

**VESSEL MEMBERS
LARGE SIZE**



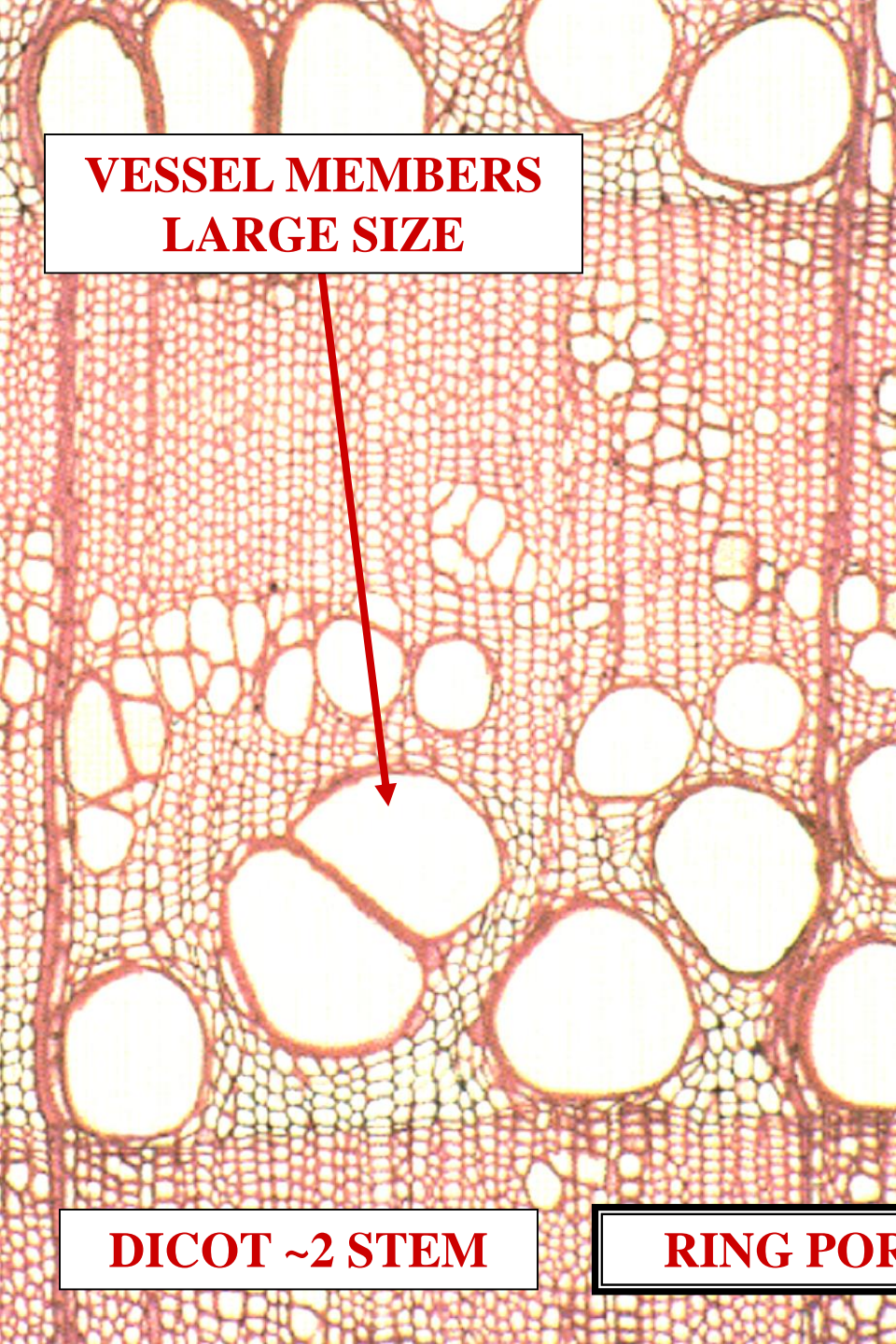
**ANNUAL
RING**

EARLY WOOD

DICOT ~2 STEM

RING POROUS WOOD

C.S.



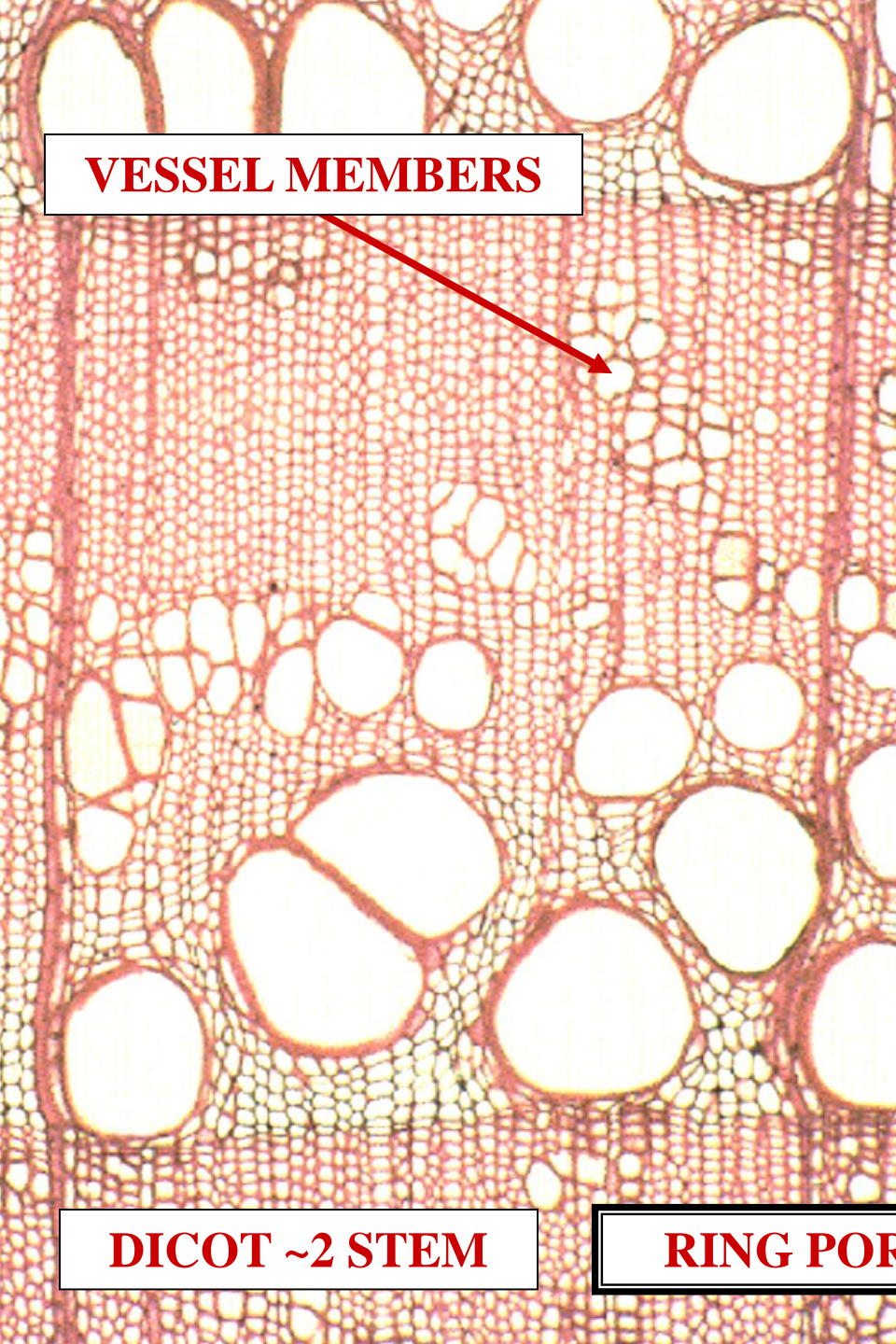
LATE WOOD

RING POROUS WOOD
LATE WOOD

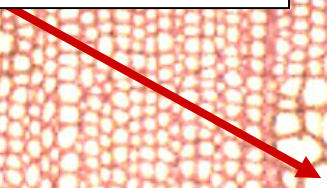


SMALLER
VESSEL MEMBER
SIZE

RING POROUS WOOD
LATE WOOD



VESSEL MEMBERS



EARLY WOOD

ANNUAL RING

DICOT ~2 STEM

RING POROUS WOOD

C.S.

LW

**VESSEL MEMBERS
SMALL SIZE**



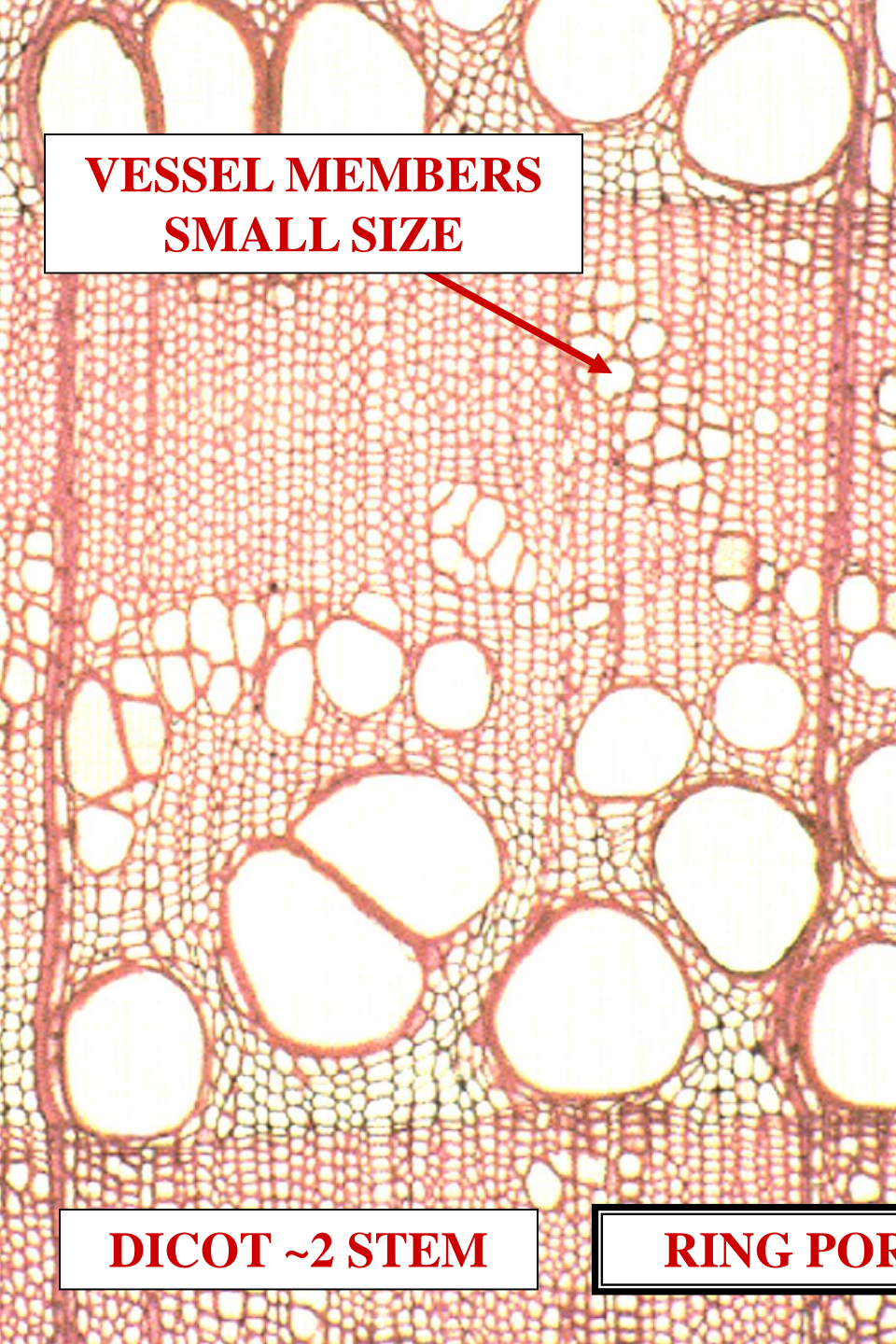
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RING**

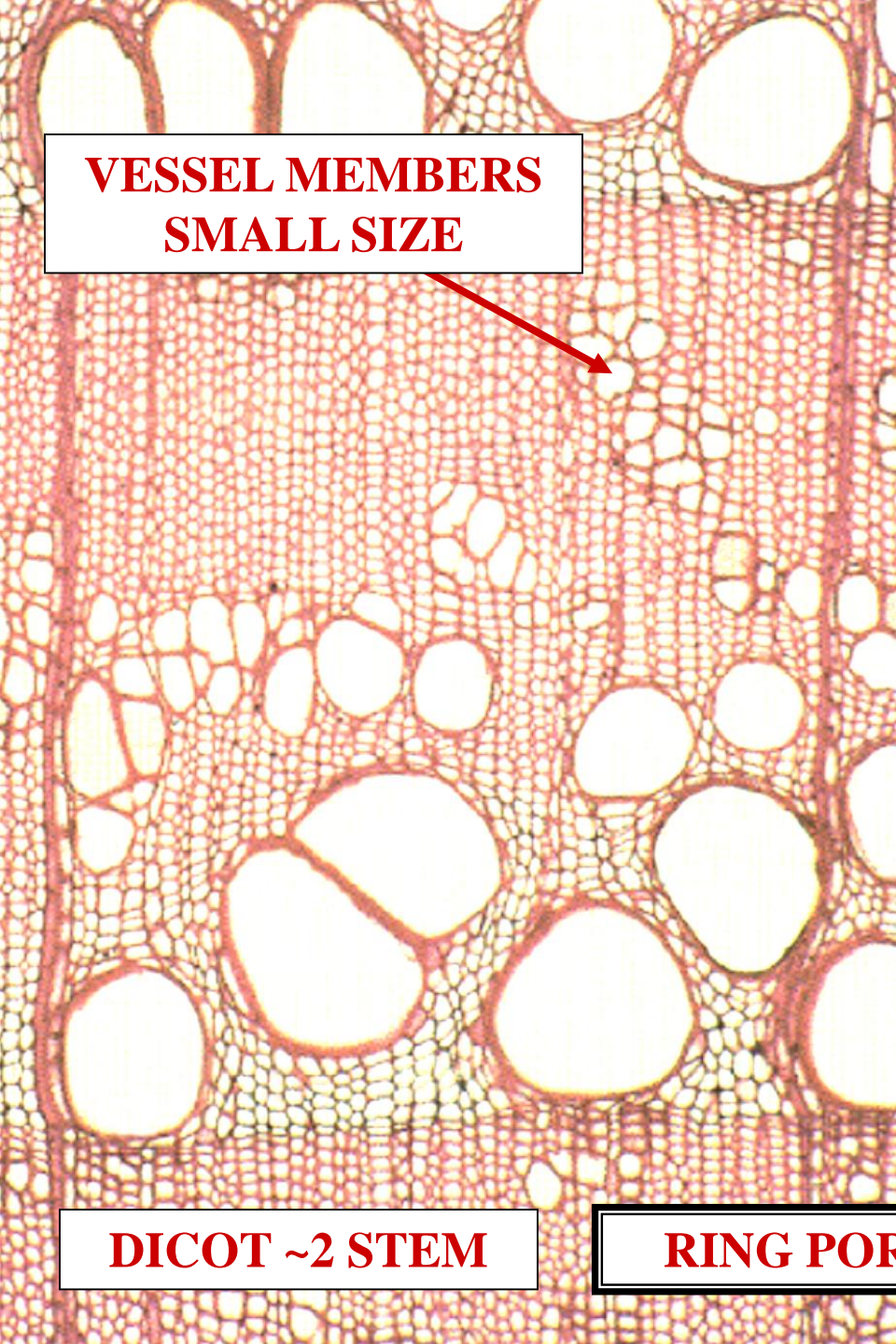
EARLY WOOD

DICOT ~2 STEM

RING POROUS WOOD

C.S.





**VESSEL MEMBERS
SMALL SIZE**



LATE WOOD

EARLY WOOD

**ANNUAL
RING**

DICOT ~2 STEM

RING POROUS WOOD

C.S.

DIFFUSE POROUS WOOD

DIFFUSE POROUS WOOD

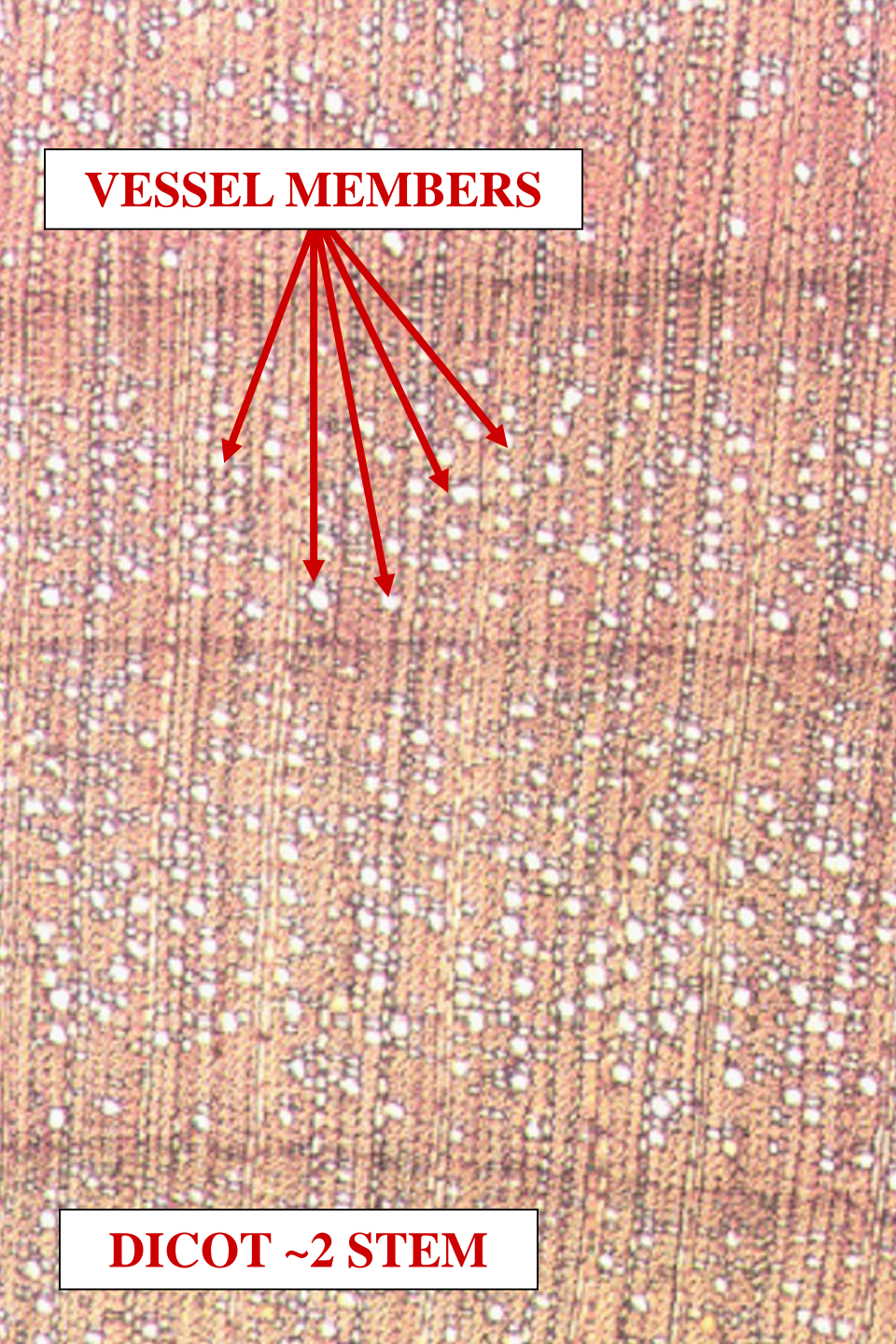
WOOD TYPES
RING POROUS WOOD



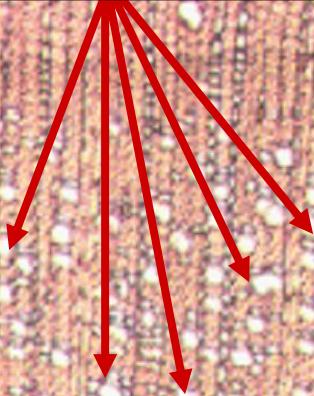
VM

VESSEL MEMBRANE SIZE
UNIFORM WITHIN
ANNUAL RING

WOOD TYPES
RING POROUS WOOD



VESSEL MEMBERS



ANNUAL RING

ANNUAL RING

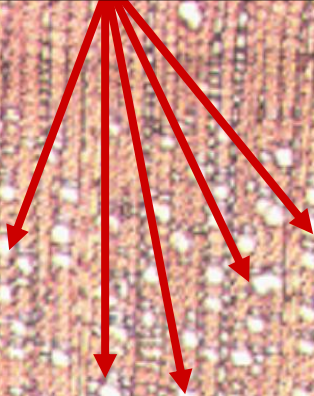
ANNUAL RING

DICOT ~2 STEM

C.S.

