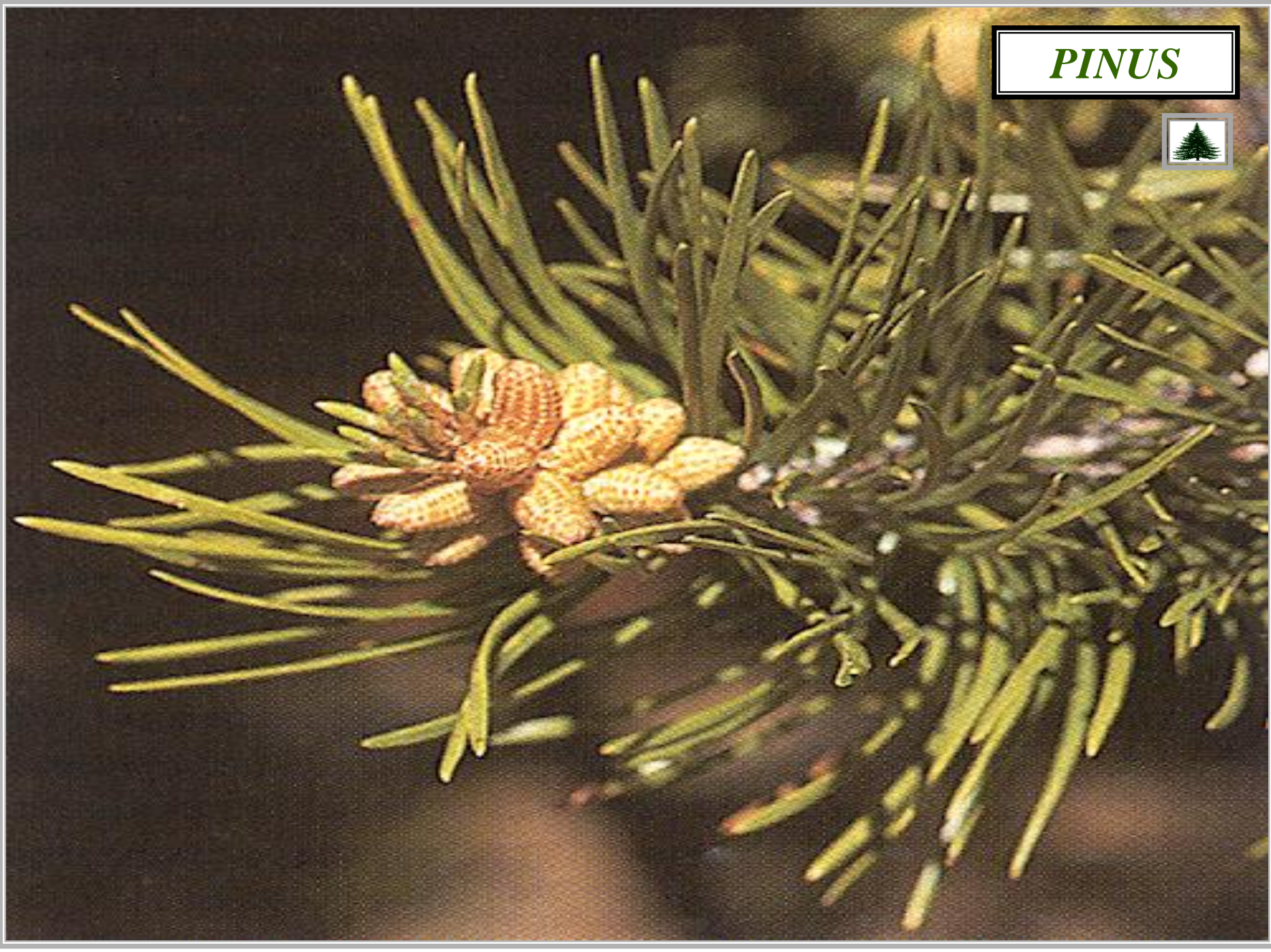


PINUS



PINUS



PINUS



MICROSPORANGIA



MICROSTROBILI

MEGASTROBILI

MEGASPORANGIA



MICROSPORANGIA



MICROSTROBILI

PINUS

M



MEGASPORANGIA



PINUS

^

D

MONOECIOUS



MICROSPORANGIA



**DIOECIOUS
GYMNOSPERM**

**GYMNOSPERM
DIOECIOUS**



**MICROSPORANGIA
AND
MEGASPORANGIA
DIFFERENT PLANTS**

**GYMNOSPERM
DIOECIOUS**



?

GINKGO

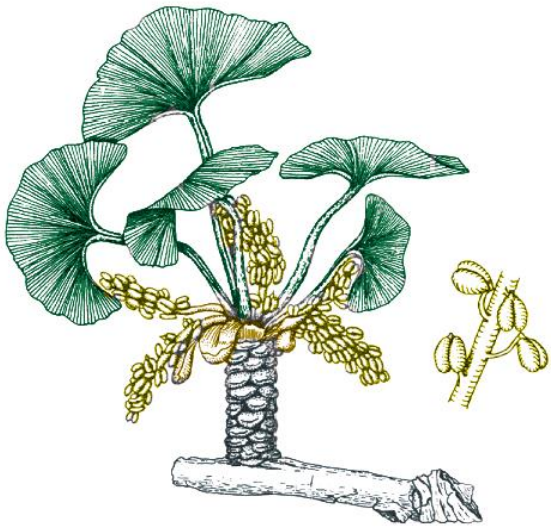
M



GINKGO

M

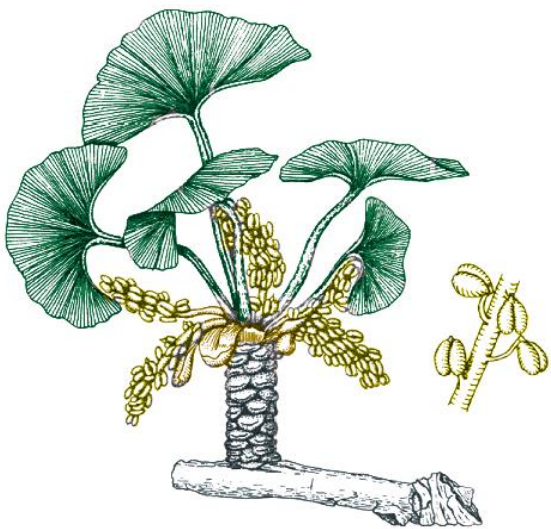
MICROSTROBILI



GINKGO

“M

MICROSPORANGIA



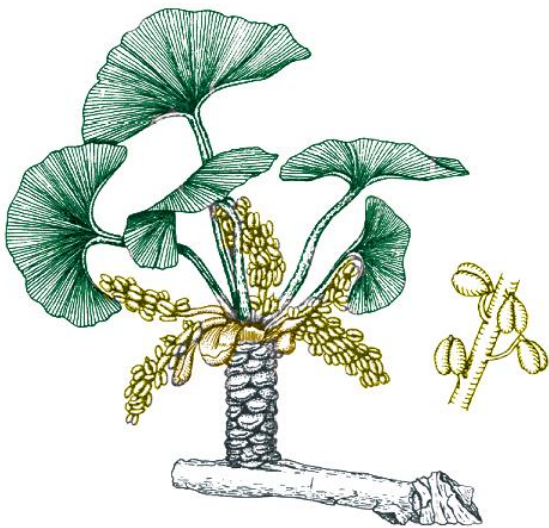
GINKGO

^

+

“MALE” PLANT

MICROSPORANGIA



GINKGO

M



GINKGO

M

MEGASTROBILI



GINKGO

“F”

