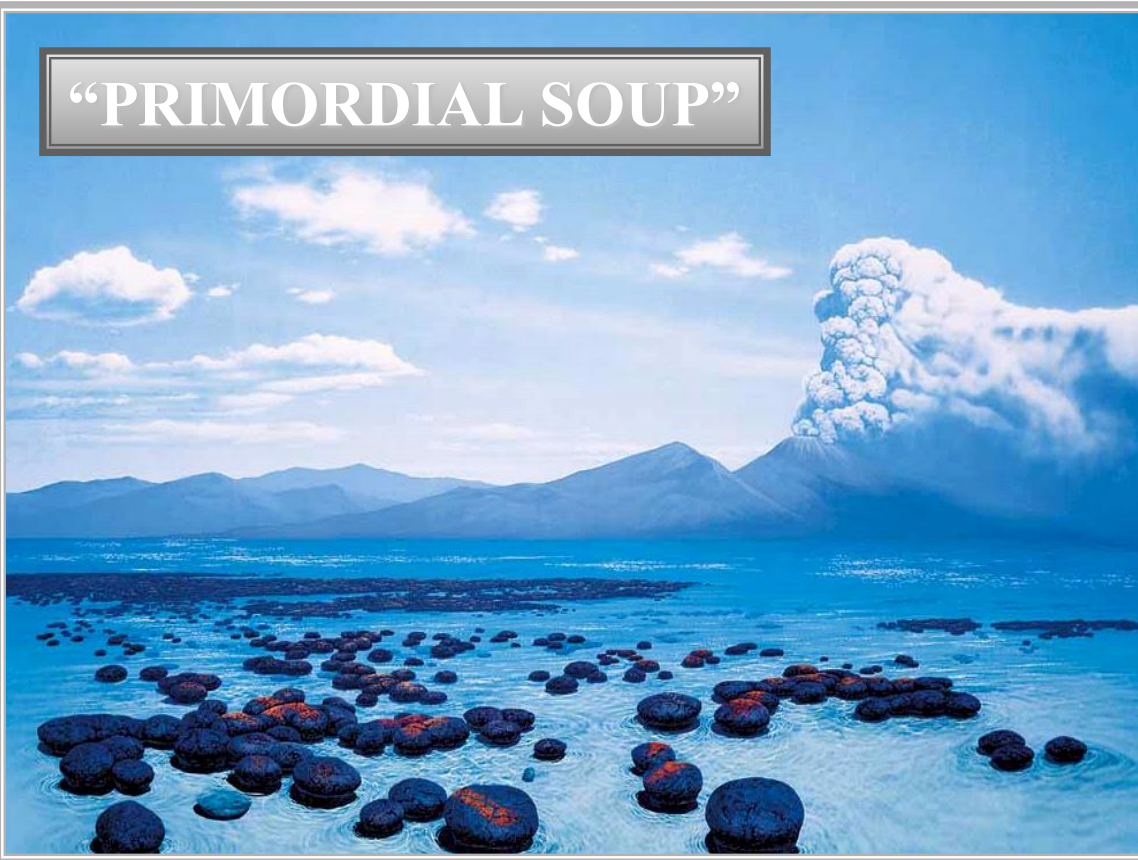


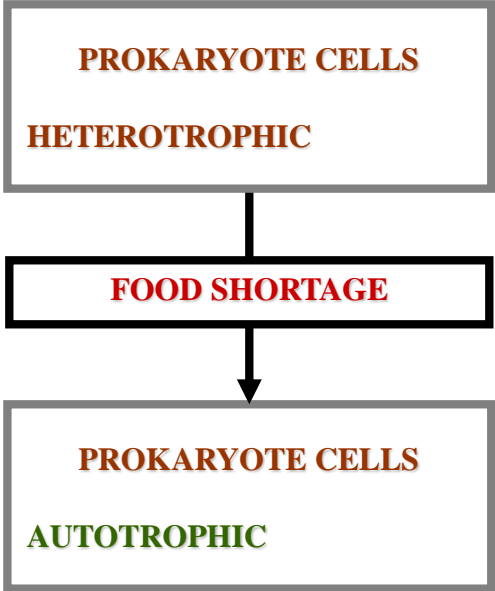
PROKARYOTE CELLS
HETEROTROPHIC

PROKARYOTE CELLS
HETEROTROPHIC

FOOD SHORTAGE

“PRIMORDIAL SOUP”





PROKARYOTE CELLS
HETEROTROPHIC



FOOD SHORTAGE



PROKARYOTE CELLS
AUTOTROPHIC



?

