

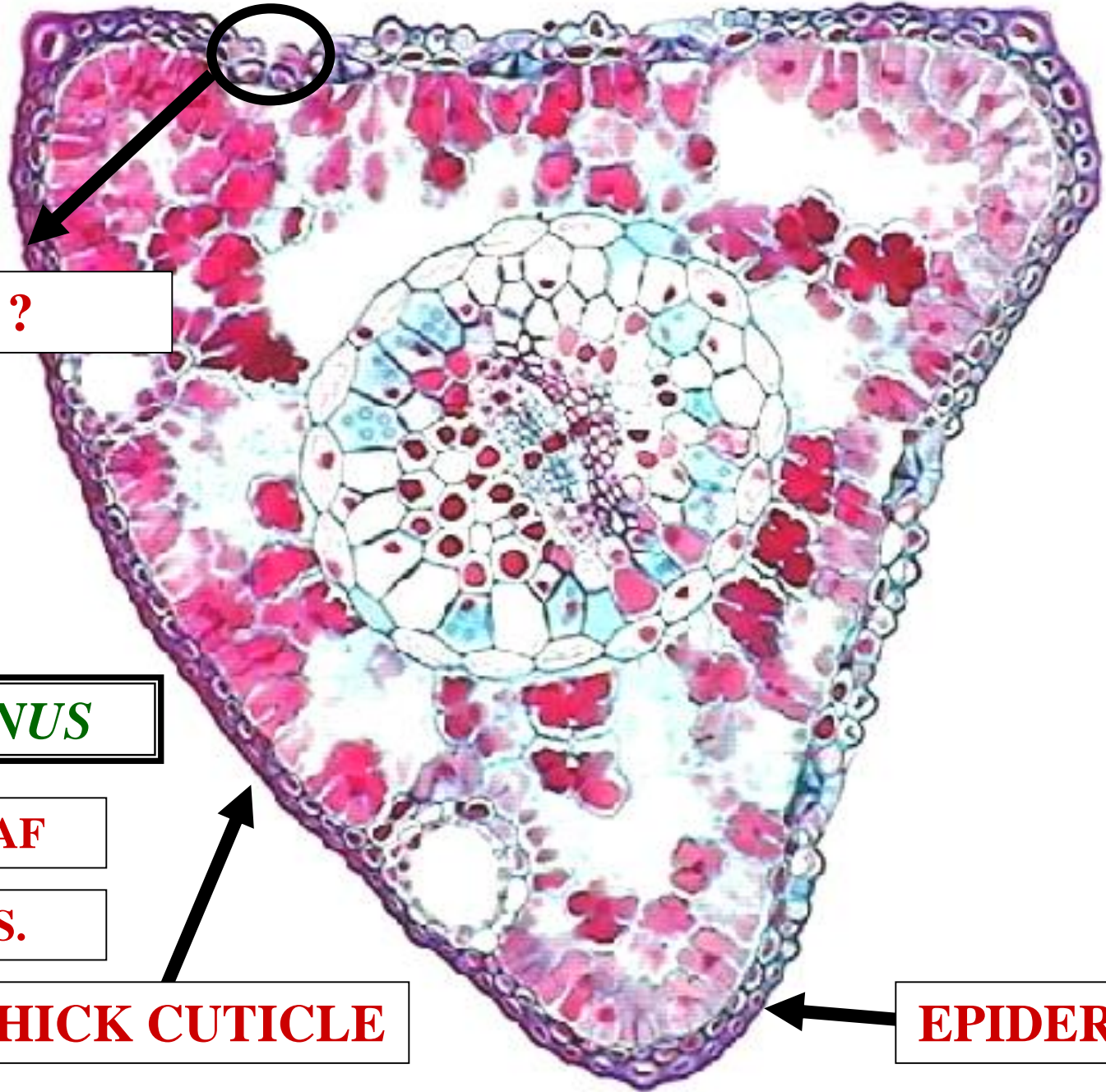
PINUS

LEAF

C.S.

THICK CUTICLE

EPIDERMIS



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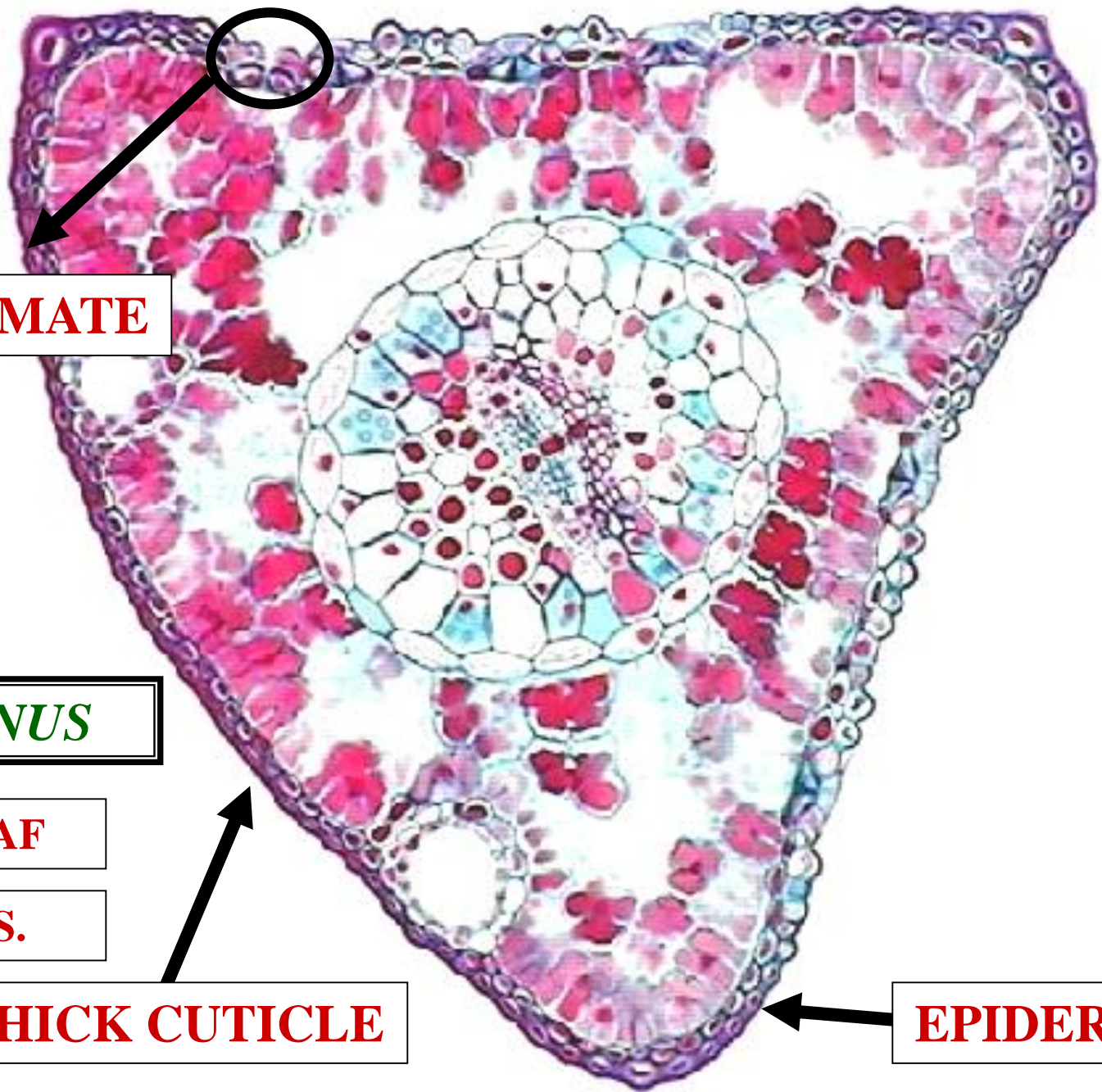
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C.S.

THICK CUTICLE

EPIDERMIS



STOMATE

PINUS

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C.S.

THICK CUTICLE

EPIDERMIS

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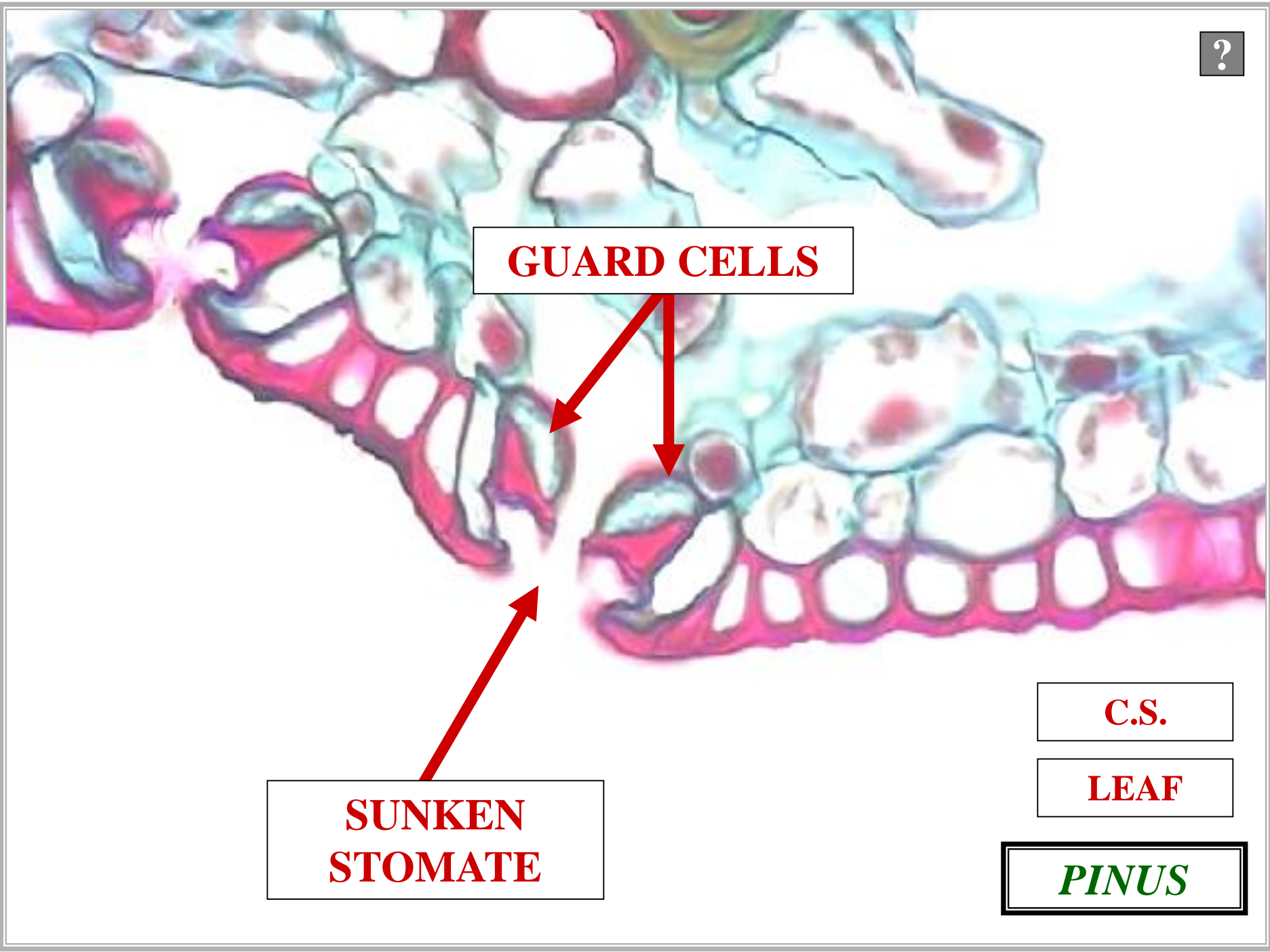
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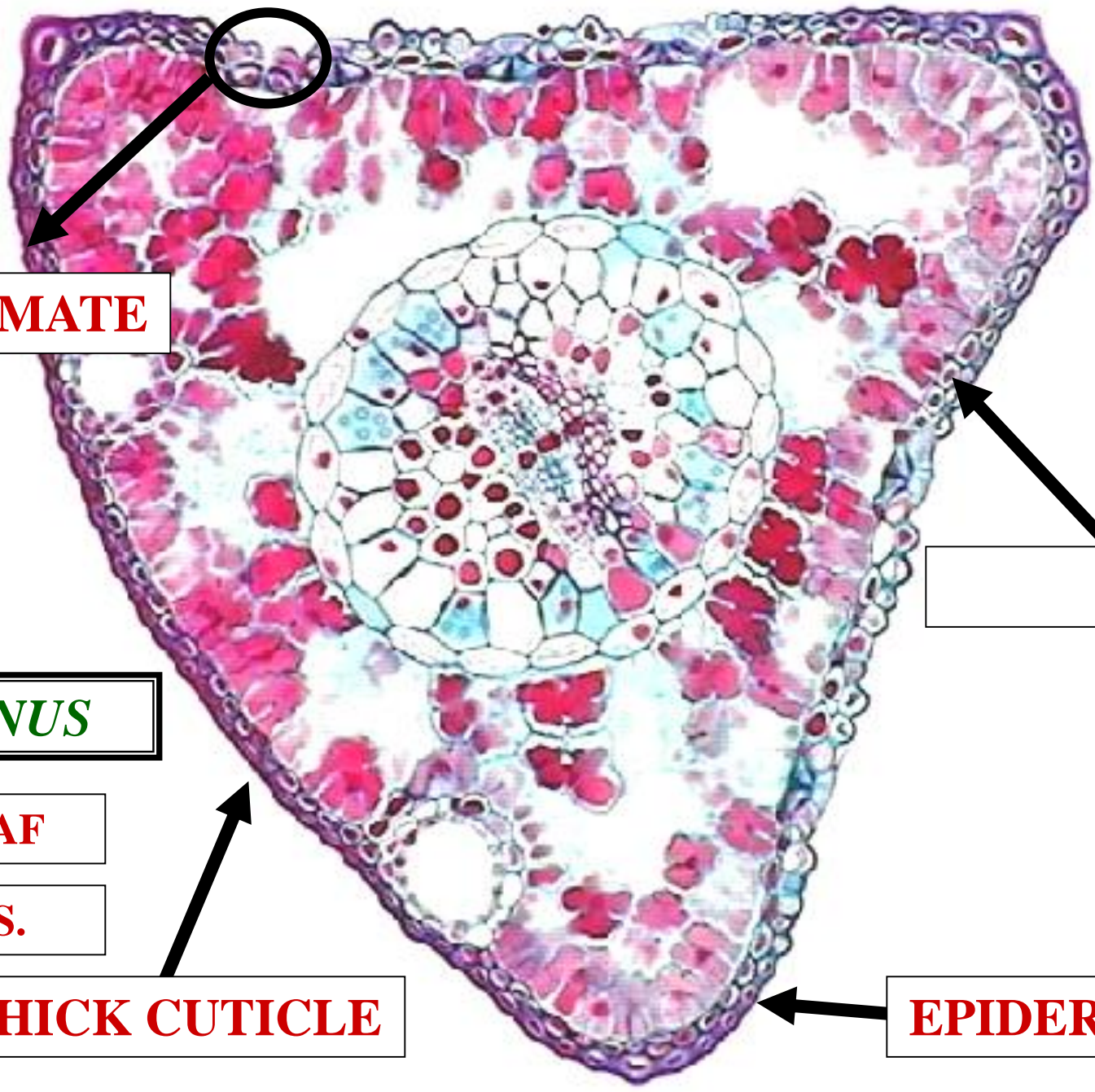
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STOMATE**

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PINUS





STOMATE

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PINUS

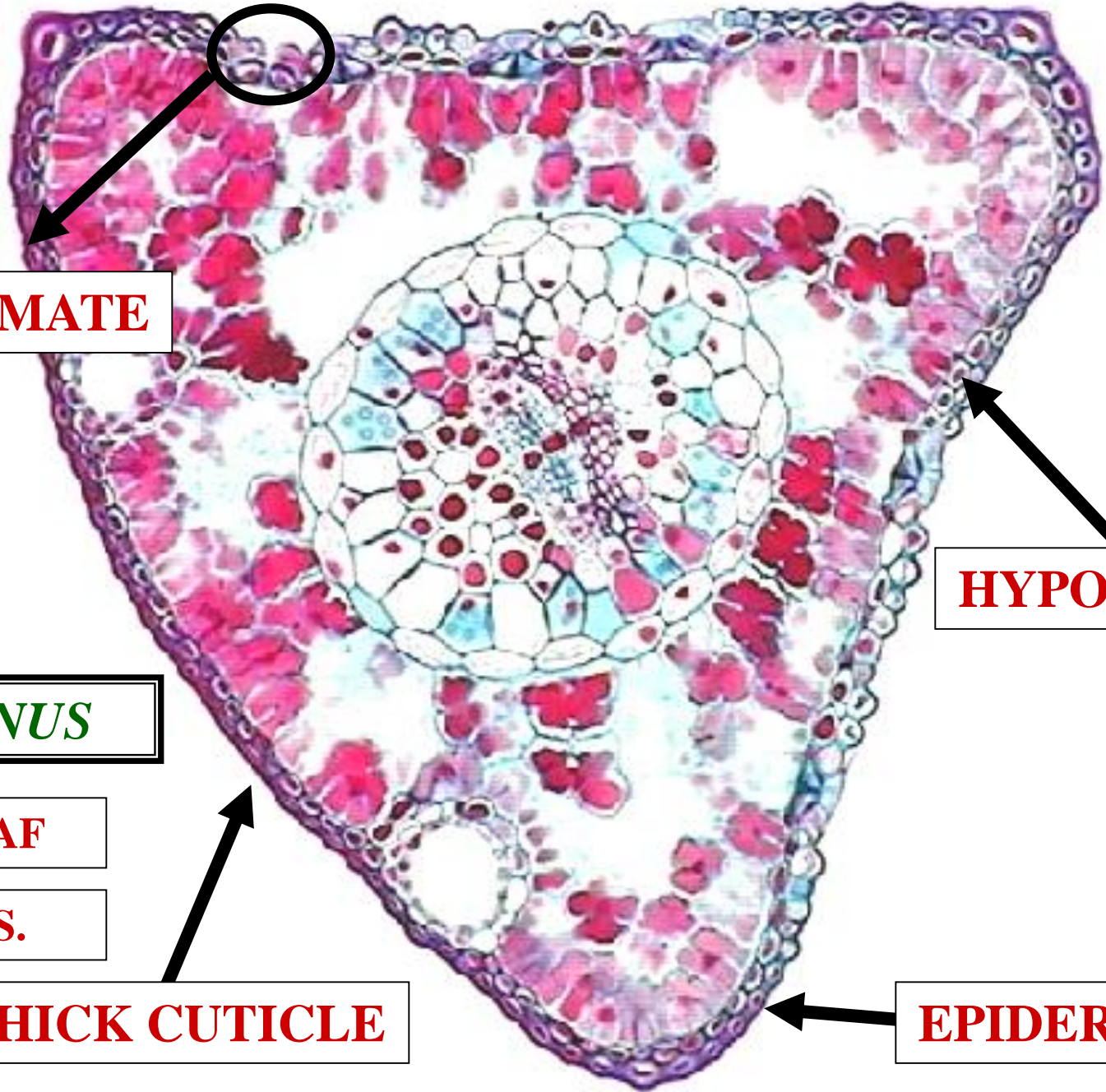
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THICK CUTICLE

