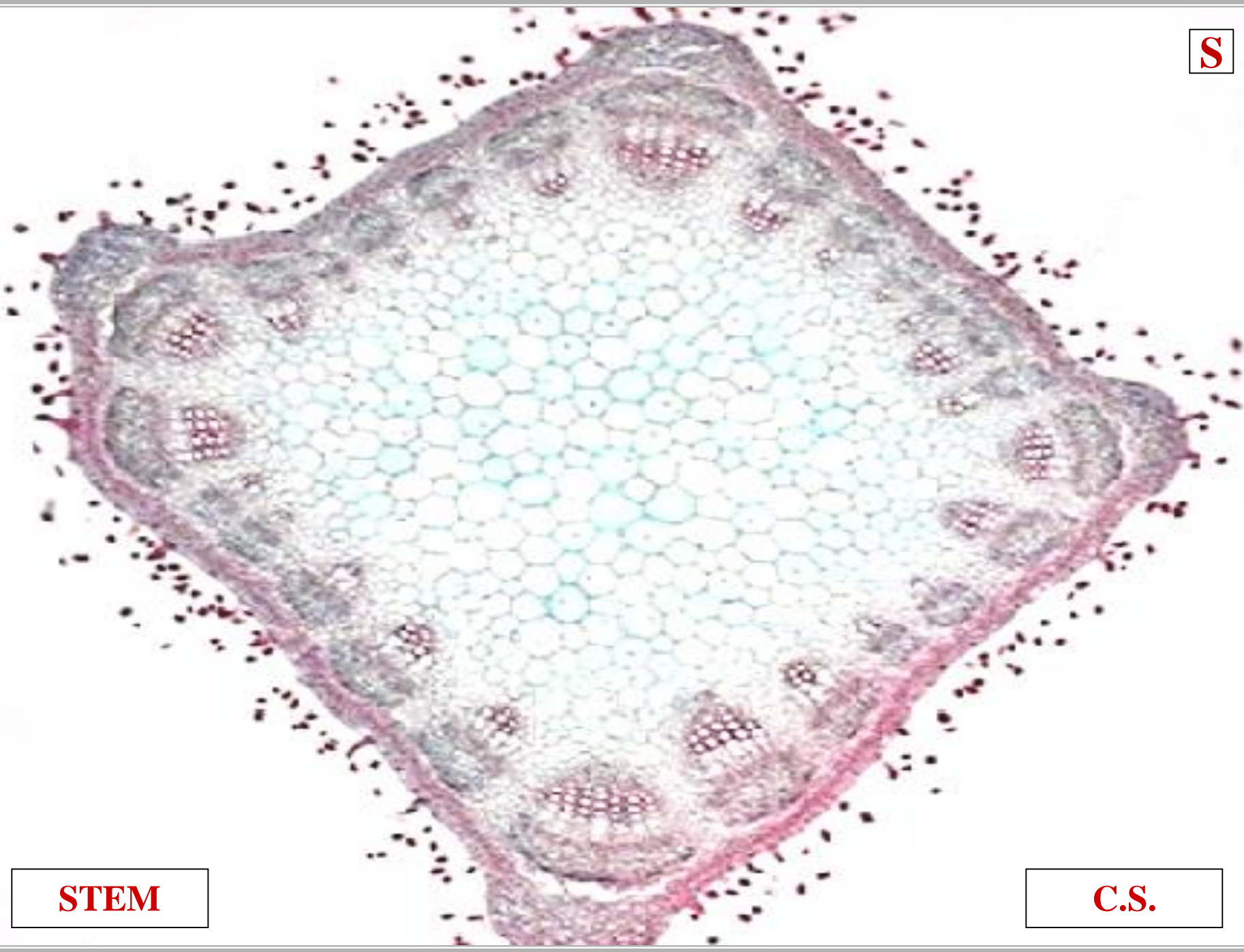
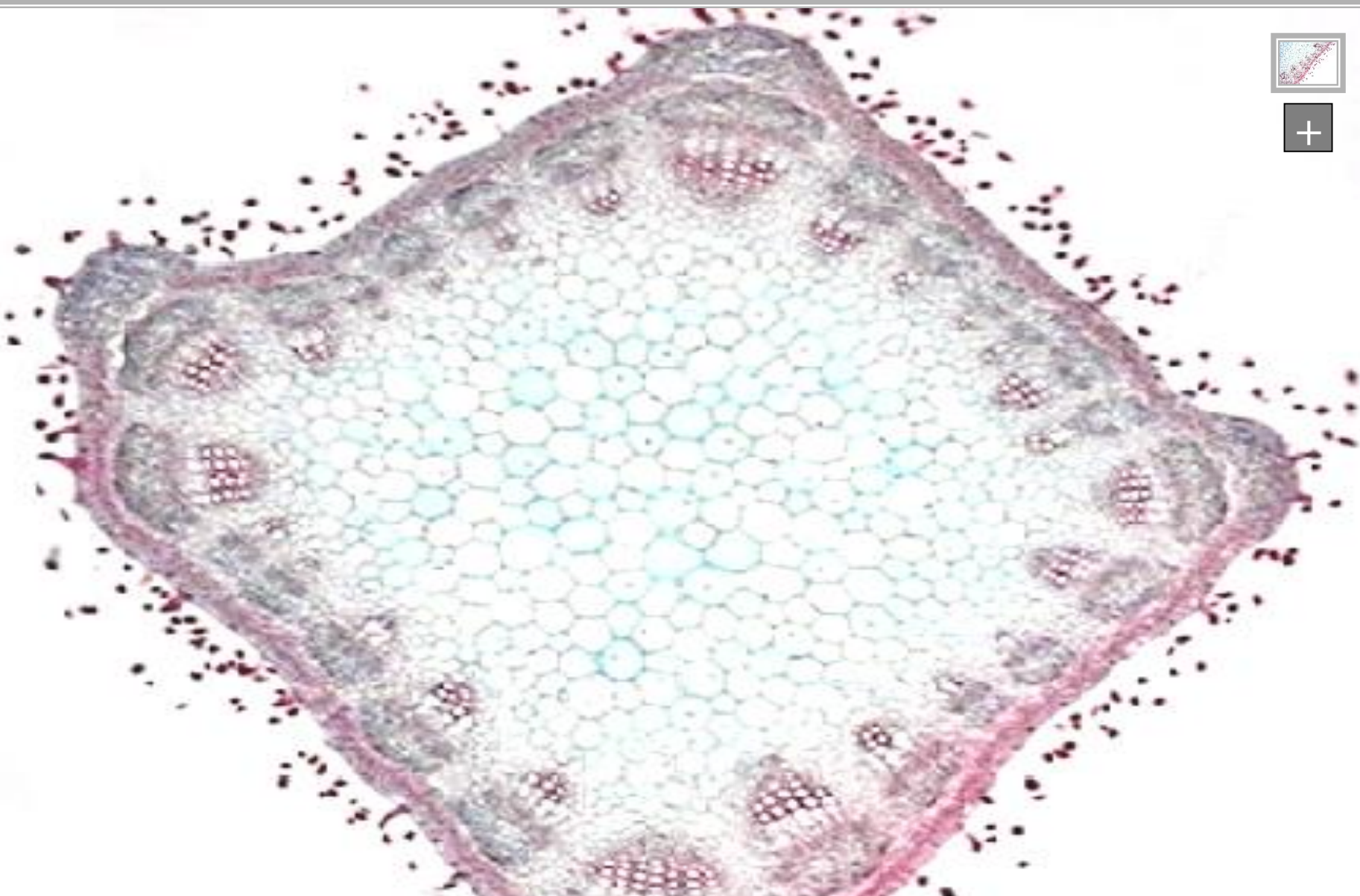


S



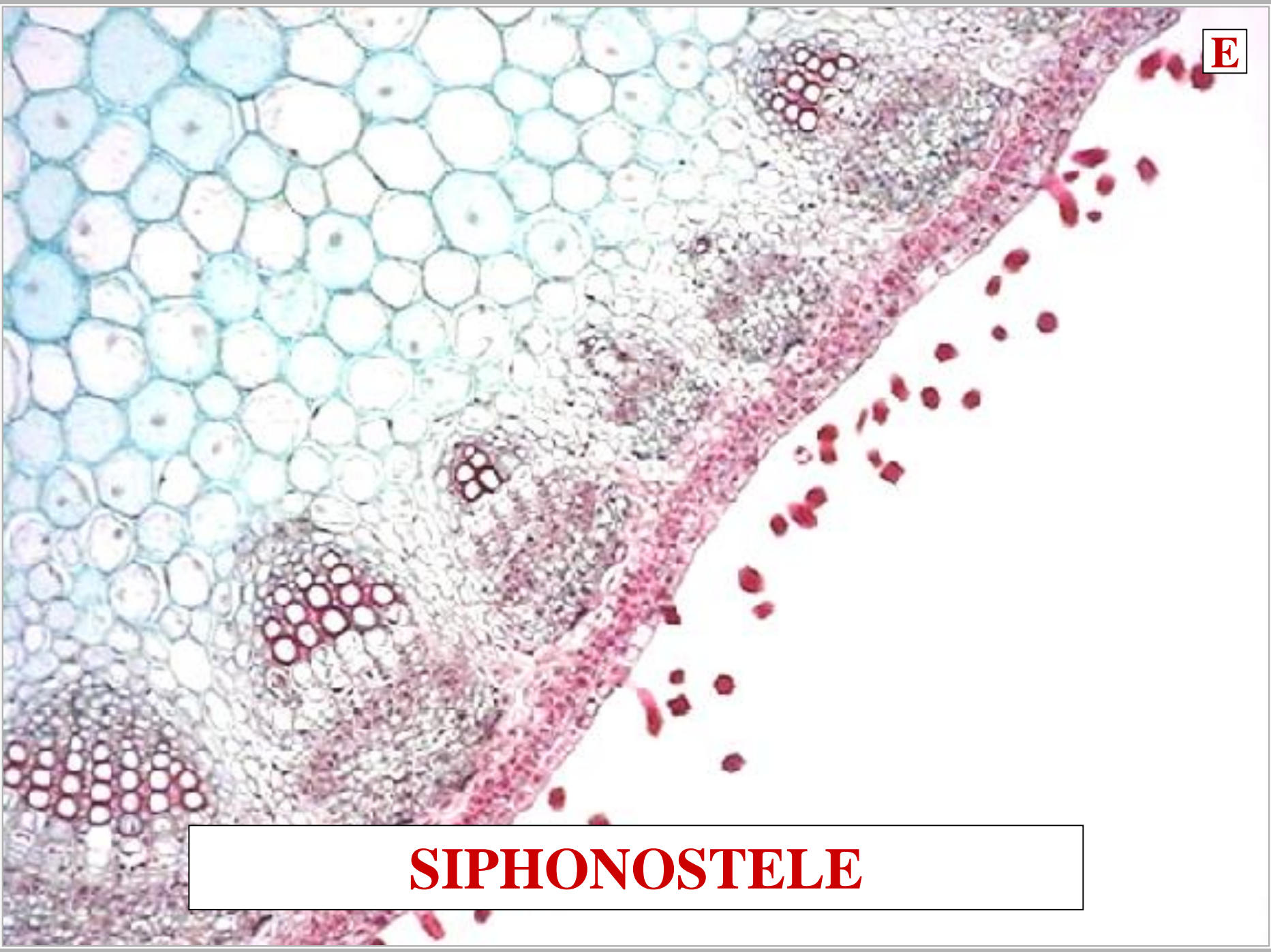
STEM

C.S.

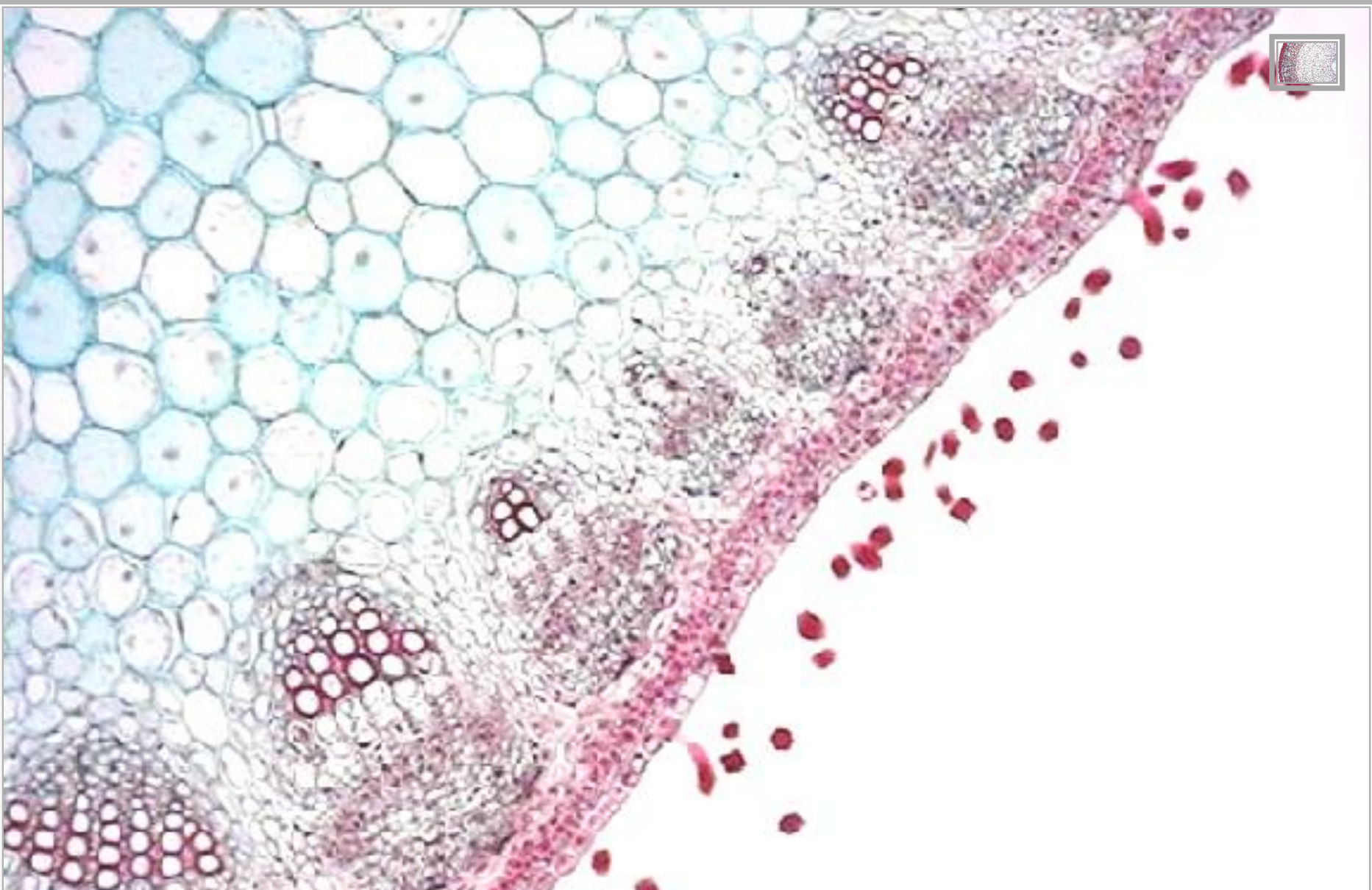


SIPHONOSTELE

E



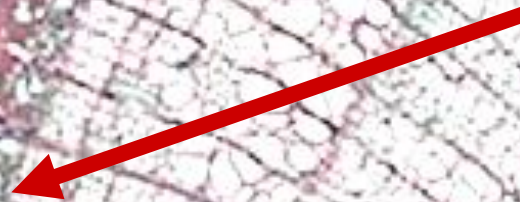
SIPHONOSTELE



SIPHONOSTELE / EUSTELE

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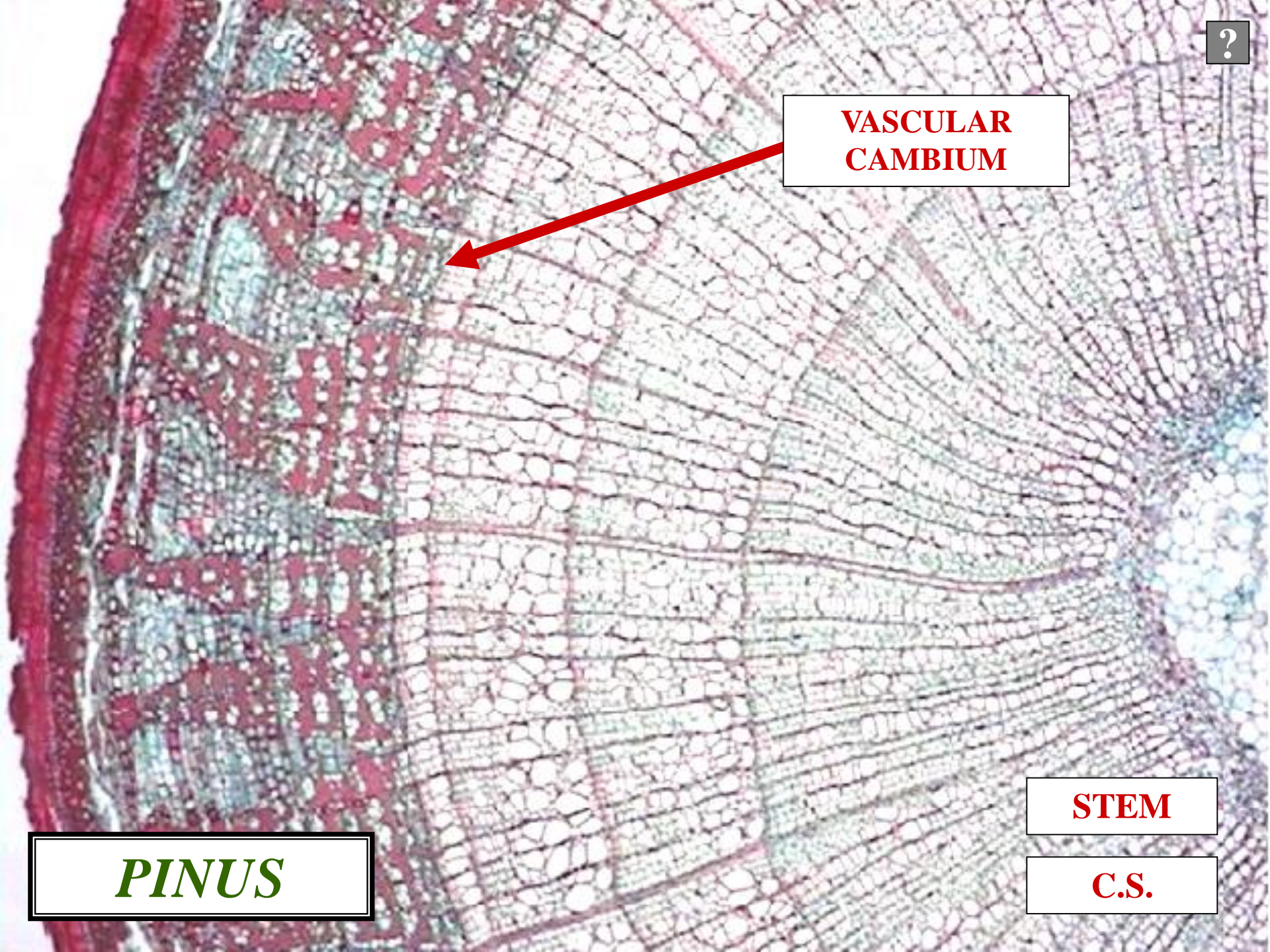
**VASCULAR
CAMBIUM**



STEM

C.S.

PINUS



P

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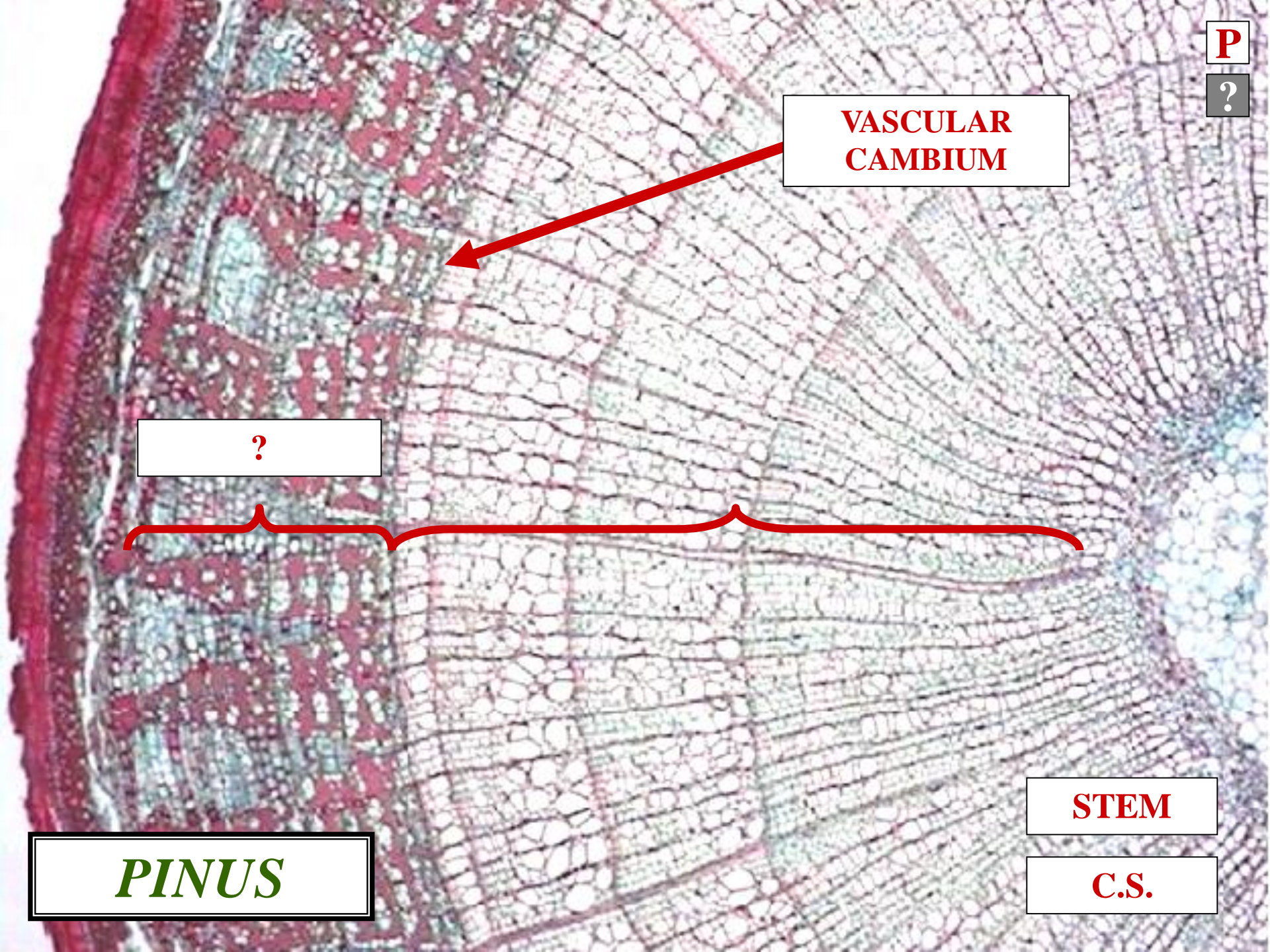
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CAMBIUM

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STEM

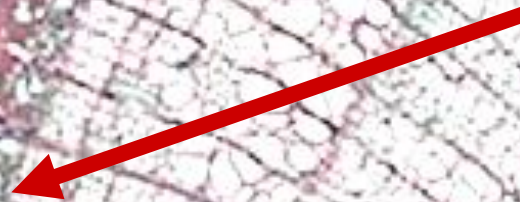
C.S.

PINUS



X

VASCULAR
CAMBIUM



~2 PHLOEM

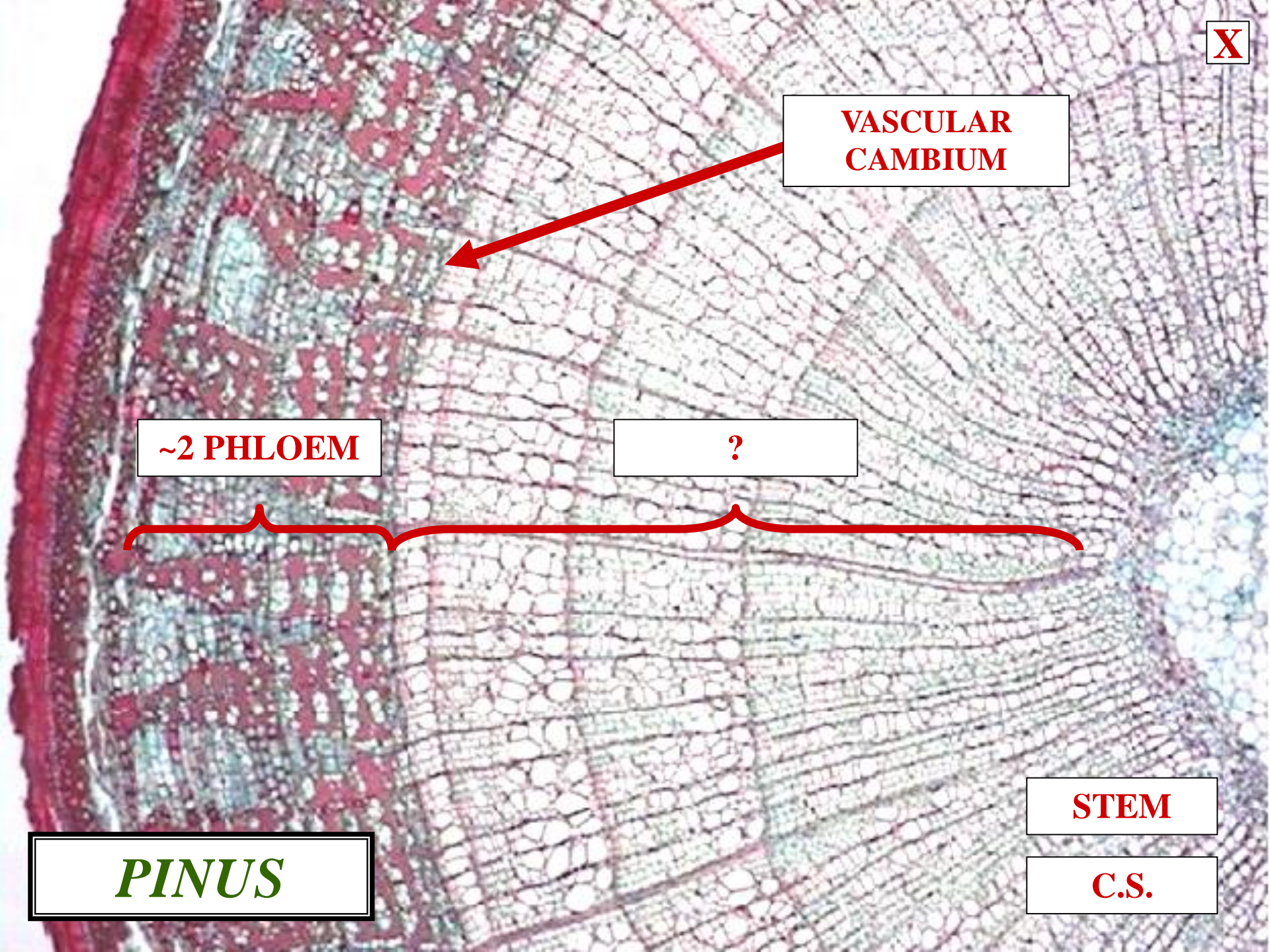
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STEM

C.S.