DP

**VESSEL MEMBERS
UNIFORM SIZE**



ANNUAL RING

ANNUAL RING

ANNUAL RING

DICOT ~2 STEM

C.S.

**VESSEL MEMBERS
UNIFORM SIZE**



ANNUAL RING

ANNUAL RING

ANNUAL RING

DIFFUSE POROUS WOOD

DICOT ~2 STEM

C.S.

RING POROUS

WOOD

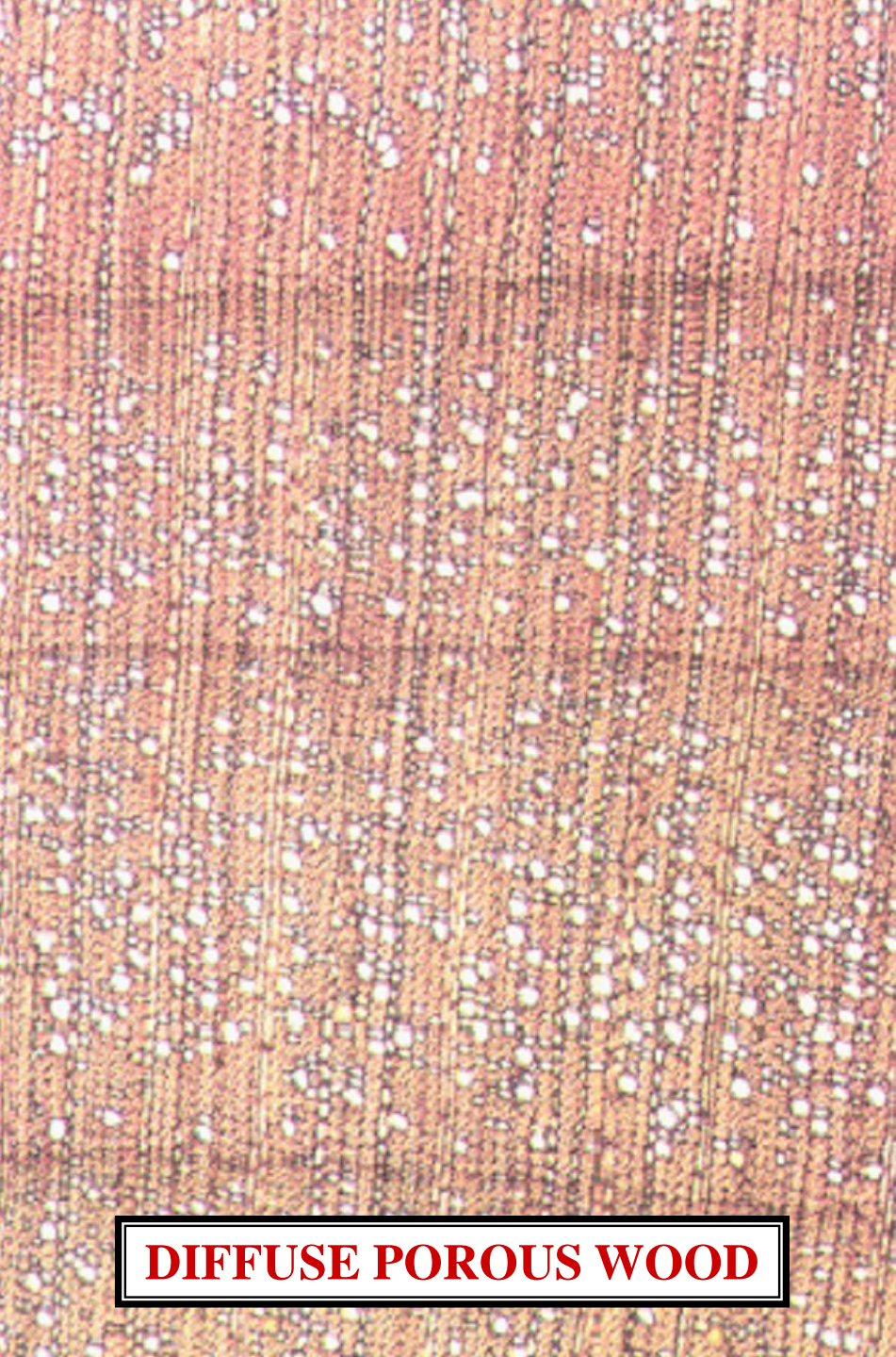
VS

DIFFUSE POROUS

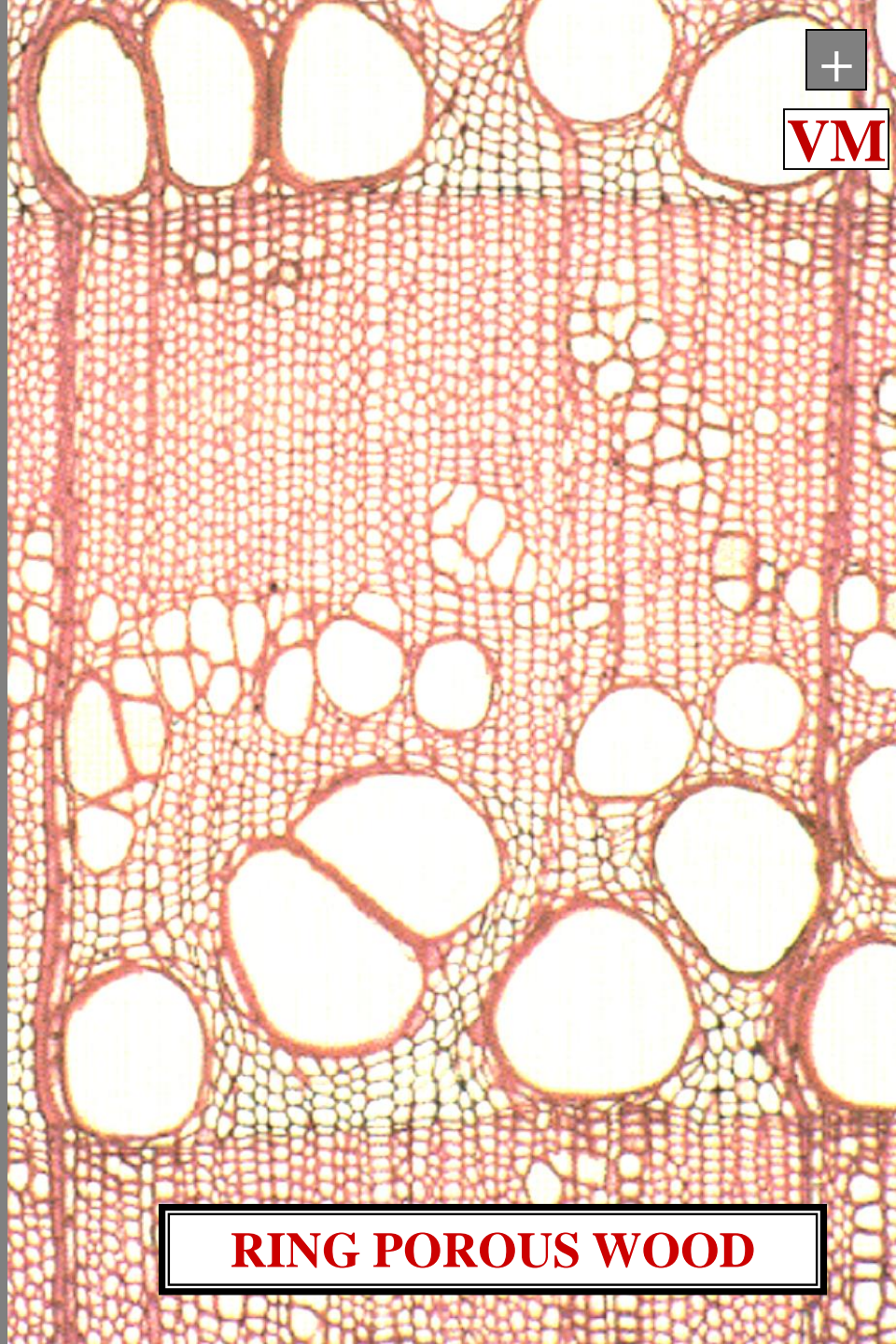
WOOD

SUMMARY





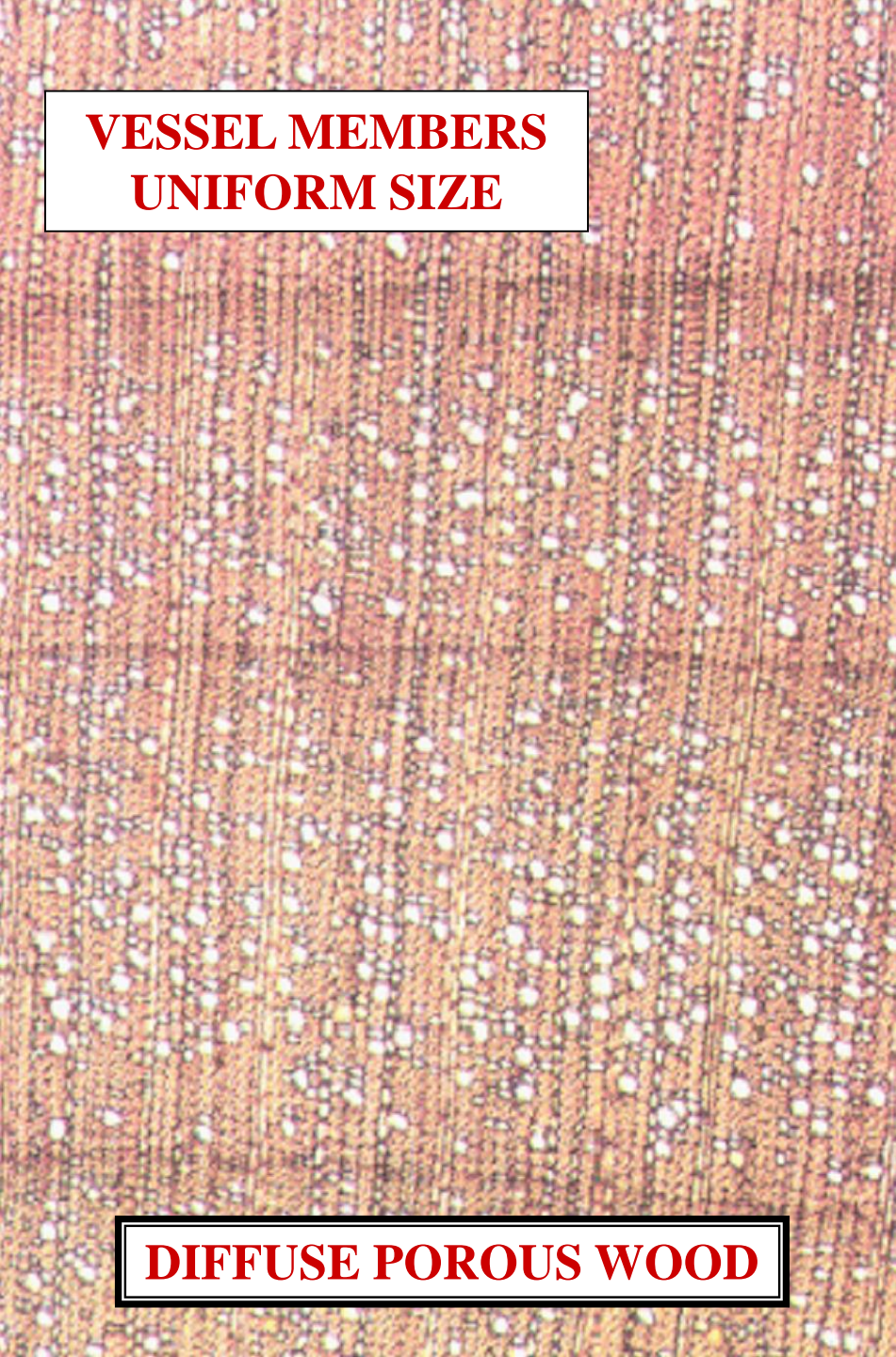
DIFFUSE POROUS WOOD



RING POROUS WOOD

**VESSEL MEMBERS
UNIFORM SIZE**

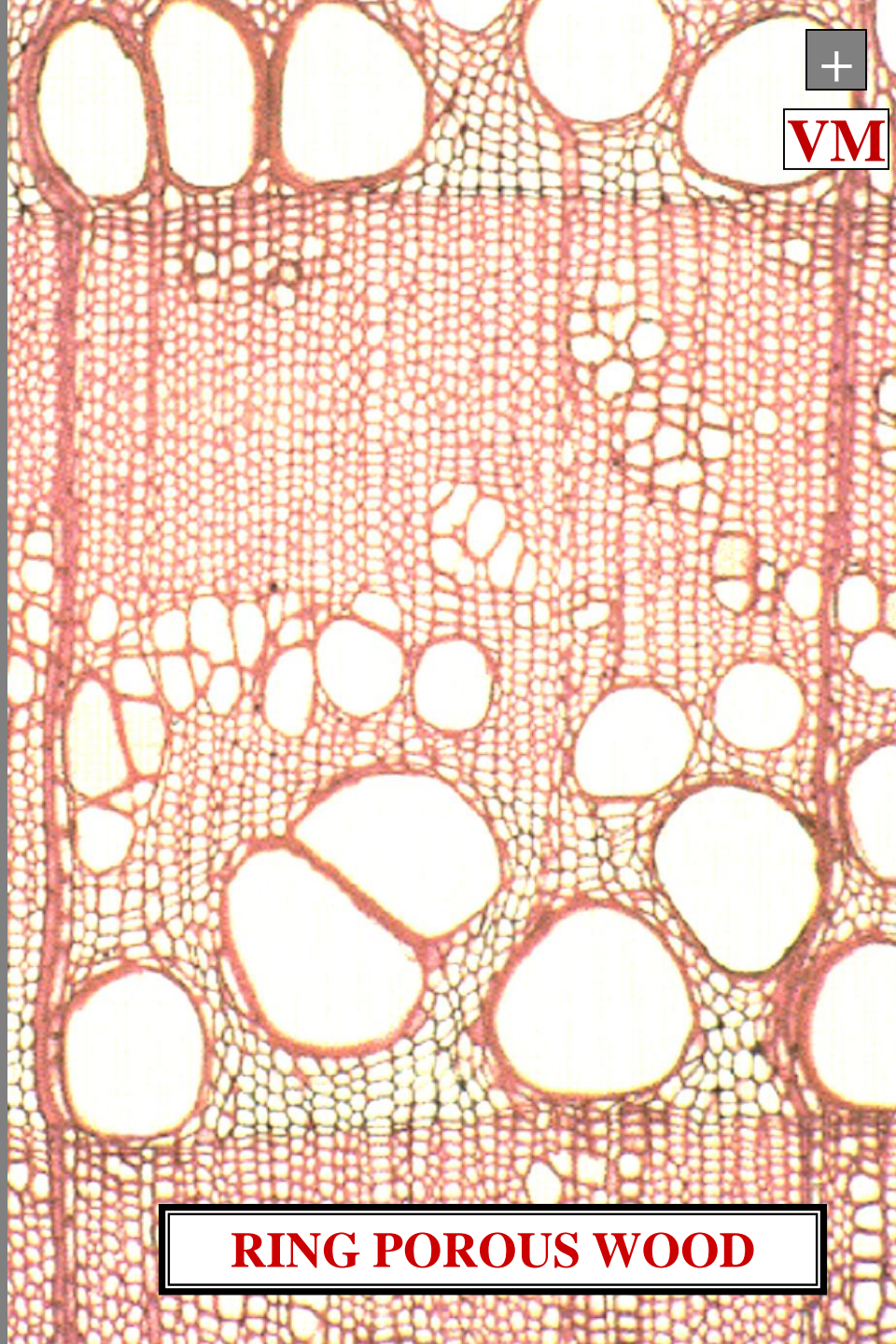
DIFFUSE POROUS WOOD



+

VM

RING POROUS WOOD





**VESSEL MEMBERS
UNIFORM SIZE**

This micrograph shows a cross-section of diffuse porous wood. The vessel members are distributed evenly throughout the wood, appearing as small, uniform circular or oval openings. The surrounding tissue is a dense network of small, thin-walled cells.

DIFFUSE POROUS WOOD



**VESSEL MEMBERS
DIFFER IN SIZE**

This micrograph shows a cross-section of ring porous wood. The vessel members are arranged in distinct radial rows. Within each row, the vessel sizes vary significantly, with larger vessels in the early wood and smaller vessels in the late wood. The surrounding tissue is a dense network of small, thin-walled cells.

LATE WOOD

EARLY WOOD

RING POROUS WOOD



SAPWOOD
VS
HEARTWOOD

SAPWOOD

WOOD TYPES

SAPWOOD



LIGHT COLORED FUNCTIONAL XYLEM

WOOD TYPES

SAPWOOD

WOOD TYPES



SAPWOOD

LIGHT COLORED FUNCTIONAL XYLEM

TRANSPORTS WATER

WOOD TYPES

SAPWOOD

WOOD TYPES

SAPWOOD



SW

LIGHT COLORED FUNCTIONAL XYLEM

TRANSPORTS WATER

HIGH GRADE LUMBER

WOOD TYPES

SAPWOOD



DICOT ~2 STEM

C.S.

LC

SAPWOOD





DICOT ~2 STEM

C.S.

WT

**SAPWOOD
LIGHT COLOR
FUNCTIONAL
XYLEM**



DICOT ~2 STEM

C.S.

HG

**SAPWOOD
TRANSPORTS
WATER**





DICOT ~2 STEM

C.S.

^

H

**SAPWOOD
HIGH GRADE
LUMBER**



HEARTWOOD



WOOD TYPES

HEARTWOOD

DARK COLORED NON-FUNCTIONAL XYLEM

WOOD TYPES

HEARTWOOD



WOOD TYPES

HEARTWOOD

DARK COLORED NON-FUNCTIONAL XYLEM

STORES METABOLIC WASTE

WOOD TYPES

HEARTWOOD

WOOD TYPES

HEARTWOOD



DARK COLORED NON-FUNCTIONAL XYLEM

STORES METABOLIC WASTE

LOW GRADE LUMBER

WOOD TYPES

HEARTWOOD



DICOT ~2 STEM

C.S.

