

**ONCE PINNATE
COMPOUND
FROND**

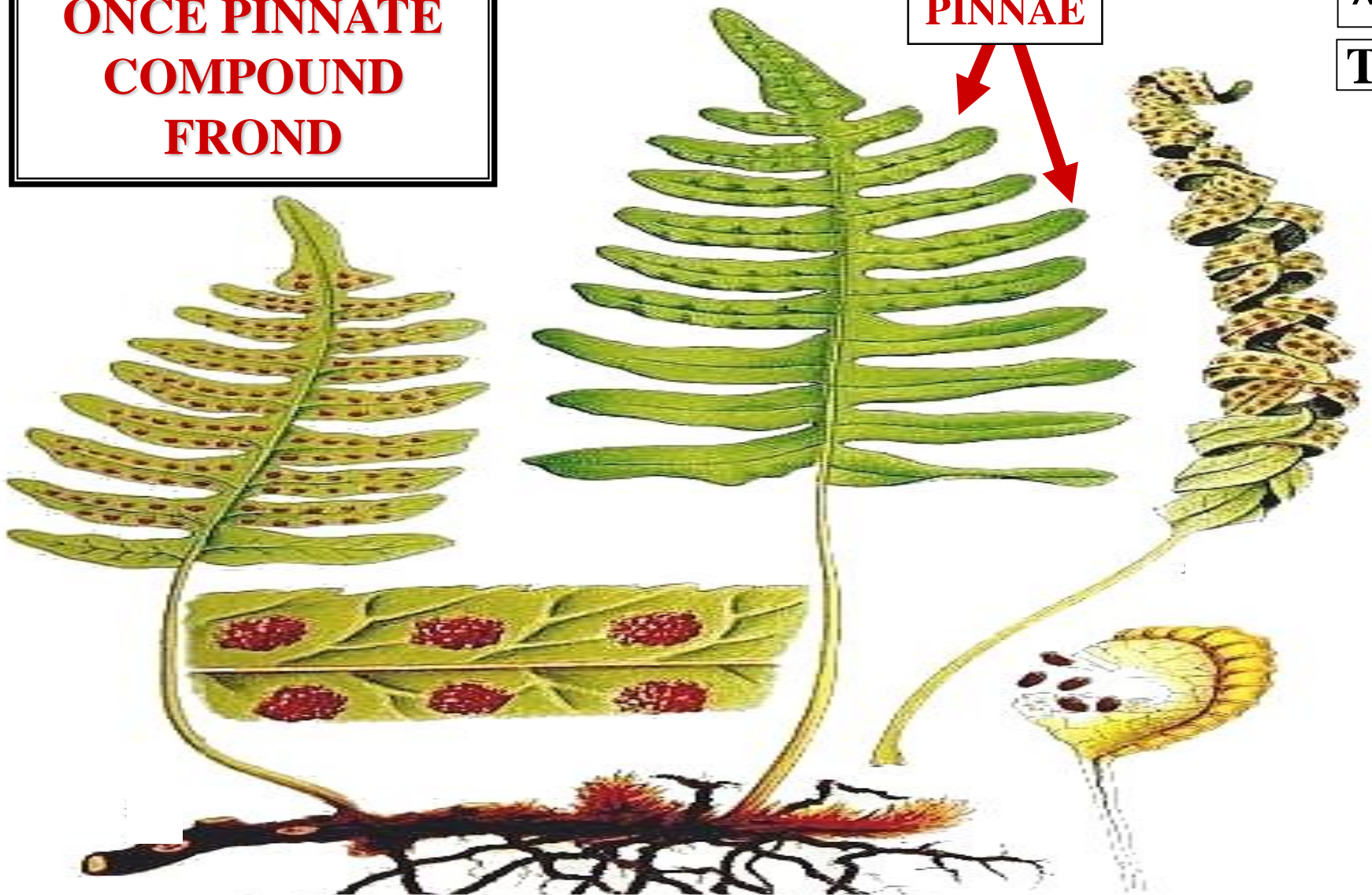


POLYPODIUM

**ONCE PINNATE
COMPOUND
FROND**

PINNAE

^
T



POLYPODIUM

**TWICE PINNATE
COMPOUND
FROND**

**COMPOUND FROND
TWICE PINNATE**



**COMPOUND FROND
BEARS
PINNAE & PINNULES**

**COMPOUND FROND
TWICE PINNATE**

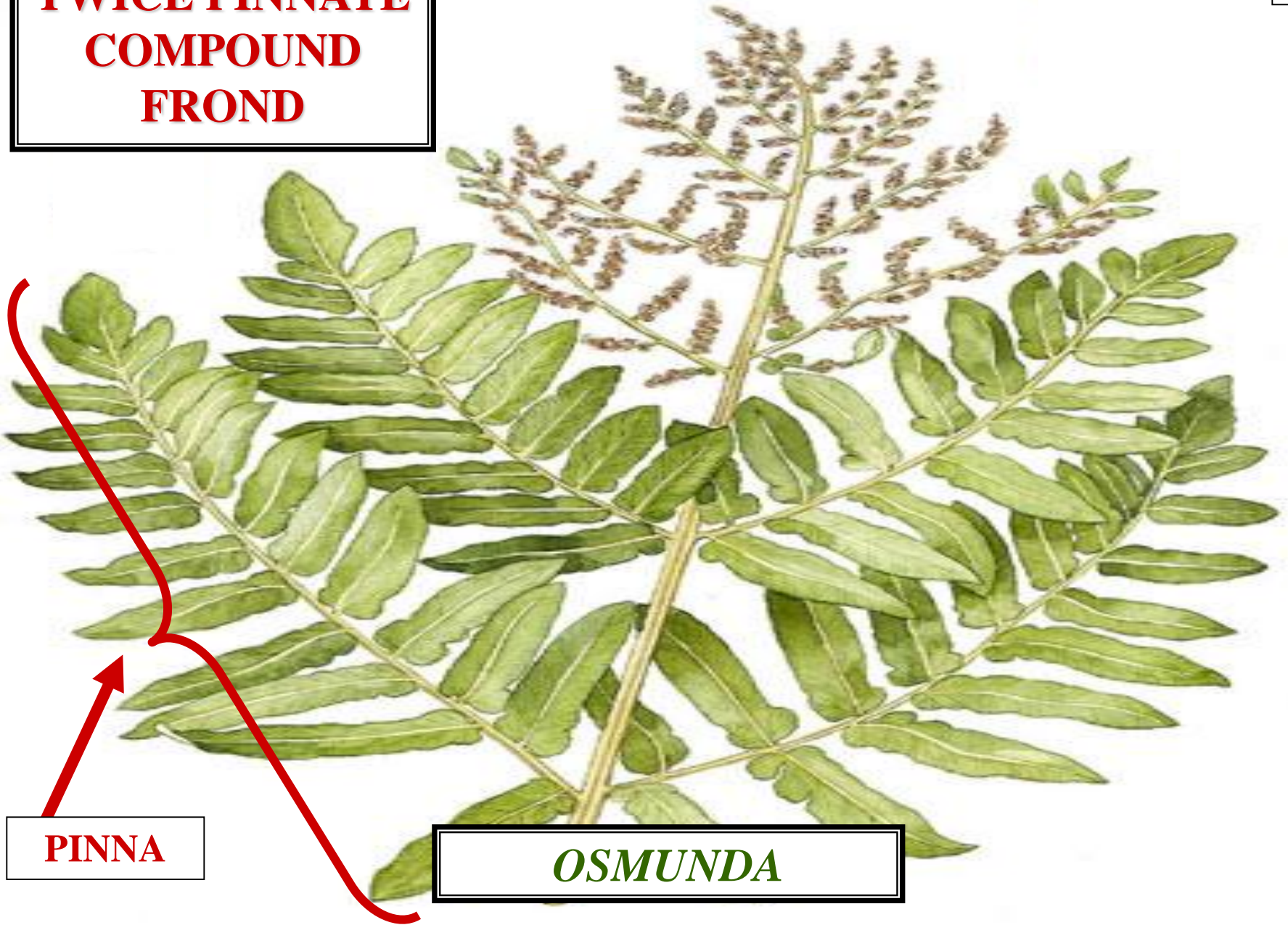
**TWICE PINNATE
COMPOUND
FROND**

P



OSMUNDA

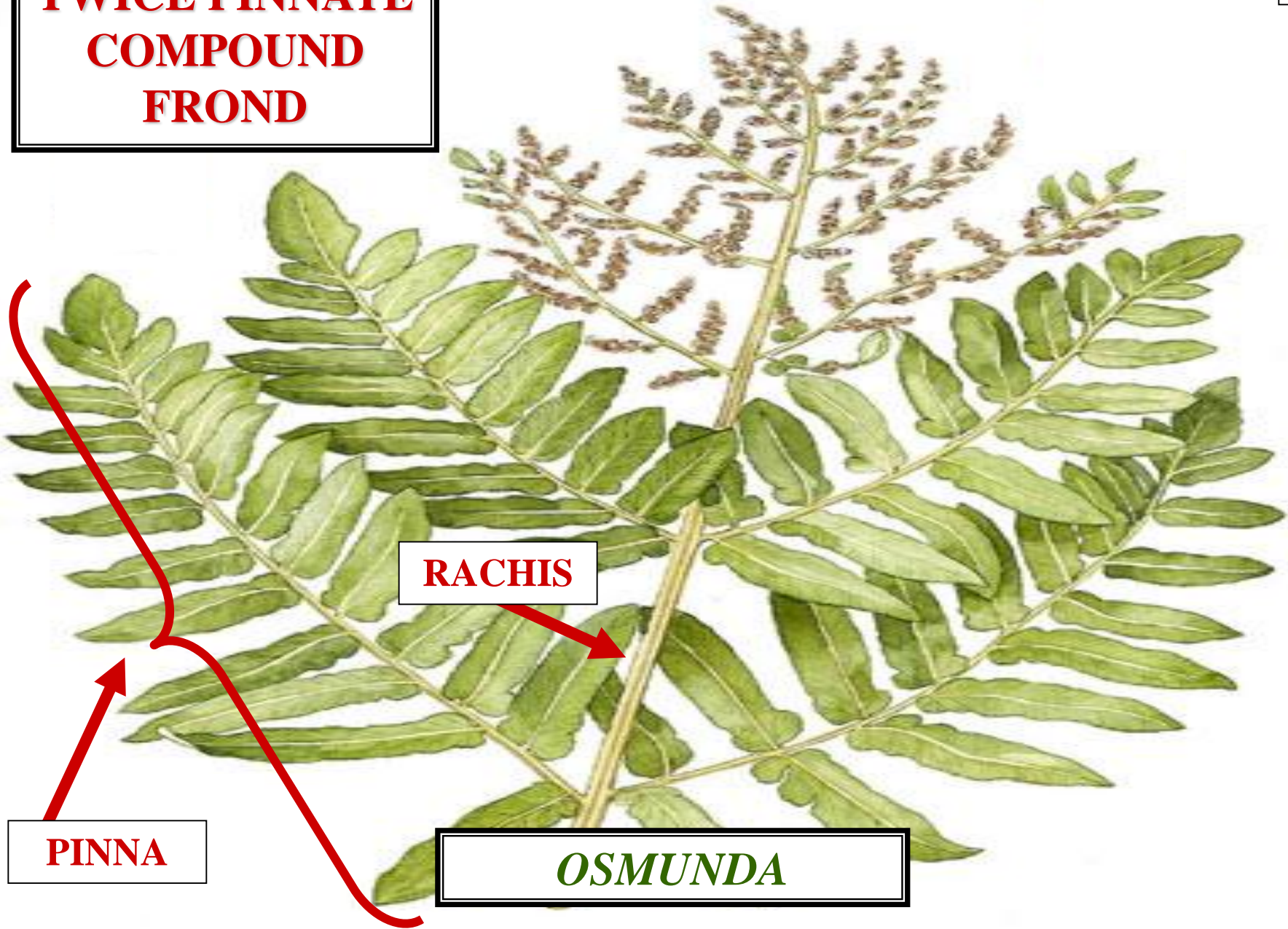
**TWICE PINNATE
COMPOUND
FROND**



PINNA

OSMUNDA

**TWICE PINNATE
COMPOUND
FROND**

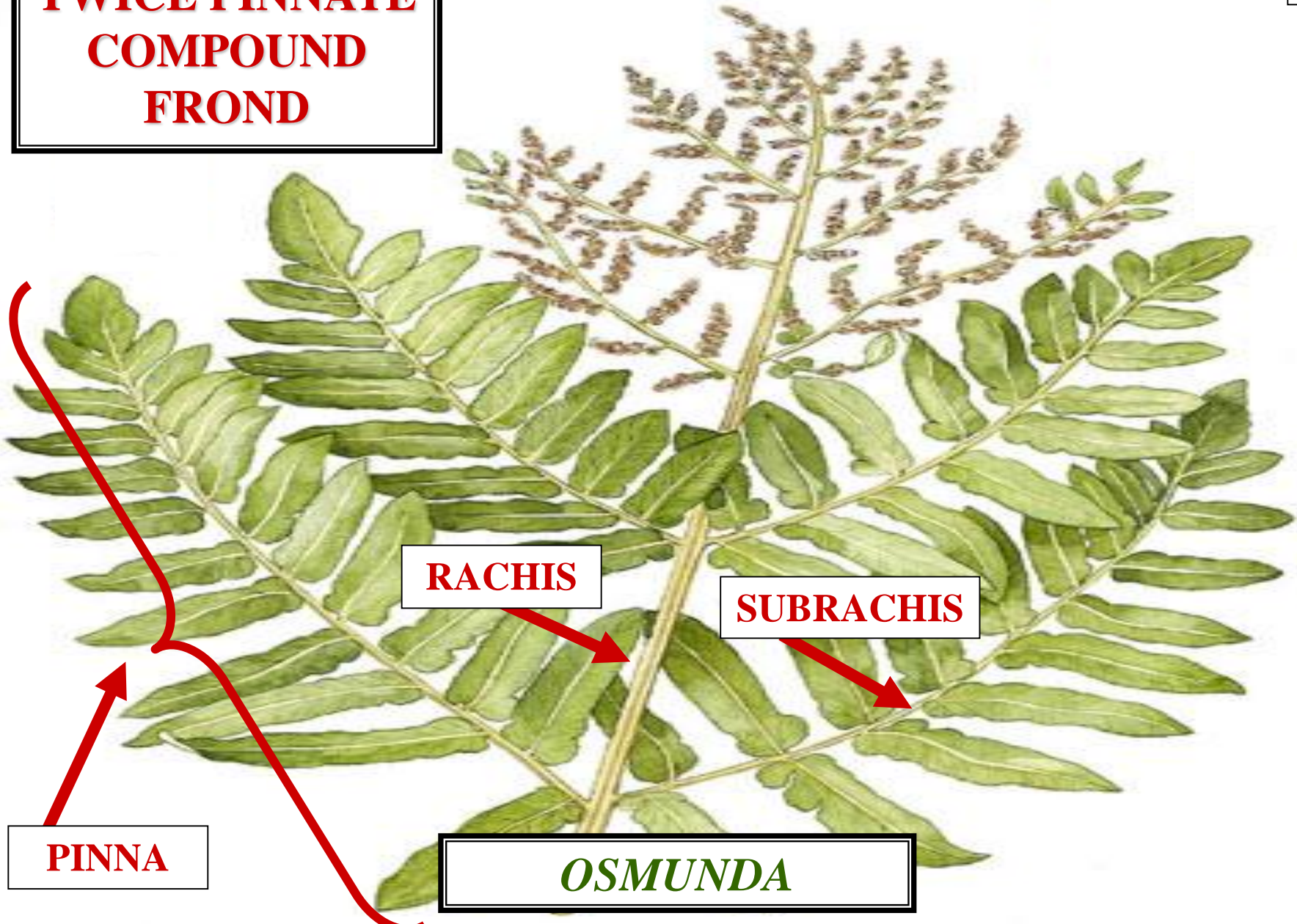


RACHIS

PINNA

OSMUNDA

**TWICE PINNATE
COMPOUND
FROND**



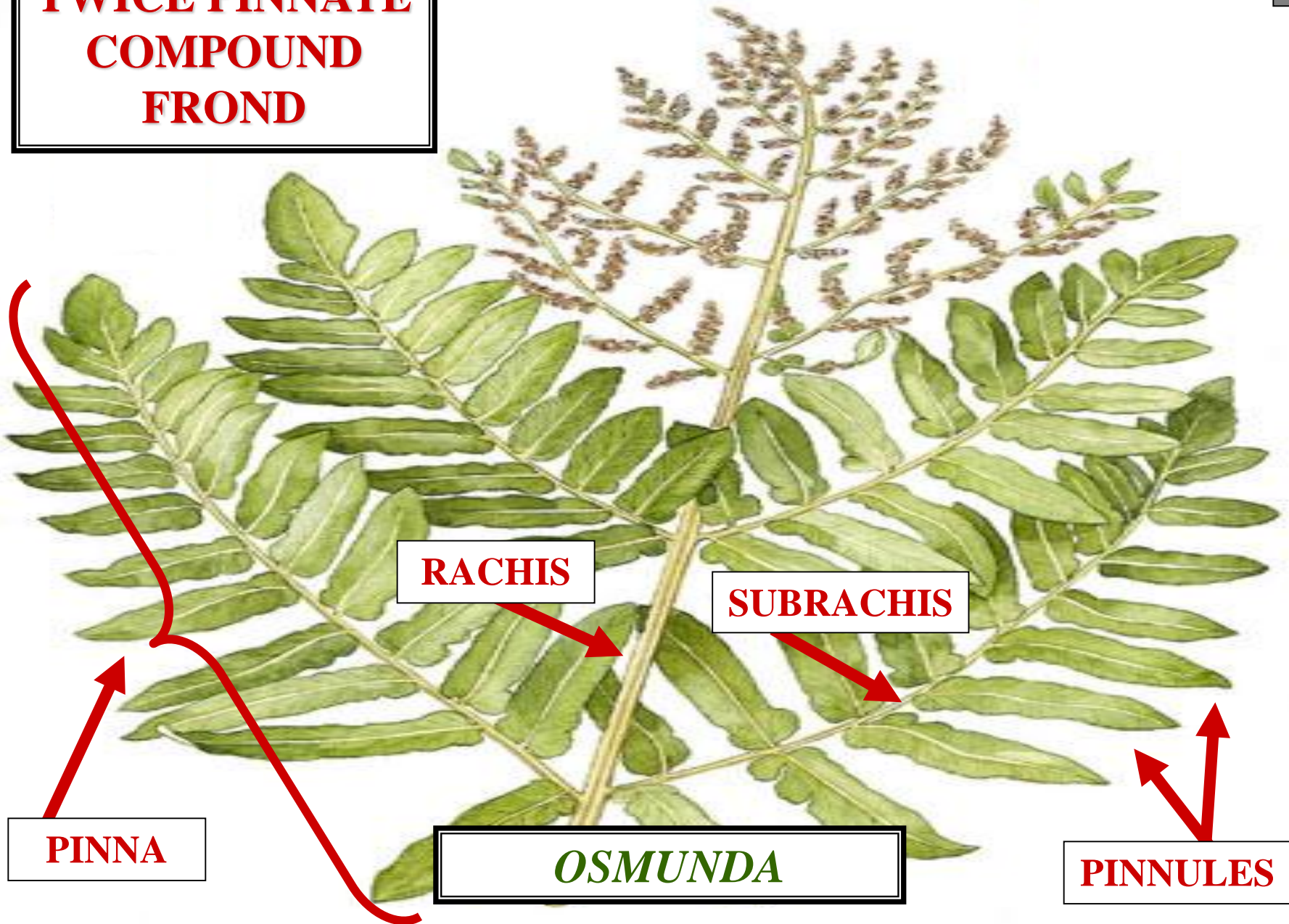
RACHIS

SUBRACHIS

PINNA

OSMUNDA

TWICE PINNATE COMPOUND FROND



RACHIS

SUBRACHIS

PINNA

OSMUNDA

PINNULES

SIMPLE FROND

SIMPLE FROND

FROND MORPHOLOGY

SIMPLE FROND



PINNAE ABSENT

FROND MORPHOLOGY

SIMPLE FROND

**SIMPLE
FERN FROND
MORPHOLOGY**



**SIMPLE
FERN FROND
MORPHOLOGY**

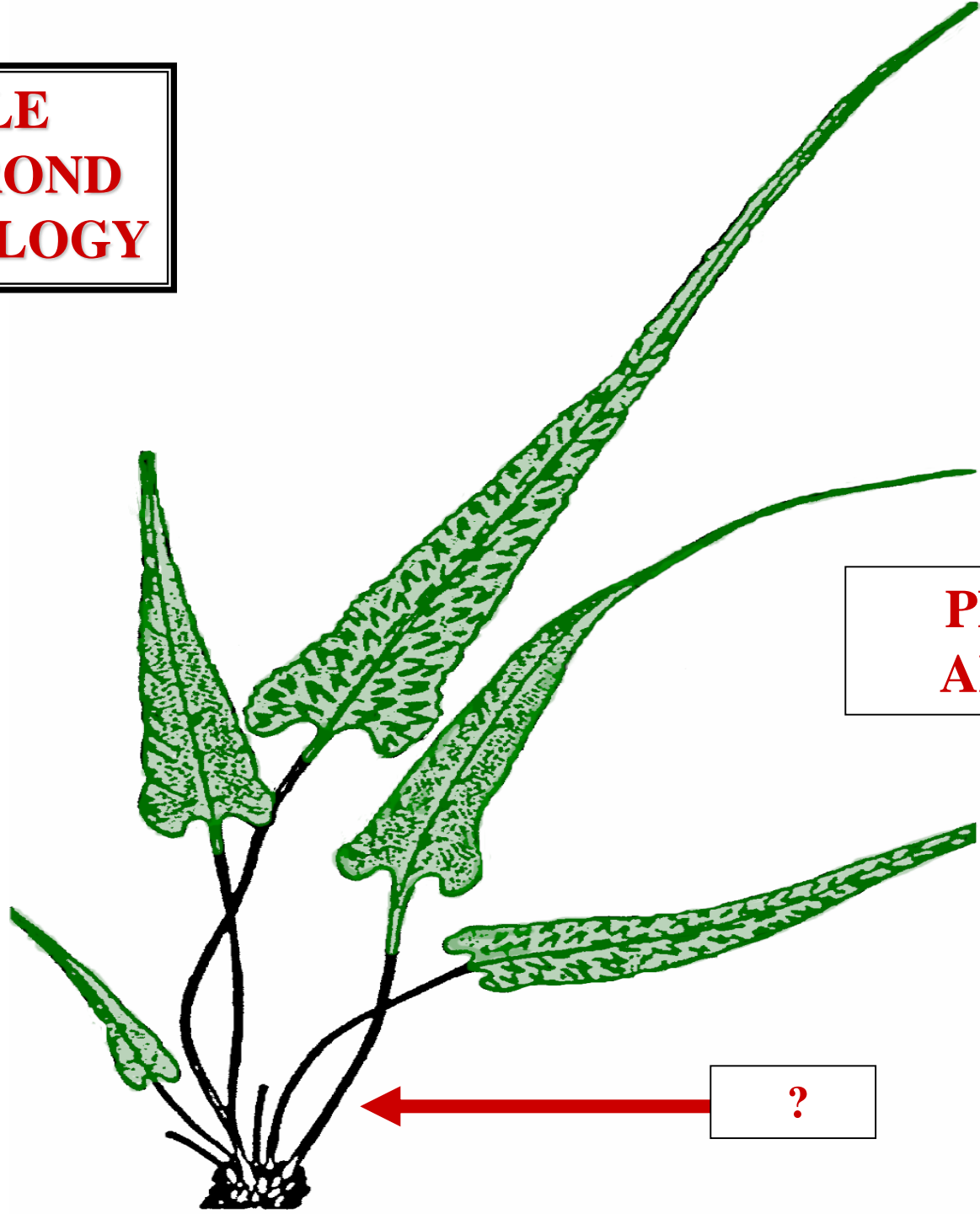


**PINNAE
ABSENT**



SIMPLE FROND MORPHOLOGY

**SIMPLE
FERN FROND
MORPHOLOGY**

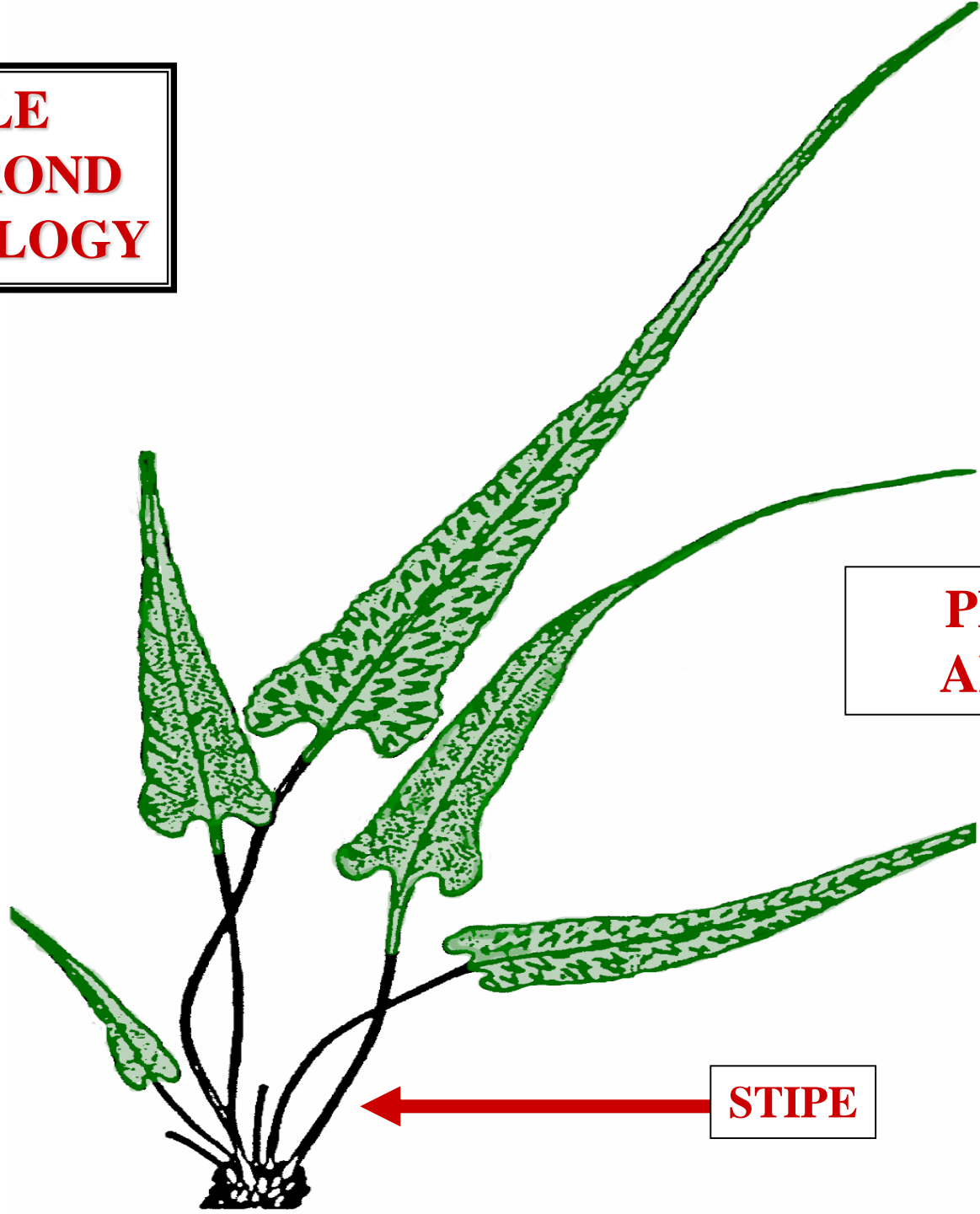


**PINNAE
ABSENT**

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**SIMPLE
FERN FROND
MORPHOLOGY**



