

STEM

PRIMARY GROWTH

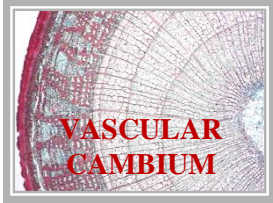
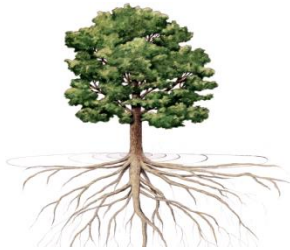
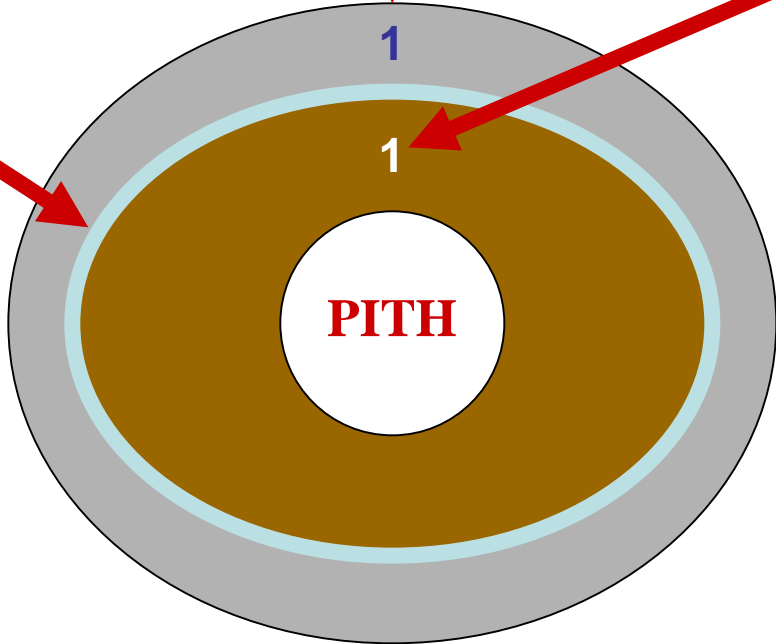
C.S.

VASCULAR CAMBIUM ACTIVITY

PRIMARY PHLOEM

VASCULAR CAMBIUM

PRIMARY XYLEM



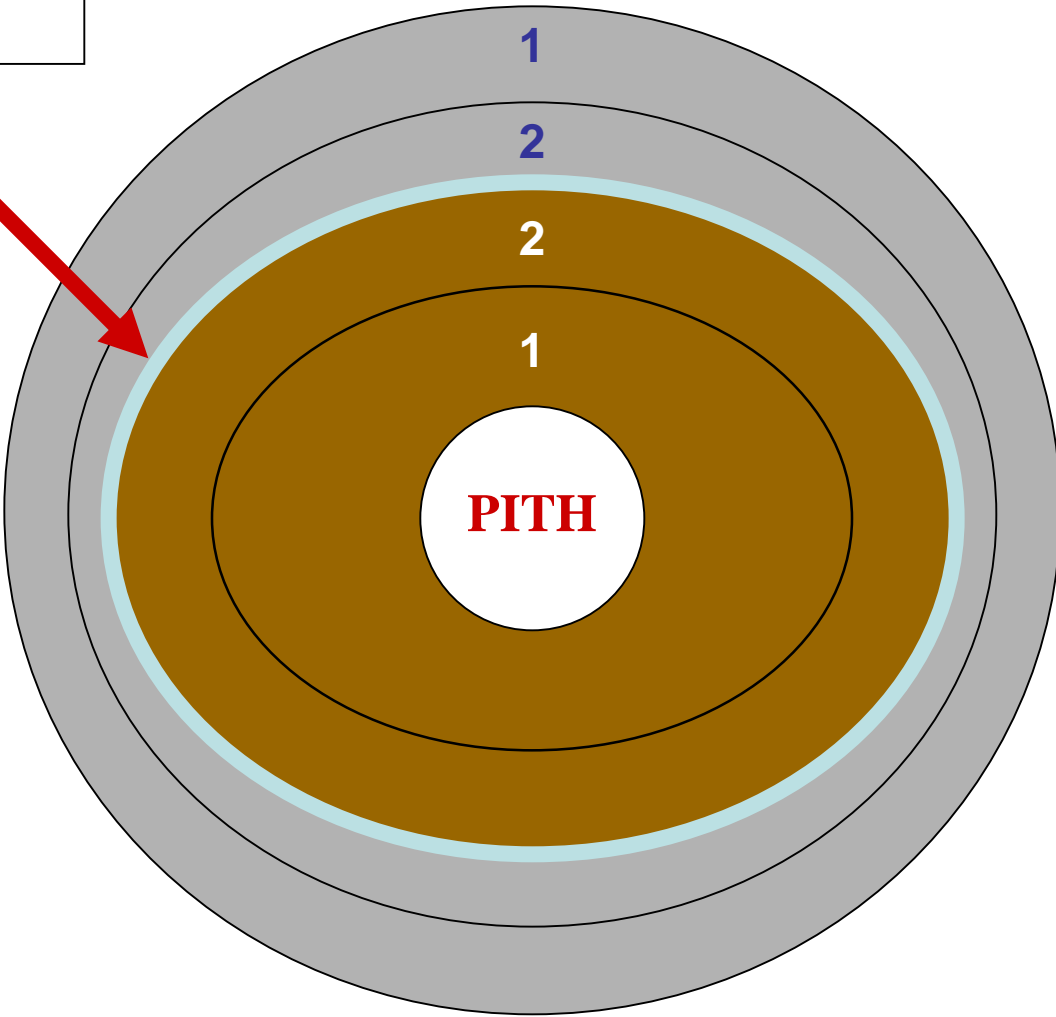
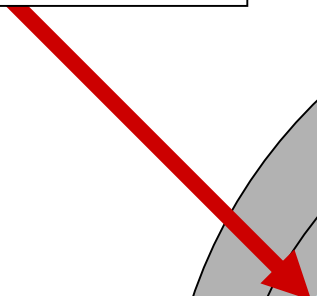
STEM

SECONDARY GROWTH

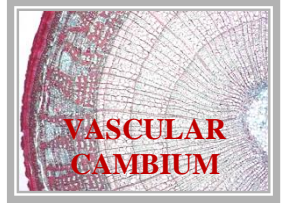
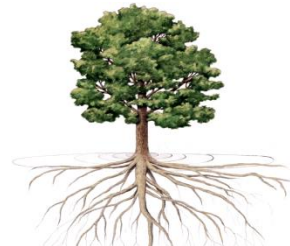
C.S.

VASCULAR CAMBIUM ACTIVITY

VASCULAR CAMBIUM



STEM



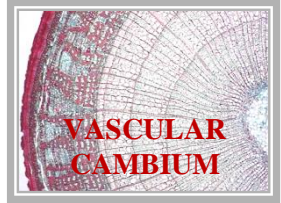
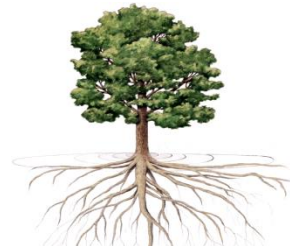
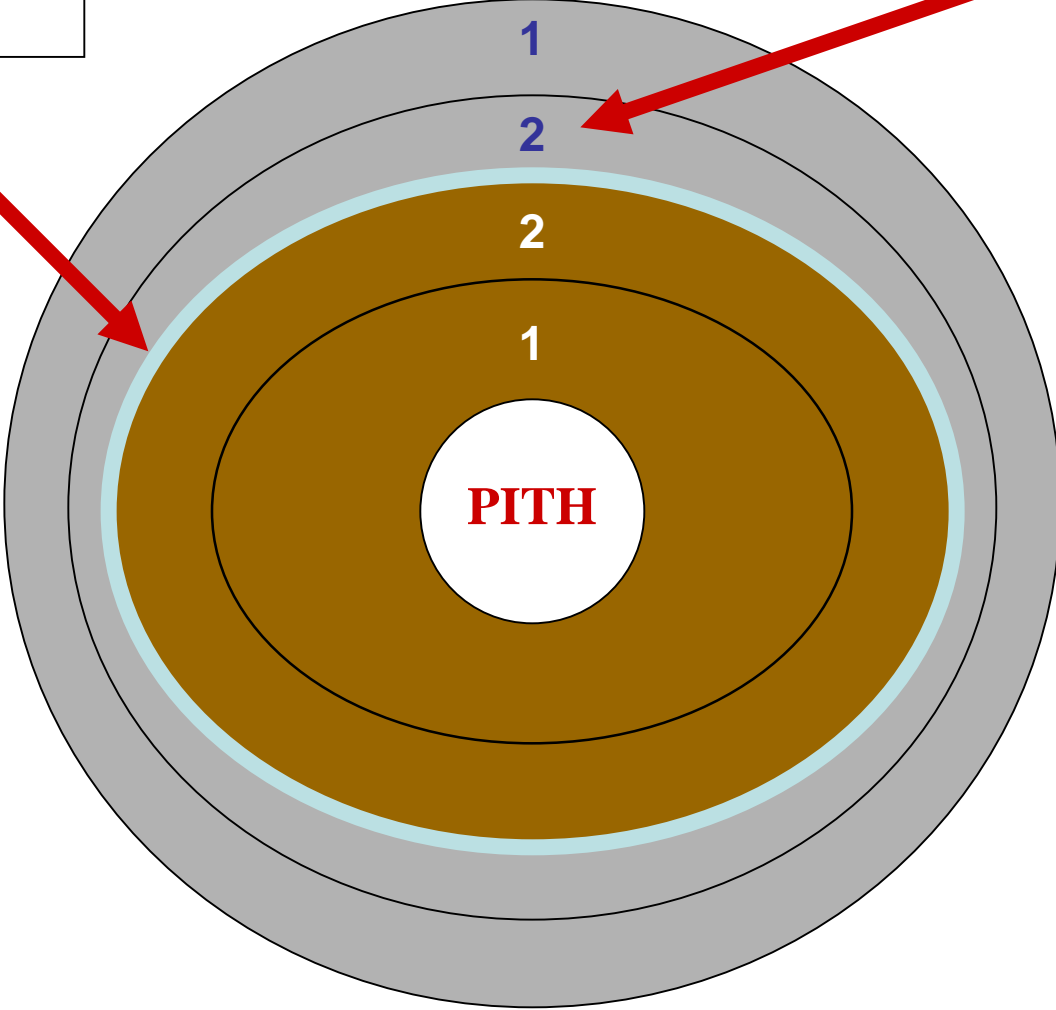
C.S.

VASCULAR CAMBIUM ACTIVITY

~SP

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VASCULAR CAMBIUM



STEM

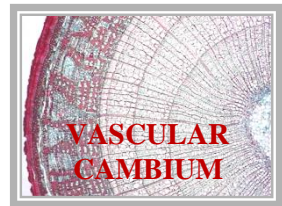
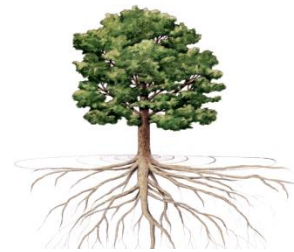
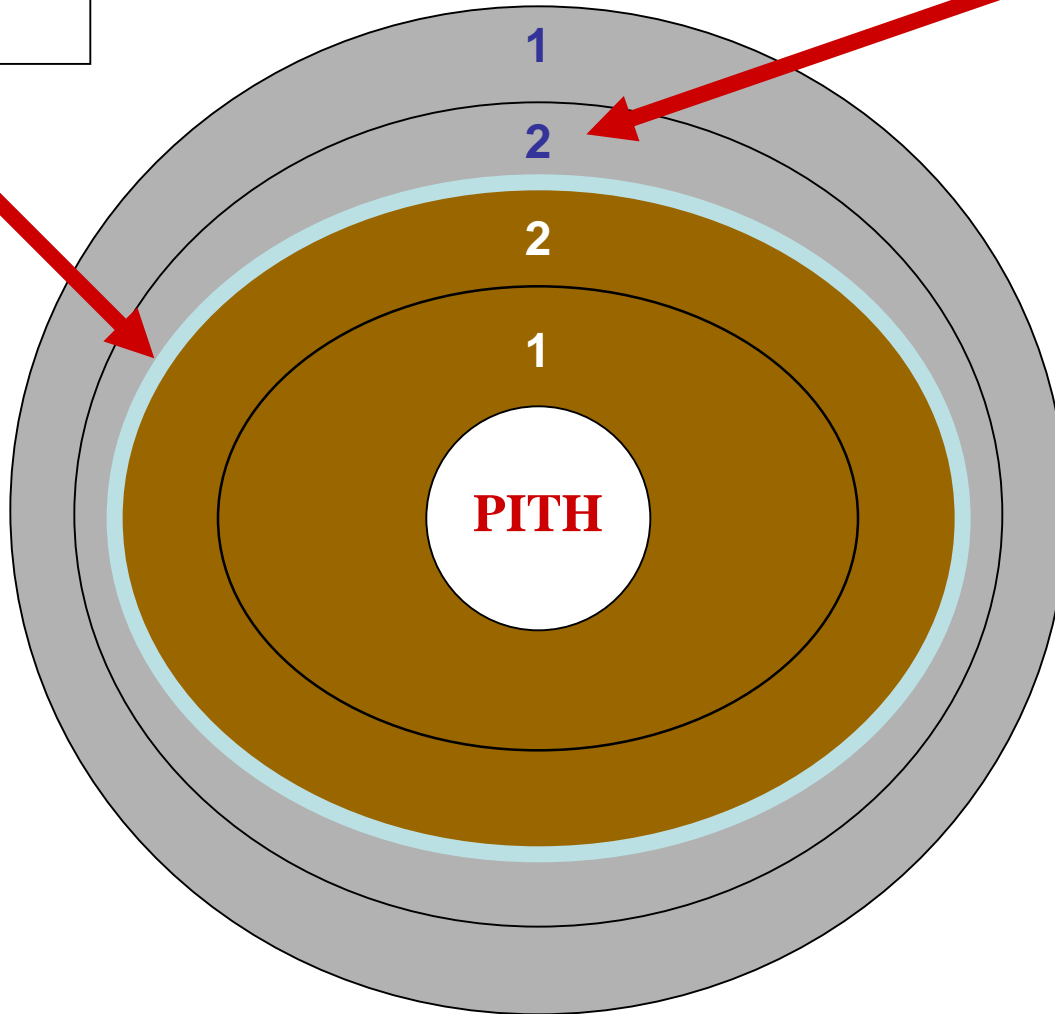
C.S.

VASCULAR CAMBIUM ACTIVITY



SECONDARY PHLOEM

VASCULAR CAMBIUM



STEM

C.S.

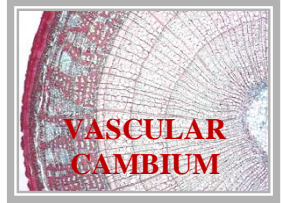
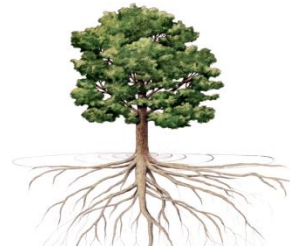
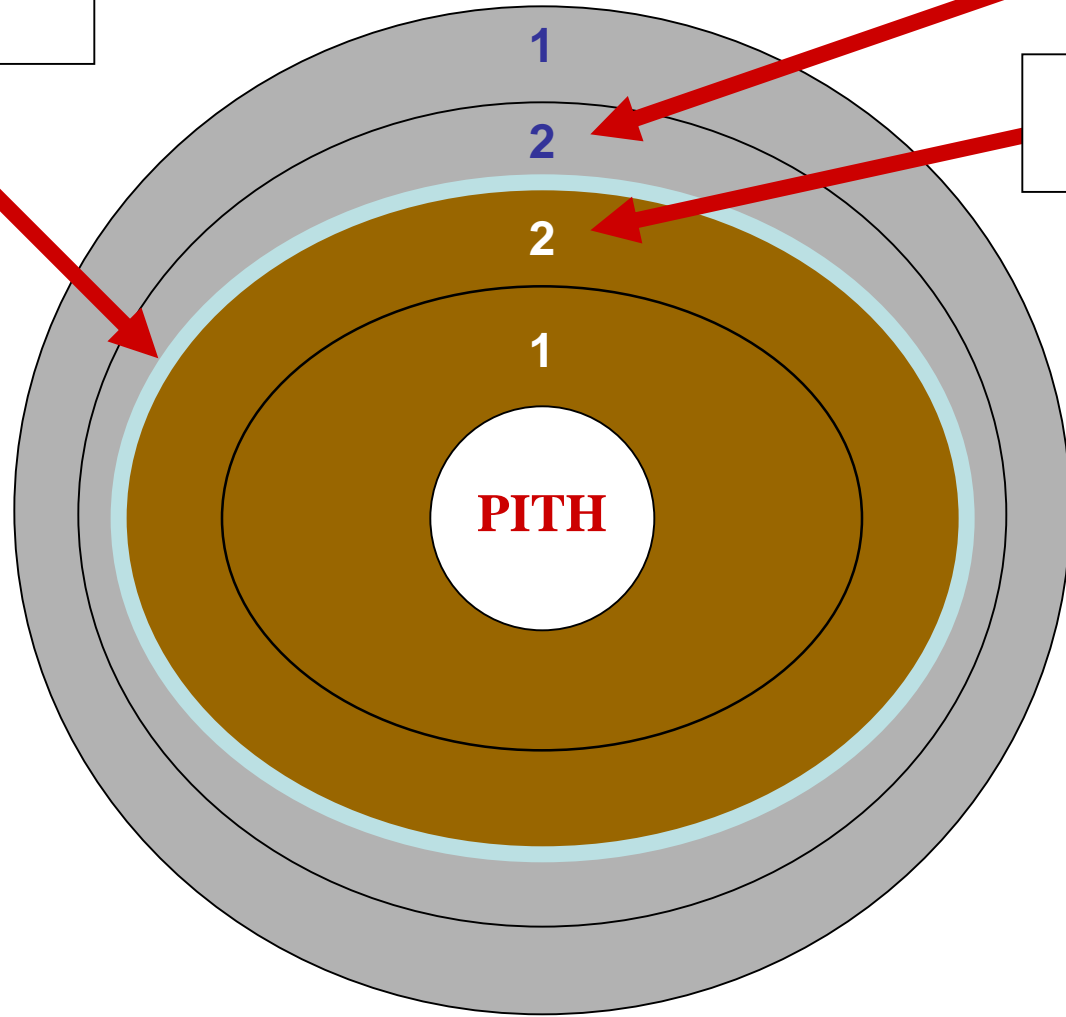
VASCULAR CAMBIUM ACTIVITY

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SECONDARY PHLOEM

VASCULAR CAMBIUM

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STEM

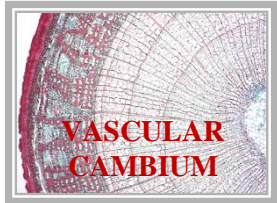
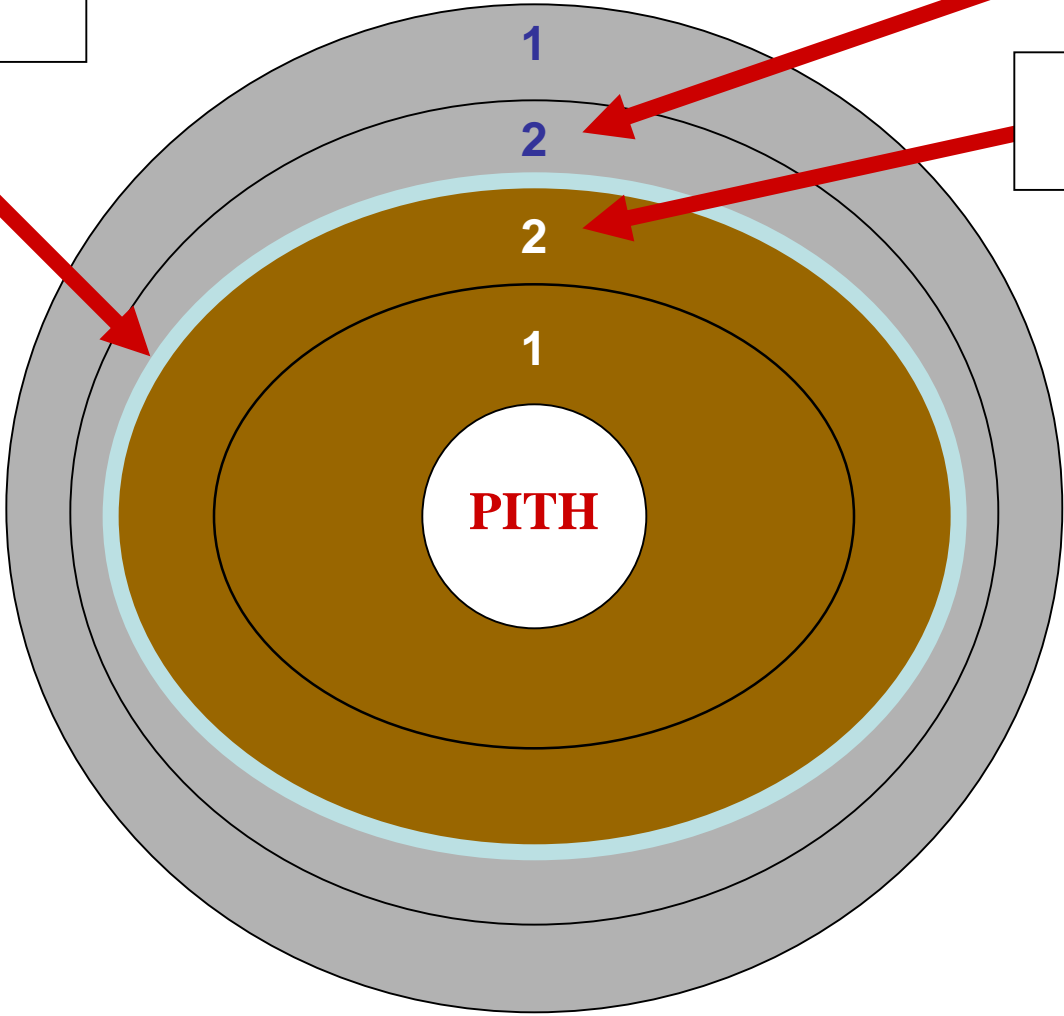
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VASCULAR CAMBIUM ACTIVITY