DC

HEARTWOOD



DICOT ~2 STEM

C.S.

SM

**HEARTWOOD
DARK COLOR
NON-FUNCTIONAL
XYLEM**



DICOT ~2 STEM

C.S.

LG

**HEARTWOOD
STORES
METABOLIC
WASTE**



DICOT ~2 STEM

C.S.



**HEARTWOOD
LOW GRADE
LUMBER**



SOFTWOOD
VS
HARDWOOD

SOFTWOOD

WOOD TYPES

SOFTWOOD



GYMNOSPERM WOOD

WOOD TYPES

SOFTWOOD



GYMNOSPERM WOOD SOFT WOOD

HARDWOOD

WOOD TYPES

HARDWOOD



ANGIOSPERM WOOD

WOOD TYPES

HARDWOOD



ANGIOSPERM WOOD HARD WOOD



WOOD SECTIONS

WOOD SECTION TYPES

WOOD SECTION TYPES

TRANSVERSE WOOD SECTION

WOOD SECTION TYPES

WOOD SECTION TYPES

**TRANSVERSE WOOD SECTION
RADIAL WOOD SECTION**

WOOD SECTION TYPES



WOOD SECTION TYPES

TRANSVERSE WOOD SECTION

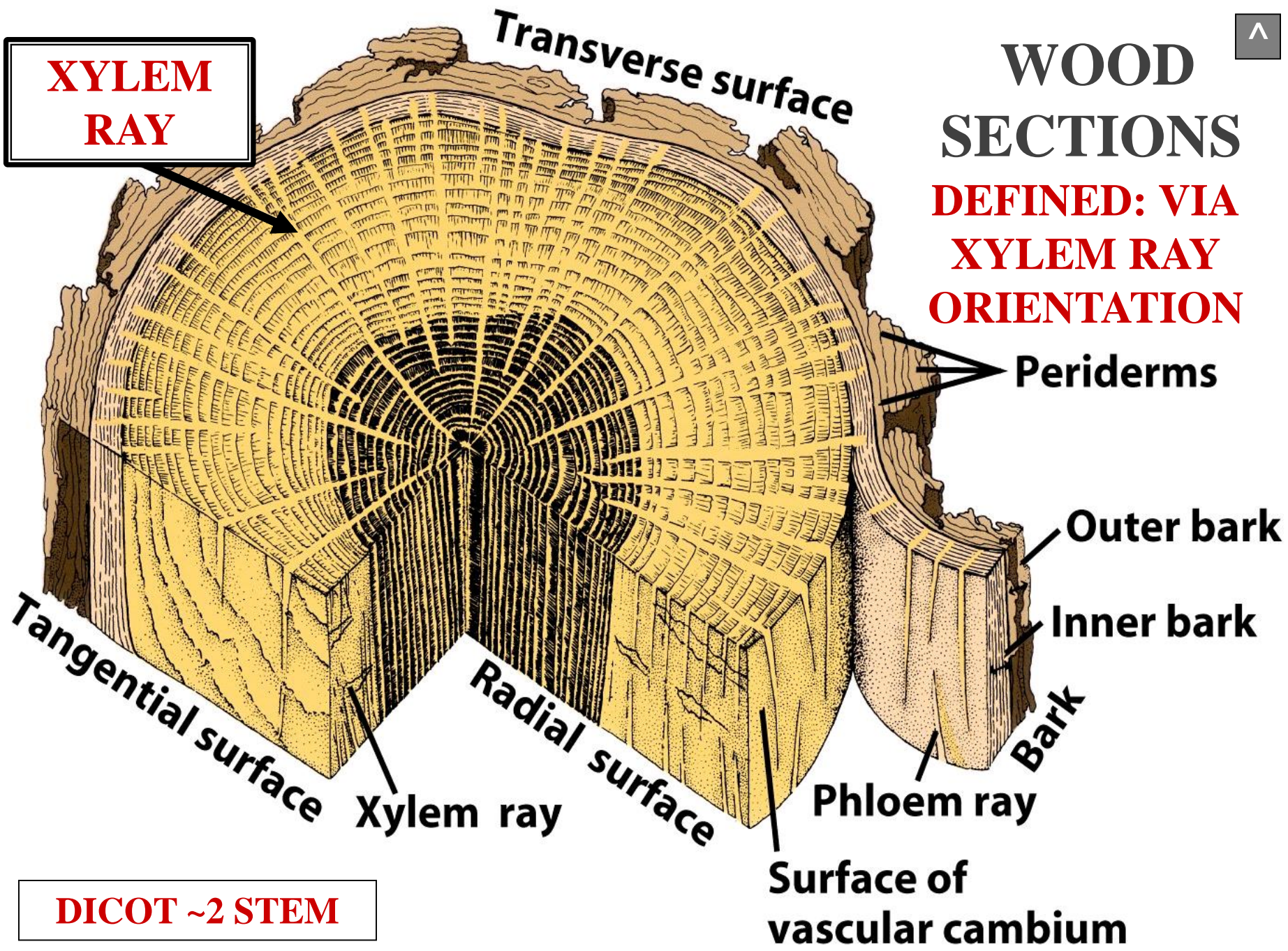
RADIAL WOOD SECTION

TANGENTIAL WOOD SECTION

WOOD SECTION TYPES



WOOD SECTIONS DEFINED: VIA XYLEM RAY ORIENTATION



**XYLEM
RAY**

Transverse surface

Tangential surface

Radial surface

Xylem ray

Phloem ray

**Surface of
vascular cambium**

Periderms

Outer bark

Inner bark

Bark

DICOT ~2 STEM

TRANSVERSE WOOD SECTION

**TRANSVERSE
WOOD SECTION**

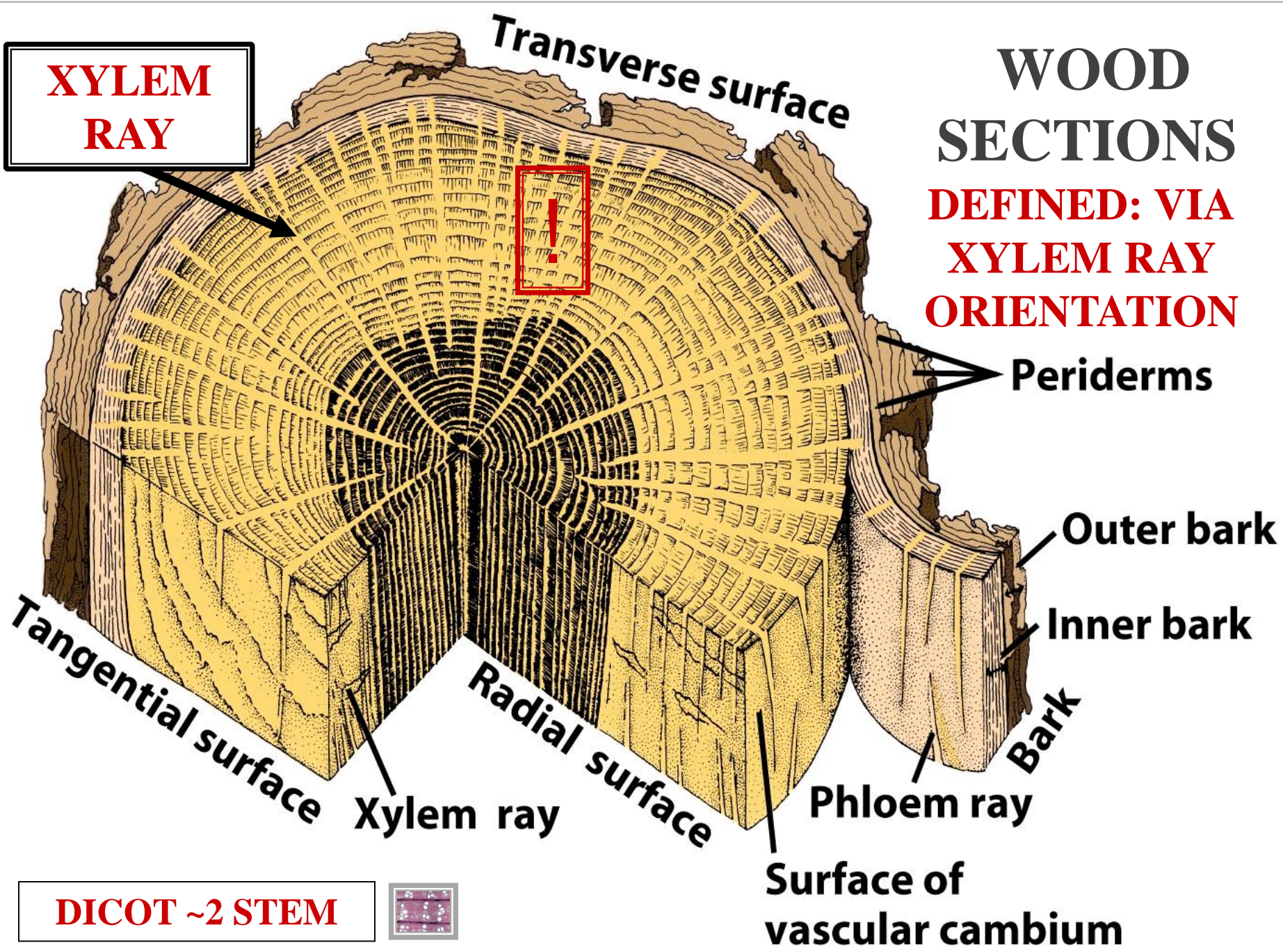
TRANSVERSE WOOD SECTION



CROSS SECTION

TRANSVERSE WOOD SECTION

WOOD SECTIONS DEFINED: VIA XYLEM RAY ORIENTATION



**XYLEM
RAY**

Tangential surface

Radial surface

Xylem ray

Phloem ray

**Surface of
vascular cambium**

Periderms

Outer bark

Inner bark

Bark

DICOT ~2 STEM

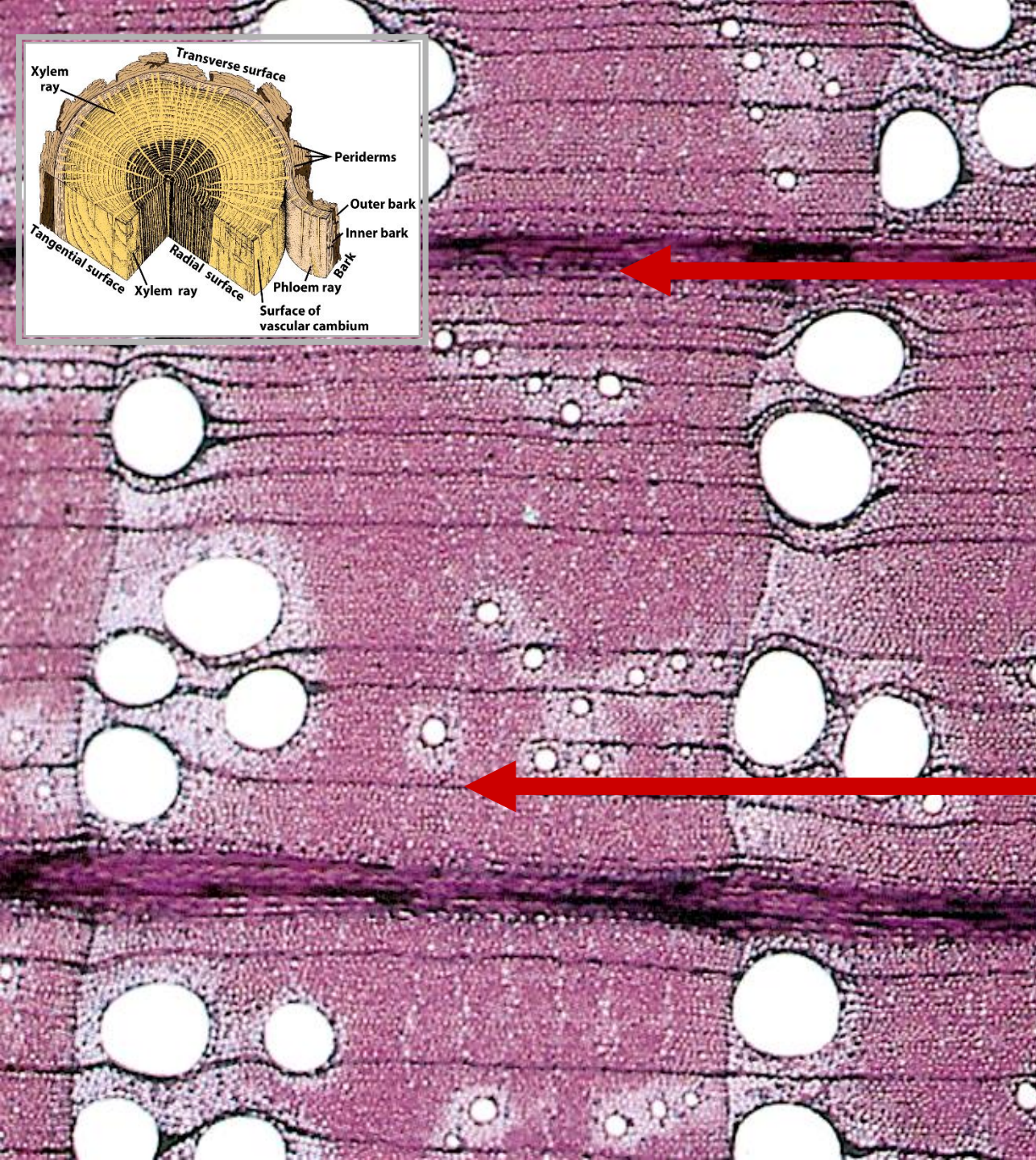
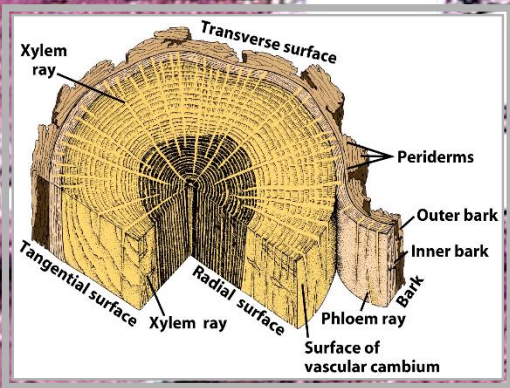


DICOT ~2 STEM



**MULTISERIATE
XYLEM RAY**

**UNISERIATE
XYLEM RAY**



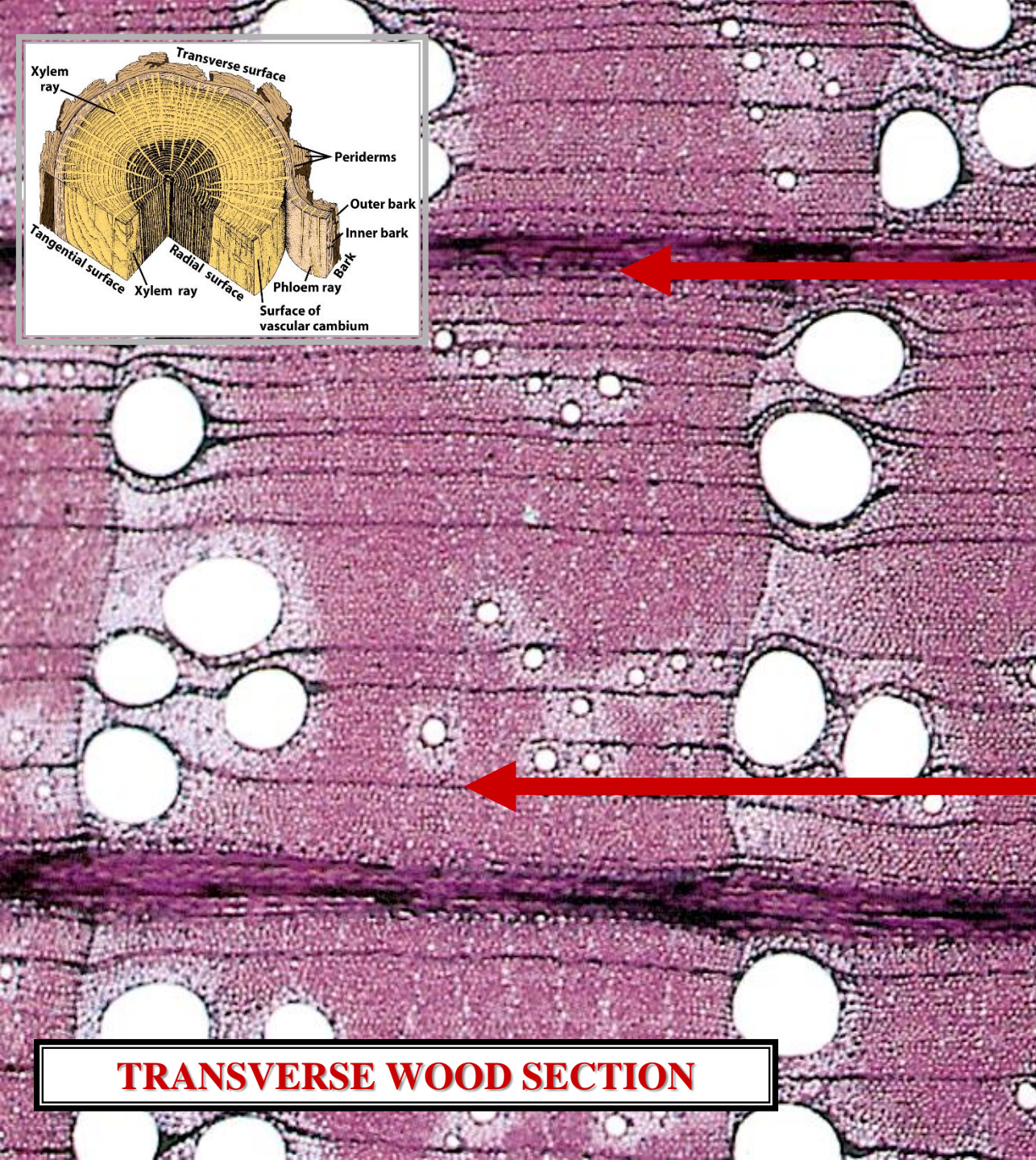
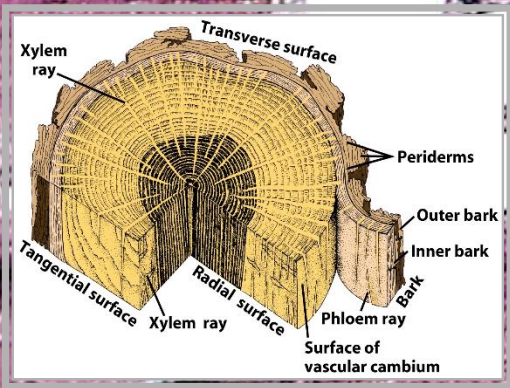
DICOT ~2 STEM