PINUS



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**VASCULAR
CAMBIUM**

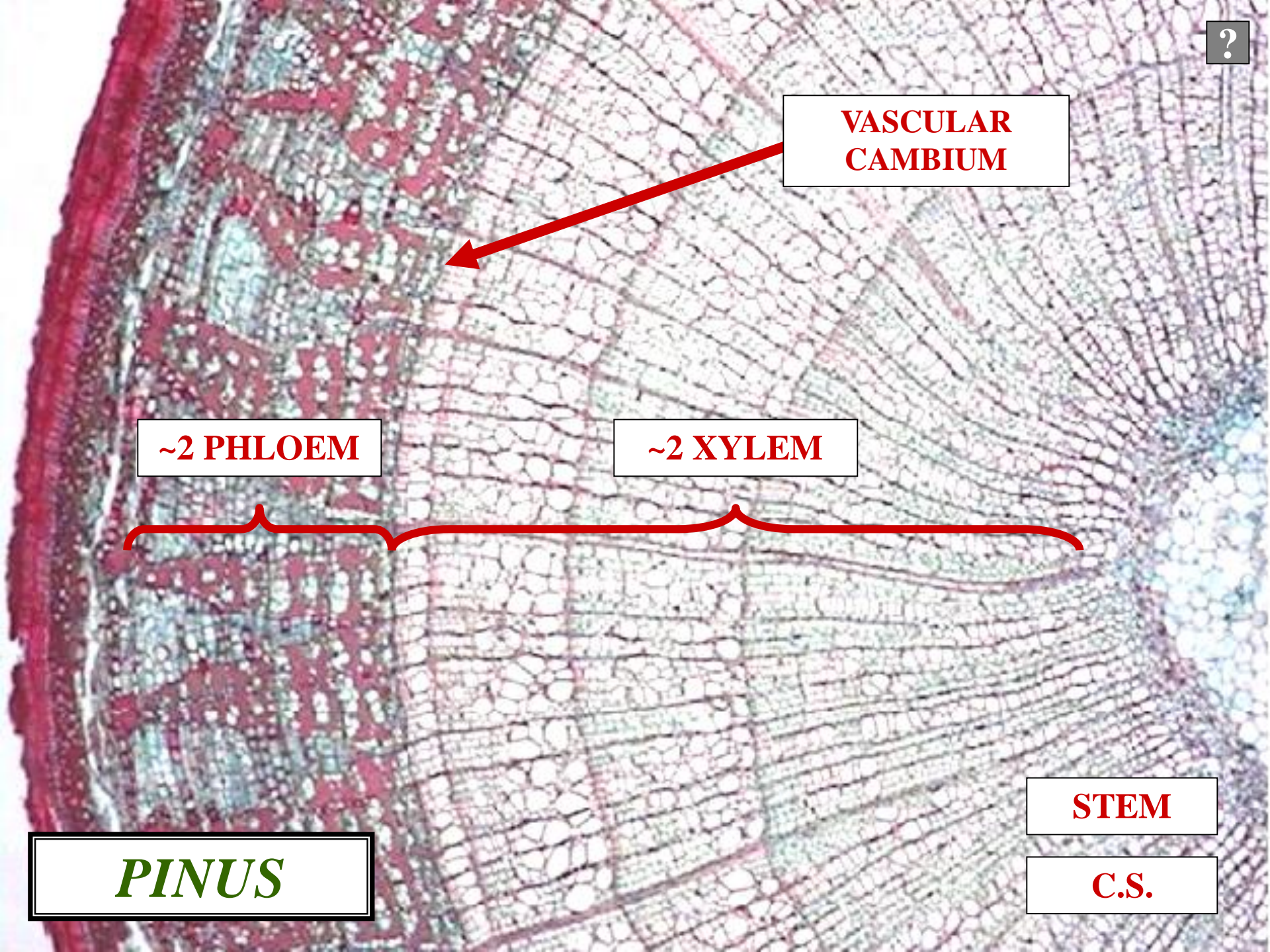
~2 PHLOEM

~2 XYLEM

STEM

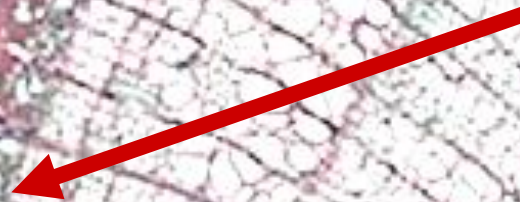
C.S.

PINUS



S

VASCULAR
CAMBIUM



~2 PHLOEM

~2 XYLEM

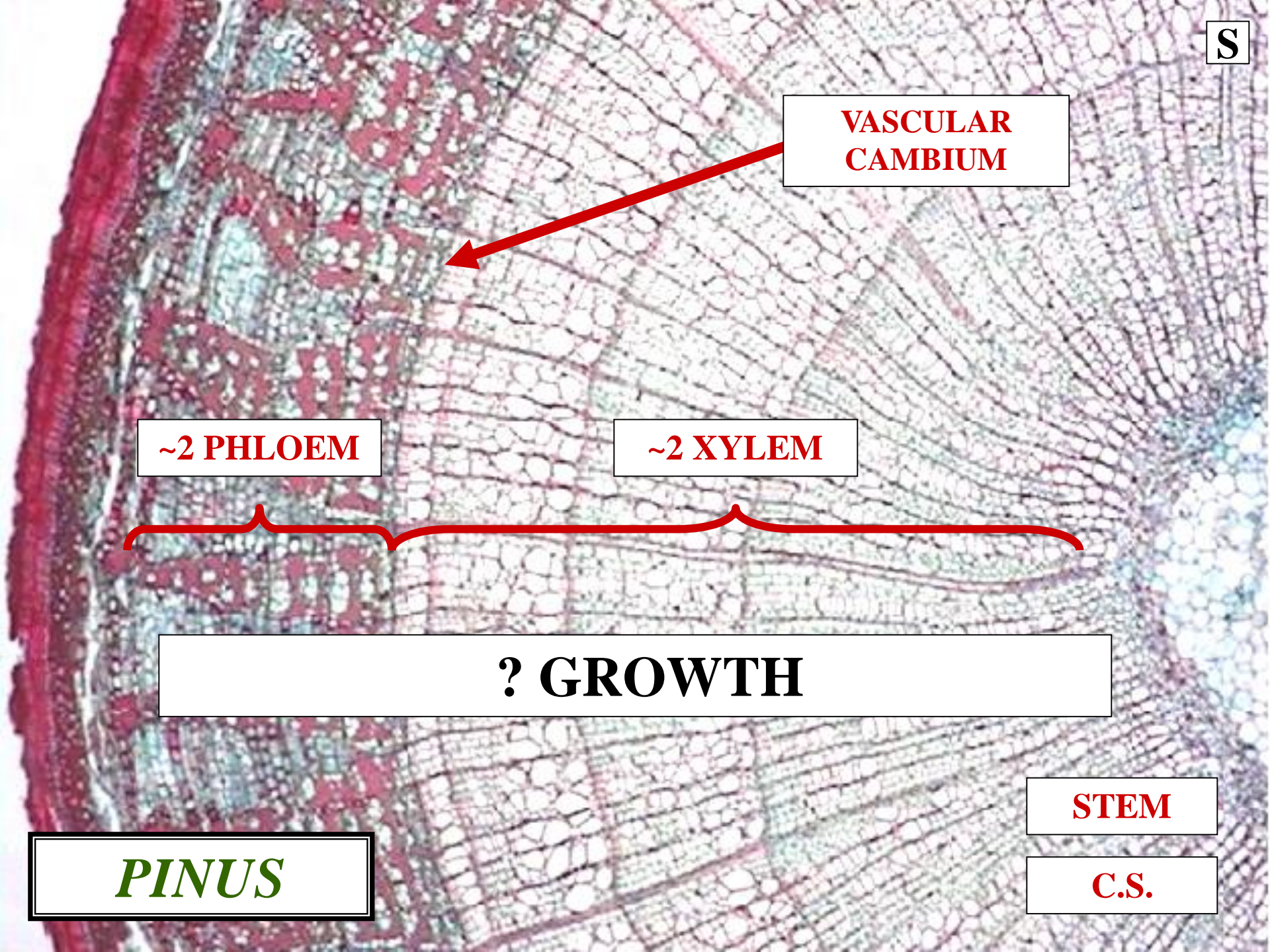


? GROWTH

STEM

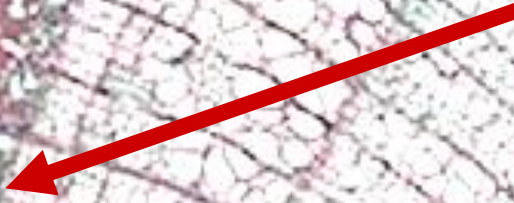
C.S.

PINUS





**VASCULAR
CAMBIUM**



~2 PHLOEM

~2 XYLEM



~2 GROWTH: PRESENT

STEM

C.S.

PINUS



M

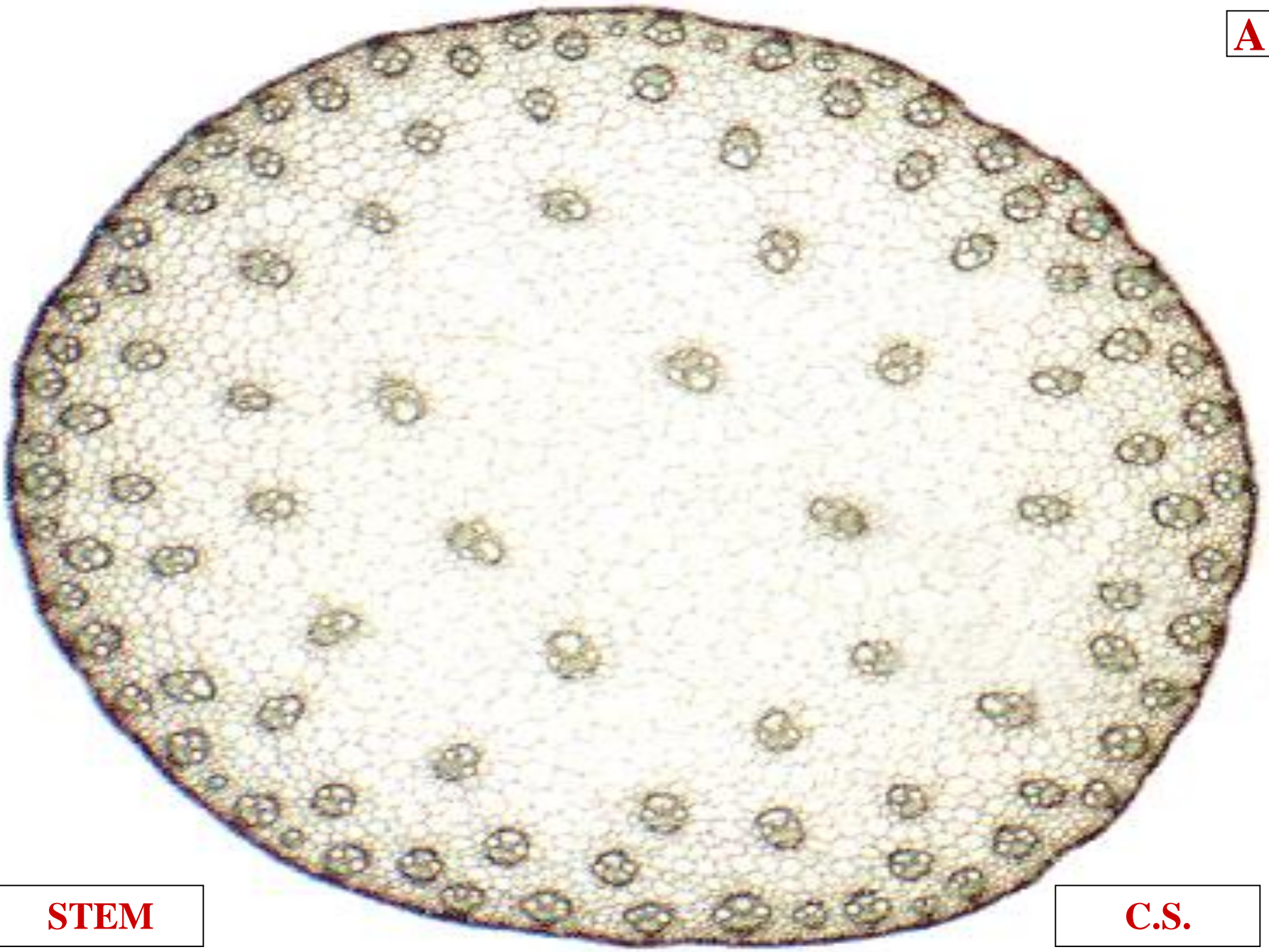
MONOCOTS



MONOCOTS



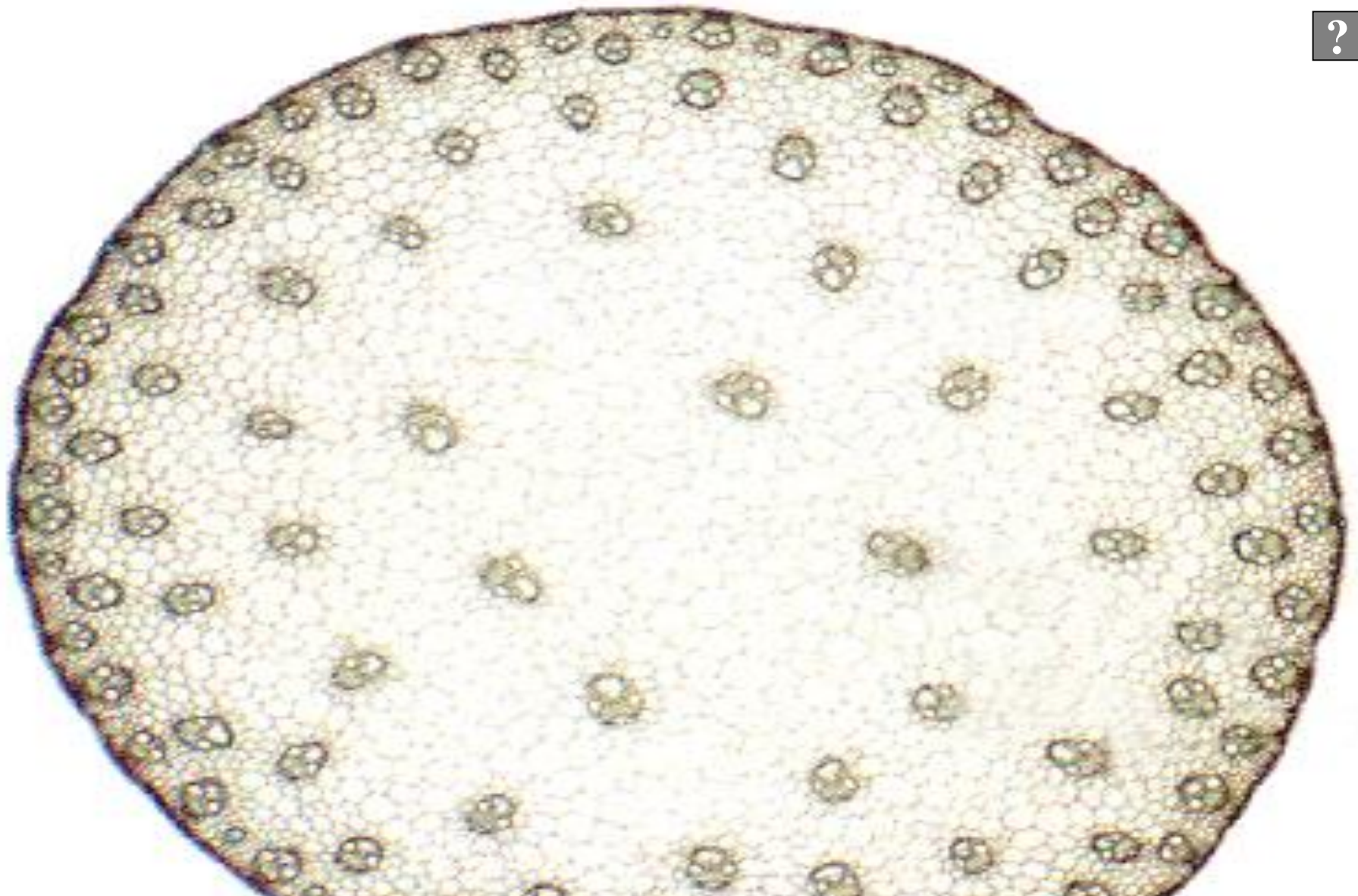
A



STEM

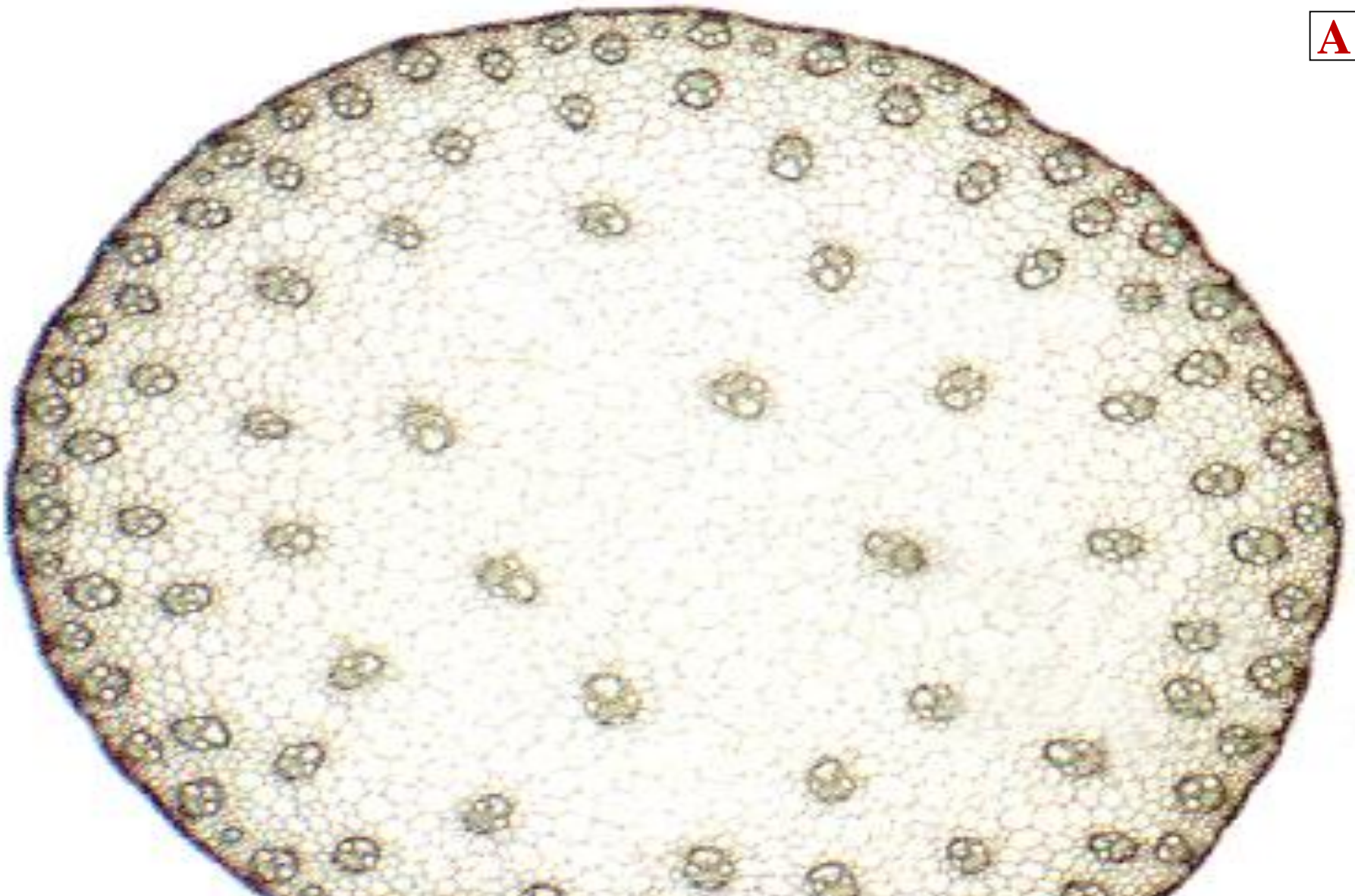
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ATACTOSTELE

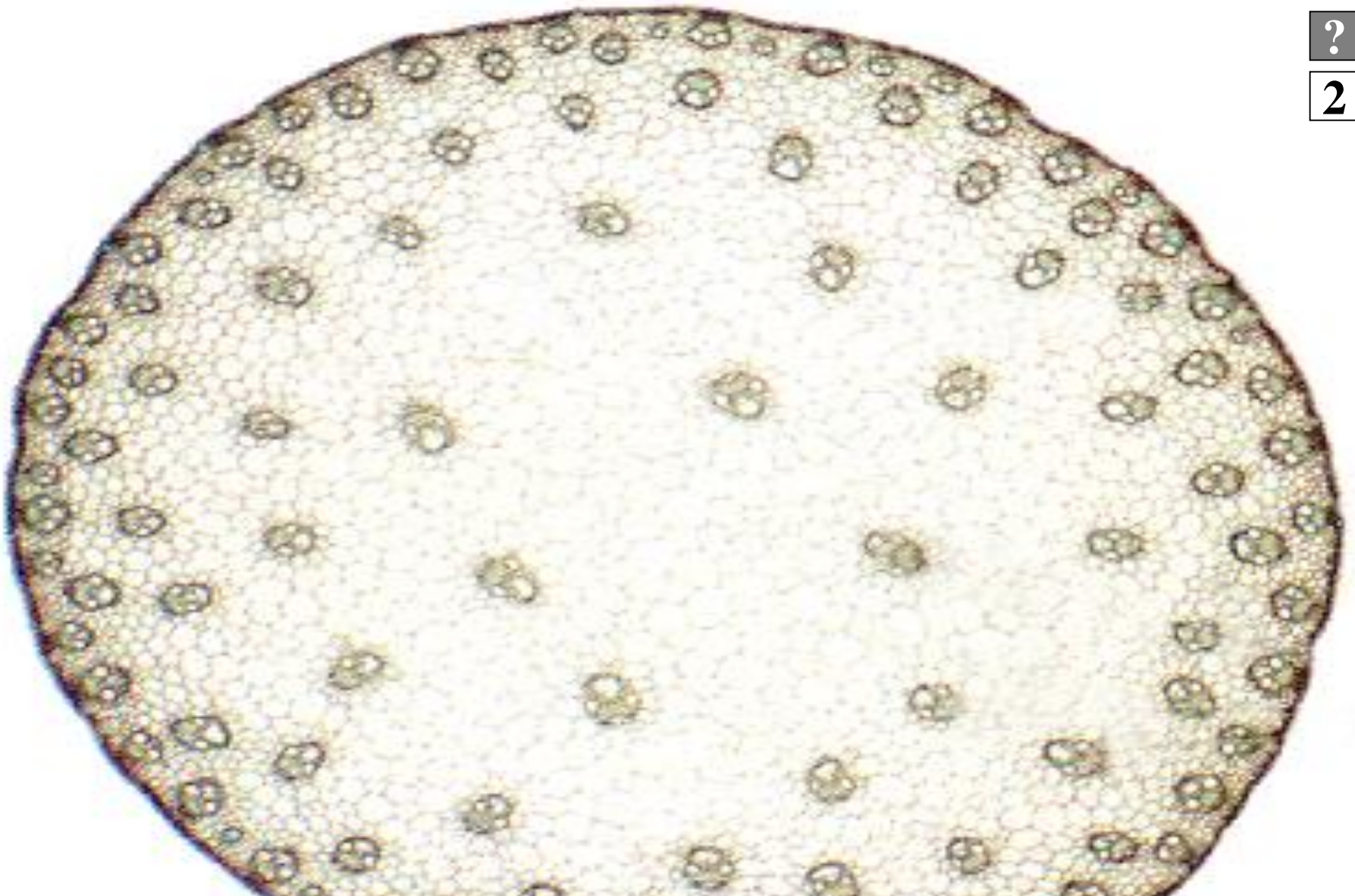
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VASCULAR CAMBIUM: ?

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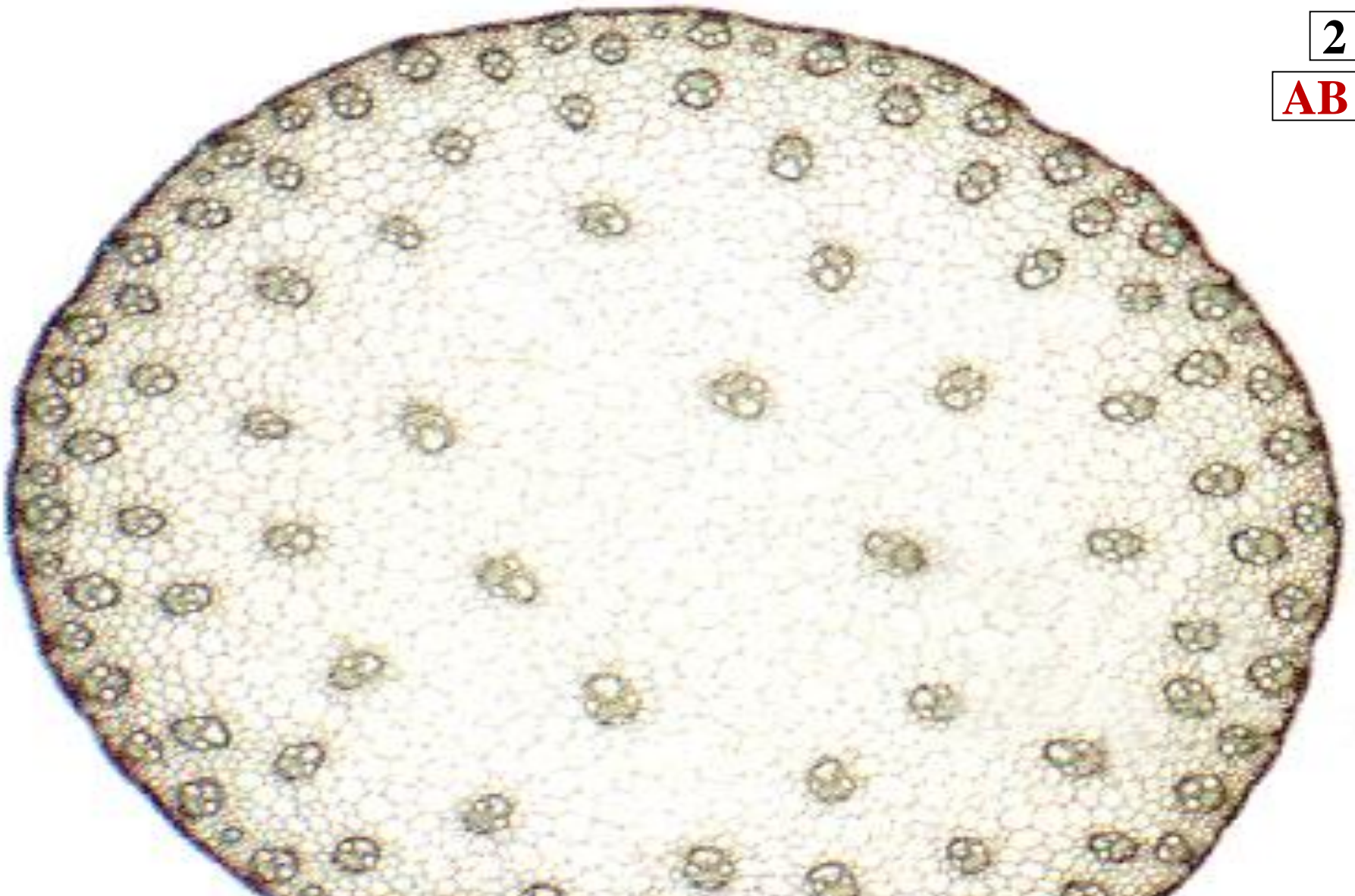
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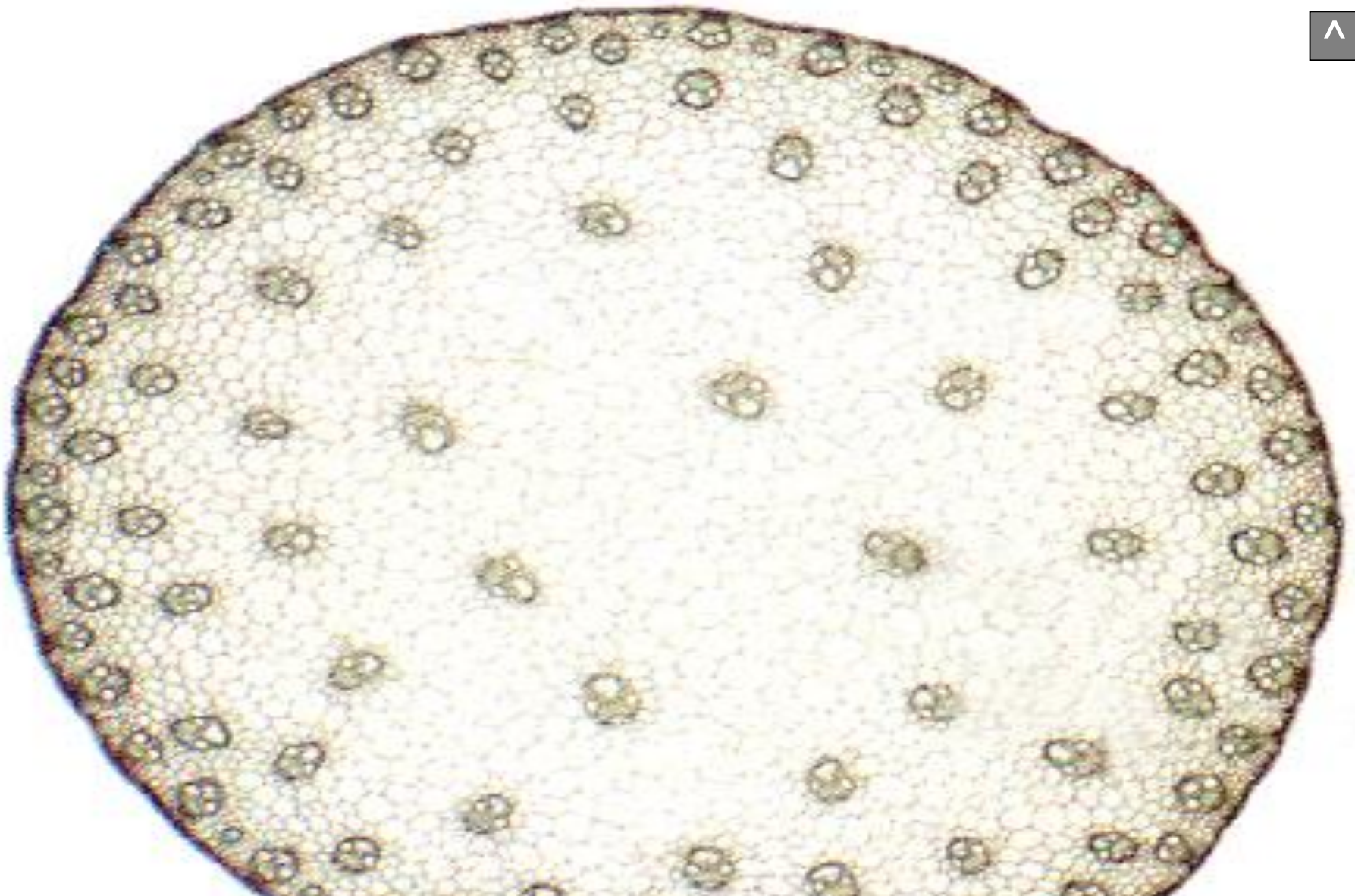
VASCULAR CAMBIUM: ABSENT

2

AB



SECONDARY GROWTH: ?



