



HETEROSPOROUS

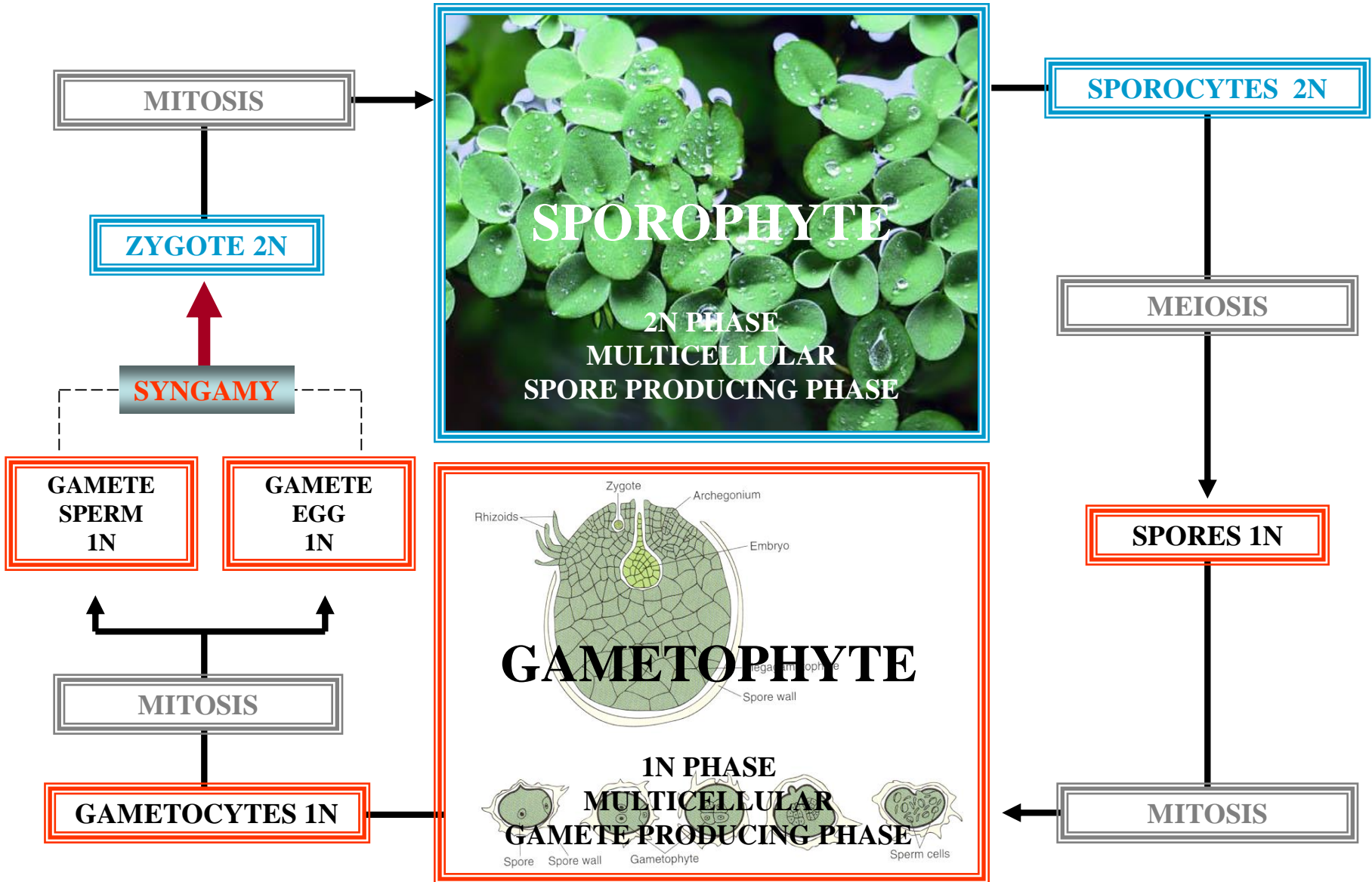
SALVINIA



HETEROSPOROUS

AZOLLA

SALVINIALES LIFE CYCLE





GAMETOPHYTE CHARACTERS

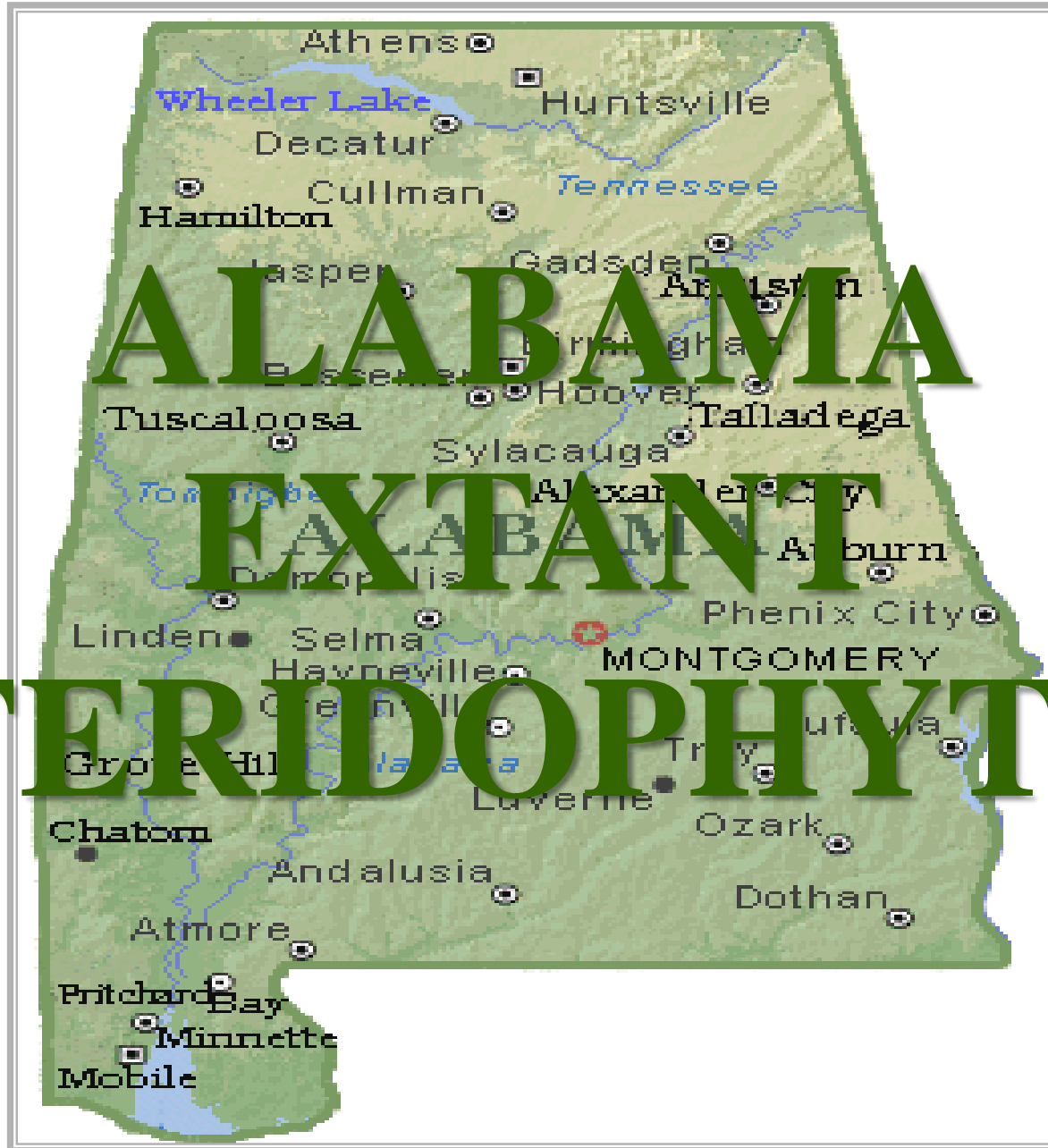


**GAMETOPHYTE
CHARACTERS
IDENTICAL
MARSILEALES**



PTERIDOPHYTA CLASSIFICATION

ALABAMA EXTANT PTERIDOPHYTES



PHYLUM PROGYMNOSPERMOPHYTA



ALABAMA
EXTINCT PHYLUM

PHYLUM

PROGYMNOSPERMOPHYTA

ALABAMA
EXTINCT PHYLUM

COMMON NAME



PROGYMNOSPERMS

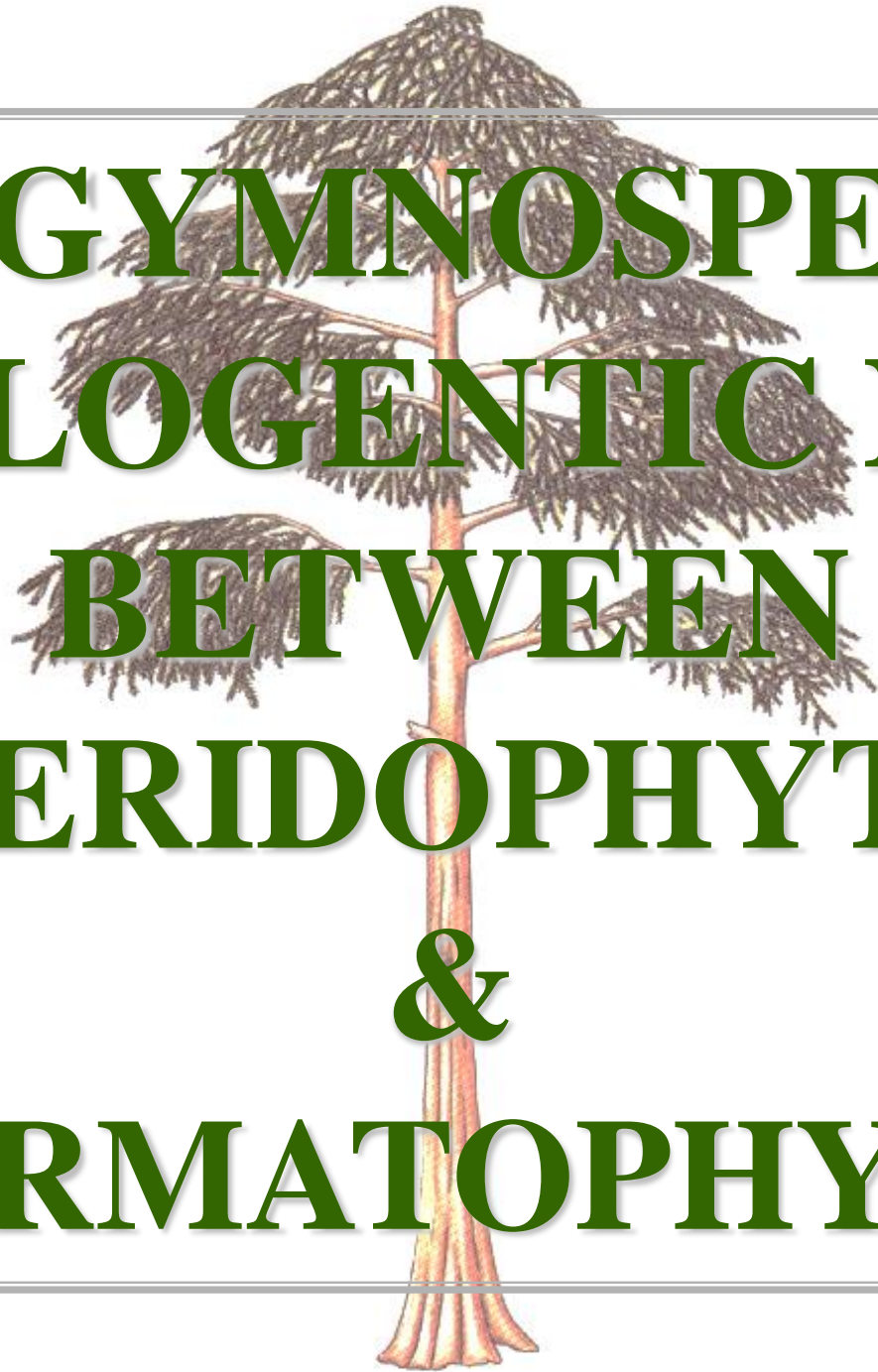




PROGYMNOSPERMS
PIVOTAL
TRACHEOPHYTE
PHYLUM



**PROGYMNOSPERMS
PHYLOGENETIC LINK
BETWEEN
PTERIDOPHYTES
&
SPERMATOPHYTES**



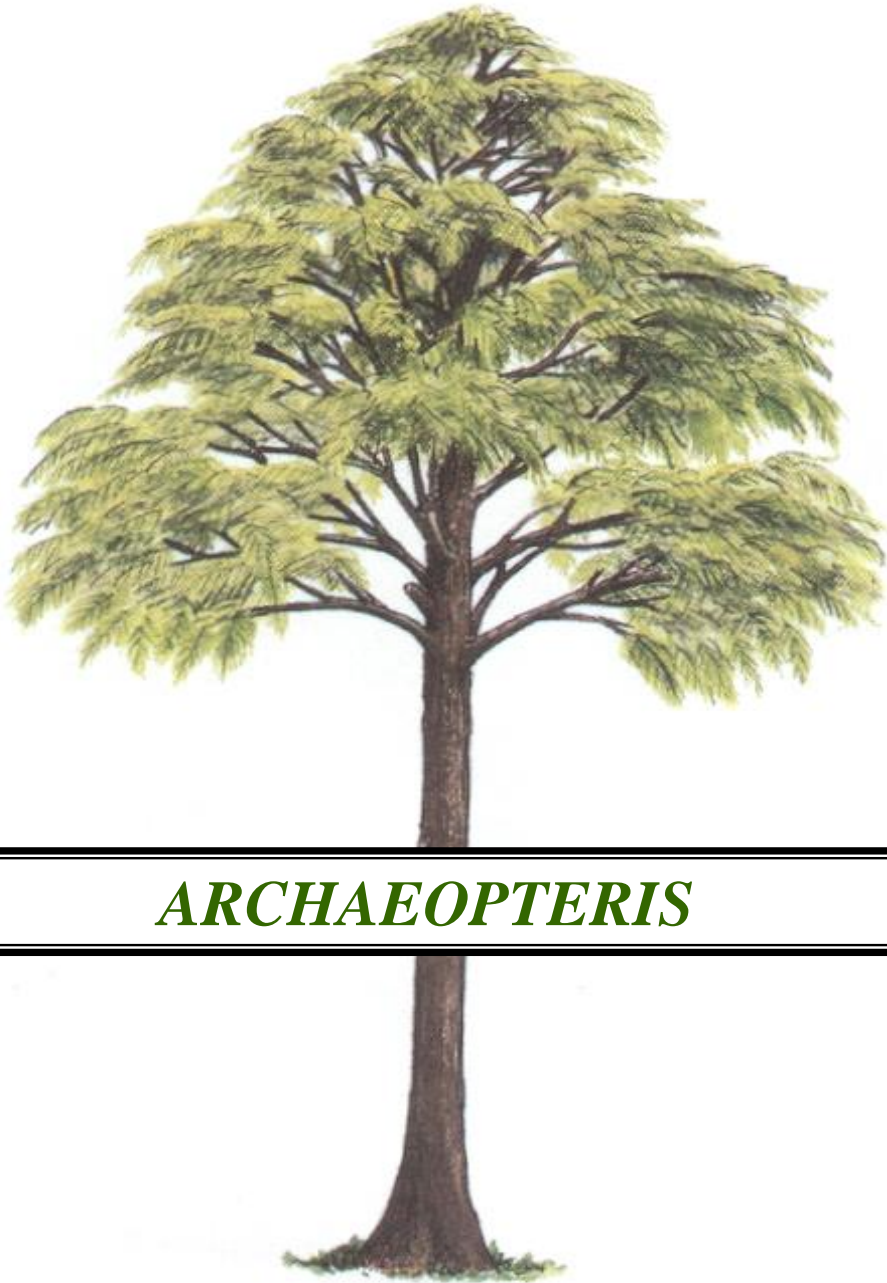


**PROGYMNOSPERMS
EVOLVED
SPERMATOPHYTES**



REPRESENTATIVE GENUS

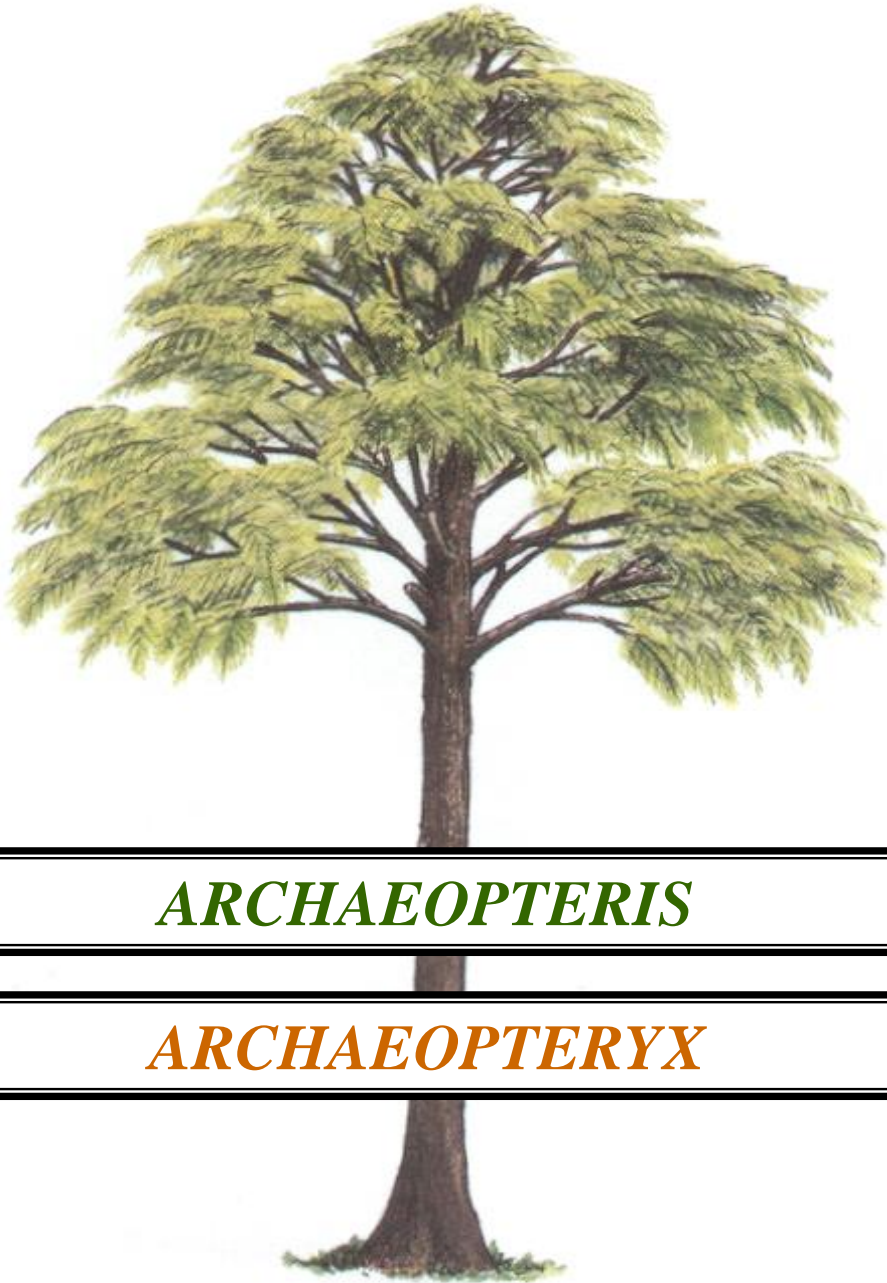
**DEVONIAN
PROGYMNOSPERM**



ARCHAEOPTERIS



DEVONIAN PROGYMNOSPERM



ARCHAEOPTERIS

ARCHAEOPTERYX



ARCHAEOPTERIS

**PROGYMNOSPERMS
EVOLVED
SEEDS**





OVULE / SEED EVOLUTION

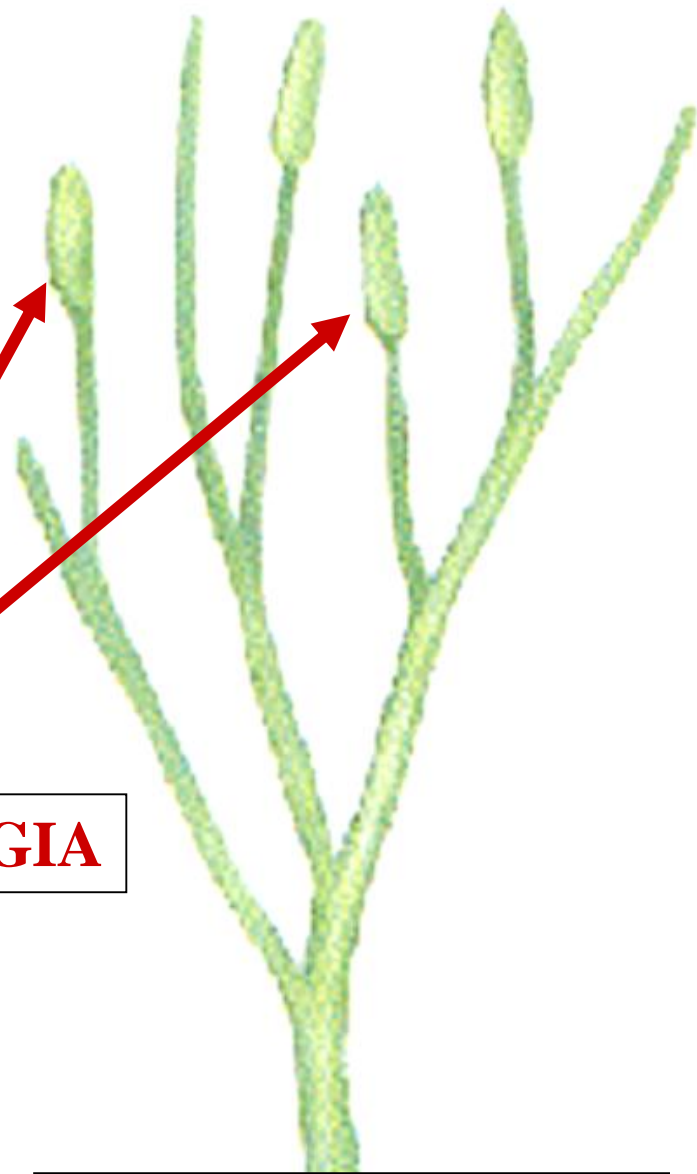


HYPOTHETICAL SCENARIO

**START
HYPOTHETICAL
SCENARIO**

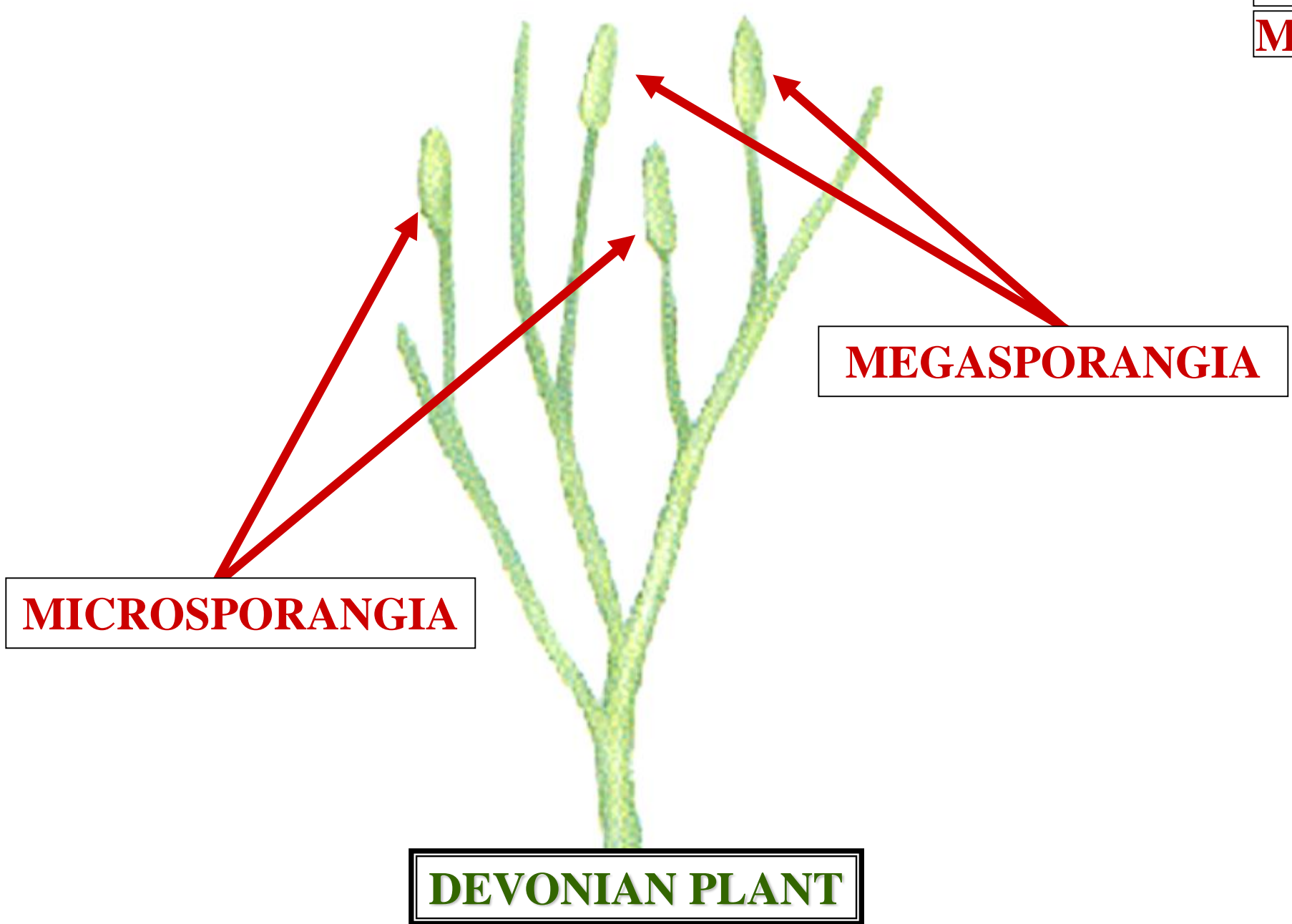


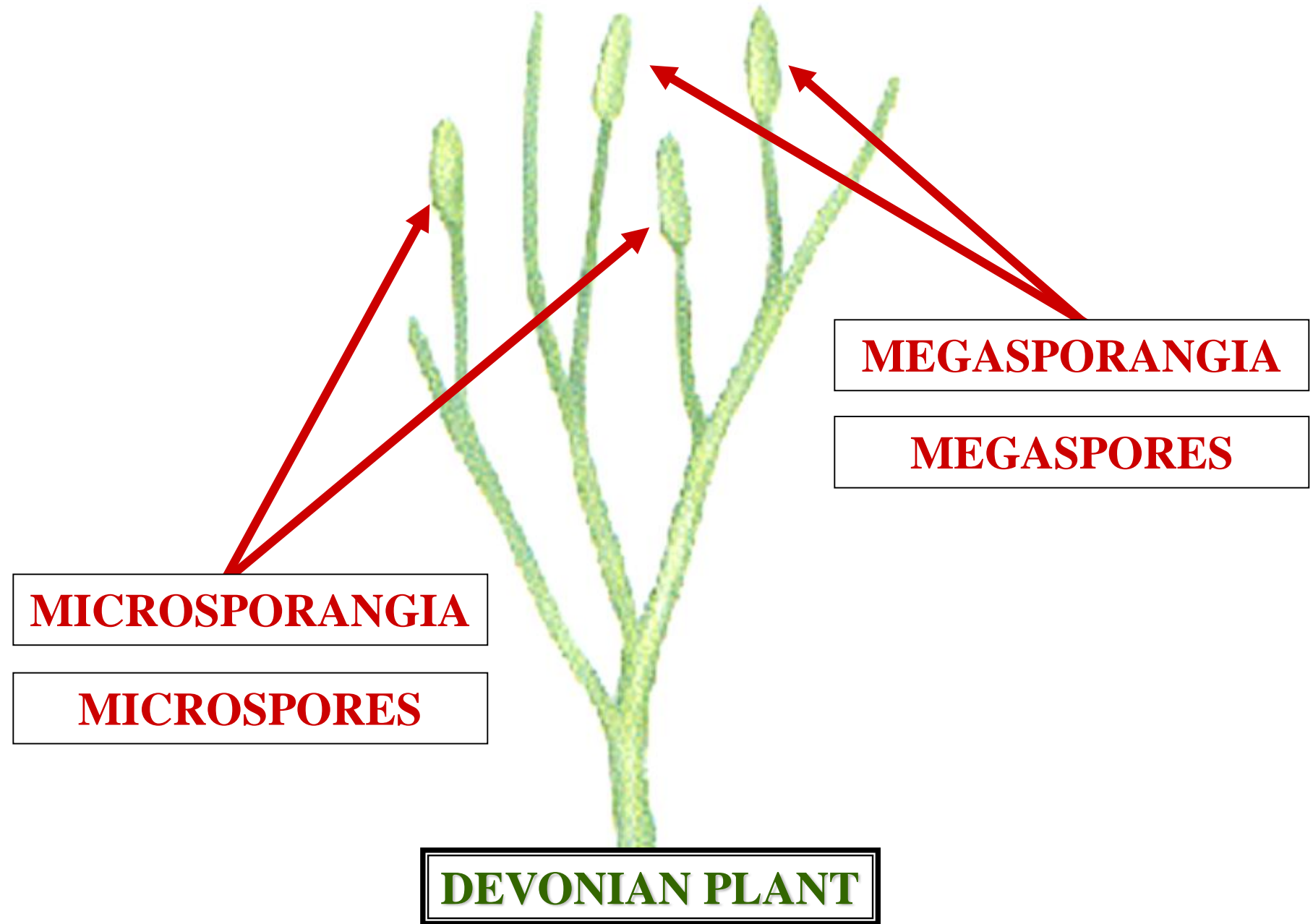
DEVONIAN PLANT



MICROSPORANGIA

DEVONIAN PLANT