**PINNAE
ABSENT**

STIPE

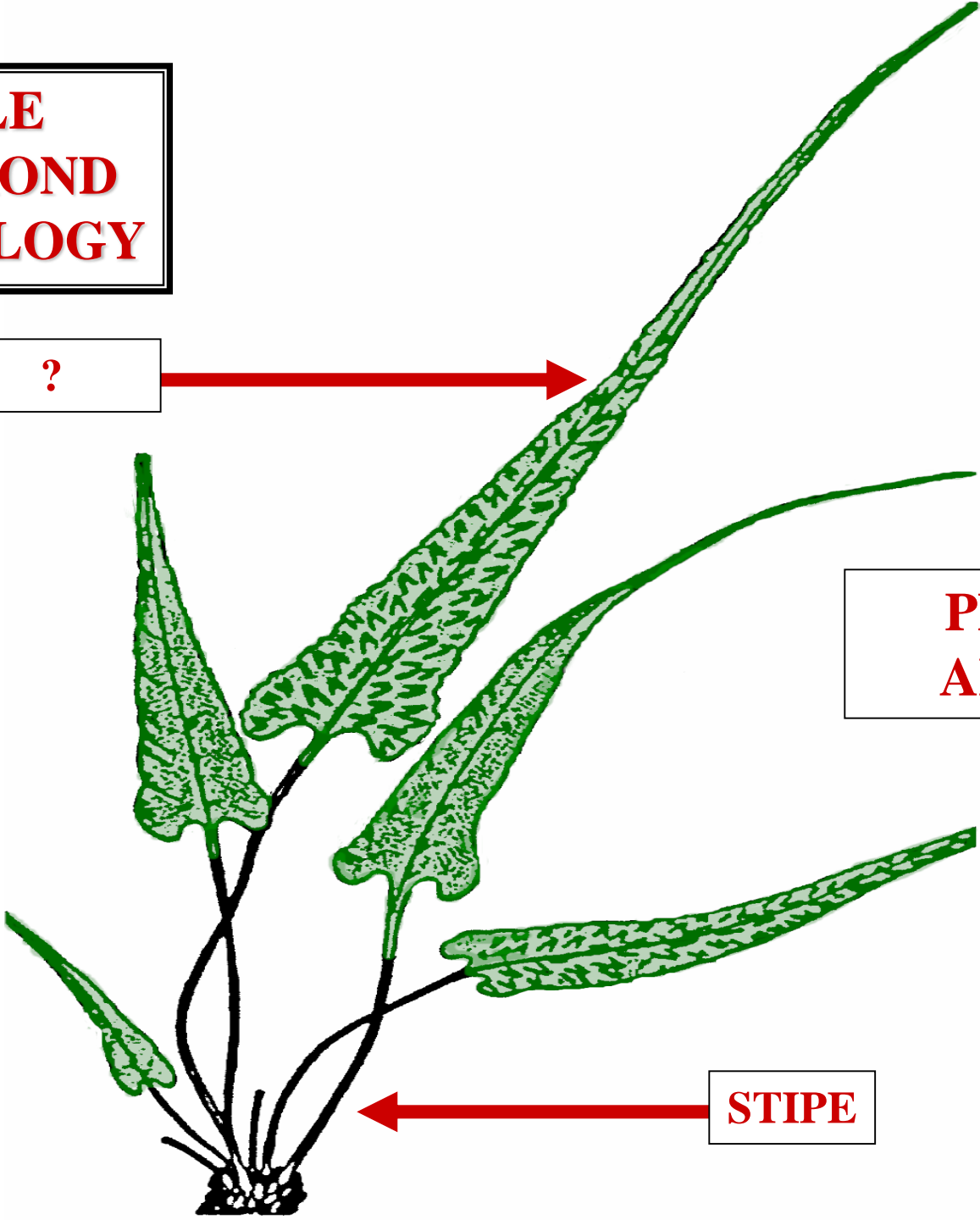


**SIMPLE
FERN FROND
MORPHOLOGY**

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**PINNAE
ABSENT**



STIPE





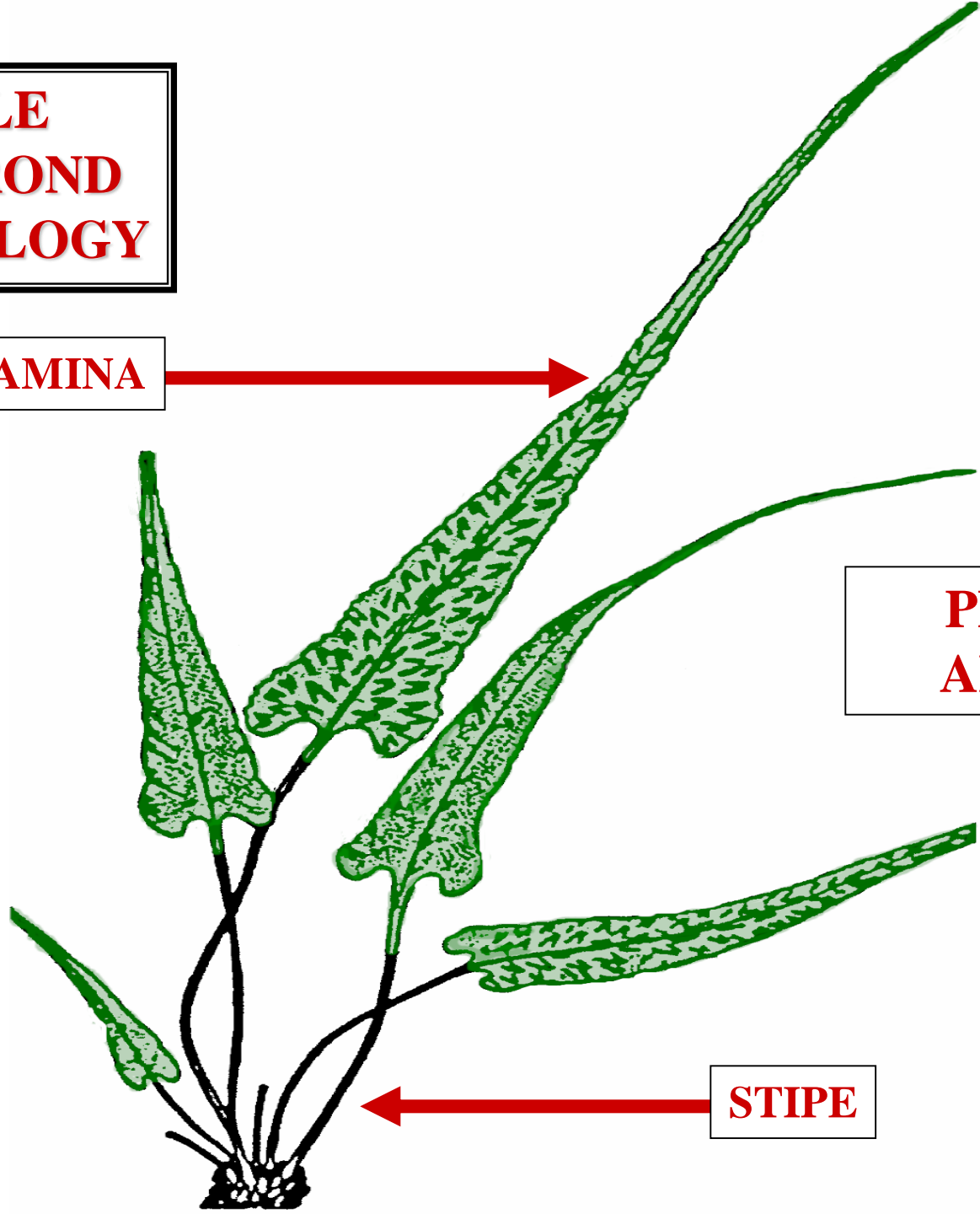
**SIMPLE
FERN FROND
MORPHOLOGY**

LAMINA



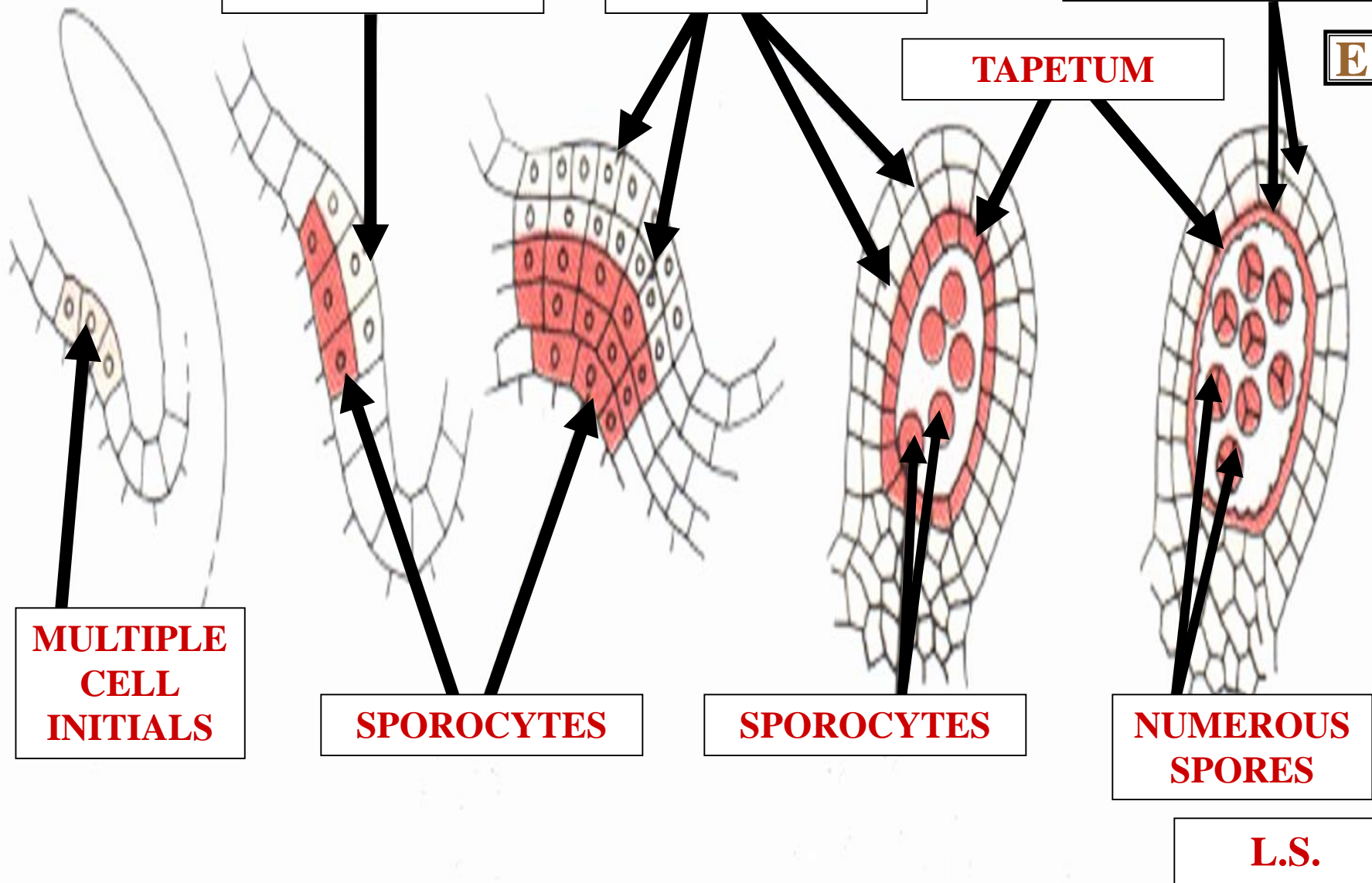
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ABSENT**

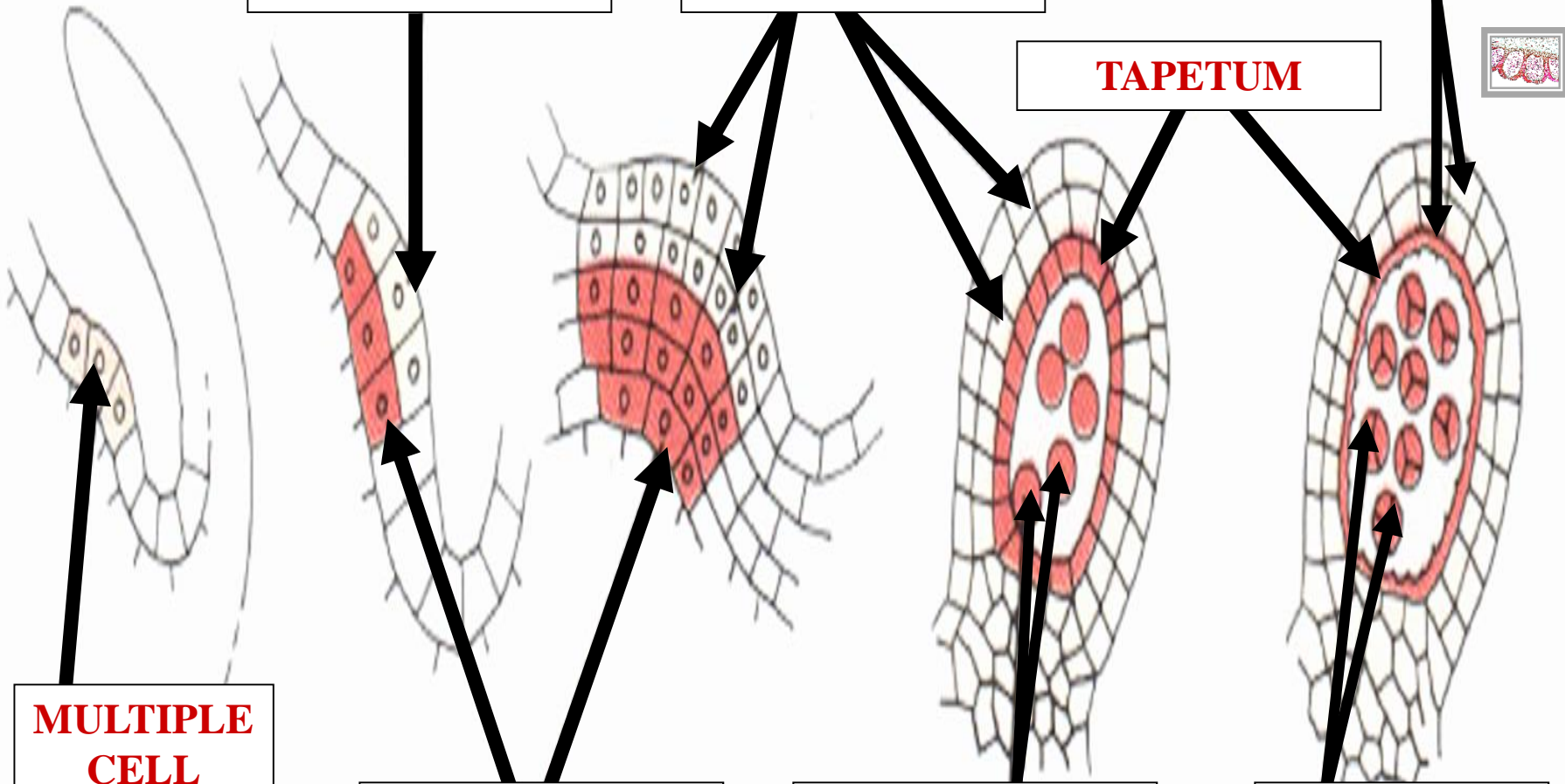
STIPE





SPORANGIUM





WALL CELLS

WALL CELLS

LARGE SIZE

THICK WALL

TAPETUM



**MULTIPLE
CELL
INITIALS**

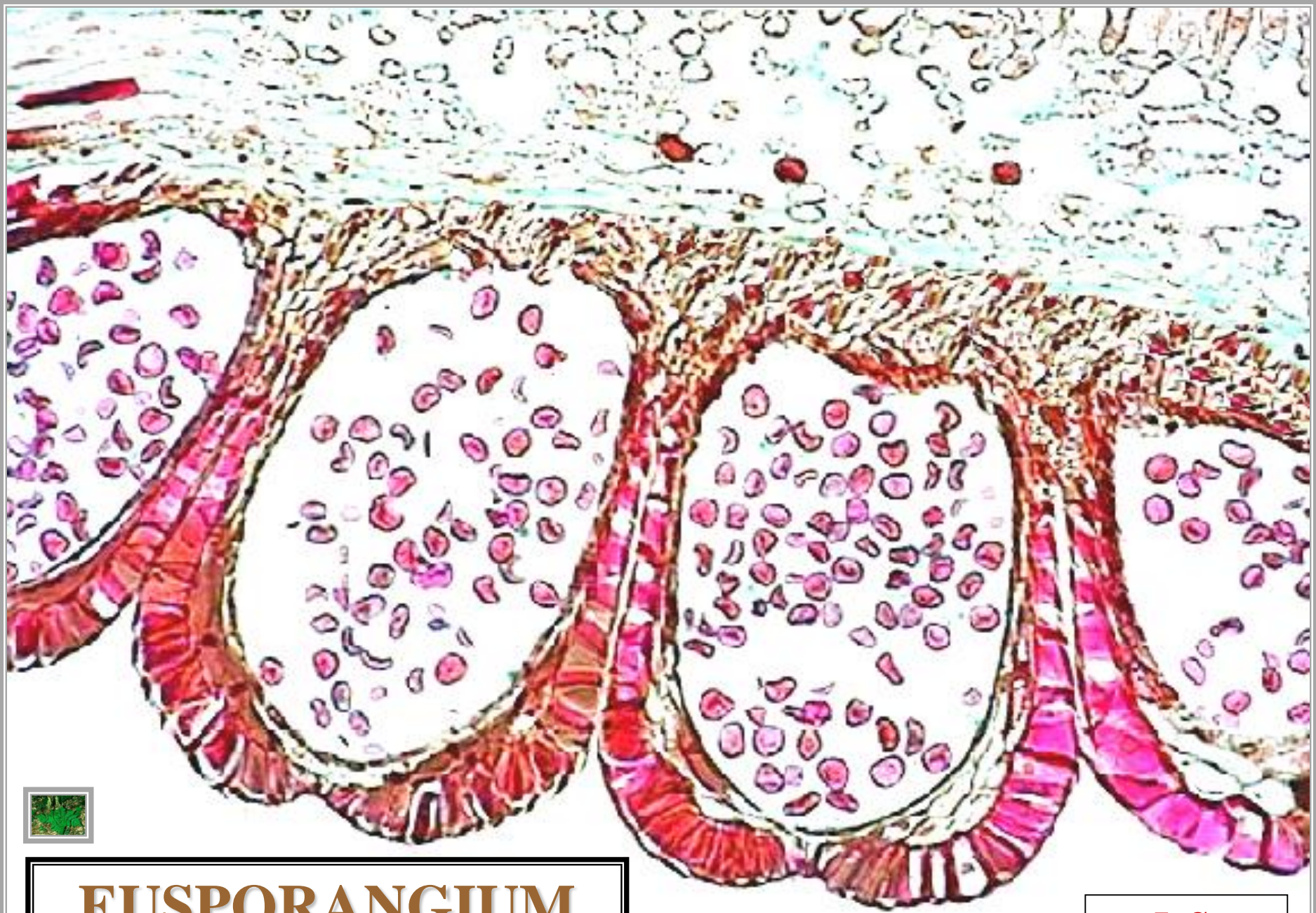
SPOROCYTES

SPOROCYTES

**NUMEROUS
SPORES**

EUSPORANGIUM

L.S.



EUSPORANGIUM

L.S.



BOTRYCHIUM

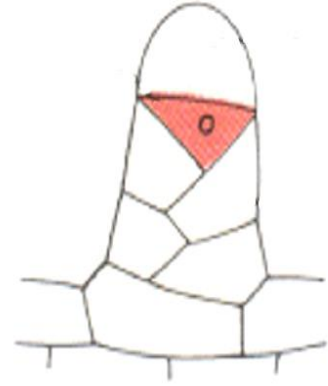
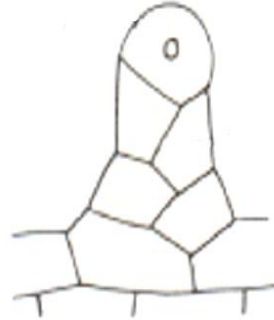
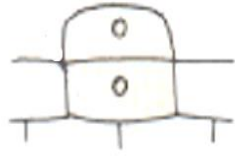
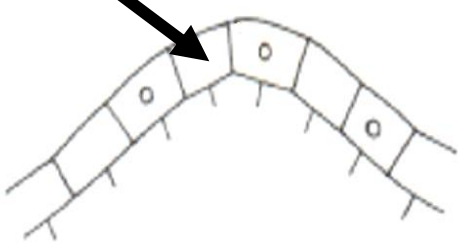
EUSPORANGIUM



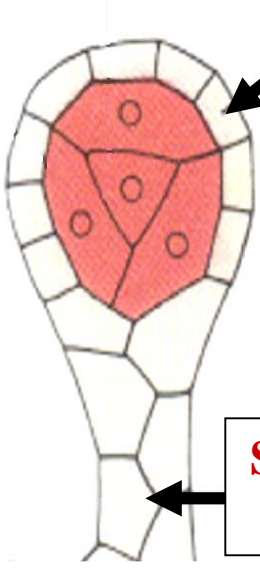
OPHIOGLOSSUM

EUSPORANGIUM

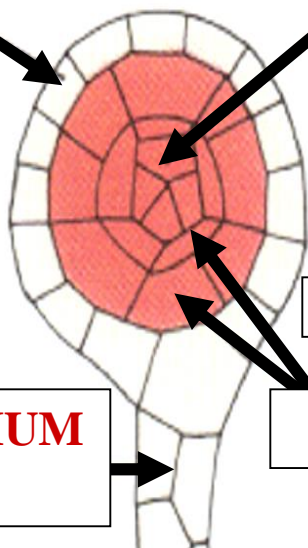
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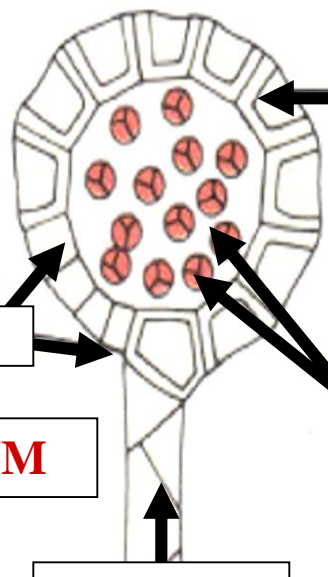
SPORANGIUM WALL



SPOROCYTES



SMALL SIZE



ANNULUS

THIN WALL

FEW SPORES

STOMIUM

TAPETUM

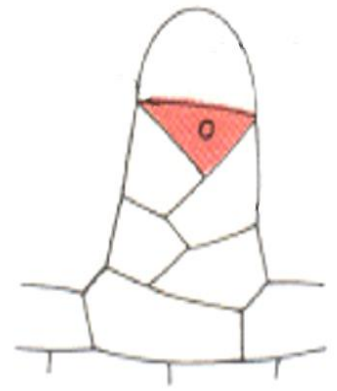
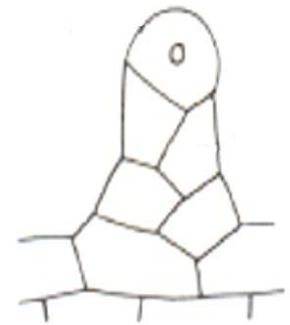
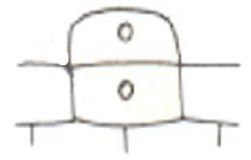
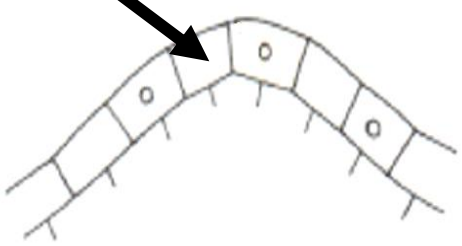
SPORANGIUM STALK

STALK

L.S.