MEGASPORANGIA



GINKGO

2

+

“FEMALE” PLANT

MEGASPORANGIA

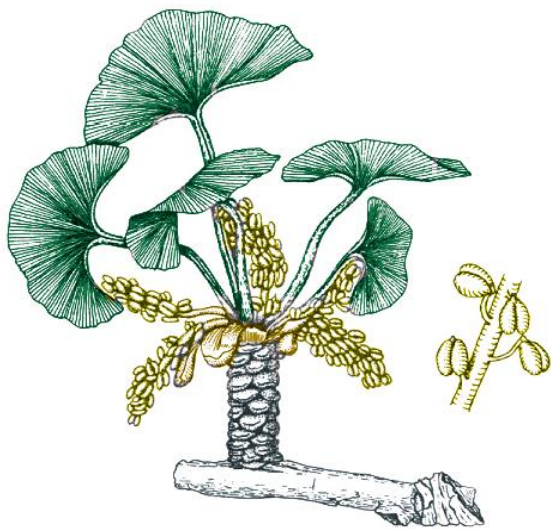


GINKGO

D

“MALE” PLANT

MICROSPORANGIA



“FEMALE” PLANT

MEGASPORANGIA

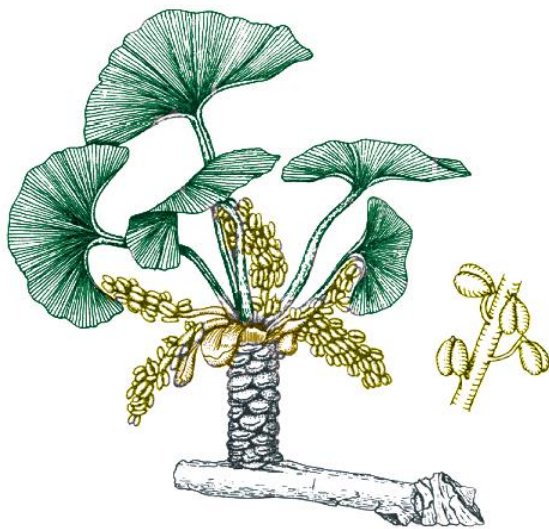


GINKGO

DIOECIOUS

“MALE” PLANT

MICROSPORANGIA



“FEMALE” PLANT

MEGASPORANGIA



POLLINATION

POLLINATION

GYMNOSPERM POLLINATION



**POLLEN GRAIN
DISSEMINATION TO
MEGASPORANGIUM**

**GYMNOSPERM
POLLINATION**

PINUS

M



MICROSTROBILI

PINUS

M



MICROSPORANGIA

PINUS

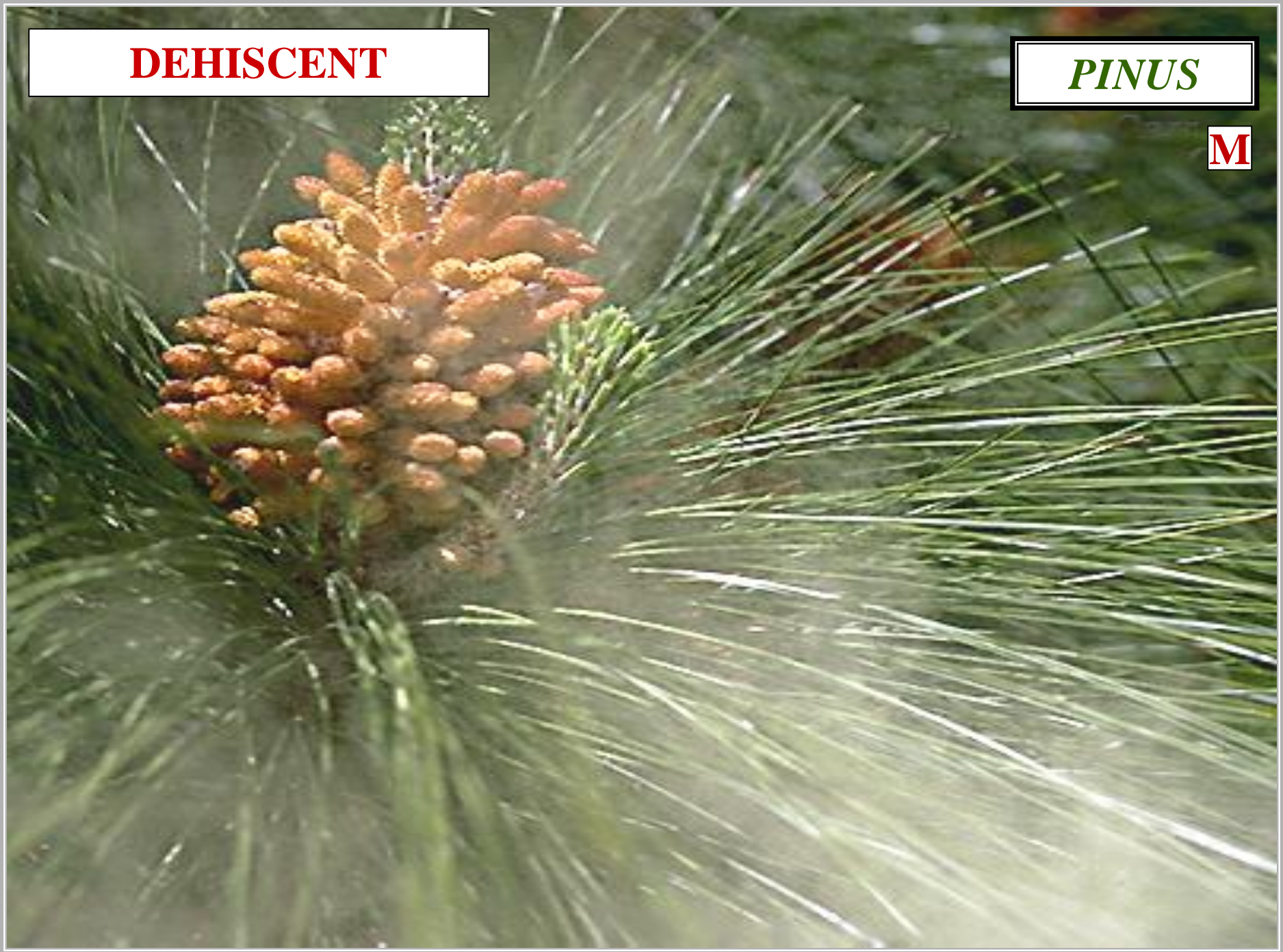
D



DEHISCENT

PINUS

M

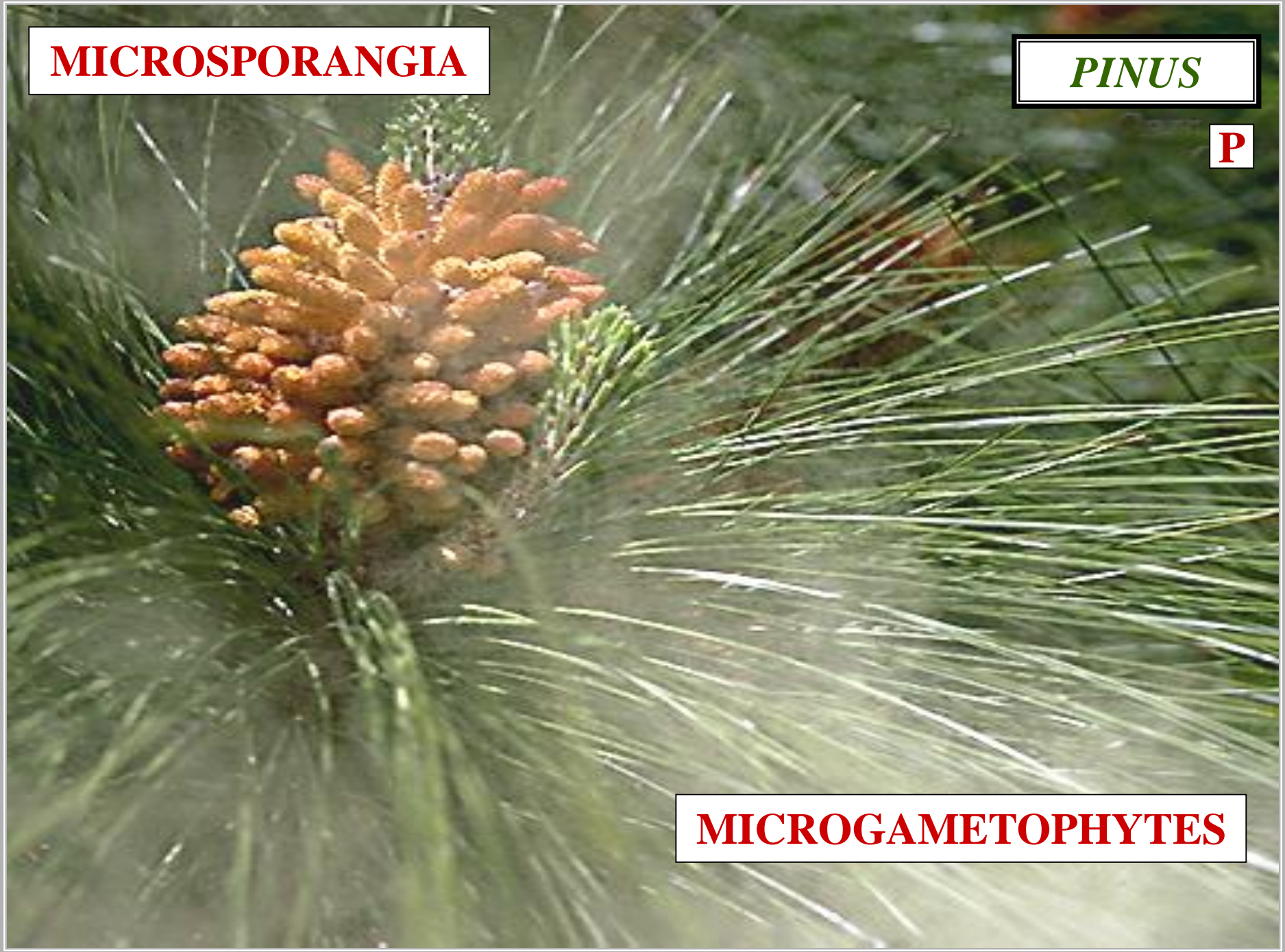


MICROSPORANGIA

PINUS

P

MICROGAMETOPHYTES



MICROSPORANGIA

PINUS

W



POLLIN GRAINS

MICROSPORANGIA

PINUS



WIND DISSEMINATED

MEGASTROBILUS

PINUS

OS



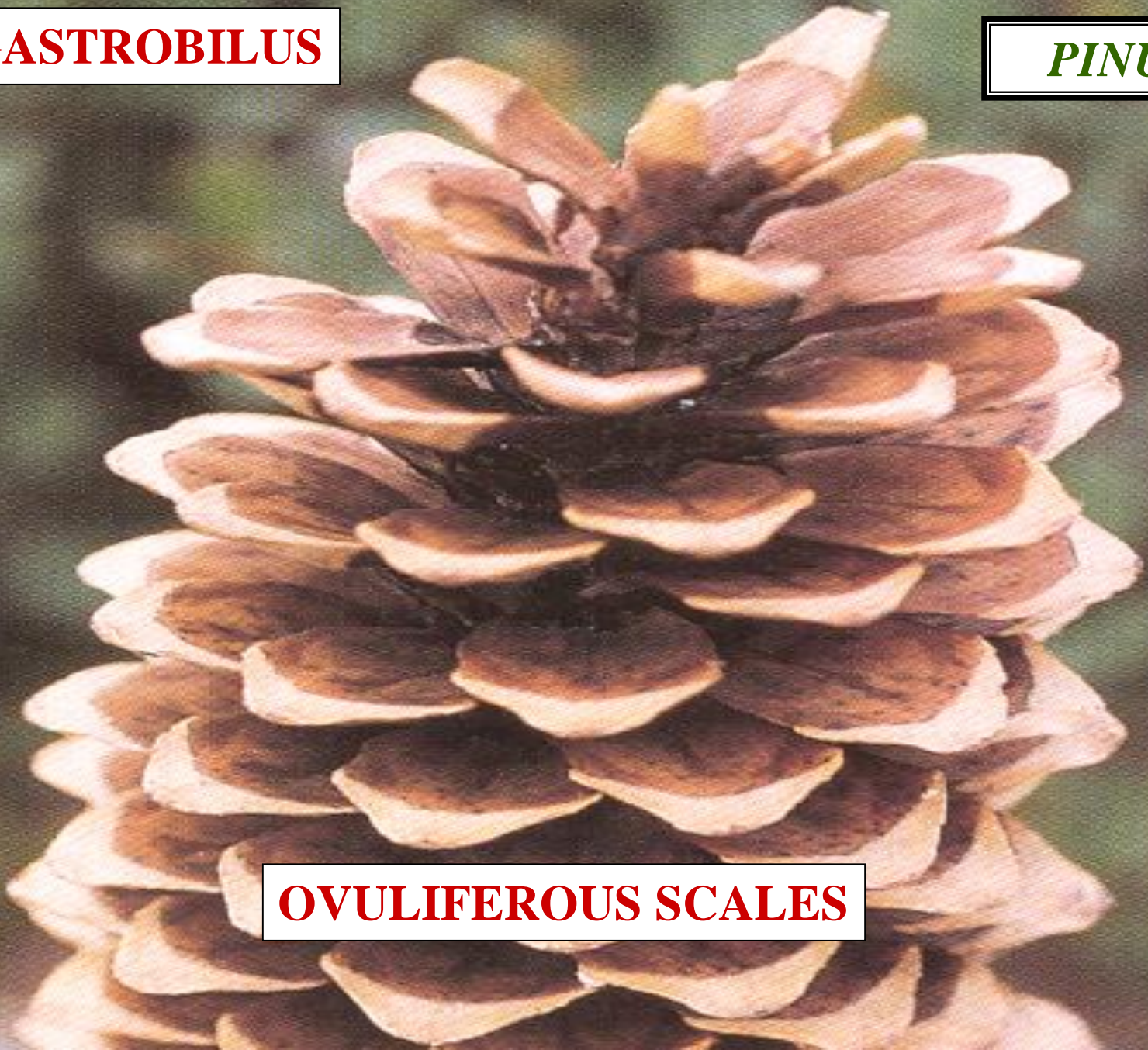
MEGASTROBILUS

PINUS

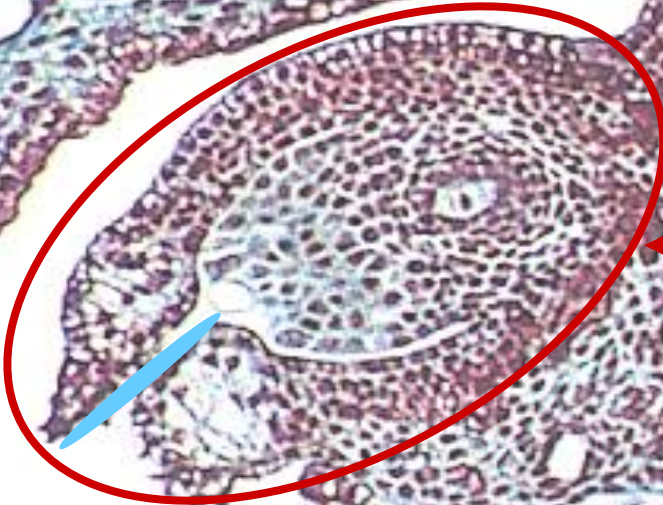
OS



OVULIFEROUS SCALES



MEGASTROBILUS



OVULIFEROUS SCALE

EXPOSED OVULE

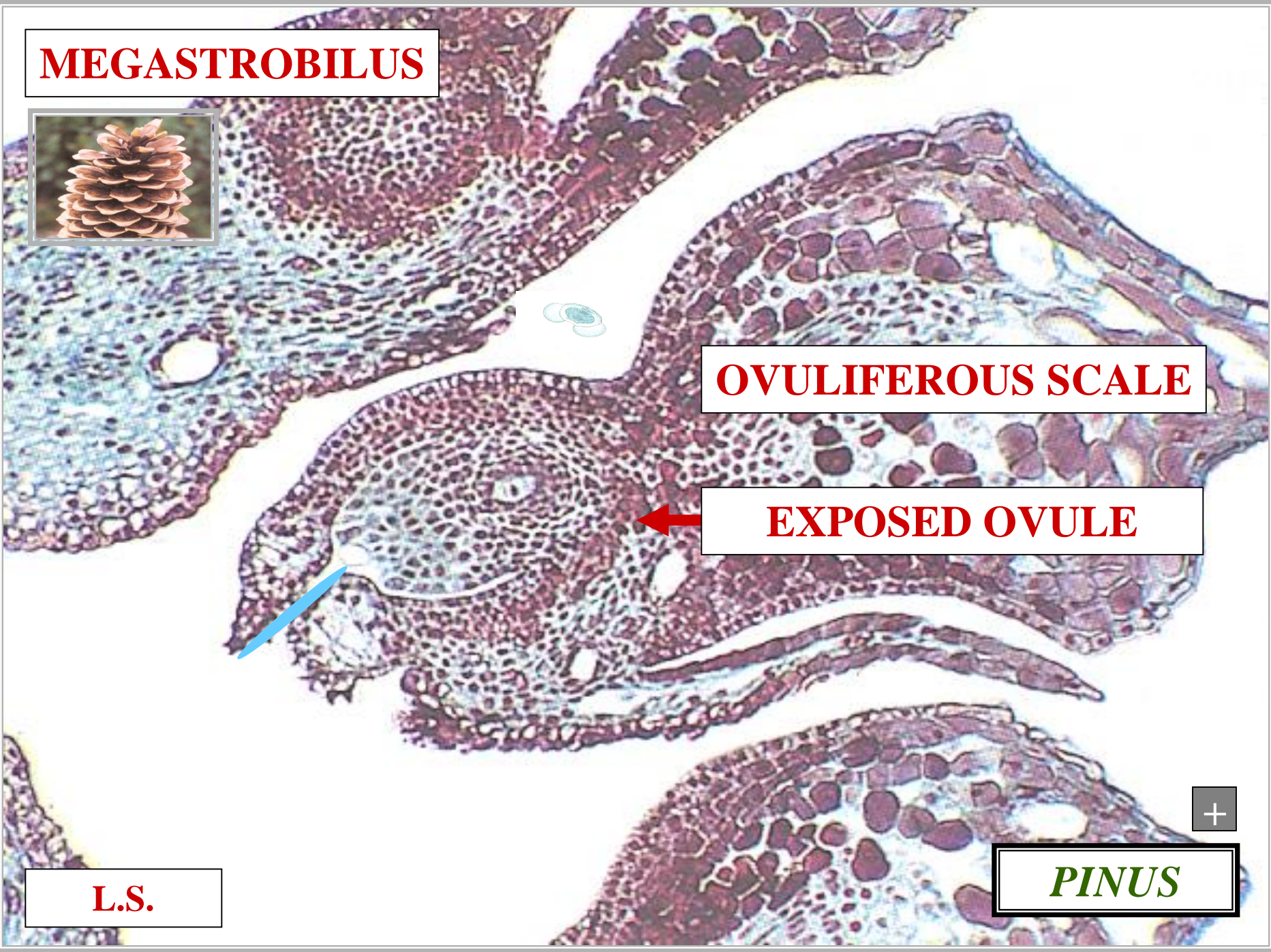
**GYMNOSPERM
OVULE EXPOSED
DURING
POLLINATION**

L.S.

PINUS



MEGASTROBILUS



OVULIFEROUS SCALE

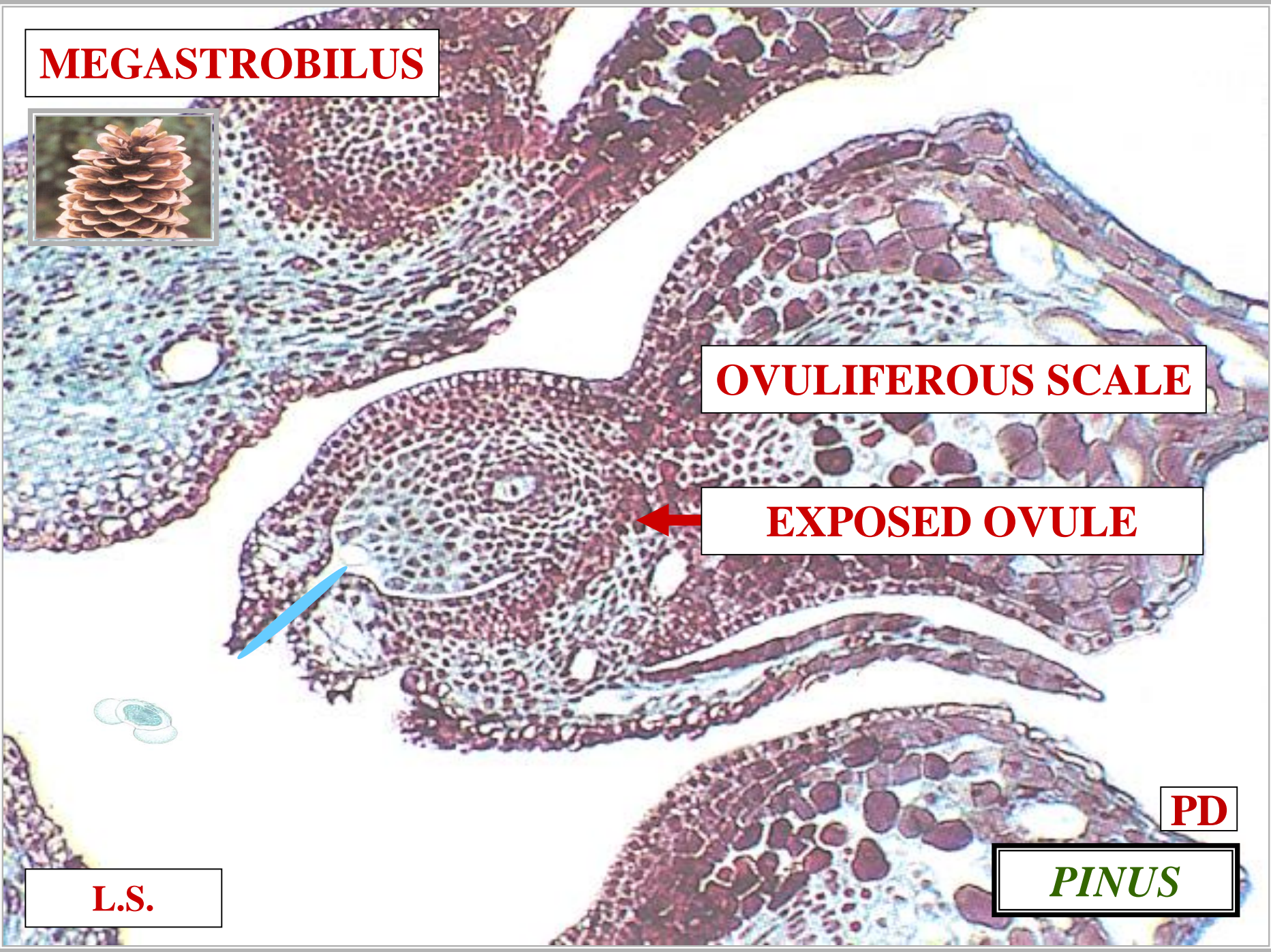
EXPOSED OVULE



PINUS

L.S.

MEGASTROBILUS



OVULIFEROUS SCALE

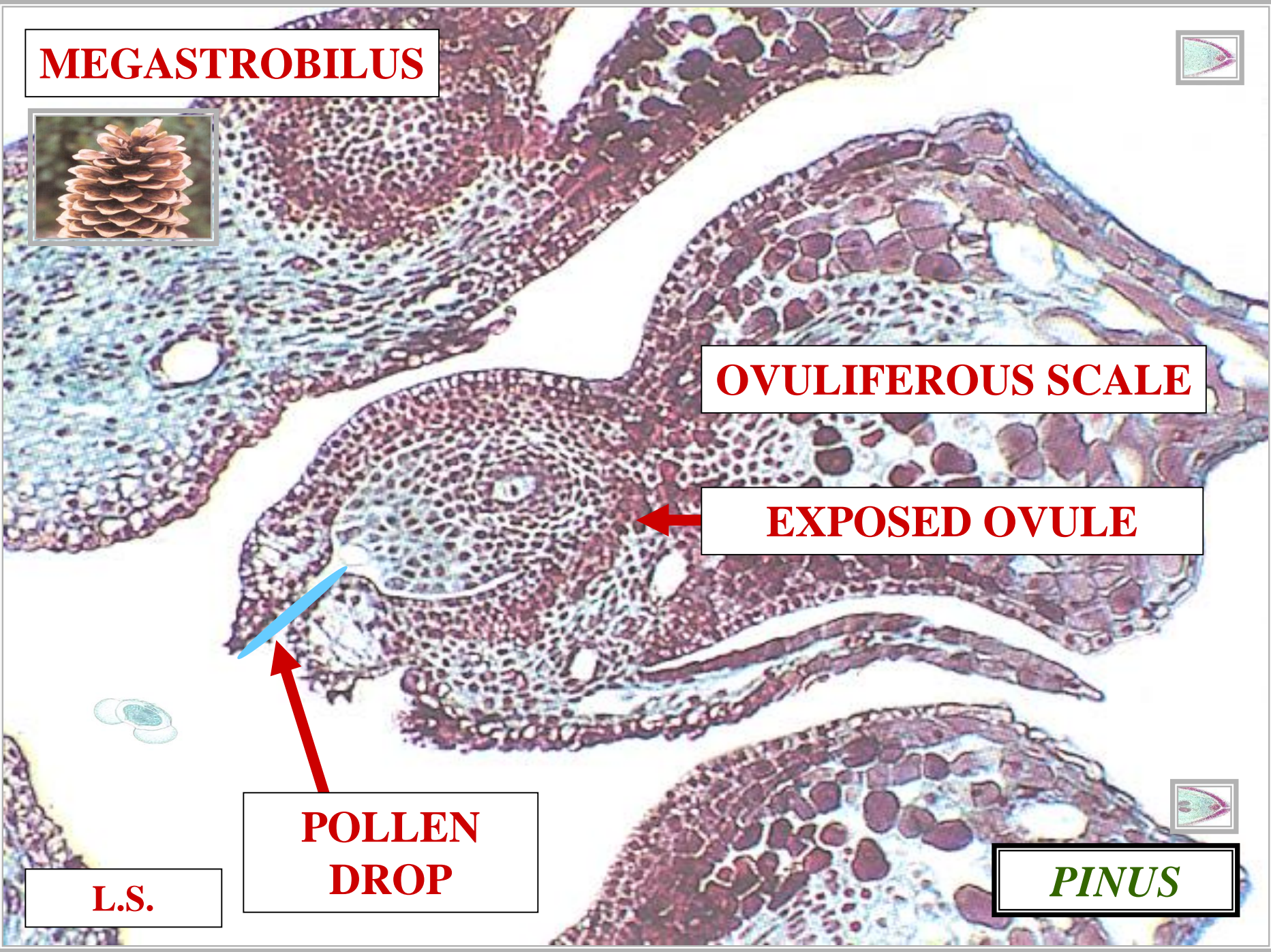
EXPOSED OVULE

PD

PINUS

L.S.

MEGASTROBILUS



OVULIFEROUS SCALE

EXPOSED OVULE

**POLLEN
DROP**

L.S.

PINUS



OVULE

INTEGUMENT

?

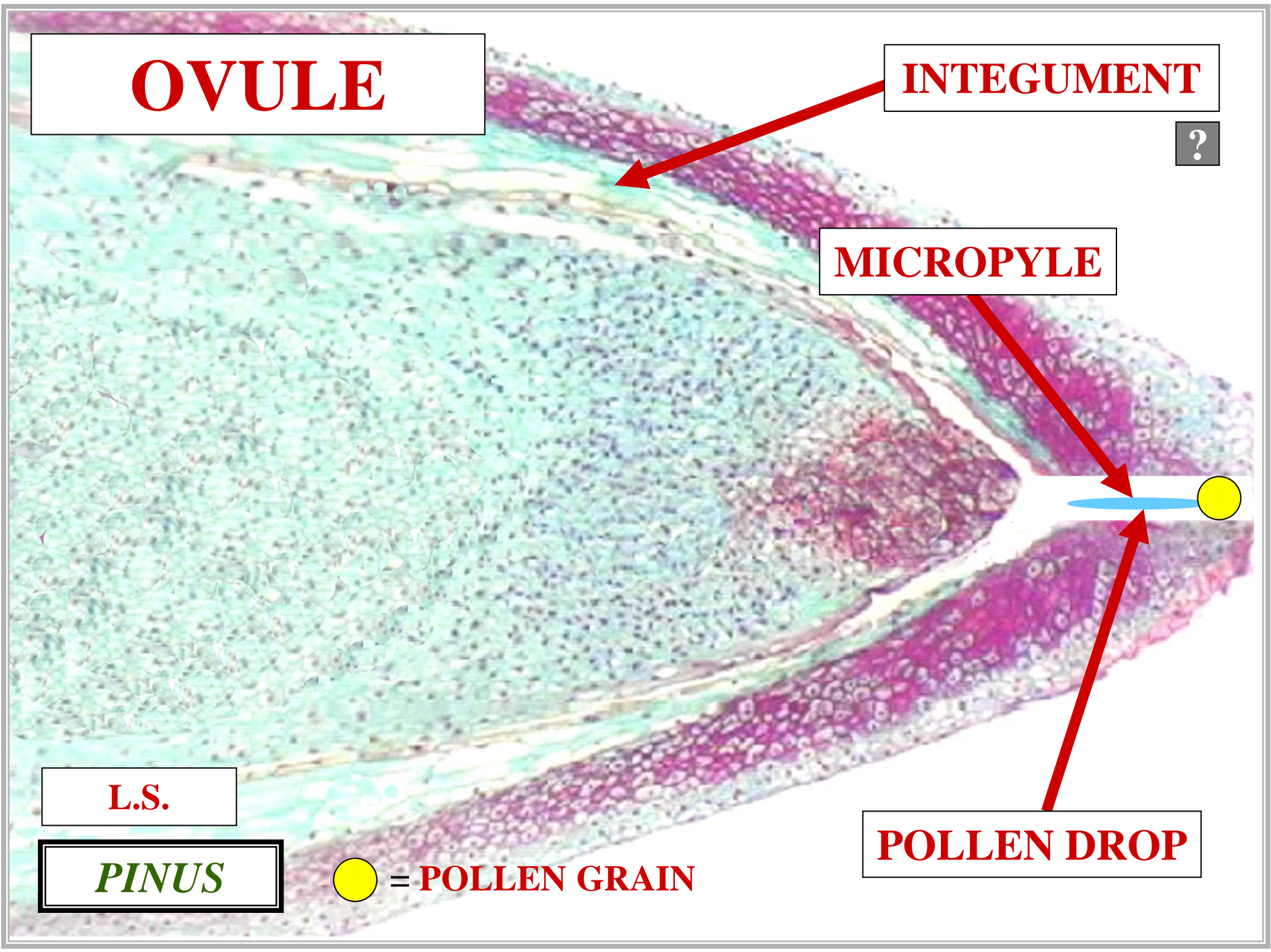
MICROPYLE

L.S.