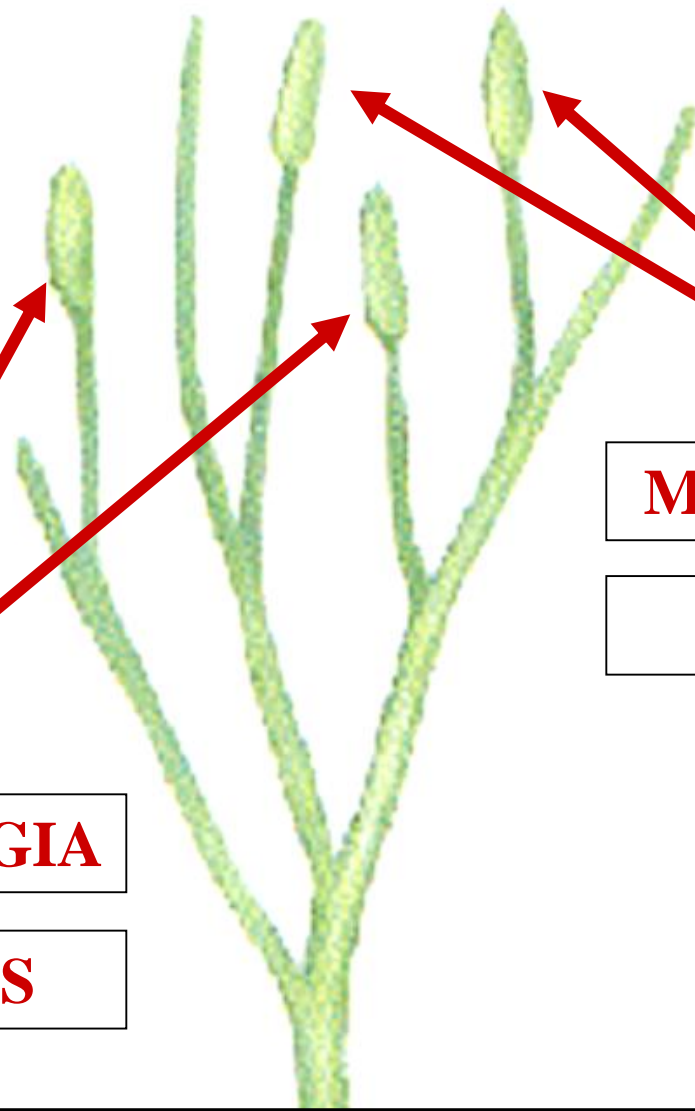
MICROSPORANGIA

MICROSPORES

MEGASPORANGIA

MEGASPORES

DEVONIAN PLANT



MICROSPORANGIA

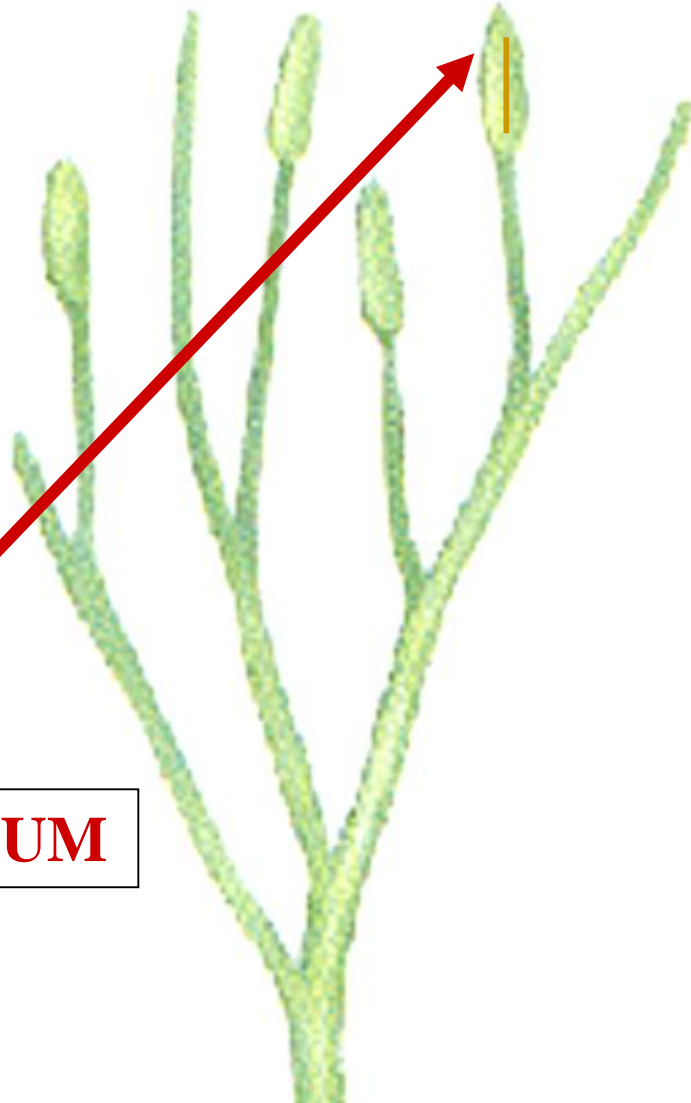
MICROSPORES

MEGASPORANGIA

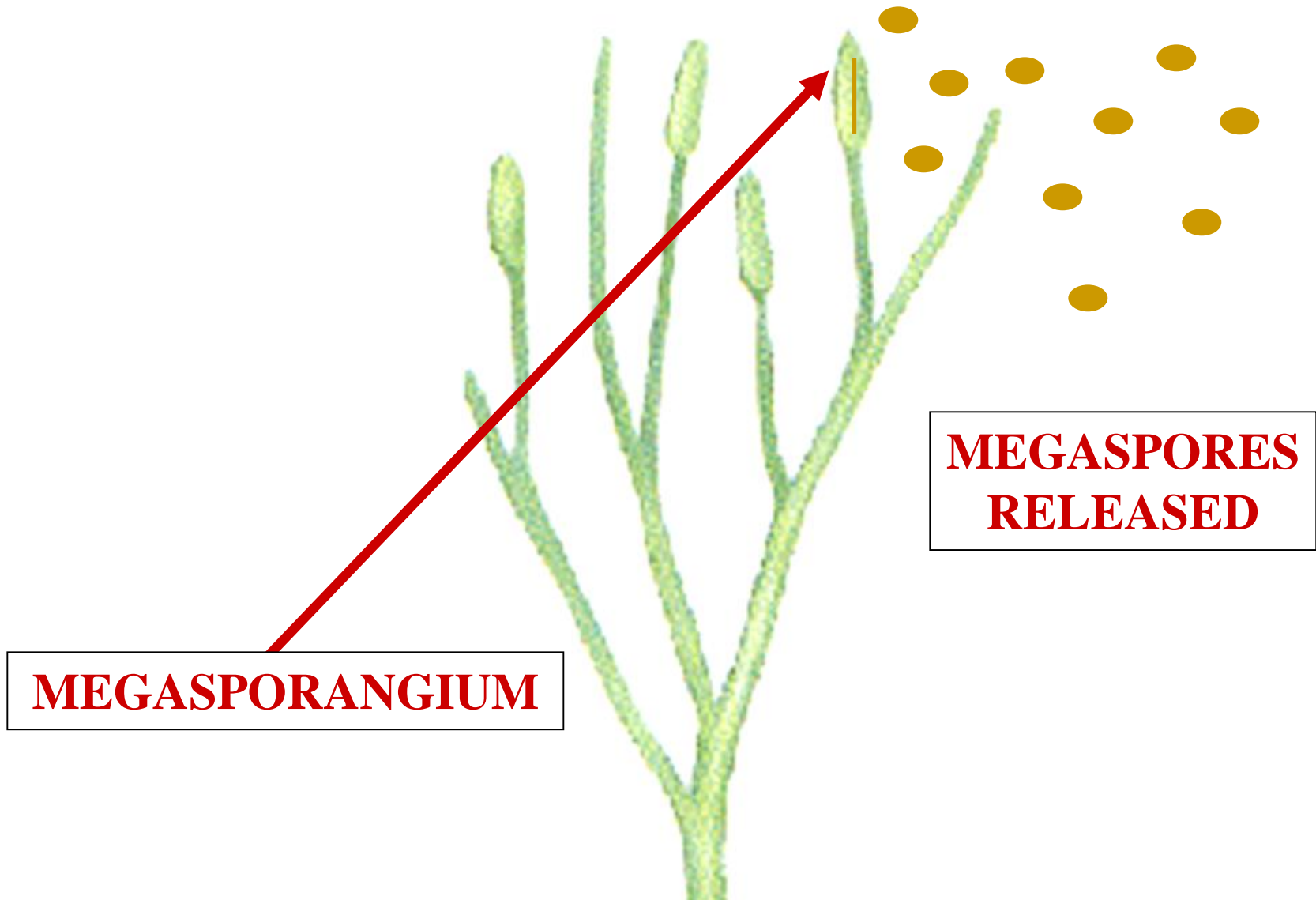
MEGASPORES

**DEVONIAN
HETEROSPOROUS PLANT**

MEGASPORANGIUM



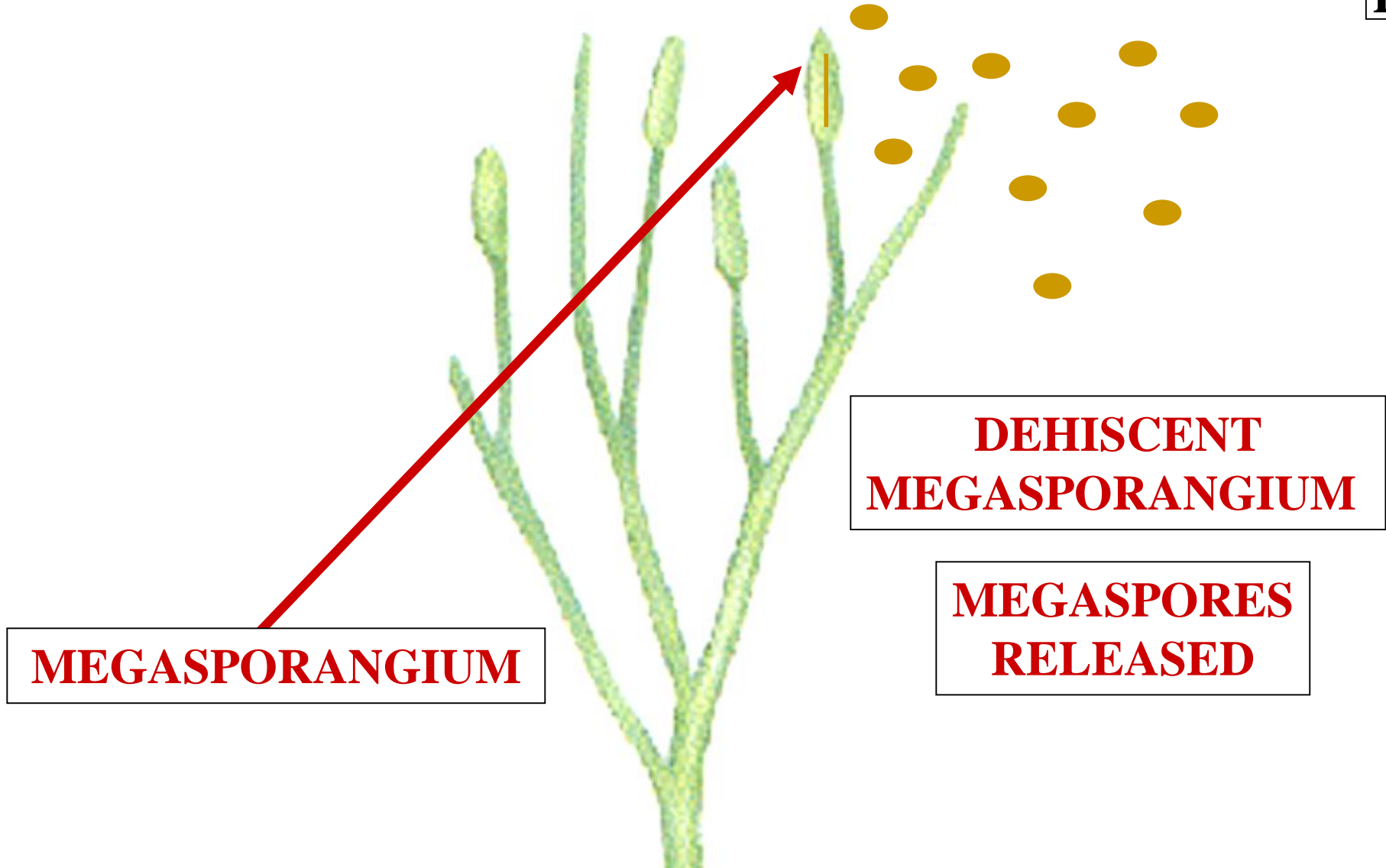
**DEVONIAN
HETEROSPOROUS PLANT**



MEGASPORANGIUM

**MEGASPORES
RELEASED**

**DEVONIAN
HETEROSPOROUS PLANT**



MEGASPORANGIUM

**DEHISCENT
MEGASPORANGIUM**

**MEGASPORES
RELEASED**

**DEVONIAN
HETEROSPOROUS PLANT**

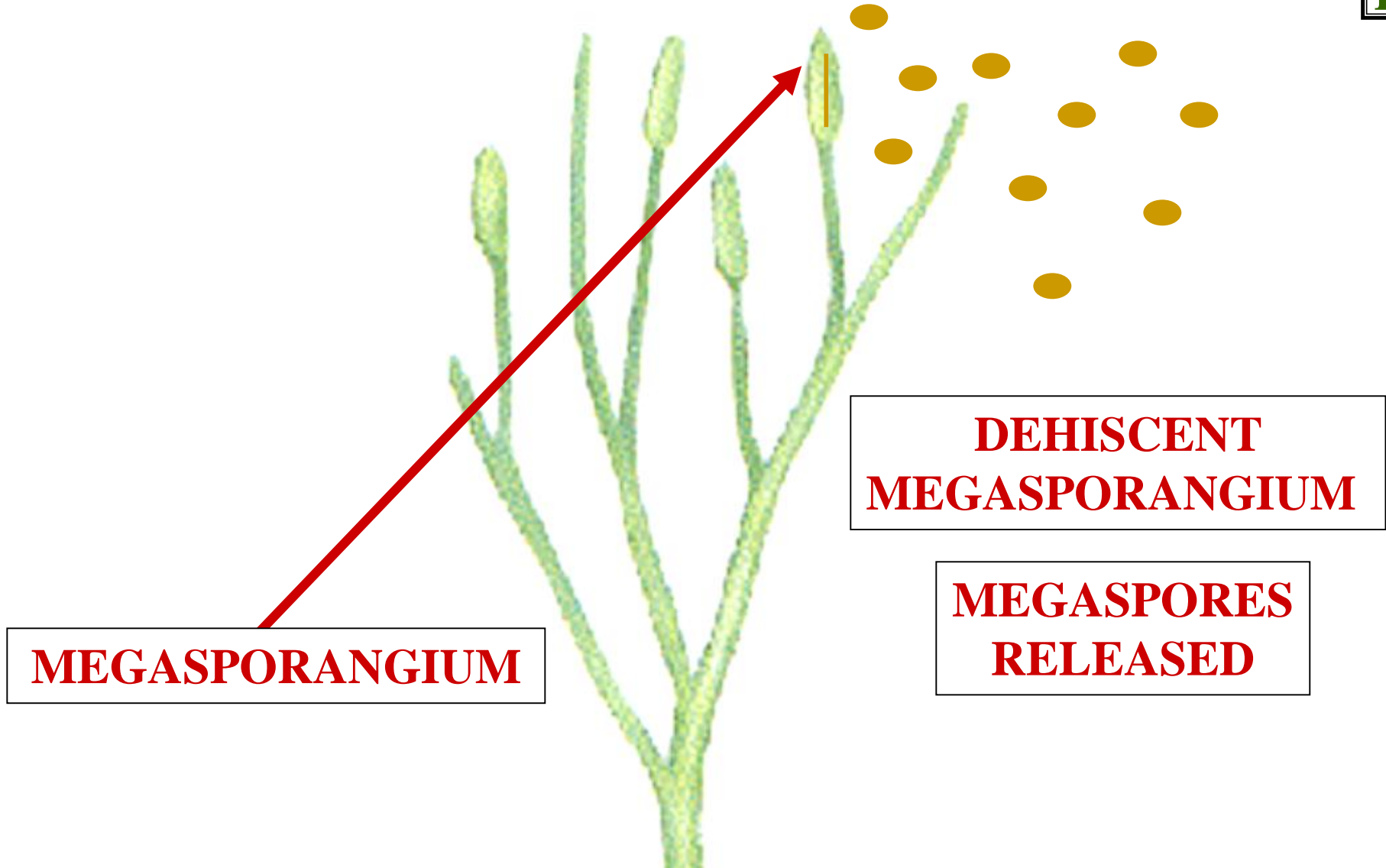
DEHISCENT SPORANGIUM

DEHISCENT SPORANGIUM



SPORANGIUM OPENS
SPORES RELEASED

DEHISCENT
SPORANGIUM

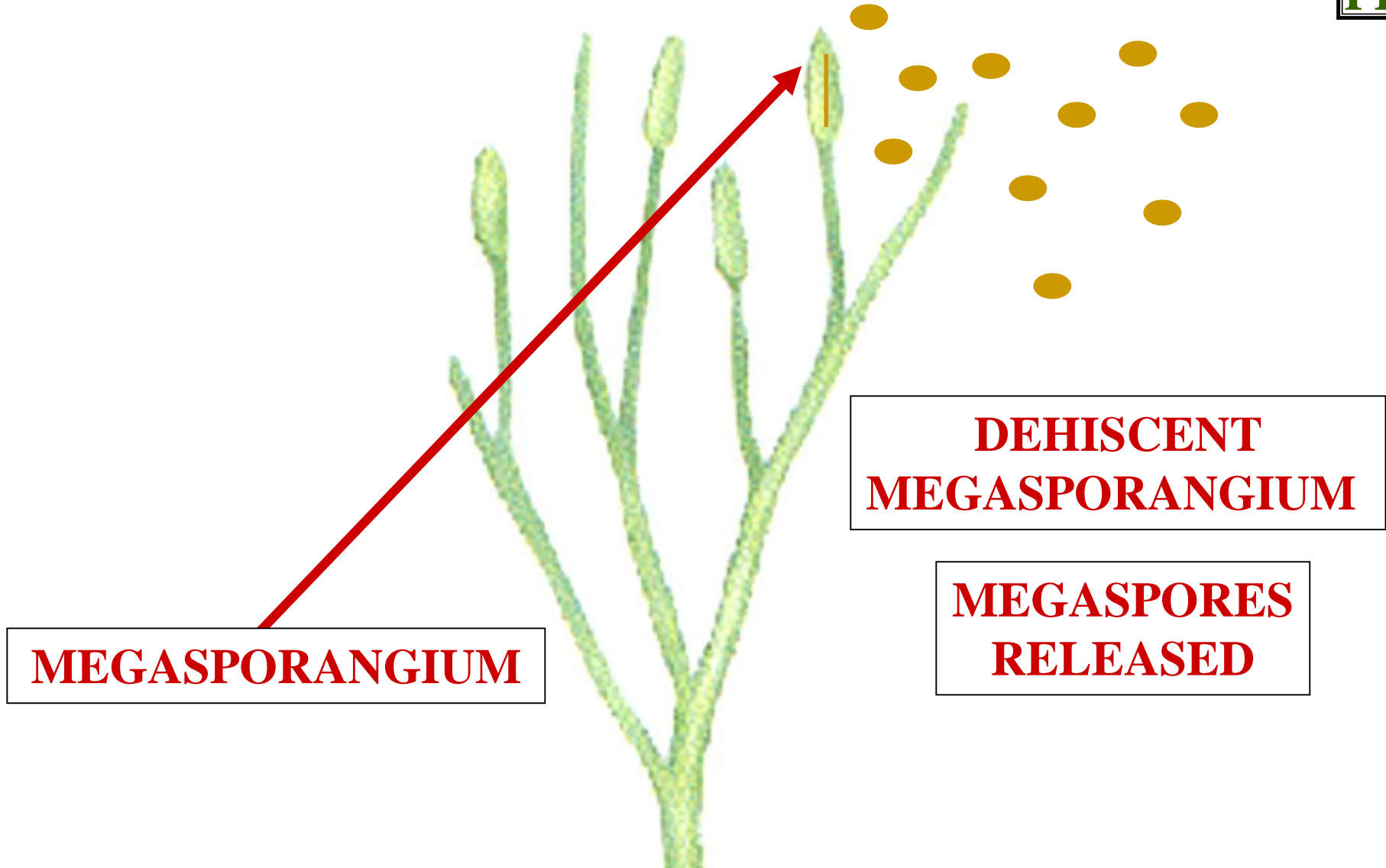


MEGASPORANGIUM

**DEHISCENT
MEGASPORANGIUM**

**MEGASPORES
RELEASED**

**DEVONIAN
HETEROSPOROUS PLANT**

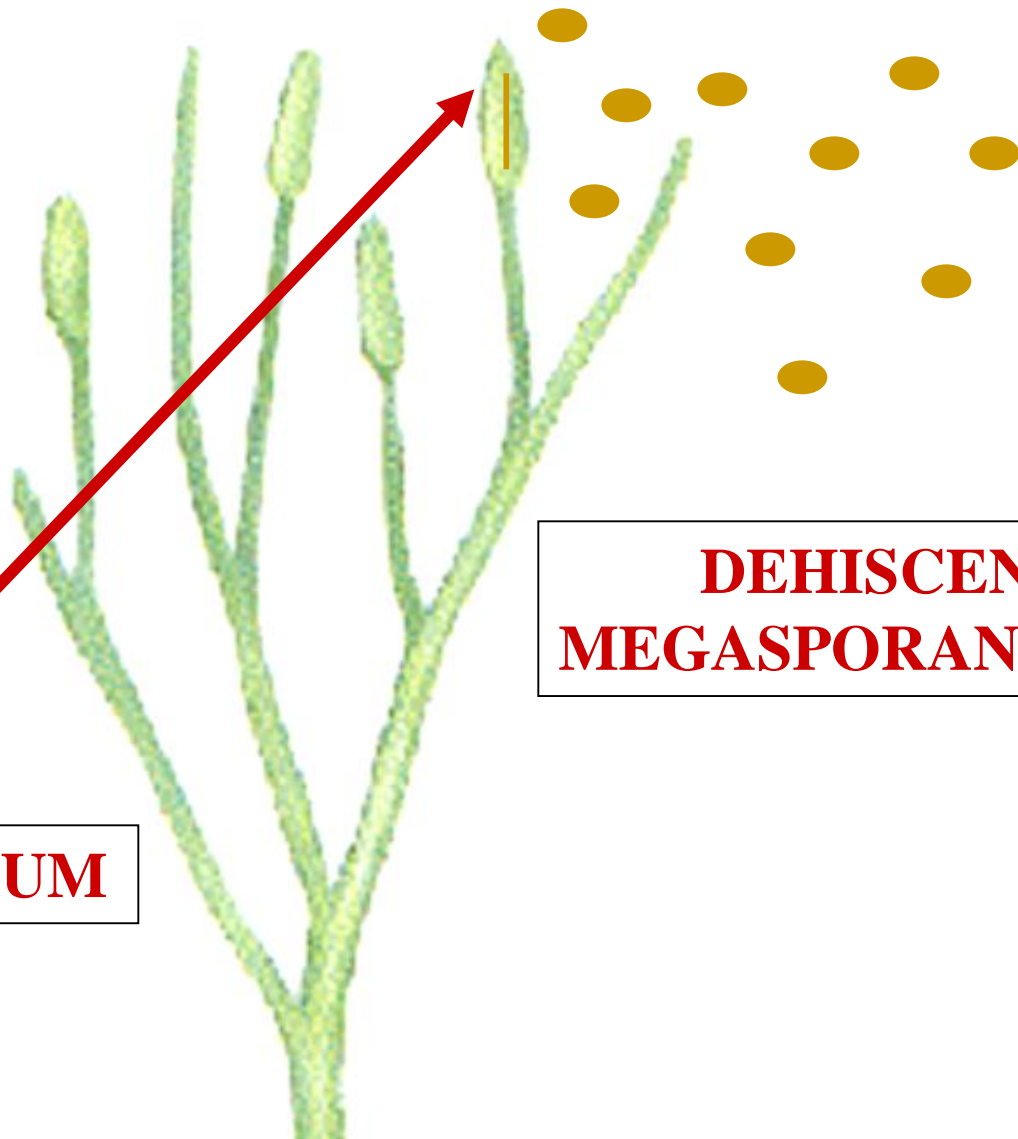


MEGASPORANGIUM

**DEHISCENT
MEGASPORANGIUM**

**MEGASPORES
RELEASED**

**DEVONIAN
PTERIDOPHYTE**



MEGASPORANGIUM

**DEHISCENT
MEGASPORANGIUM**

**DEVONIAN
PROGYMNOSPERM**



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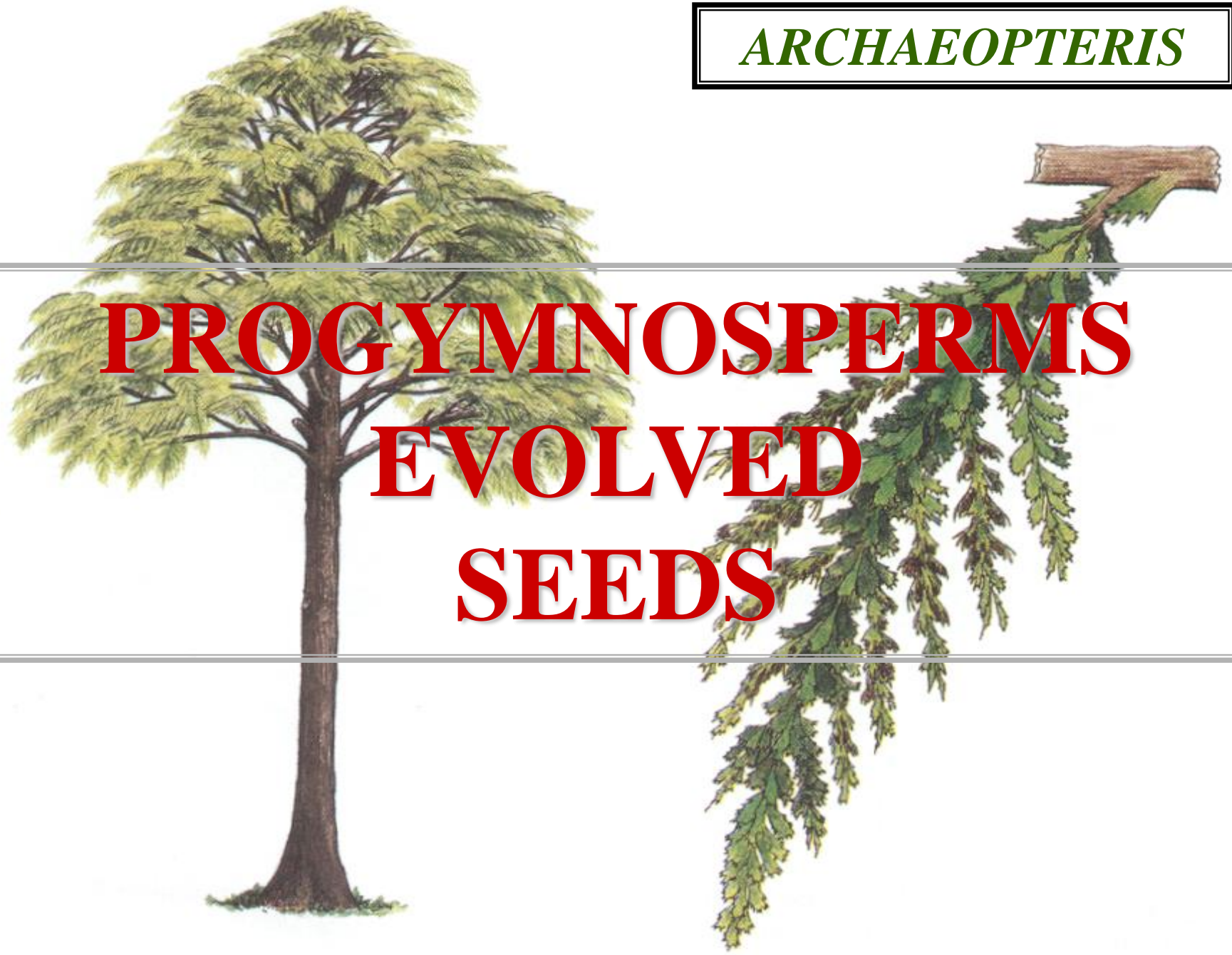
ARCHAEOPTERIS





