

DEPOSITED INWARD OF ~1 WALL

MIDDLE LAMELLA

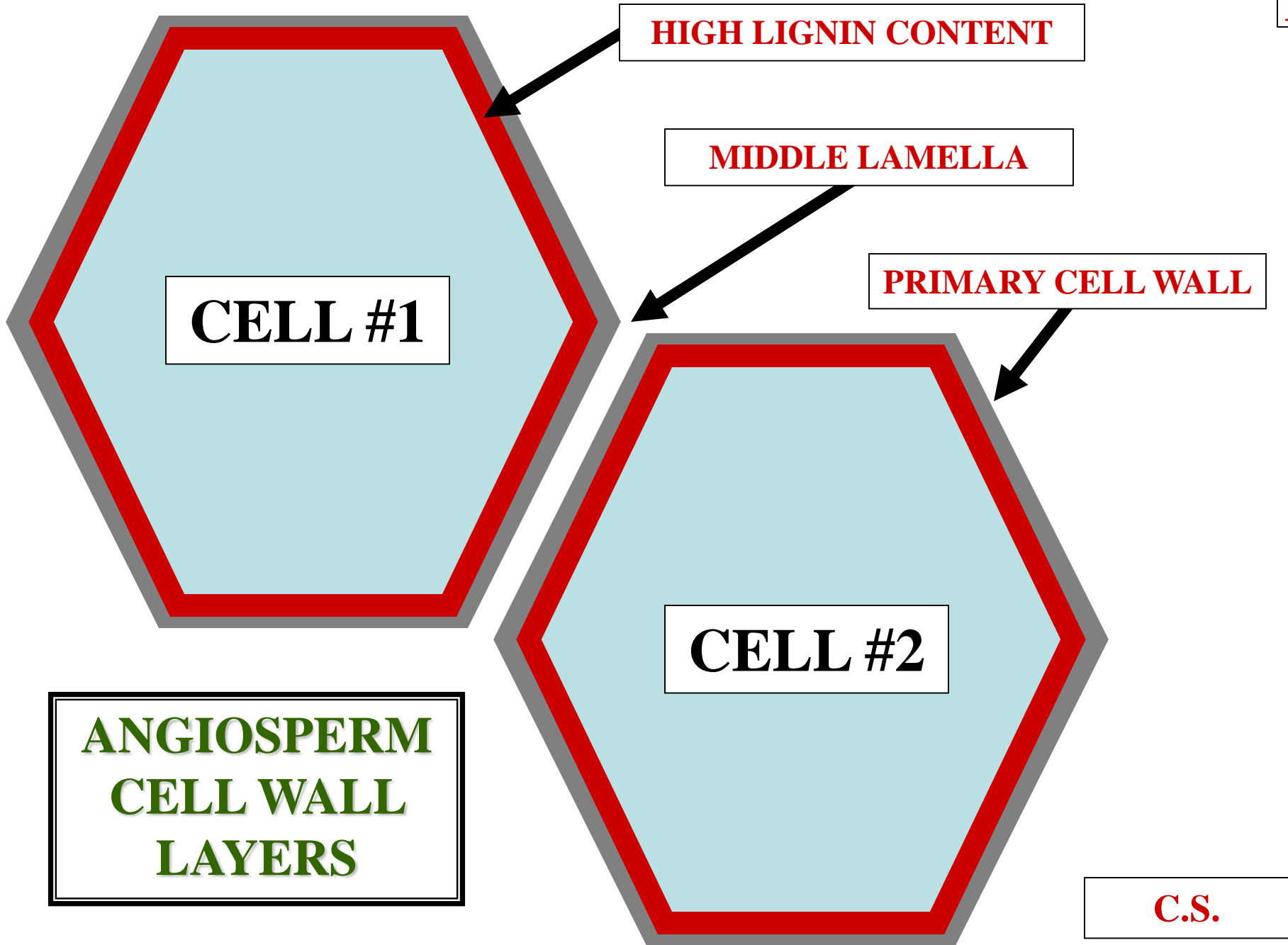
PRIMARY CELL WALL