VASCULAR CAMBIUM

SECONDARY PHLOEM

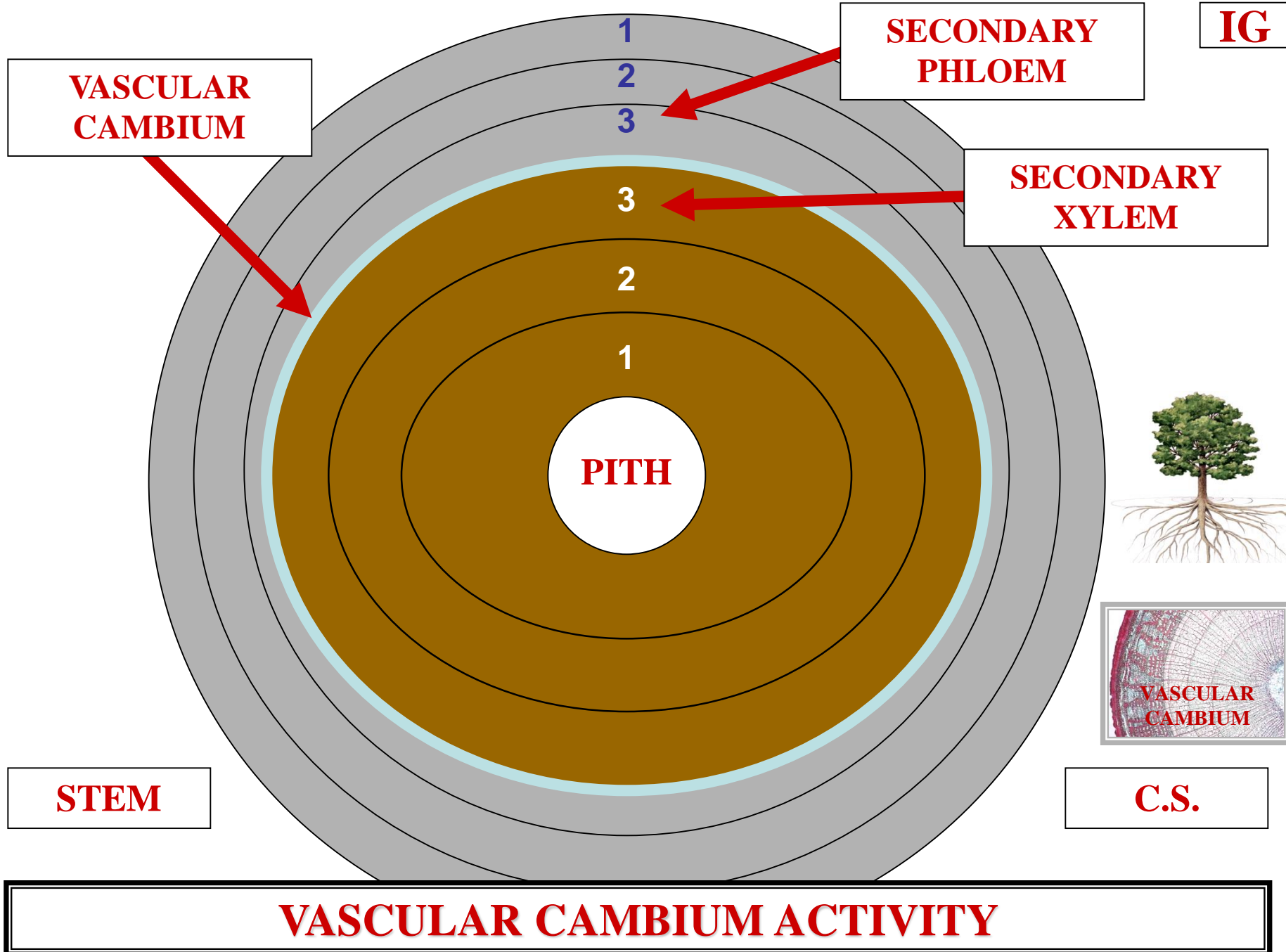
SECONDARY XYLEM

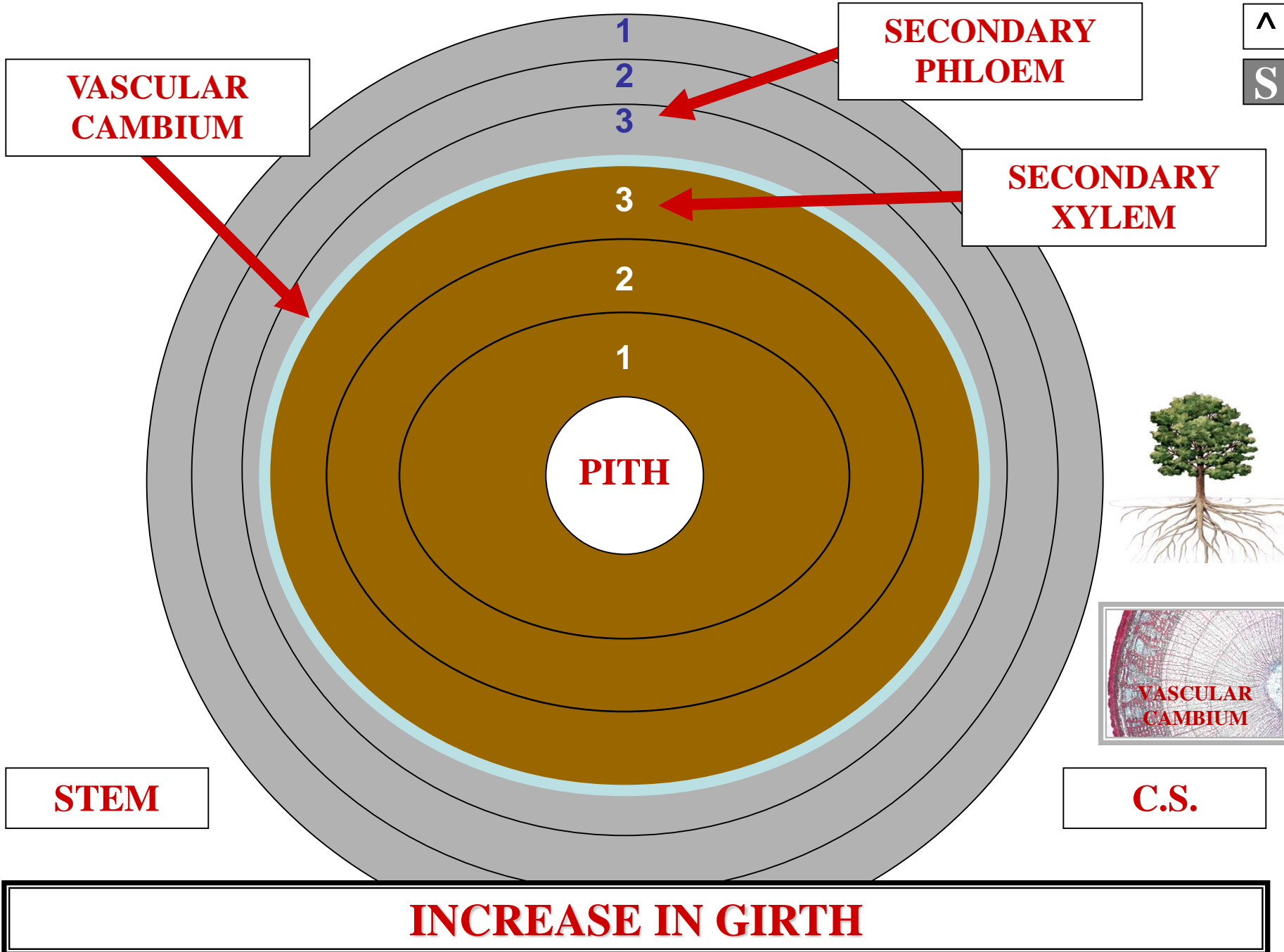


STEM

C.S.

VASCULAR CAMBIUM ACTIVITY



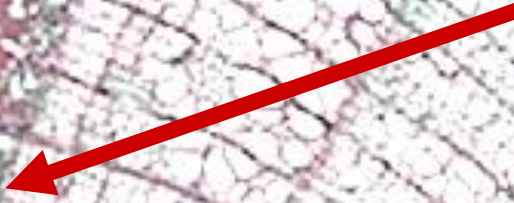




VASCULAR CAMBIUM ACTIVITY SUMMARY

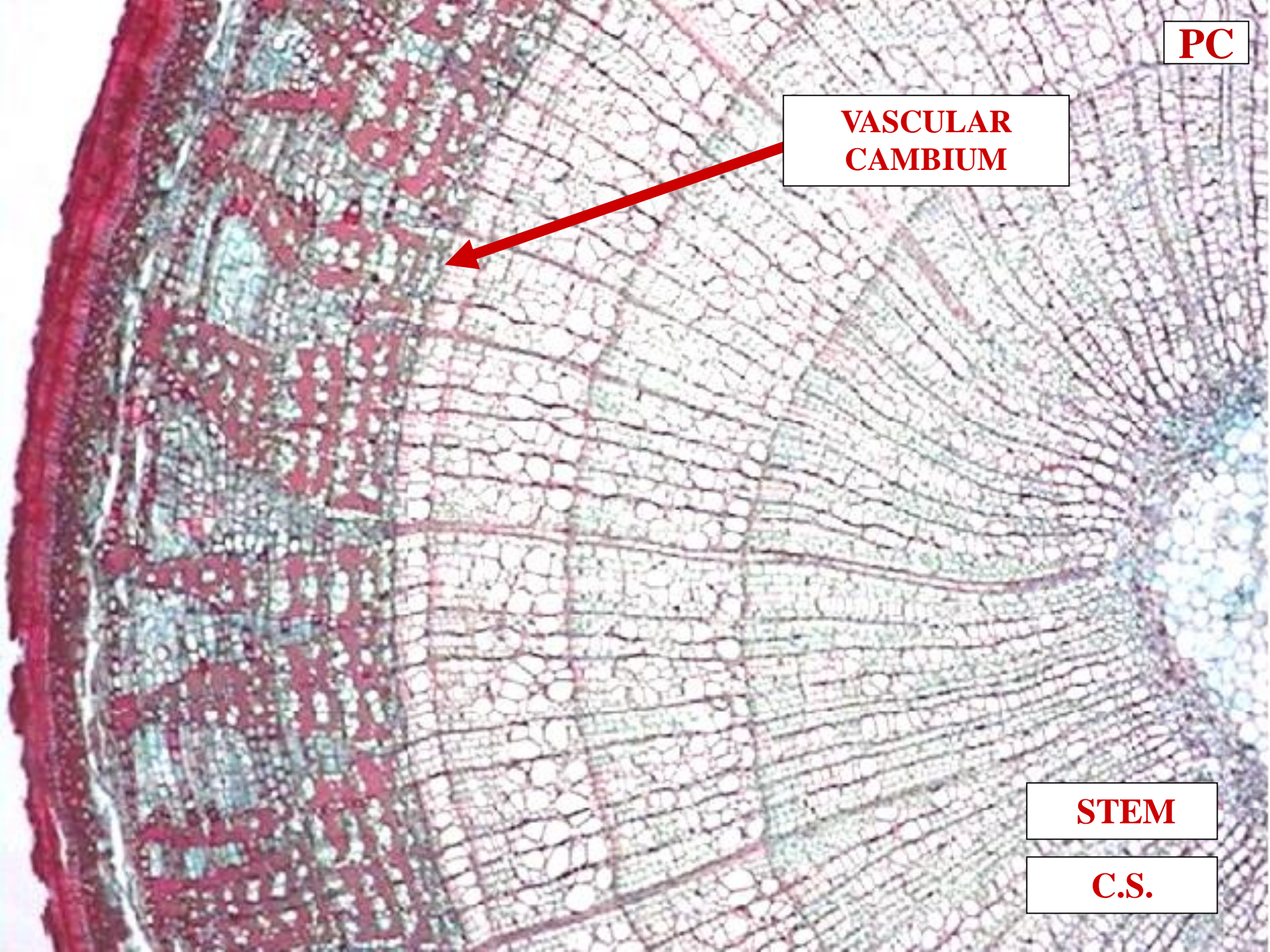
PC

**VASCULAR
CAMBIUM**

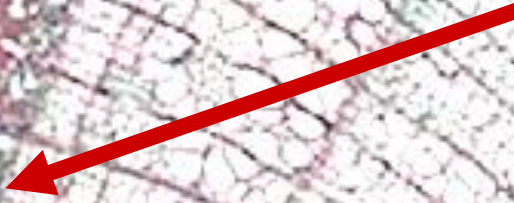


STEM

C.S.

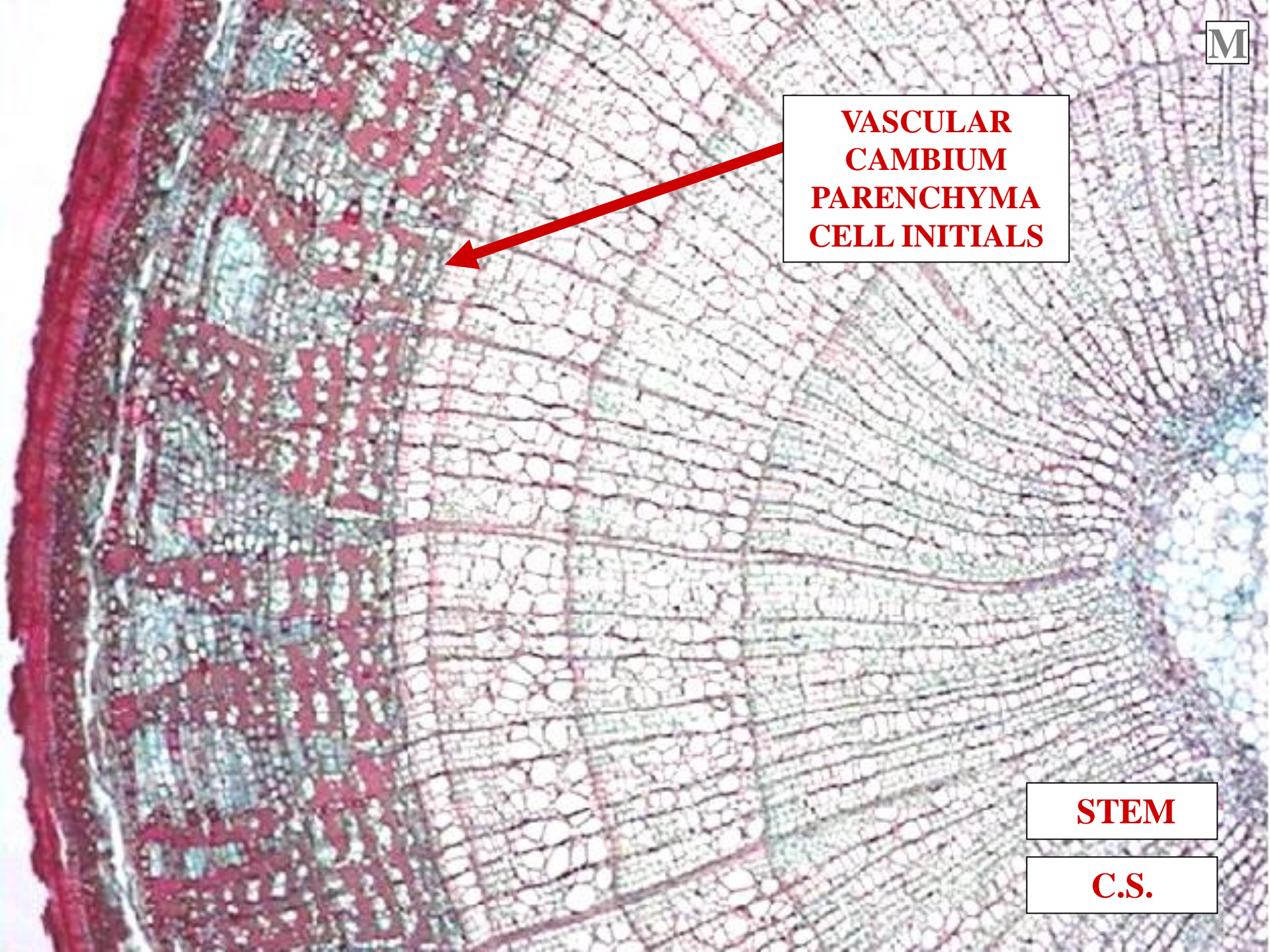


**VASCULAR
CAMBIUM
PARENCHYMA
CELL INITIALS**

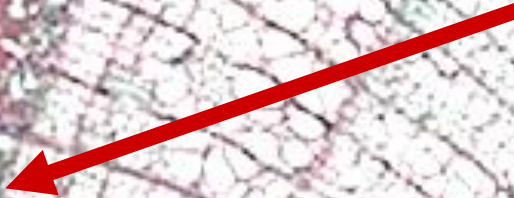


STEM

C.S.

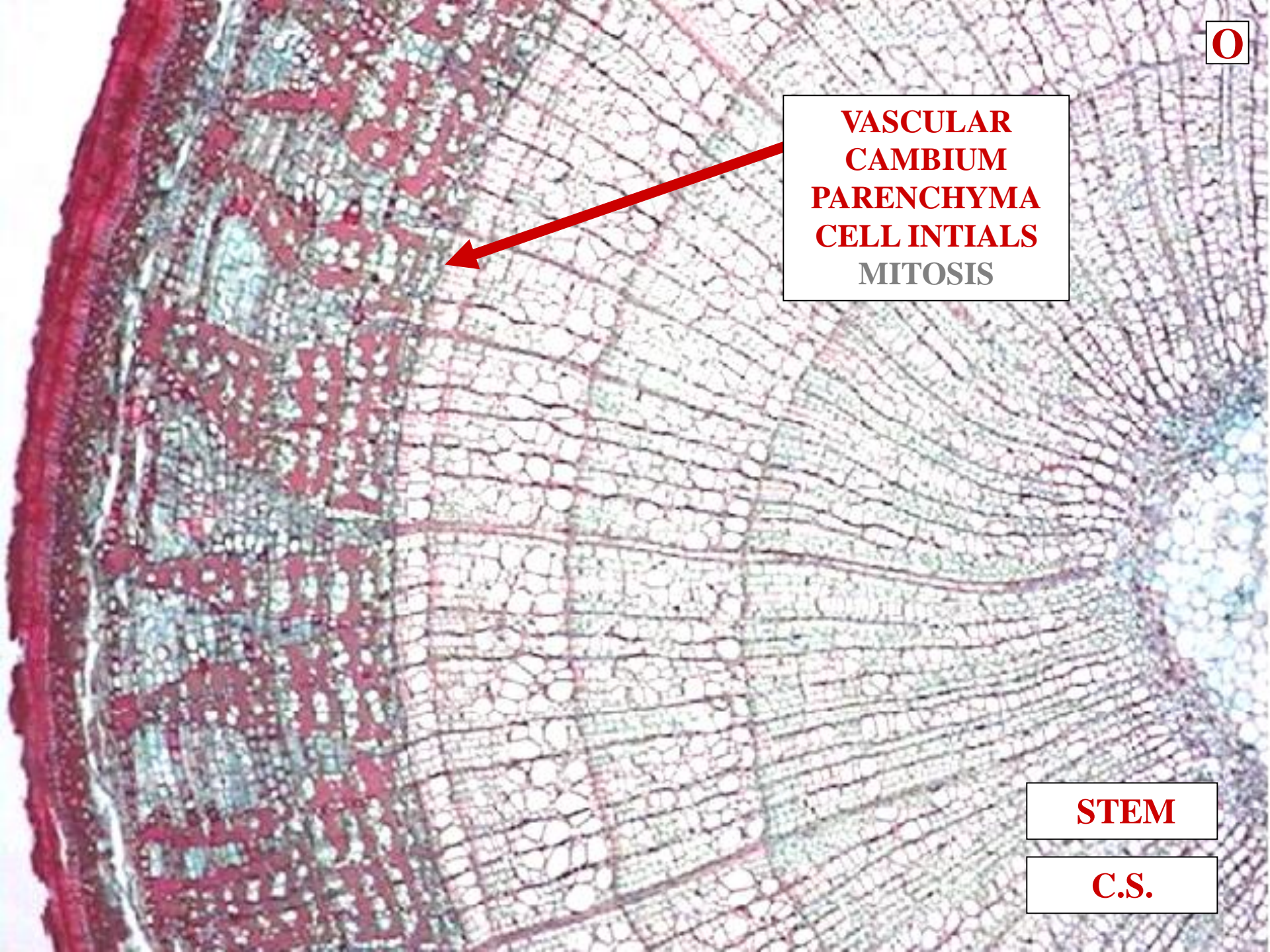


**VASCULAR
CAMBIUM
PARENCHYMA
CELL INTIALS
MITOSIS**



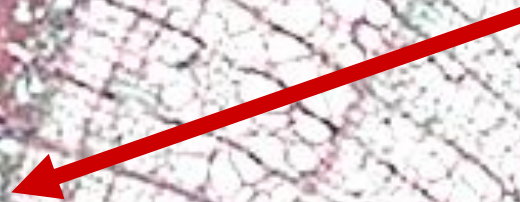
STEM

C.S.



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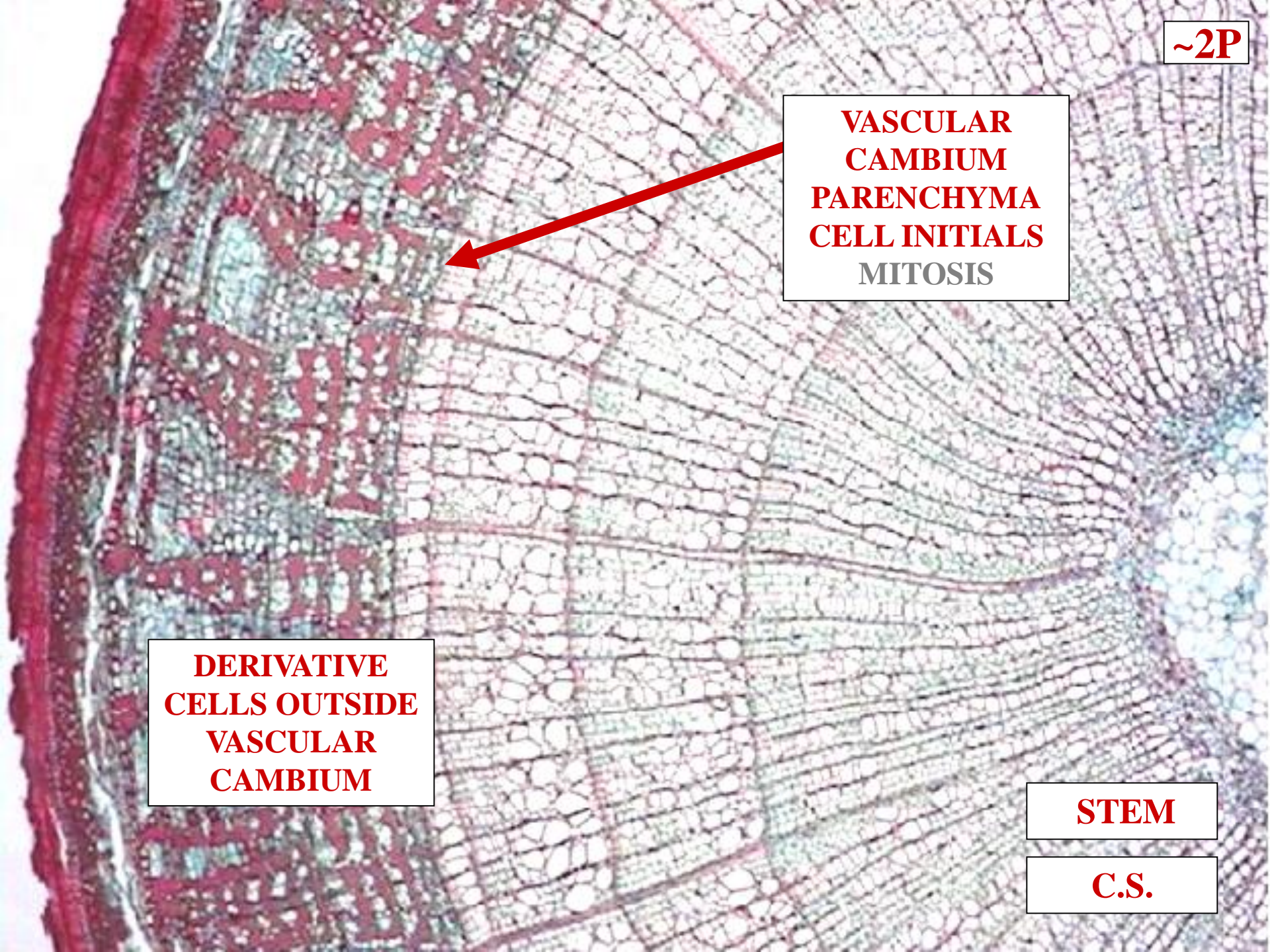
**VASCULAR
CAMBIUM
PARENCHYMA
CELL INITIALS
MITOSIS**



**DERIVATIVE
CELLS OUTSIDE
VASCULAR
CAMBIUM**

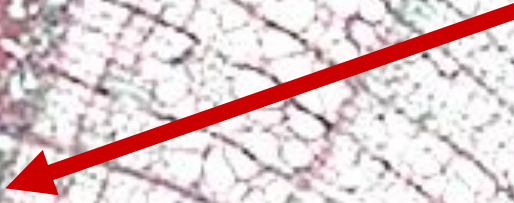
STEM

C.S.