ARCHAEOPTERIS

**PROGYMNOSPERMS
EVOLVED
SEEDS**



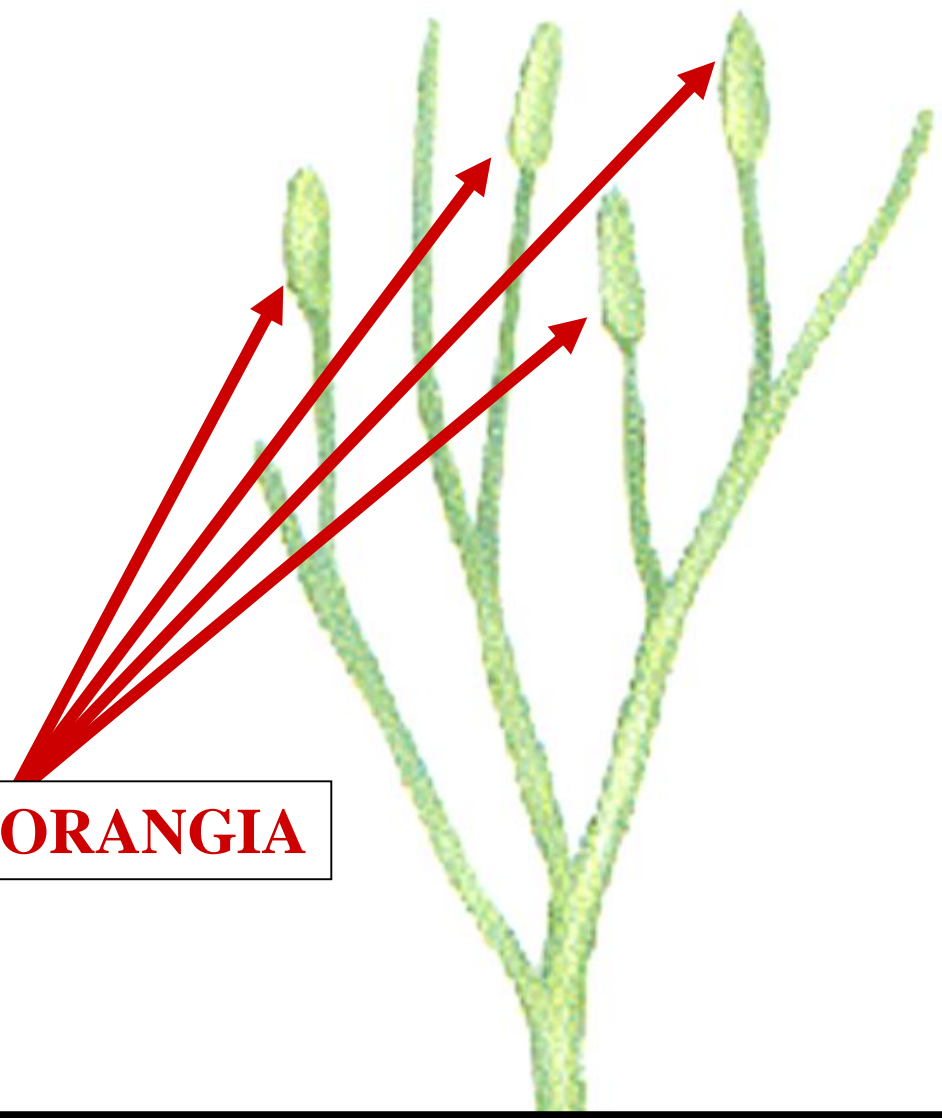
HYPOTHETICAL EVOLUTION EVENTS



**HYPOTHETICAL
OVULE / SEED
EVOLUTION
EVENT**

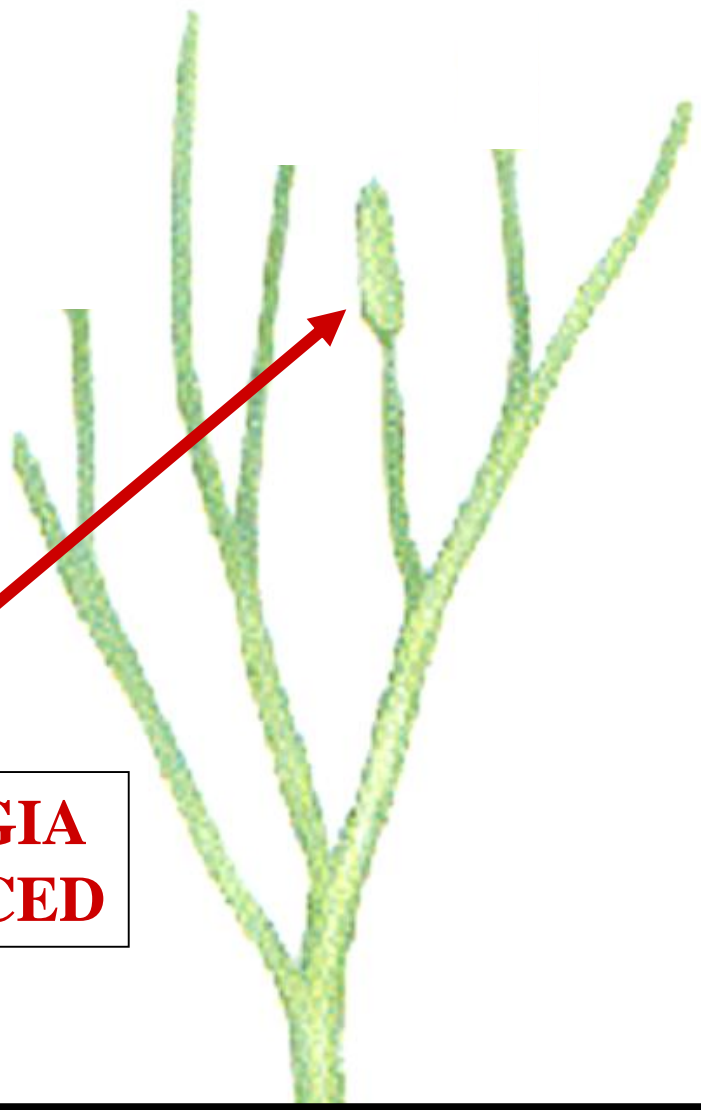
#1

MEGASPORANGIA NO. REDUCED



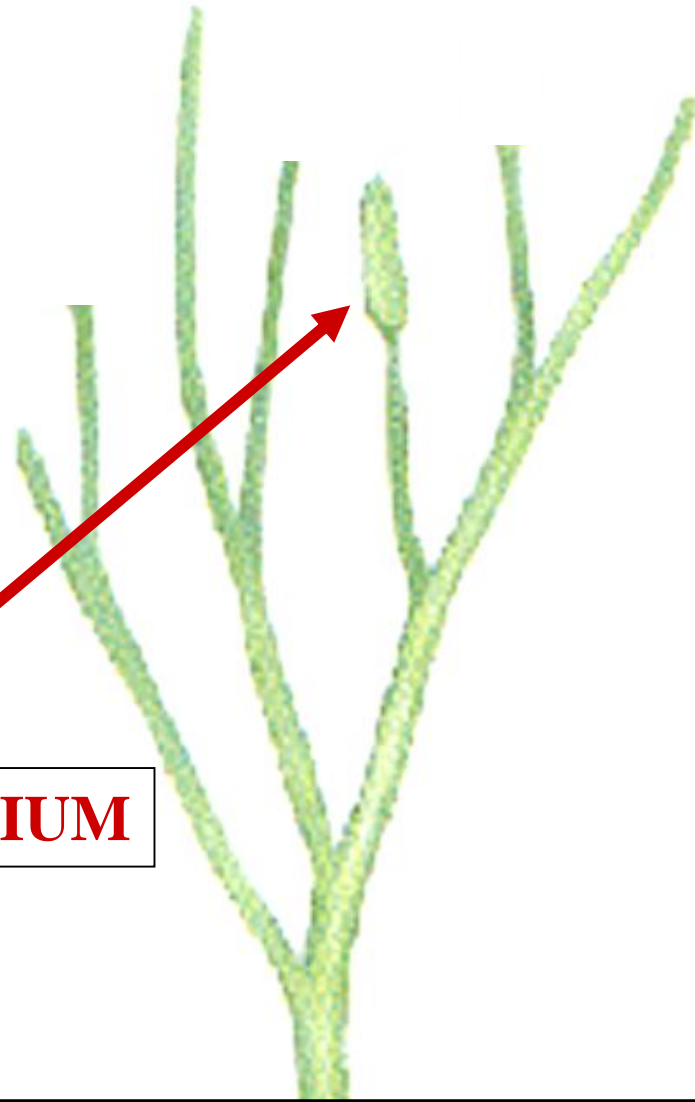
MEGASPORANGIA

**DEVONIAN
HETEROSPOROUS PROGYMNOSPERM**



**MEGASPORANGIA
NUMBER REDUCED**

**DEVONIAN
HETEROSPOROUS PROGYMNOSPERM**

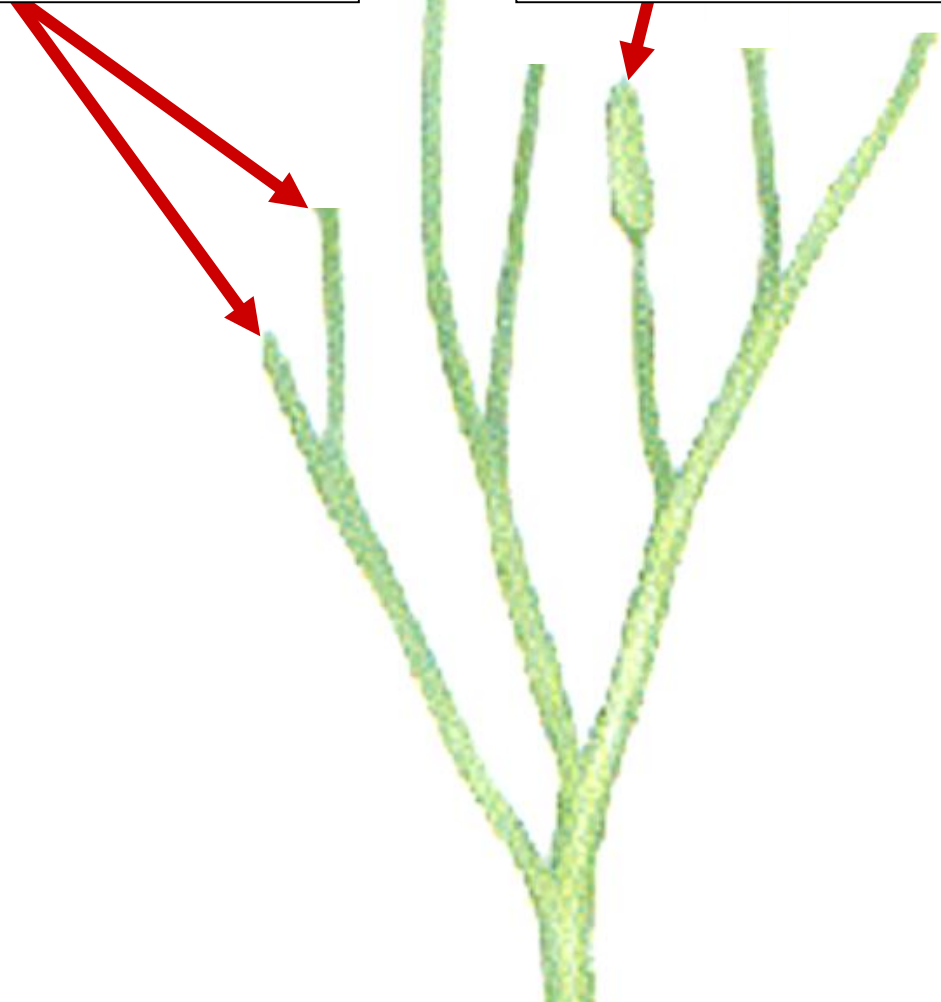


MEGASPORANGIUM

**DEVONIAN
HETEROSPOROUS PROGYMNOSPERM**

STERILE BRANCHES

MEGASPORANGIUM



**DEVONIAN
HETEROSPOROUS PROGYMNOSPERM**

**HYPOTHETICAL
OVULE / SEED
EVOLUTION
EVENT**

#2

CUPULE FORMATION

CUPULE

SEED EVOLUTION



CUPULE

**ENVELOPING STERILE
BRANCHES ABOUT
MEGASPORANGIUM**

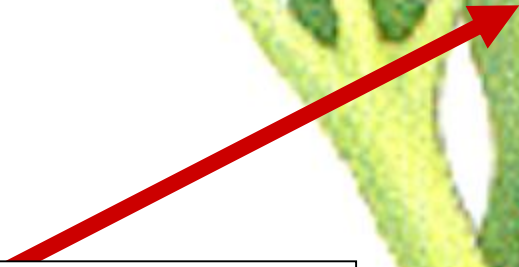
SEED EVOLUTION

CUPULE

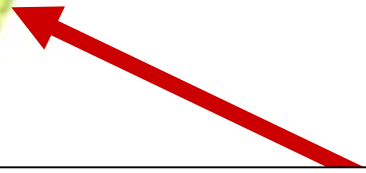
STERILE BRANCHES



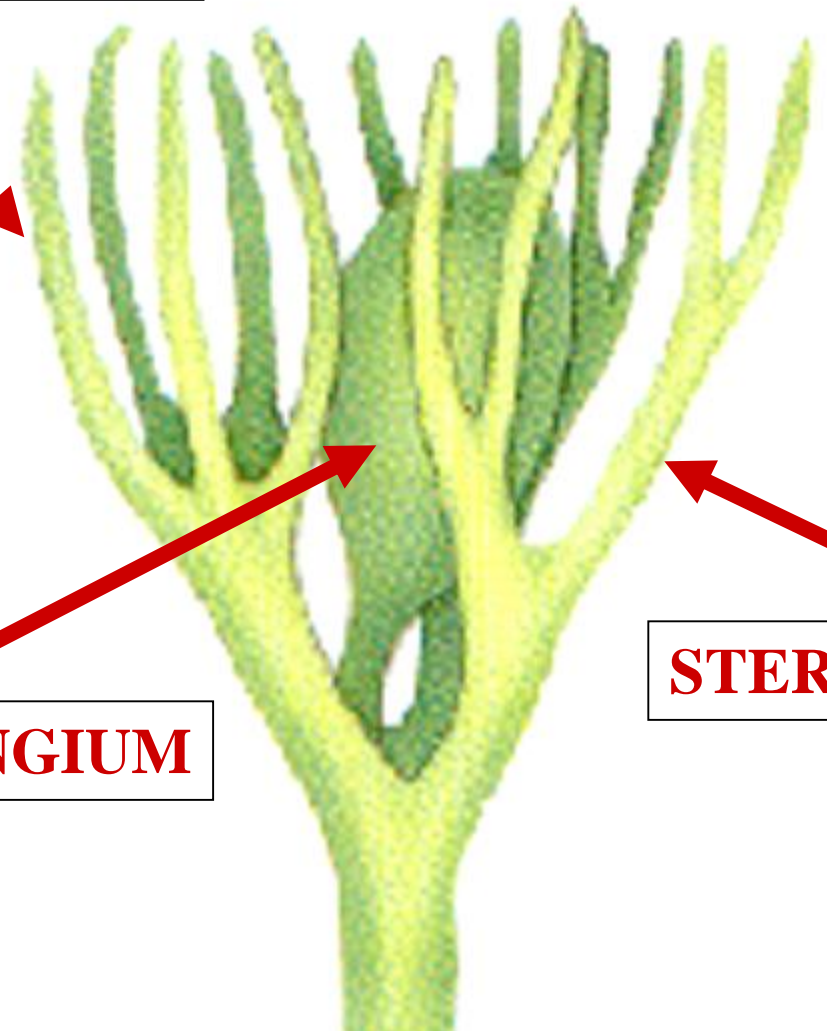
MEGASPORANGIUM



STERILE BRANCHES

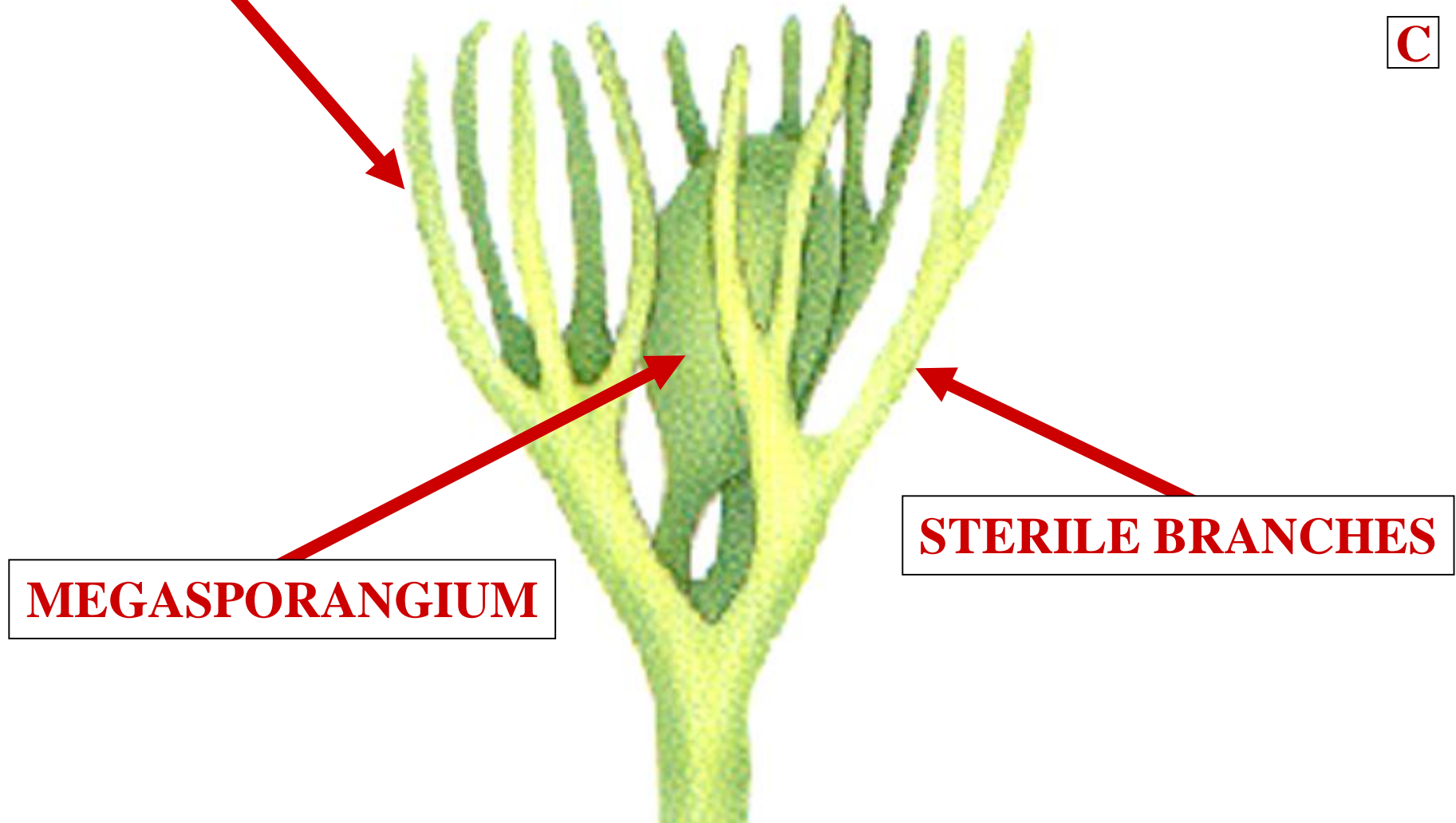


**DEVONIAN
HETEROSPOROUS PROGYMNOSPERM**



STERILE BRANCHES ENVELOPE MEGASPORANGIUM

C

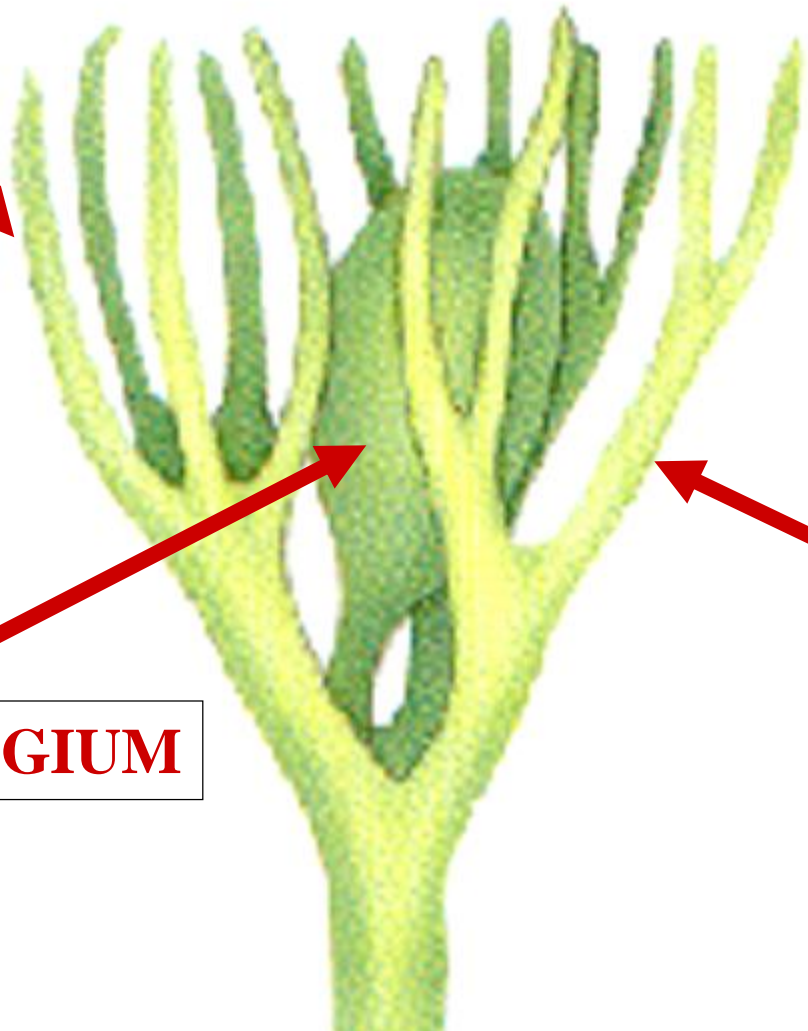


MEGASPORANGIUM

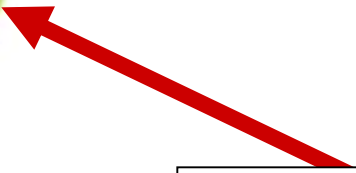
STERILE BRANCHES

**DEVONIAN
HETEROSPOROUS PROGYMNOSPERM**

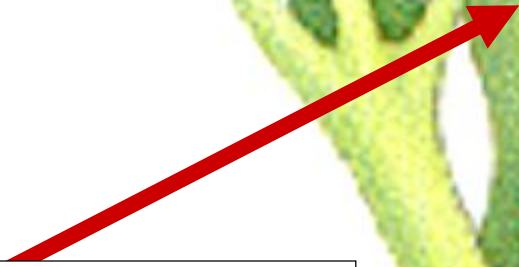
CUPULE



CUPULE



MEGASPORANGIUM



**DEVONIAN
HETEROSPOROUS PROGYMNOSPERM**

**HYPOTHETICAL
OVULE / SEED
EVOLUTION
EVENT**

#3

INTEGUMENT FORMATION

INTEGUMENT

SEED EVOLUTION INTEGUMENT

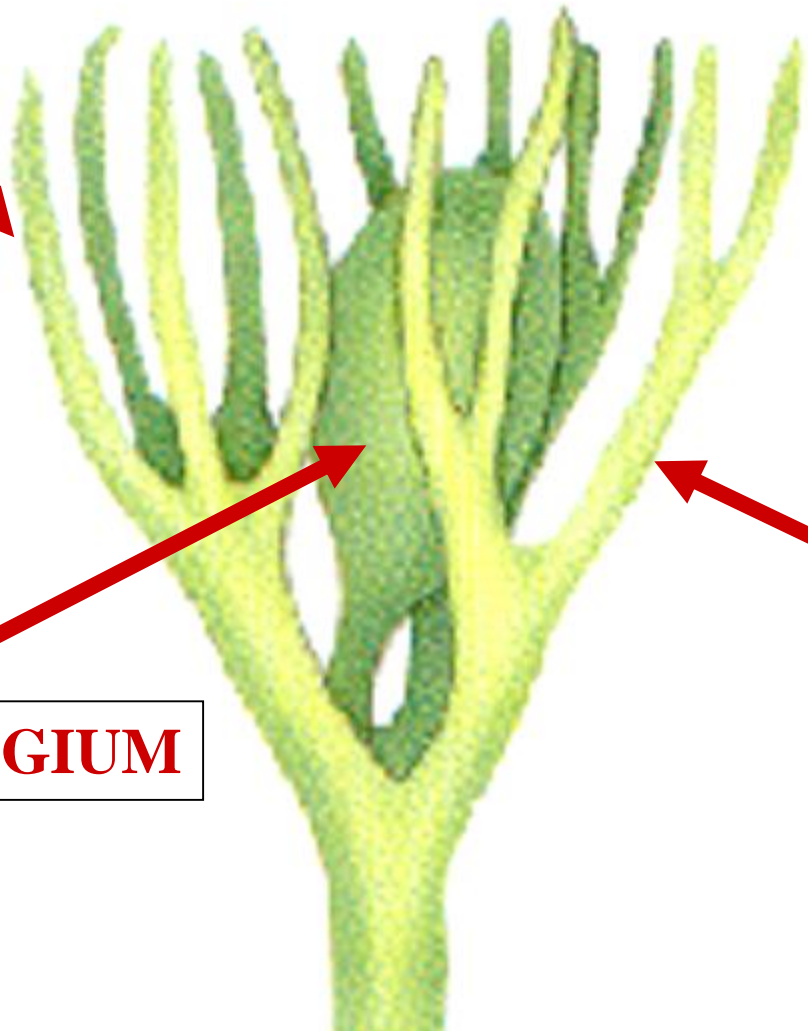


FORMED VIA CUPULE
FUSION ABOUT
MEGASPORANGIUM

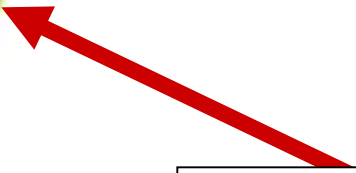
SEED EVOLUTION
INTEGUMENT



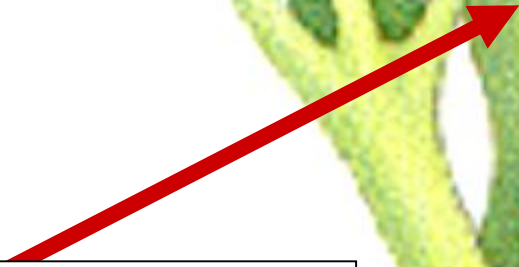
CUPULE



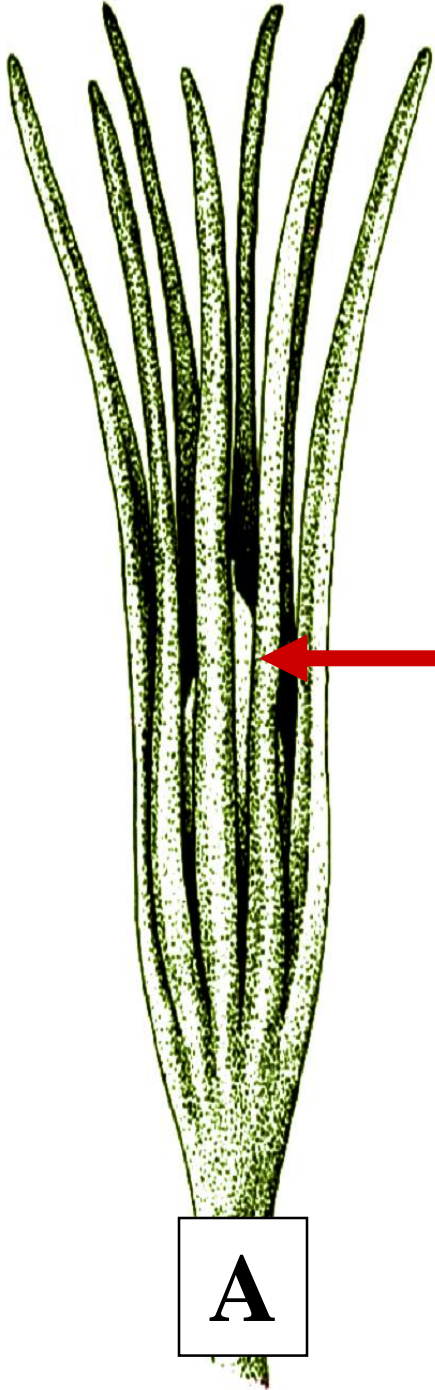
CUPULE



MEGASPORANGIUM



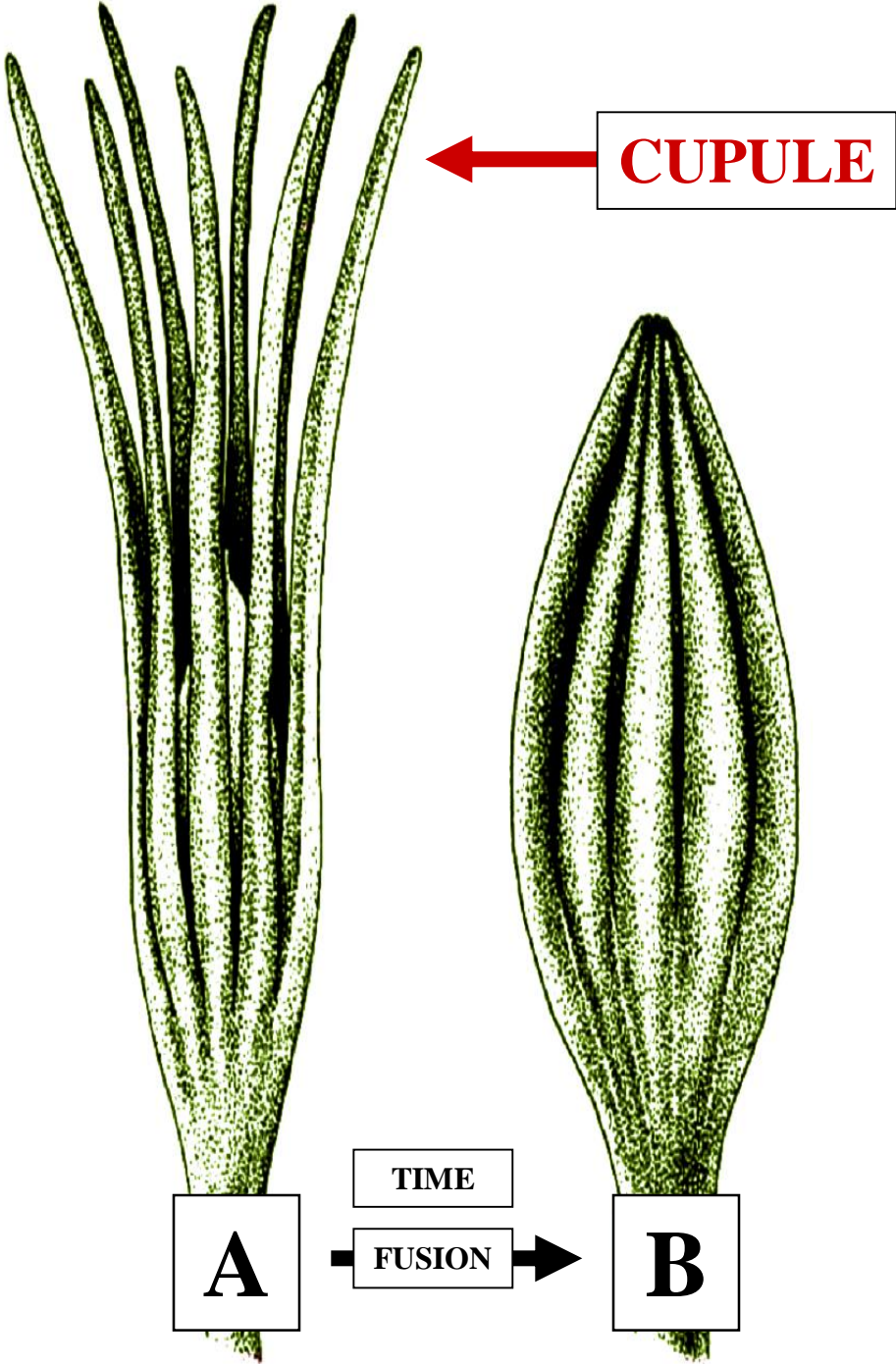
**DEVONIAN
HETEROSPOROUS PROGYMNOSPERM**