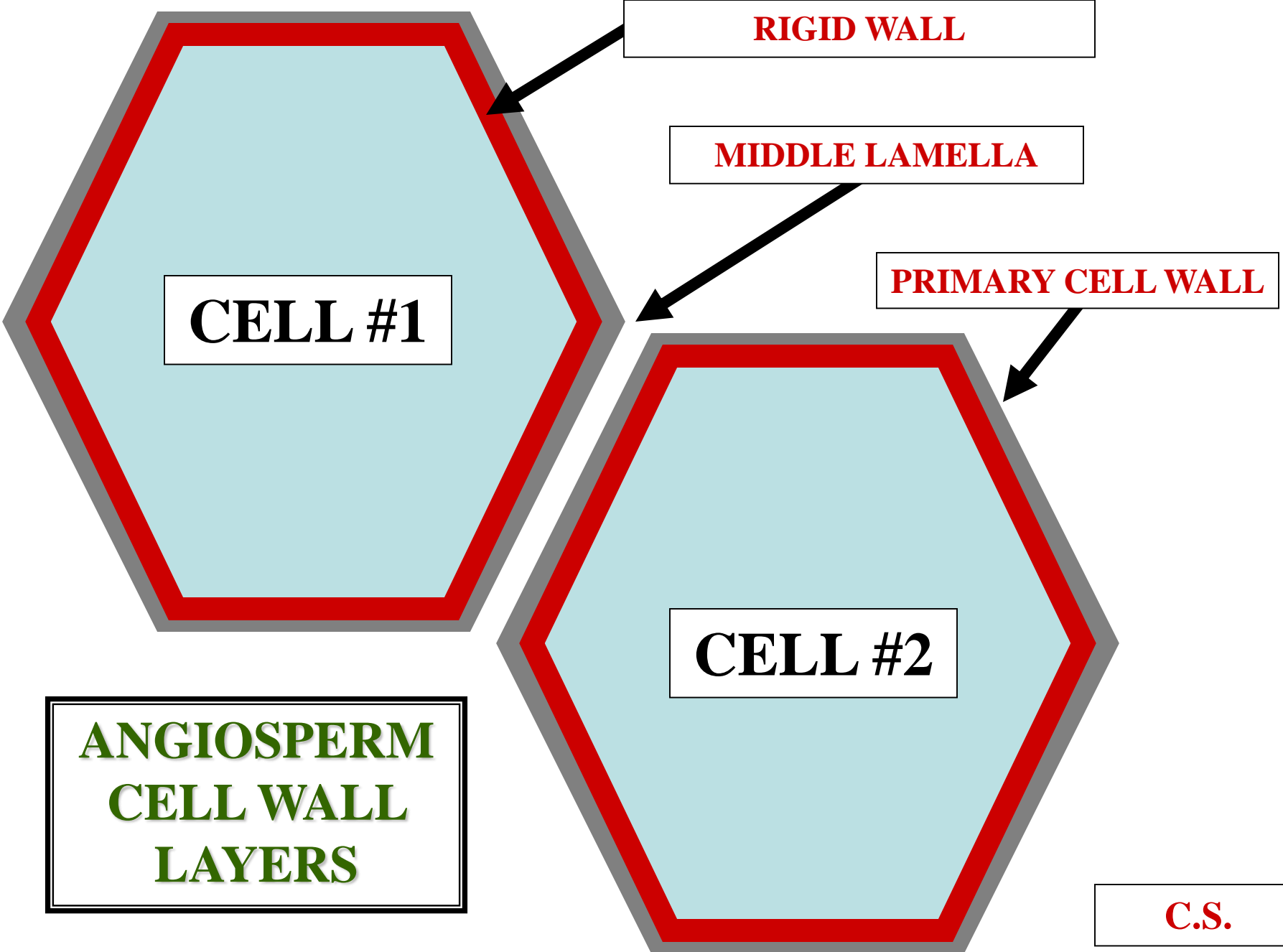
CELL #1

CELL #2

**ANGIOSPERM
CELL WALL
LAYERS**

C.S.