SECONDARY GROWTH: ABSENT



LEAF



GYMNOSPERMS

?



GYMNOSPERMS

MEGAPHYLL

?



ANGIOSPERMS

?



ANGIOSPERMS

MEGAPHYLL



TRACHEOPHYTES

RHYNIOPHYTA

STEM ENATIONS

ZOSTEROPHYLLOPHYTA

**MICROPHYLLS
ENATION THEORY**

LYCOPODIOPHYTA

**PHYLOGENETIC
DEAD-END**

COMPLEX TELOMES

TRIMEROPHYTOPHYTA

**MEGAPHYLLS
TELOME THEORY**

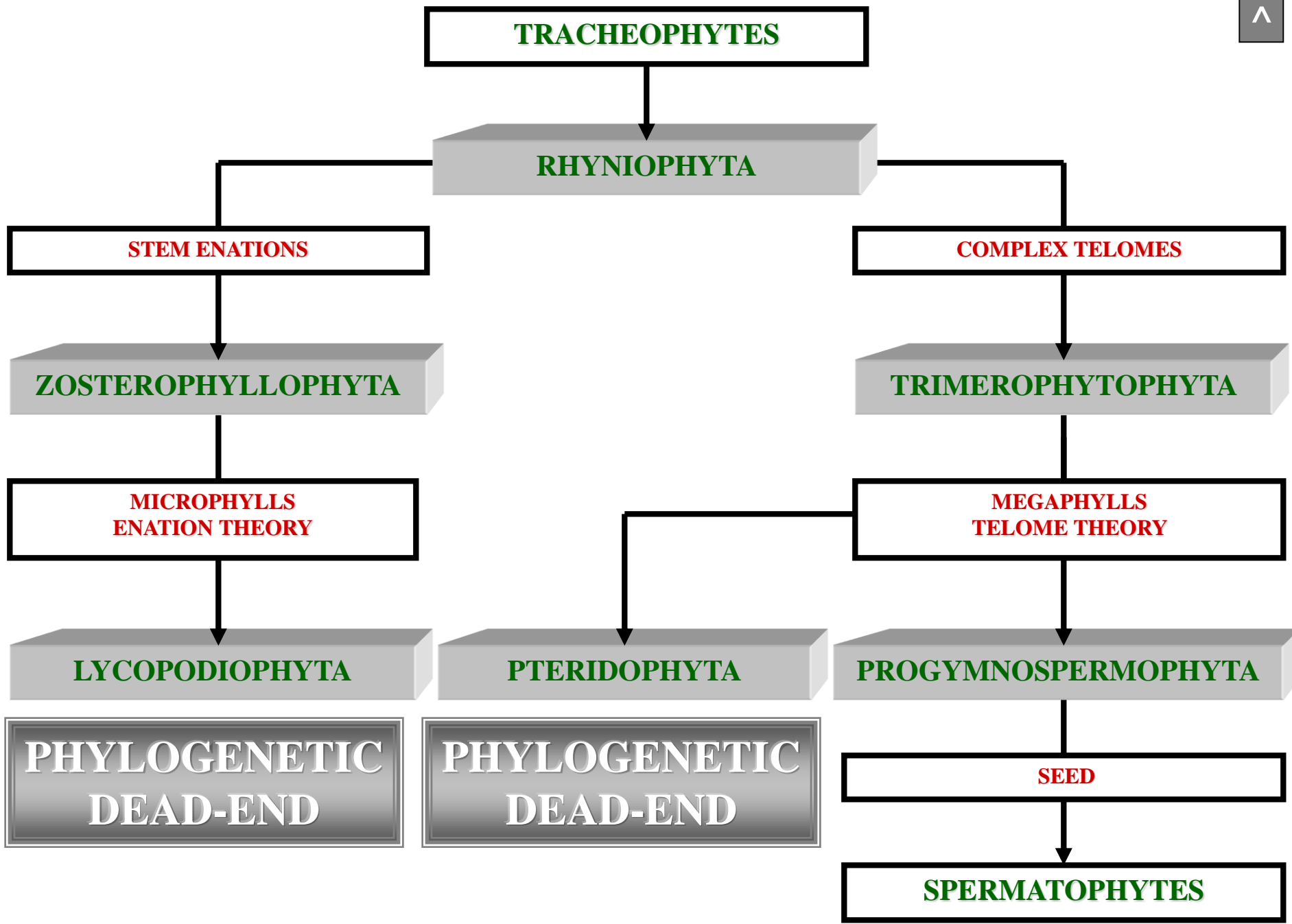
PTERIDOPHYTA

**PHYLOGENETIC
DEAD-END**

PROGYMNOSPERMOPHYTA

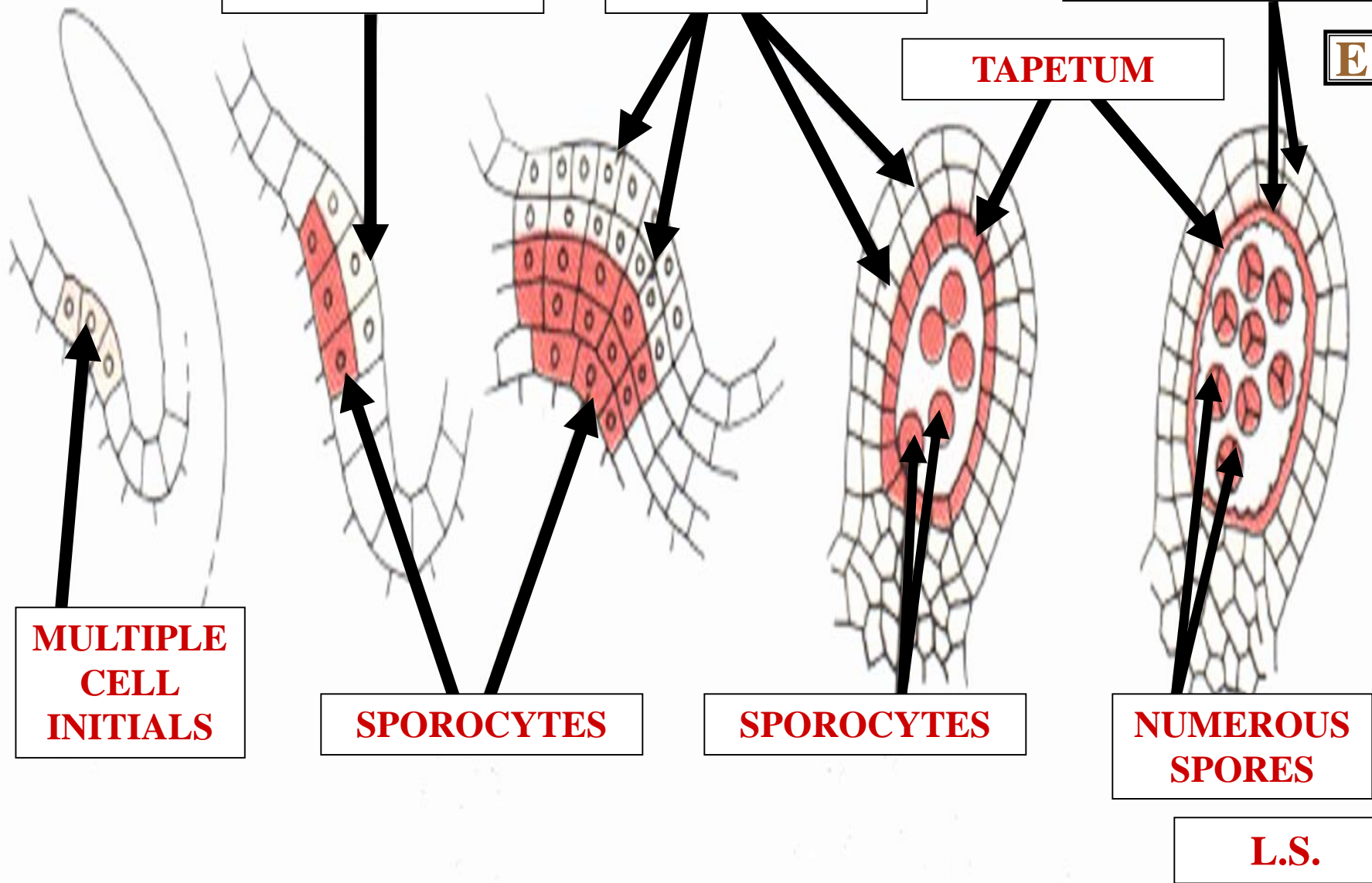
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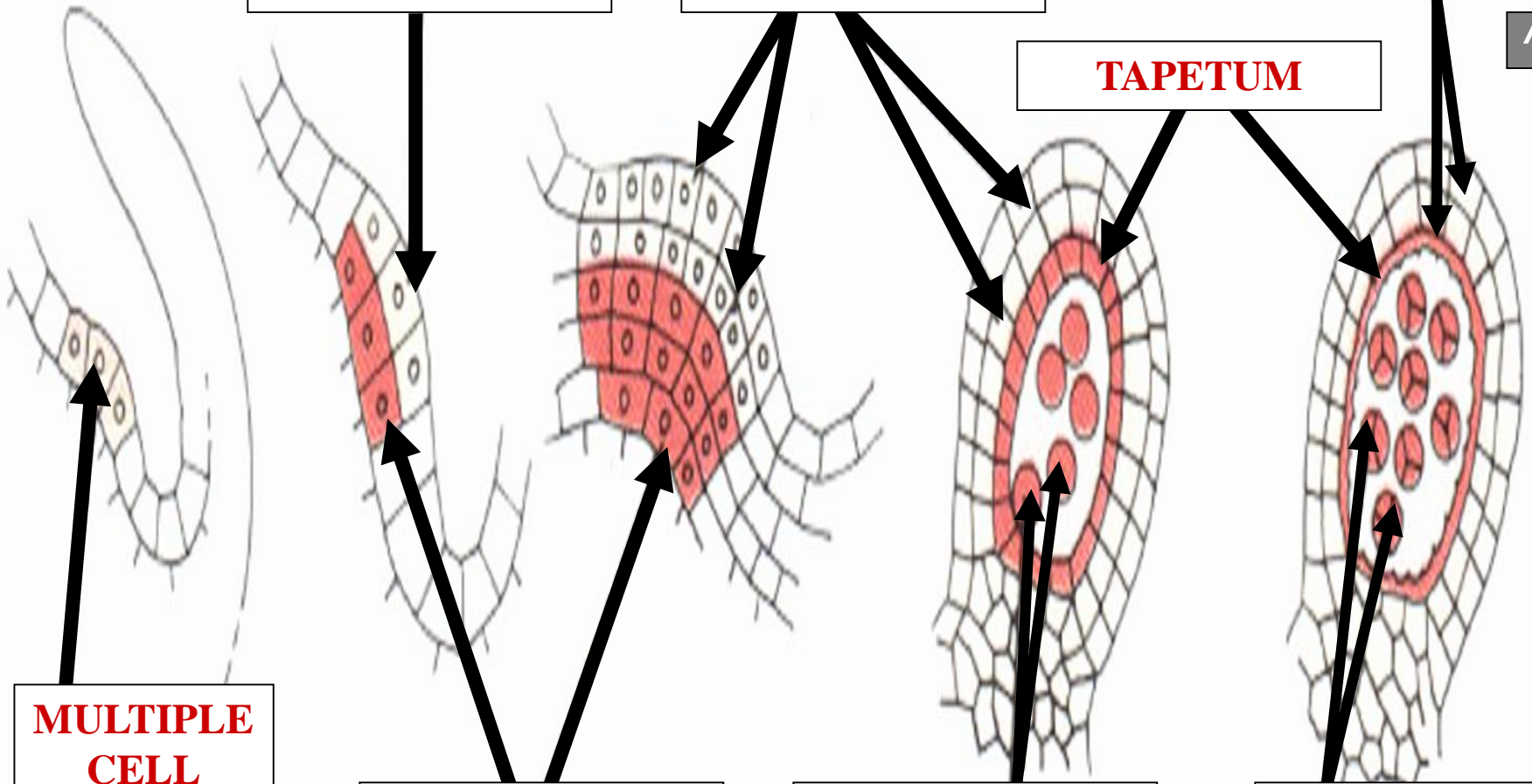
SPERMATOPHYTES





SPORANGIUM





WALL CELLS

WALL CELLS

LARGE SIZE

THICK WALL



TAPETUM

**MULTIPLE
CELL
INITIALS**

SPOROCTES

SPOROCTES

**NUMEROUS
SPORES**

EUSPORANGIUM

L.S.



MICROSPORANGIUM

?



PINUS

?



PINUS

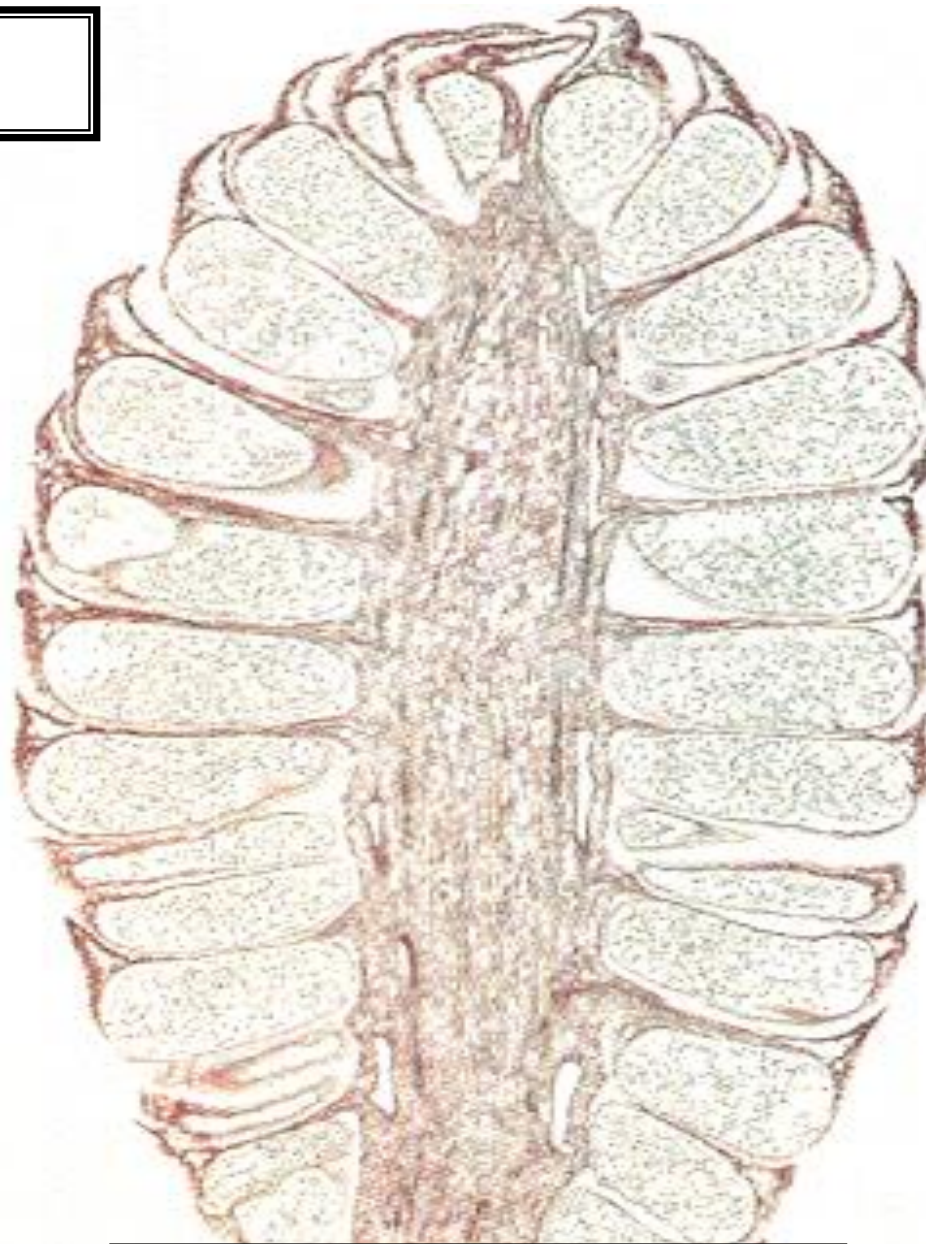


MICROSTROBILI



PINUS

PINUS



MICROSTROBILUS

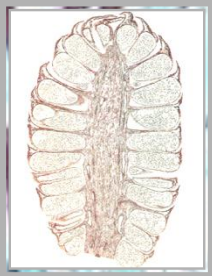


L.S.

PINUS

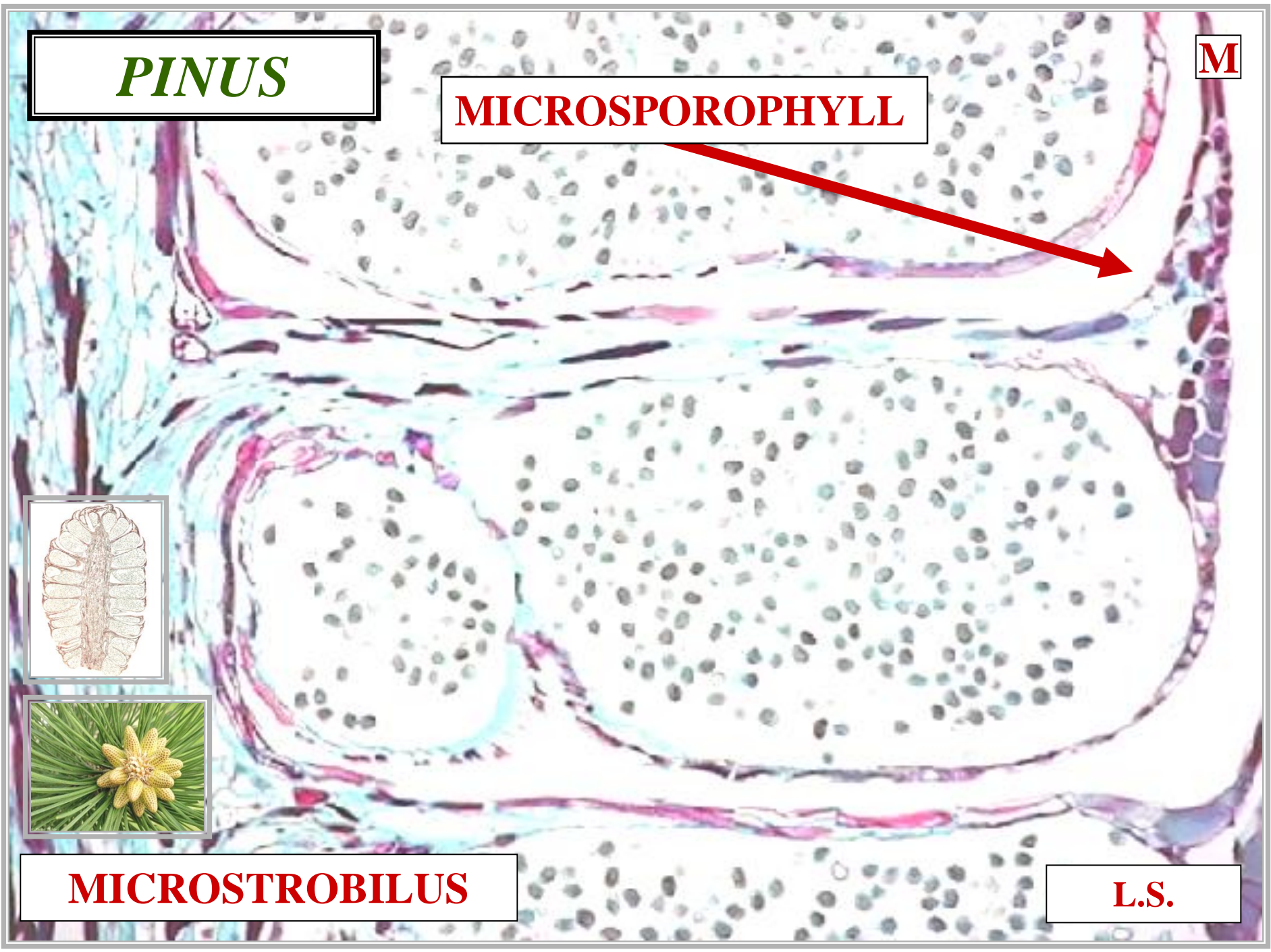
MICROSPOROPHYLL

M



MICROSTROBILUS

L.S.



PINUS

MICROSPOROPHYLL

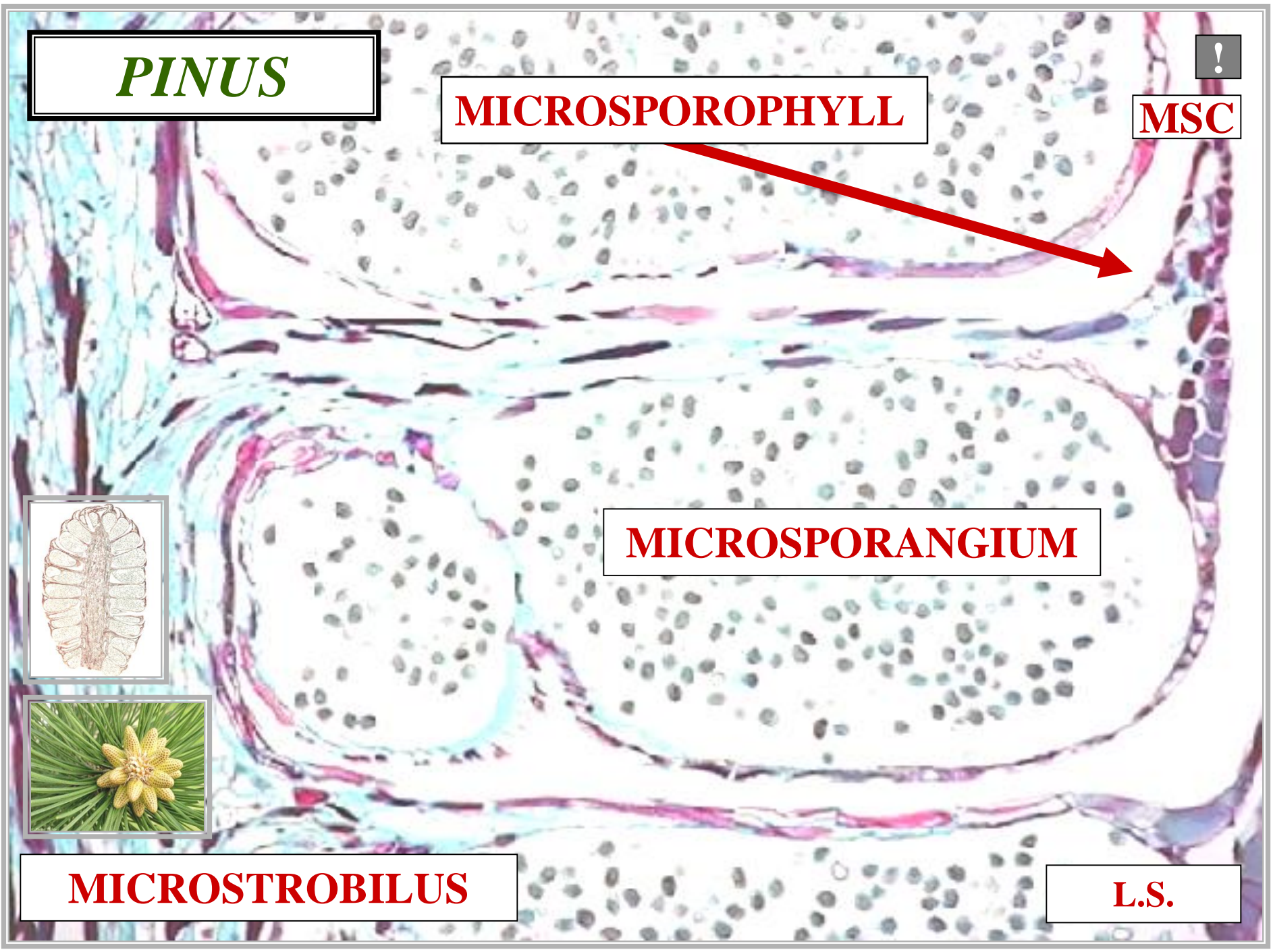
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MICROSPORANGIUM

MICROSTROBILUS

L.S.