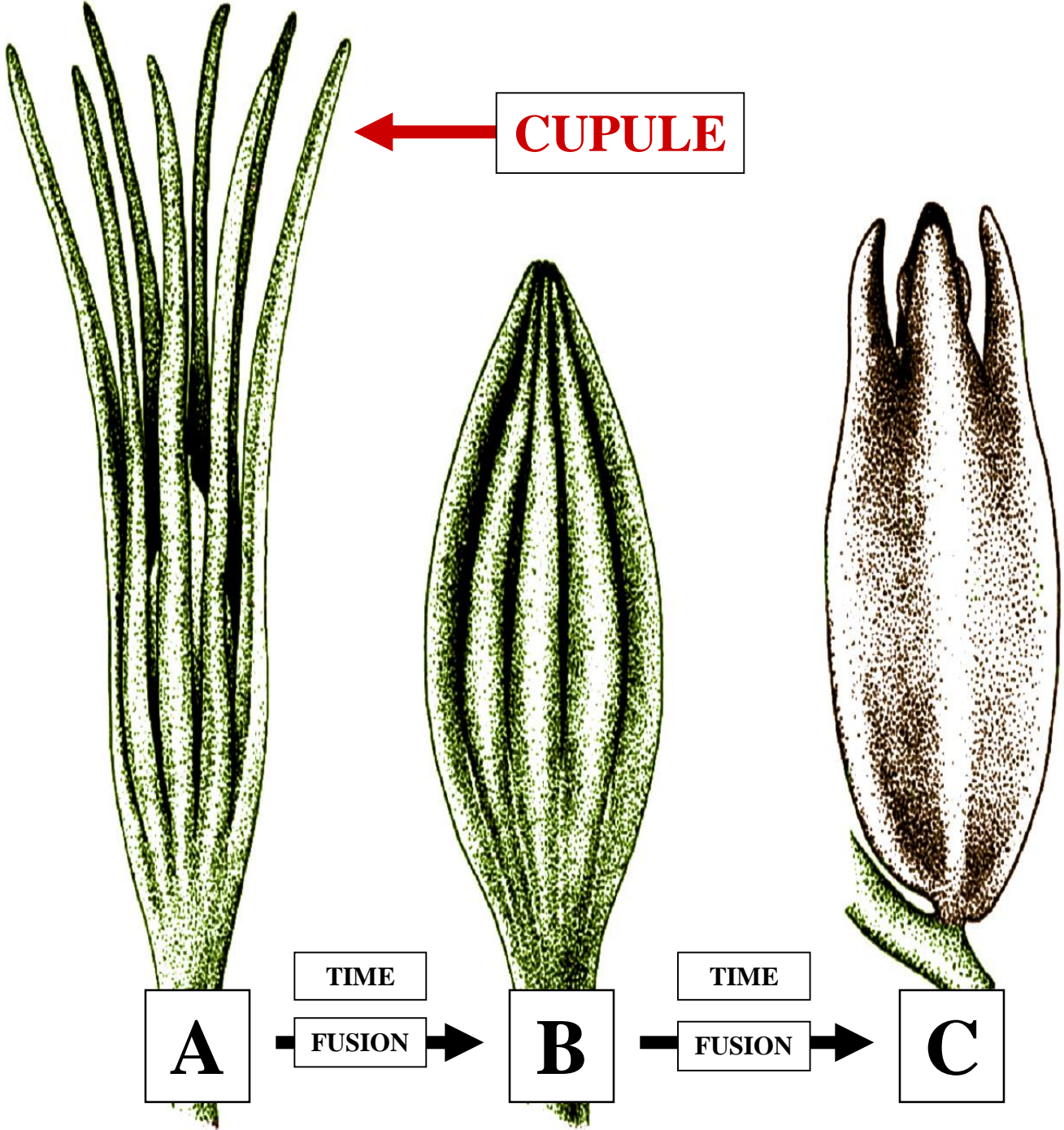


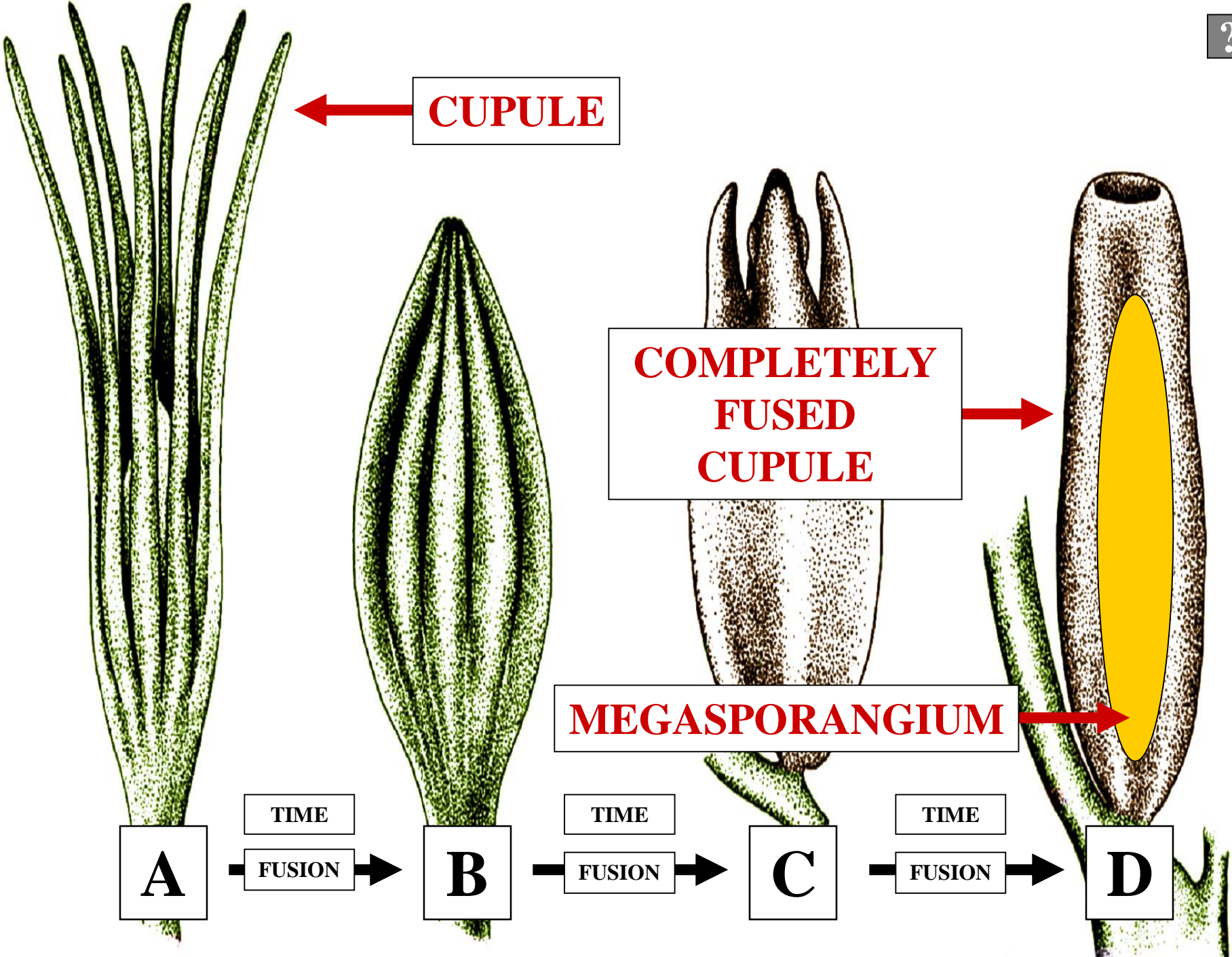
CUPULE

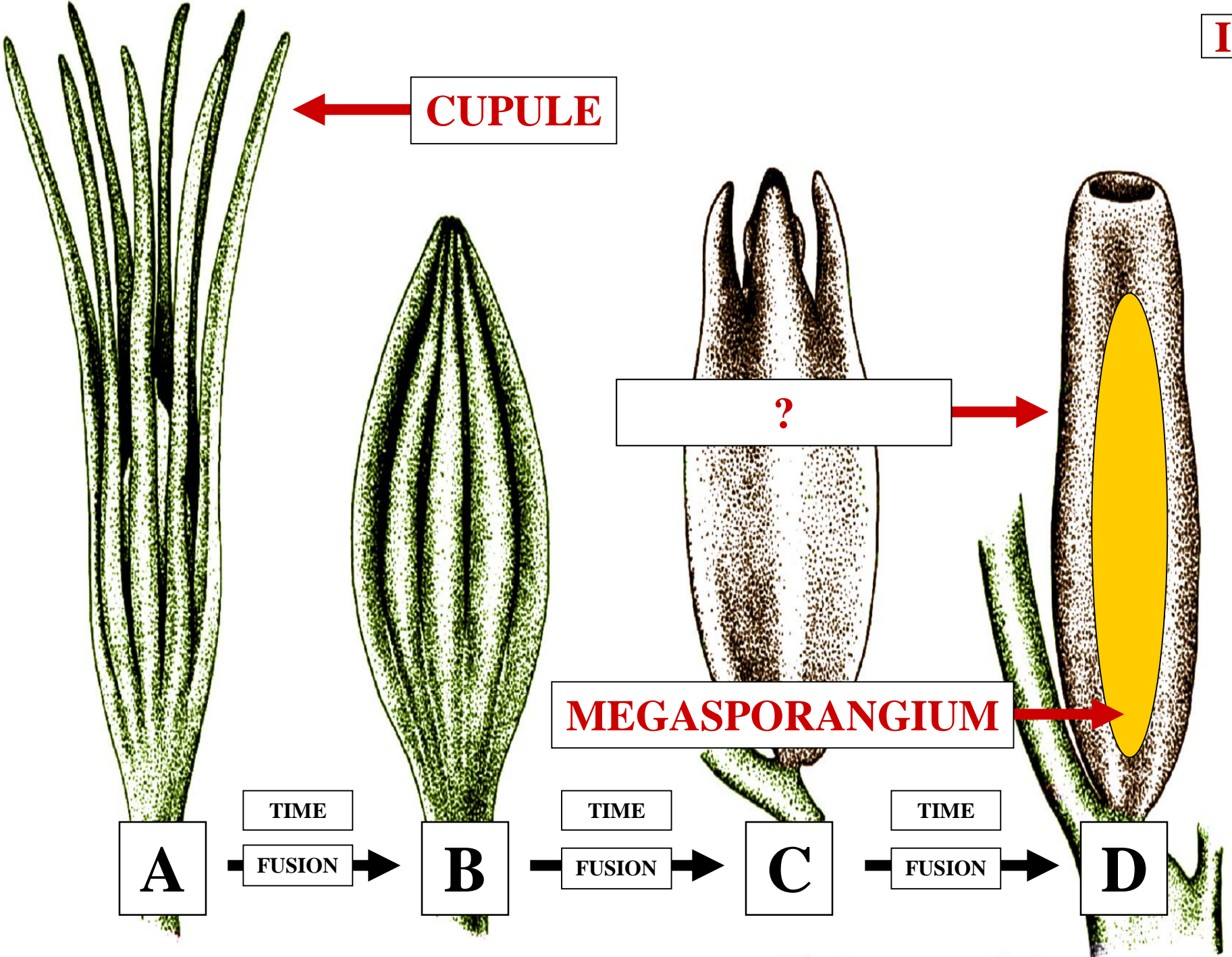
MEGASPORANGIUM

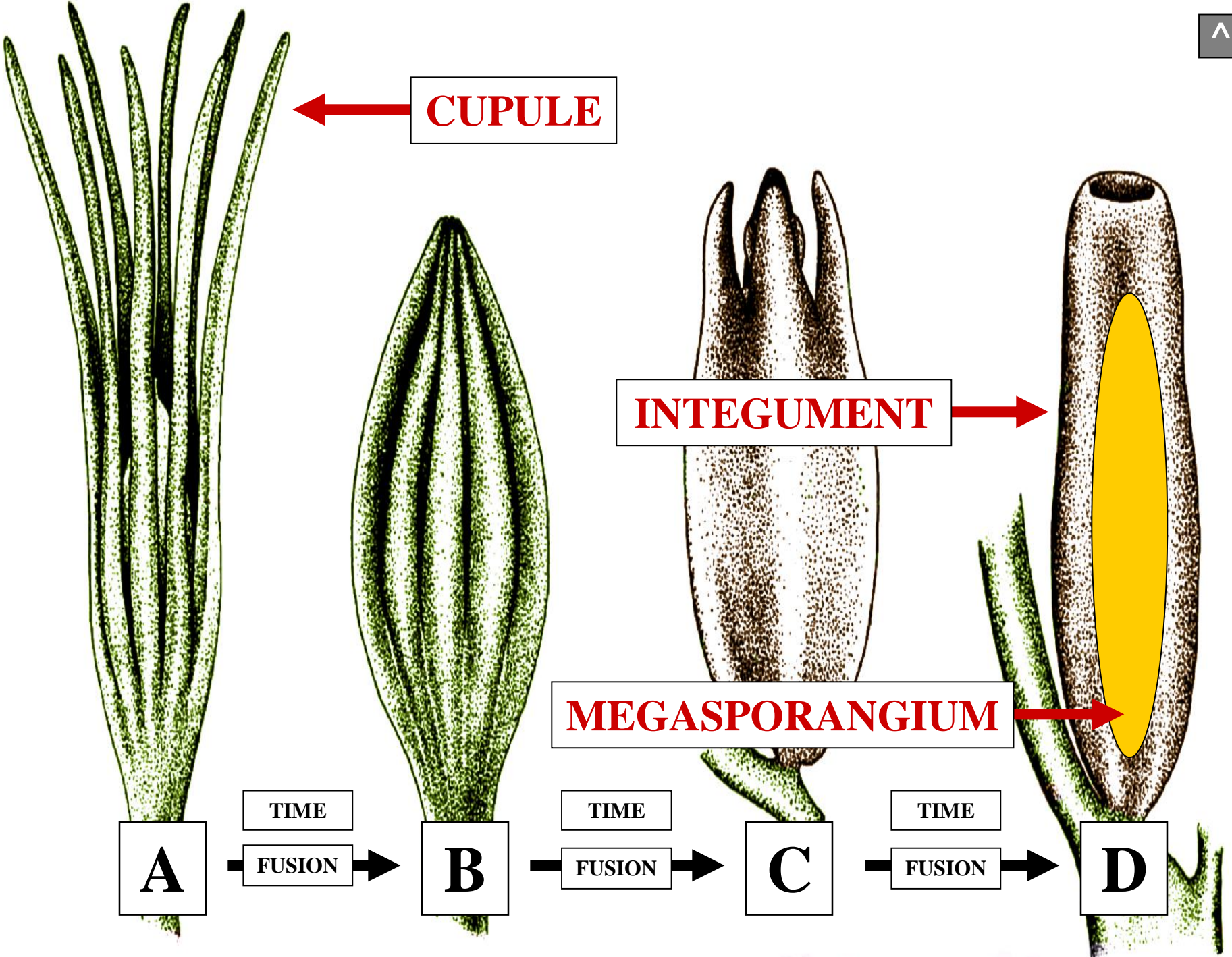
A









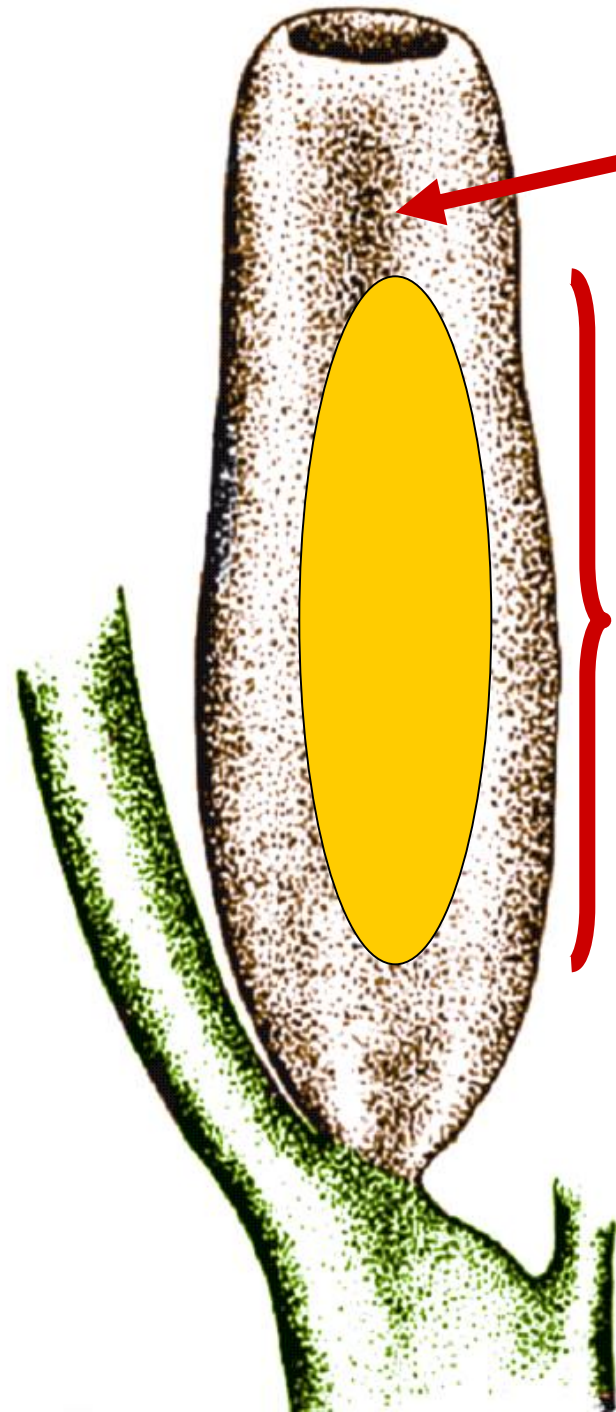




**END
HYPOTHETICAL
SCENARIO**

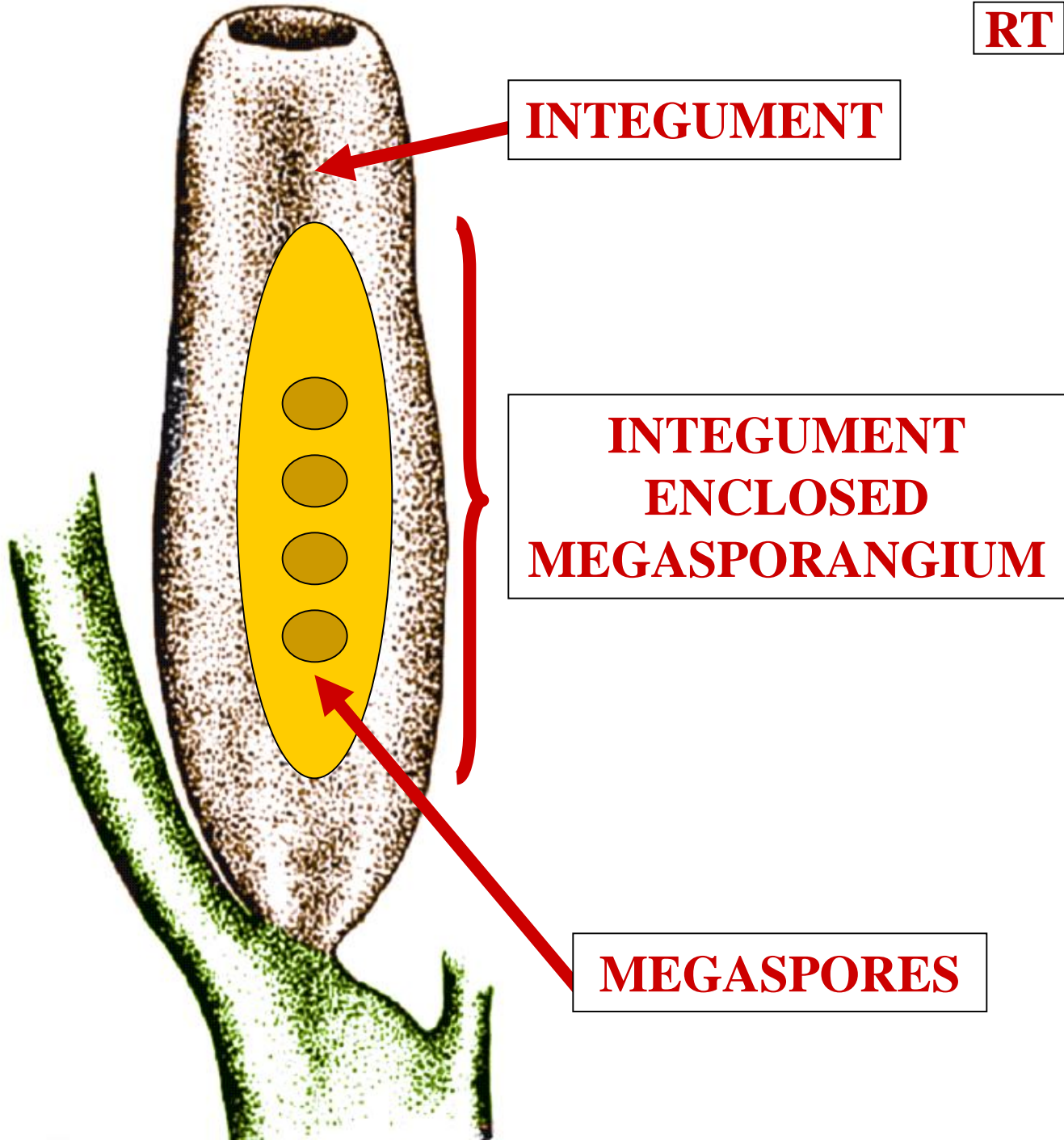


M



INTEGUMENT

**INTEGUMENT
ENCLOSED
MEGASPORANGIUM**



INTEGUMENT

**INTEGUMENT
ENCLOSED
MEGASPORANGIUM**

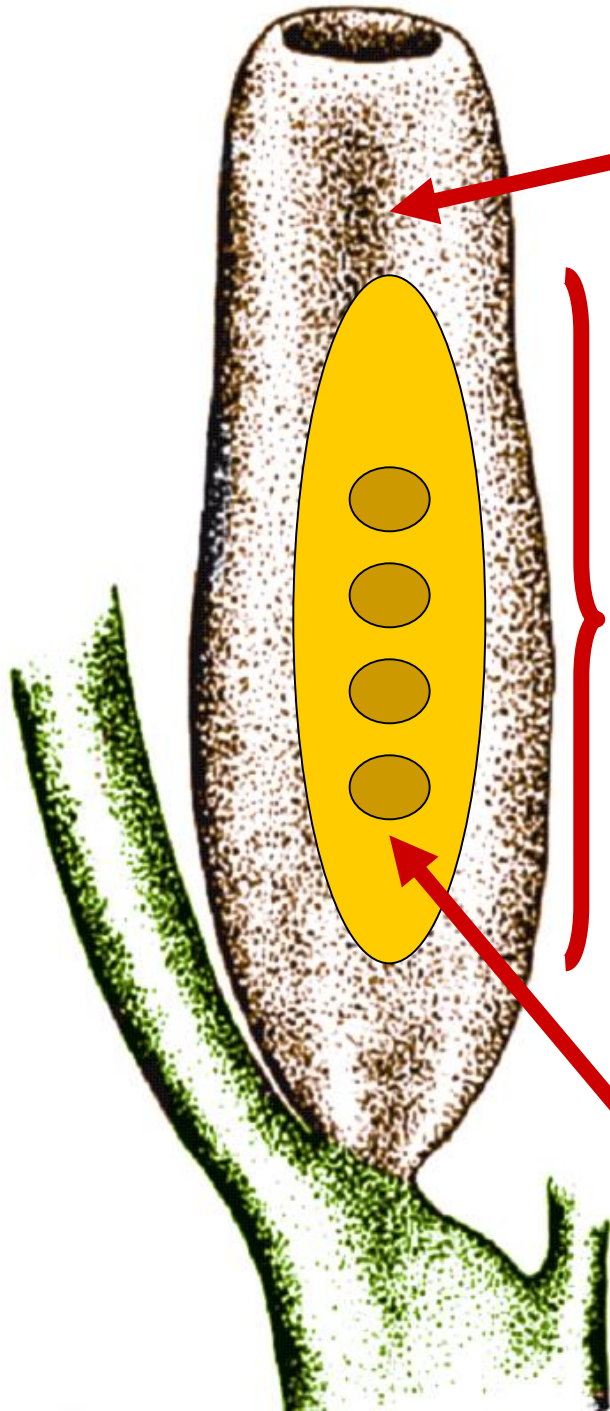
MEGASPORES

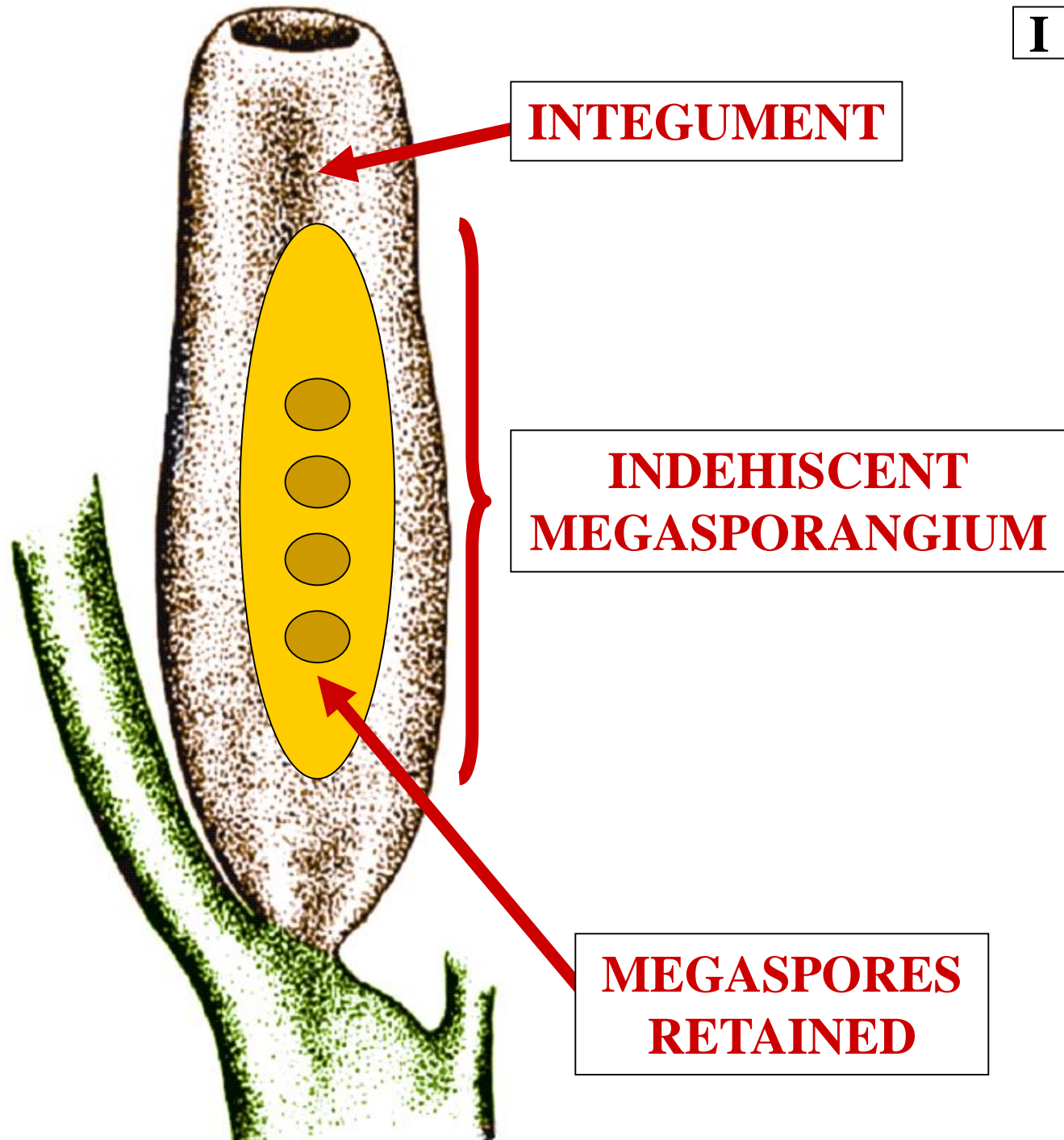
I-MS

INTEGUMENT

**INTEGUMENT
ENCLOSED
MEGASPORANGIUM**

**MEGASPORES
RETAINED**



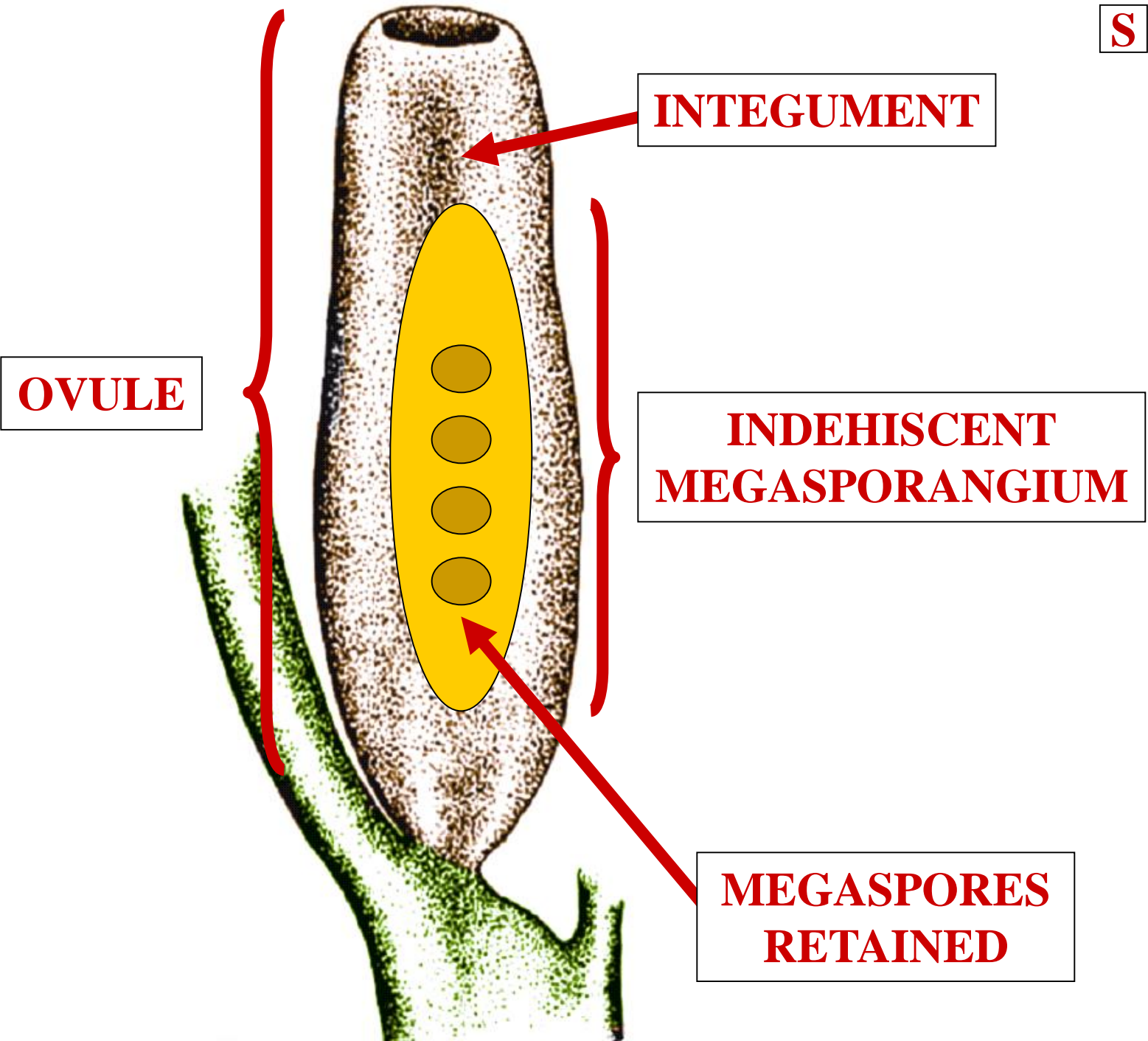


**INDEHISCENT
SPORANGIUM**

INDEHISCENT SPORANGIUM

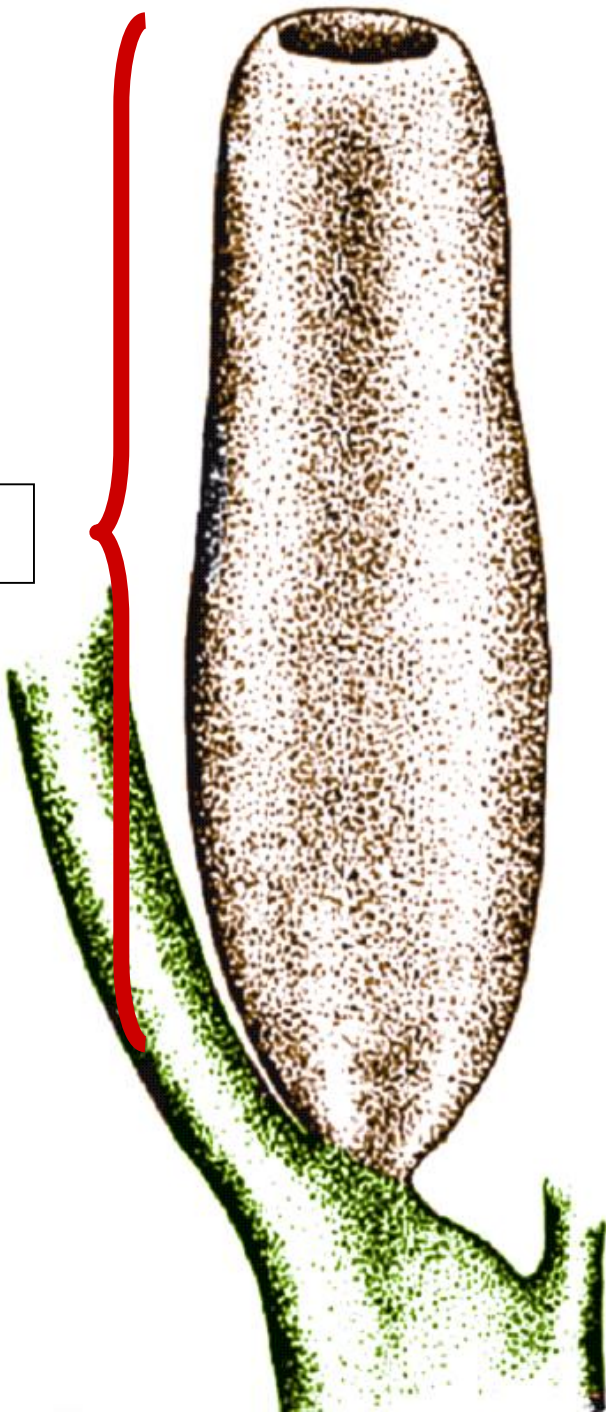
**SPORANGIUM
DOES NOT OPEN
MEGASPORES RETAINED**