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**VASCULAR
CAMBIUM
PARENCHYMA
CELLS
MITOSIS**

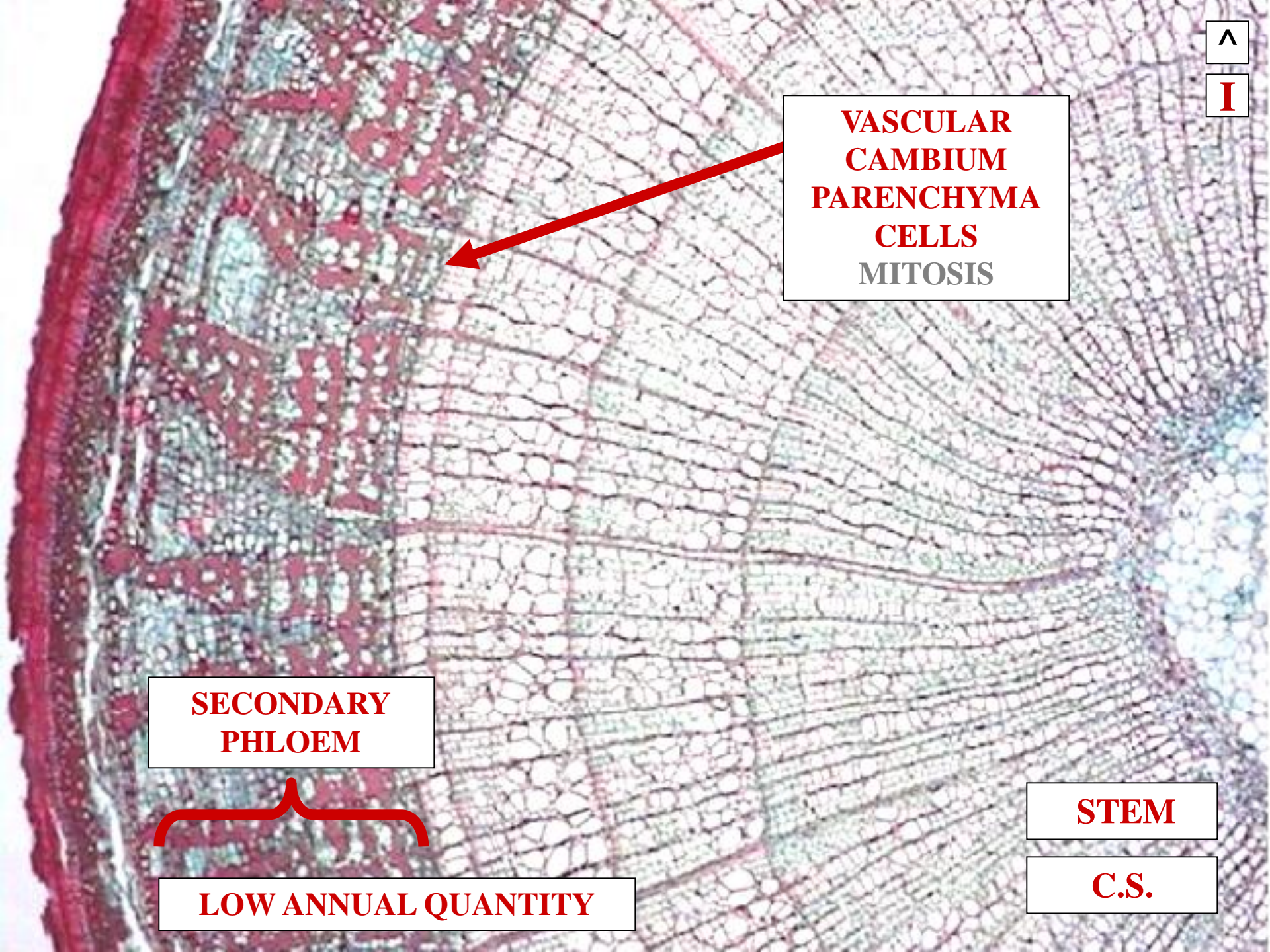


**SECONDARY
PHLOEM**



STEM

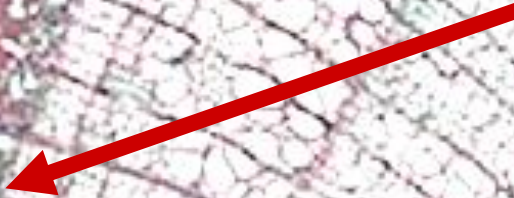
C.S.



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**VASCULAR
CAMBIUM
PARENCHYMA
CELLS
MITOSIS**



**SECONDARY
PHLOEM**



LOW ANNUAL QUANTITY

STEM

C.S.

~2X

**VASCULAR
CAMBIUM
PARENCHYMA
CELLS
MITOSIS**

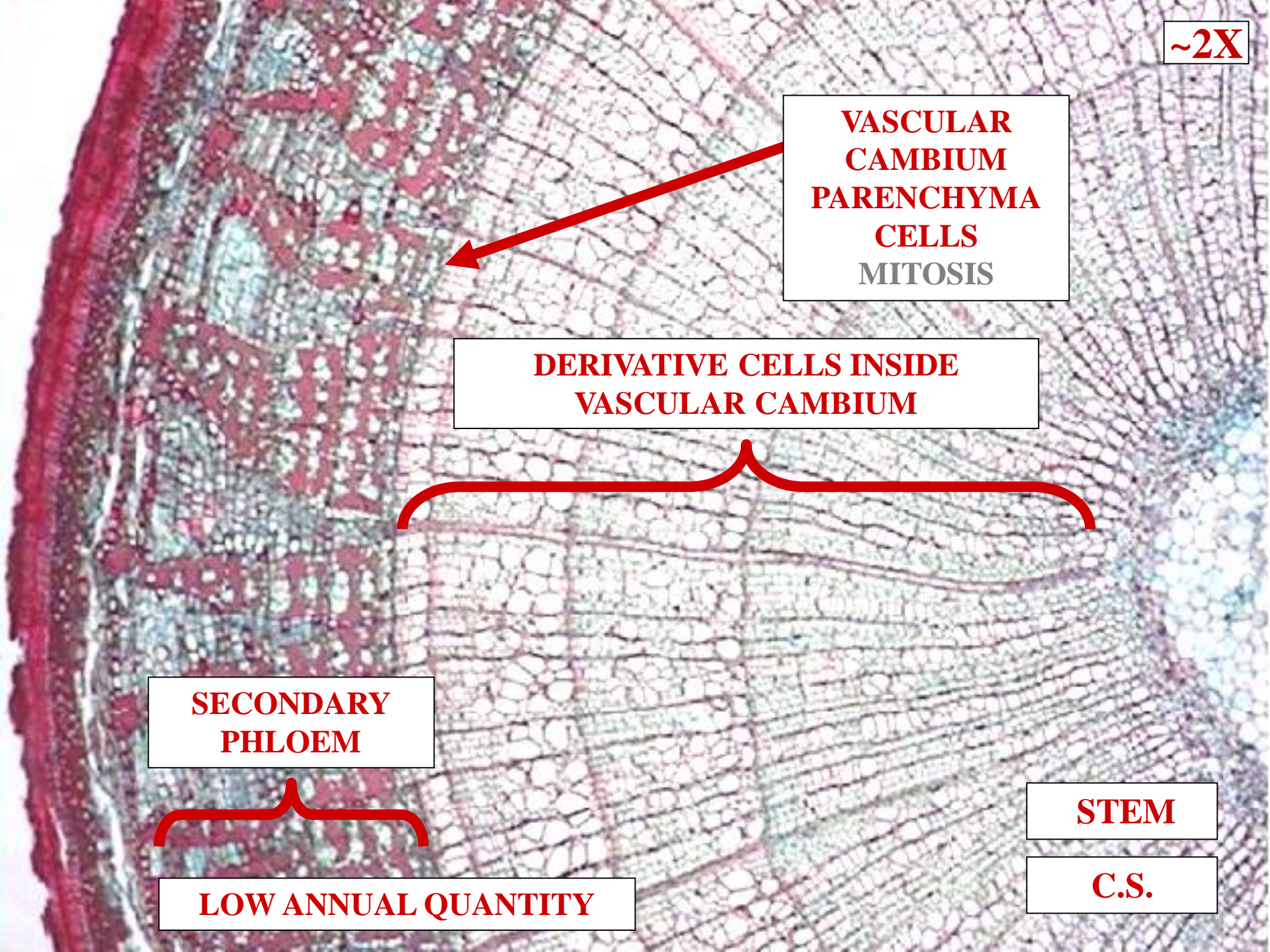
**DERIVATIVE CELLS INSIDE
VASCULAR CAMBIUM**

**SECONDARY
PHLOEM**

STEM

LOW ANNUAL QUANTITY

C.S.



**VASCULAR
CAMBIUM
PARENCHYMA
CELLS
MITOSIS**

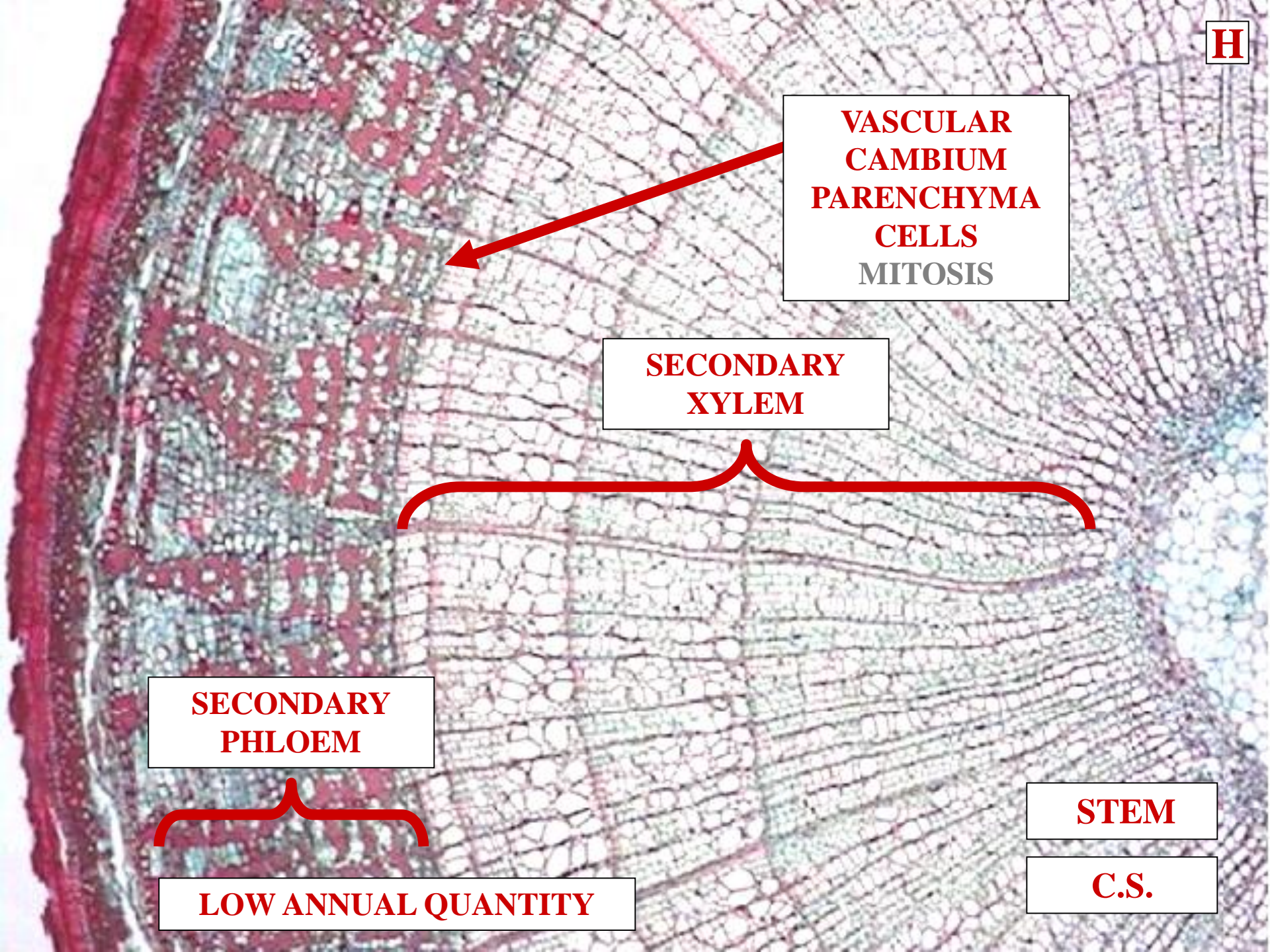
**SECONDARY
XYLEM**

**SECONDARY
PHLOEM**

STEM

LOW ANNUAL QUANTITY

C.S.





**VASCULAR
CAMBIUM
PARENCHYMA
CELLS
MITOSIS**

**SECONDARY
XYLEM**



HIGH ANNUAL QUANTITY

**SECONDARY
PHLOEM**



LOW ANNUAL QUANTITY

STEM

C.S.

**SECONDARY
XYLEM
ANNUAL RINGS**

ANNUAL RING



**LATERAL MERISTEM
VASCULAR CAMBIUM
ANNUAL RING**

**1 YEAR'S GROWTH
OF ~2 XYLEM**

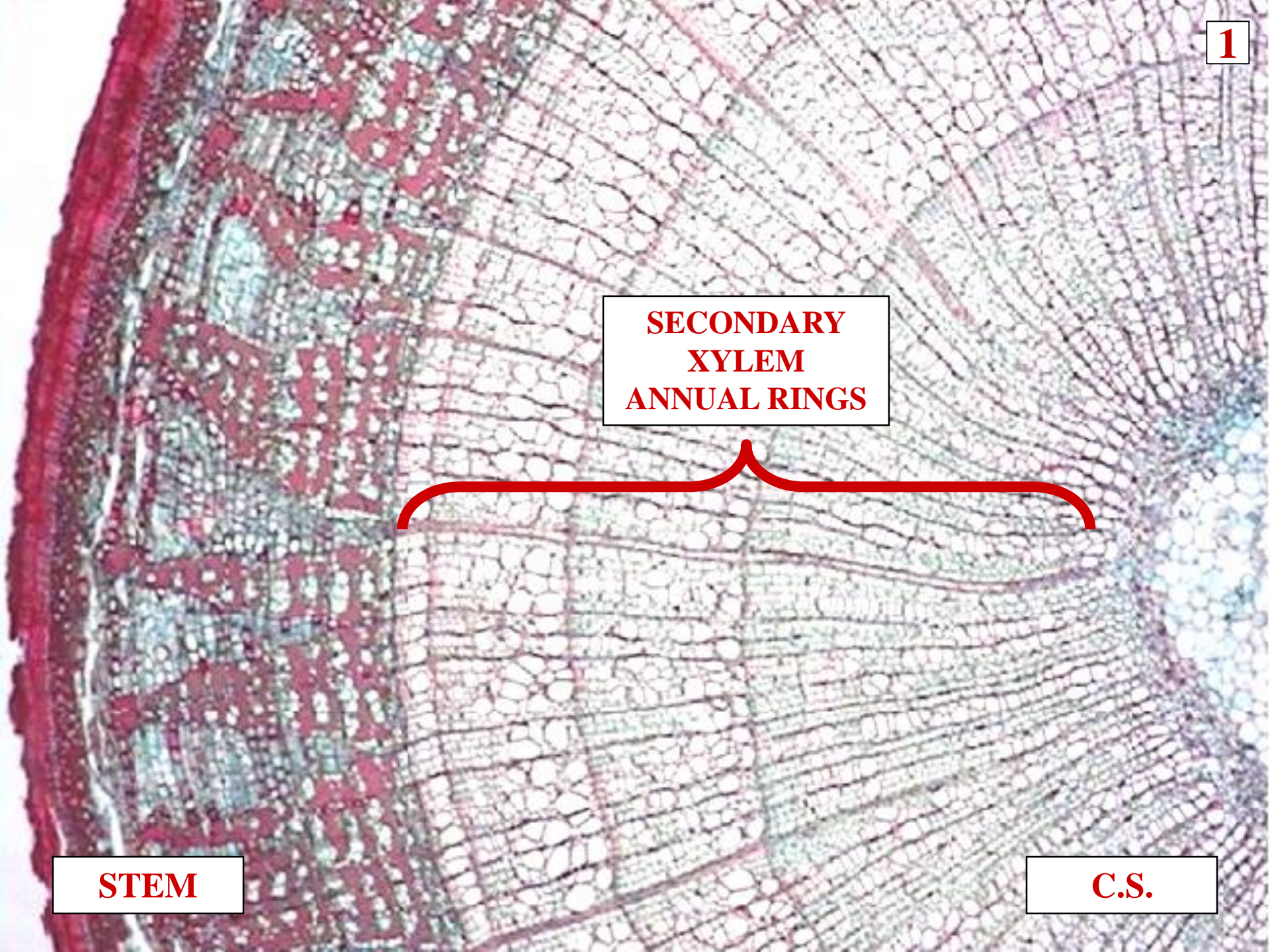
**LATERAL MERISTEM
VASCULAR CAMBIUM
ANNUAL RING**

**SECONDARY
XYLEM
ANNUAL RINGS**



STEM

C.S.



**SECONDARY
XYLEM
ANNUAL RINGS**

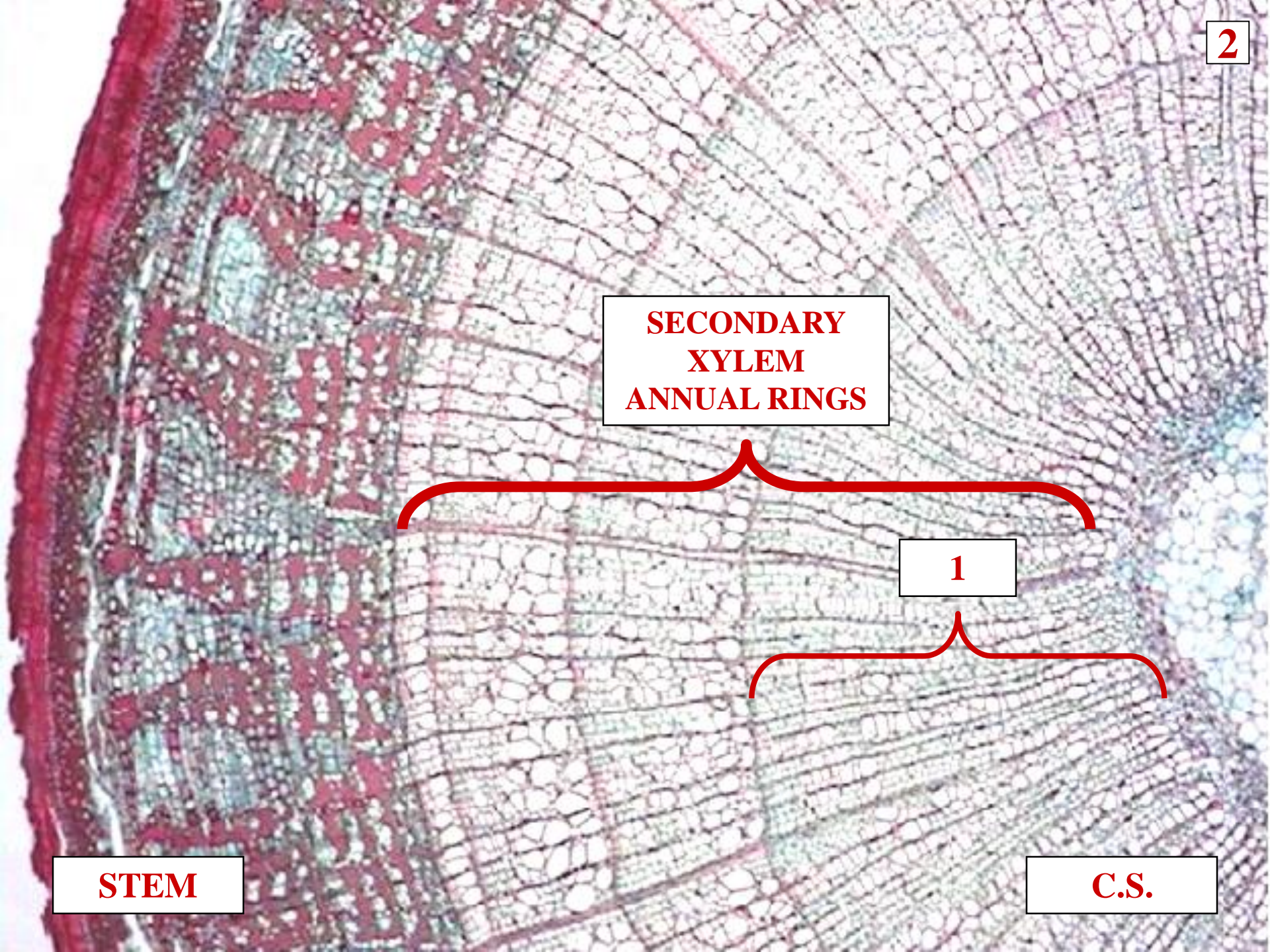


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STEM

C.S.