EPIDERMIS

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STOMATE

HYPODERMIS

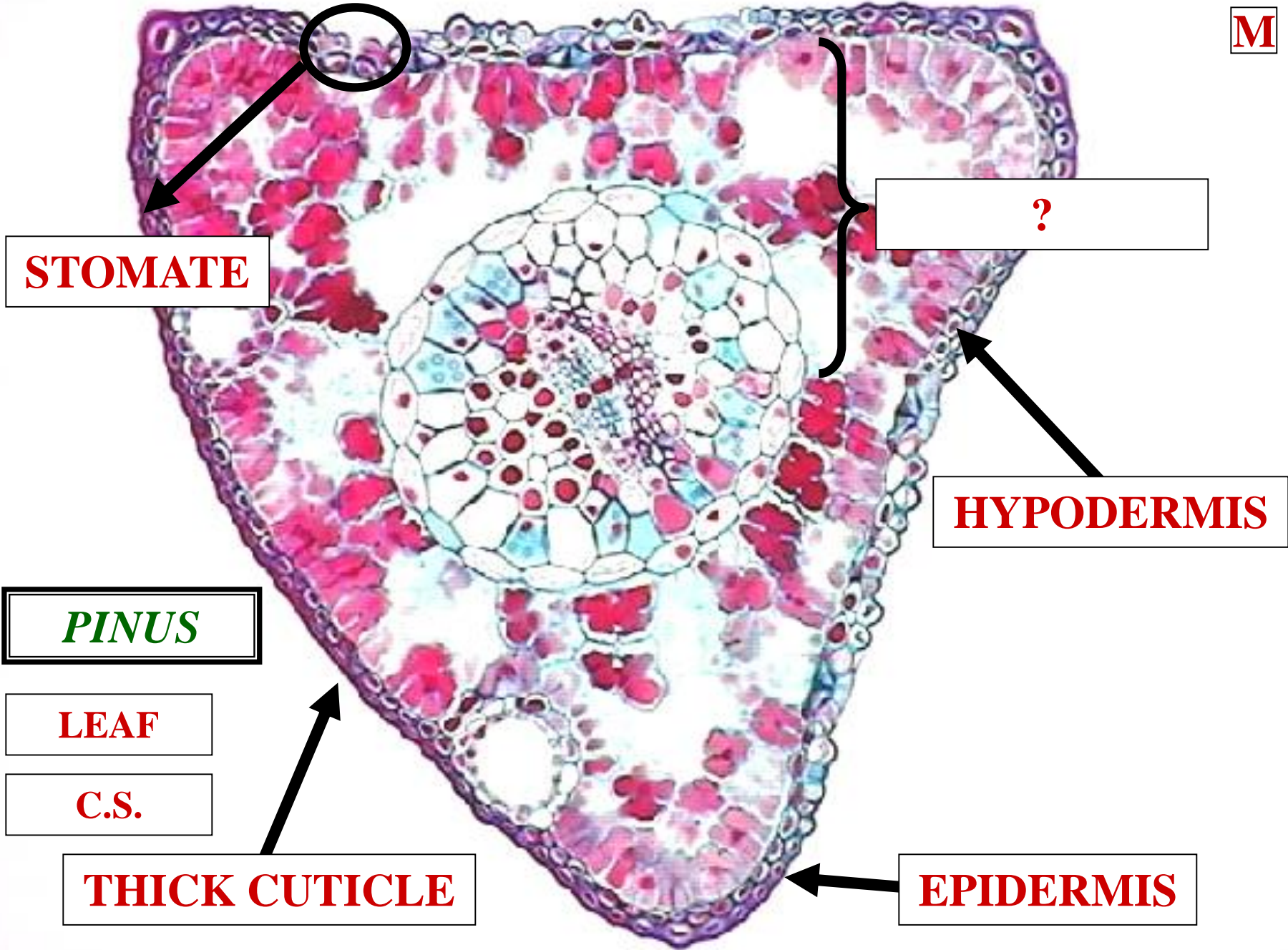
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THICK CUTICLE

EPIDERMIS



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HYPODERMIS

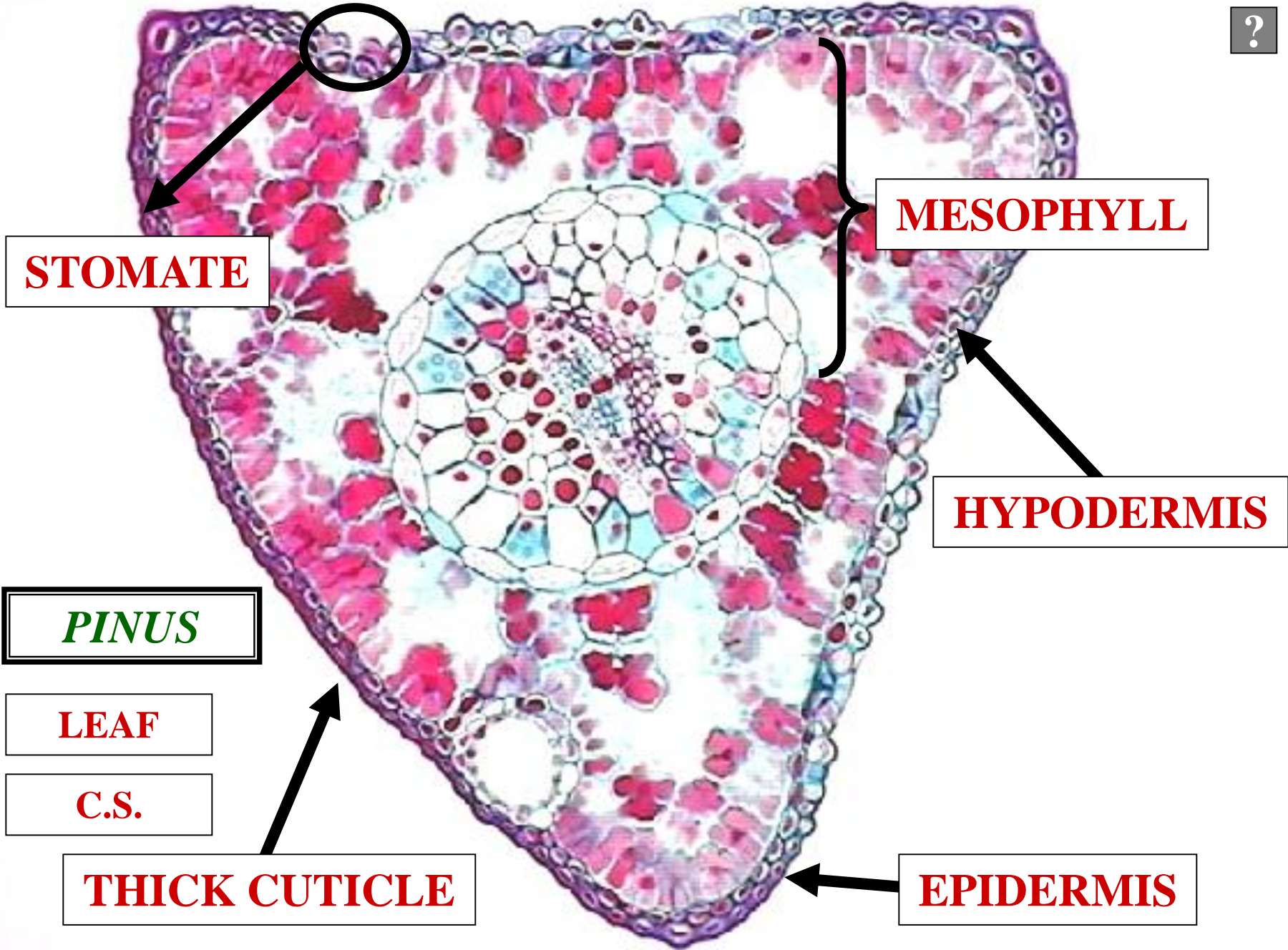
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THICK CUTICLE

EPIDERMIS



STOMATE

MESOPHYLL

HYPODERMIS

PINUS

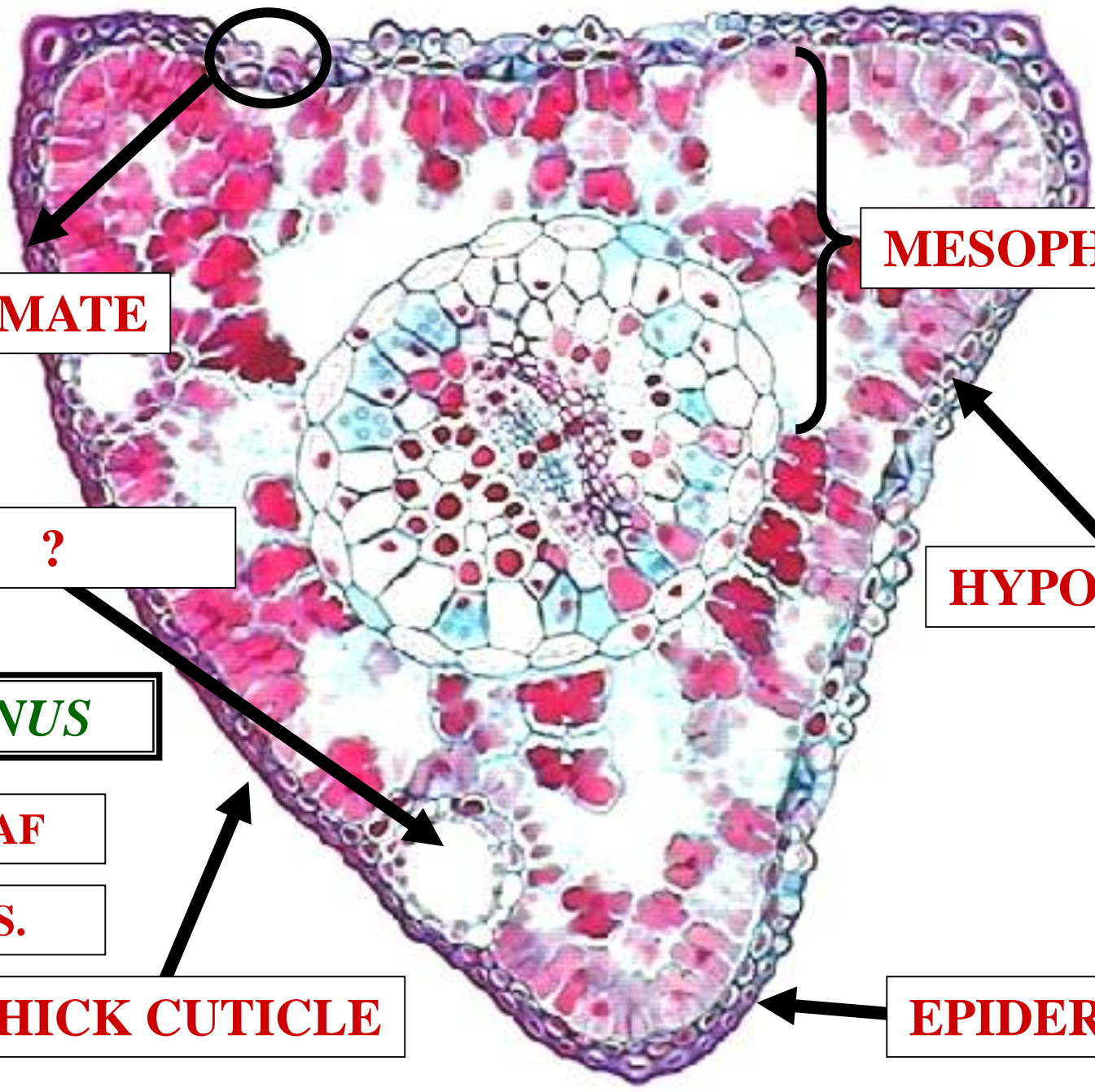
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THICK CUTICLE

EPIDERMIS

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STOMATE

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HYPODERMIS

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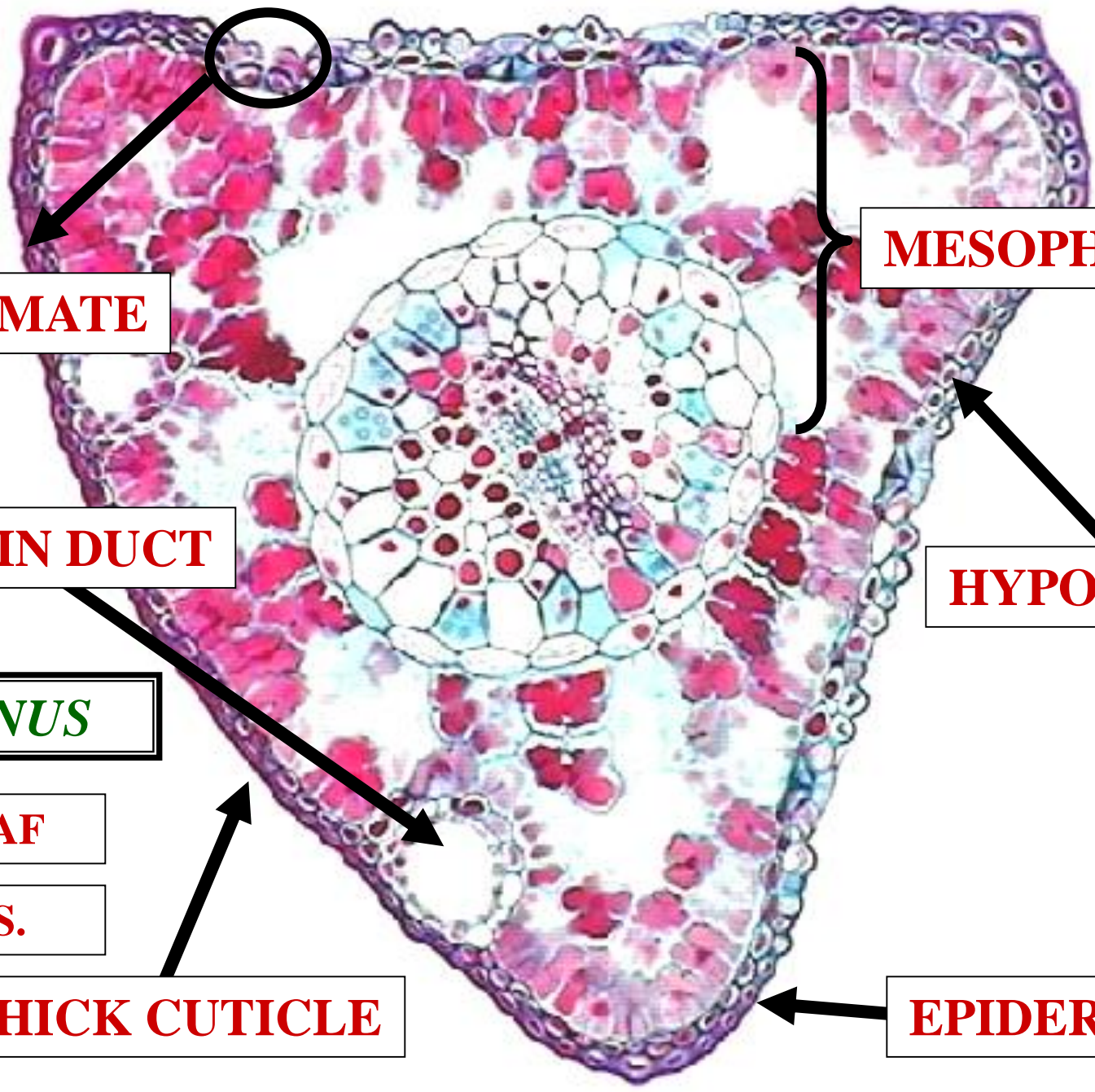
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THICK CUTICLE

EPIDERMIS

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STOMATE

MESOPHYLL

RESIN DUCT

HYPODERMIS

PINUS

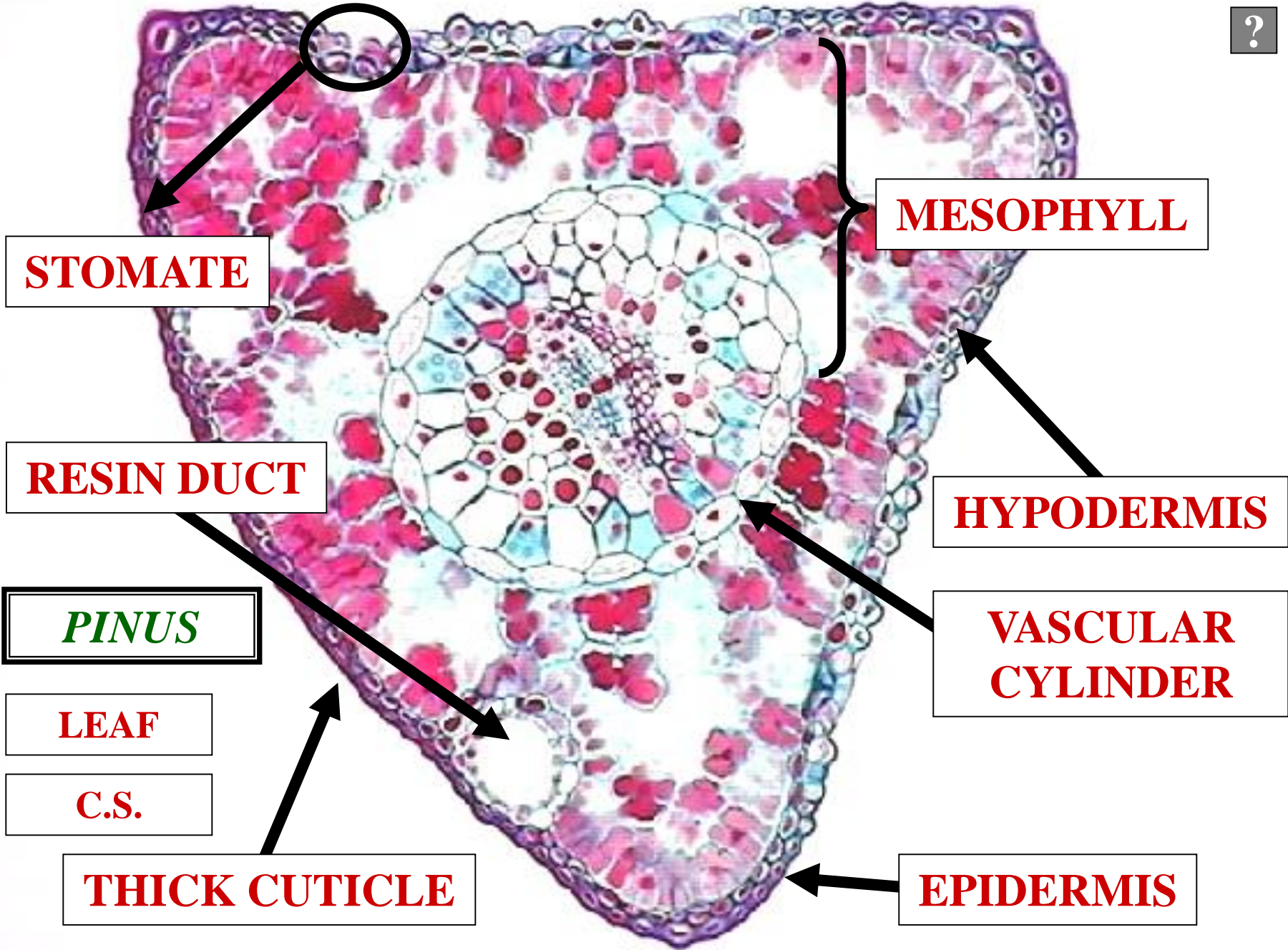
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THICK CUTICLE

EPIDERMIS

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MESOPHYLL

RESIN DUCT

HYPODERMIS

PINUS

VASCULAR CYLINDER

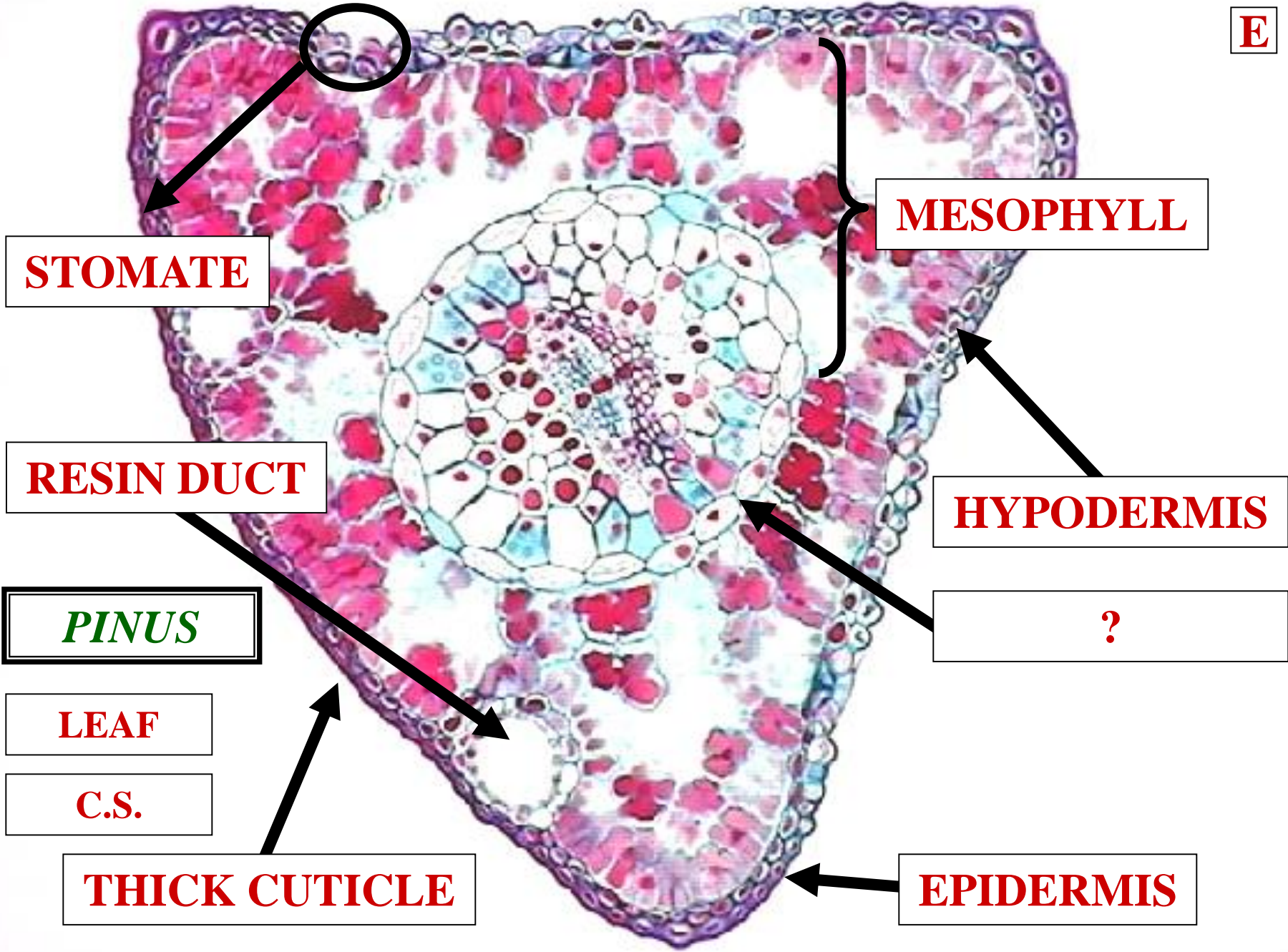
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THICK CUTICLE