PROKARYOTE CELLS
HETEROTROPHIC



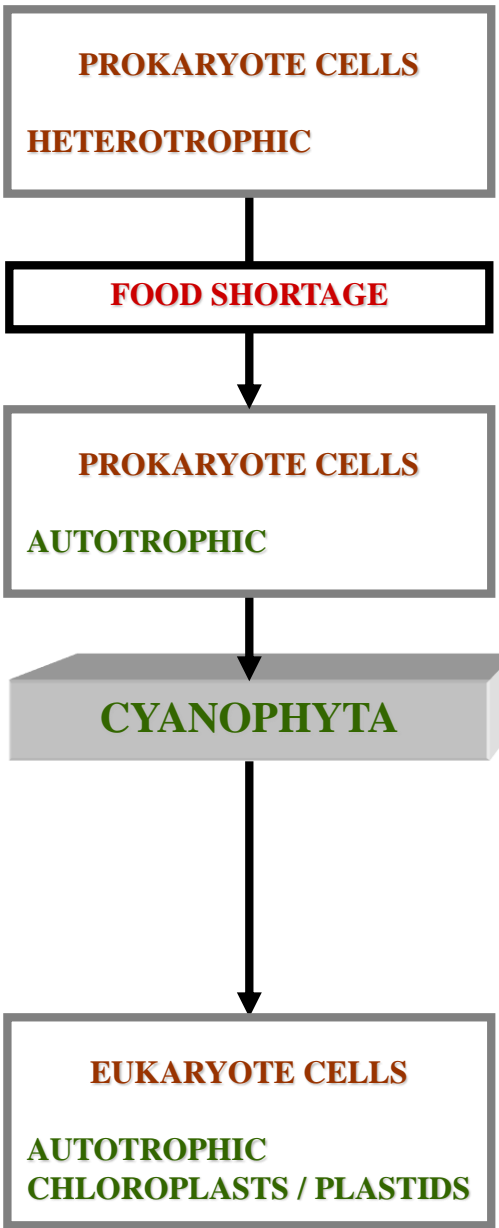
FOOD SHORTAGE

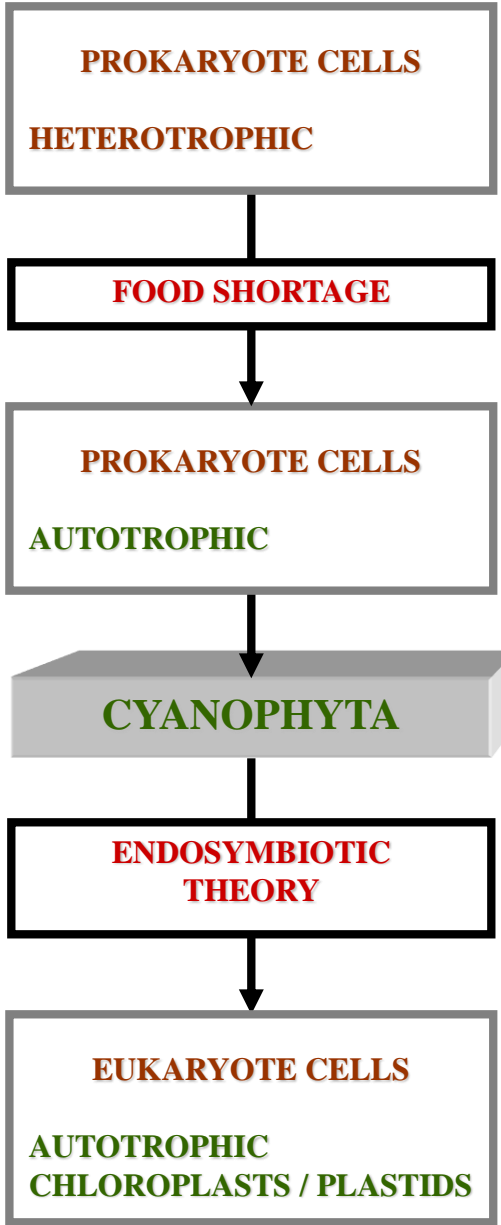


PROKARYOTE CELLS
AUTOTROPHIC



CYANOPHYTA





PROKARYOTE CELLS
HETEROTROPHIC



FOOD SHORTAGE



PROKARYOTE CELLS
AUTOTROPHIC



CYANOPHYTA



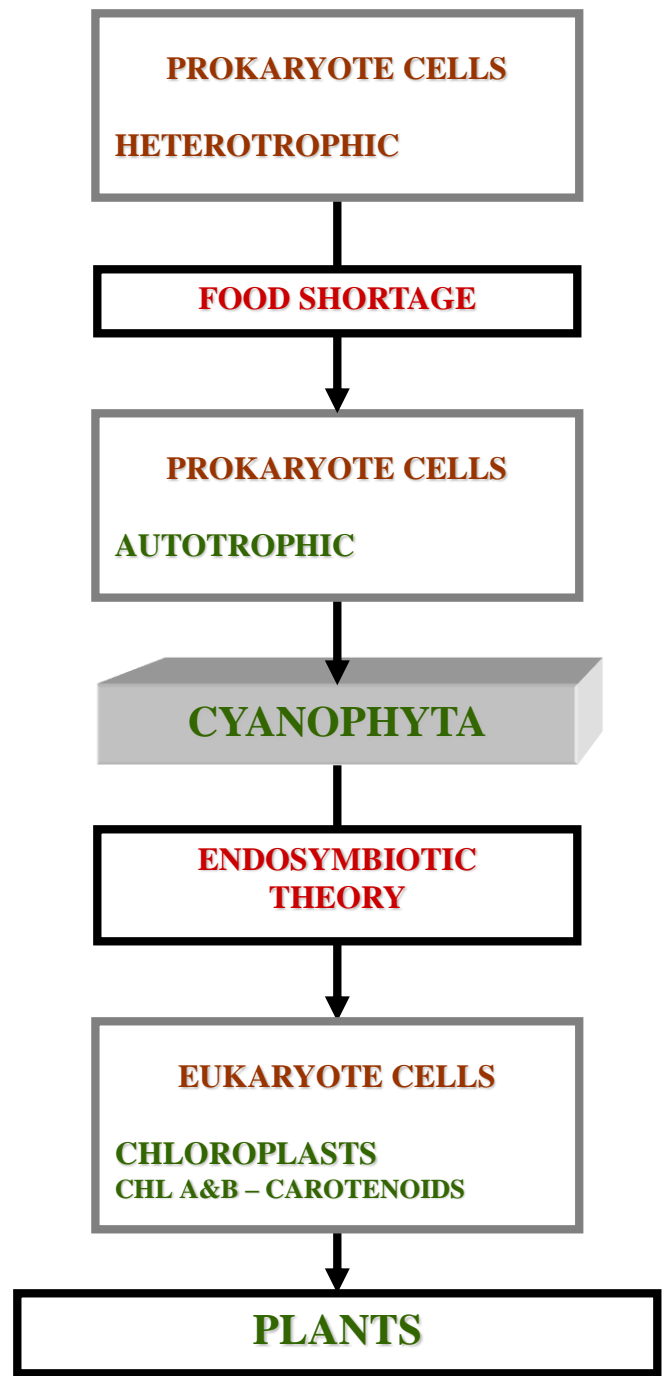
**ENDOSYMBIOTIC
THEORY**



EUKARYOTE CELLS
AUTOTROPHIC
CHLOROPLASTS / PLASTIDS



?



PROKARYOTE CELLS
HETEROTROPHIC



FOOD SHORTAGE



PROKARYOTE CELLS
AUTOTROPHIC



CYANOPHYTA



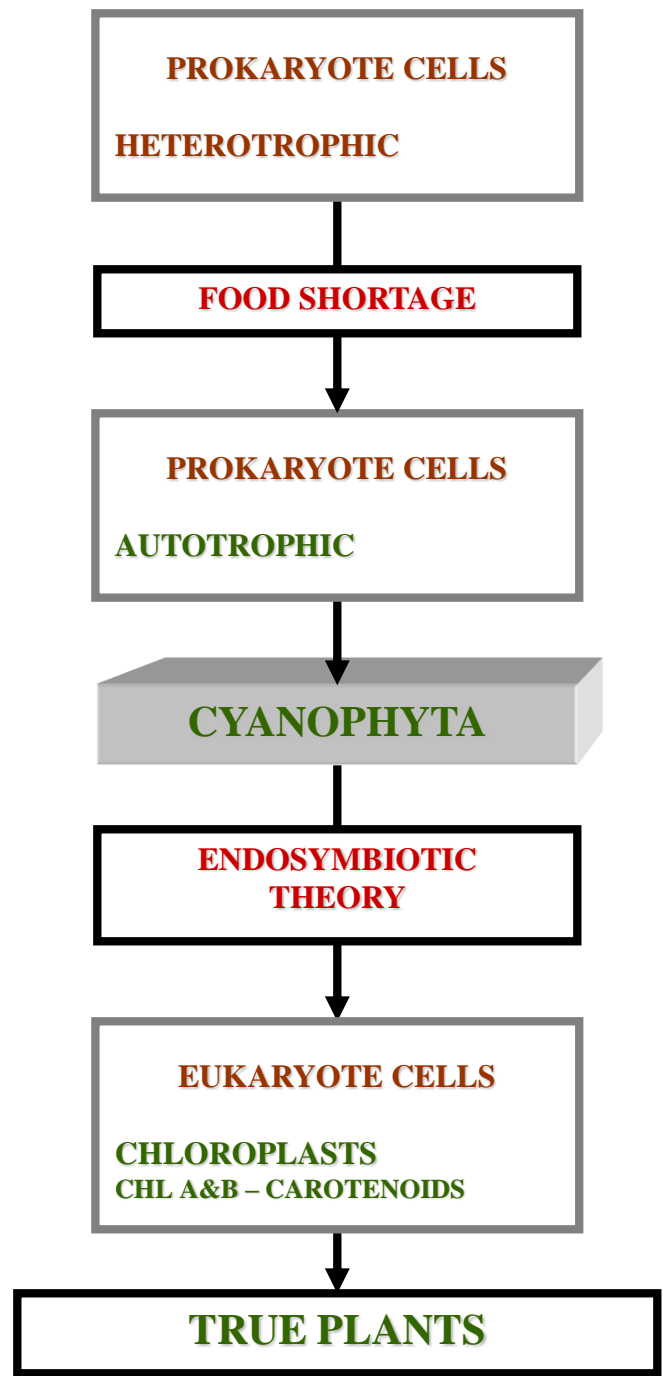
**ENDOSYMBIOTIC
THEORY**



EUKARYOTE CELLS
CHLOROPLASTS
CHL A&B – CAROTENOIDS



? PLANTS



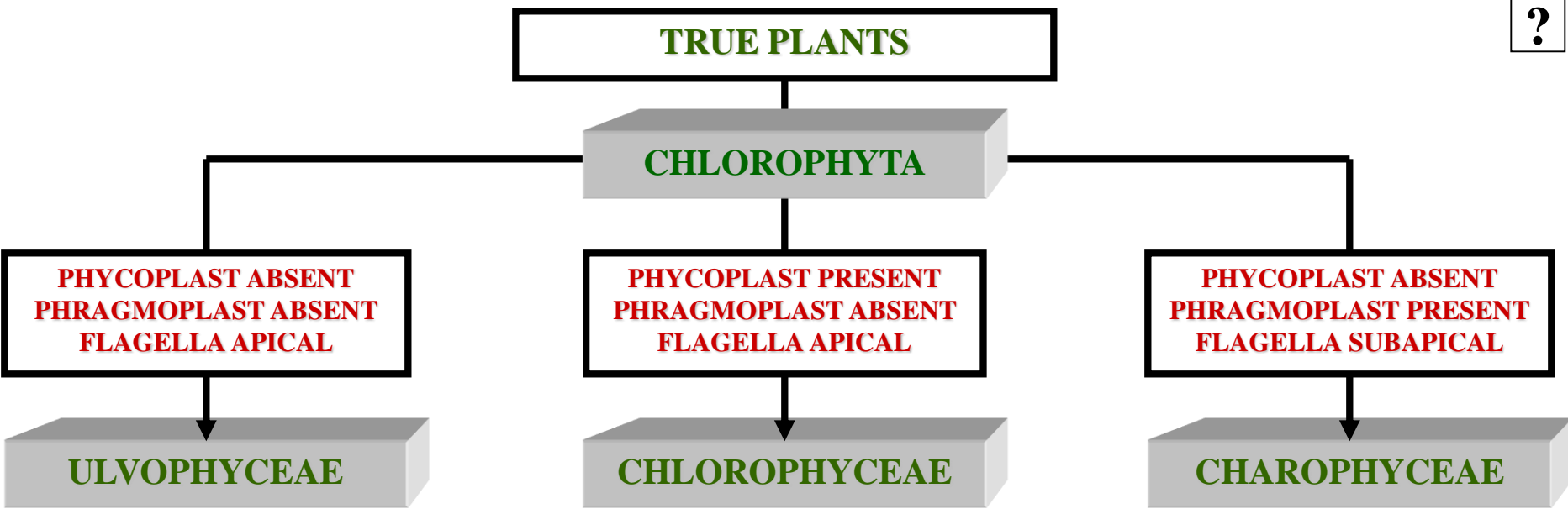
TRUE PLANTS

?