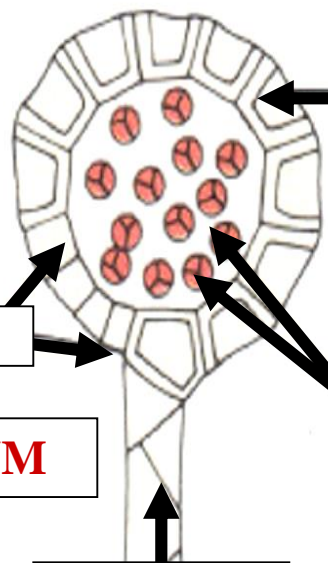
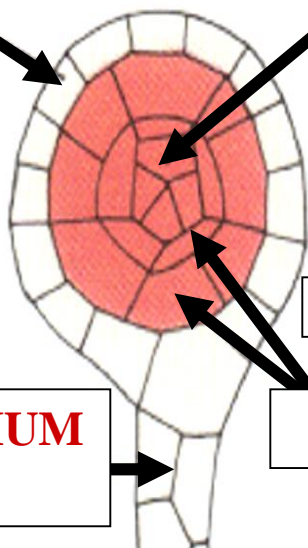
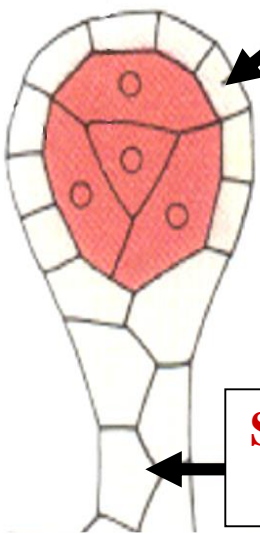
CELL INITIAL



SPORANGIUM WALL

SPOROCYTES

SMALL SIZE



ANNULUS

THIN WALL

STOMIUM

FEW SPORES

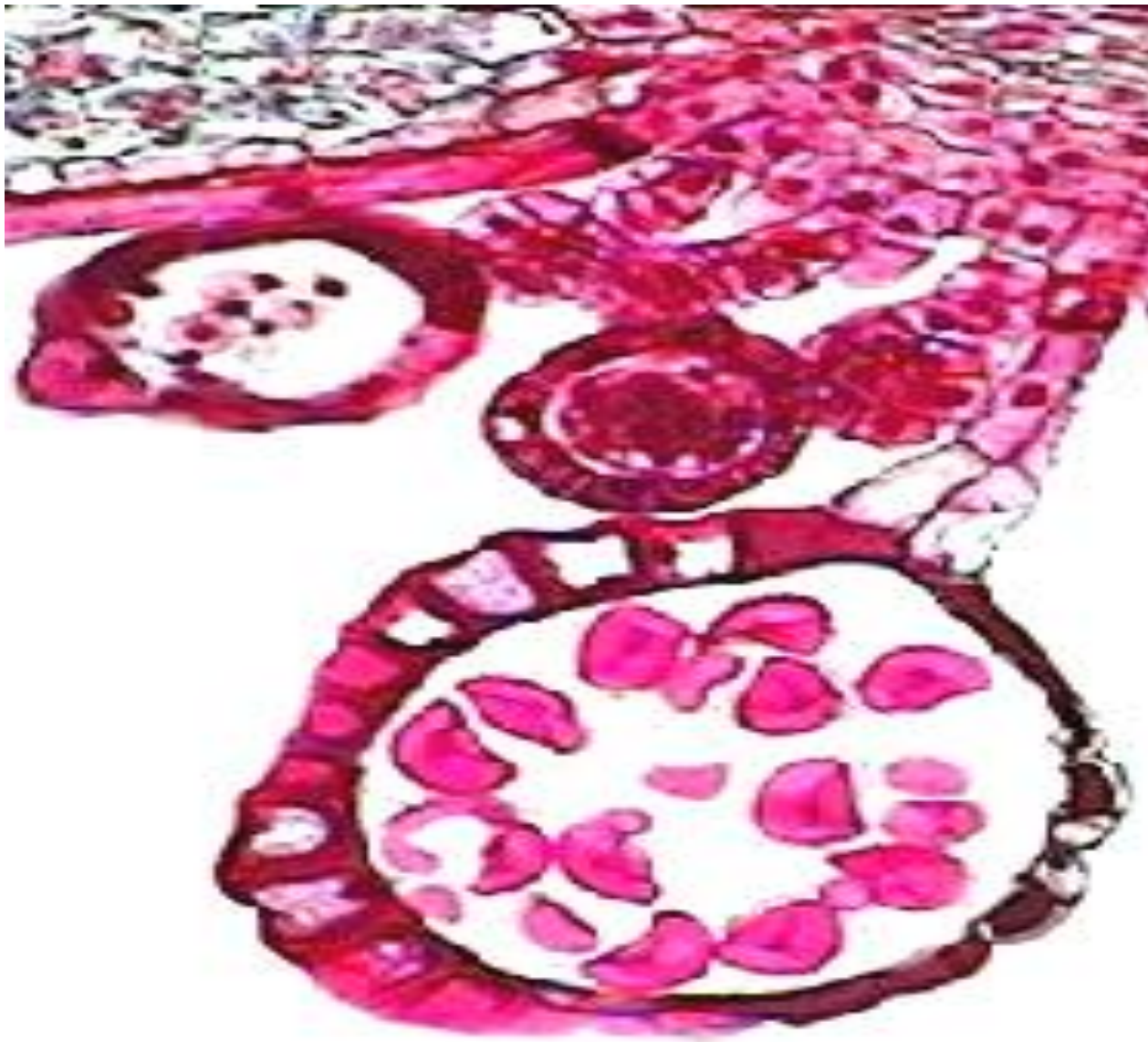
SPORANGIUM STALK

TAPETUM

STALK

LEPTOSPORANGIUM

L.S.



LEPTOSPORANGIUM

L.S.

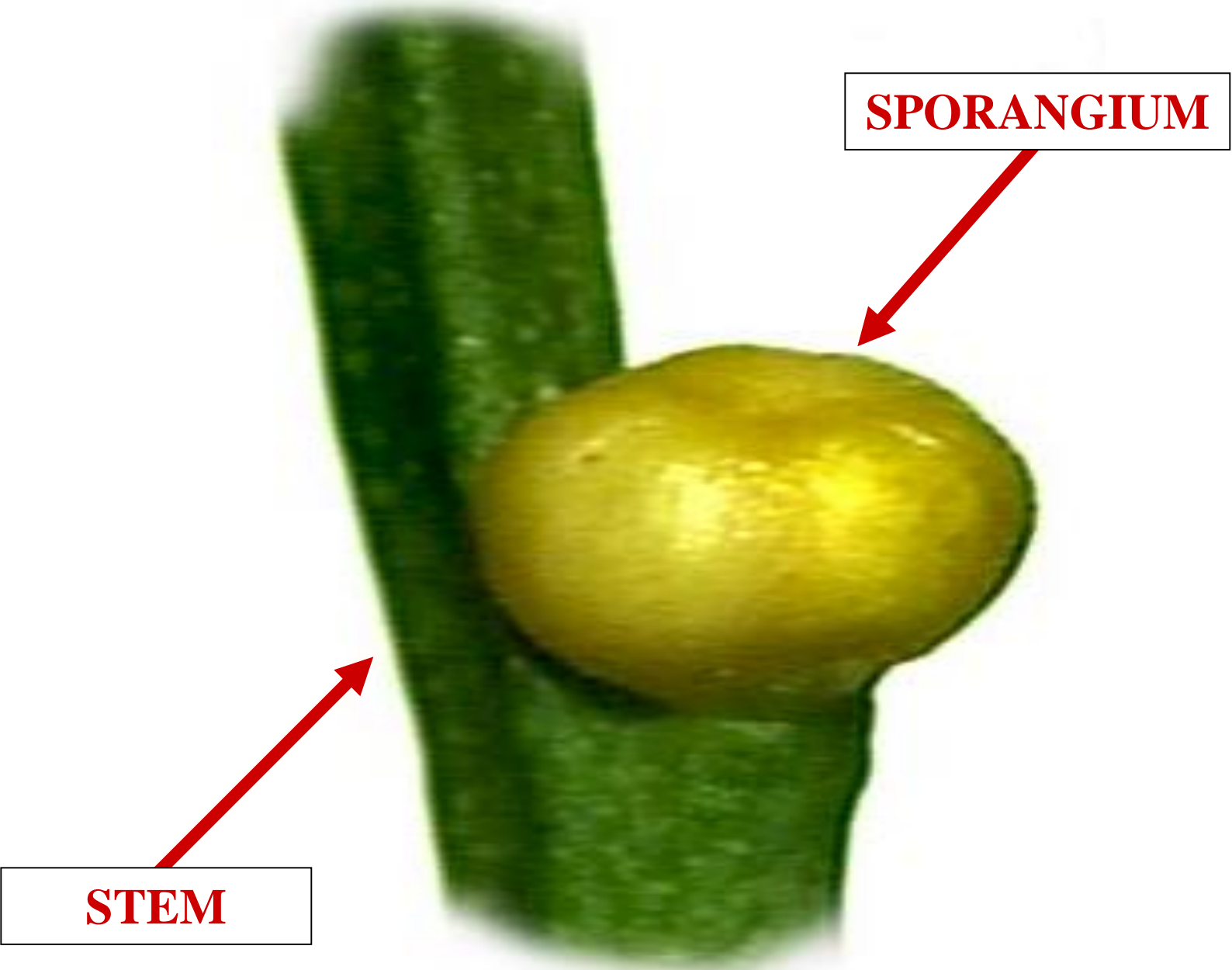


“ADVANCED FERNS”





SPORANGIUM POSITION



SPORANGIUM

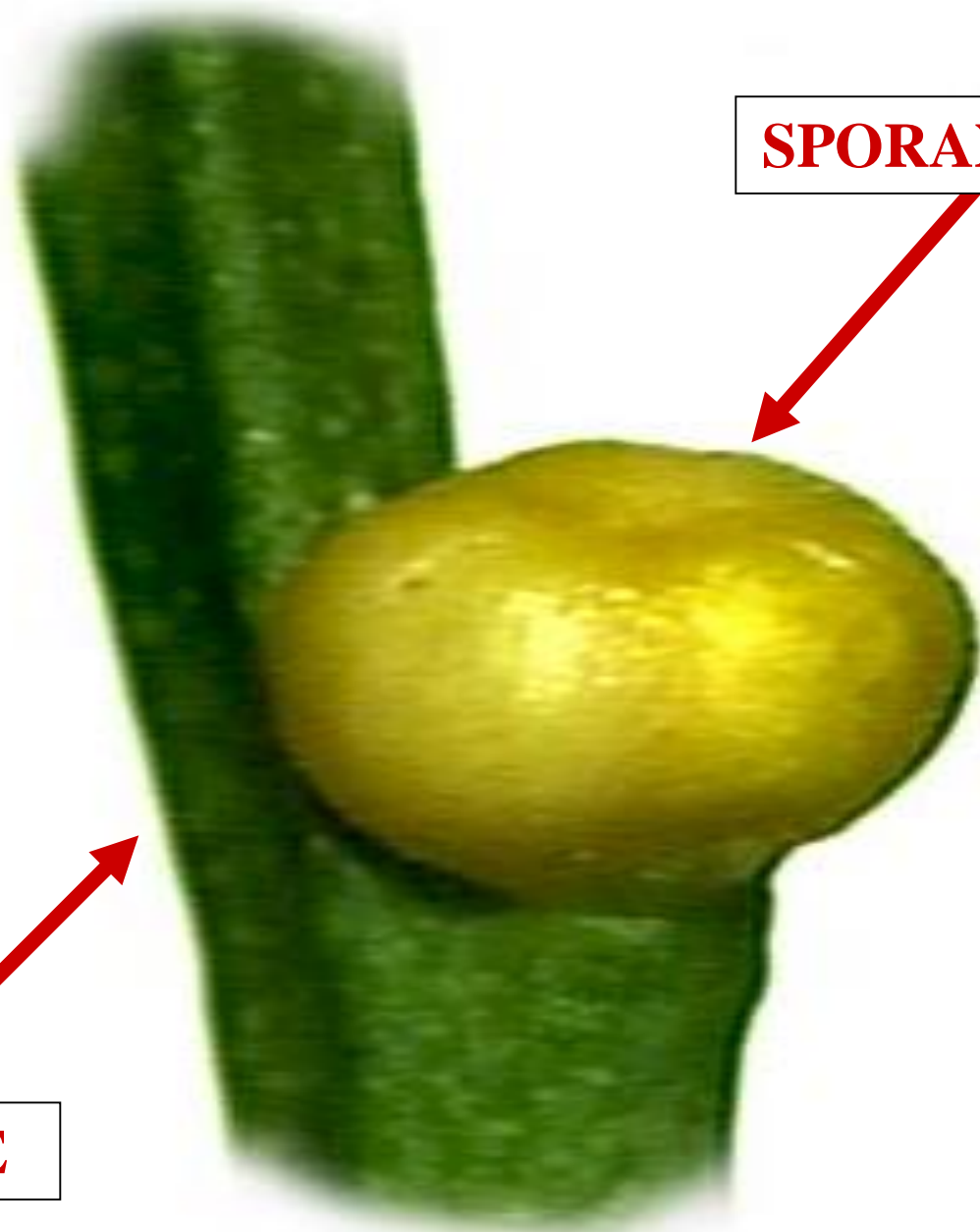
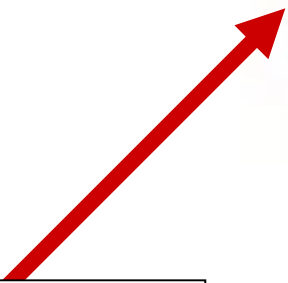
STEM



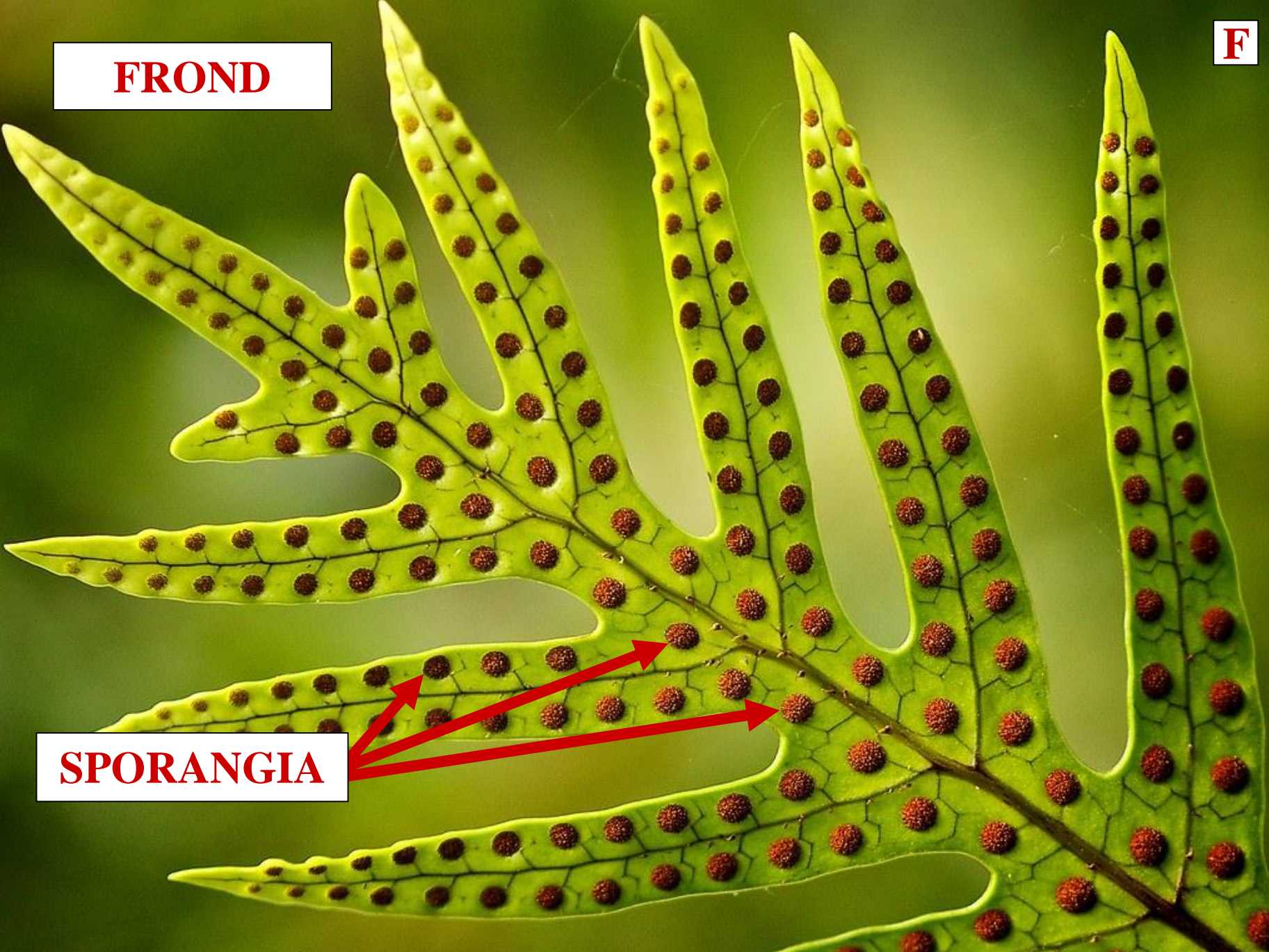
SPORANGIUM



CAULINE



FROND

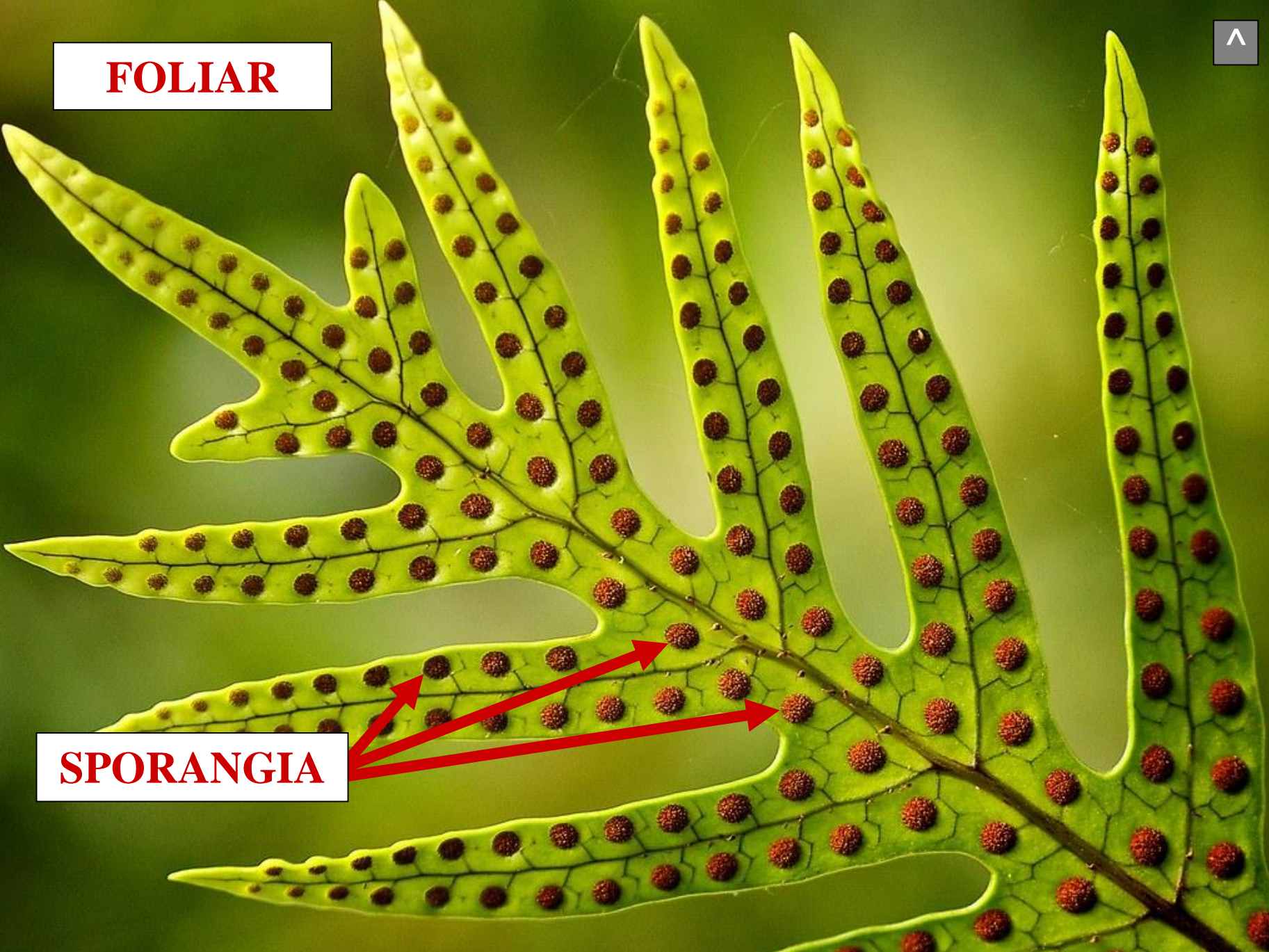


SPORANGIA





FOLIAR



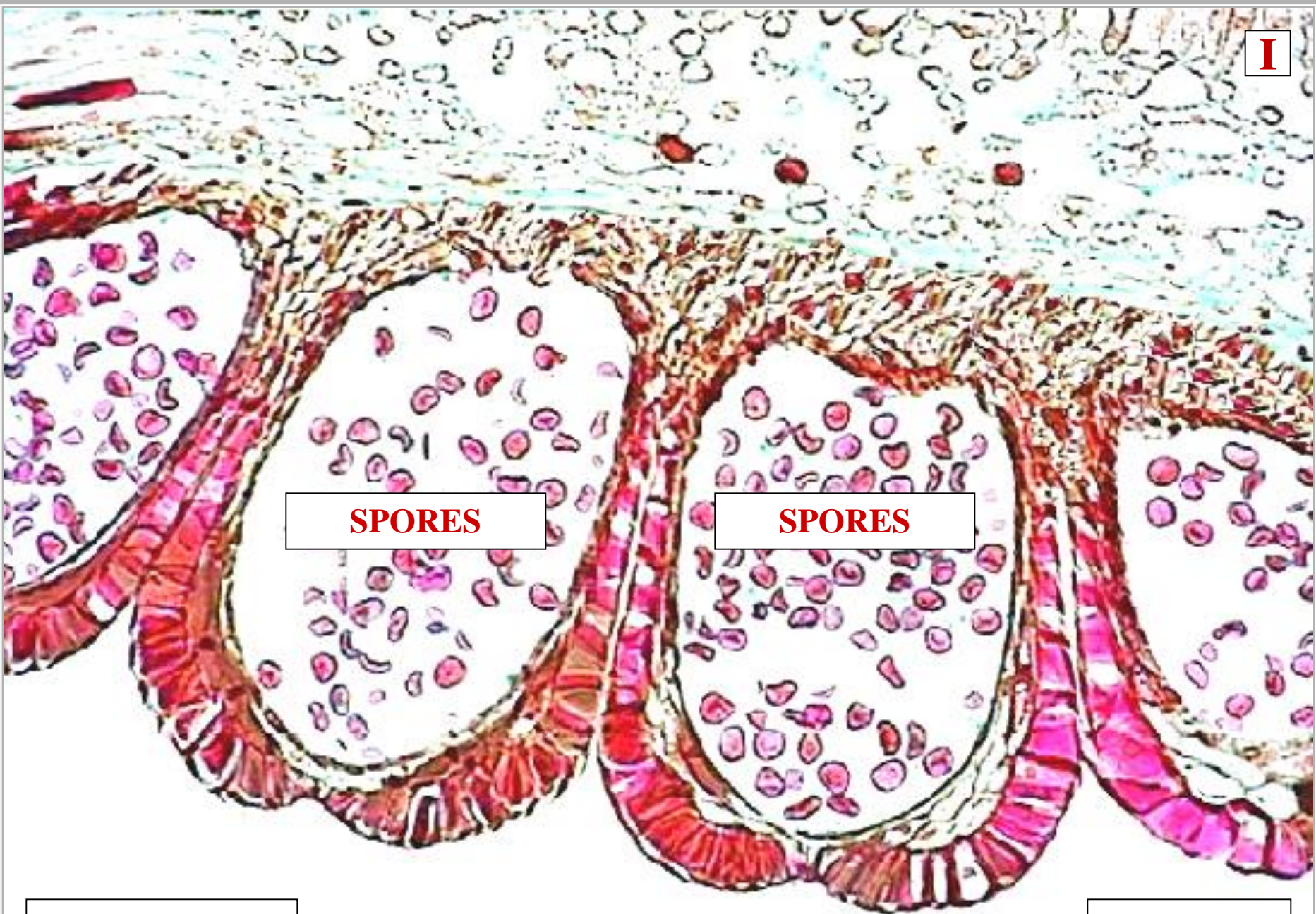
SPORANGIA





SPORE HABIT

I

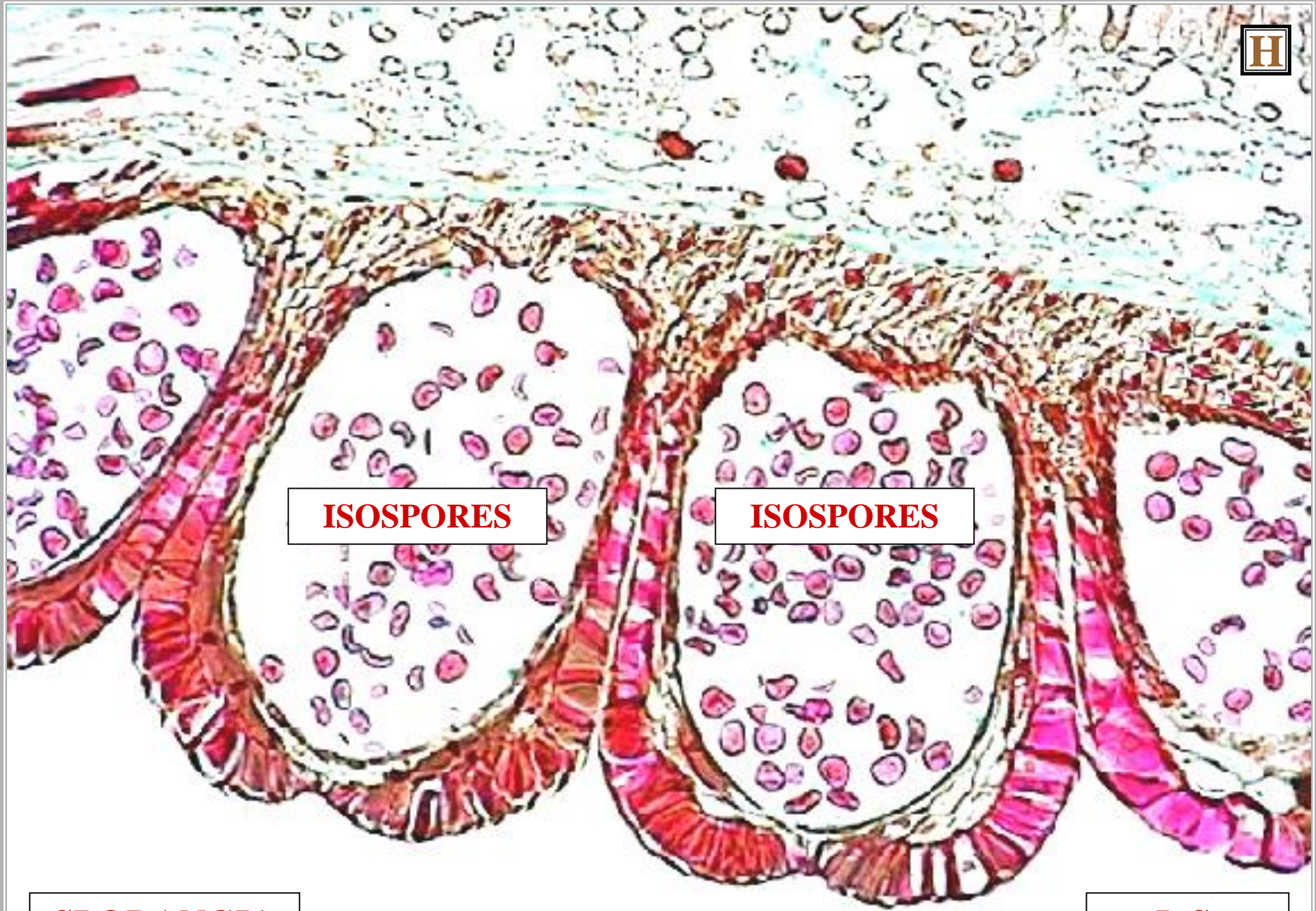


SPORES

SPORES

SPORANGIA

L.S.