PINUS

MICROSPOROPHYLL

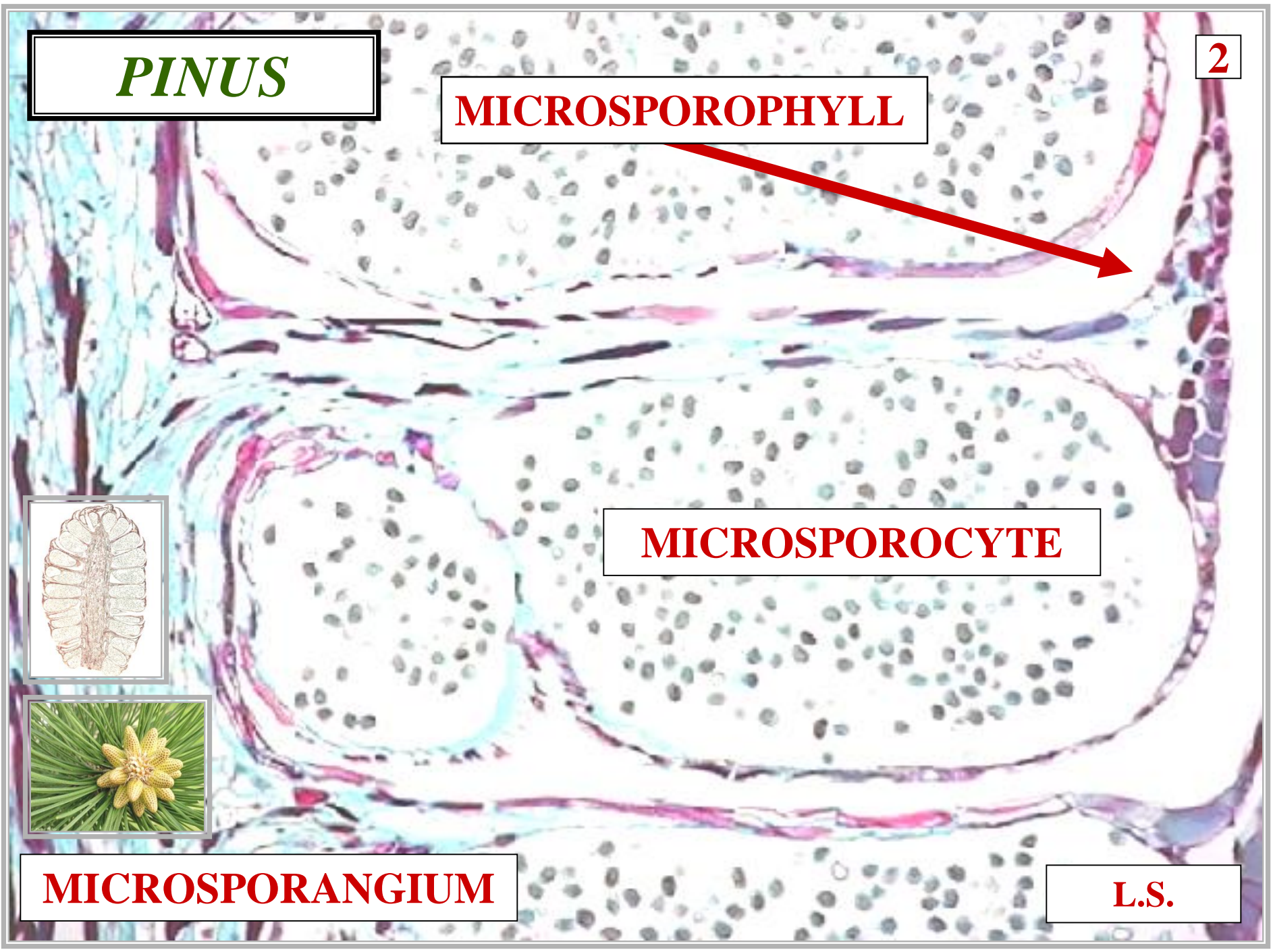
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MICROSPOROCTE



MICROSPORANGIUM

L.S.



PINUS

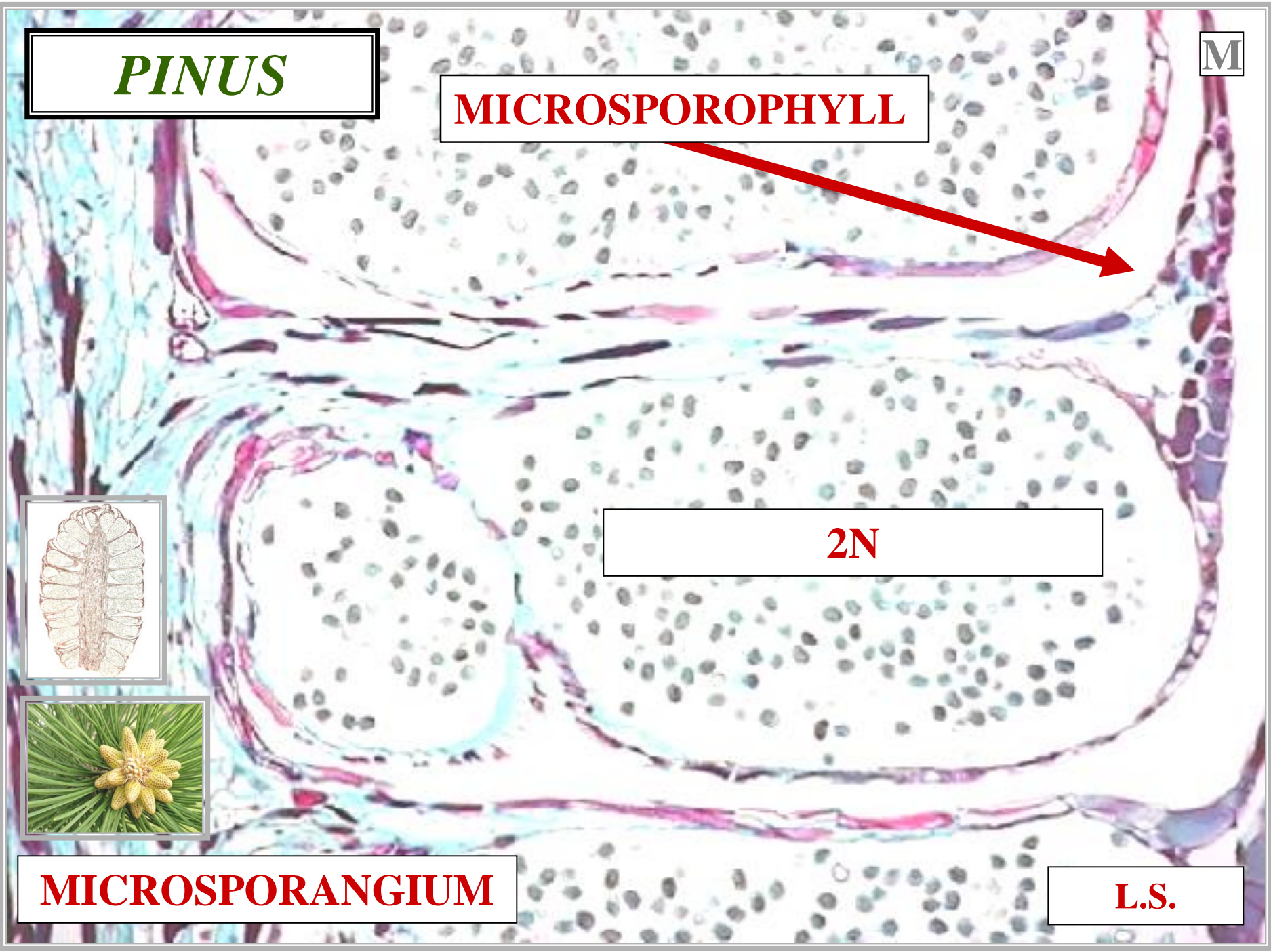
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2N

MICROSPORANGIUM

L.S.



PINUS

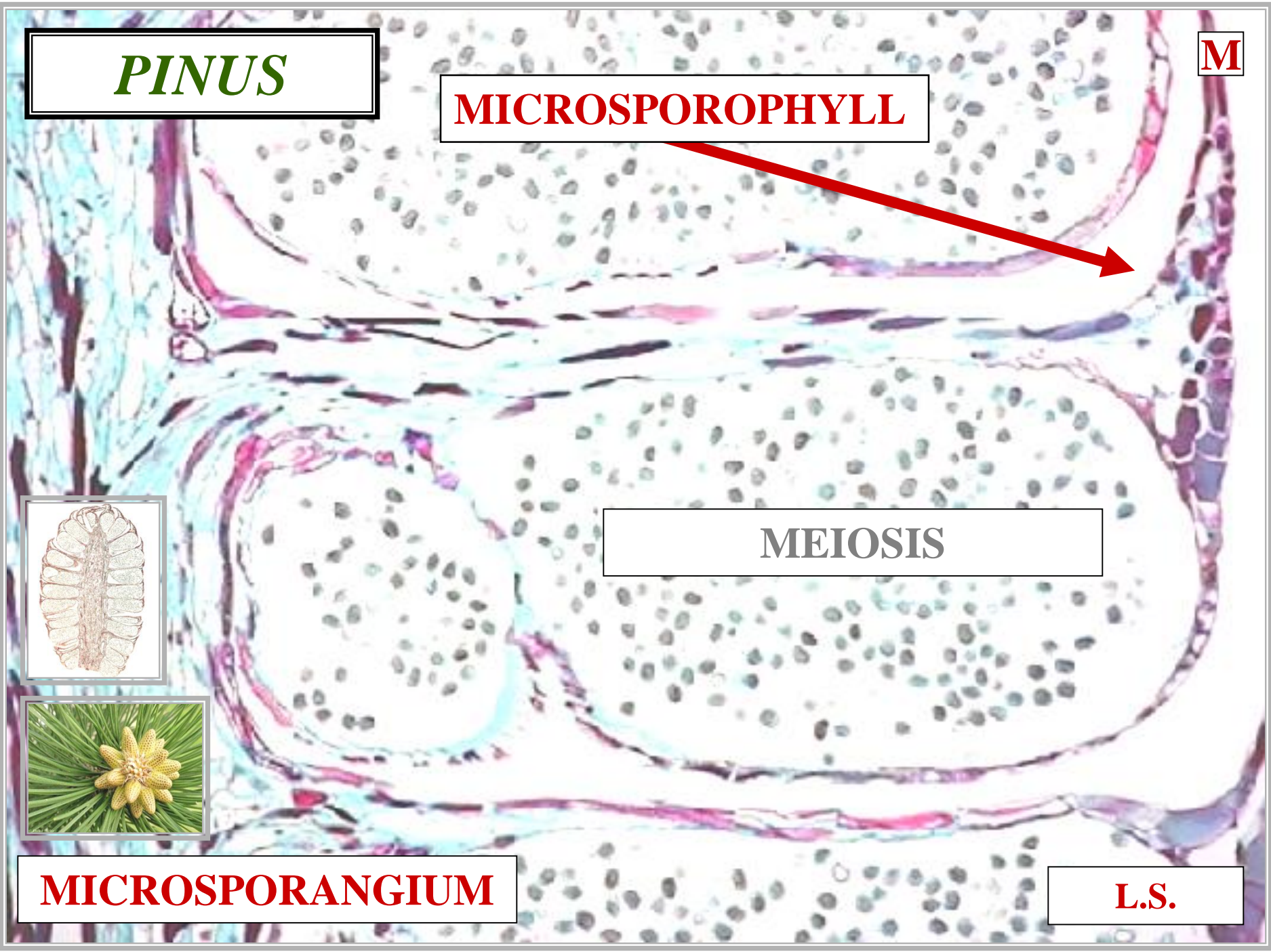
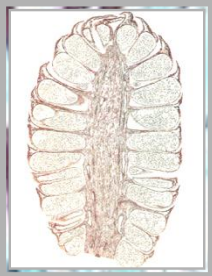
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MEIOSIS

MICROSPORANGIUM

L.S.

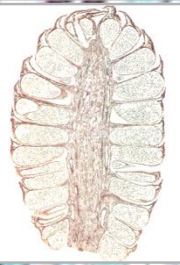


PINUS

MICROSPOROPHYLL

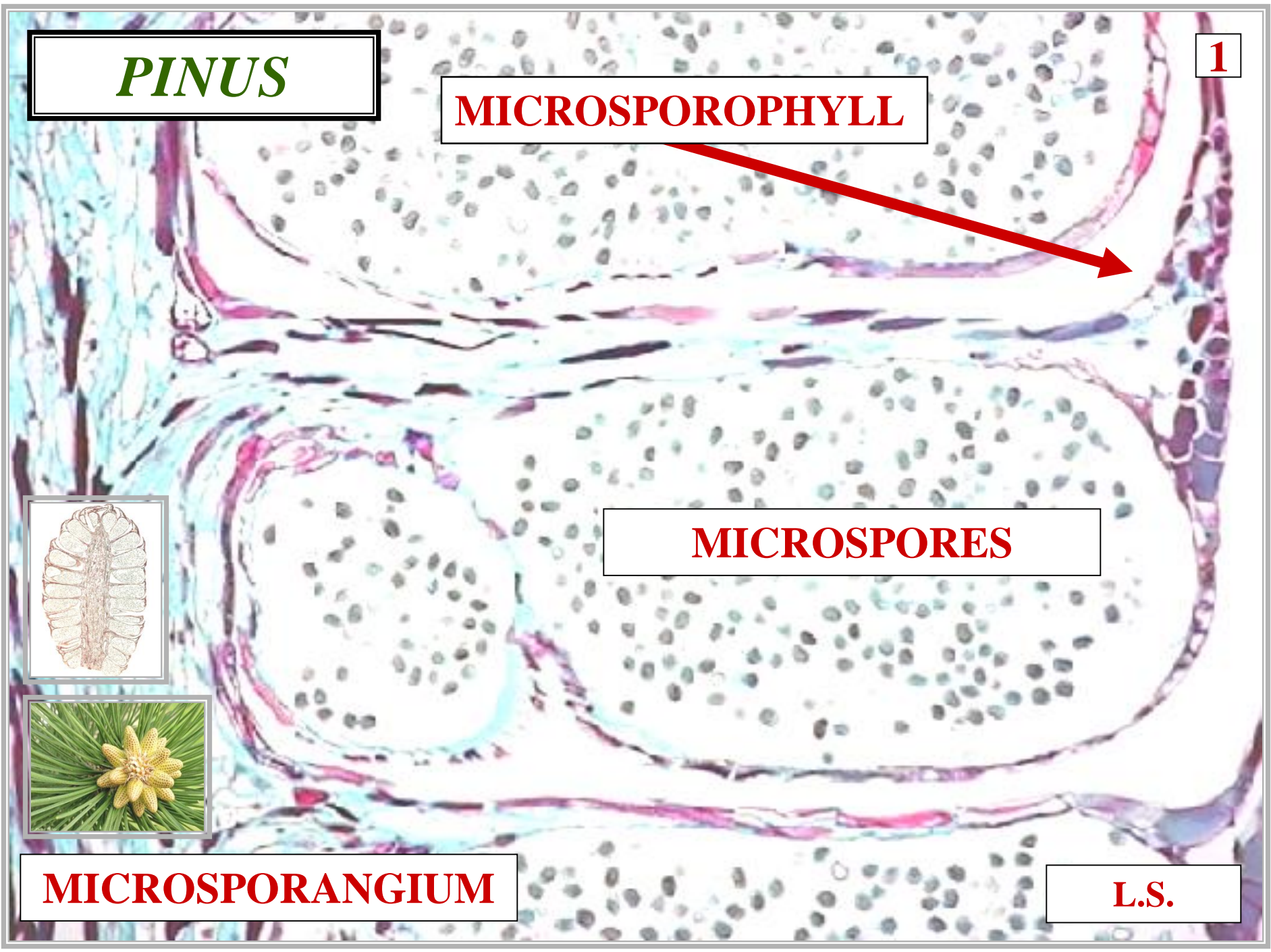
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MICROSPORES



MICROSPORANGIUM

L.S.



PINUS

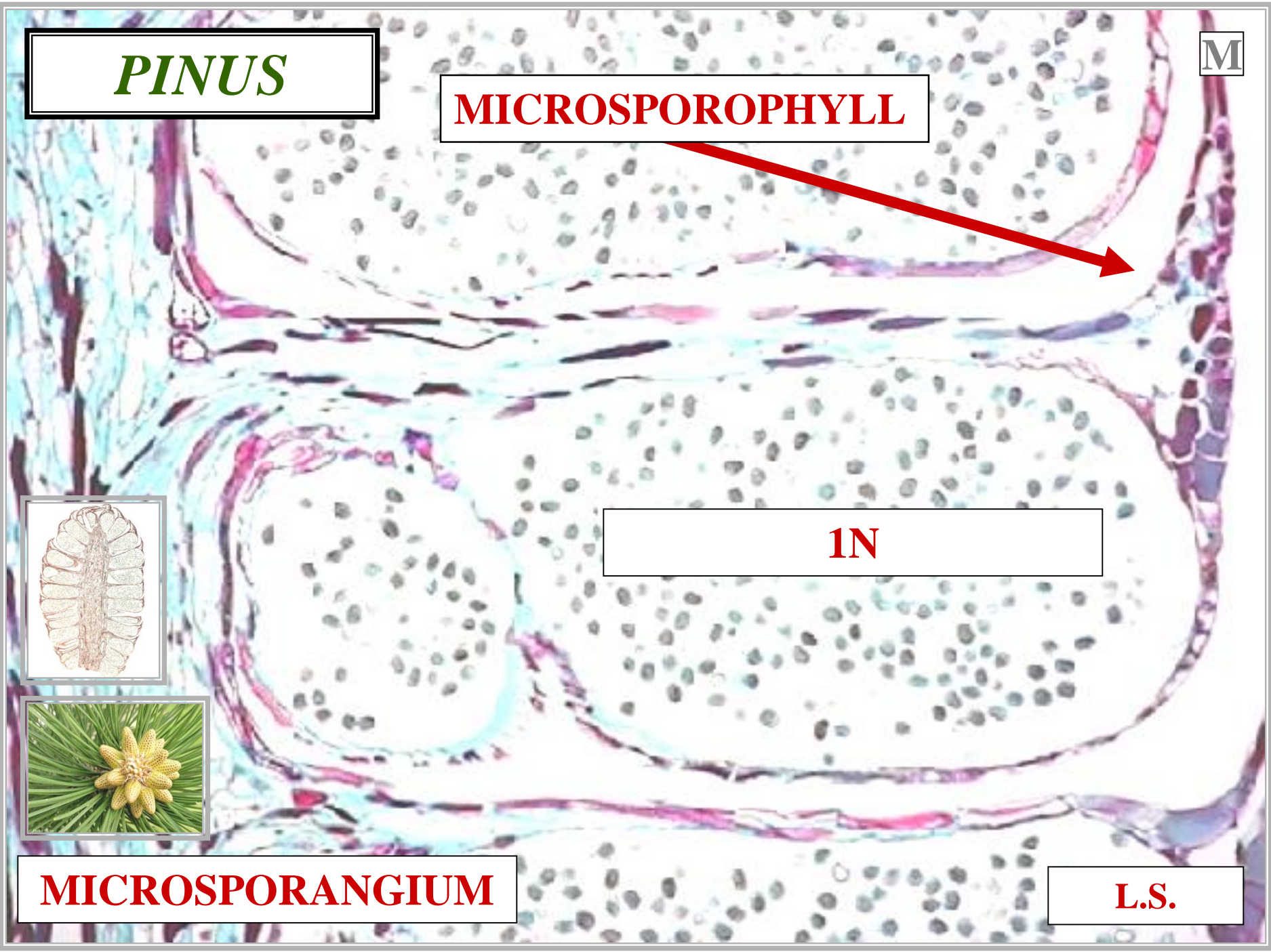
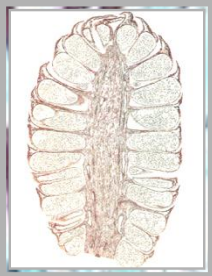
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M

1N

MICROSPORANGIUM

L.S.



PINUS

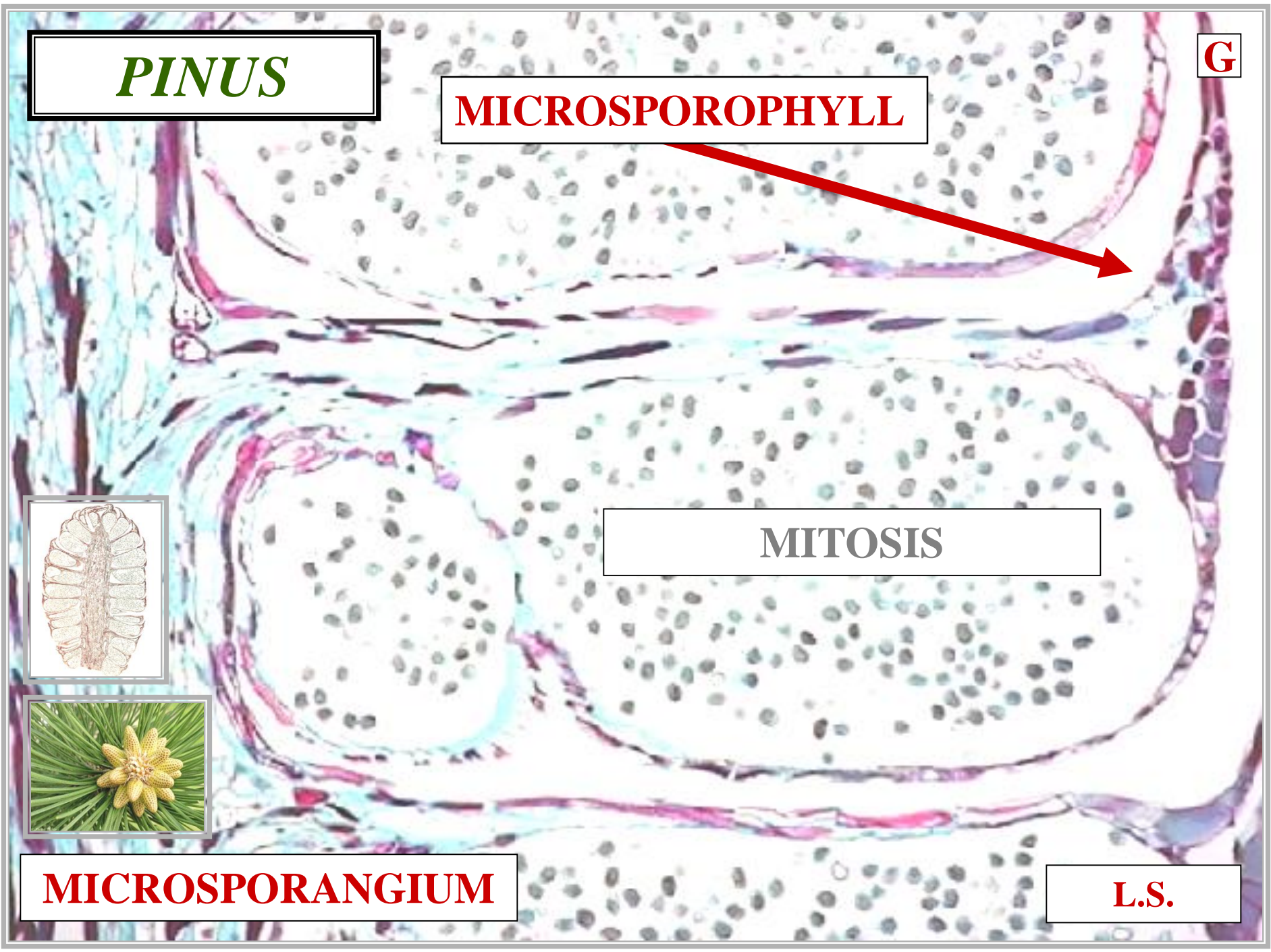
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MITOSIS

MICROSPORANGIUM

L.S.

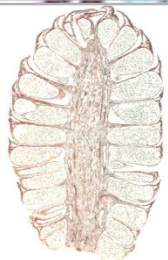


PINUS

MICROSPOROPHYLL

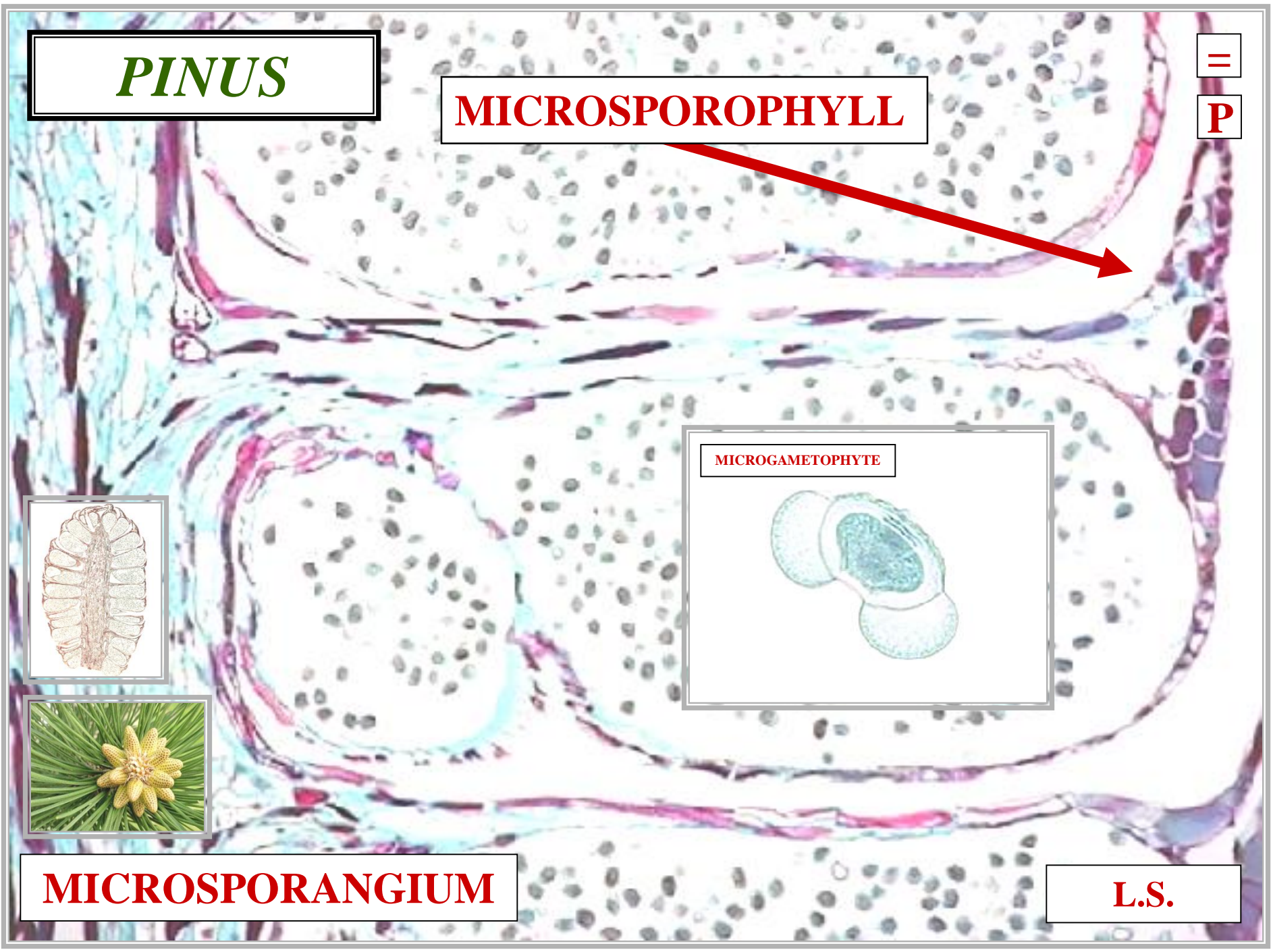
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MICROGAMETOPHYTE



MICROSPORANGIUM

L.S.