**MULTISERIATE
XYLEM RAY**

**UNISERIATE
XYLEM RAY**

TRANSVERSE WOOD SECTION



RADIAL WOOD SECTION

**RADIAL
WOOD SECTION**



**RADIAL
WOOD SECTION**

**LONGITUDINAL SECTION
THROUGH STEM CENTER**

**RADIAL
WOOD SECTION**



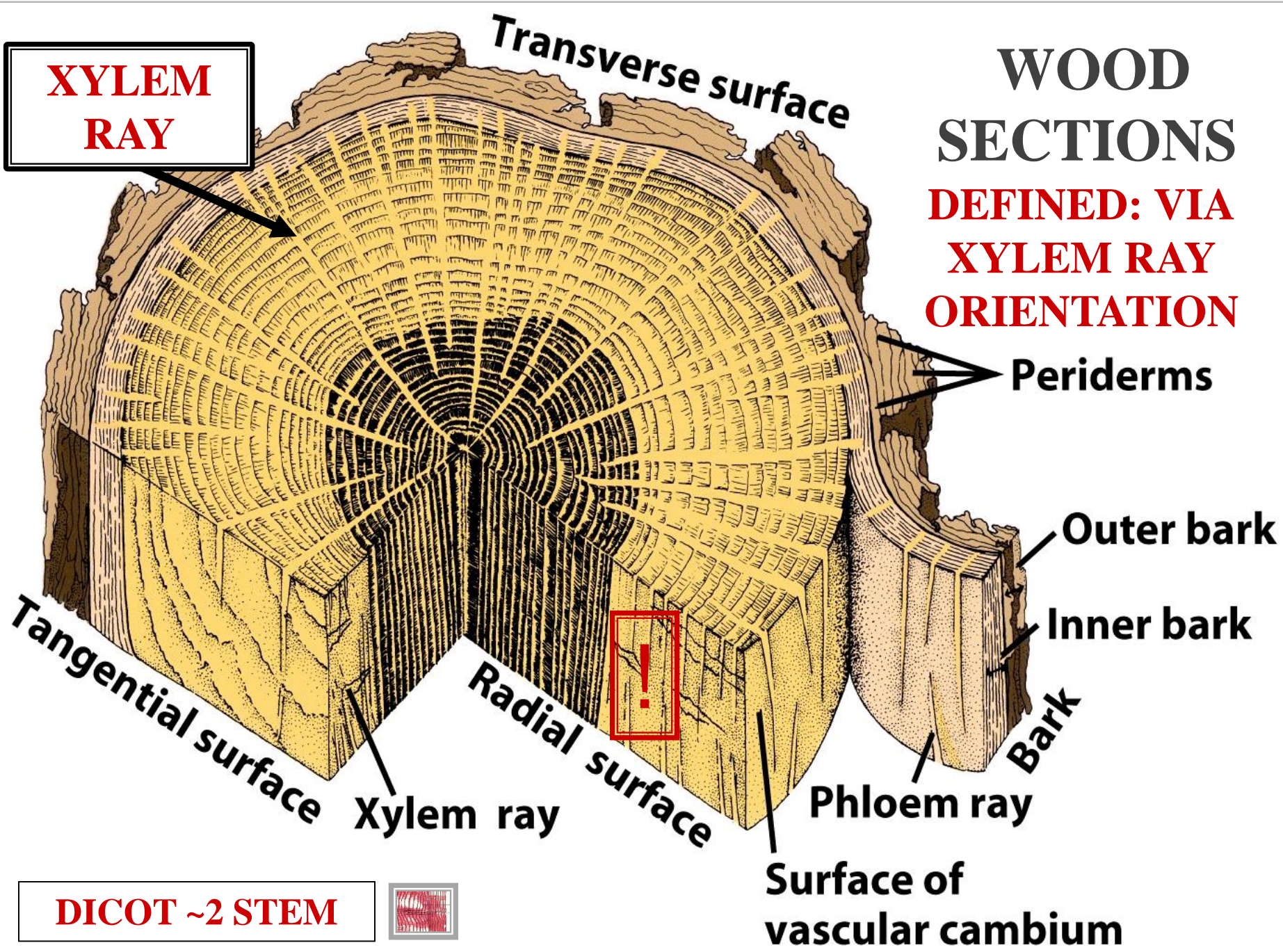
**RADIAL
WOOD SECTION**

**LONGITUDINAL SECTION
THROUGH STEM CENTER**

**XYLEM RAYS
PARALLEL WITH SECTION**

**RADIAL
WOOD SECTION**

WOOD SECTIONS DEFINED: VIA XYLEM RAY ORIENTATION



**XYLEM
RAY**

Tangential surface

Radial surface

Transverse surface

Xylem ray

Phloem ray

**Surface of
vascular cambium**

Periderms

Outer bark

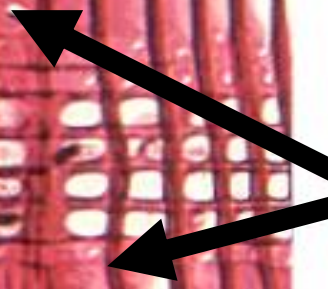
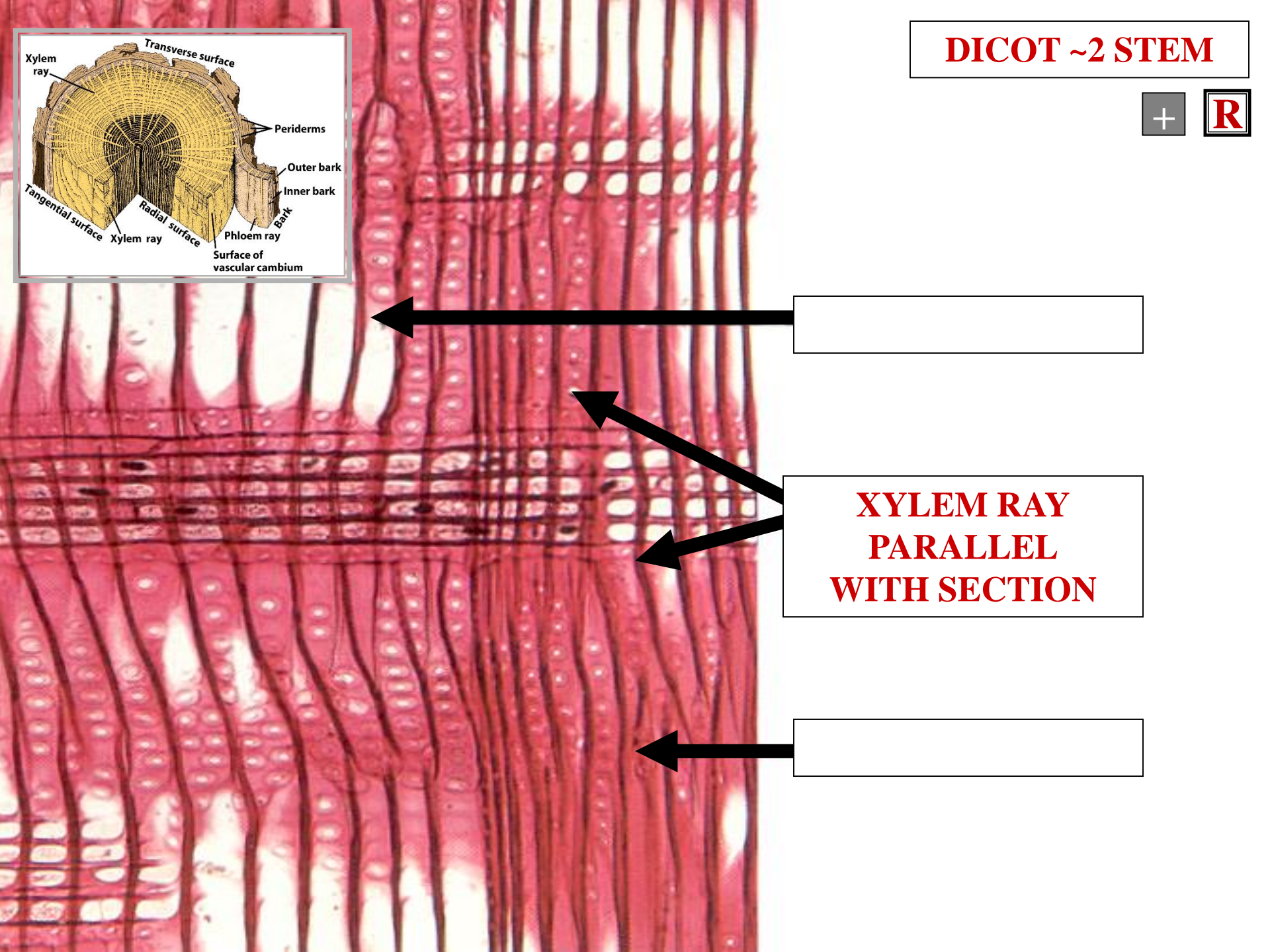
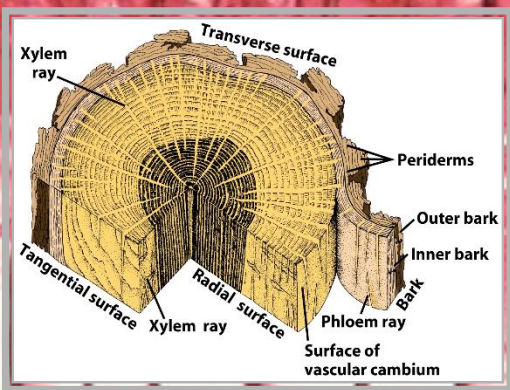
Inner bark

Bark

DICOT ~2 STEM



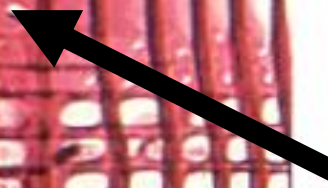
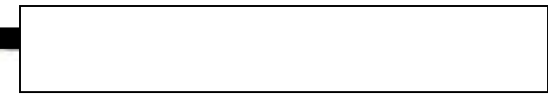
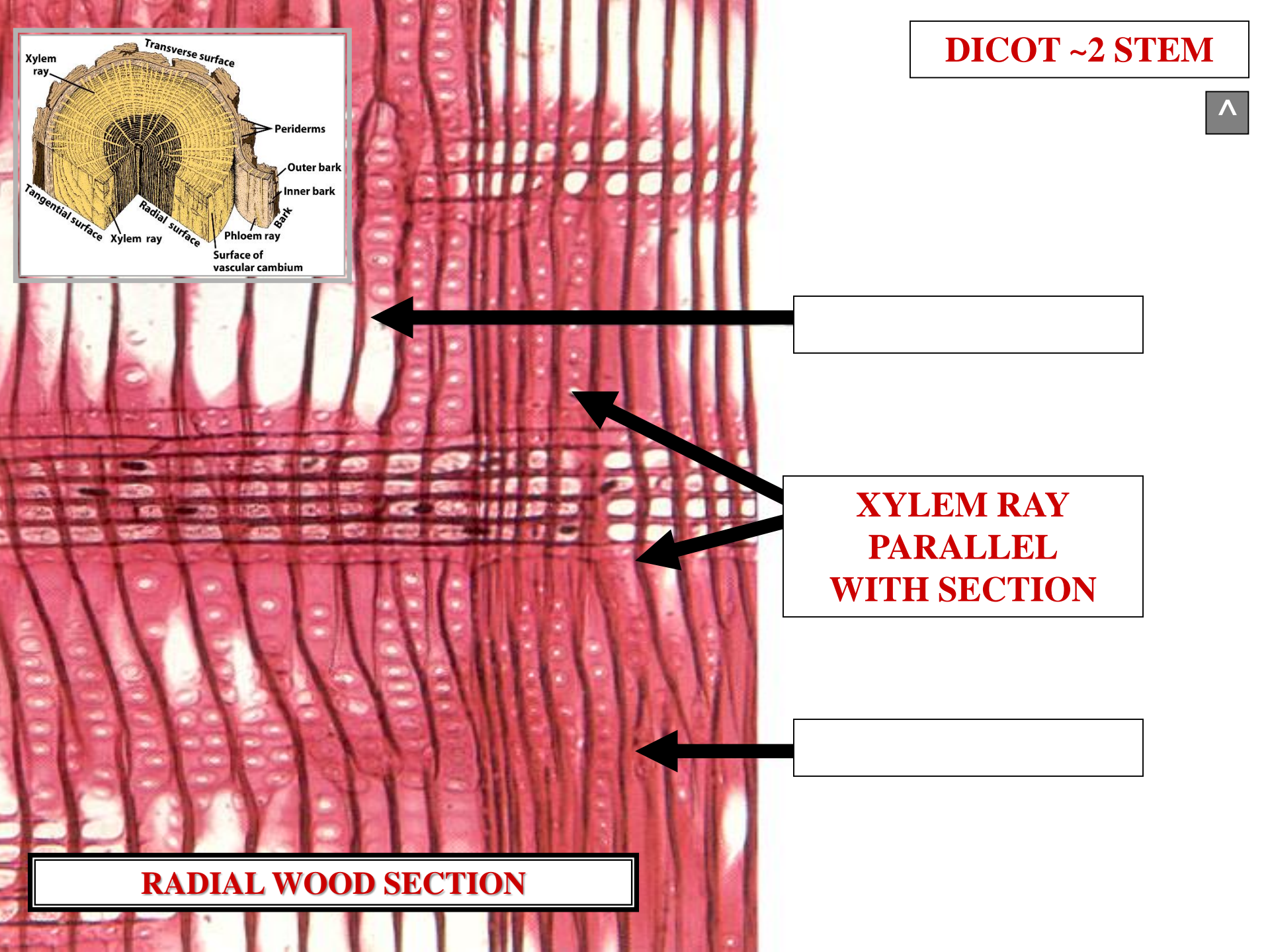
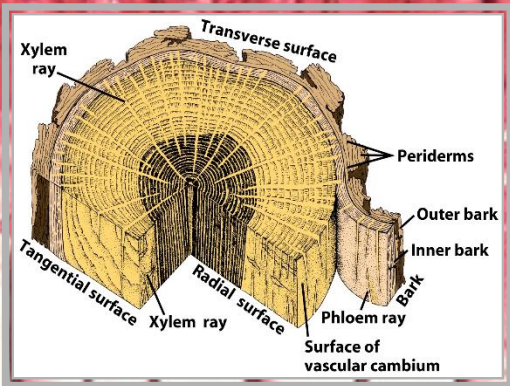
DICOT ~2 STEM



