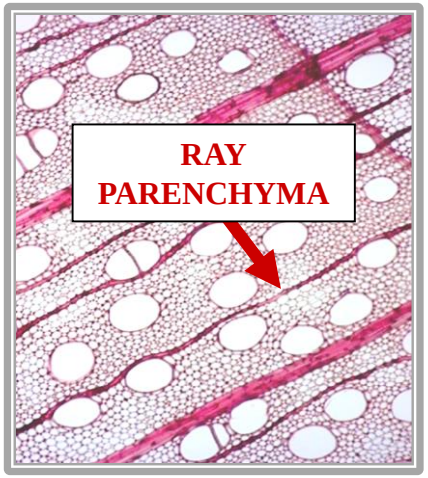
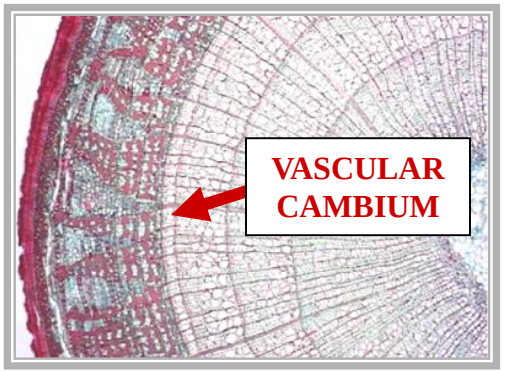
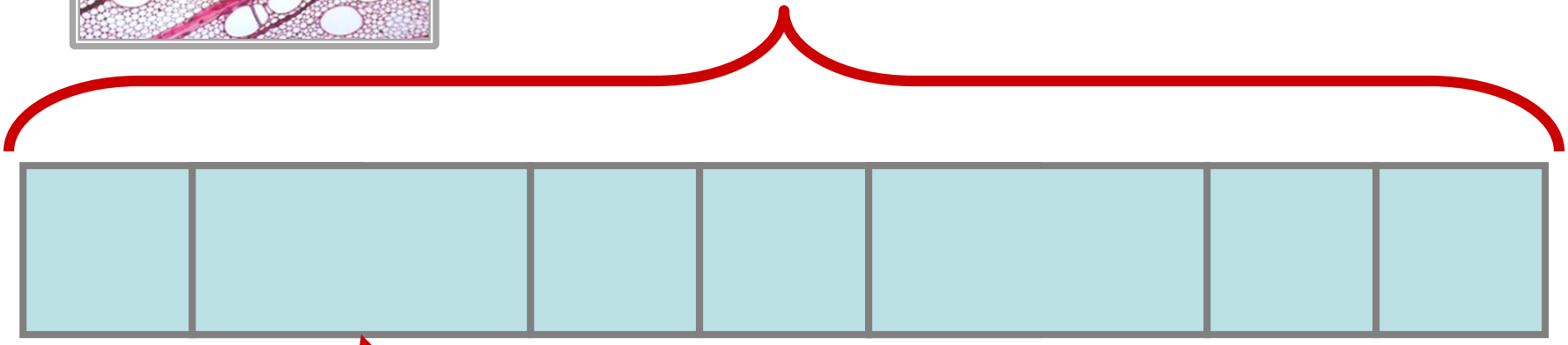




RAY PARENCHYMA

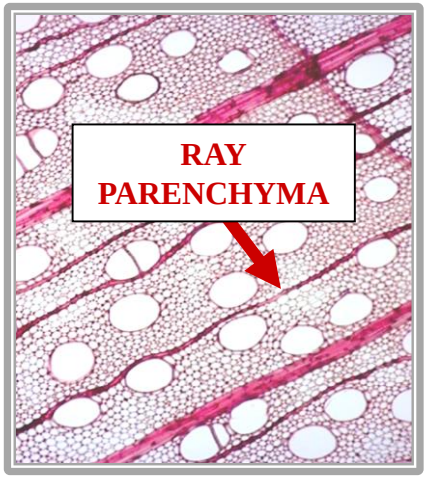


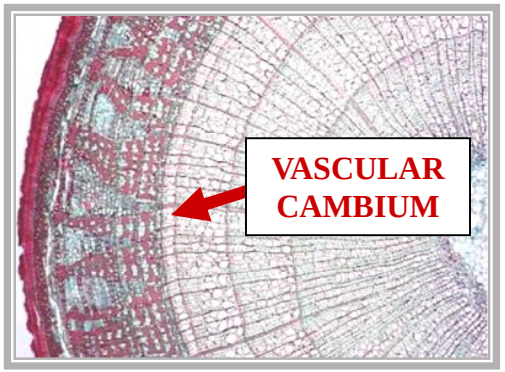
PROCUMBENT CELL RECTANGULAR SHAPE

UC

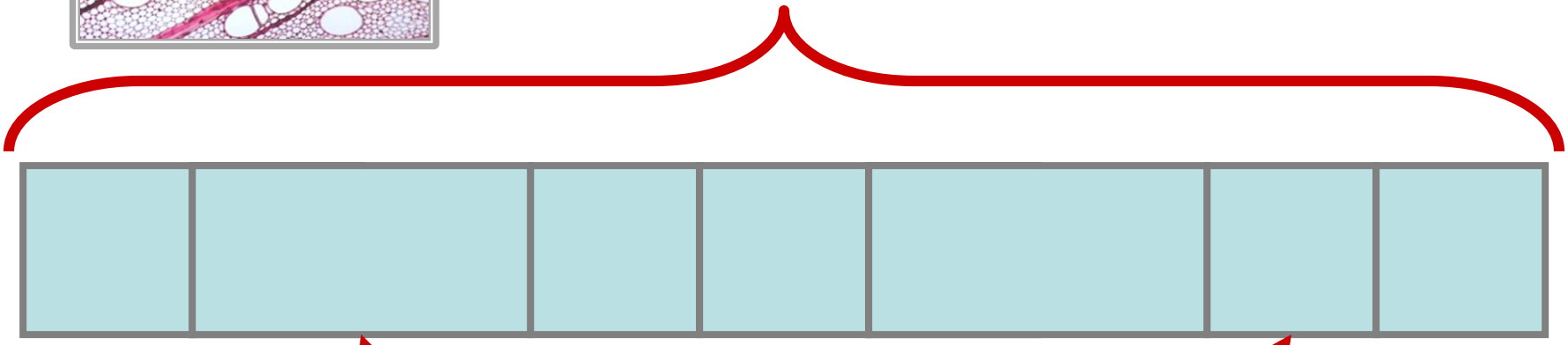
DICOT ~2 STEM

C.S.





RAY PARENCHYMA



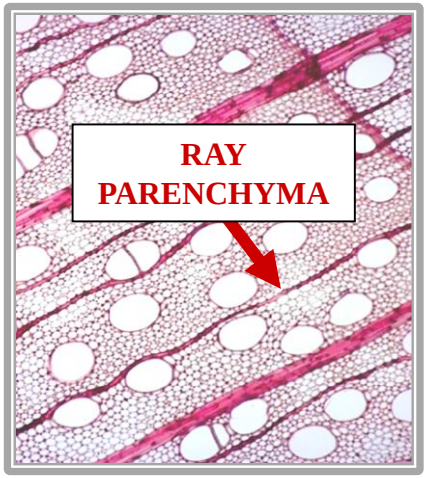
PROCUMBENT CELL RECTANGULAR SHAPE

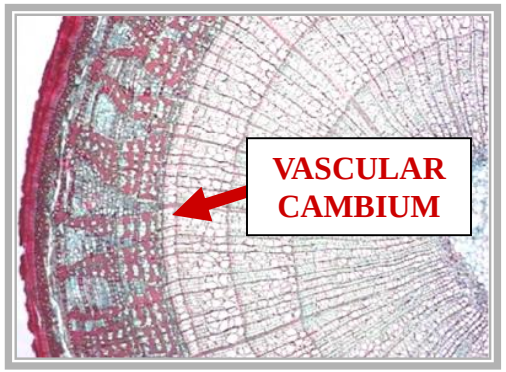
UPRIGHT CELL

SS

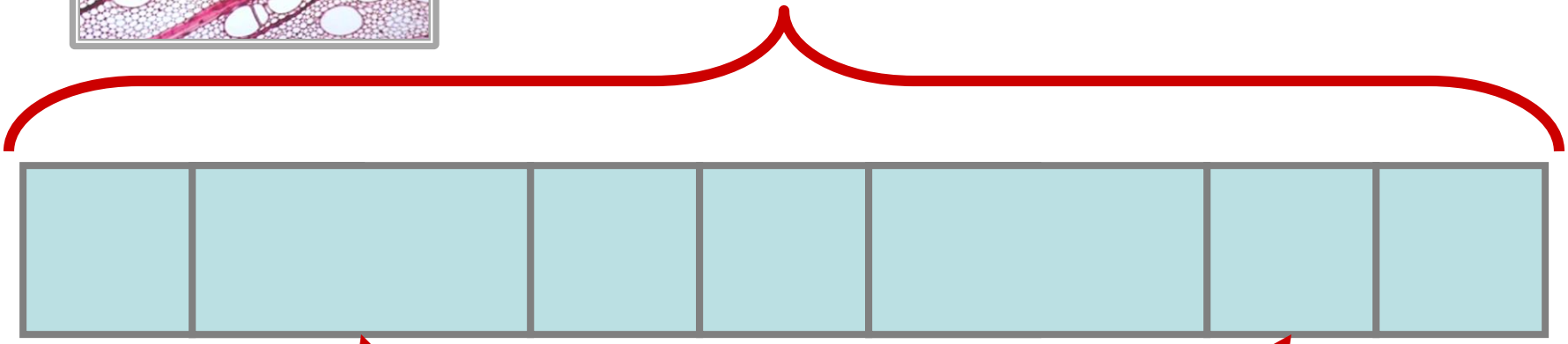
DICOT ~2 STEM

C.S.





RAY PARENCHYMA



PROCUMBENT CELL RECTANGULAR SHAPE

UPRIGHT CELL SQUARE SHAPE

DICOT ~2 STEM

C.S.

RAY PARENCHYMA TERMS

U

UNICELLULAR RAY

HETEROCELLULAR RAY

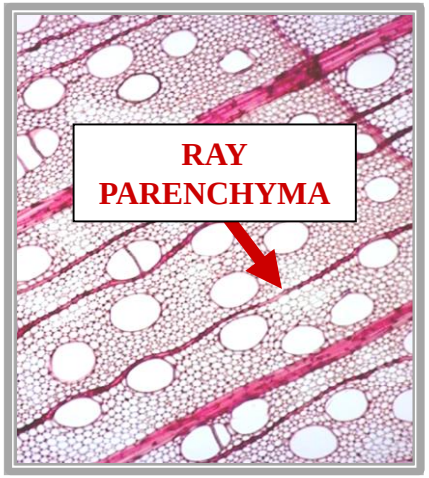
UNICELLULAR RAY

RAY PARENCHYMA
UNICELLULAR RAY

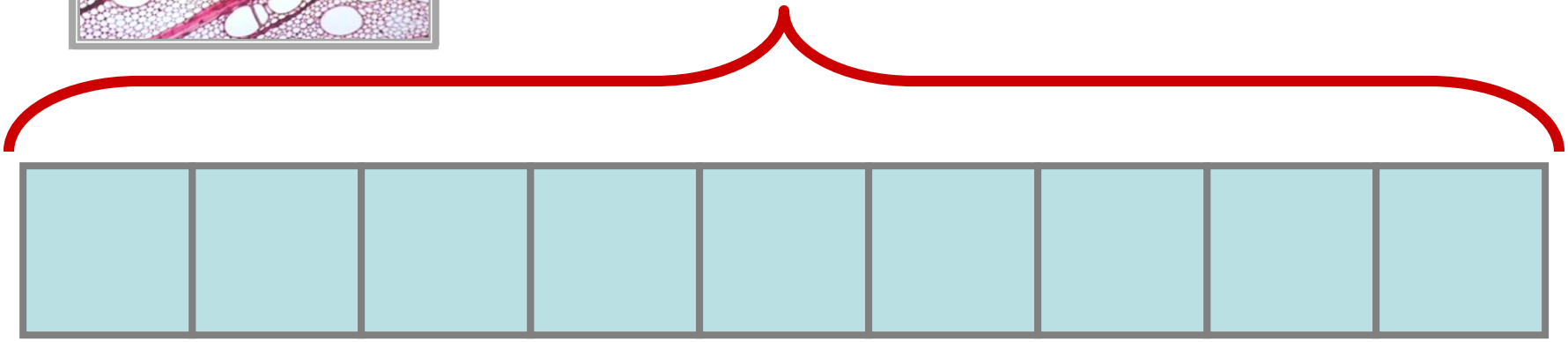
ONE CELL TYPE WITHIN RAY

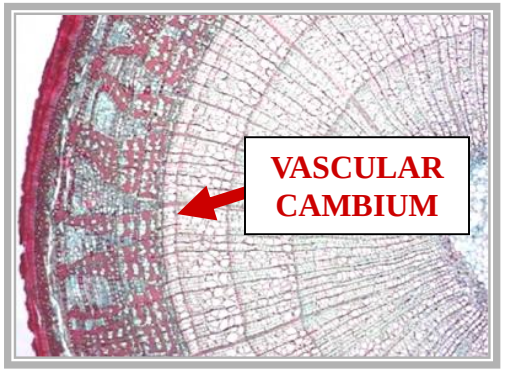
RAY PARENCHYMA
UNICELLULAR RAY

UR



RAY
PARENCHYMA

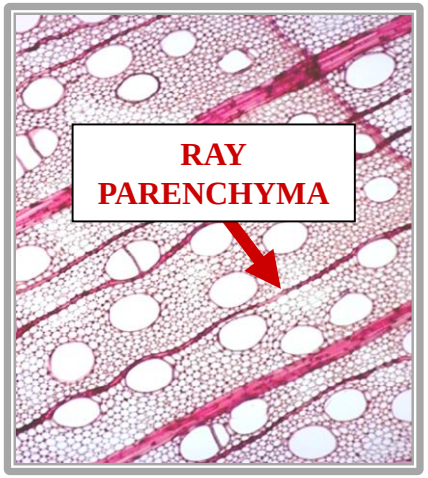




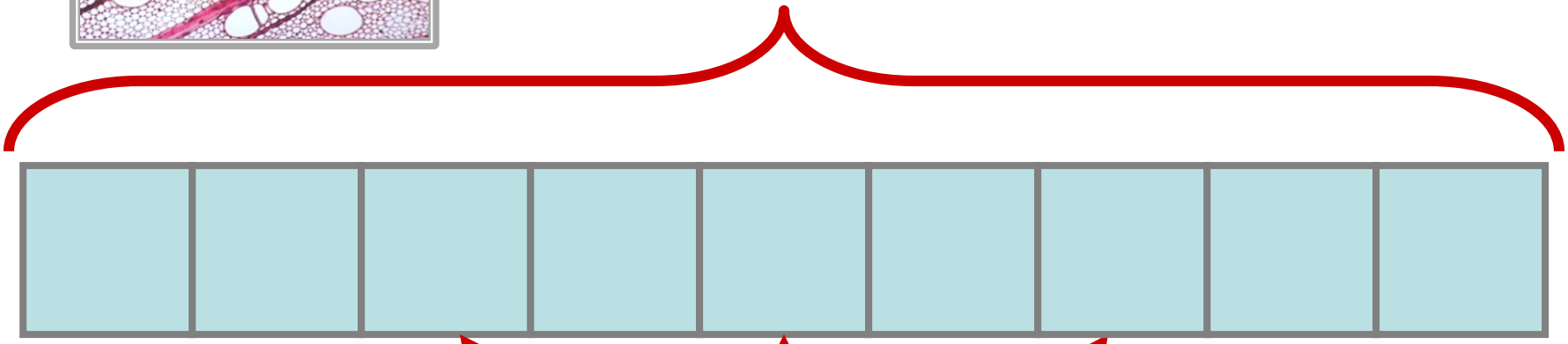
DICOT ~2 STEM

C.S.

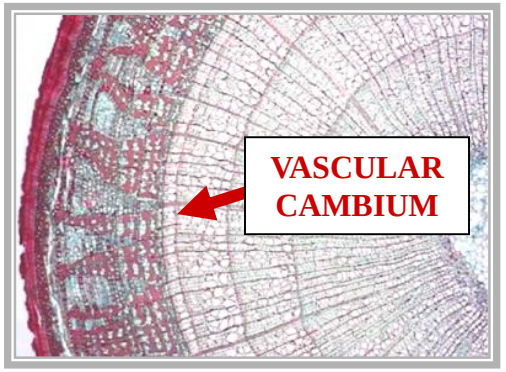
UC



RAY
PARENCHYMA

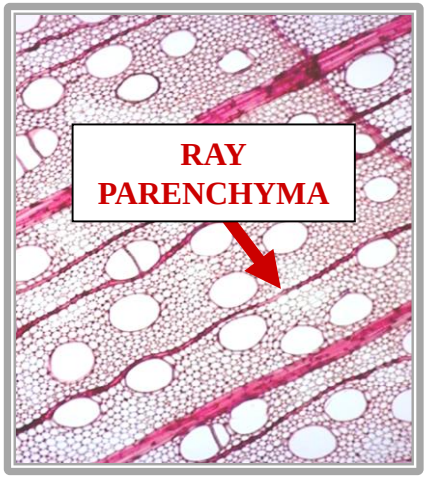


UPRIGHT
CELLS



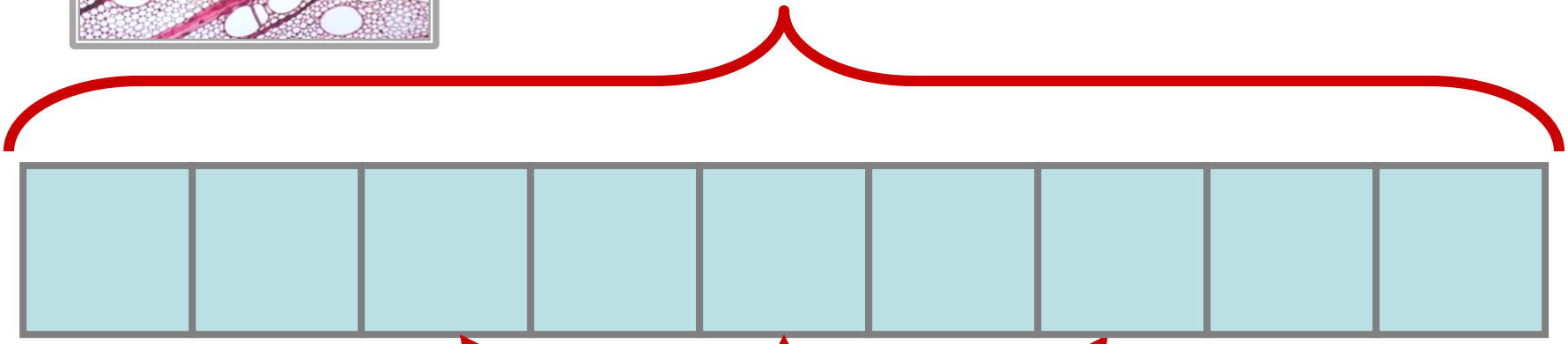
DICOT ~2 STEM

C.S.

