

OVULE

INTEGUMENT

MEGASPORANGIUM

MICROPYLE

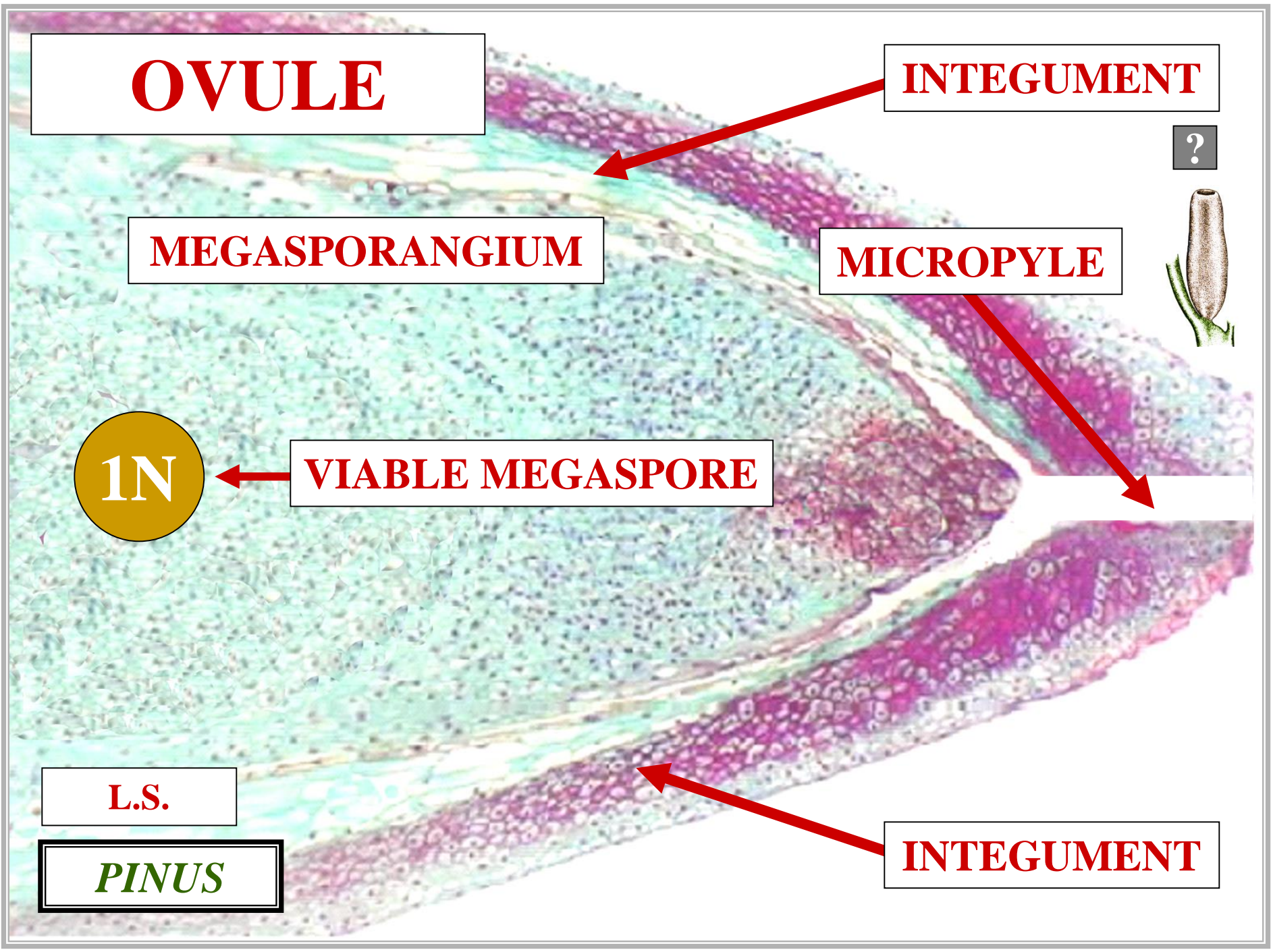
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VIABLE MEGASPORE

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MEGASPORANGIUM

MICROPYLE

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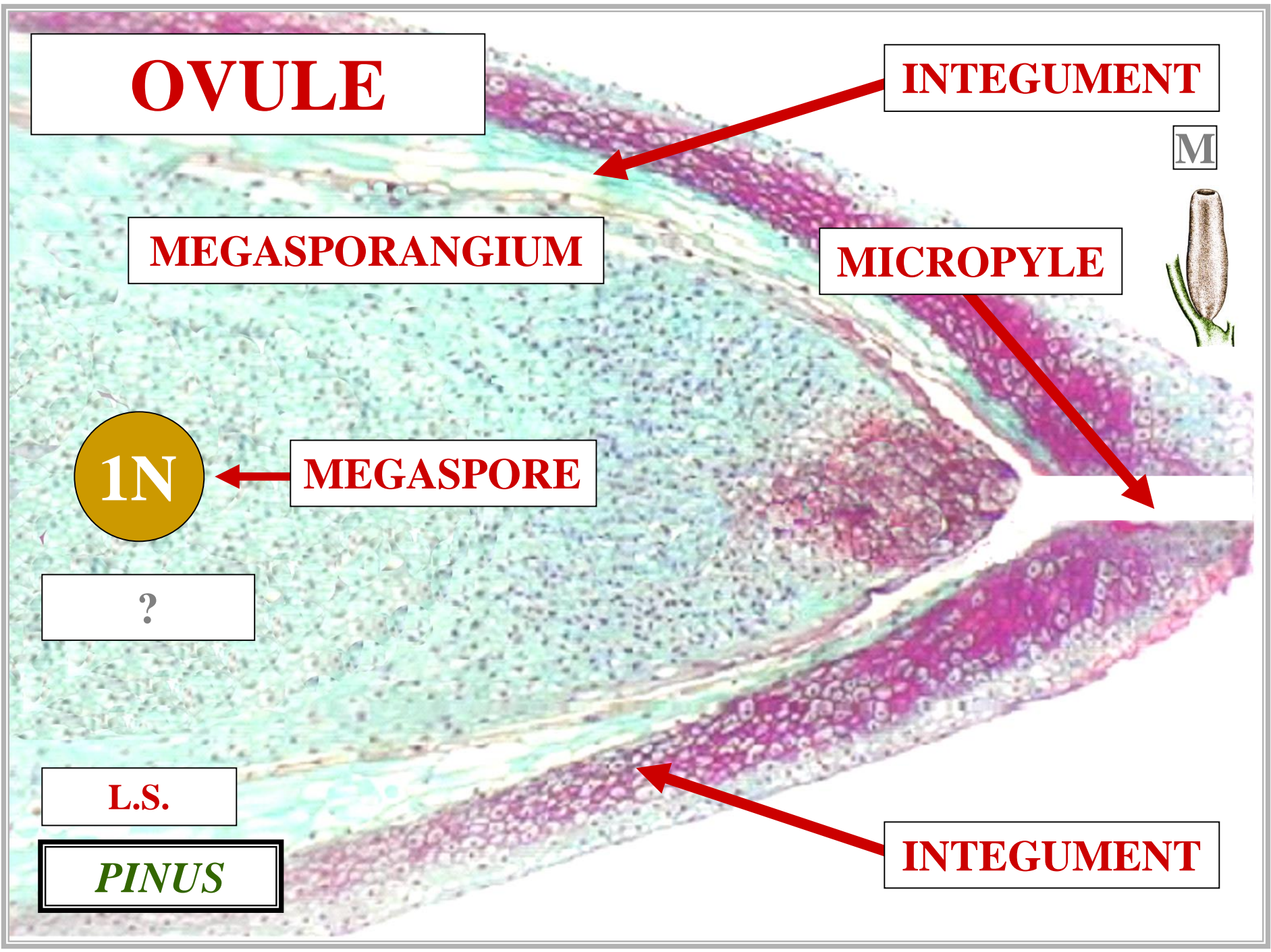
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MEGASPORANGIUM

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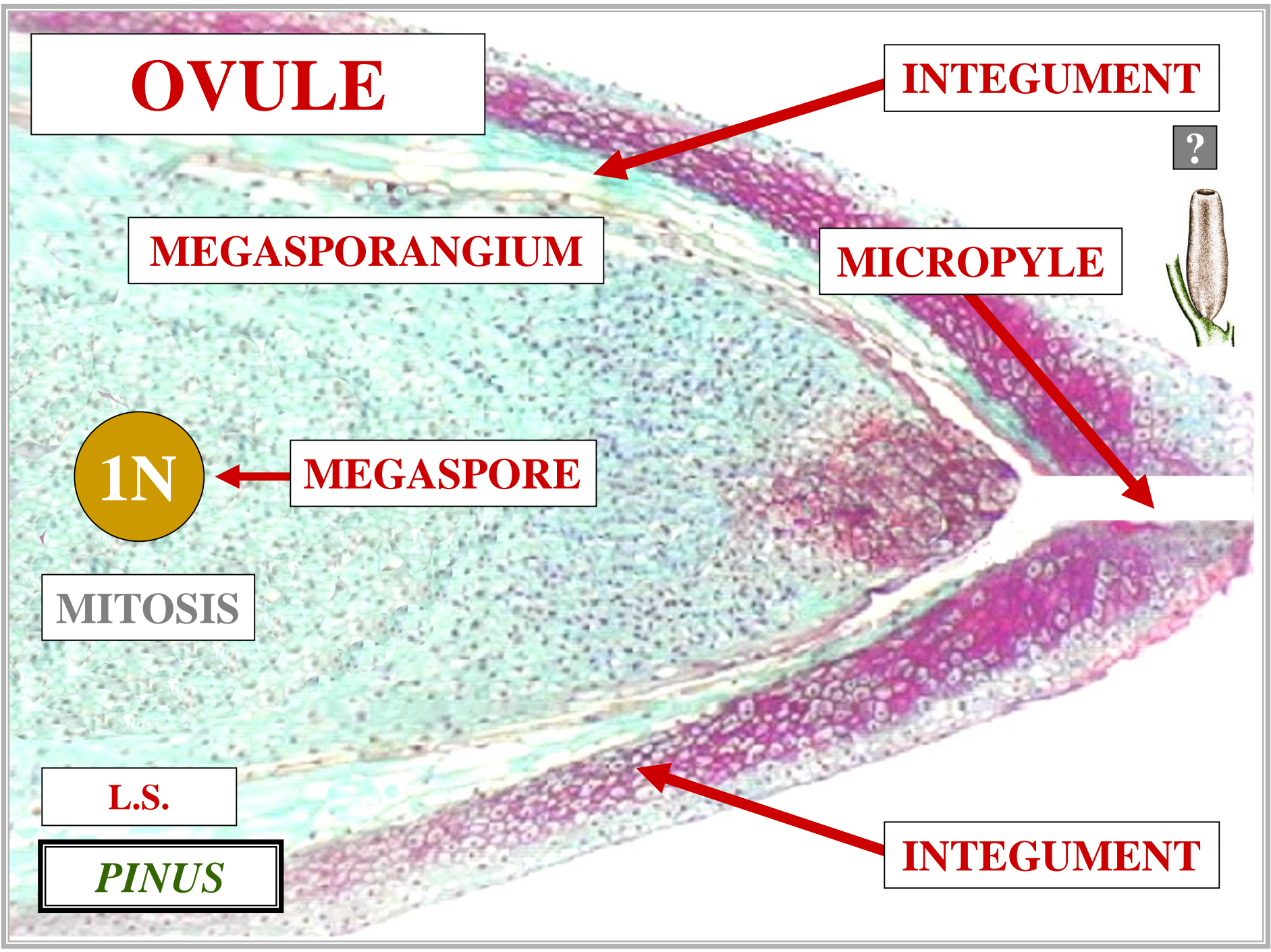
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MICROPYLE