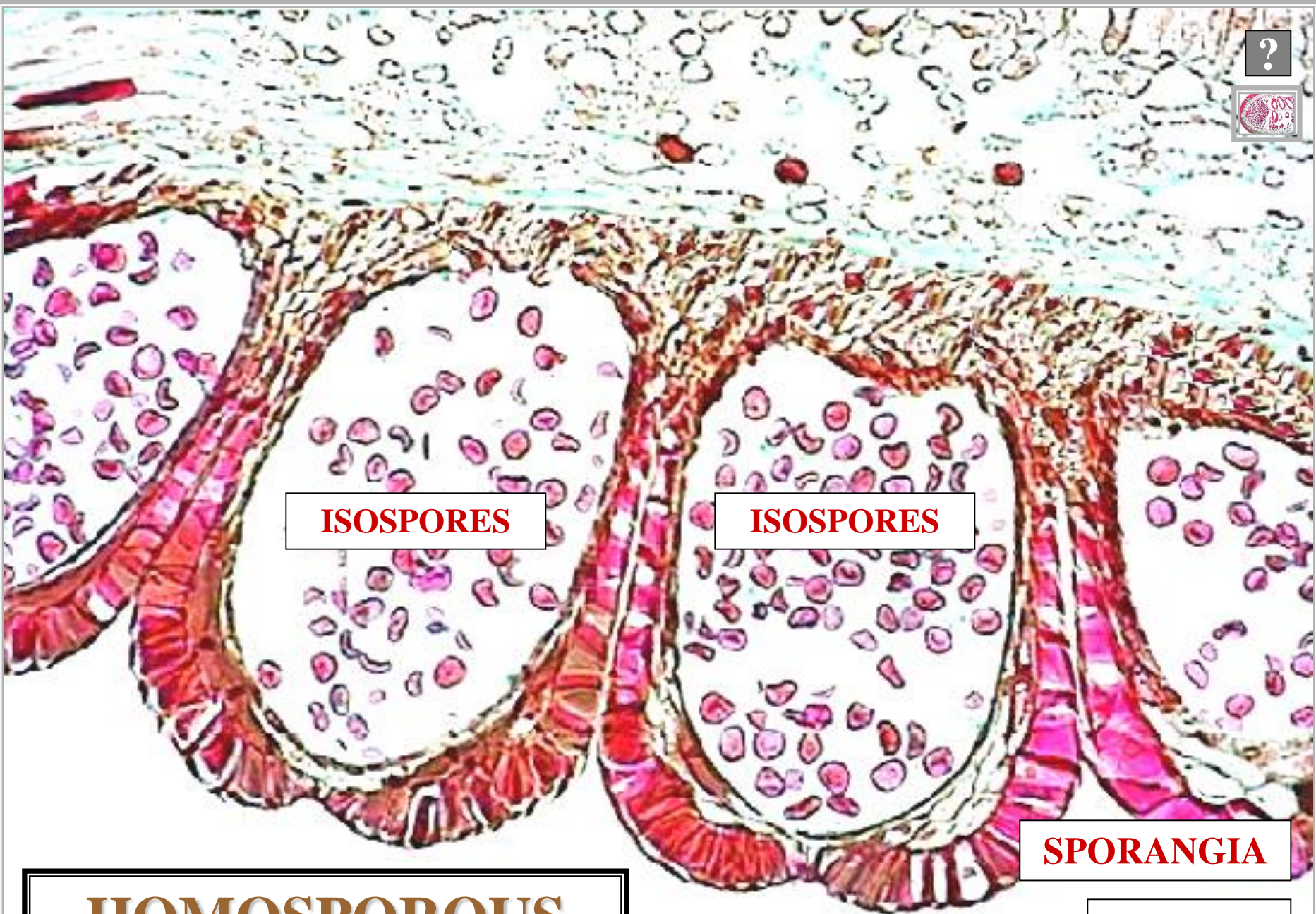
ISOSPORES

ISOSPORES

SPORANGIA

L.S.

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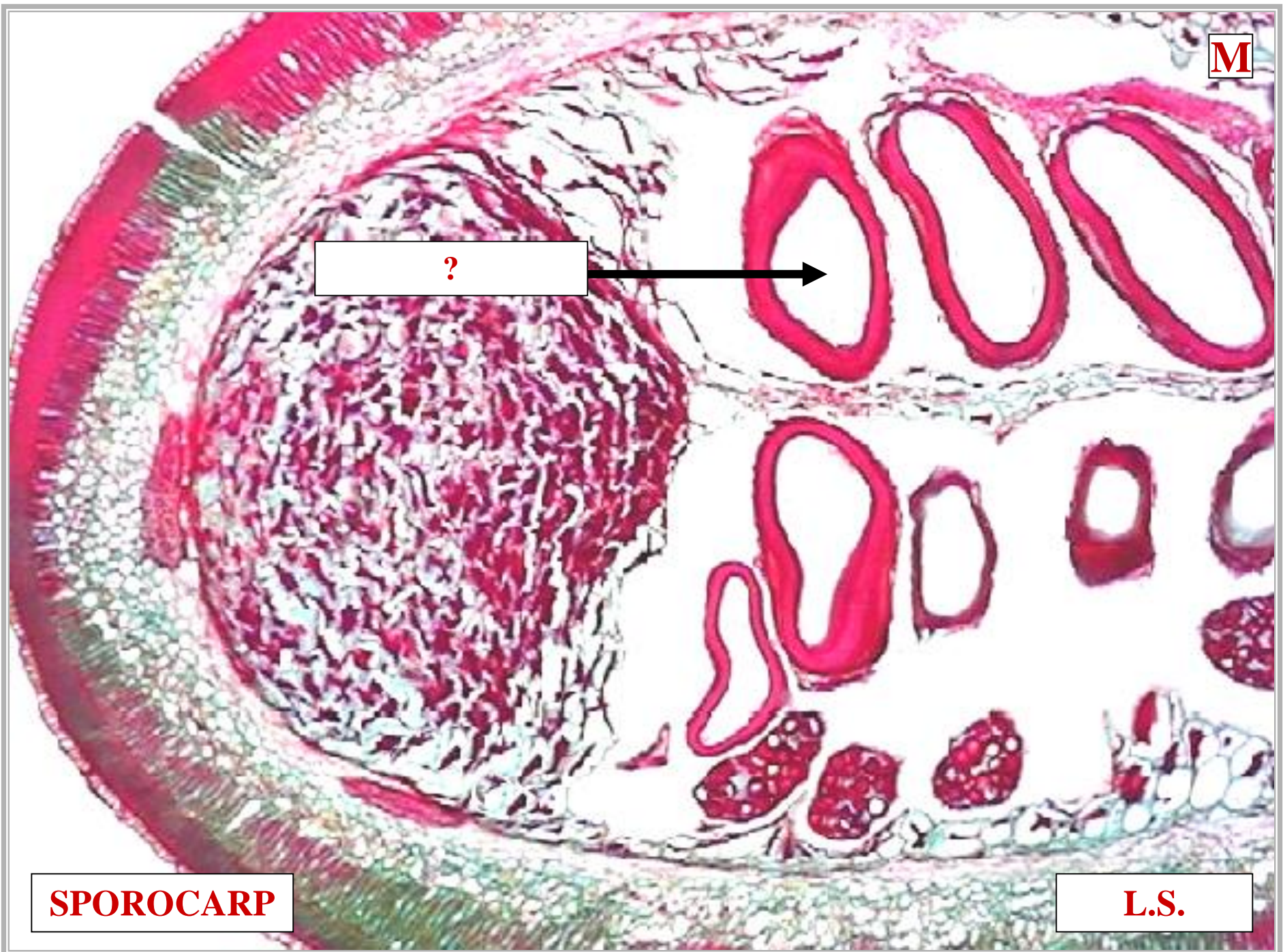
ISOSPORES

ISOSPORES

SPORANGIA

HOMOSPOROUS

L.S.



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SPOROCARP

L.S.

M

MEGASPORES



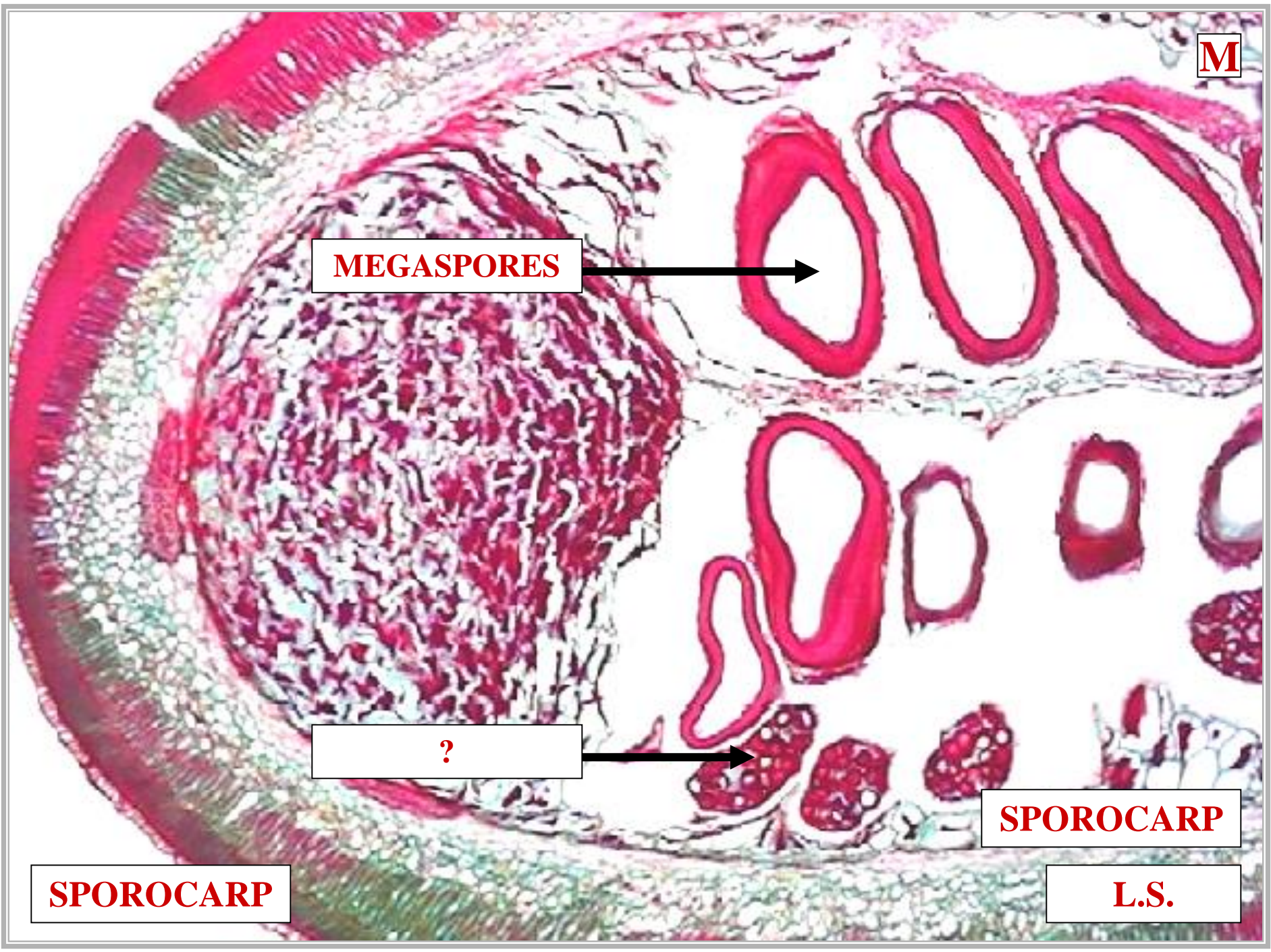
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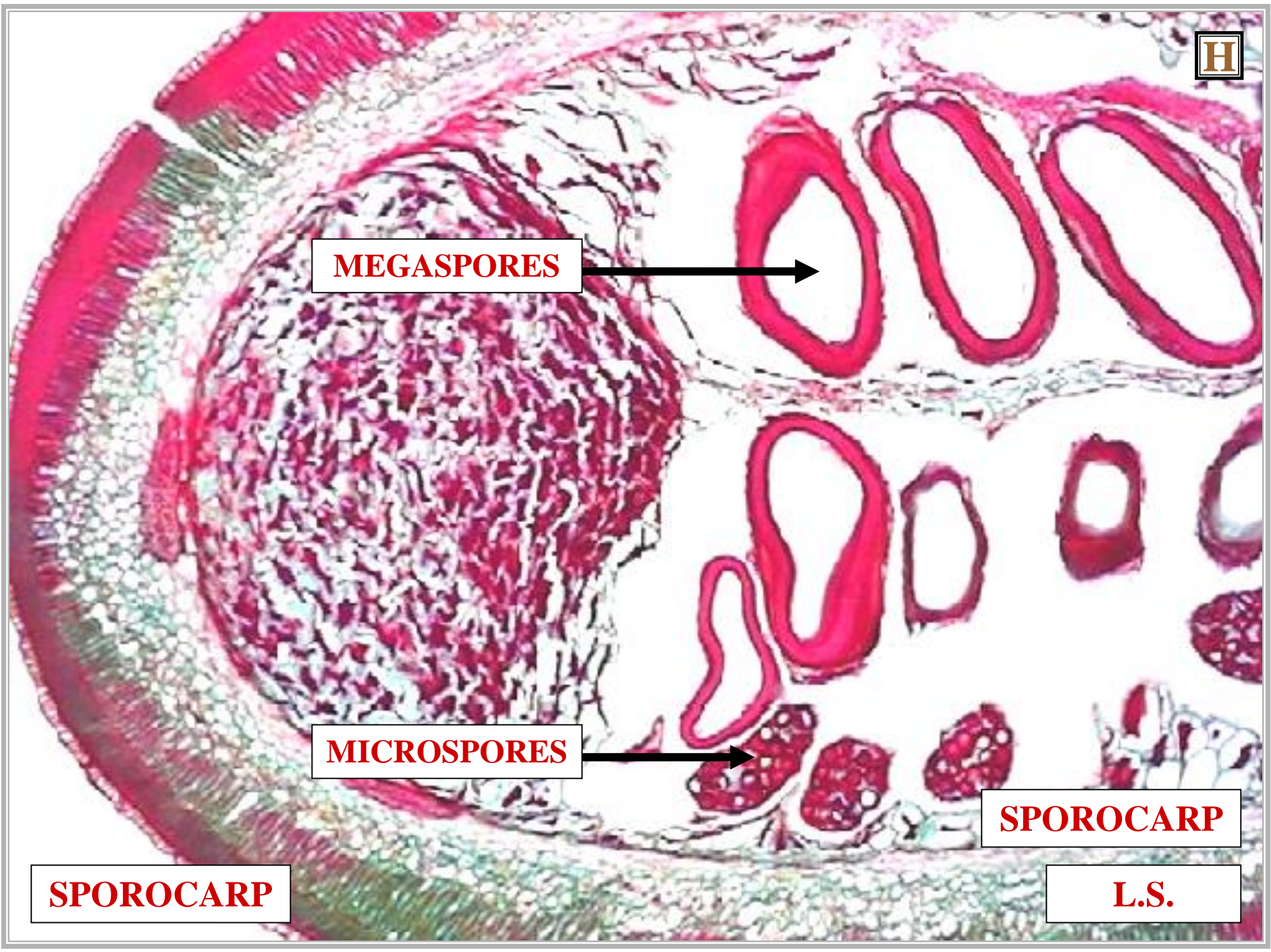


SPOROCARP

SPOROCARP

L.S.





MEGASPORES



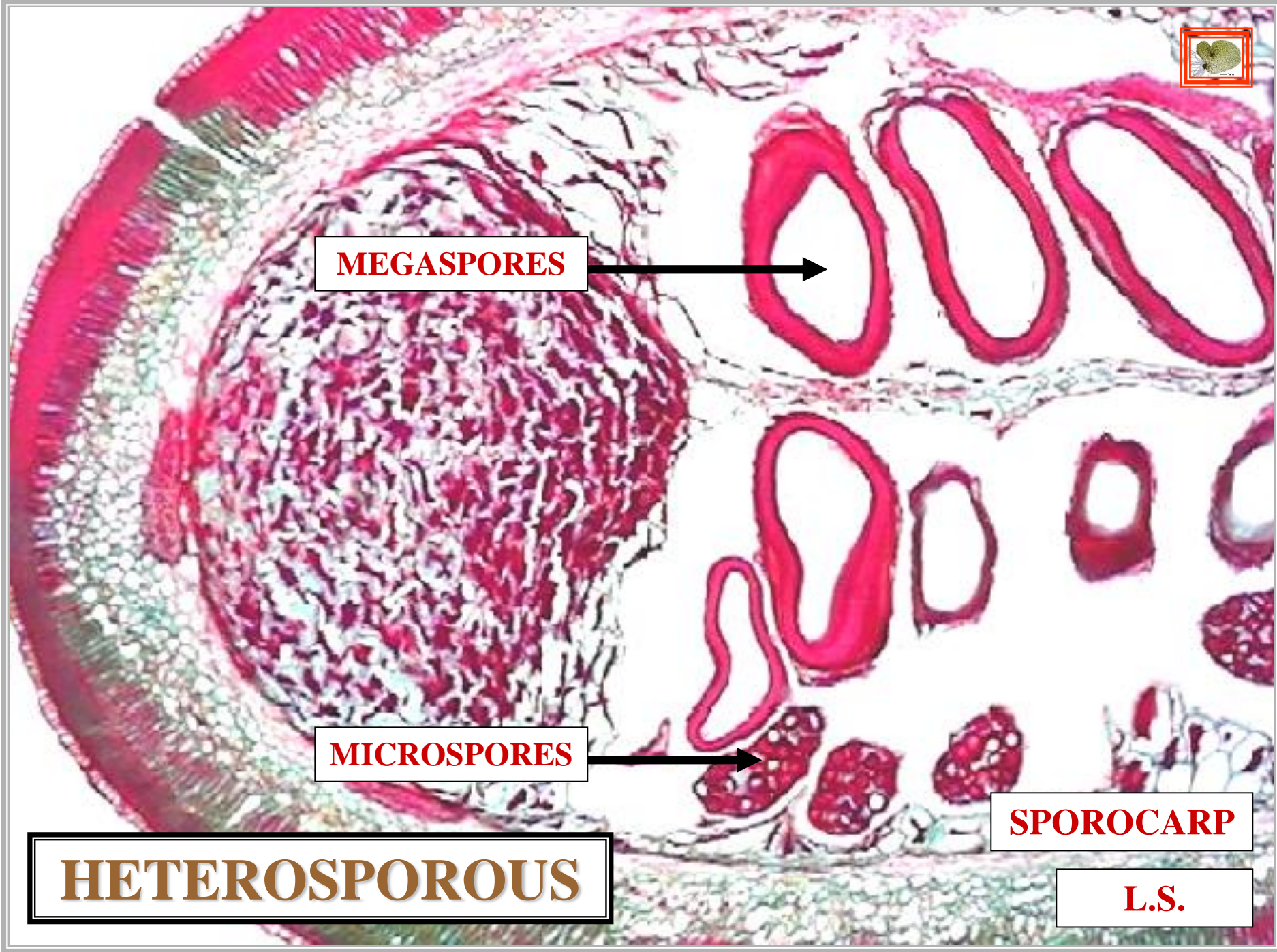
MICROSPORES



SPOROCARP

SPOROCARP

L.S.



MEGASPORES



MICROSPORES

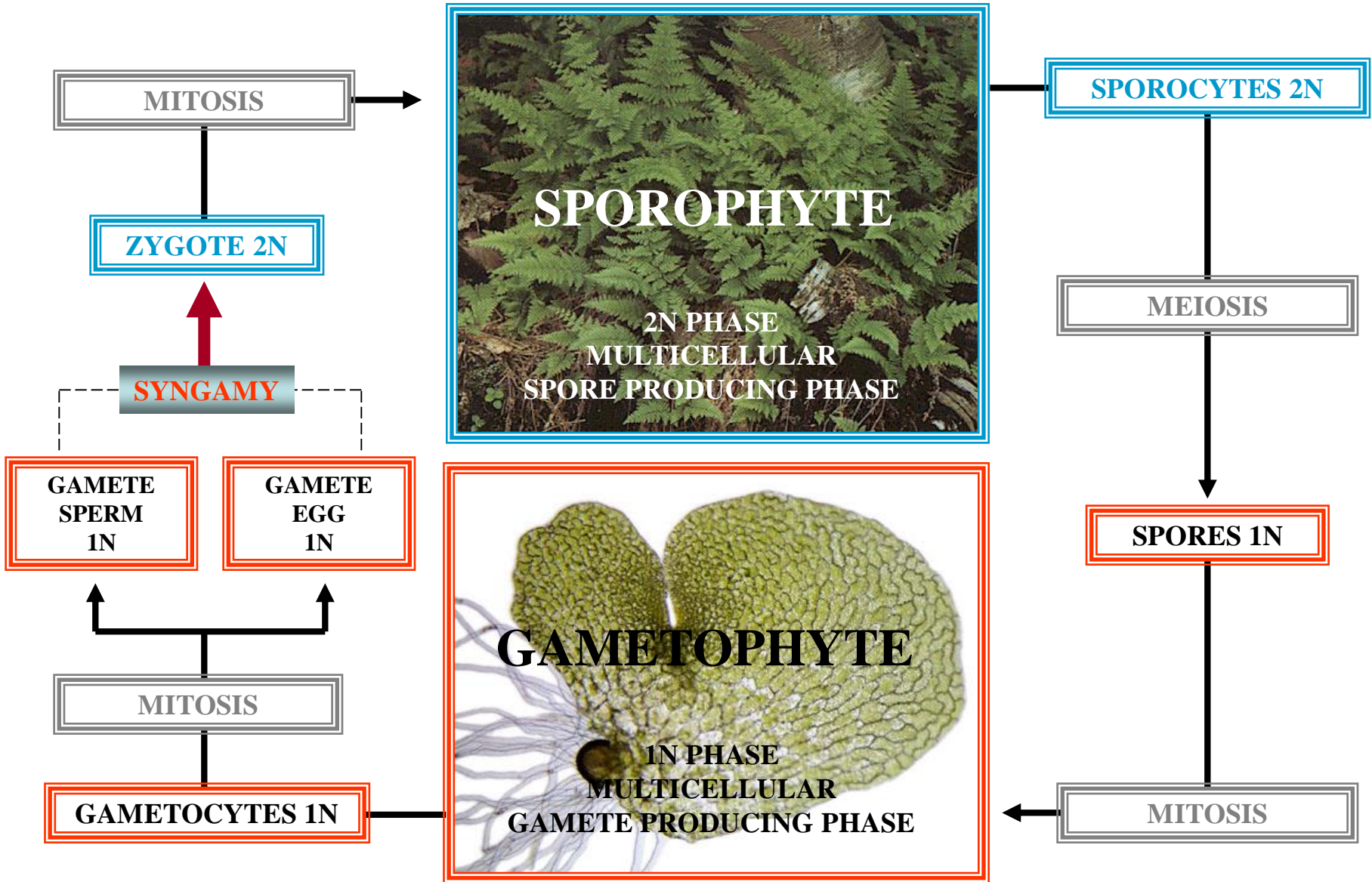


SPOROCARP

HETEROSPOROUS

L.S.