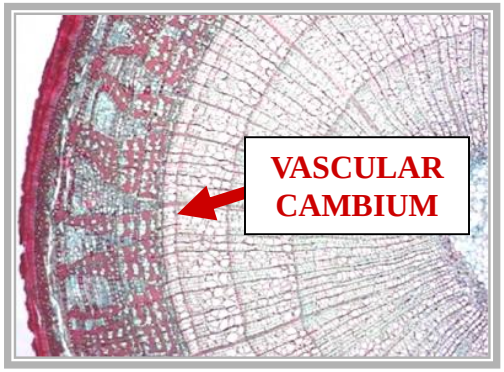


RAY PARENCHYMA

UNICELLULAR RAY



UPRIGHT CELLS



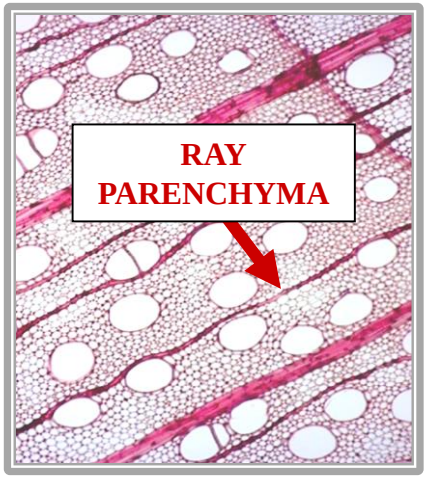
Λ

PR

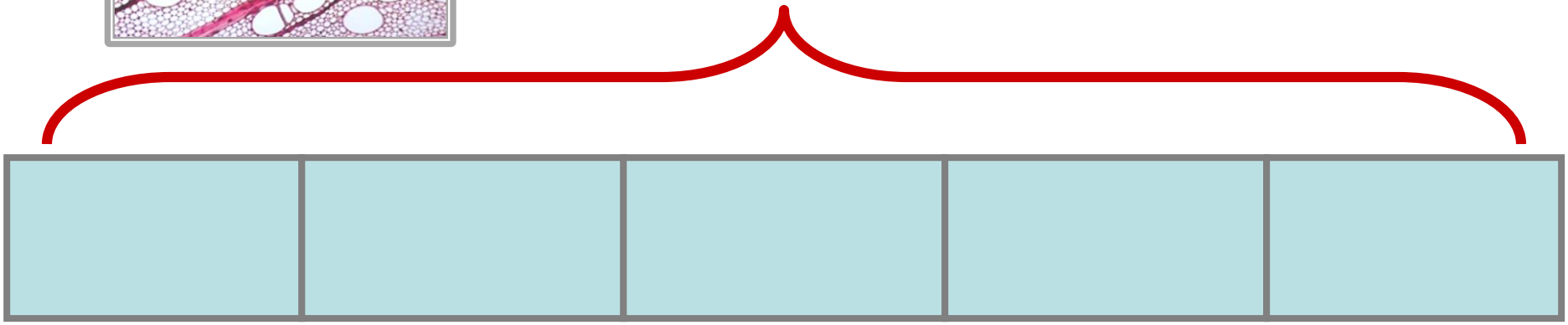
DICOT ~2 STEM

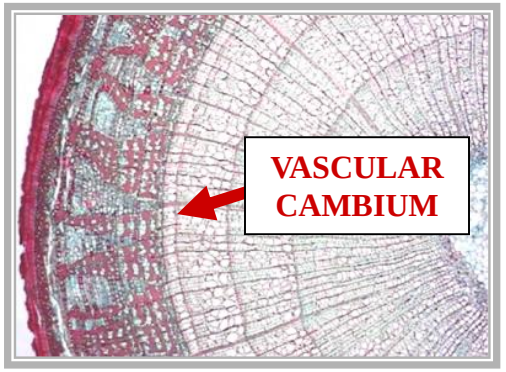
C.S.

PRC



RAY
PARENCHYMA

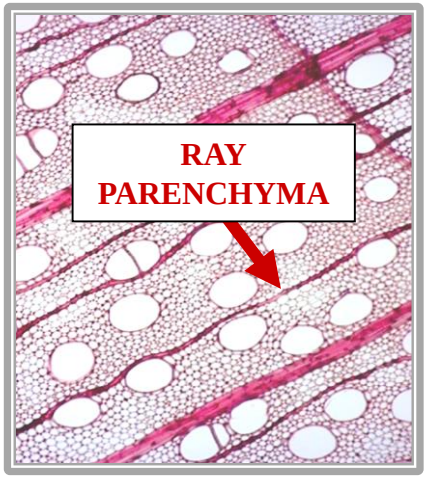




DICOT ~2 STEM

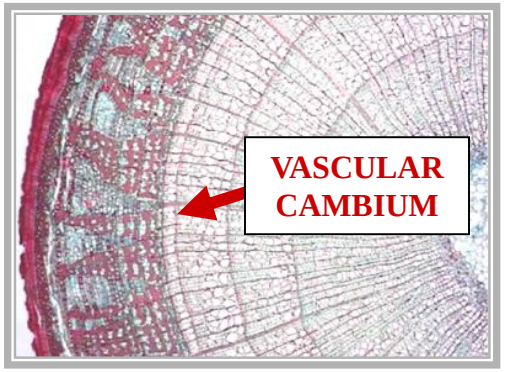
C.S.

UC



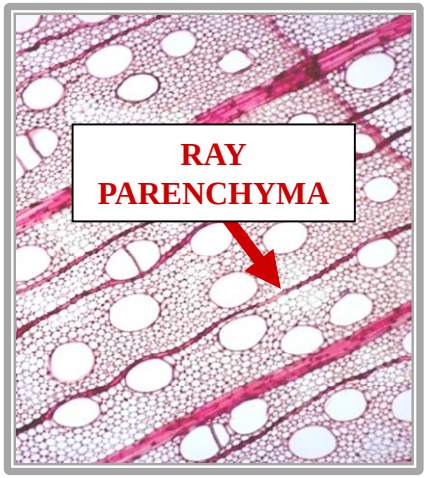
RAY
PARENCHYMA

PROCUMBENT
CELLS



DICOT ~2 STEM

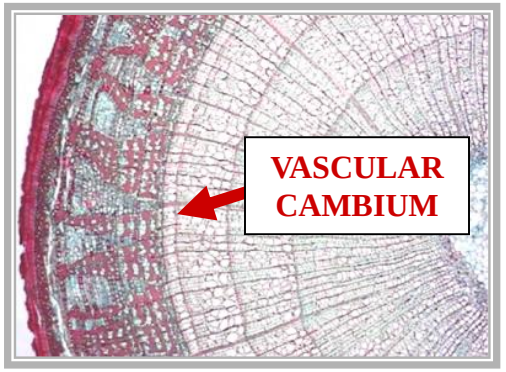
C.S.



RAY
PARENCHYMA

UNICELLULAR
RAY

PROCUMBENT
CELLS



DICOT ~2 STEM

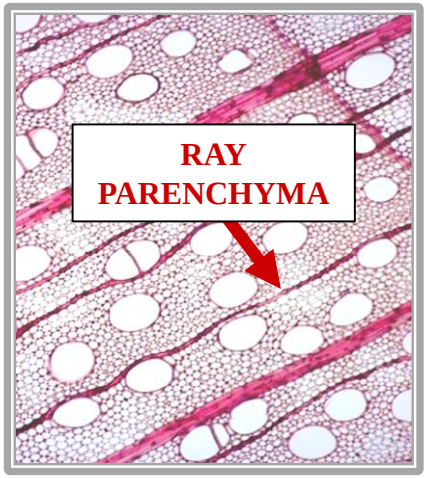
C.S.

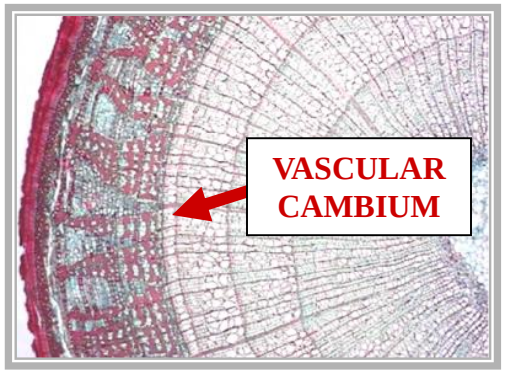
HETEROCELLULAR RAY

RAY PARENCHYMA
HETEROCELLULAR RAY

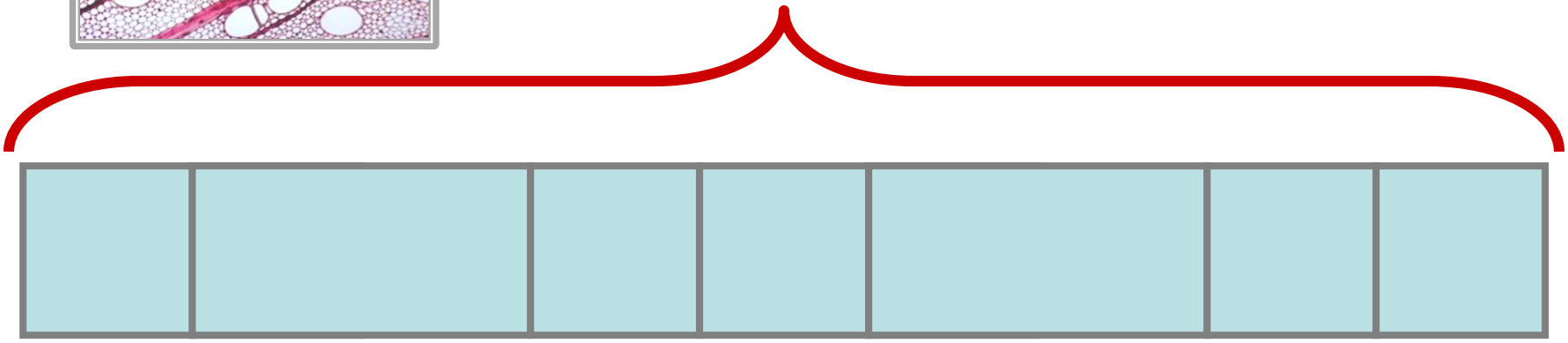
TWO CELL TYPES WITHIN RAY

RAY PARENCHYMA
HETEROCELLULAR RAY





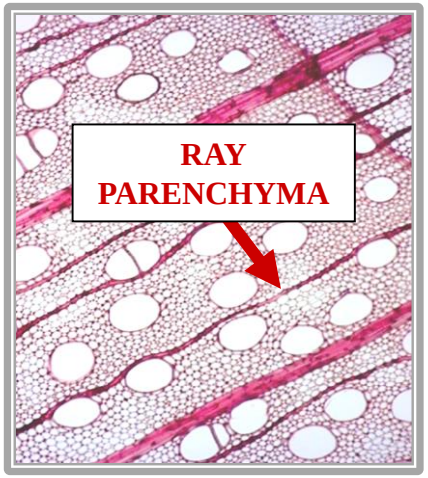
RAY PARENCHYMA

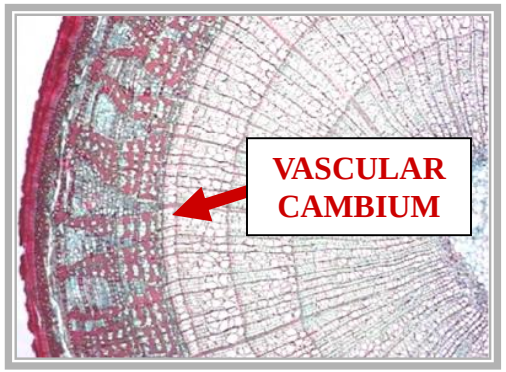


PRC

C.S.

DICOT ~2 STEM





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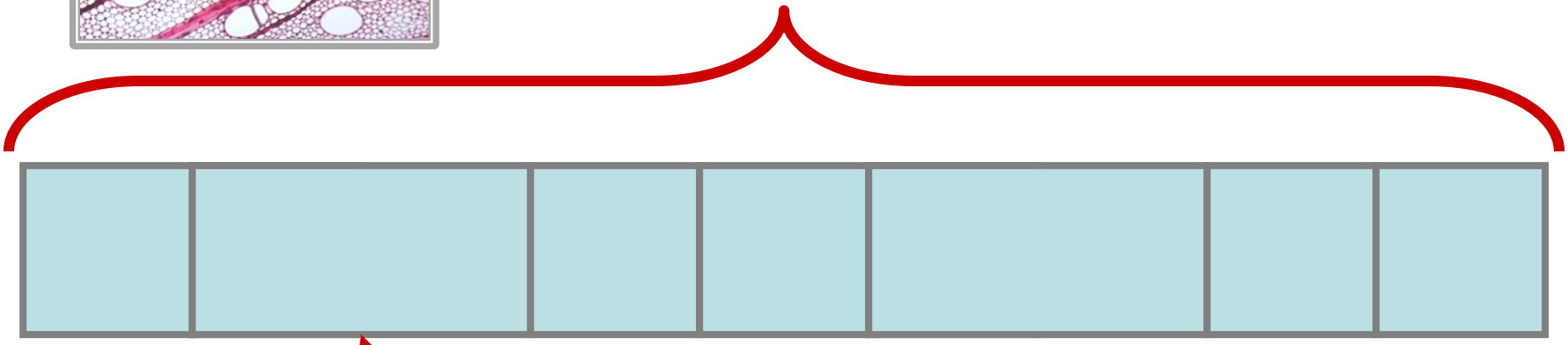
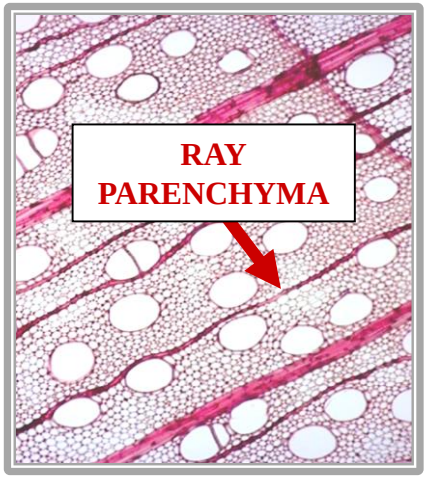


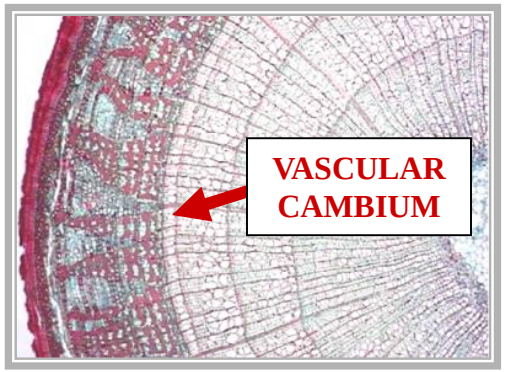
PROCUMBENT CELL

UR

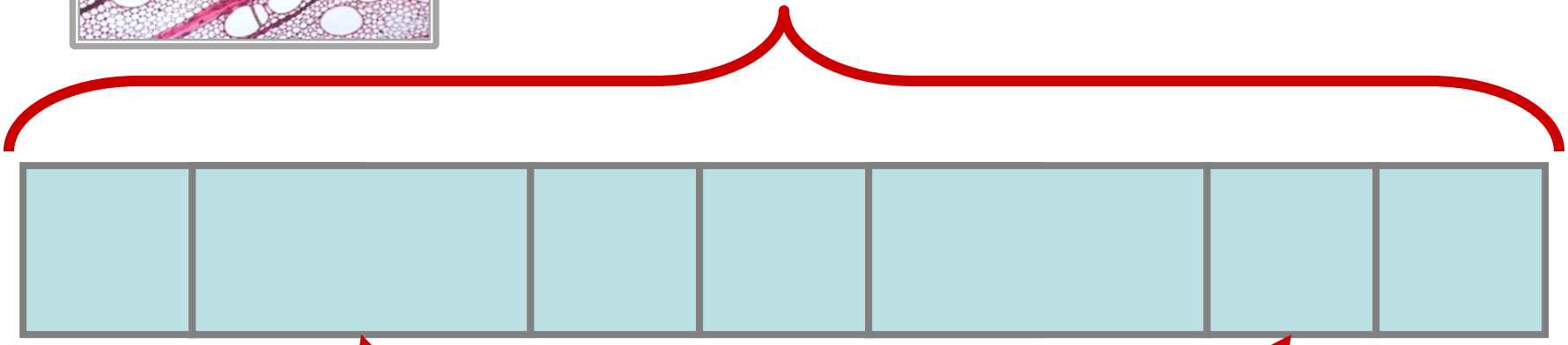
C.S.

DICOT ~2 STEM





RAY PARENCHYMA



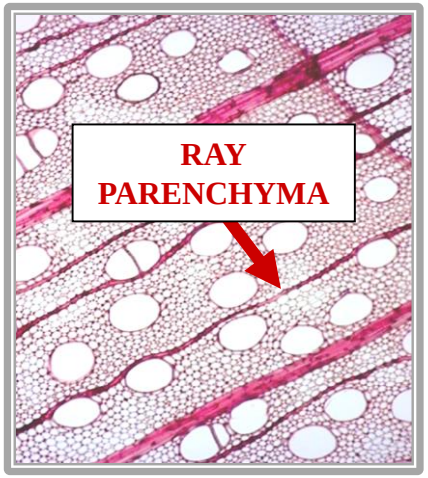
PROCUMBENT CELL

UPRIGHT CELL

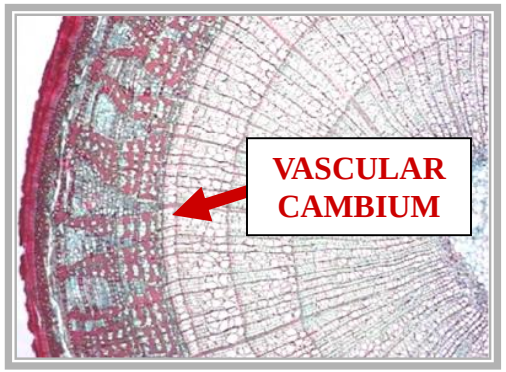
HC

C.S.

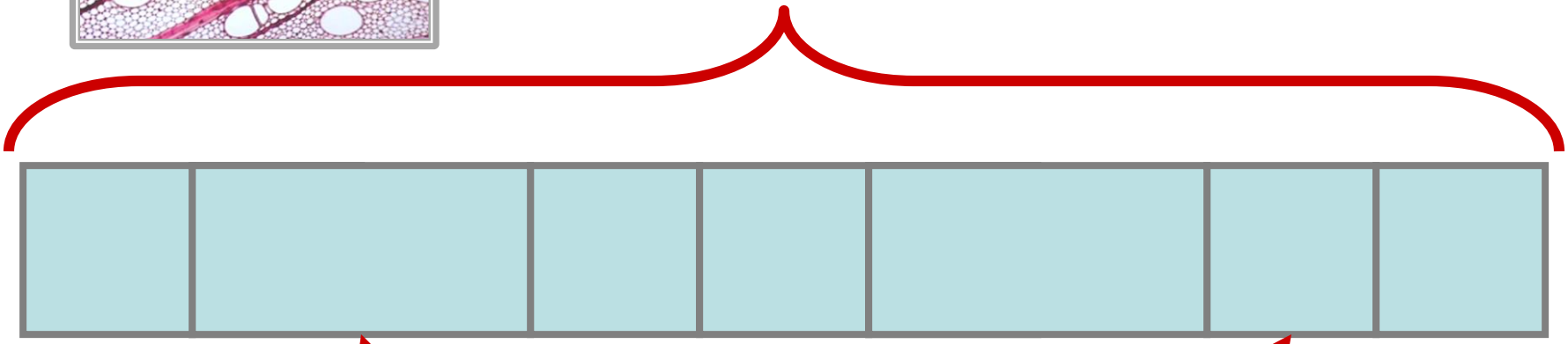
DICOT ~2 STEM



RAY PARENCHYMA



HETEROCELLULAR RAY



PROCUMBENT CELL

UPRIGHT CELL

DICOT ~2 STEM

C.S.