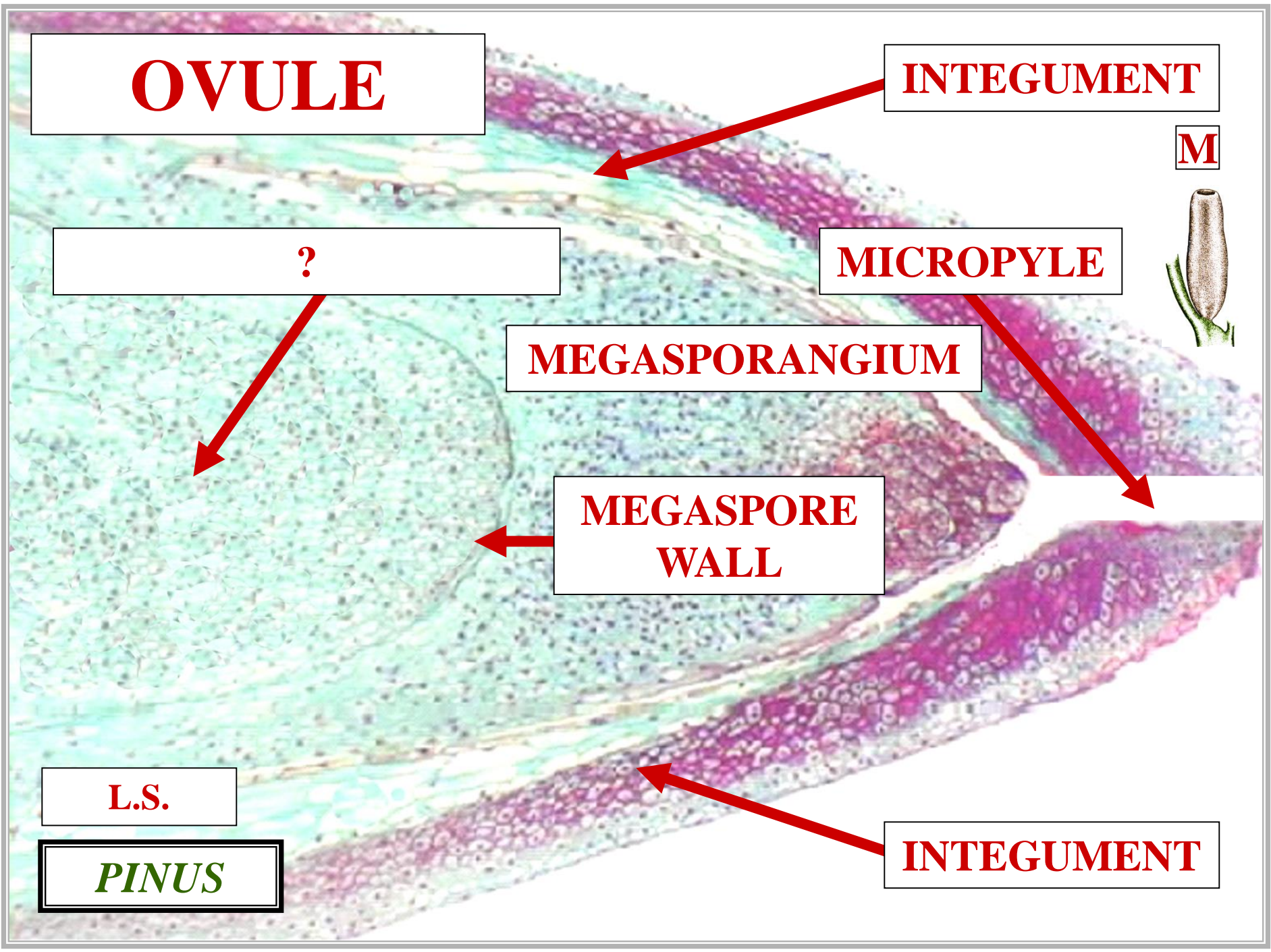
MEGASPORANGIUM

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MEGAGAMETOPHYTE

MICROPYLE

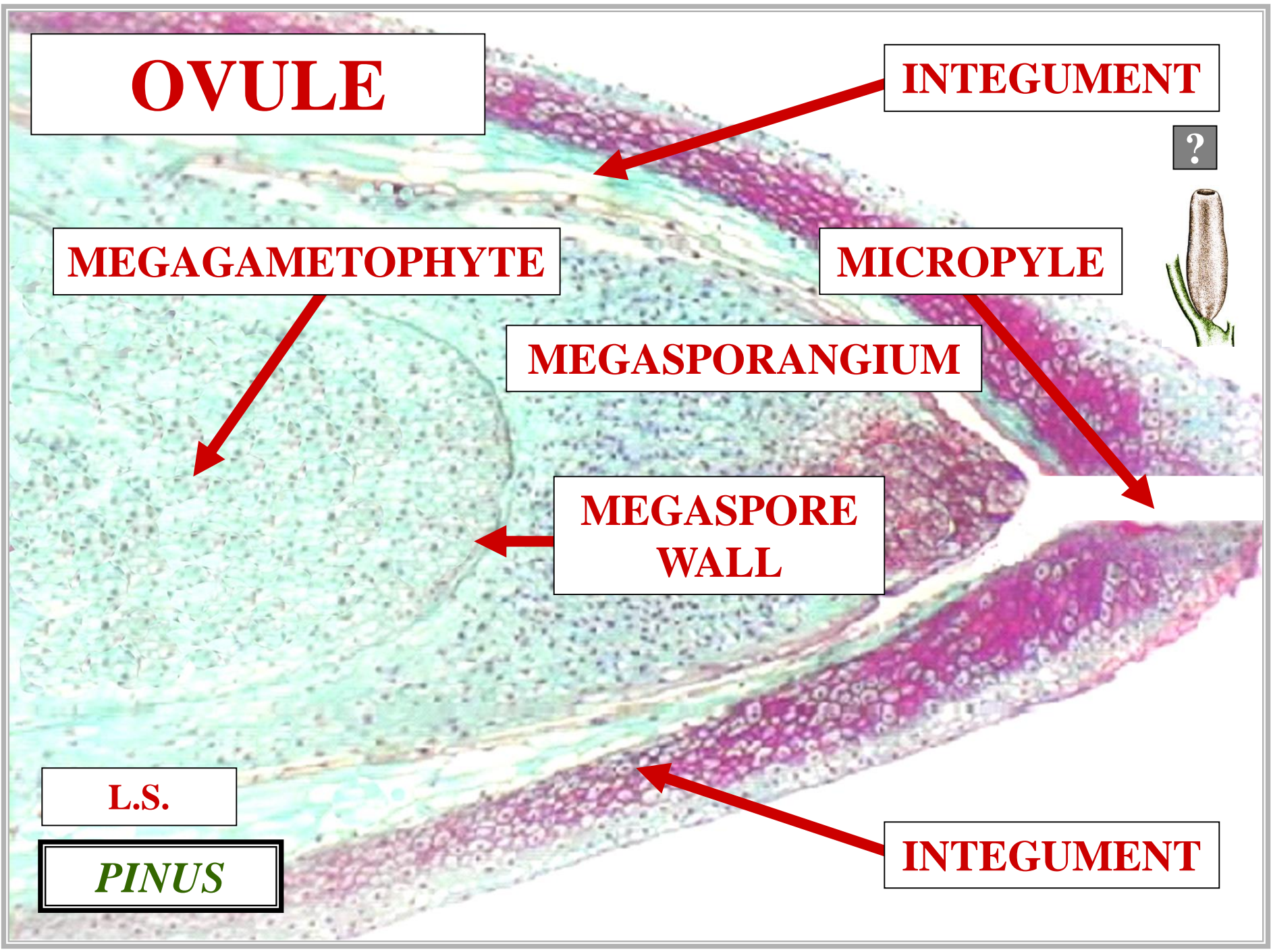
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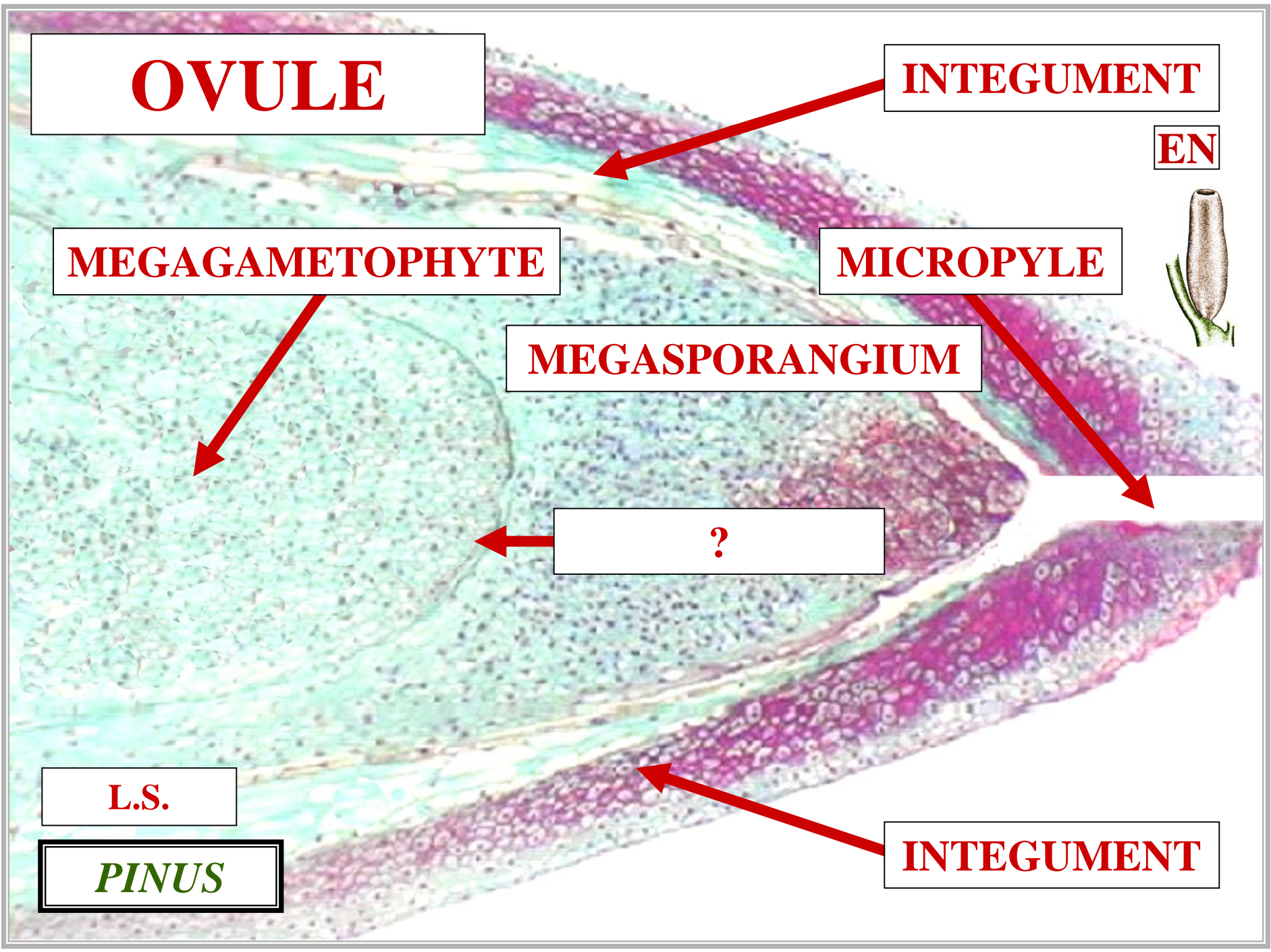
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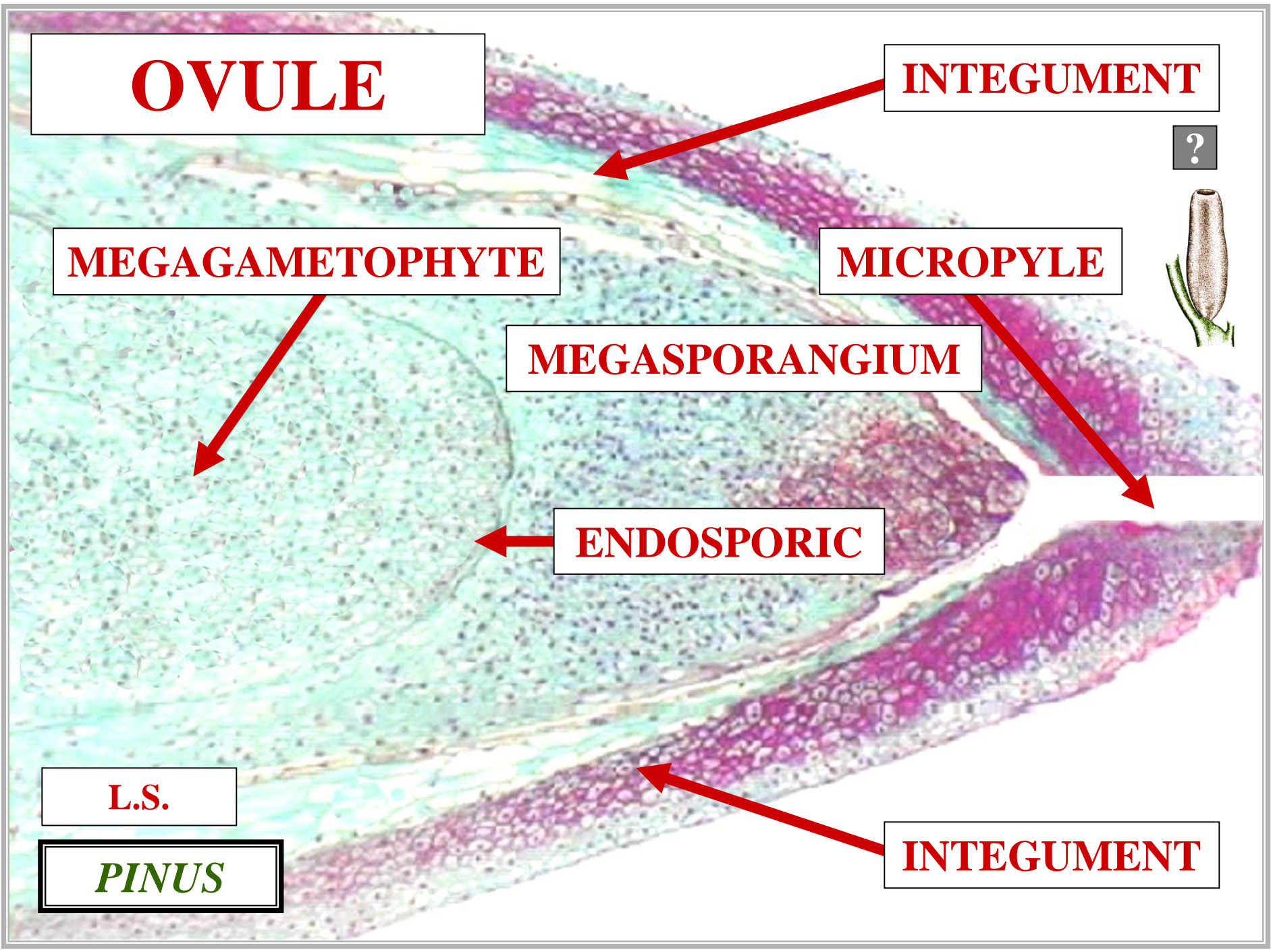
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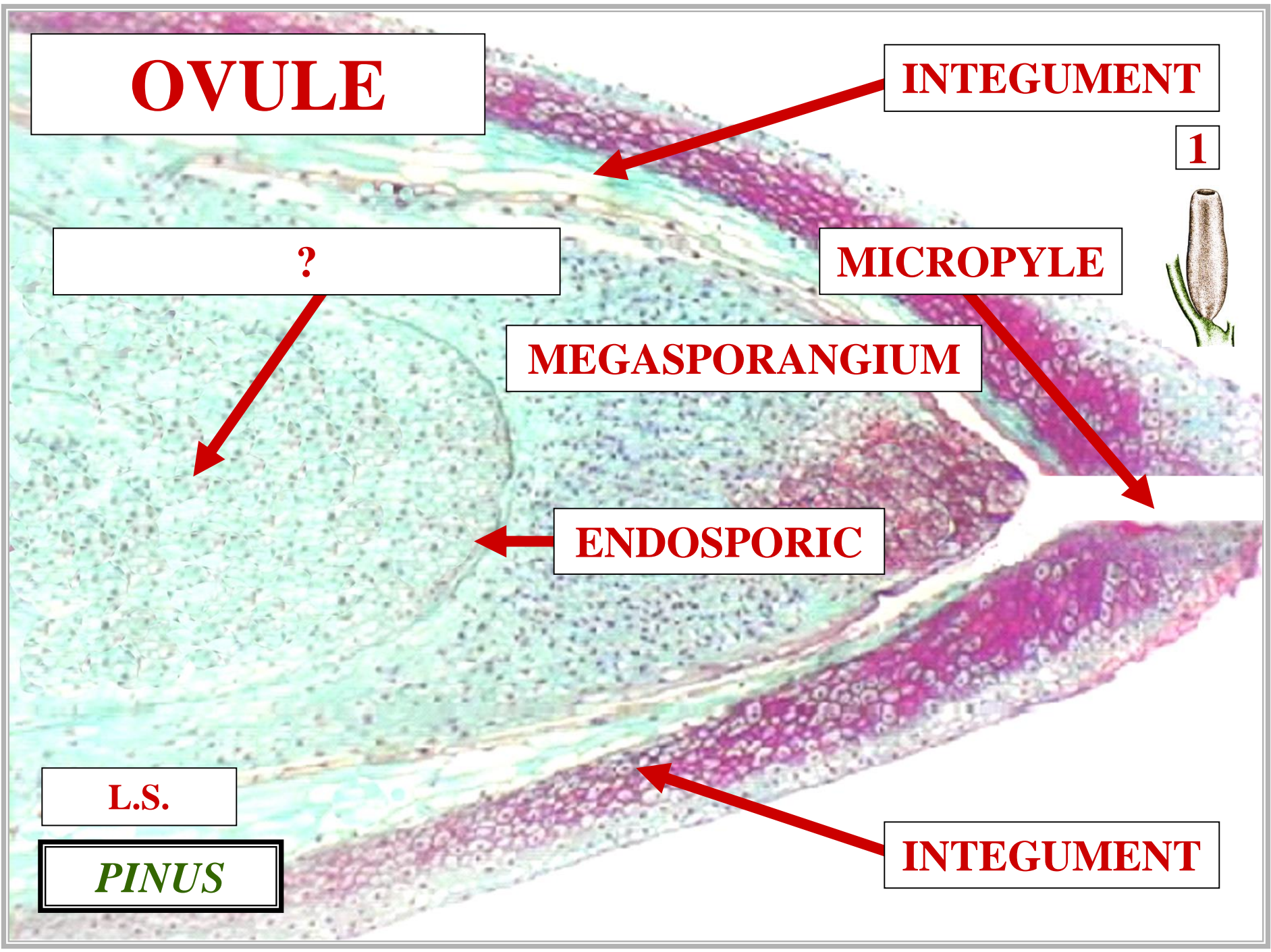
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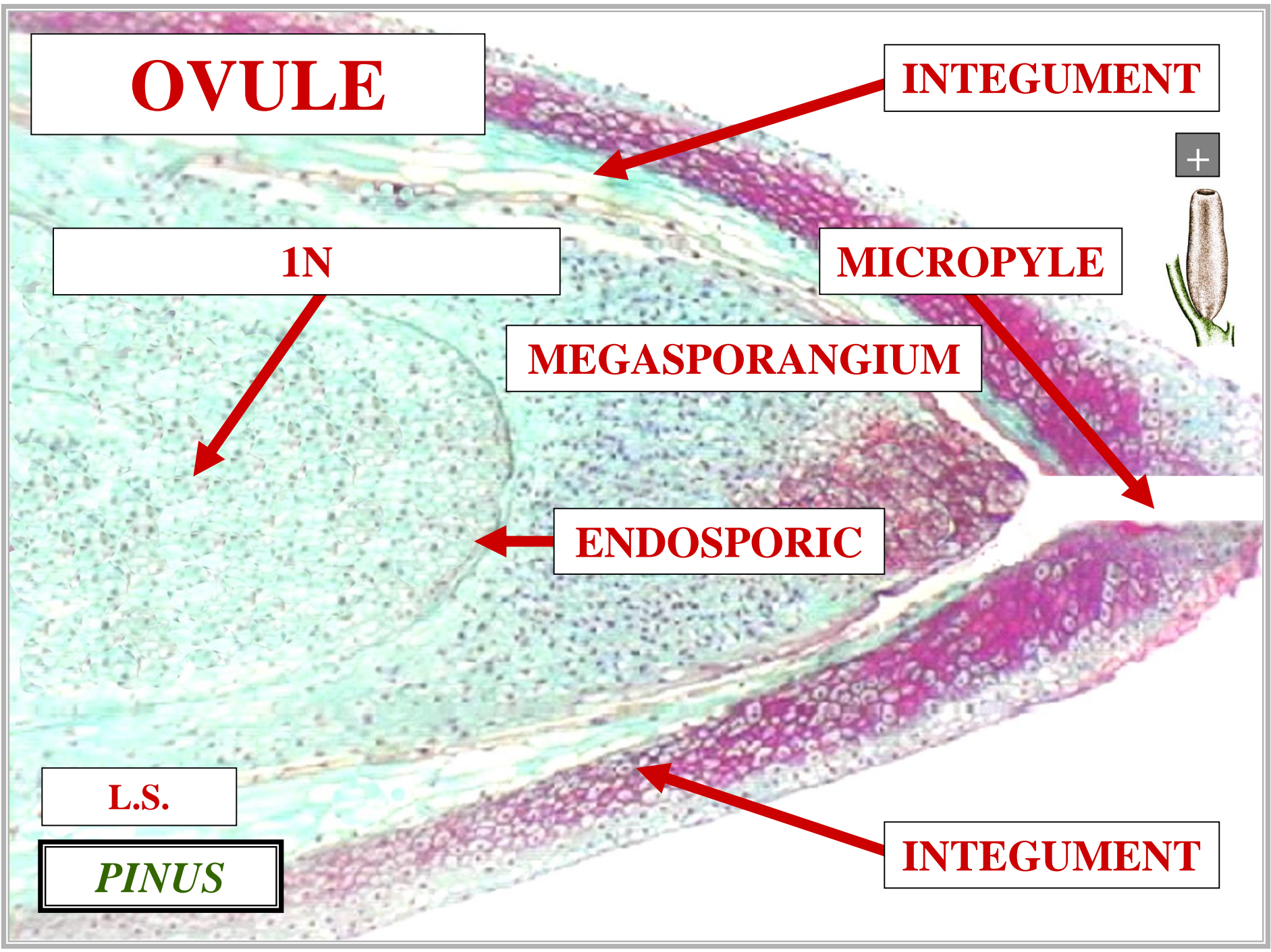
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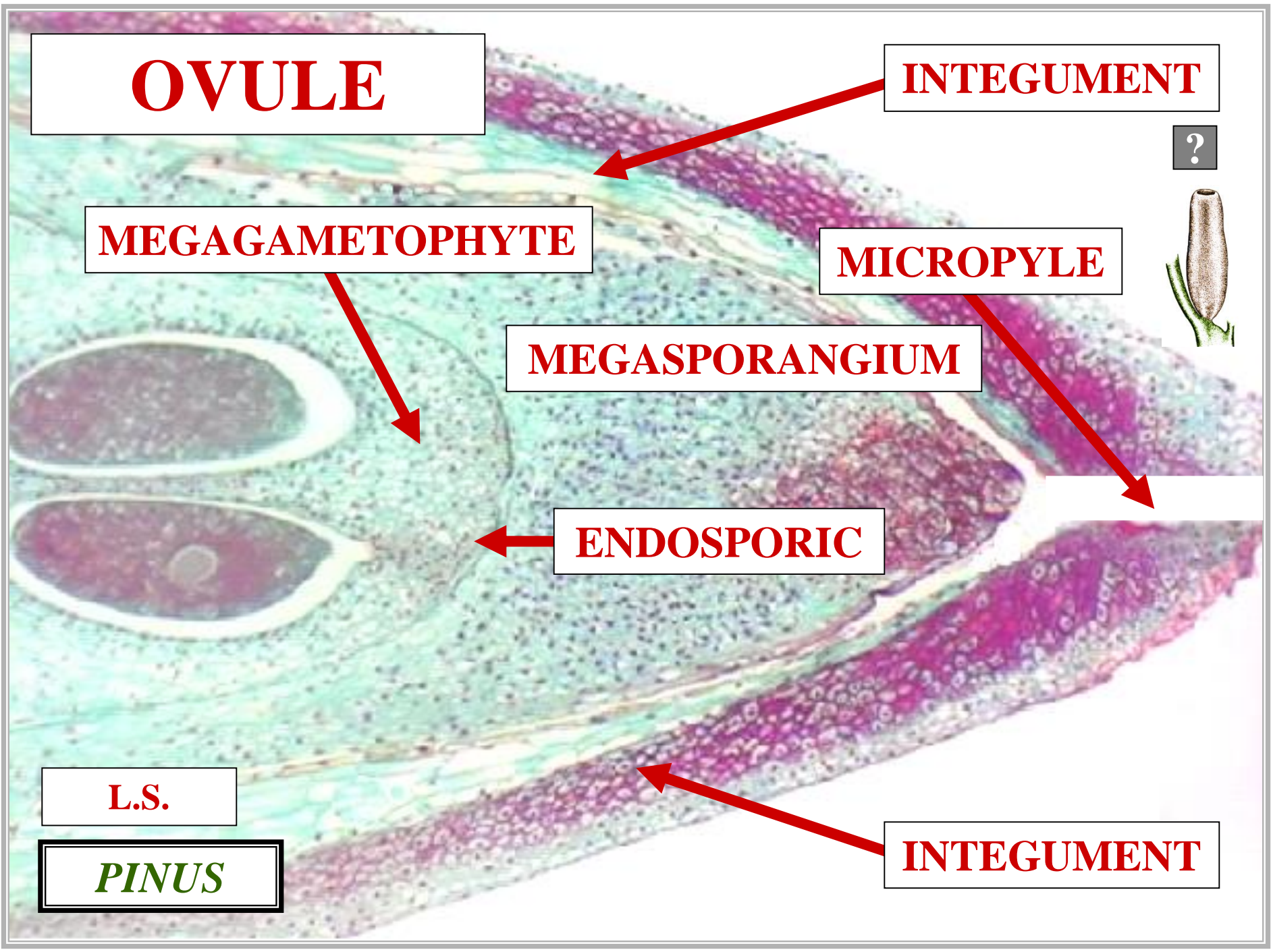
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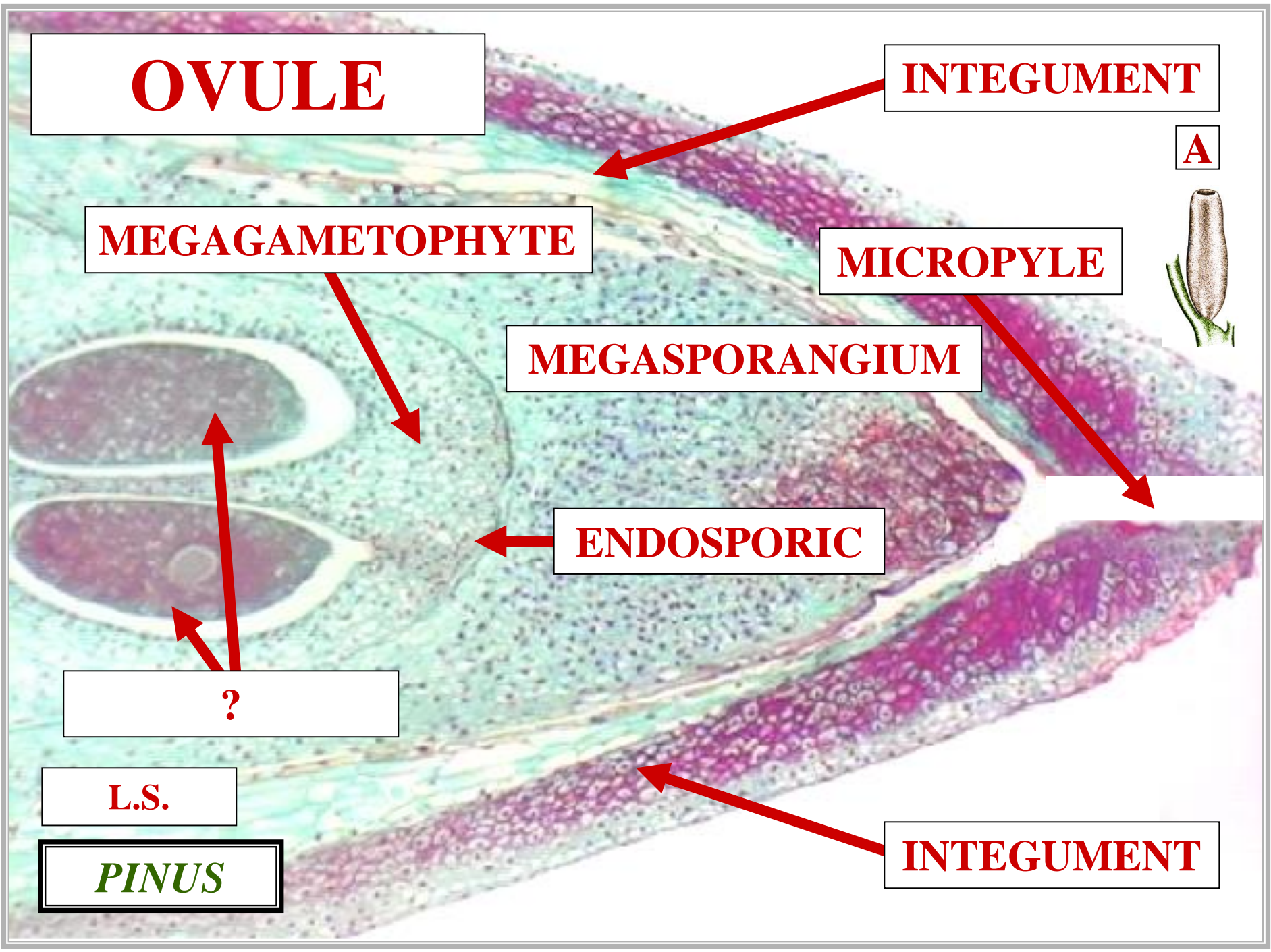
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MEGAGAMETOPHYTE

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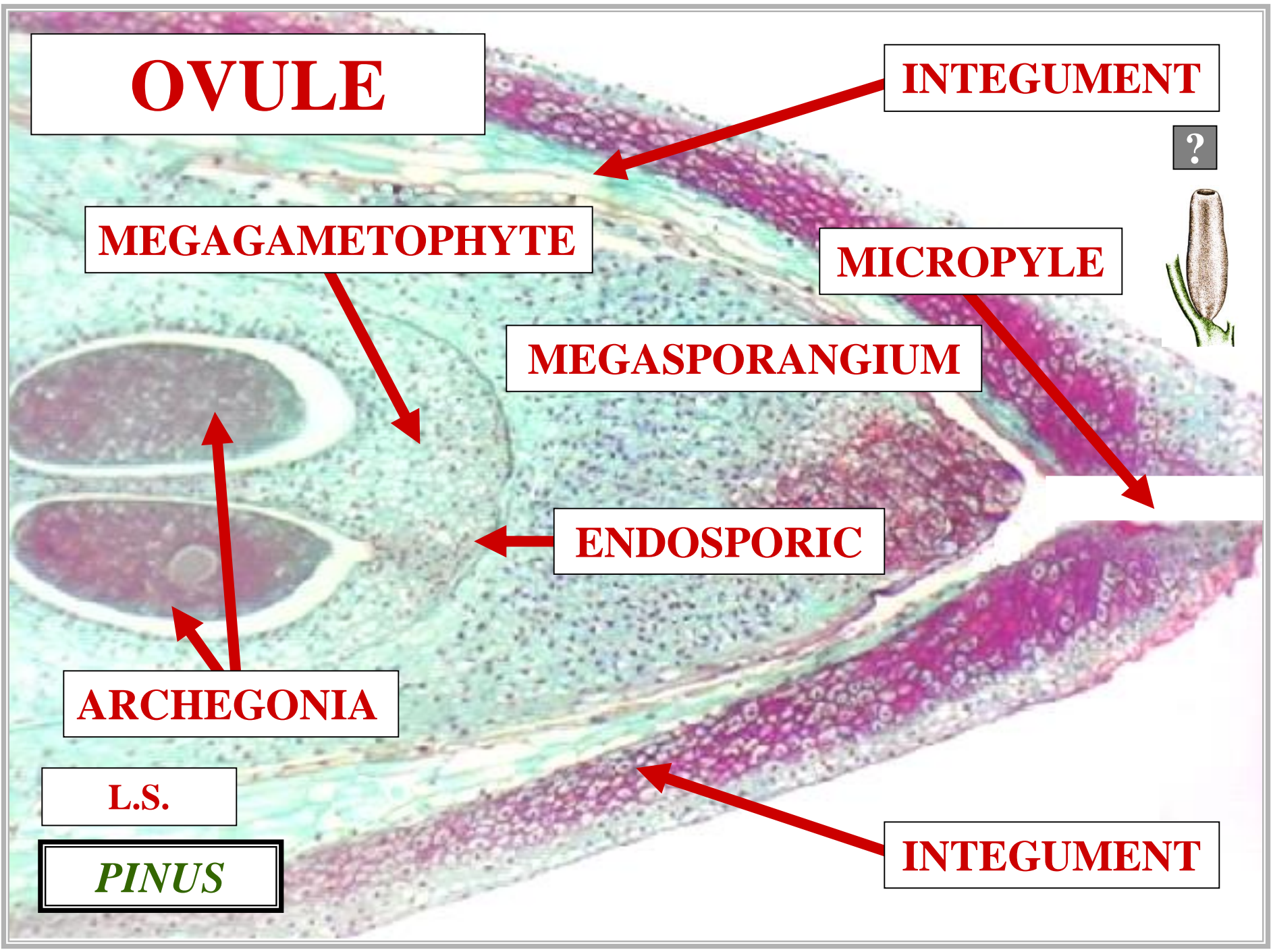
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MEGAGAMETOPHYTE

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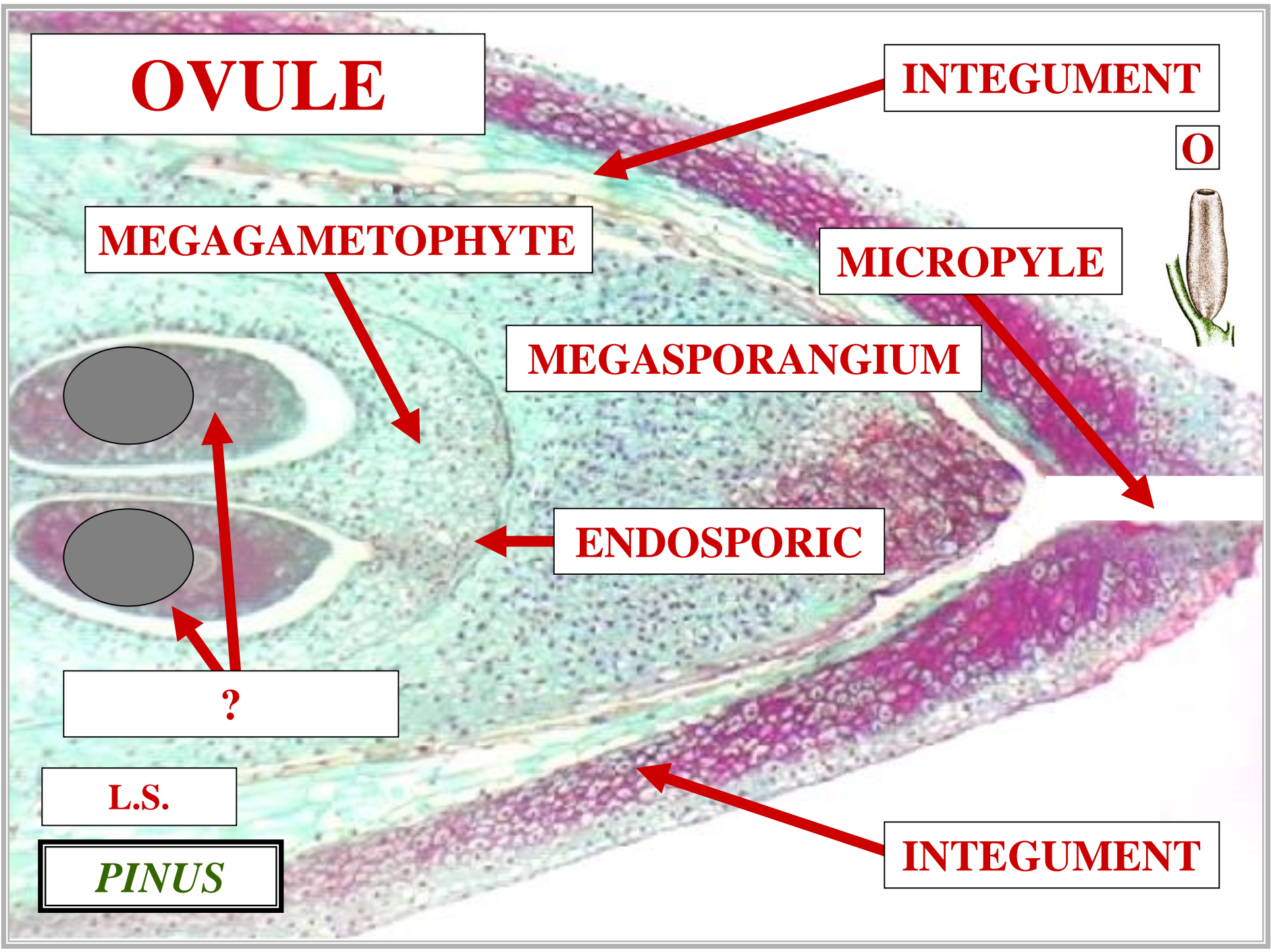
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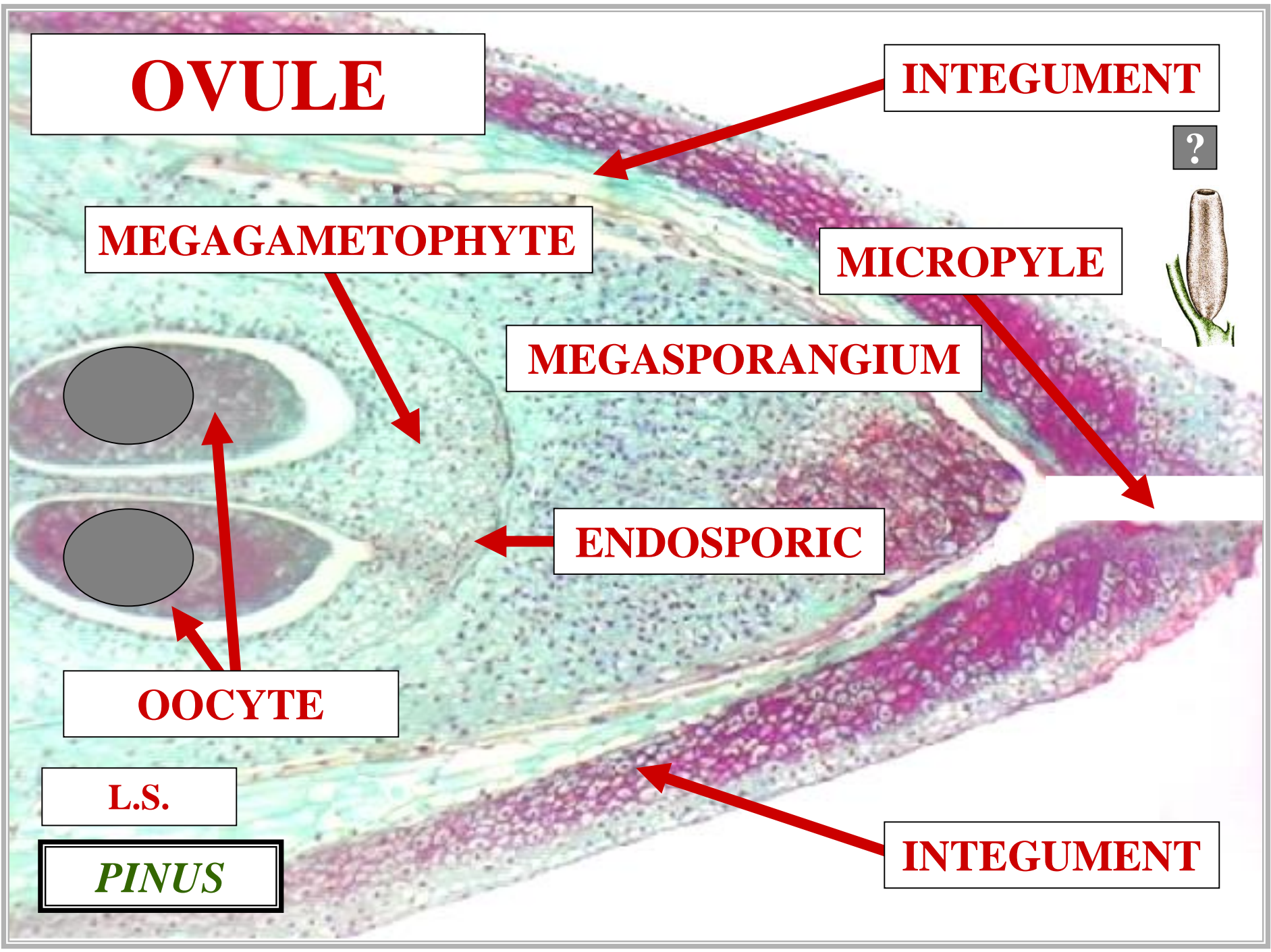
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MEGAGAMETOPHYTE