PINUS

● = **POLLEN GRAIN**

POLLEN DROP



OVULE

INTEGUMENT

M

MICROPYLE

POLLEN GRAIN

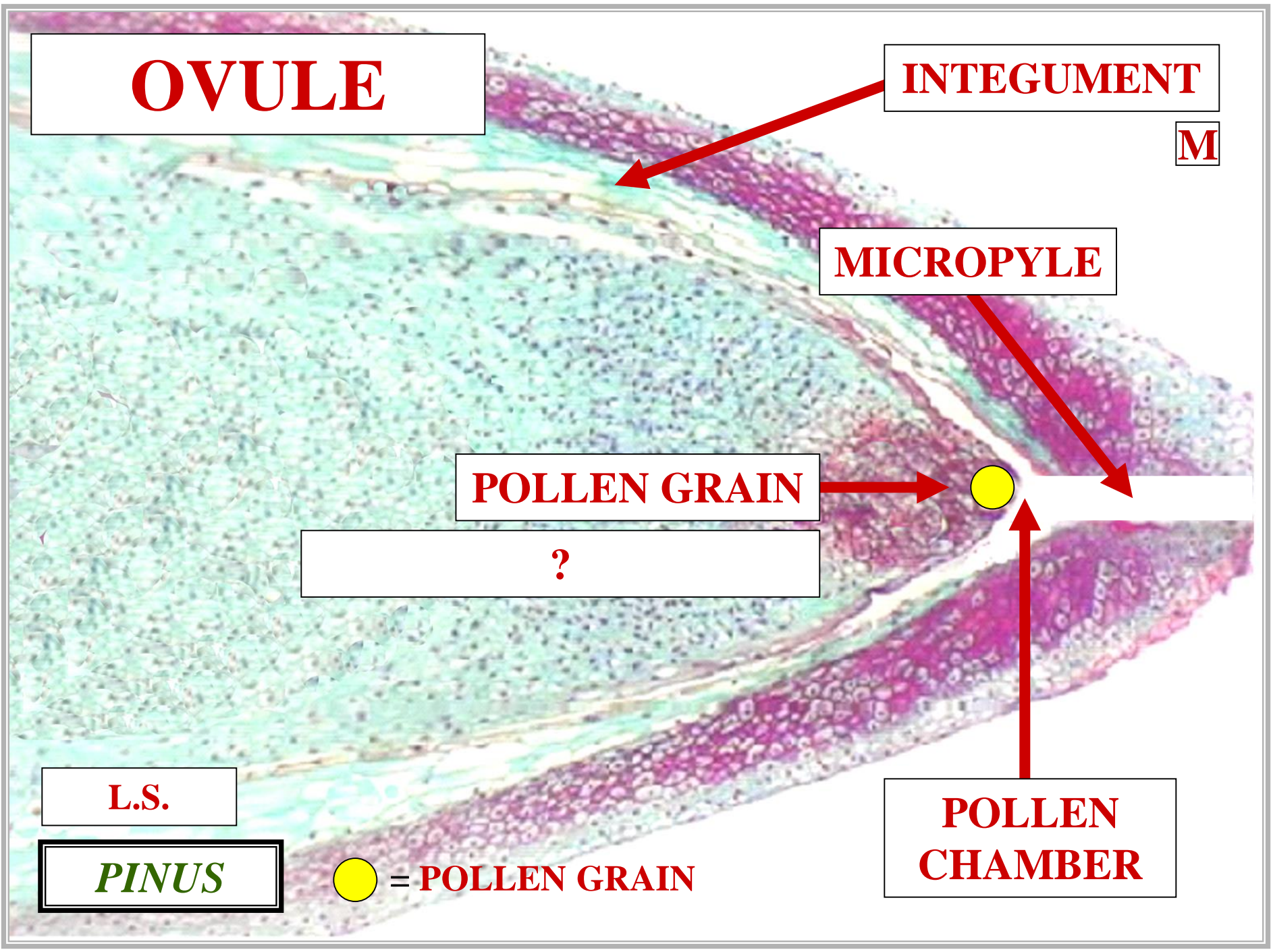
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L.S.

PINUS

● = POLLEN GRAIN

POLLEN CHAMBER



OVULE

INTEGUMENT

=

MICROPYLE

POLLEN GRAIN

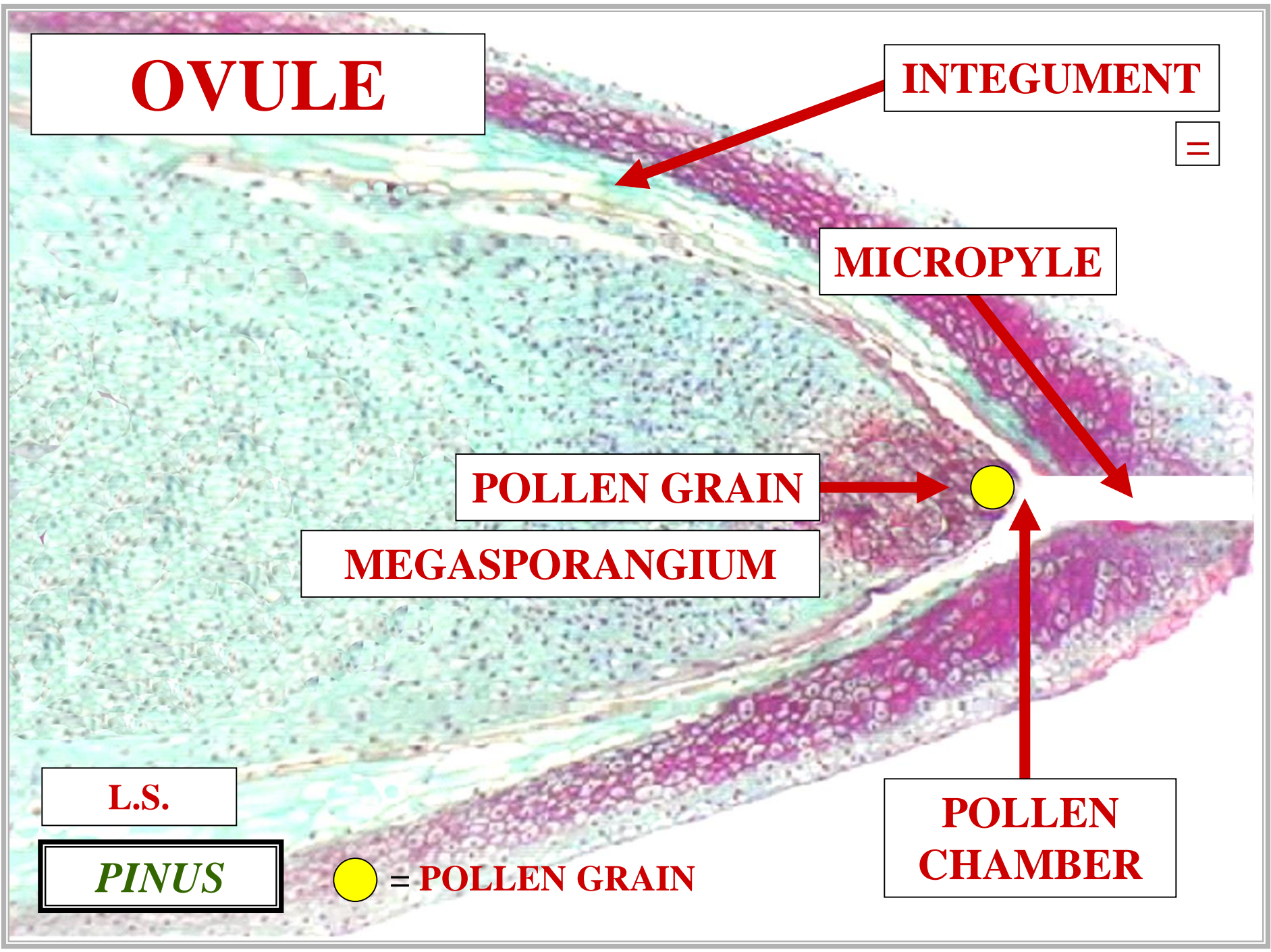
MEGASPORANGIUM

L.S.

PINUS

● = **POLLEN GRAIN**

POLLEN CHAMBER



OVULE

INTEGUMENT

?

MICROPYLE

POLLEN GRAIN

MEGASPORANGIUM

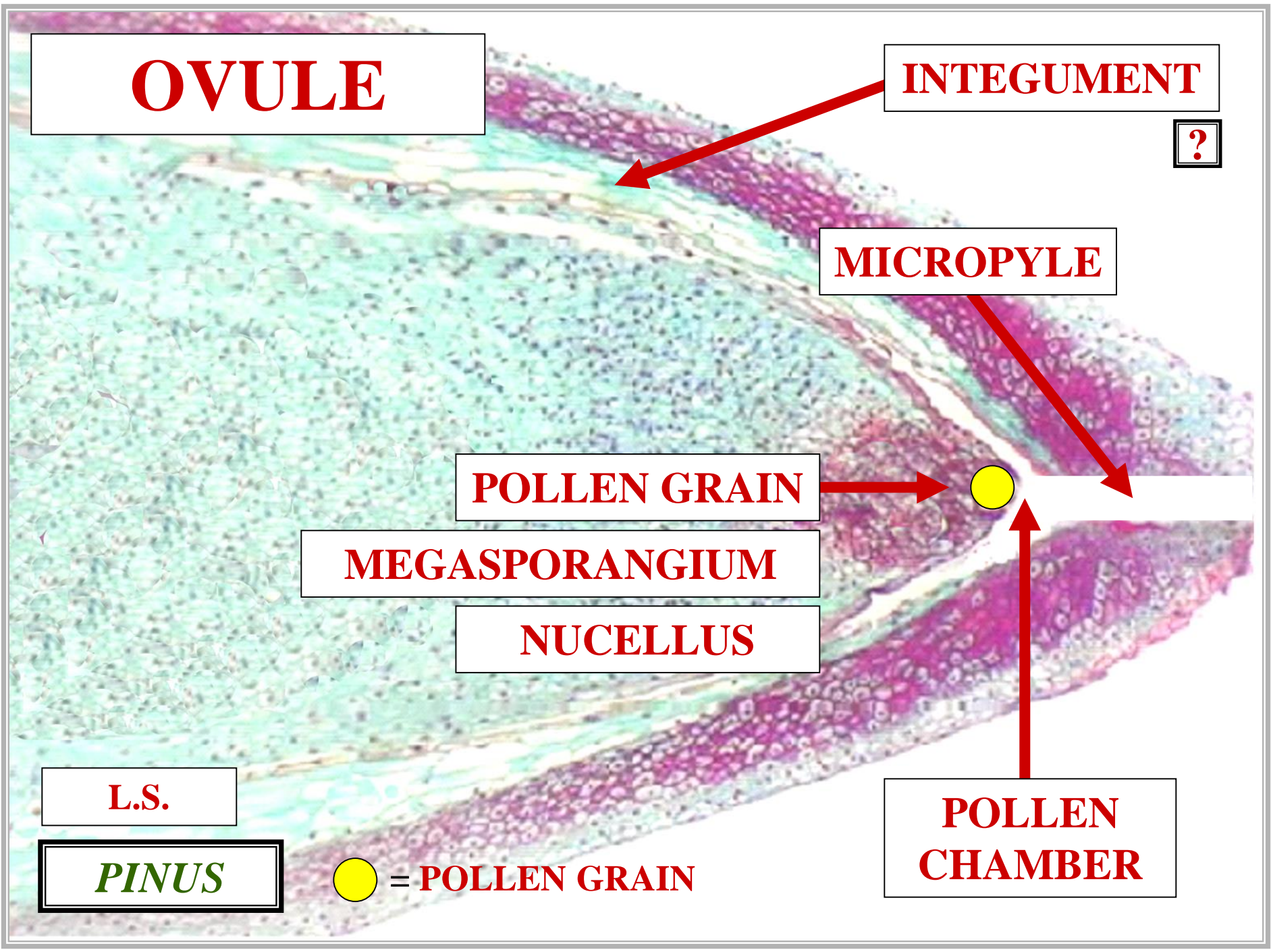
NUCELLUS

L.S.

PINUS

● = POLLEN GRAIN

POLLEN CHAMBER



OVULE

INTEGUMENT

P

MICROPYLE

?

POLLEN GRAIN

MEGASPORANGIUM

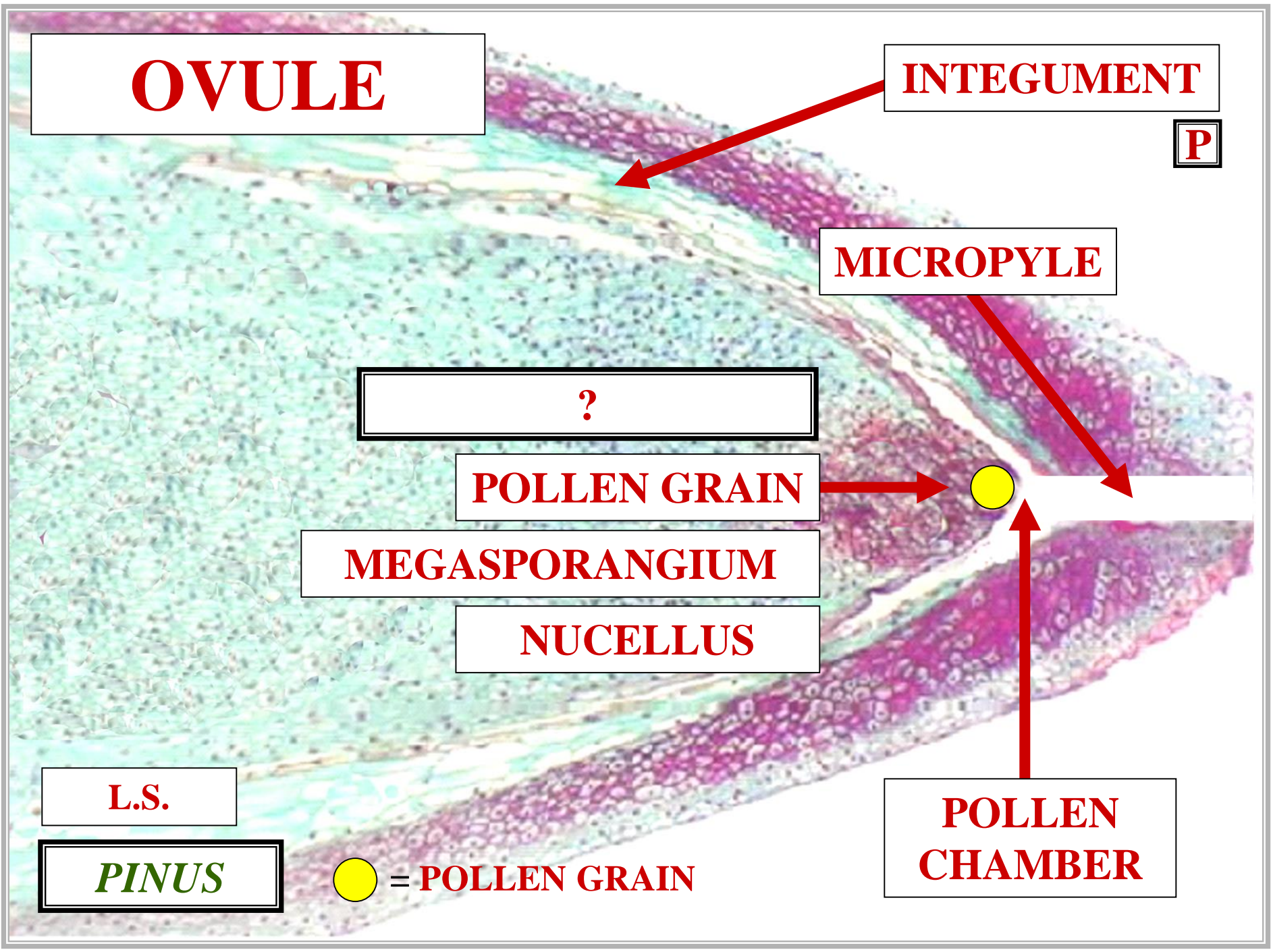
NUCELLUS

L.S.