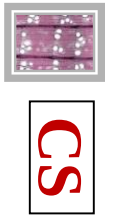
U

UNISERIATE RAY

MULTISERIATE RAY

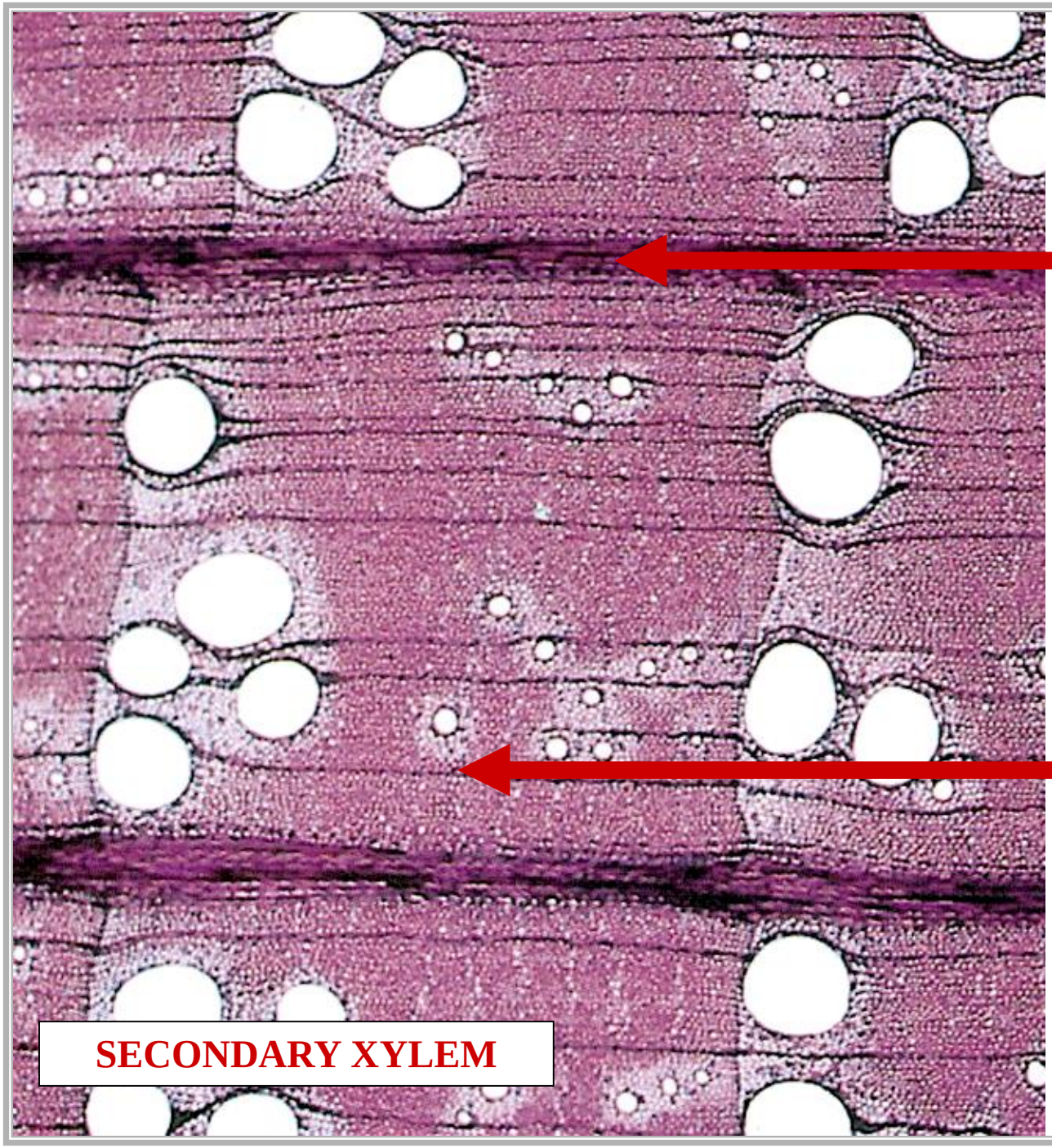
UNISERIATE RAY

RAY PARENCHYMA
UNISERIATE RAY



ONE CELL LAYER WIDE

RAY PARENCHYMA
UNISERIATE RAY



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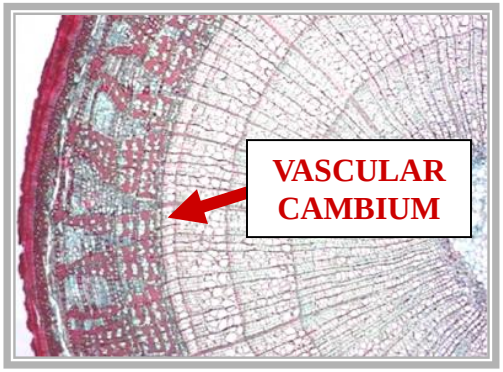


PARENCHYMA
RAY

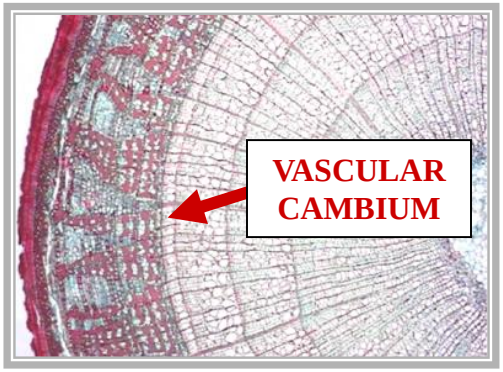
SECONDARY XYLEM

DICOT ~2 STEM

C.S.

U

+

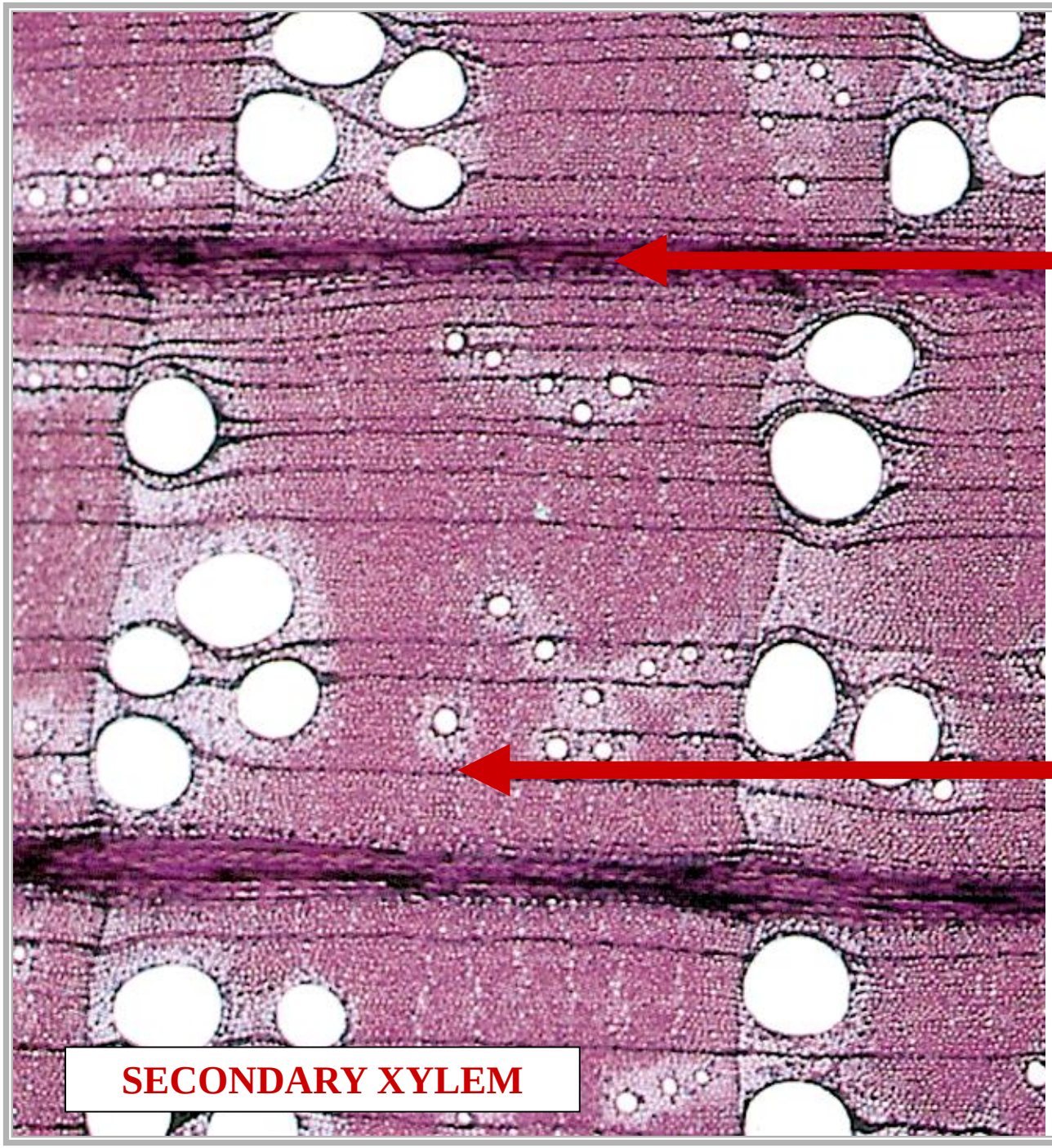


ONE CELL LAYER WIDE

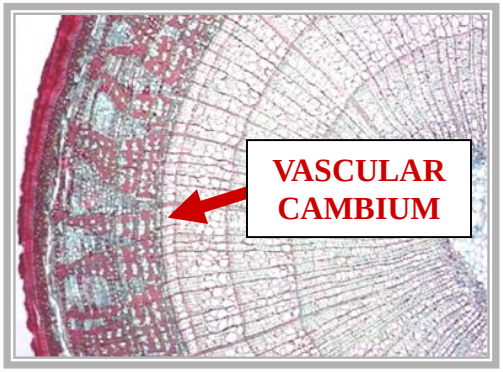
SECONDARY XYLEM

DICOT ~2 STEM

C.S.



LS



UNISERIATE
RAY

SECONDARY XYLEM

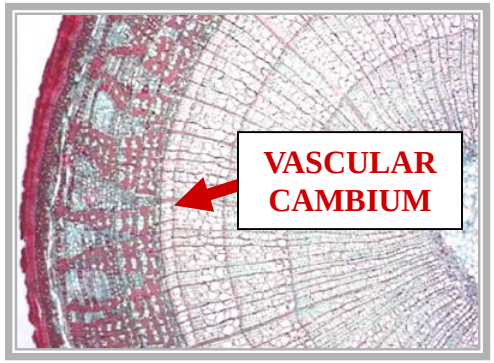
DICOT ~2 STEM

C.S.

SECONDARY XYLEM

DICOT ~2 STEM

L.S.



^

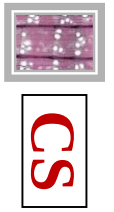
M

UNISERIATE
RAY

L.S.

MULTISERIATE RAY

RAY PARENCHYMA
MULTISERIATE RAY



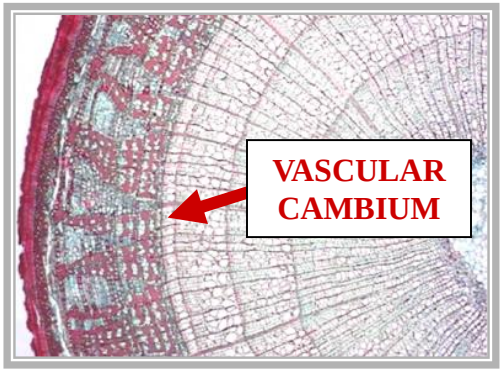
MORE THAN ONE CELL LAYER WIDE

RAY PARENCHYMA
MULTISERIATE RAY

1+

+

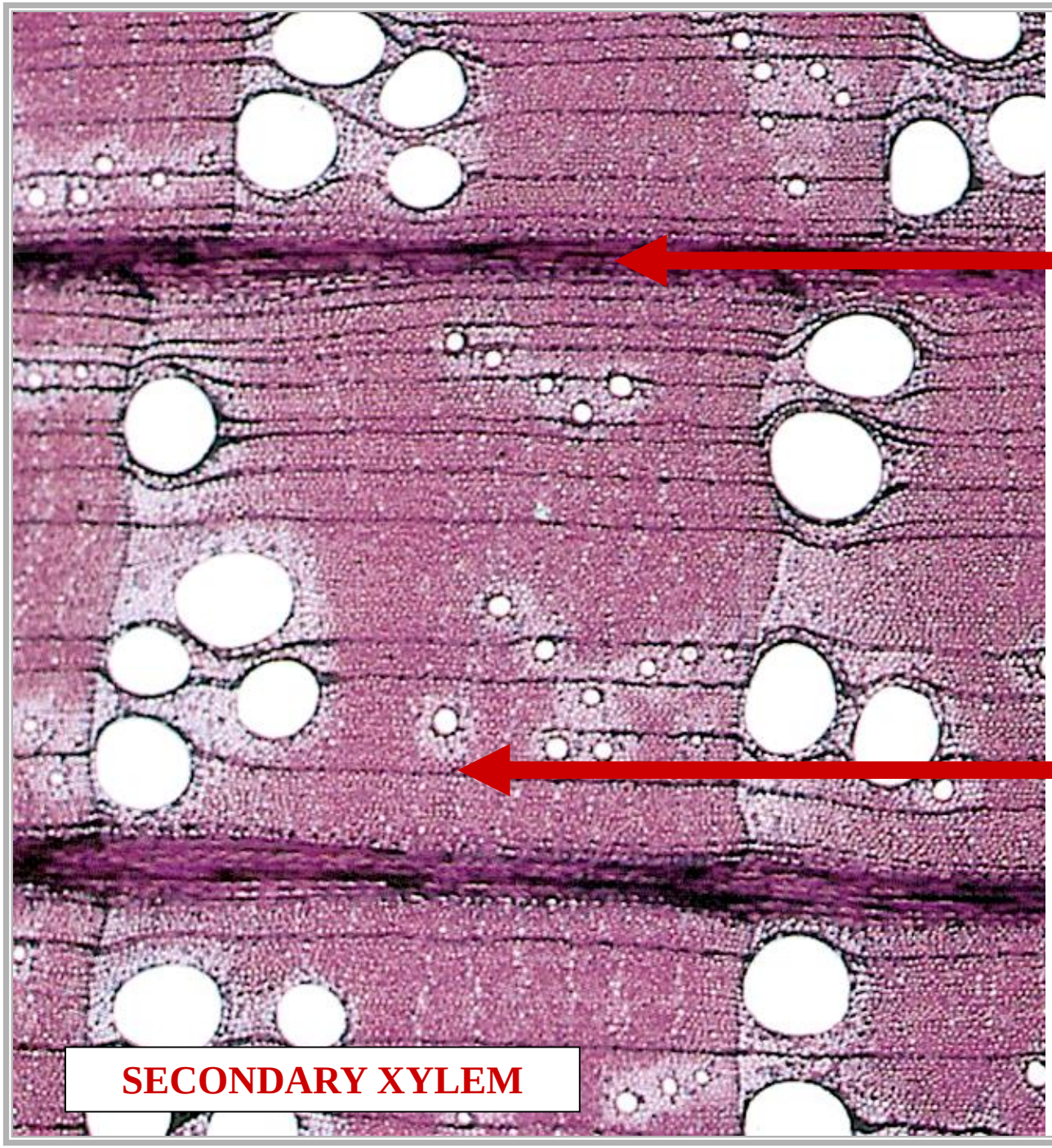
PARENCHYMA RAY



SECONDARY XYLEM

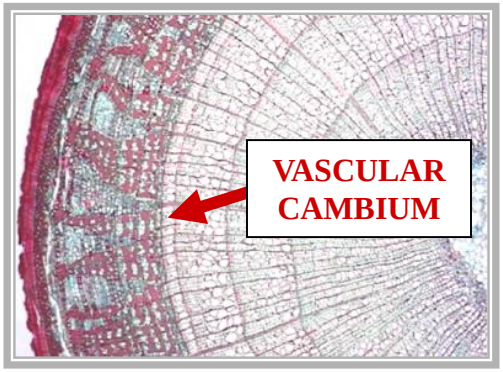
STEM

C.S.



+ M

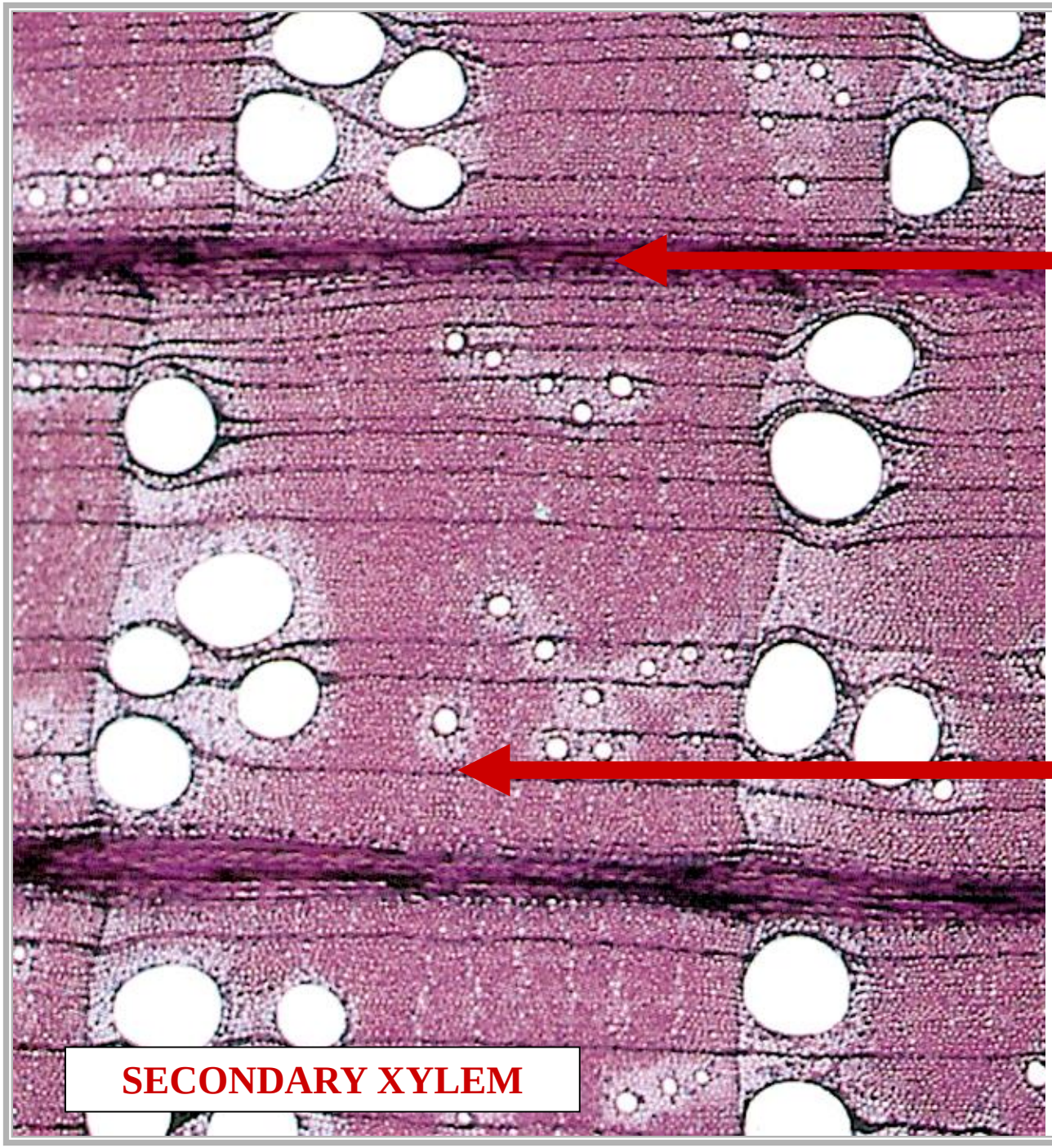
MORE THAN ONE CELL LAYER WIDE



SECONDARY XYLEM

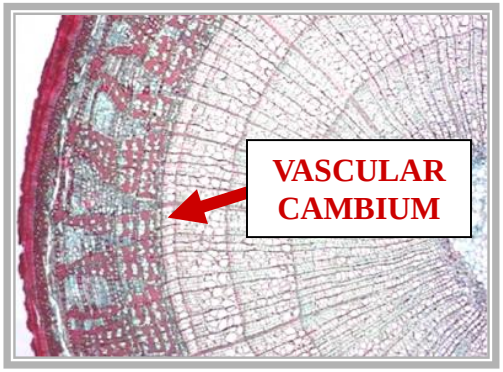
STEM

C.S.