TRUE PLANTS



CHLOROPHYTA



!!!ALGAE CLASS STANDARD ENDING: PHYCEAE!!!

TRUE PLANTS

CHLOROPHYTA

**PHYCOPLAST ABSENT
PHRAGMOPLAST ABSENT
FLAGELLA APICAL**

ULVOPHYCEAE

?

**PHYCOPLAST PRESENT
PHRAGMOPLAST ABSENT
FLAGELLA APICAL**

CHLOROPHYCEAE

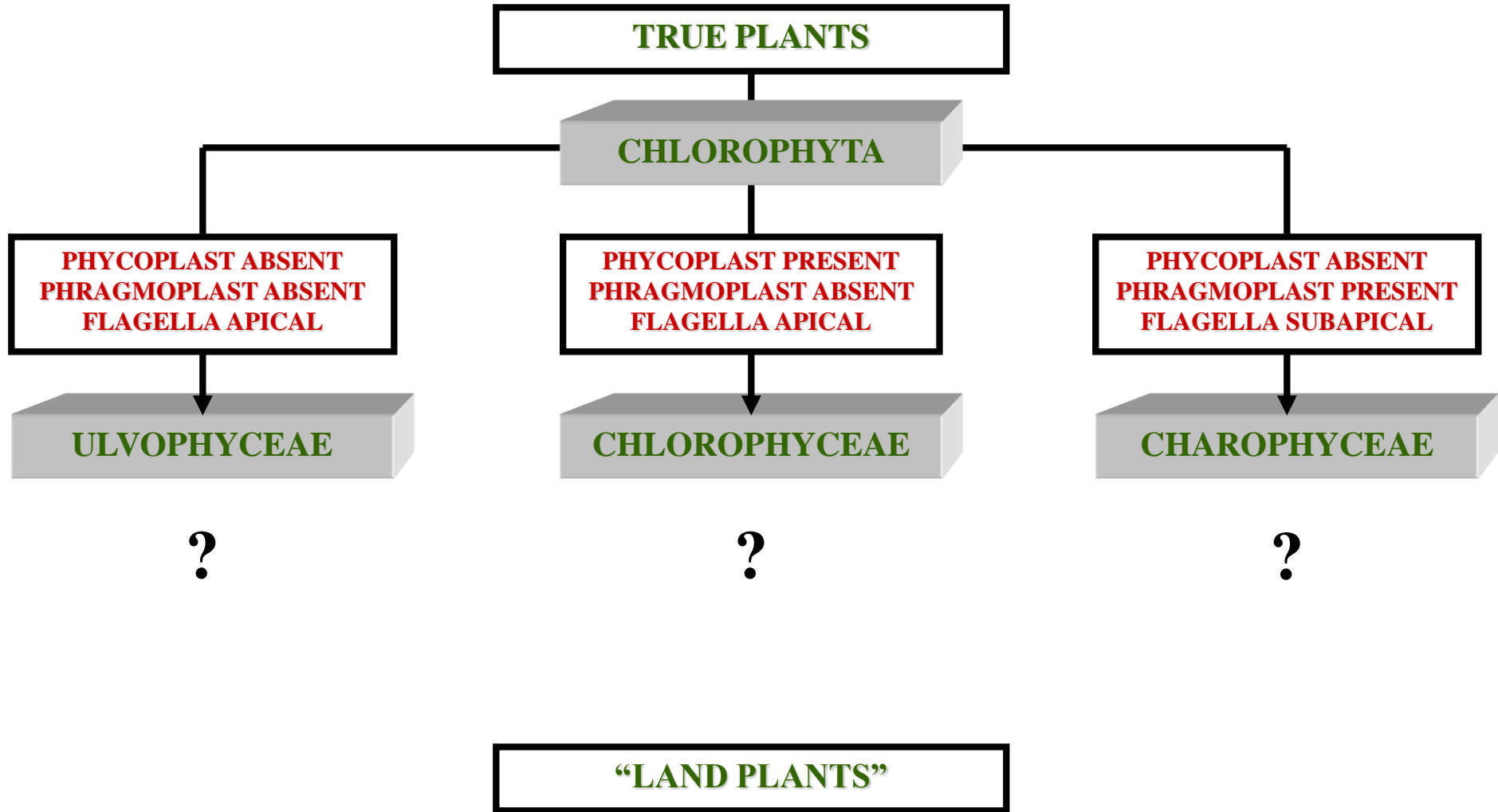
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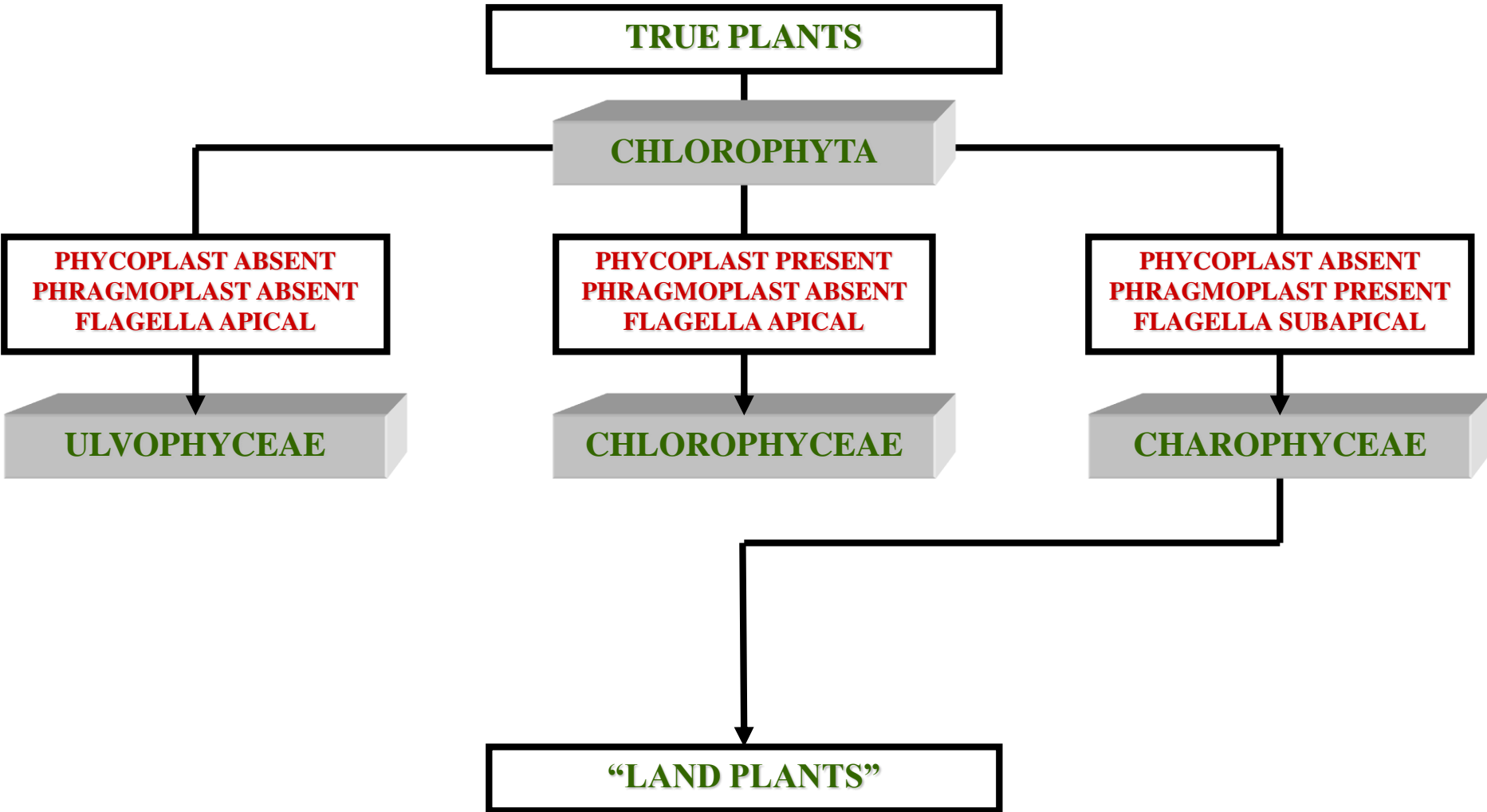
**PHYCOPLAST ABSENT
PHRAGMOPLAST PRESENT
FLAGELLA SUBAPICAL**

CHAROPHYCEAE

?