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MESOPHYLL

RESIN DUCT

HYPODERMIS

PINUS

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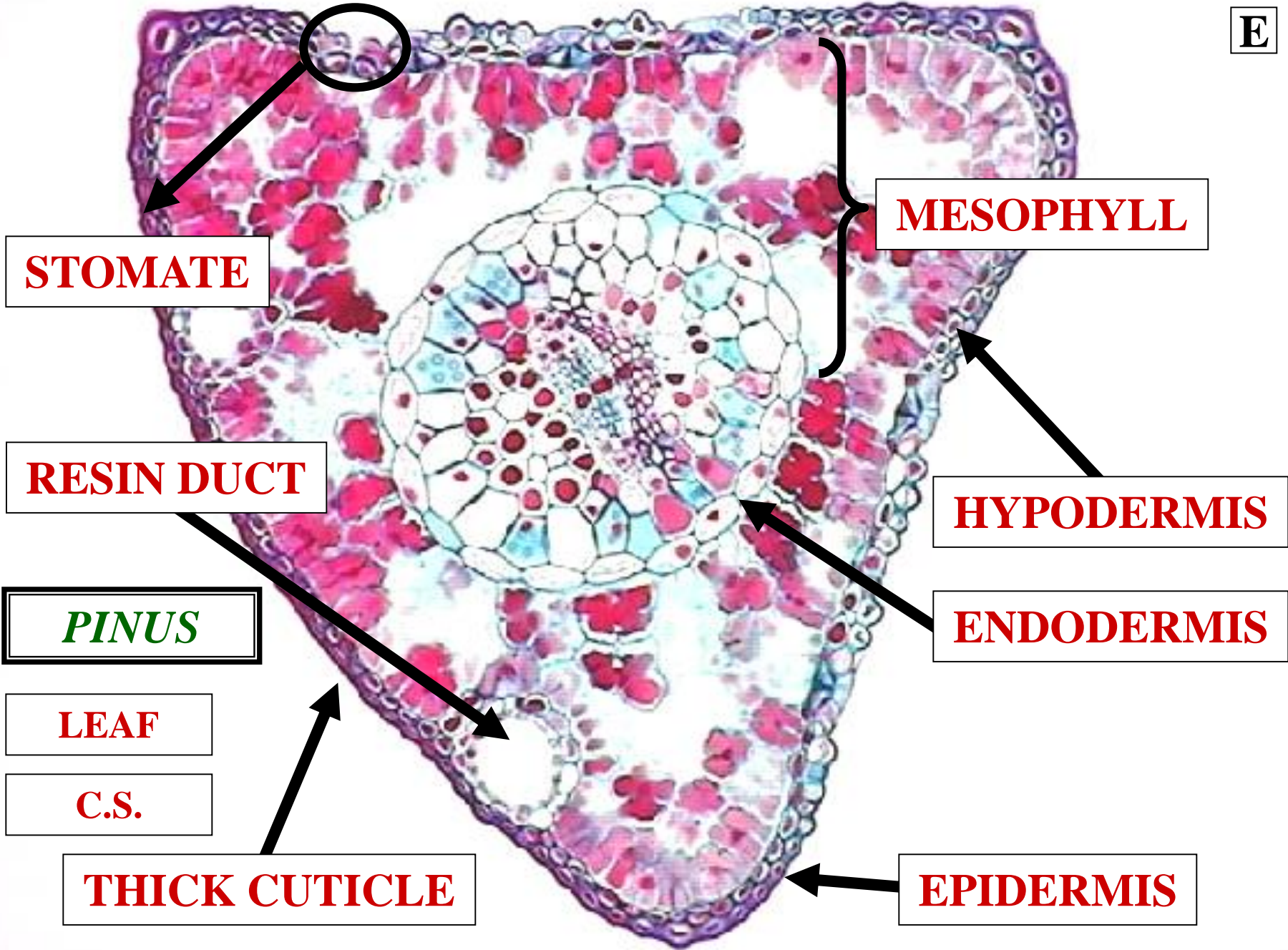
LEAF

C.S.

THICK CUTICLE

EPIDERMIS

E



STOMATE

RESIN DUCT

PINUS

LEAF

C.S.

THICK CUTICLE

MESOPHYLL

HYPODERMIS

ENDODERMIS

EPIDERMIS

LEAF
ENDODERMIS

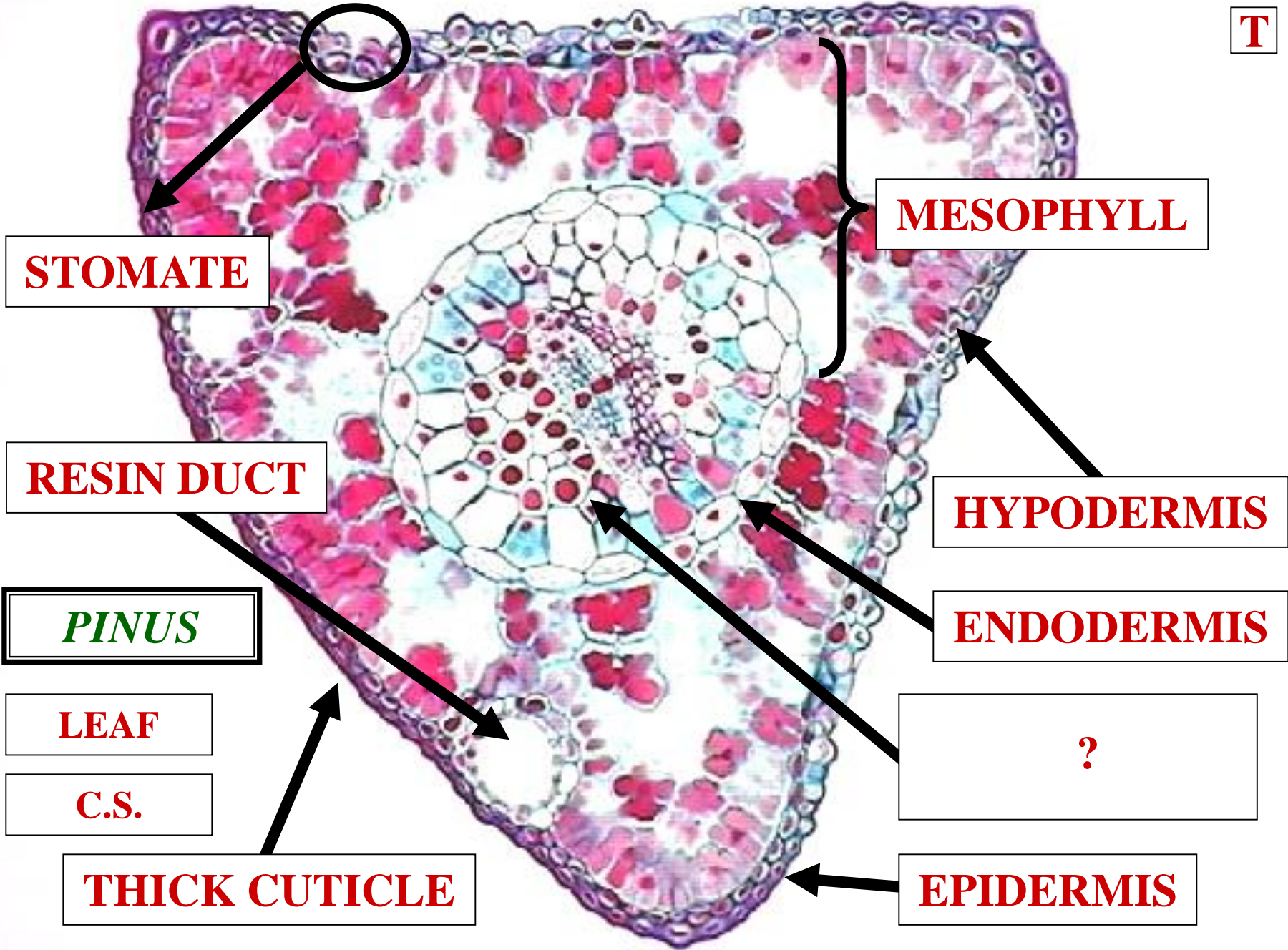
PINOPHYTA
LEAF ENDODERMIS



RETAINS WATER
WITHIN
VASCULAR CYLINDER

PINOPHYTA
LEAF ENDODERMIS

T



STOMATE

MESOPHYLL

RESIN DUCT

HYPODERMIS

PINUS

ENDODERMIS

LEAF

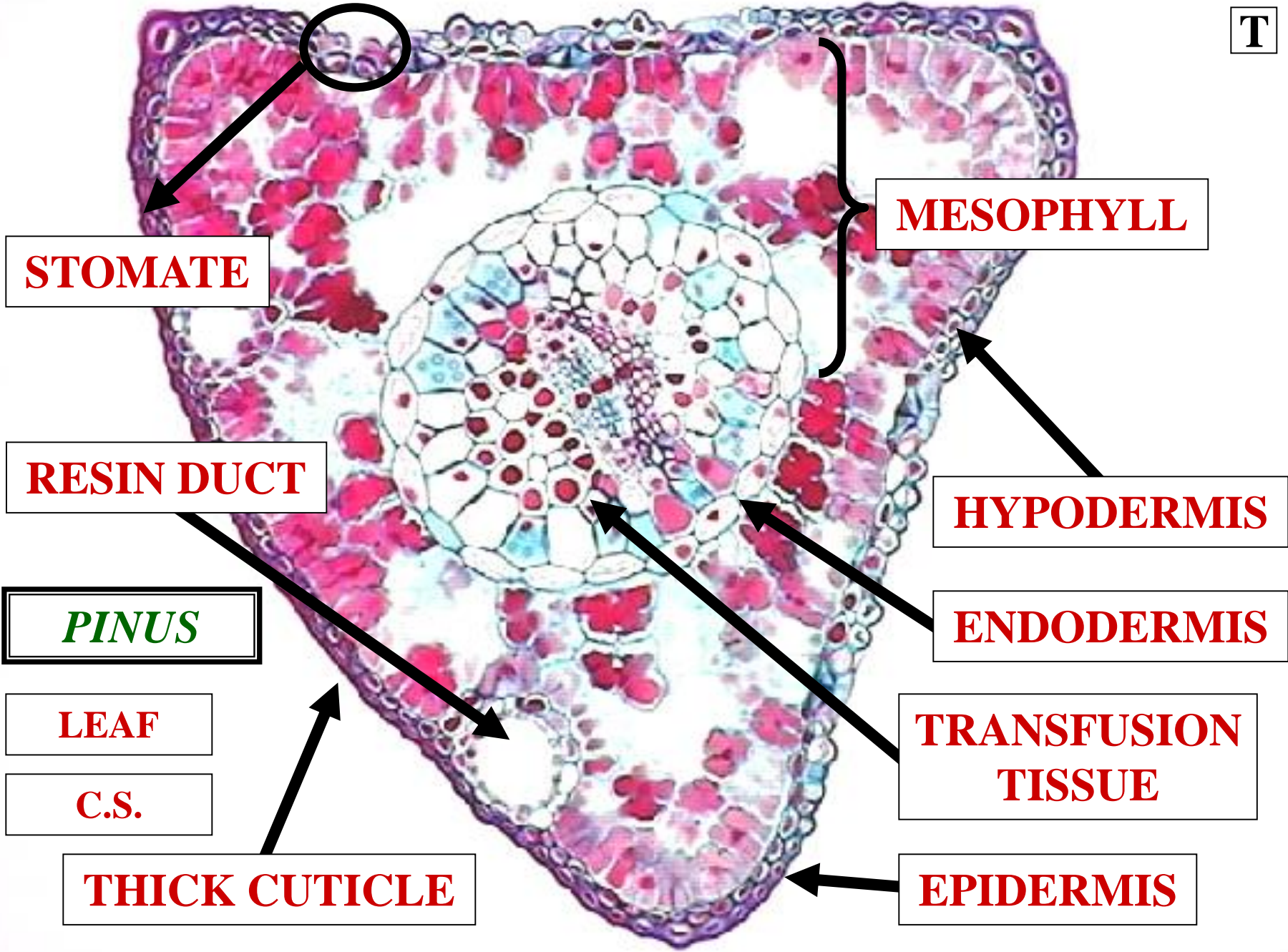
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C.S.