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MEGASPORANGIUM

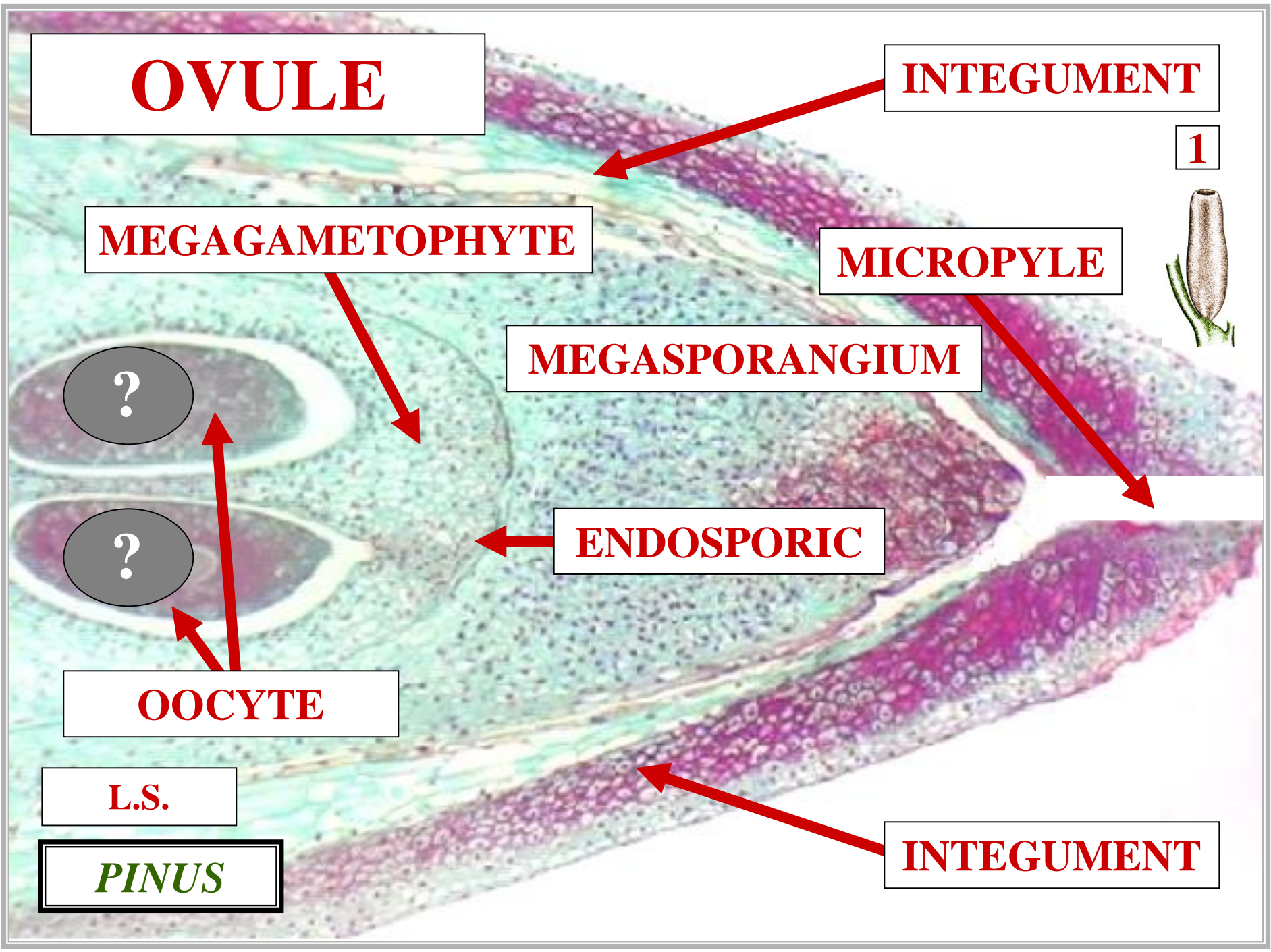
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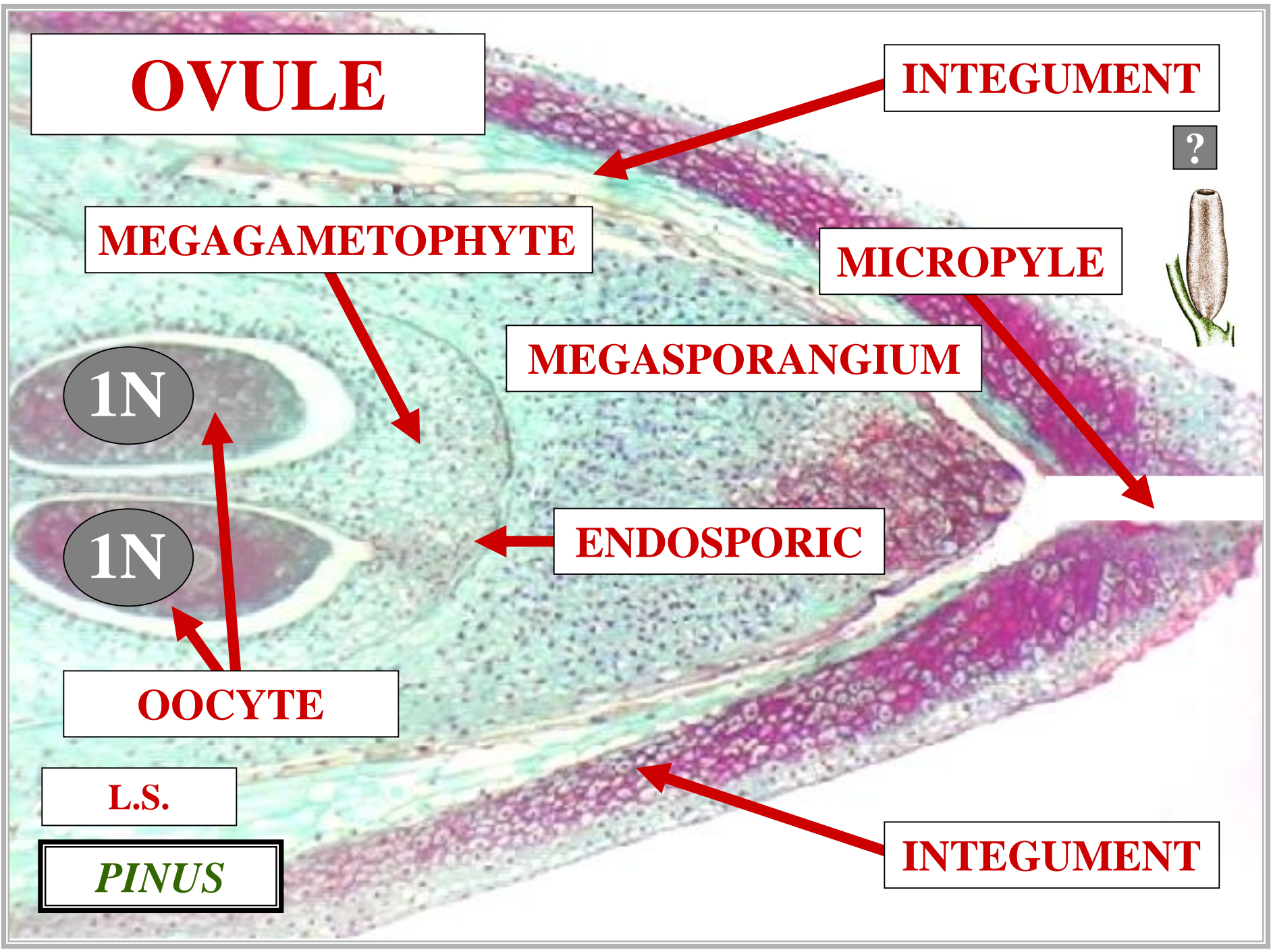
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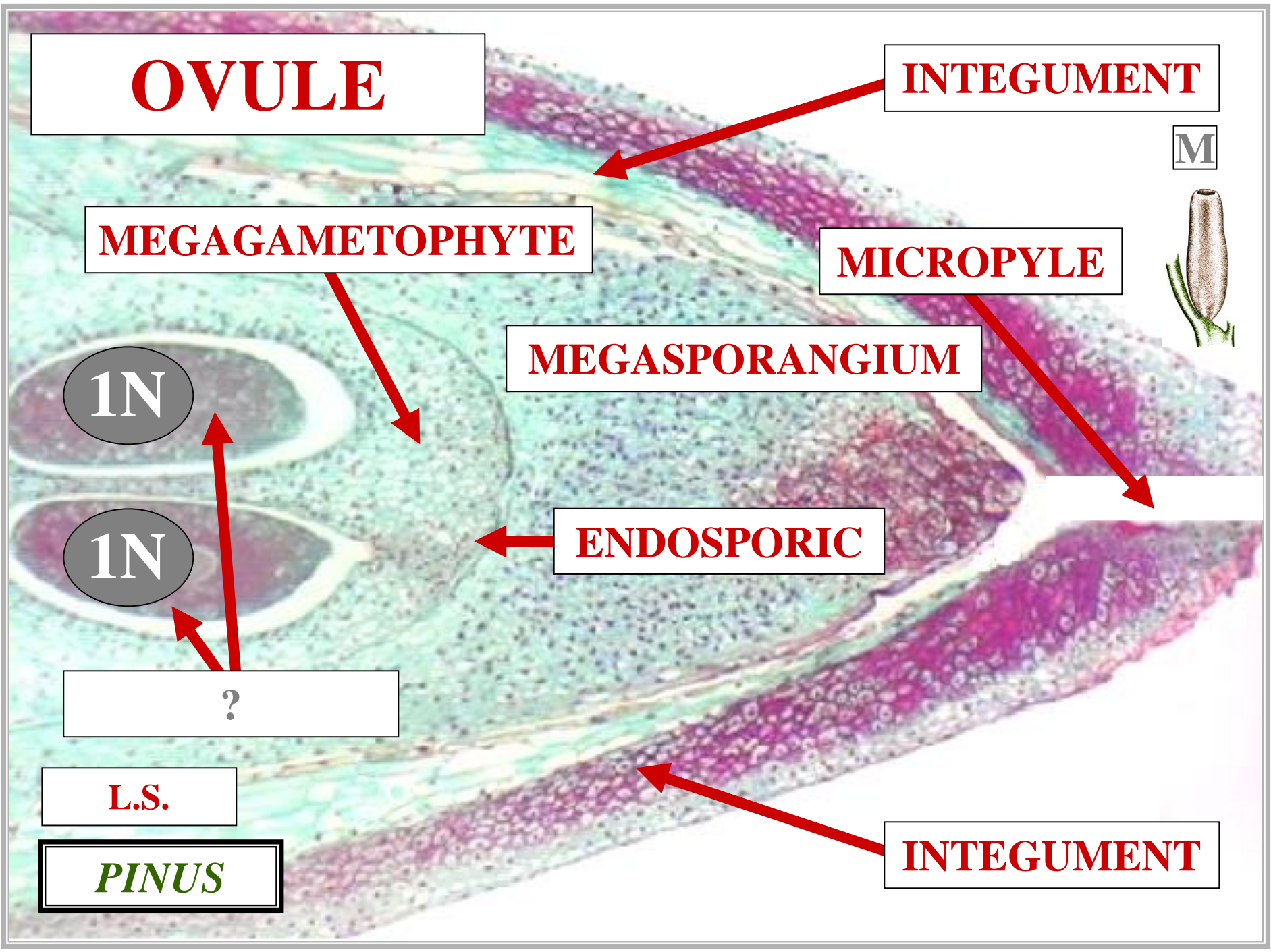
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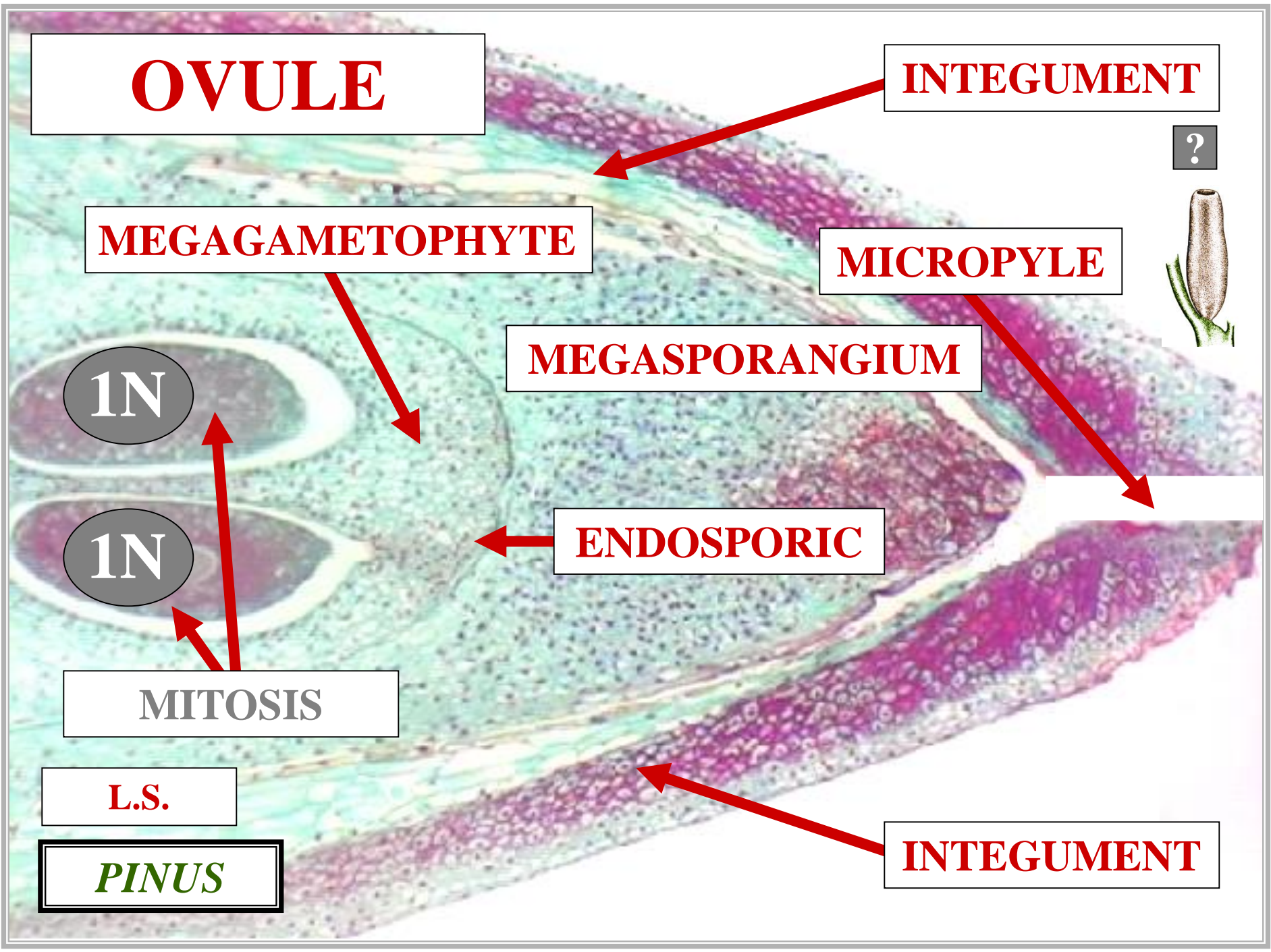
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MEGAGAMETOPHYTE

MICROPYLE

MEGASPORANGIUM

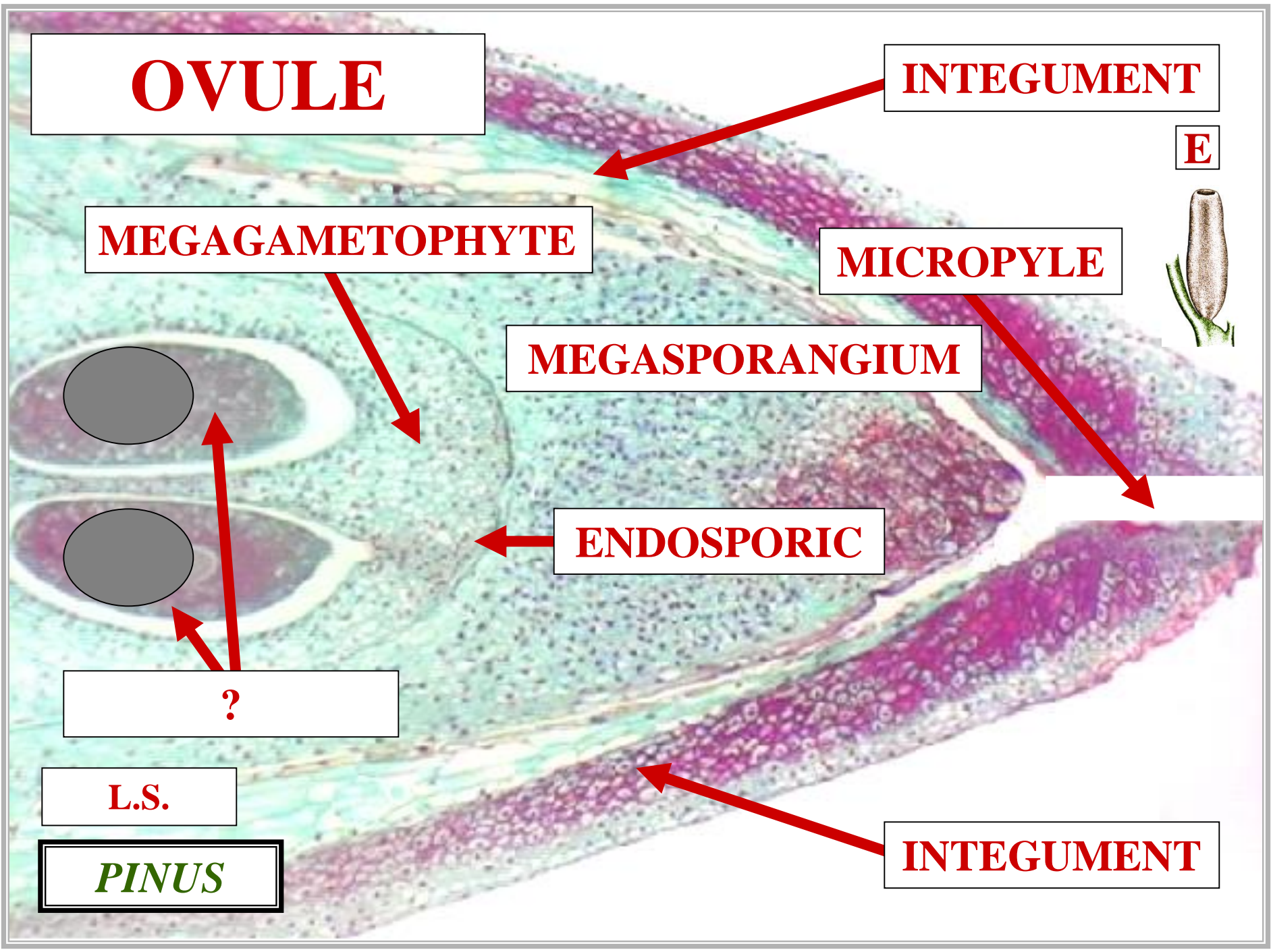
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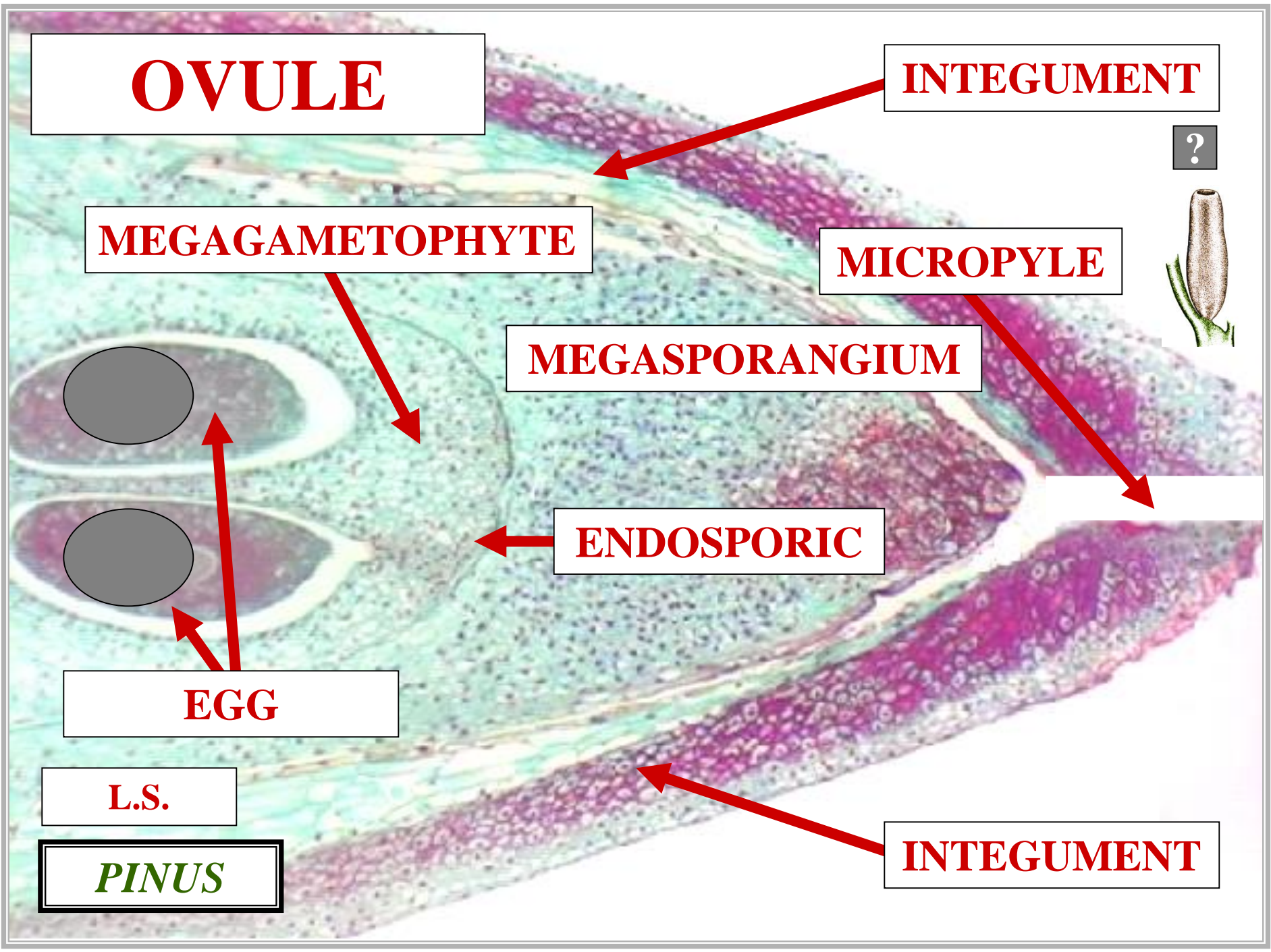
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MEGAGAMETOPHYTE

MICROPYLE

MEGASPORANGIUM

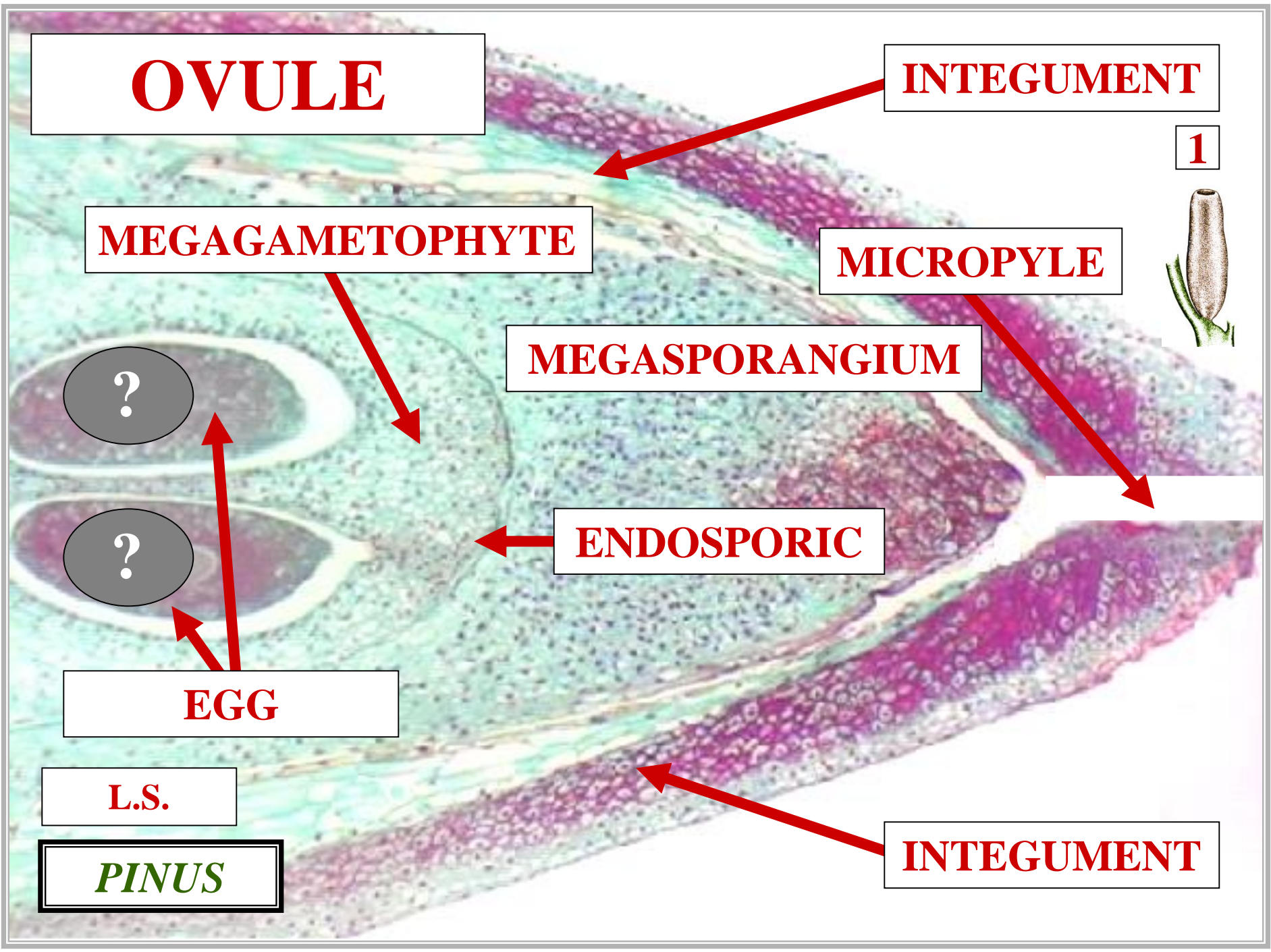
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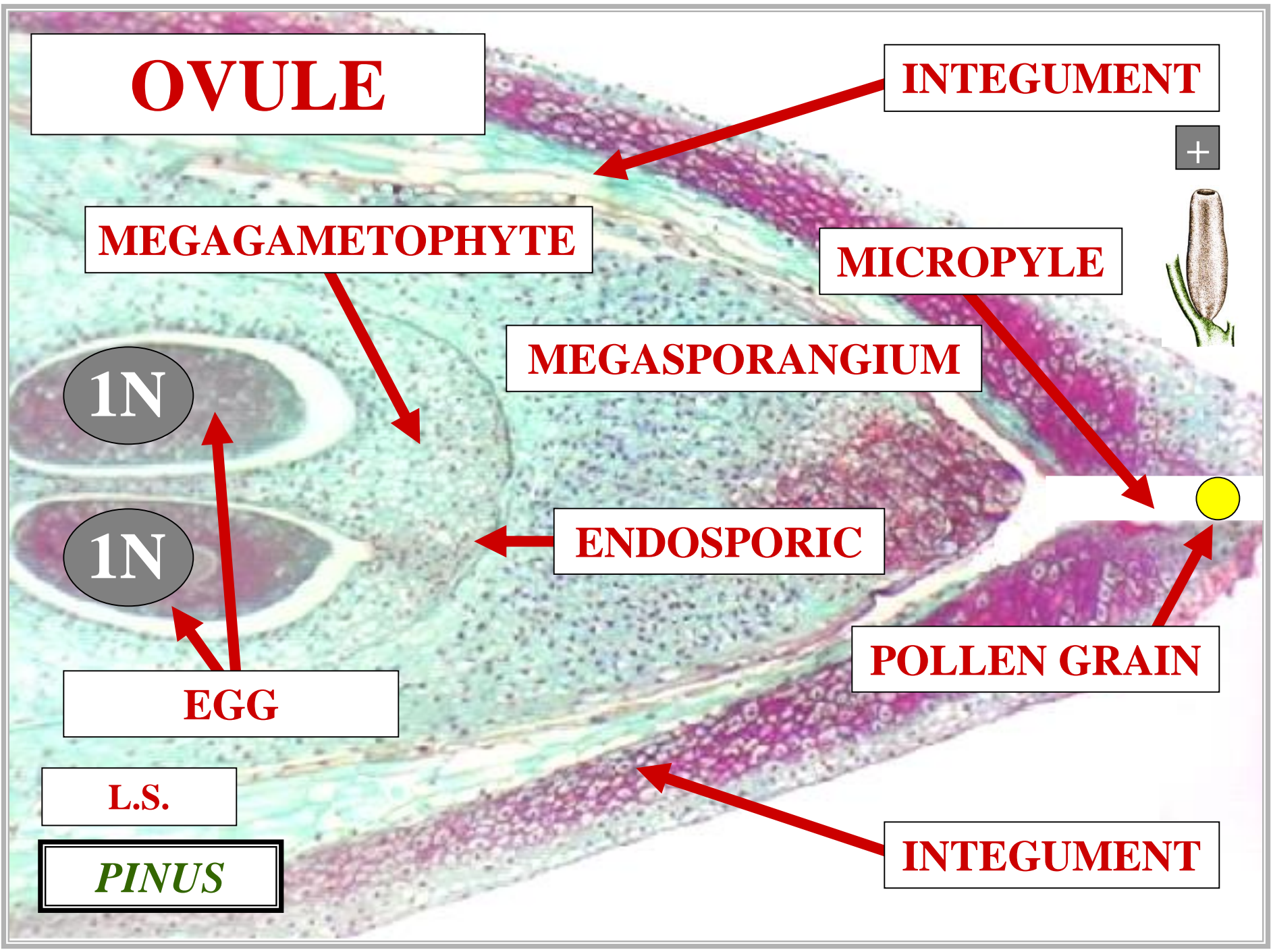
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POLLEN GRAIN