**SECONDARY
XYLEM
ANNUAL RINGS**



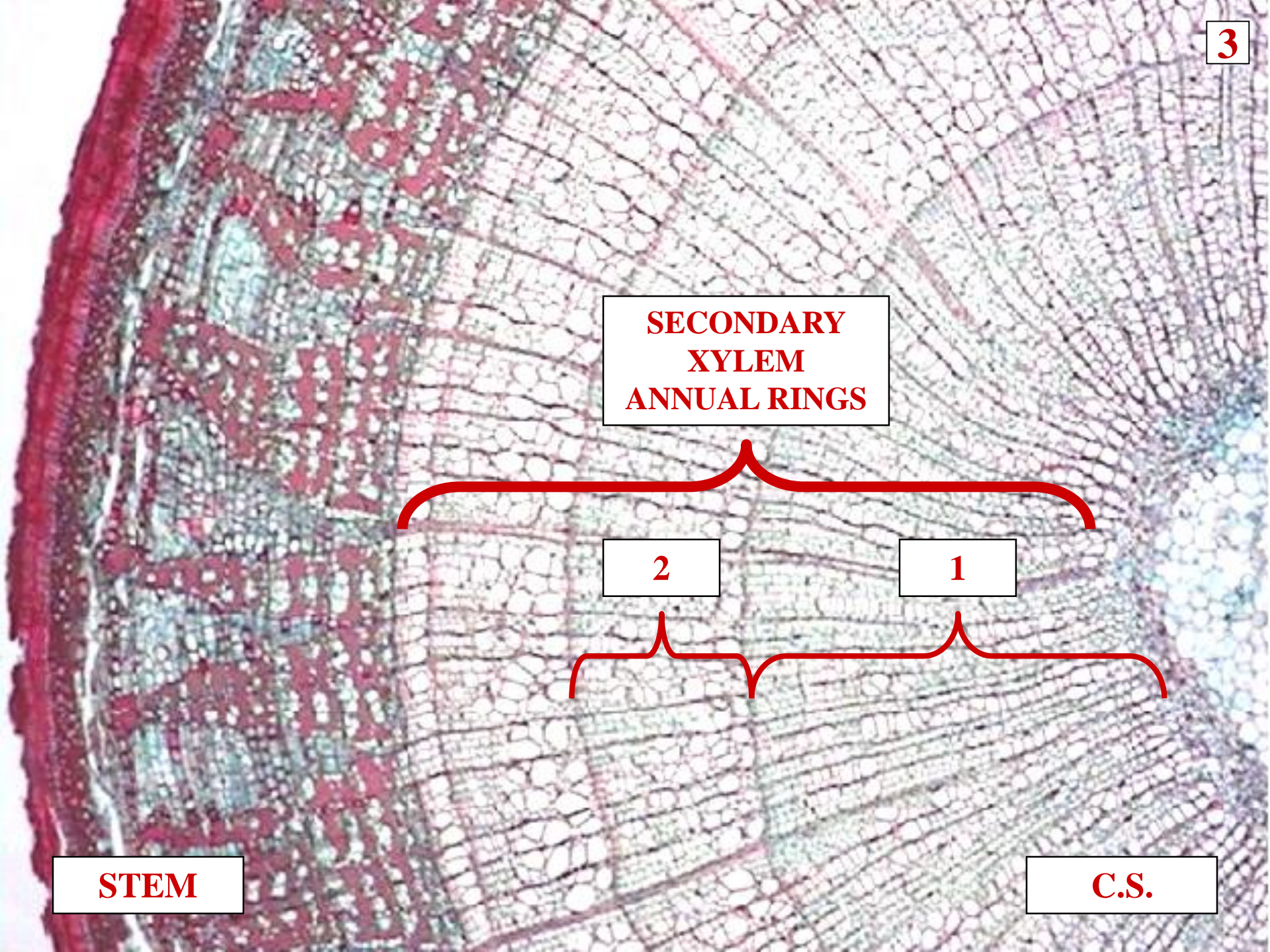
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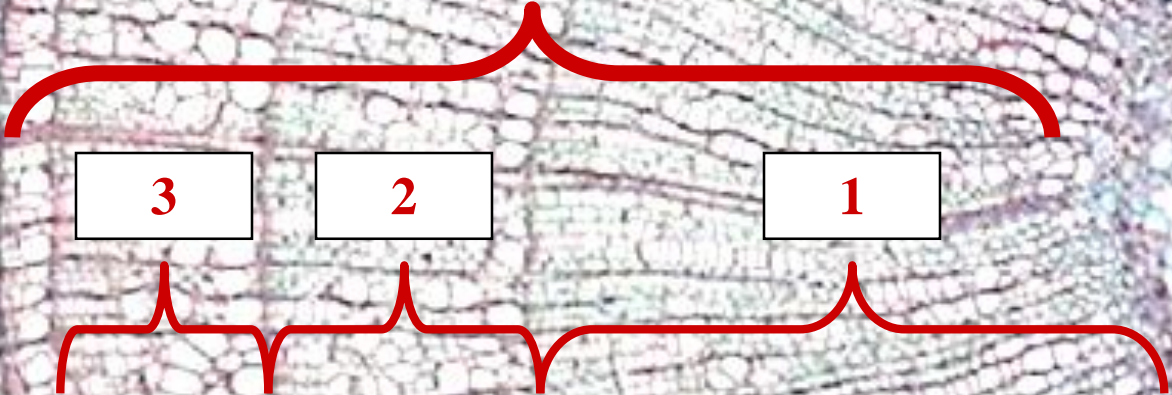
STEM

C.S.



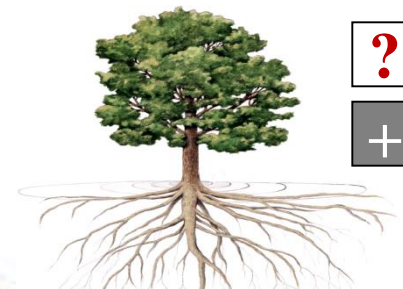


**SECONDARY
XYLEM
ANNUAL RINGS**



STEM

C.S.



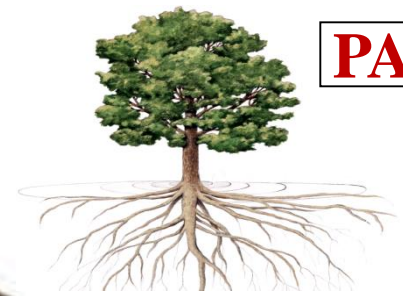
**SECONDARY
XYLEM
ANNUAL RINGS**



STEM

C.S.

PA



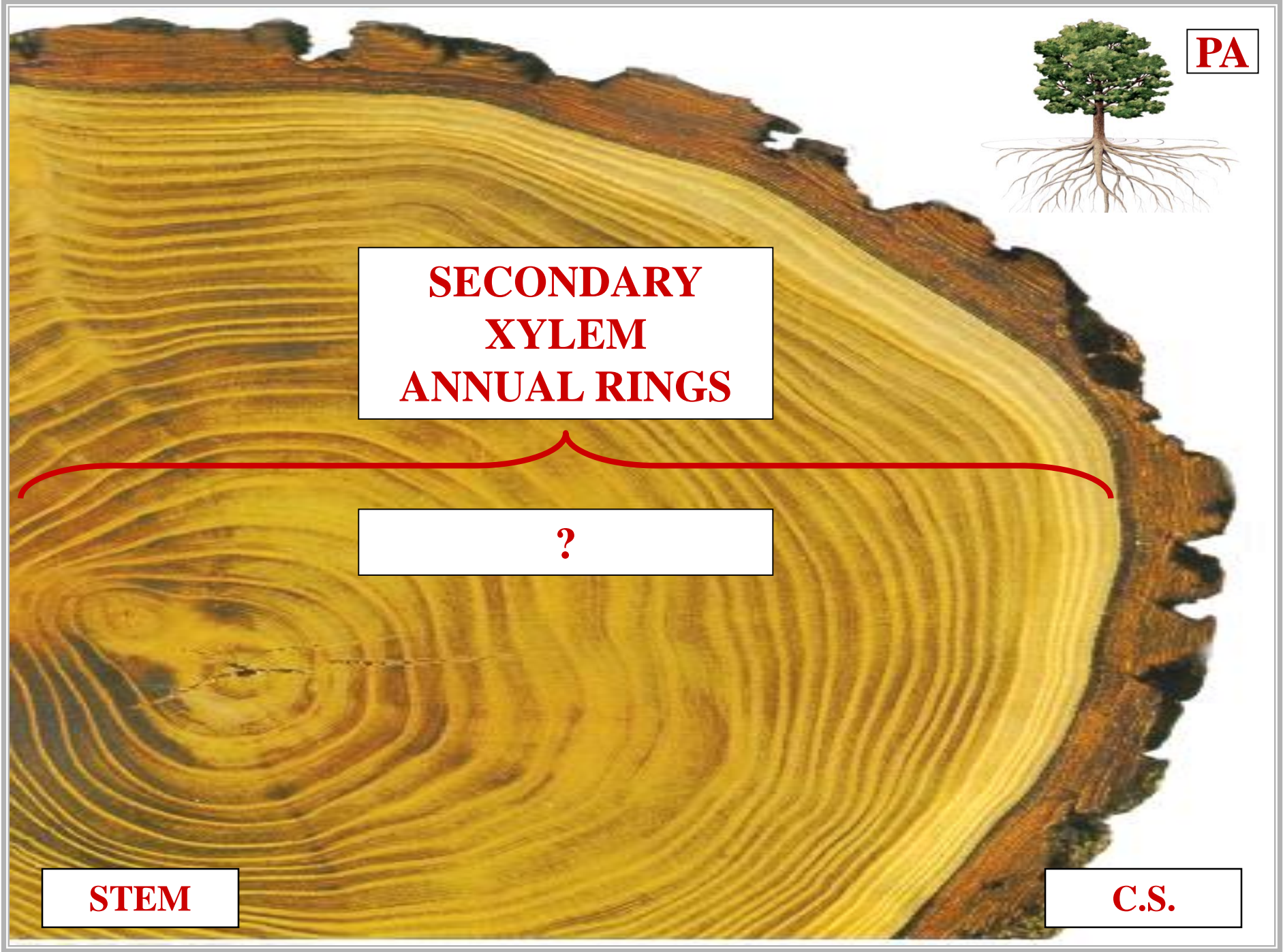
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XYLEM
ANNUAL RINGS**

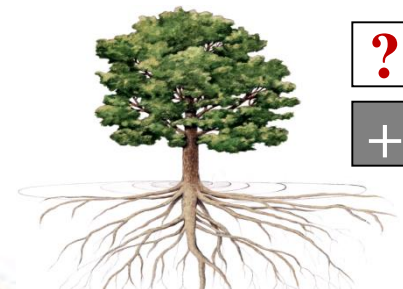


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STEM

C.S.





**SECONDARY
XYLEM
ANNUAL RINGS**



PLANT AGE

STEM

C.S.

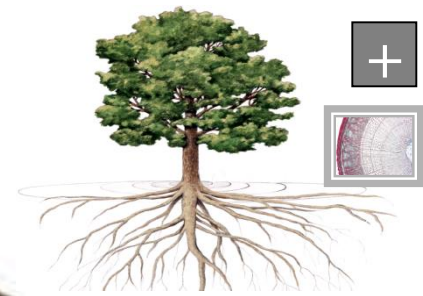


**SECONDARY
XYLEM
ANNUAL RINGS**

?

STEM

C.S.



**SECONDARY
XYLEM
ANNUAL RINGS**

WOOD

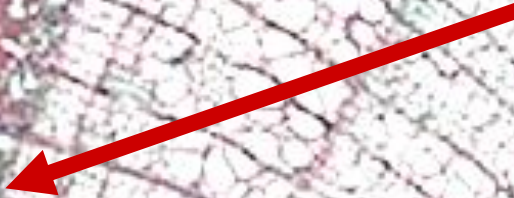
STEM

C.S.





**VASCULAR
CAMBIUM**



**SECONDARY
XYLEM**



WOOD

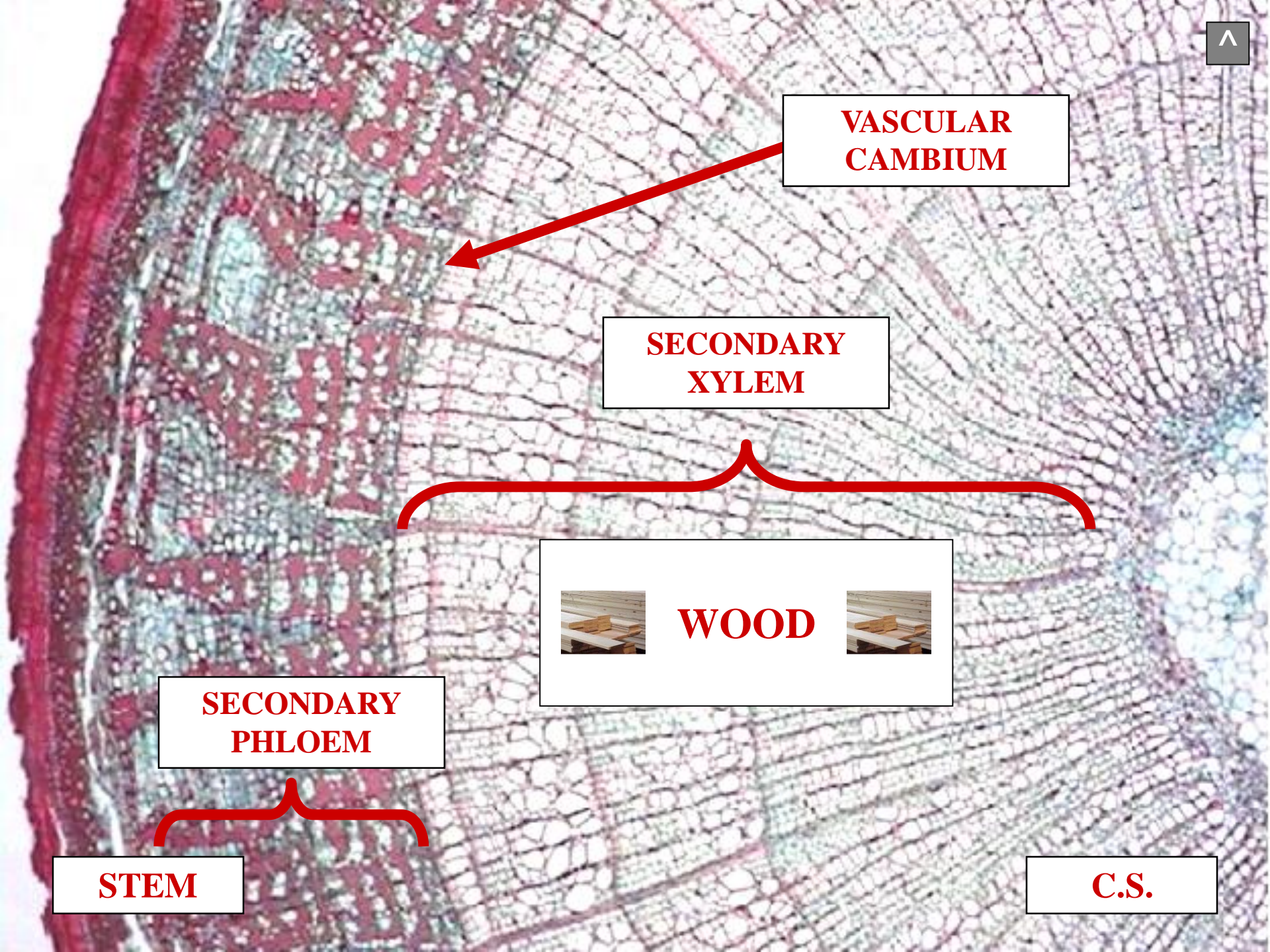


**SECONDARY
PHLOEM**



STEM

C.S.



CORK CAMBIUM

CORK
CAMBIUM

LATERAL MERISTEM CORK CAMBIUM



**DERIVES
OUTER BARK**

**LATERAL MERISTEM
CORK CAMBIUM**

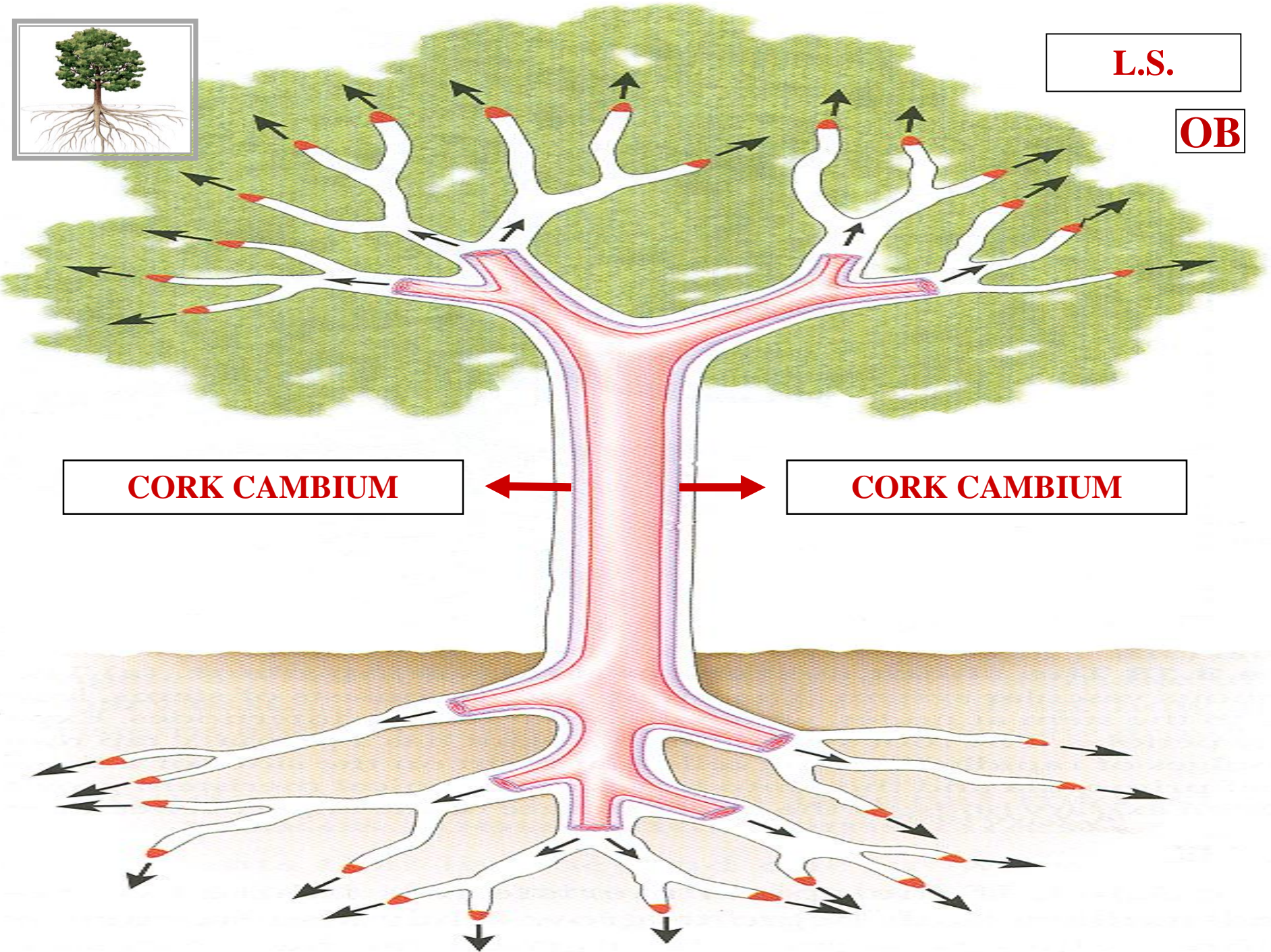


L.S.

OB

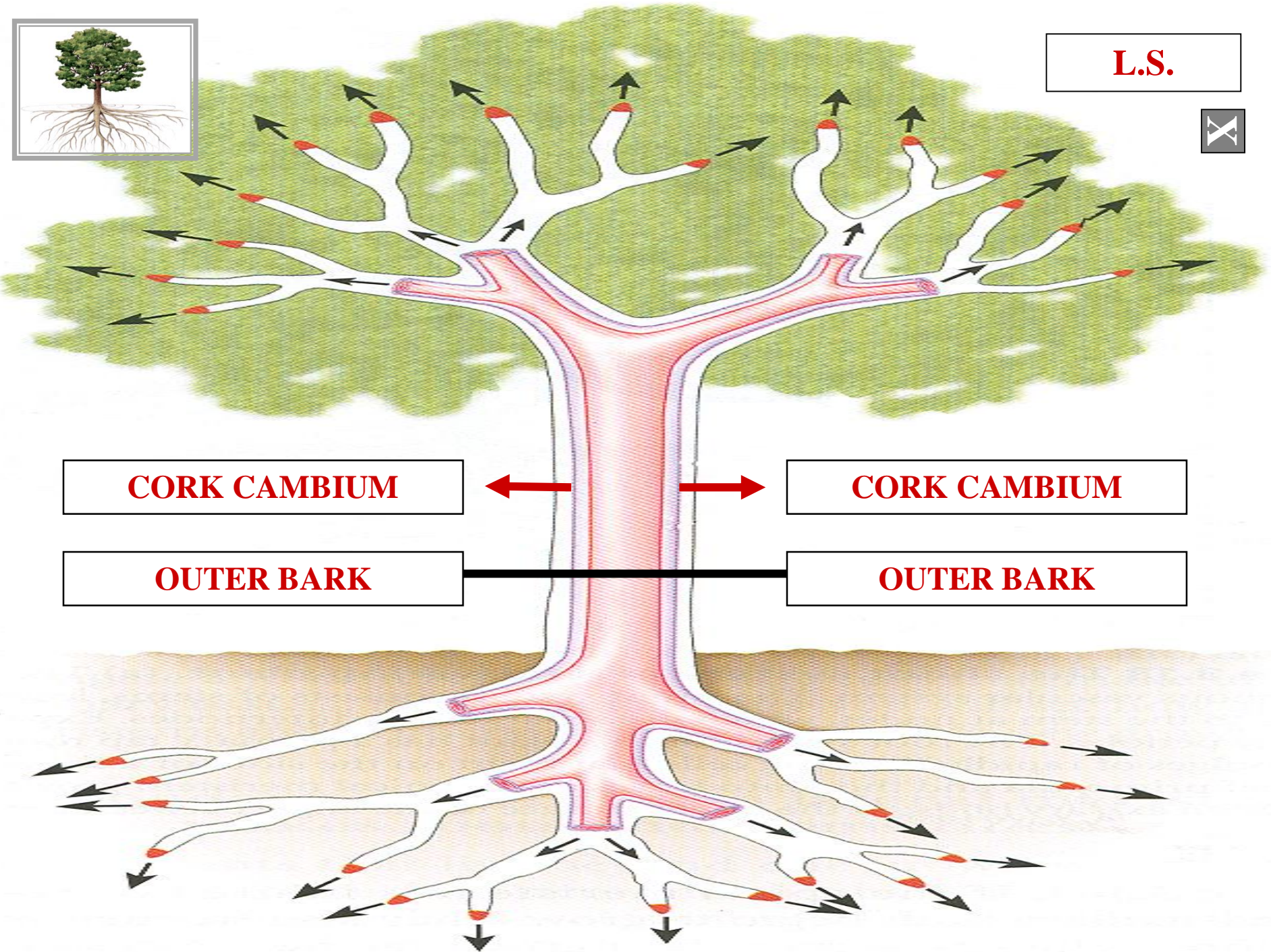
CORK CAMBIUM

CORK CAMBIUM





L.S.