PTERIDOPHYTA LIFE CYCLE





EX

GAMETOPHYTE CHARACTERS



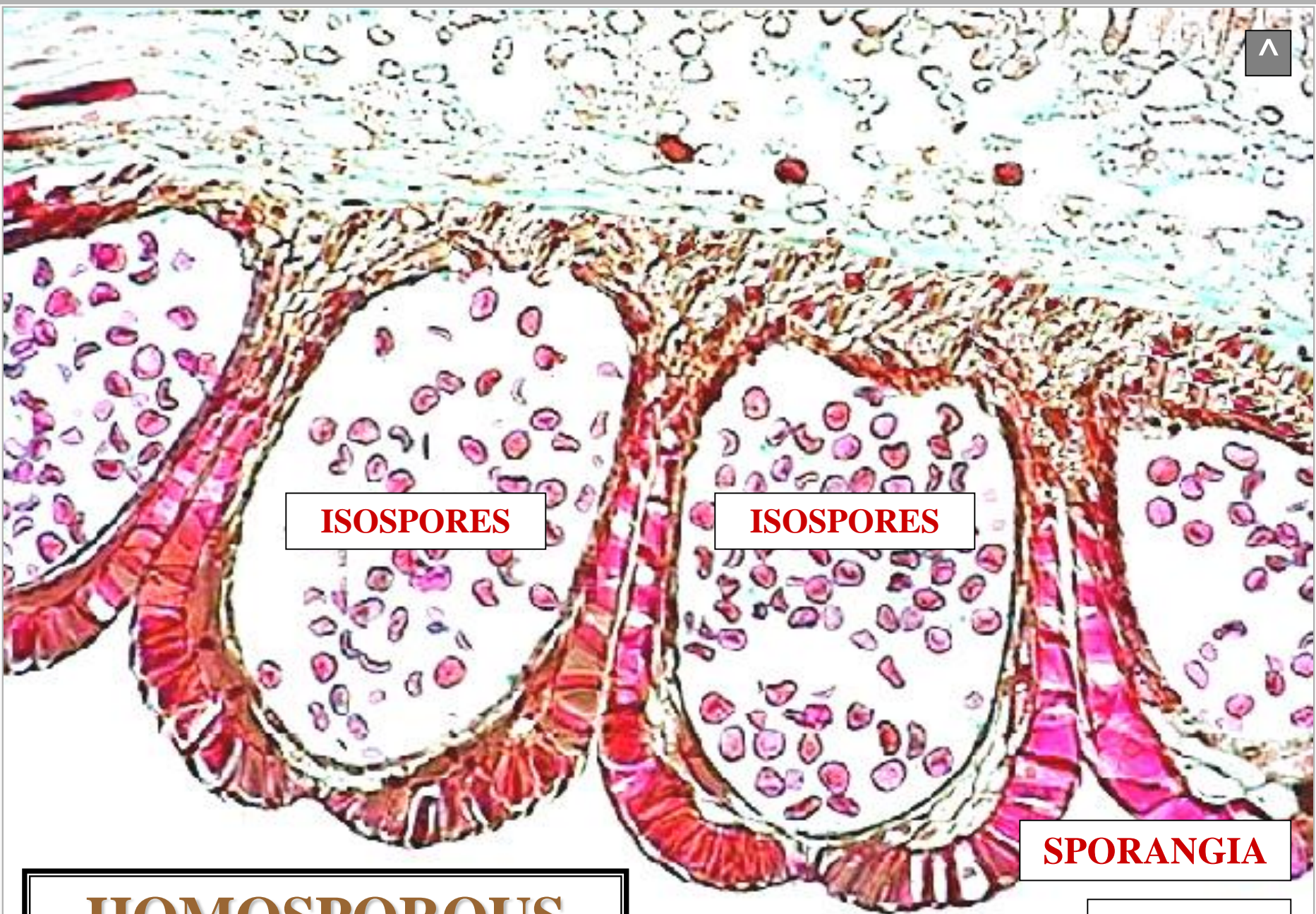
EN

EXOSPORIC GAMETOPHYTES



ENDOSPORIC GAMETOPHYTES





ISOSPORES

ISOSPORES

SPORANGIA

HOMOSPOROUS

L.S.

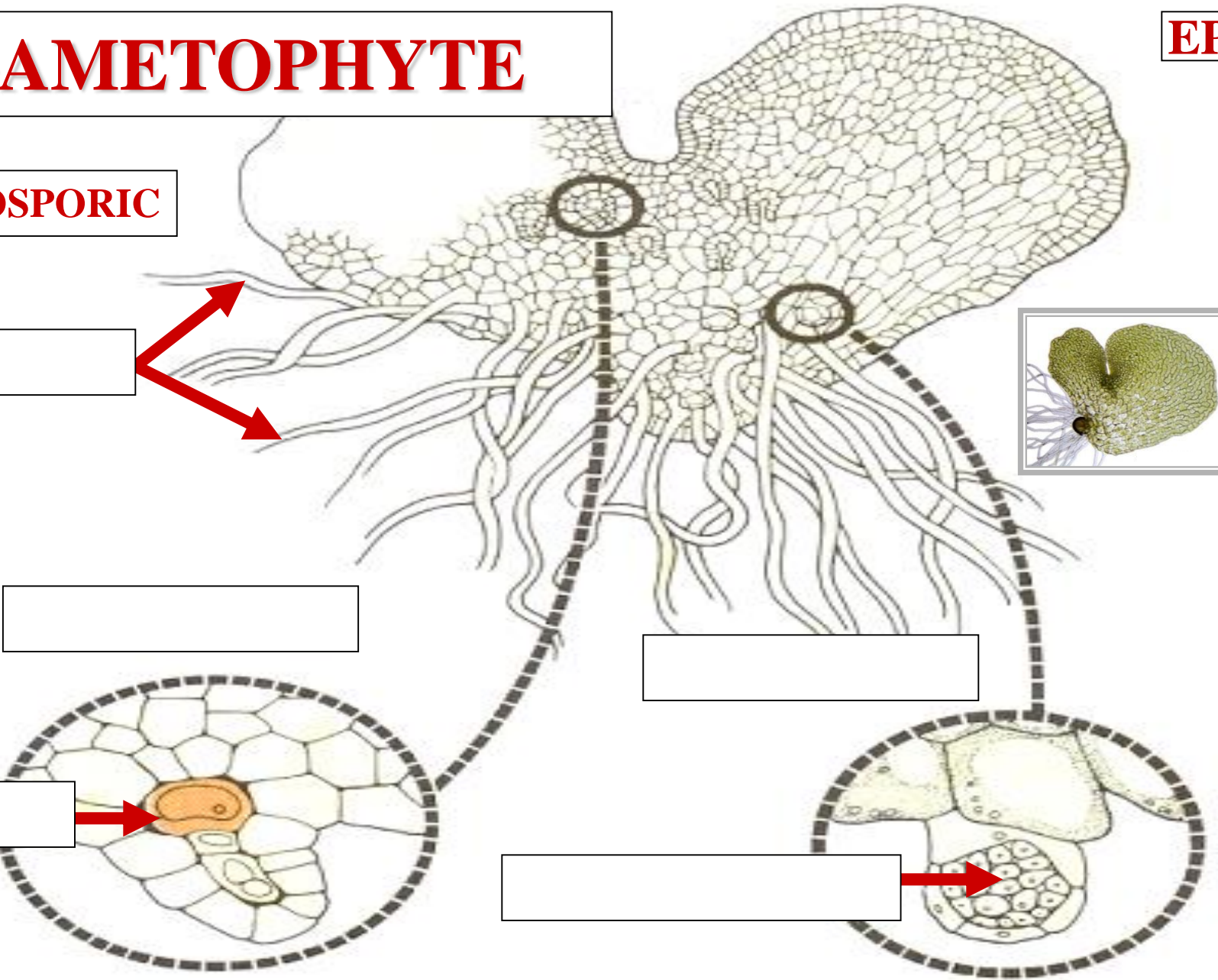
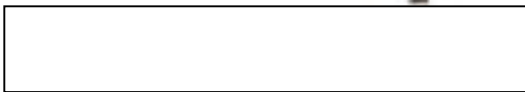
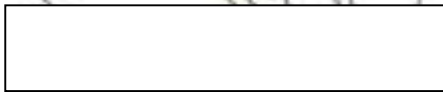
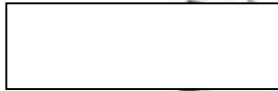
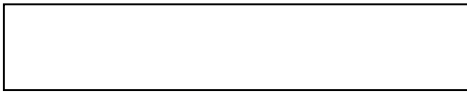
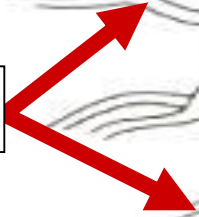


EXOSPORIC GAMETOPHYTE

GAMETOPHYTE

EP

EXOSPORIC



GAMETOPHYTE

EPITERRANEAN

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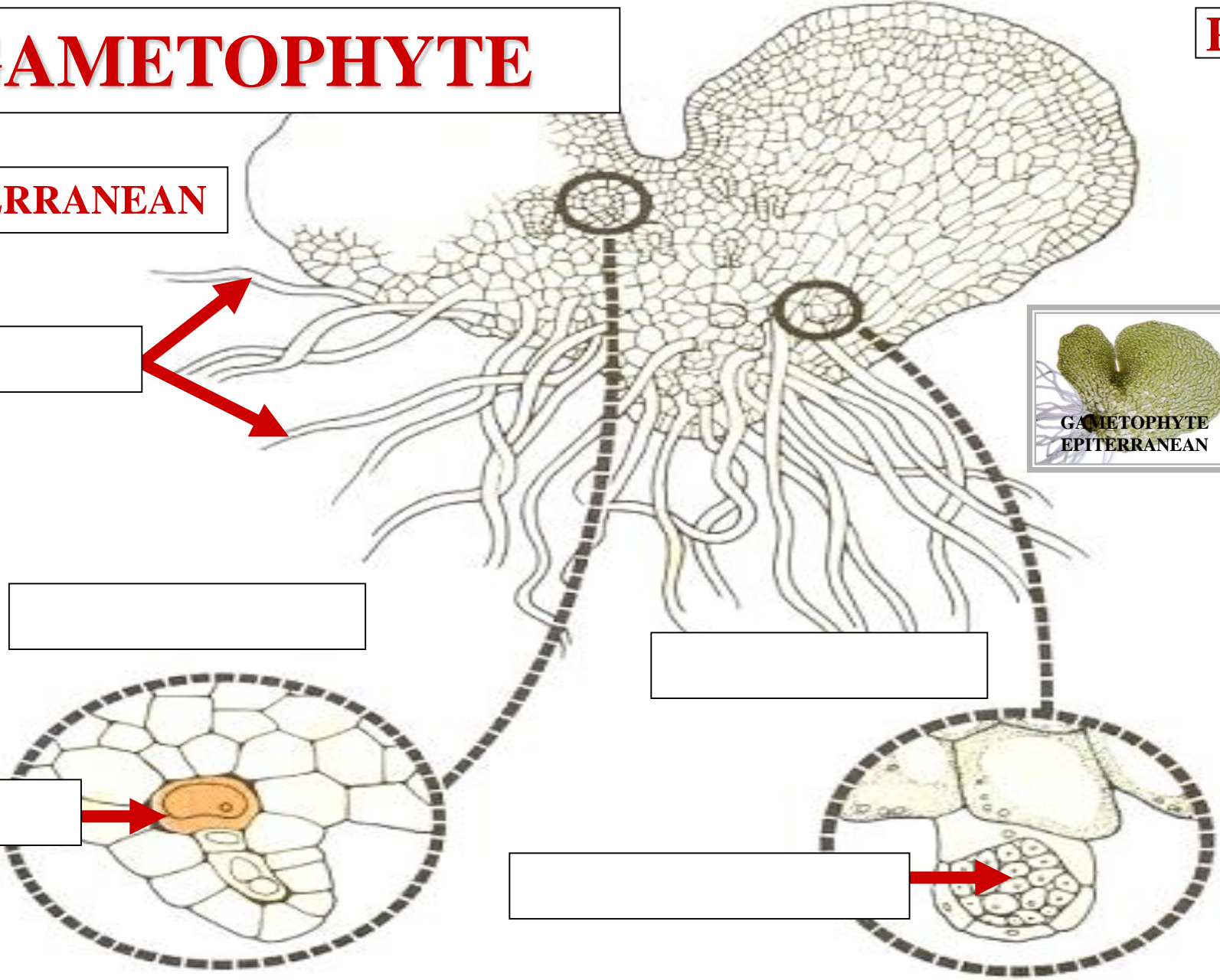
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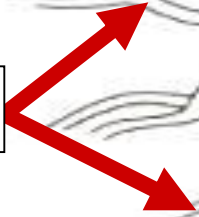
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GAMETOPHYTE

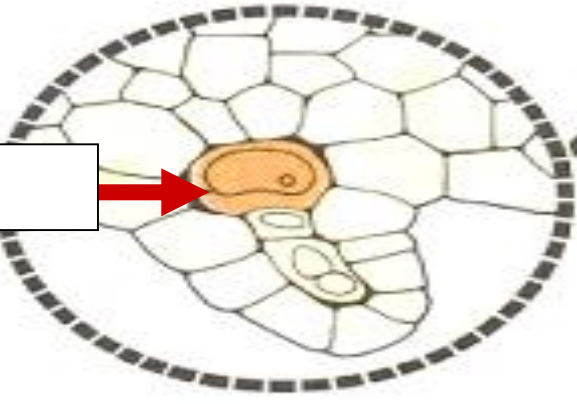
PSYN

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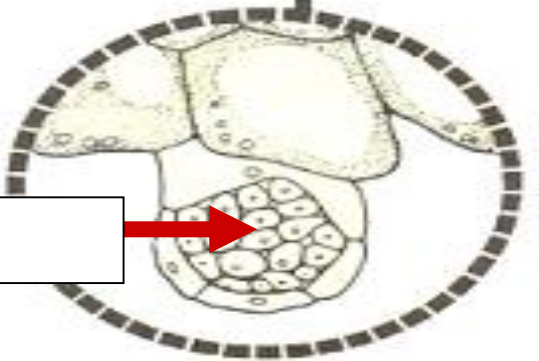
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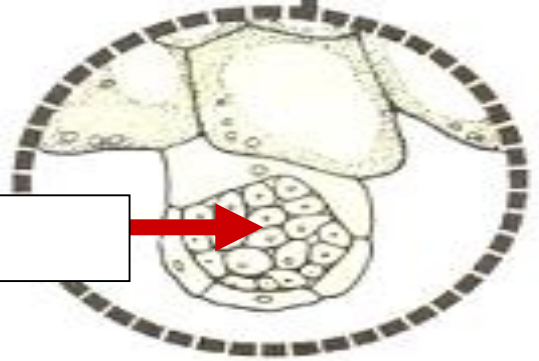
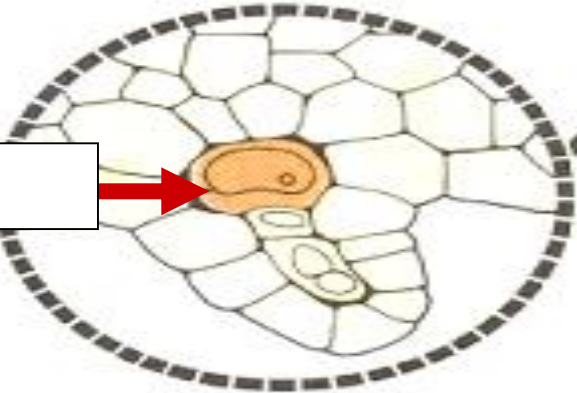
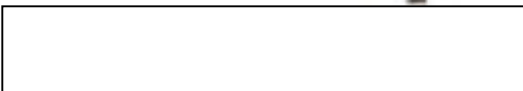
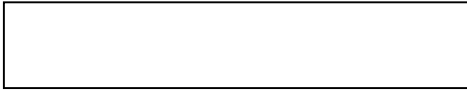
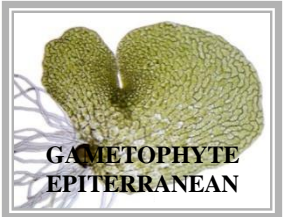
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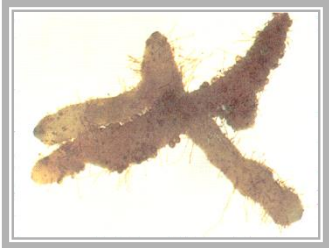
GAMETOPHYTE
EPITERRANEAN

GAMETOPHYTE

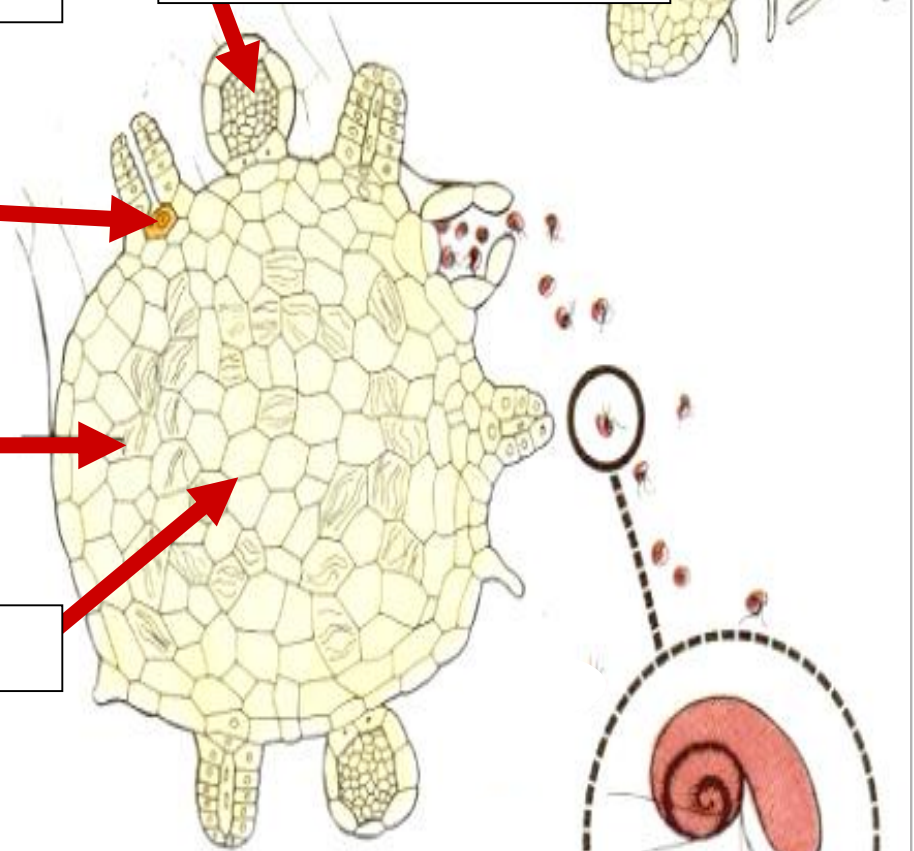
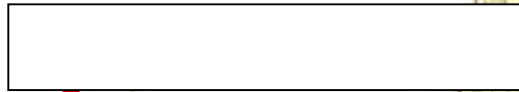
**MYCORRHIZAE
ABSENT**



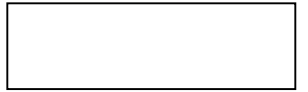
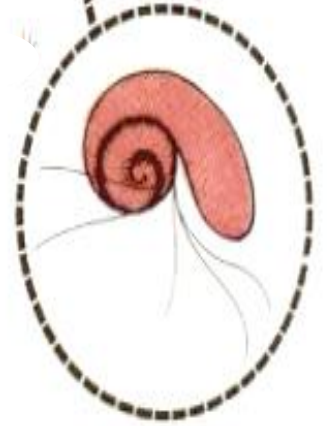
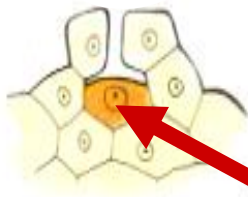
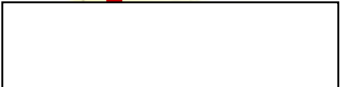
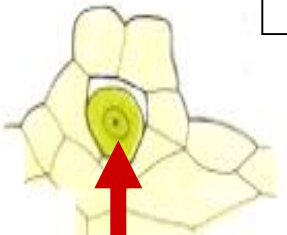
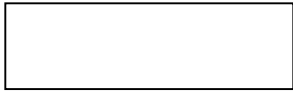
GAMETOPHYTE



EXOSPORIC



S



GAMETOPHYTE

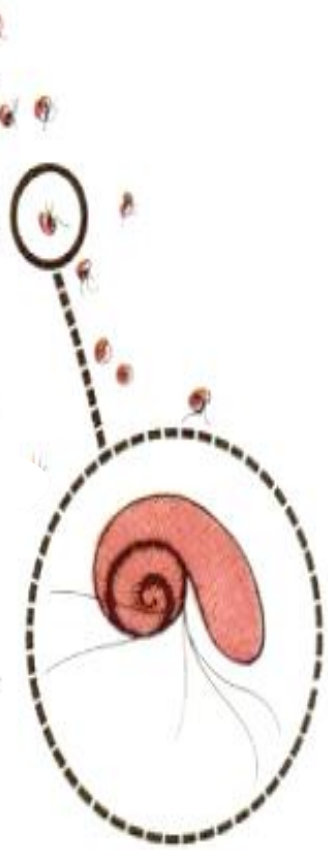
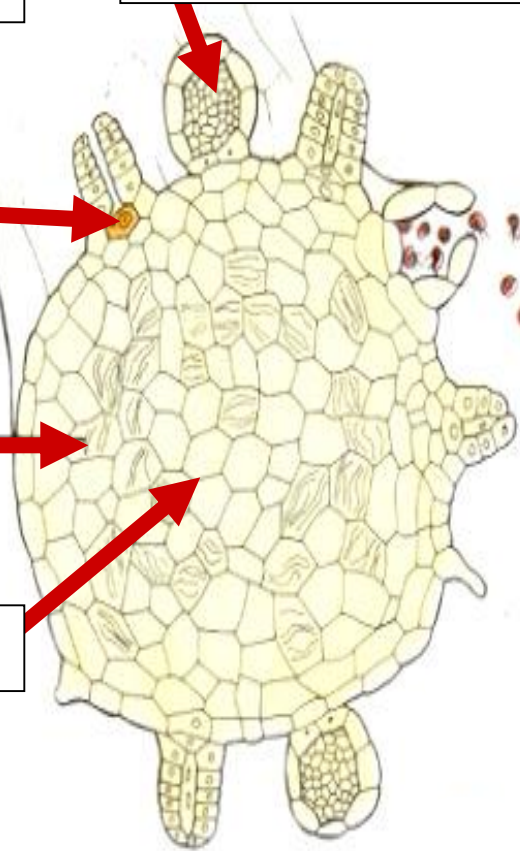
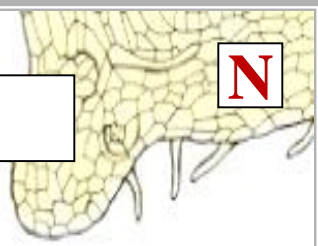


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SUBTERRANEAN

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GAMETOPHYTE

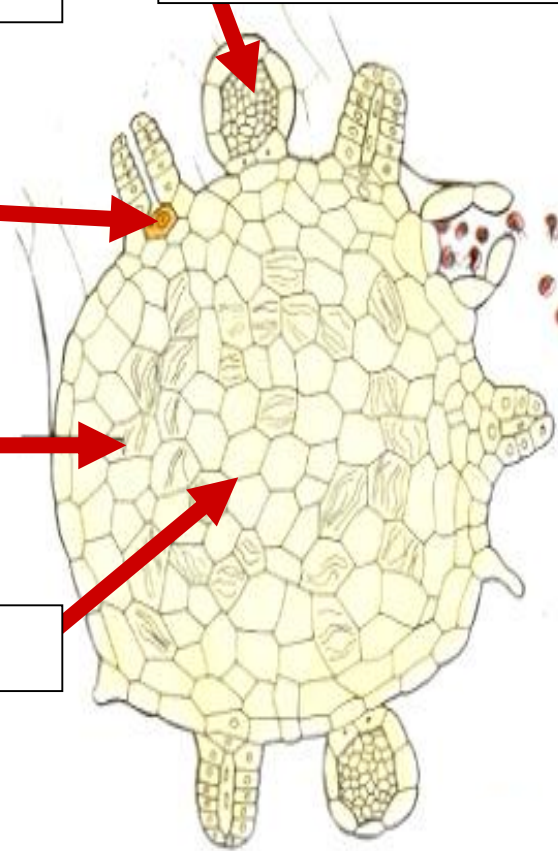
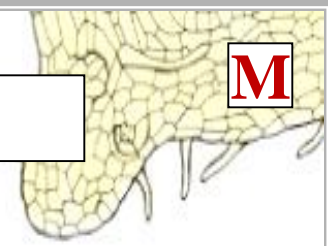


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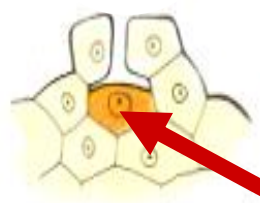
NON-PSYN

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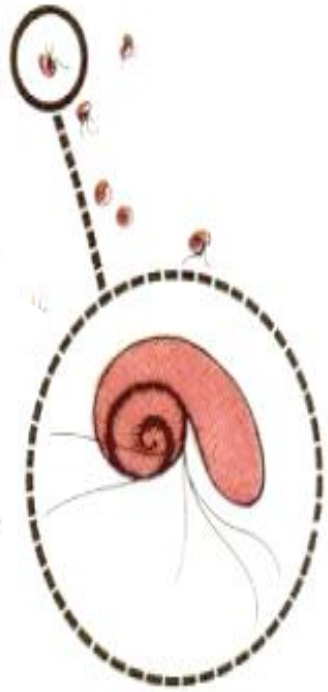
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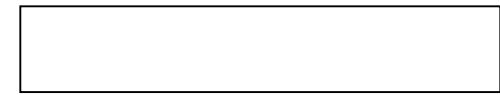