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MEGAGAMETOPHYTE

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MEGASPORANGIUM

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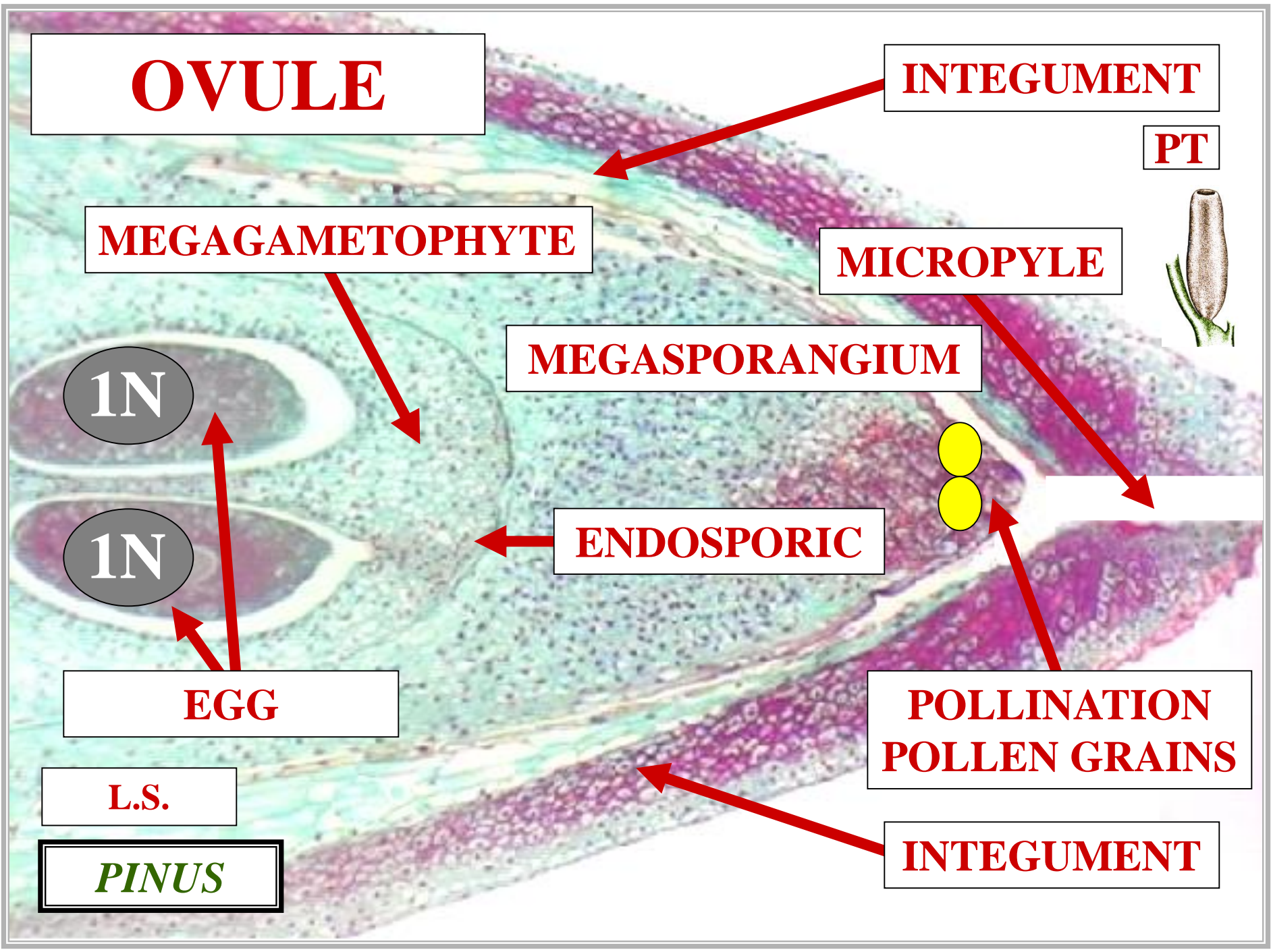
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**POLLINATION
POLLEN GRAINS**

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MEGAGAMETOPHYTE

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MEGASPORANGIUM

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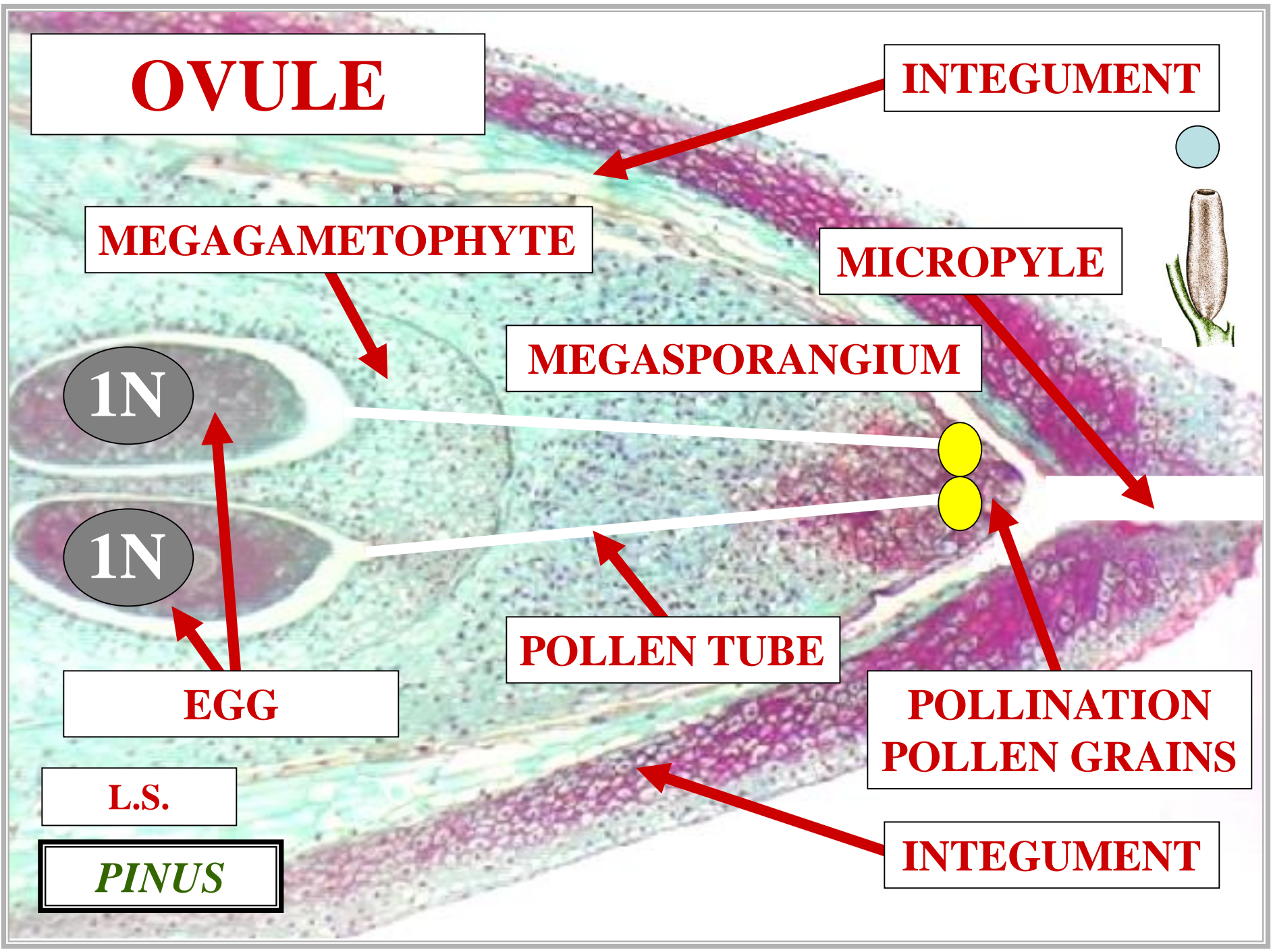
POLLEN TUBE

**POLLINATION
POLLEN GRAINS**

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MEGAGAMETOPHYTE

MICROPYLE

MEGASPORANGIUM

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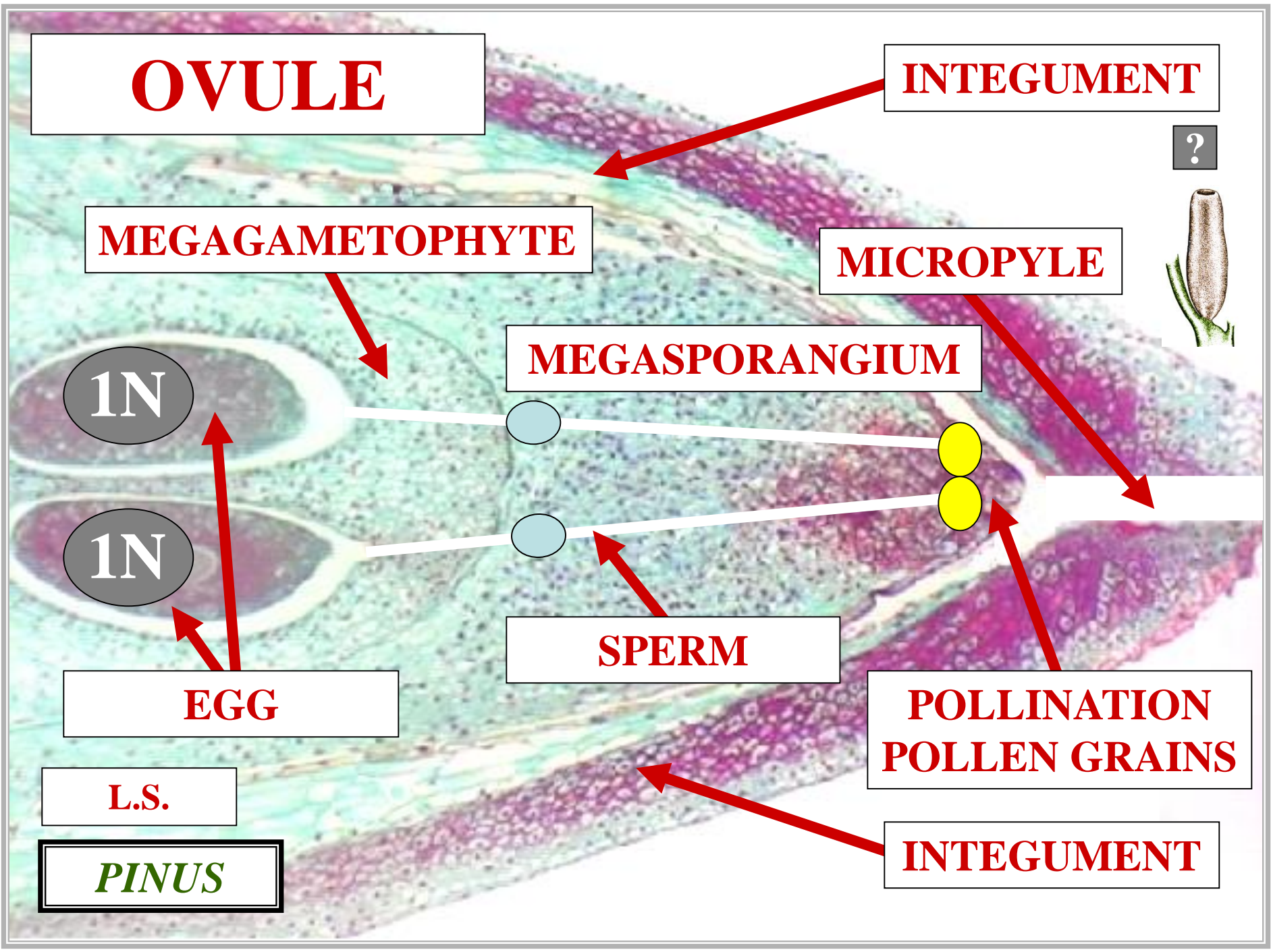
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**POLLINATION
POLLEN GRAINS**

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MEGAGAMETOPHYTE

MICROPYLE

MEGASPORANGIUM

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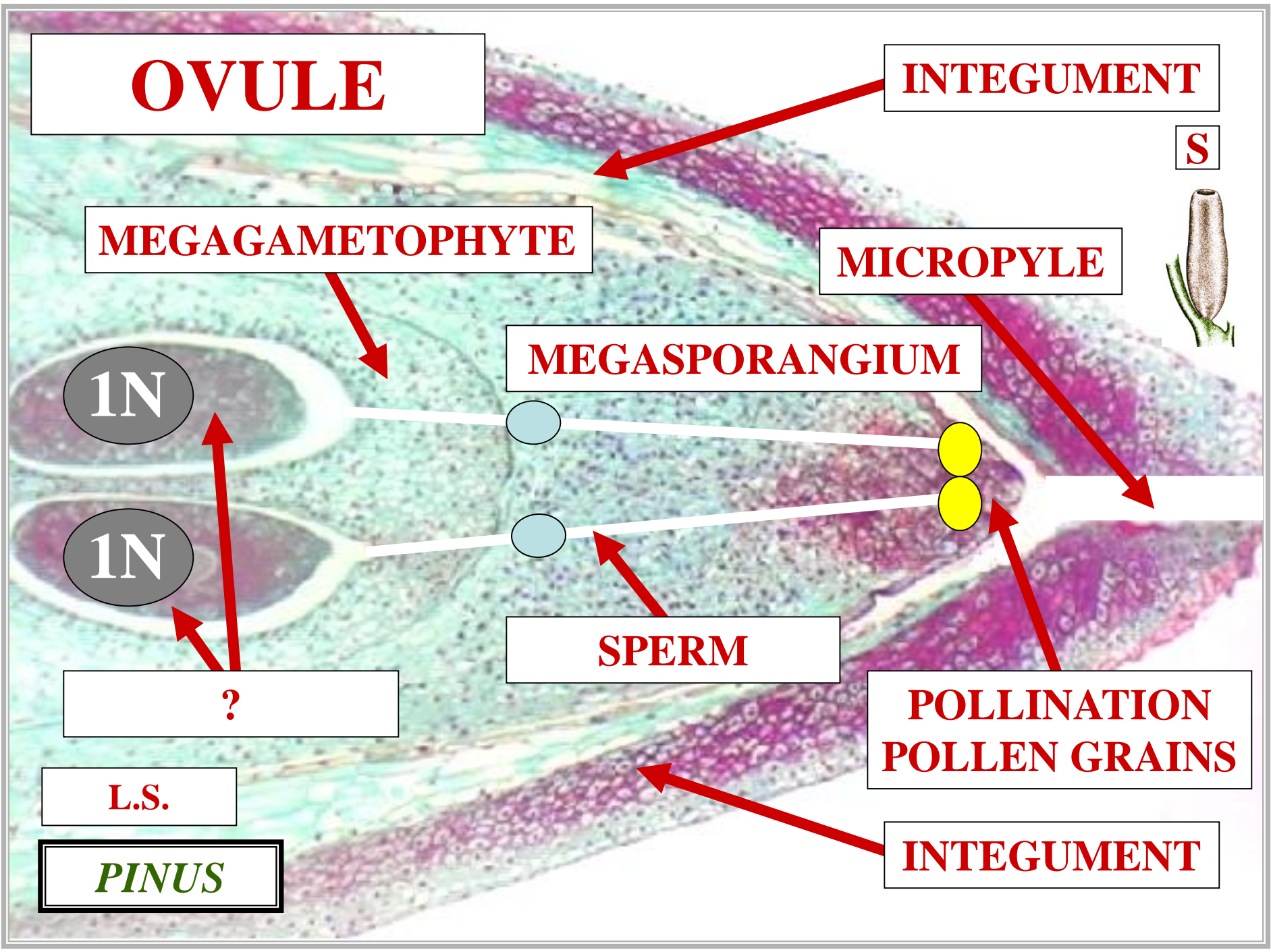
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**POLLINATION
POLLEN GRAINS**

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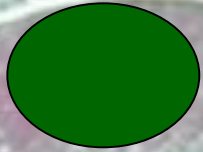
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MICROPYLE

MEGASPORANGIUM

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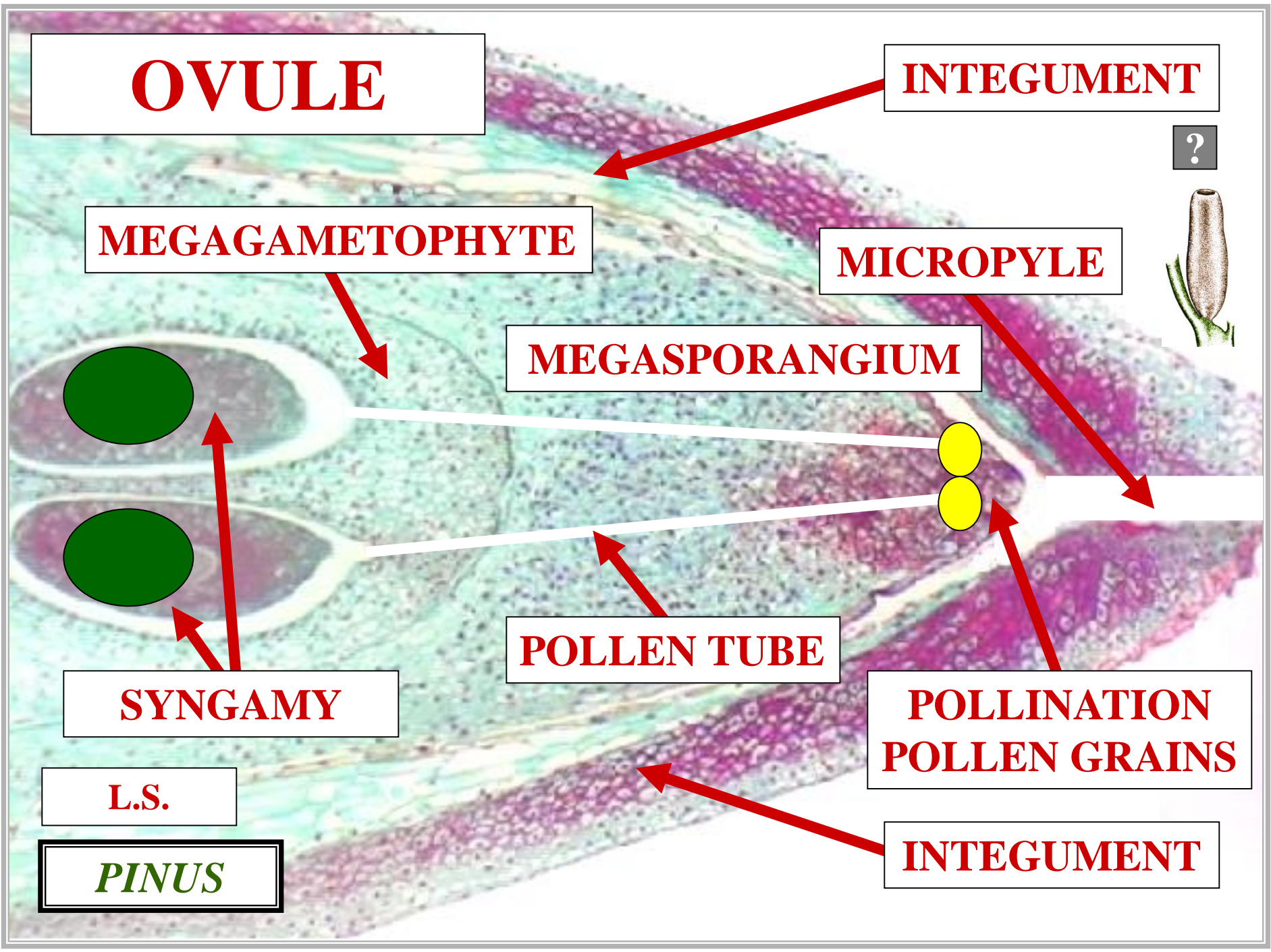
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POLLEN GRAINS**

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MEGAGAMETOPHYTE

MICROPYLE



MEGASPORANGIUM

POLLEN TUBE

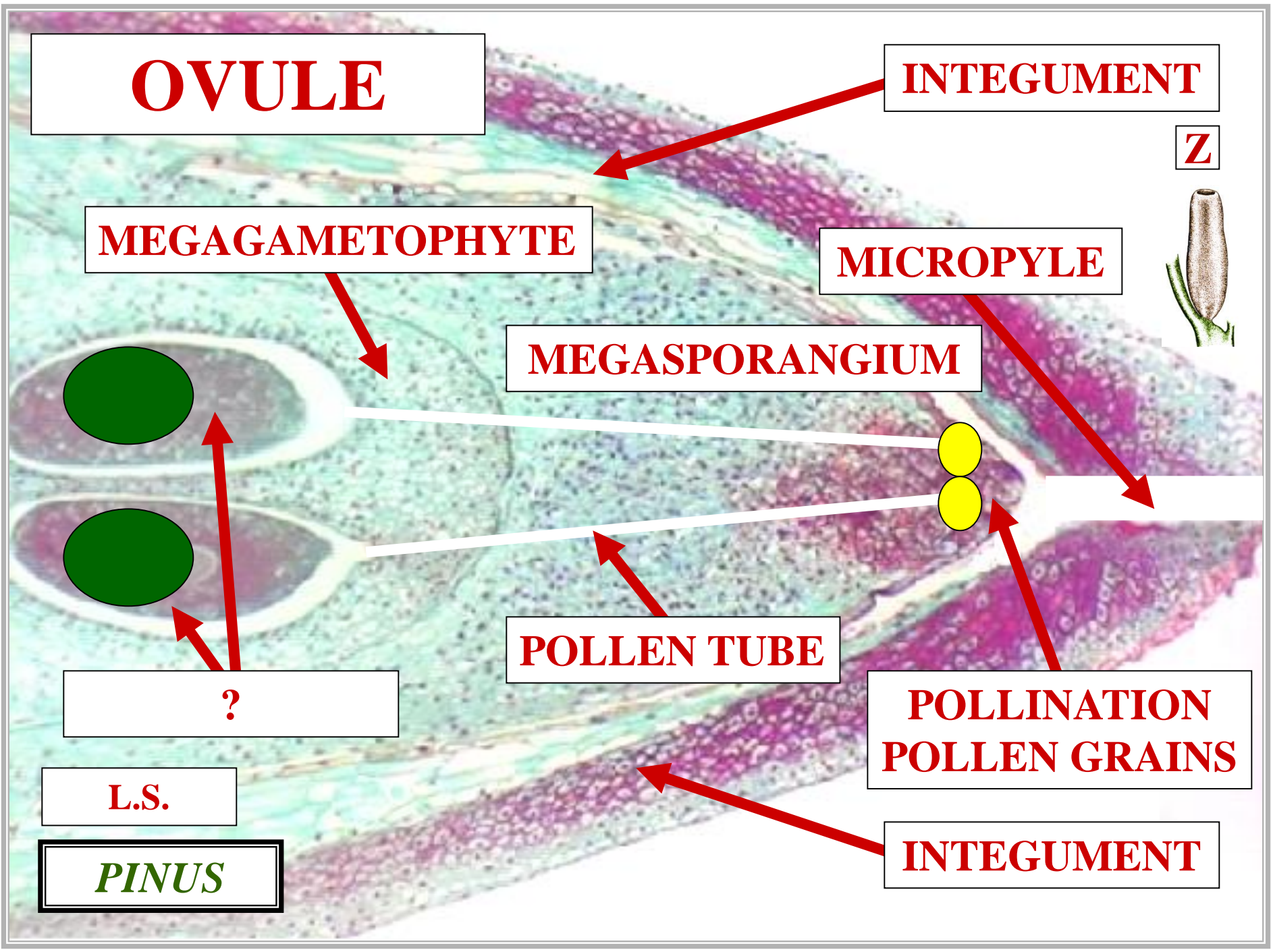
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POLLEN GRAINS**