“LAND PLANTS”







TRUE PLANTS

CHLOROPHYTA

**PHYCOPLAST ABSENT
PHRAGMOPLAST ABSENT
FLAGELLA APICAL**

**PHYCOPLAST PRESENT
PHRAGMOPLAST ABSENT
FLAGELLA APICAL**

**PHYCOPLAST ABSENT
PHRAGMOPLAST PRESENT
FLAGELLA SUBAPICAL**

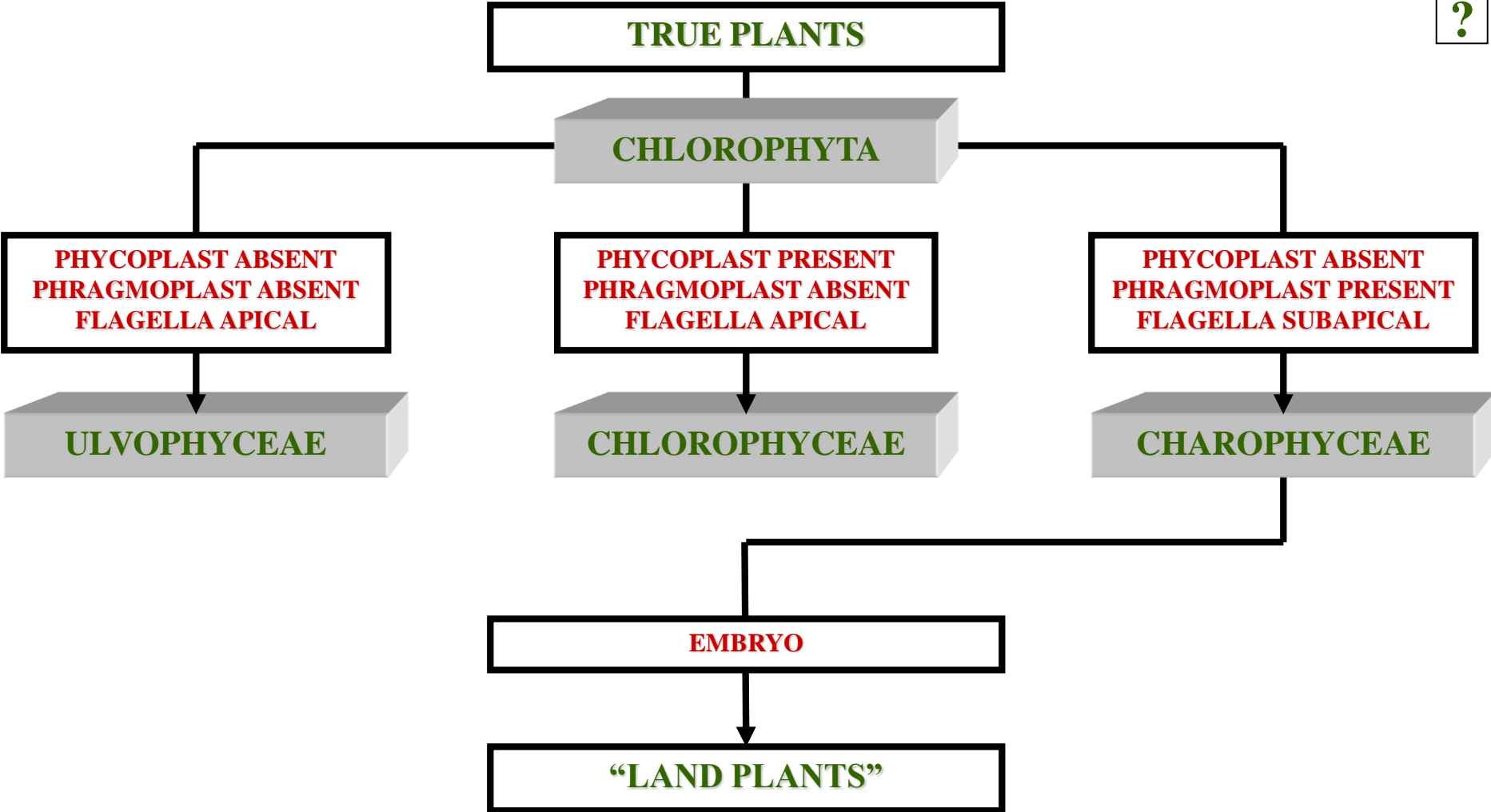
ULVOPHYCEAE

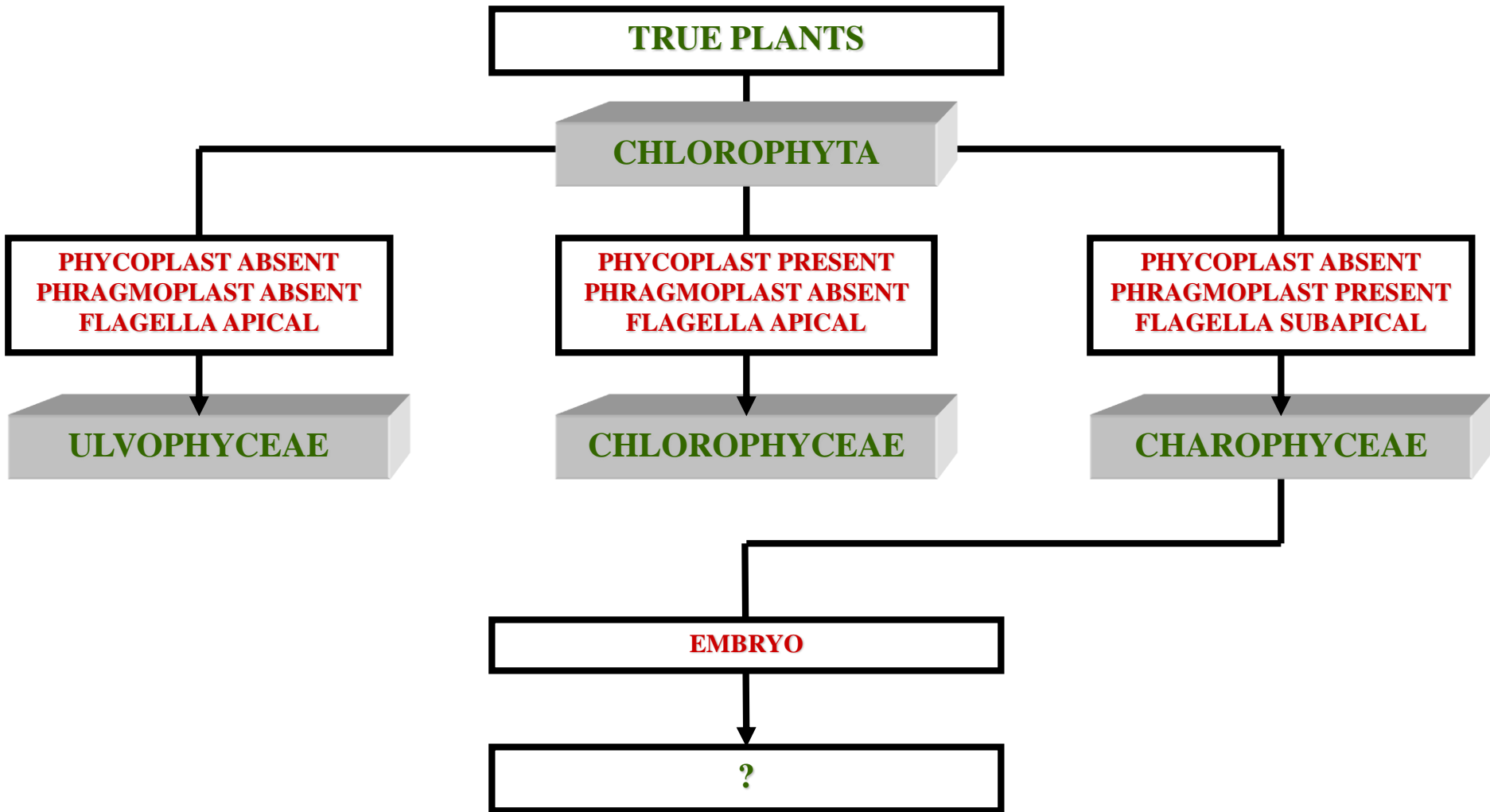
CHLOROPHYCEAE

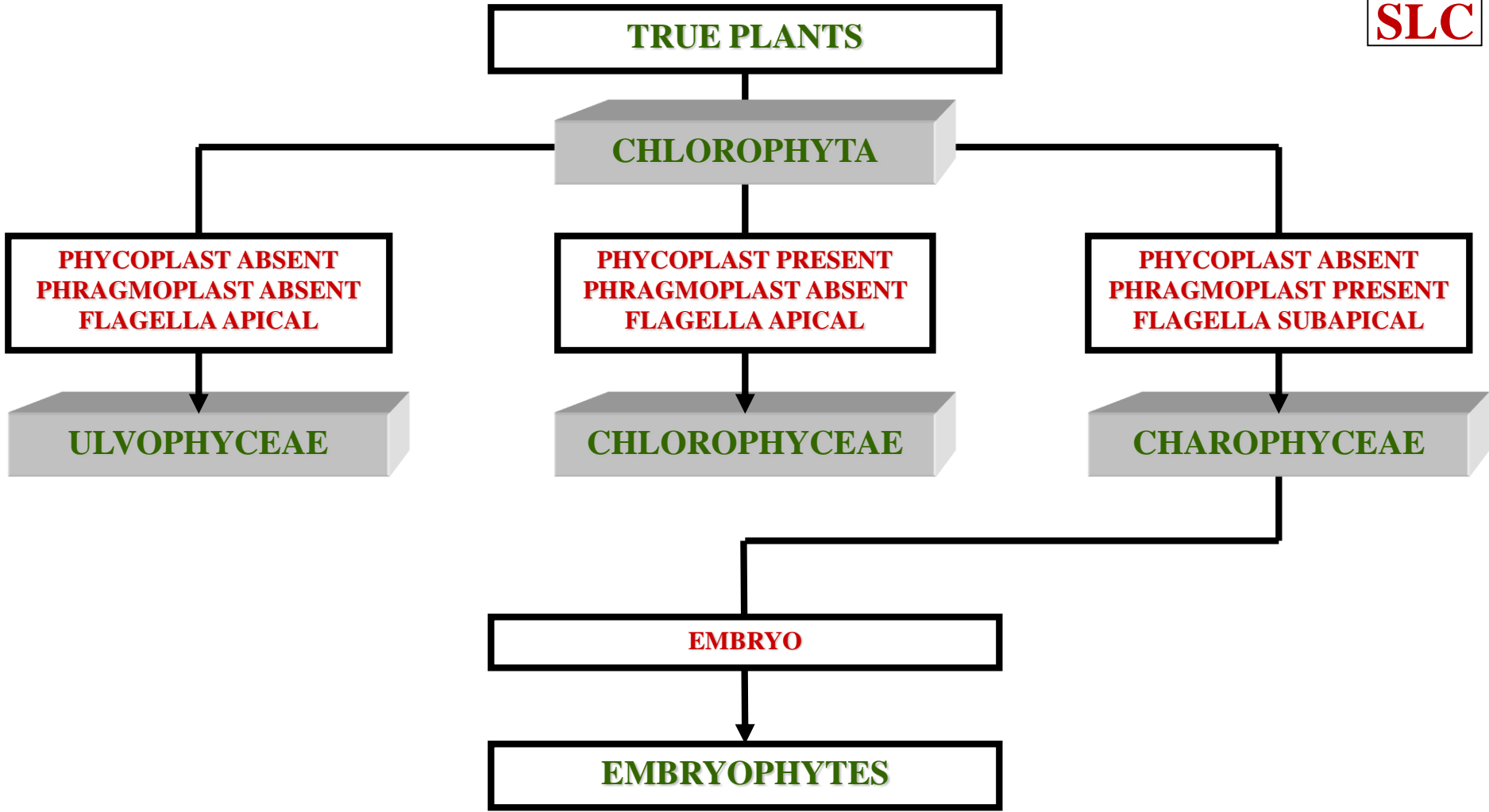
CHAROPHYCEAE

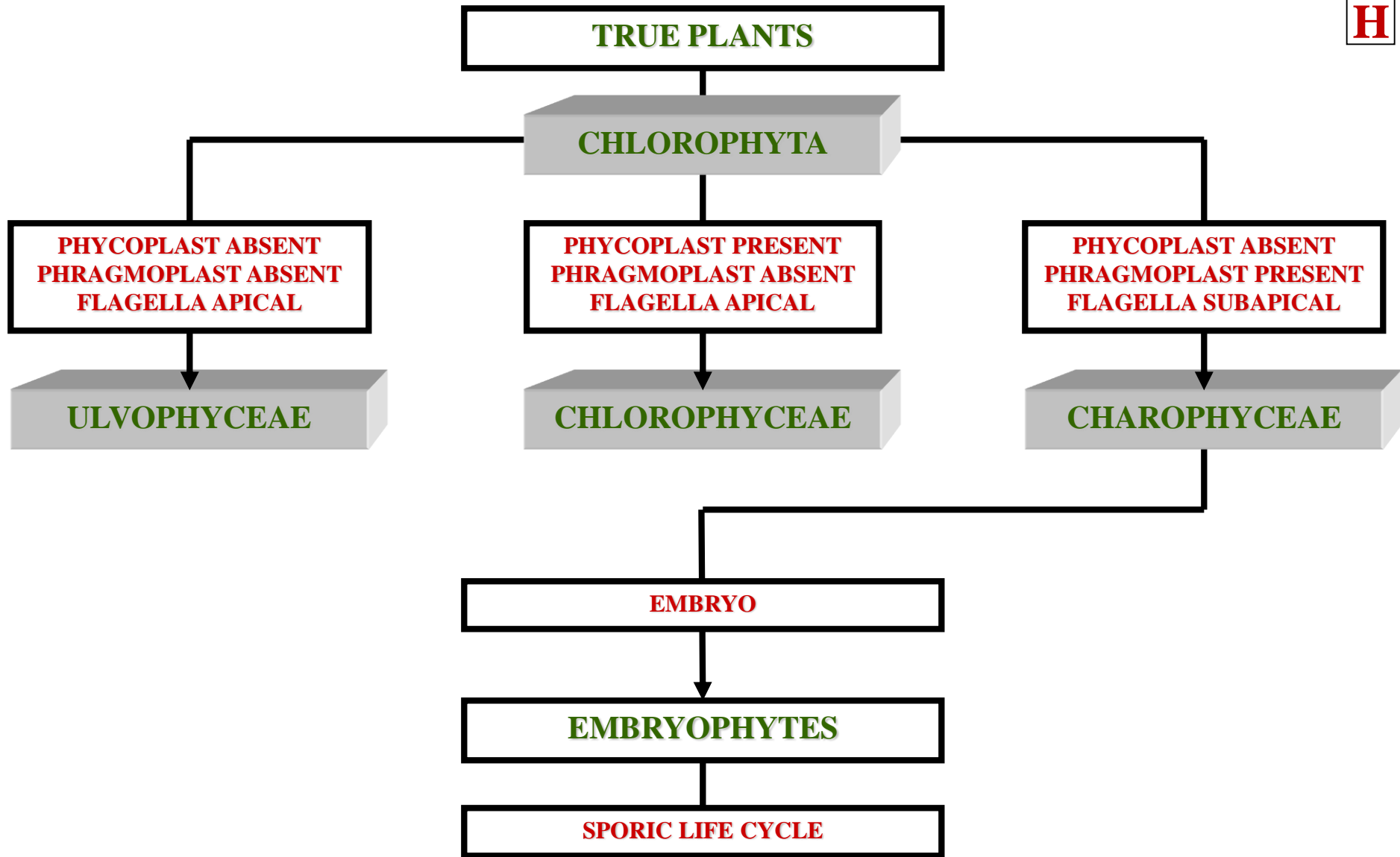
EMBRYO

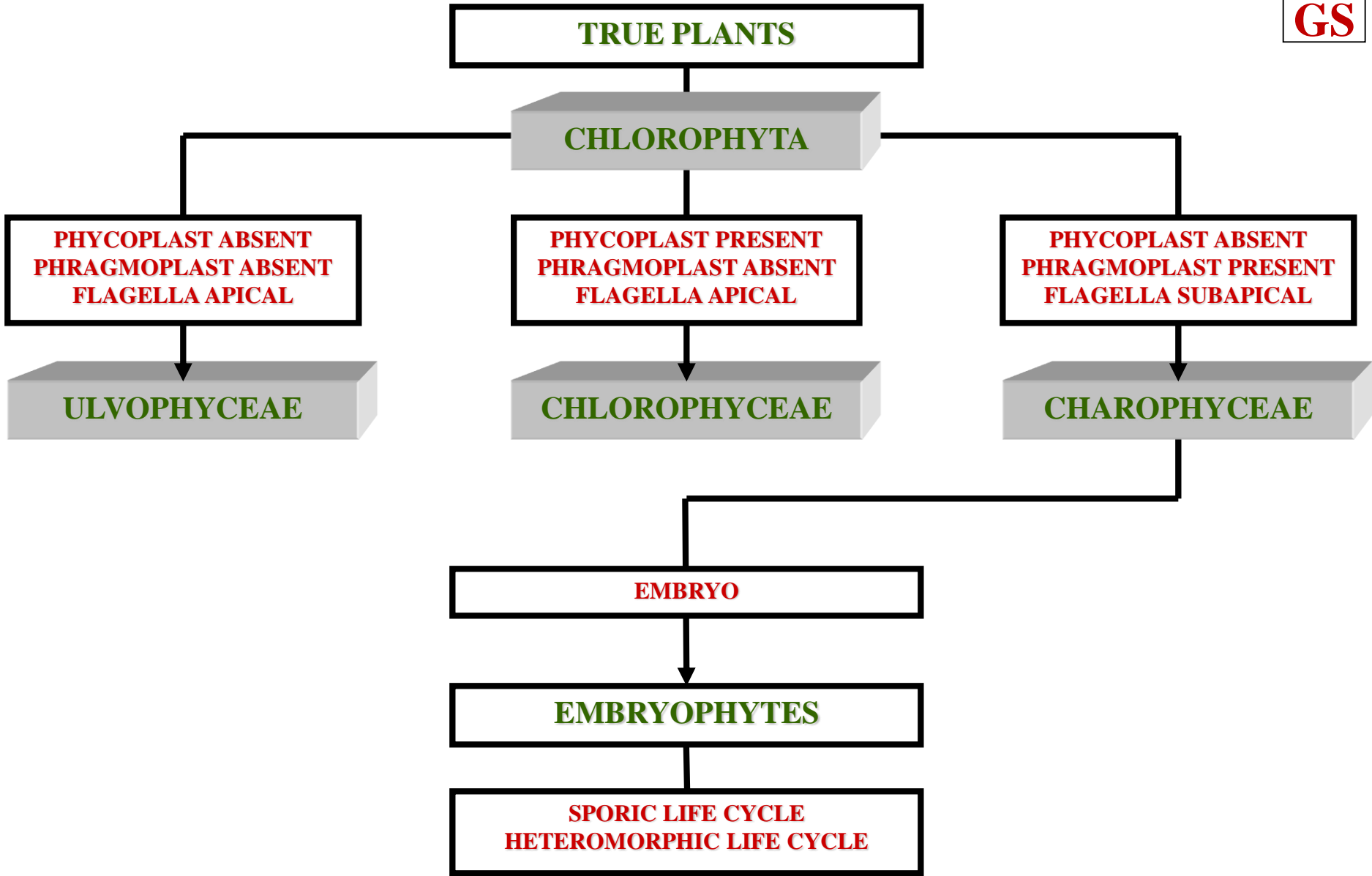
“LAND PLANTS”