CELL #1

RIGID WALL

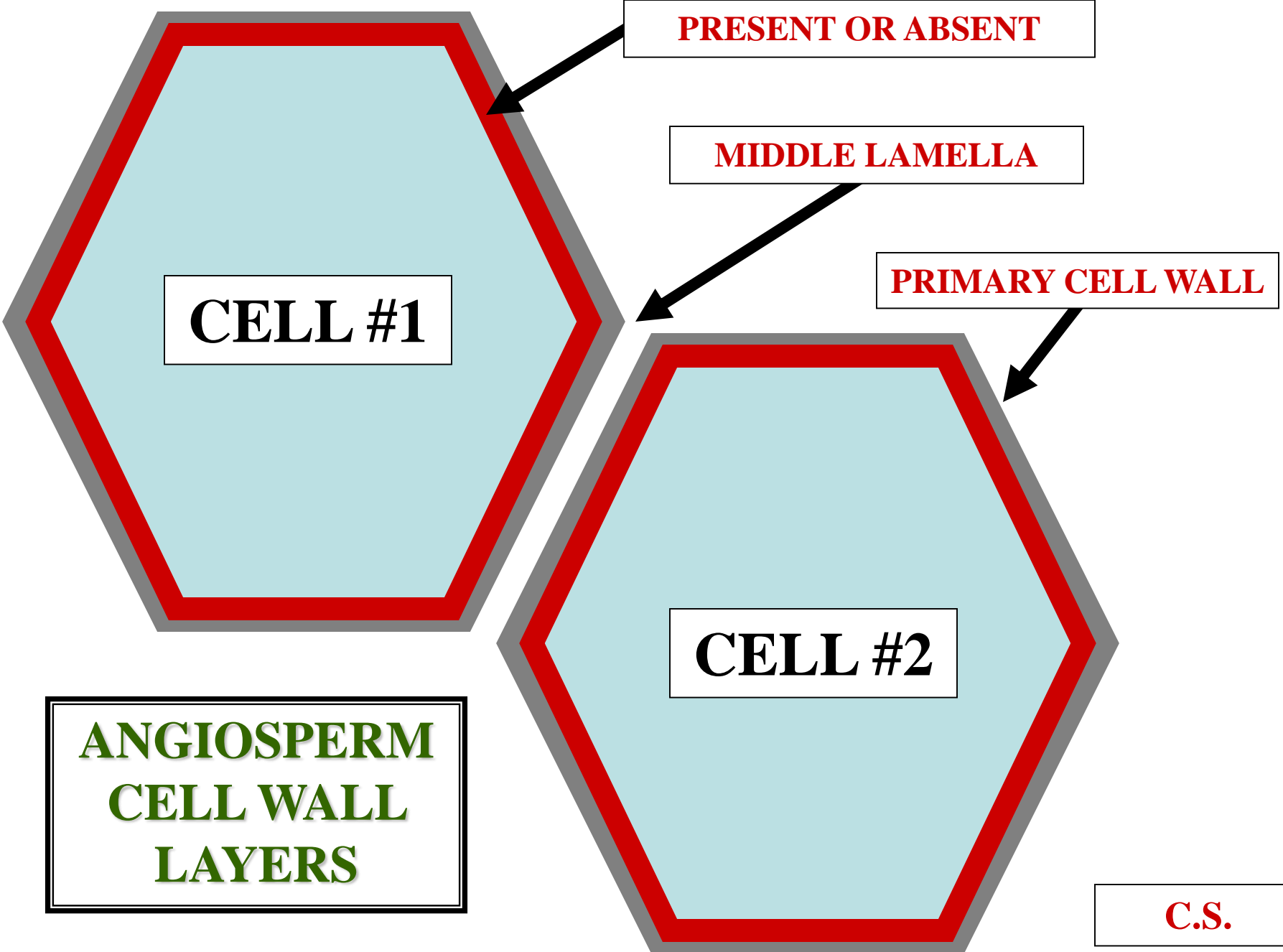
MIDDLE LAMELLA

PRIMARY CELL WALL

CELL #2

**ANGIOSPERM
CELL WALL
LAYERS**

C.S.