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MEGAGAMETOPHYTE

MICROPYLE

MEGASPORANGIUM

ZYGOTE

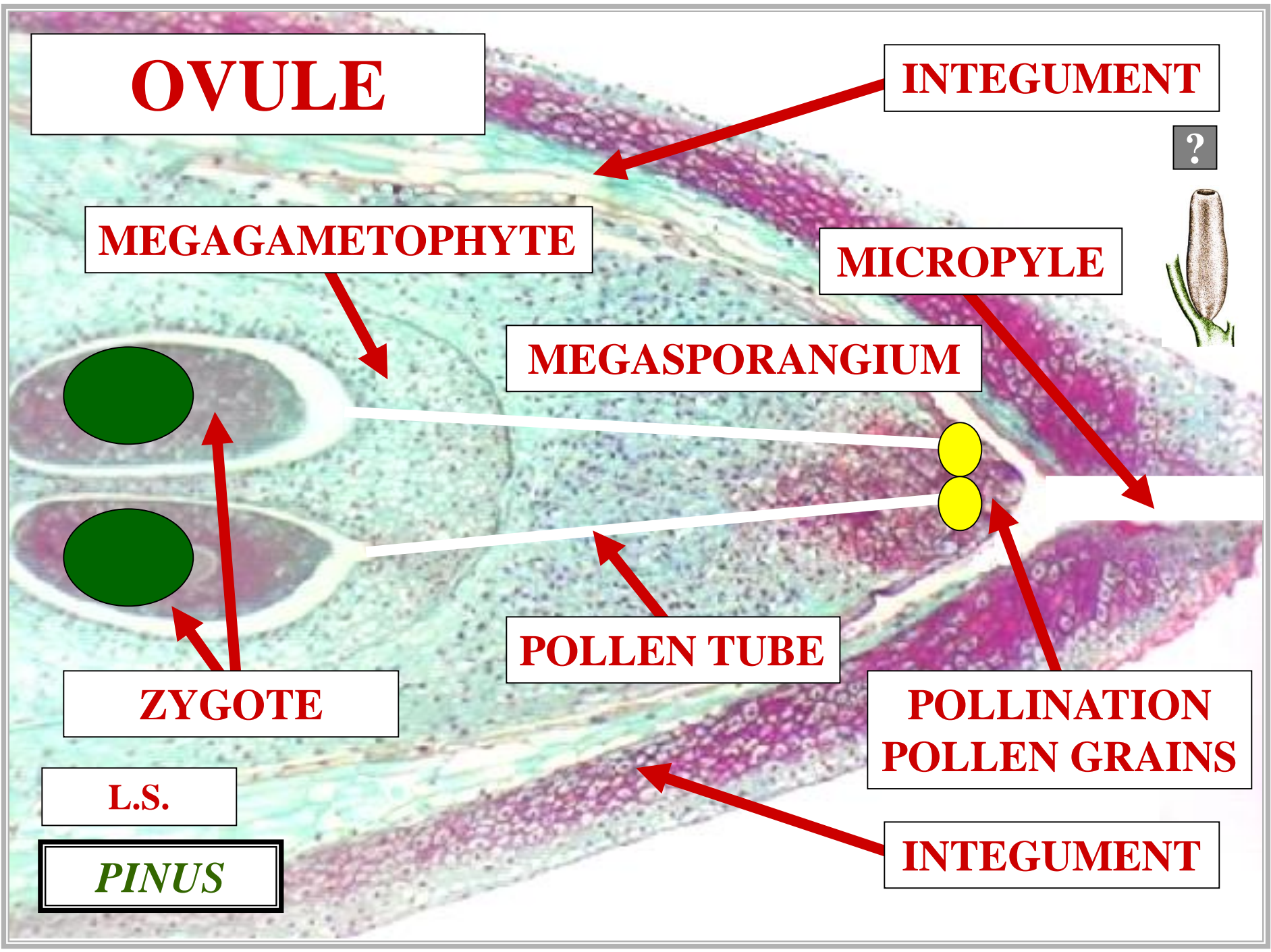
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**POLLINATION
POLLEN GRAINS**

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MEGAGAMETOPHYTE

MICROPYLE



MEGASPORANGIUM

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POLLEN TUBE

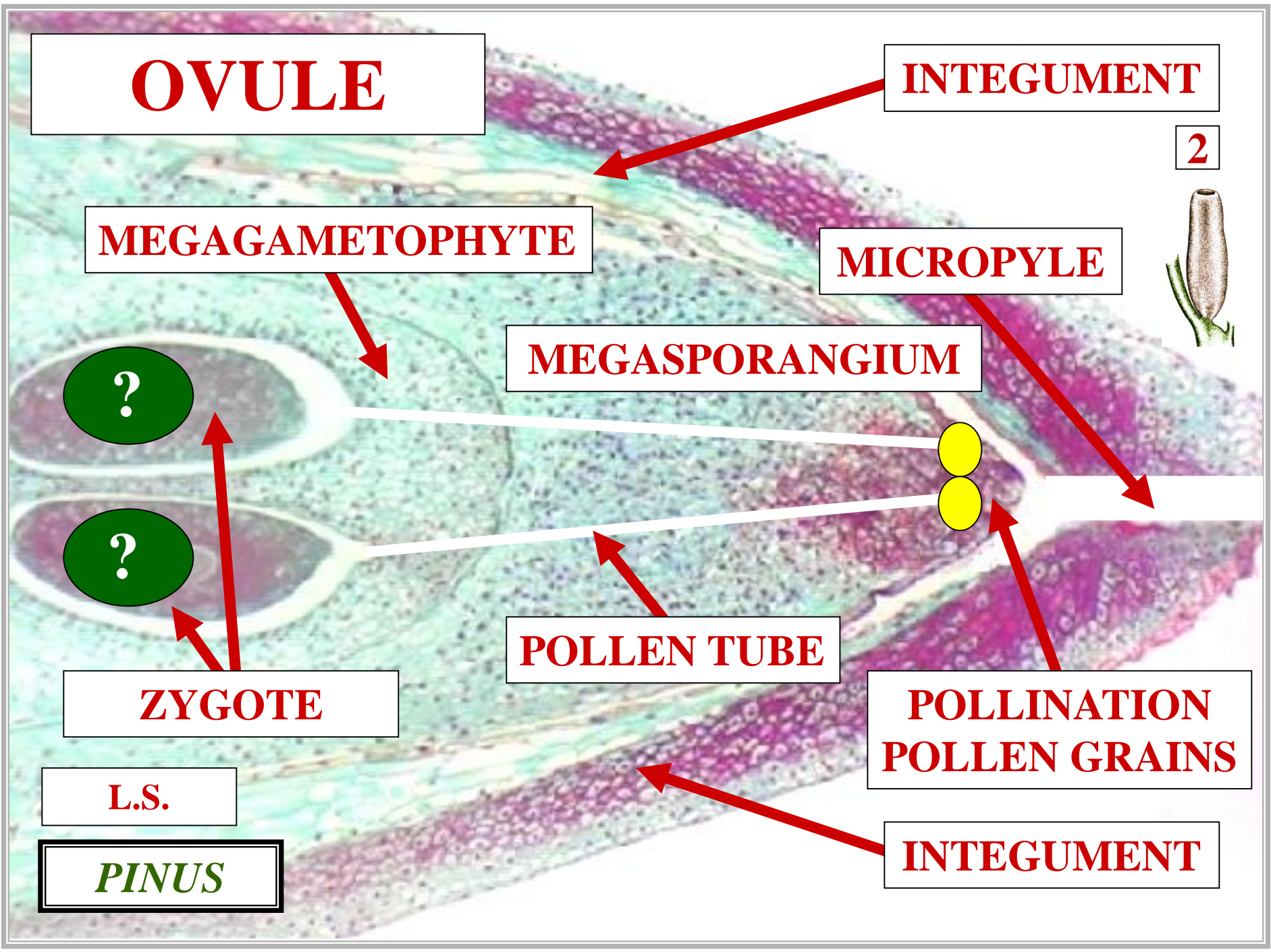
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POLLEN GRAINS**

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MEGAGAMETOPHYTE

MICROPYLE

MEGASPORANGIUM

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POLLEN TUBE

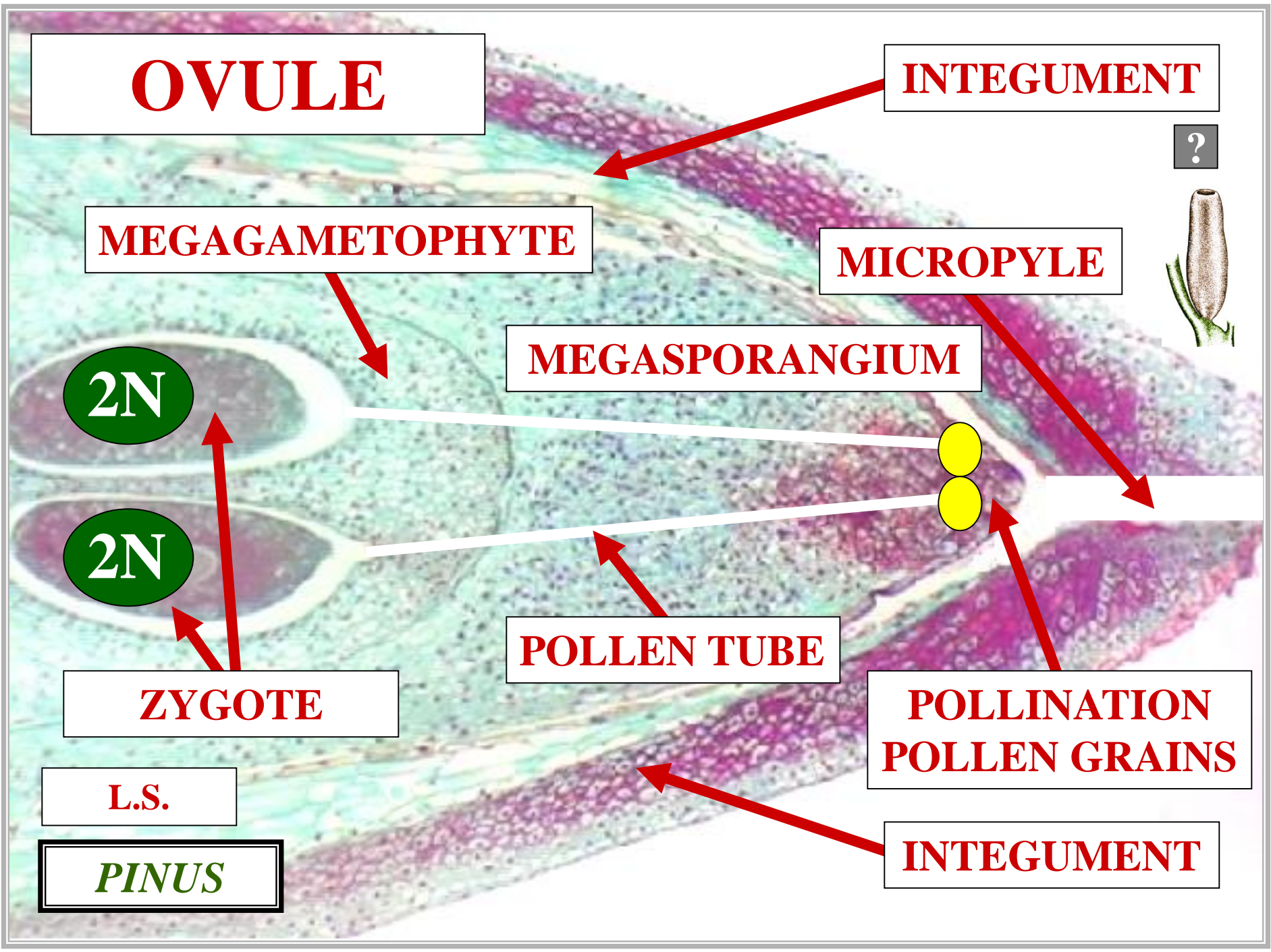
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POLLEN GRAINS**

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MEGAGAMETOPHYTE

MICROPYLE

MEGASPORANGIUM

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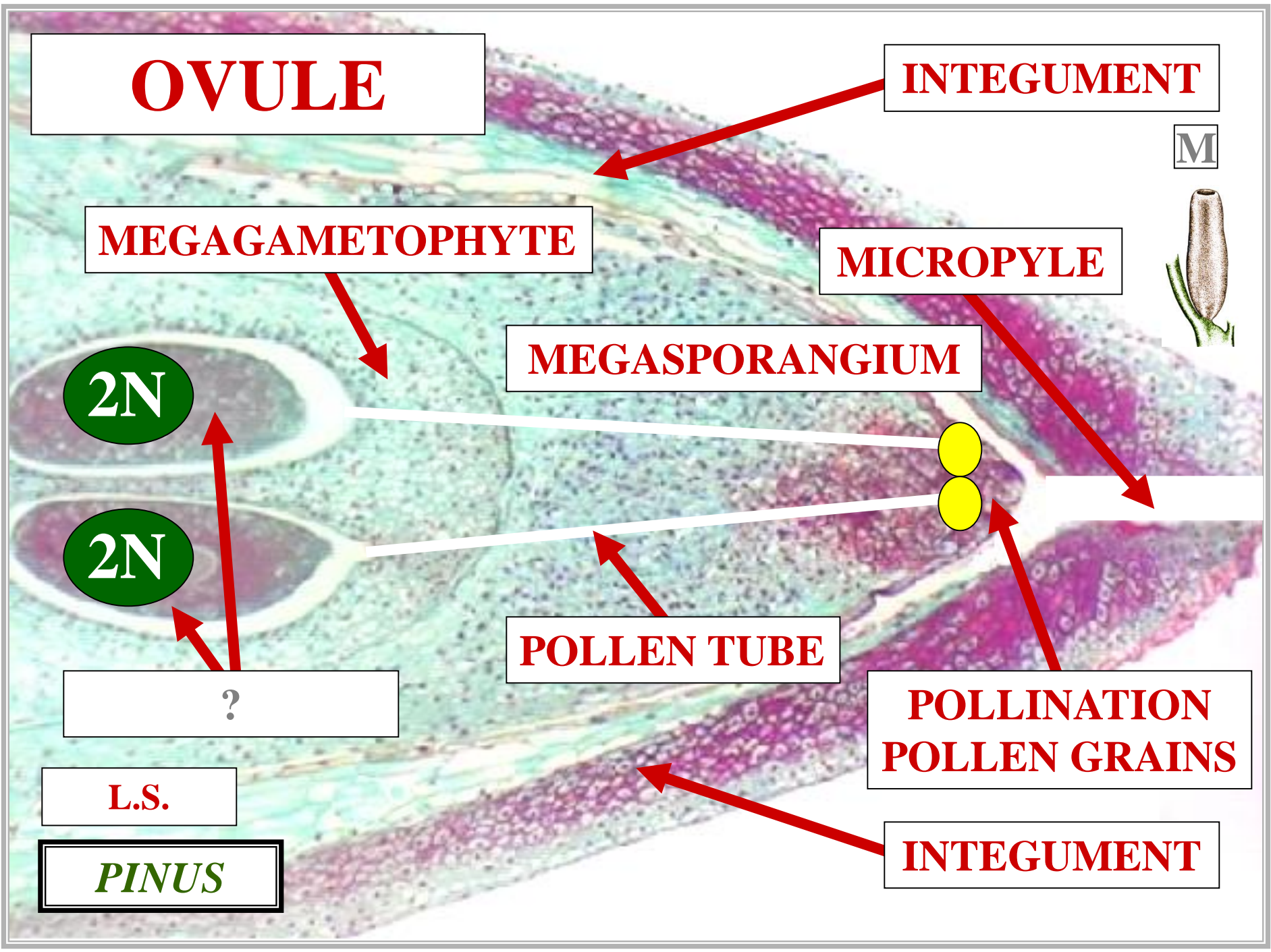
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**POLLINATION
POLLEN GRAINS**

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PINUS

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MEGAGAMETOPHYTE

MICROPYLE



MEGASPORANGIUM

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POLLEN TUBE

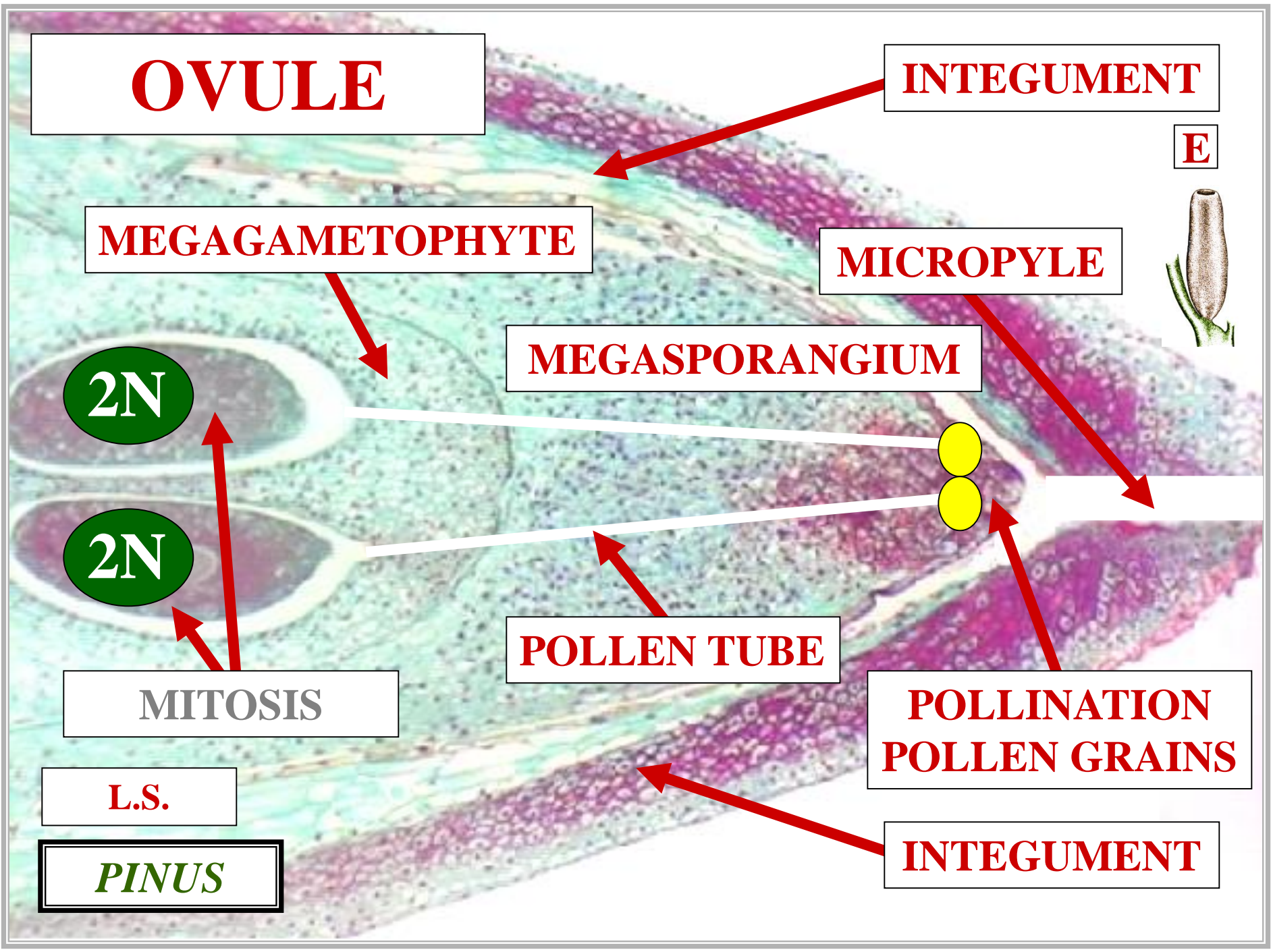
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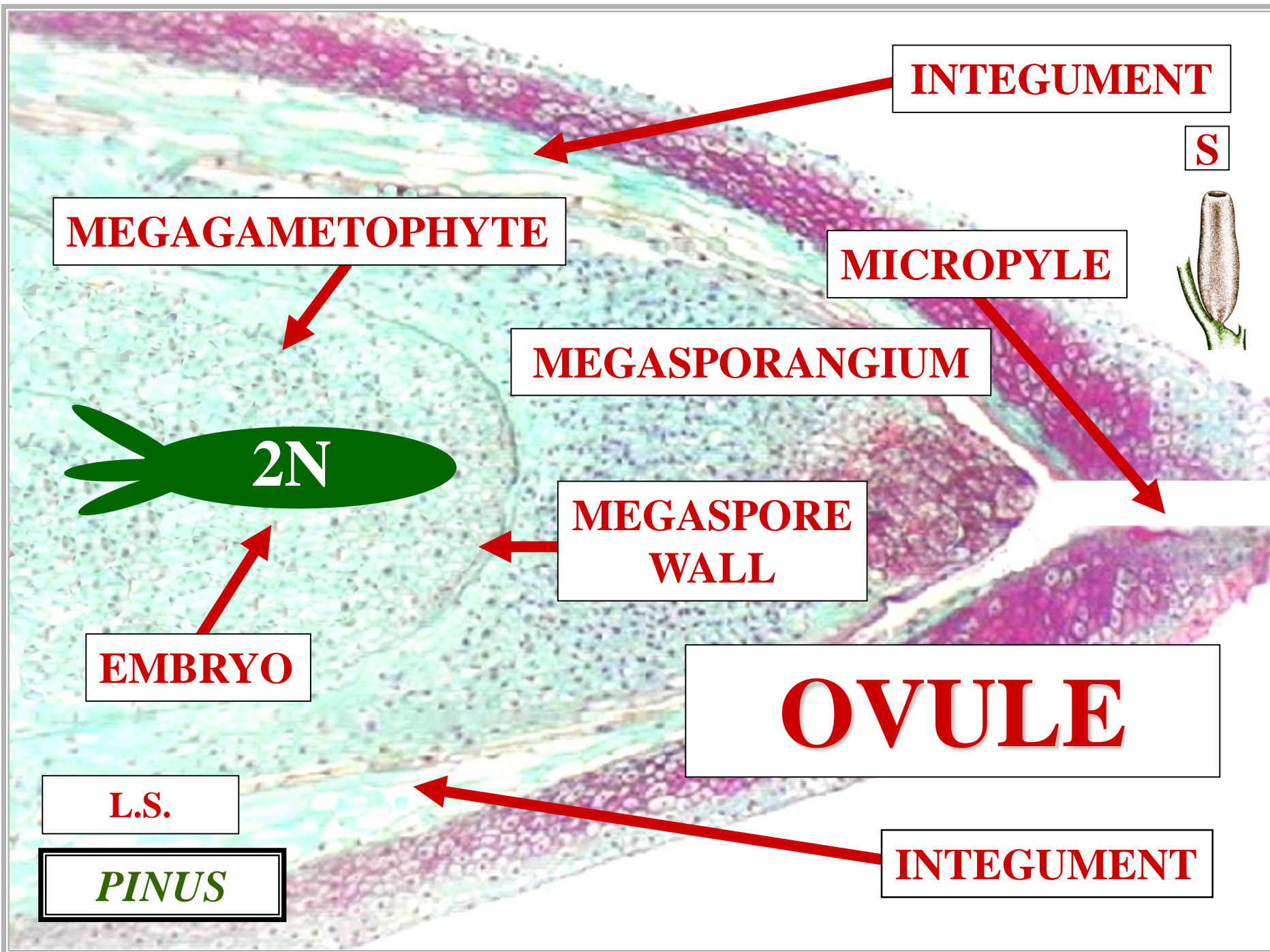
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POLLEN GRAINS**

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INTEGUMENT

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MEGAGAMETOPHYTE

MICROPYLE

MEGASPORANGIUM



MEGASPORE WALL

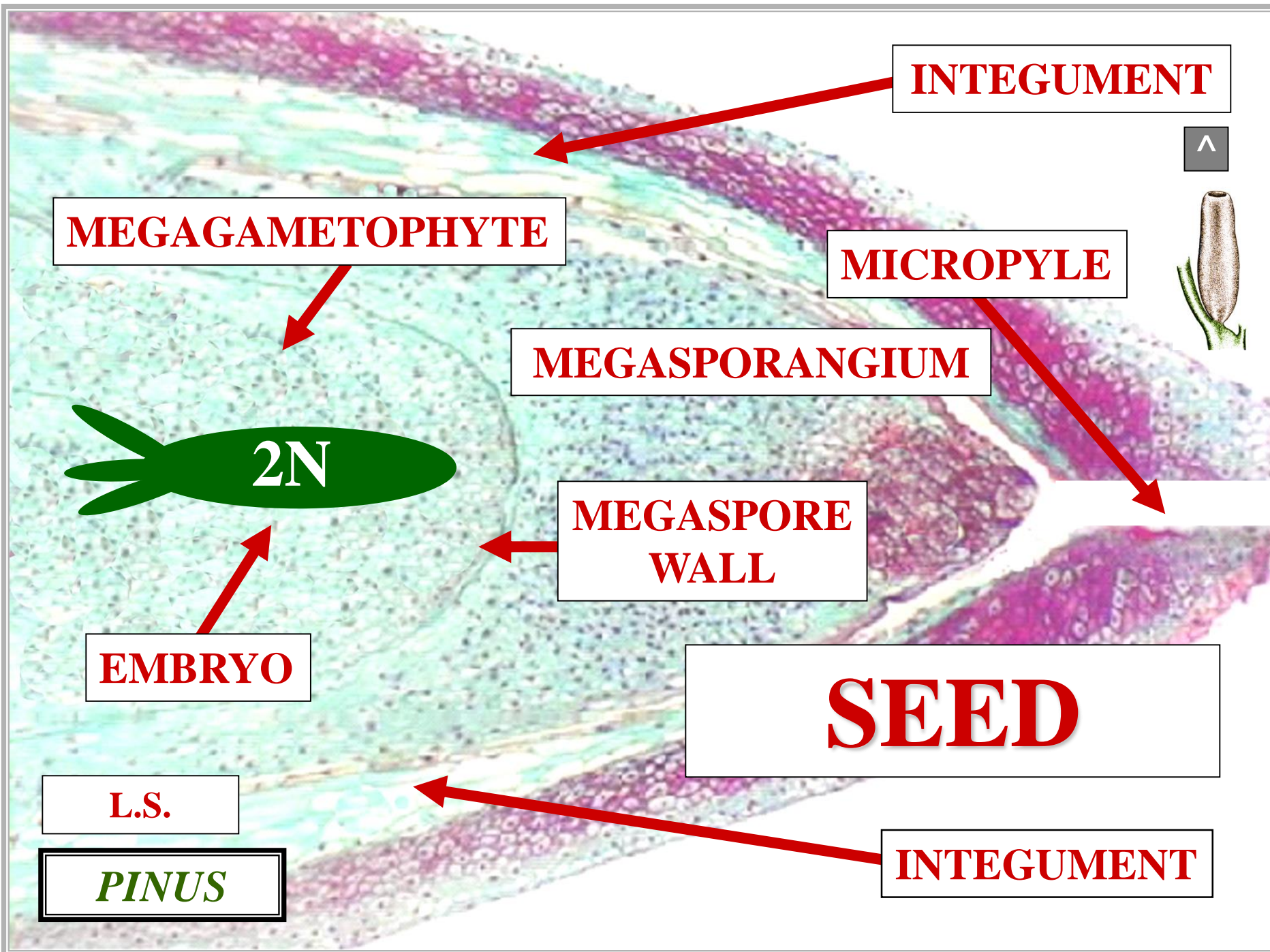
EMBRYO

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INTEGUMENT

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INTEGUMENT



MEGAGAMETOPHYTE



MICROPYLE



MEGASPORANGIUM



MEGASPORE WALL



EMBRYO



SEED

L.S.