CORK CAMBIUM

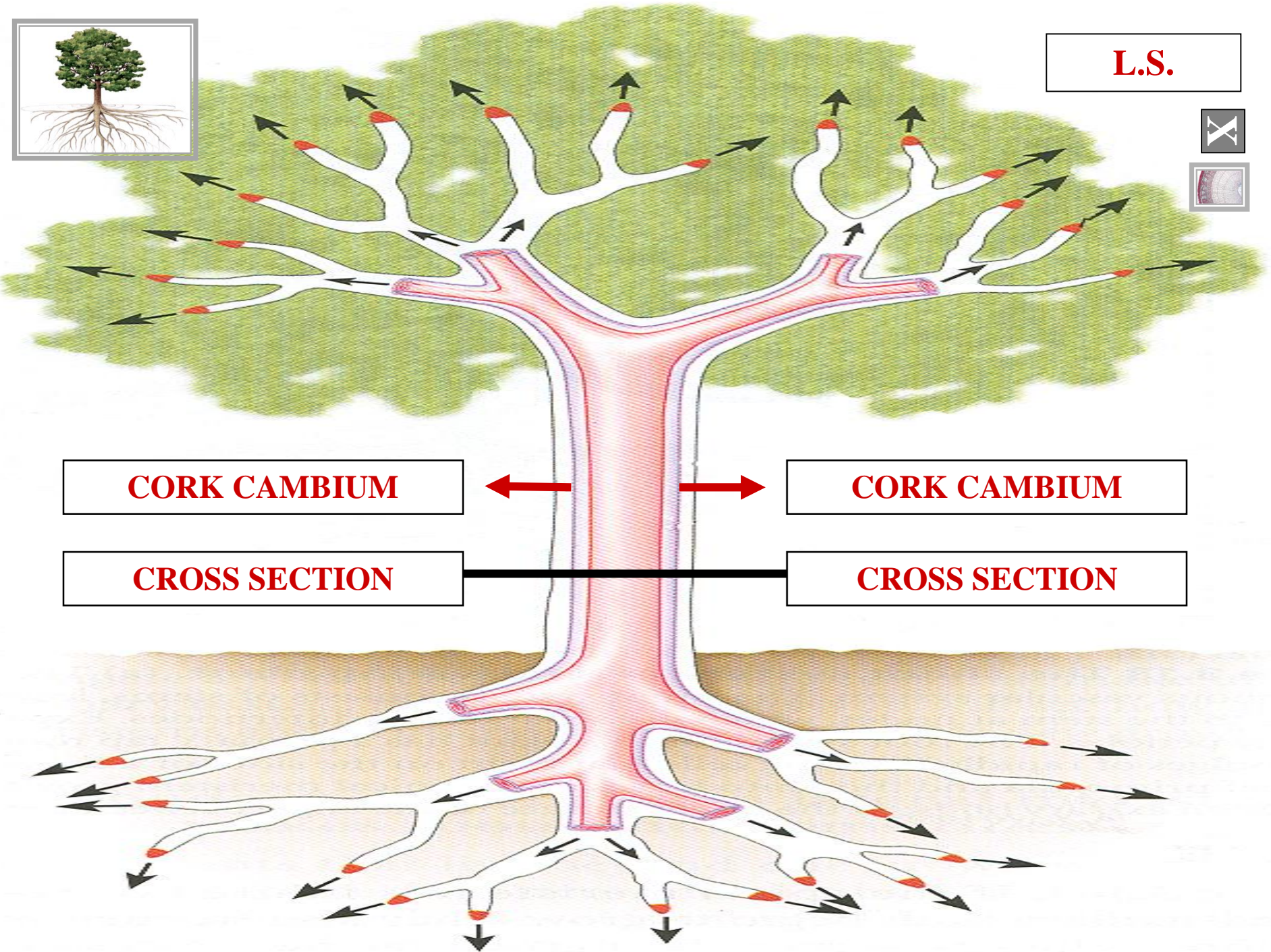
CORK CAMBIUM

OUTER BARK

OUTER BARK



L.S.



CORK CAMBIUM

CORK CAMBIUM

CROSS SECTION

CROSS SECTION

OB

**CORK
CAMBIUM**



STEM



C.S.



**CORK
CAMBIUM**



OUTER BARK



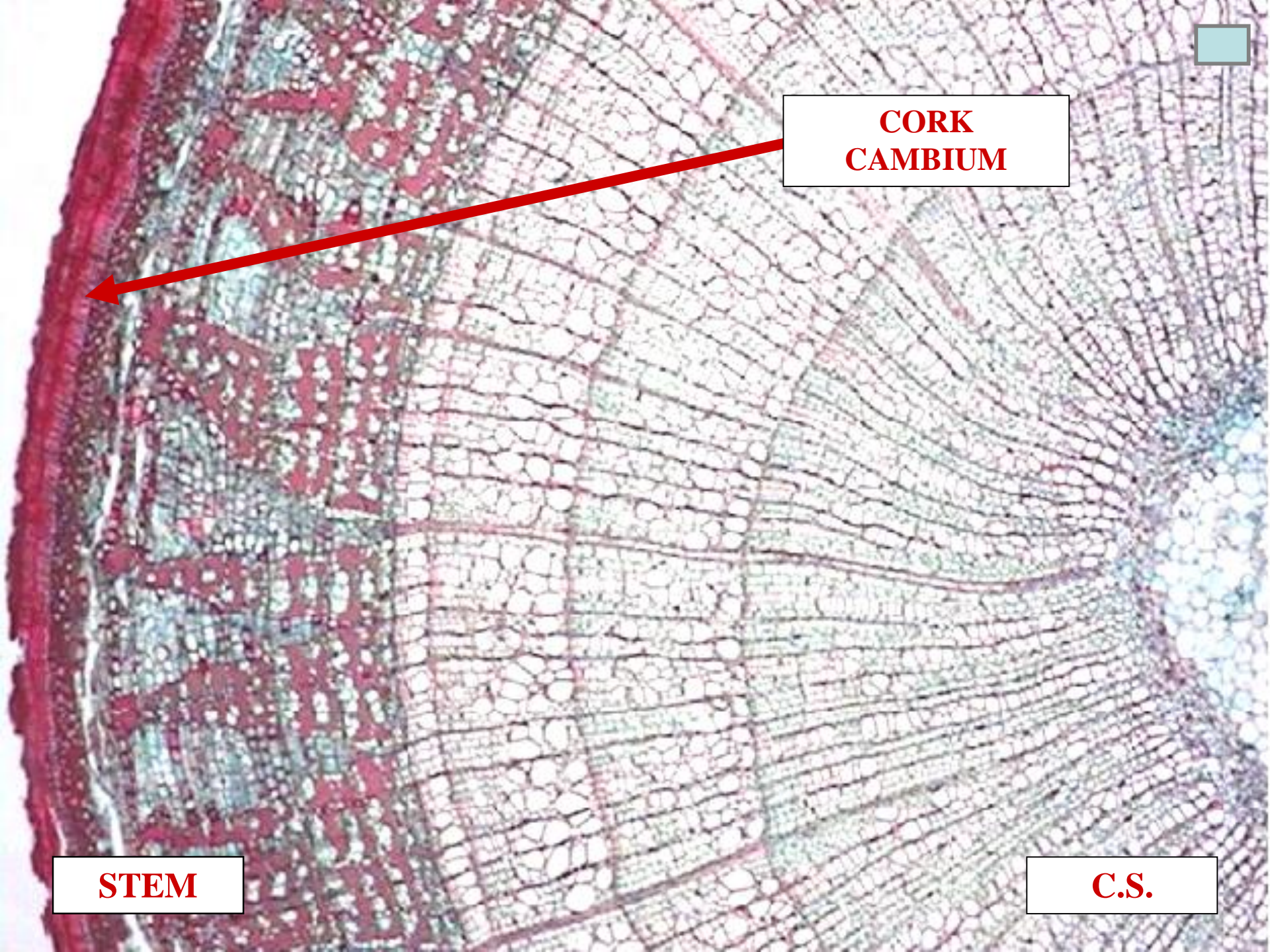
STEM



C.S.



CORK CAMBIUM ACTIVITY



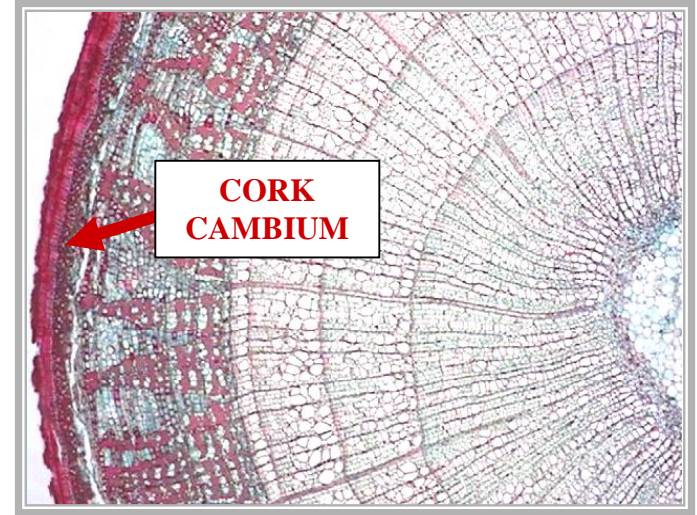
**CORK
CAMBIUM**

STEM

C.S.



CELL



**CORK
CAMBIUM**

**CORK
CAMBIUM**

PC

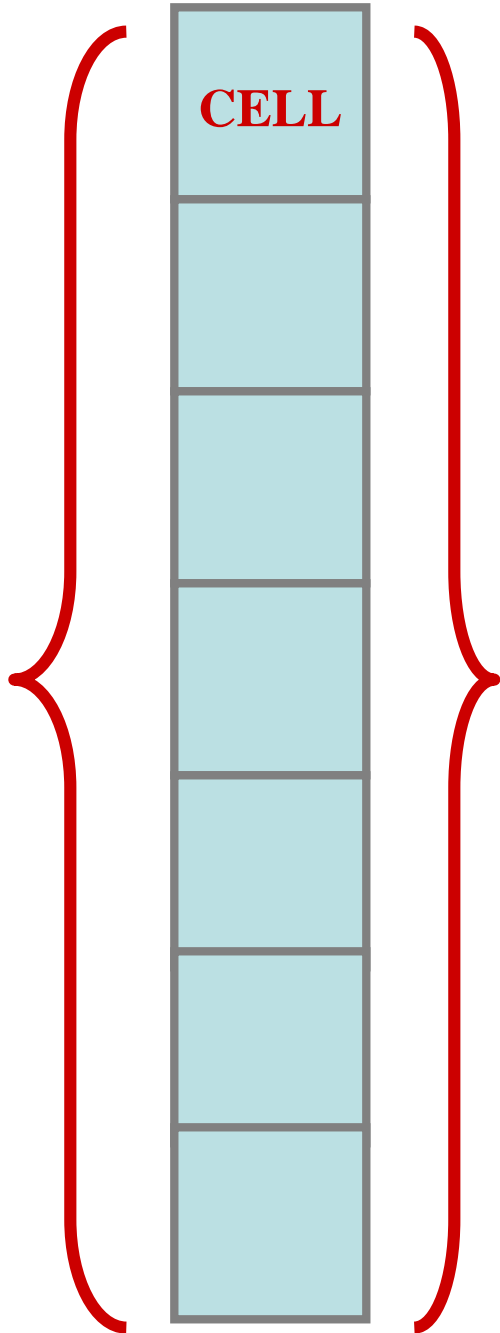
STEM

C.S.

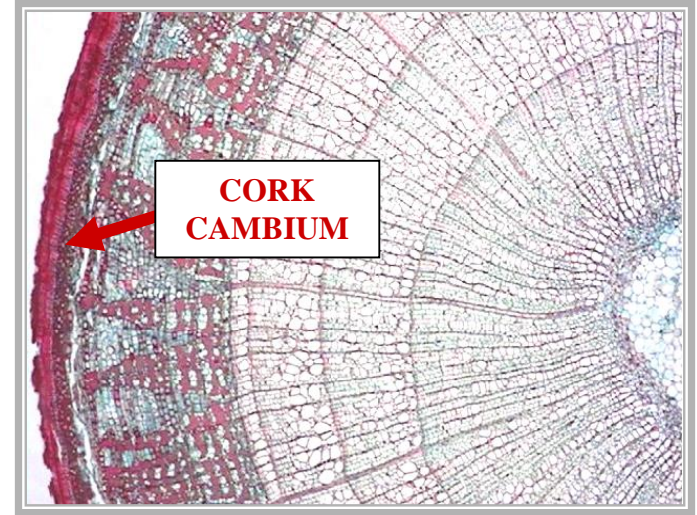


**PARENCHYMA
CELL INITIALS**

STEM



CELL



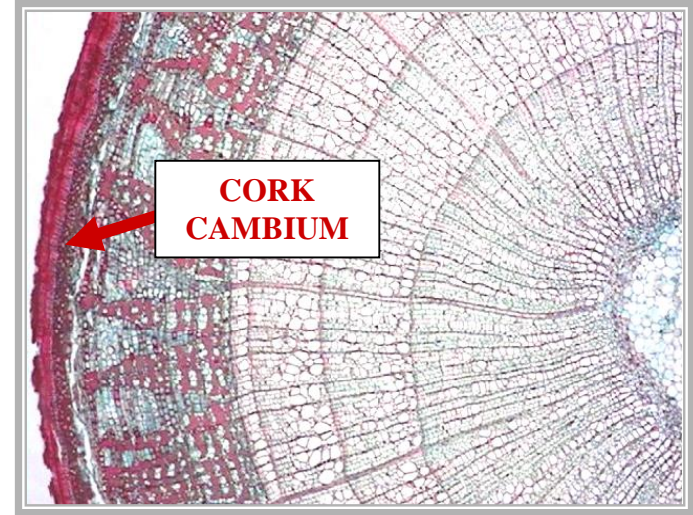
**PARENCHYMA
CELL INITIALS**

C.S.

M



CELL



MITOSIS

MITOSIS

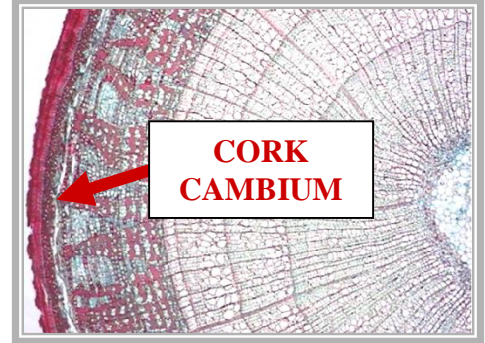
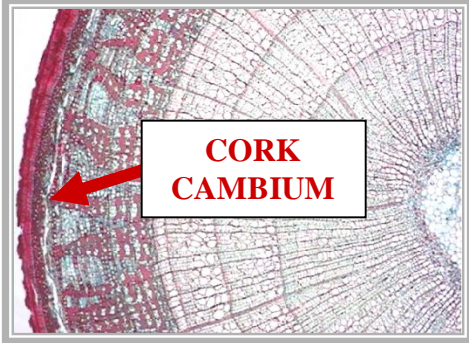
STEM

C.S.



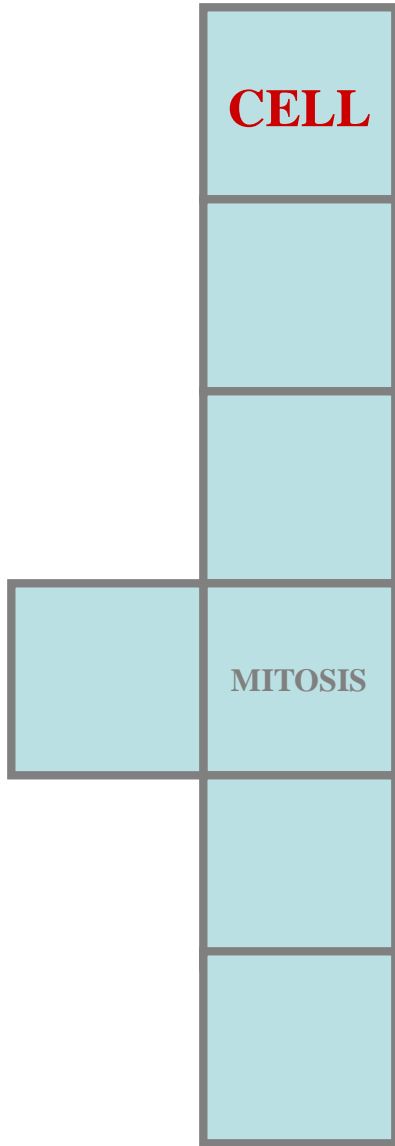
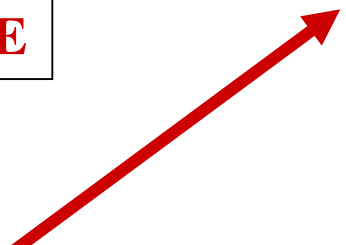
**OUTSIDE
CORK
CAMBIUM**

**INSIDE
CORK
CAMBIUM**



OUTSIDE

**DERIVATIVE
PARENCHYMA
CELLS**



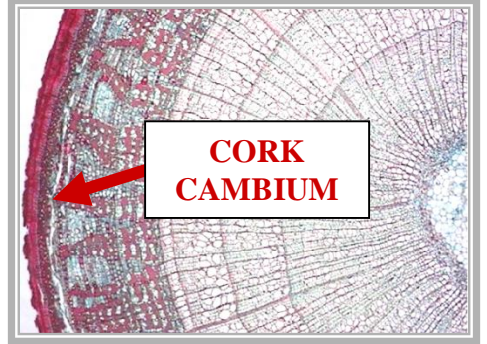
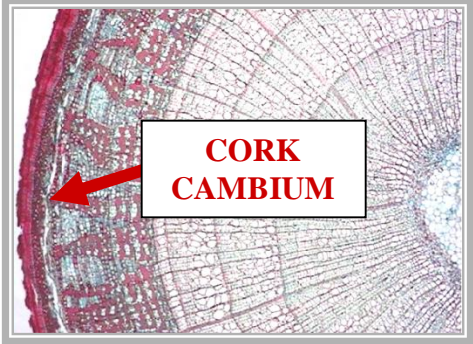
STEM

**CORK
CAMBIUM**

C.S.

**OUTSIDE
CORK
CAMBIUM**

**INSIDE
CORK
CAMBIUM**



OUTSIDE

INSIDE

**DERIVATIVE
PARENCHYMA
CELLS**

**DERIVATIVE
PARENCHYMA
CELLS**

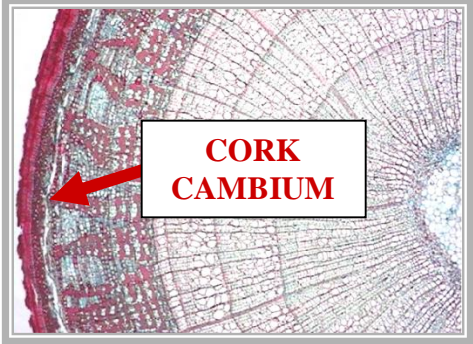
STEM



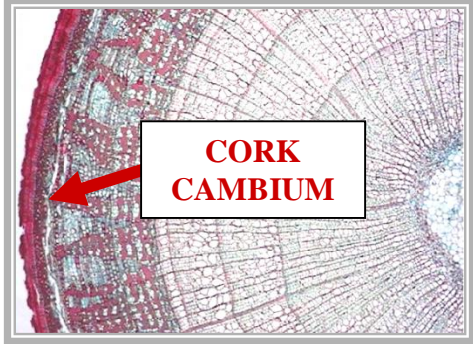
**CORK
CAMBIUM**

C.S.

**OUTSIDE
CORK
CAMBIUM**



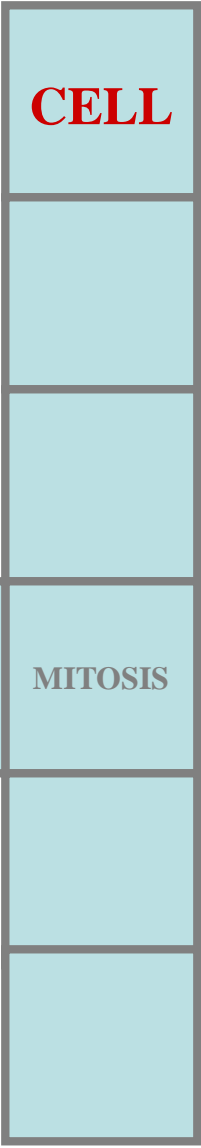
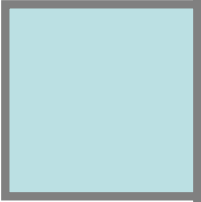
**INSIDE
CORK
CAMBIUM**



OUTSIDE

**DERIVATIVE
PARENCHYMA
CELLS**

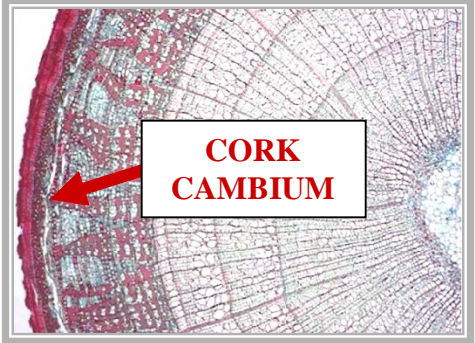
STEM



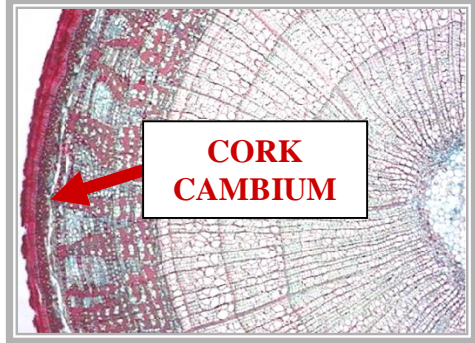
**CORK
CAMBIUM**

C.S.

**OUTSIDE
CORK
CAMBIUM**



**INSIDE
CORK
CAMBIUM**



OUTSIDE

CORK

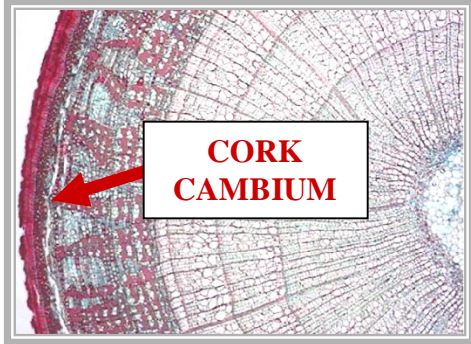
STEM



**CORK
CAMBIUM**

C.S.