LS

MULTISERIATE RAY



SECONDARY XYLEM

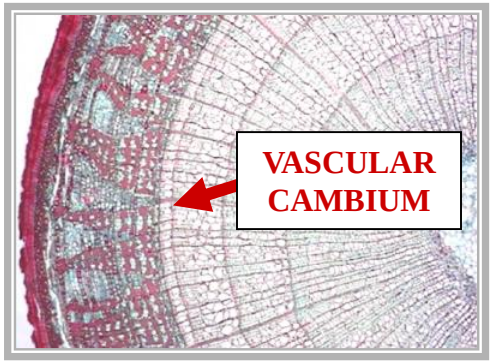
STEM

C.S.

SECONDARY XYLEM

DICOT ~2 STEM

L.S.



MULTISERIATE
RAY

^

X

XYLEM RAY

XYLEM RAY

2X

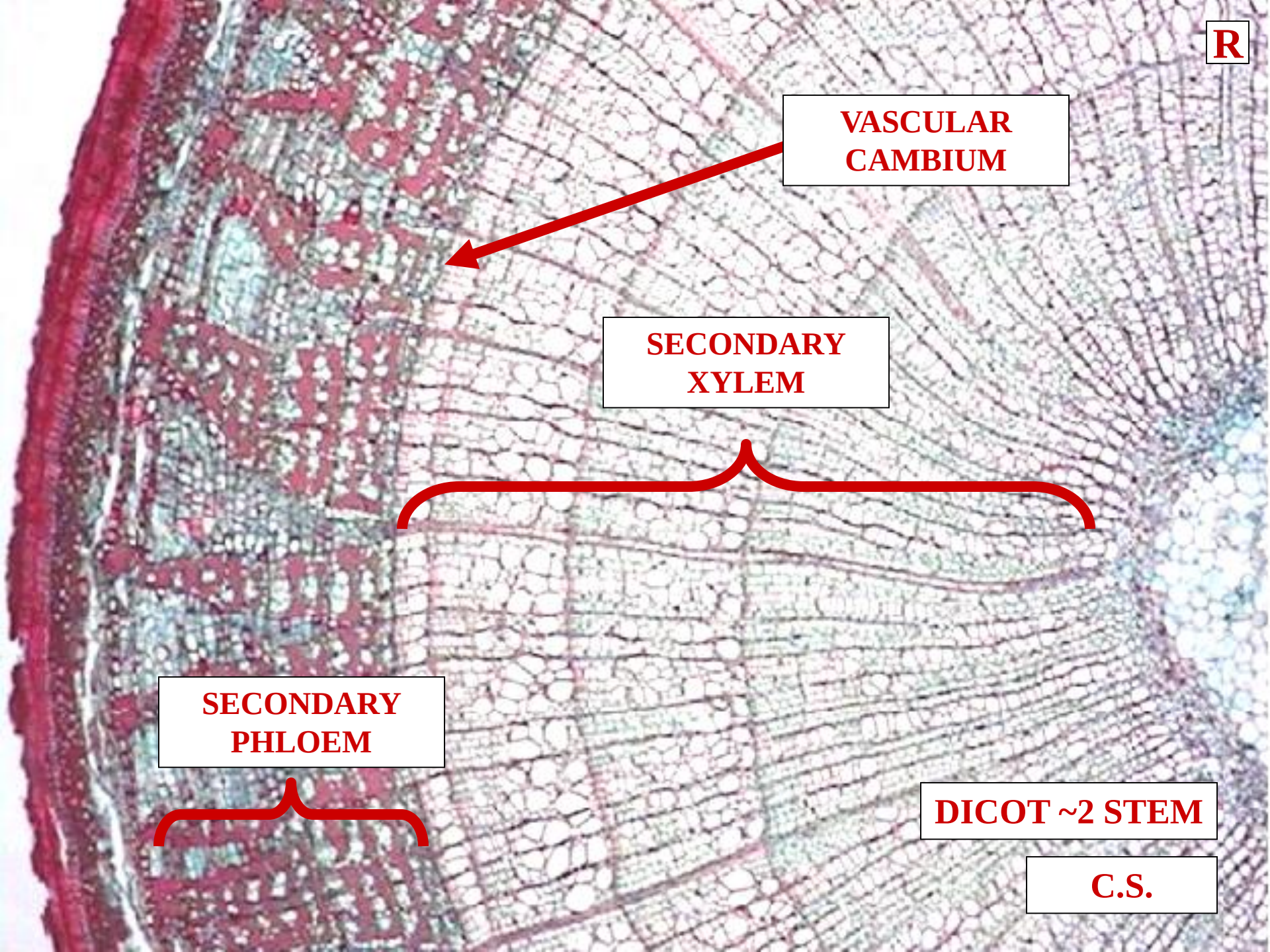
RAY PARENCHYMA

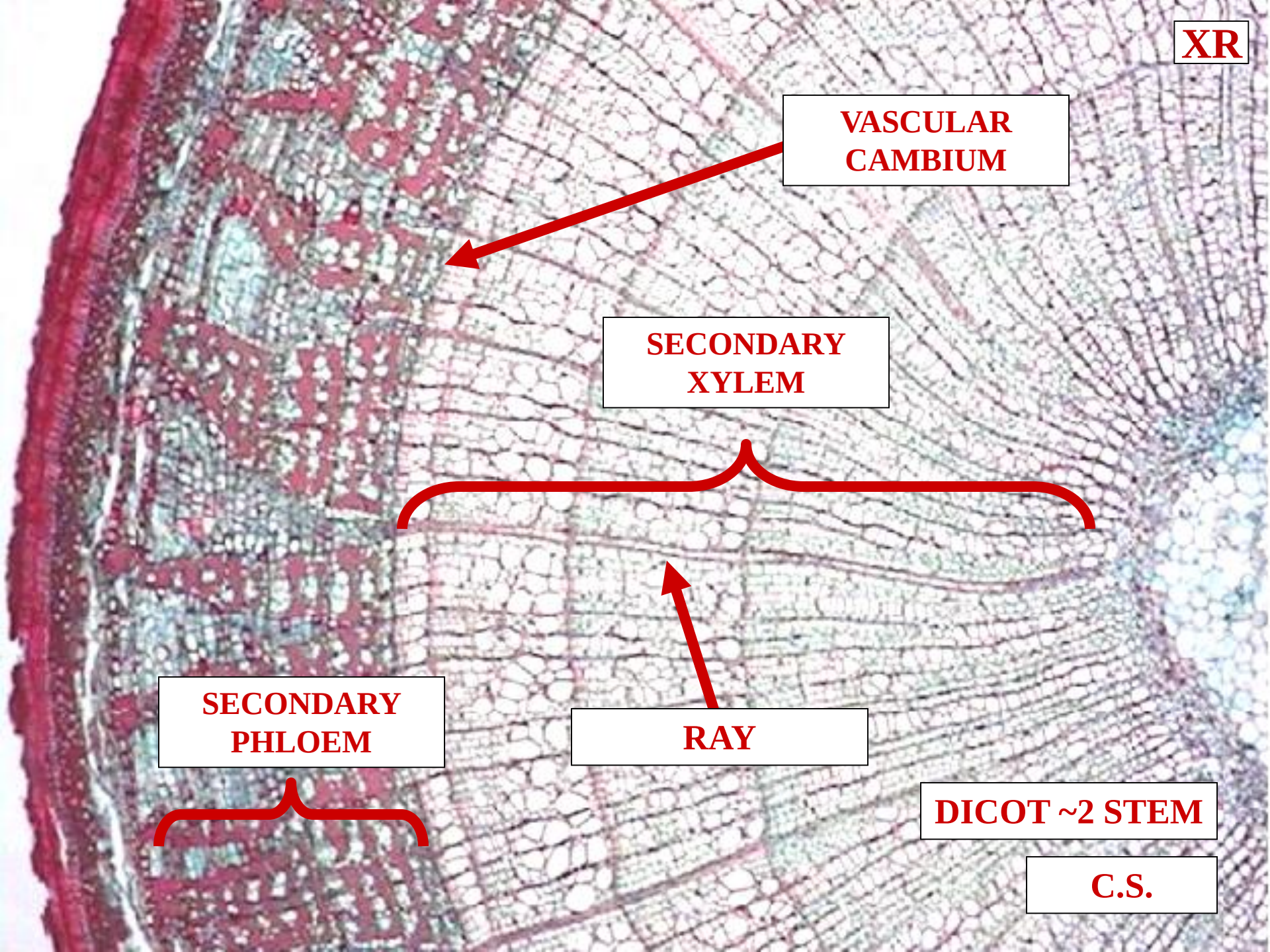
XYLEM RAY

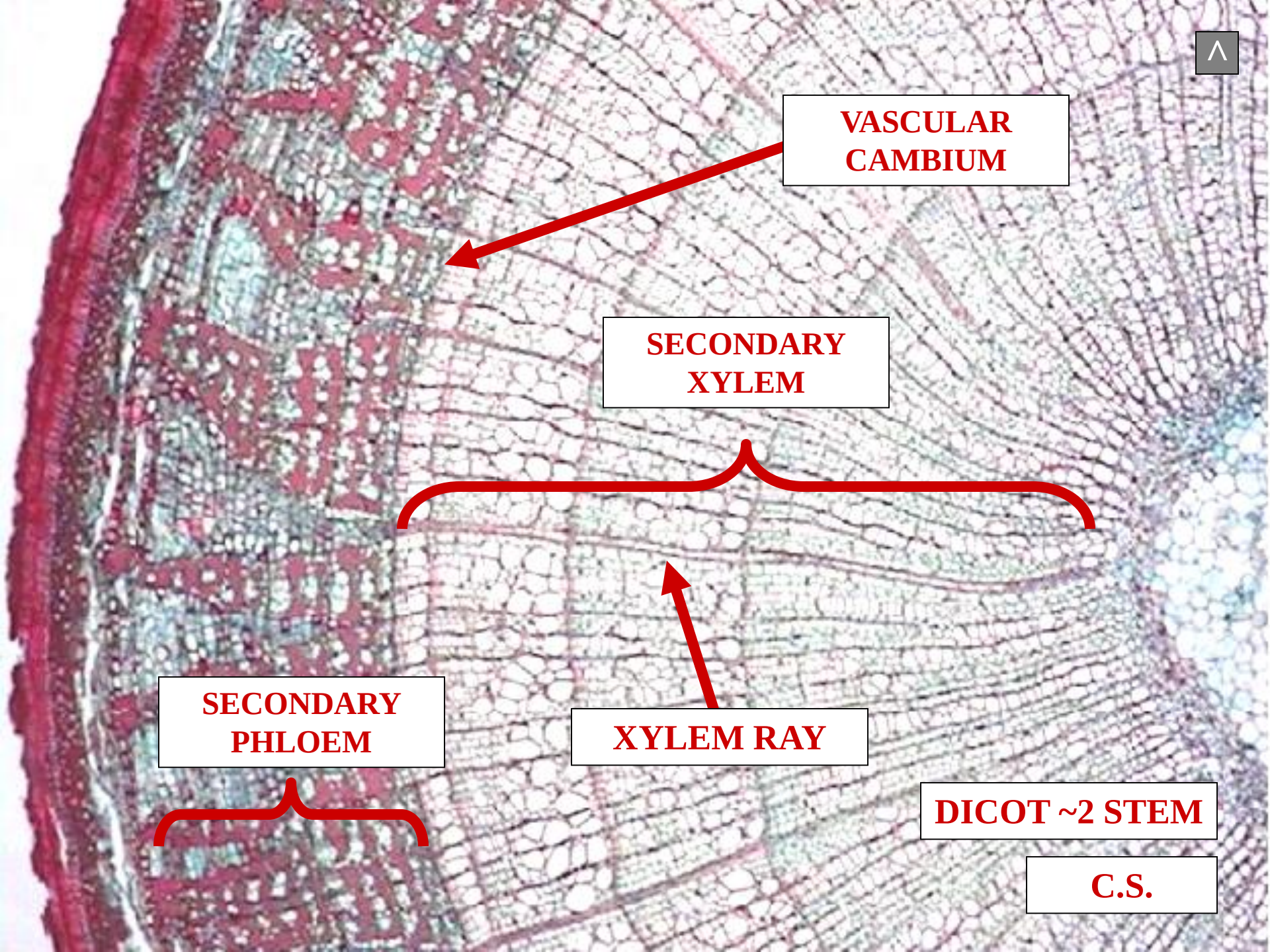
RAY WITHIN XYLEM

RAY PARENCHYMA

XYLEM RAY


R
VASCULAR CAMBIUM
SECONDARY XYLEM
SECONDARY PHLOEM
DICOT ~2 STEM
C.S.


XR
VASCULAR CAMBIUM
SECONDARY XYLEM
SECONDARY PHLOEM
RAY
DICOT ~2 STEM
C.S.


VASCULAR CAMBIUM
SECONDARY XYLEM
SECONDARY PHLOEM
XYLEM RAY
DICOT ~2 STEM
C.S.