PINUS

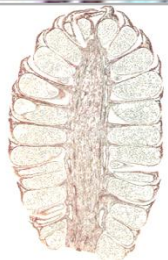
MICROSPOROPHYLL



MICROGAMETOPHYTE



POLLEN GRAIN



MICROSPORANGIUM

L.S.

PINUS

MICROGAMETOPHYTE



POLLEN GRAIN

D



MICROSPORANGIUM

PINUS

MICROGAMETOPHYTE



POLLEN GRAIN

R
P



DEHISCENT

MICROSPORANGIUM

PINUS

MICROGAMETOPHYTE



POLLEN GRAIN



REQUIRED FOR POLLINATION

DEHISCENT

MICROSPORANGIUM



MEGASPORANGIUM



MEGASPORANGIUM

SYNONYMOUS

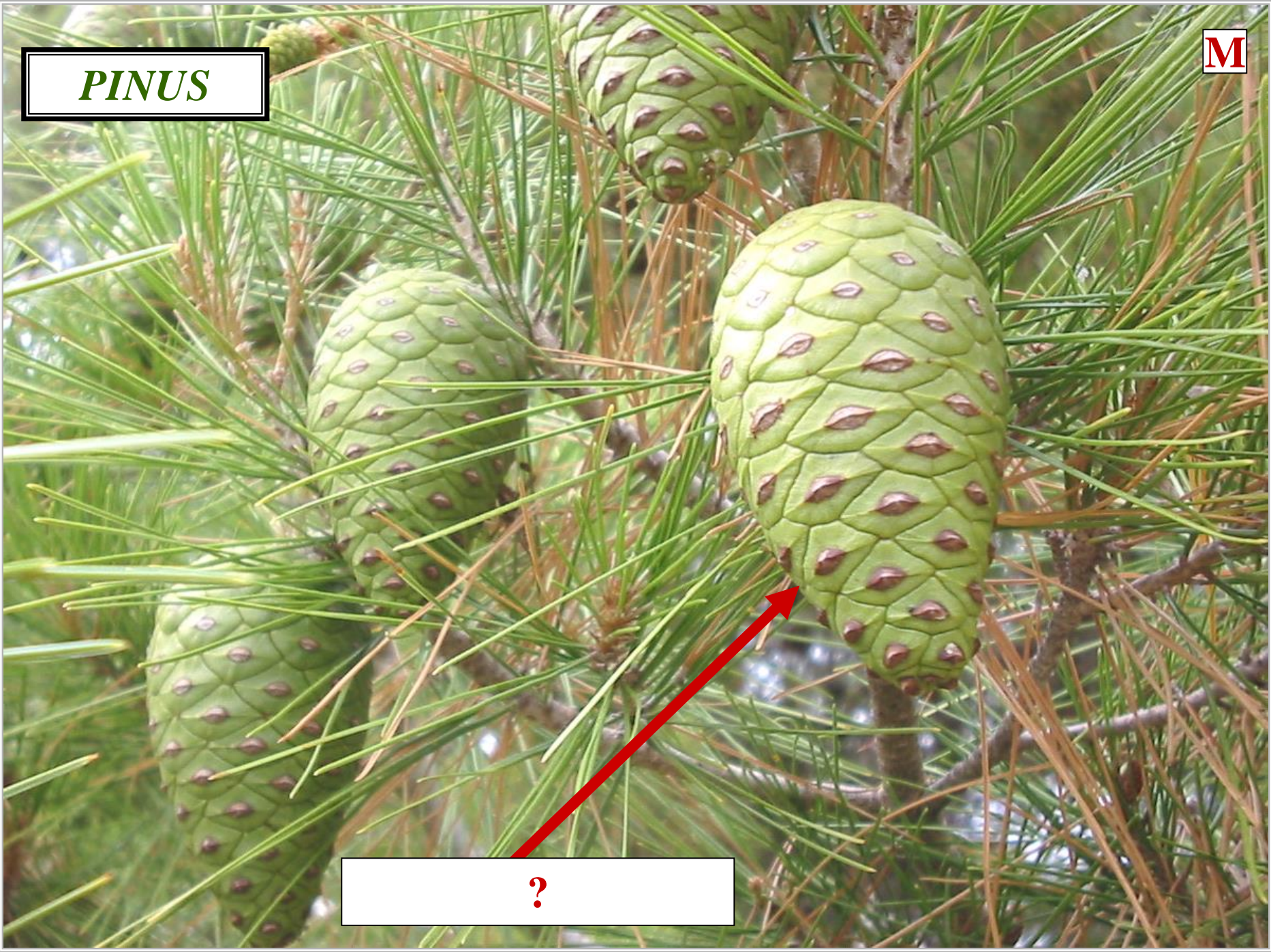
NUCELLUS

PINUS

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PINUS



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PINUS



MEGASTROBIUS



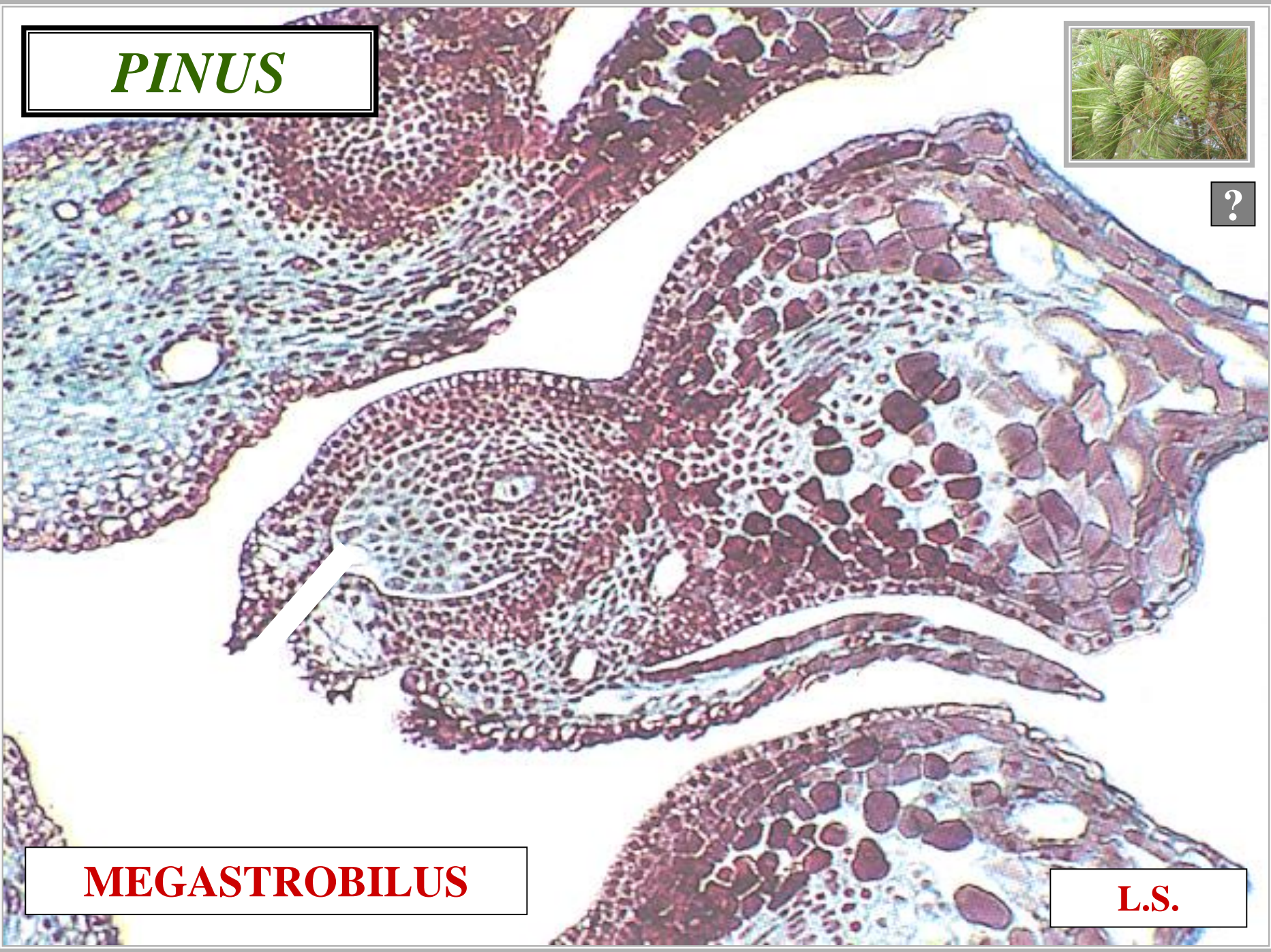
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MEGASTROBILUS

L.S.



PINUS

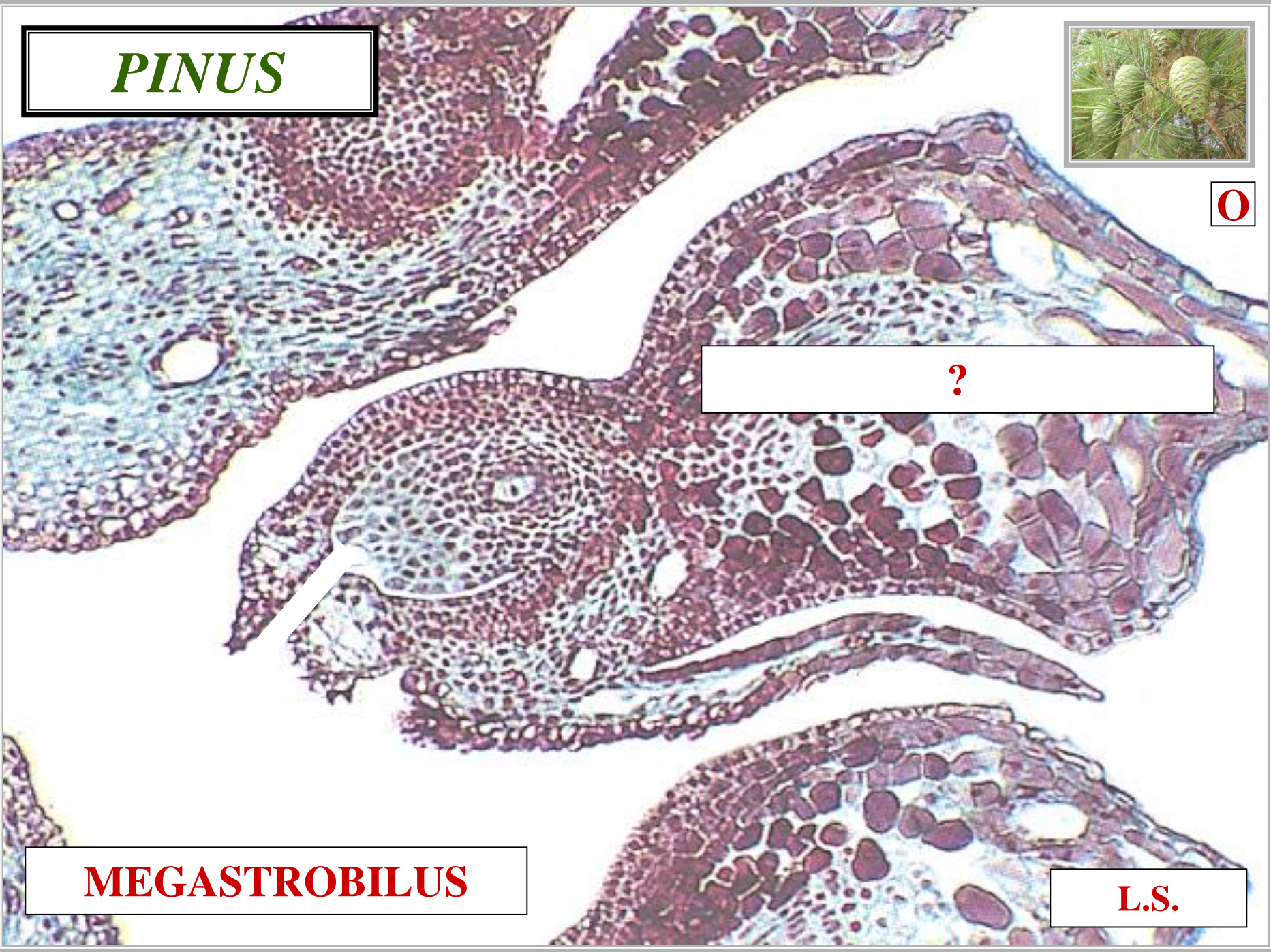


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MEGASTROBILUS

L.S.



PINUS

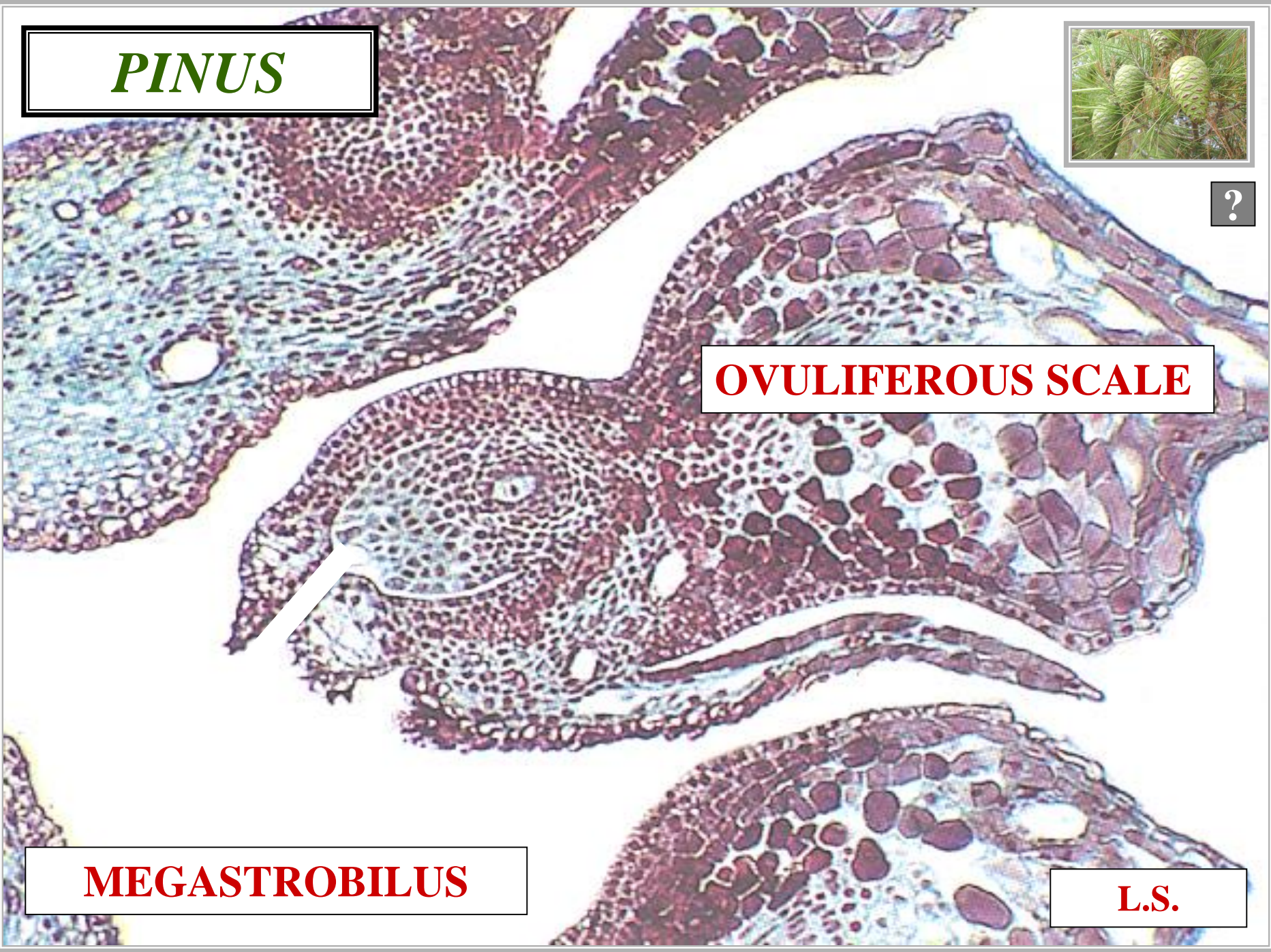


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OVULIFEROUS SCALE

MEGASTROBILUS

L.S.



PINUS



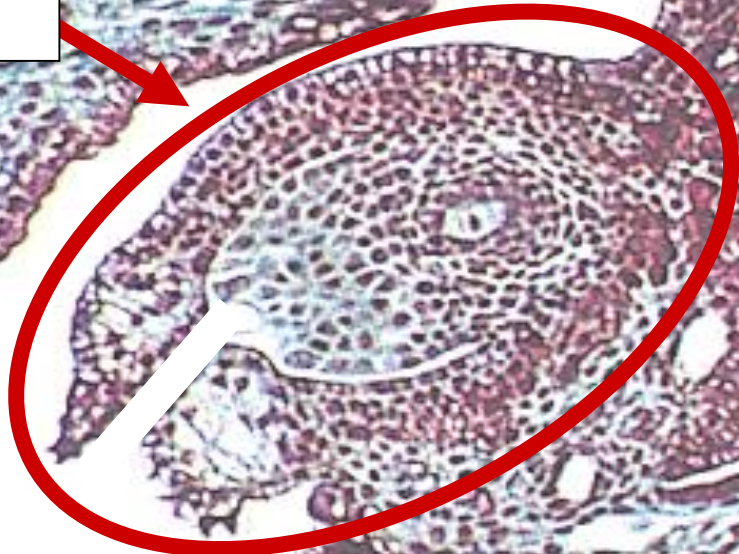
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OVULIFEROUS SCALE

MEGASTROBILUS

L.S.



PINUS



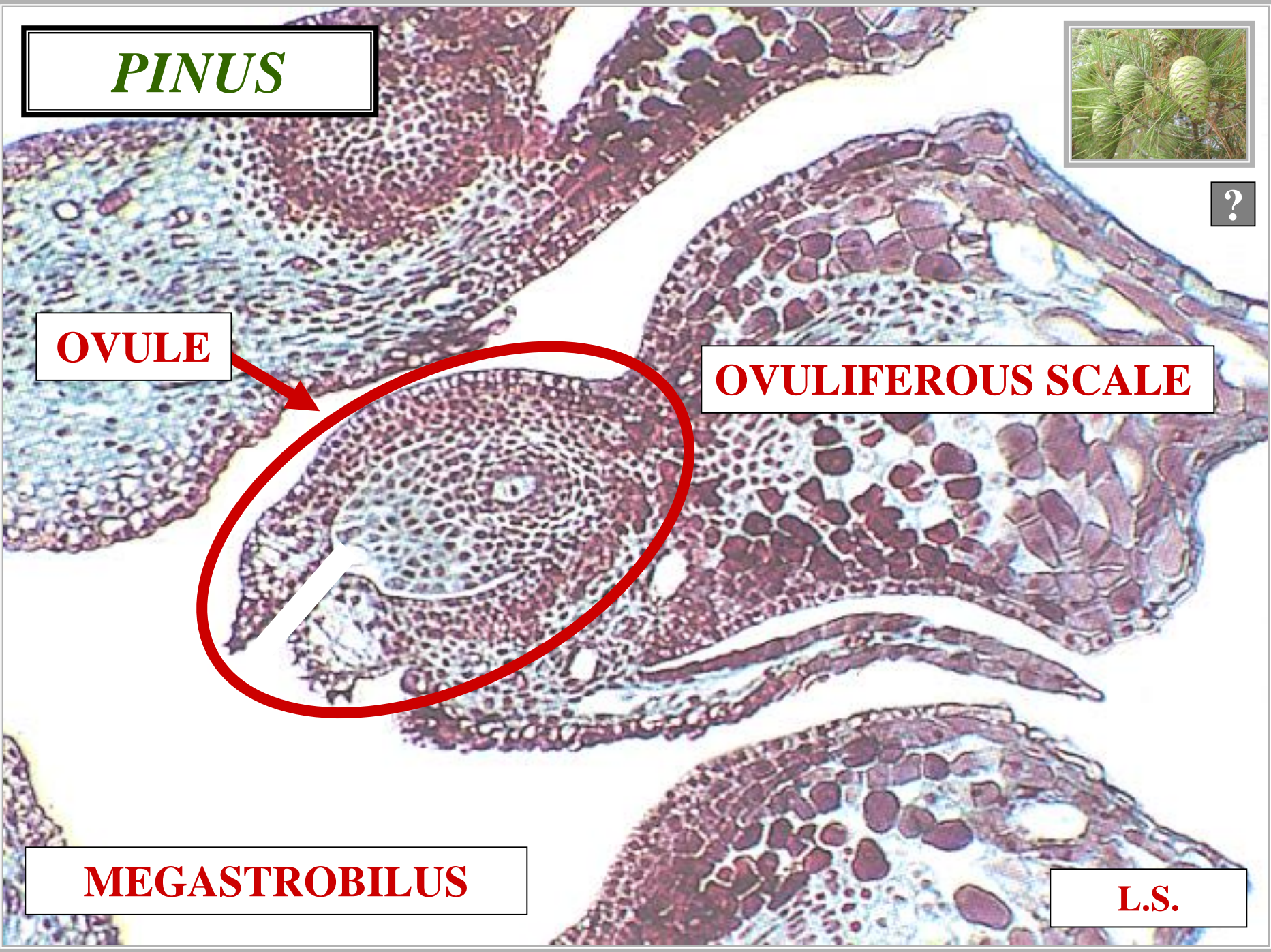
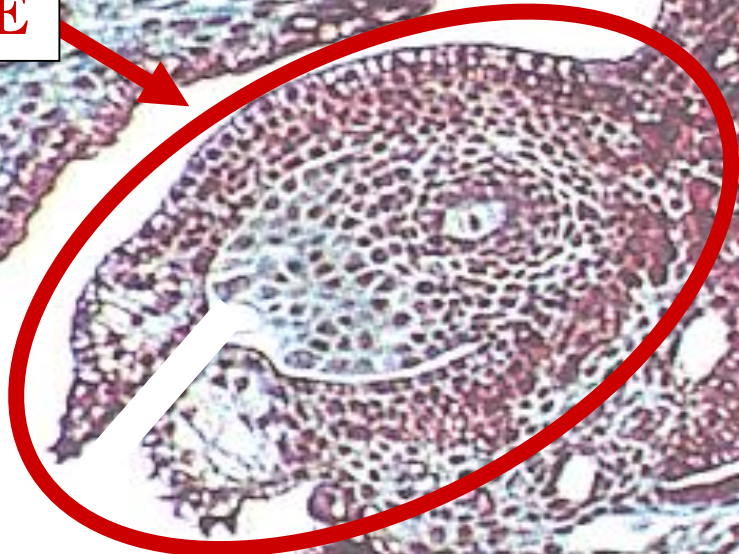
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OVULE

OVULIFEROUS SCALE

MEGASTROBILUS

L.S.



PINUS



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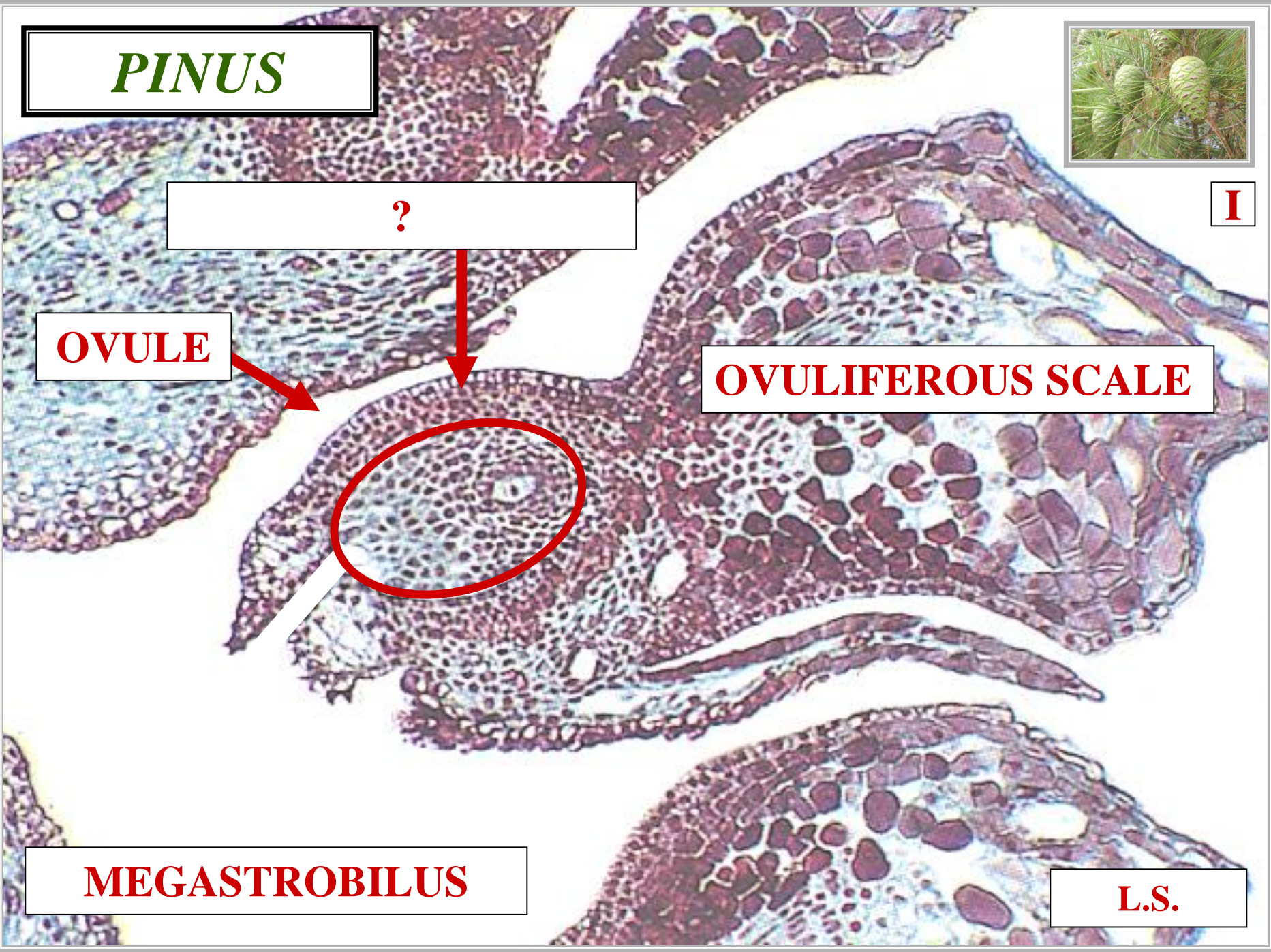
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OVULE

OVULIFEROUS SCALE

MEGASTROBILUS

L.S.