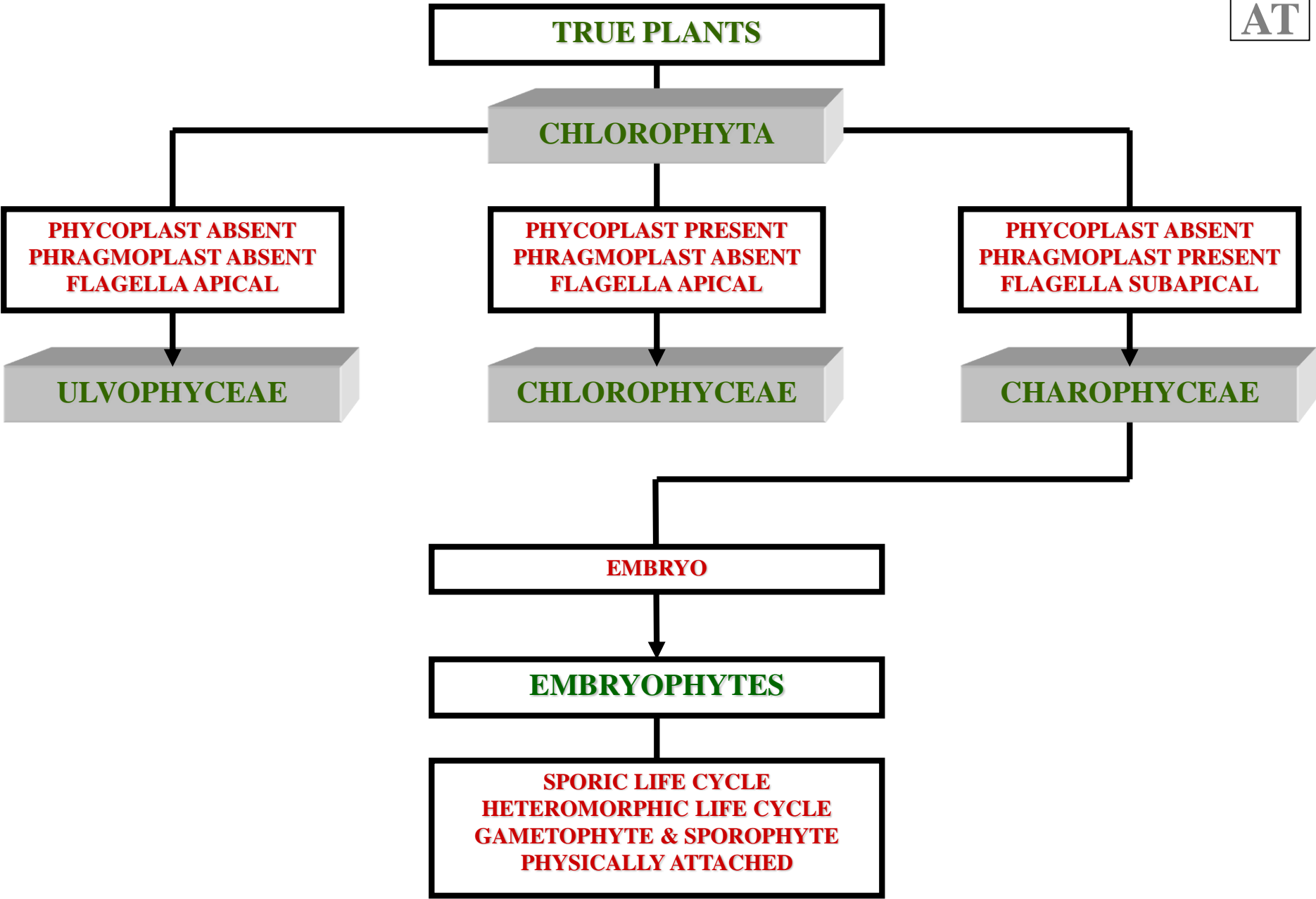














TRUE PLANTS

CHLOROPHYTA

**PHYCOPLAST ABSENT
PHRAGMOPLAST ABSENT
FLAGELLA APICAL**

ULVOPHYCEAE

**PHYCOPLAST PRESENT
PHRAGMOPLAST ABSENT
FLAGELLA APICAL**

CHLOROPHYCEAE

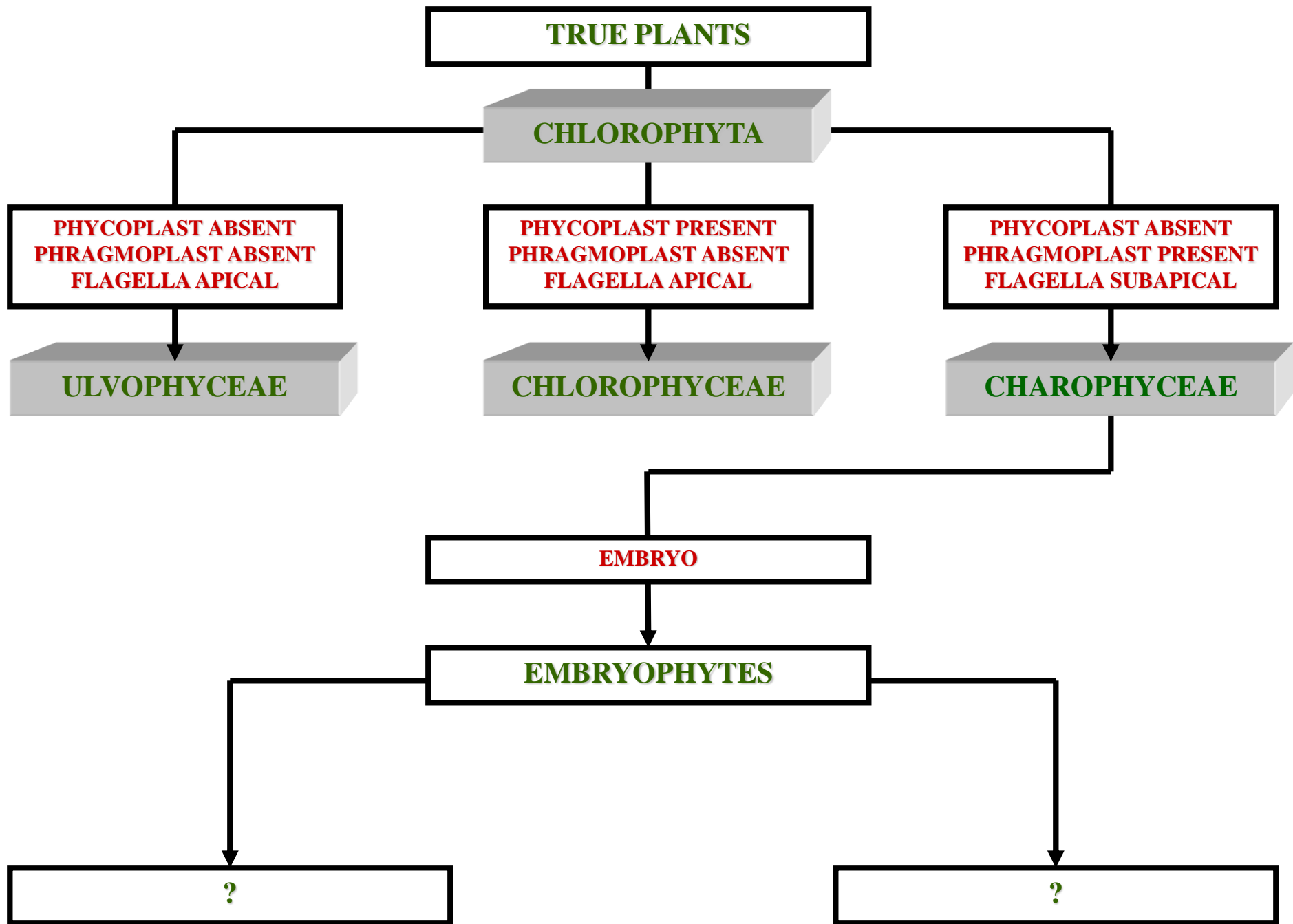
**PHYCOPLAST ABSENT
PHRAGMOPLAST PRESENT
FLAGELLA SUBAPICAL**

CHAROPHYCEAE

EMBRYO

EMBRYOPHYTES

**SPORIC LIFE CYCLE
HETEROMORPHIC LIFE CYCLE