THICK CUTICLE

EPIDERMIS

T



TRANSFUSION TISSUE

PINOPHYTA

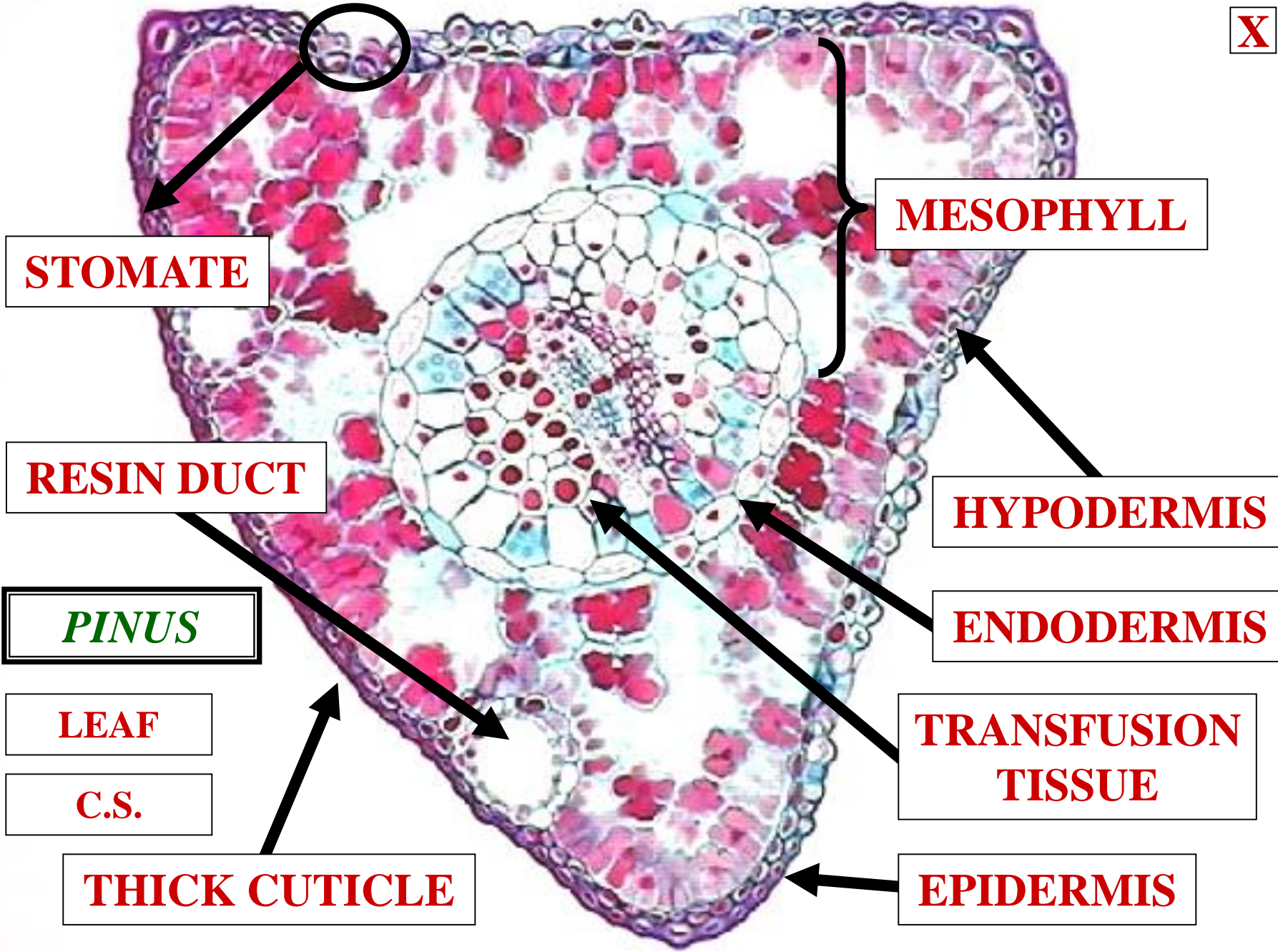


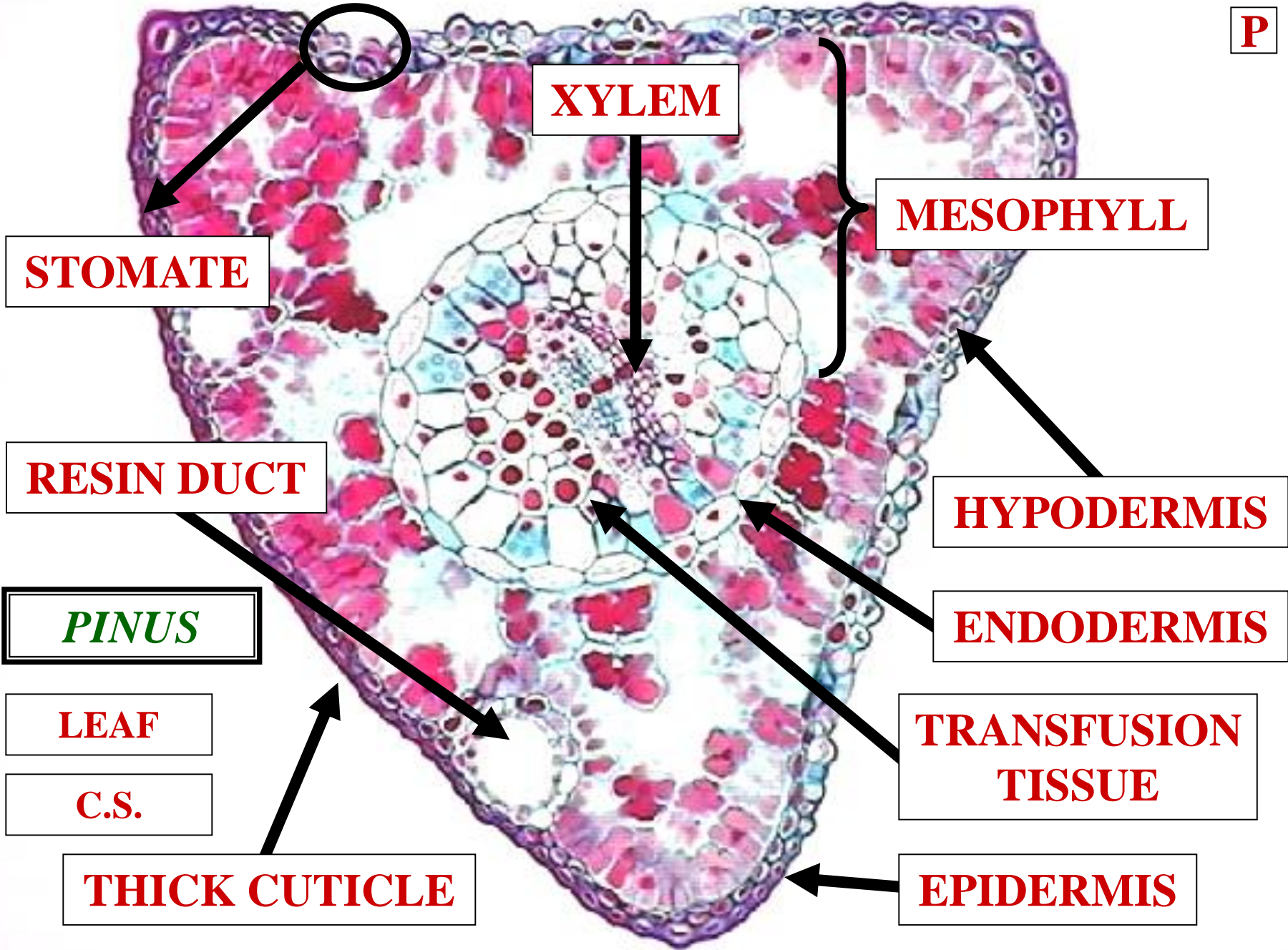
LEAF TRANSFUSION TISSUE

**RETAINS WATER
WITHIN
VASCULAR TISSUE**

PINOPHYTA

LEAF TRANSFUSION TISSUE





XYLEM

MESOPHYLL

STOMATE

RESIN DUCT

HYPODERMIS

PINUS

ENDODERMIS

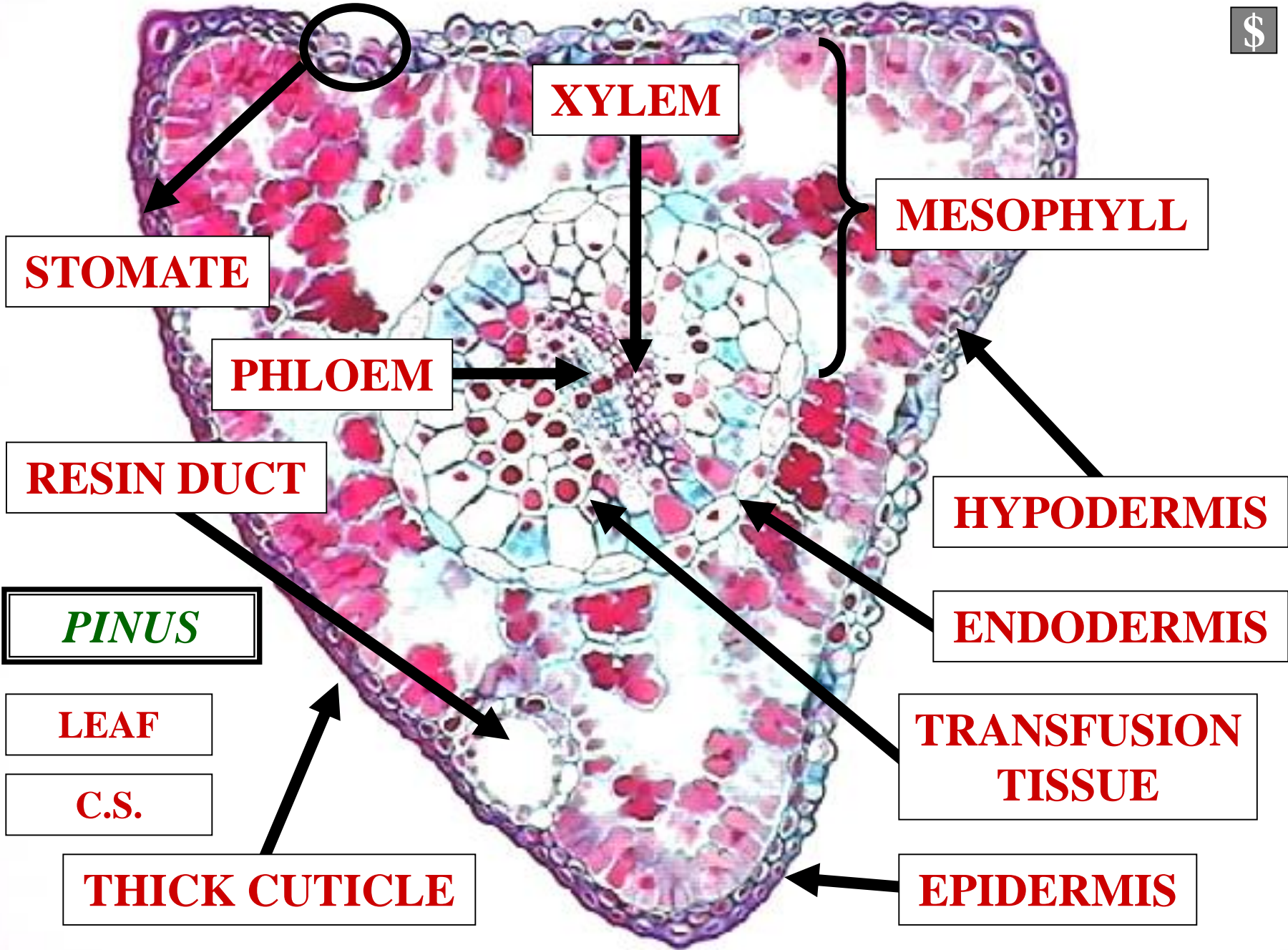
LEAF

**TRANSFUSION
TISSUE**

C.S.

THICK CUTICLE

EPIDERMIS



XYLEM

MESOPHYLL

STOMATE

PHLOEM

RESIN DUCT

HYPODERMIS

PINUS

ENDODERMIS

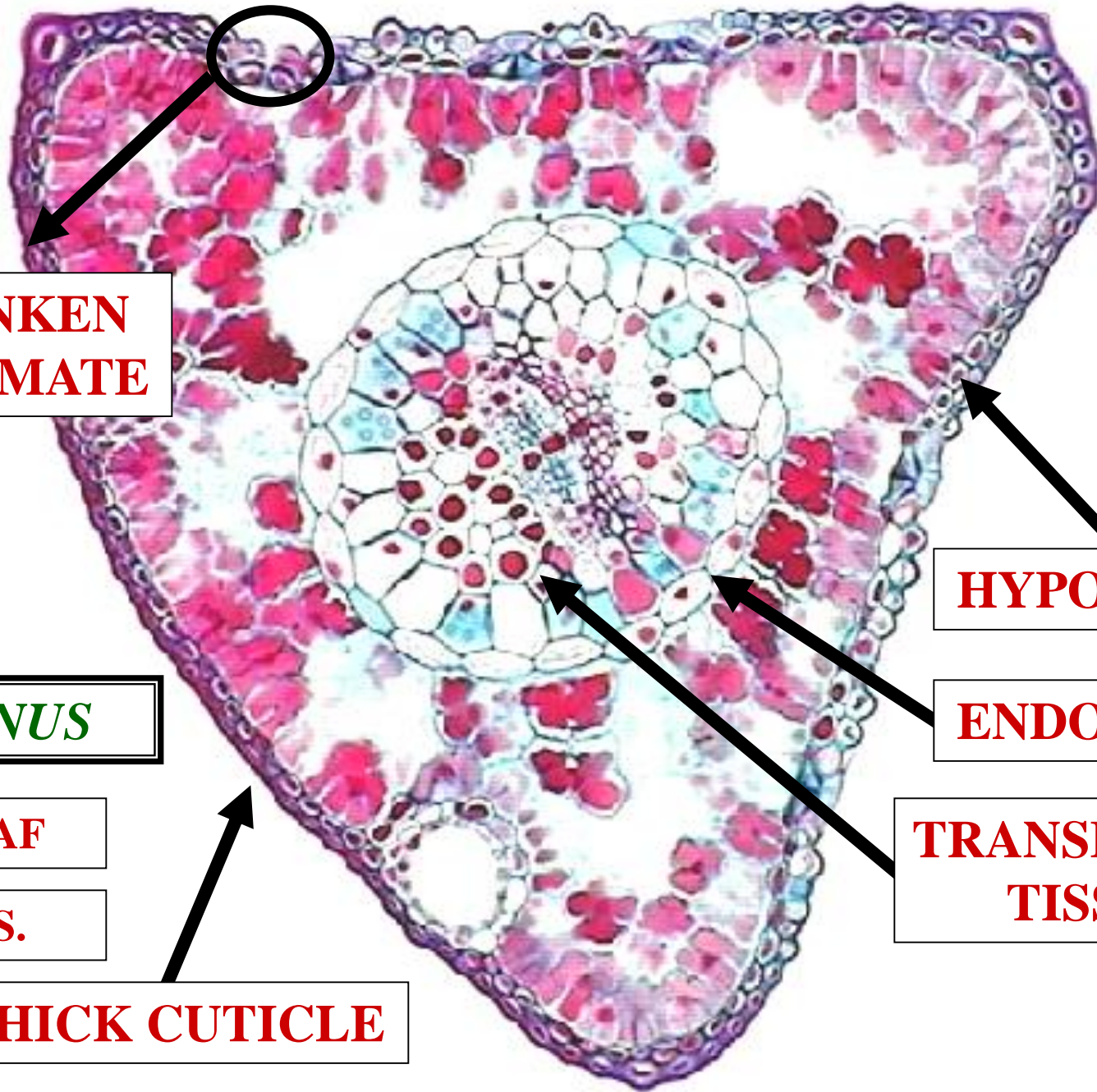
LEAF

C.S.

TRANSFUSION TISSUE

THICK CUTICLE

EPIDERMIS



**SUNKEN
STOMATE**

HYPODERMIS

PINUS

ENDODERMIS

LEAF

**TRANSFUSION
TISSUE**

C.S.

THICK CUTICLE



**LEAF
ADAPTED
ZERIC
HABITAT**



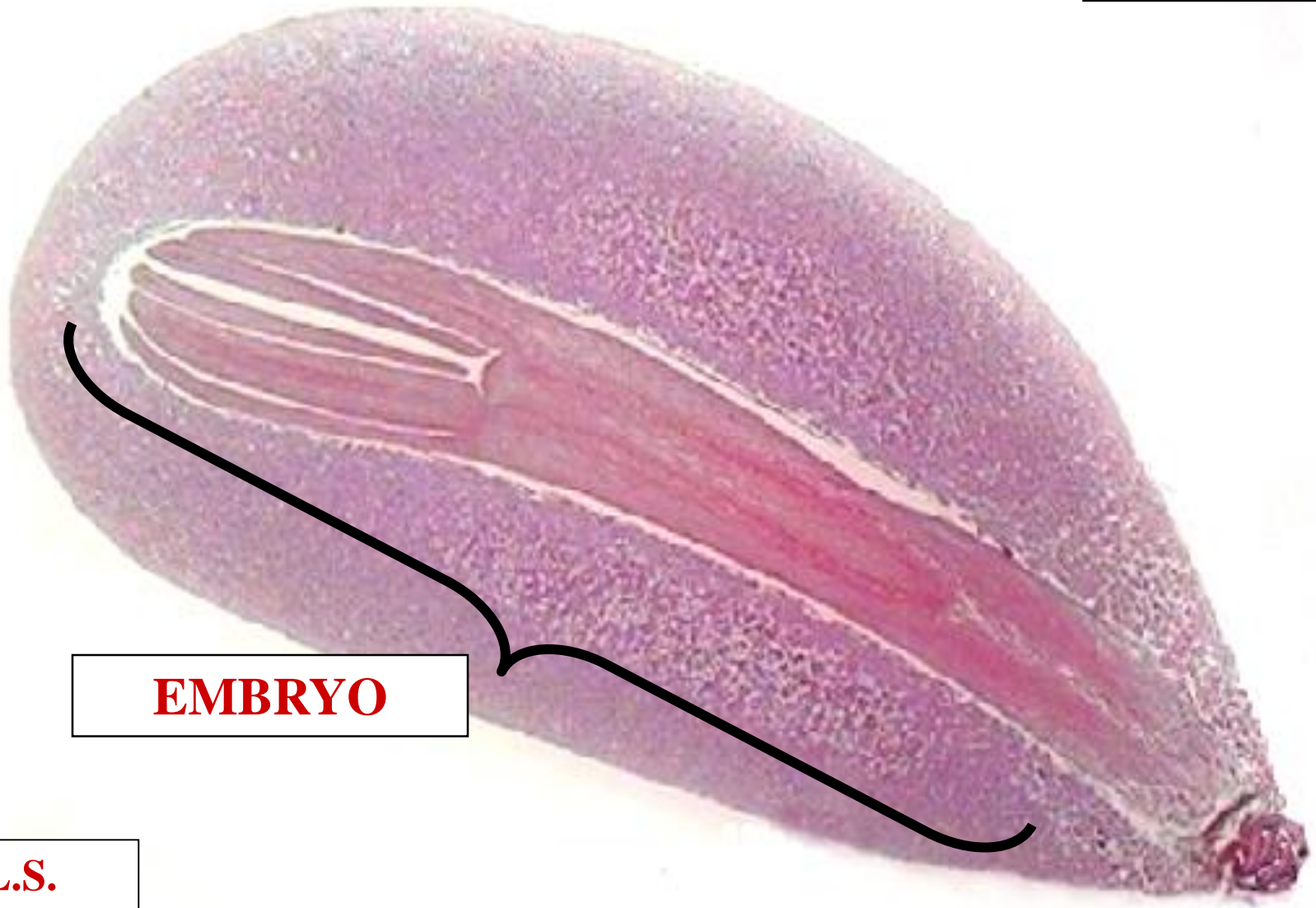
EMBRYO



EMBRYO STRUCTURE

PINUS

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EMBRYO

L.S.

EMBRYO

PINUS

M

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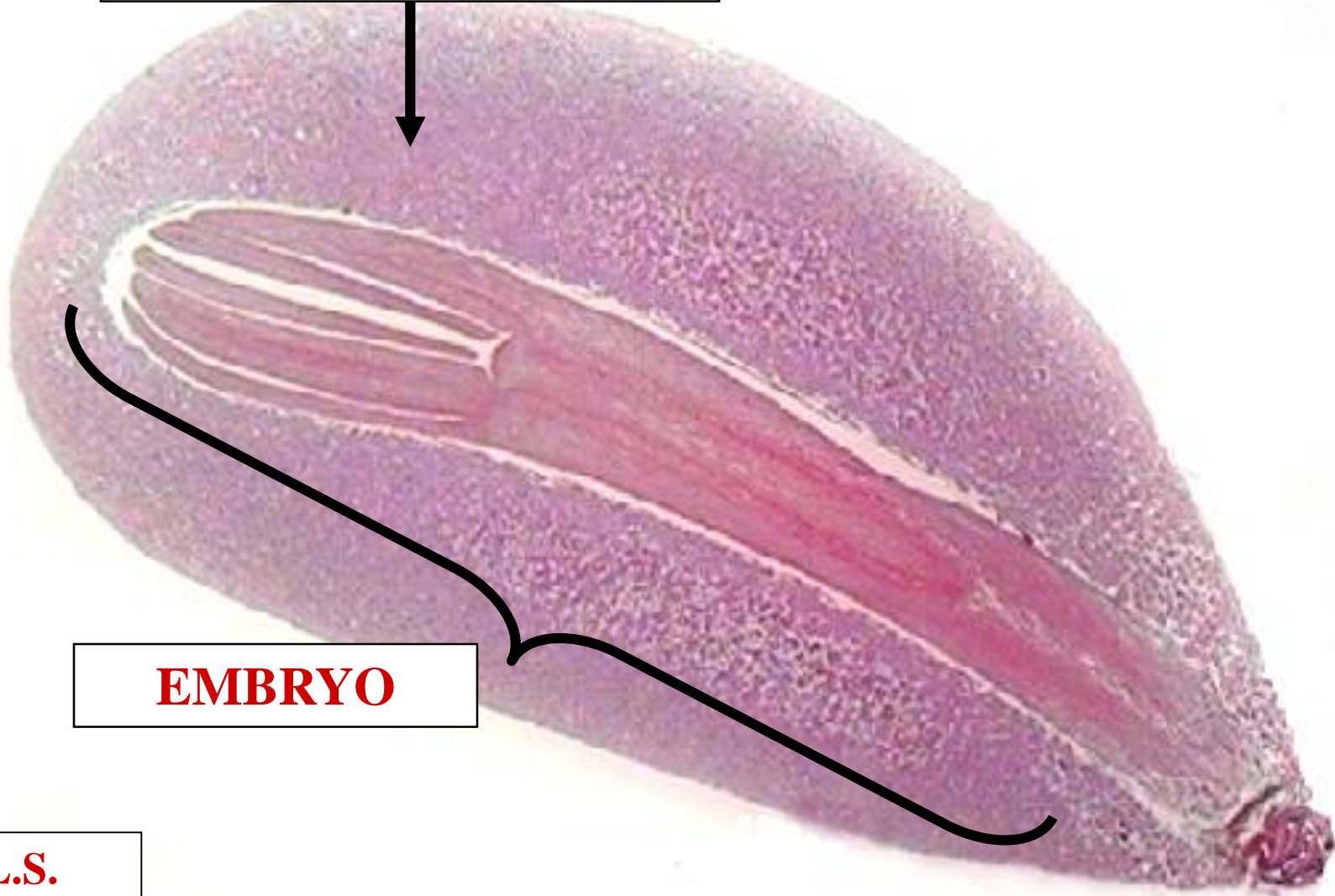


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EMBRYO

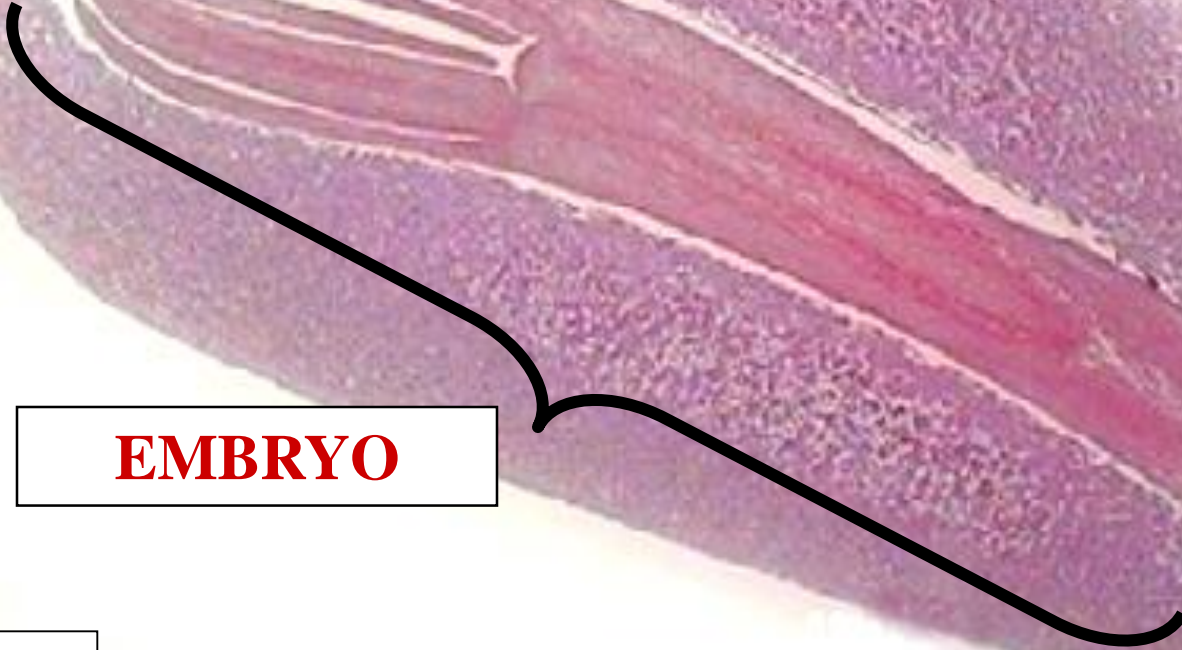


PINUS

MEGAGAMETOPHYTE



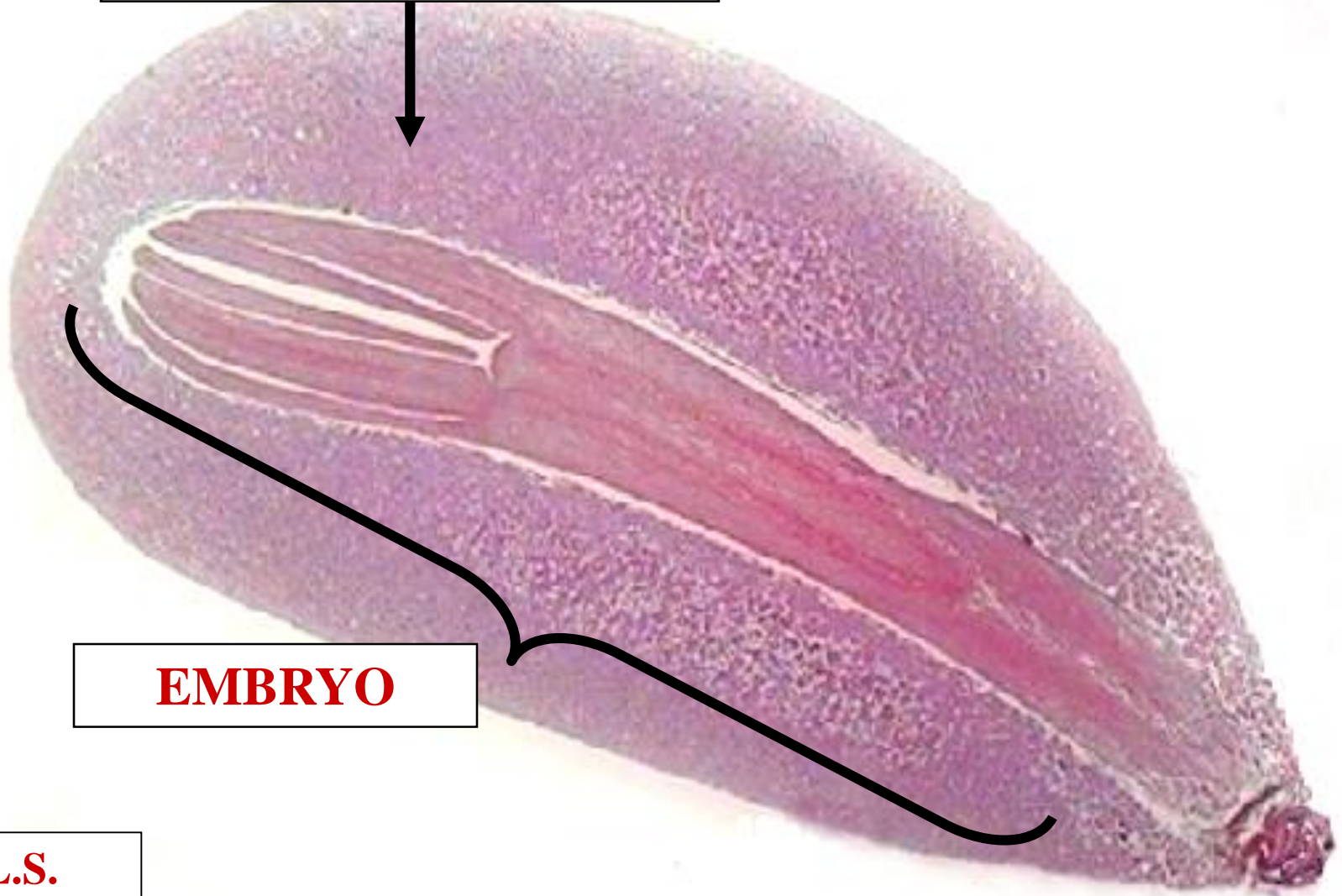
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L.S.