PINUS

● = POLLEN GRAIN

POLLEN CHAMBER



OVULE

INTEGUMENT



MICROPYLE

POLLINATION

POLLEN GRAIN

MEGASPORANGIUM

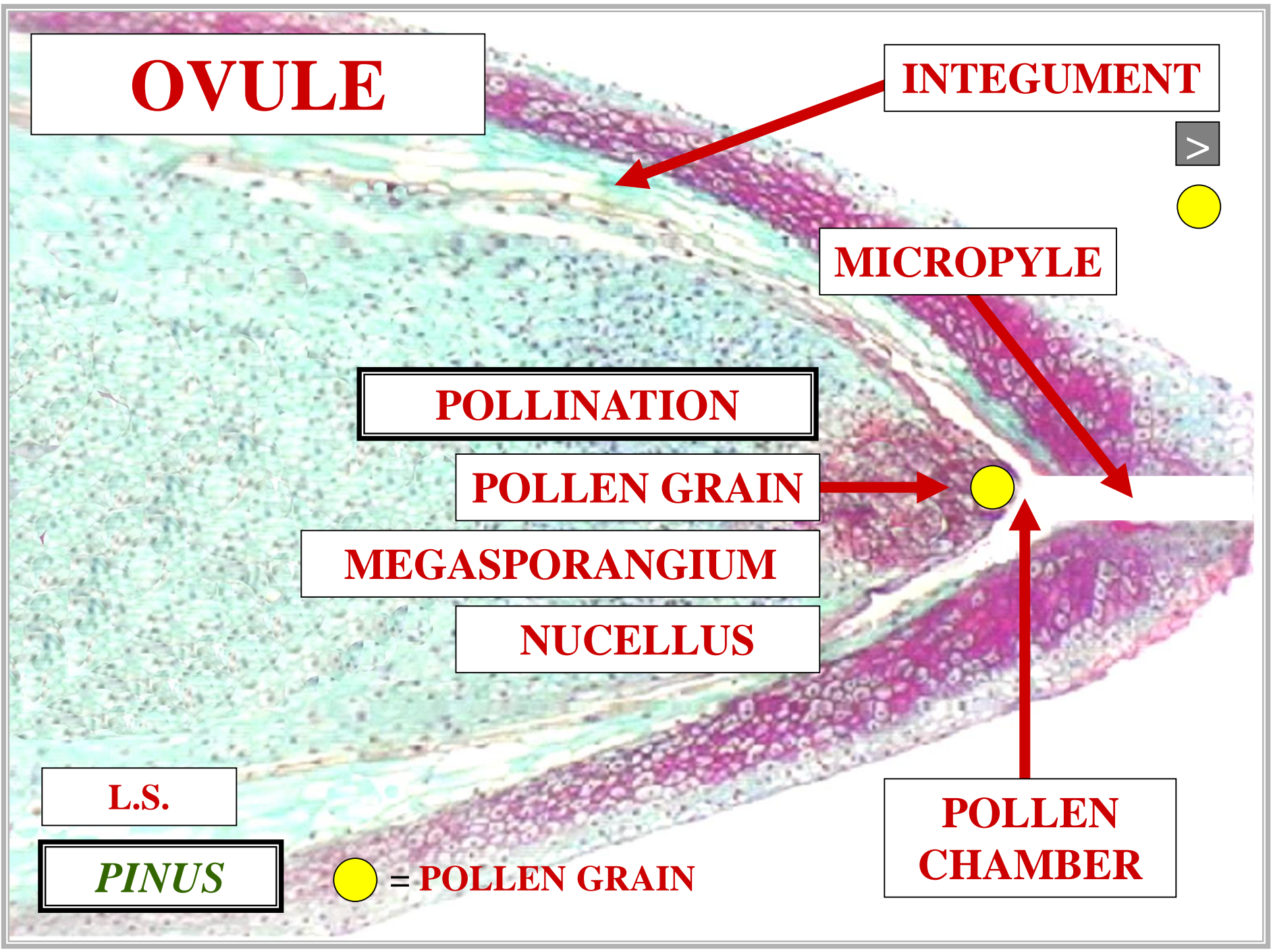
NUCELLUS

L.S.

PINUS

 = **POLLEN GRAIN**

POLLEN CHAMBER



OVULE

INTEGUMENT

PT

MEGAGAMETOPHYTE

MICROPYLE

POLLINATION

1N

1N

ENDOSPORIC

EGG

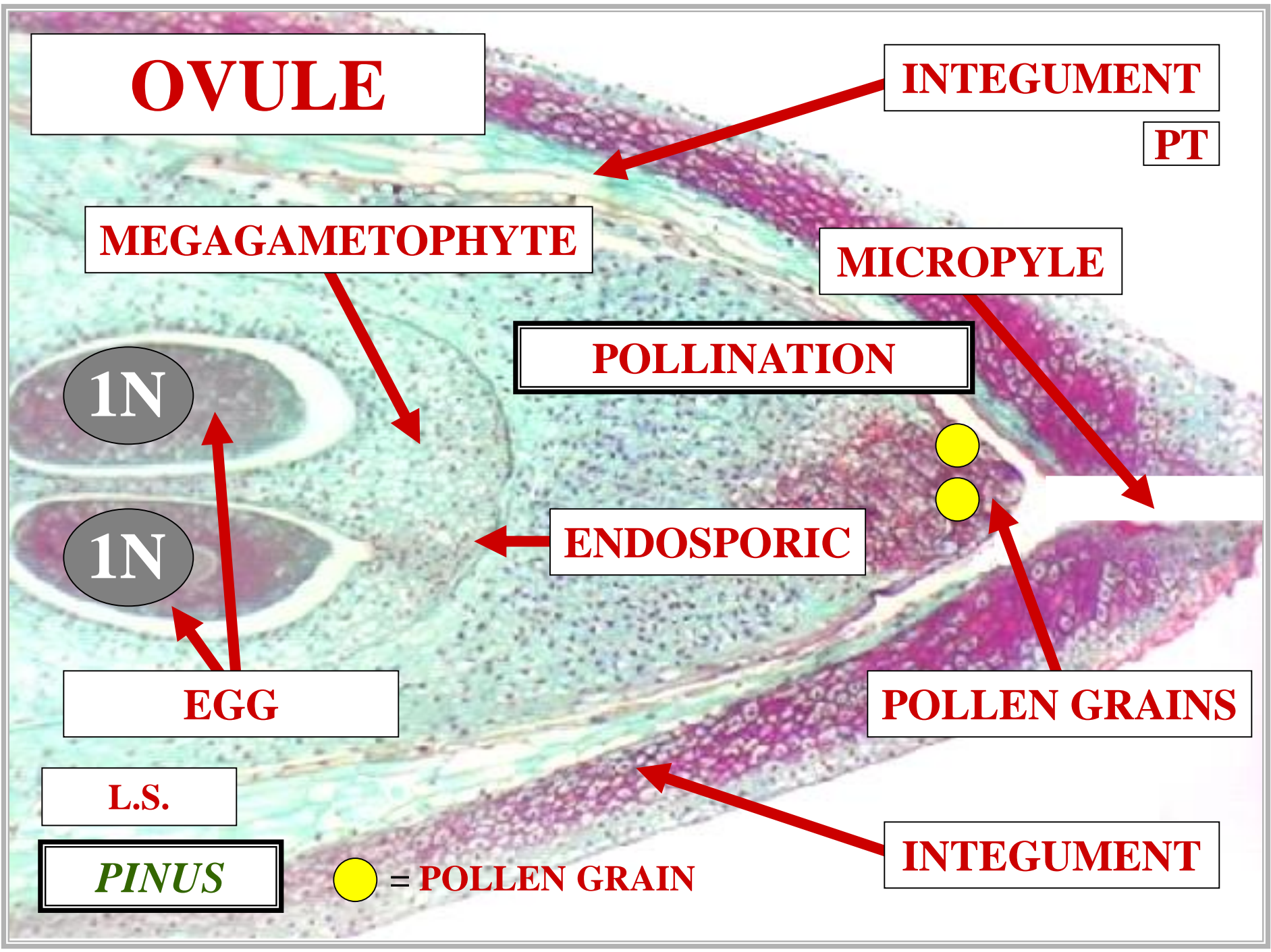
POLLEN GRAINS

L.S.

INTEGUMENT

PINUS

● = POLLEN GRAIN



OVULE

INTEGUMENT

S

MEGAGAMETOPHYTE

MICROPYLE

POLLINATION

1N

1N

EGG

POLLEN TUBE

POLLEN GRAINS

L.S.

PINUS

● = POLLEN GRAIN

INTEGUMENT

OVULE

INTEGUMENT

S

MEGAGAMETOPHYTE

MICROPYLE

POLLINATION

1N

1N

EGG

SPERM

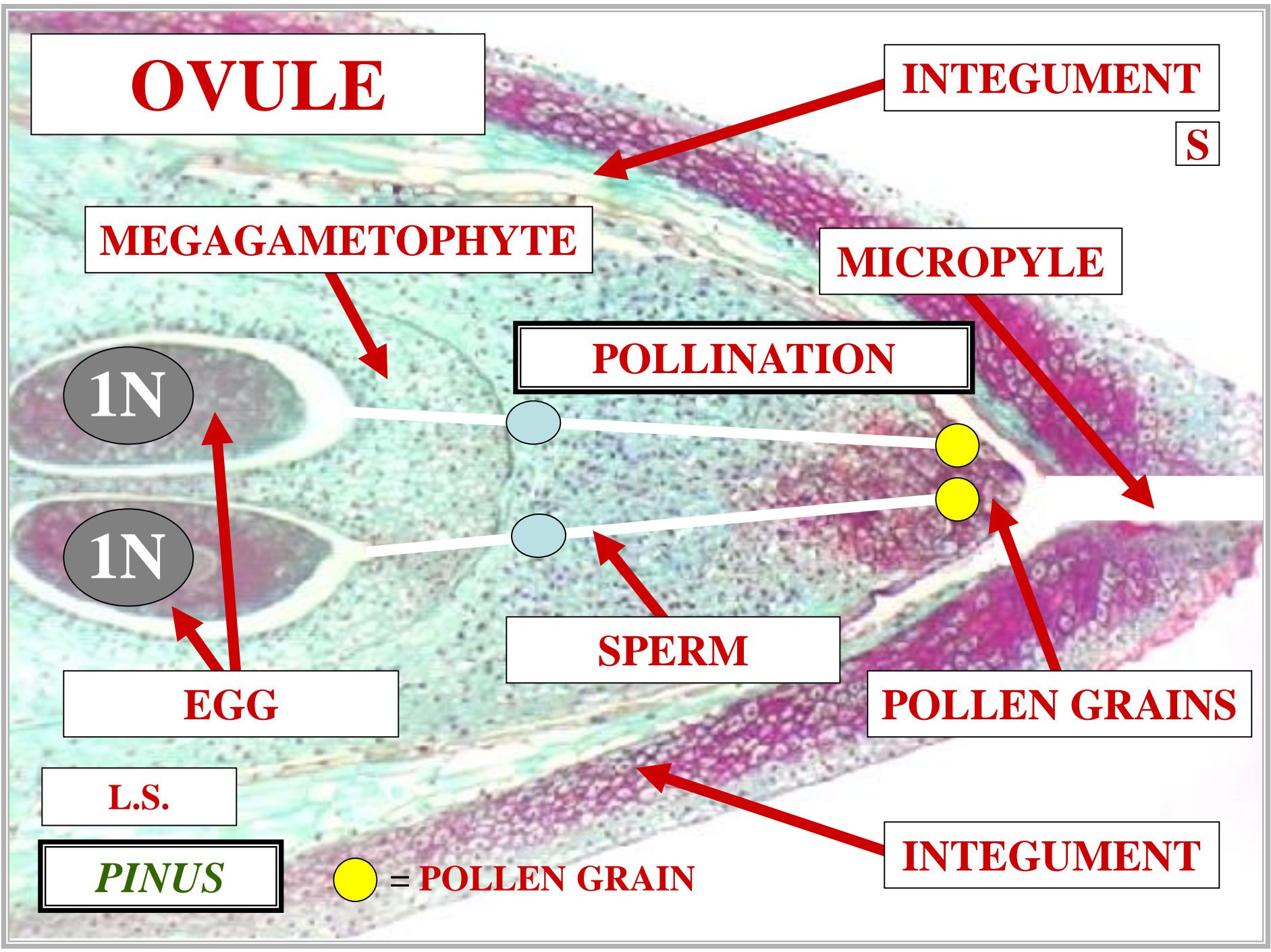
POLLEN GRAINS

L.S.

PINUS

● = POLLEN GRAIN

INTEGUMENT



OVULE

INTEGUMENT



MEGAGAMETOPHYTE

MICROPYLE

POLLINATION

2N

2N

SYNGAMY

POLLEN TUBE

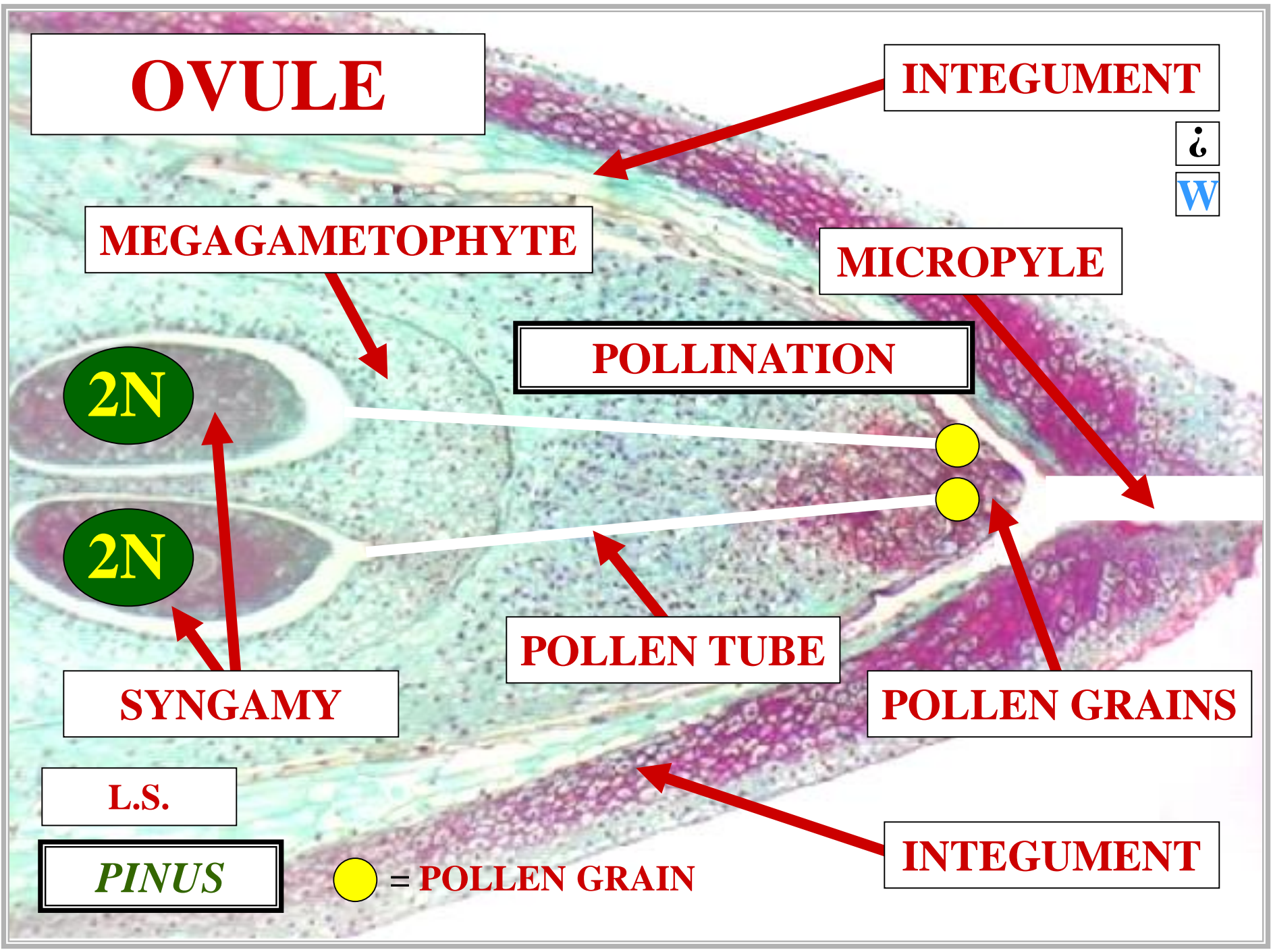
POLLEN GRAINS

L.S.

PINUS

 = **POLLEN GRAIN**

INTEGUMENT



OVULE

INTEGUMENT

XD

MEGAGAMETOPHYTE

MICROPYLE

POLLINATION

2N

2N

POLLEN TUBE

SYNGAMY

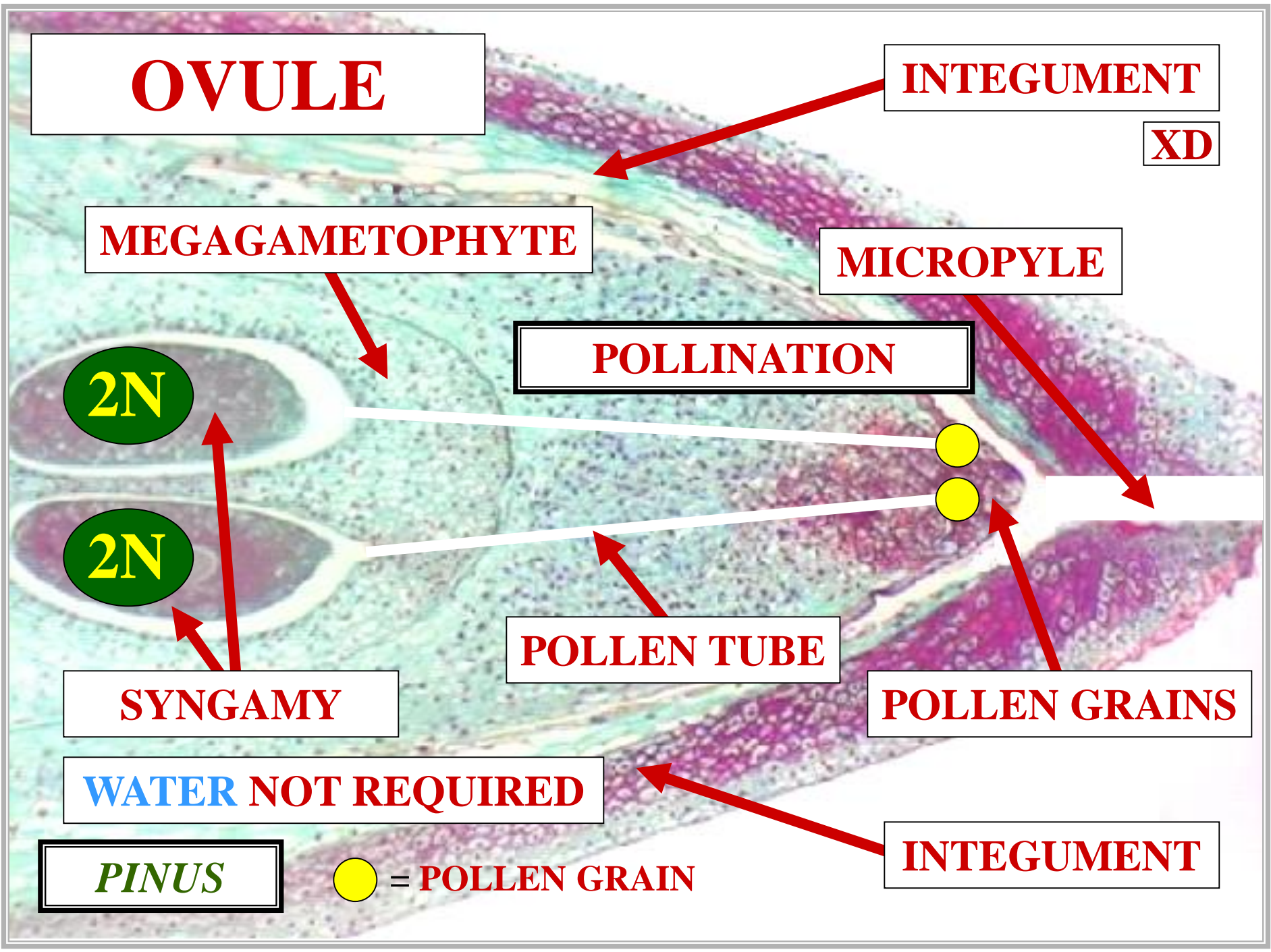
POLLEN GRAINS

WATER NOT REQUIRED

INTEGUMENT

PINUS

● = POLLEN GRAIN



OVULE

INTEGUMENT



P

MEGAGAMETOPHYTE

MICROPYLE

POLLINATION

2N

2N

SYNGAMY

POLLEN TUBE

POLLEN GRAINS

XERIC ADAPTATION

PINUS

● = POLLEN GRAIN

INTEGUMENT

~260 MILLION YEARS AGO

PERMIAN



~260 MILLION YEARS AGO

PERMIAN
XERIC PERIOD



A vibrant, detailed illustration of a prehistoric landscape. In the foreground, a waterfall cascades over rocks into a stream. The ground is covered with various types of ferns and other ancient plants. In the middle ground, several dinosaurs are visible, including a large, scaly dinosaur near the waterfall and a smaller, more slender dinosaur further back. The background features a range of mountains under a clear blue sky with a few clouds. The overall scene is bright and colorful, capturing the essence of a lush, ancient world.