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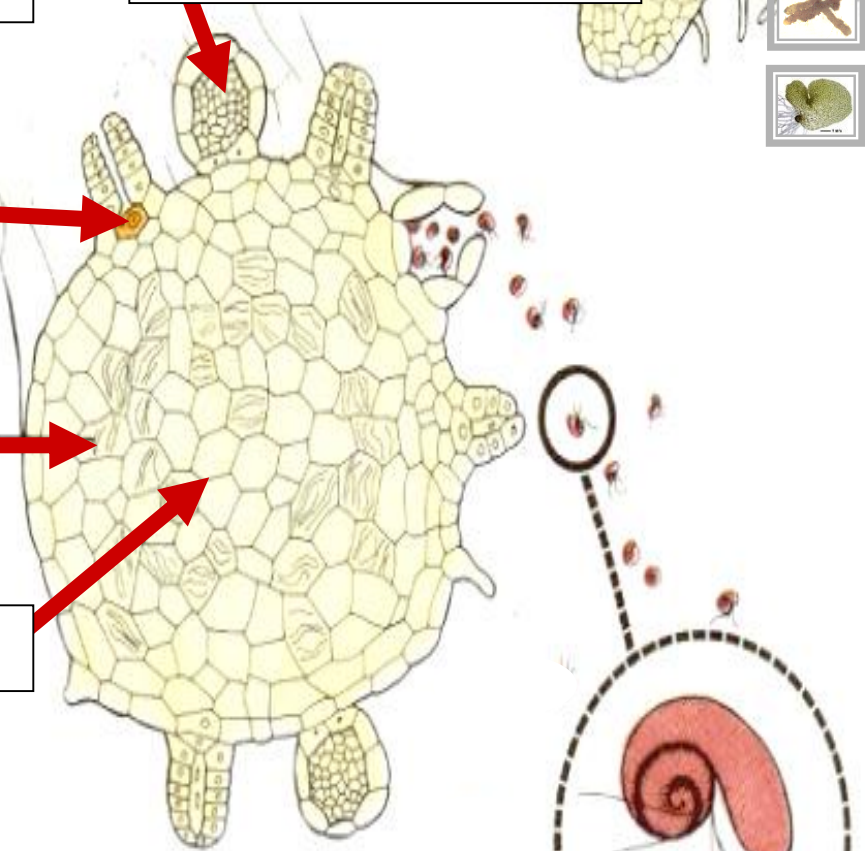
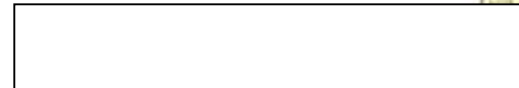
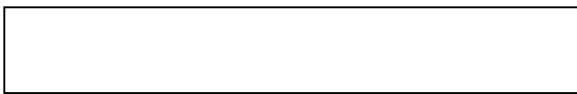


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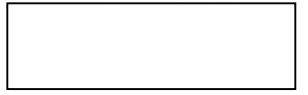
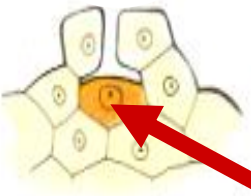
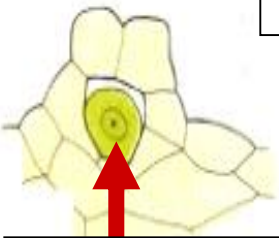
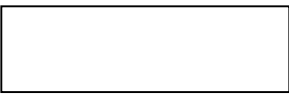
GAMETOPHYTE



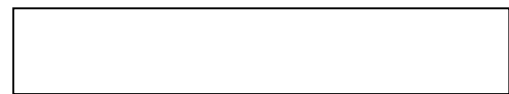
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ABUNDANT**



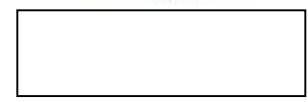
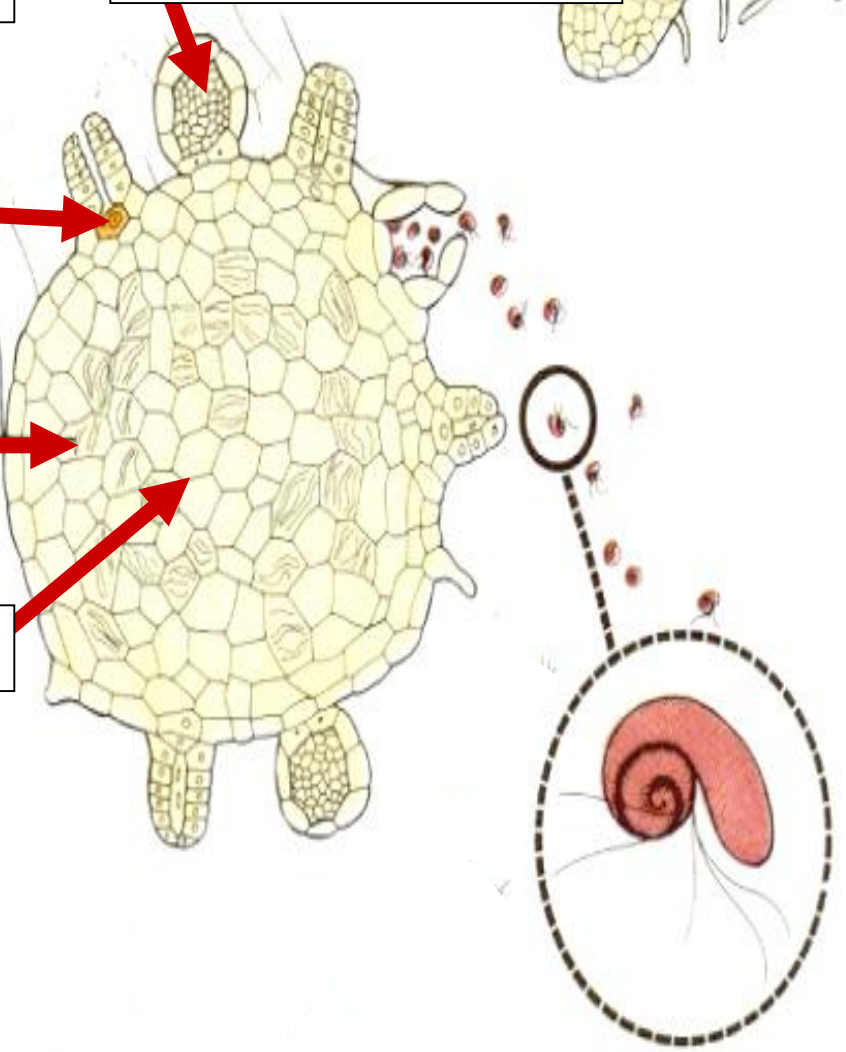
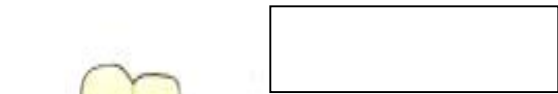
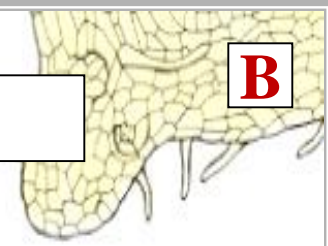
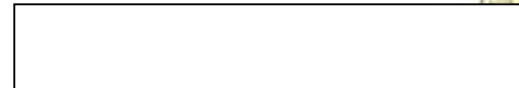
EX



GAMETOPHYTE



EXOSPORIC



GAMETOPHYTE

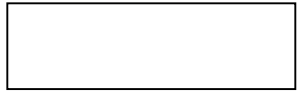
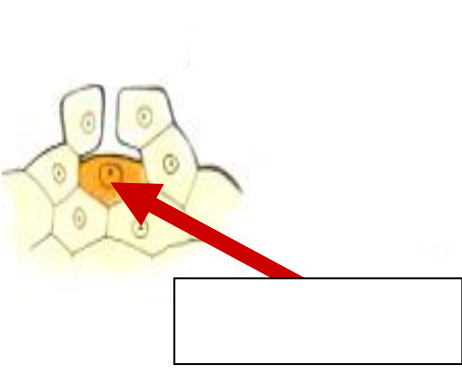
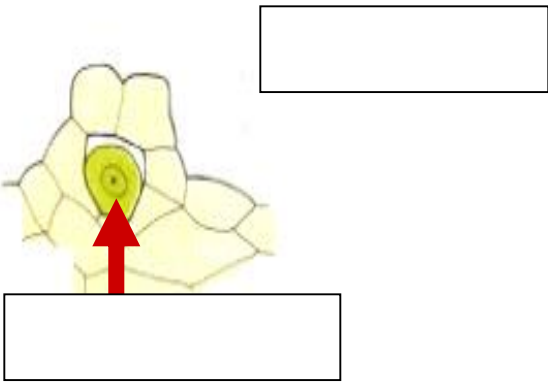
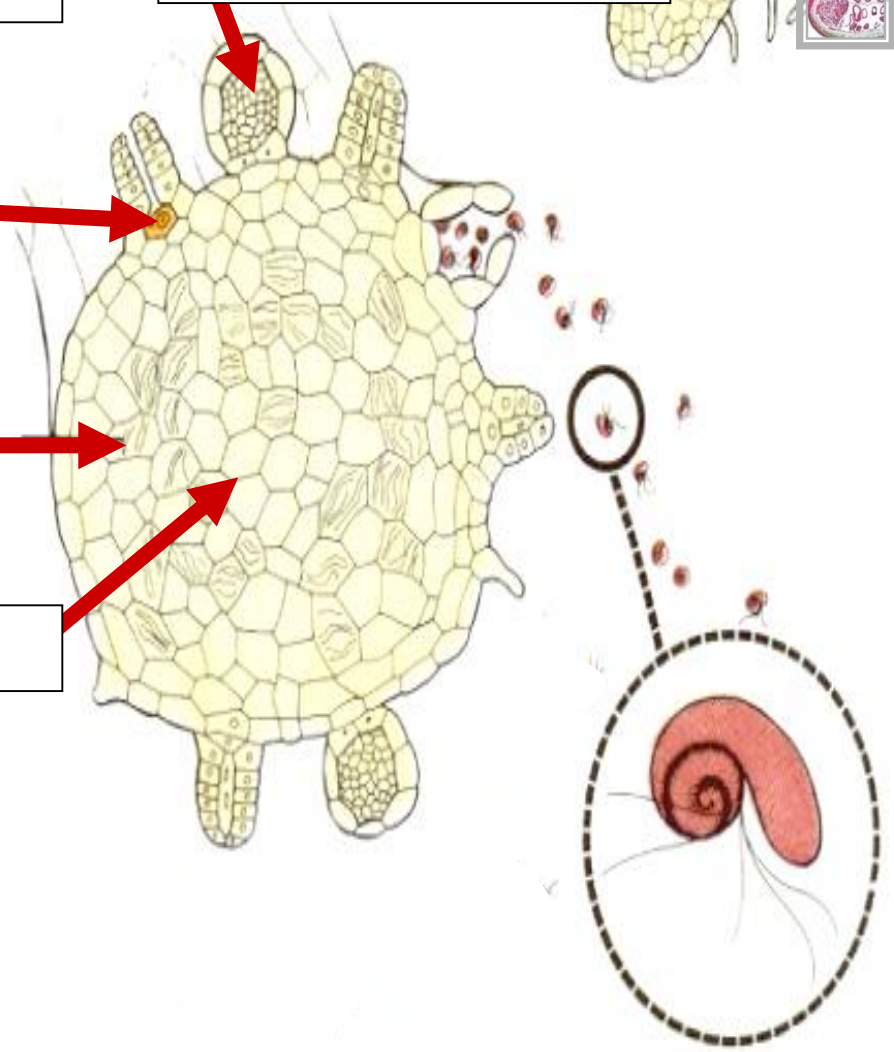


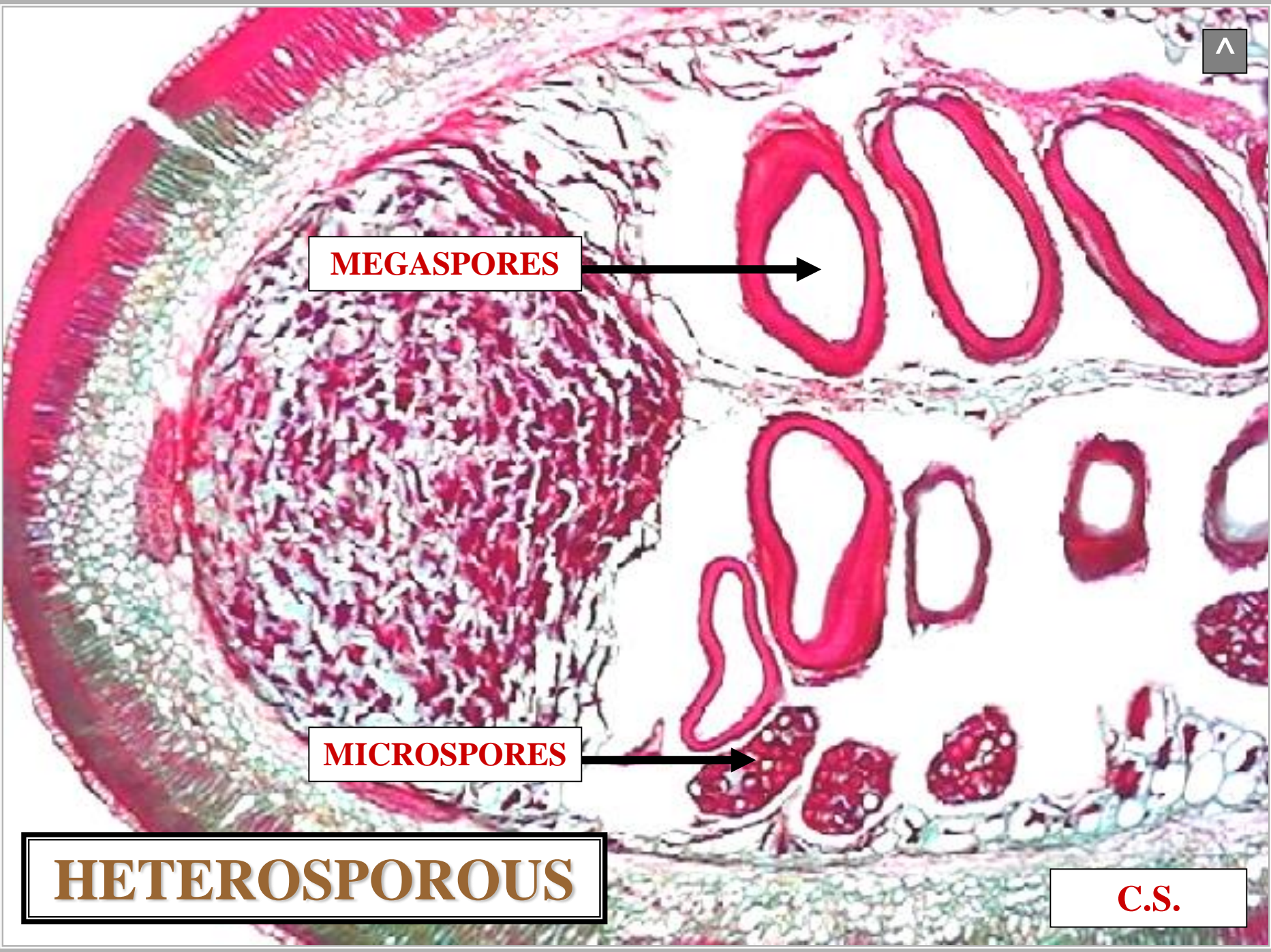
ARCHEGONIUM

BISEXUAL

EXOSPORIC

ANTHERIDIUM





MEGASPORES

MICROSPORES

HETEROSPOROUS

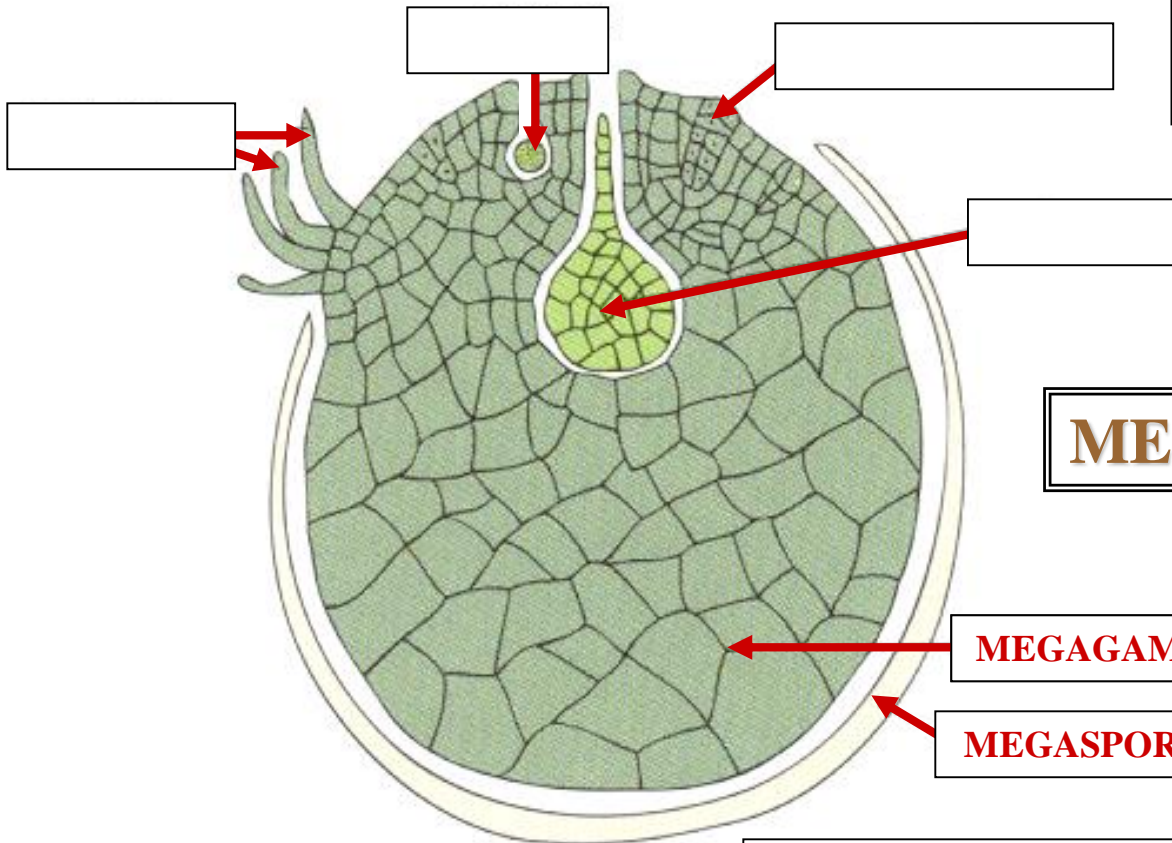
C.S.



ENDOSPORIC GAMETOPHYTE

FERN

EN



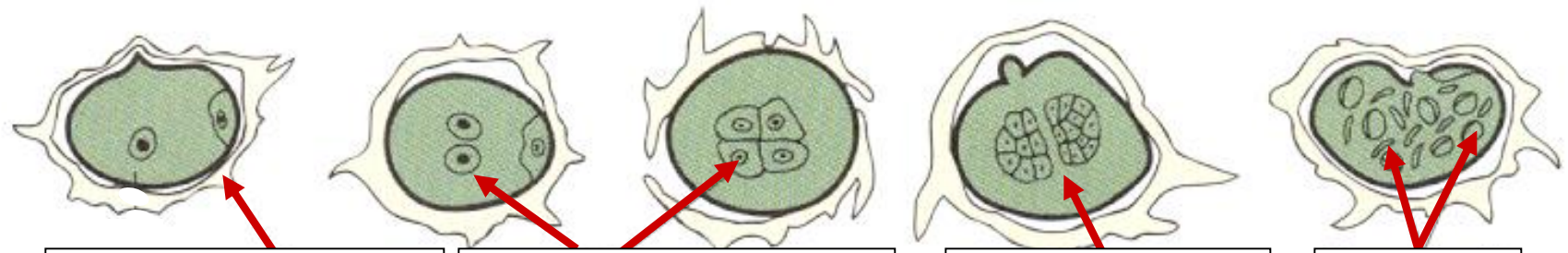
MEGASPORE

MEGAGAMETOPHYTE

MEGASPORE WALL

MICROSPORE

GAMETOPHYTE

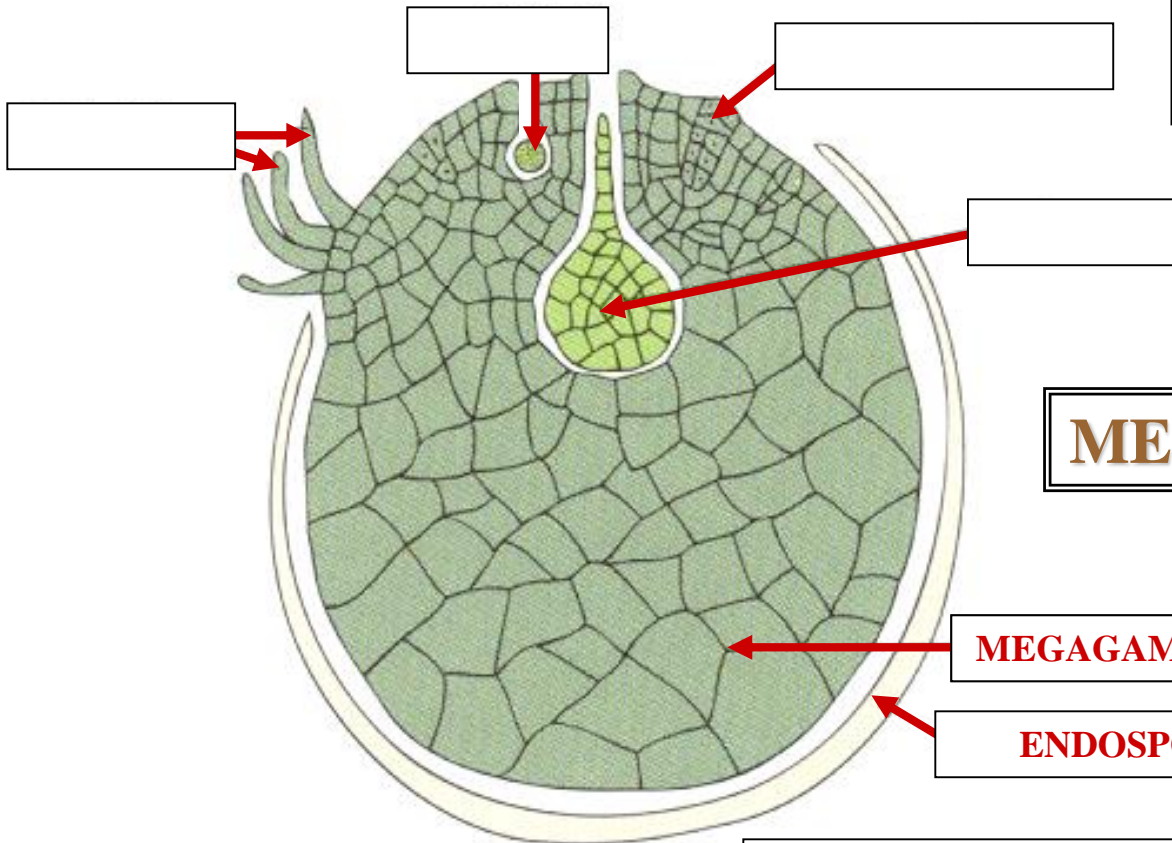


MICROSPORE WALL

MICROGAMETOPHYTE

FERN

EP



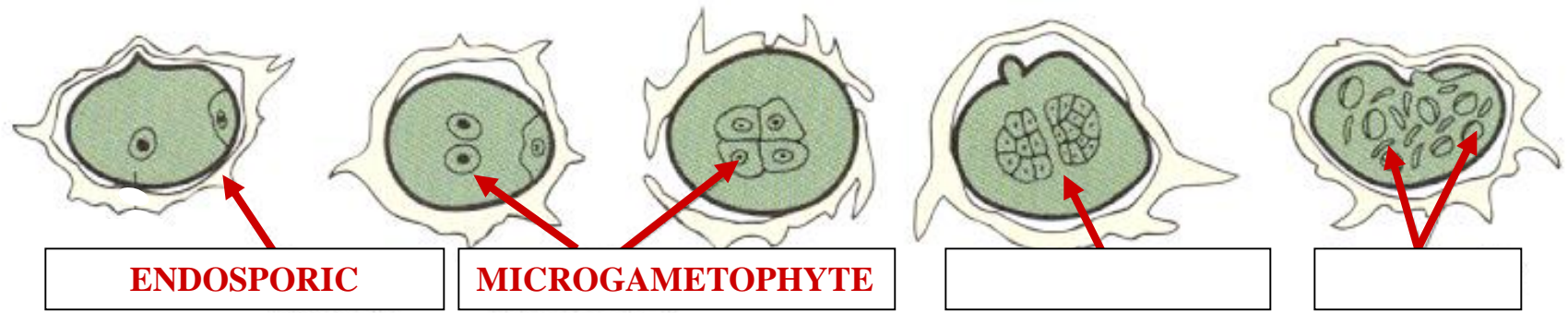
MEGASPORE

MEGAGAMETOPHYTE

ENDOSPORIC

MICROSPORE

GAMETOPHYTE

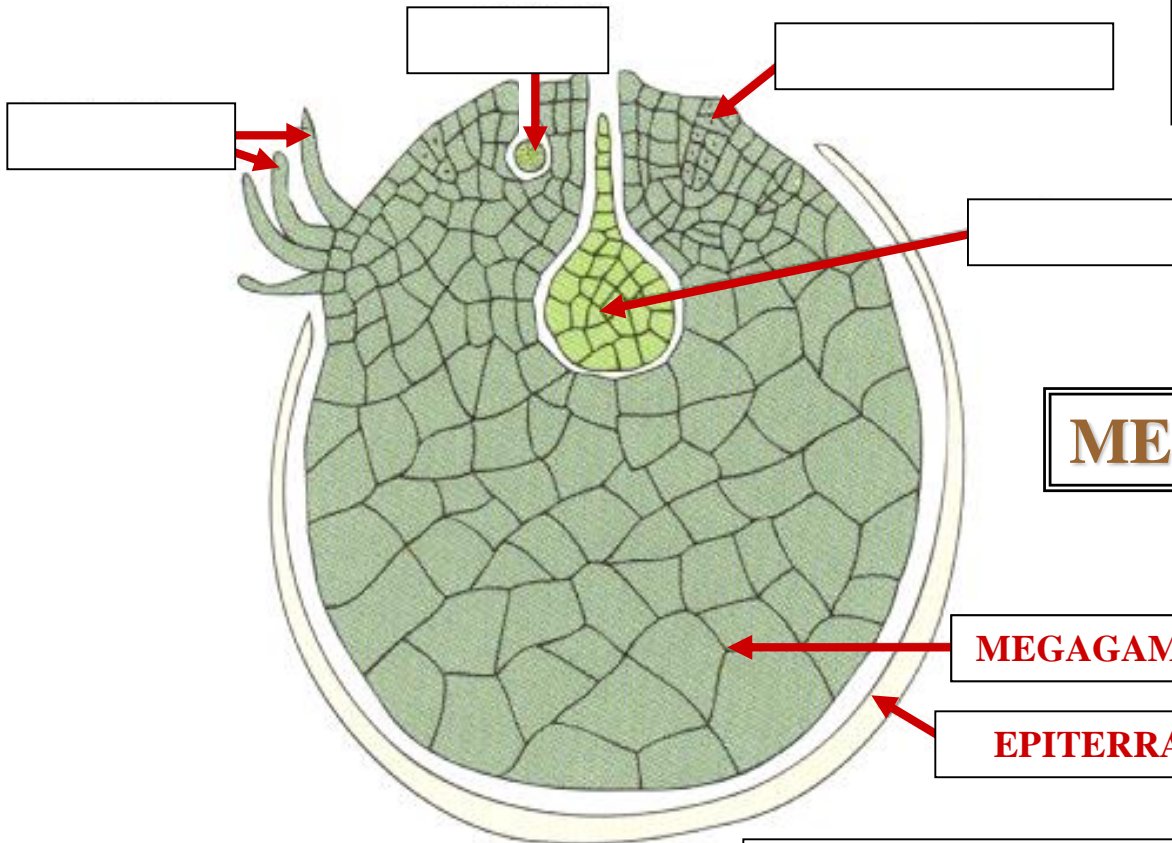


ENDOSPORIC

MICROGAMETOPHYTE

FERN

W



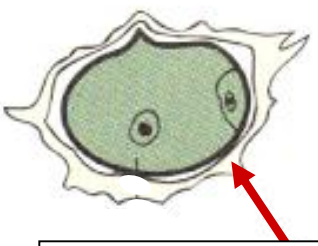
MEGASPORE

MEGAGAMETOPHYTE

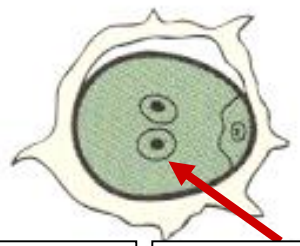
EPITERRANEAN

MICROSPORE

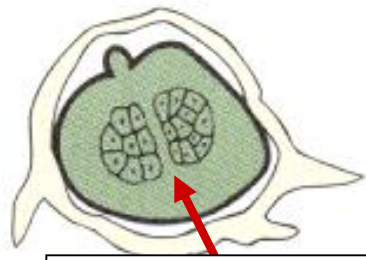
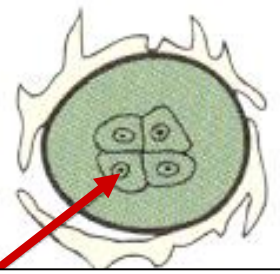
GAMETOPHYTE