**INDEHISCENT
SPORANGIUM**





SEED



SEED



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SEED



SPERMATOPHYTE

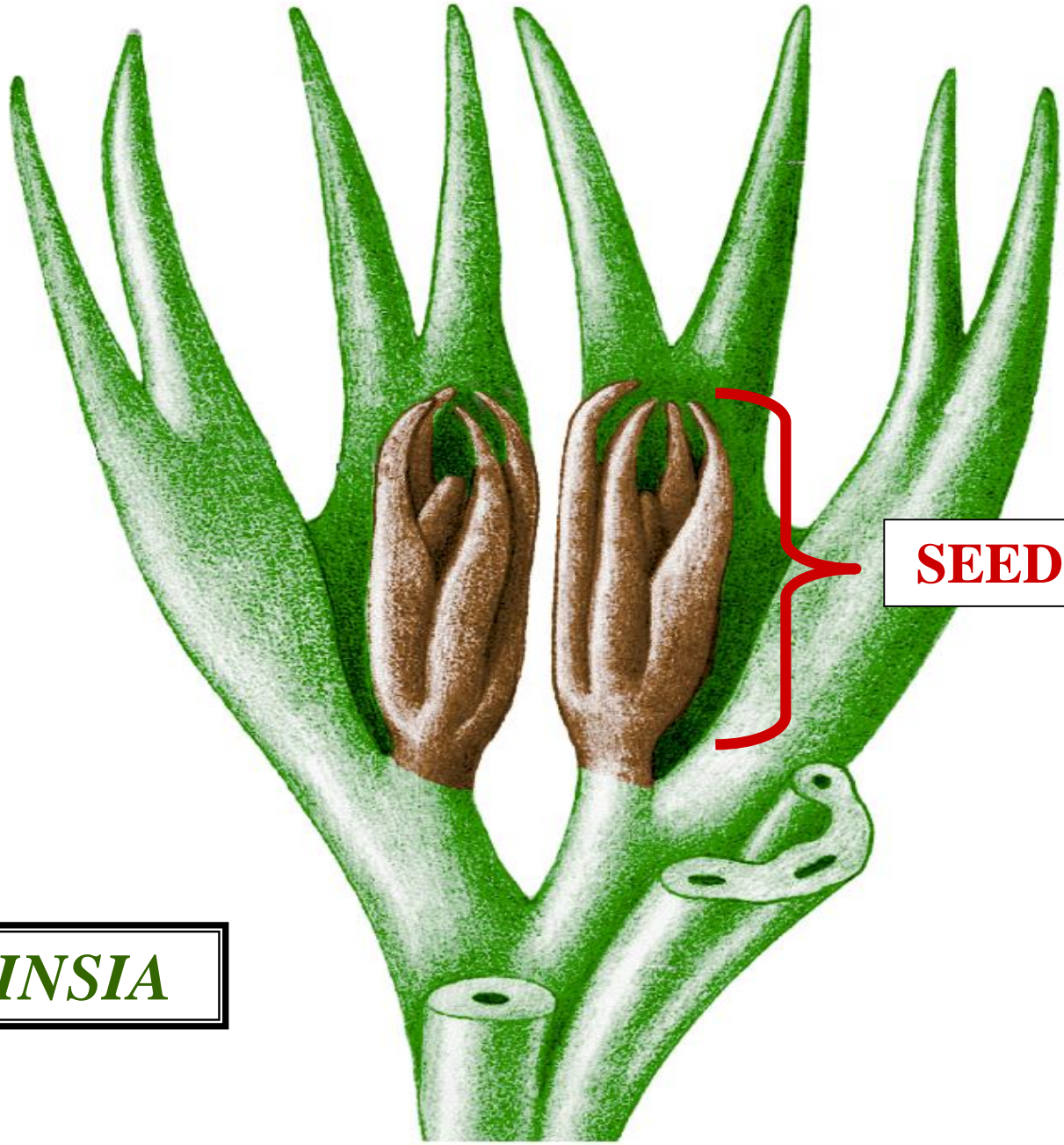


EL

SEED



SPERMATOPHYTE / GYMNOSPERM

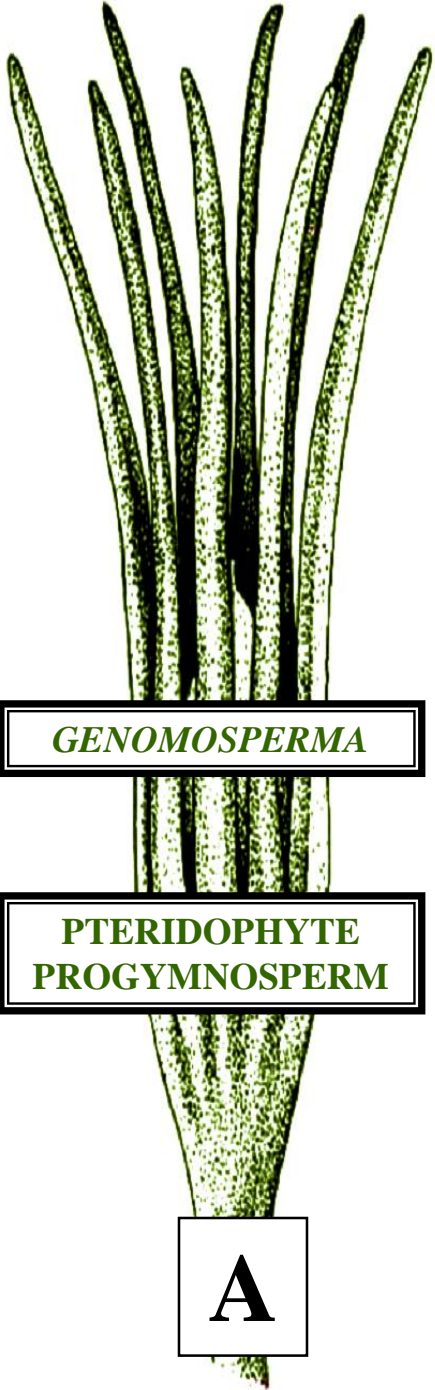


SEED

ELKINSIA



FOSSIL EVIDENCE

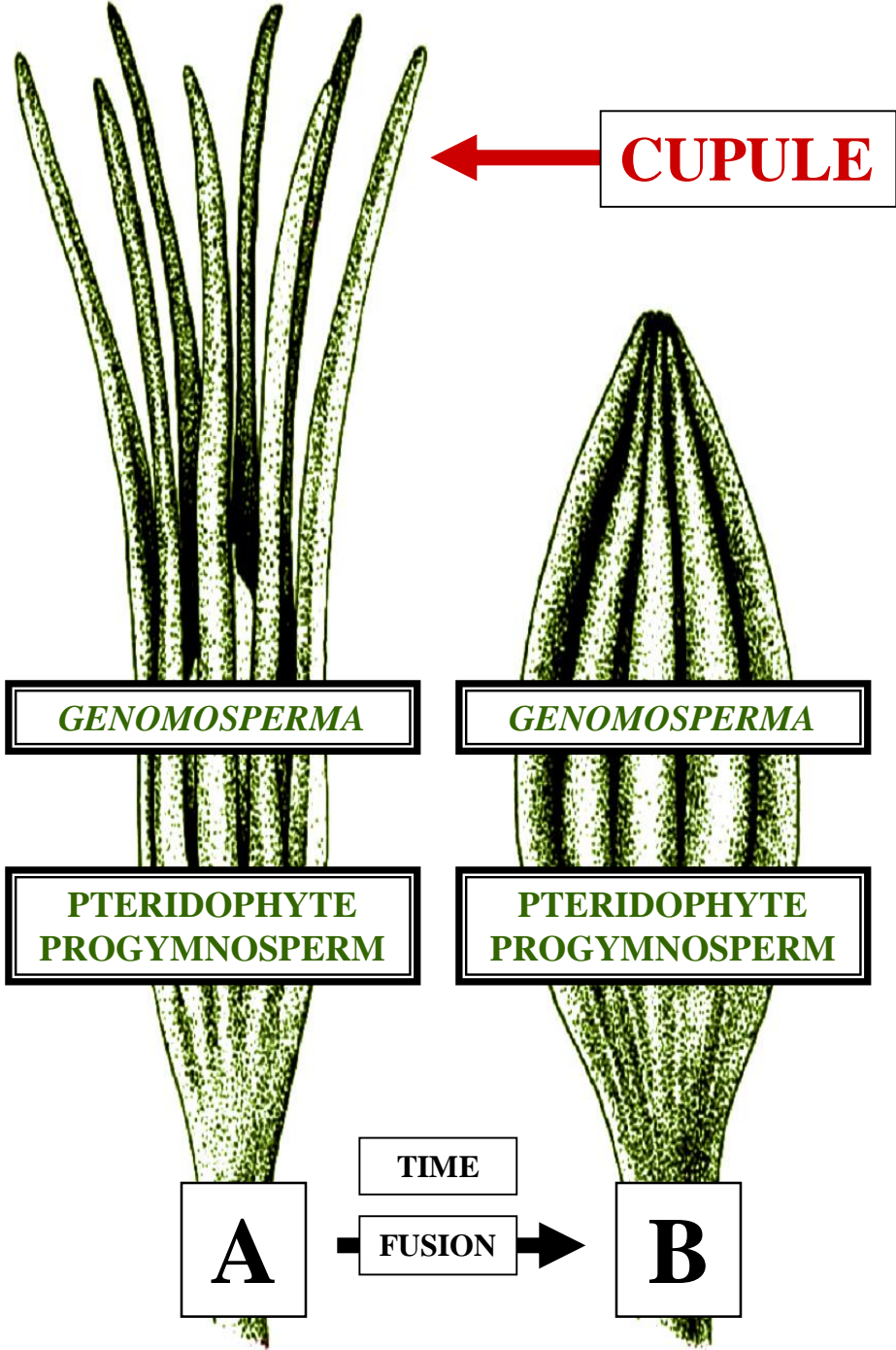


CUPULE

GENOMOSPERMA

**PTERIDOPHYTE
PROGYMNOSPERM**

A





CUPULE

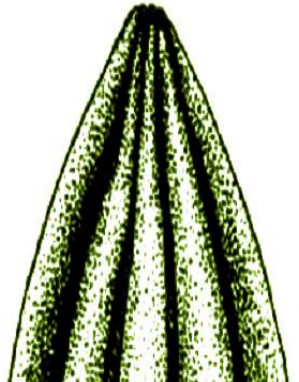


GENOMOSPERMA

**PTERIDOPHYTE
PROGYMNOSPERM**

A

TIME
FUSION

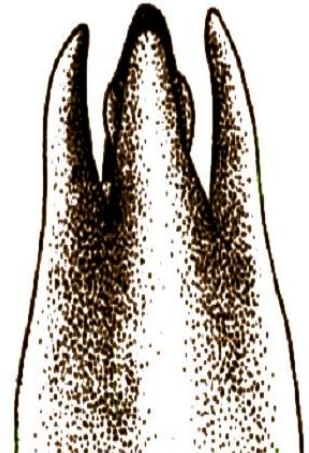


GENOMOSPERMA

**PTERIDOPHYTE
PROGYMNOSPERM**

B

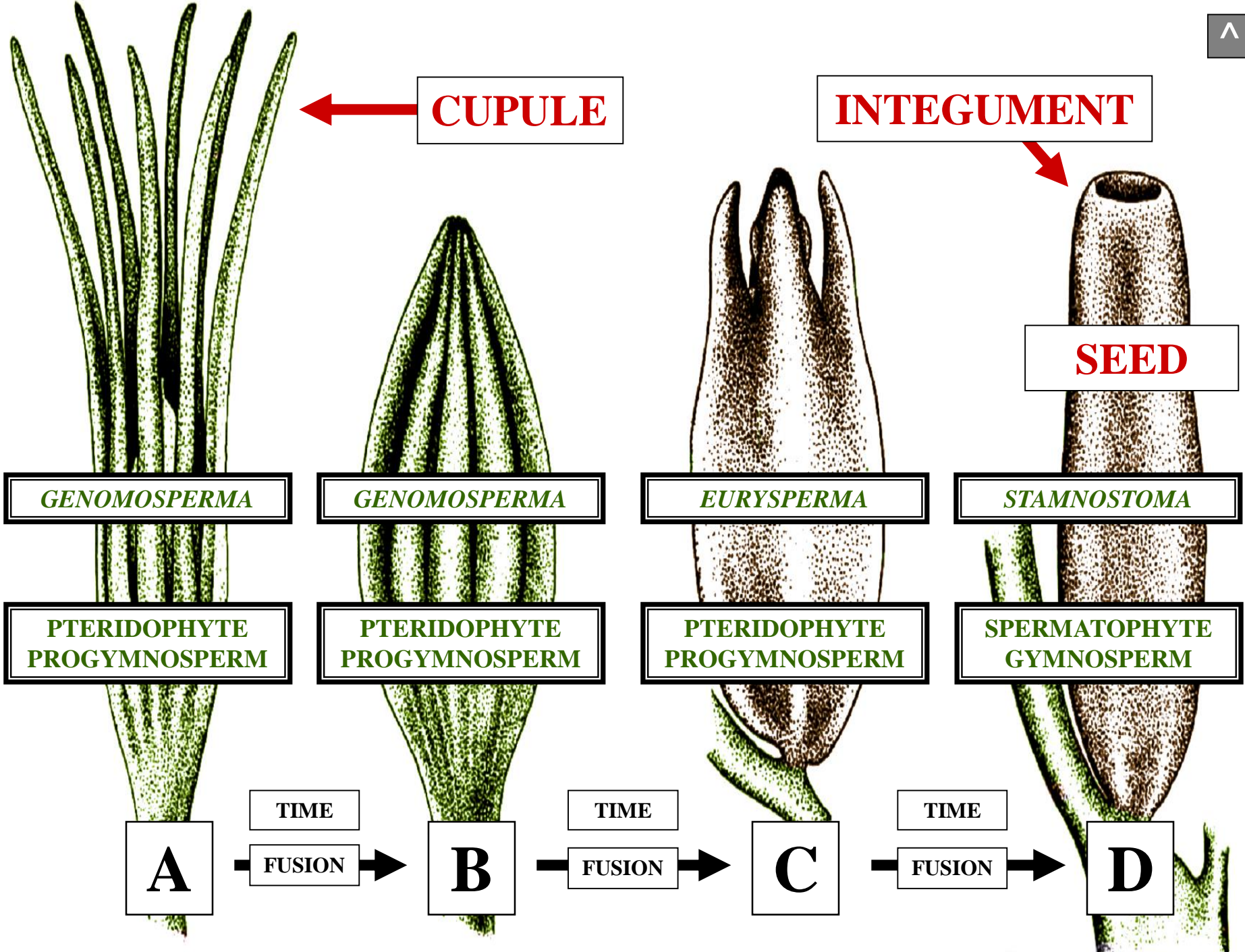
TIME
FUSION



EURYSPERMA

**PTERIDOPHYTE
PROGYMNOSPERM**

C



OVULE / SEED ANATOMY

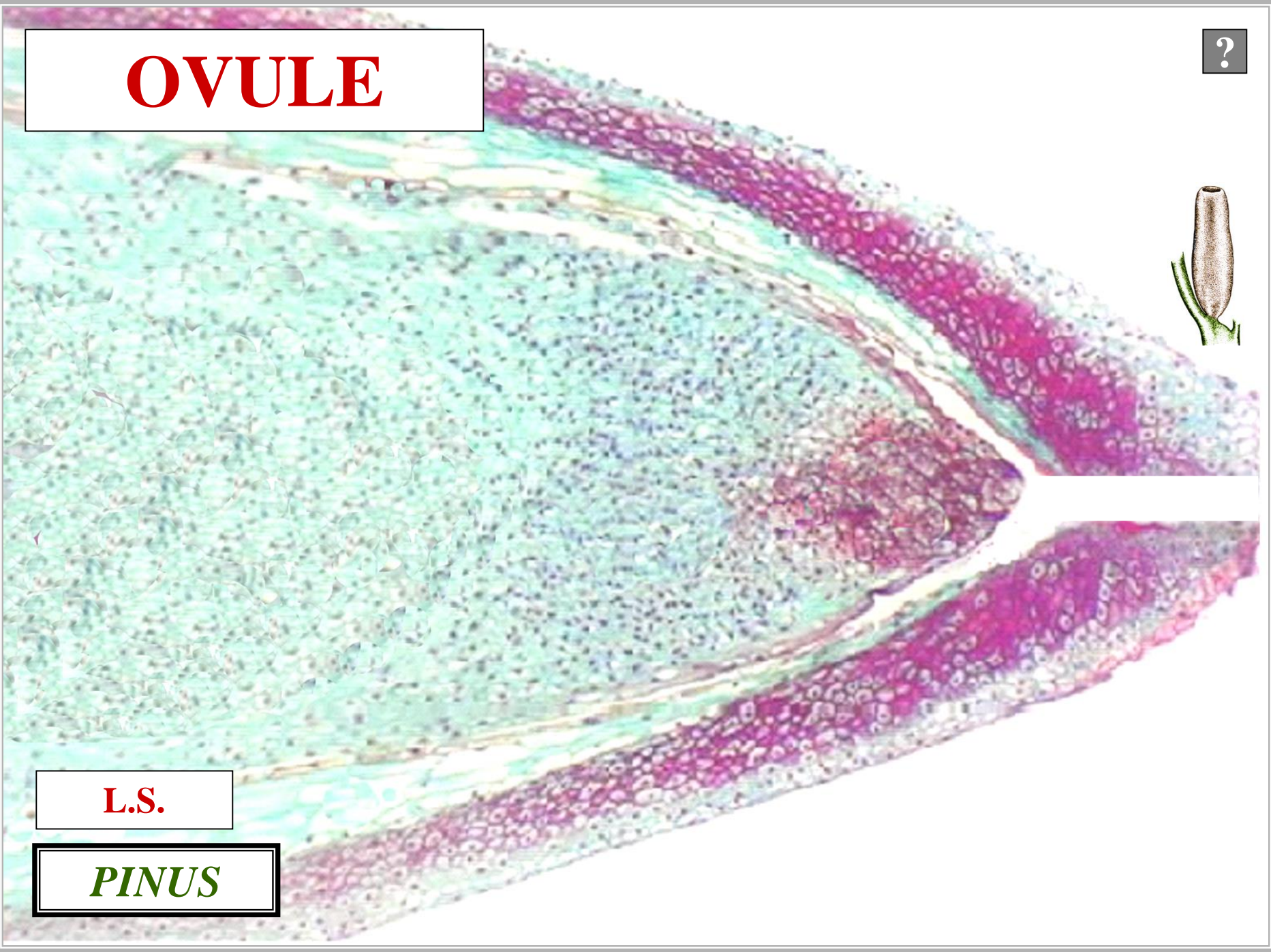
OVULE

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L.S.

PINUS



OVULE