**OUTSIDE
CORK
CAMBIUM**



**CORK
CAMBIUM**

OUTSIDE

**CORK
HIGH ANNUAL
QUANTITY**

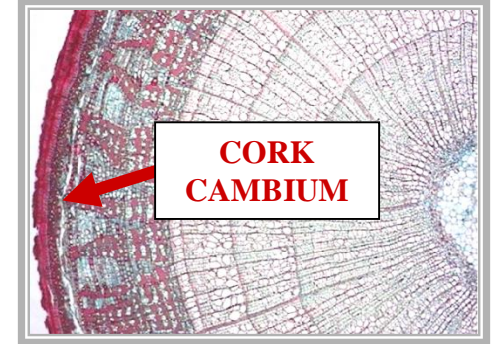
STEM

CELL

MITOSIS

**CORK
CAMBIUM**

**INSIDE
CORK
CAMBIUM**



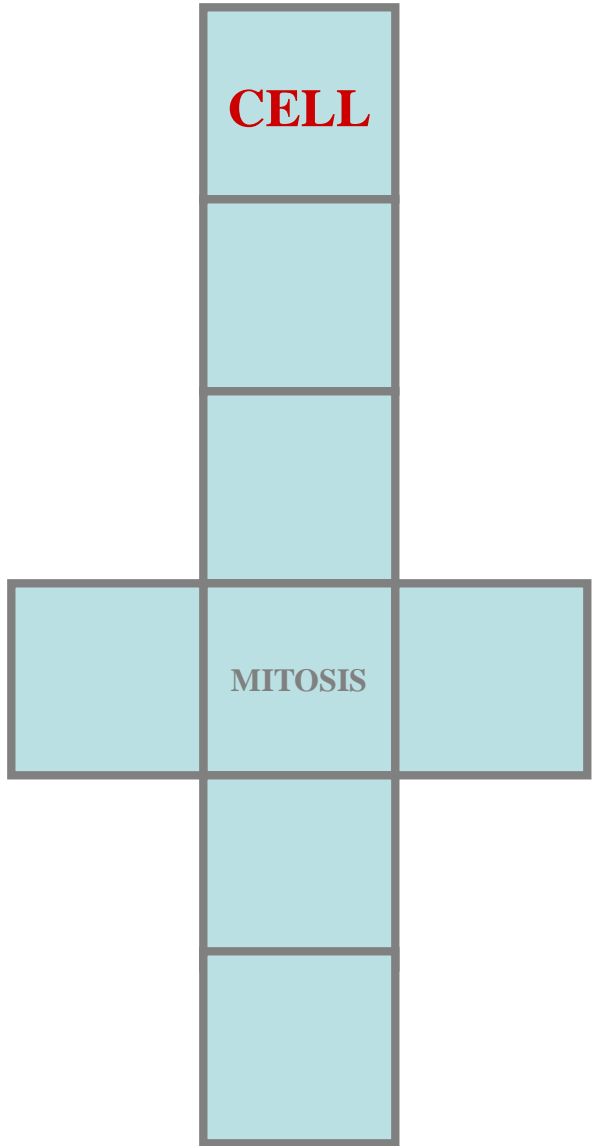
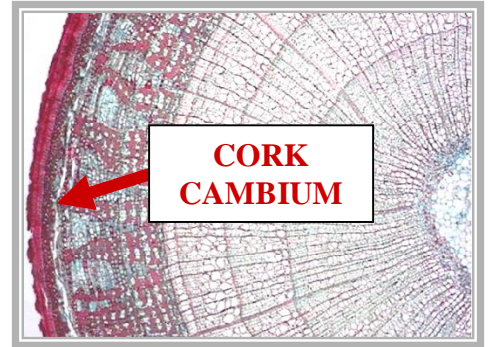
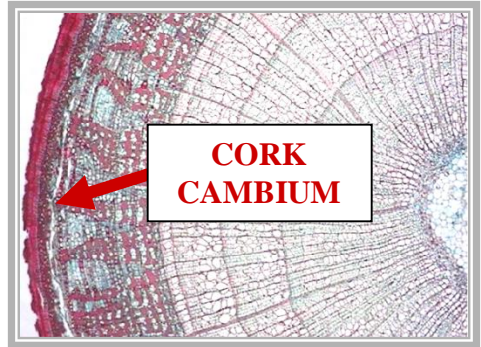
**CORK
CAMBIUM**

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**OUTSIDE
CORK
CAMBIUM**

**INSIDE
CORK
CAMBIUM**



OUTSIDE

INSIDE

**CORK
HIGH ANNUAL
QUANTITY**

**DERIVATIVE
PARENCHYMA
CELLS**

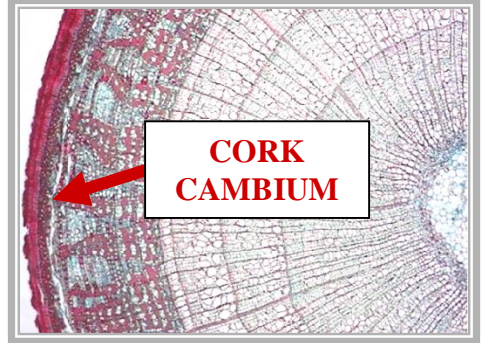
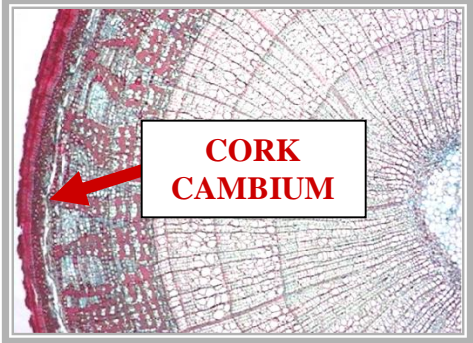
STEM

**CORK
CAMBIUM**

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**OUTSIDE
CORK
CAMBIUM**

**INSIDE
CORK
CAMBIUM**



OUTSIDE

INSIDE

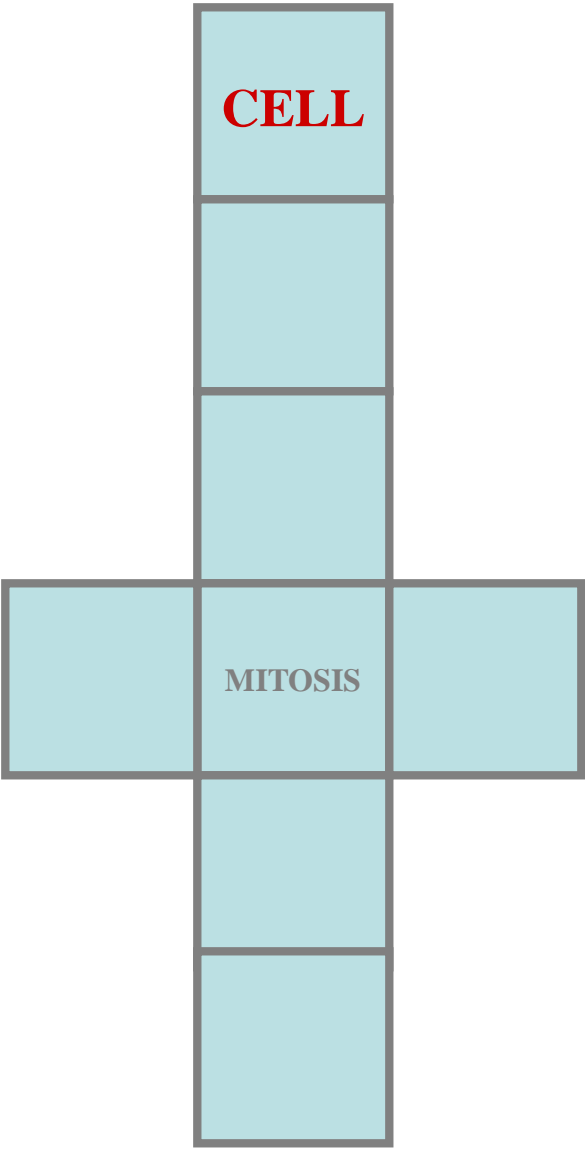
**CORK
HIGH ANNUAL
QUANTITY**

PHELLODERM

STEM

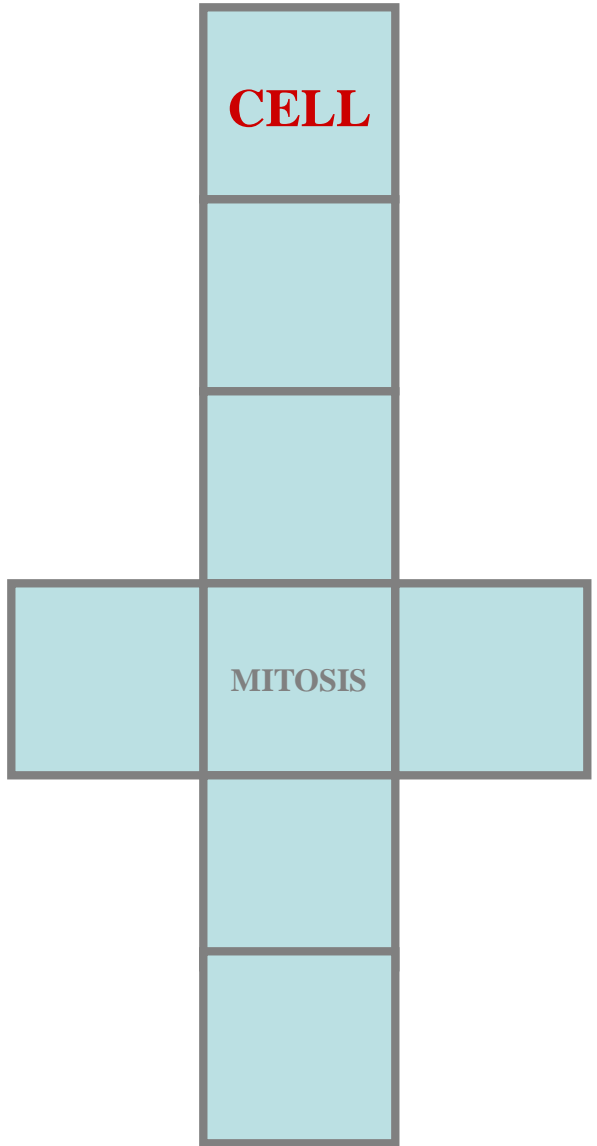
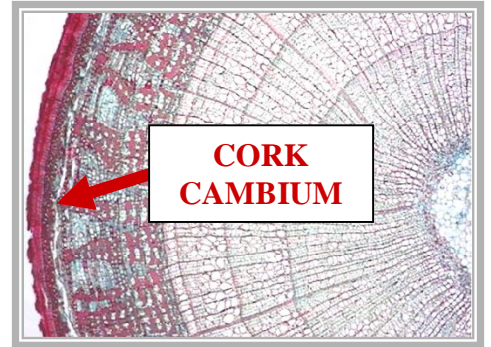
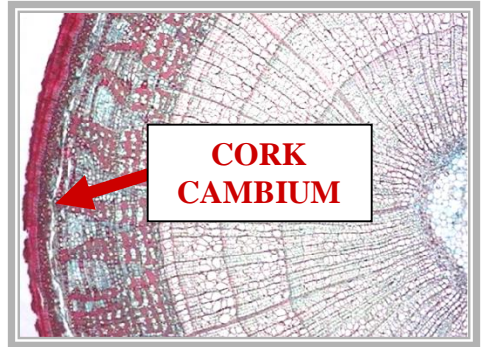
**CORK
CAMBIUM**

C.S.



**OUTSIDE
CORK
CAMBIUM**

**INSIDE
CORK
CAMBIUM**



OUTSIDE

INSIDE

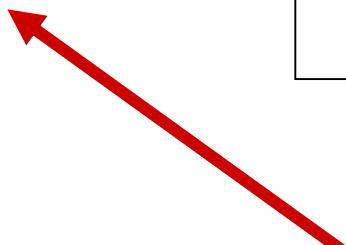
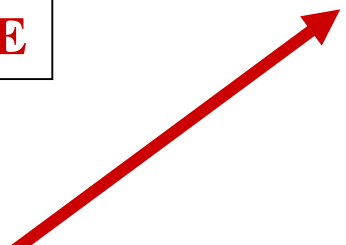
**CORK
HIGH ANNUAL
QUANTITY**

**PHELLODERM
LOW ANNUAL
QUANTITY**

STEM

**CORK
CAMBIUM**

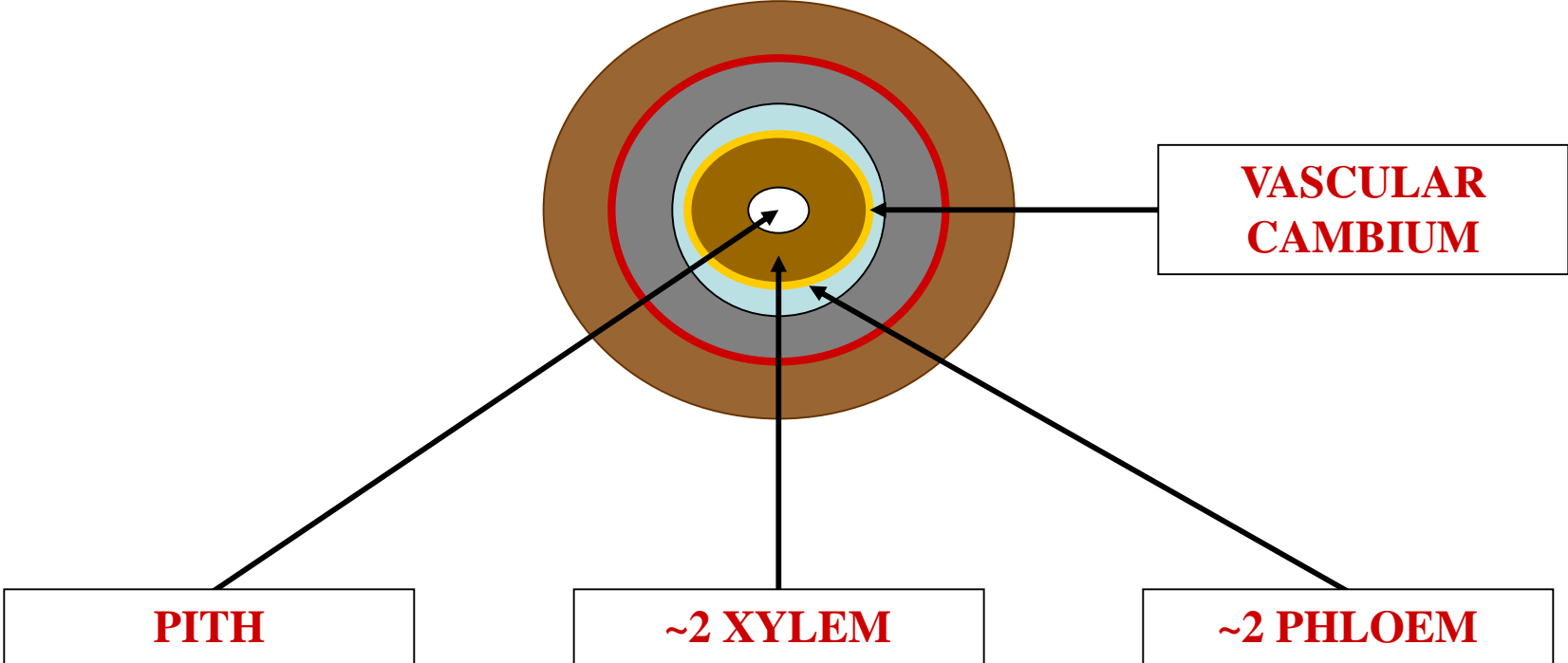
C.S.



CORK
CAMBIIUM
ACTIVITY
EXAMPLE

DICOT ~2 STEM

CC



PITH

~2 XYLEM

~2 PHLOEM

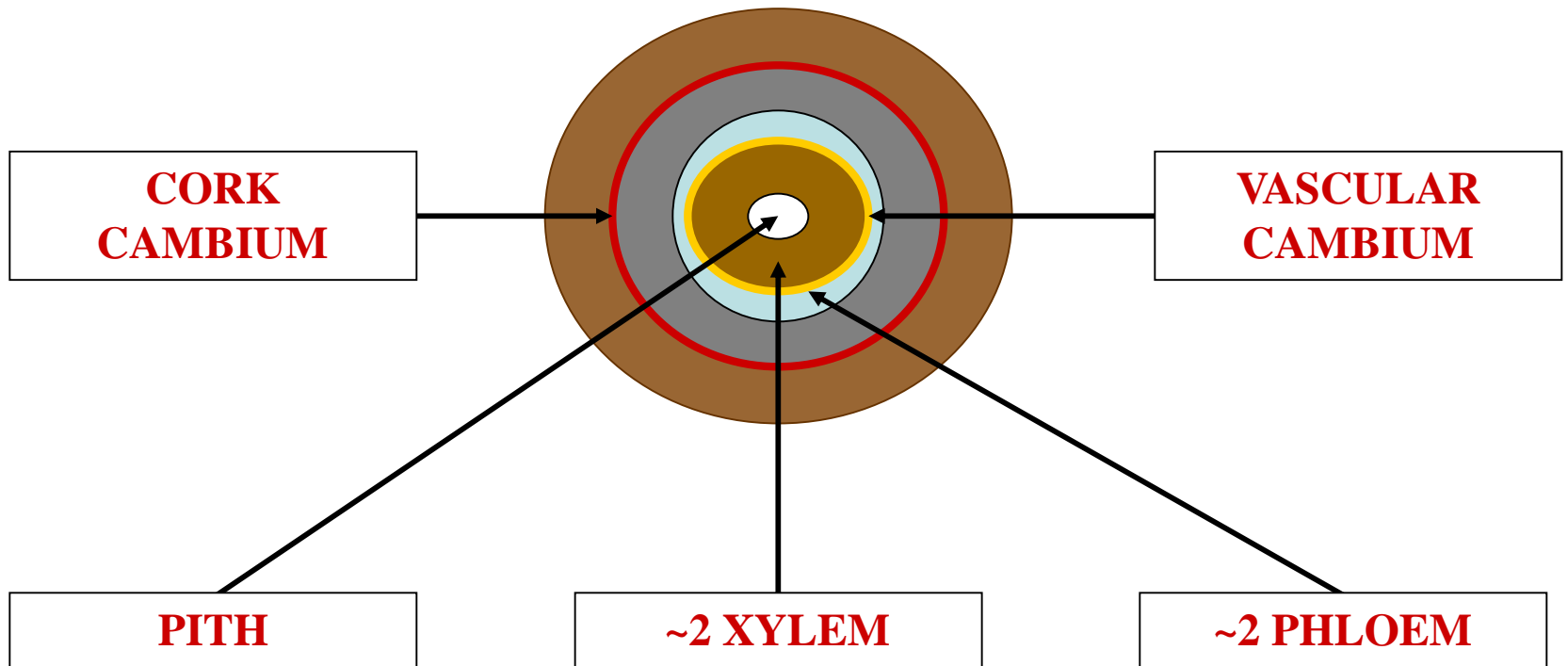
**VASCULAR
CAMBIUM**

CORK CAMBIUM ACTIVITY

C.S.

DICOT ~2 STEM

?



CORK CAMBIUM ACTIVITY

C.S.

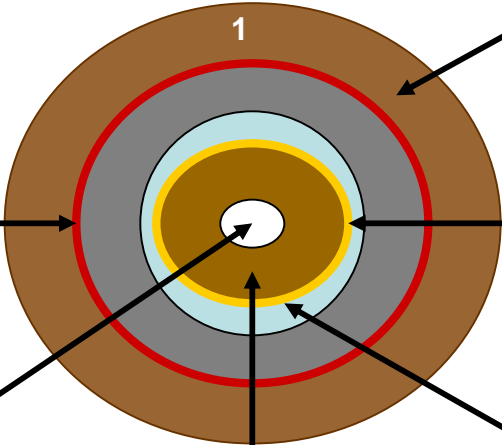
DICOT ~2 STEM

C



?

**CORK
CAMBIUM**



**VASCULAR
CAMBIUM**

PITH

~2 XYLEM

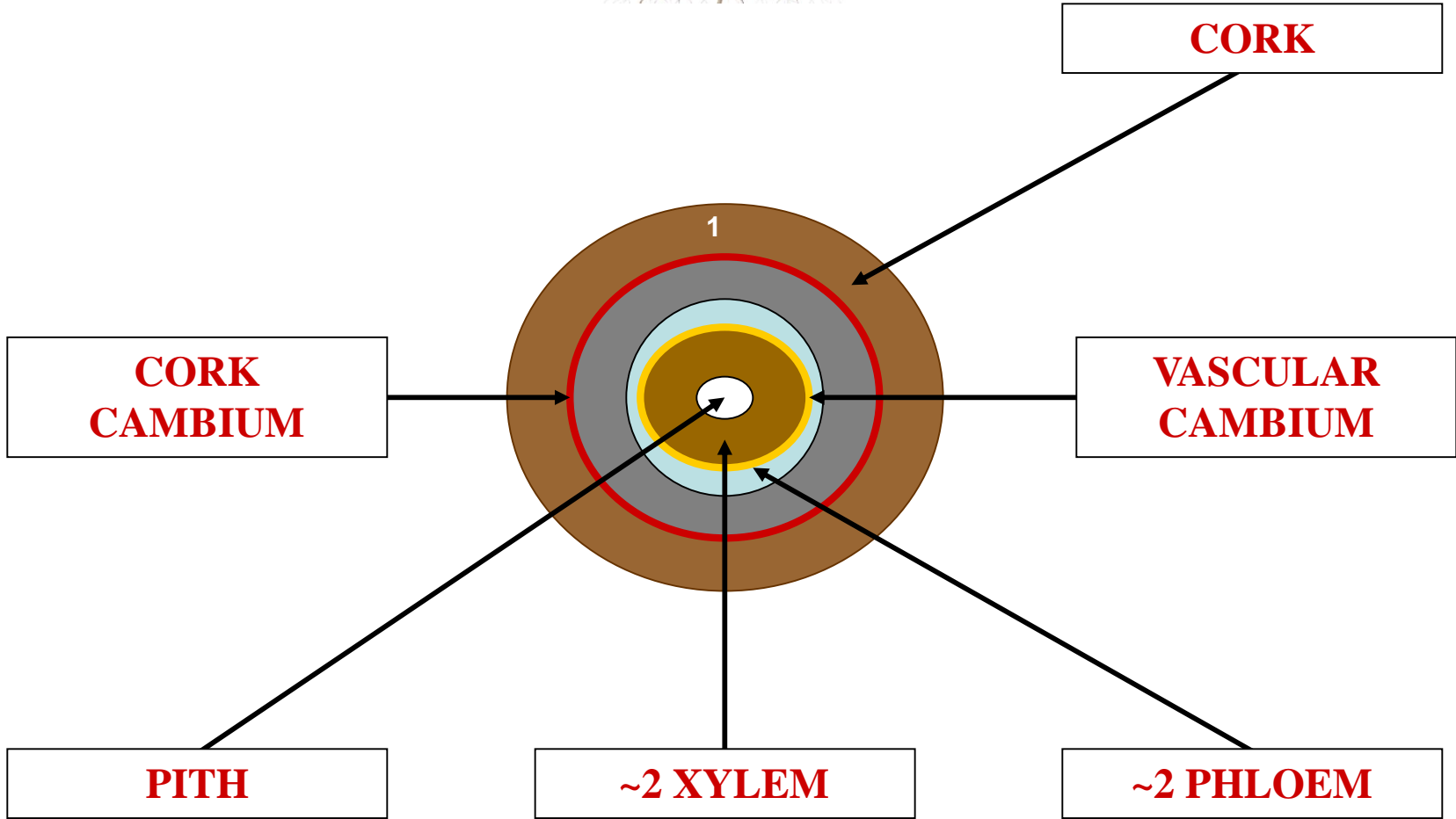
~2 PHLOEM

CORK CAMBIUM ACTIVITY

C.S.

DICOT ~2 STEM

?



CORK CAMBIUM ACTIVITY

C.S.

DICOT ~2 STEM



?

CORK

**CORK
CAMBIUM**

**VASCULAR
CAMBIUM**

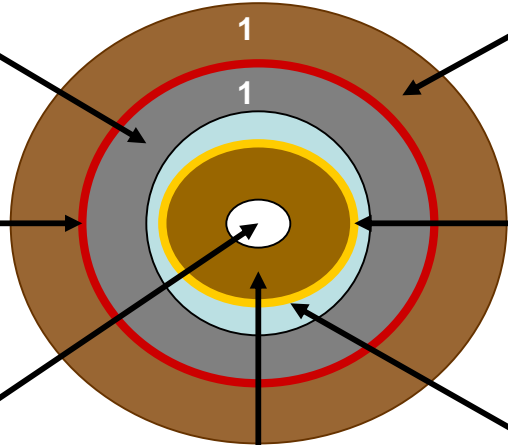
PITH

~2 XYLEM

~2 PHLOEM

CORK CAMBIUM ACTIVITY

C.S.





DICOT ~2 STEM

PHELLODERM

CORK

**CORK
CAMBIUM**

**VASCULAR
CAMBIUM**

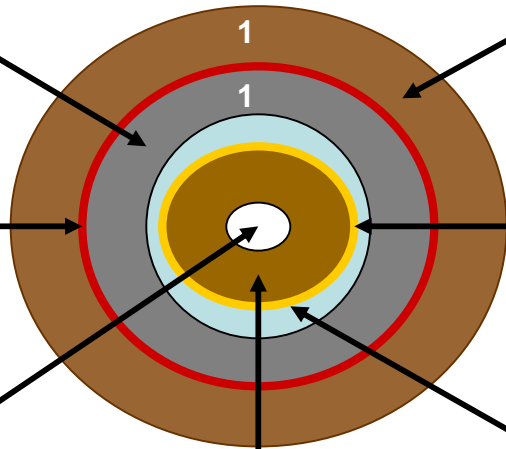
PITH

~2 XYLEM

~2 PHLOEM

CORK CAMBIUM ACTIVITY

C.S.