EMBRYO

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PINUS

MEGAGAMETOPHYTE

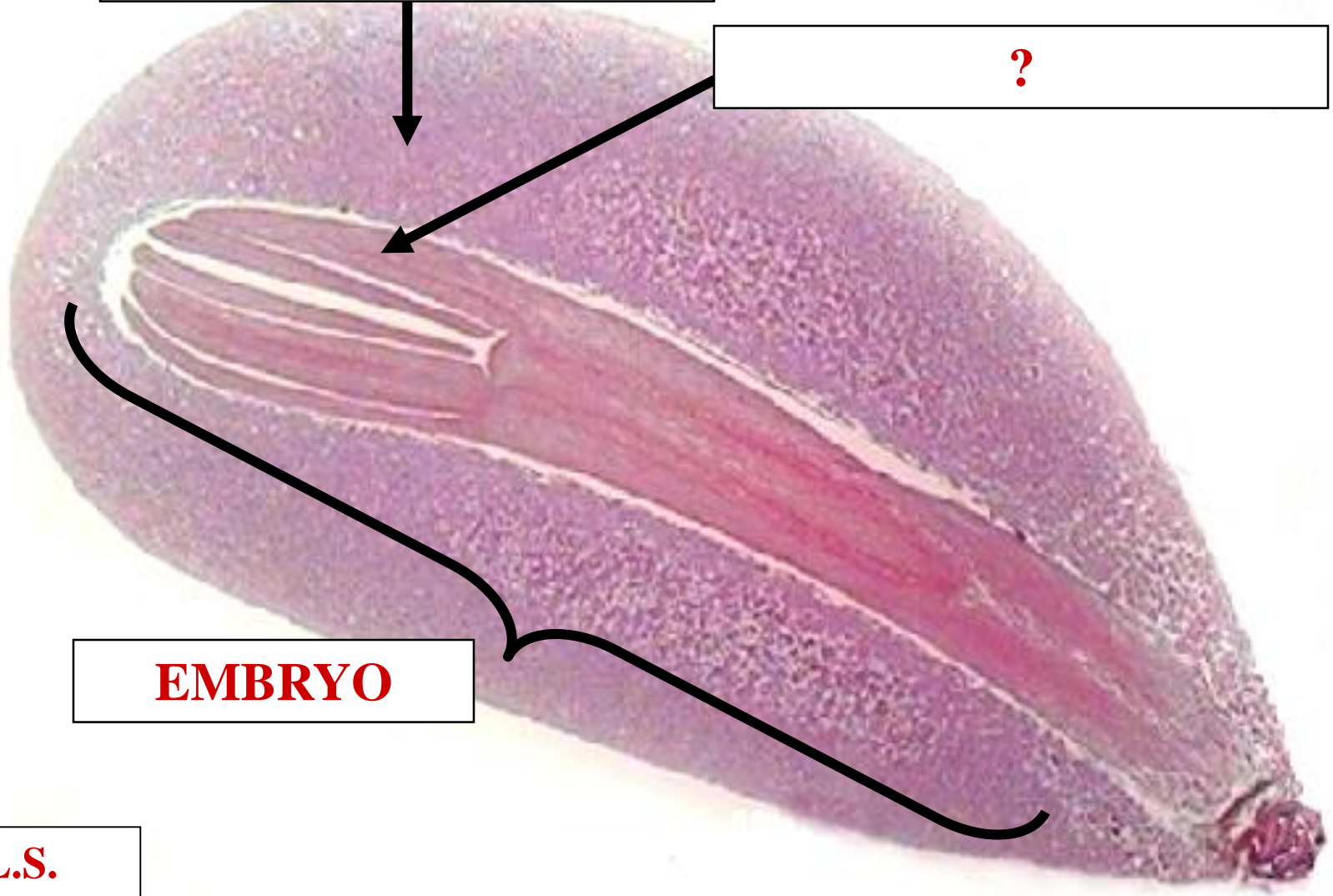
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PINUS

MEGAGAMETOPHTE

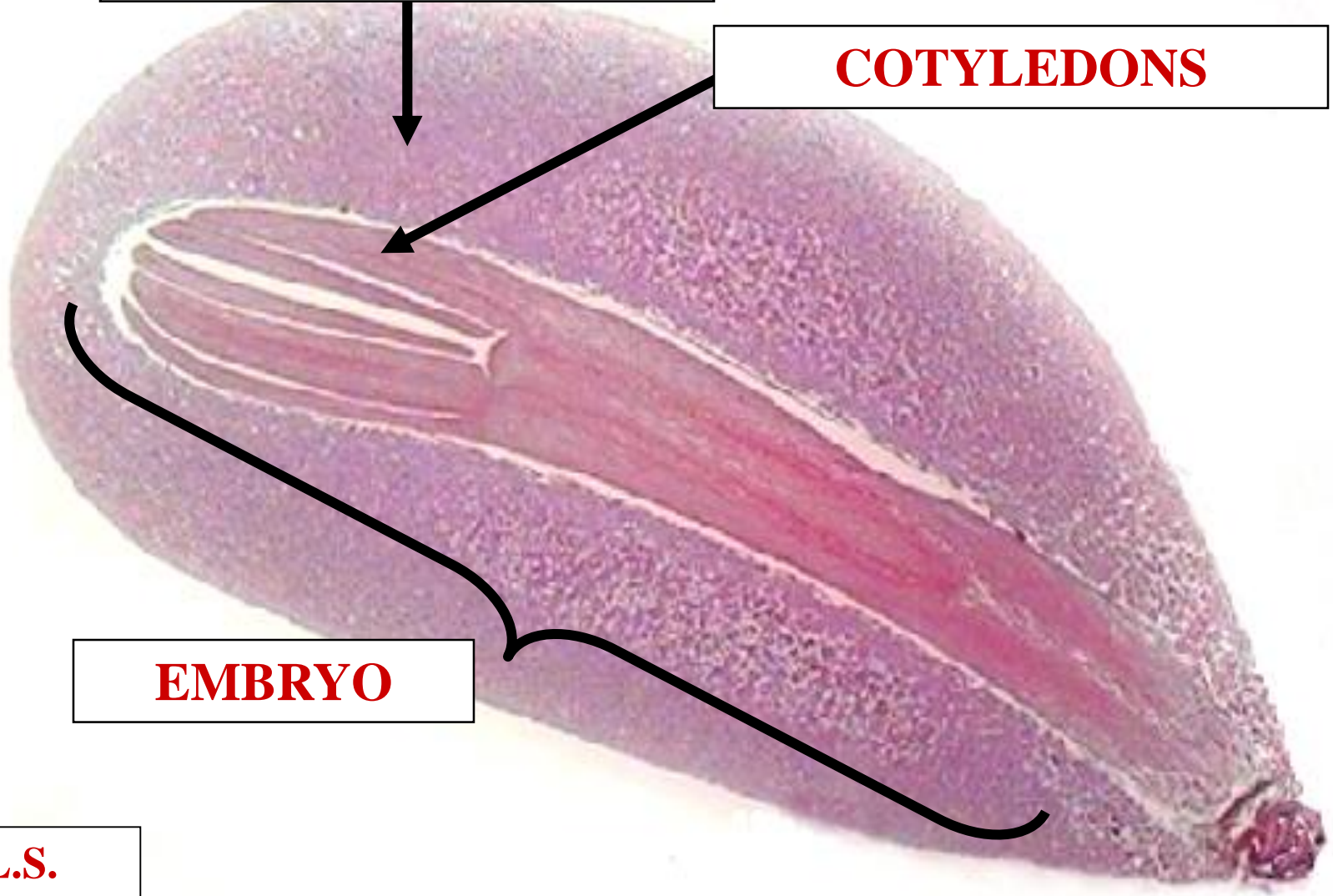
COTYLEDONS

EMBRYO

L.S.

EMBRYO

C



COTYLEDON



PINOPHYTA
EMBRYO COTYLEDON

EMBRYO SEED LEAF

PINOPHYTA
EMBRYO COTYLEDON

PINUS

MEGAGAMETOPHTE

COTYLEDONS

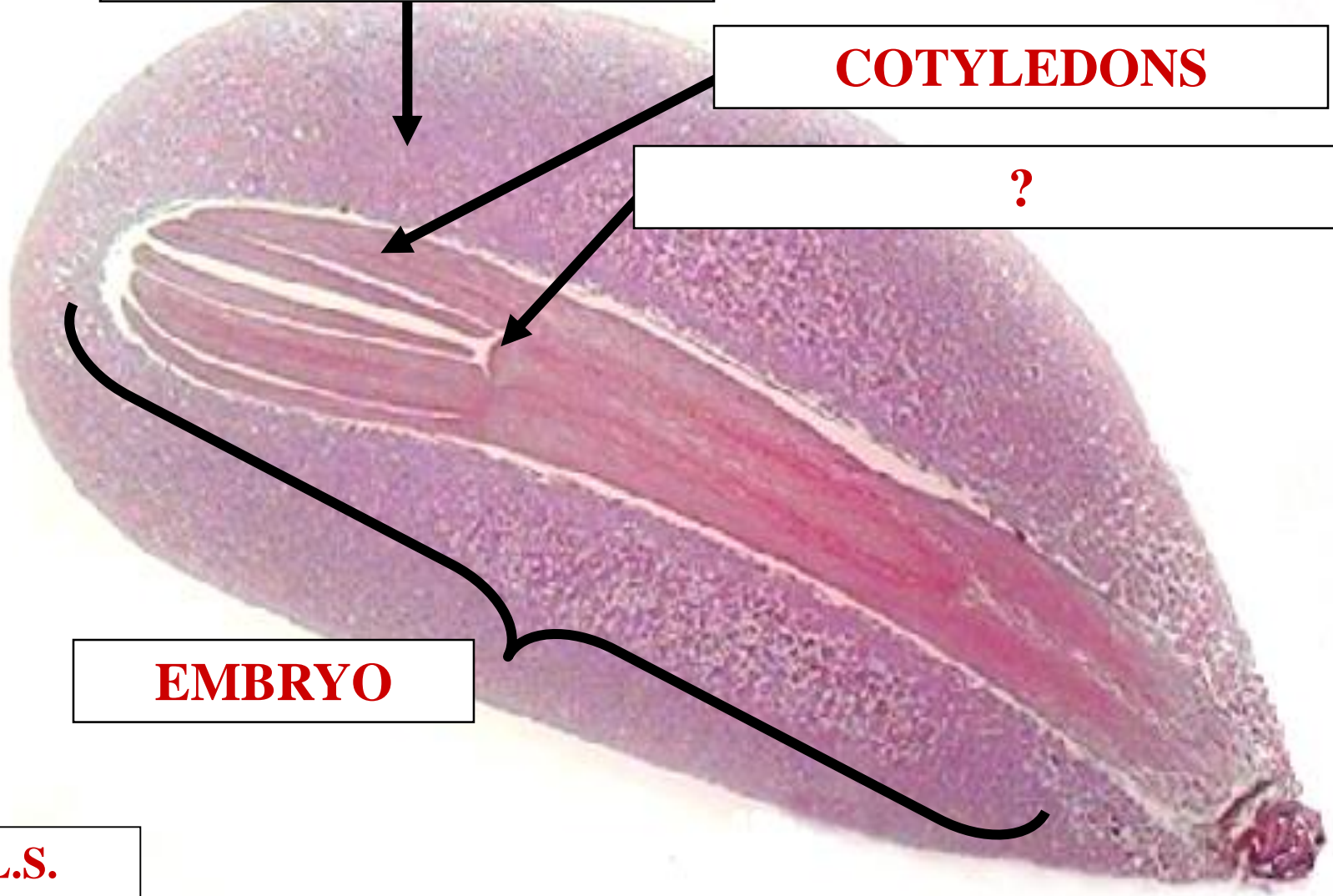
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L.S.

EMBRYO

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PINUS

MEGAGAMETOPHYTE

COTYLEDONS

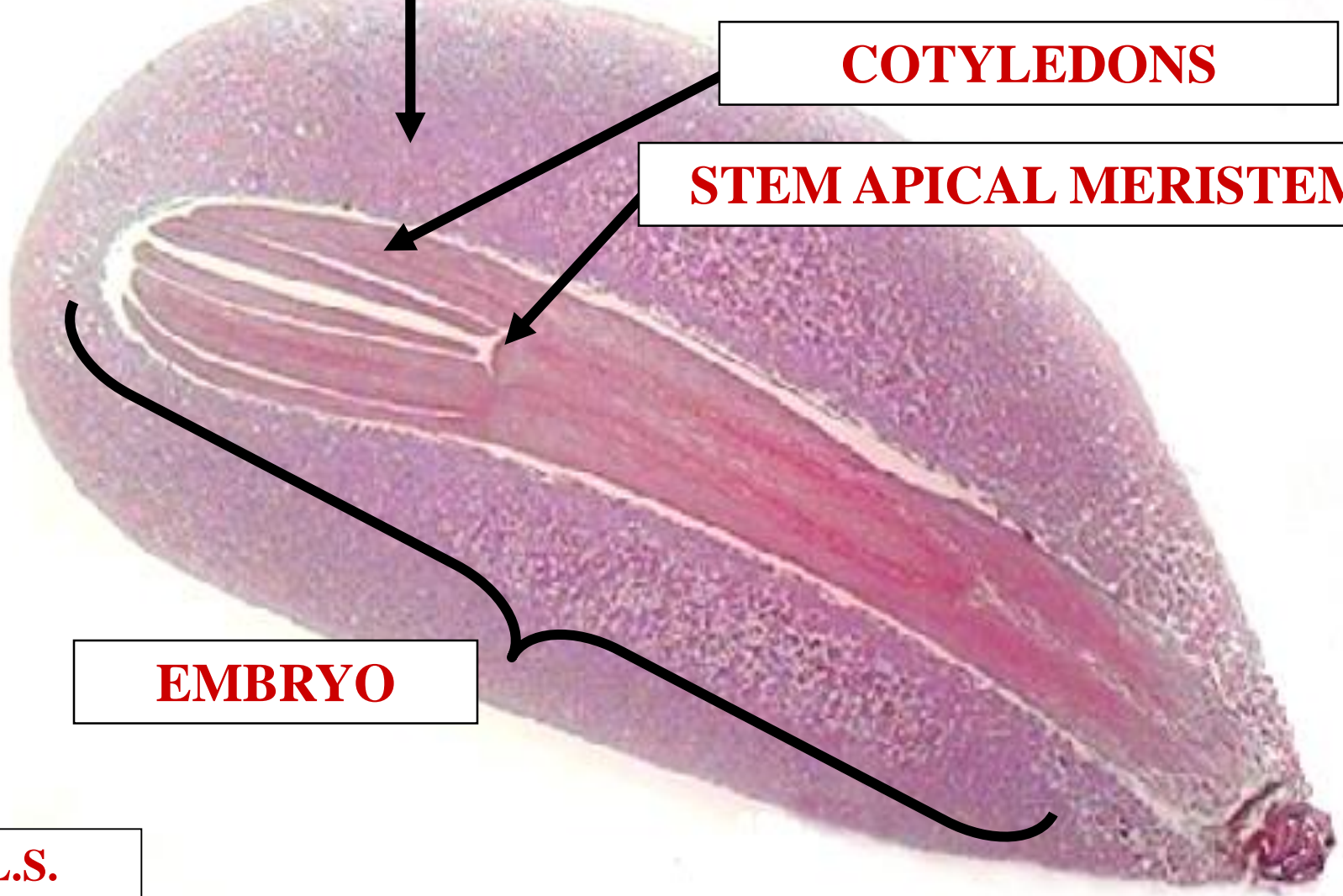
STEM APICAL MERISTEM

EMBRYO

L.S.

EMBRYO

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PINUS

MEGAGAMETOPHYTE

COTYLEDONS

STEM APICAL MERISTEM

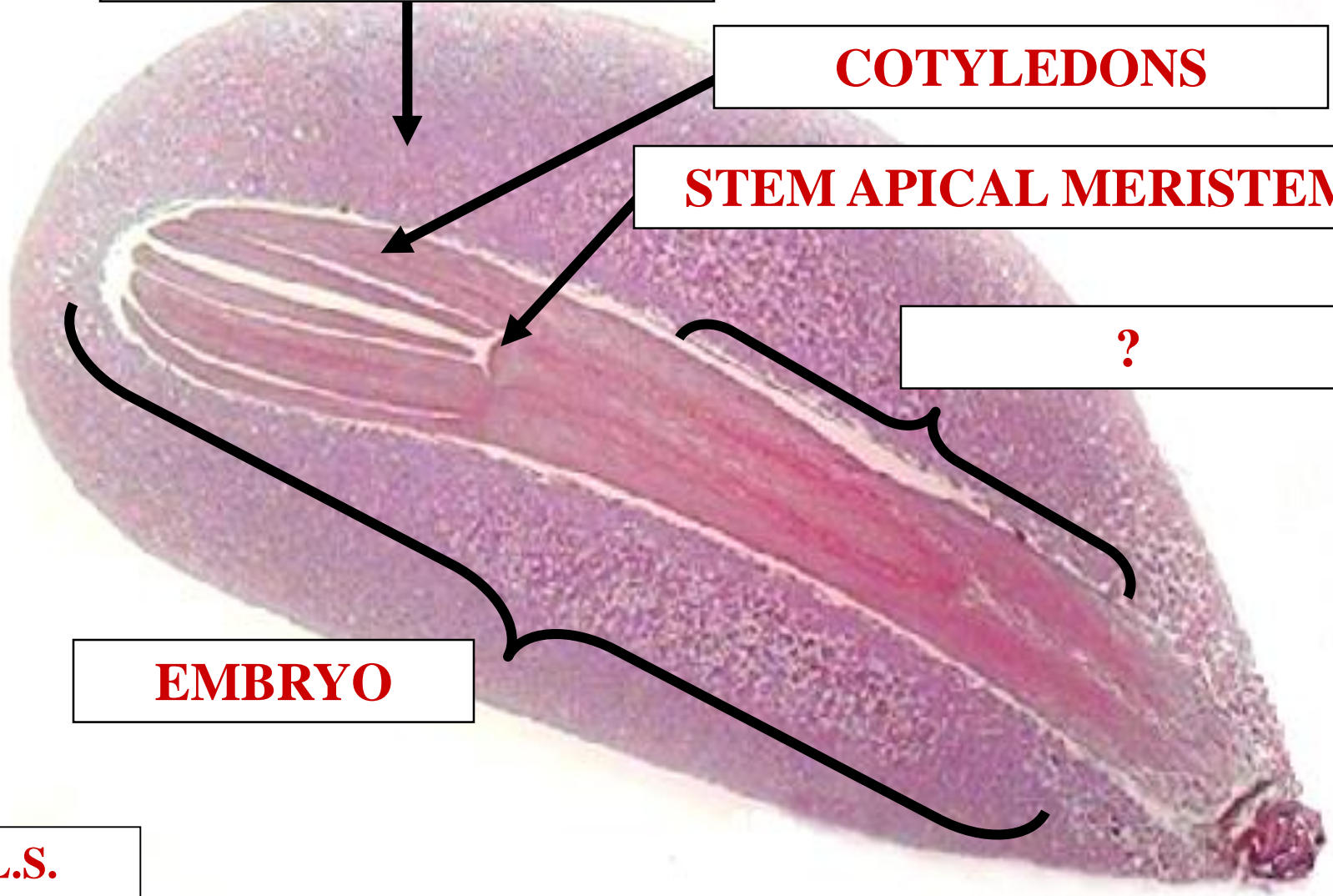
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PINUS