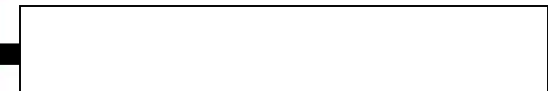
**XYLEM RAY
PARALLEL
WITH SECTION**



DICOT ~2 STEM



**XYLEM RAY
PARALLEL
WITH SECTION**



RADIAL WOOD SECTION

**TANGENTIAL
WOOD SECTION**

TANGENTIAL WOOD SECTION



**TANGENTIAL
WOOD SECTION**

**LONGITUDINAL SECTION
OFF STEM CENTER**

**TANGENTIAL
WOOD SECTION**



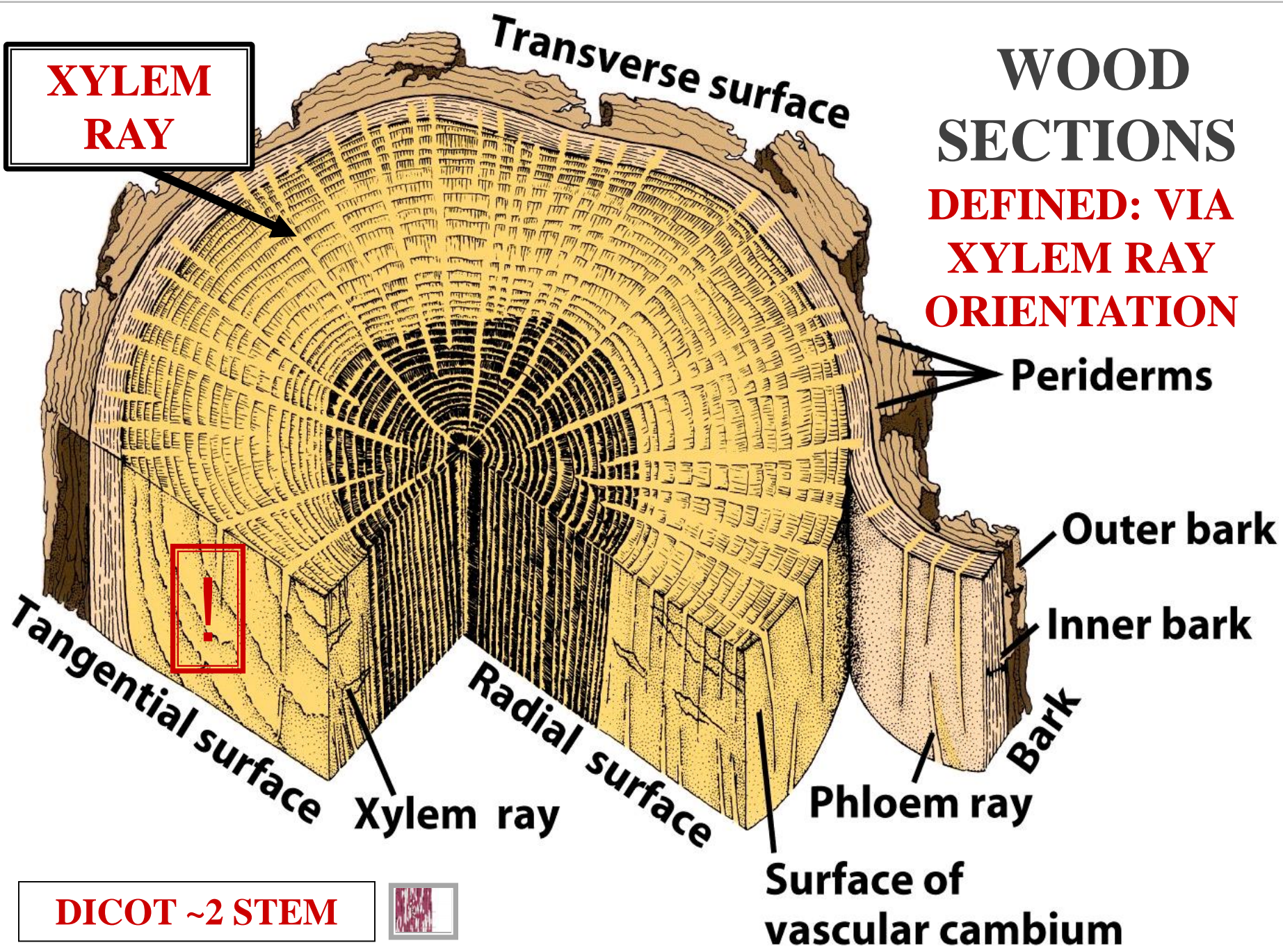
TANGENTIAL WOOD SECTION

**LONGITUDINAL SECTION
OFF STEM CENTER**

**XYLEM RAYS
PERPENDICULAR WITH SECTION**

TANGENTIAL WOOD SECTION

WOOD SECTIONS DEFINED: VIA XYLEM RAY ORIENTATION



**XYLEM
RAY**

Transverse surface

Periderms

Outer bark

Inner bark

Bark

Phloem ray

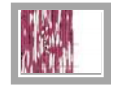
**Surface of
vascular cambium**

Tangential surface

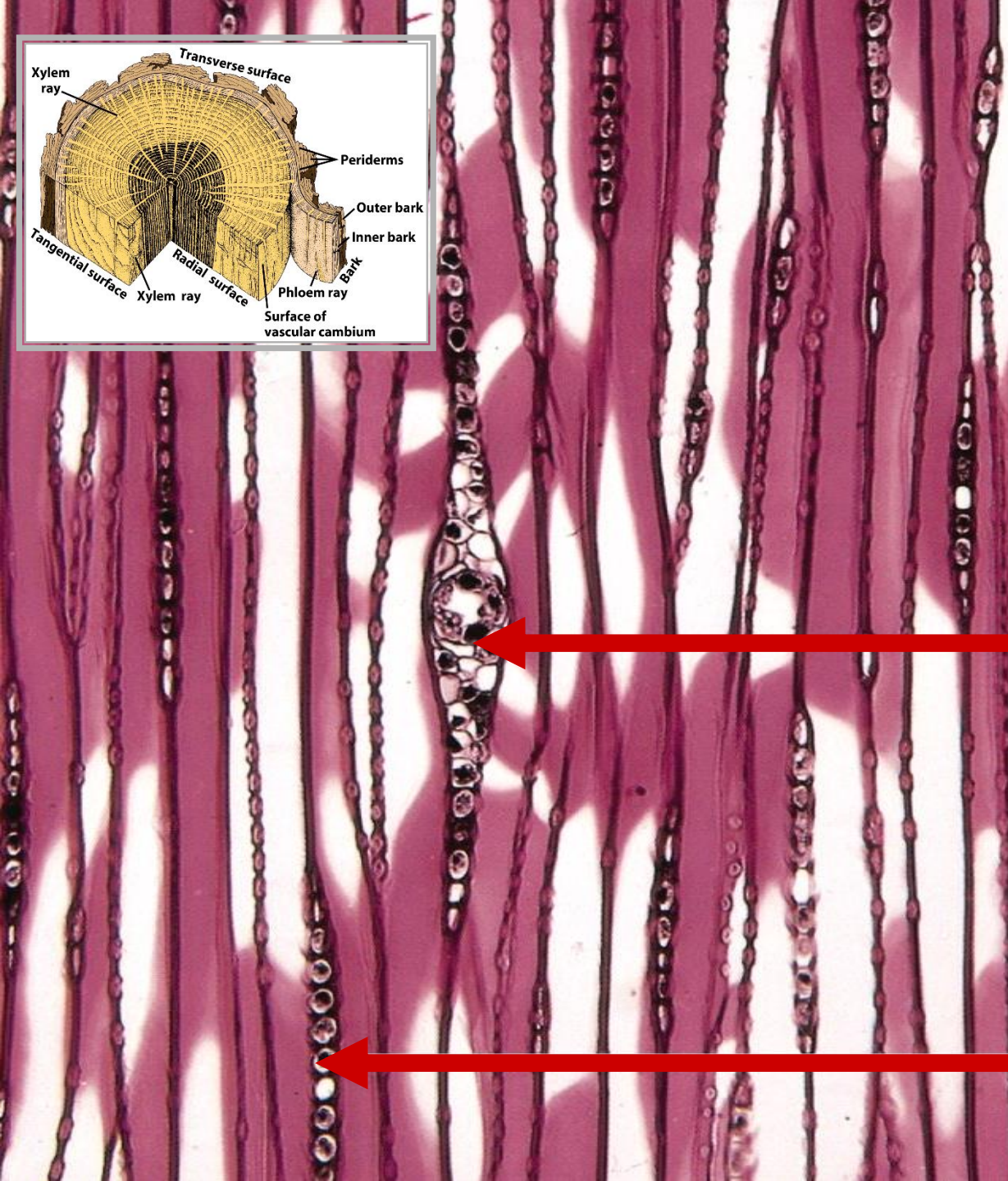
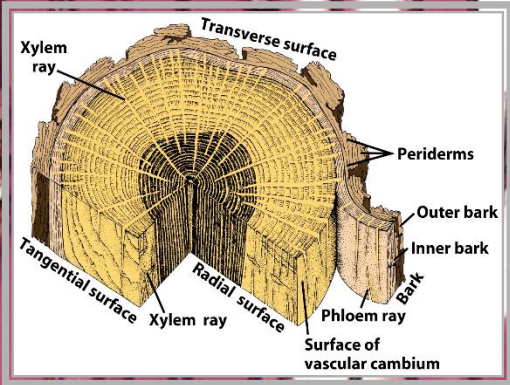
Radial surface

Xylem ray

DICOT ~2 STEM



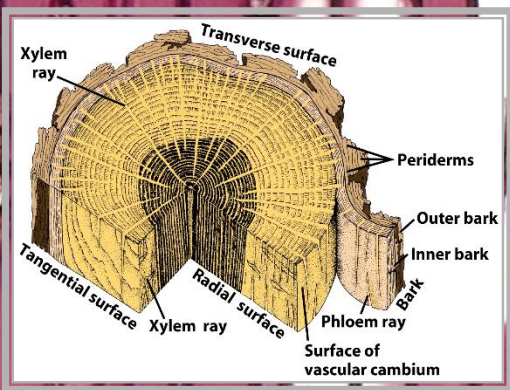
DICOT ~2 STEM



**XYLEM RAY
PERPENDICULAR
WITH SECTION**

**XYLEM RAY
PERPENDICULAR
WITH SECTION**

DICOT ~2 STEM



TANGENTIAL WOOD SECTION

**XYLEM RAY
PERPENDICULAR
WITH SECTION**

**XYLEM RAY
PERPENDICULAR
WITH SECTION**



WOOD SECTIONS SUMMARY

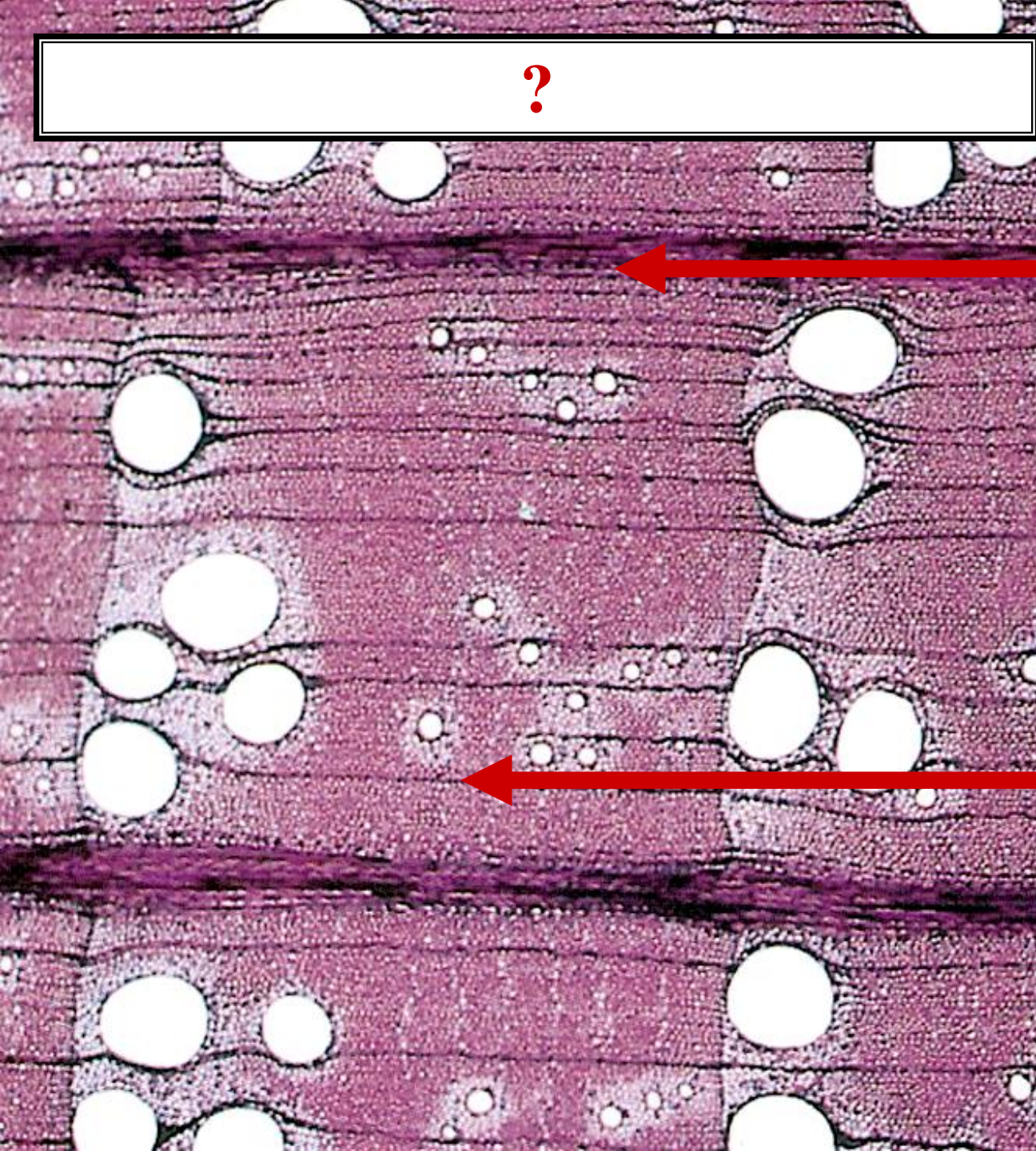
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DICOT ~2 STEM

T

**MULTISERIATE
XYLEM RAY**

**UNISERIATE
XYLEM RAY**



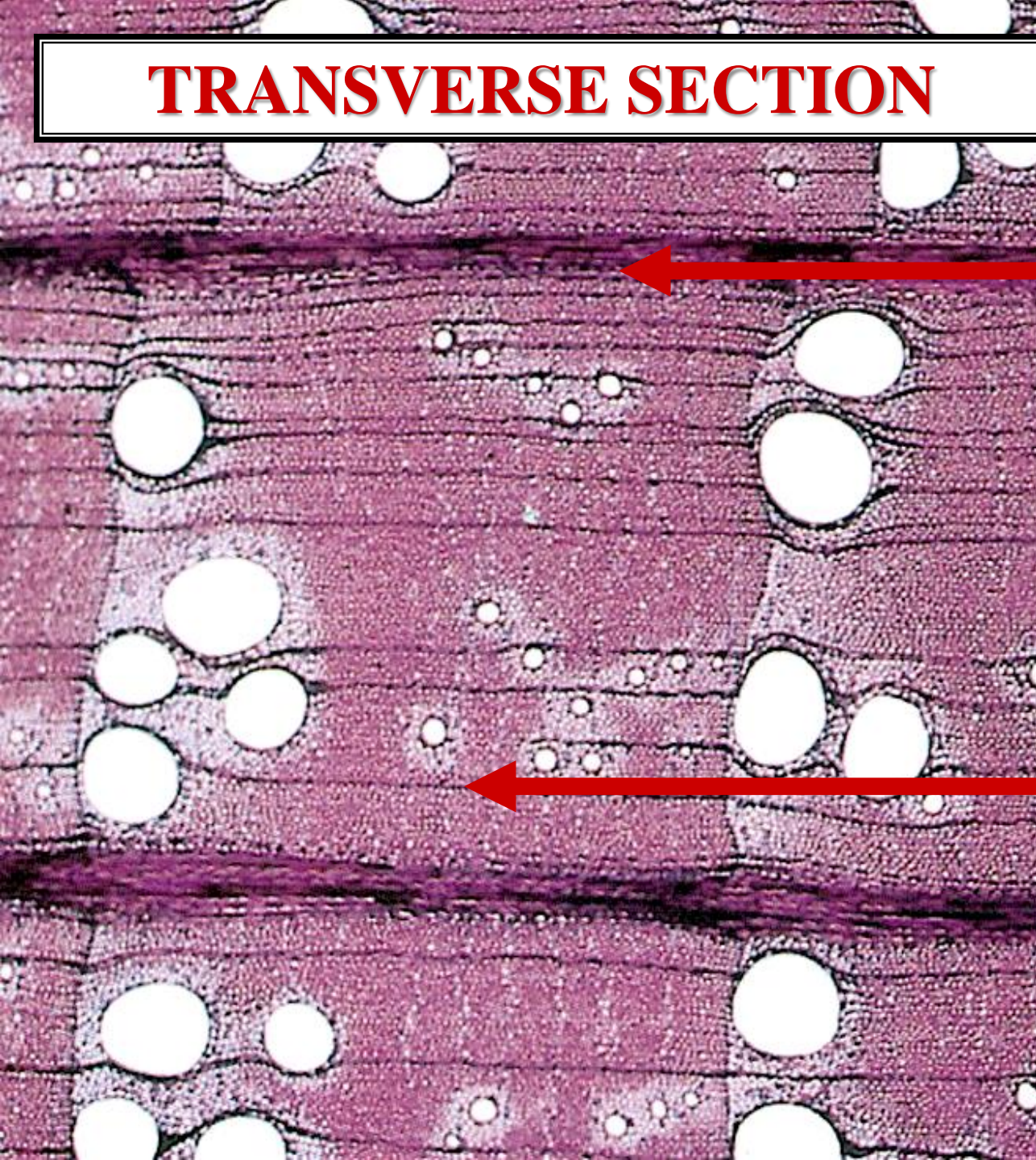
TRANSVERSE SECTION

DICOT ~2 STEM

?

MULTISERIATE
XYLEM RAY

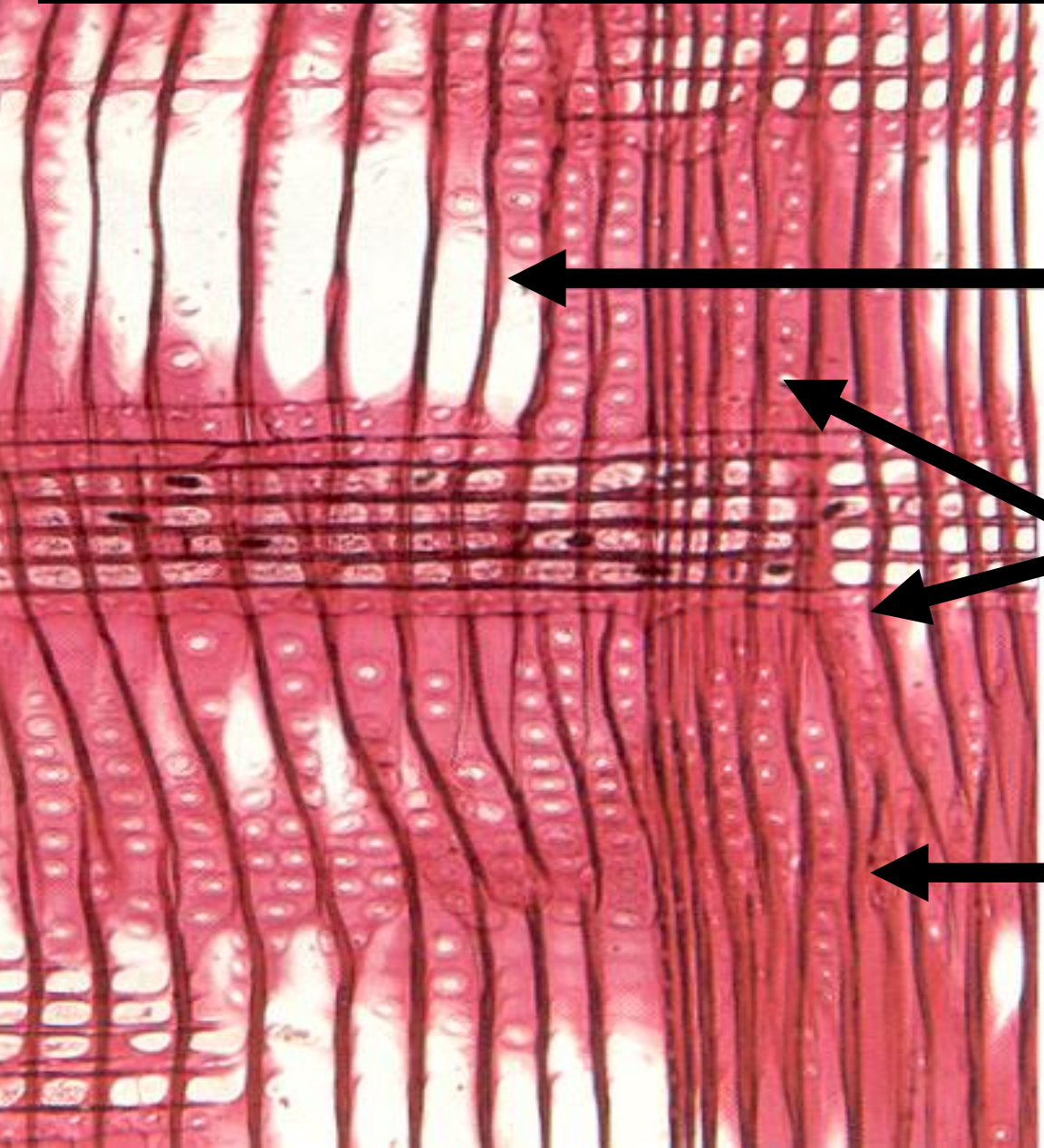
UNISERIATE
XYLEM RAY



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DICOT ~2 STEM

R



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**XYLEM RAY
PARALLEL
WITH SECTION**

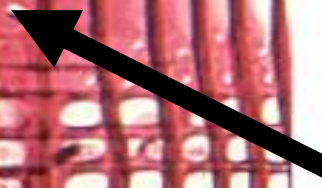
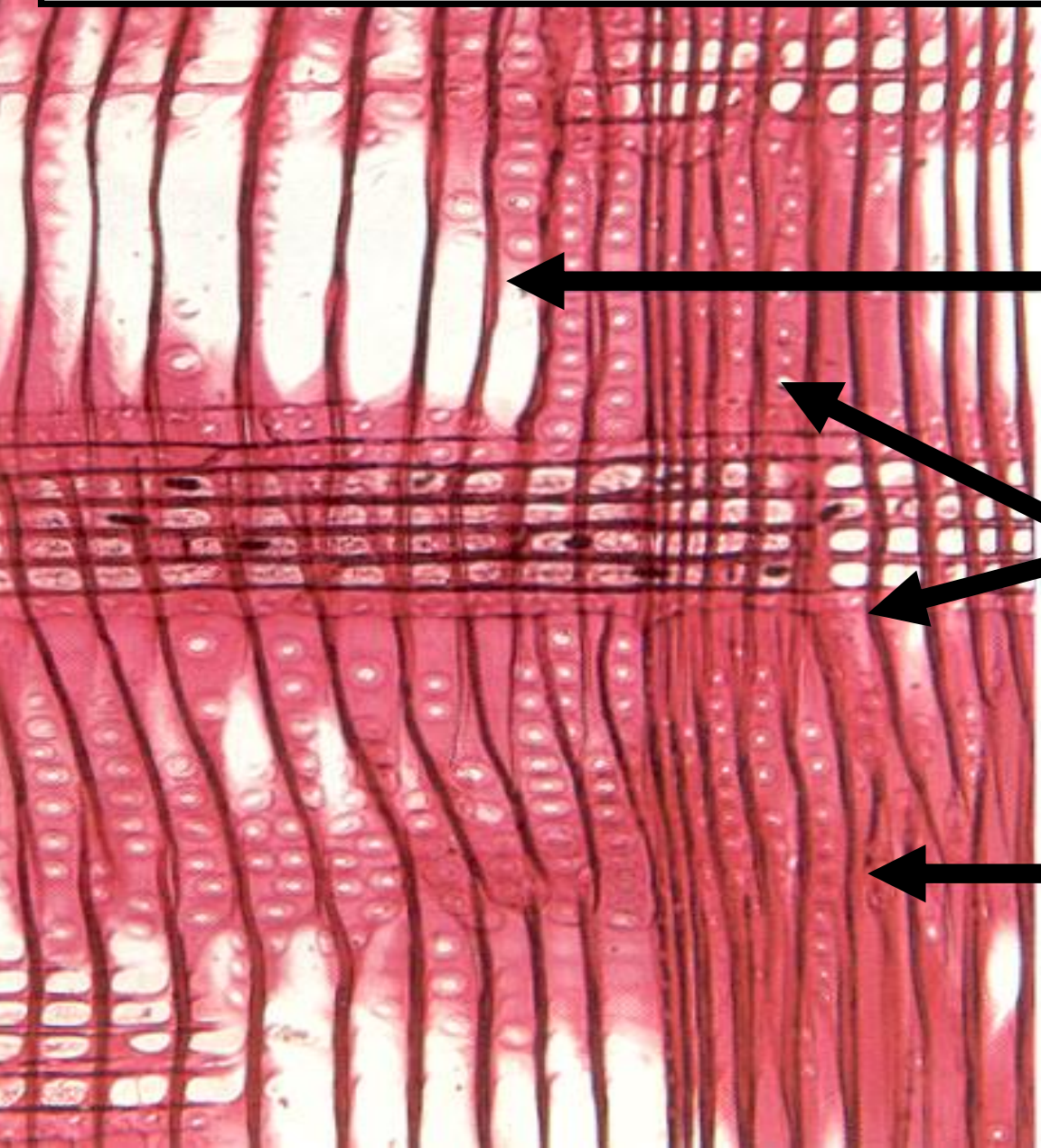
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←

RADIAL SECTION

DICOT ~2 STEM

?