PRESENT OR ABSENT

MIDDLE LAMELLA

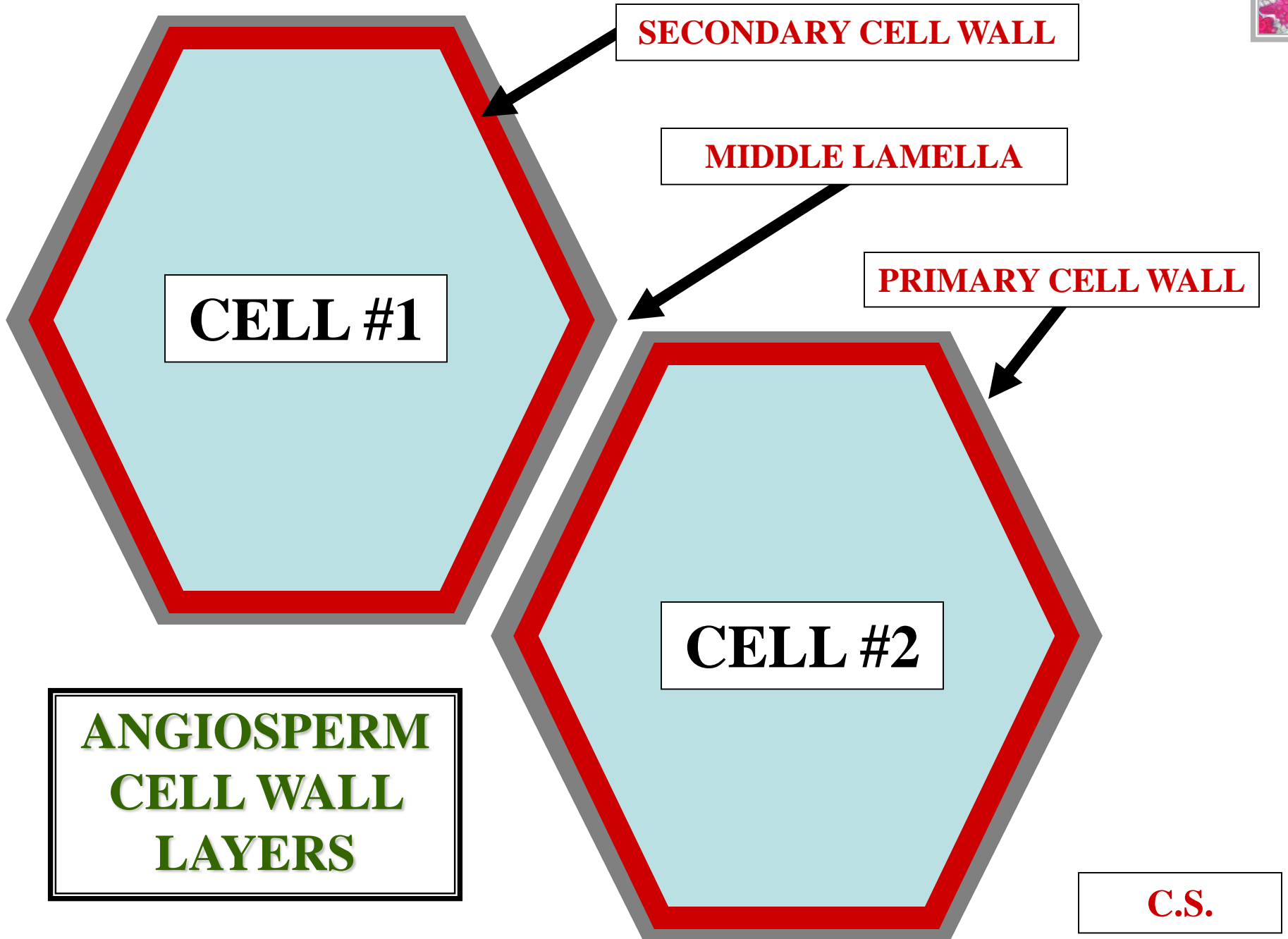
PRIMARY CELL WALL

CELL #1

CELL #2

**ANGIOSPERM
CELL WALL
LAYERS**

C.S.