PINUS



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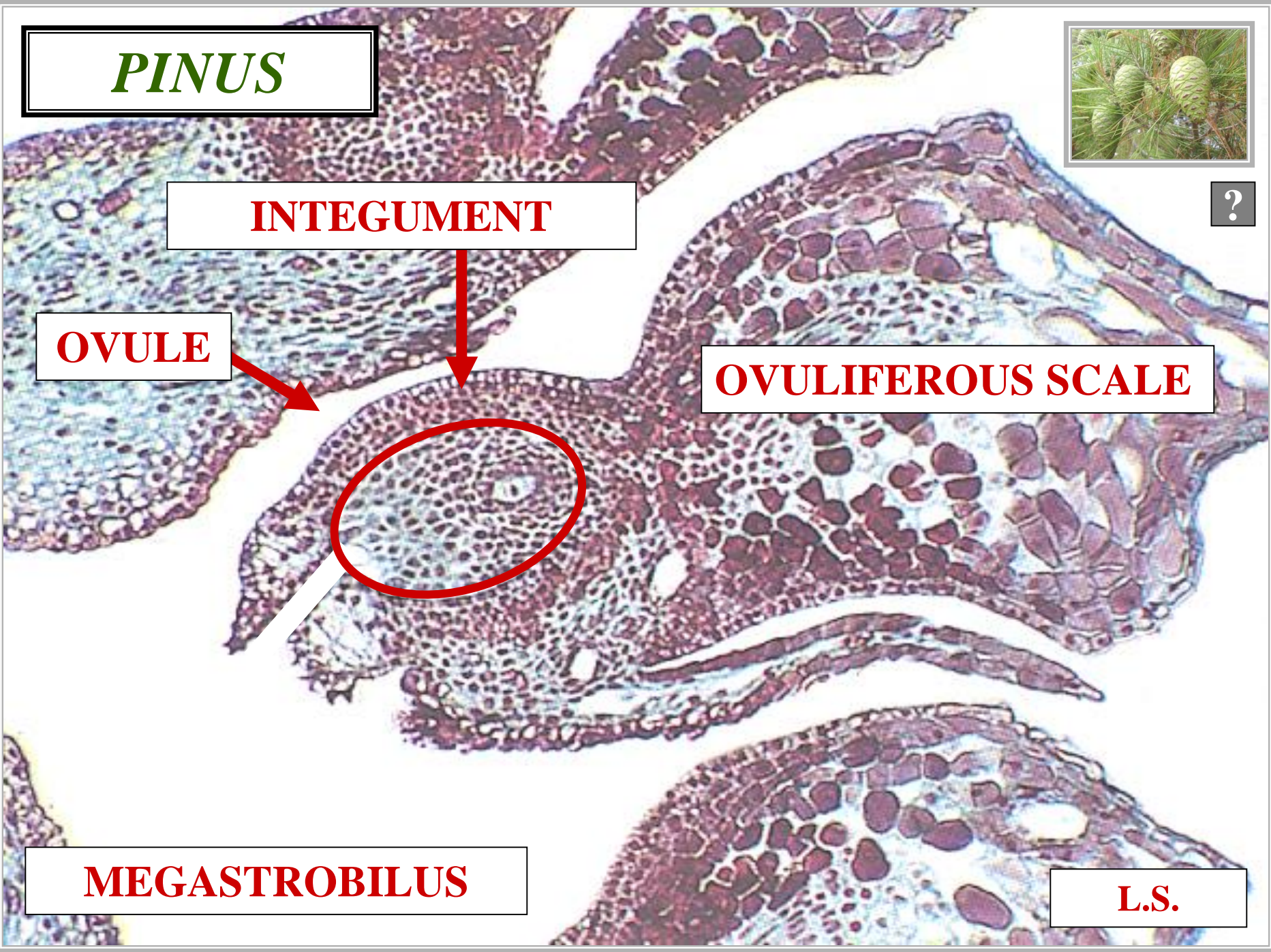
INTEGUMENT

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OVULIFEROUS SCALE

MEGASTROBILUS

L.S.



PINUS



M

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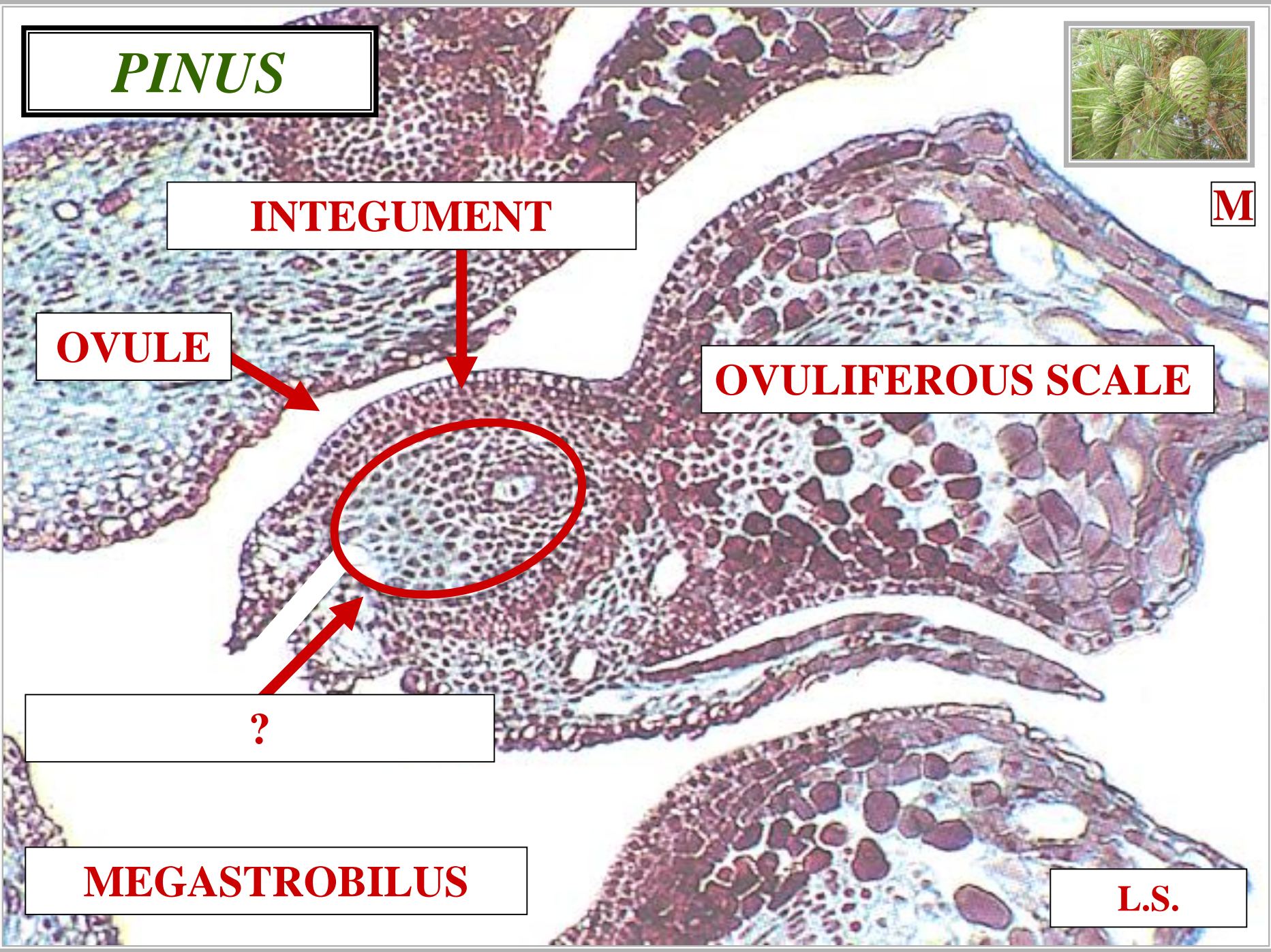
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MEGASTROBILUS

L.S.



PINUS



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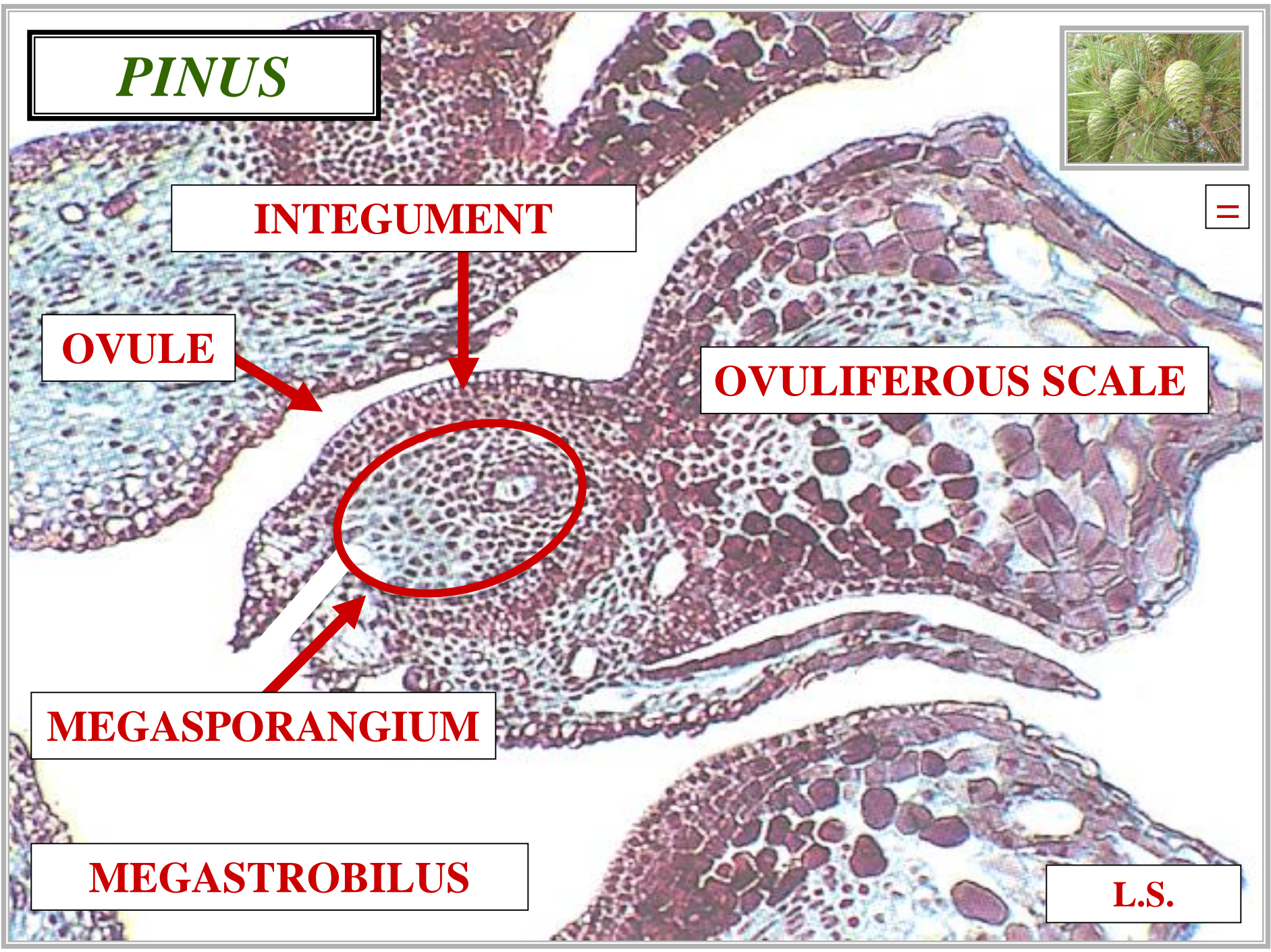
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OVULIFEROUS SCALE

MEGASPORANGIUM

MEGASTROBILUS

L.S.



PINUS



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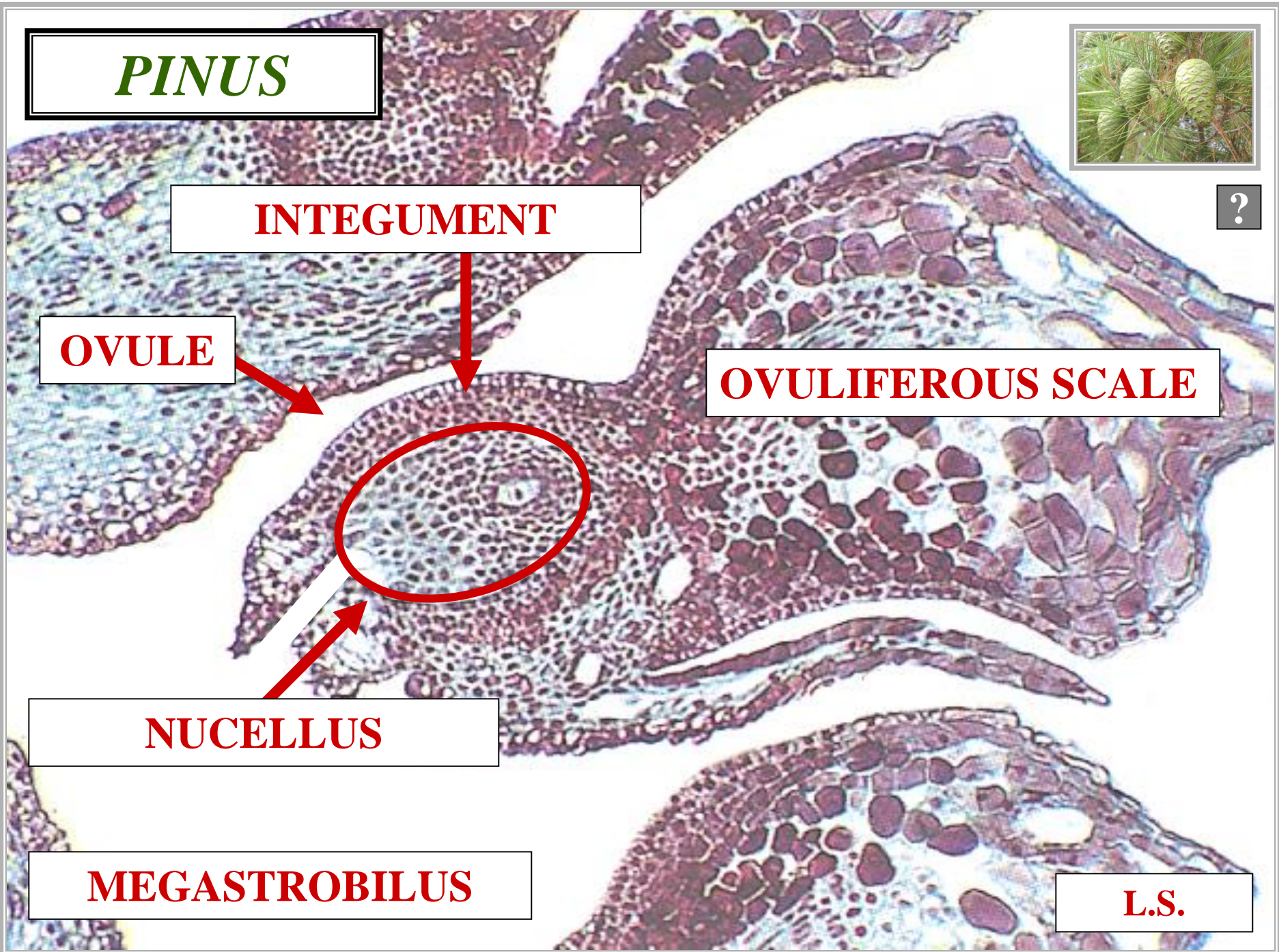
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OVULIFEROUS SCALE

NUCELLUS

MEGASTROBILUS

L.S.



PINUS



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INTEGUMENT

OVULE

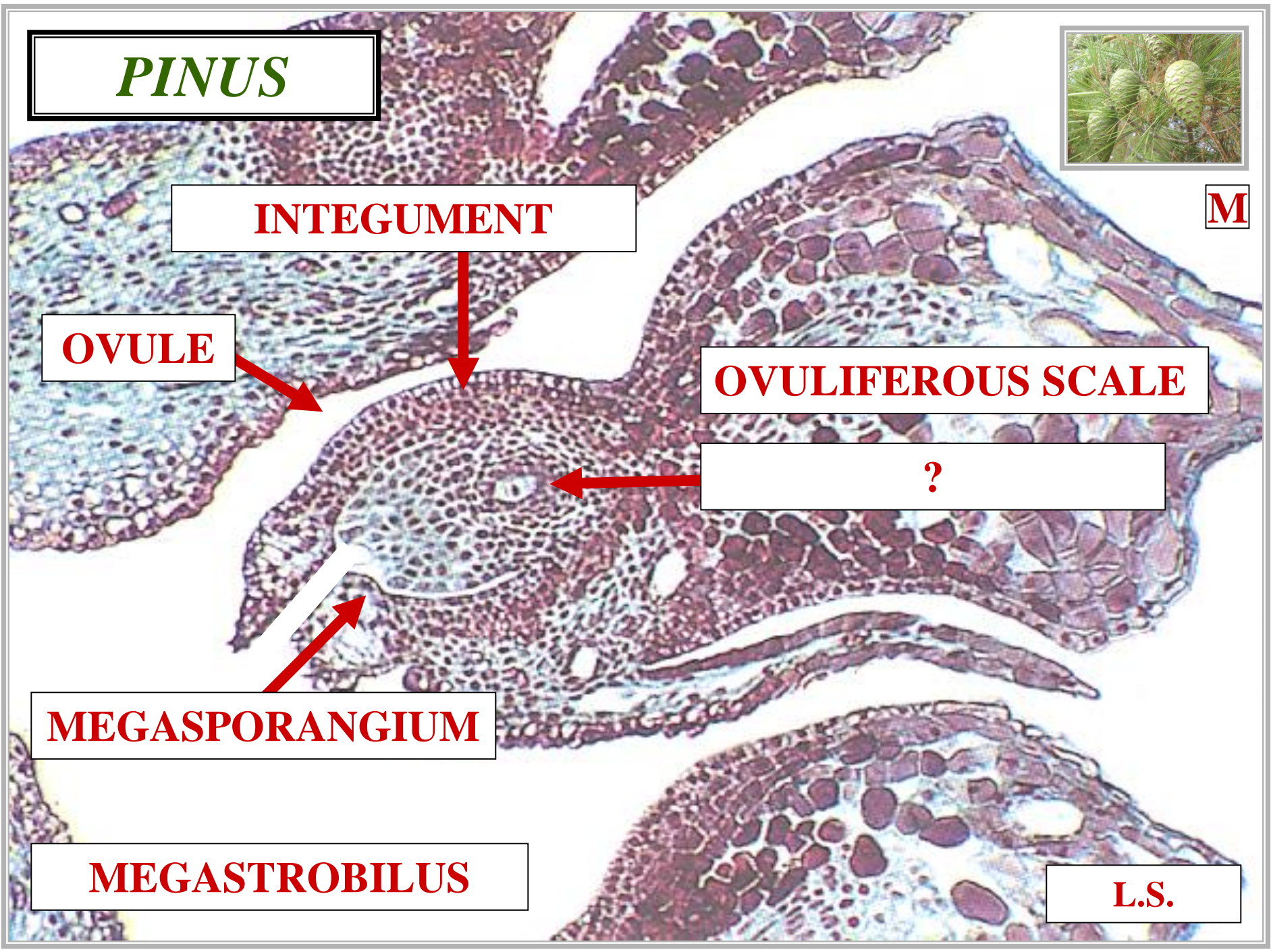
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MEGASPORANGIUM

MEGASTROBILUS

L.S.



PINUS



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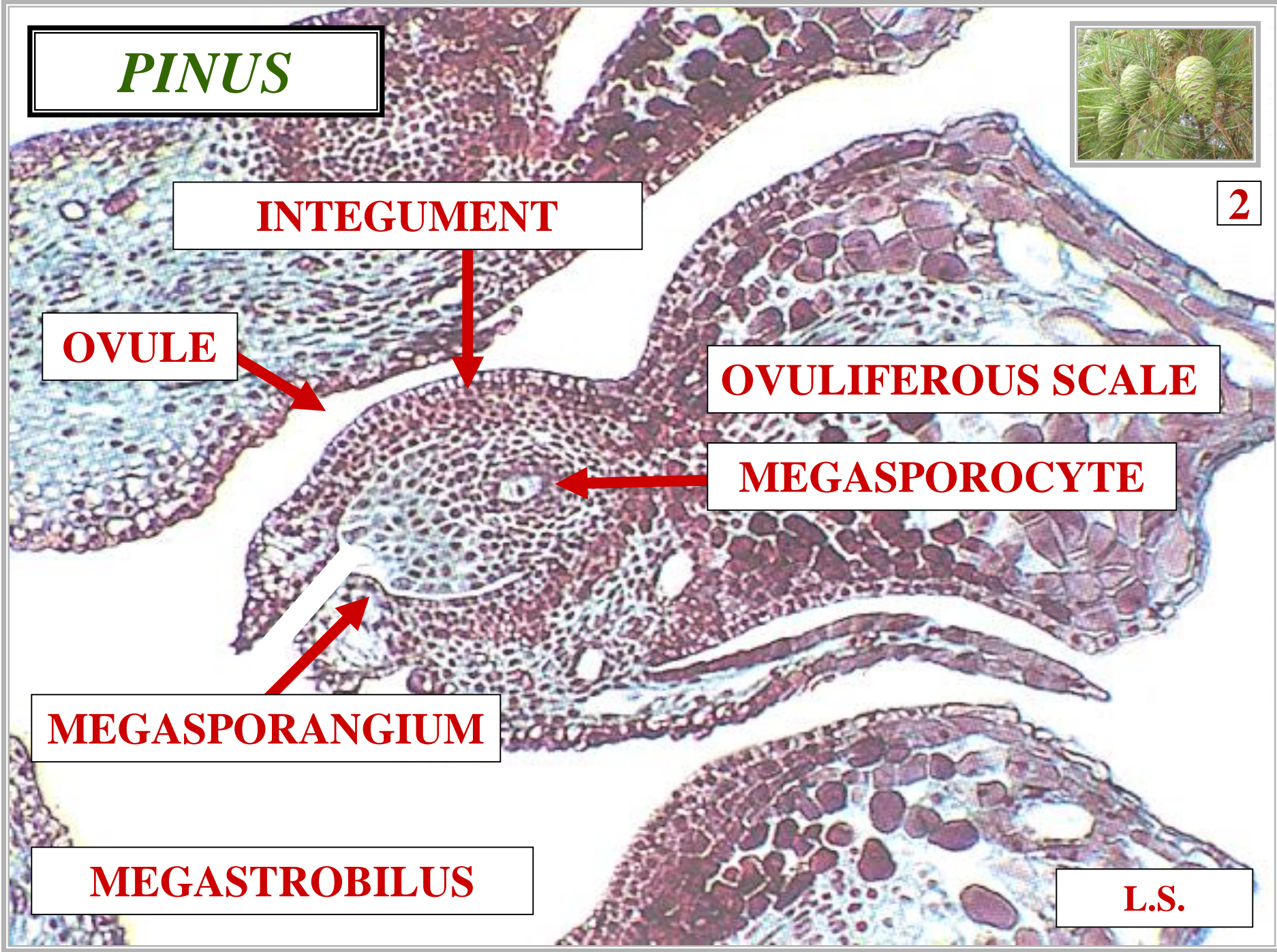
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MEGASPOROCYTE

MEGASPORANGIUM

MEGASTROBILUS

L.S.



PINUS



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INTEGUMENT

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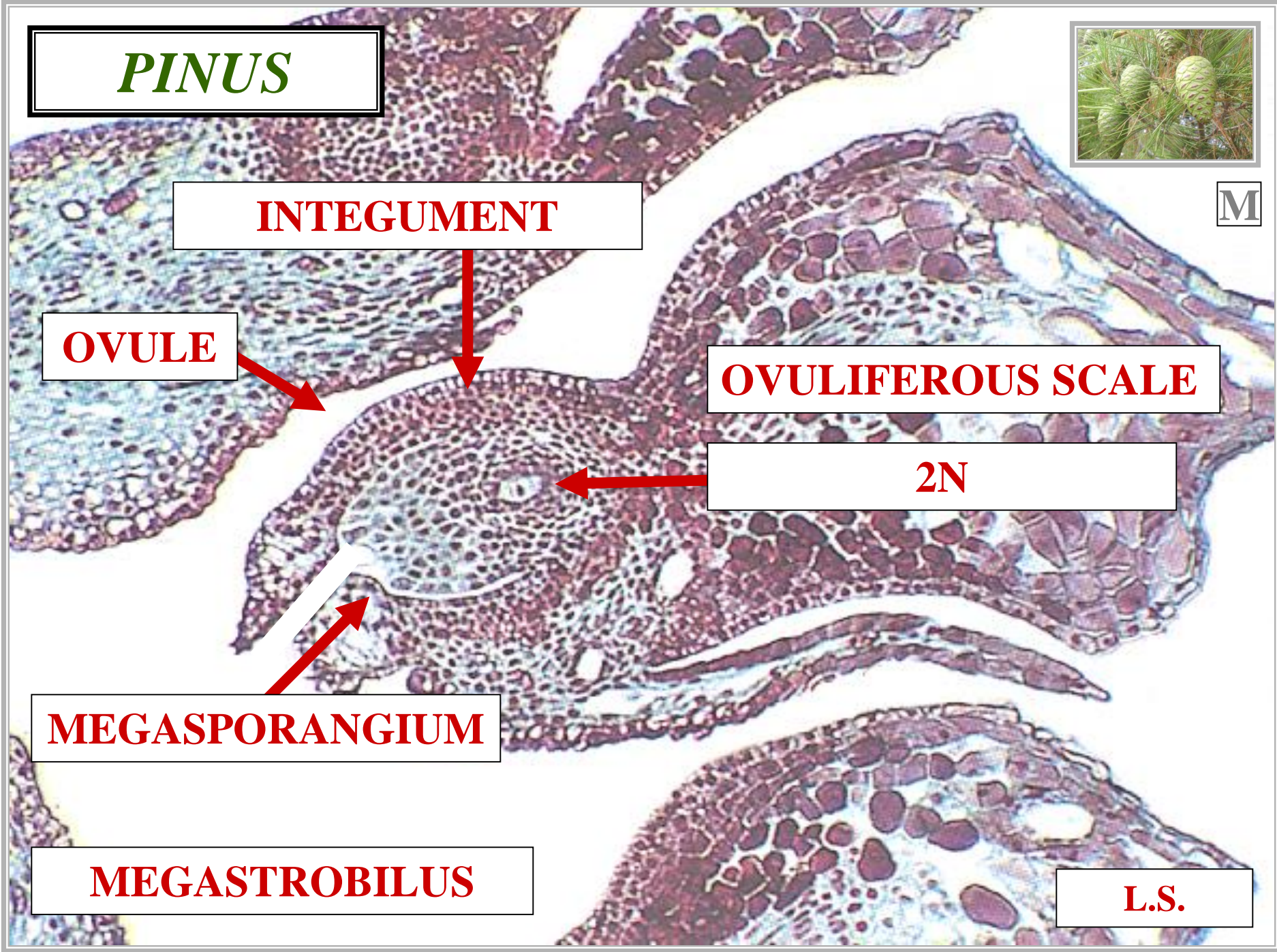
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MEGASPORANGIUM

MEGASTROBILUS

L.S.