INTEGUMENT



PINUS

DEFINITION

OVULE / SEED

OVULE

**SEED EVOLUTION
OVULE**



IMMATURE SEED

**SEED EVOLUTION
OVULE**

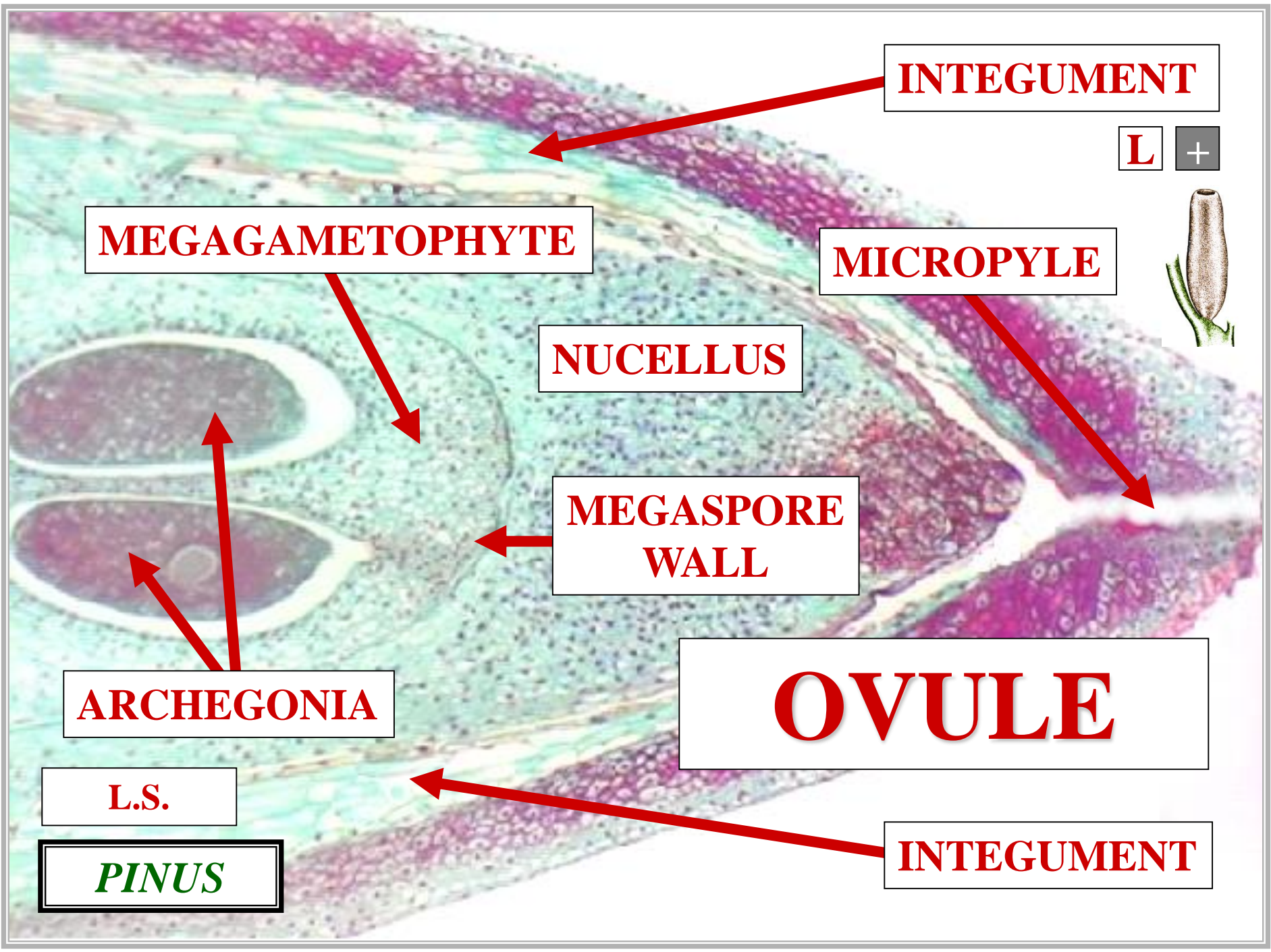
**SEED EVOLUTION
OVULE**



IMMATURE SEED

EMBRYO LACKING

**SEED EVOLUTION
OVULE**



INTEGUMENT

L +



MEGAGAMETOPHYTE

MICROPYLE

NUCELLUS

**MEGASPORE
WALL**

OVULE

ARCHEGONIA

L.S.

PINUS

INTEGUMENT

EMBRYO: LACKING

INTEGUMENT

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MEGAGAMETOPHYTE

MICROPYLE



NUCELLUS

MEGASPORE WALL

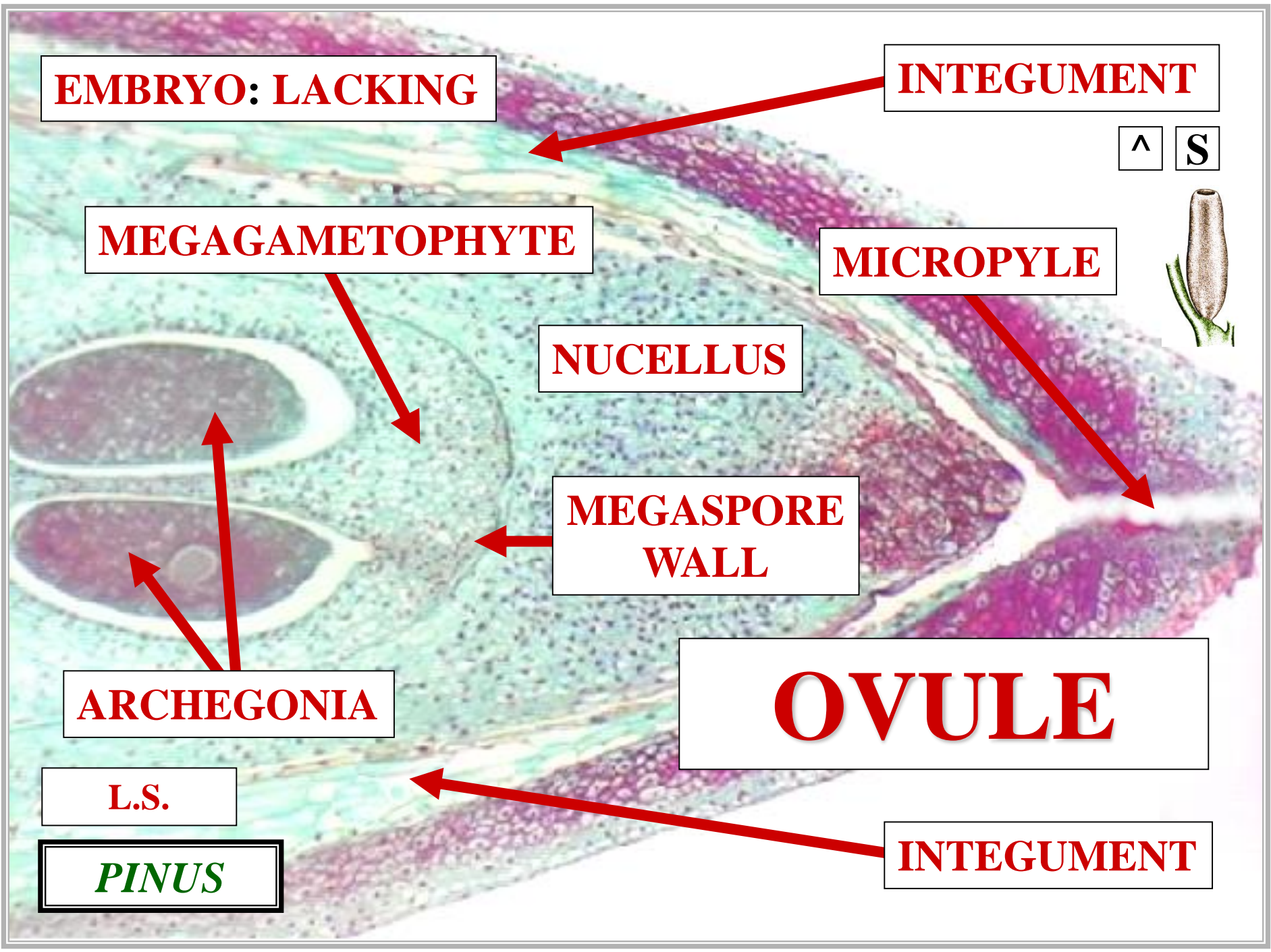
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ARCHEGONIA

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SEED

SEED EVOLUTION
SEED



MATURE OVULE

SEED EVOLUTION
SEED

SEED EVOLUTION

SEED

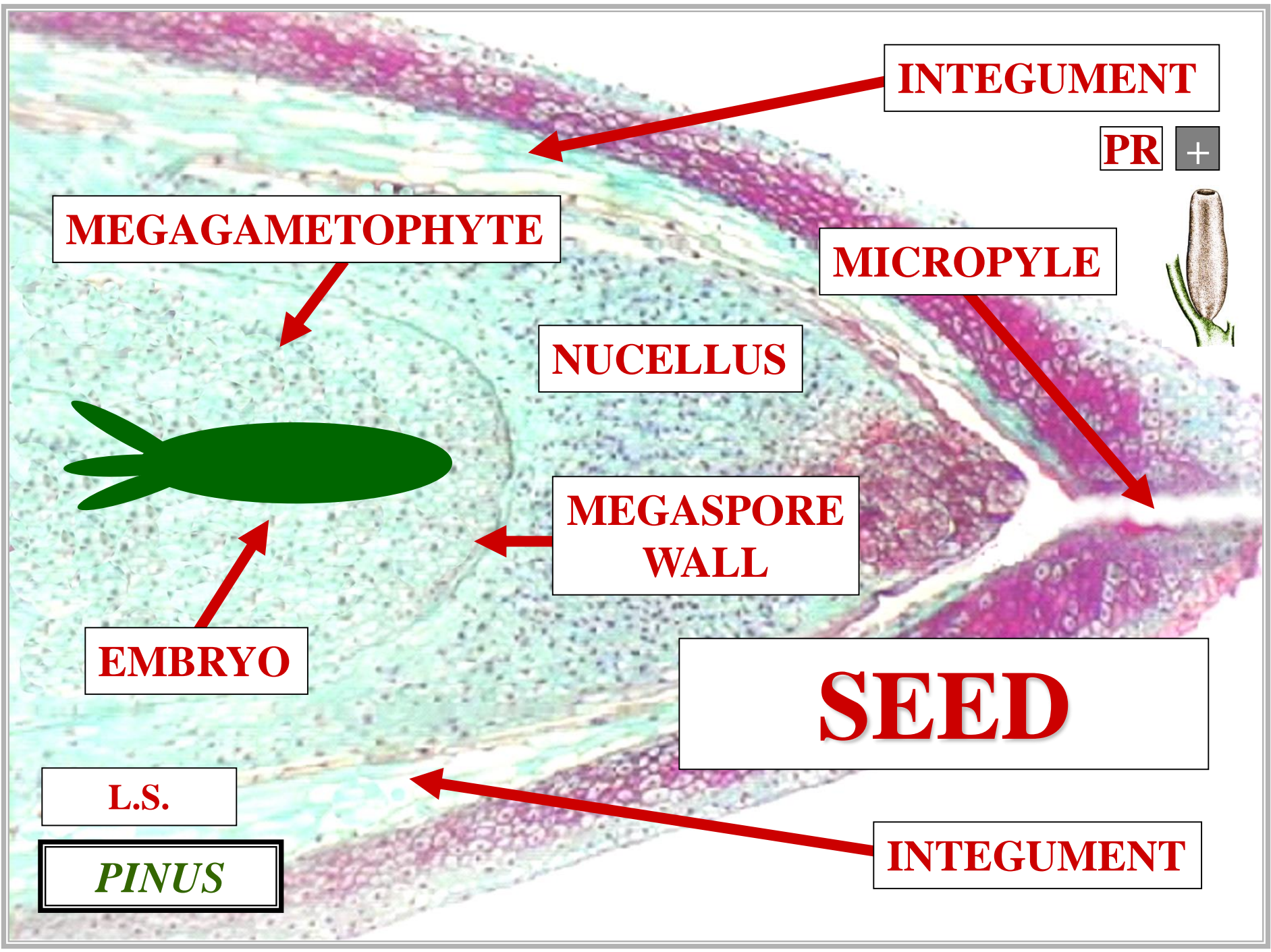


MATURE OVULE

EMBRYO PRESENT

SEED EVOLUTION

SEED



INTEGUMENT

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MEGAGAMETOPHYTE

MICROPYLE

NUCELLUS

MEGASPORE WALL

SEED

EMBRYO

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INTEGUMENT

EMBRYO: PRESENT

INTEGUMENT

MEGAGAMETOPHYTE

MICROPYLE

NUCELLUS

MEGASPORE WALL

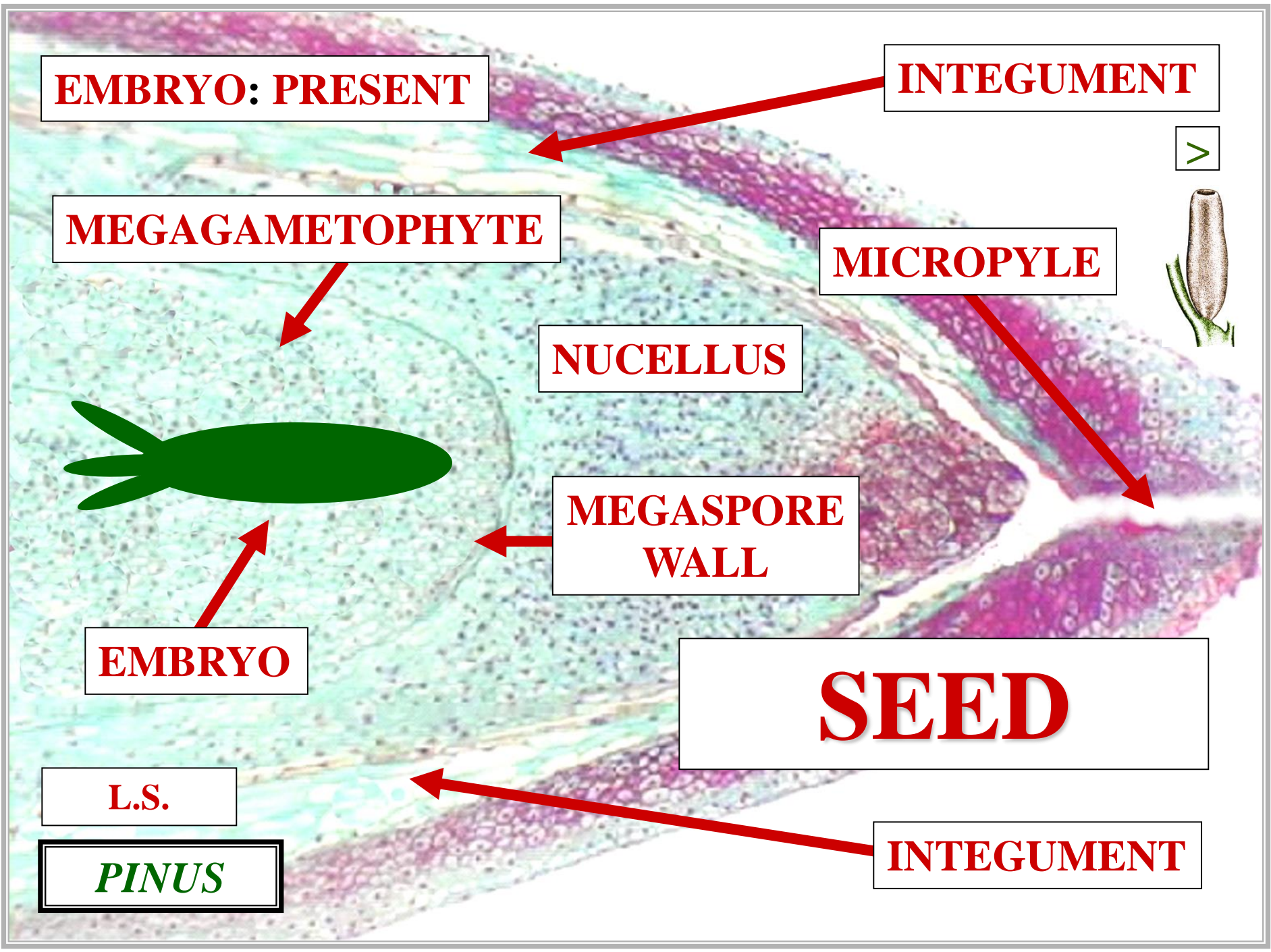
EMBRYO

SEED

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**SPERMATOPHYTE
SEED
ENHANCES
EMBRYO
SURVIVAL**



SEED EMBRYO SURVIVAL



SEED EMBRYO PROTECTION



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MEGAGAMETOPHYTE

MICROPYLE

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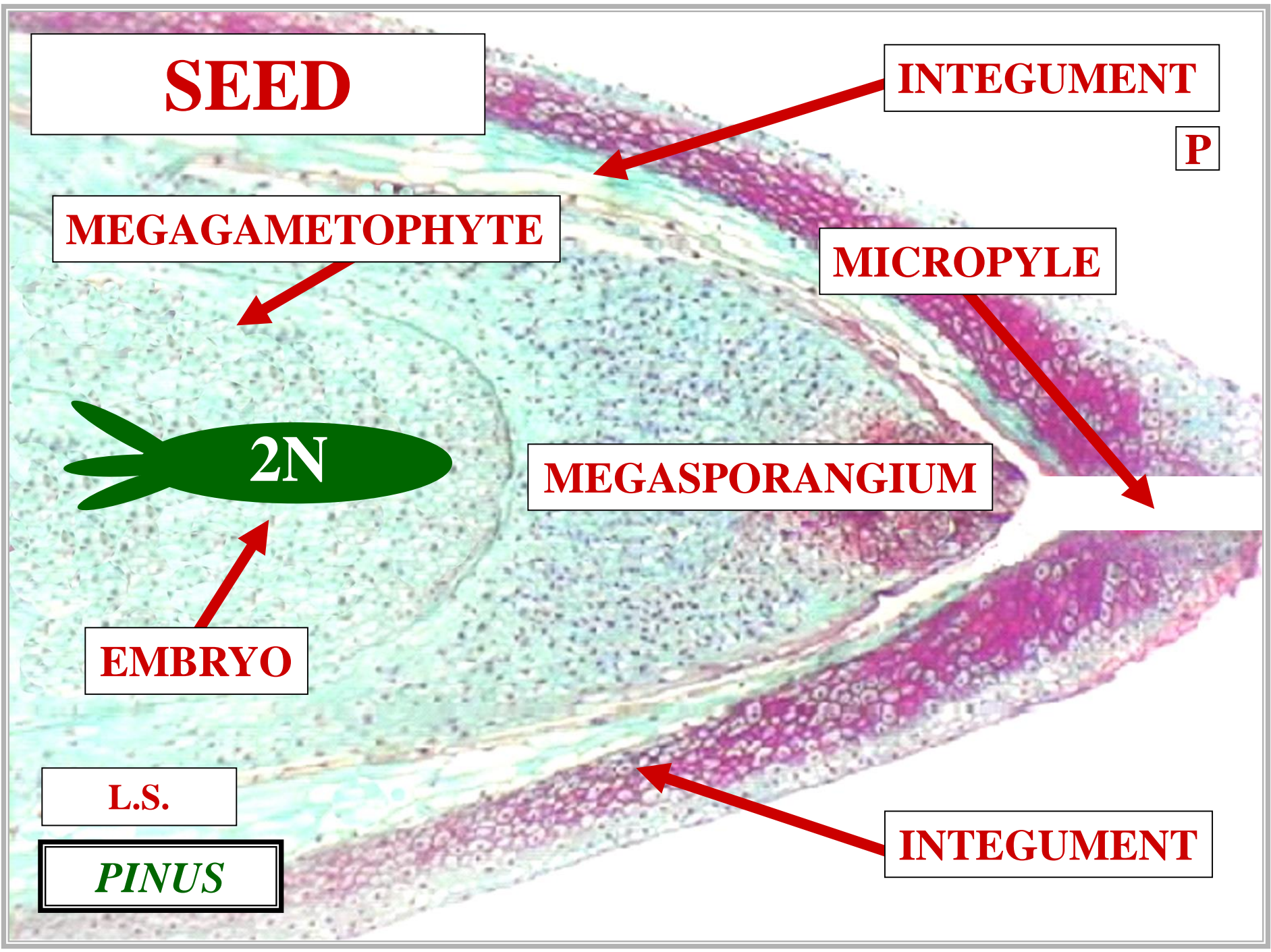
MEGASPORANGIUM

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SEED

**PREVENTS
PHYSICAL
DAMAGE**

MEGAGAMETOPHYTE

MICROPYLE

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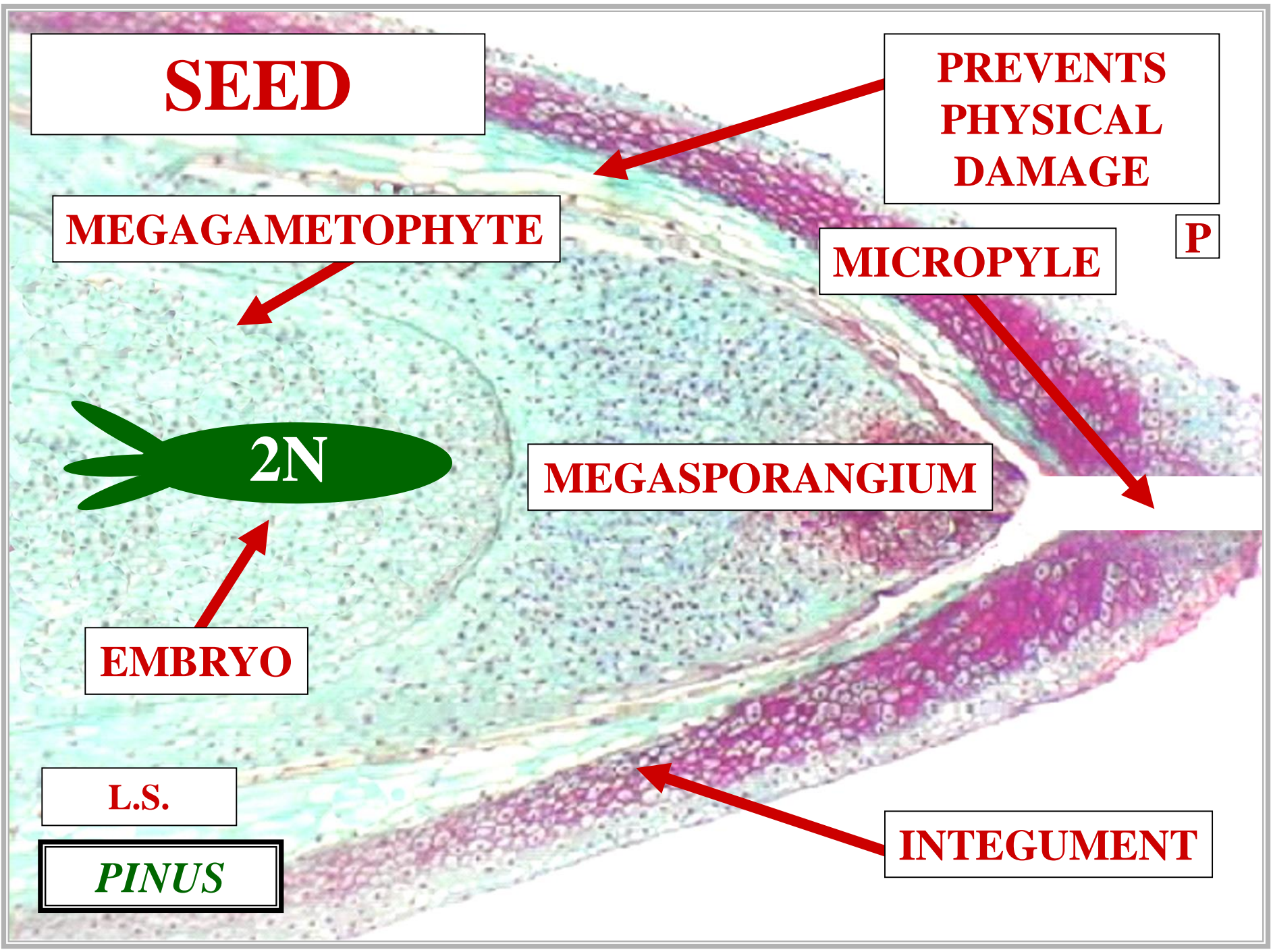
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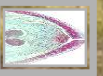




SEED EMBRYO NUTRITION



GYMNOSPERMS



GYMNOSPERMS

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**INHIBITS
PHYSICAL
DAMAGE**

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MICROPYLE

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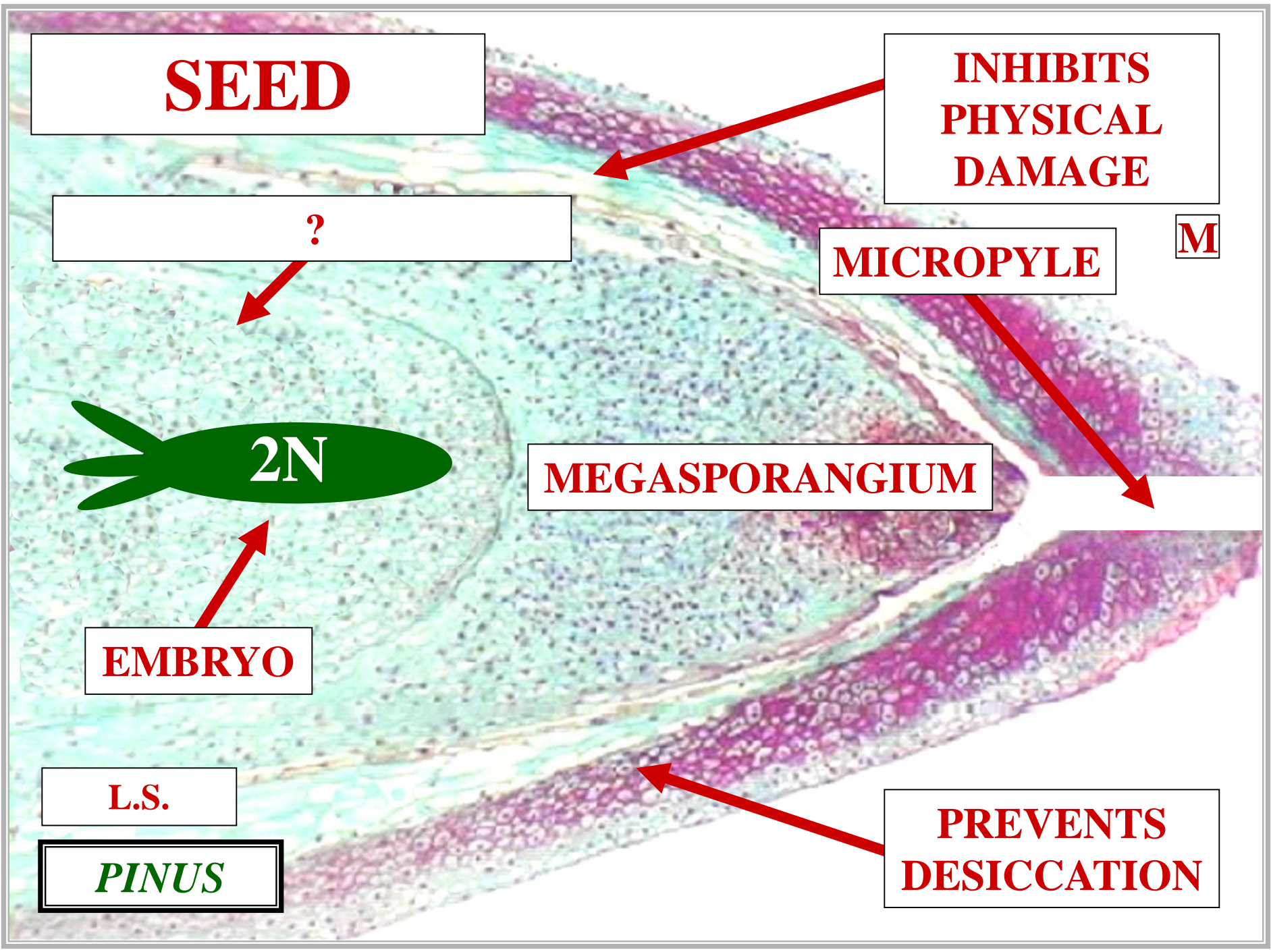
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**PREVENTS
DESICCATION**



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**INHIBITS
PHYSICAL
DAMAGE**