WOOD CHARACTERS

WOOD

WOOD

ALL TISSUES *INSIDE* VASCULAR CAMBIUM

WOOD

WOOD

ALL TISSUES *INSIDE* VASCULAR CAMBIUM

CONSISTS MOSTLY SECONDARY XYLEM

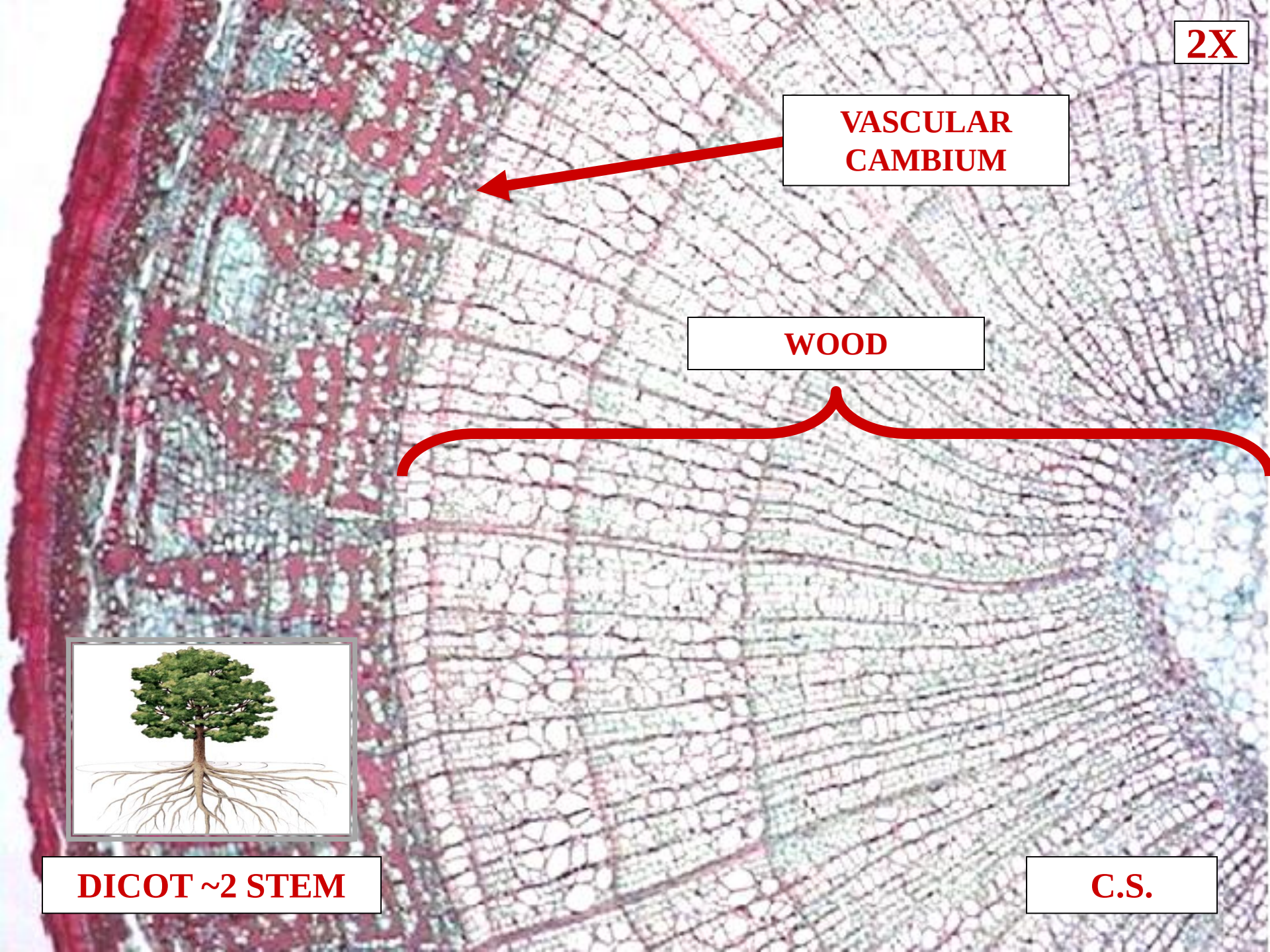
WOOD

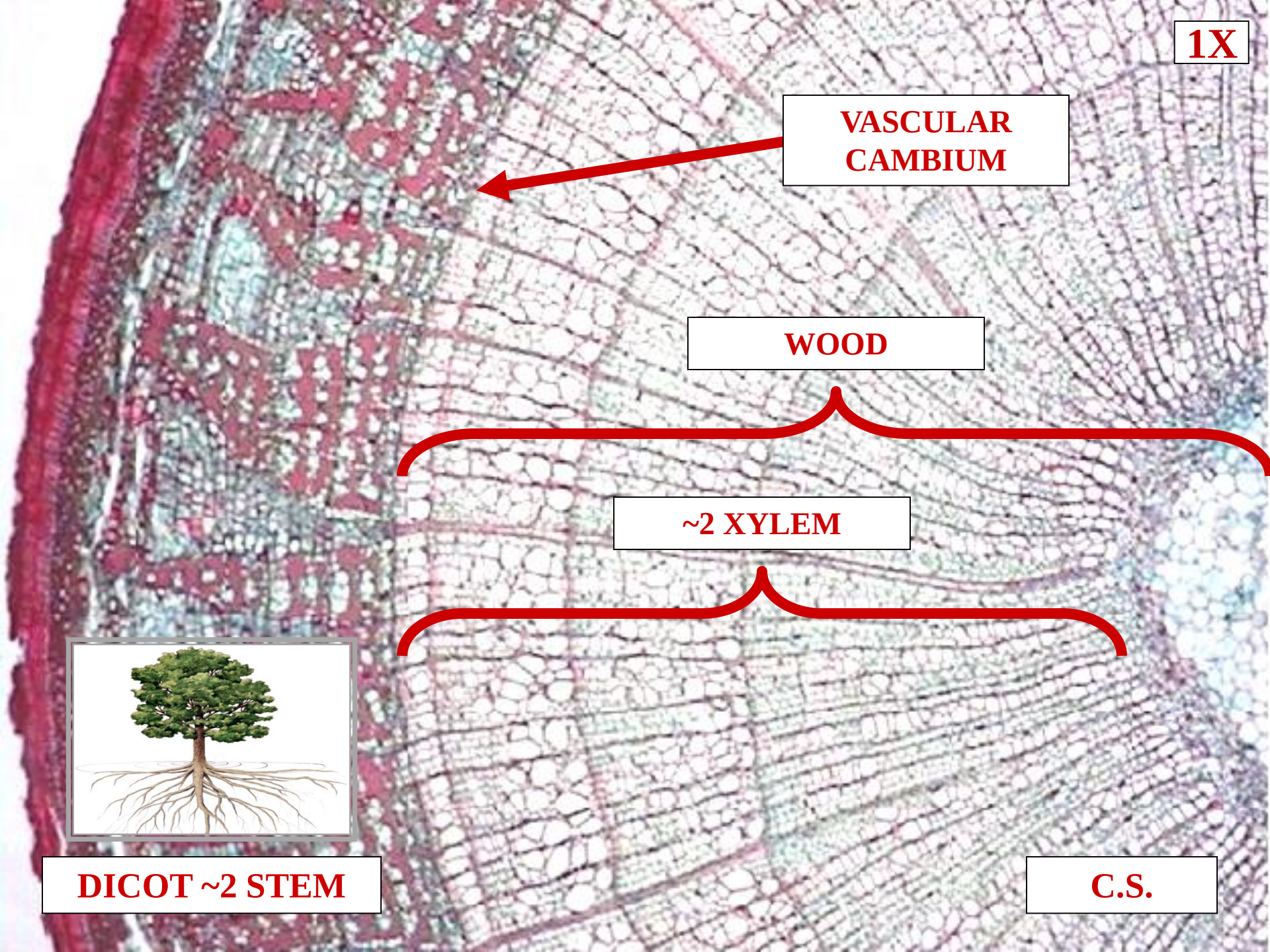
W

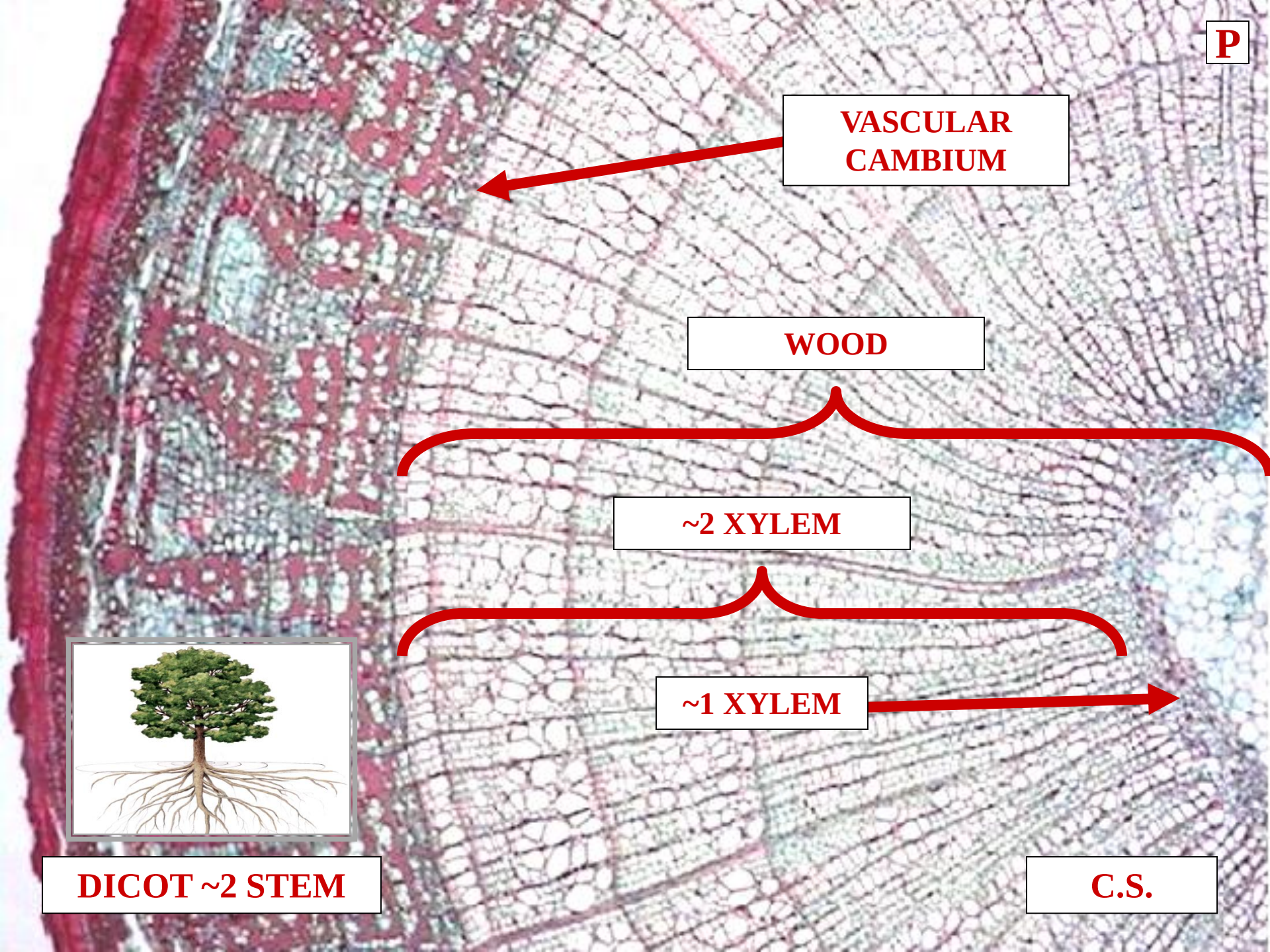
VASCULAR CAMBIUM

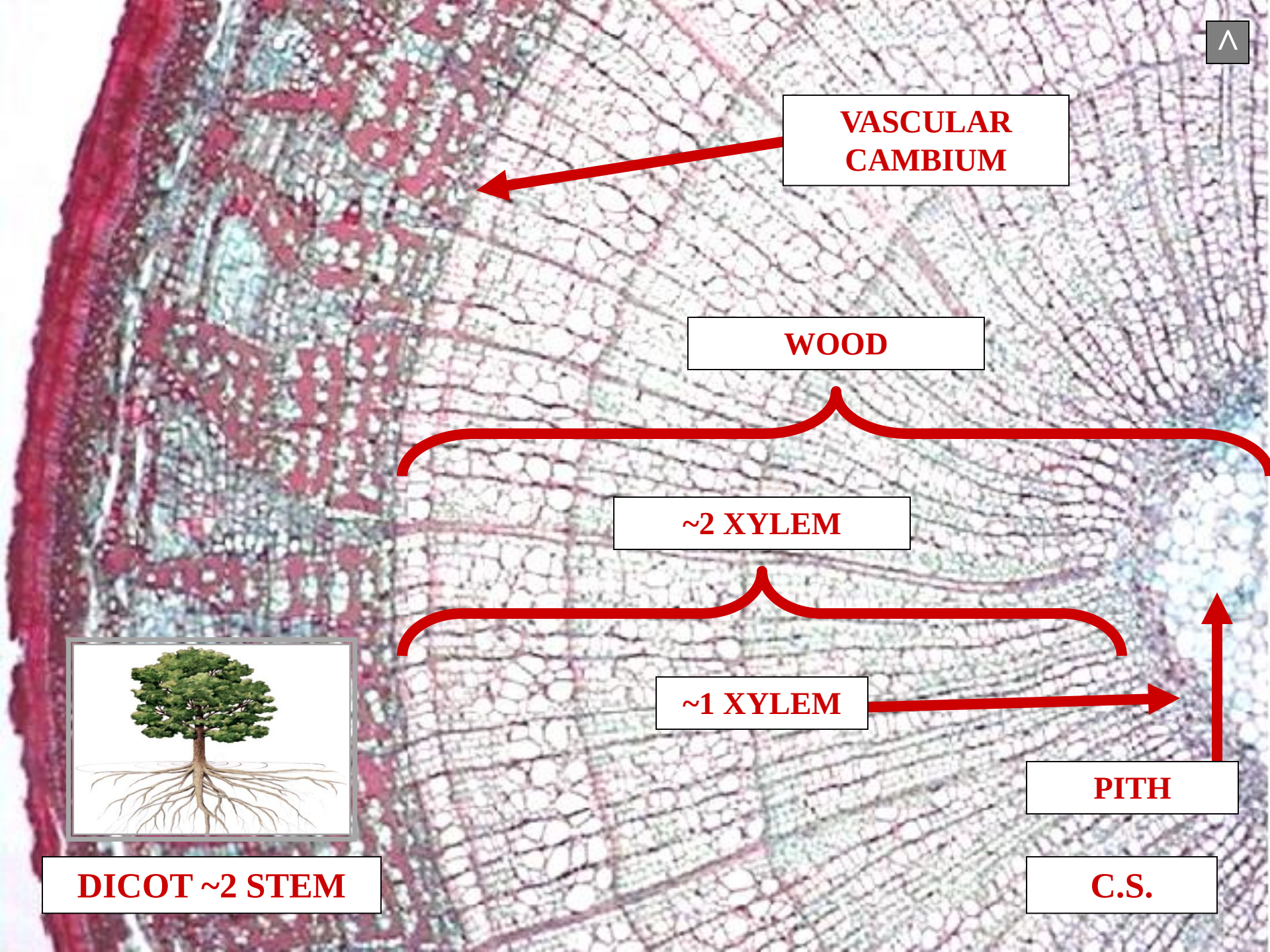
DICOT ~2 STEM

C.S.


2X
VASCULAR CAMBIUM
WOOD
DICOT ~2 STEM
C.S.


1X
VASCULAR CAMBIUM
WOOD
~2 XYLEM
DICOT ~2 STEM
C.S.


P
VASCULAR CAMBIUM
WOOD
~2 XYLEM
~1 XYLEM
DICOT ~2 STEM
C.S.


VASCULAR CAMBIUM
WOOD
~2 XYLEM
~1 XYLEM
PITH
DICOT ~2 STEM
C.S.

GR

SECONDARY XYLEM GROWTH RINGS

SECONDARY XYLEM GROWTH RING

SECONDARY XYLEM
GROWTH RING

VASCULAR CAMBIUM DERIVED

SECONDARY XYLEM
GROWTH RING

SECONDARY XYLEM GROWTH RING

VASCULAR CAMBIUM DERIVED

ANNUAL ~2 XYLEM GROWTH

SECONDARY XYLEM GROWTH RING

2X

VASCULAR CAMBIUM

DICOT ~2 STEM

C.S.

GR

VASCULAR CAMBIUM

~2 XYLEM

DICOT ~2 STEM

C.S.

VASCULAR CAMBIUM

~2 XYLEM GROWTH RINGS

DICOT ~2 STEM

C.S.

VASCULAR CAMBIUM

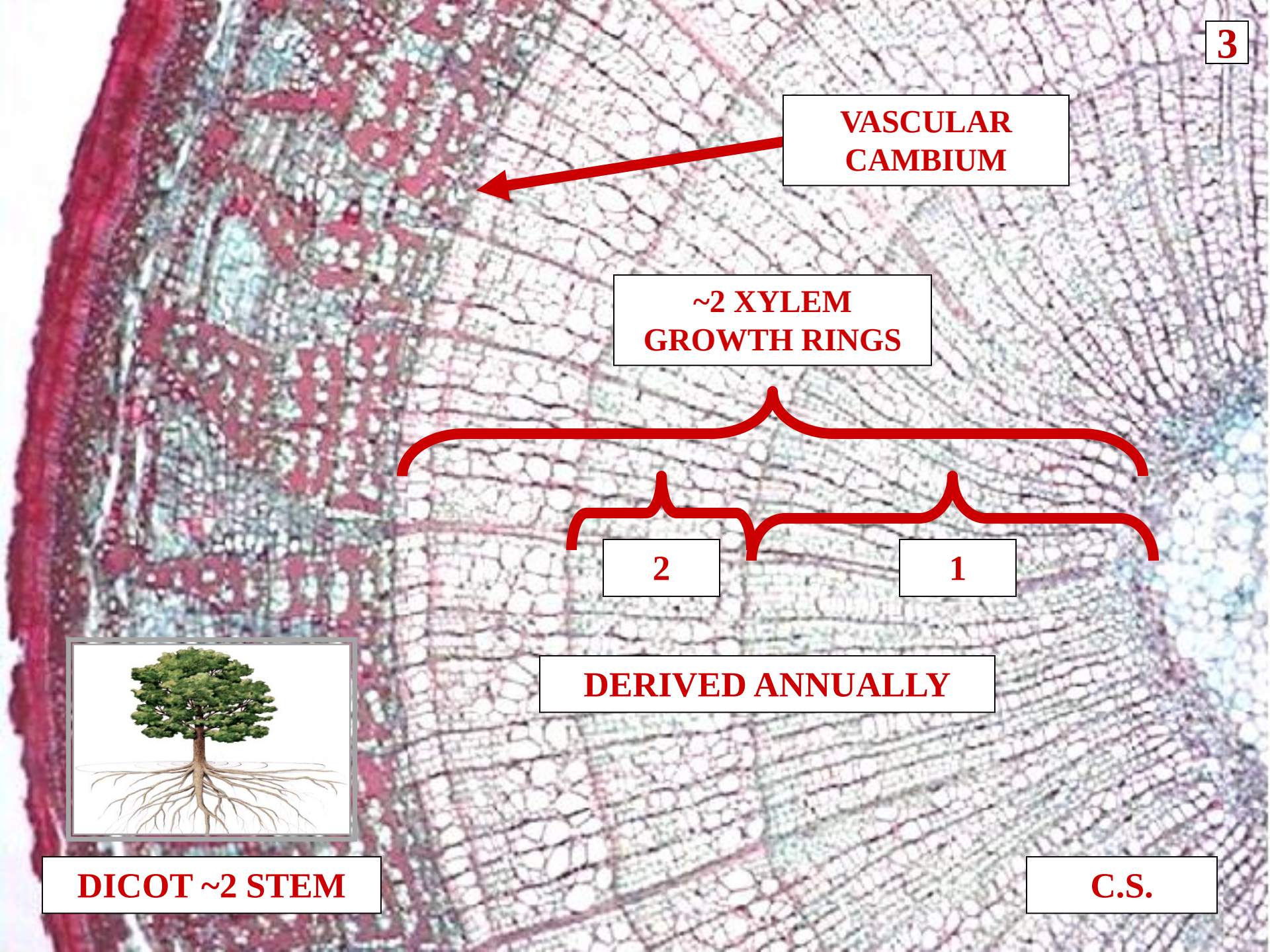
~2 XYLEM GROWTH RINGS

1

DERIVED ANNUALLY

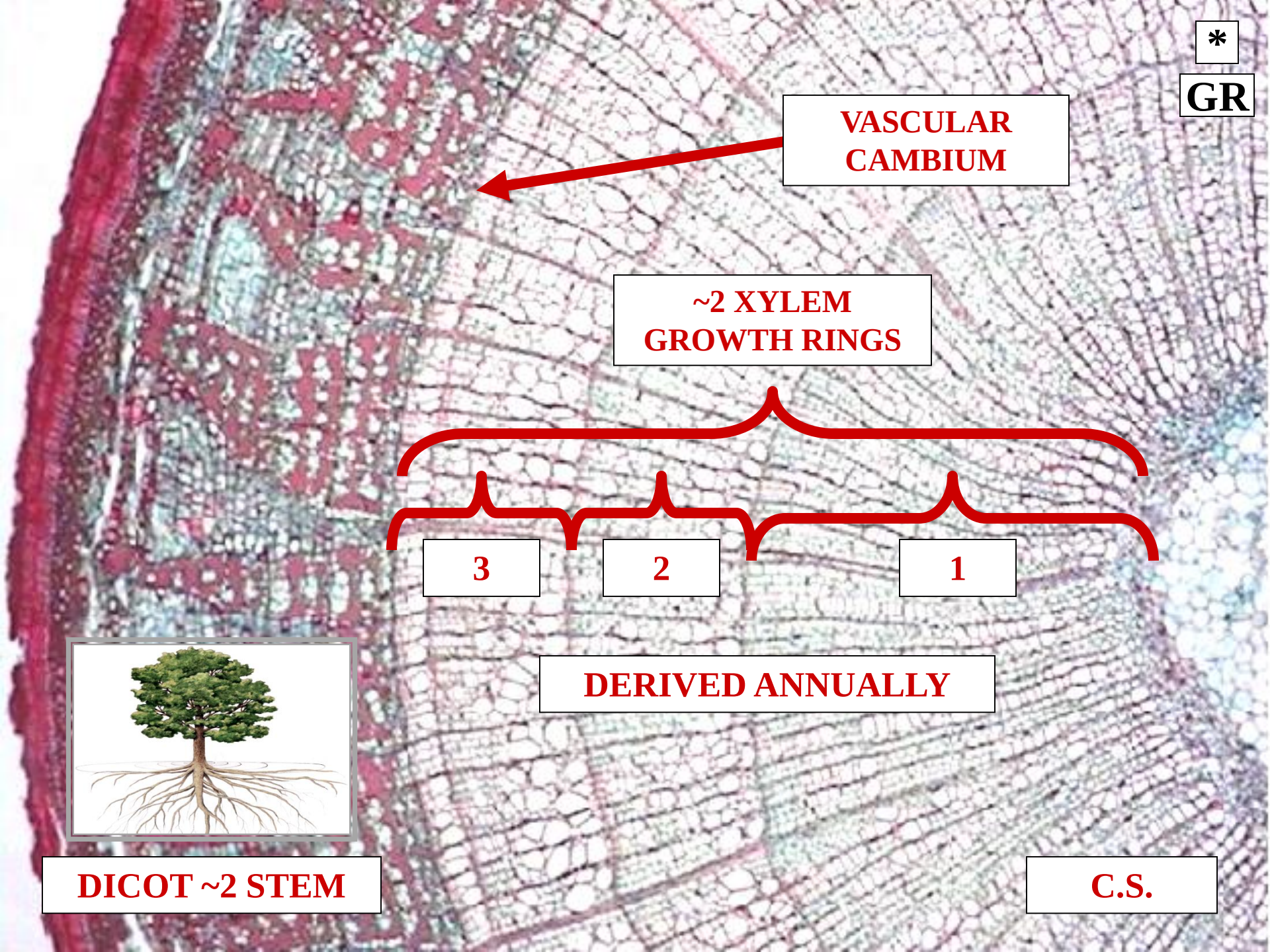
DICOT ~2 STEM

C.S.