~260 MILLION YEARS AGO



GYMNOSPERMS DISPLACED PTERIDOPHYTES



GYMNOSPERMS POLLINATION



The background of the slide is a close-up photograph of a pine cone. The pine needles are long, thin, and green, with a silvery underside. The cone itself is a mix of brown and orange, showing the overlapping scales. The text is overlaid on this image.

GYMNOSPERMS POLLINATION POLLEN GRAIN DESTINATION



GYMNOSPERMS

POLLINATION

POLLEN GRAIN

DESTINATION

OVULE

MEGASPORANGIUM



GYMNOSPERM PHYLA

**EXTINCT
GYMNOSPERM
PHYLA**

**GYMNOSPERM
EXTINCT PHYLA**

PTERIDOSPERMOPHYTA

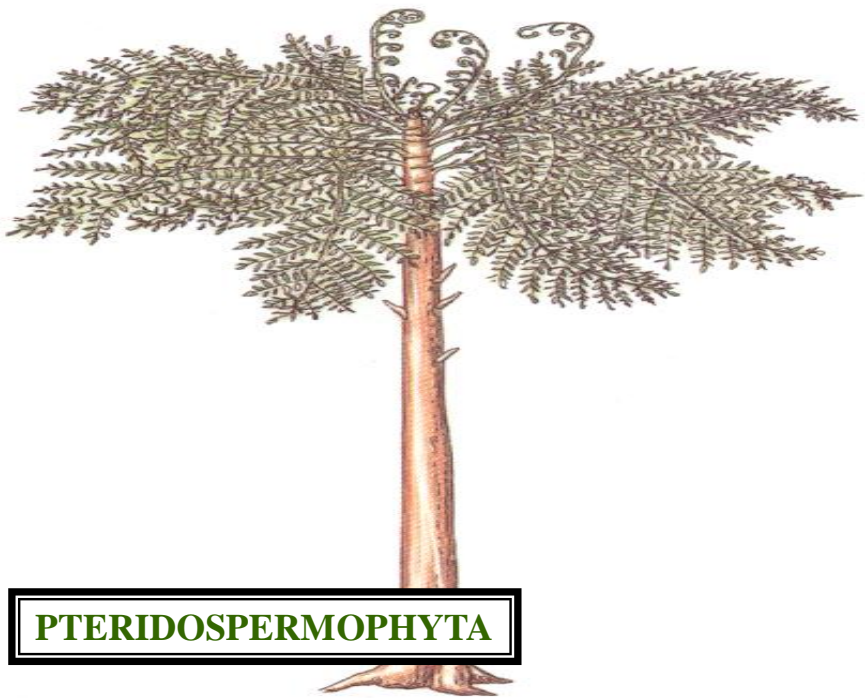
**GYMNOSPERM
EXTINCT PHYLA**

**GYMNOSPERM
EXTINCT PHYLA**



**PTERIDOSPERMOPHYTA
CYCADEOIDOPHYTA**

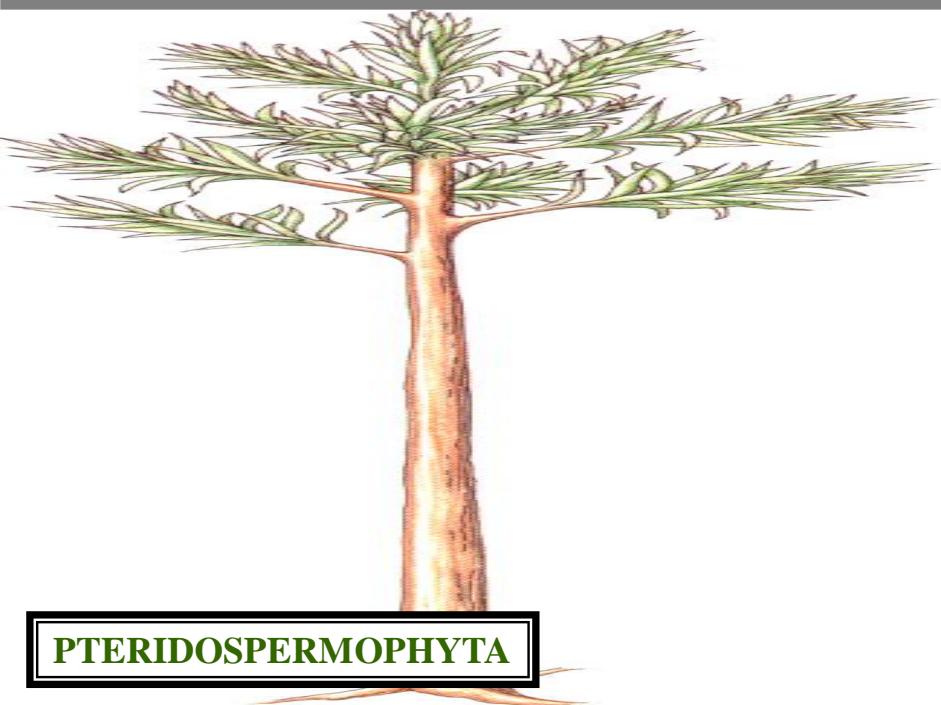
**GYMNOSPERM
EXTINCT PHYLA**



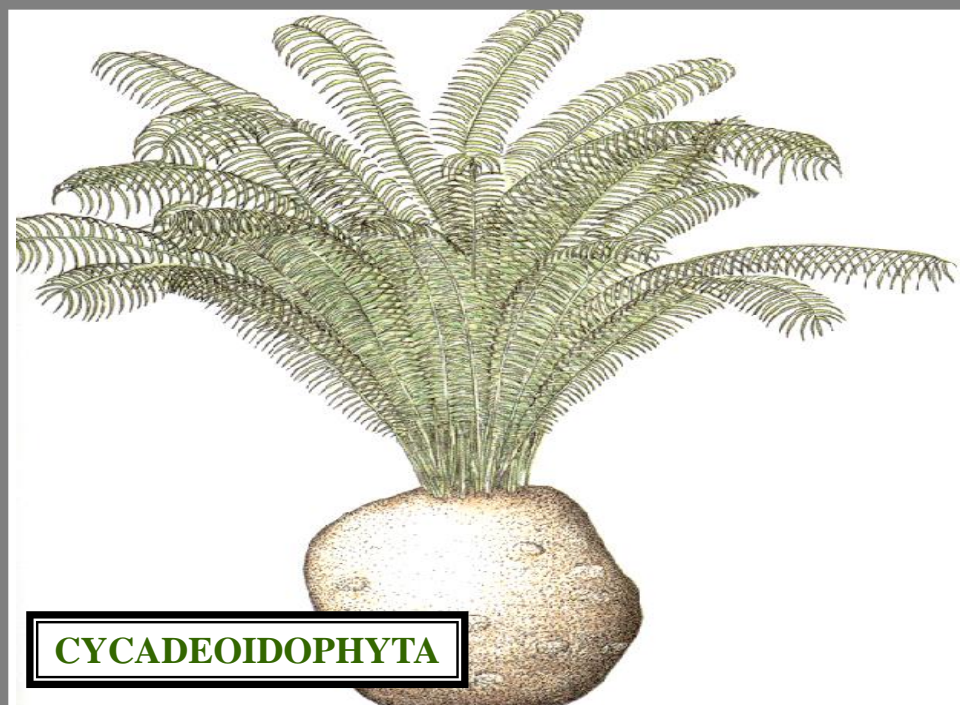
PTERIDOSPERMOPHYTA



PTERIDOSPERMOPHYTA



PTERIDOSPERMOPHYTA



CYCADEOIDOPHYTA

**EXTANT
GYMNOSPERM
PHYLA**

**GYMNOSPERM
EXTANT PHYLA**

CYCADOPHYTA

**GYMNOSPERM
EXTANT PHYLA**

**GYMNOSPERM
EXTANT PHYLA**