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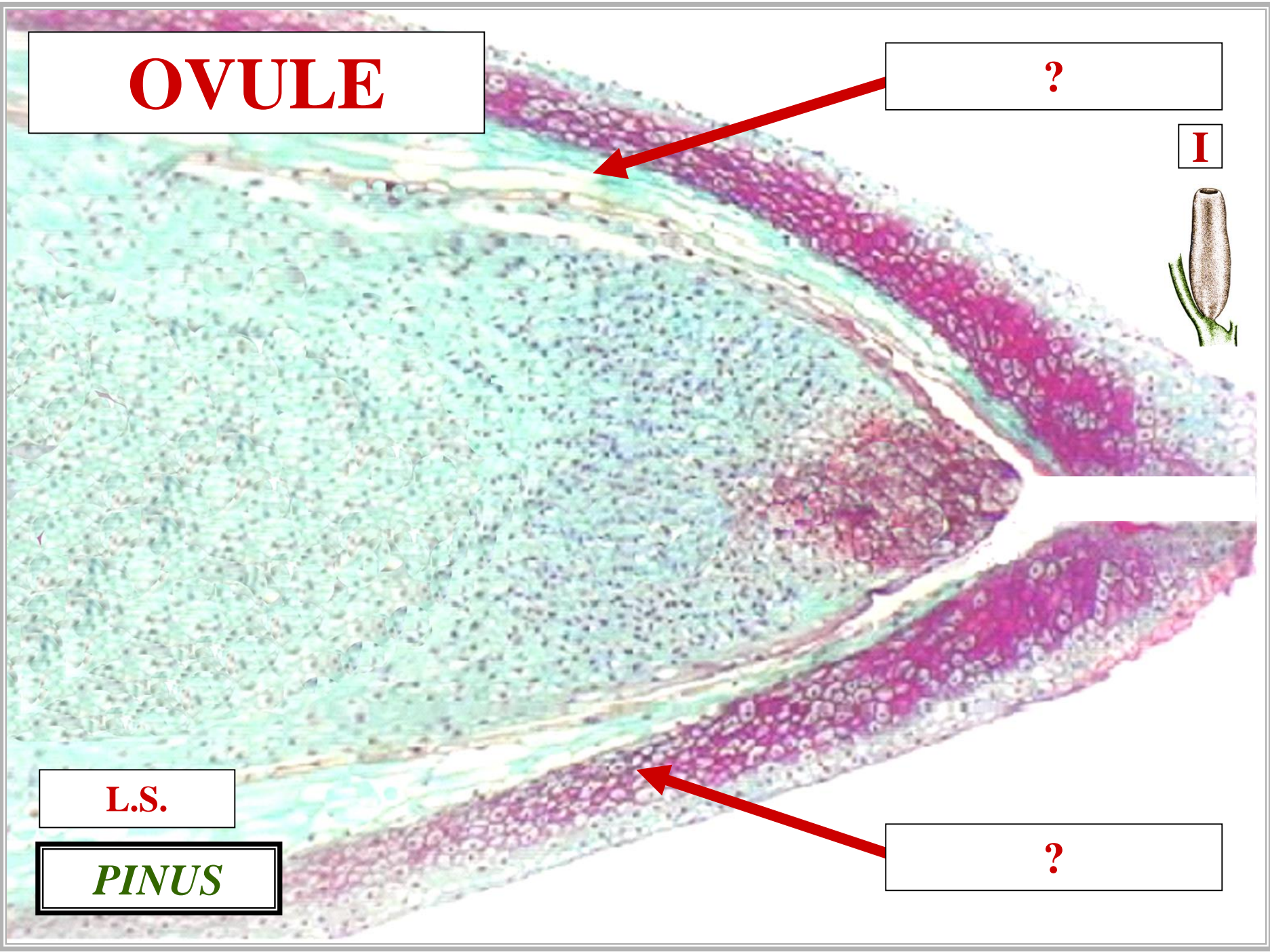
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L.S.

PINUS

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OVULE

INTEGUMENT

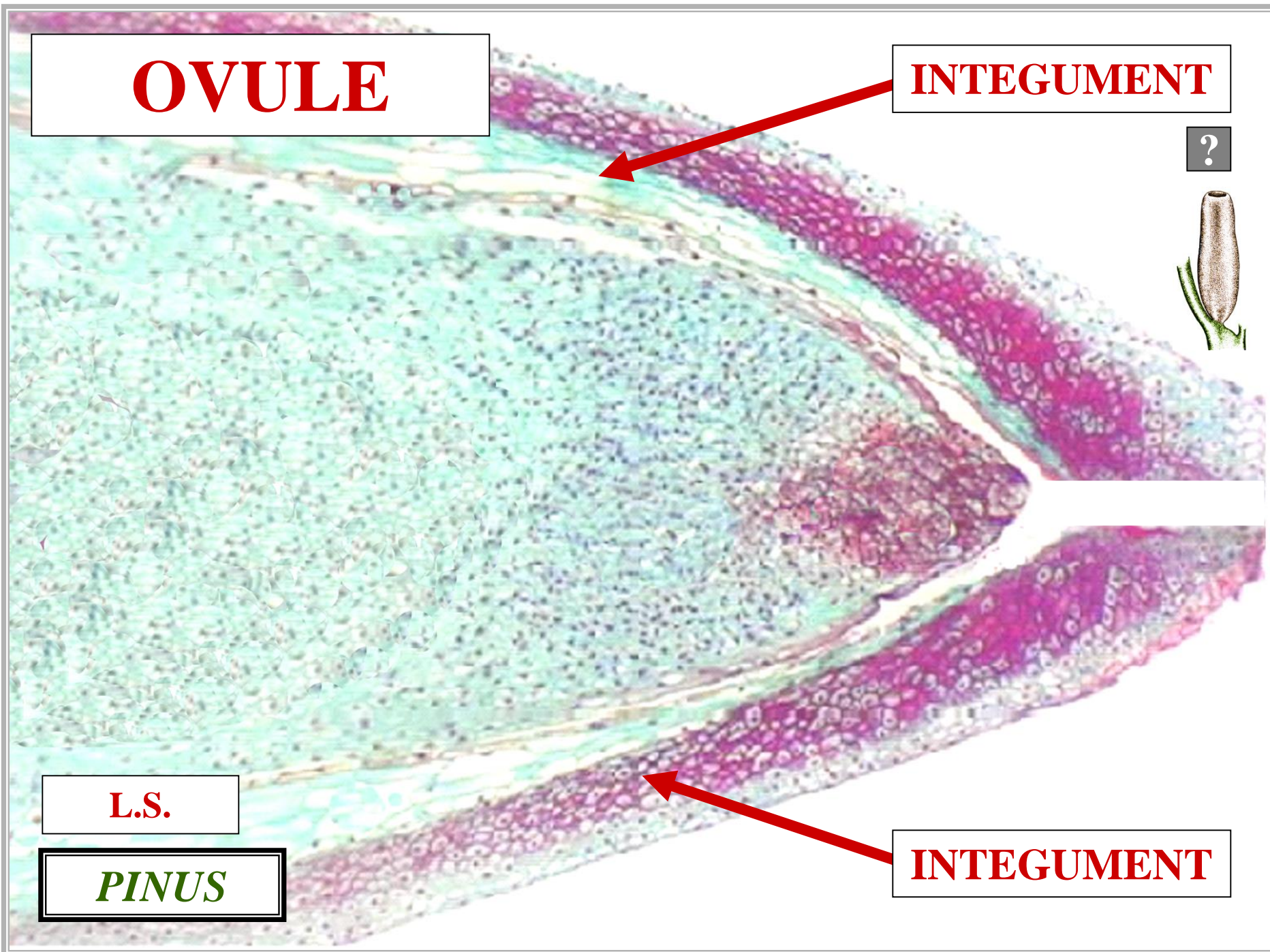
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PINUS

INTEGUMENT



OVULE

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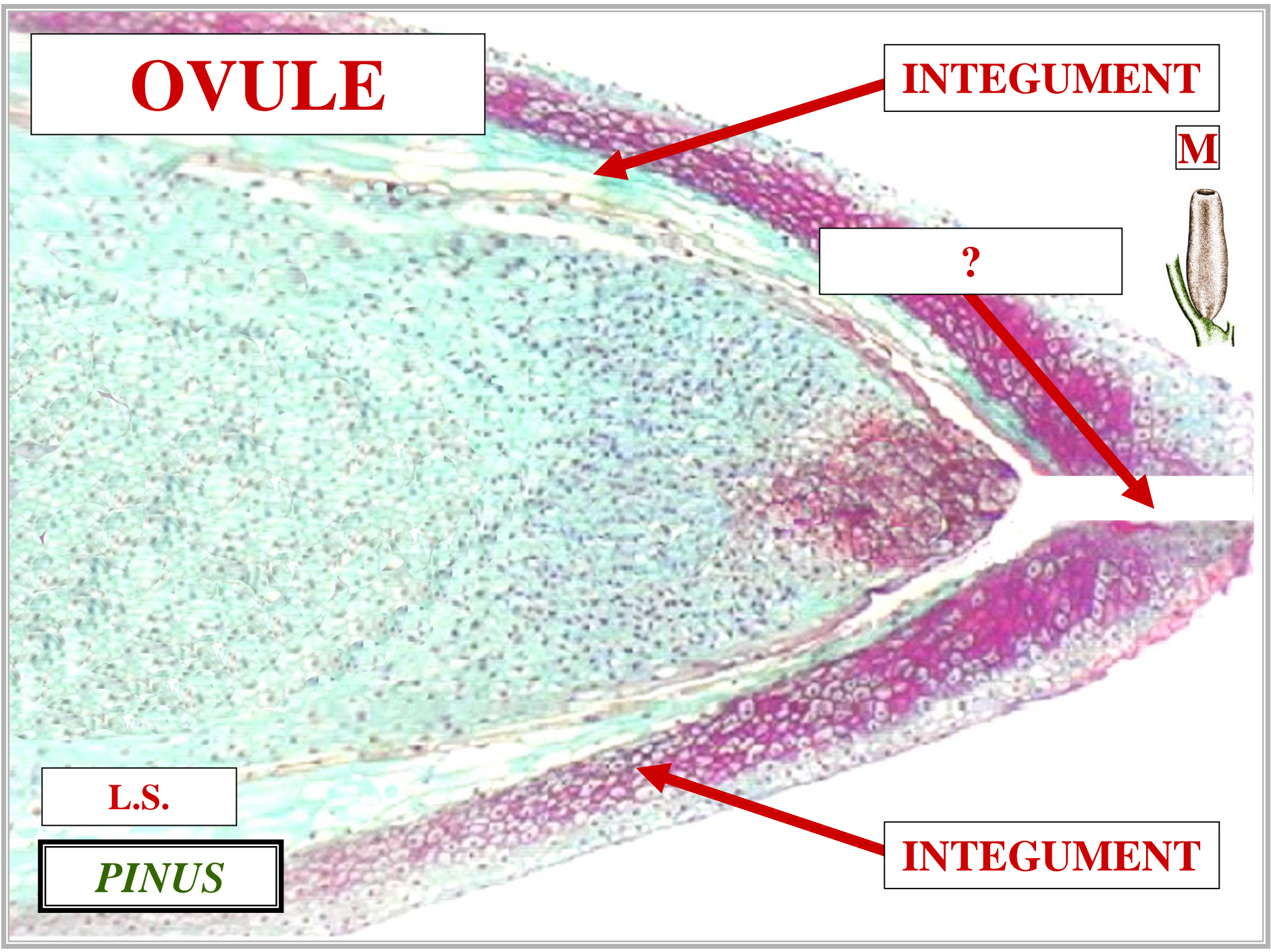
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PINUS

INTEGUMENT



OVULE

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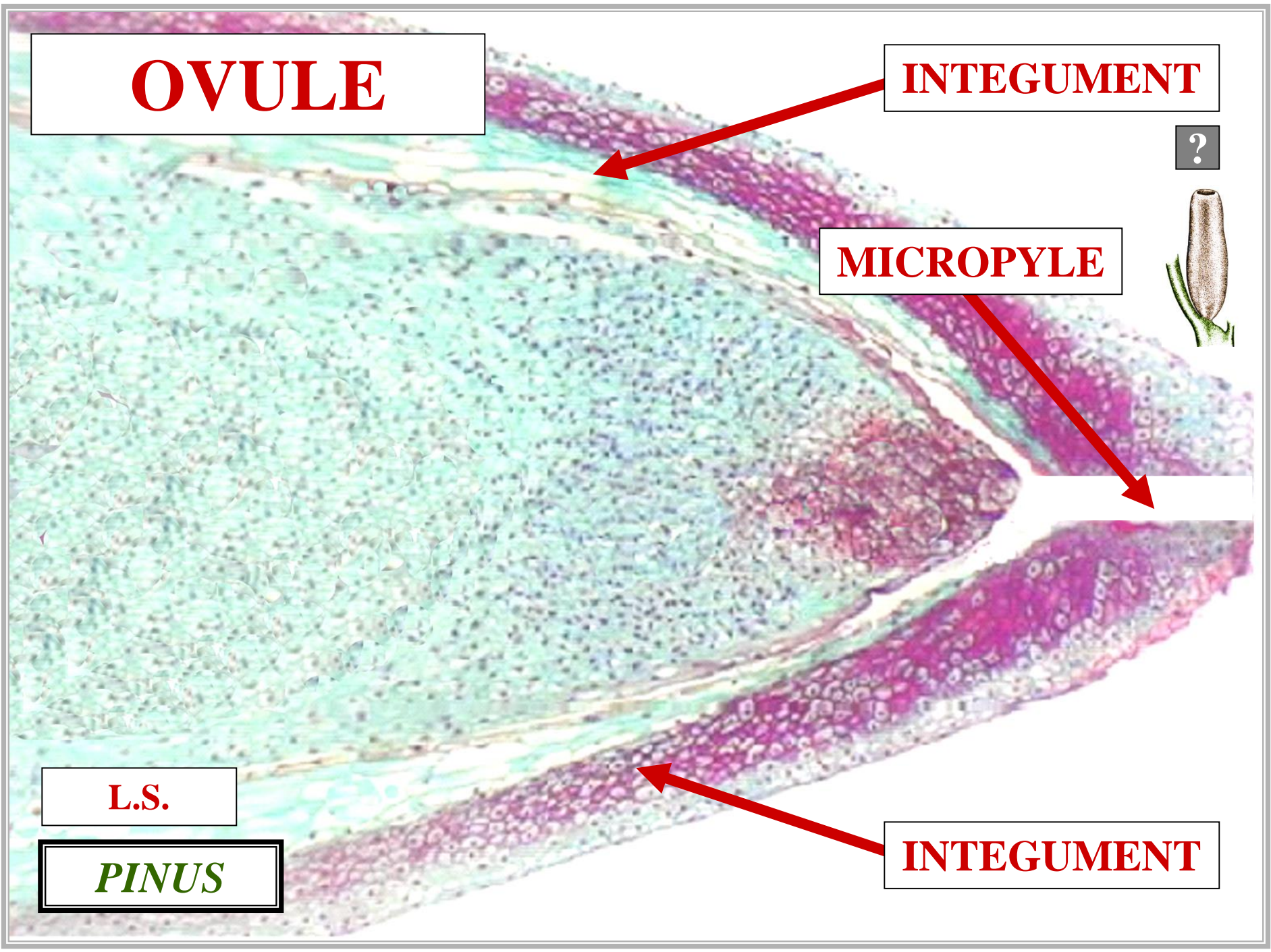
MICROPYLE



L.S.

PINUS

INTEGUMENT



OVULE

INTEGUMENT

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MICROPYLE

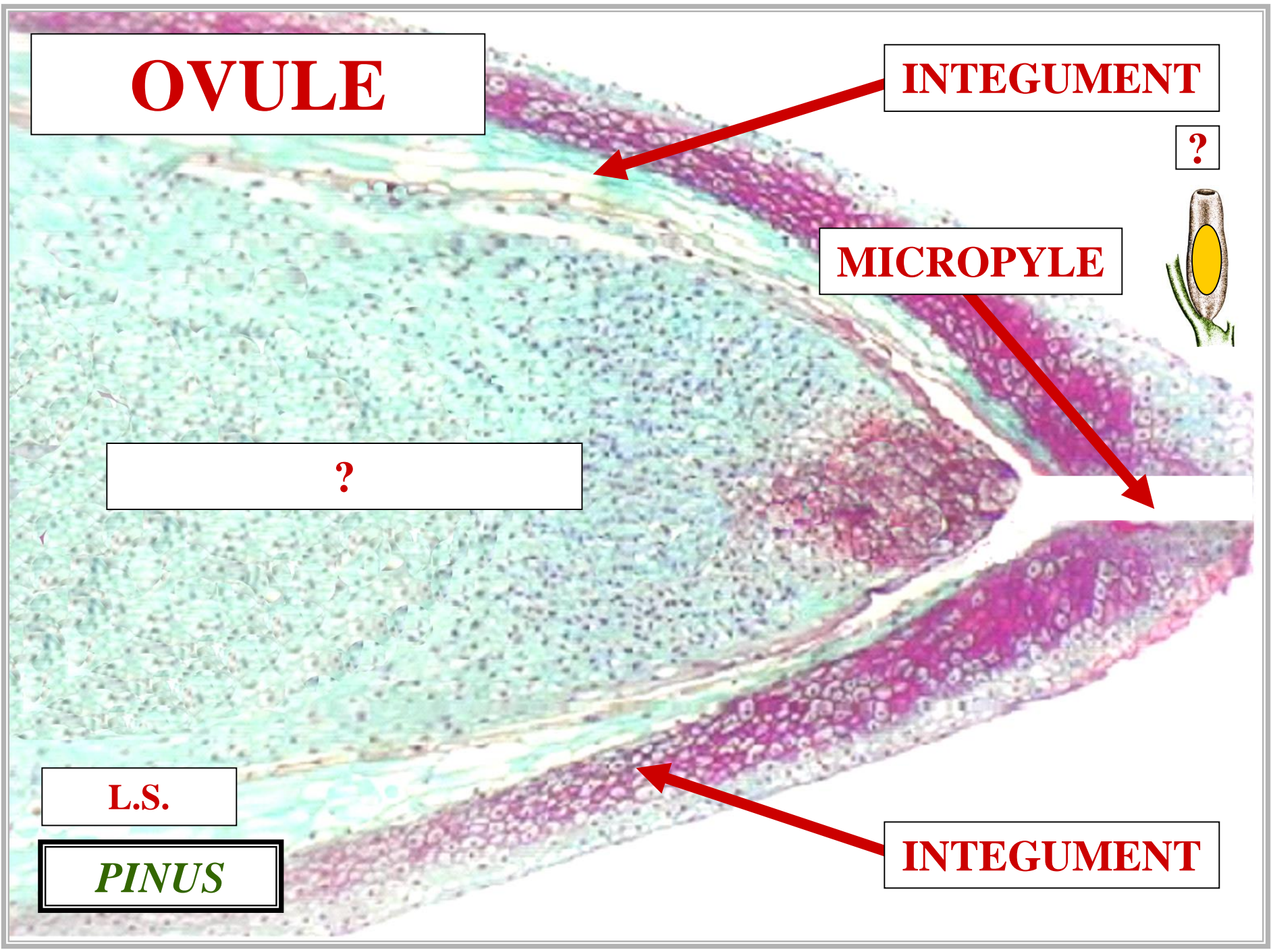


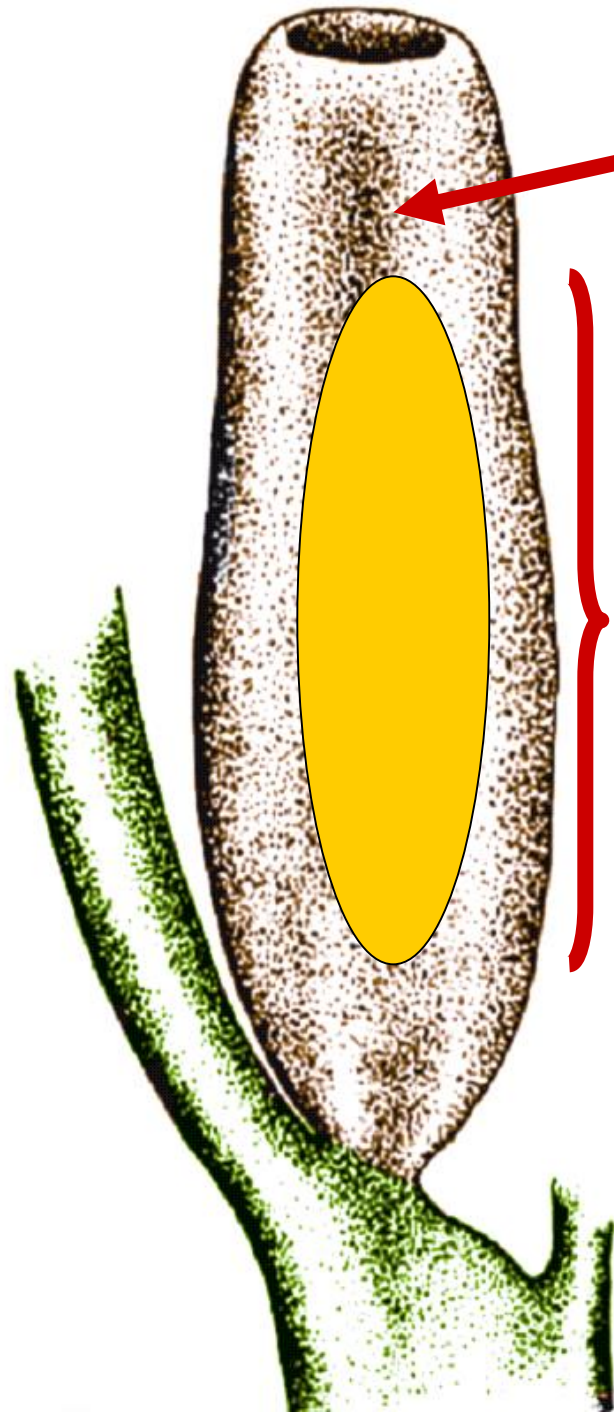
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PINUS