MEGAGAMETOPHYTE

MICROPYLE

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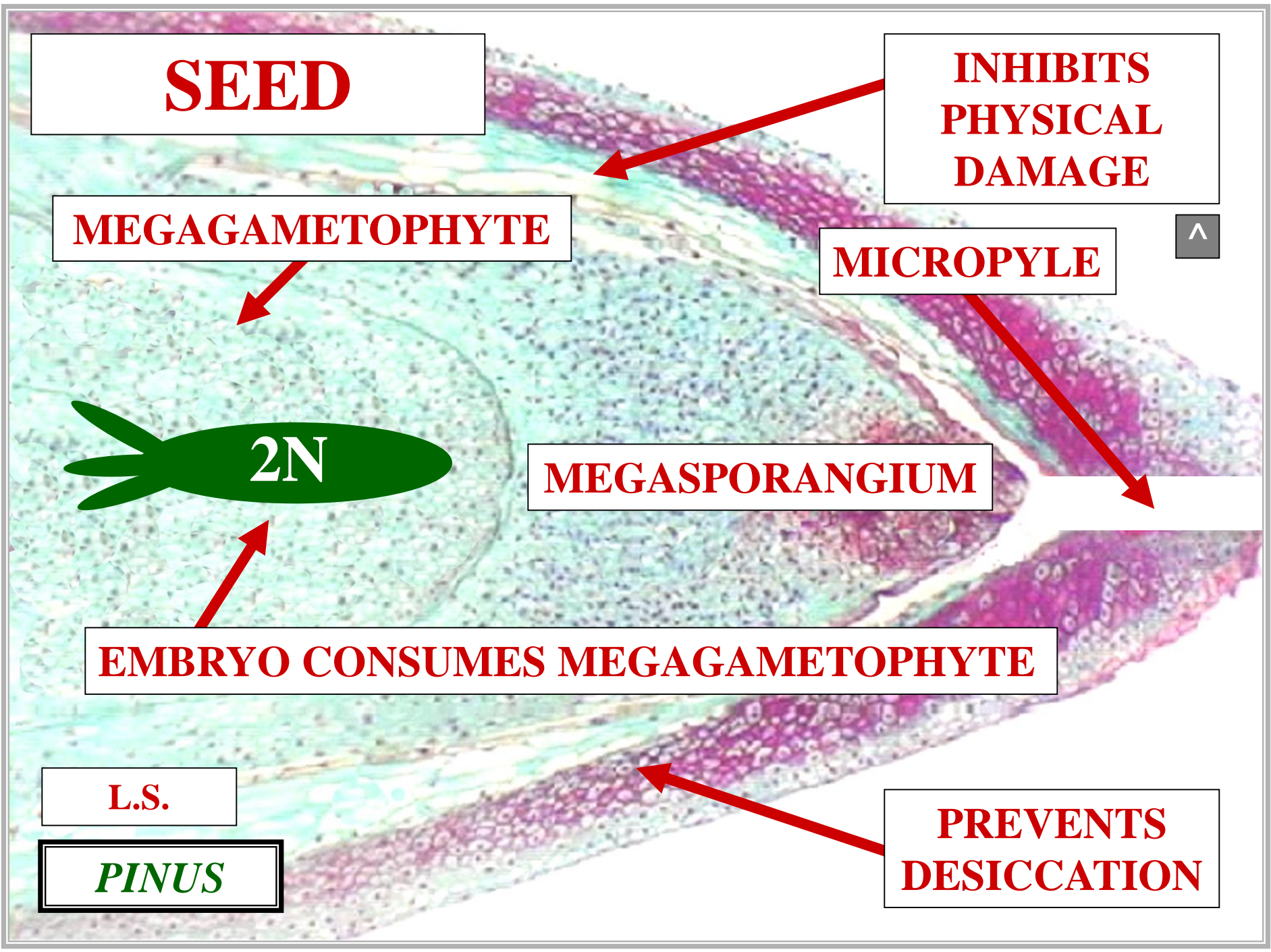
MEGASPORANGIUM

EMBRYO CONSUMES MEGAGAMETOPHYTE

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**PREVENTS
DESICCATION**





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ANGIOSPERMS

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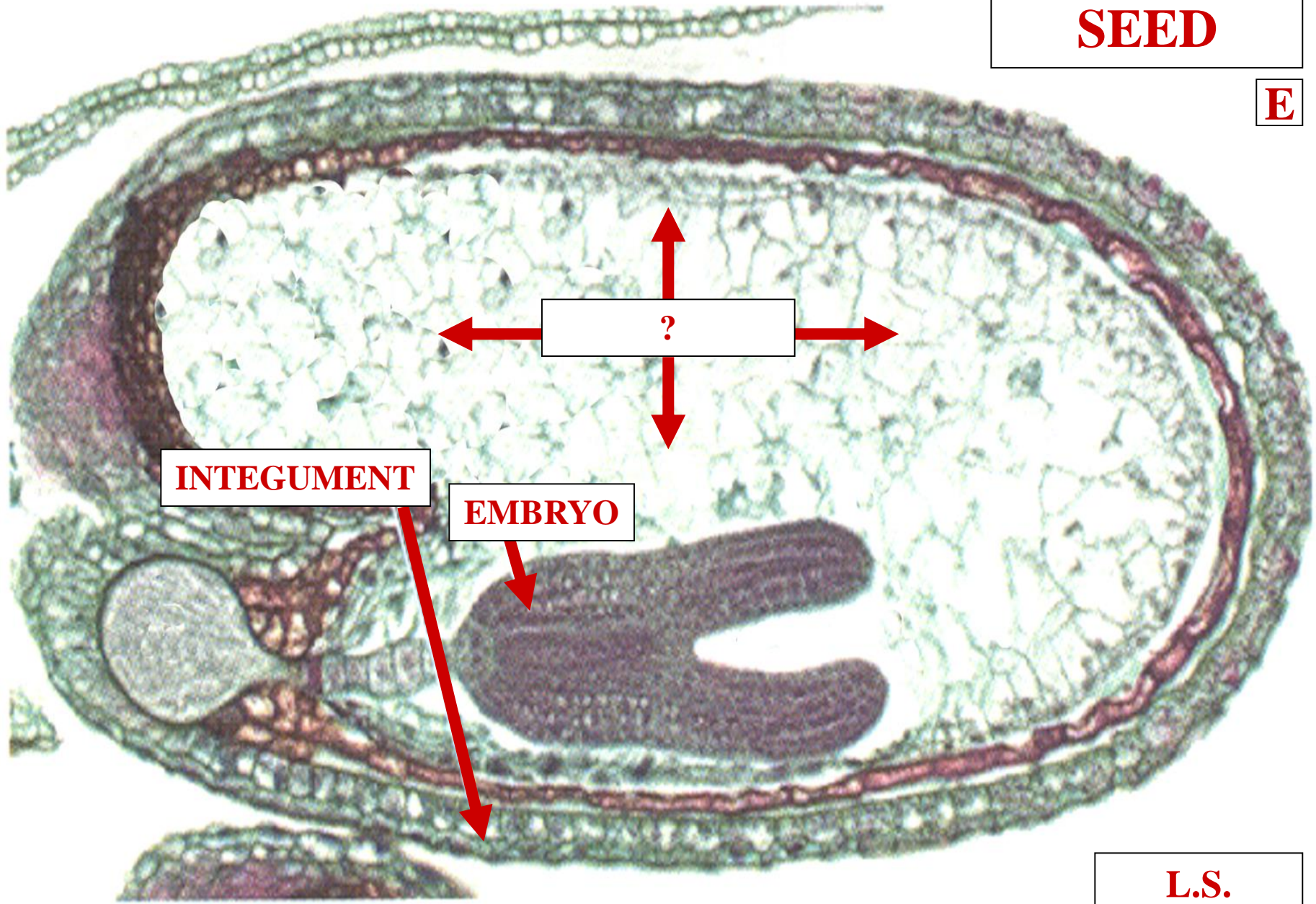
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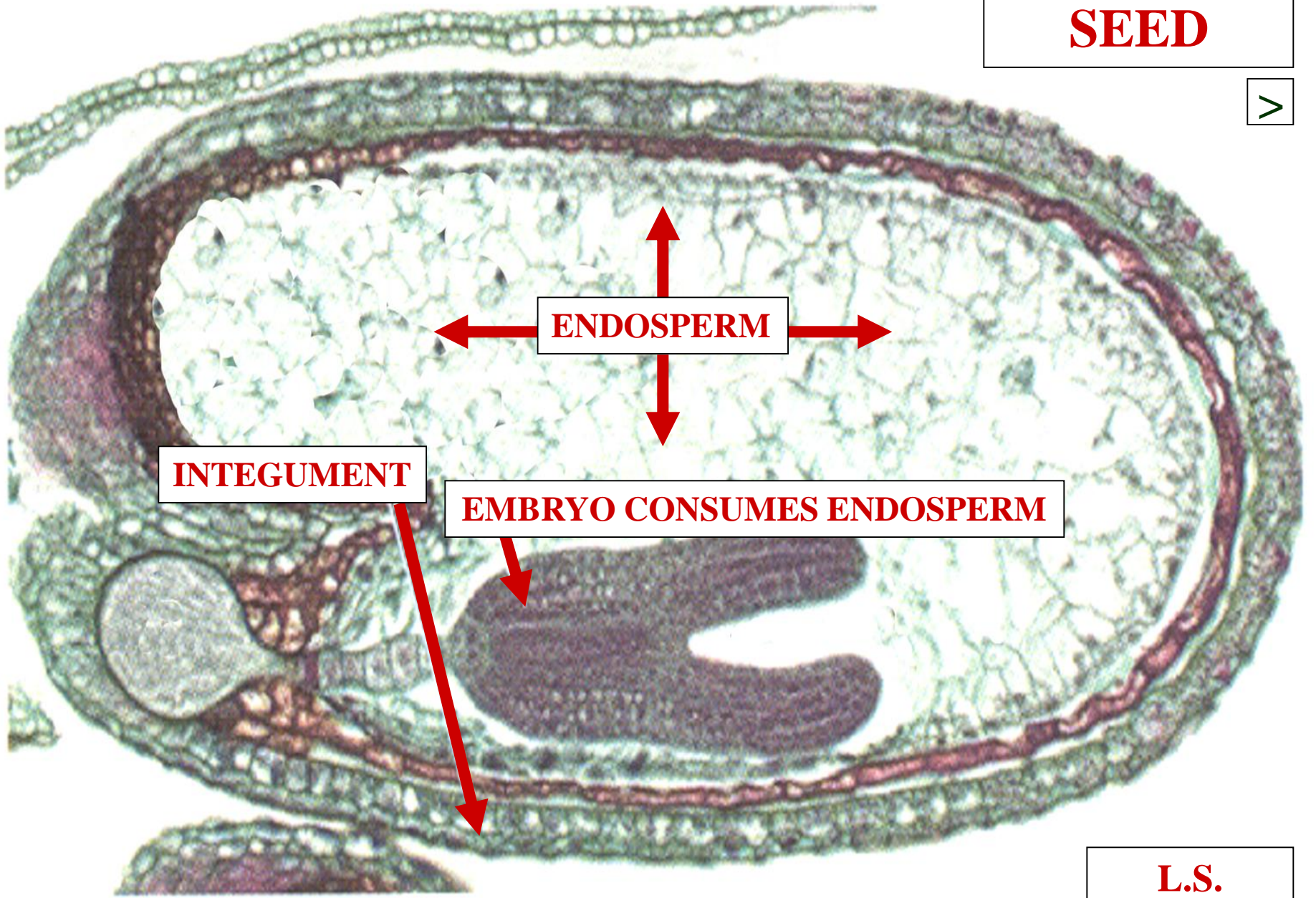


ENDOSPERM

INTEGUMENT

EMBRYO CONSUMES ENDOSPERM

L.S.





**SPERMATOPHYTE
SEED
ENHANCES
EMBRYO
SURVIVAL**



SPERMATOPHYTE FOSSIL RECORD



~360

MILLION YEARS

~385 MILLION YEARS AGO

S

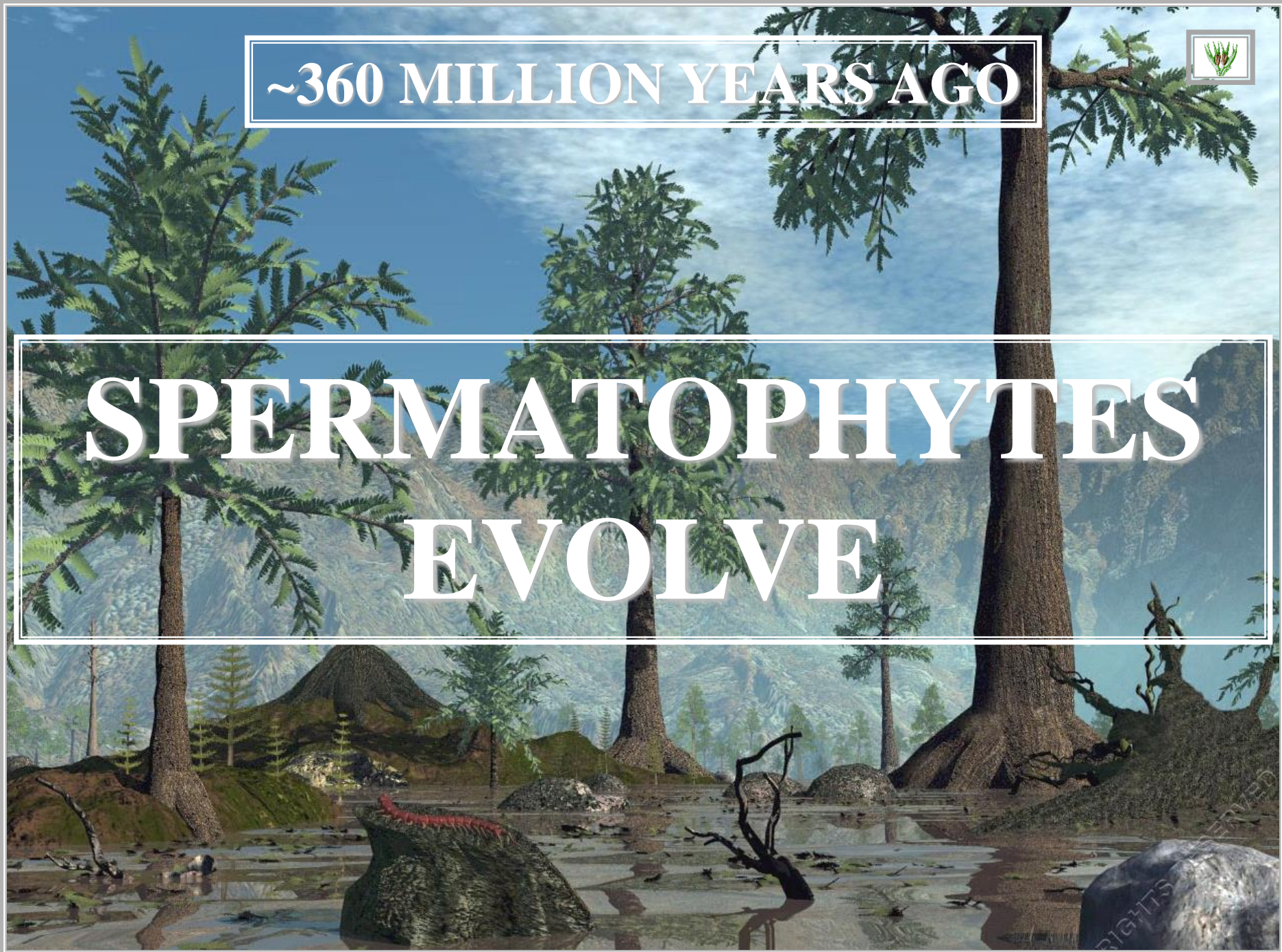
DEVONIAN

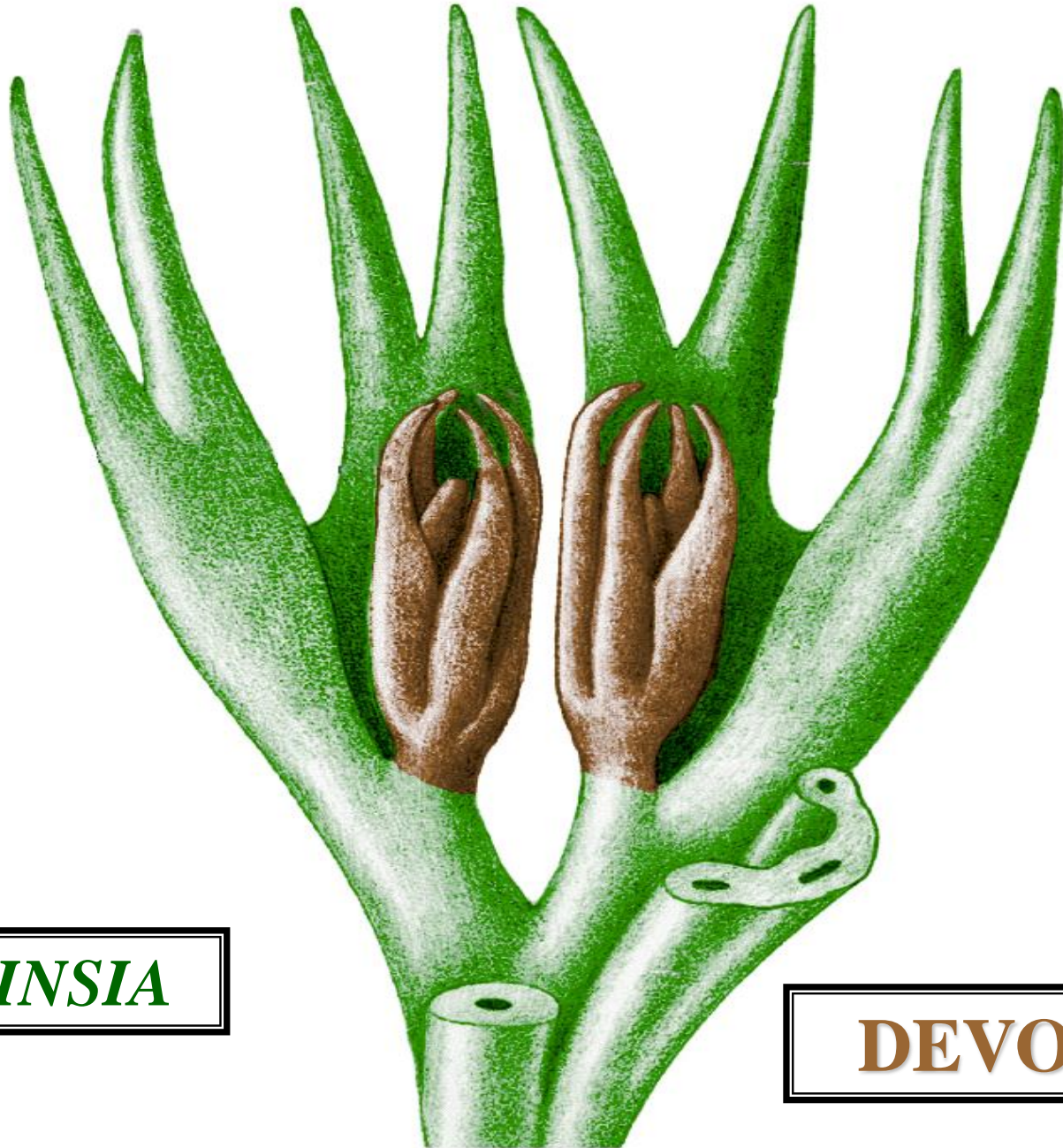


~360 MILLION YEARS AGO



SPERMATOPHYTES EVOLVE





ELKINSIA

DEVONIAN



**OLDEST KNOWN
SPERMATOPHYTE**

ELKINSIA

DEVONIAN



~260

MILLION YEARS

~260 MILLION YEARS AGO

PERMIAN



A vibrant, detailed illustration of a prehistoric landscape. In the foreground, a waterfall cascades over rocks into a pool. The scene is filled with various types of ferns and other ancient plants. In the background, a range of mountains is visible under a clear blue sky. Several dinosaurs are depicted: a long-necked sauropod is partially visible on the left, and a triceratops is in the lower right. The overall atmosphere is one of a thriving, ancient ecosystem.