EPITERRANEAN

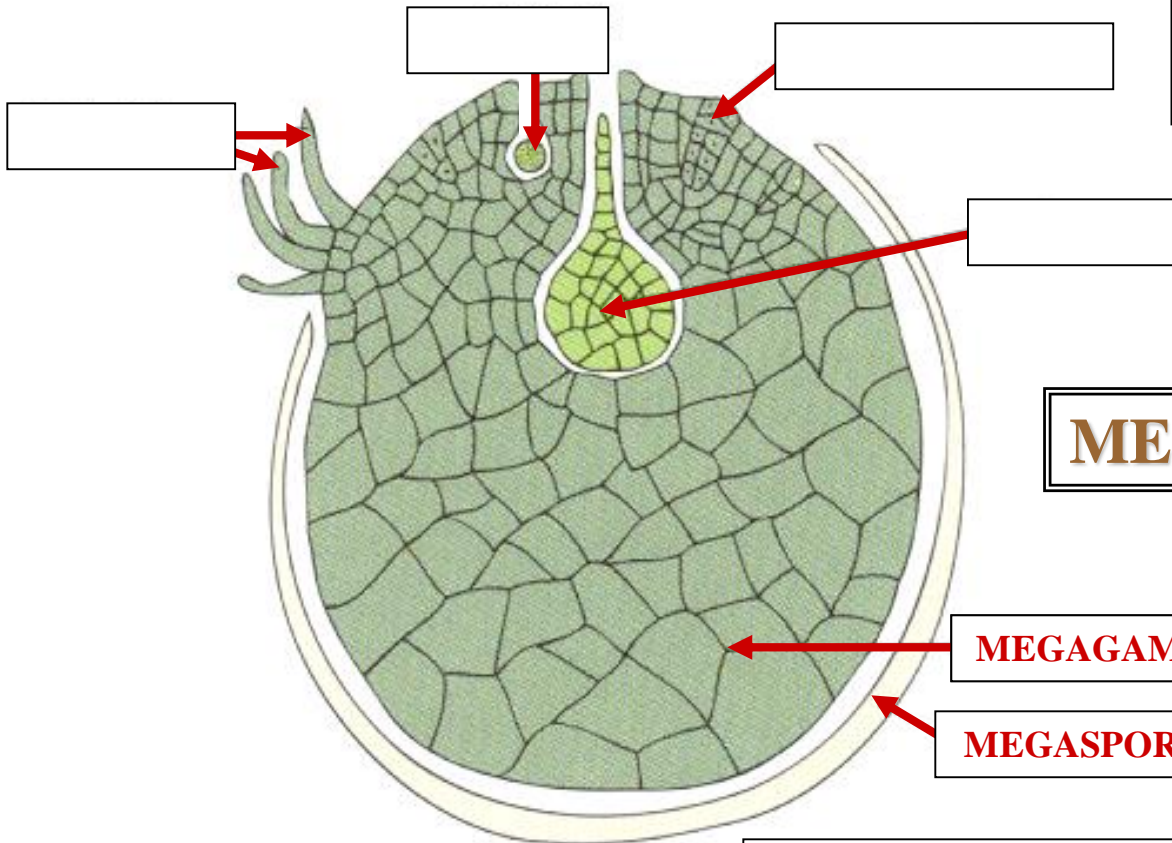


MICROGAMETOPHYTE



FERN

N



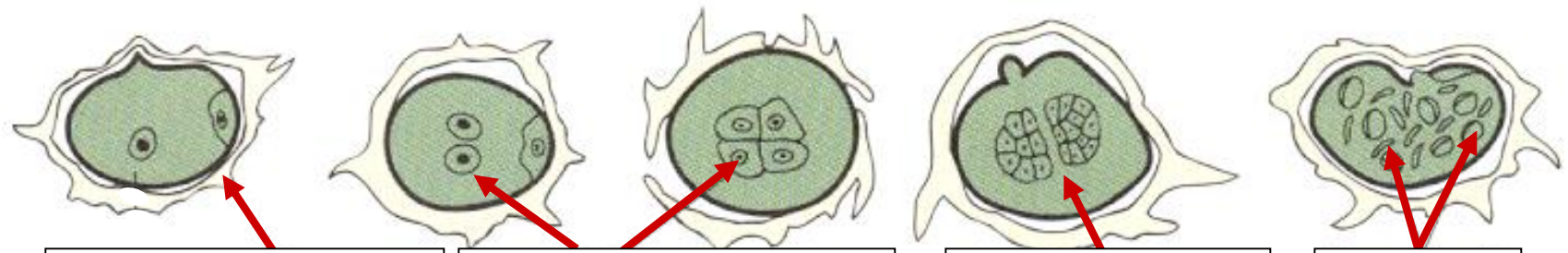
MEGASPORE

MEGAGAMETOPHYTE

MEGASPORE WALL

MICROSPORE

GAMETOPHYTE

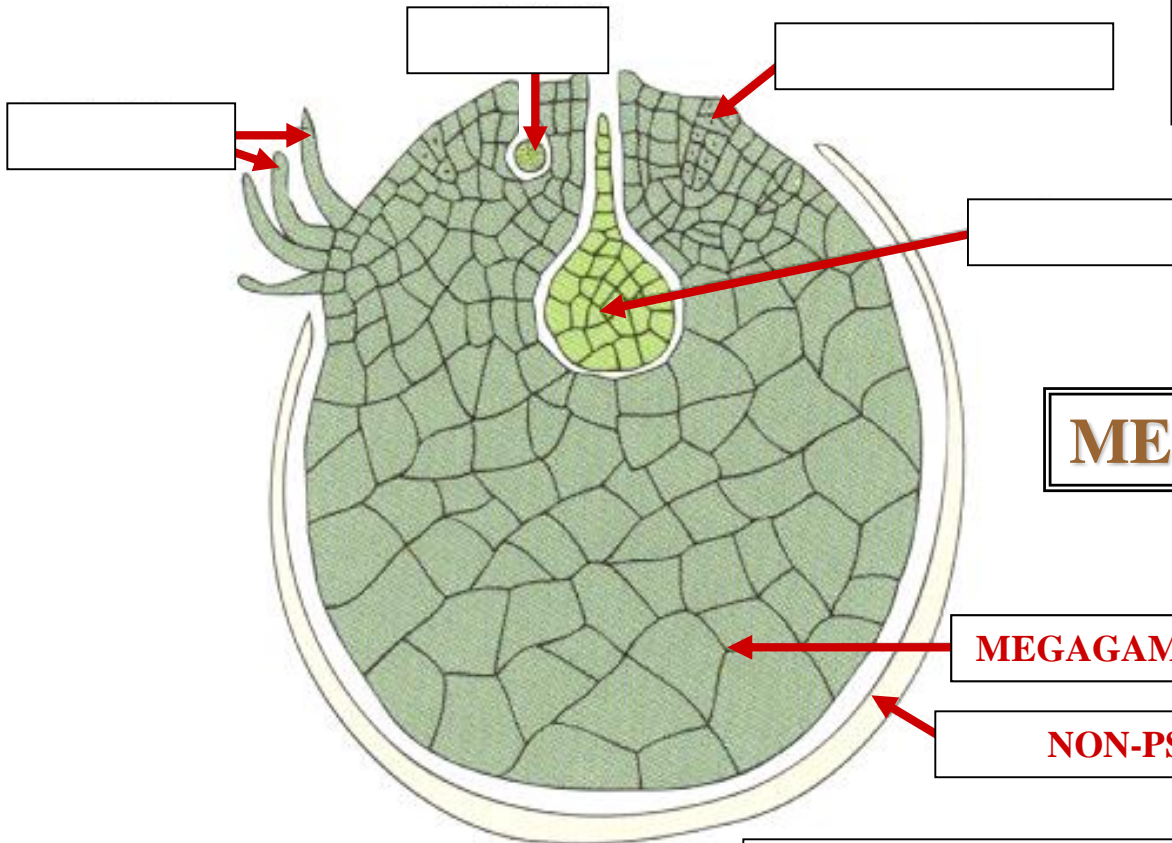


MICROSPORE WALL

MICROGAMETOPHYTE

FERN

W



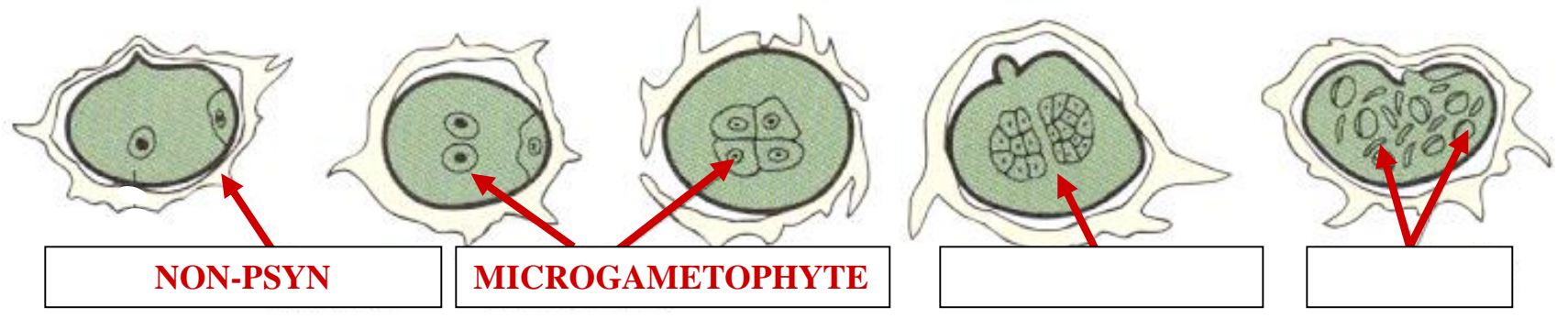
MEGASPORE

MEGAGAMETOPHYTE

NON-PSYN

MICROSPORE

GAMETOPHYTE

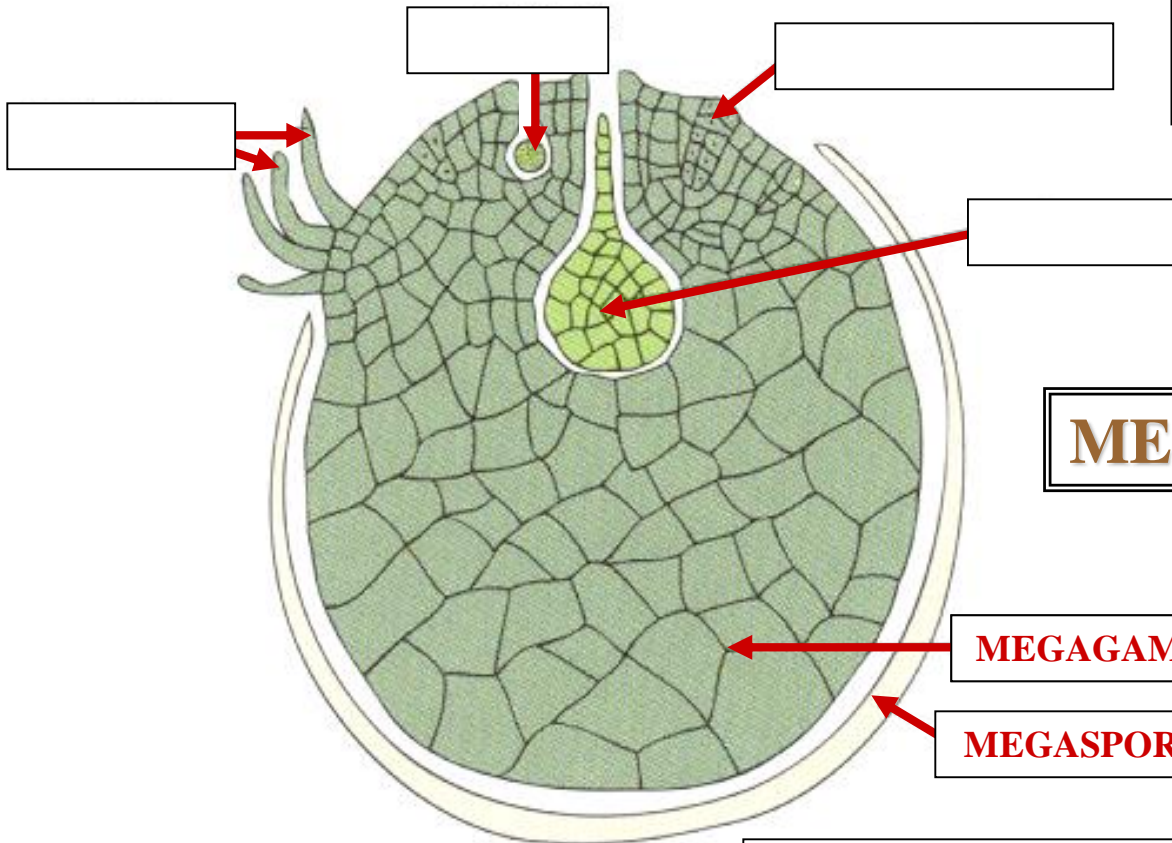


NON-PSYN

MICROGAMETOPHYTE

FERN

M



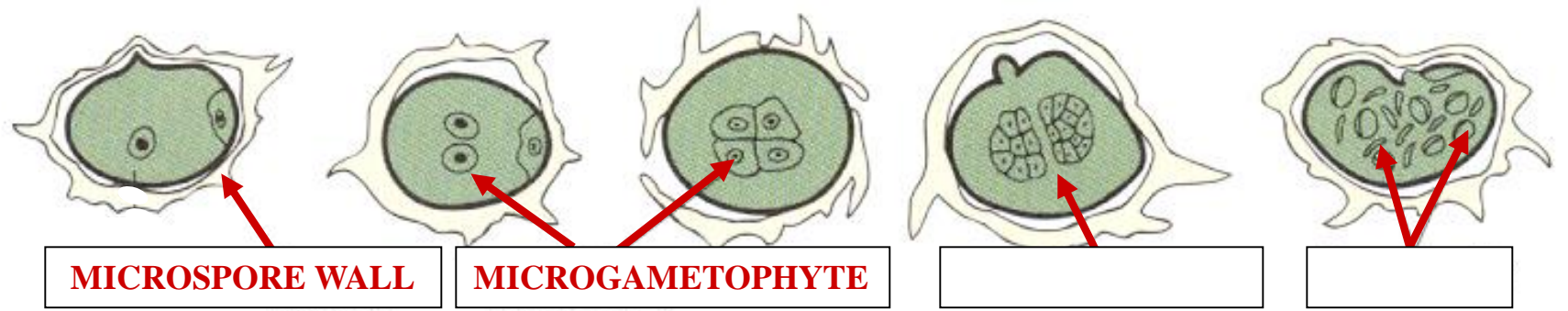
MEGASPORE

MEGAGAMETOPHYTE

MEGASPORE WALL

MICROSPORE

GAMETOPHYTE

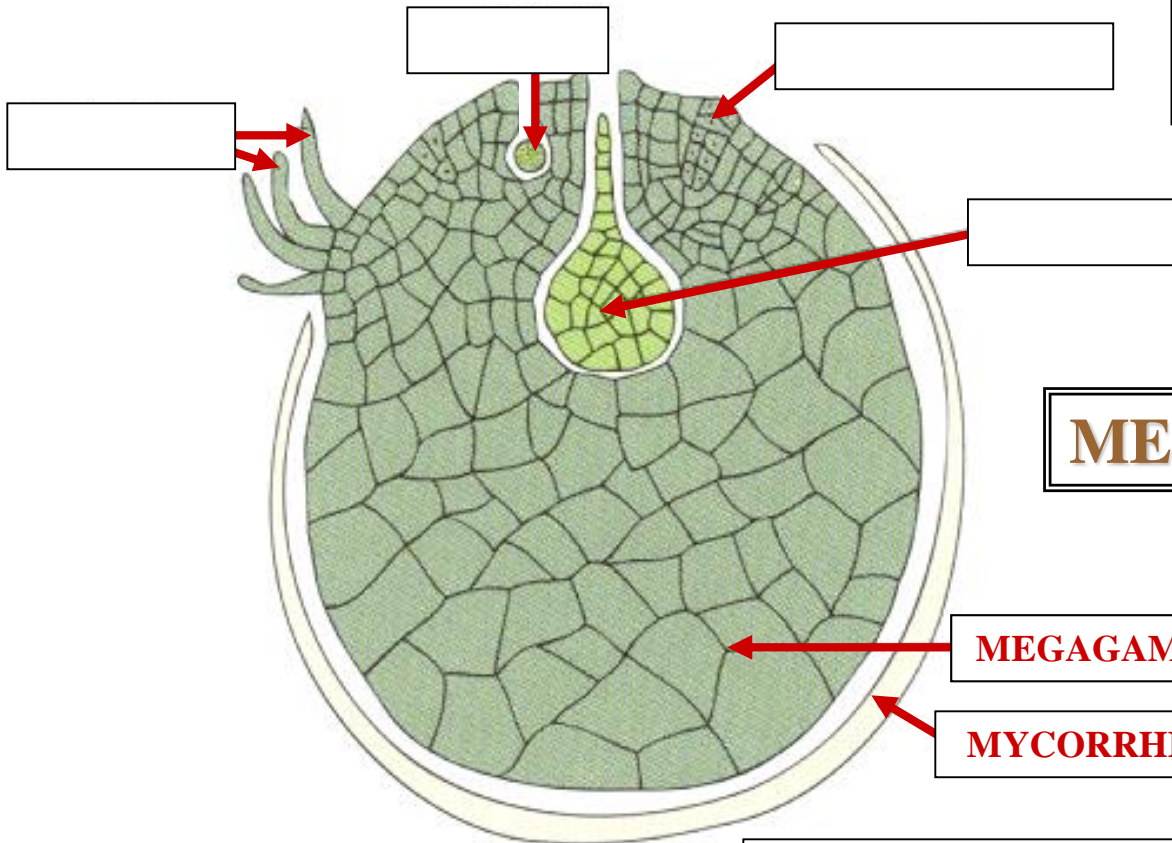


MICROSPORE WALL

MICROGAMETOPHYTE

FERN

EN



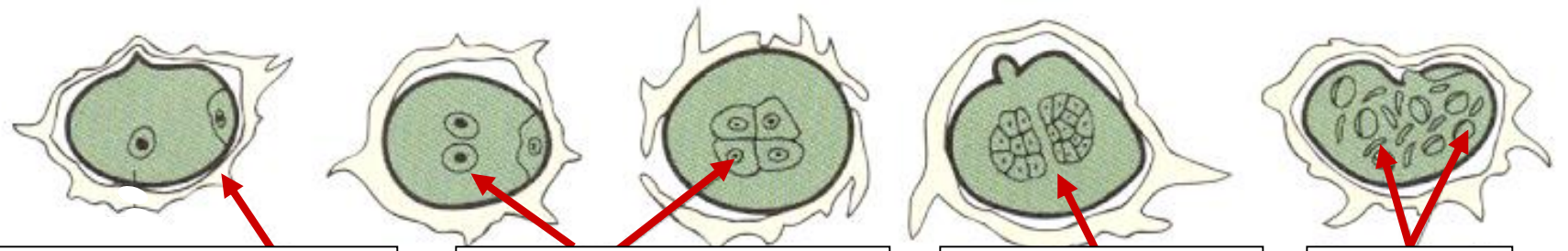
MEGASPORE

MEGAGAMETOPHYTE

MYCORRHIZAE ABSENT

MICROSPORE

GAMETOPHYTE



MYCORRHIZAE ABSENT

MICROGAMETOPHYTE

FERN

U

ARCHEGONIUM

[]

[]

[]

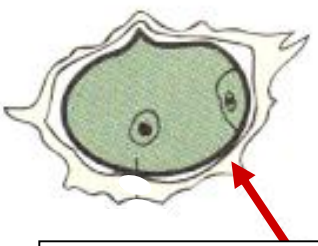
MEGASPORE

MEGAGAMETOPHYTE

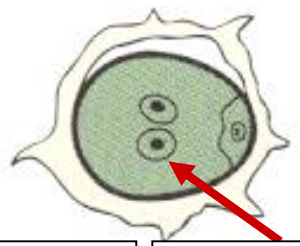
ENDOSPORIC

MICROSPORE

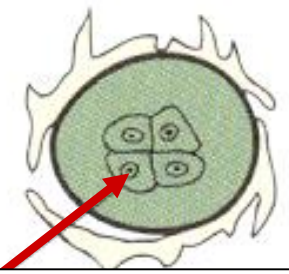
GAMETOPHYTE



ENDOSPORIC



MICROGAMETOPHYTE



ANTHERIDIUM



[]

FERN

ARCHEGONIUM

[]

[]

[]

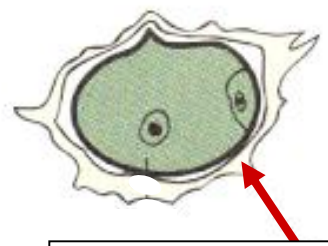
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MEGAGAMETOPHYTE

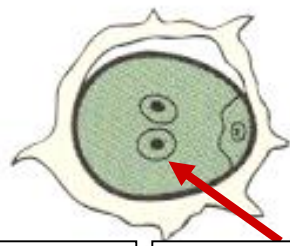
UNISEXUAL

MICROSPORE

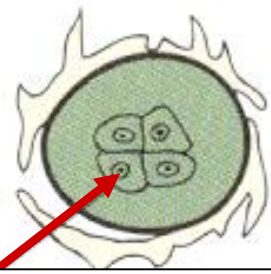
GAMETOPHYTE



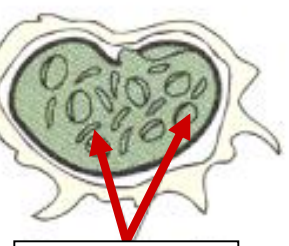
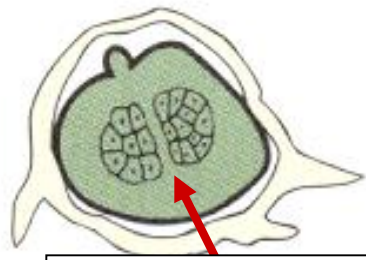
UNISEXUAL