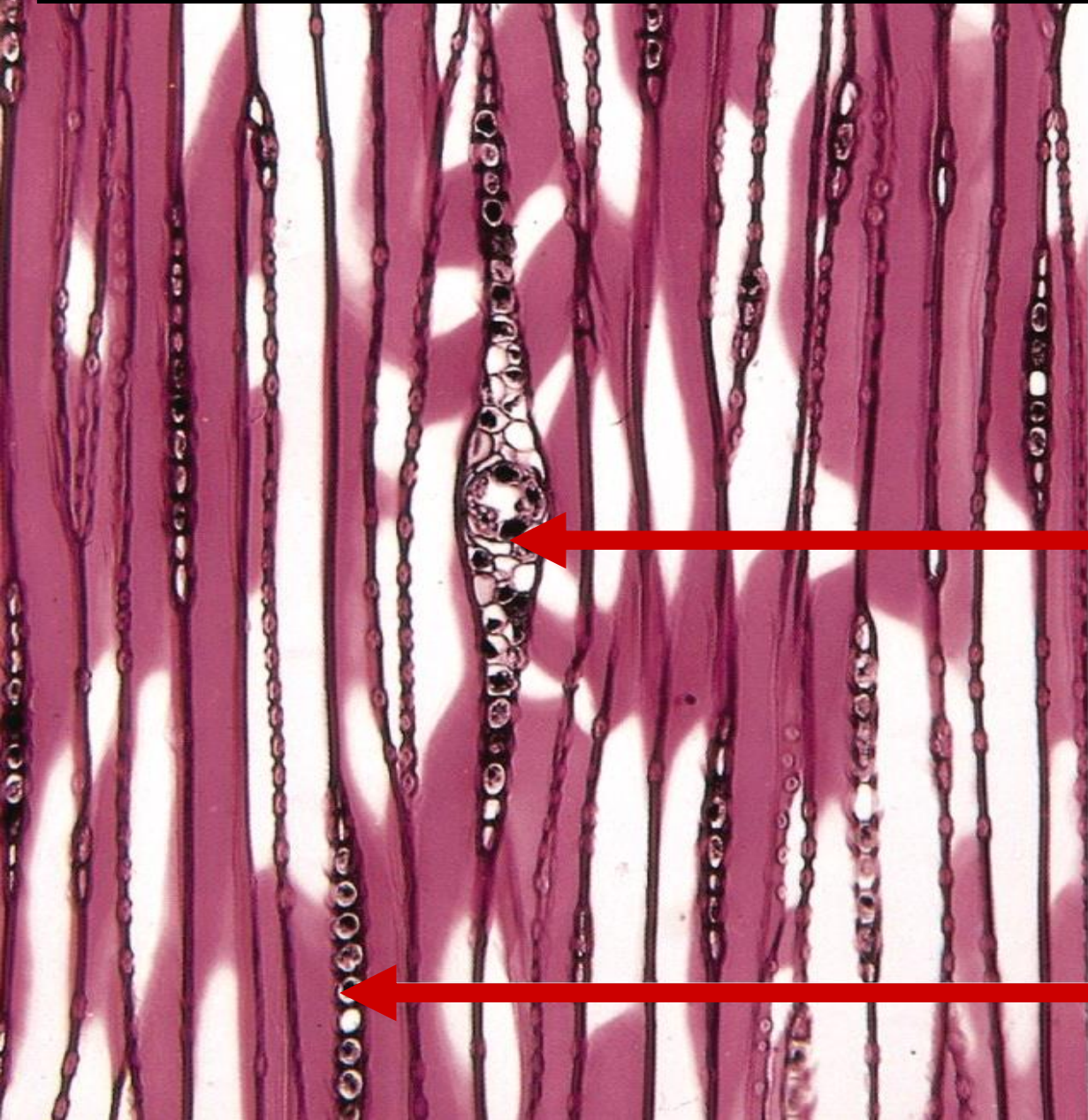
**XYLEM RAY
PARALLEL
WITH SECTION**



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DICOT ~2 STEM

T



XYLEM RAY
PERPENDICULAR
WITH SECTION

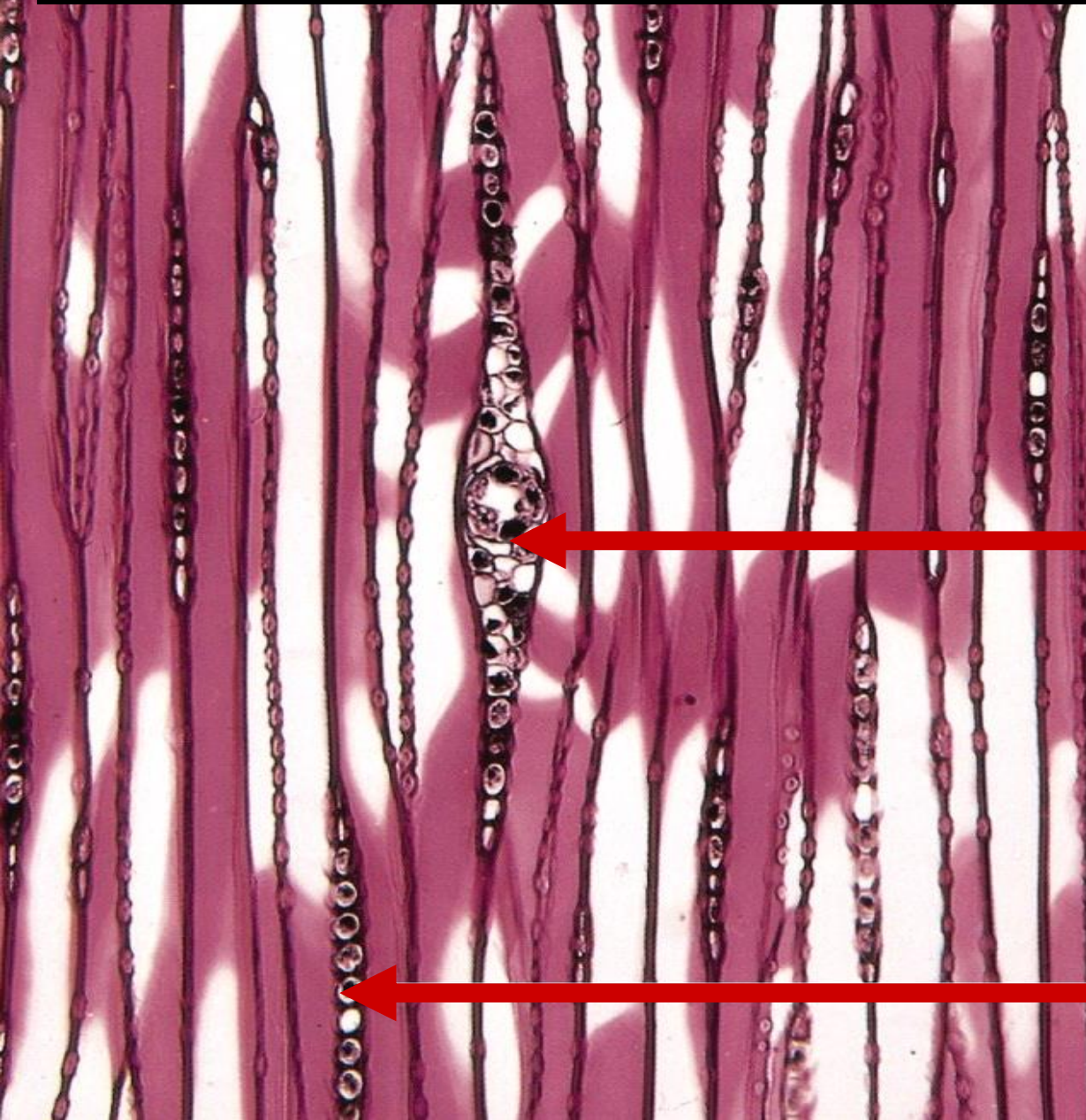
XYLEM RAY

TANGENTIAL SECTION

DICOT ~2 STEM

S

VC



**XYLEM RAY
PERPENDICULAR
WITH SECTION**

XYLEM RAY

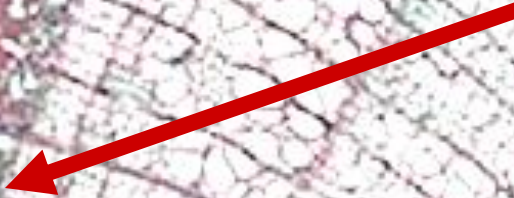


VC

VASCULAR CAMBIUM ACTIVITY SUMMARY

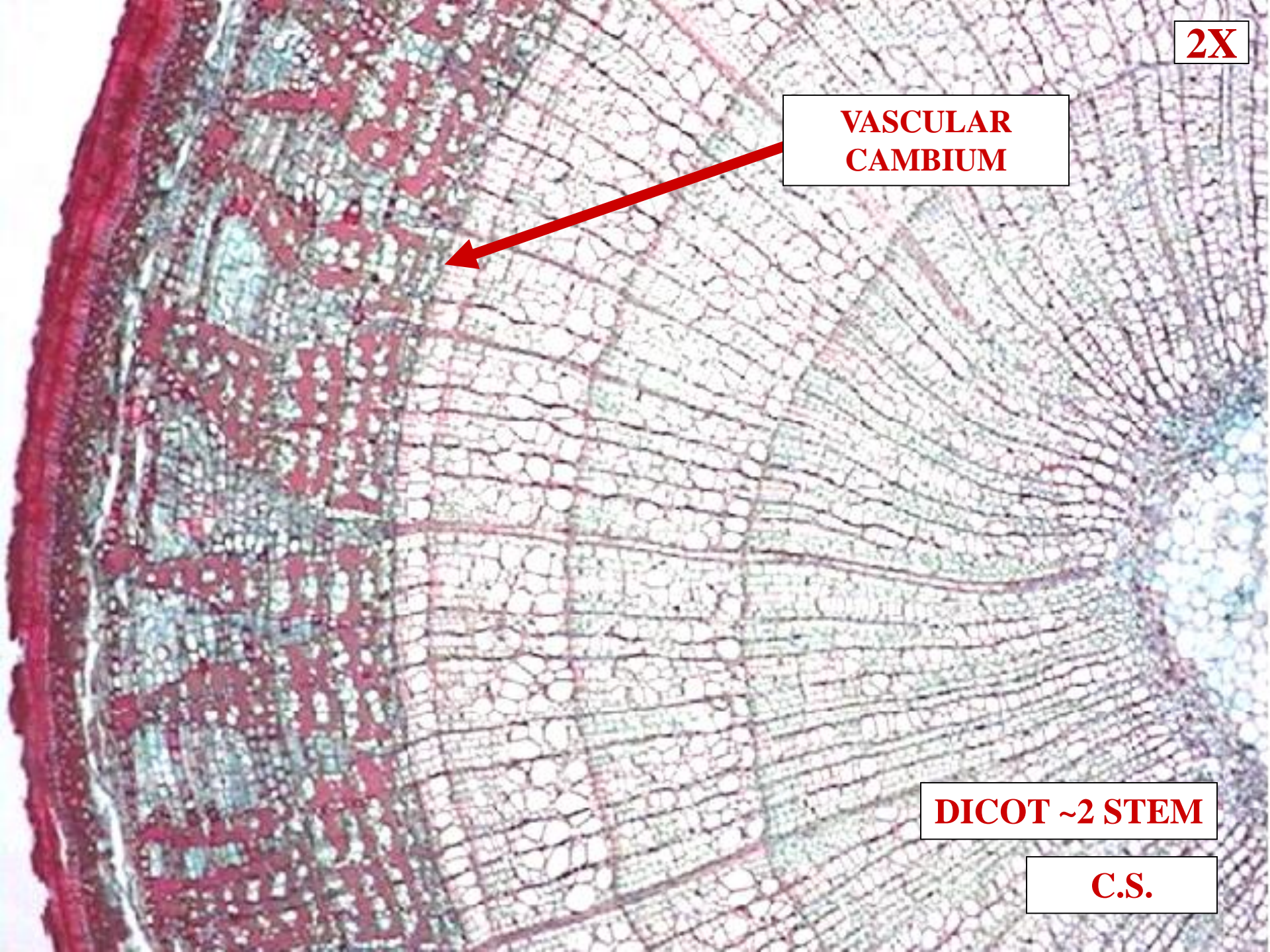
2X

**VASCULAR
CAMBIUM**



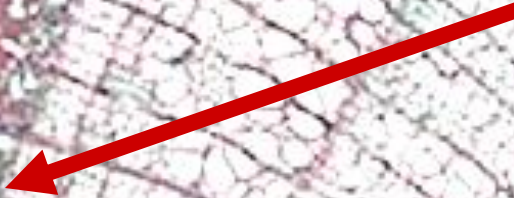
DICOT ~2 STEM

C.S.



2P

**VASCULAR
CAMBIUM**

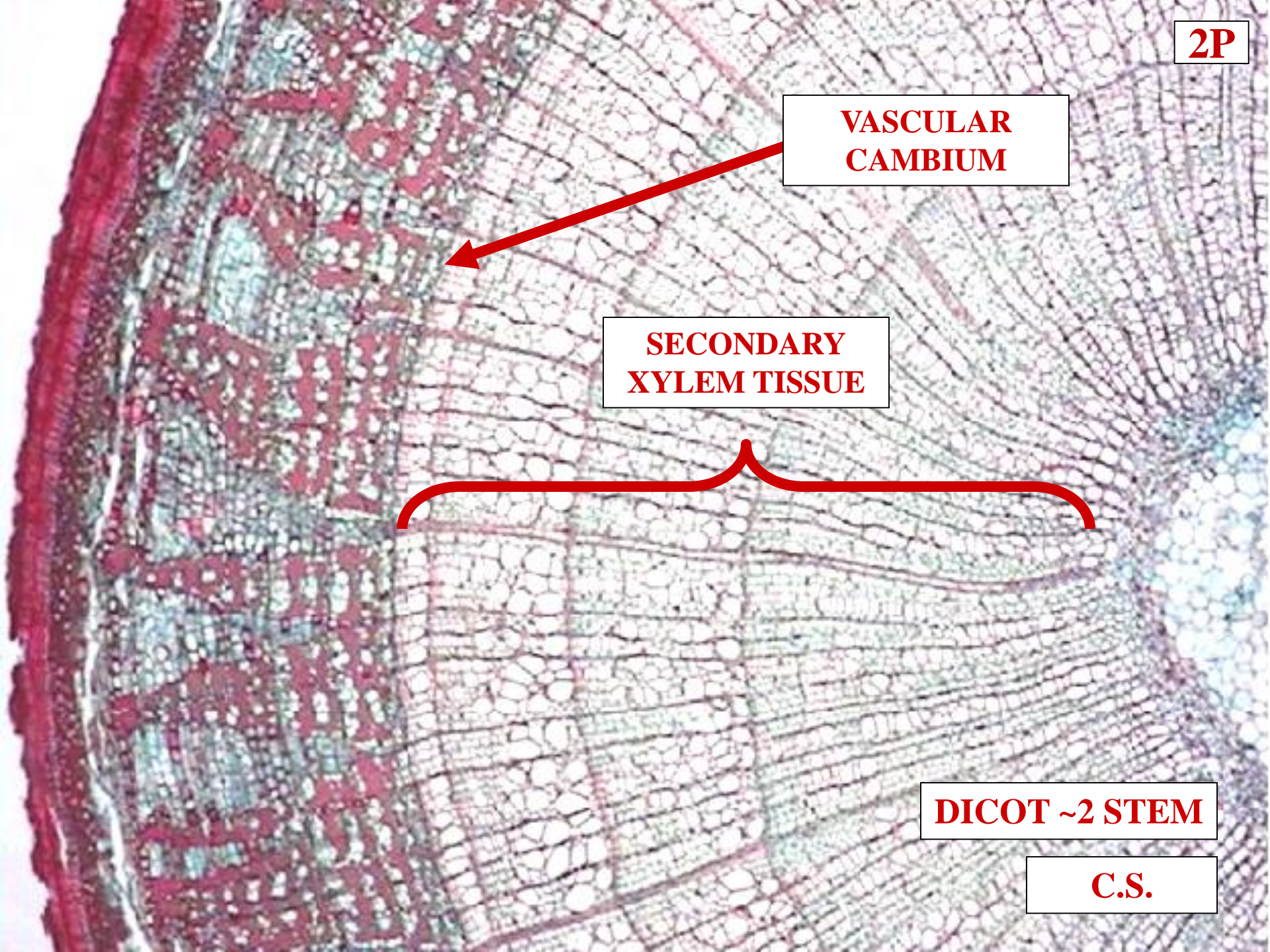


**SECONDARY
XYLEM TISSUE**



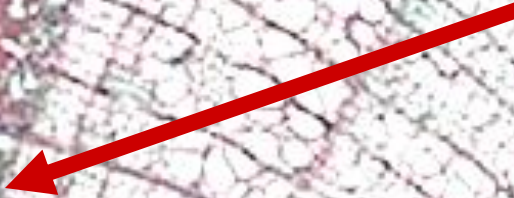
DICOT ~2 STEM

C.S.