**CYCADOPHYTA
GINKGOPHYTA**

**GYMNOSPERM
EXTANT PHYLA**

**GYMNOSPERM
EXTANT PHYLA**

CYCADOPHYTA

GINKGOPHYTA

PINOPHYTA

**GYMNOSPERM
EXTANT PHYLA**

**GYMNOSPERM
EXTANT PHYLA**



CYCADOPHYTA

GINKGOPHYTA

PINOPHYTA

GNETOPHYTA

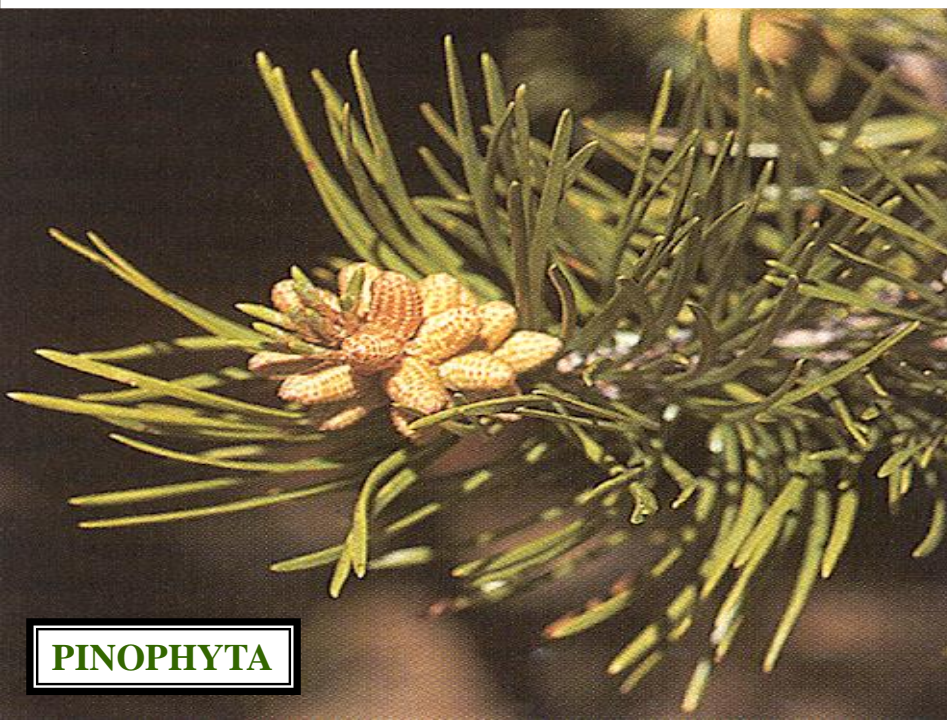
**GYMNOSPERM
EXTANT PHYLA**



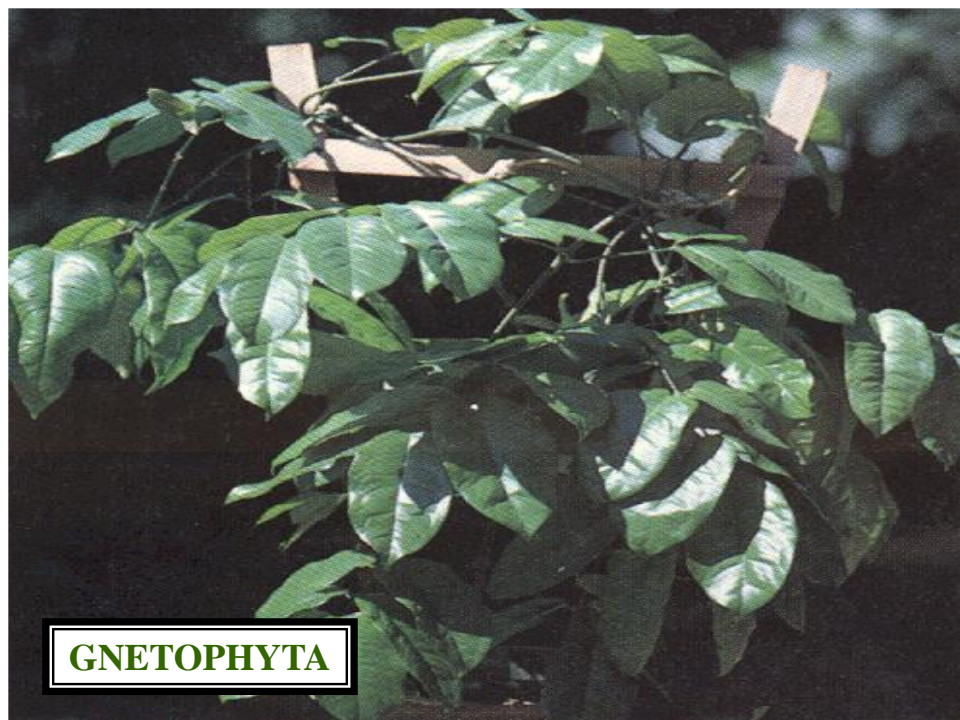
CYCADOPHYTA



GINKGOPHYTA



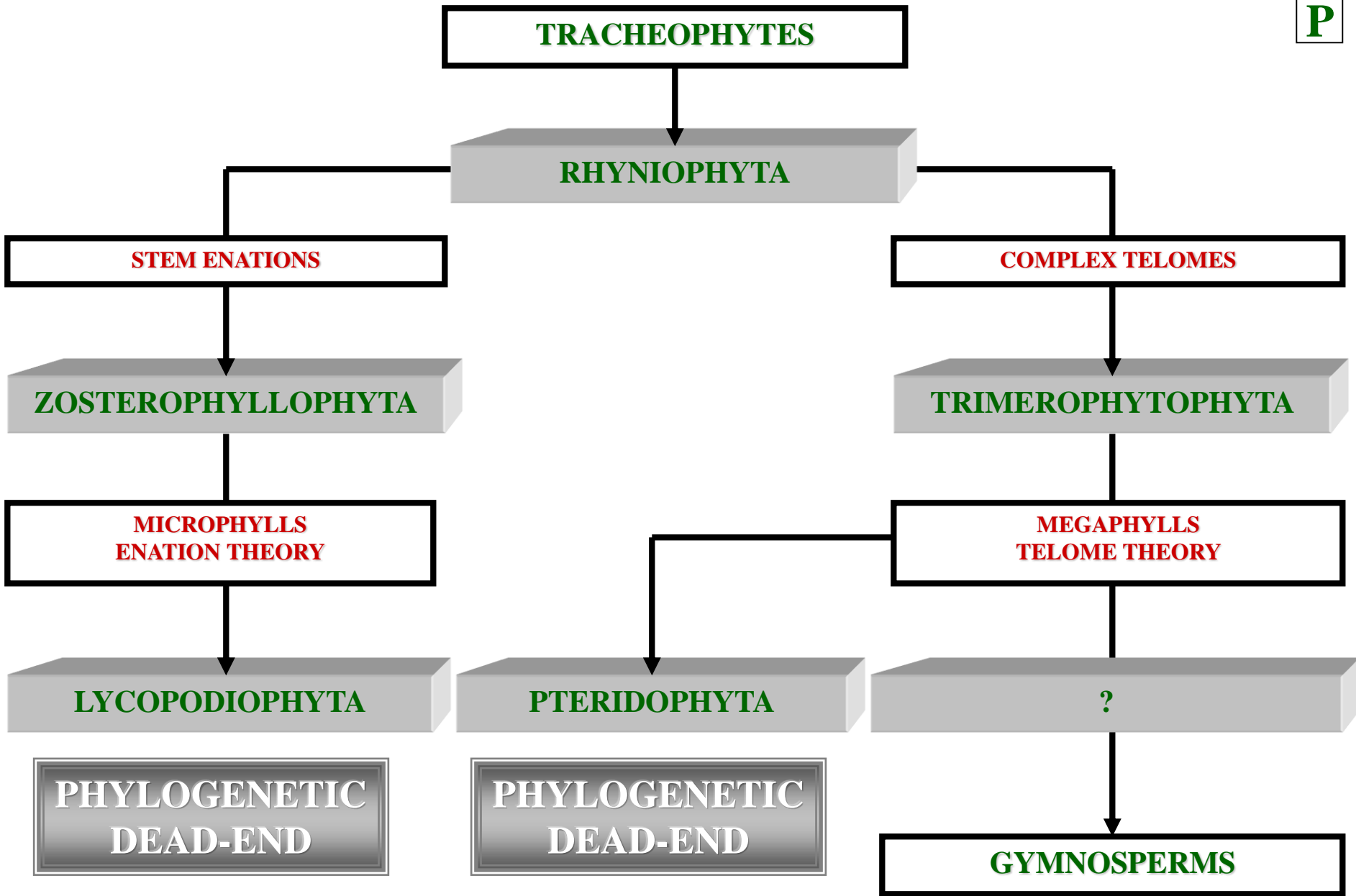
PINOPHYTA

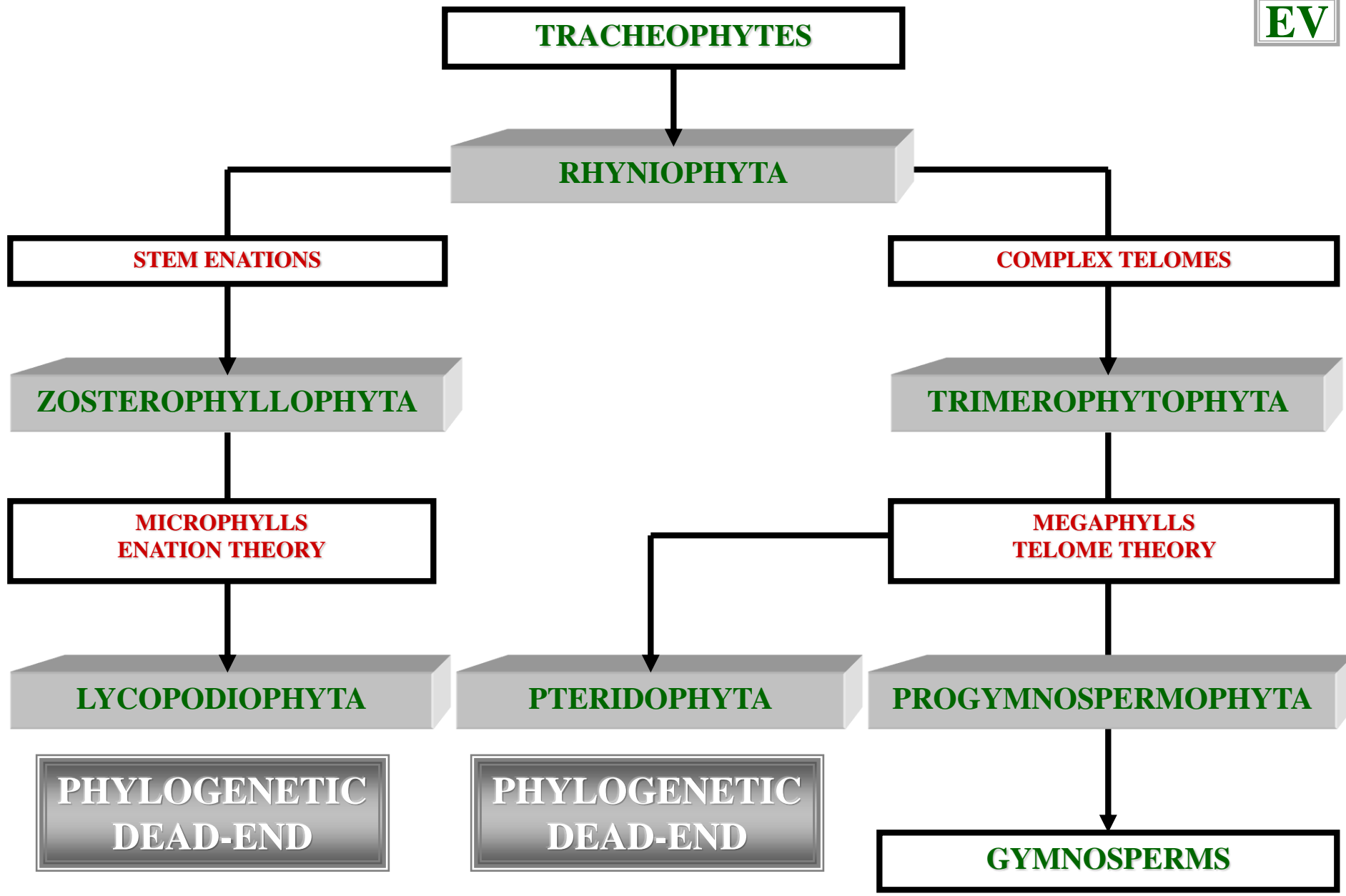


GNETOPHYTA



PHYLOGENETIC RELATIONSHIP







VASCULAR PLANT EVOLUTION

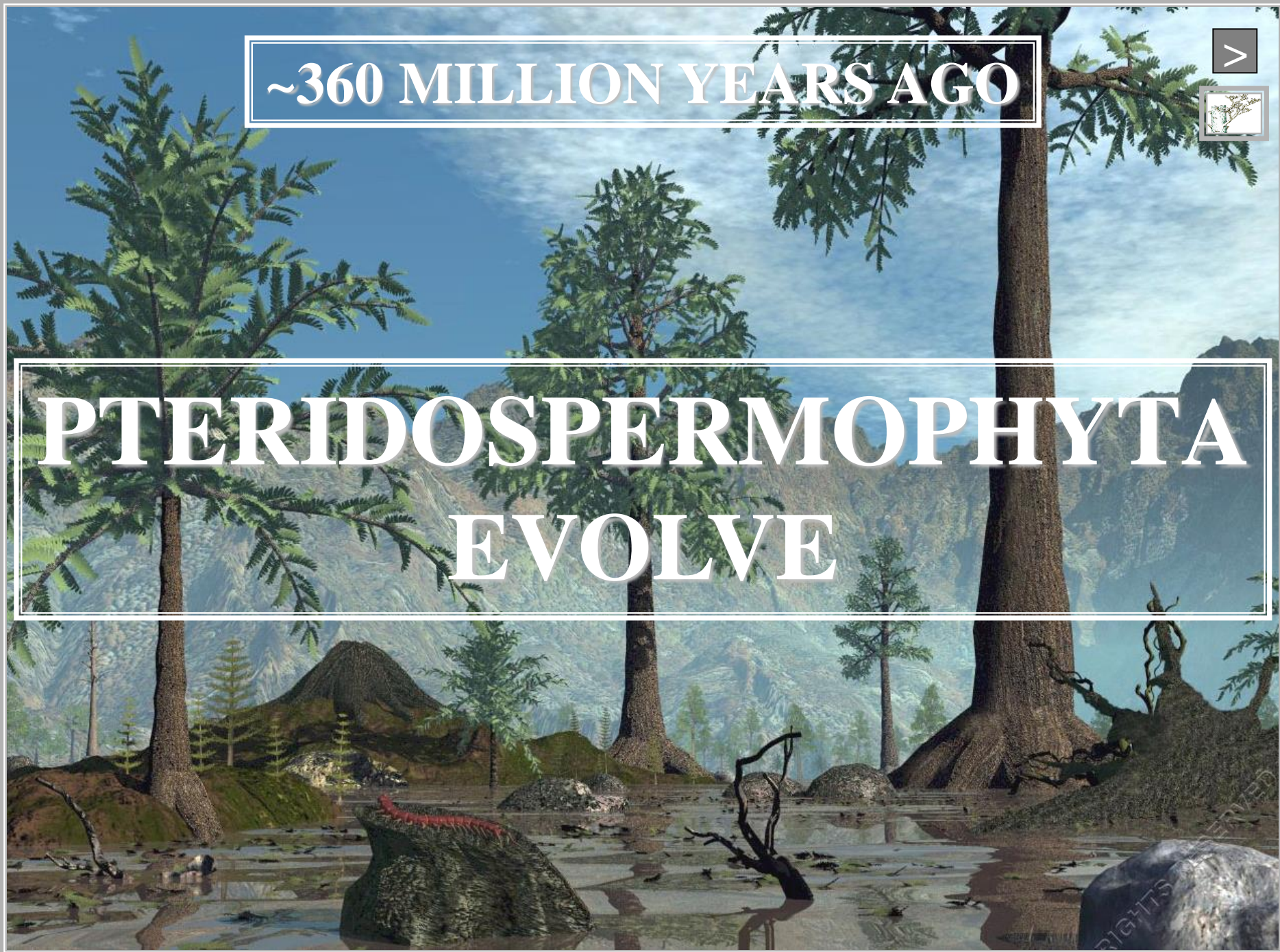


~360

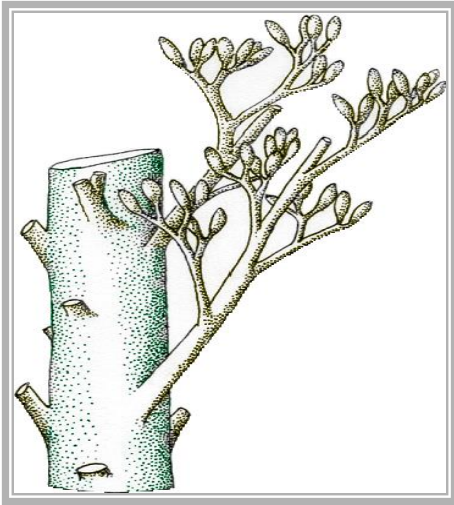
MILLION YEARS

~360 MILLION YEARS AGO

PTERIDOSPERMOPHYTA
EVOLVE

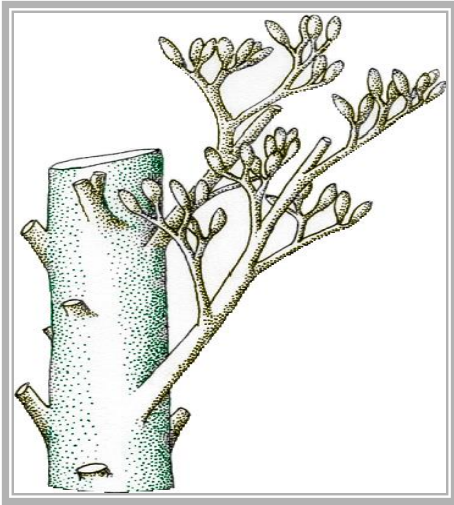


PTERIDOSPERMOPHYTA EVOLUTION



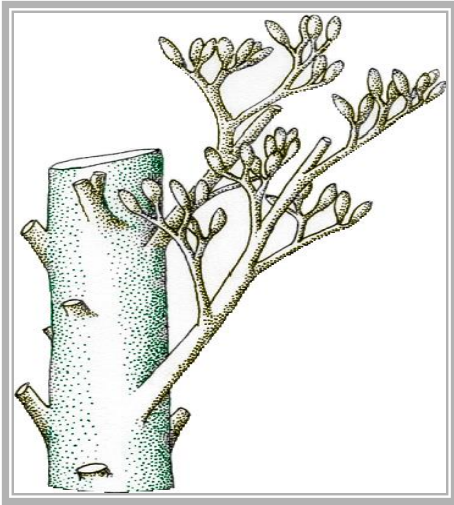
OOCAMPSA

PTERIDOSPERMOPHYTA EVOLUTION

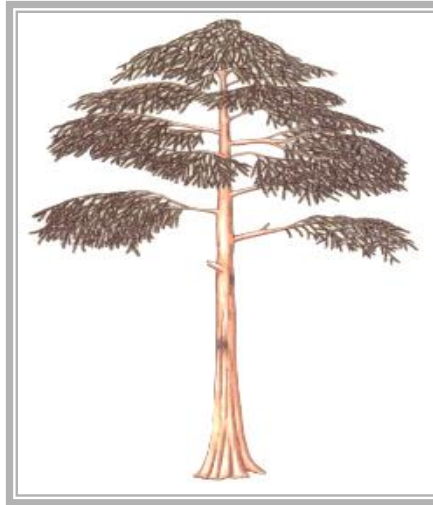


TRIMEROPHYTE

PTERIDOSPERMOPHYTA EVOLUTION

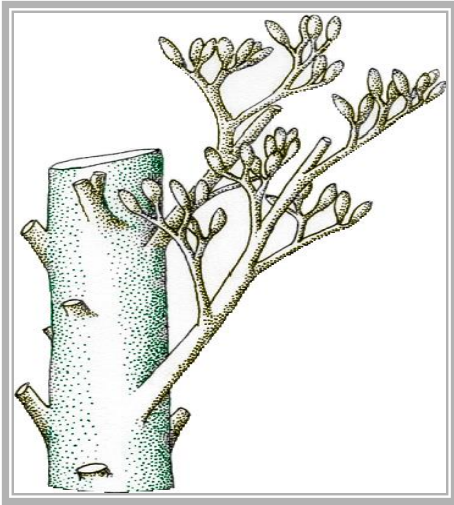


TRIMEROPHYTE

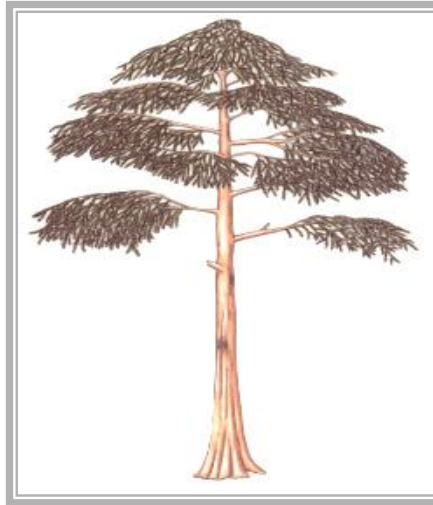