DICOT ~2 STEM

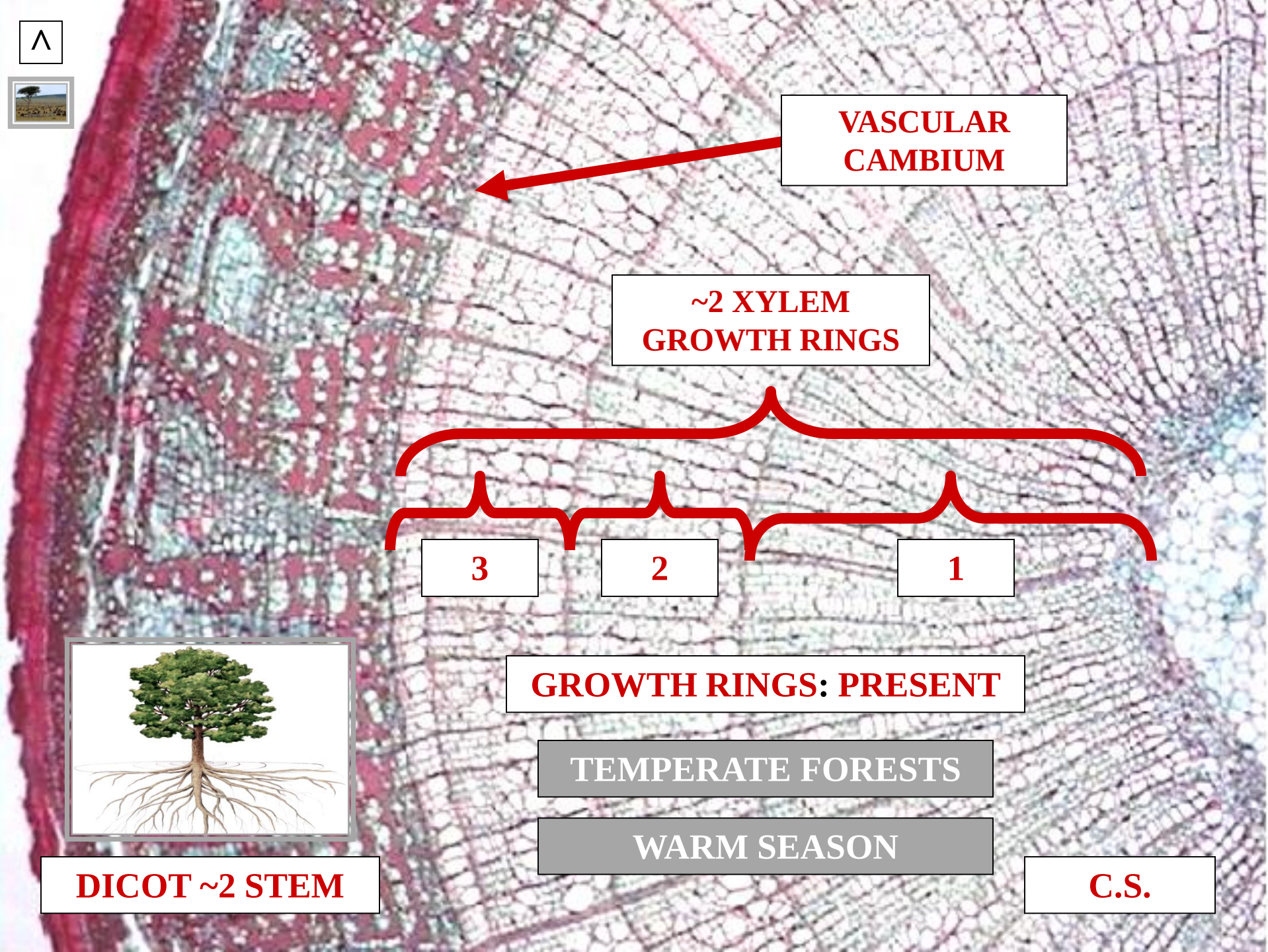
C.S.


*
GR
VASCULAR CAMBIUM
~2 XYLEM GROWTH RINGS
3
2
1
DERIVED ANNUALLY
DICOT ~2 STEM
C.S.

GROWTH RINGS ASSOCIATED WITH SEASONAL CLIMATES

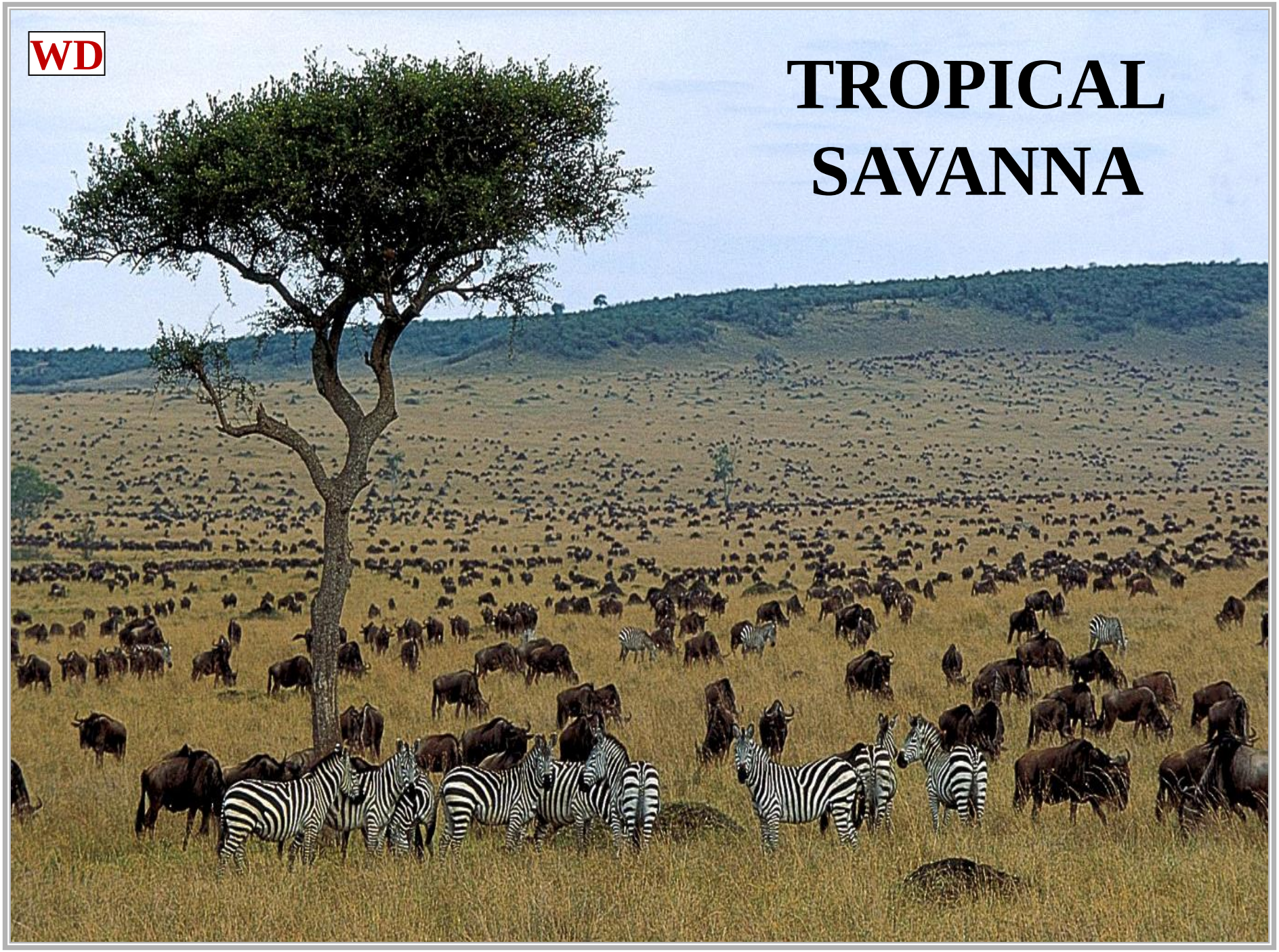

WC
TEMPERATE
FOREST


TEMPERATE
FOREST
WARM SEASON
&
COLD SEASON


VASCULAR CAMBIUM
~2 XYLEM GROWTH RINGS
3
2
1
GROWTH RINGS: PRESENT
TEMPERATE FORESTS
WARM SEASON
DICOT ~2 STEM
C.S.

WD

TROPICAL SAVANNA




TROPICAL
SAVANNA
WET SEASON
&
DRY SEASON

*

GR

VASCULAR CAMBIUM

~2 XYLEM GROWTH RINGS

3

2

1

GROWTH RINGS: PRESENT

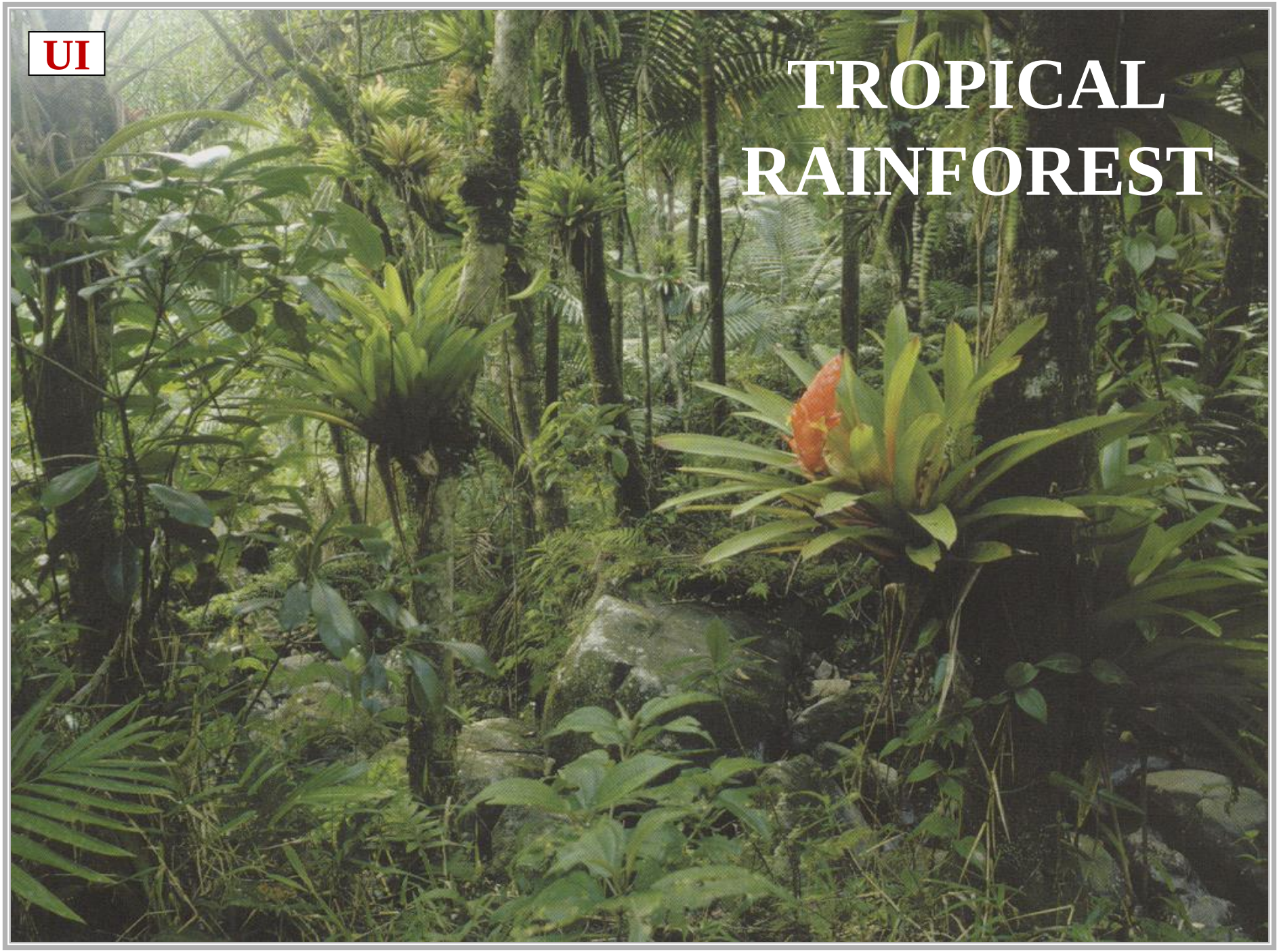
TROPICAL SAVANNAS

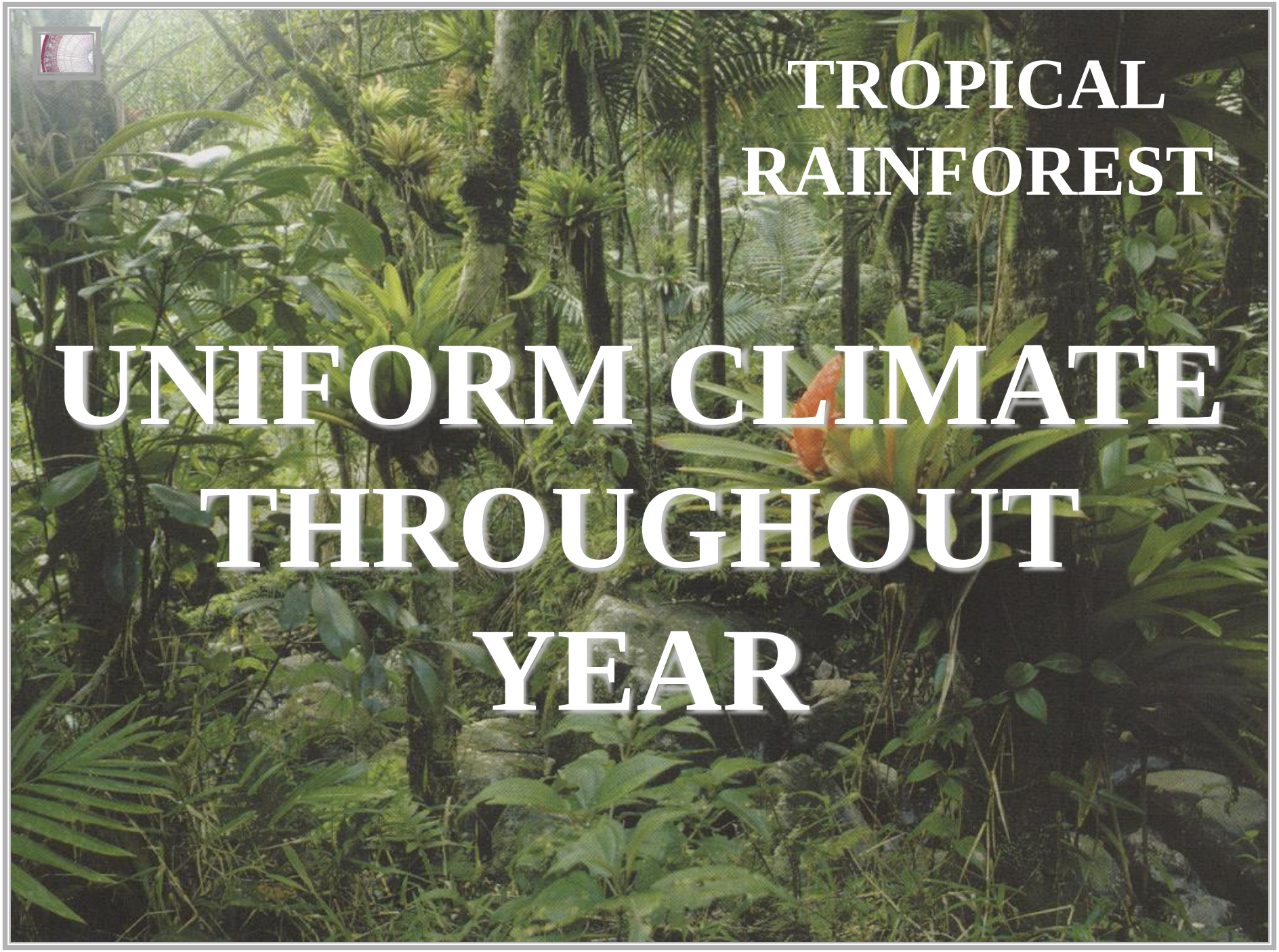
WET SEASON

DICOT ~2 STEM

C.S.

GROWTH RINGS NOT ASSOCIATES WITH UNIFORM CLIMATES


UI
TROPICAL
RAINFOREST


TROPICAL RAINFOREST
UNIFORM CLIMATE THROUGHOUT YEAR

VASCULAR CAMBIUM

~2 XYLEM GROWTH RINGS

3

2

1

GROWTH RINGS: ABSENT

TROPICAL RAINFORESTS

DICOT ~2 STEM

C.S.

SECONDARY XYLEM GROWTH RINGS TYPES

SECONDARY XYLEM
GROWTH RING
TYPES

ANNUAL RING

SECONDARY XYLEM
GROWTH RING
TYPES

SECONDARY XYLEM
GROWTH RING
TYPES

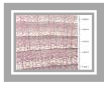
A

ANNUAL RING
FALSE RING

SECONDARY XYLEM
GROWTH RING
TYPES

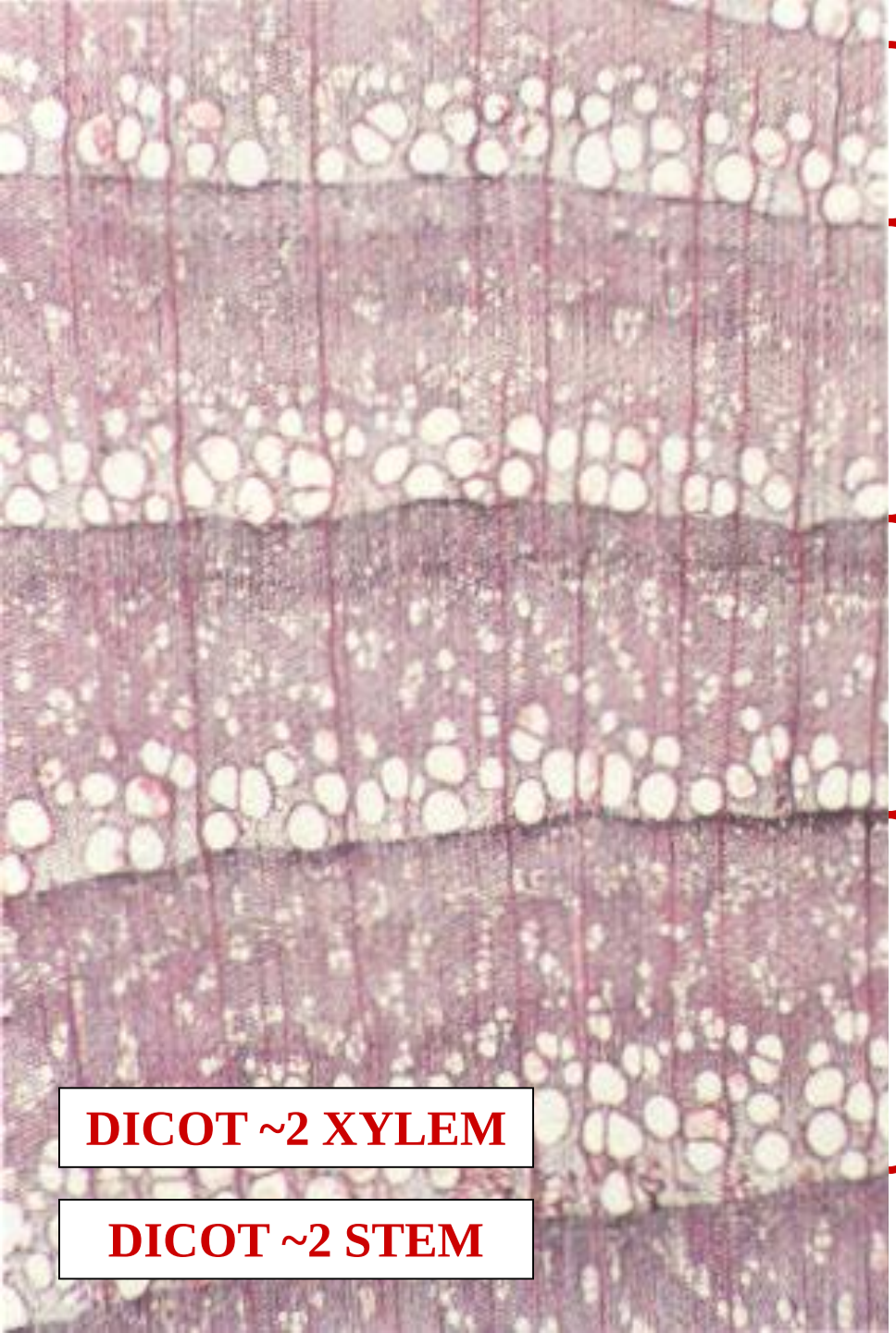
SECONDARY XYLEM ANNUAL RING

SECONDARY XYLEM ANNUAL RING



YEARLY XYLEM GROWTH

SECONDARY XYLEM ANNUAL RING



2004

2003

2002

2001

ANNUAL RINGS

^

F

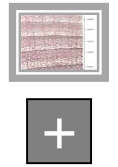
DICOT ~2 XYLEM

DICOT ~2 STEM

C.S.