~260 MILLION YEARS AGO

**SPERMATOPHYTES
DISPLACED
PTERIDOPHYTES**



PRESENT



**SPERMATOPHYTES
DOMINATE
EXTANT
FLORA**

**SEED
EVOLUTION
KEY TO
SPERMATOPHYTES
DOMINANCE
OVER
PTERIDOPHYTES**



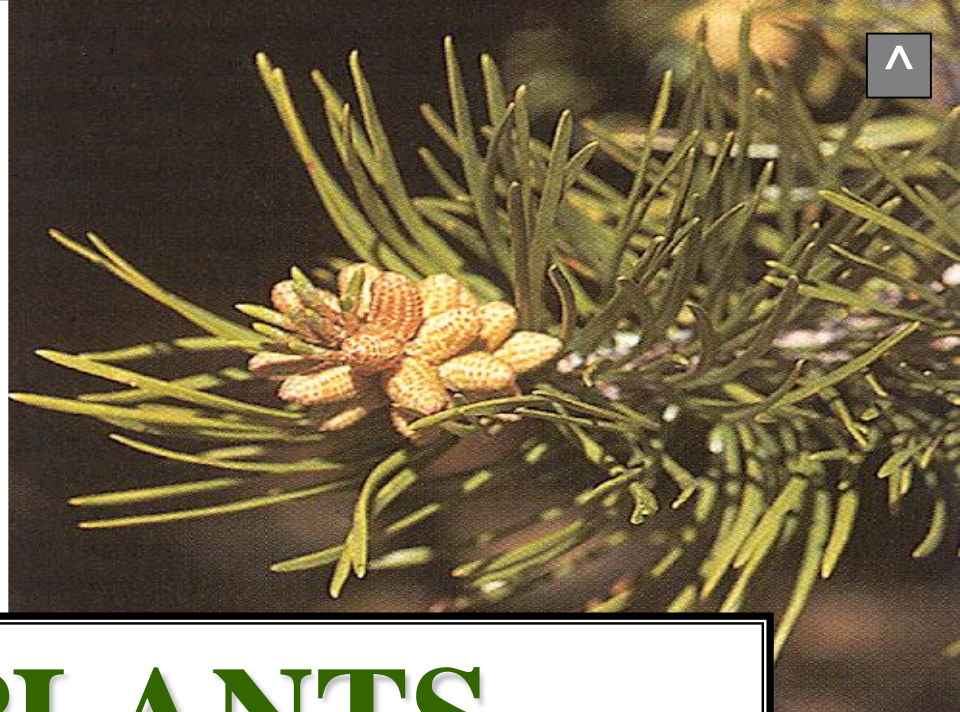
**ALABAMA
SPERMATOPHYTE
DIVERSITY**



ALABAMA SPERMATOPHYTES



COMMON NAME



SEED PLANTS





DIVERSITY



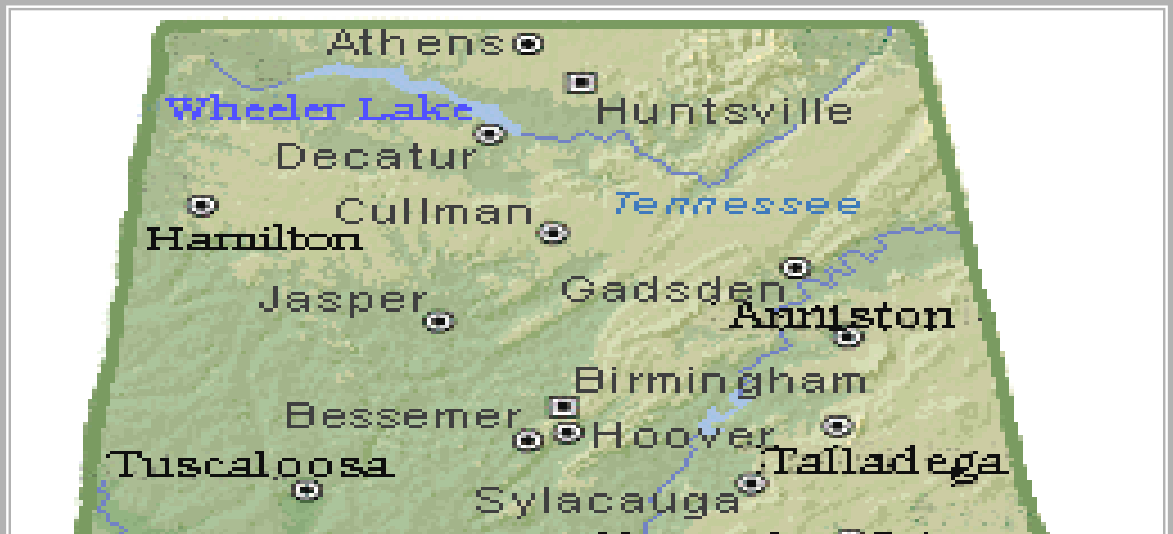
~285,000 SPECIES

EARTH



~300,000 SPECIES

EARTH



~3,500 SPECIES

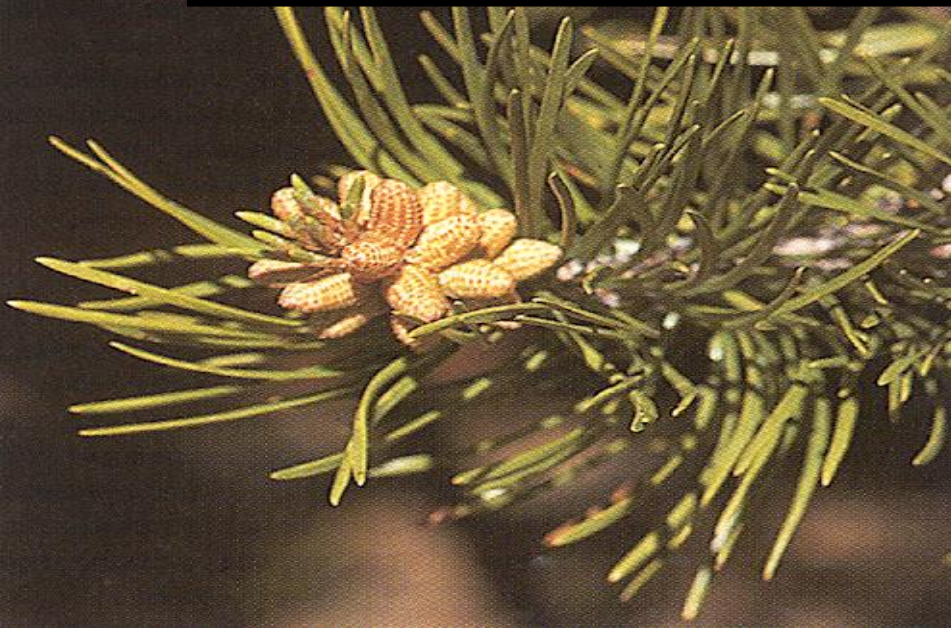


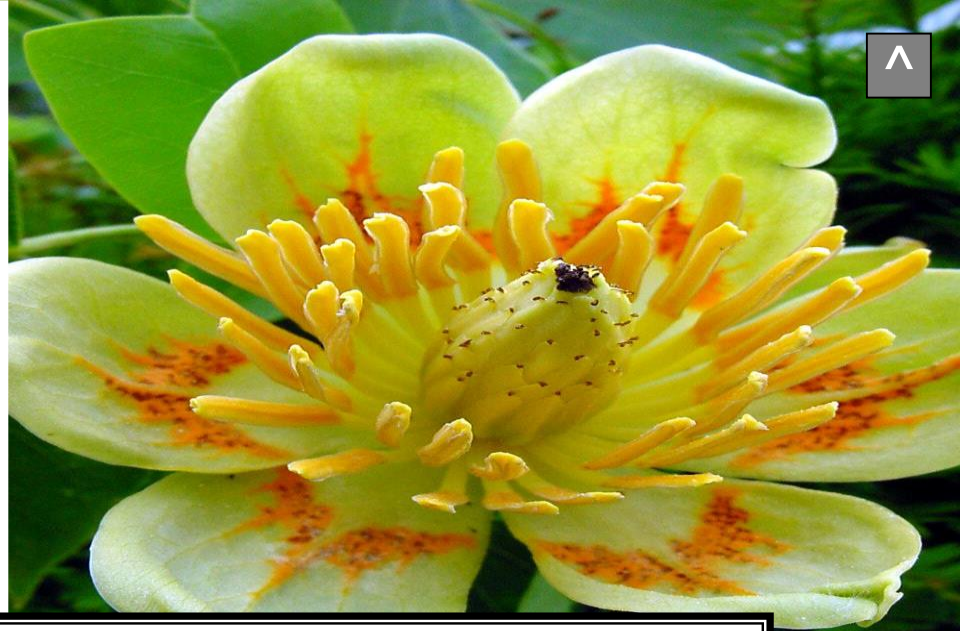


SPERMATOPHYTE EVOLUTION GRADES



GYMNOSPERMS





ANGIOSPERMS





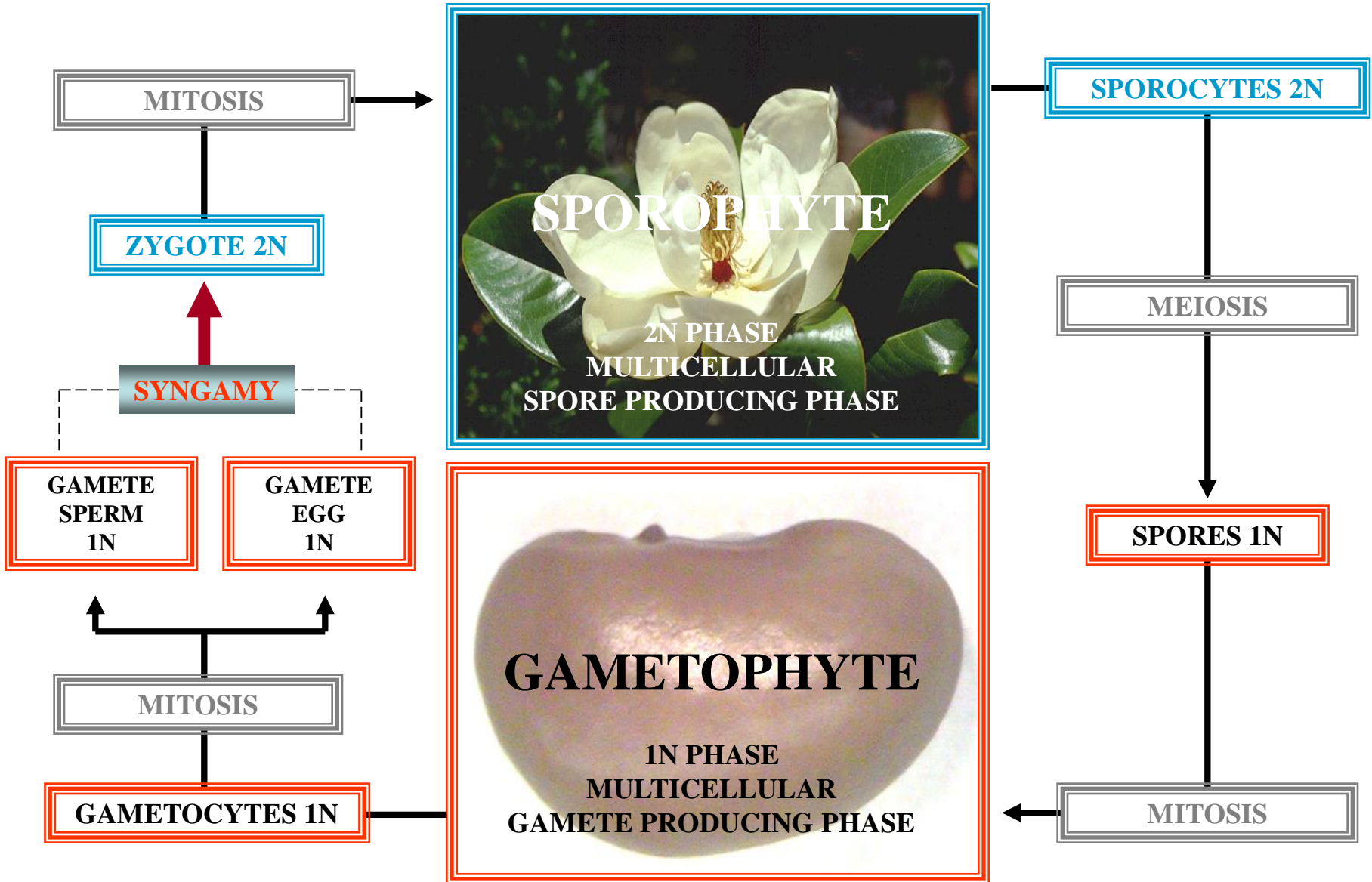
GENERAL CHARACTERS



CONTRAST: GYMNOSPERMS & ANGIOSPERMS



SPERMATOPHYTE LIFE CYCLE





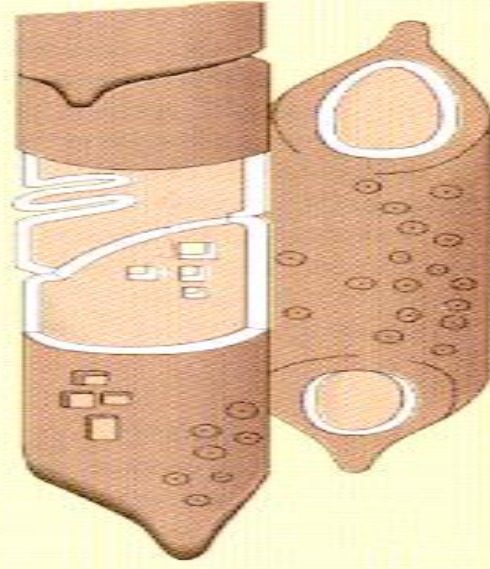
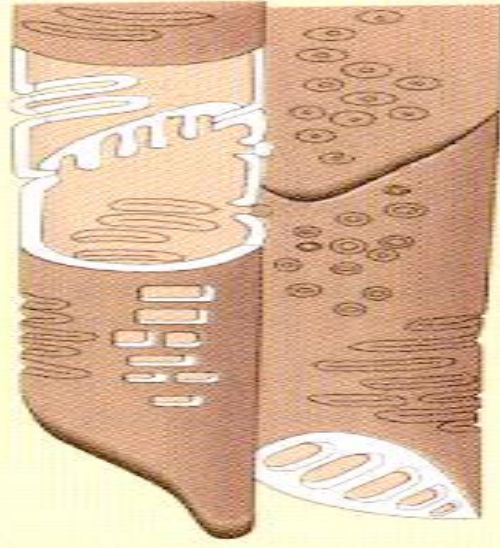
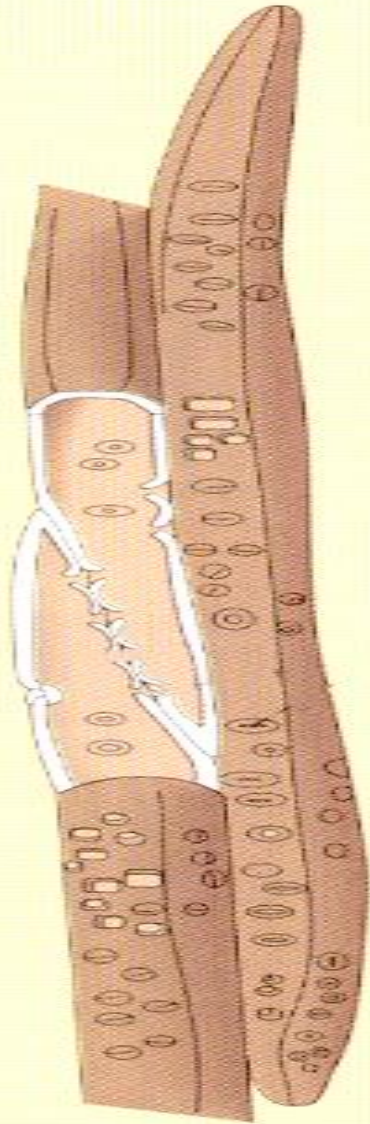
SPOROPHYTE CHARACTERS



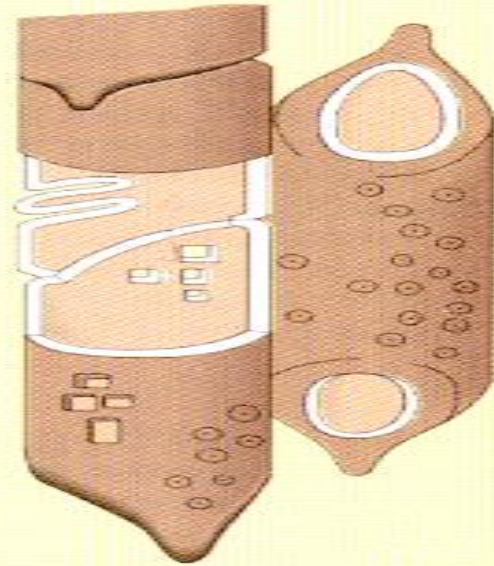
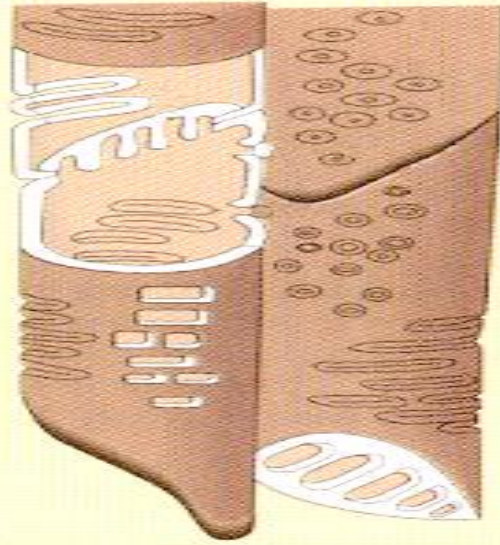
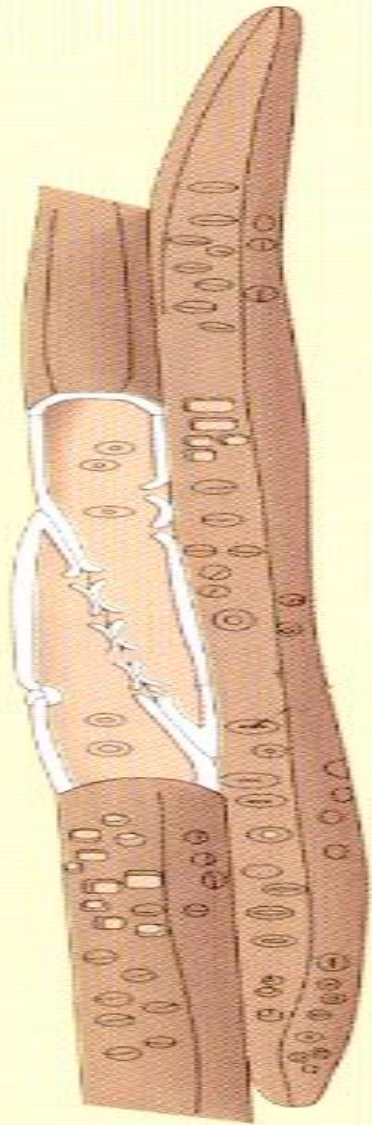
VASCULAR TISSUE



XYLEM



XYLEM CELLS



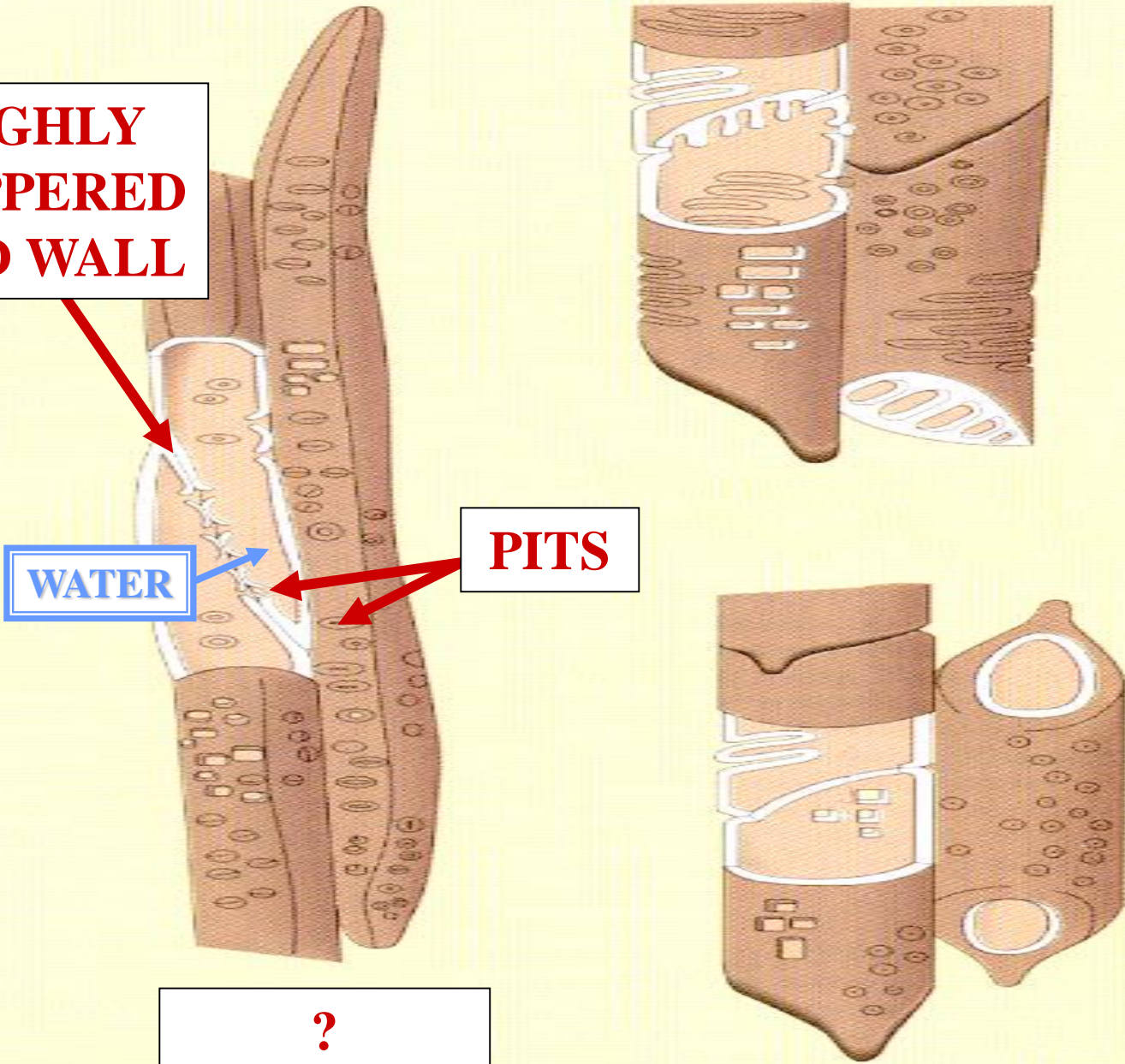
TRACHEARY ELEMENTS

**HIGHLY
TAPPERED
END WALL**

WATER

PITS

?

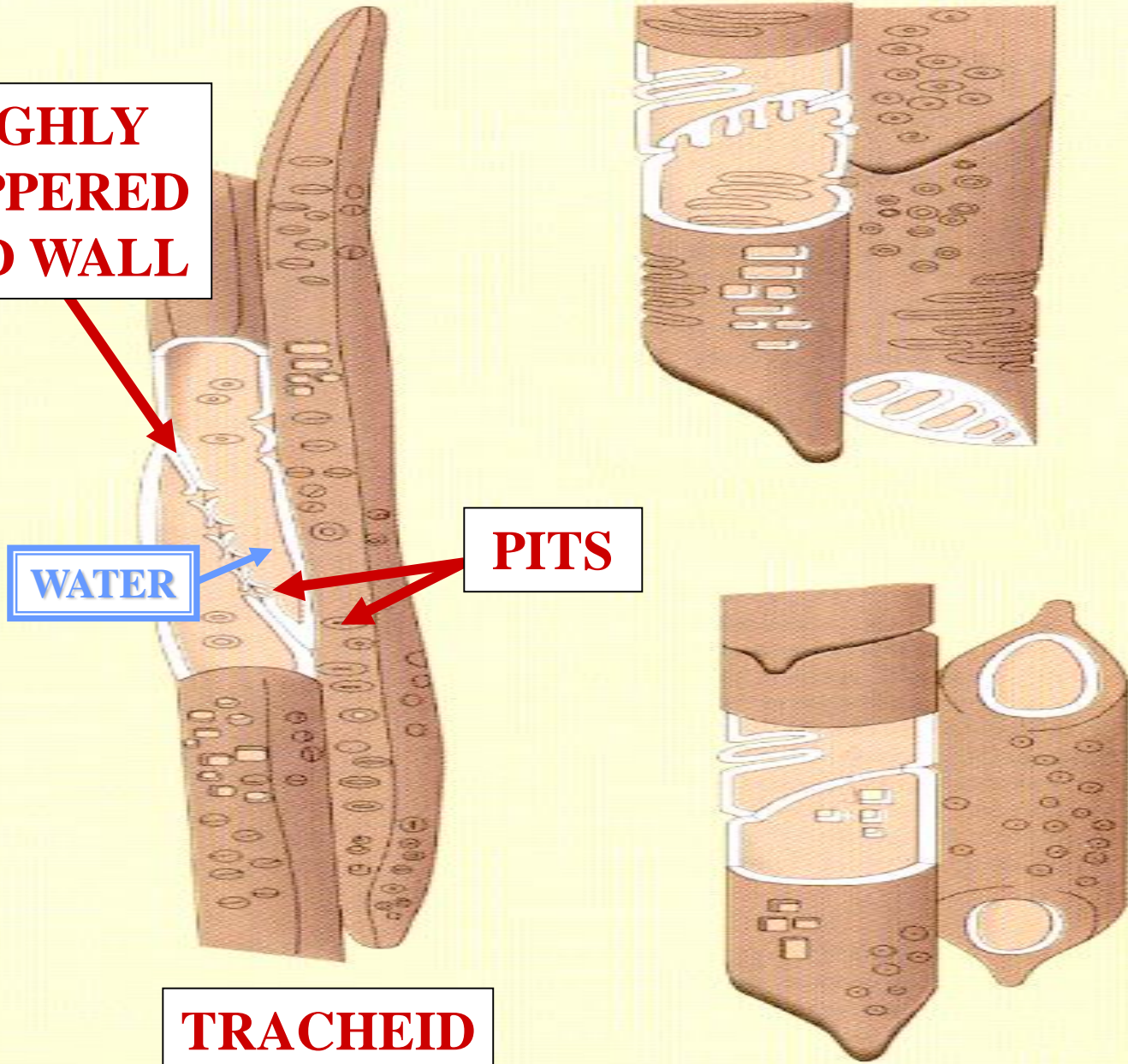


**HIGHLY
TAPPED
END WALL**

WATER

PITS

TRACHEID



**HIGHLY
TAPPED
END WALL**

**LESS
TAPPED
END WALL**

?

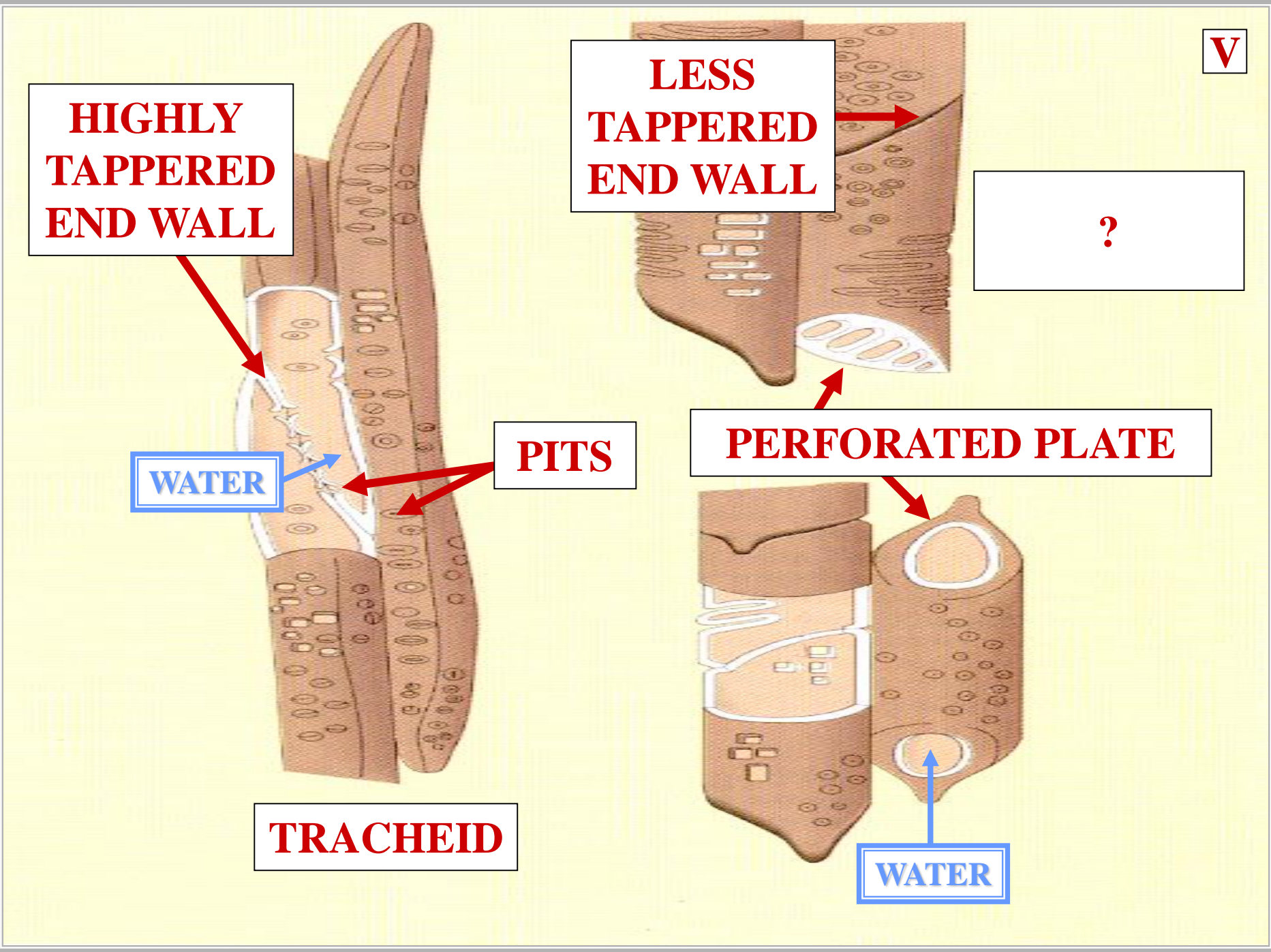
WATER

PITS

PERFORATED PLATE

TRACHEID

WATER





**HIGHLY
TAPPED
END WALL**

**LESS
TAPPED
END WALL**

**VESSEL
MEMBER**

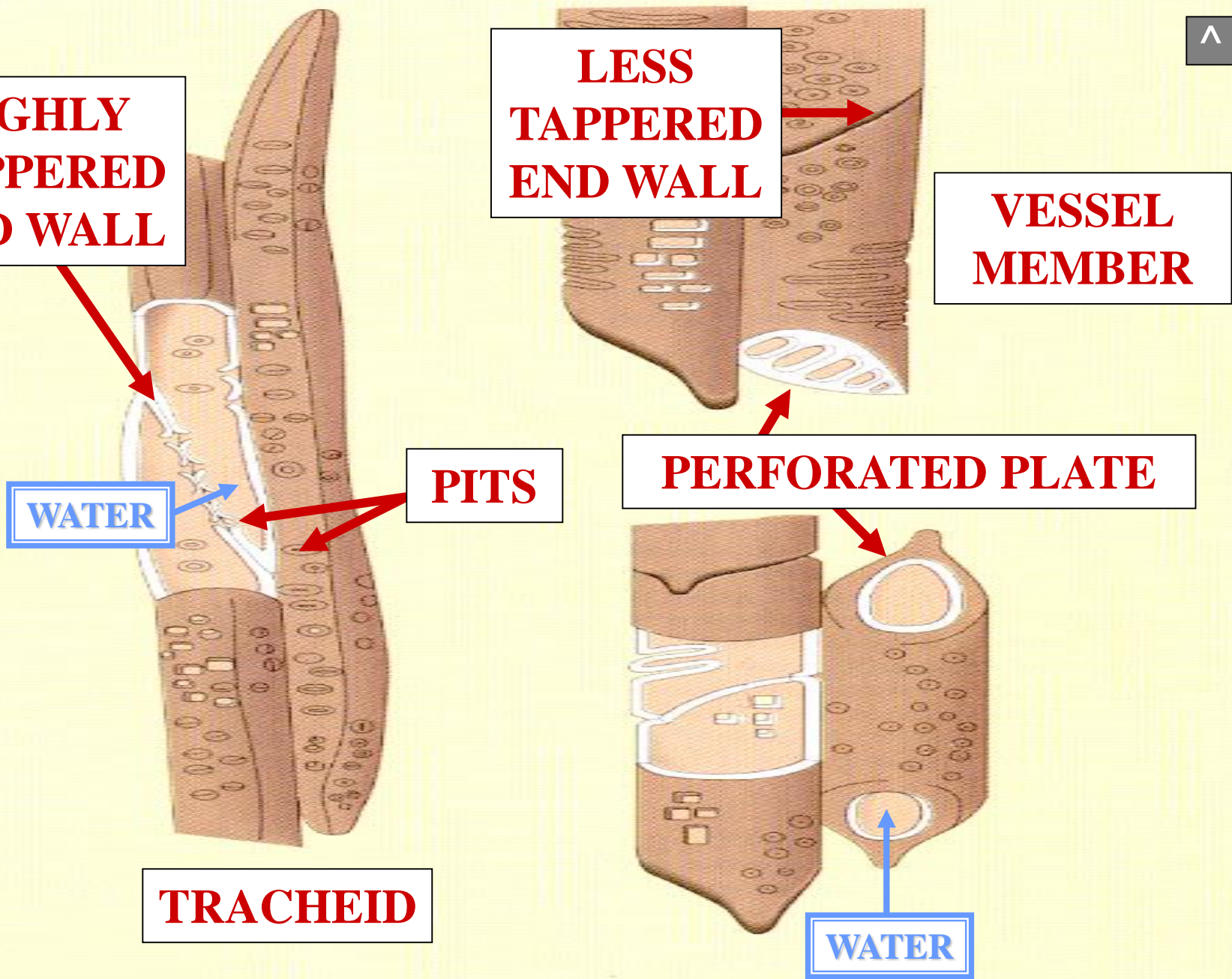
WATER

PITS

**PERFORATED
PLATE**

TRACHEID

WATER





GYMNOSPERMS

T



GYMNOSPERMS