ARCHEOPTERIS

PTERIDOSPERMOPHYTA EVOLUTION

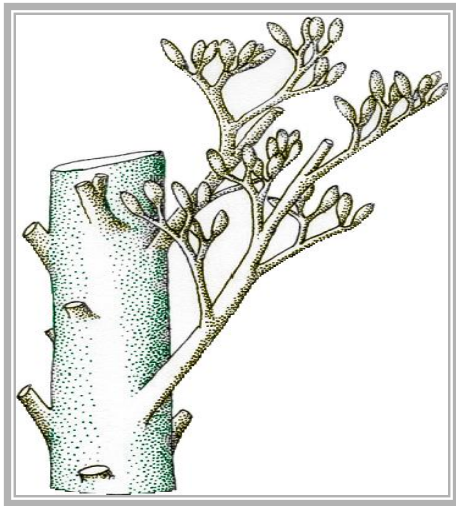


TRIMEROPHYTE

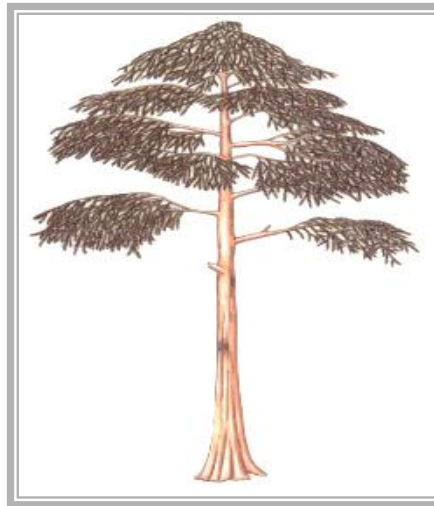


PROGYMNOSPERM

PTERIDOSPERMOPHYTA EVOLUTION



TRIMEROPHYTE



PROGYMNOSPERM



GYMNOSPERM

PTERIDOSPERMOPHYTA



PHYLUM PTERIDOSPERMOPHYTA



**EXTINCT
PHYLUM**

PHYLUM

PTERIDOSPERMOPHYTA

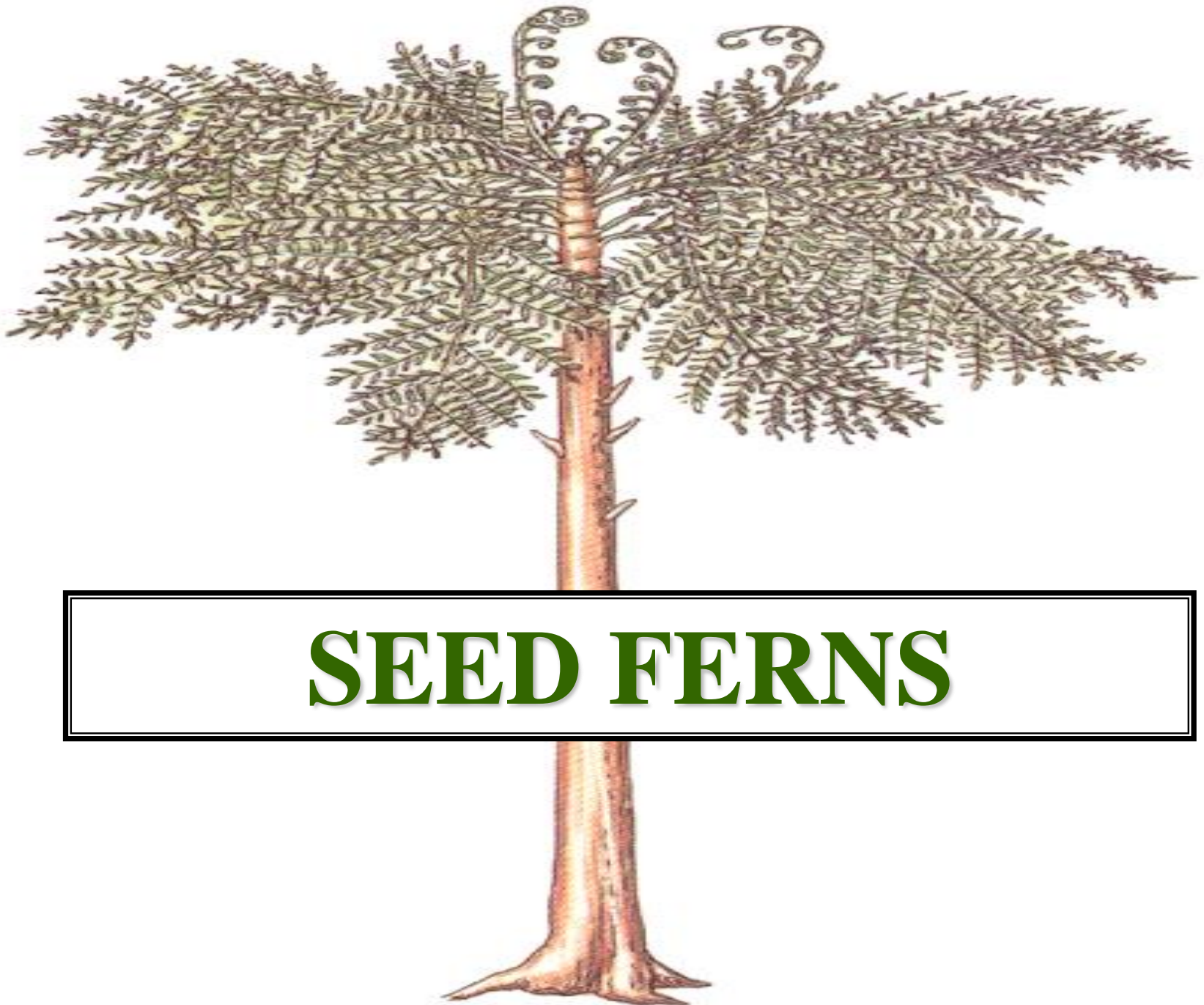
**EXTINCT
PHYLUM**



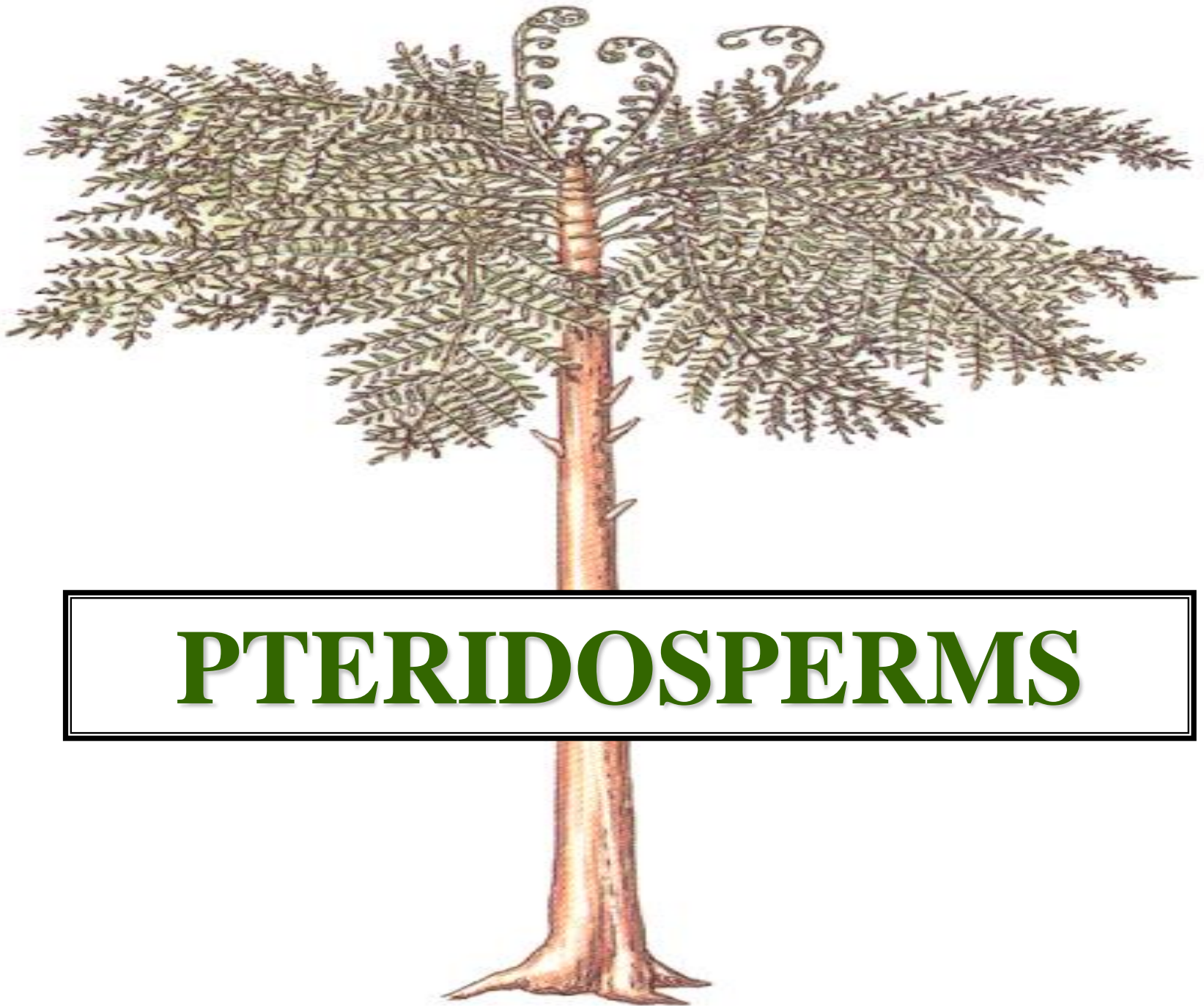
COMMON NAMES



P



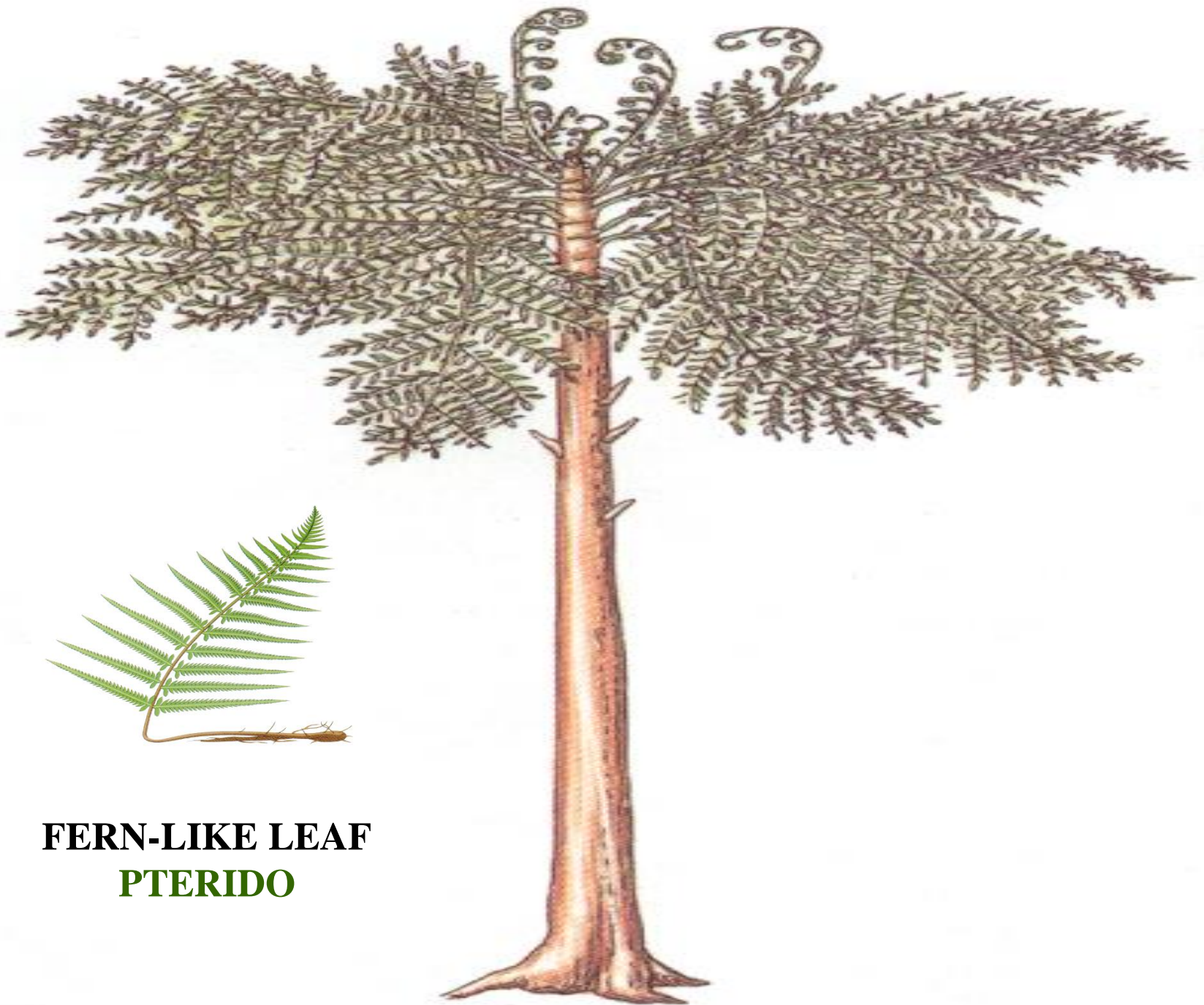
SEED FERNS



PTERIDOSPERMS



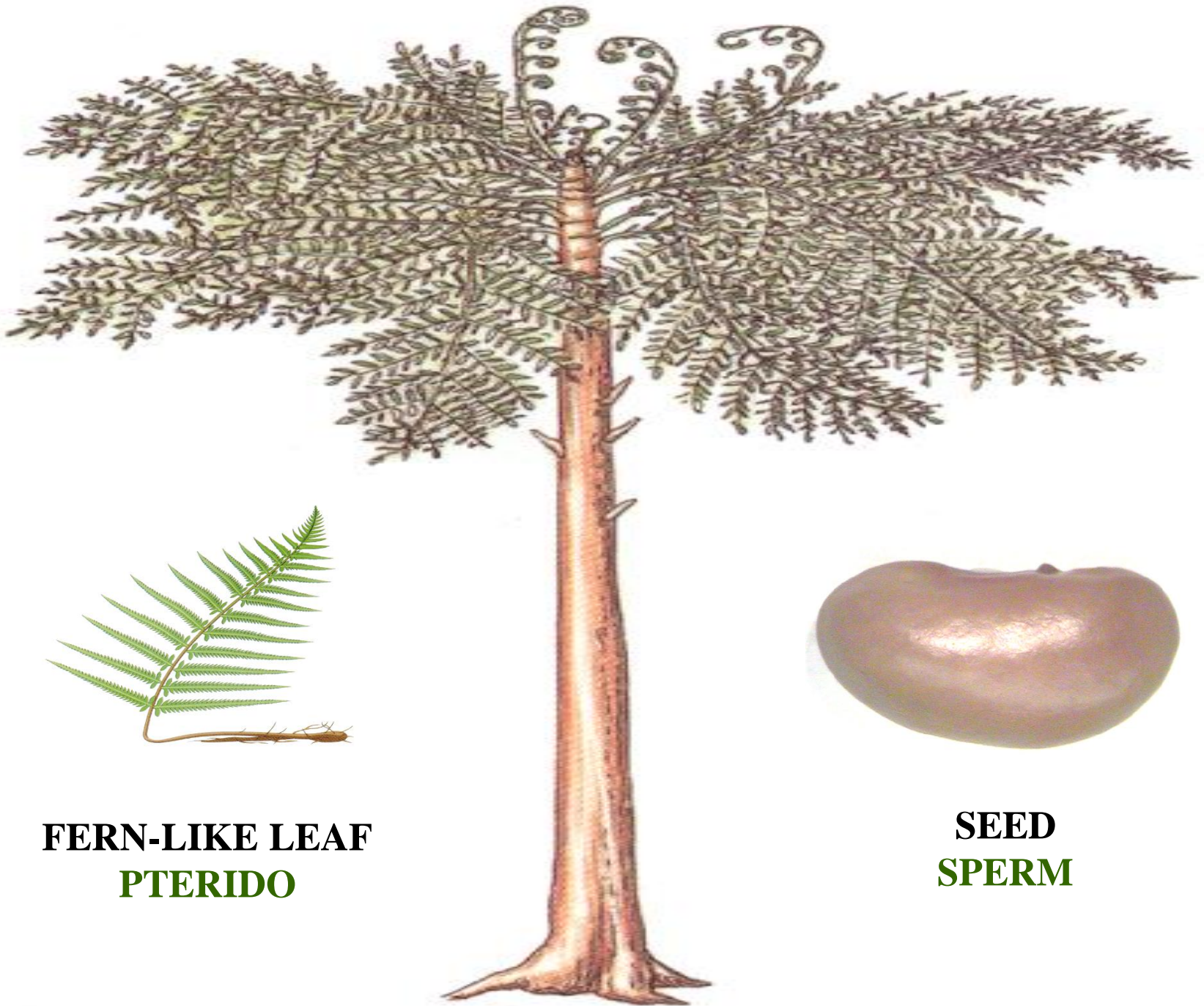
PTERIDO



FERN-LIKE LEAF
PTERIDO

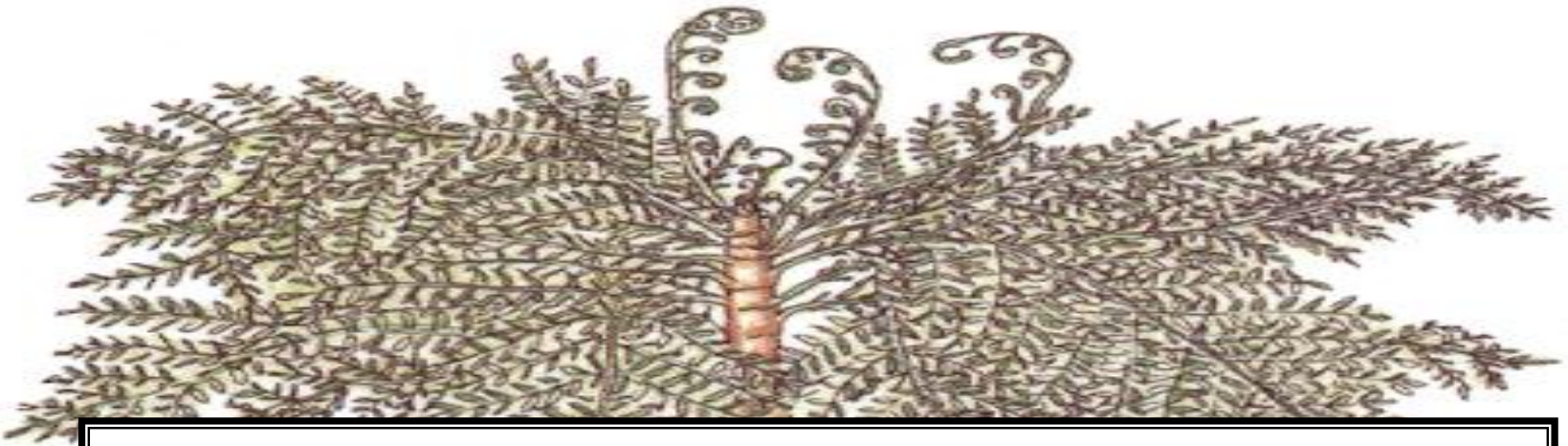


SPERM



FERN-LIKE LEAF
PTERIDO

SEED
SPERM



PTERIDOSPERMS



FERN-LIKE LEAF
PTERIDO



SEED
SPERM

PTERIDOSPERMS
DISCOVERY

MAJOR
PALEOBOTANICAL
EVENT





PTERIDOSPERMS DISCOVERY

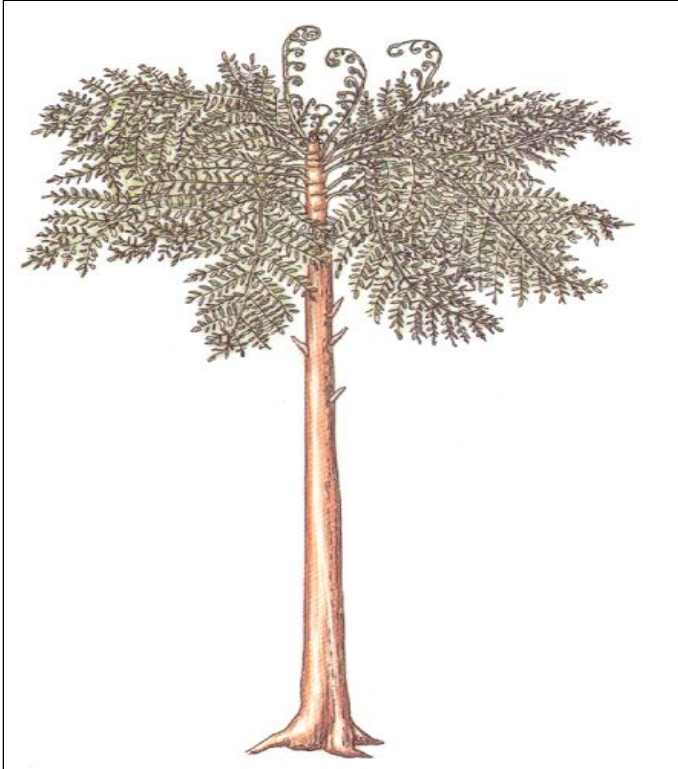
PRIOR 1904

FOSSIL BEDS



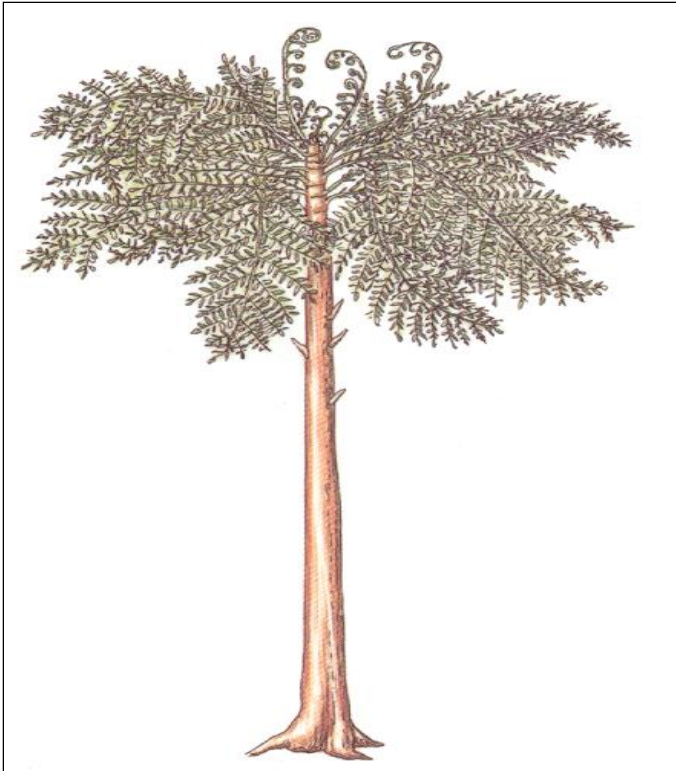


FOSSIL BEDS

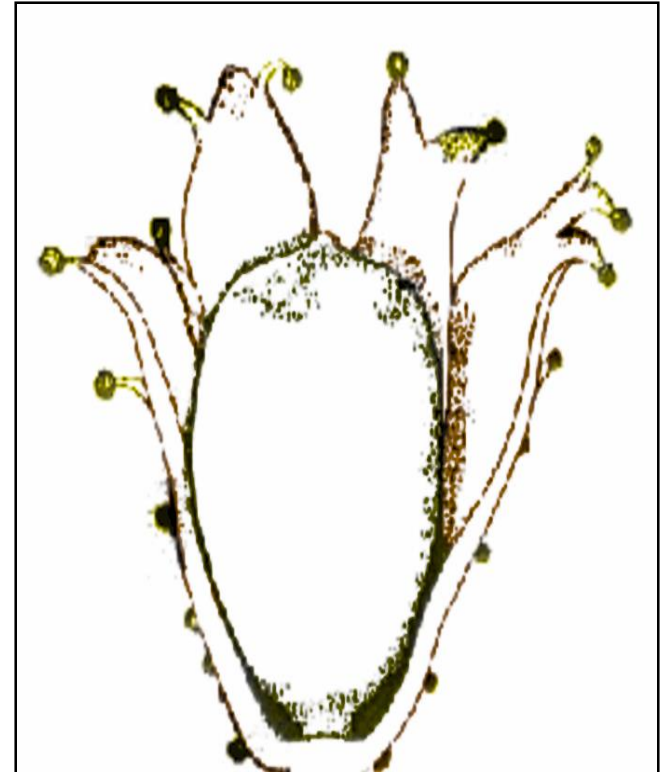


LYGINOPTERIS