PINUS



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INTEGUMENT

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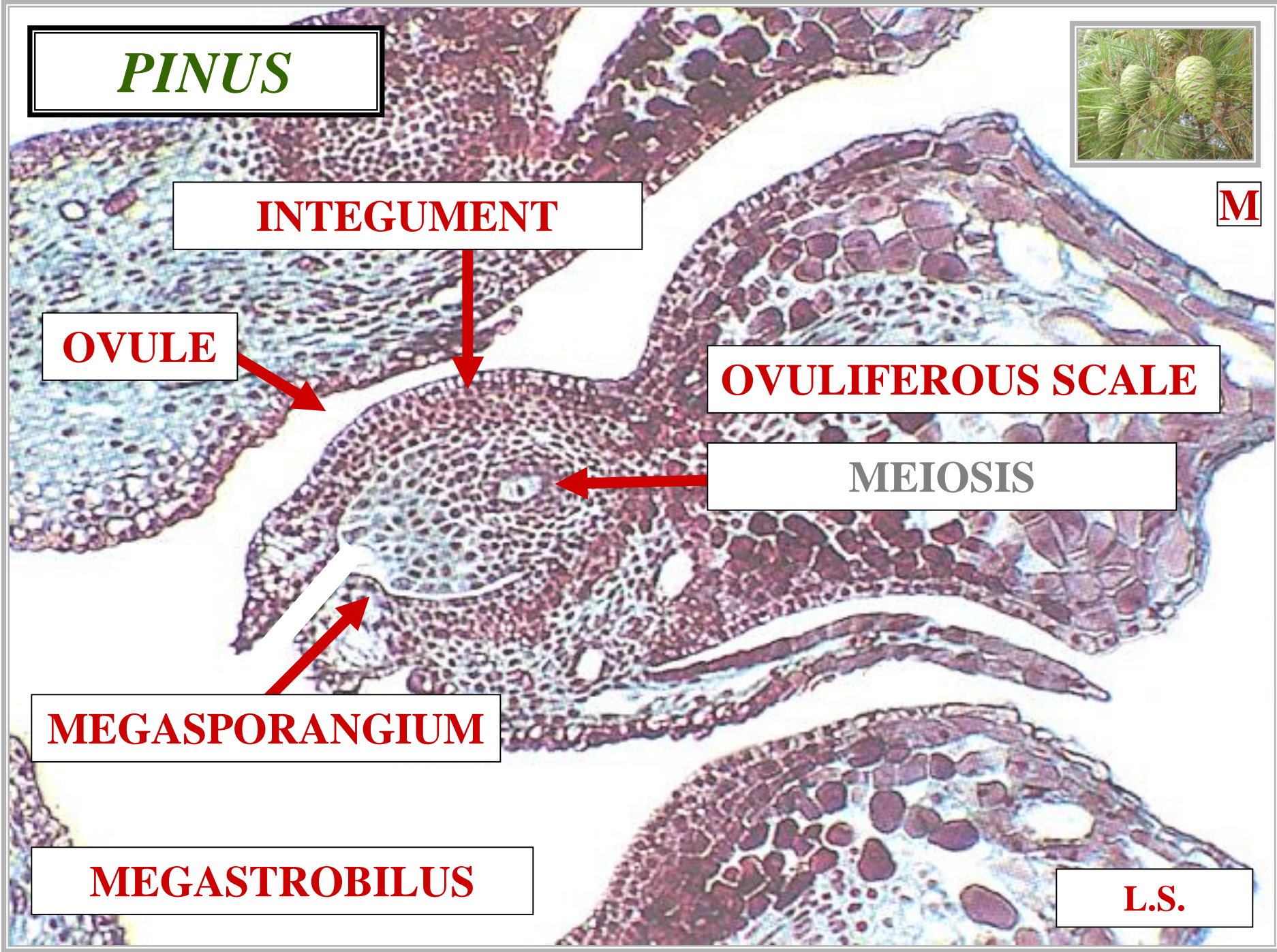
OVULIFEROUS SCALE

MEIOSIS

MEGASPORANGIUM

MEGASTROBILUS

L.S.



PINUS



1

INTEGUMENT

OVULE

OVULIFEROUS SCALE

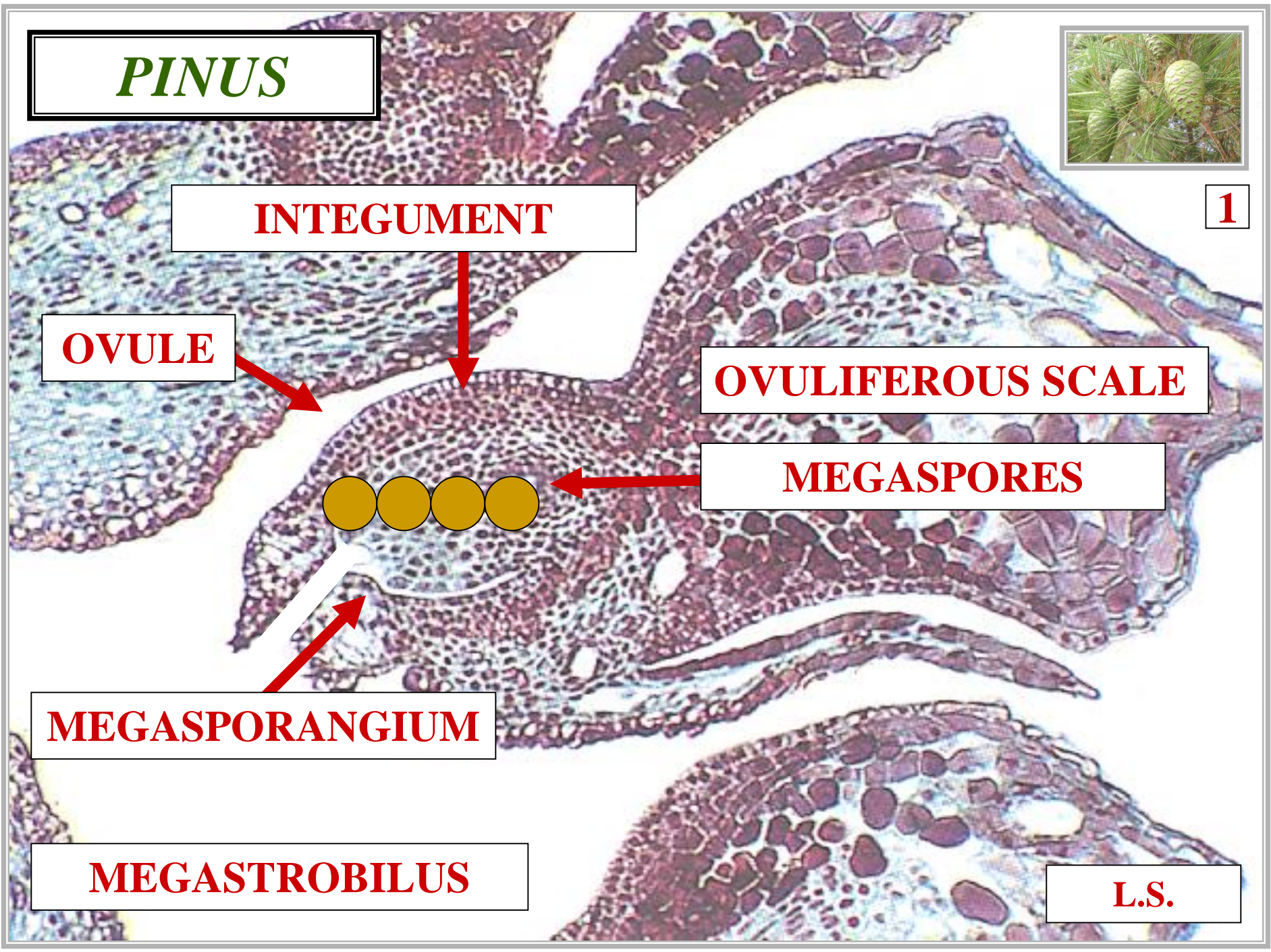
MEGASPORES



MEGASPORANGIUM

MEGASTROBILUS

L.S.



PINUS



RT
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INTEGUMENT

OVULE

OVULIFEROUS SCALE

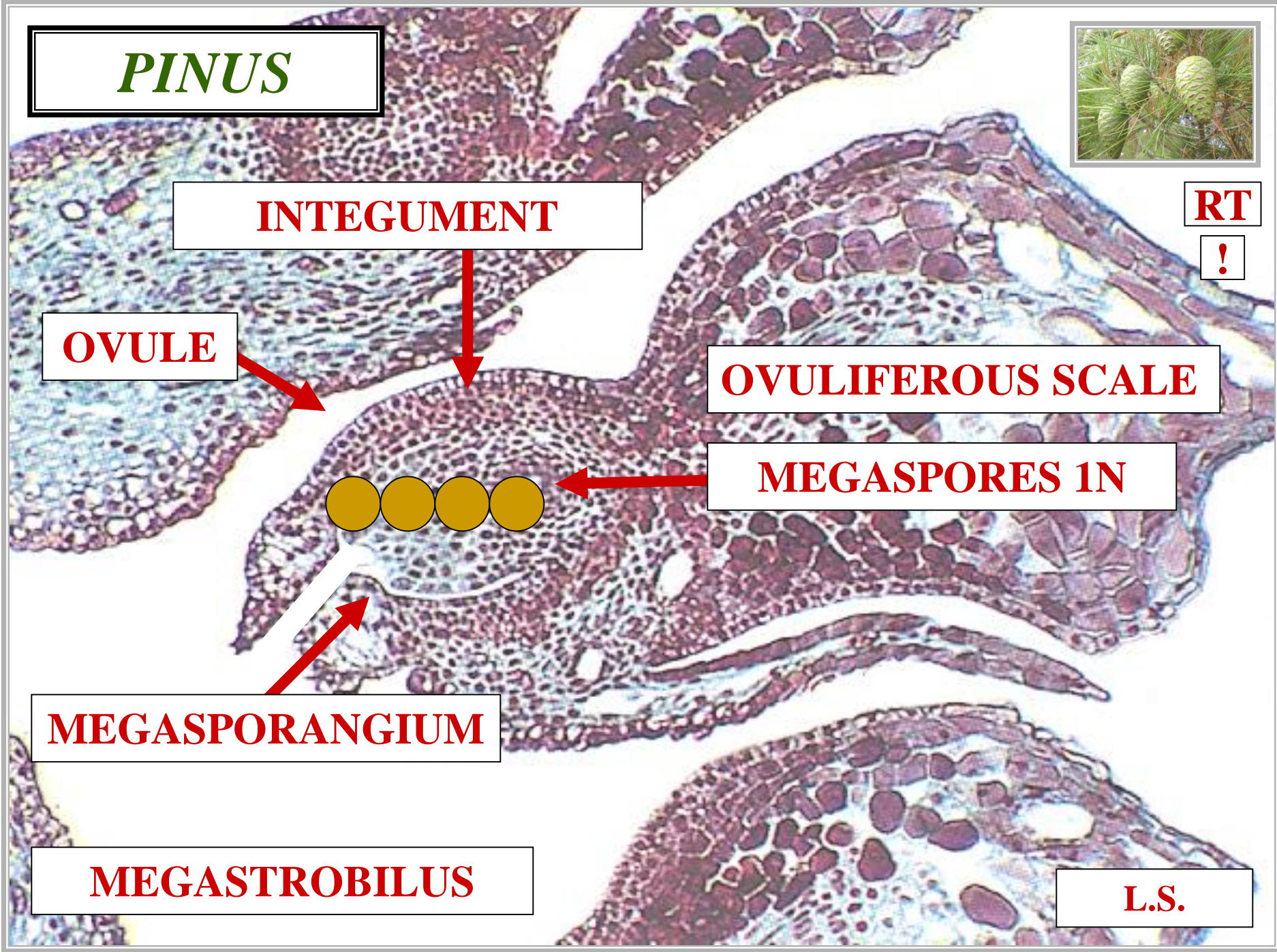
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MEGASPORANGIUM

MEGASTROBILUS

L.S.



PINUS



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INTEGUMENT

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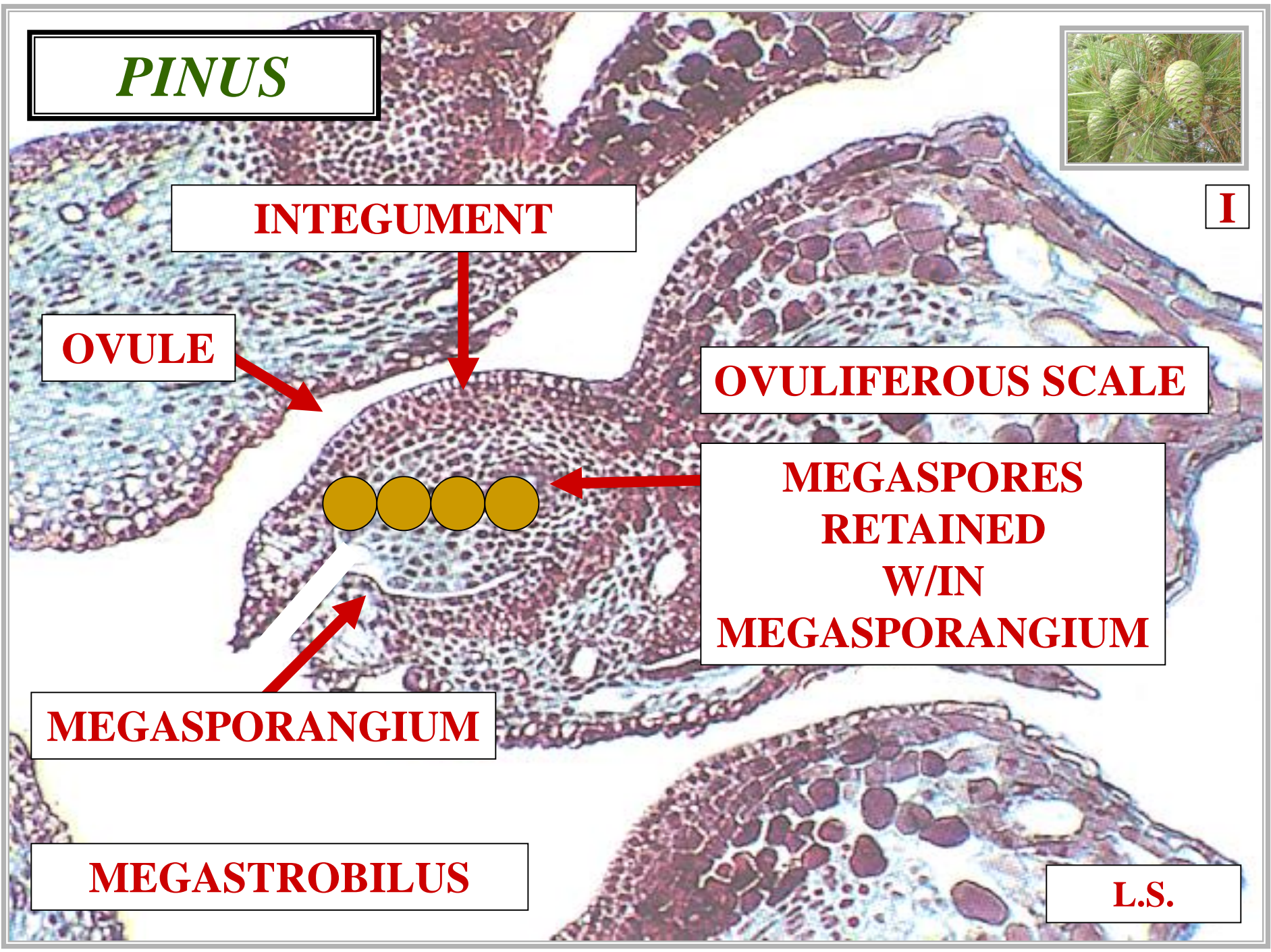
OVULIFEROUS SCALE

**MEGASPORES
RETAINED
W/IN
MEGASPORANGIUM**

MEGASPORANGIUM

MEGASTROBILUS

L.S.



PINUS



INTEGUMENT

OVULE

OVULIFEROUS SCALE

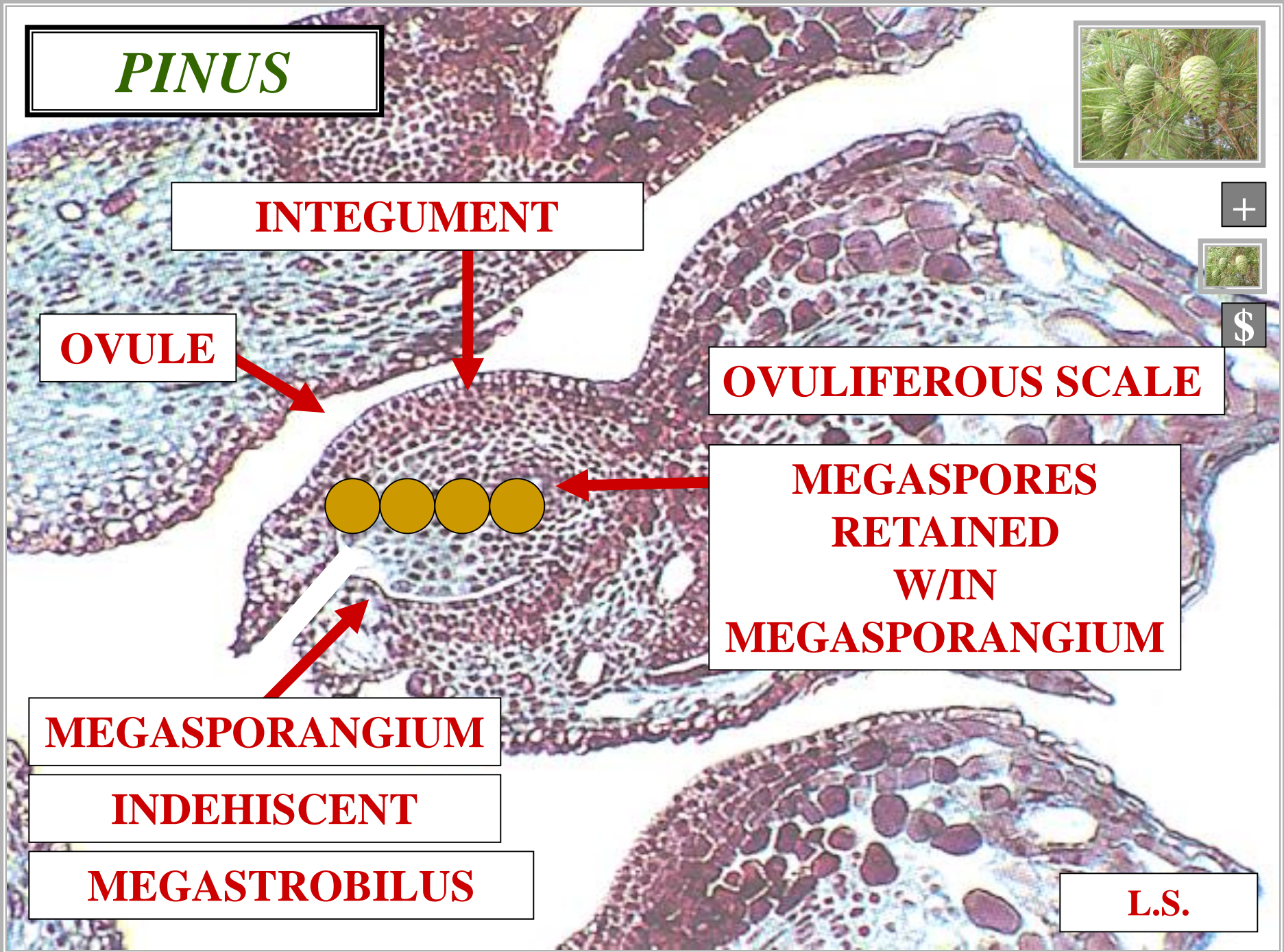
**MEGASPORES
RETAINED
W/IN
MEGASPORANGIUM**

MEGASPORANGIUM

INDEHISCENT

MEGASTROBILUS

L.S.





**MEGASPORES
RETAINED
WITHIN
INDEHISCENT
MEGASPORANGIUM**



**INDEHISCENT
MEGASPORANGIUM
DIAGNOSTIC
TO
SPERMATOPHYTES**



M

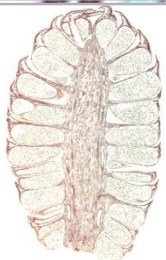
SPORE HABIT

PINUS



M

MICROSPORES



MICROSPORANGIUM

L.S.

PINUS



H

MEGASPORES

OVULE

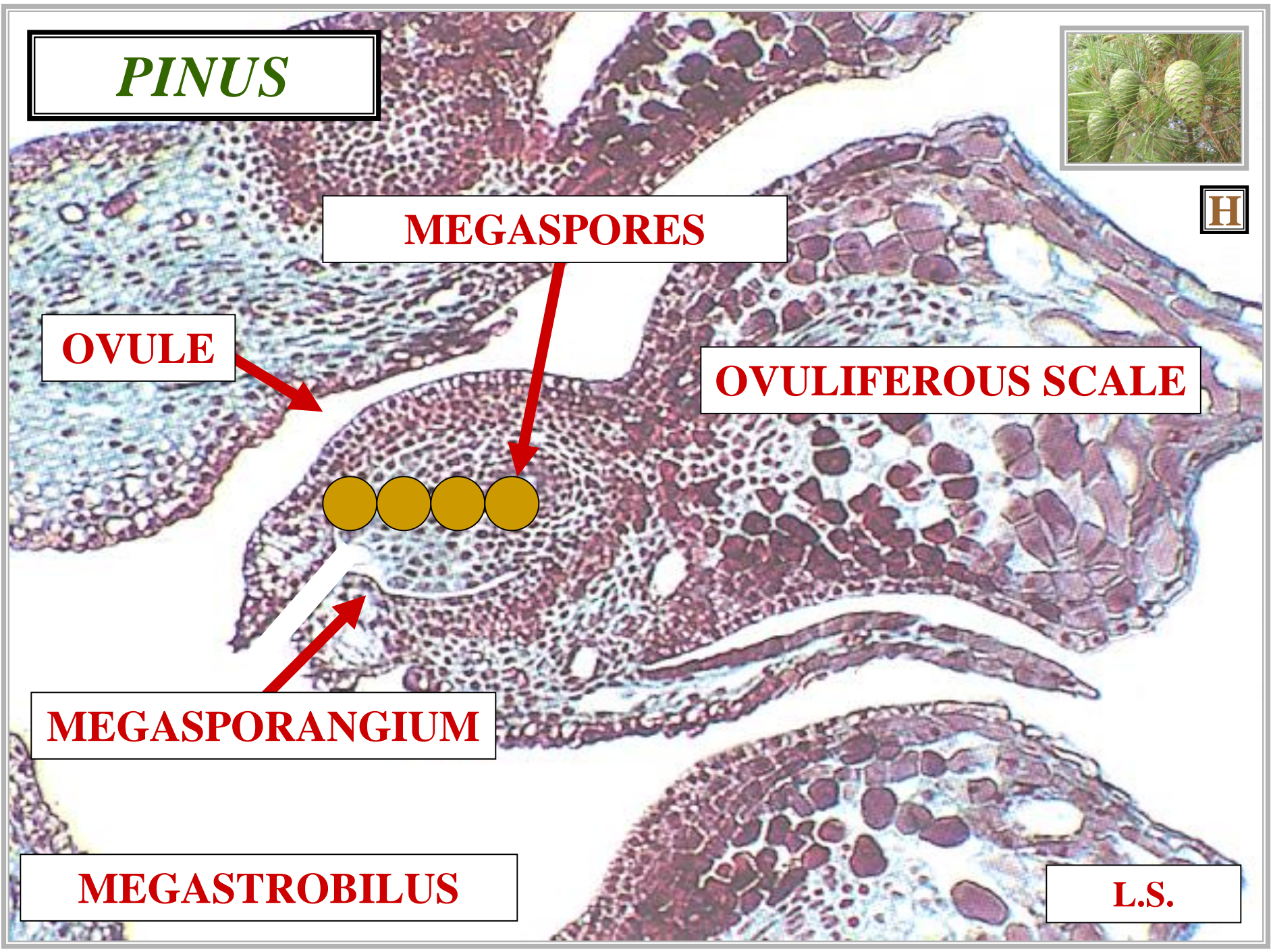
OVULIFEROUS SCALE



MEGASPORANGIUM

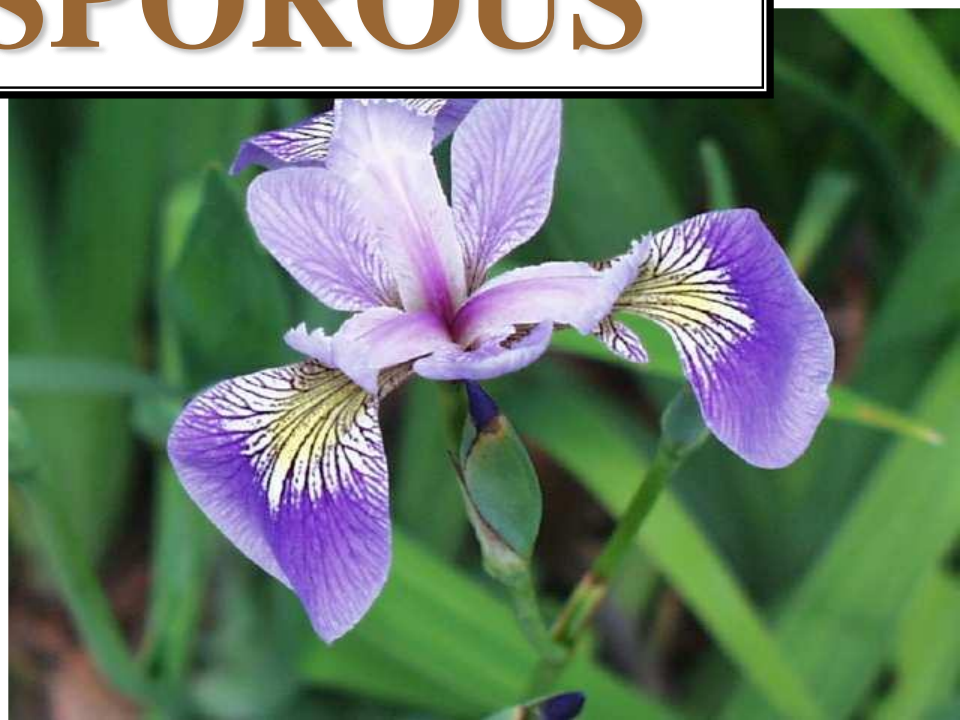
MEGASTROBILUS

L.S.