GAMETOPHYTE & SPOROPHYTE
PHYSICALLY ATTACHED
ANTITHETIC THEORY**





TRUE PLANTS

CHLOROPHYTA

**PHYCOPLAST ABSENT
PHRAGMOPLAST ABSENT
FLAGELLA APICAL**

**PHYCOPLAST PRESENT
PHRAGMOPLAST ABSENT
FLAGELLA APICAL**

**PHYCOPLAST ABSENT
PHRAGMOPLAST PRESENT
FLAGELLA SUBAPICAL**

ULVOPHYCEAE

CHLOROPHYCEAE

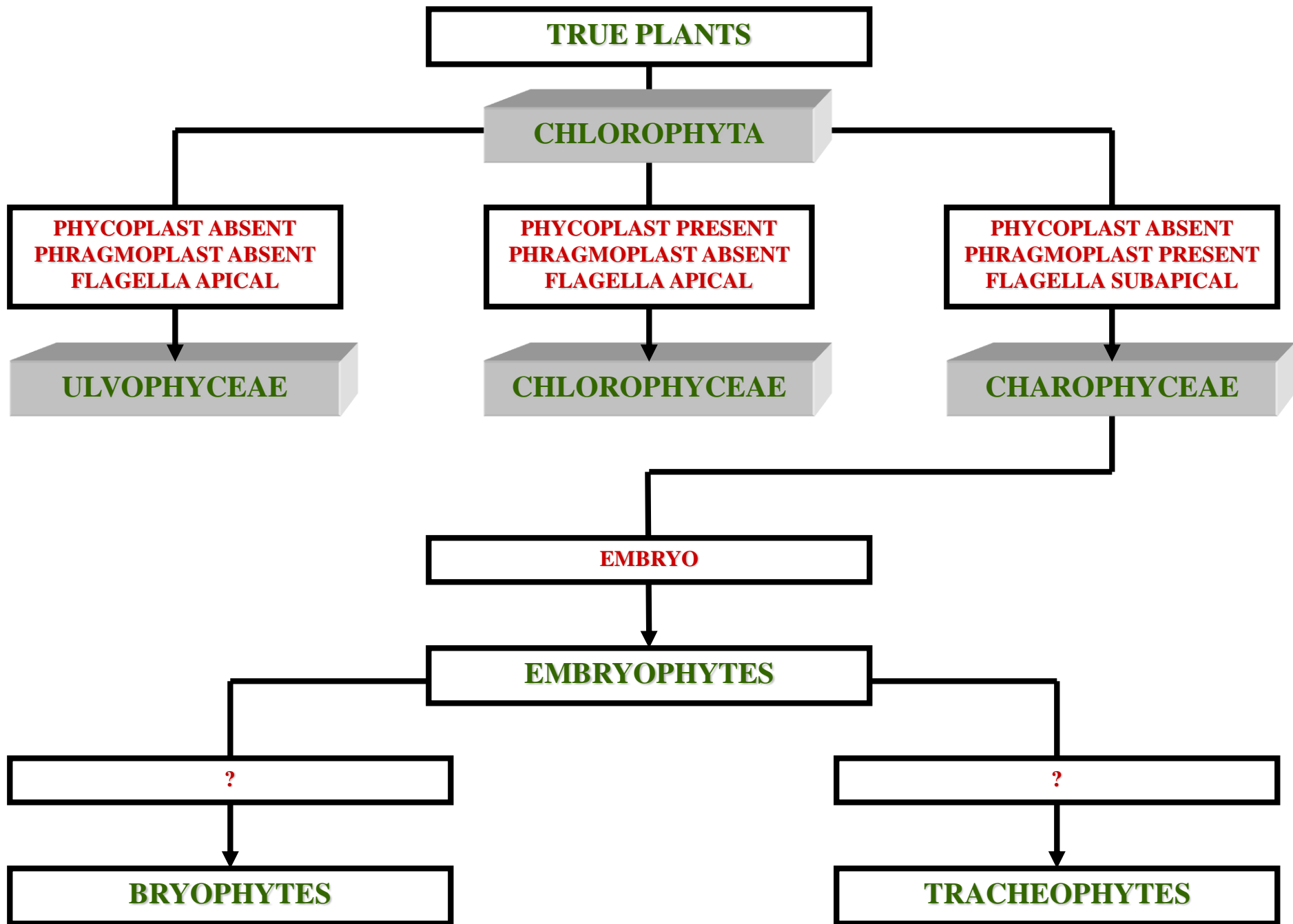
CHAROPHYCEAE

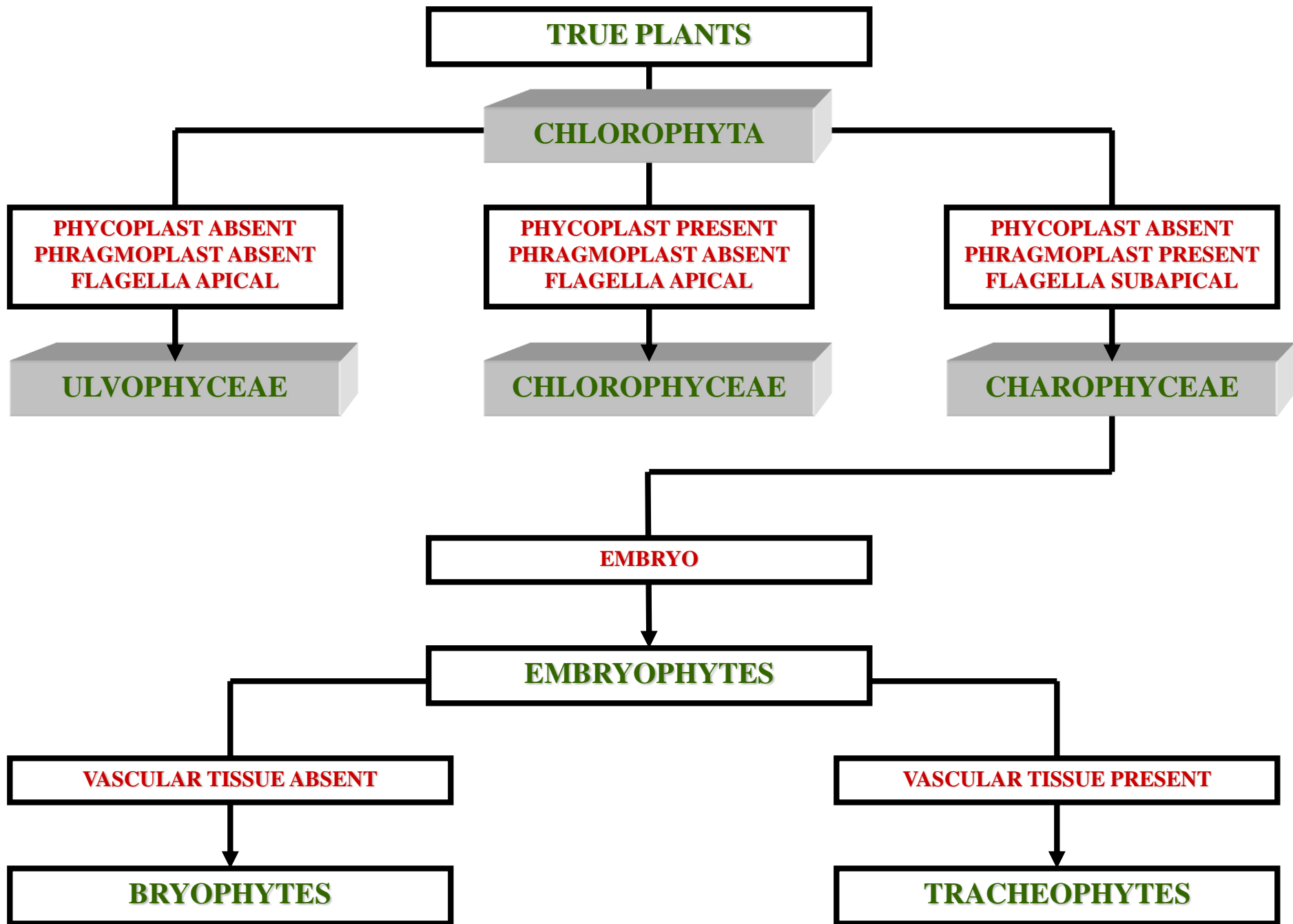
EMBRYO

EMBRYOPHYTES

BRYOPHYTES