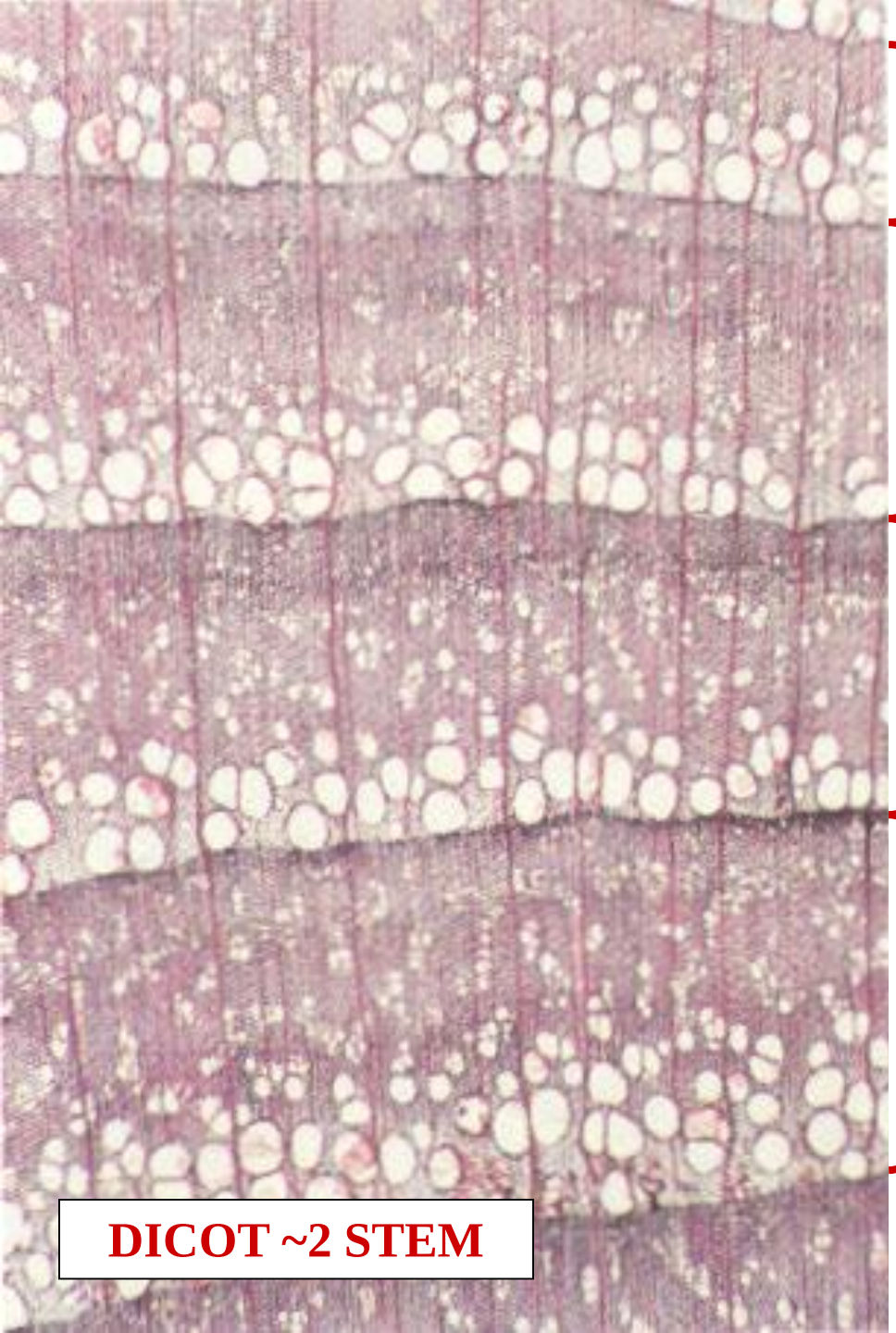
SECONDARY XYLEM FALSE RING

SECONDARY XYLEM FALSE RING



LOCATED WTHIN ANNUAL RING

SECONDARY XYLEM FALSE RING



FR

2004

2003

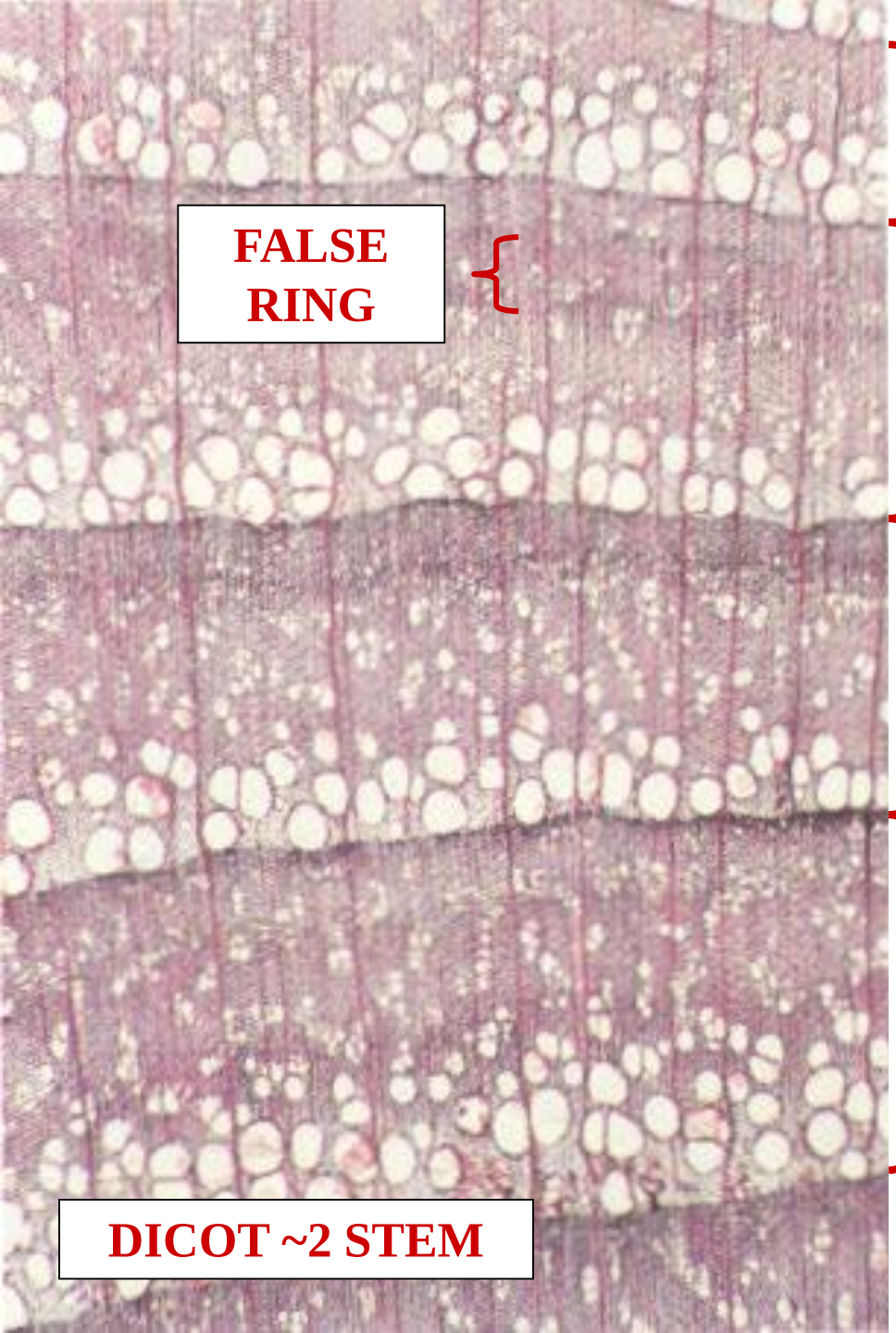
2002

2001

ANNUAL RINGS

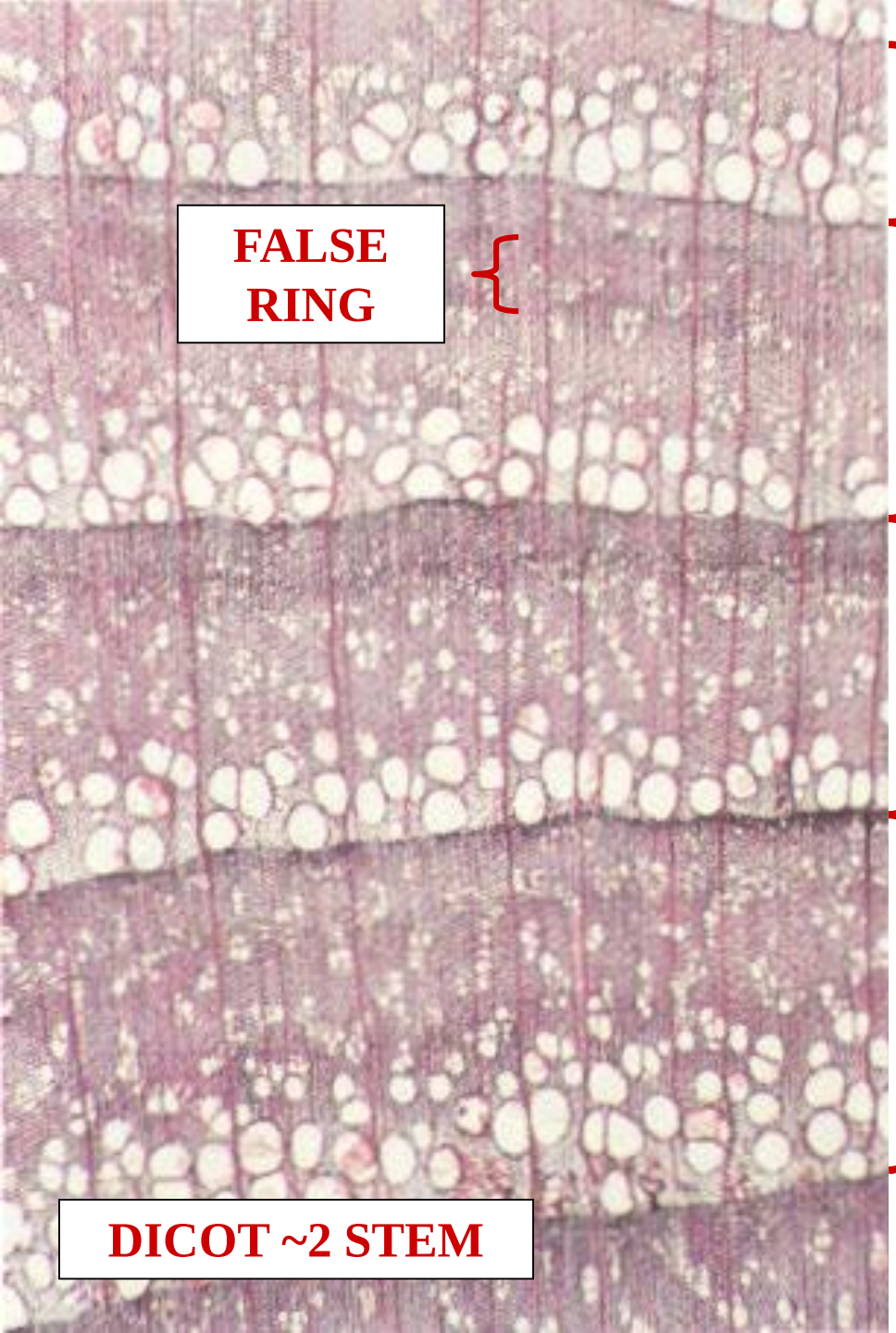
DICOT ~2 STEM

C.S.


FALSE RING
2004
2003
2002
2001
ANNUAL RINGS
DICOT ~2 STEM
C.S.

FALSE RING INDUCED BY MID SEASON DROUGHT

FALSE RING INDUCED BY MID SEASON DROUGHT


FALSE RING
2004
2003
2002
2001
ANNUAL RINGS
DICOT ~2 STEM
C.S.

D

DENDROCHRONOLOGY

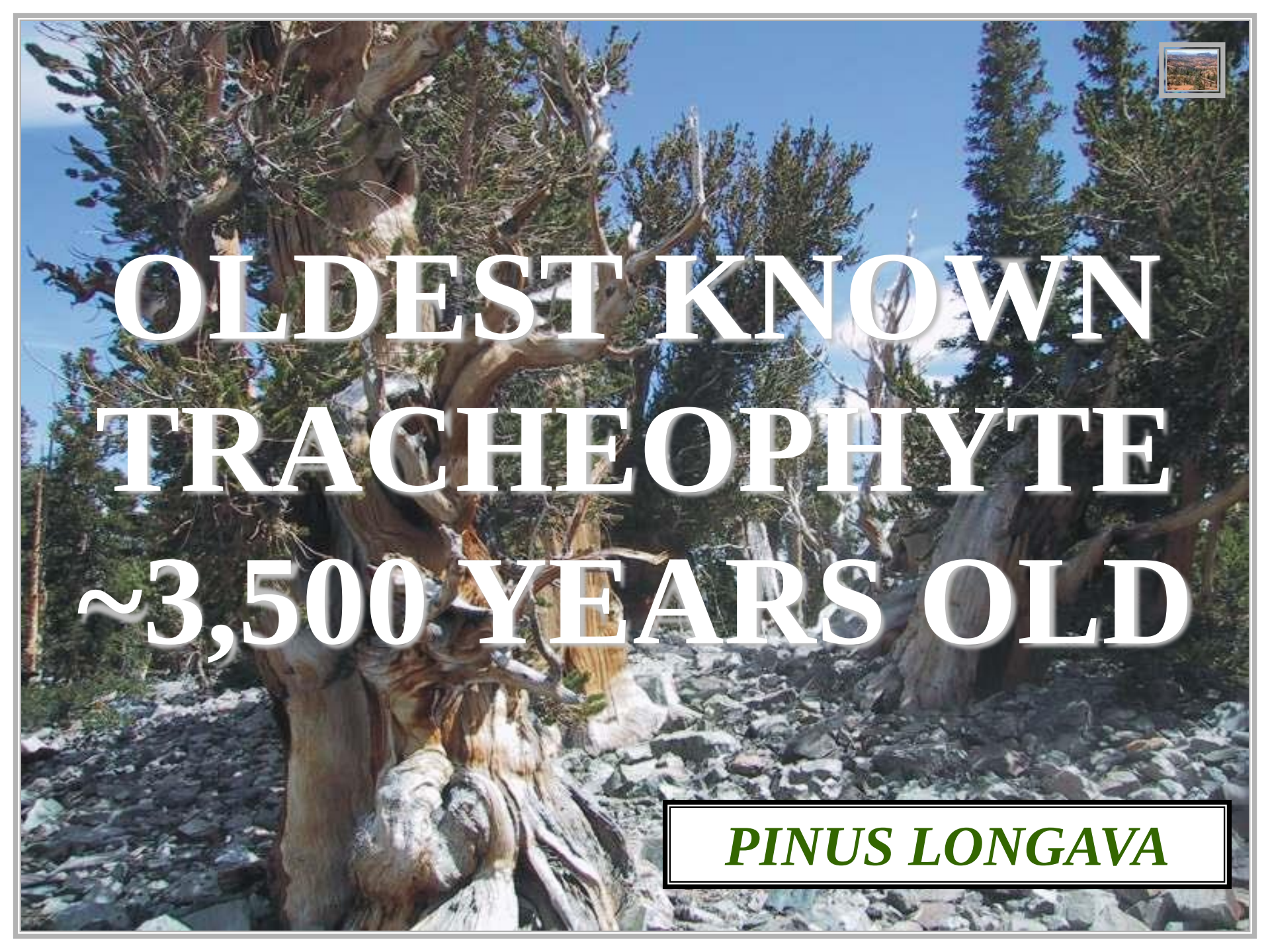
DENDROCHRONOLOGY

DENDROCHRONOLOGY

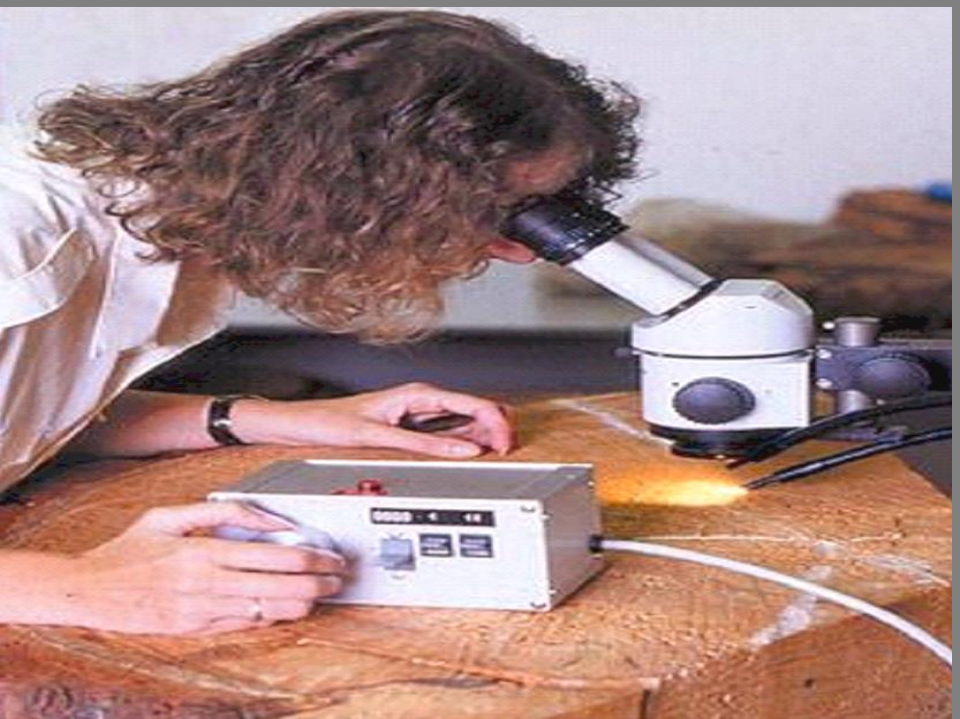
STUDY
HISTORICAL CLIMATES
VIA ANNUAL RINGS