**VASCULAR
CAMBIUM**



**SECONDARY
XYLEM TISSUE**

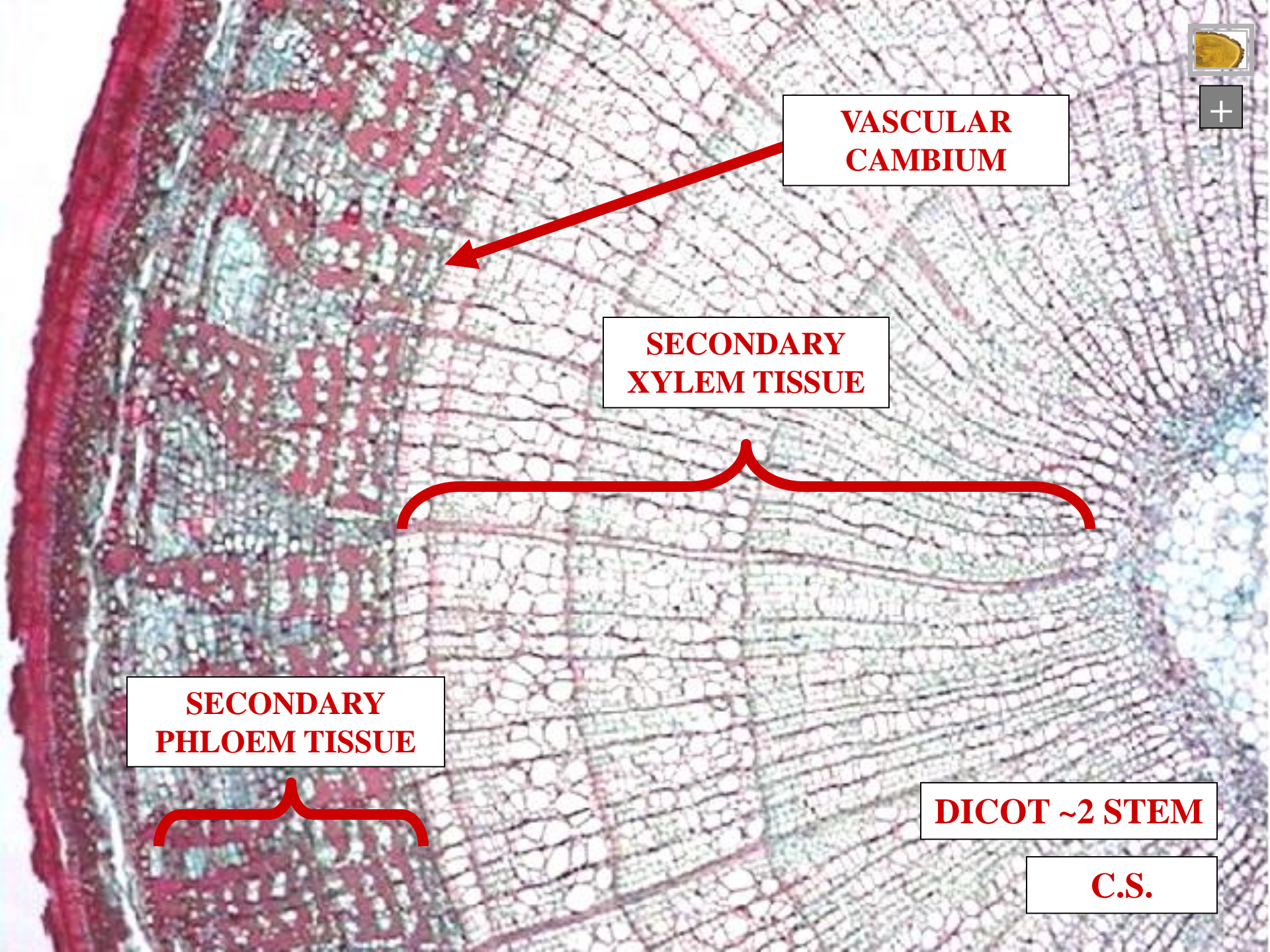


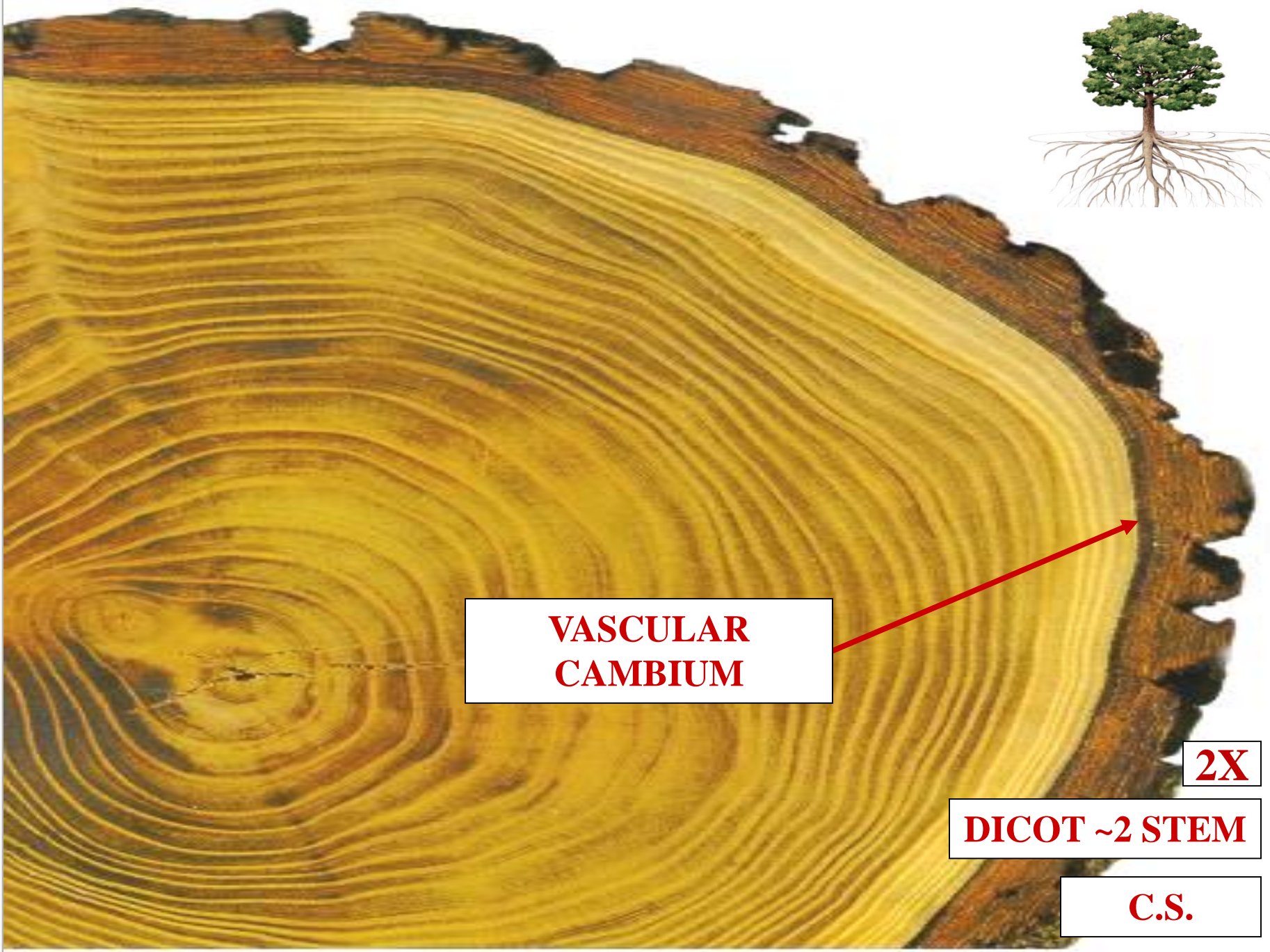
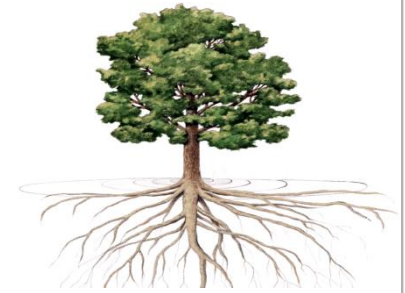
**SECONDARY
PHLOEM TISSUE**



DICOT ~2 STEM

C.S.



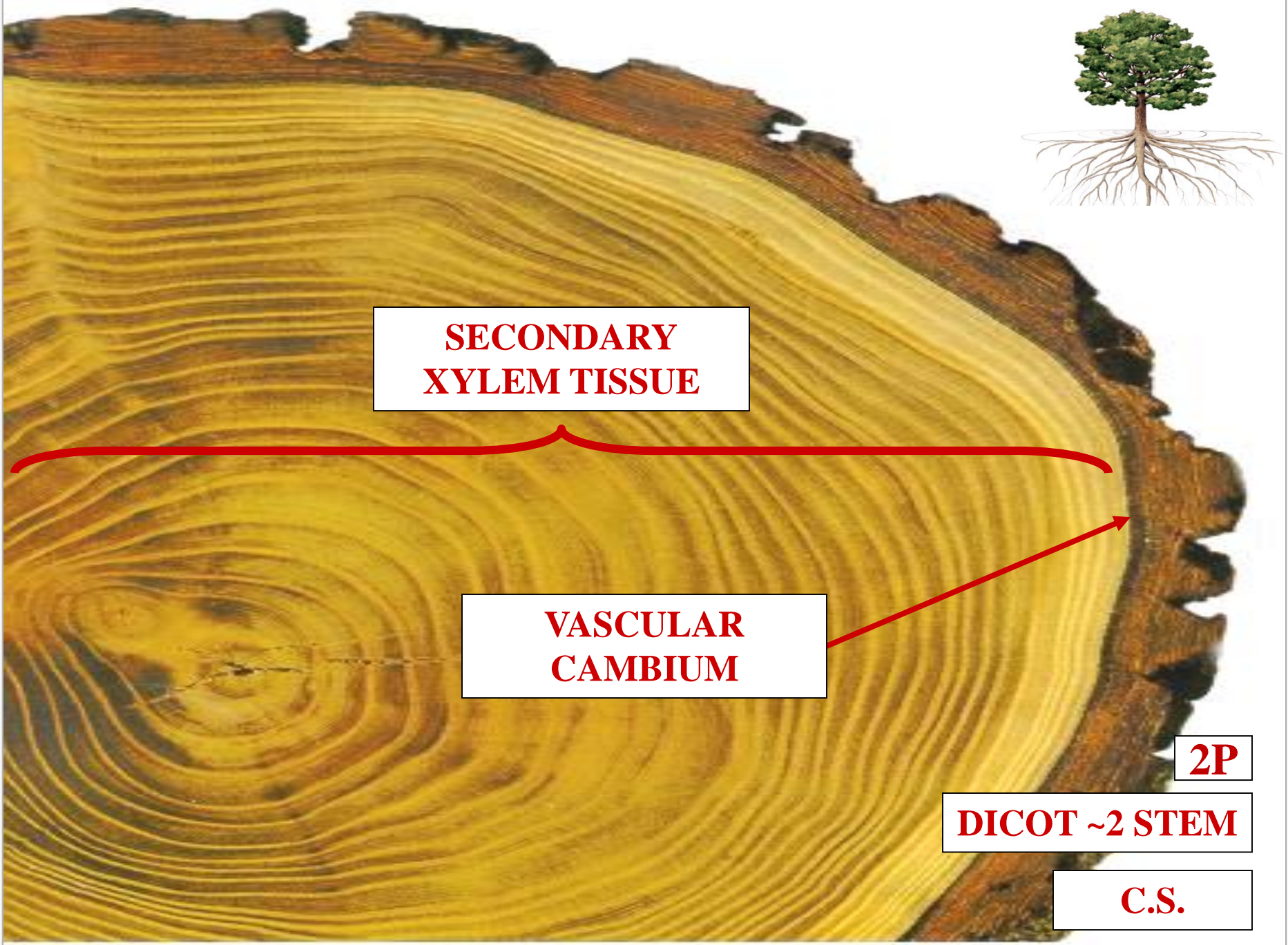
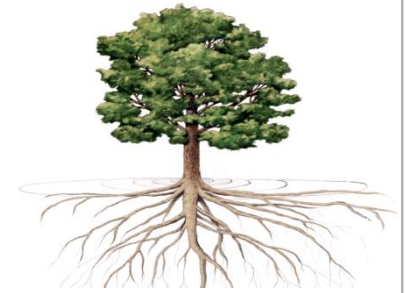


**VASCULAR
CAMBIUM**

2X

DICOT ~2 STEM

C.S.



**SECONDARY
XYLEM TISSUE**



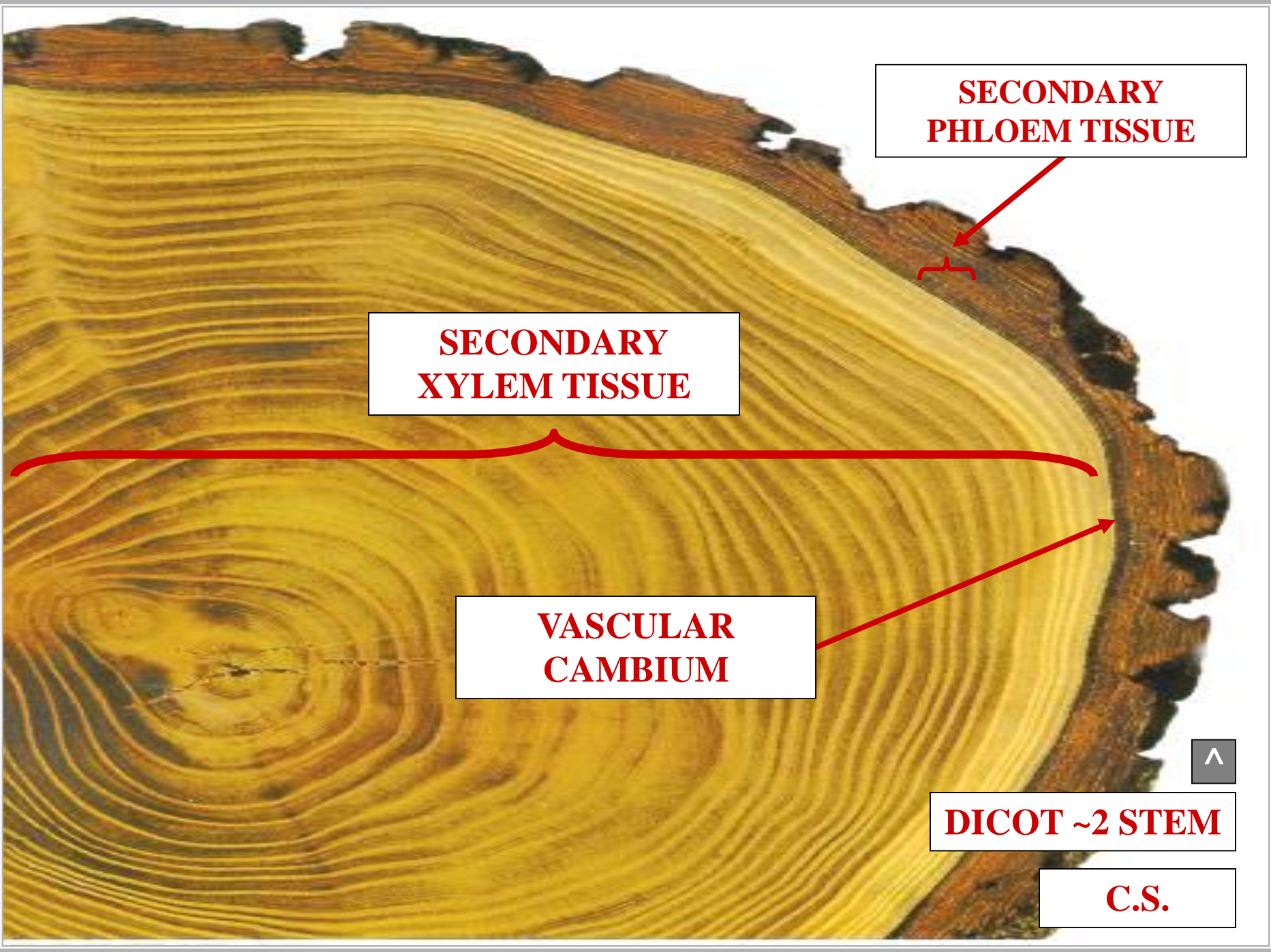
**VASCULAR
CAMBIUM**



2P

DICOT ~2 STEM

C.S.



**SECONDARY
PHLOEM TISSUE**

**SECONDARY
XYLEM TISSUE**

**VASCULAR
CAMBIUM**

DICOT ~2 STEM

C.S.





SECONDARY PHILOEM TISSUE

SECONDARY PHLOEM CELL TYPES

**SECONDARY
PHLOEM TISSUE
CELL TYPES**

FIBERS

**SECONDARY
PHLOEM TISSUE
CELL TYPES**

**SECONDARY
PHLOEM TISSUE
CELL TYPES**

FIBERS

SIEVE MEMBERS

**SECONDARY
PHLOEM TISSUE
CELL TYPES**

**SECONDARY
PHLOEM TISSUE
CELL TYPES**

FIBERS

SIEVE MEMBERS

COMPANION CELLS

**SECONDARY
PHLOEM TISSUE
CELL TYPES**

**SECONDARY
PHLOEM TISSUE
CELL TYPES**

FIBERS

SIEVE MEMBERS

COMPANION CELLS

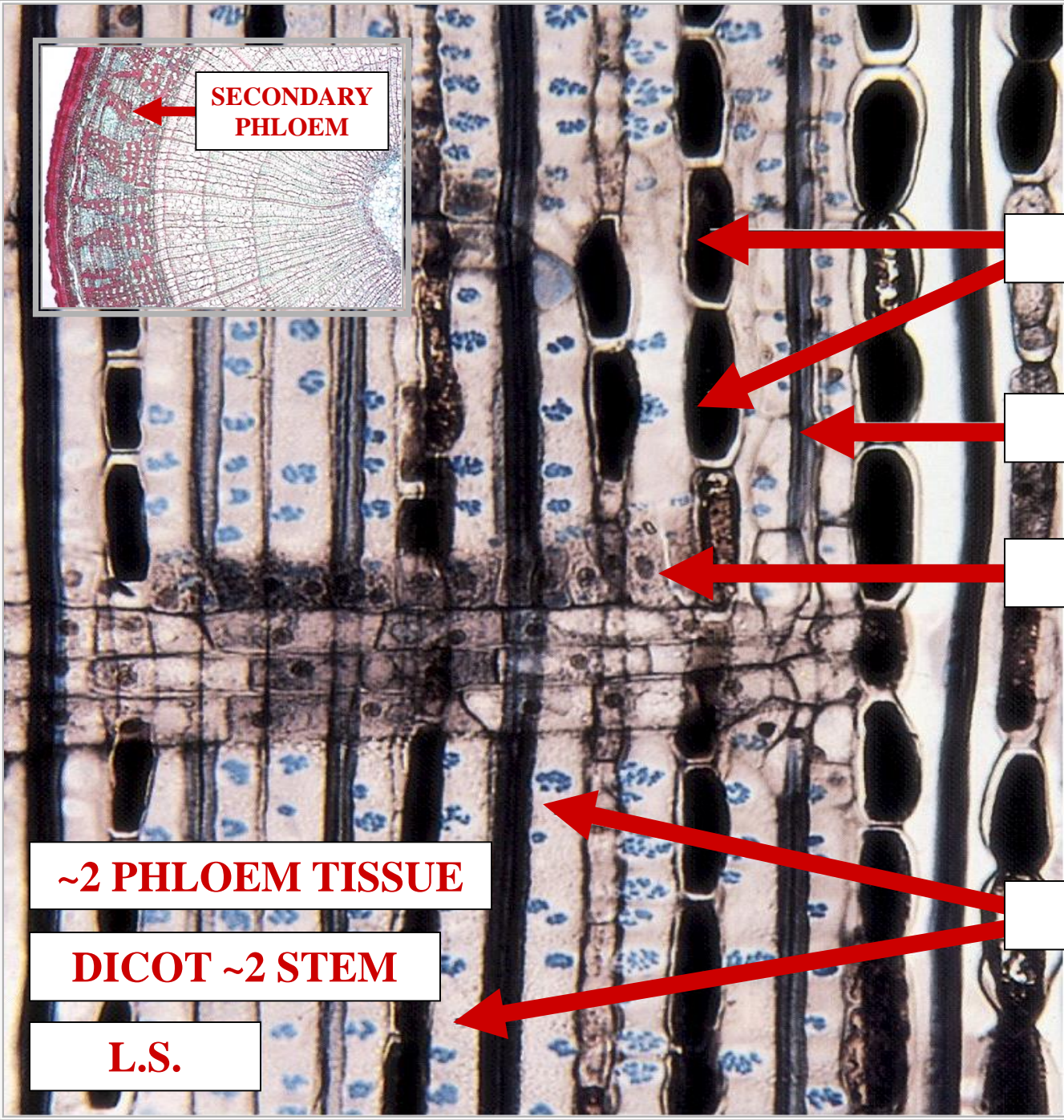
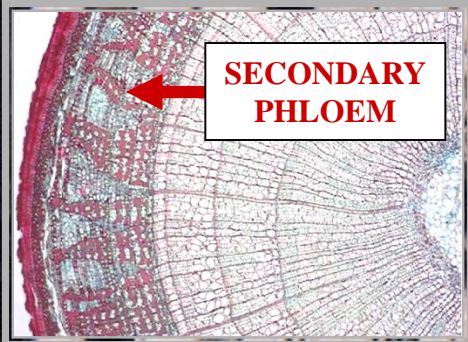
PARENCHYMA