FOSSIL BEDS



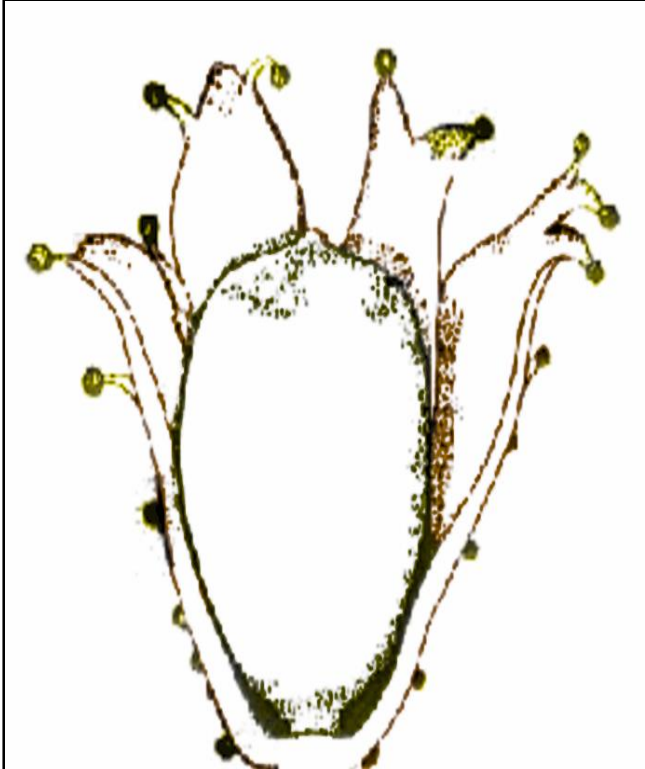
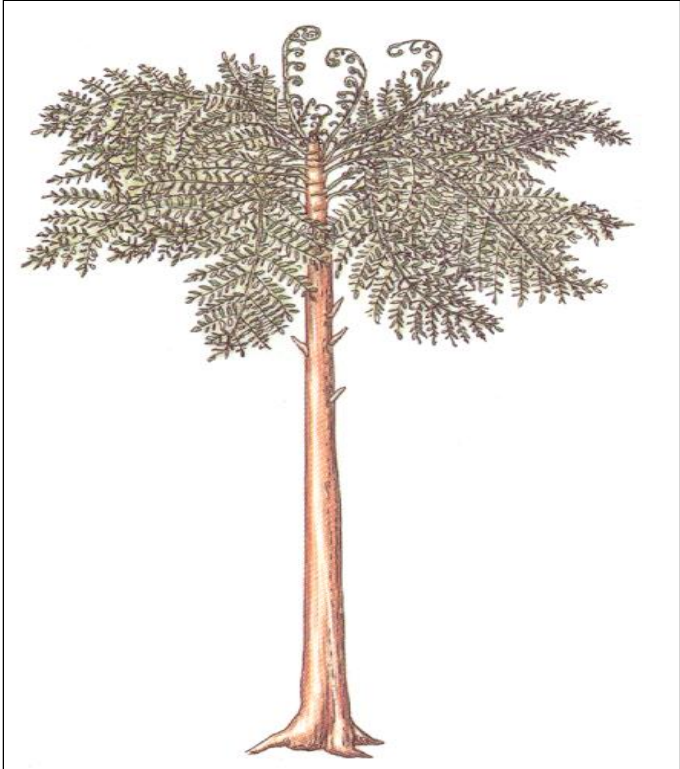
LYGINOPTERIS



LAGENOSTOMA



FOSSIL BEDS

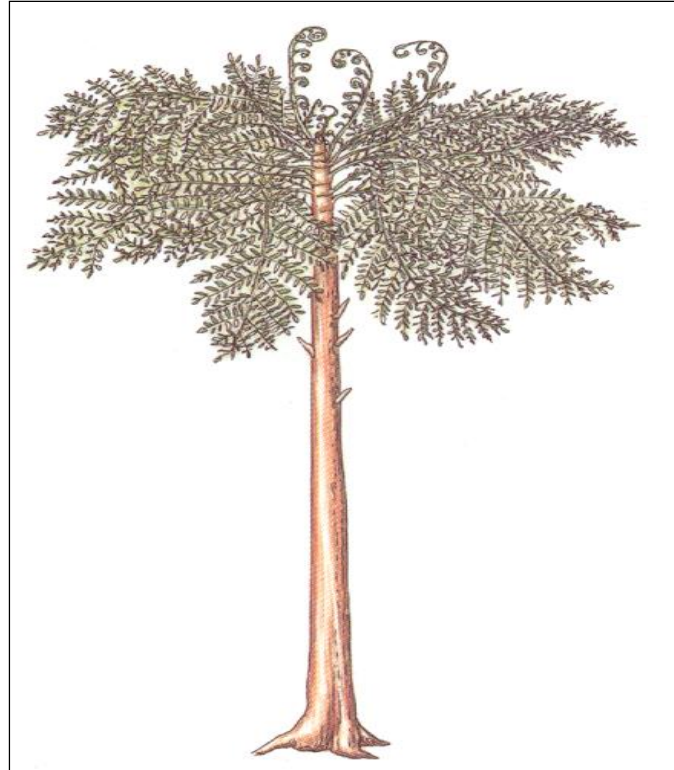


FOUND SAME FOSSIL BEDS

LYGINOPTERIS

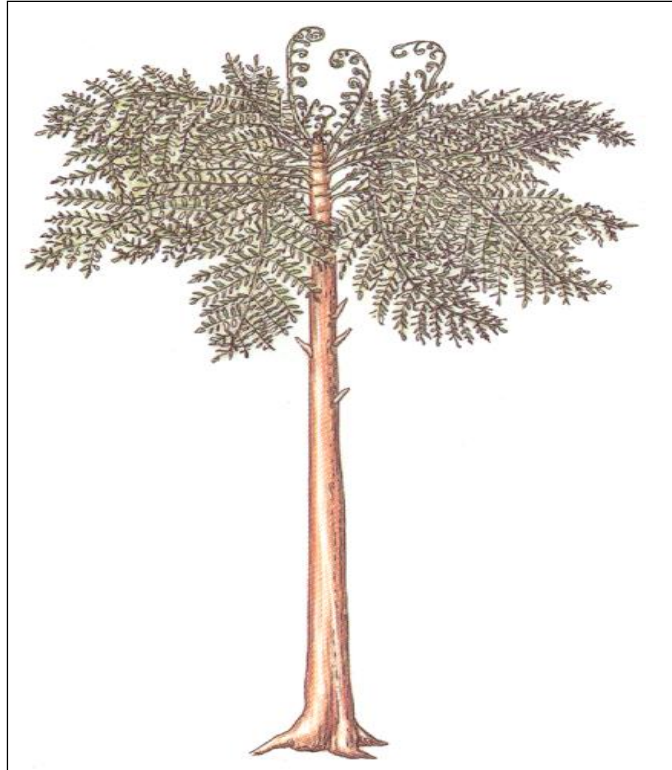
LAGENOSTOMA

LYGINOPTERIS



LYGINOPTERIS

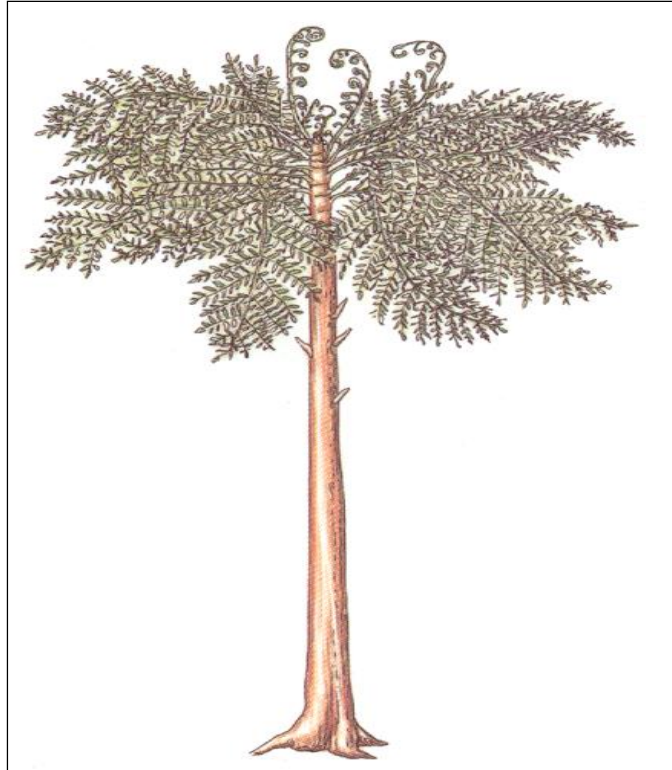
F



WOODY STEM

LYGINOPTERIS

P

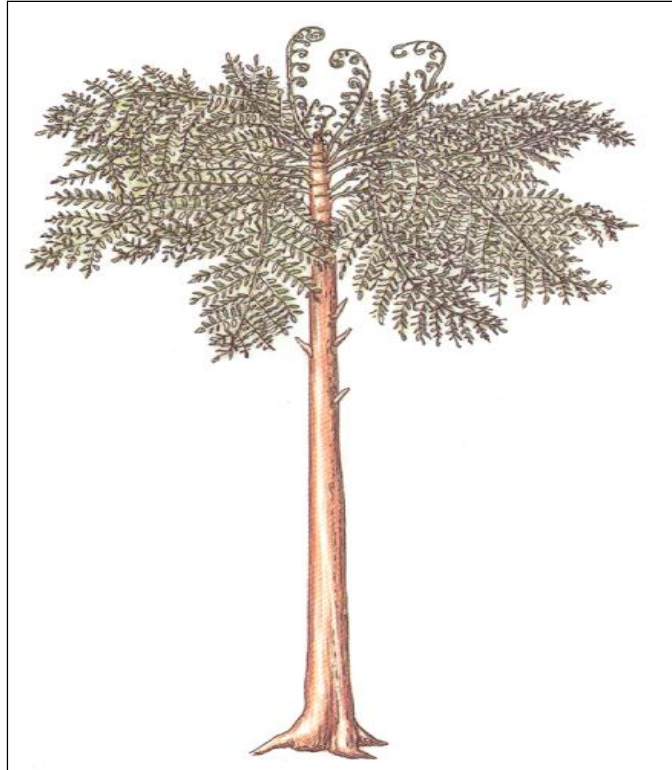


WOODY STEM

FERN-LIKE FROND

LYGINOPTERIS

P

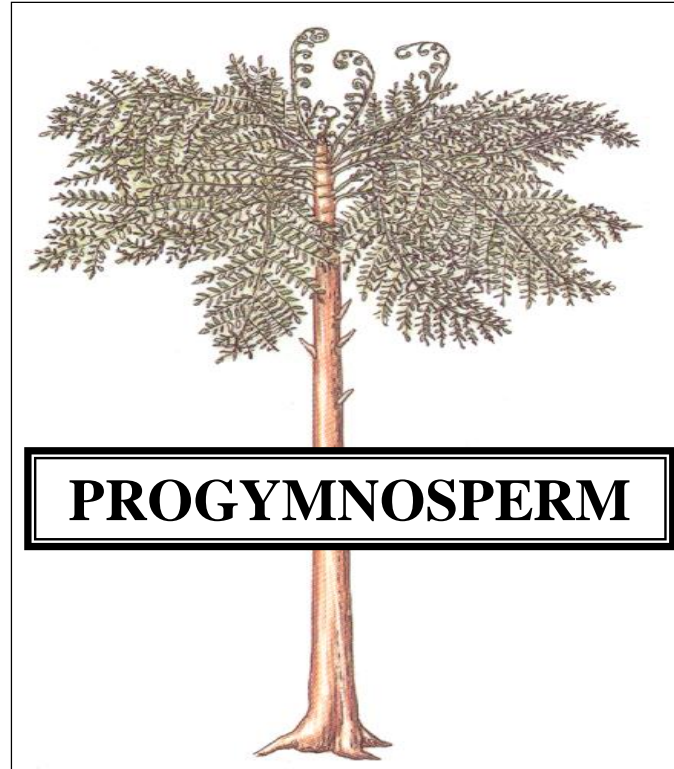


WOODY STEM

FERN-LIKE FROND

PROGYMNOSPERM CHARACTERS

LYGINOPTERIS



PROGYMNOSPERM

WOODY STEM

FERN-LIKE FROND

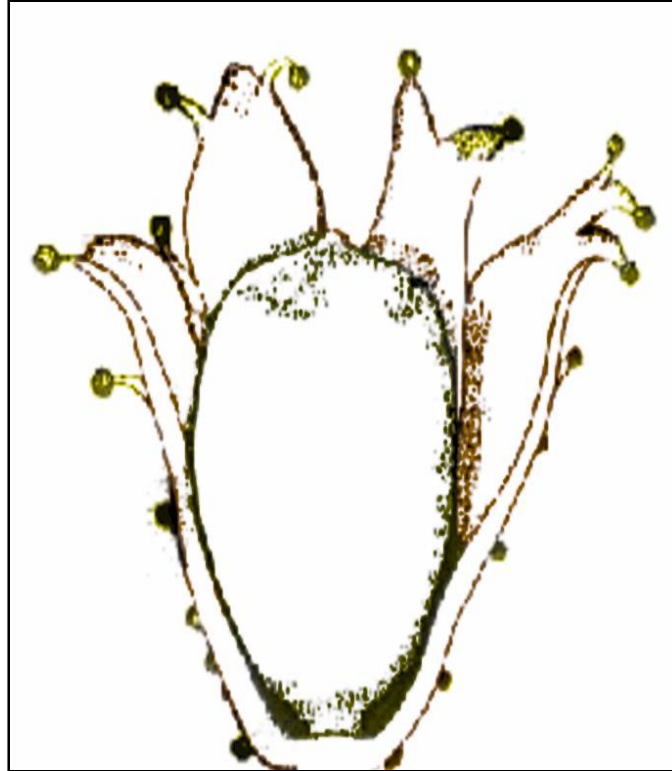
PROGYMNOSPERM CHARACTERS

^



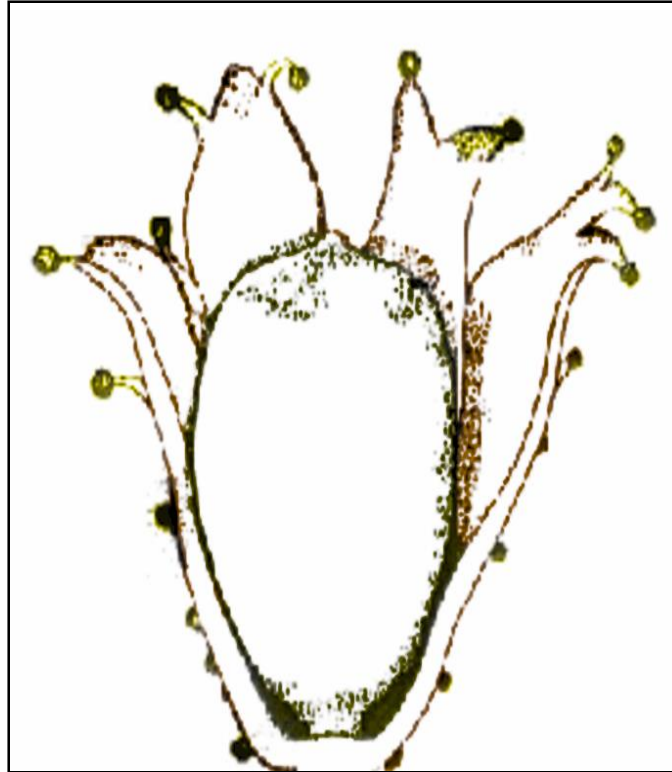
LAGENOSTOMA

O



LAGENOSTOMA

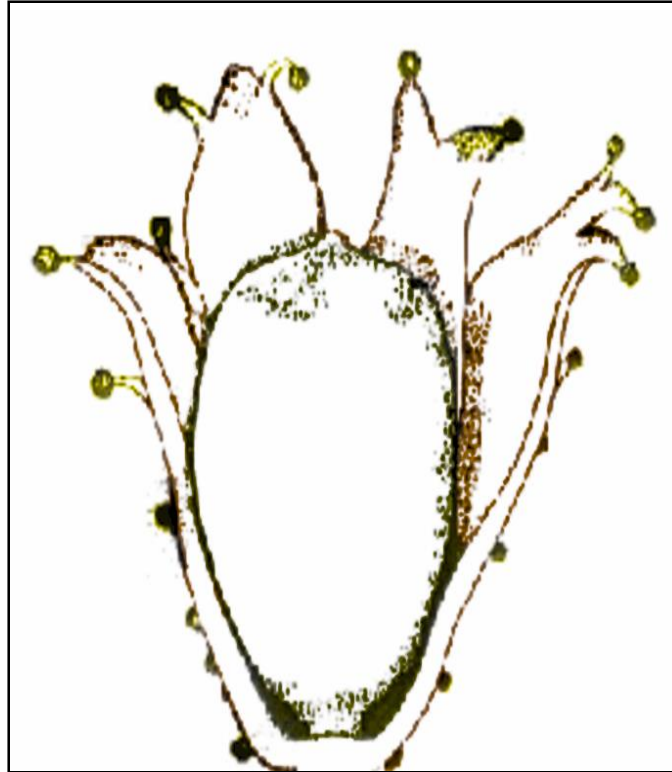
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OVULE / SEED

LAGENOSTOMA

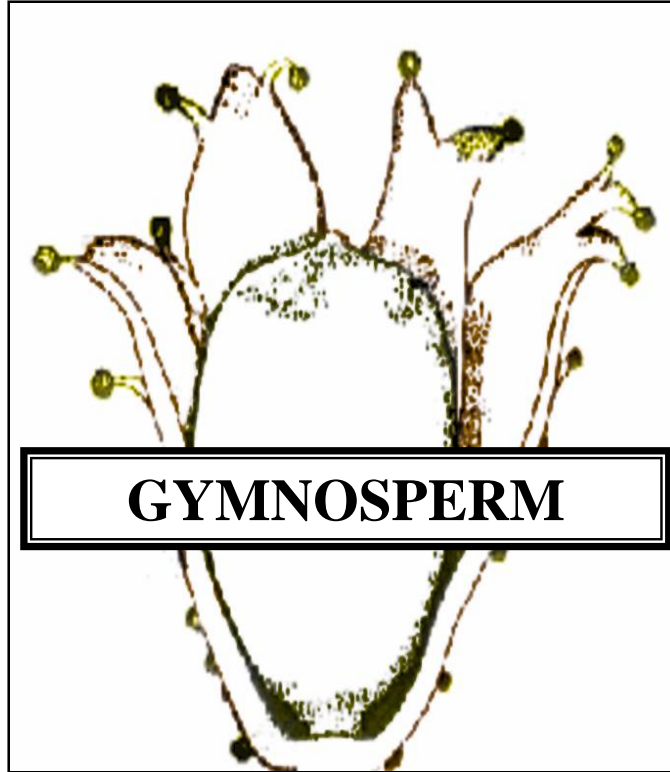
G



OVULE / SEED

GYMNOSPERM CHARACTERS

LAGENOSTOMA



GYMNOSPERM

OVULE / SEED

GYMNOSPERM CHARACTERS



FB