TRACHEOPHYTES



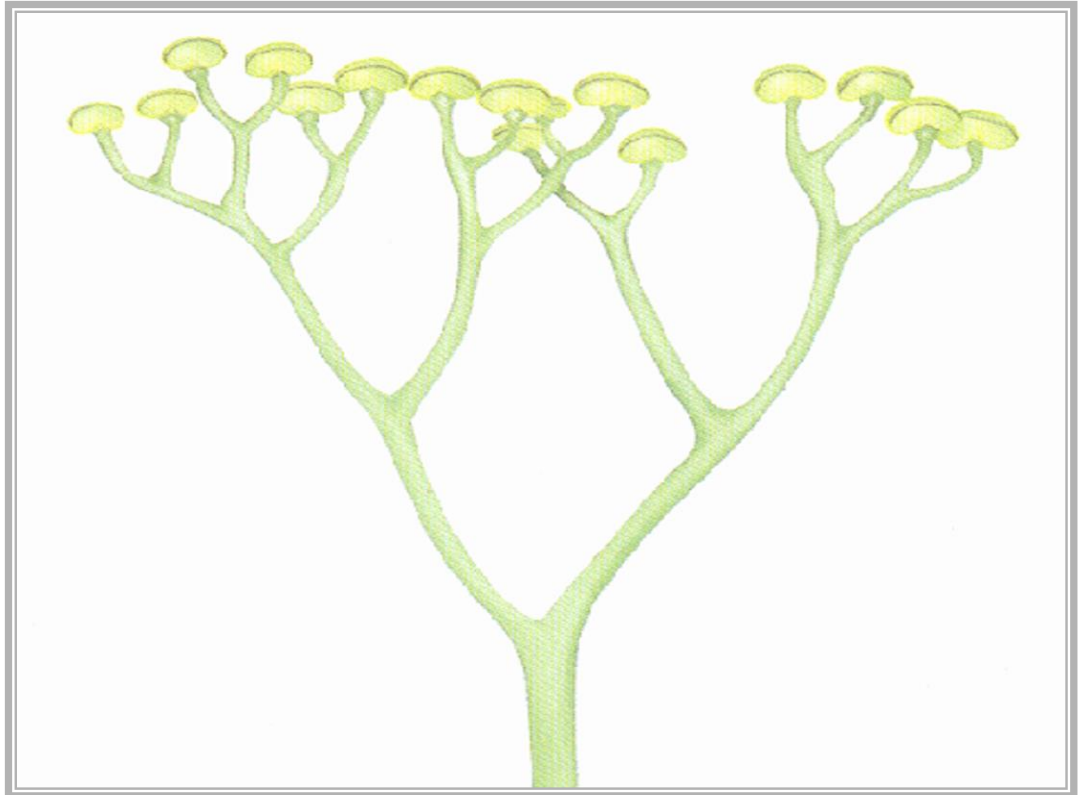


TRACHEOPHYTES



TRACHEOPHYTES

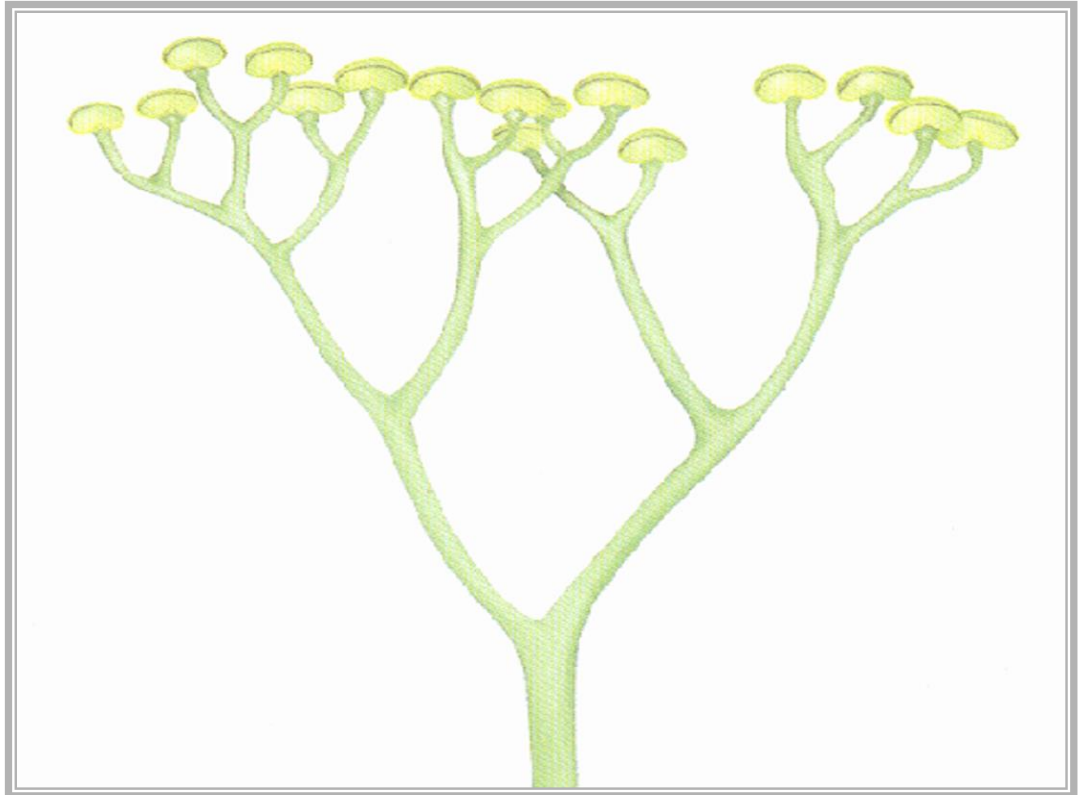
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TRACHEOPHYTES



RHYNIOPHYTA



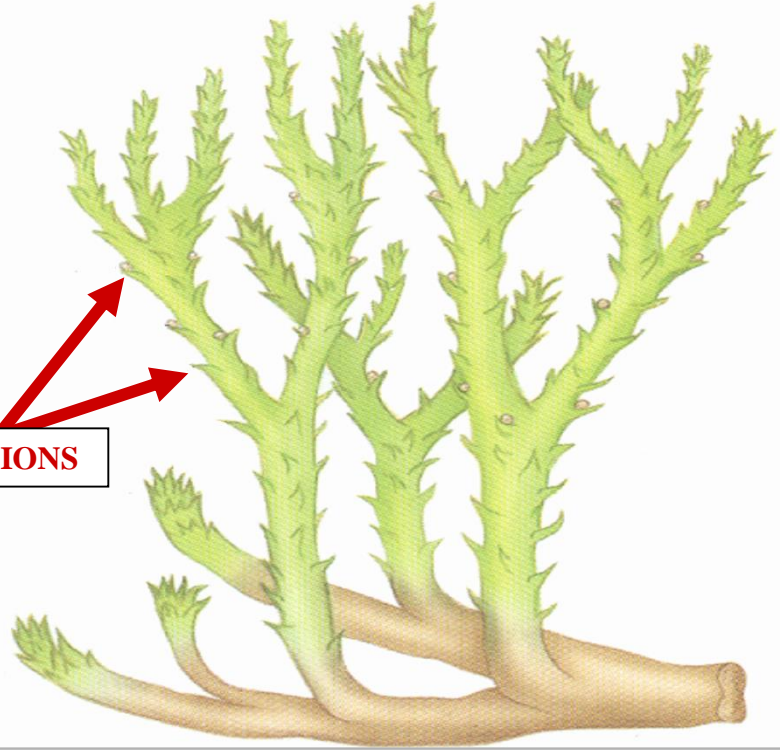
TRACHEOPHYTES

RHYNIOPHYTA

STEM ENATIONS

ZOSTEROPHYLLOPHYTA

ENATIONS



TRACHEOPHYTES

RHYNIOPHYTA

STEM ENATIONS

ZOSTEROPHYLLOPHYTA

MICROPHYLLS

ENATIONS