MICROGAMETOPHYTE



ANTHERIDIUM



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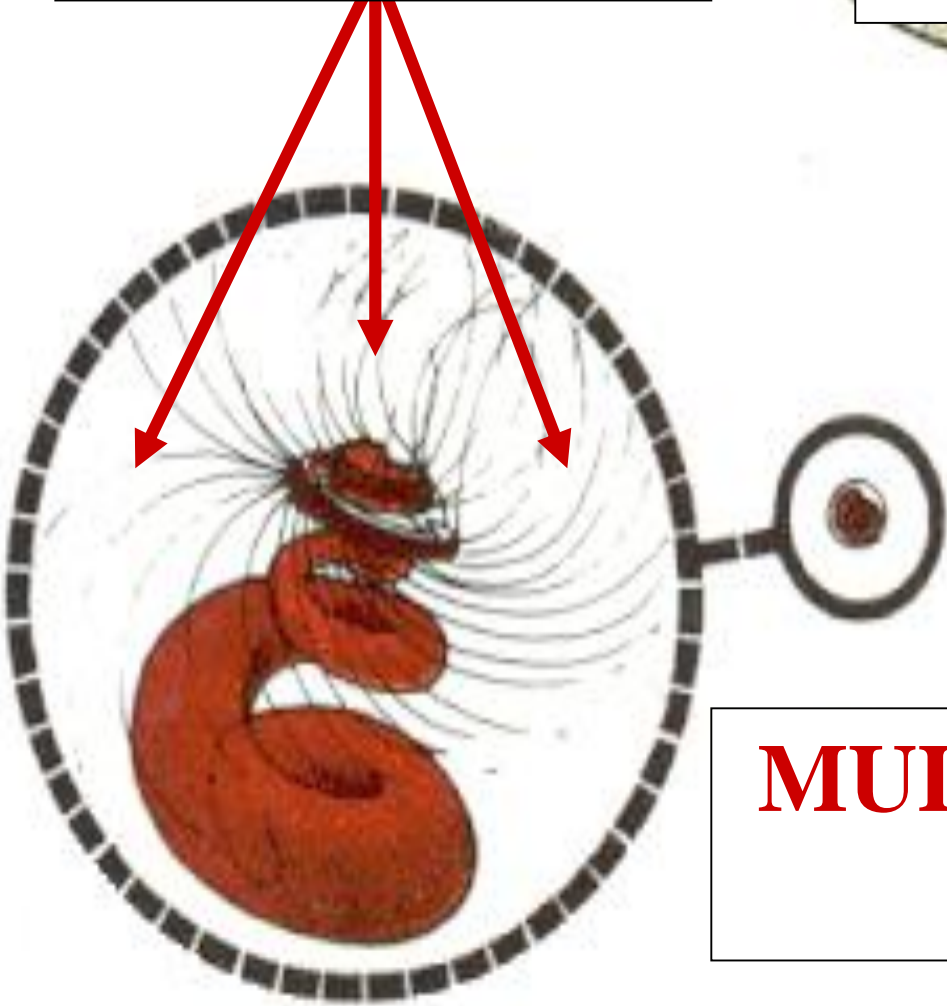




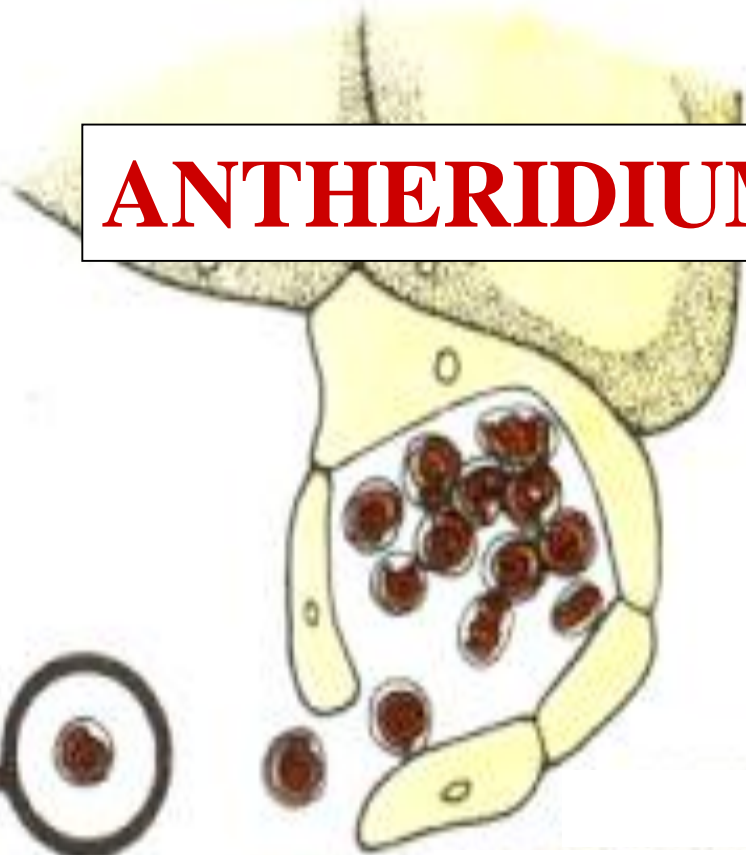
SPERM

**MULTIPLE
FLAGELLA**

ANTHERIDIUM



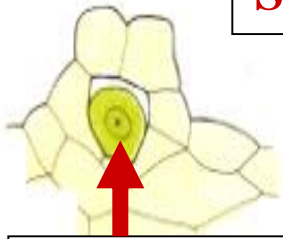
**MULTIFLAGELLATED
SPERM**



SYNGAMY REQUIRES

?

SYNGAMY



ZYGOTE



EGG

SPERM

FERNS

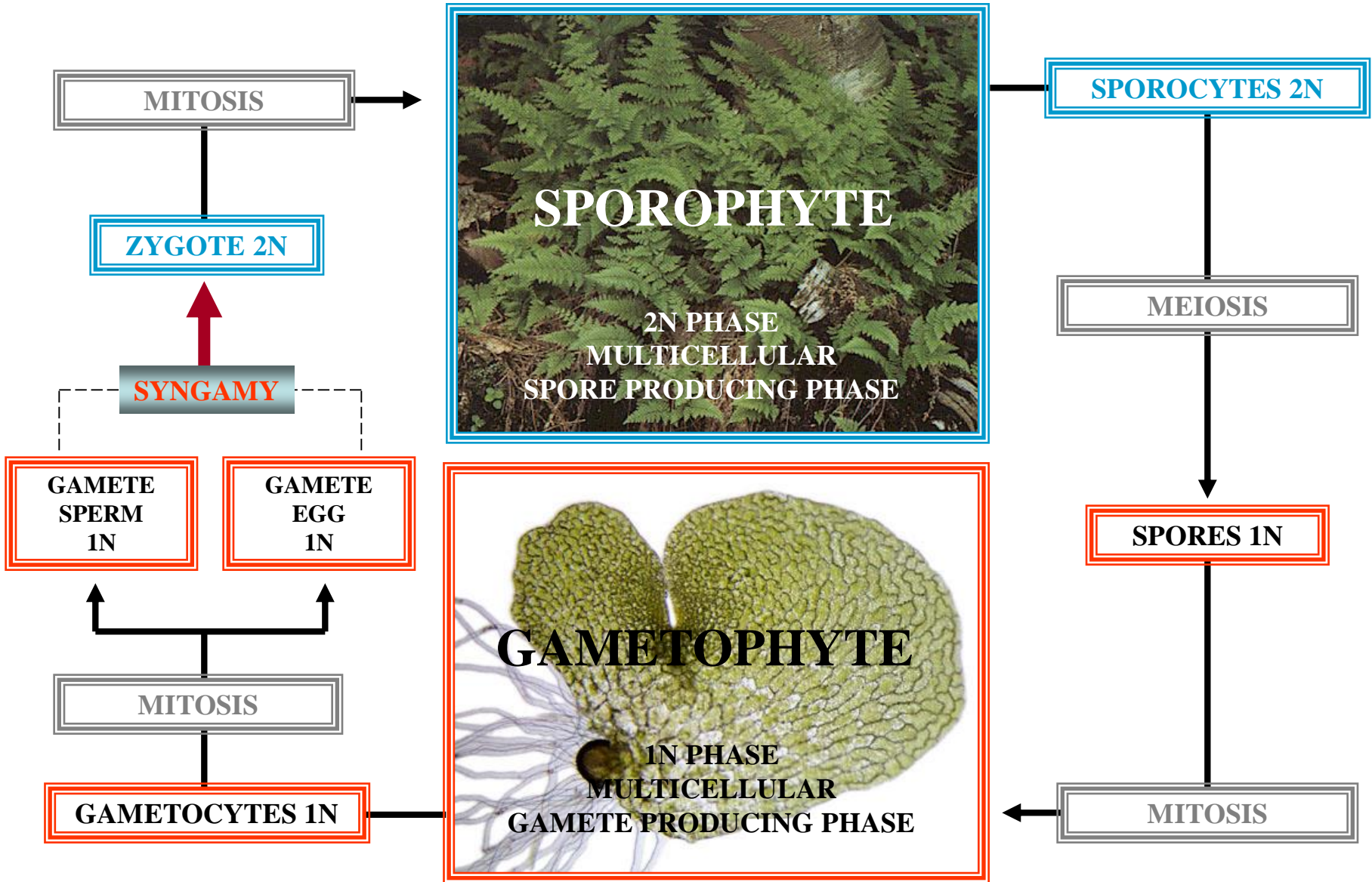


SYNGAMY REQUIRES WATER



PTERIDOPHYTA

LIFE CYCLE





FERN FOSSIL RECORD



~385

MILLION YEARS

~385 MILLION YEARS AGO

F

DEVONIAN



~385 MILLION YEARS AGO

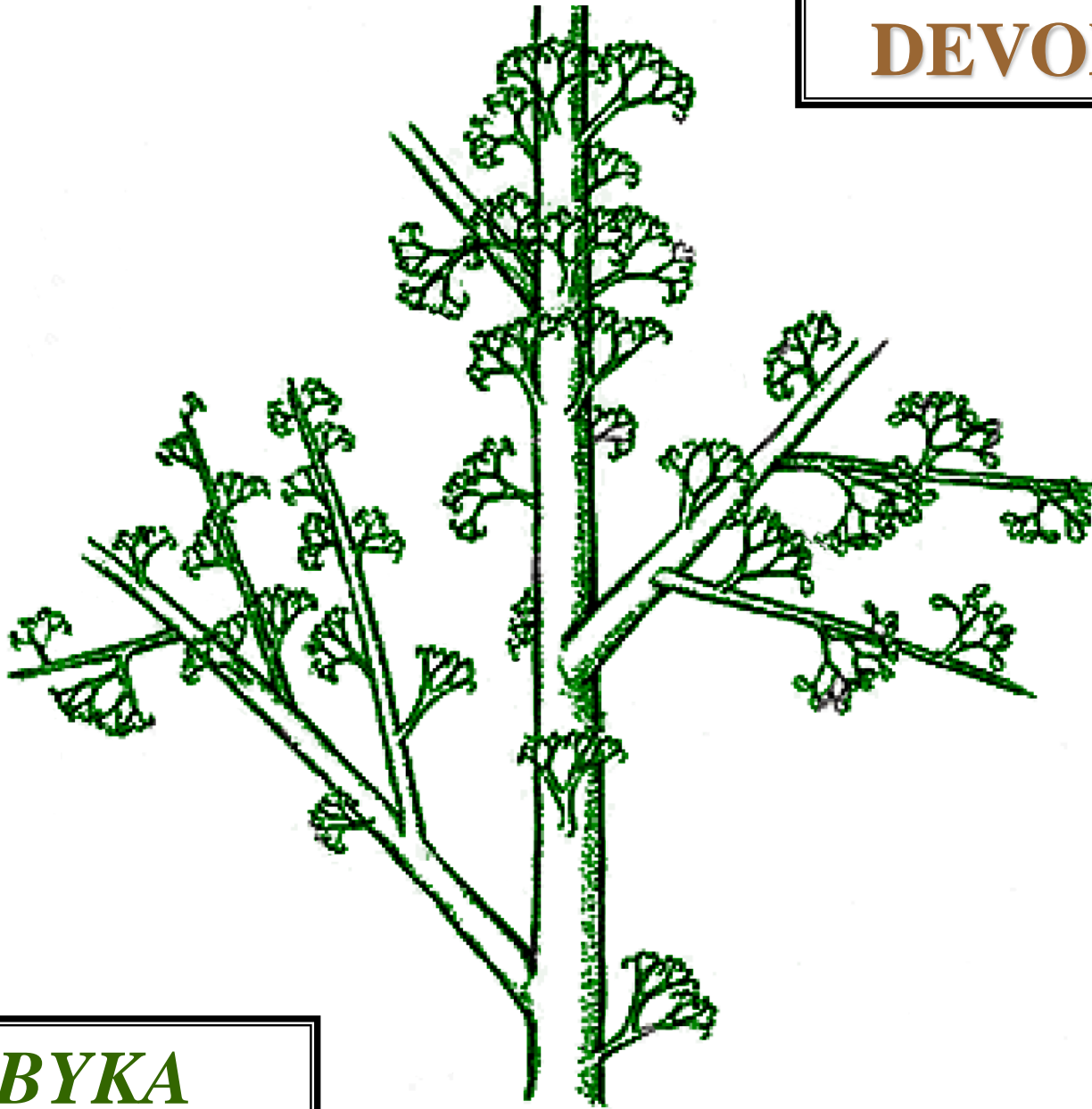


FERNS EVOLVE



DEVONIAN

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IBYKA

DEVONIAN



**OLDEST
KNOWN
FERN**

IBYKA

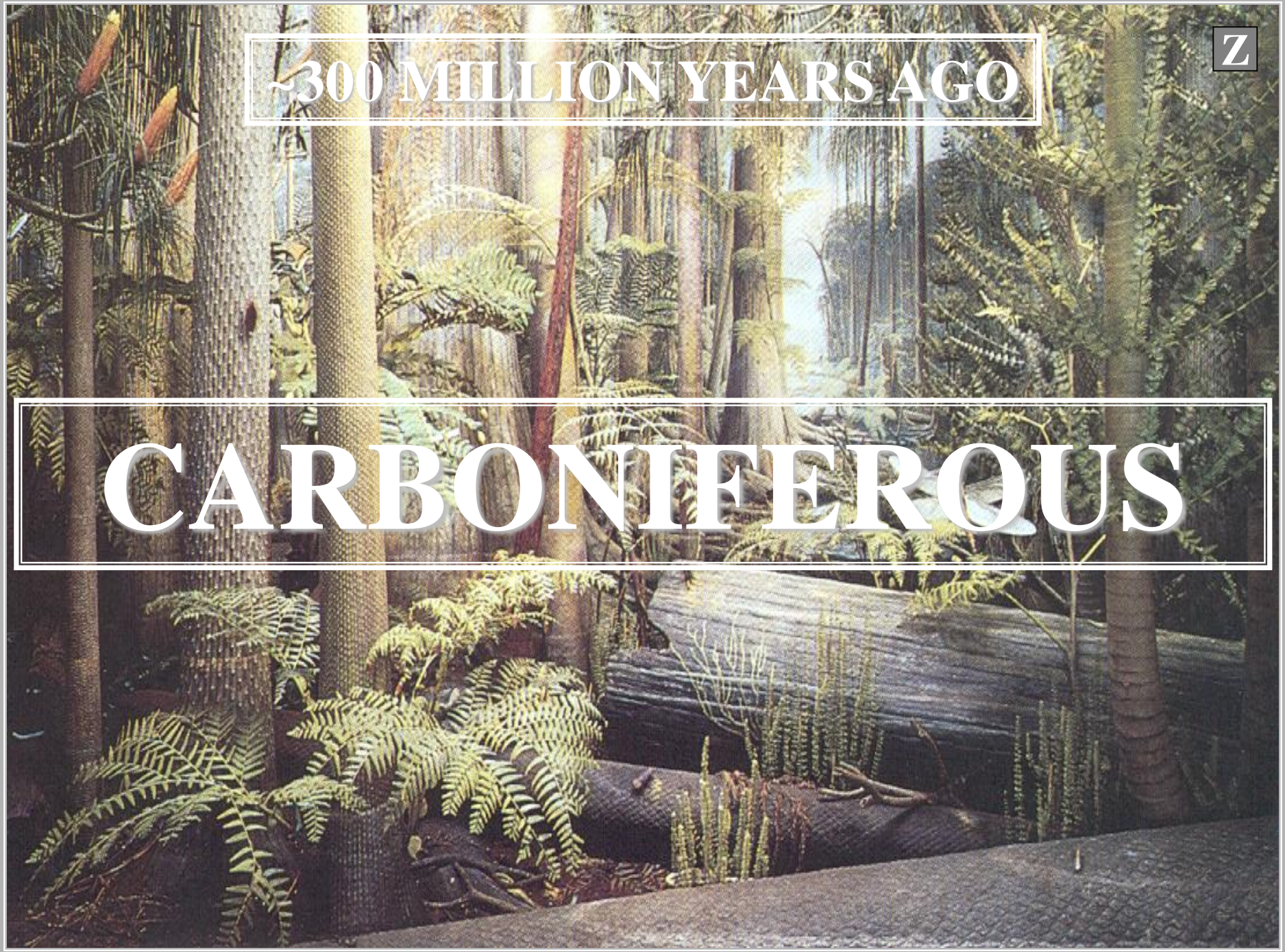




**~300
MILLION YEARS**

~300 MILLION YEARS AGO

CARBONIFEROUS





~300 MILLION YEARS AGO

CARBONIFEROUS FERN ZENITH

PHYLOGENETIC RELATIONSHIP

TRACHEOPHYTES

RHYNIOPHYTA

MICROPHYLLS

MEGAPHYLLS

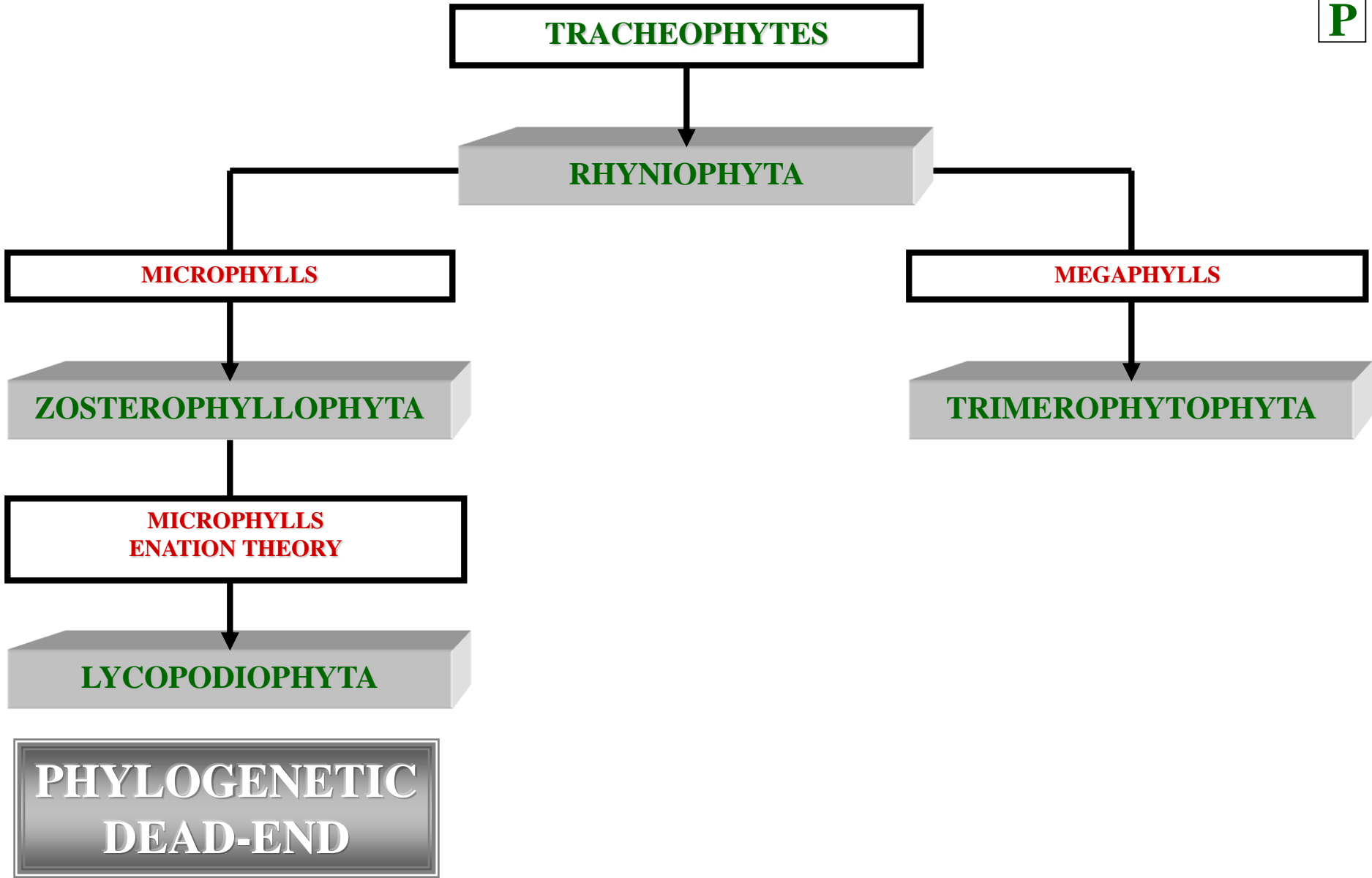
ZOSTEROPHYLLOPHYTA

TRIMEROPHYTOPHYTA

**MICROPHYLLS
ENATION THEORY**

LYCOPODIOPHYTA

**PHYLOGENETIC
DEAD-END**





TRACHEOPHYTES

RHYNIOPHYTA

MICROPHYLLS

MEGAPHYLLS

ZOSTEROPHYLLOPHYTA

TRIMEROPHYTOPHYTA

**MICROPHYLLS
ENATION THEORY**

**MEGAPHYLLS
TELOME THEORY**

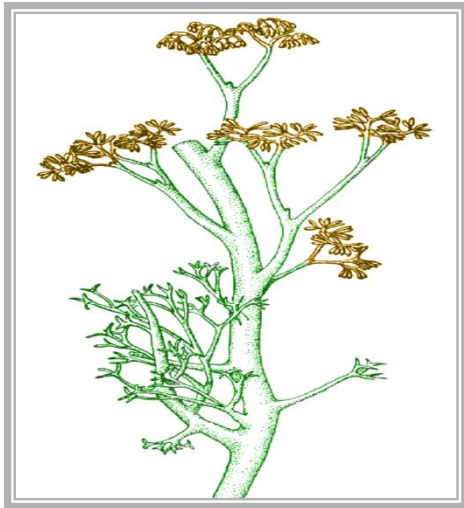
LYCOPODIOPHYTA

PTERIDOPHYTA

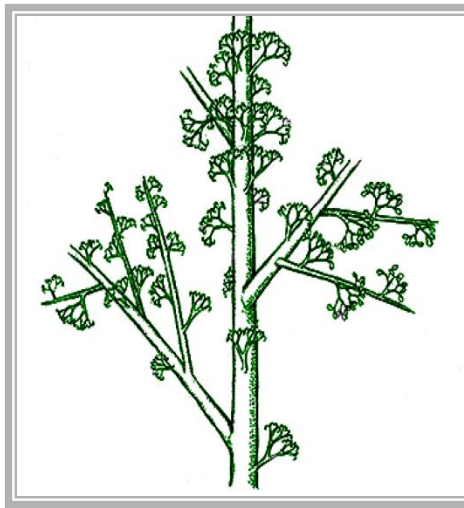
**PHYLOGENETIC
DEAD-END**



PTERIDOPHYTE EVOLUTION



TRIMEROPHYTE



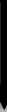
IBYKA



PTERIDOPHYTE



TRACHEOPHYTES



RHYNIOPHYTA



MICROPHYLLS



ZOSTEROPHYLLOPHYTA



**MICROPHYLLS
ENATION THEORY**



LYCOPODIOPHYTA

**PHYLOGENETIC
DEAD-END**



MEGAPHYLLS



TRIMEROPHYTOPHYTA



**MEGAPHYLLS
TELOME THEORY**



PTERIDOPHYTA

**PHYLOGENETIC
DEAD-END**



PTERIDOPHYTA CLASSIFICATION



**EXTANT
CLASS**

OPHIOGLOSSOPSIDA

**EXTANT
CLASS**



COMMON NAME



OPHIOGLOSSOPSIDS

OPHIOGLOSSOPSIDA CHARACTERS

OPHIOGLOSSOPSIDA CHARACTERS

TERRESTRIAL

OPHIOGLOSSOPSIDA CHARACTERS

OPHIOGLOSSOPSIDA CHARACTERS

**TERRESTRIAL
ROOTS REDUCED
OR
ROOTS ABSENT**

OPHIOGLOSSOPSIDA CHARACTERS

OPHIOGLOSSOPSIDA CHARACTERS

TERRESTRIAL
ROOTS REDUCED
OR
ROOTS ABSENT
FROND NON-REDUCED
OR
FROND REDUCED

OPHIOGLOSSOPSIDA CHARACTERS

OPHIOGLOSSOPSIDA CHARACTERS

TERRESTRIAL
ROOTS REDUCED
OR
ROOTS ABSENT
FROND NON-REDUCED
OR
FROND REDUCED
EUSPORANGIATE

OPHIOGLOSSOPSIDA CHARACTERS

OPHIOGLOSSOPSIDA CHARACTERS

TERRESTRIAL
ROOTS REDUCED
OR
ROOTS ABSENT
FROND NON-REDUCED
OR
FROND REDUCED
EUSPORANGIATE
NON-SYNGIATE
OR
SYNGIATE

OPHIOGLOSSOPSIDA CHARACTERS

OPHIOGLOSSOPSIDA

CHARACTERS



TERRESTRIAL
ROOTS REDUCED
OR
ROOTS ABSENT
FROND NON-REDUCED
OR
FROND REDUCED
EUSPORANGIATE
NON-SYNANGIATE
OR
SYNANGIATE
HOMOSPOROUS

OPHIOGLOSSOPSIDA

CHARACTERS

OPHIOGLOSSOPSIDA ORDERS

**OPHIOGLOSSOPSIDA
ORDERS**

OPHIOGLOSSALES

**OPHIOGLOSSOPSIDA
ORDERS**