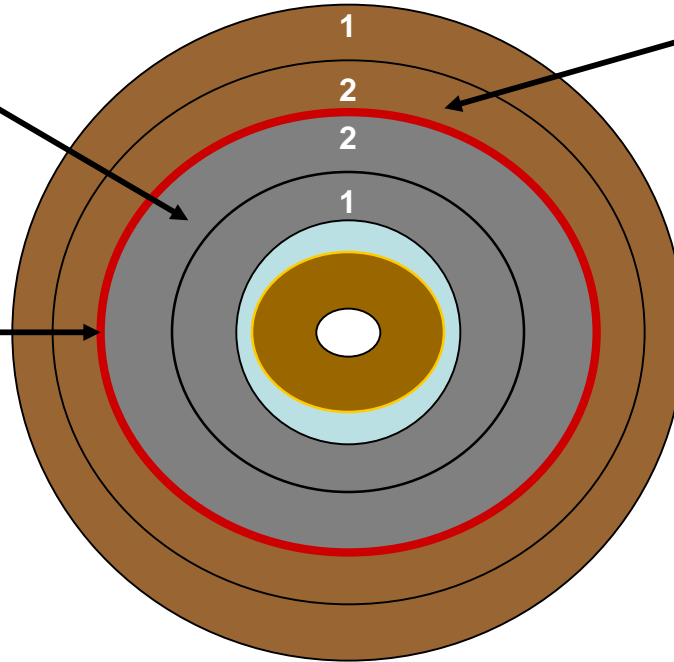
DICOT ~2 STEM



PHELLODERM

CORK

**CORK
CAMBIUM**



CORK CAMBIUM ACTIVITY

C.S.

DICOT ~2 STEM

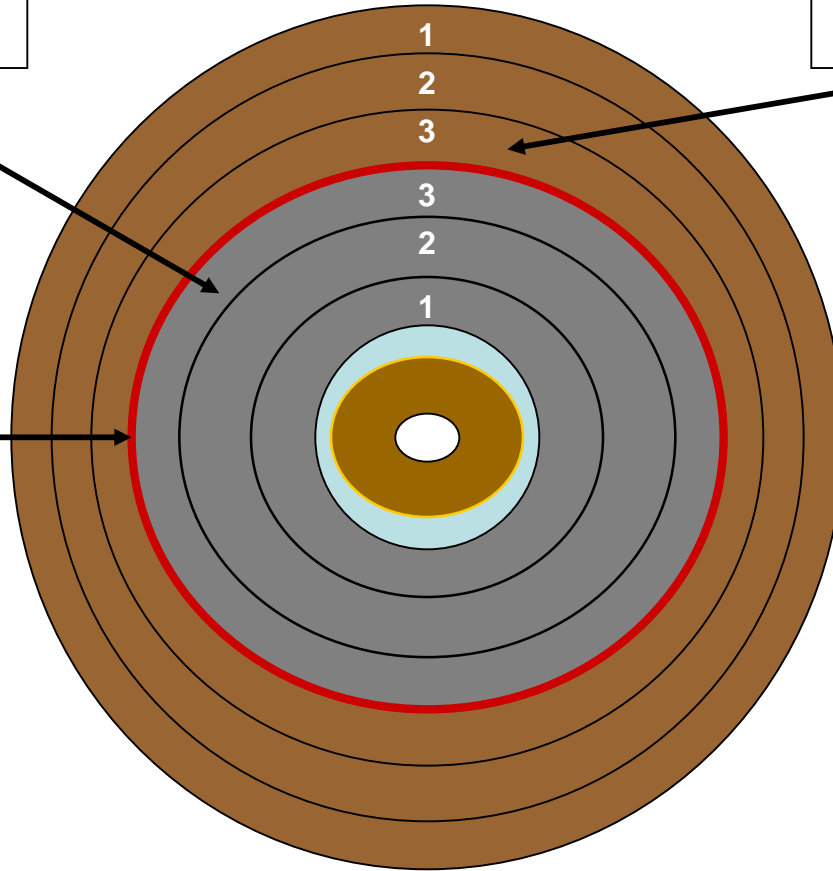
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PHELLODERM

CORK

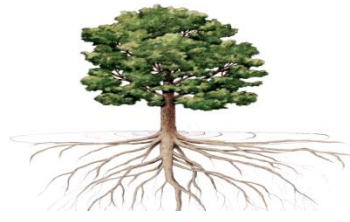
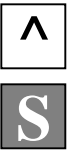
**CORK
CAMBIUM**



CORK CAMBIUM ACTIVITY

C.S.

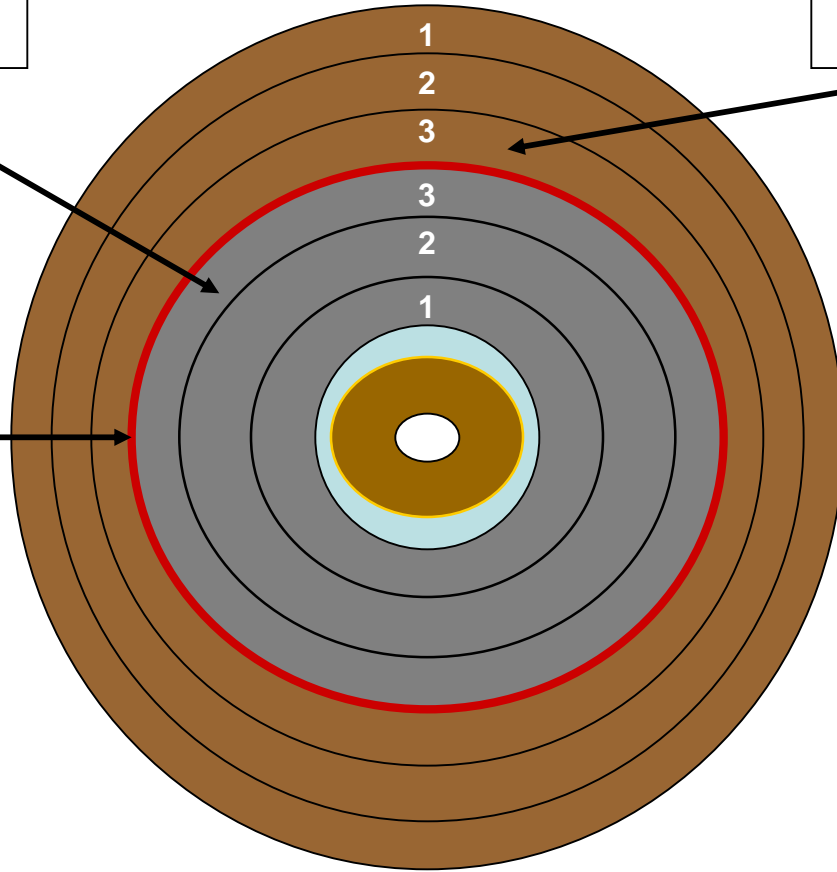
DICOT ~2 STEM



PHELLODERM

CORK

**CORK
CAMBIUM**



C.S.

INCREASE IN GIRTH



CORK CAMBIUM ACTIVITY SUMMARY

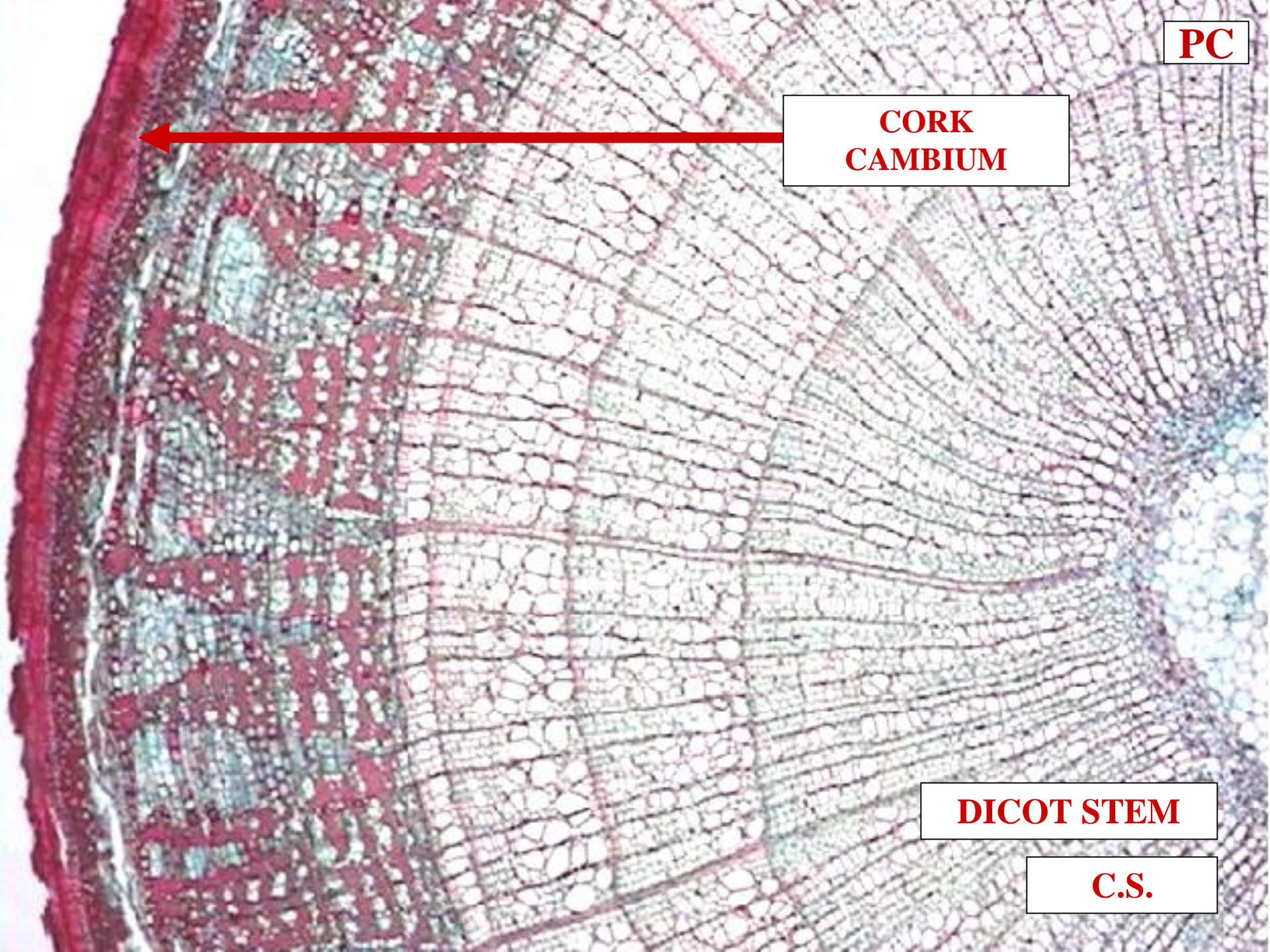
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**CORK
CAMBIUM**



DICOT STEM

C.S.

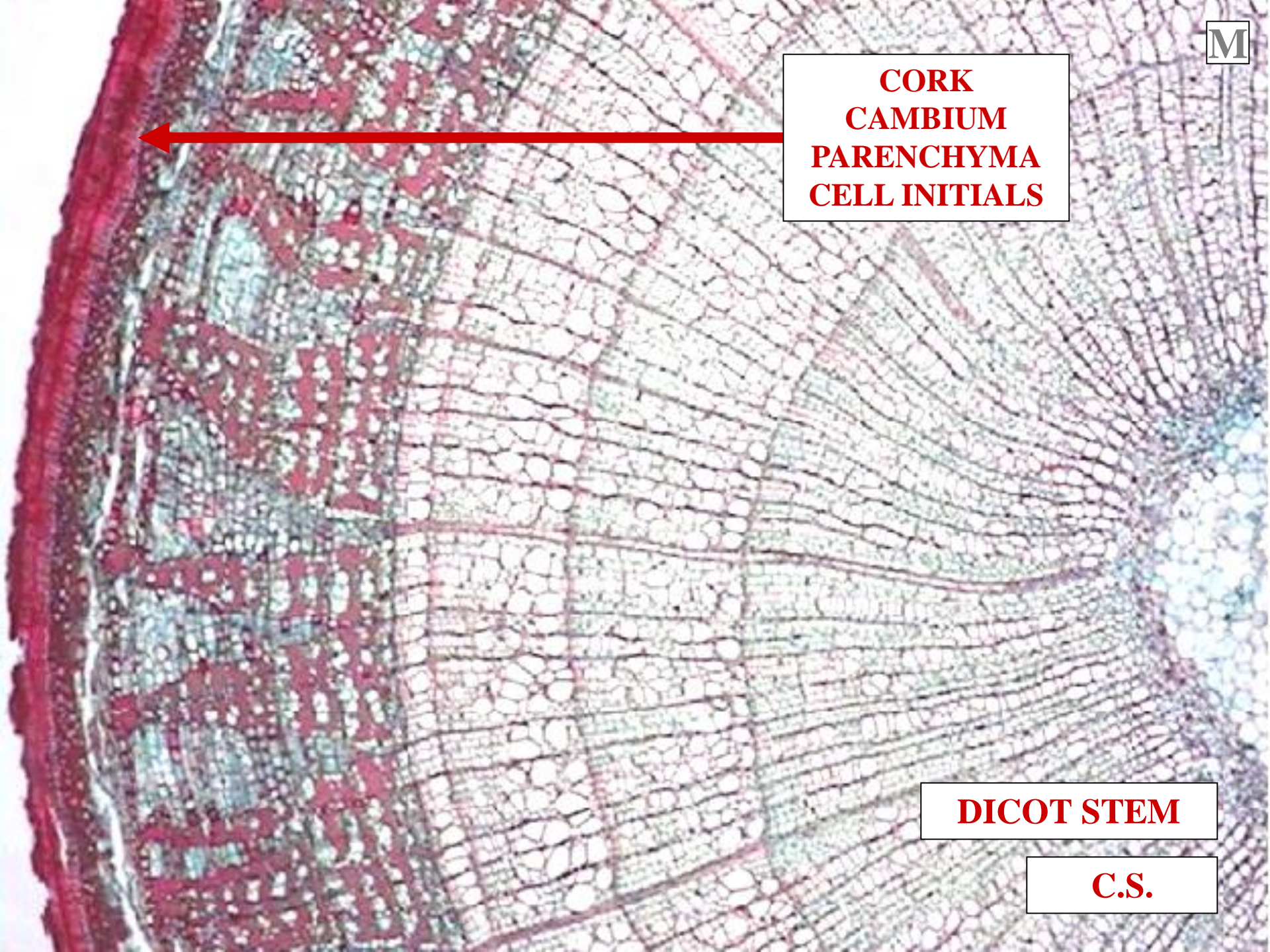


CORK
CAMBIUM
PARENCHYMA
CELL INITIALS



DICOT STEM

C.S.

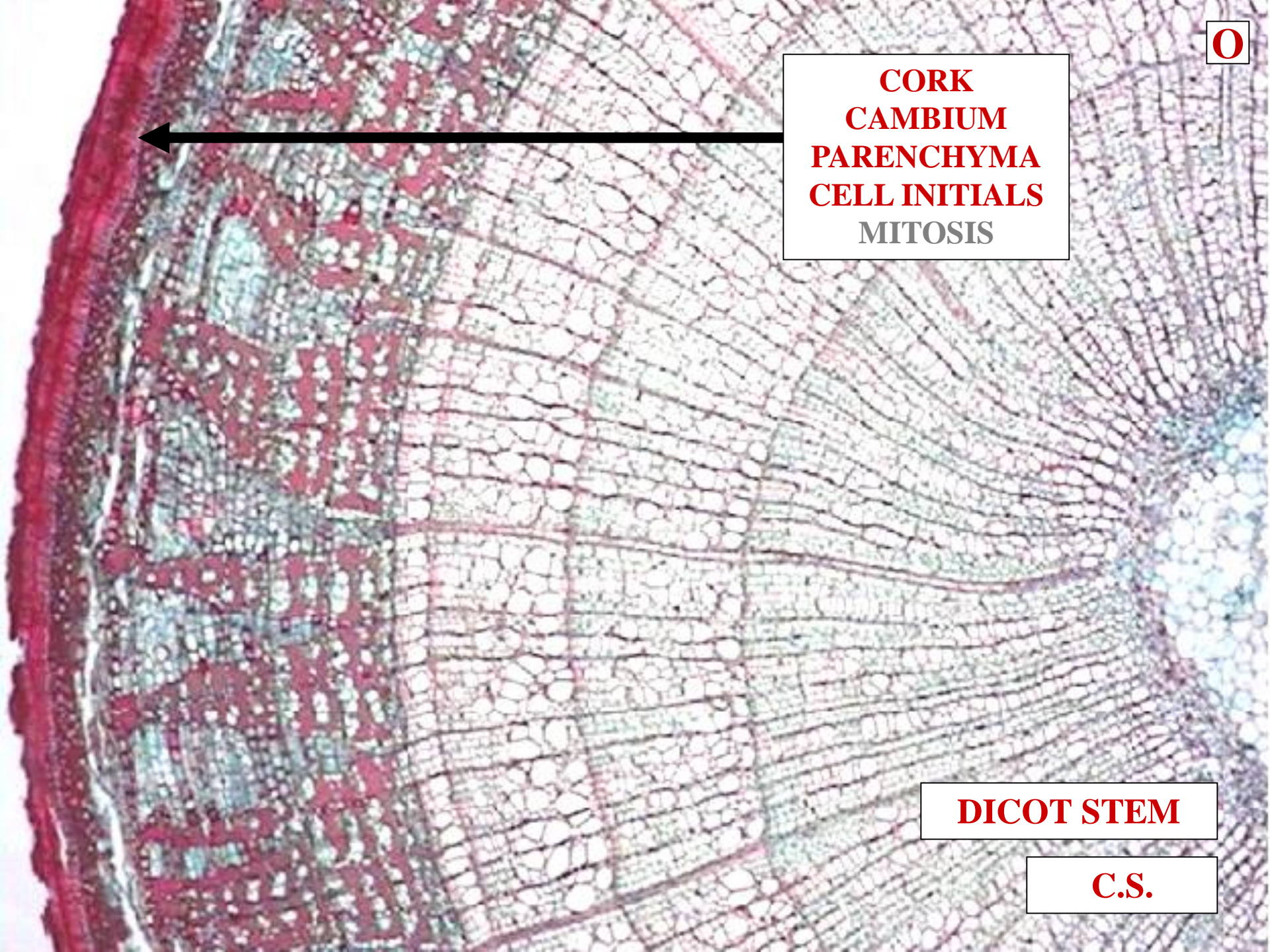


CORK
CAMBIUM
PARENCHYMA
CELL INITIALS
MITOSIS



DICOT STEM

C.S.



CORK
CAMBIUM
PARENCHYMA
CELL INITIALS
MITOSIS

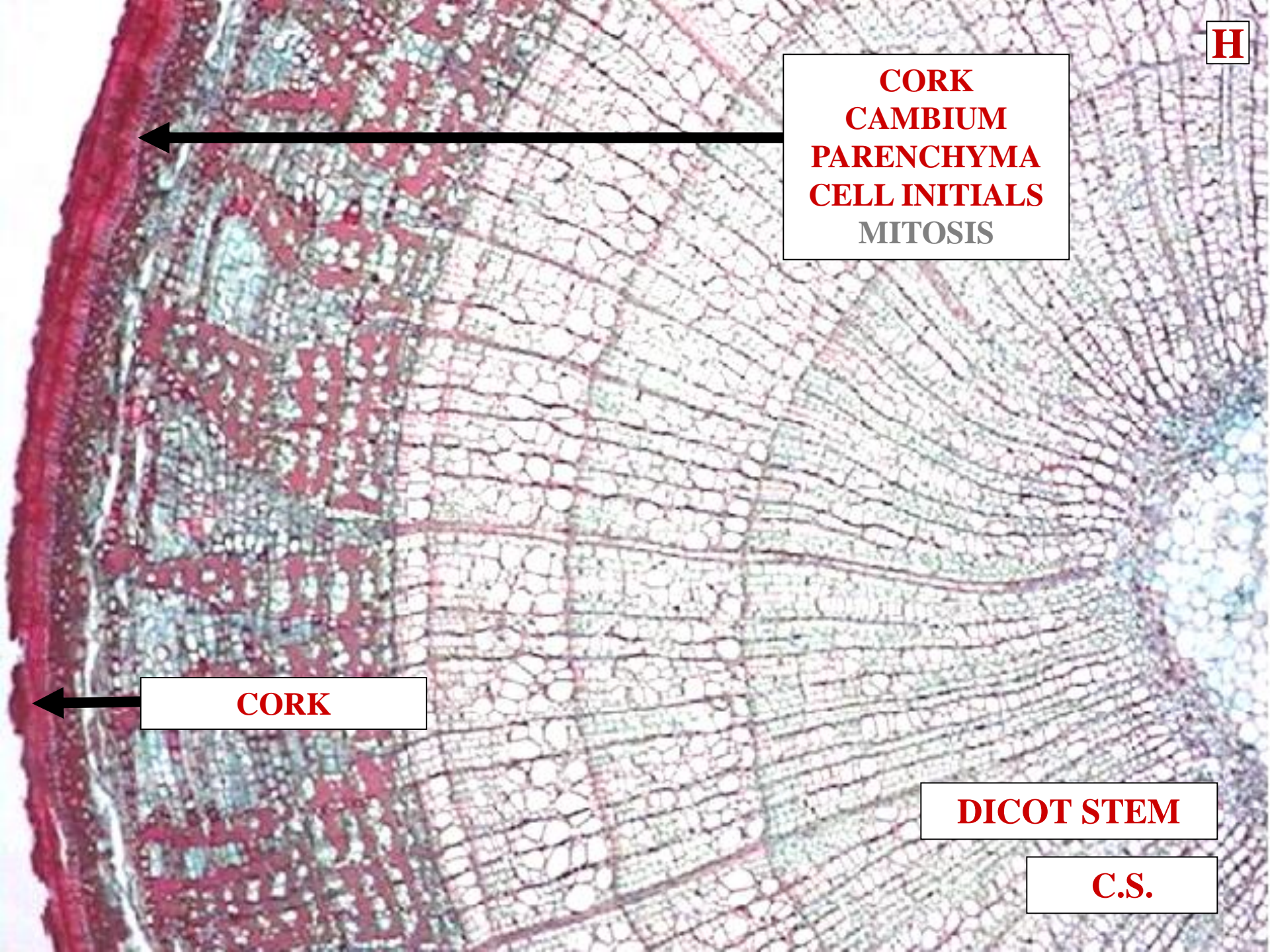


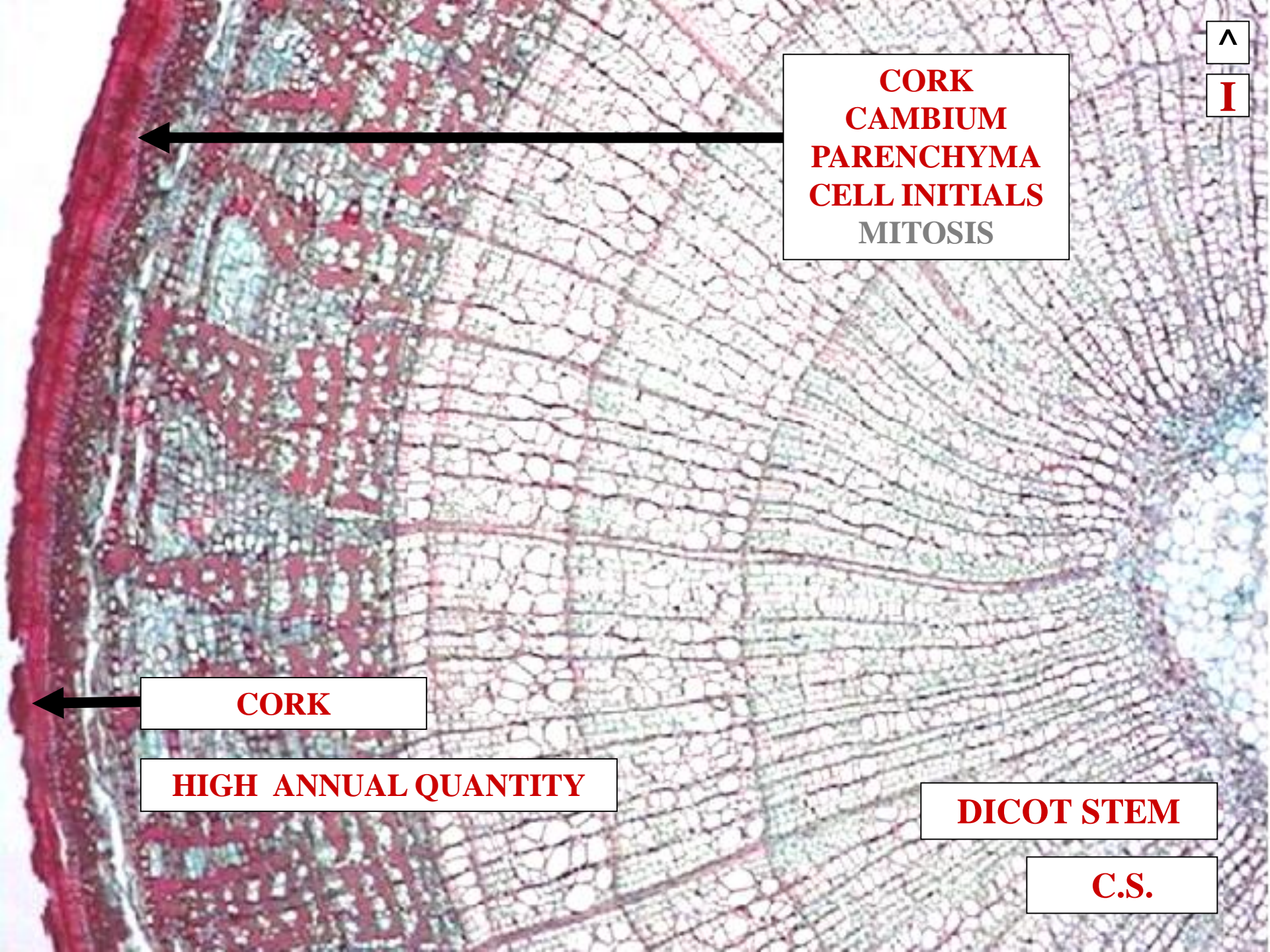
CORK



DICOT STEM

C.S.