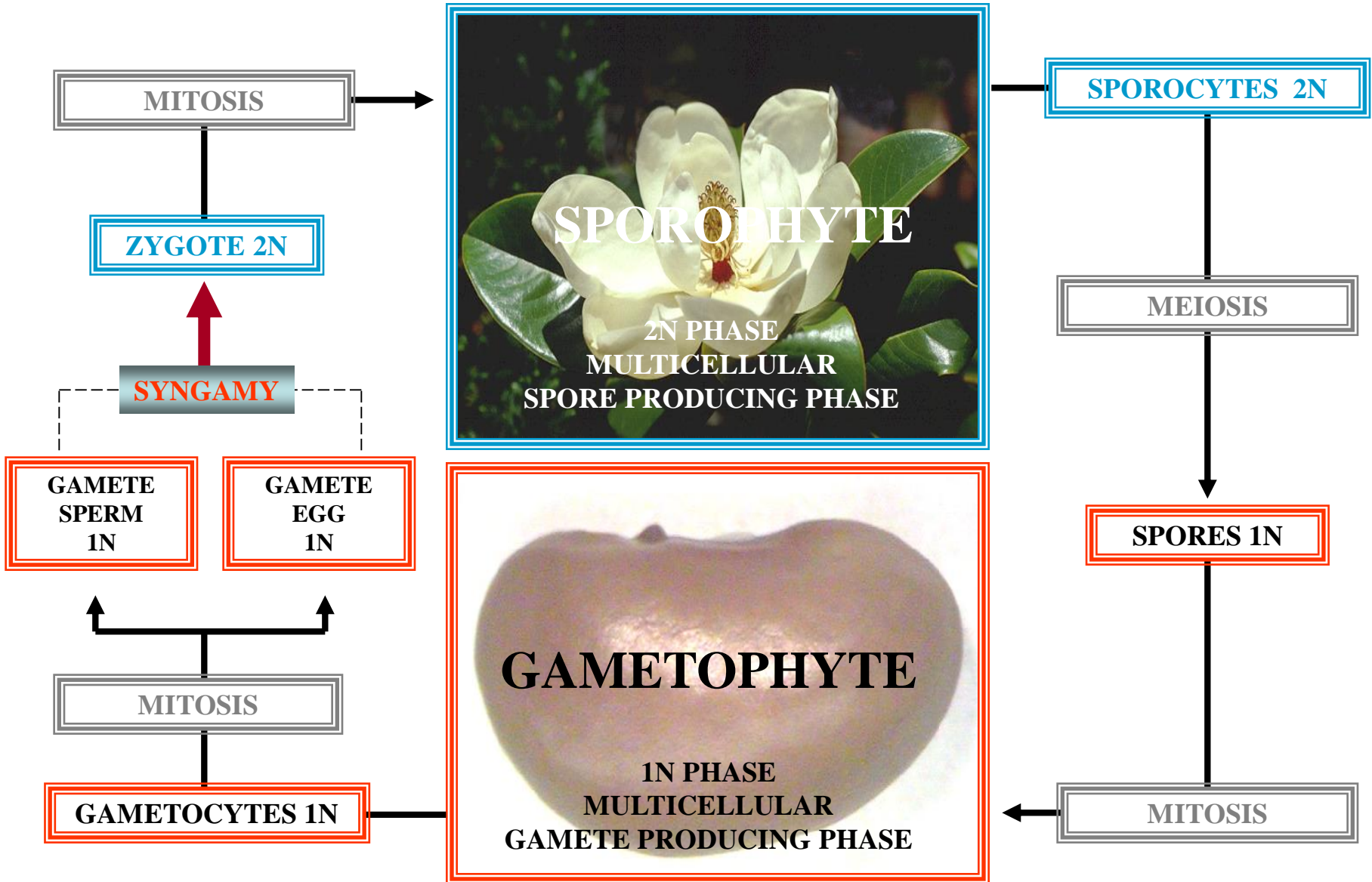




HETEROSPOROUS



SPERMATOPHYTE LIFE CYCLE

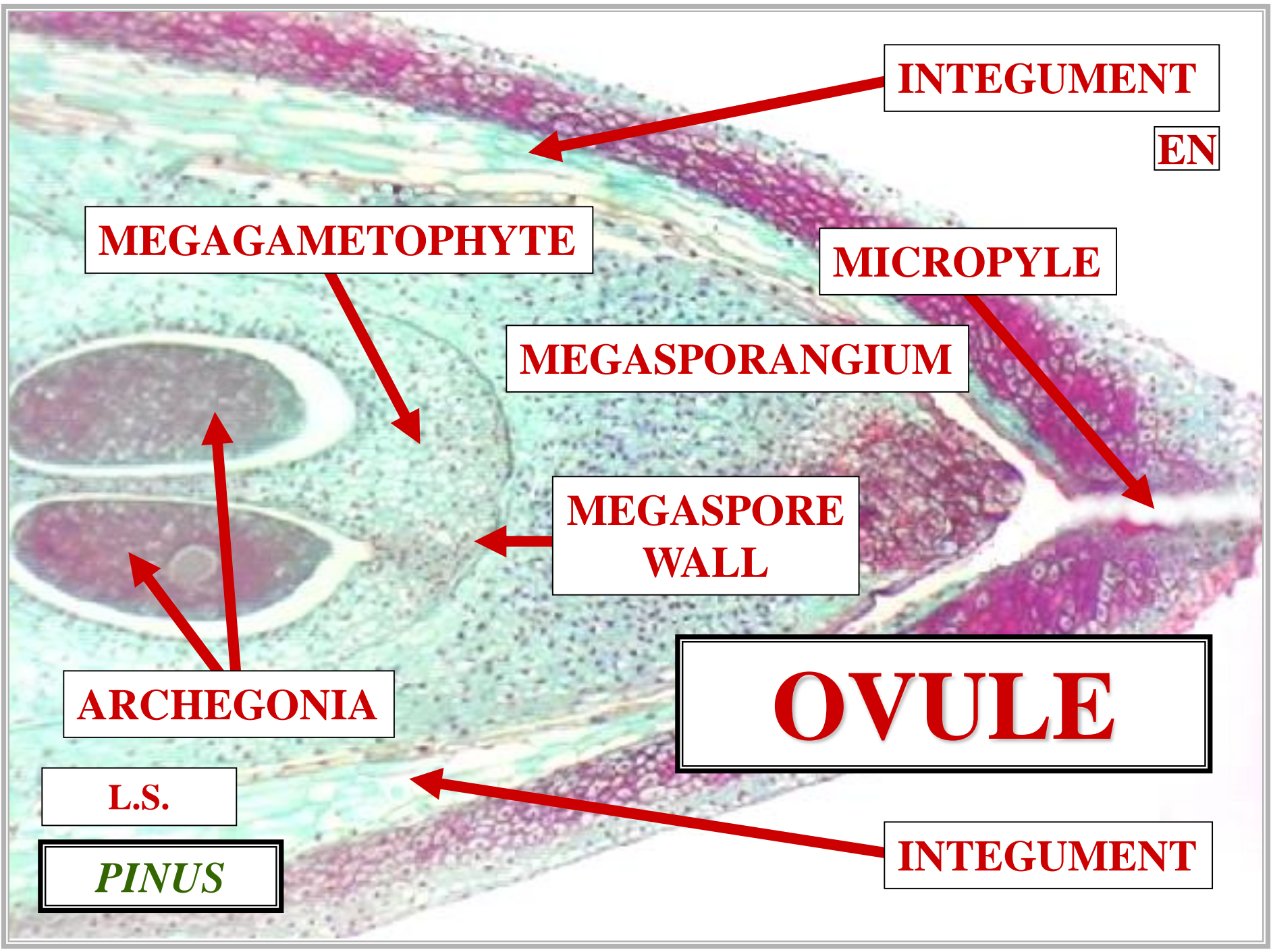




GAMETOPHYTE CHARACTERS



MEGAGAMETOPHYTE



INTEGUMENT

EN

MEGAGAMETOPHYTE

MICROPYLE

MEGASPORANGIUM

**MEGASPORE
WALL**

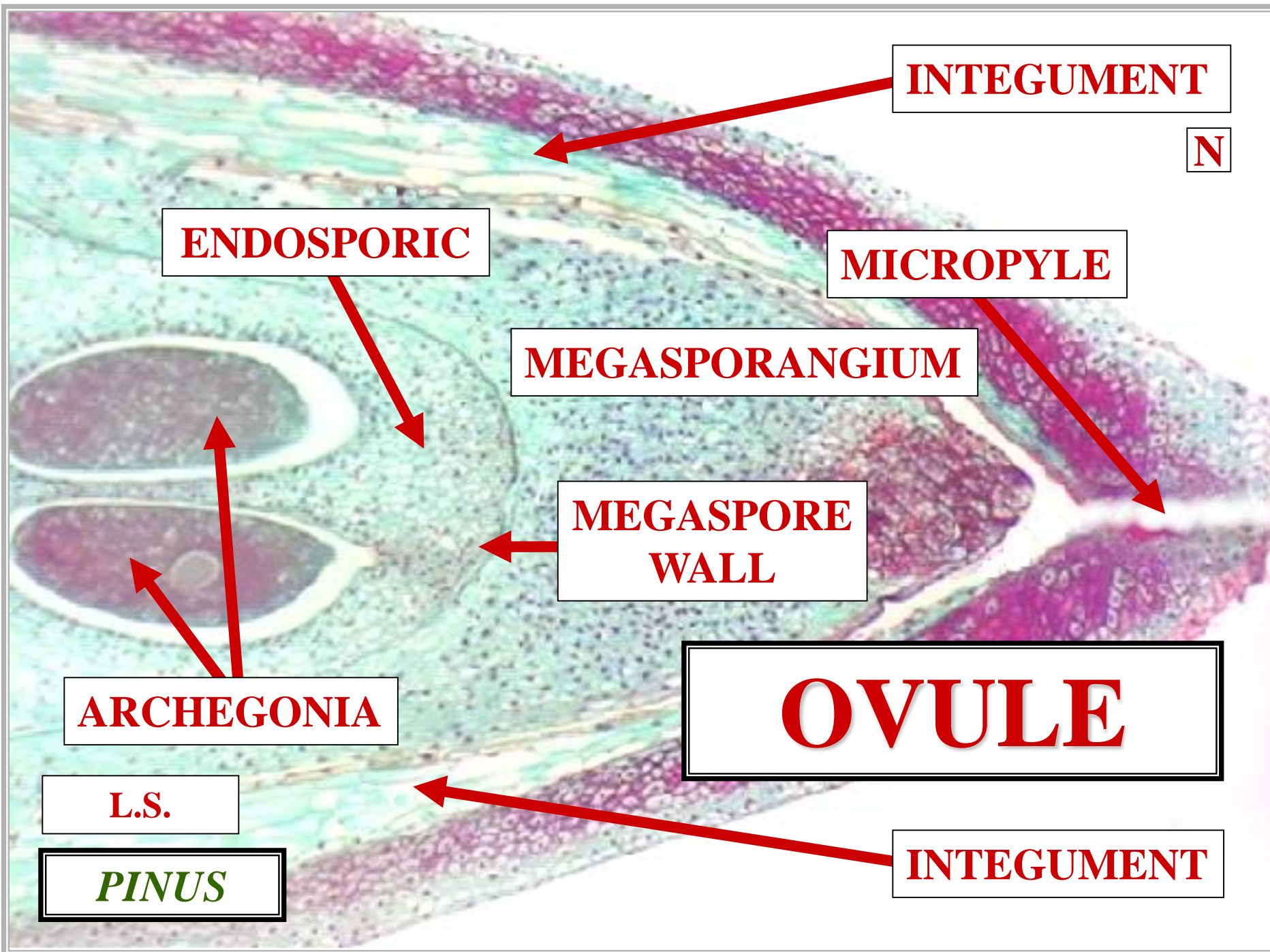
ARCHEGONIA

OVULE

L.S.

PINUS

INTEGUMENT



INTEGUMENT

N

ENDOSPORIC

MICROPYLE

MEGASPORANGIUM

**MEGASPORE
WALL**

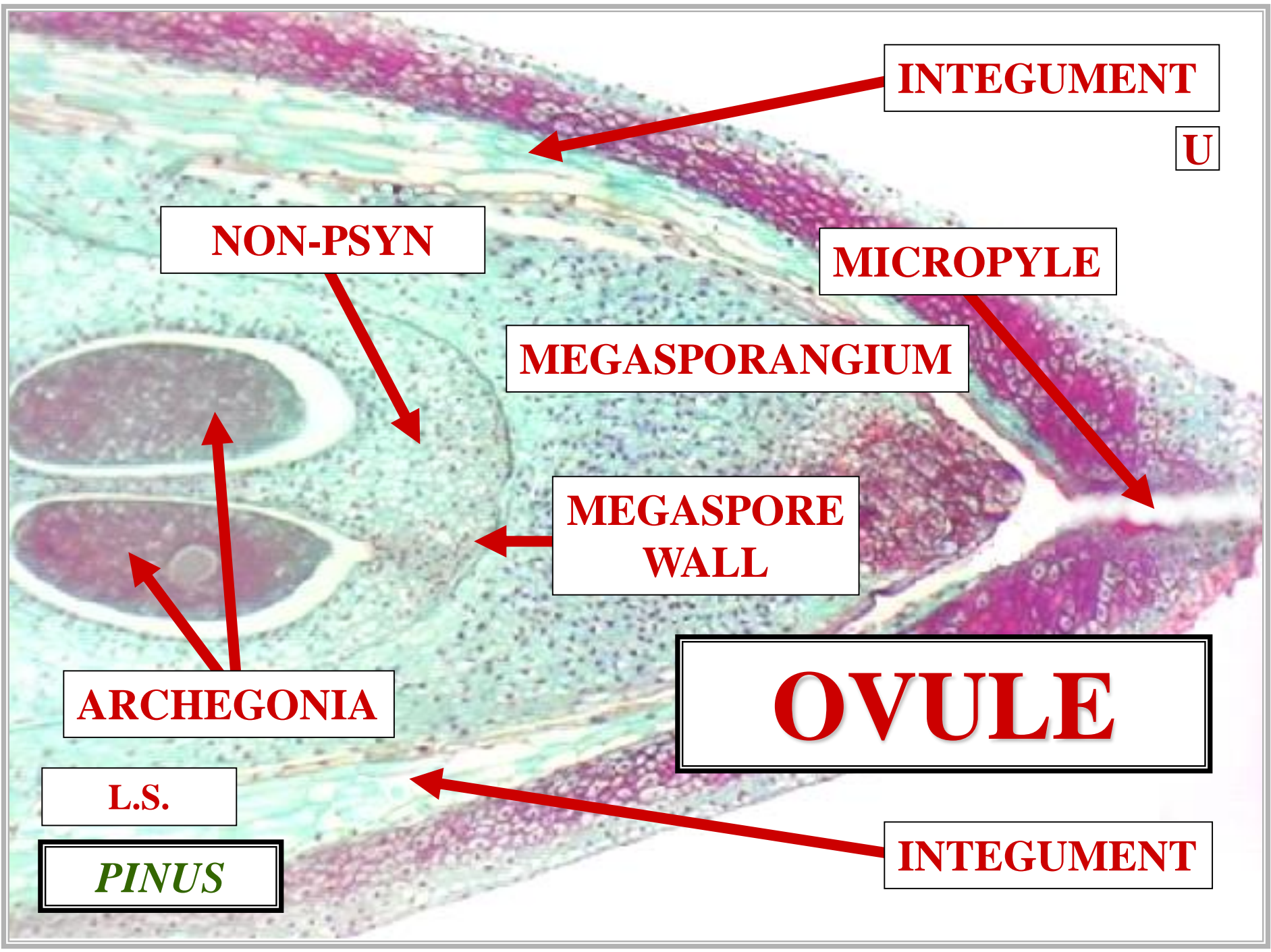
ARCHEGONIA

OVULE

L.S.

PINUS

INTEGUMENT



INTEGUMENT

U

NON-PSYN

MICROPYLE

MEGASPORANGIUM

**MEGASPORE
WALL**

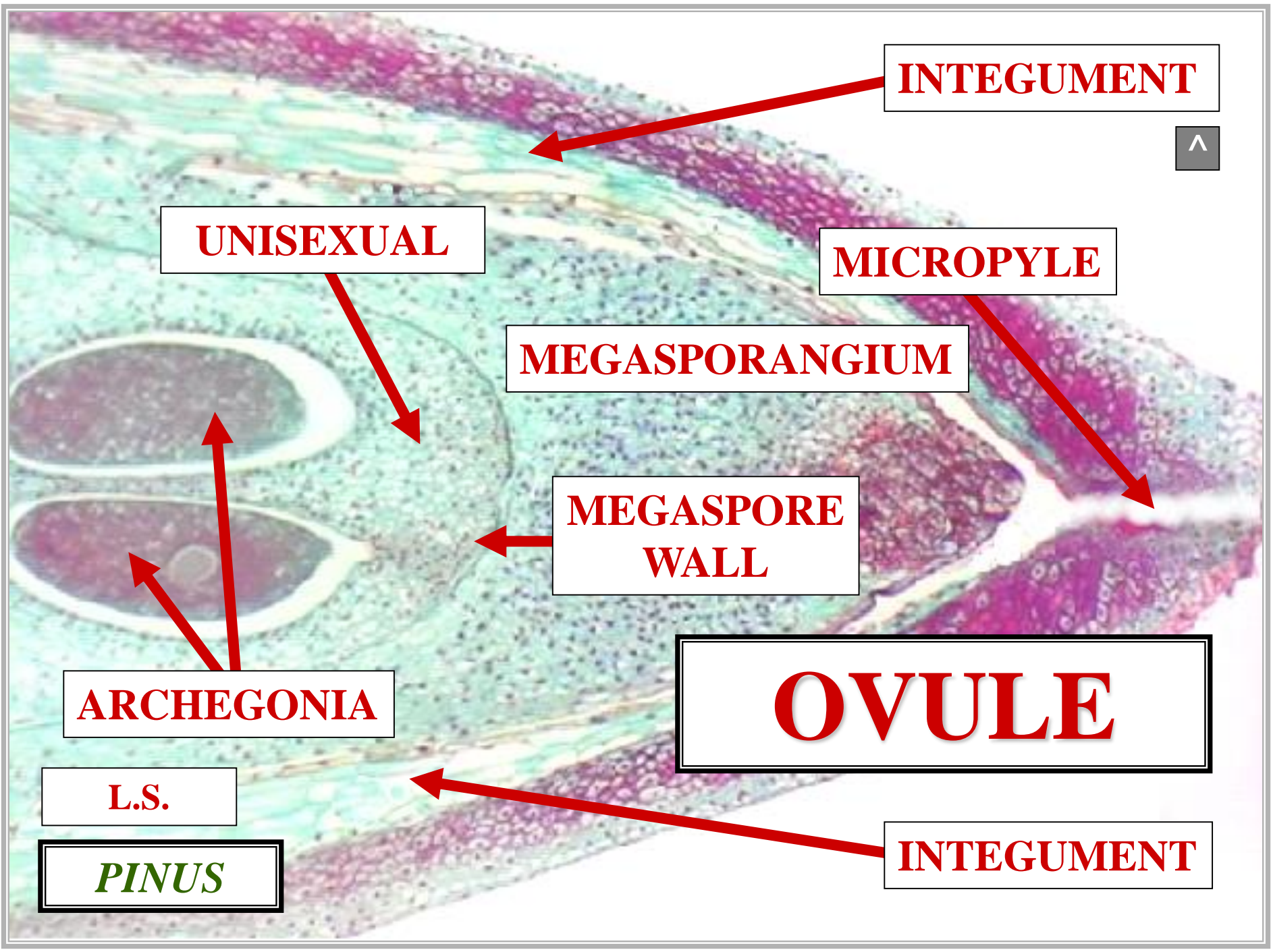
ARCHEGONIA

OVULE

L.S.

PINUS

INTEGUMENT



INTEGUMENT



UNISEXUAL

MICROPYLE

MEGASPORANGIUM

**MEGASPORE
WALL**

ARCHEGONIA

OVULE

L.S.

PINUS

INTEGUMENT



MICROGAMETOPHYTE

MICROGAMETOPHYTE



PINUS

?

MICROGAMETOPHYTE



PINUS

POLLEN GRAIN



MICROGAMETOPHYTE

SYNONYMOUS

POLLEN GRAIN

MICROGAMETOPHYTE

MICROGAMETOPHYTE



PINUS

SPORE WALL

POLLEN GRAIN

MICROGAMETOPHYTE

ENDOSPORIC



PINUS

SPORE WALL

POLLEN GRAIN

MICROGAMETOPHYTE

NON-PSYN



PINUS

SPORE WALL

POLLEN GRAIN

MICROGAMETOPHYTE



UNISEXUAL



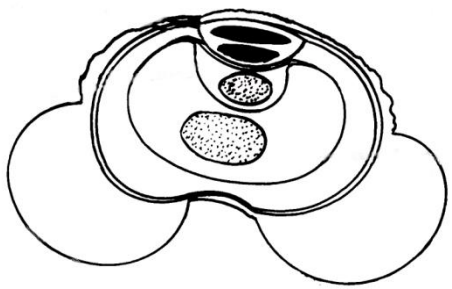
PINUS

SPORE WALL

POLLEN GRAIN

MICROGAMETOPHYTE

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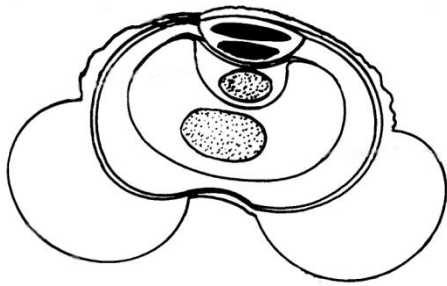


PINUS

POLLEN GRAIN

MICROGAMETOPHYTE

PROTHALLIAL CELLS



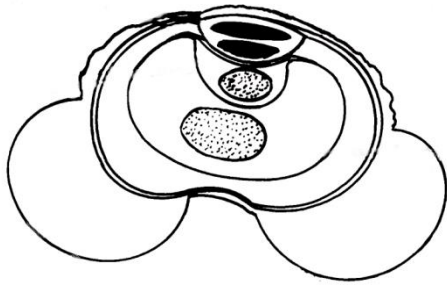
PINUS

POLLEN GRAIN

MICROGAMETOPHYTE

?

PROTHALLIAL CELLS



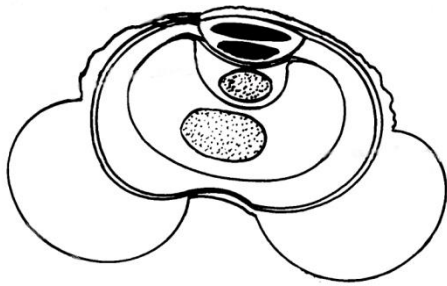
PINUS

POLLEN GRAIN

MICROGAMETOPHYTE

GENERATIVE CELL

PROTHALLIAL CELLS



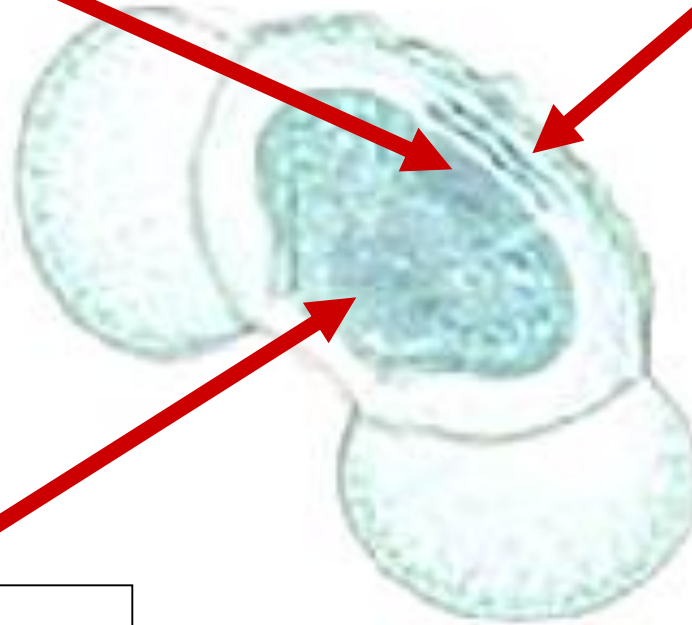
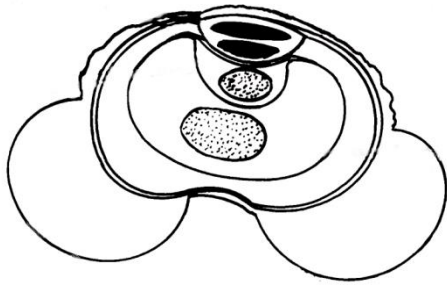
PINUS

POLLEN GRAIN

MICROGAMETOPHYTE

GENERATIVE CELL

PROTHALLIAL CELLS



PINUS

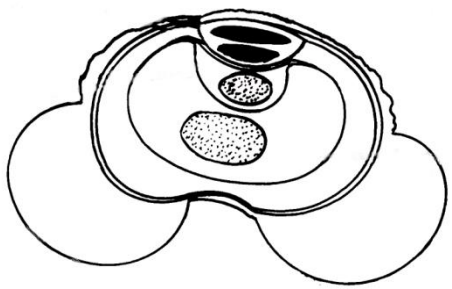
?

POLLEN GRAIN

MICROGAMETOPHYTE

GENERATIVE CELL

PROTHALLIAL CELLS



PINUS

TUBE CELL

POLLEN GRAIN

SPERMATOPHYTE

GAMETOPHYTE



4 CELLS

PTERIDOPHYTE

GAMETOPHYTE



1000'S CELLS



R

TRACHEOPHYTE EVOLUTION

SPOROPHYTE VS GAMETOPHYTE



SPOROPHYTE



GAMETOPHYTE



TRACHEOPHYTE EVOLUTION

SPOROPHYTE VS GAMETOPHYTE

SPOROPHYTE



AUGMENTS

GAMETOPHYTE



REDUCTION



SPERMATOPHYTE

PTERIDOPHYTE

GAMETOPHYTE

GAMETOPHYTE

**SPERMATOPHYTES
CONTINUED
GAMETOPHYTE
REDUCTION**

4 CELLS

1000'S CELLS

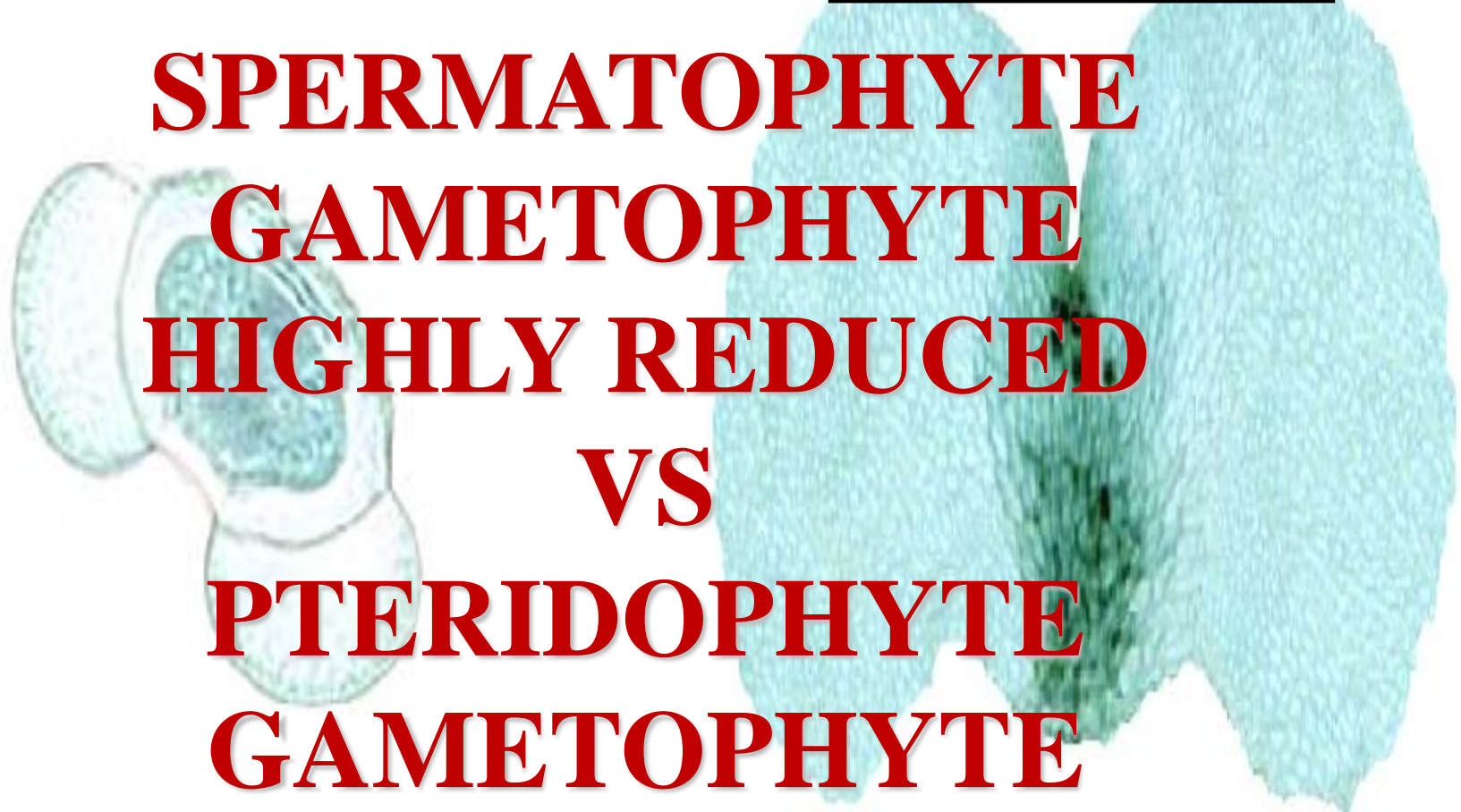


SPERMATOPHYTE

PTERIDOPHYTE

GAMETOPHYTE

GAMETOPHYTE



**SPERMATOPHYTE
GAMETOPHYTE
HIGHLY REDUCED
VS
PTERIDOPHYTE
GAMETOPHYTE**

4 CELLS

1000'S CELLS