DENDROCHRONOLOGY


O
PINUS LONGAVA


OLDEST KNOWN
TRACHEOPHYTE
≈3,500 YEARS OLD
PINUS LONGAVA

PINUS LONGAVA



WOOD TYPES

RING POROUS WOOD

DIFFUSE POROUS WOOD

P

RING POROUS WOOD

RING POROUS WOOD

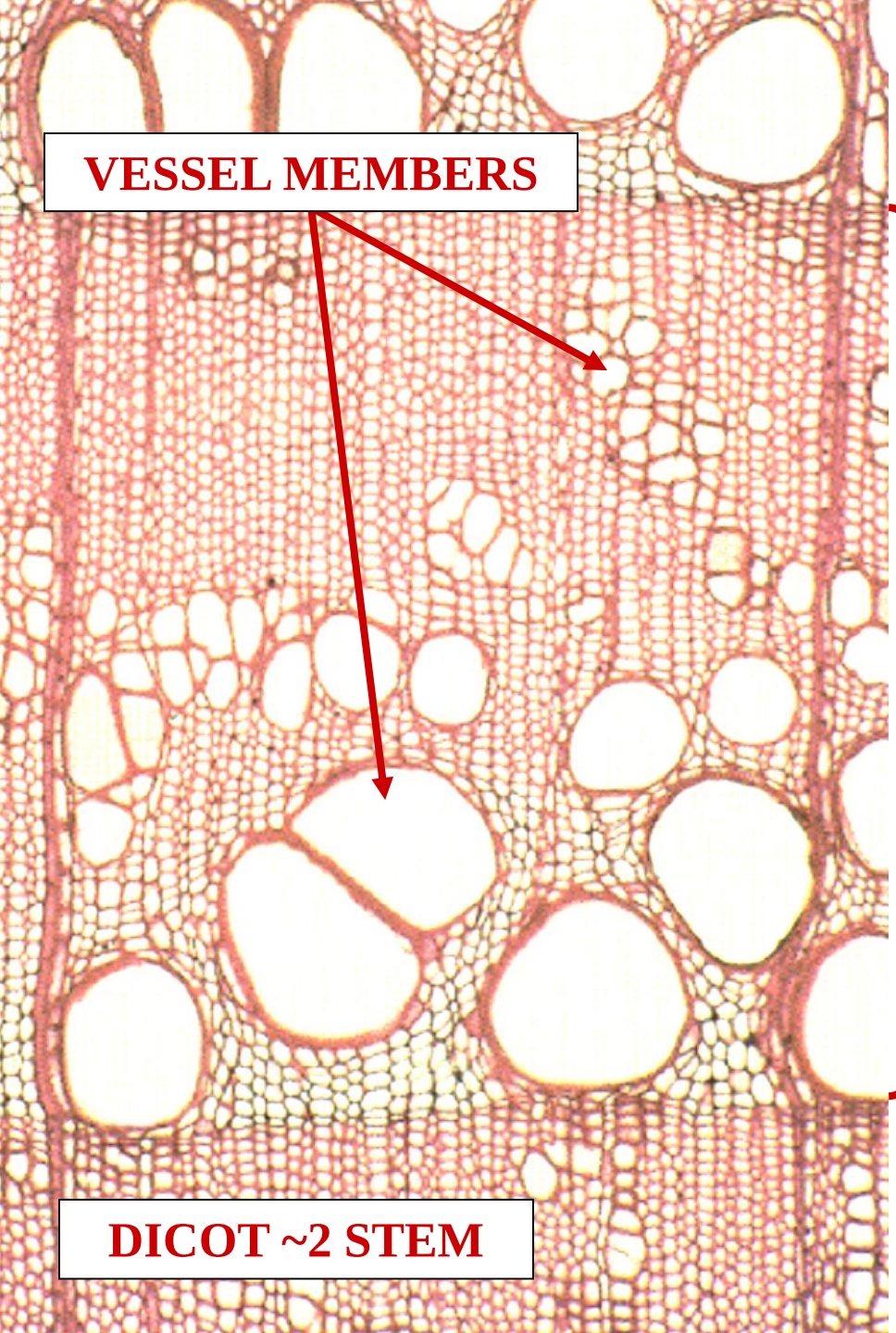
WOOD TYPES
RING POROUS WOOD

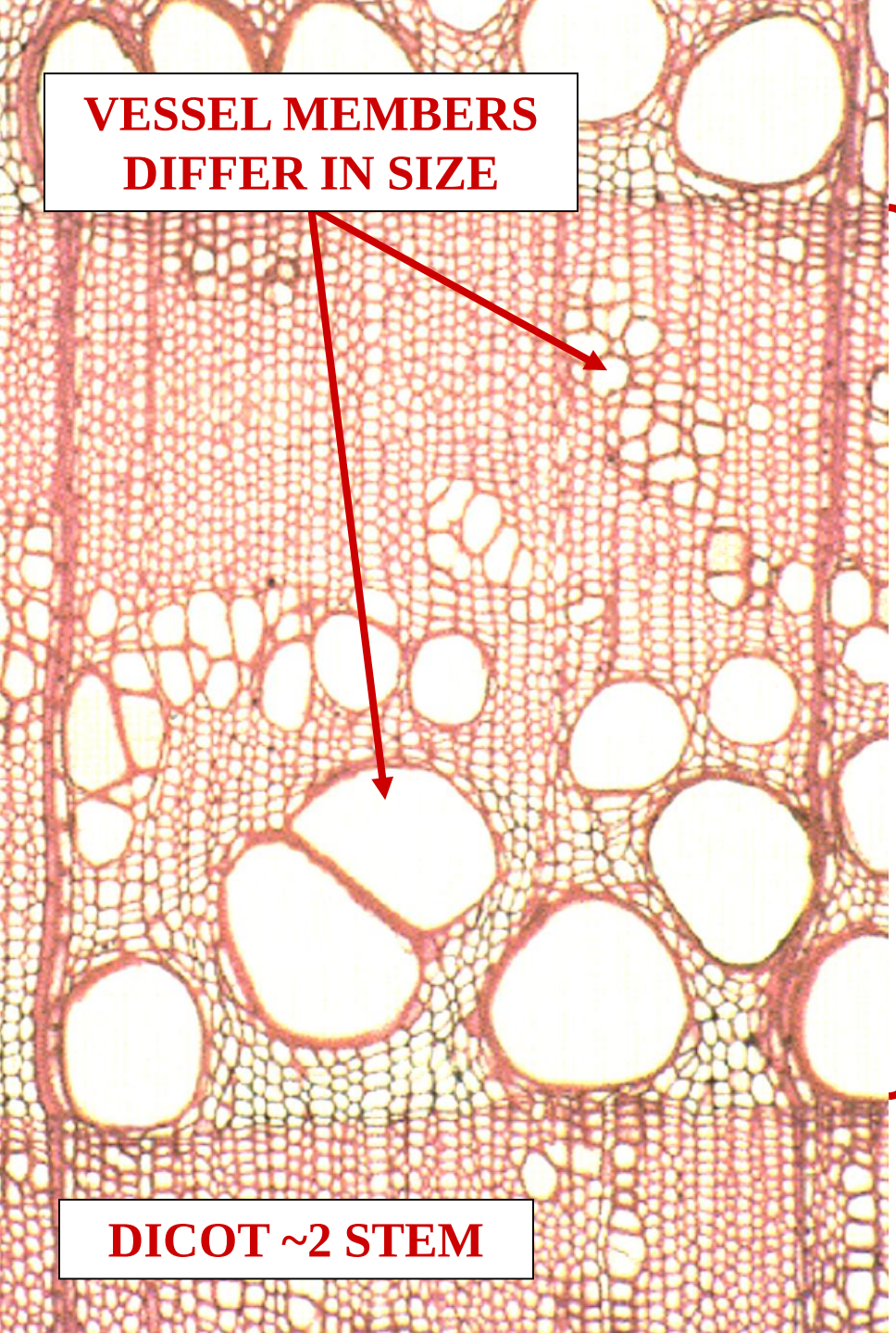
VM

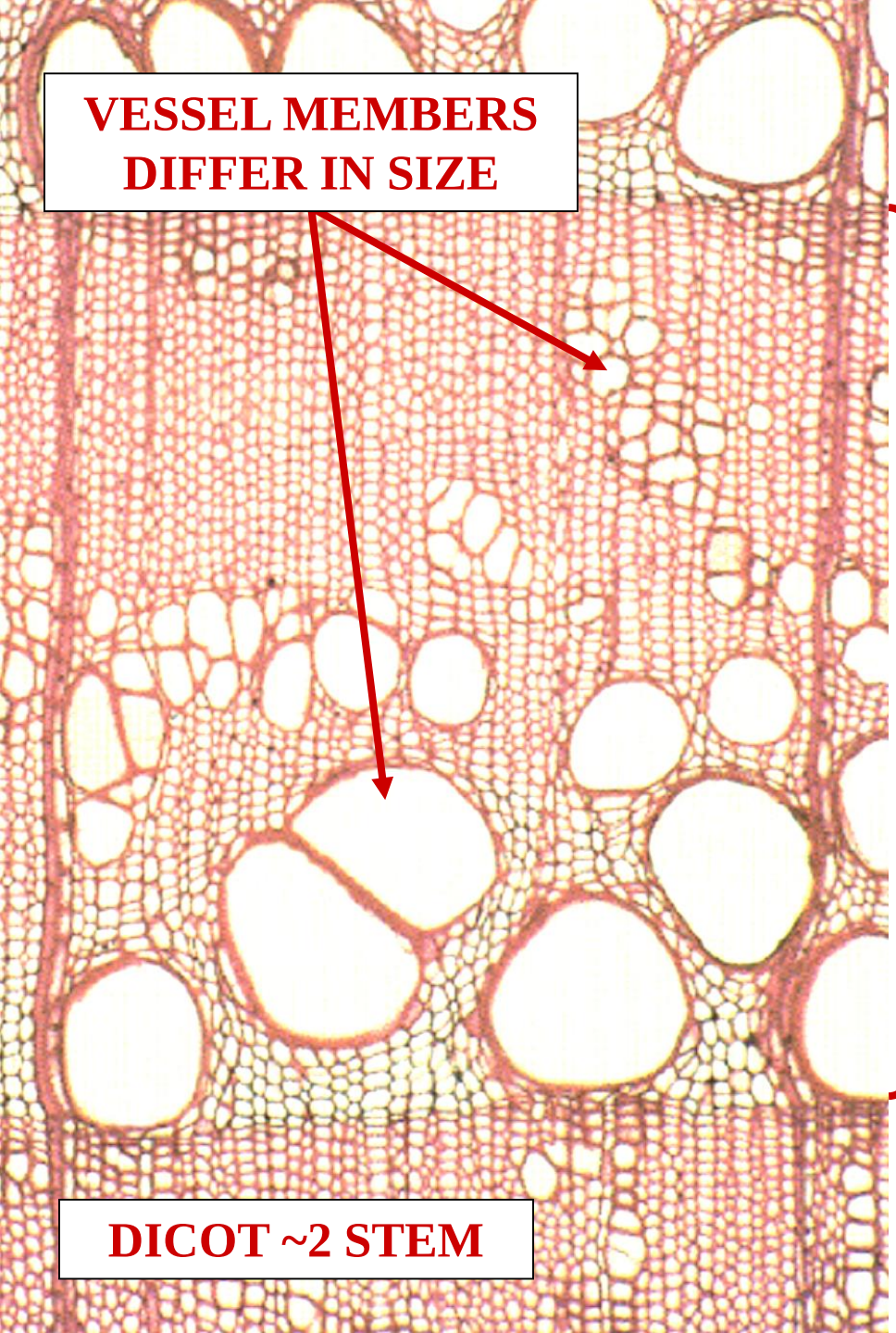
VESSEL MEMBRANE SIZE DIFFERS WITHIN ANNUAL RING

WOOD TYPES
RING POROUS WOOD

D




VESSEL MEMBERS
DIFFER IN SIZE
ANNUAL RING
DICOT ~2 STEM
C.S.
RP



RING POROUS WOOD

C.S.

E

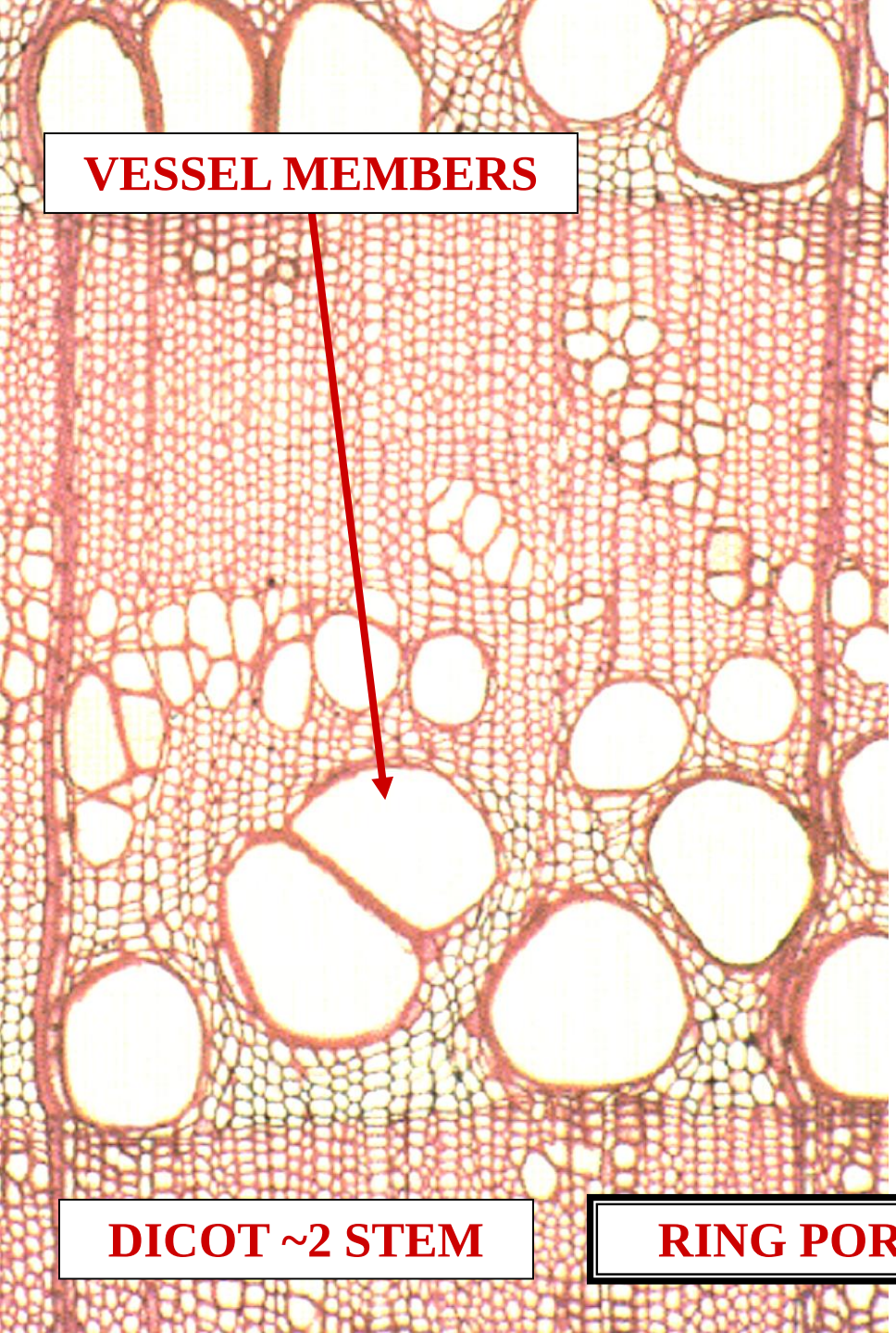
EARLY WOOD
VS
LATE WOOD

EARLY WOOD

RING POROUS WOOD
EARLY WOOD

LARGER VESSEL MEMBER SIZE

RING POROUS WOOD
EARLY WOOD



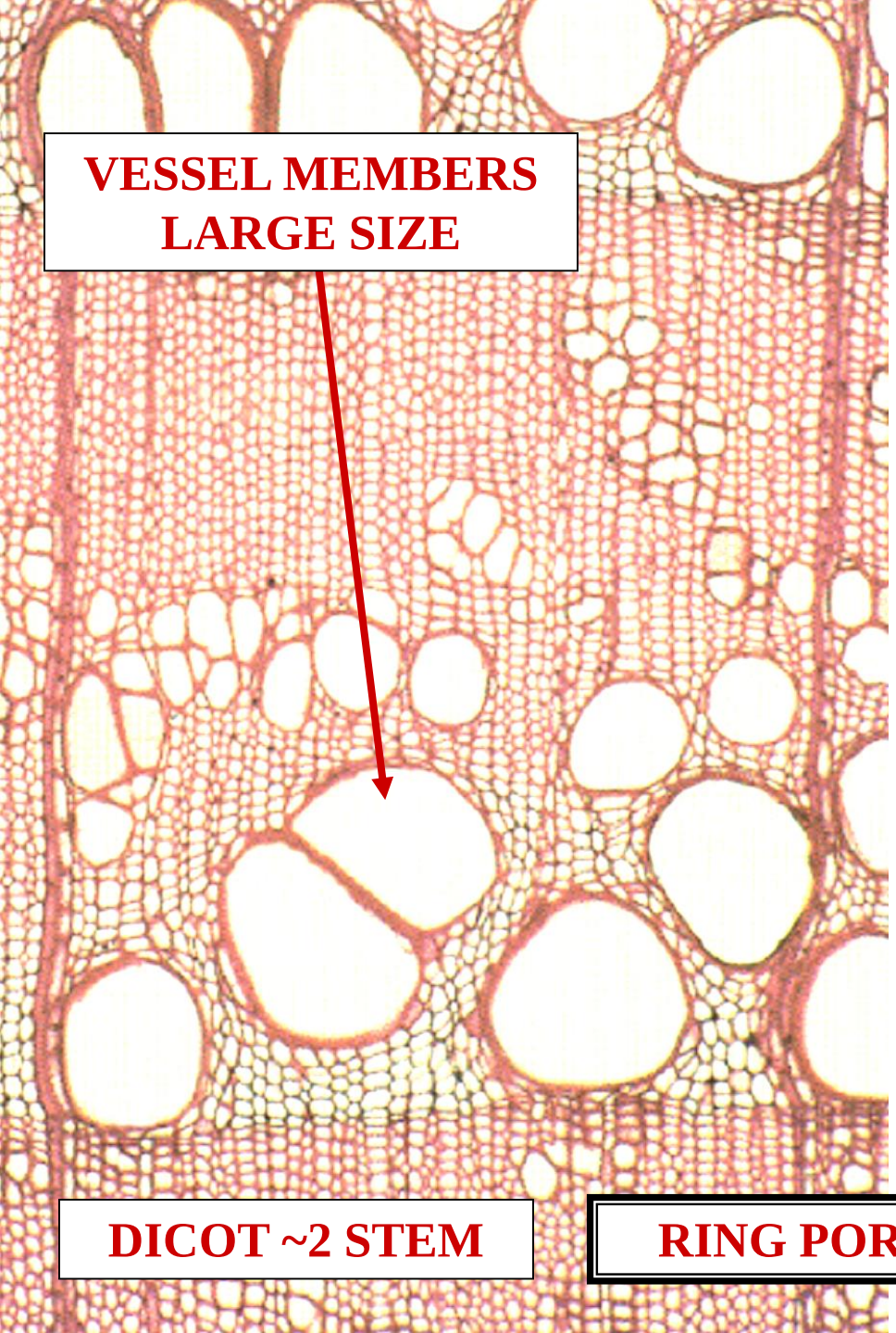
L

ANNUAL RING

DICOT ~2 STEM

RING POROUS WOOD

C.S.



EM

ANNUAL
RING

DICOT ~2 STEM

RING POROUS WOOD

C.S.