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CORK
CAMBIUM
PARENCHYMA
CELL INITIALS
MITOSIS



CORK



HIGH ANNUAL QUANTITY

DICOT STEM

C.S.

P

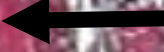
**CORK
CAMBIUM
PARENCHYMA
CELL INITIALS
MITOSIS**



**DERIVATIVE
CELLS INSIDE
CORK
CAMBIUM**



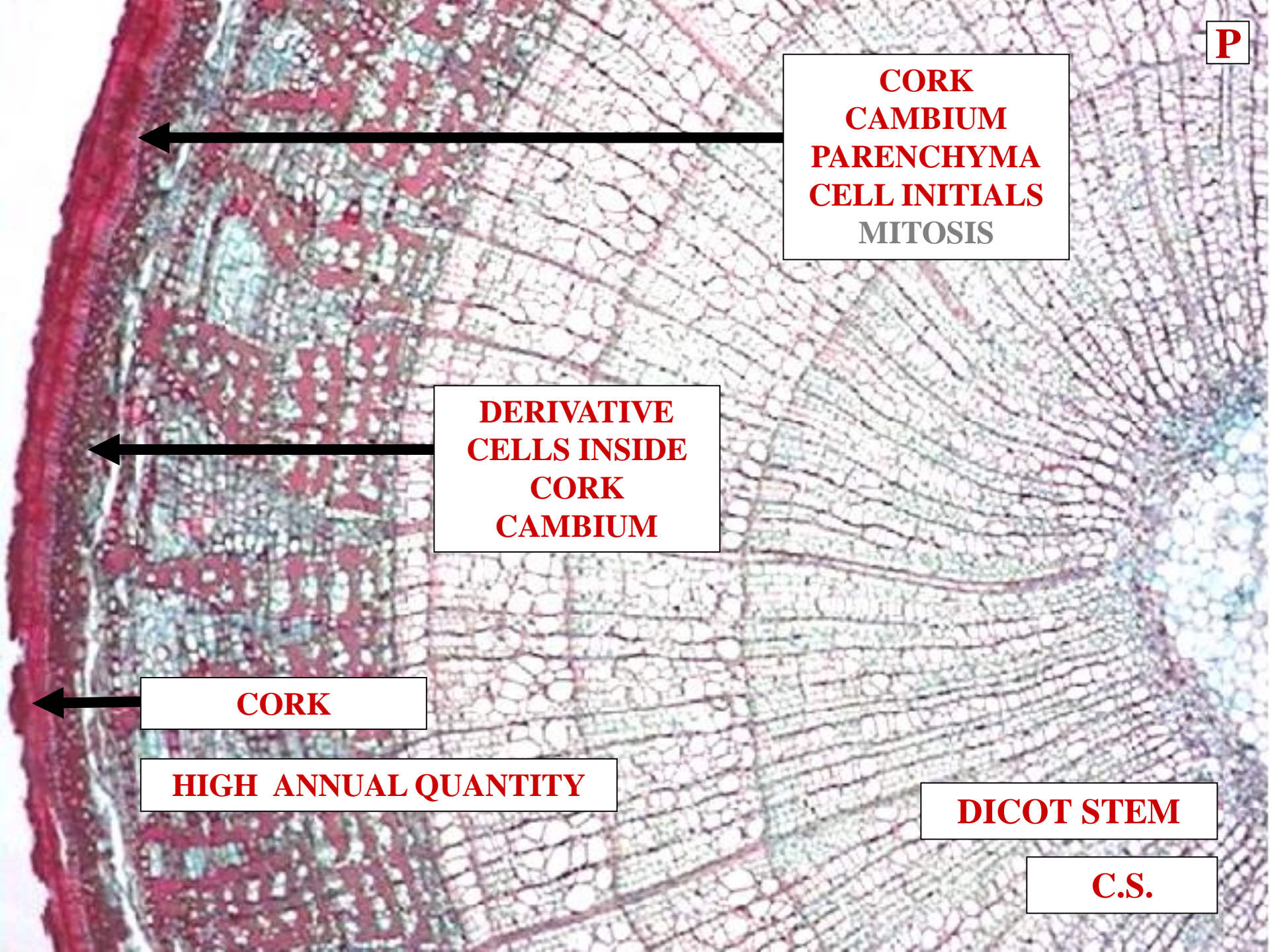
CORK



HIGH ANNUAL QUANTITY

DICOT STEM

C.S.



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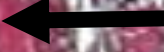
CORK
CAMBIUM
PARENCHYMA
CELL INITIALS
MITOSIS



PHELLODERM



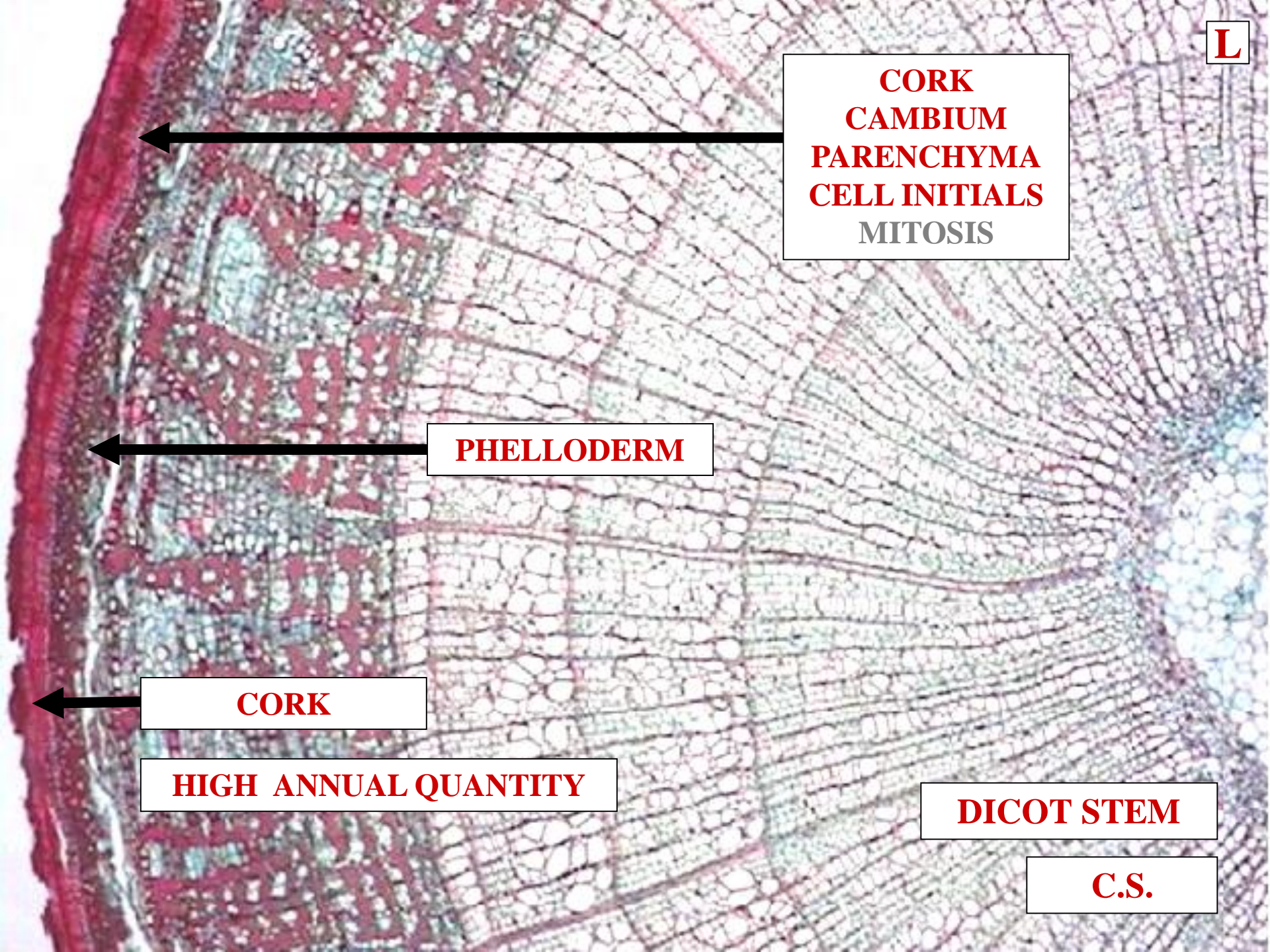
CORK

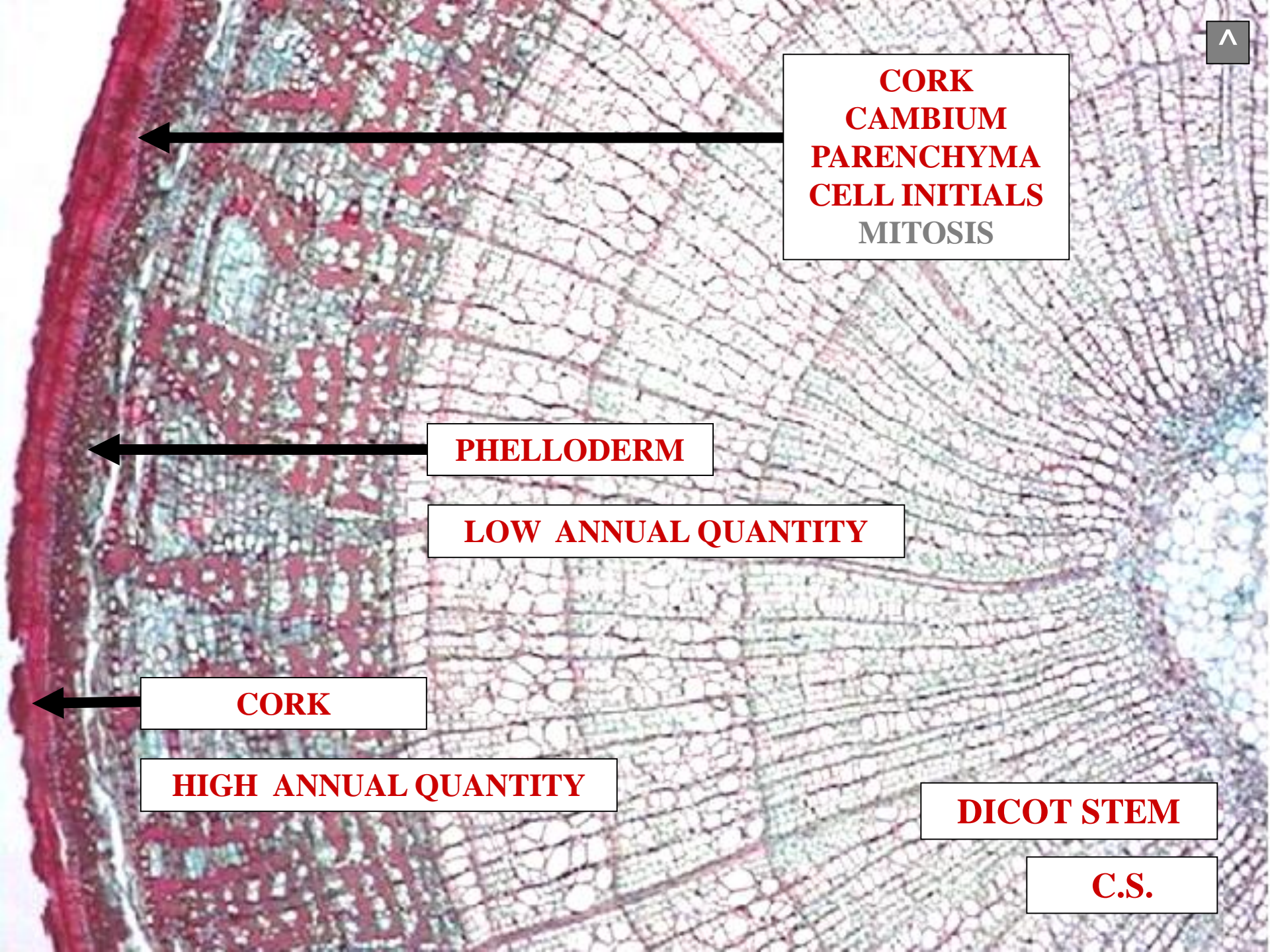


HIGH ANNUAL QUANTITY

DICOT STEM

C.S.





CORK
CAMBIUM
PARENCHYMA
CELL INITIALS
MITOSIS

PHELLODERM

LOW ANNUAL QUANTITY

CORK

HIGH ANNUAL QUANTITY

DICOT STEM

C.S.

CORK
VS
PHELLODERM

CORK

CORK VS PHELLODERM 

CORK

DERIVED OUTSIDE CORK CAMBIUM

CORK VS PHILLODERM

CORK

CORK VS PHELLODERM

CORK

DERIVED OUTSIDE CORK CAMBIUM

PARENCHYMA CELLS

CORK VS PHILLODERM

CORK

CORK VS PHELLODERM



R

CORK

DERIVED OUTSIDE CORK CAMBIUM

PARENCHYMA CELLS

HIGH SUBERIN CONTENT

CORK VS PHILLODERM

CORK

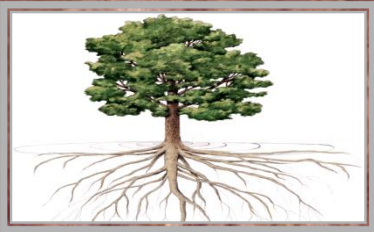


CORK

**CORK
CAMBIUM**

INSIDE

C.S.



WOODY STEM

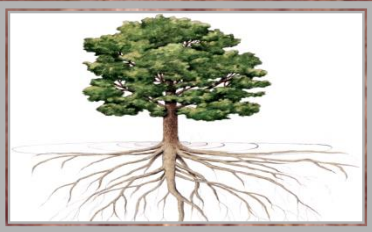


PARENCHYMA CELLS

**CORK
CAMBIUM**

INSIDE

C.S.



WOODY STEM

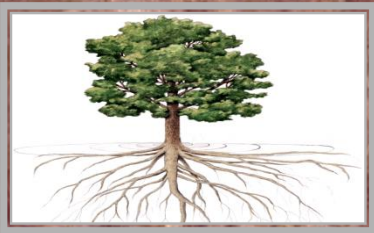


HIGH SUBERIN CONTENT

**CORK
CAMBIUM**

INSIDE

C.S.



WOODY STEM

PHELLODERM

CORK VS PHELLODERM 

PHELLODERM

DERIVED INSIDE CORK CAMBIUM

CORK VS PHILLODERM

PHELLODERM

CORK VS PHELLODERM 

PHELLODERM

DERIVED INSIDE CORK CAMBIUM

PARENCHYMA CELLS

CORK VS PHILLODERM

PHELLODERM

CORK VS PHELLODERM



PHELLODERM

R

DERIVED INSIDE CORK CAMBIUM

PARENCHYMA CELLS

LOW SUBERIN CONTENT

CORK VS PHILLODERM

PHELLODERM



CORK

**CORK
CAMBIUM**

INSIDE

C.S.



WOODY STEM

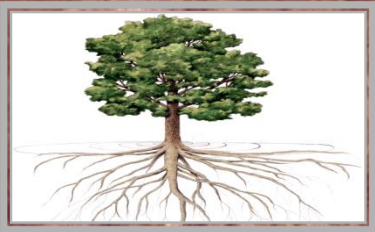


CORK

**CORK
CAMBIUM**

PHELLODERM

C.S.



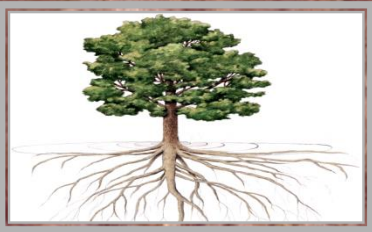
WOODY STEM



CORK

**CORK
CAMBIUM**

PARENCHYMA CELLS



WOODY STEM

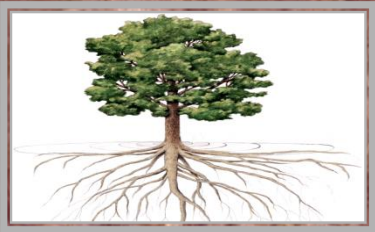
C.S.



CORK

**CORK
CAMBIUM**

LOW SUBERIN CONTENT



WOODY STEM

C.S.

SUBERIN

CORK VS PHELLODERM⁺

SUBERIN

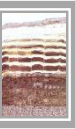
WAX-LIKE SUBSTANCE

CORK VS PHILLODERM

SUBERIN

CORK VS PHELLODERM

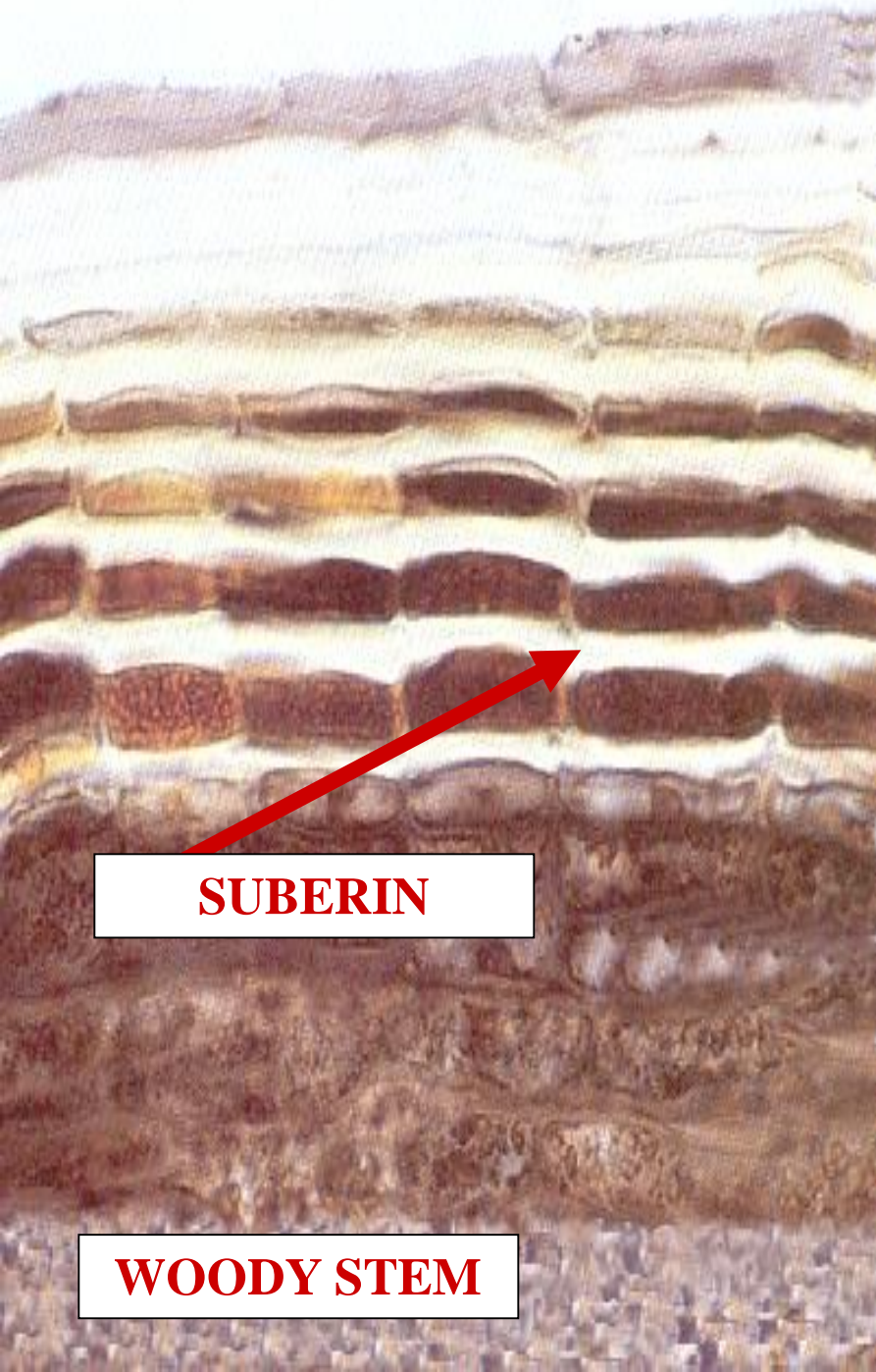
SUBERIN



WAX-LIKE SUBSTANCE
INHIBITS WATER LOSS

CORK VS PHILLODERM

SUBERIN



CORK

HIGH SUBERIN CONTENT

**CORK
CAMBIUM**

PHELLODERM

LOW SUBERIN CONTENT

SUBERIN

WOODY STEM

C.S.

PERIDERM

PERIDERM

PERIDERM



PHELLODERM

PERIDERM

PERIDERM



PHELLODERM
CORK CAMBIUM

PERIDERM

PERIDERM



PHELLODERM
CORK CAMBIUM
CORK

PERIDERM

PERIDERM

PHELLODERM

CORK CAMBIUM

CORK

COLLECTIVELY

=

PERIDERM

PERIDERM