MEGAGAMETOPHYTE

COTYLEDONS

STEM APICAL MERISTEM

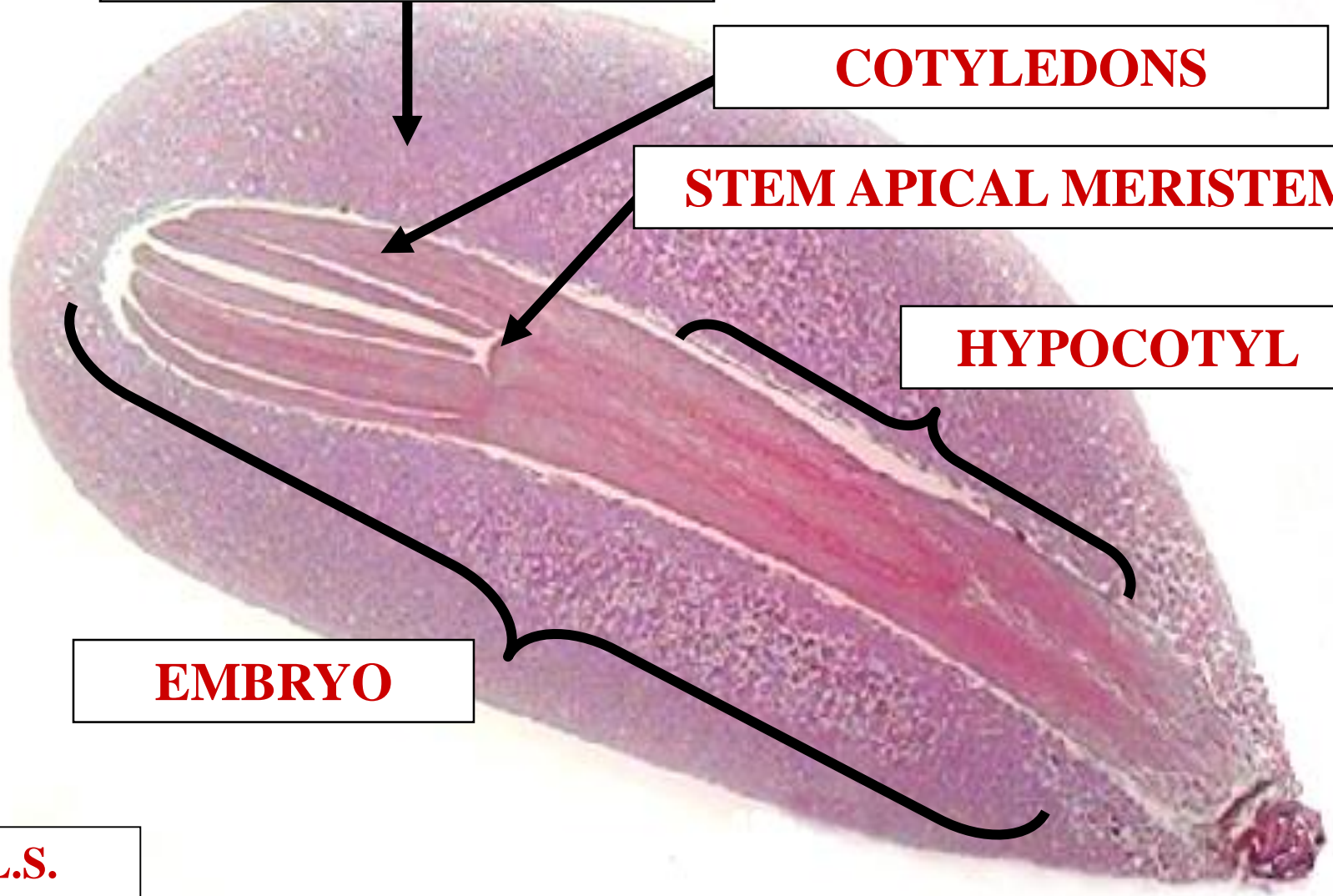
HYPOCOTYL

EMBRYO

L.S.

EMBRYO

H



HYPOCOTYL



PINOPHYTA
EMBRYO HYPOCOTYL

EMBRYO STEM

PINOPHYTA
EMBRYO HYPOCOTYL

PINUS

MEGAGAMETOPHYTE

COTYLEDONS

STEM APICAL MERISTEM

HYPOCOTYL

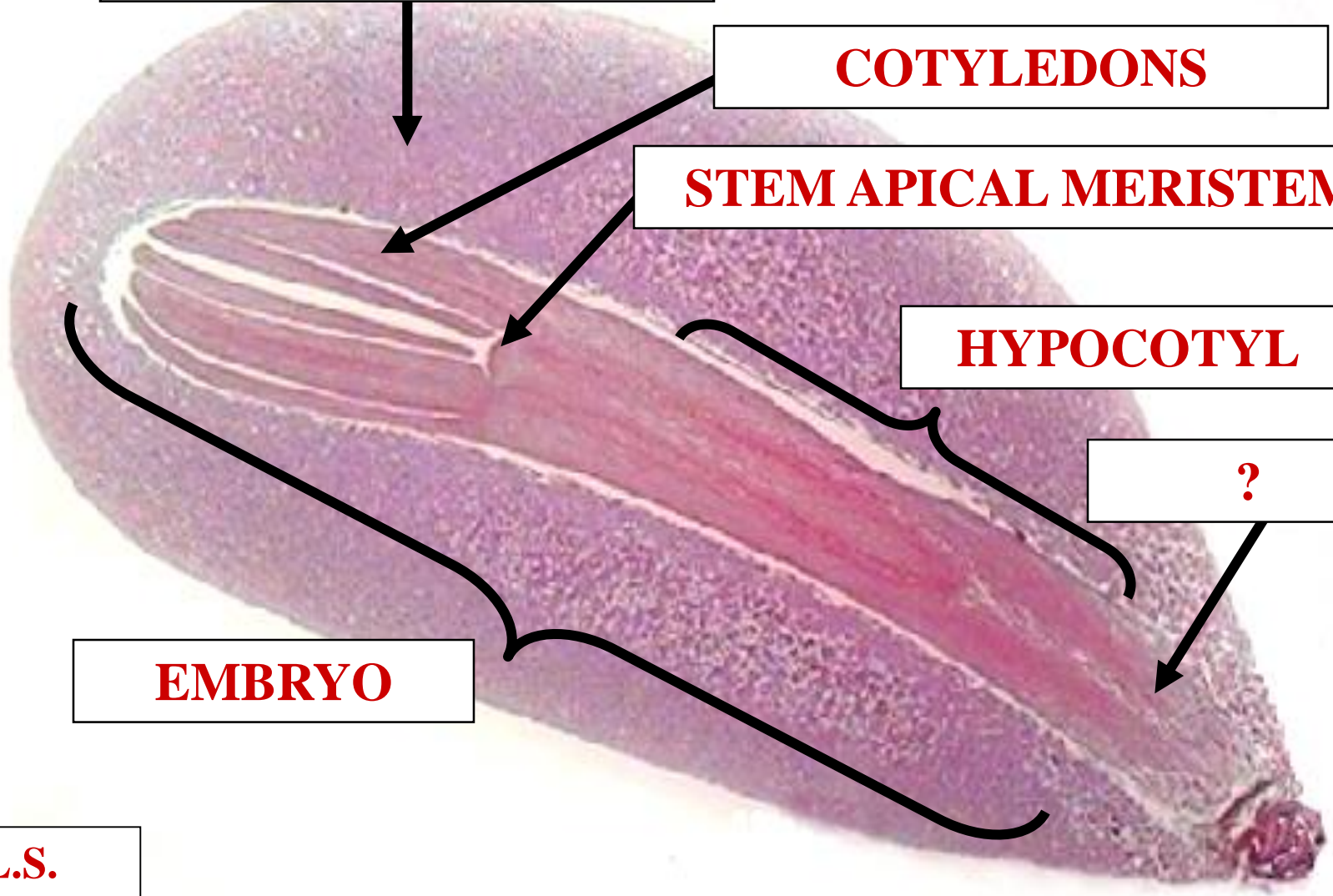
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EMBRYO

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PINUS

MEGAGAMETOPHYTE

COTYLEDONS

STEM APICAL MERISTEM

HYPOCOTYL

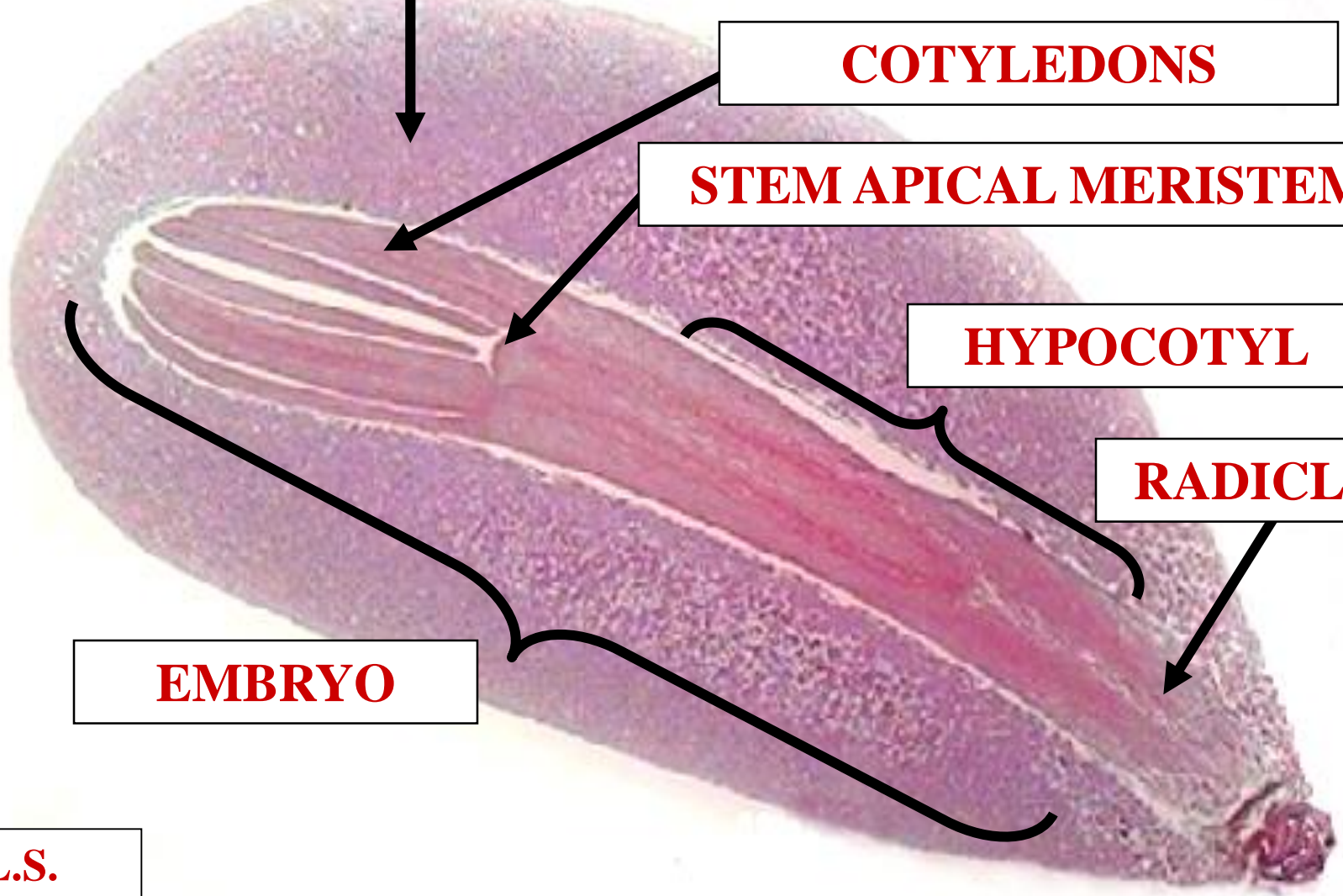
RADICLE

EMBRYO

L.S.

EMBRYO

R



RADICLE



PINOPHYTA
EMBRYO HYPOCOTYL

EMBRYO ROOT

PINOPHYTA
EMBRYO HYPOCOTYL

PINUS

MEGAGAMETOPHYTE

COTYLEDONS

STEM APICAL MERISTEM

HYPOCOTYL

RADICLE

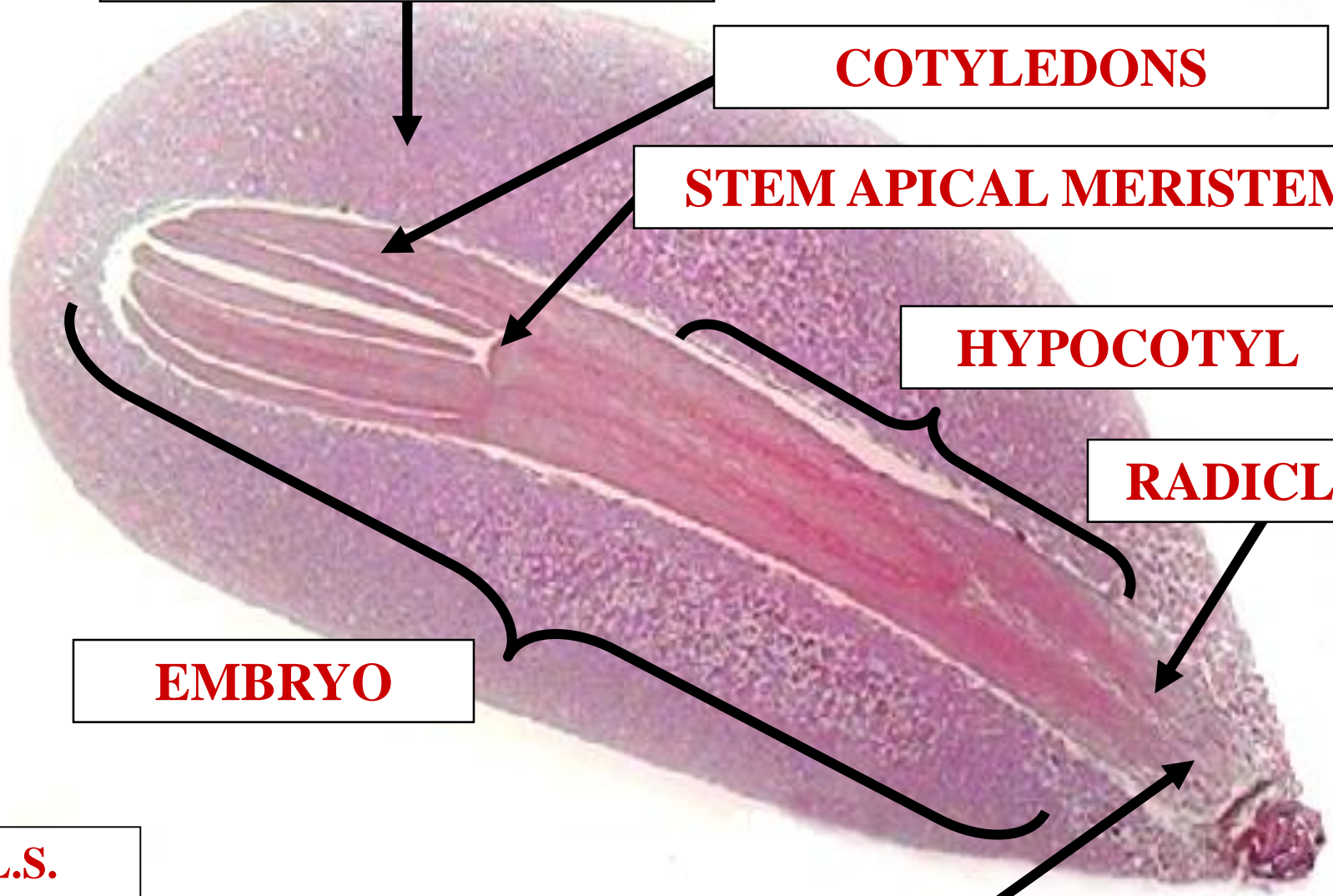
EMBRYO

L.S.

EMBRYO

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PINUS

MEGAGAMETOPHYTE

?

COTYLEDONS

STEM APICAL MERISTEM

HYPOCOTYL

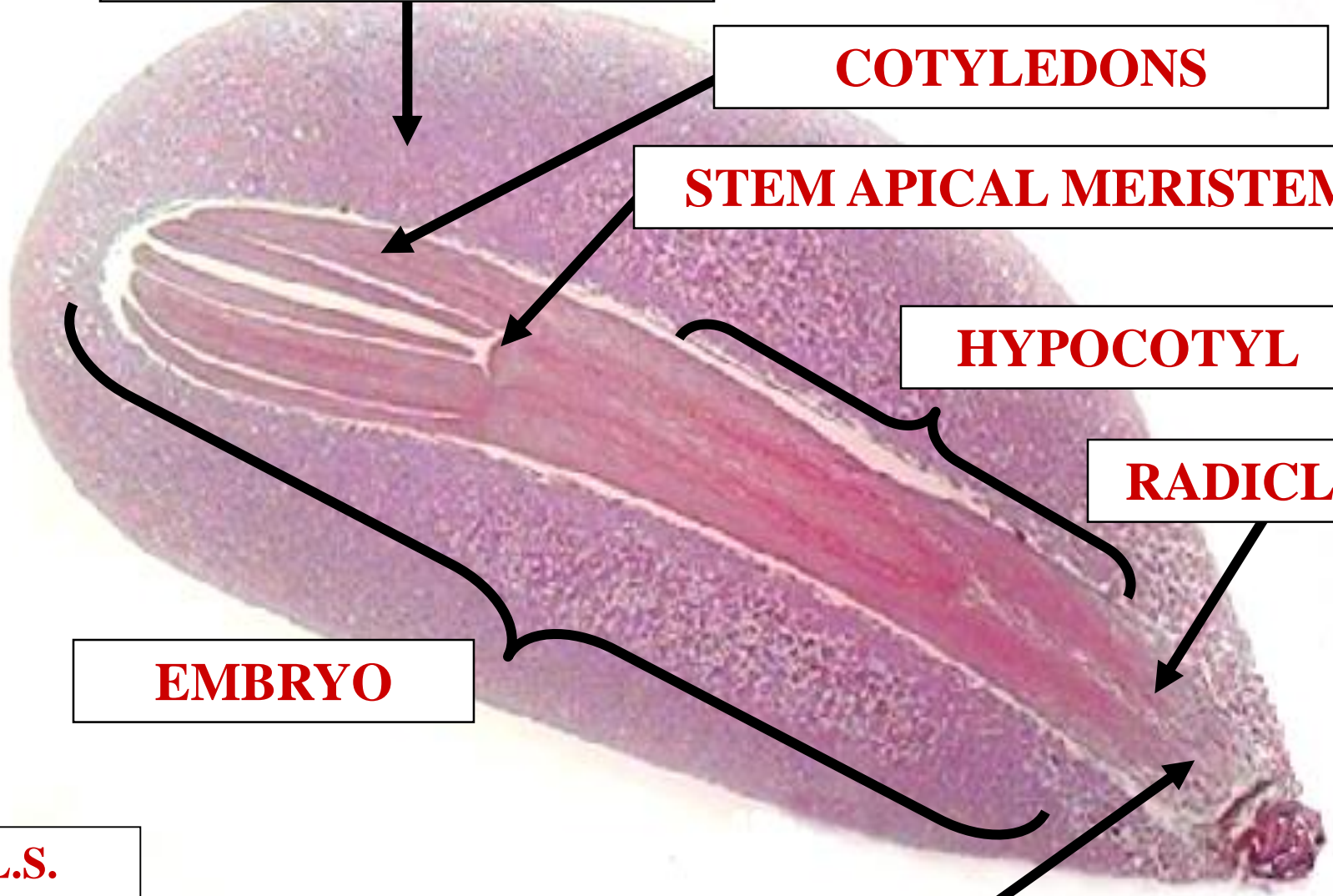
RADICLE

EMBRYO

L.S.