**SECONDARY
PHLOEM TISSUE
CELL TYPES**



SECONDARY PHLOEM CELL TYPES APPLIED

F



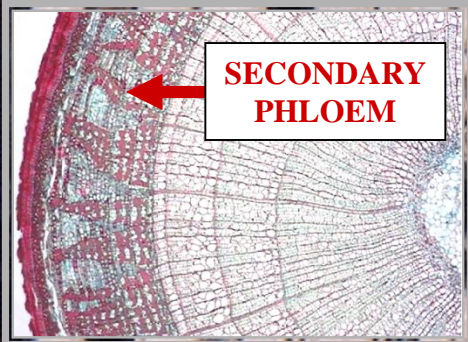
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FIBERS

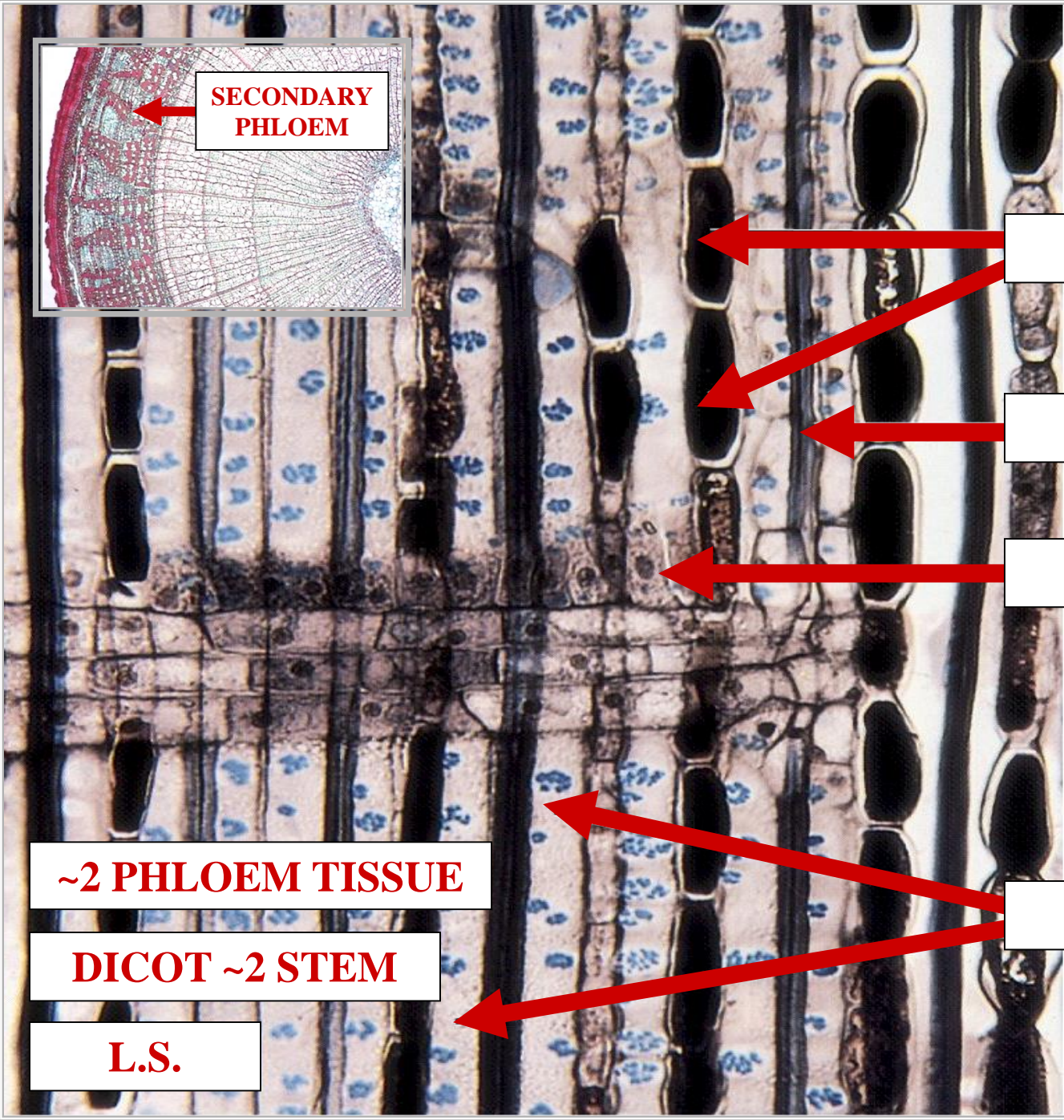


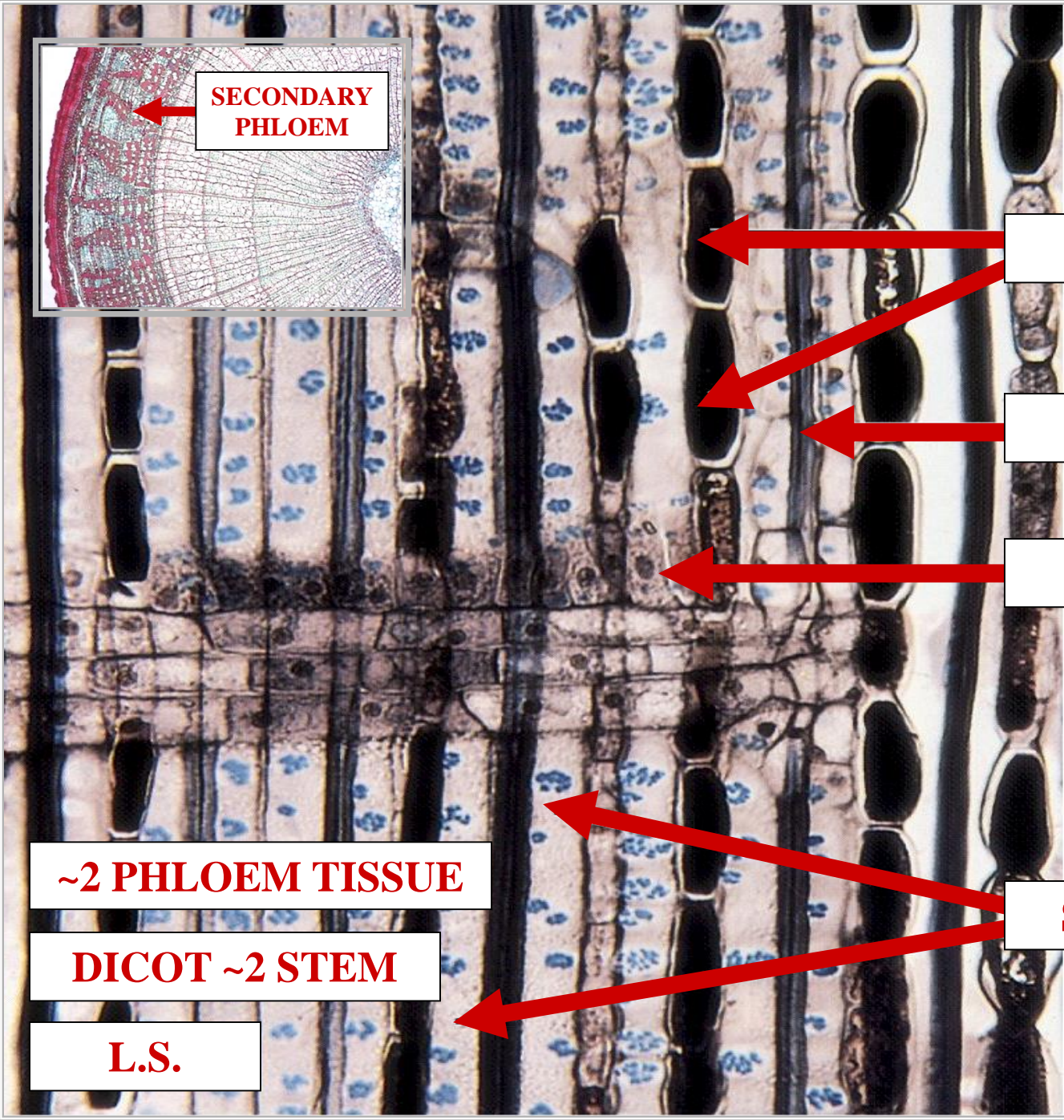
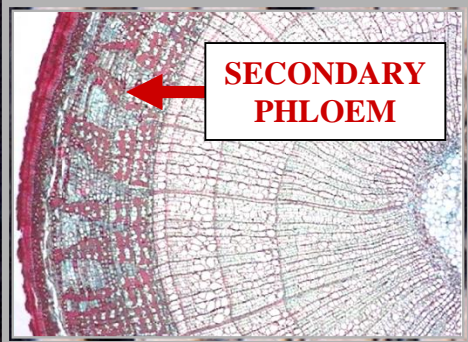
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~2 PHLOEM TISSUE

DICOT ~2 STEM

L.S.





3

FIBERS

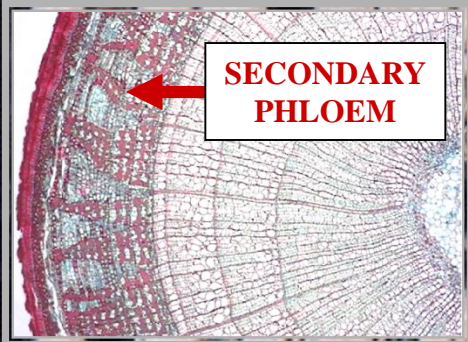
~2 PHLOEM TISSUE

DICOT ~2 STEM

L.S.

SIEVE MEMBERS

PC



COMPANION CELLS

FIBERS

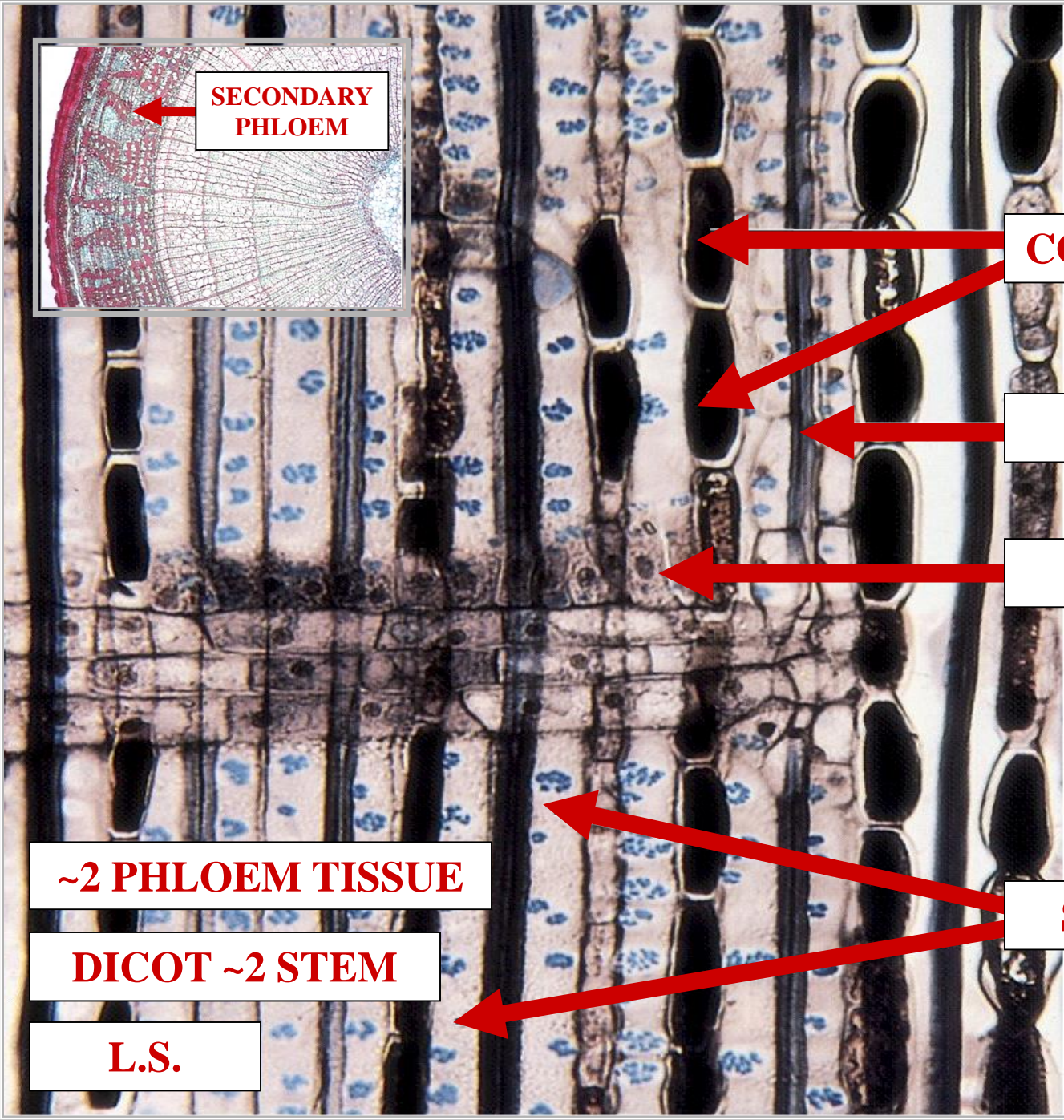
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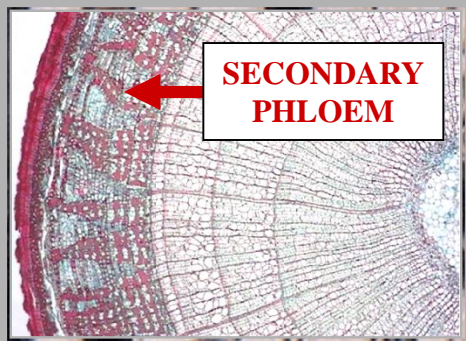
SIEVE MEMBERS

~2 PHLOEM TISSUE

DICOT ~2 STEM

L.S.





**SECONDARY
PHLOEM**

COMPANION CELLS

FIBERS

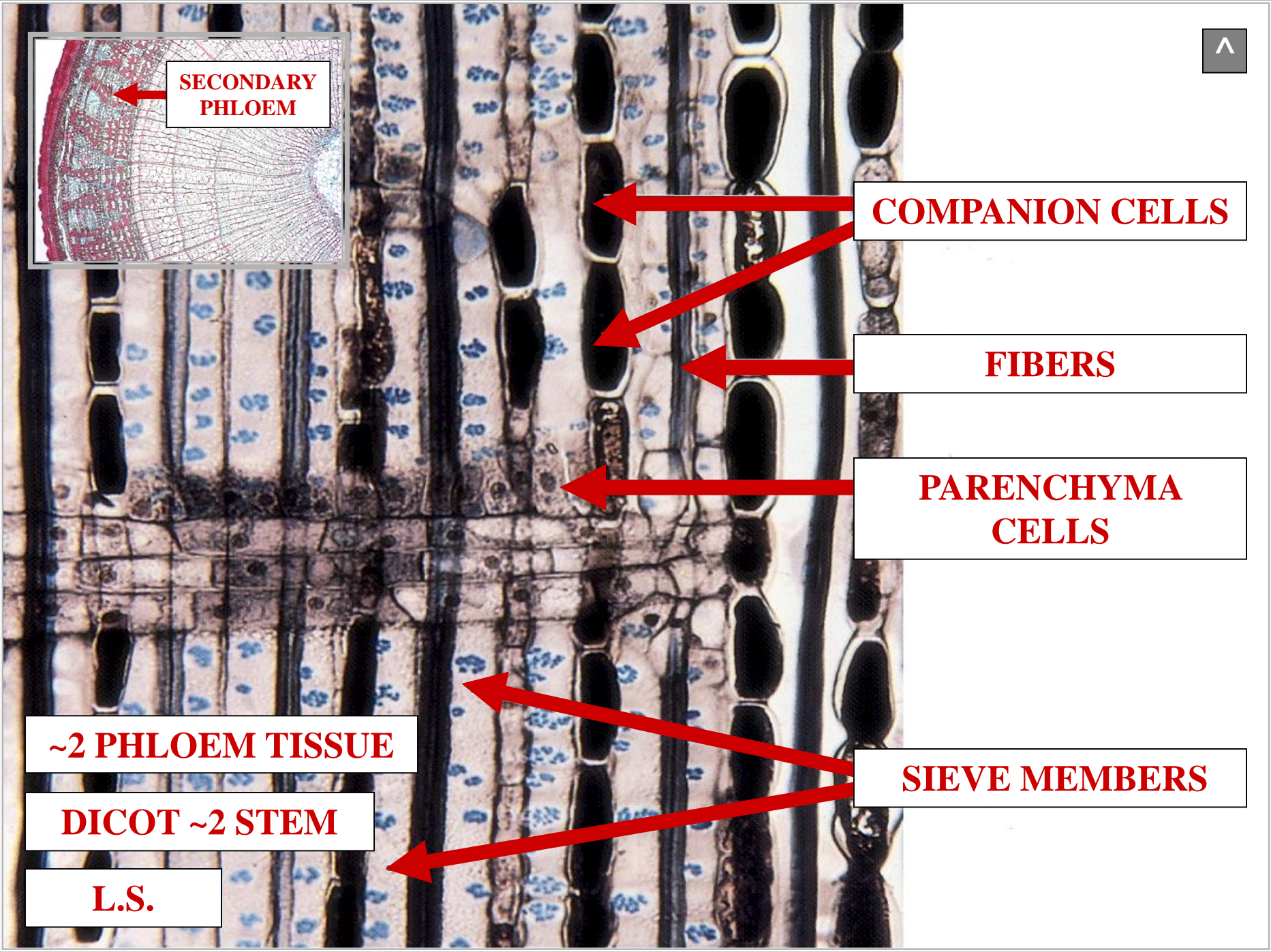
**PARENCHYMA
CELLS**

~2 PHLOEM TISSUE

DICOT ~2 STEM

L.S.

SIEVE MEMBERS



**SECONDARY
PHLOEM
PARENCHYMA
CELL TYPES**

**SECONDARY PHLOEM
PARENCHYMA
TYPES**

AXIAL PARENCHYMA

**SECONDARY PHLOEM
PARENCHYMA
TYPES**

**SECONDARY PHLOEM
PARENCHYMA
TYPES**



**AXIAL PARENCHYMA
RAY PARENCHYMA**

**SECONDARY PHLOEM
PARENCHYMA
TYPES**

**SECONDARY
PHILOEM TISSUE
AXIAL
PARENCHYMA**

**AXIAL
PARENCHYMA**

SECONDARY PHLOEM TISSUE AXIAL PARENCHYMA



VERTICAL ORIENTATION

**SECONDARY PHLOEM TISSUE
AXIAL PARENCHYMA**

SECONDARY PHLOEM TISSUE AXIAL PARENCHYMA



VERTICAL ORIENTATION

VERTICAL TRANSPORT

**SECONDARY PHLOEM TISSUE
AXIAL PARENCHYMA**

SECONDARY PHLOEM TISSUE AXIAL PARENCHYMA



VERTICAL ORIENTATION

VERTICAL TRANSPORT

FUSIFORM INITIAL DERIVED

**SECONDARY PHLOEM TISSUE
AXIAL PARENCHYMA**