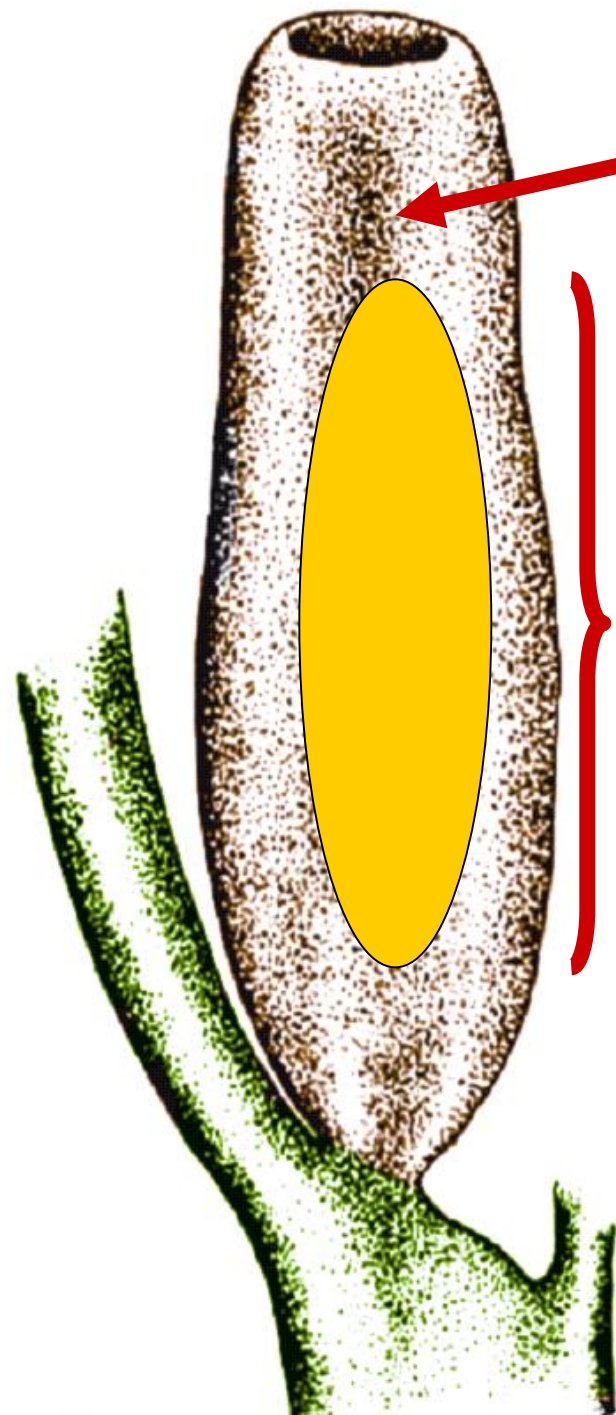
INTEGUMENT





INTEGUMENT

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INTEGUMENT

**INTEGUMENT
ENCLOSED
MEGASPORANGIUM**

OVULE

INTEGUMENT

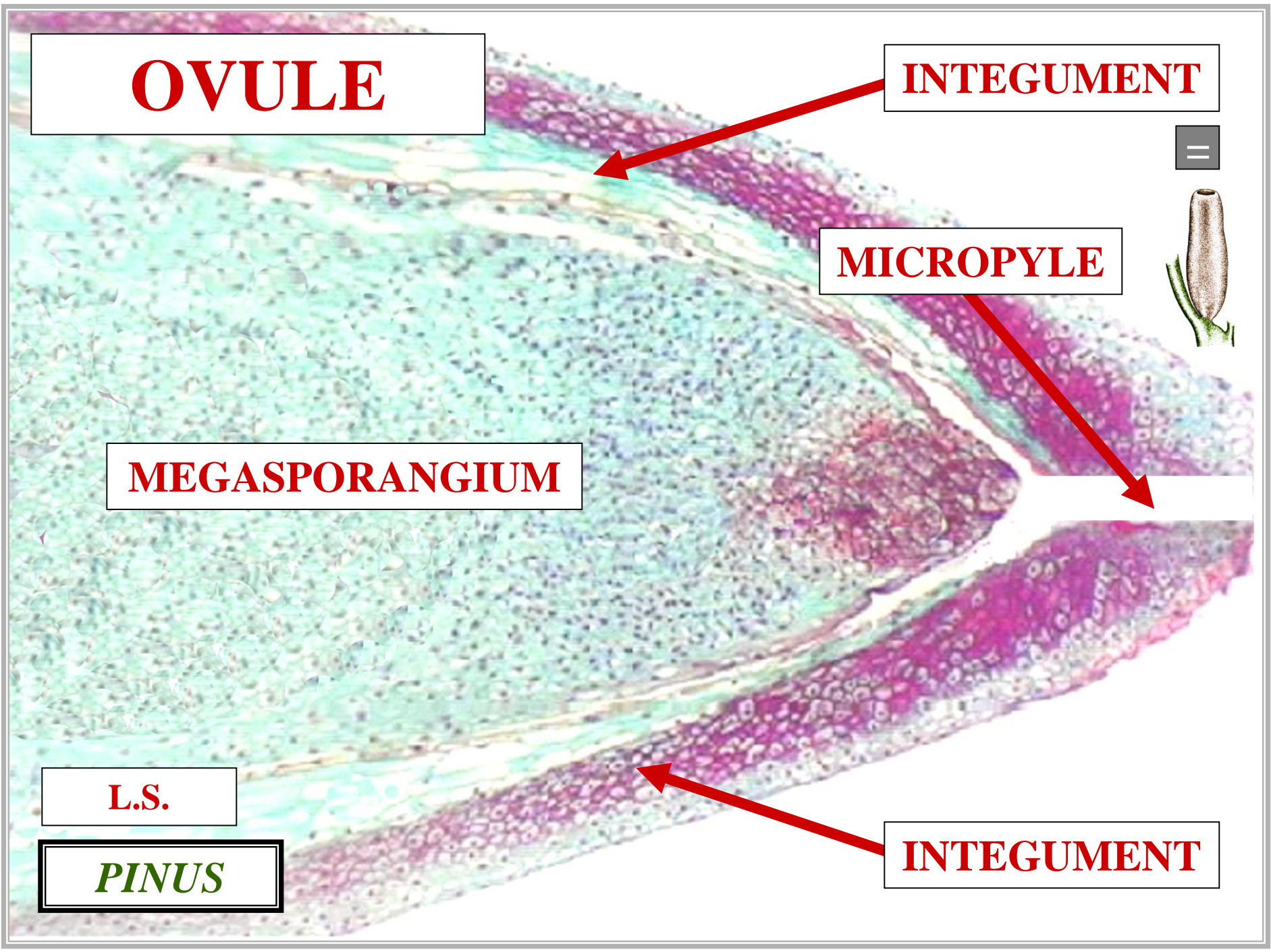
MICROPYLE

MEGASPORANGIUM

L.S.

PINUS

INTEGUMENT



OVULE

INTEGUMENT

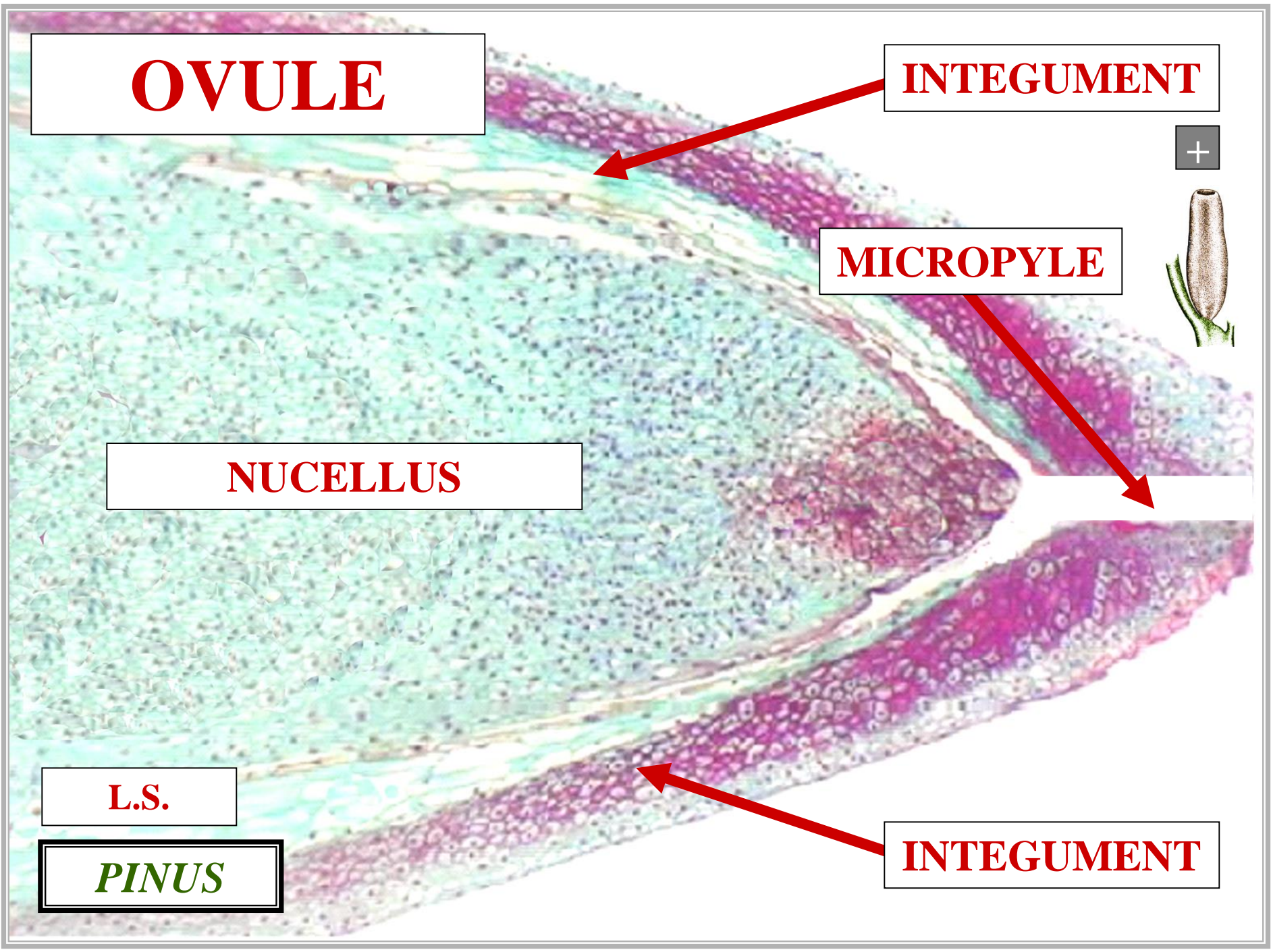
MICROPYLE

NUCELLUS

L.S.

PINUS

INTEGUMENT



OVULE

INTEGUMENT

?

MICROPYLE

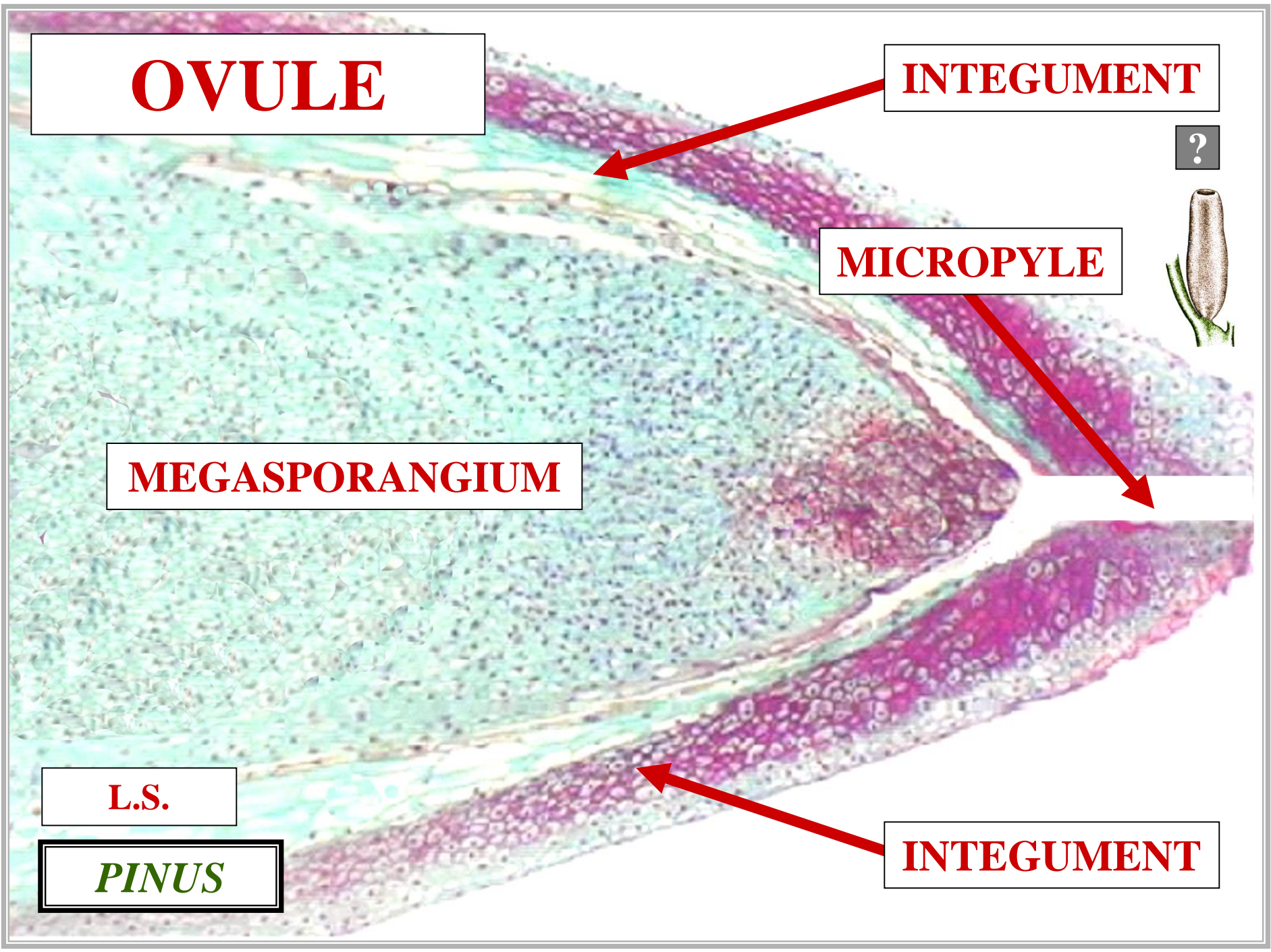


MEGASPORANGIUM

L.S.

PINUS

INTEGUMENT



OVULE

INTEGUMENT

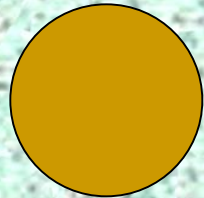
MEGASPORANGIUM

MICROPYLE

M



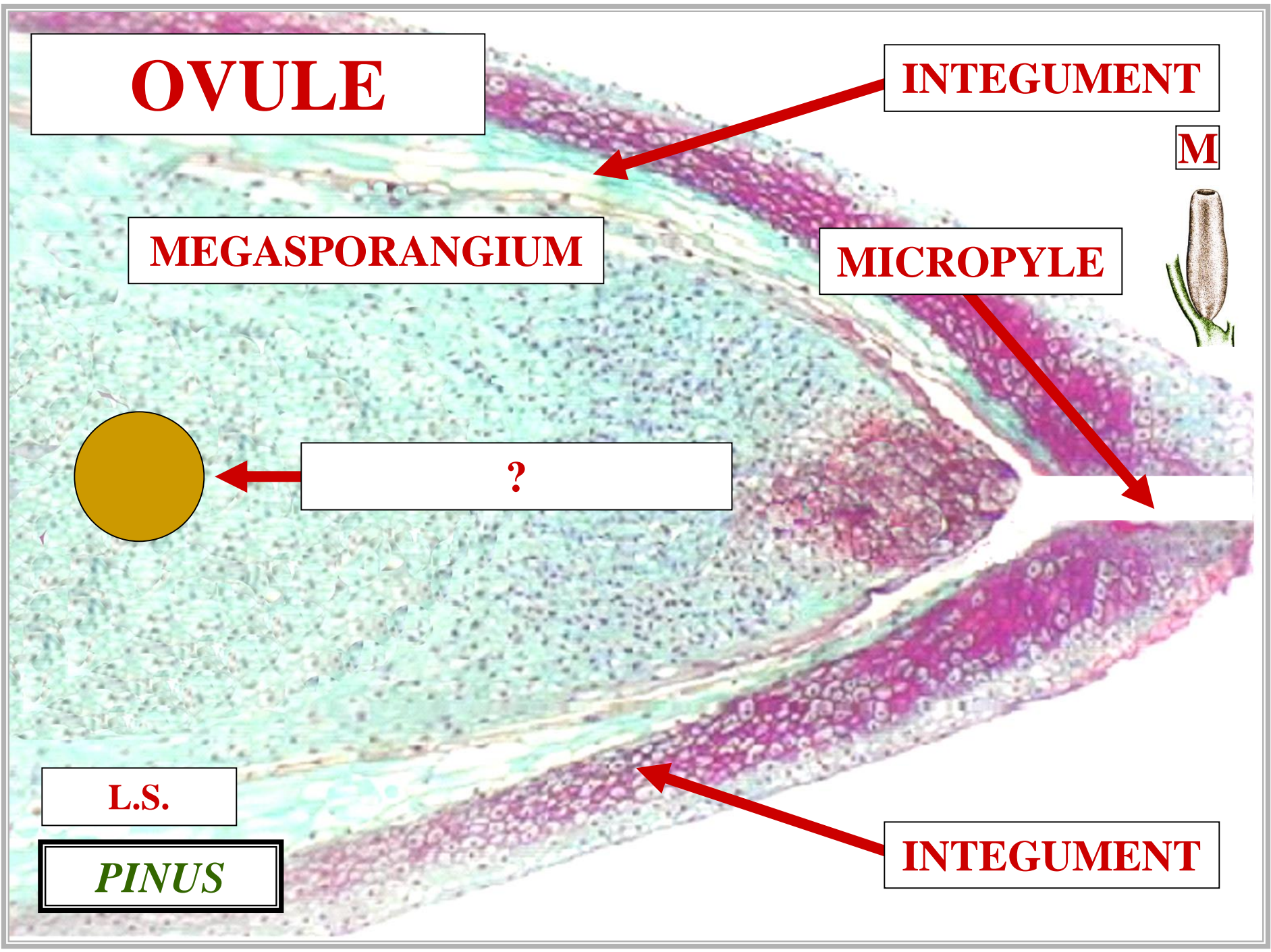
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L.S.

PINUS

INTEGUMENT



OVULE

INTEGUMENT

MEGASPORANGIUM

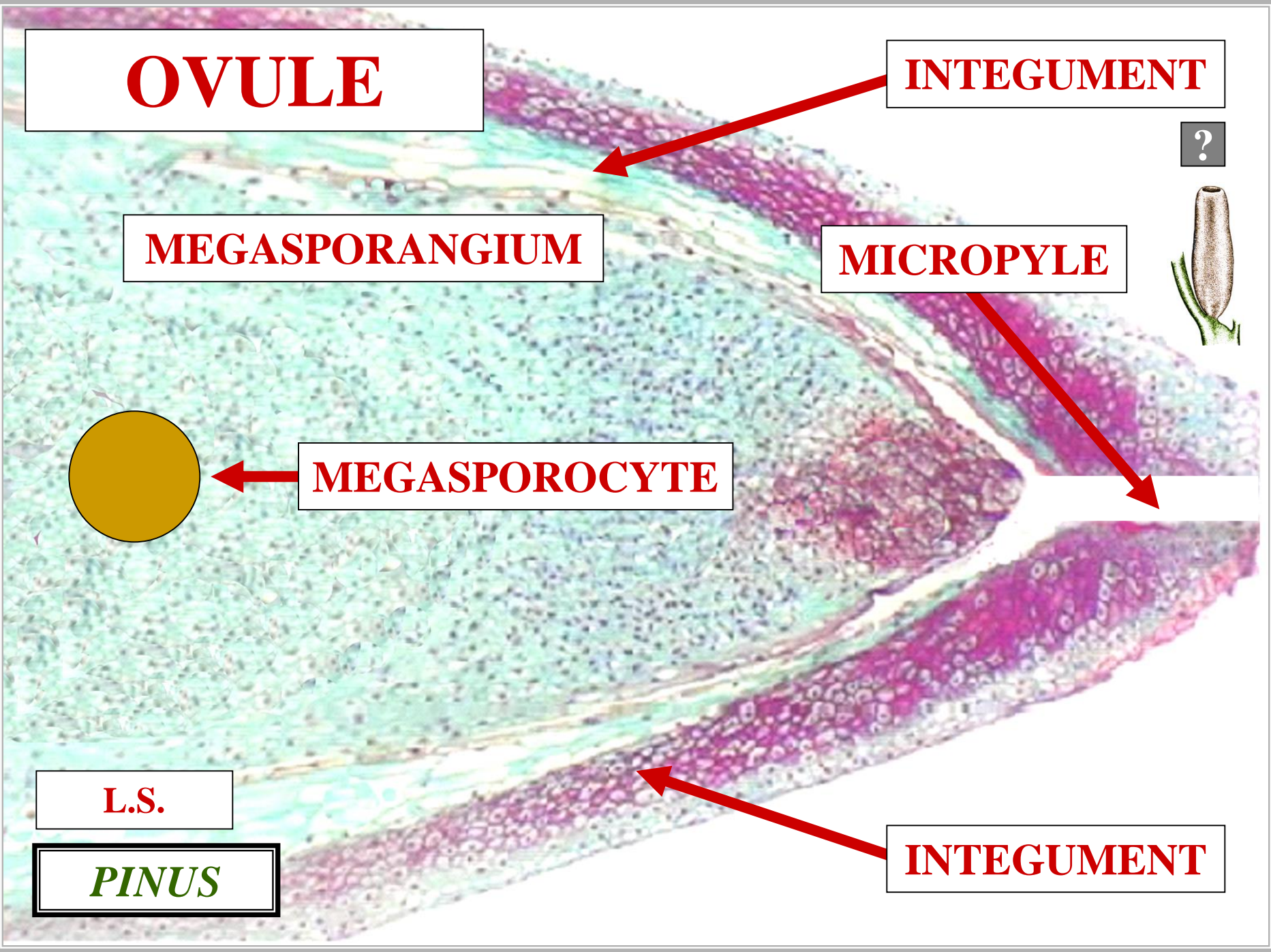
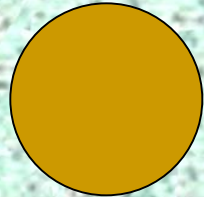
MICROPYLE

MEGASPOROCYTE

L.S.

PINUS

INTEGUMENT



OVULE

INTEGUMENT

MEGASPORANGIUM

MICROPYLE

2



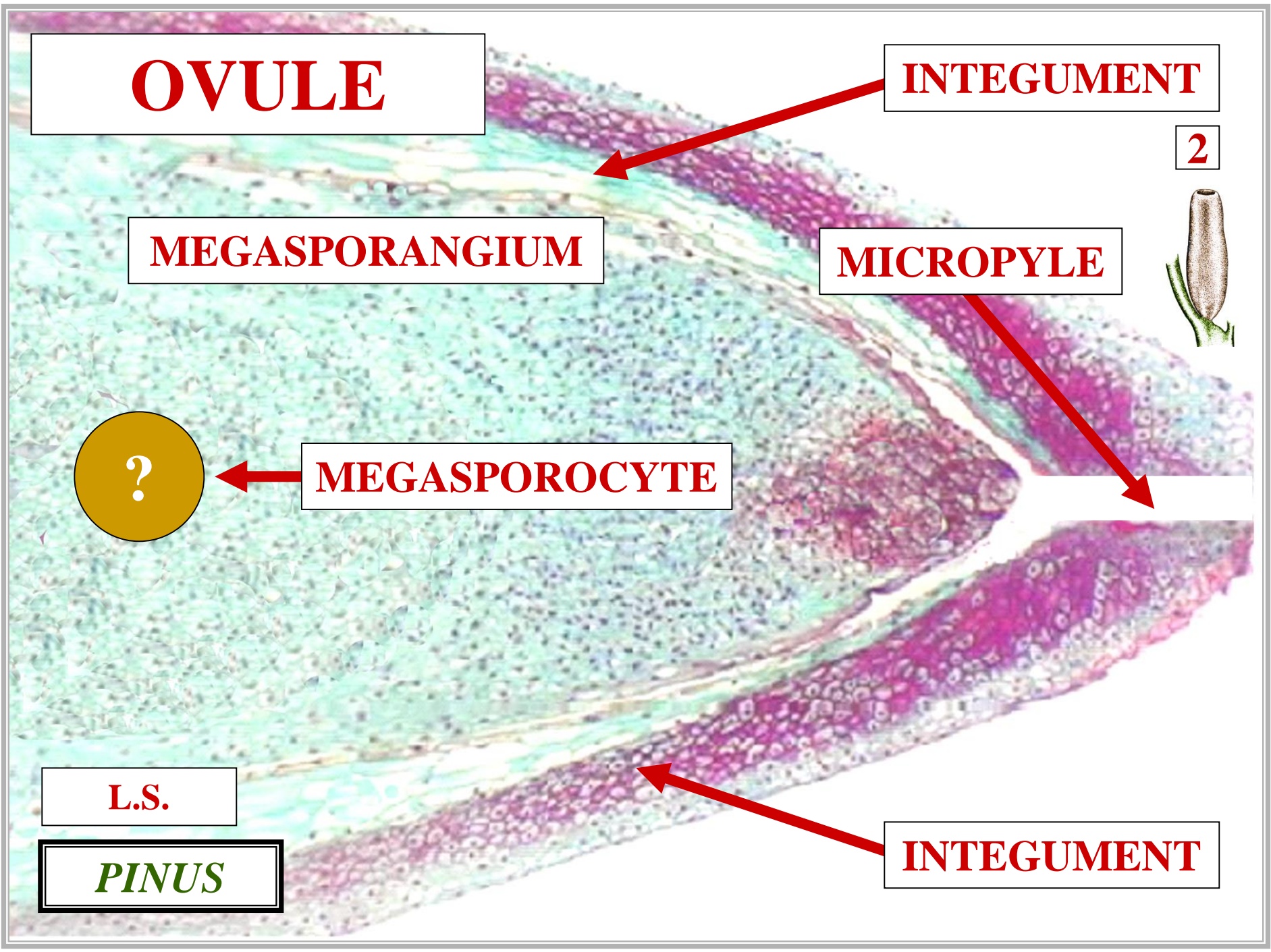
MEGASPOROCYTE



L.S.