EMBRYO

ROOT APICAL MERISTEM



PINUS

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MEGAGAMETOPHYTE

COTYLEDONS

STEM APICAL MERISTEM

HYPOCOTYL

RADICLE

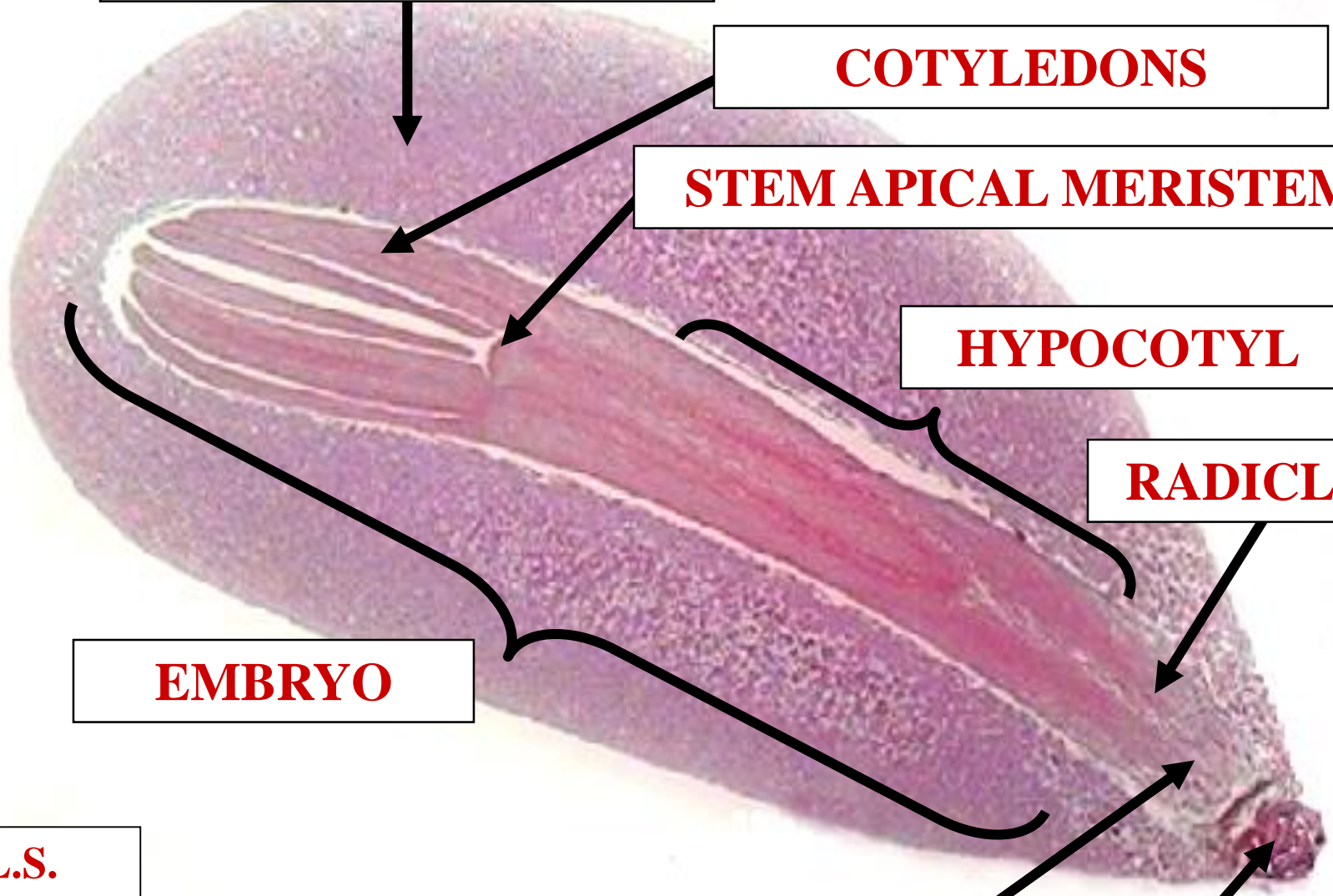
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L.S.

EMBRYO

ROOT APICAL MERISTEM

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PINUS

MEGAGAMETOPHYTE

COTYLEDONS



STEM APICAL MERISTEM

HYPOCOTYL

RADICLE

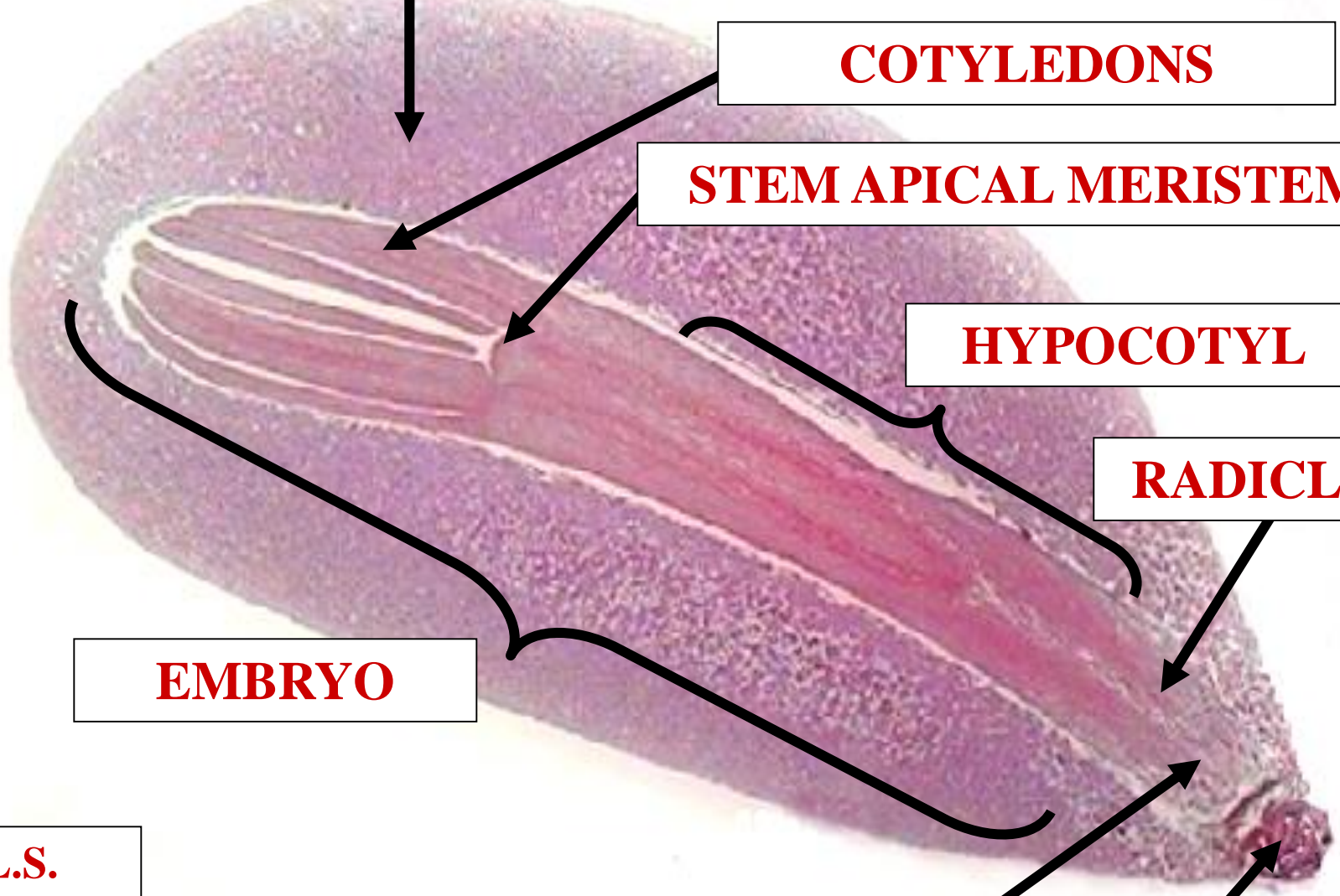
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EMBRYO

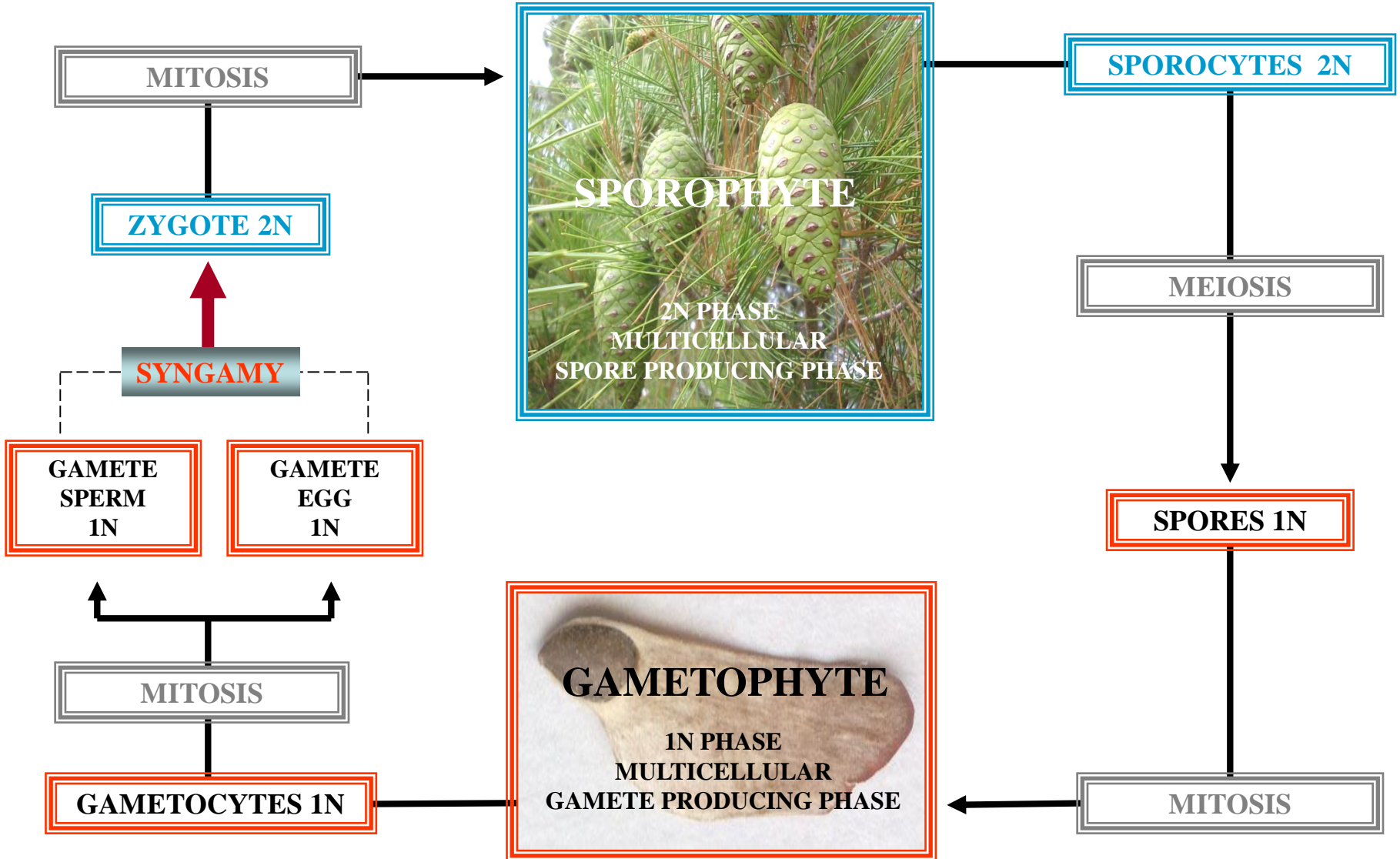
ROOT APICAL MERISTEM

SUSPENSOR





PINOPHYTA LIFE CYCLE





GAMETOPHYTE CHARACTERS



MICROGAMETOPHYTE

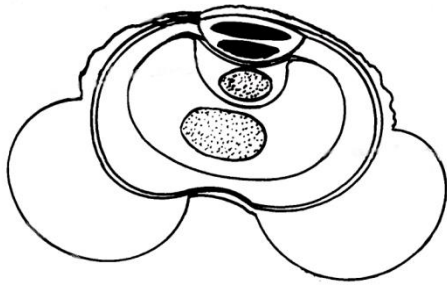


POLLEN GRAIN



POLLEN GRAIN STRUCTURE

MICROGAMETOPHYTE

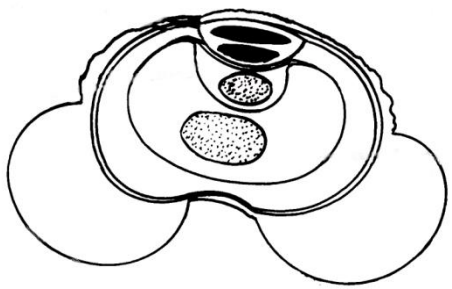


PINUS

POLLEN GRAIN

MICROGAMETOPHYTE

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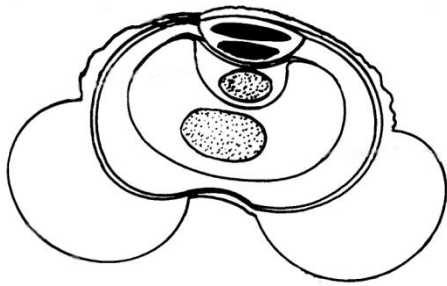


PINUS

POLLEN GRAIN

MICROGAMETOPHYTE

PROTHALLIAL CELLS



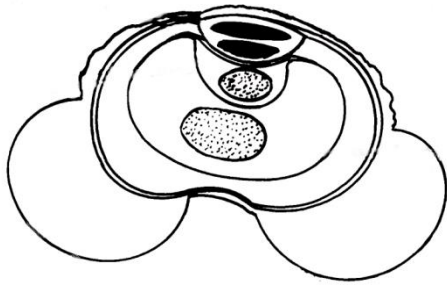
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POLLEN GRAIN

MICROGAMETOPHYTE

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PROTHALLIAL CELLS



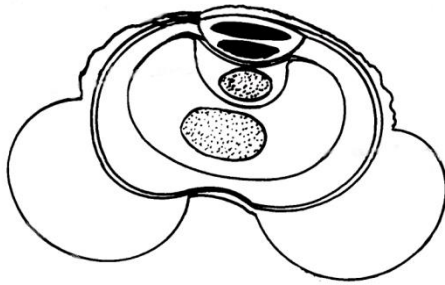
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POLLEN GRAIN

MICROGAMETOPHYTE

GENERATIVE CELL

PROTHALLIAL CELLS



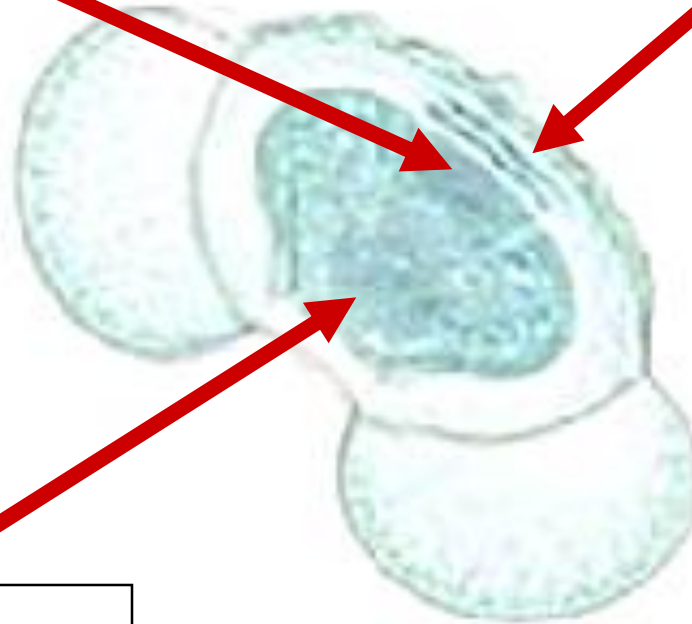
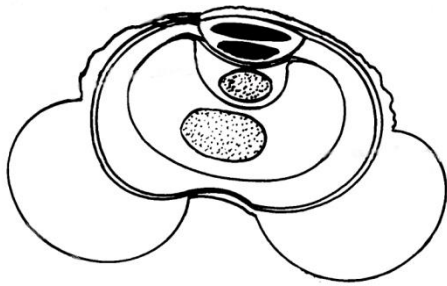
PINUS

POLLEN GRAIN

MICROGAMETOPHYTE

GENERATIVE CELL

PROTHALLIAL CELLS



PINUS

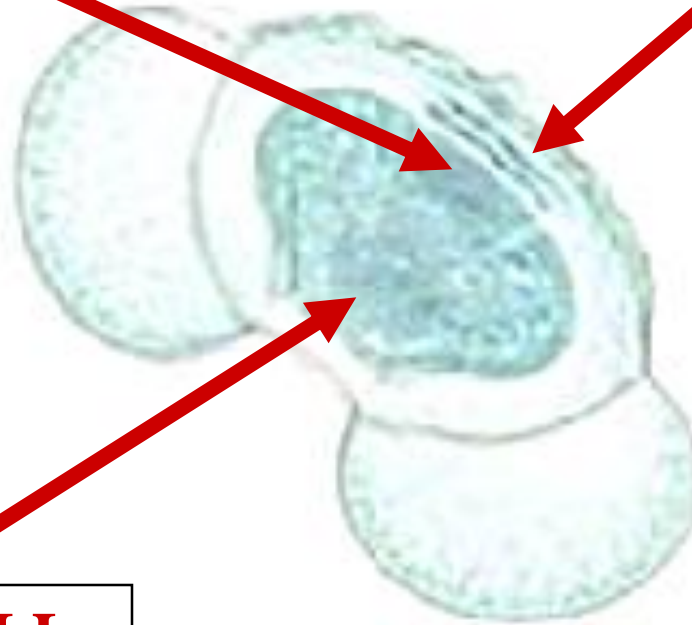
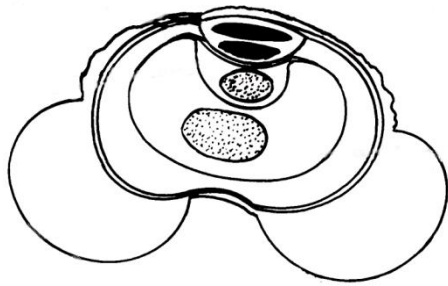
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POLLEN GRAIN

MICROGAMETOPHYTE

GENERATIVE CELL

PROTHALLIAL CELLS

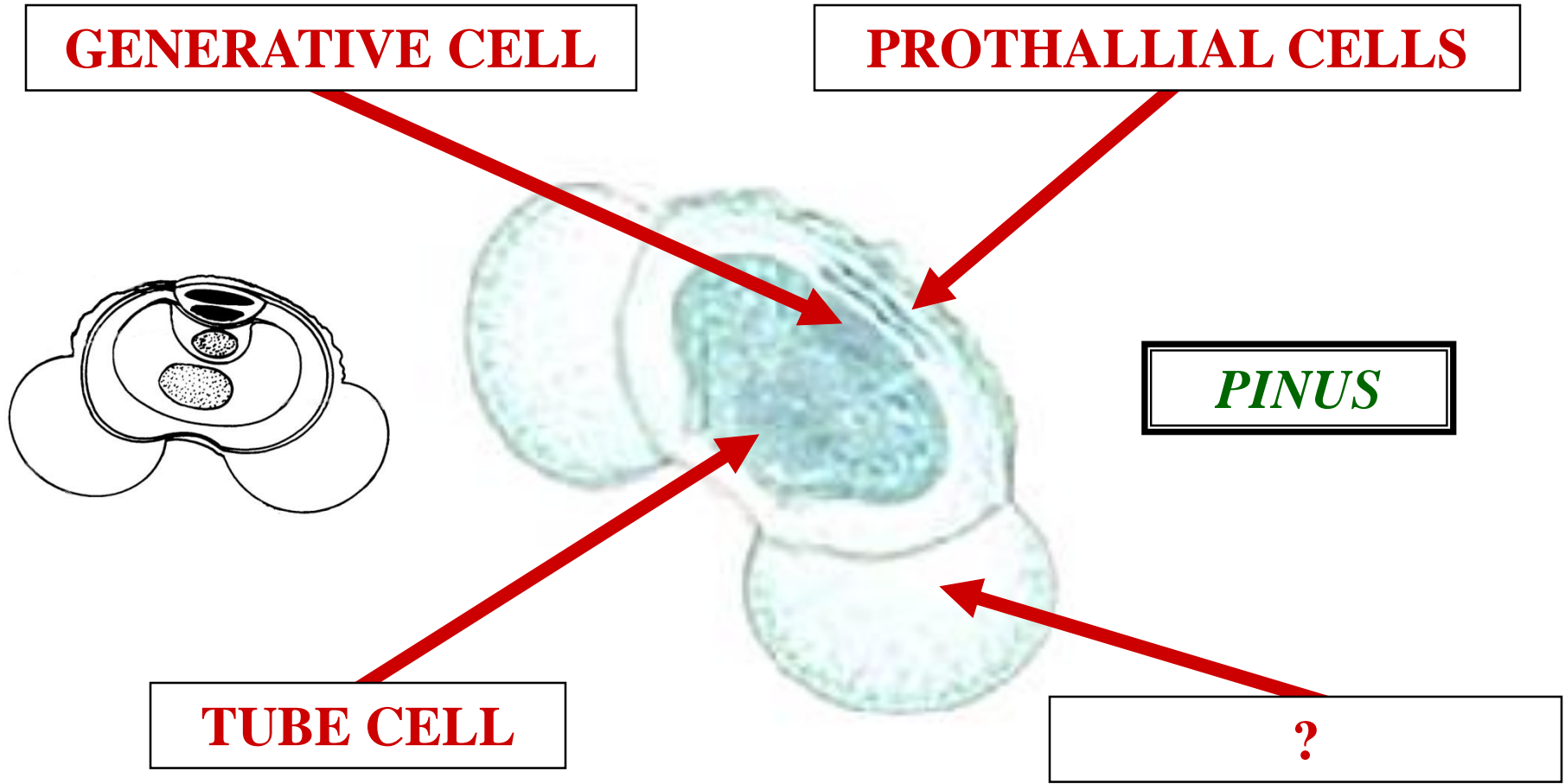


PINUS

TUBE CELL

POLLEN GRAIN

MICROGAMETOPHYTE

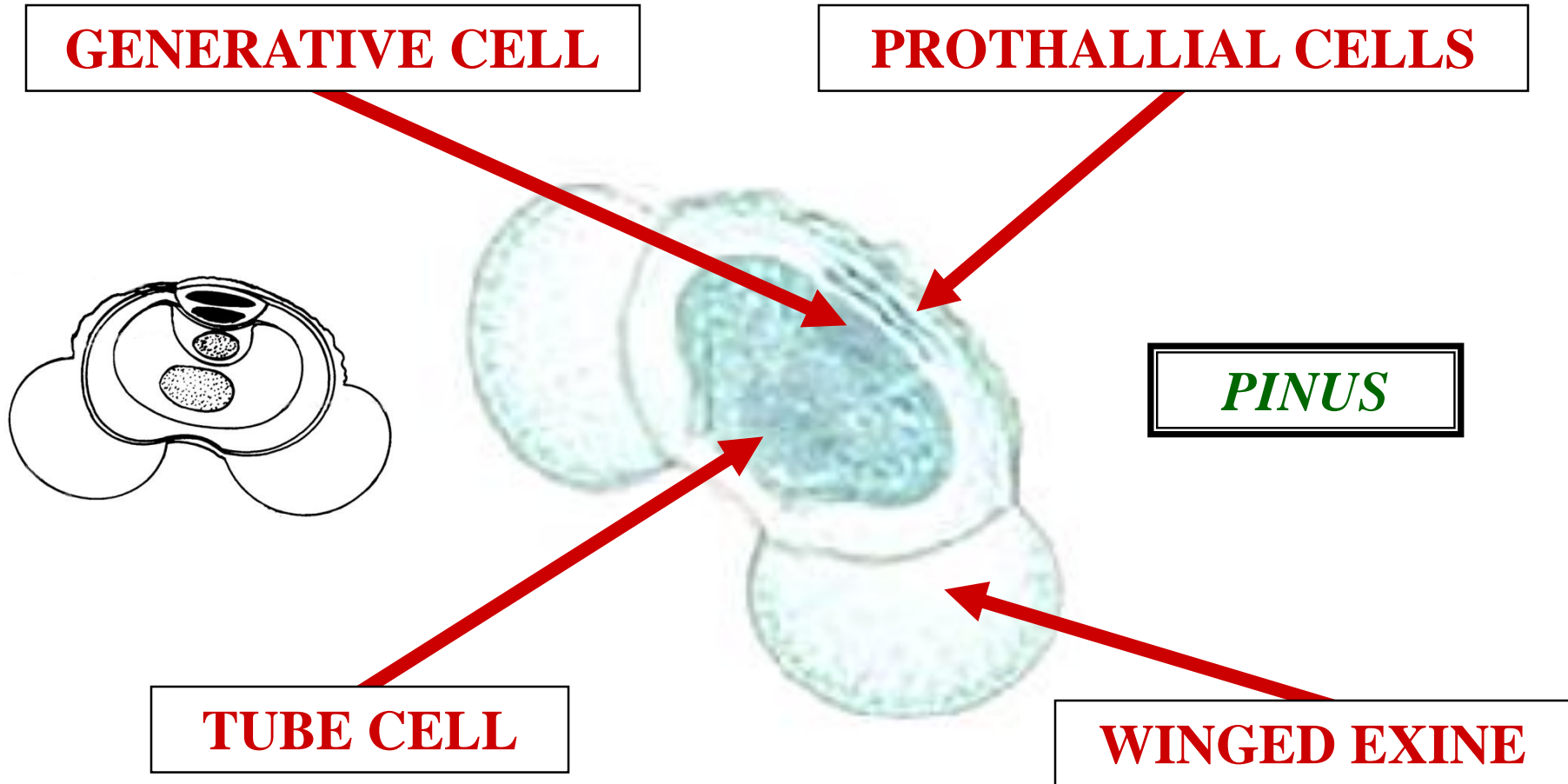


POLLEN GRAIN

MICROGAMETOPHYTE



W



POLLEN GRAIN

PINUS



POLLEN GRAIN

AP

WIND DISPERSAL

PINUS



POLLEN GRAIN

AP

ANEMOPHILOUS POLLINATION

ANEMOPHILOUS POLLINATION

PINOPHYTA



ANEMOPHILOUS POLLINATION

WIND POLLINATION

PINOPHYTA

ANEMOPHILOUS POLLINATION

SPERM

A close-up photograph of a pine branch with several green, needle-like leaves and a cluster of small, brown, textured pine cones. The background is dark and out of focus.

PINOPHYTA
SPERM
NON-FLAGELLATED



REPRODUCTION

**MONOECIOUS
GYMNOSPERM
VS
DIOECIOUS
GYMNOSPERM**

**MONOECIOUS
GYMNOSPERM**

**GYMNOSPERM
MONOECIOUS**

**MICROSPORANGIA
AND
MEGASPORANGIA
SAME PLANT**

**GYMNOSPERM
MONOECIOUS**



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**



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GINKGO

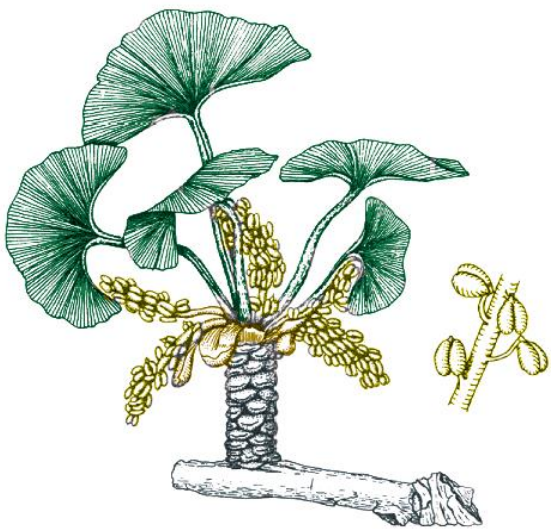
M



GINKGO

M

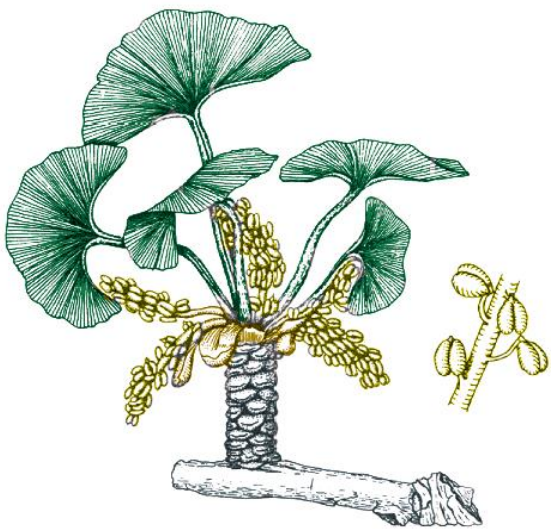
MICROSTROBILI



GINKGO

“M

MICROSPORANGIA



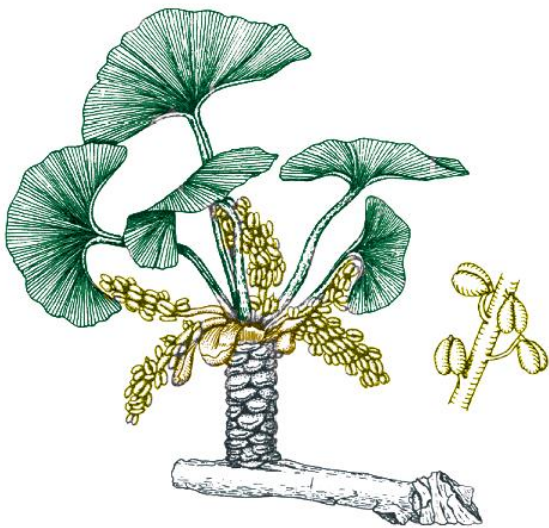
GINKGO

M

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“MALE” PLANT

MICROSPORANGIA



GINKGO

M



GINKGO

M

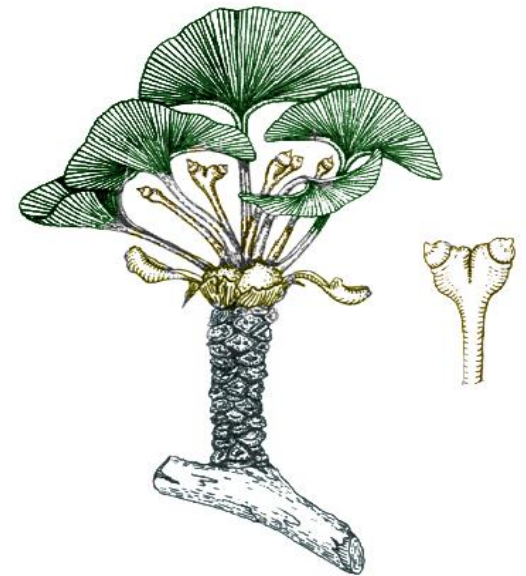
MEGASTROBILI



GINKGO

“F”

MEGASPORANGIA



GINKGO

2

“FEMALE” PLANT

MEGASPORANGIA

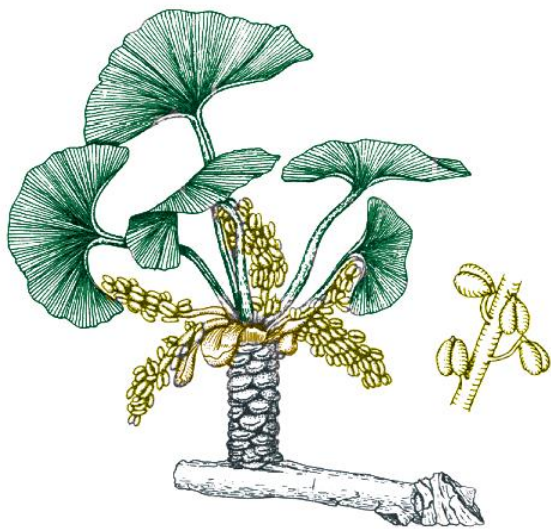


GINKGO

D

“MALE” PLANT

MICROSPORANGIA



“FEMALE” PLANT

MEGASPORANGIA

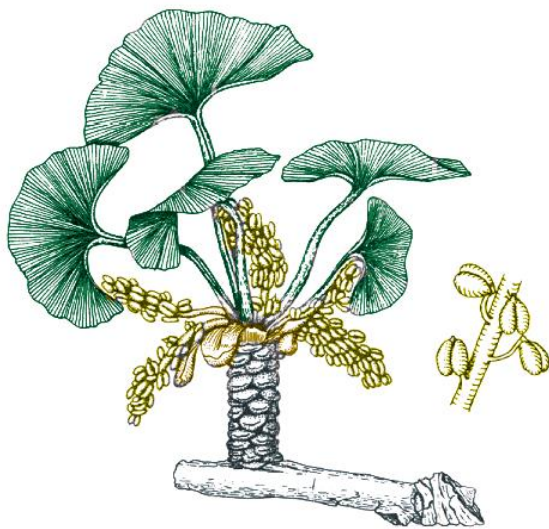


GINKGO

DIOECIOUS

“MALE” PLANT

MICROSPORANGIA



“FEMALE” PLANT

MEGASPORANGIA





PINOPHYTA

SEX

CONDITION

PINUS



PINUS



MICROSPORANGIA



MICROSTROBILI

MEGASTROBILI

MEGASPORANGIA



MICROSPORANGIA



MICROSTROBILI

PINUS

M



MEGASPORANGIA

PINUS



MONOECIOUS



MICROSPORANGIA





MICROSTROBILUS

PINUS

Two red arrows originate from the bottom left and point towards two of the yellowish, cone-shaped structures (microstrobili) on the pine branch.

MICROSTROBILI

L.S.

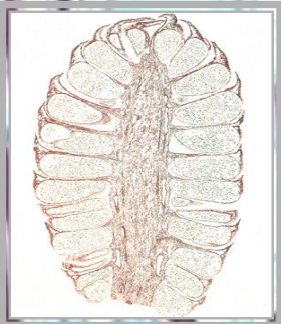
PINUS



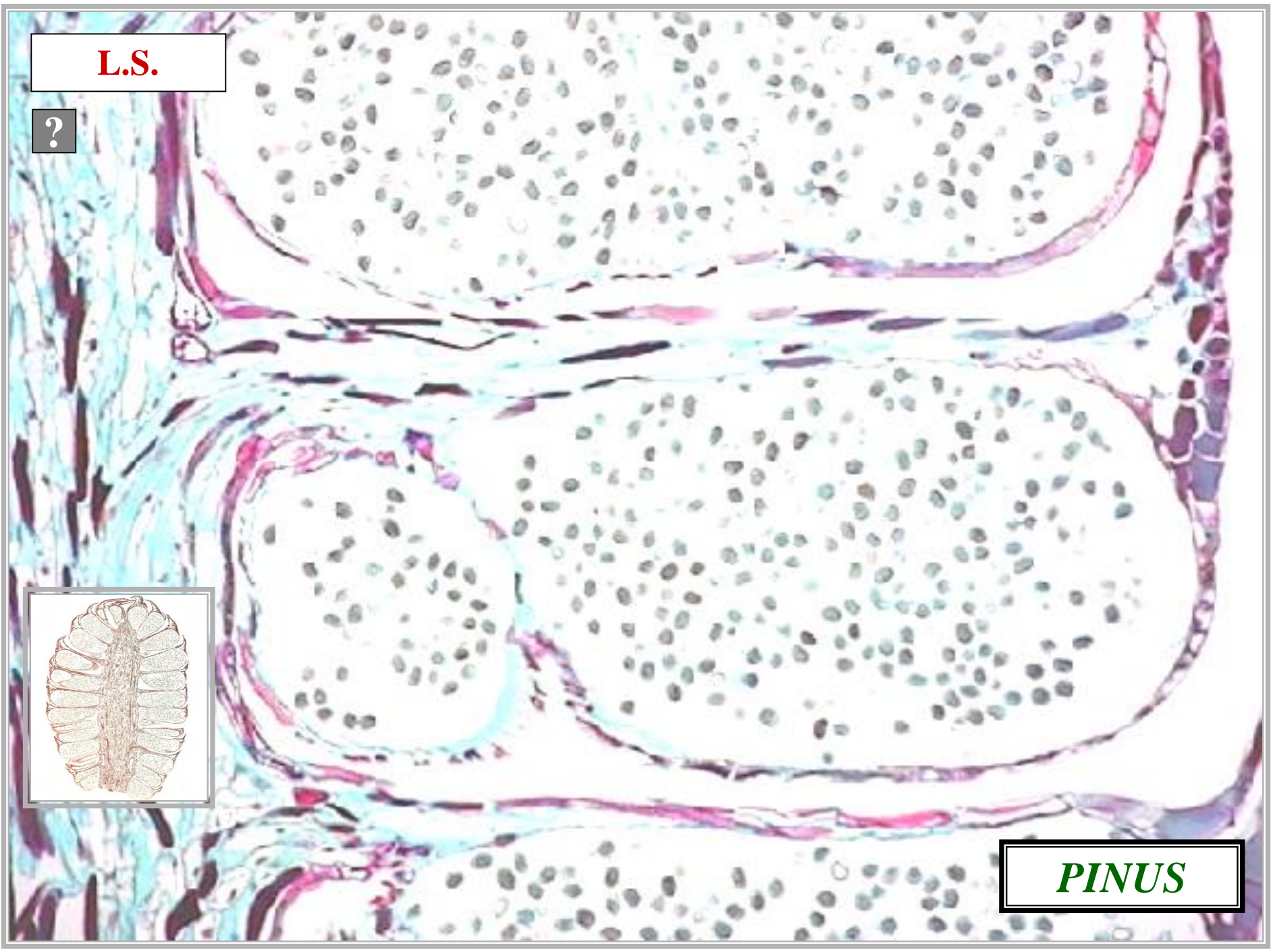
MICROSTROBILUS

L.S.

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PINUS

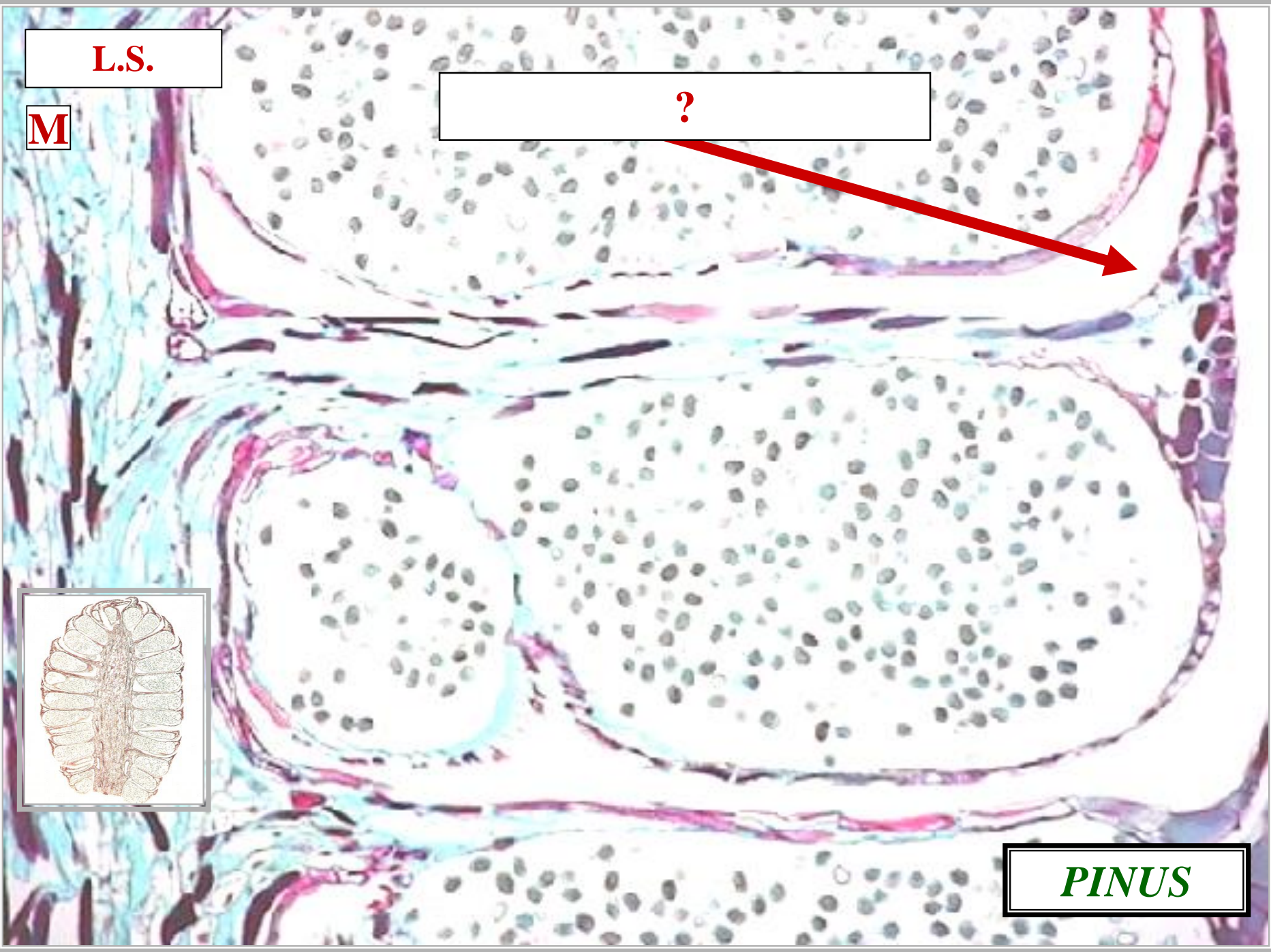
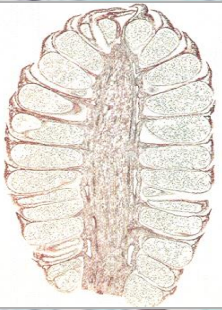


L.S.

M

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PINUS



L.S.

MICROSPOROPHYLL

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PINUS