PINUS

INTEGUMENT



OVULE

INTEGUMENT

MEGASPORANGIUM

MICROPYLE

2N

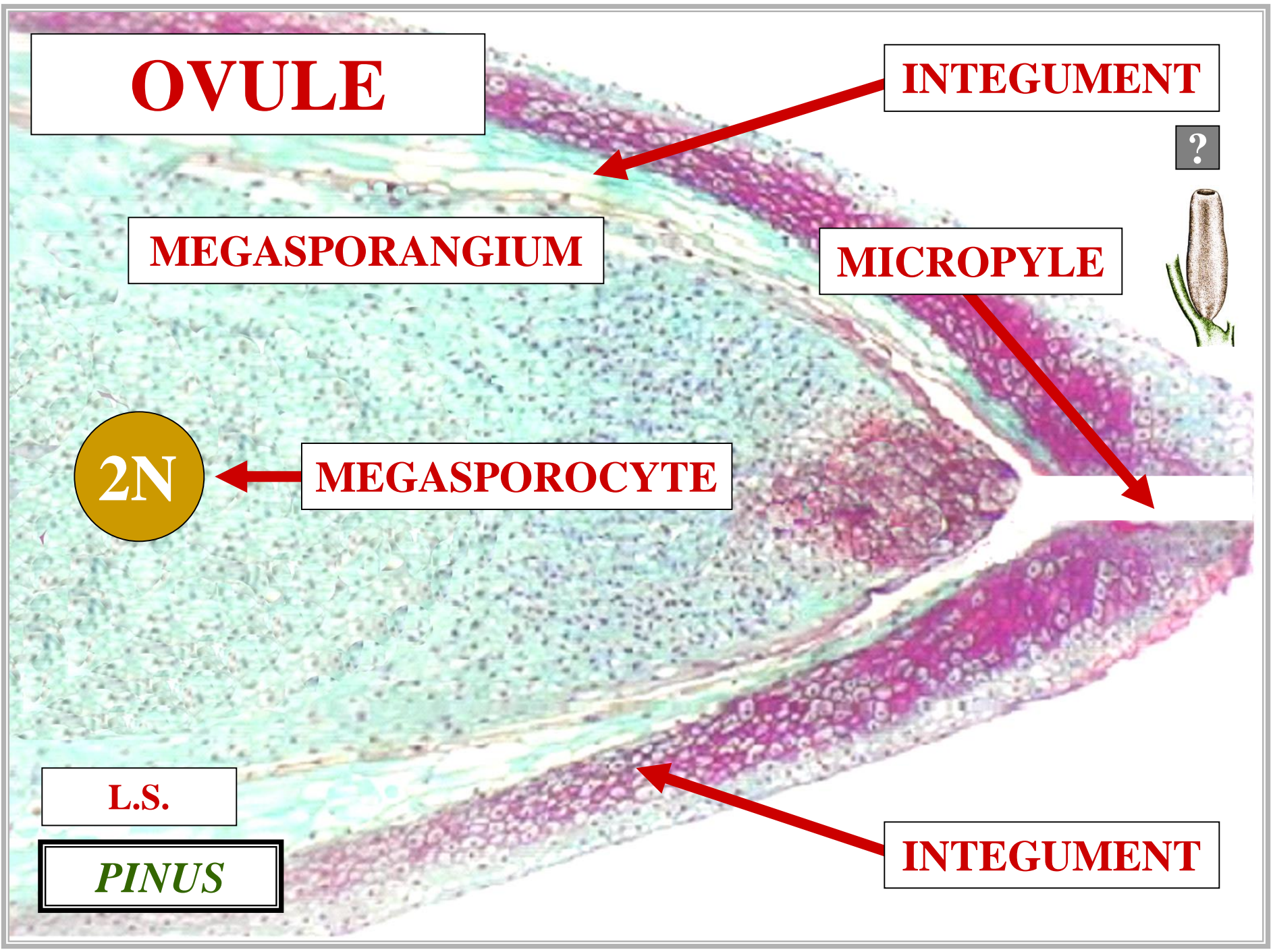
MEGASPOROCYTE

L.S.

PINUS

INTEGUMENT

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OVULE

INTEGUMENT

MEGASPORANGIUM

MICROPYLE

M



MEGASPOROCYTE

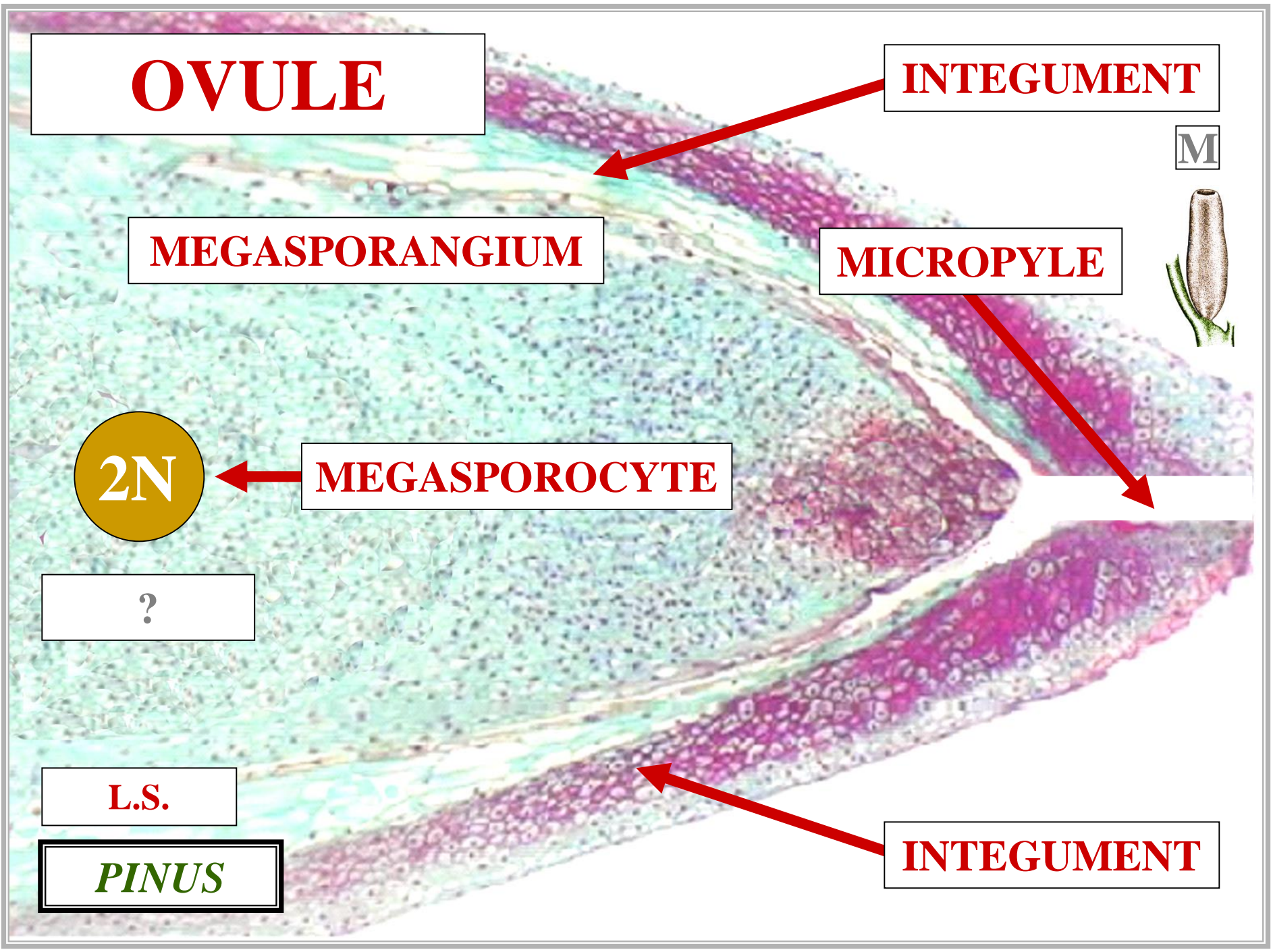
2N

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L.S.

PINUS

INTEGUMENT



OVULE

INTEGUMENT

MEGASPORANGIUM

MICROPYLE

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2N

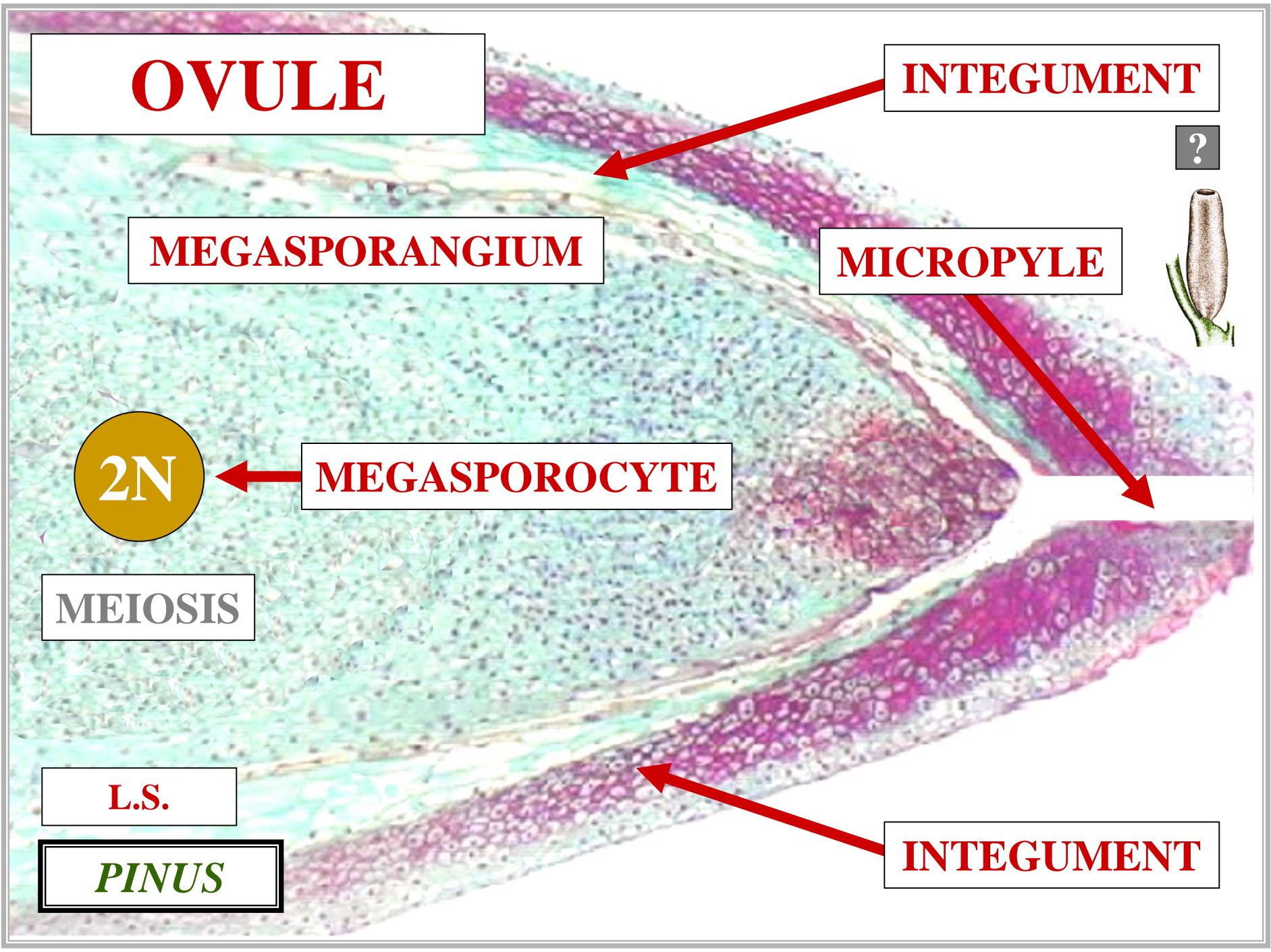
MEGASPOROCYTE

MEIOSIS

L.S.

PINUS

INTEGUMENT



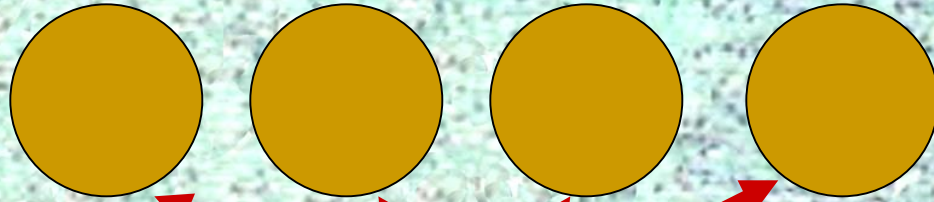
OVULE

INTEGUMENT

MEGASPORANGIUM

MICROPYLE

M

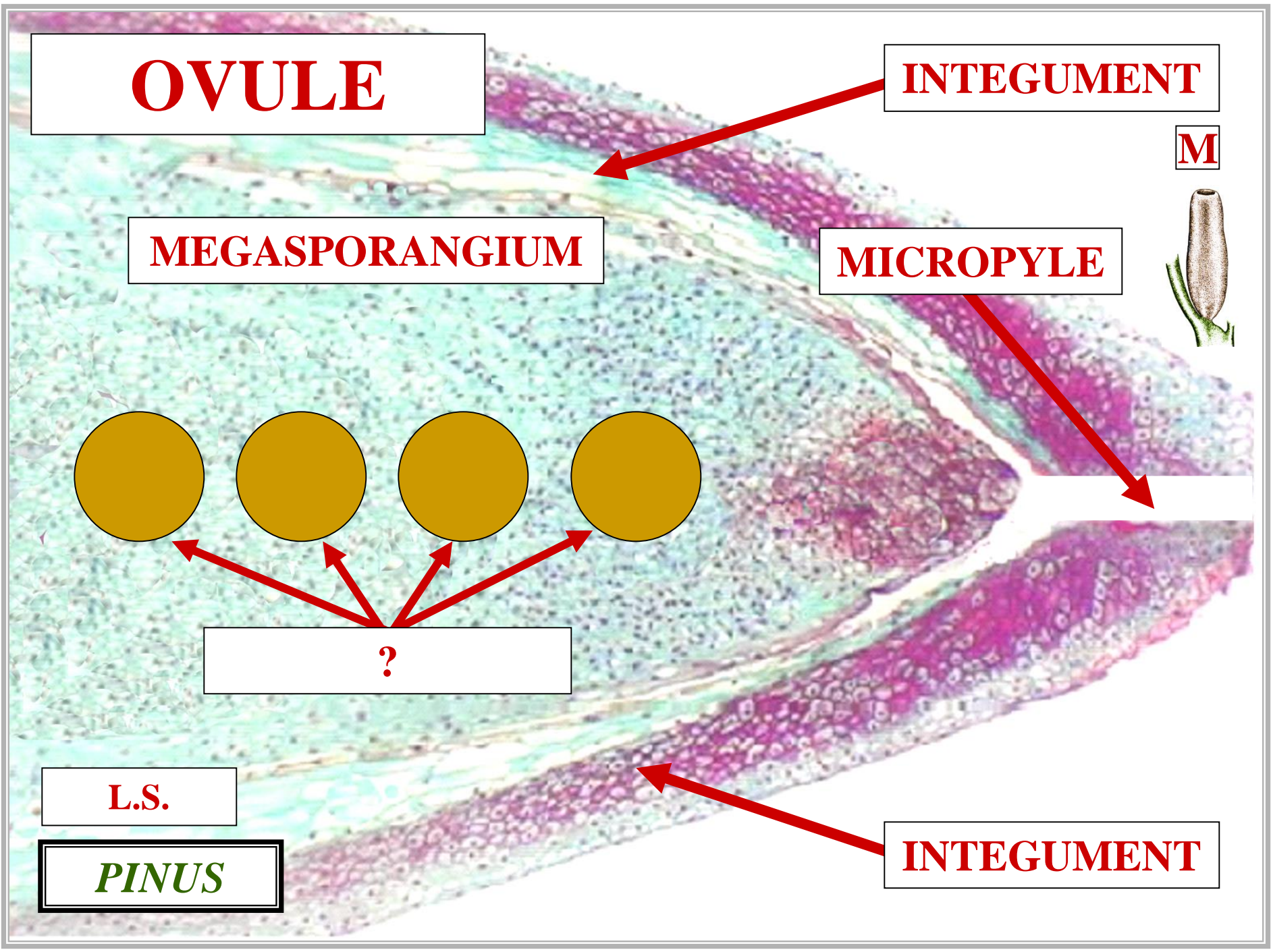


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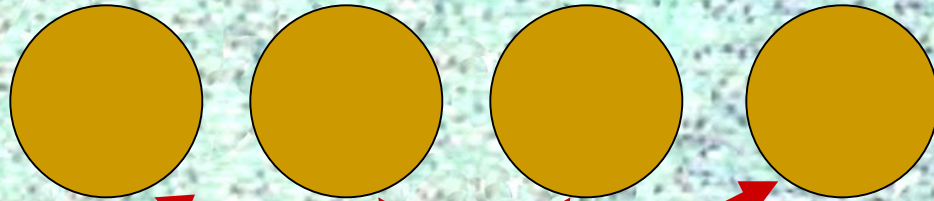
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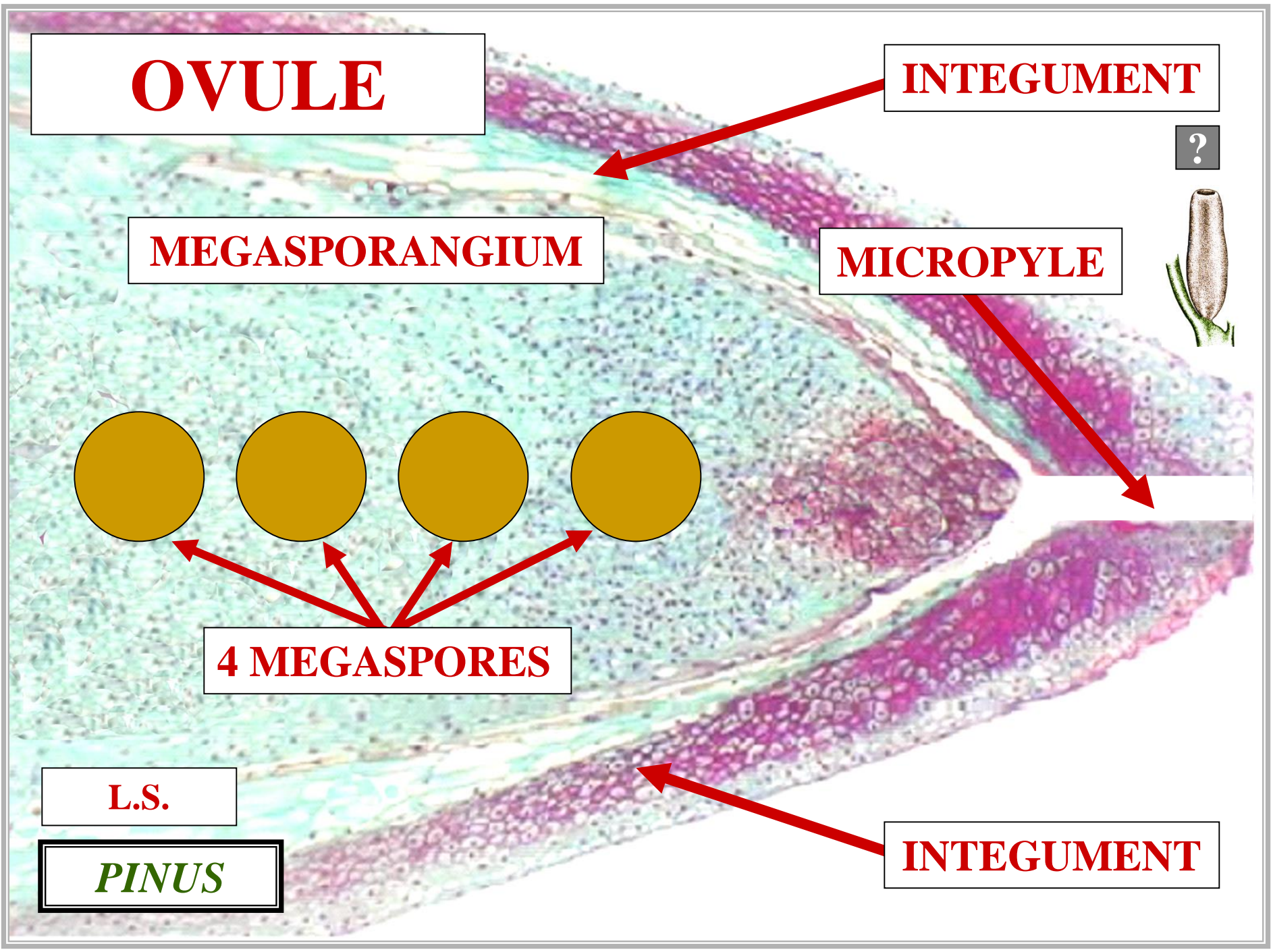


4 MEGASPORES

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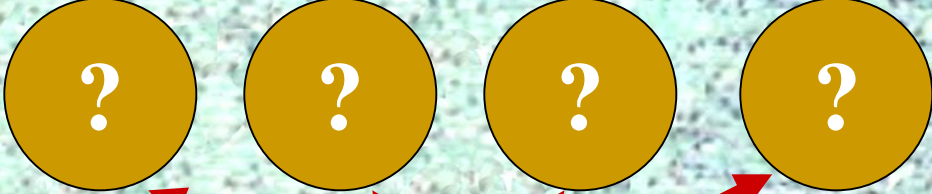
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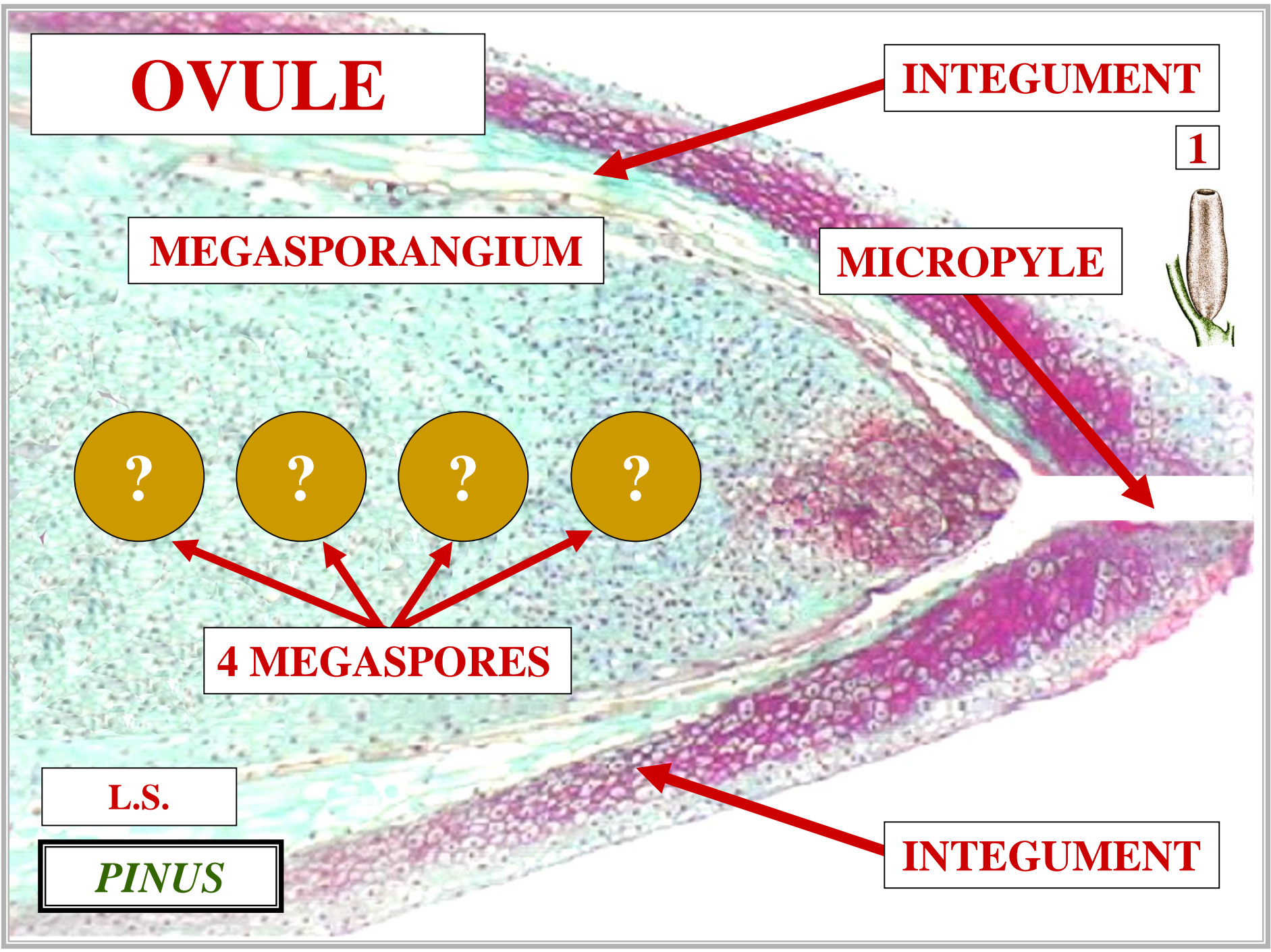


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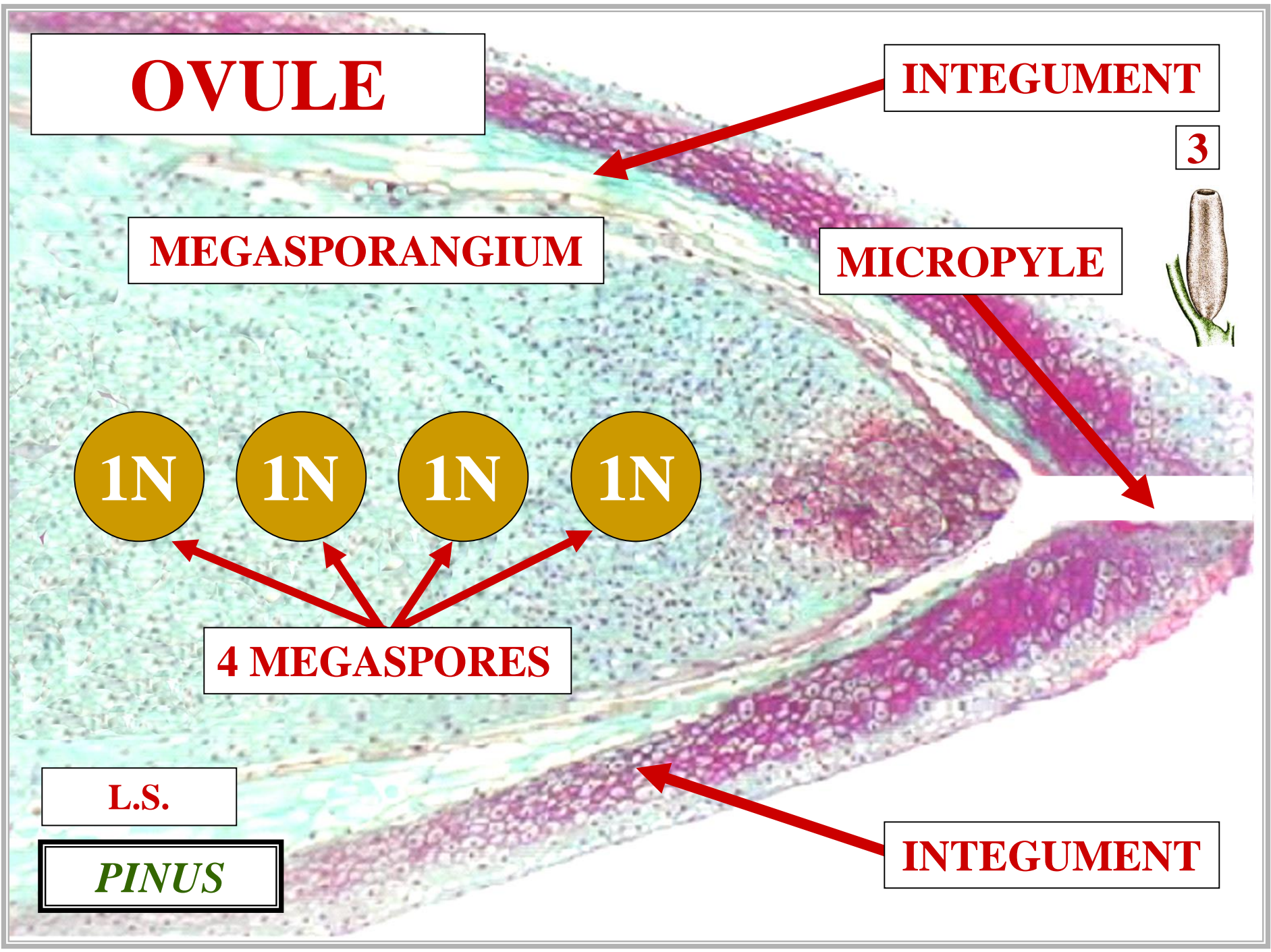


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