1

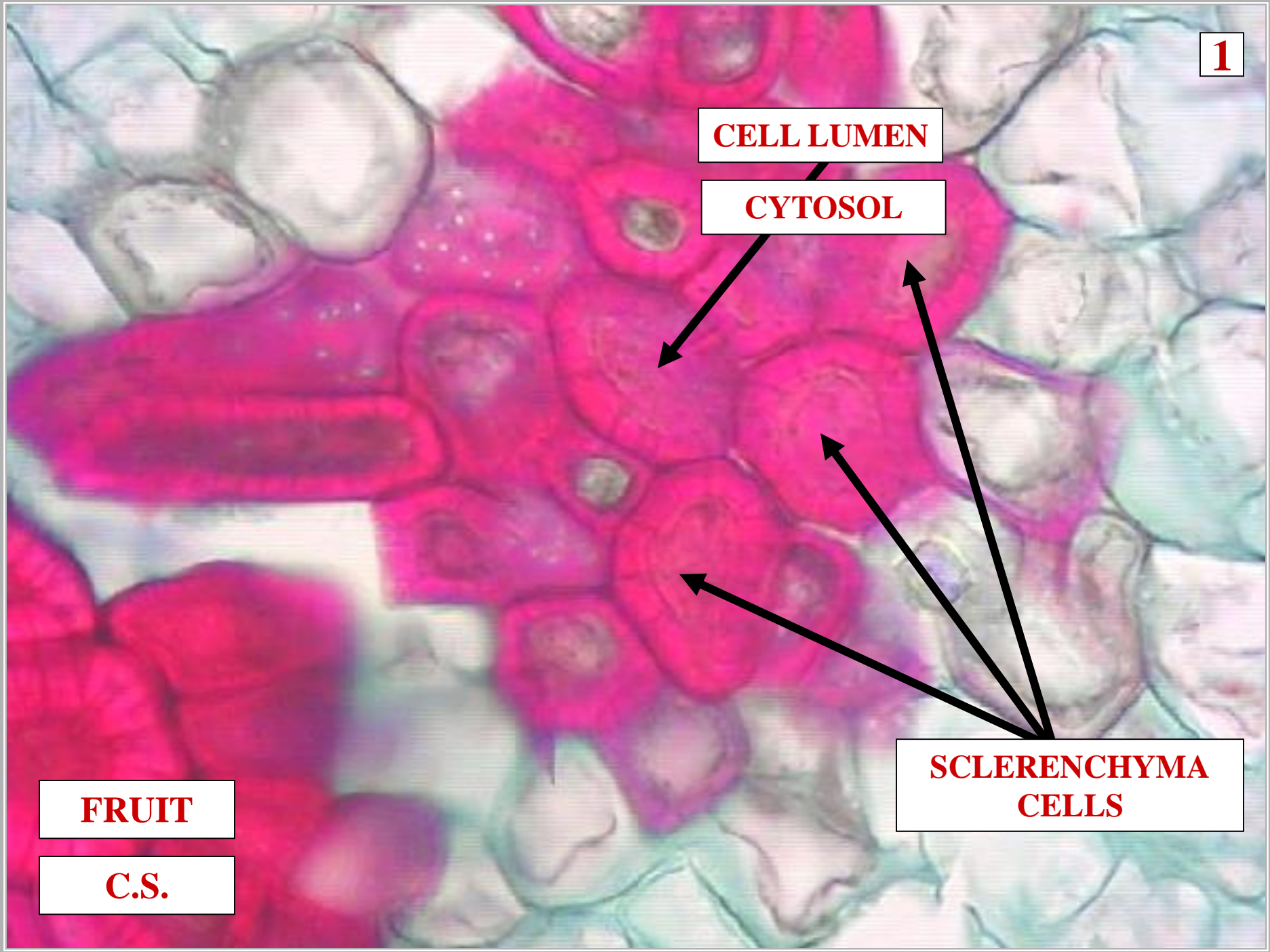
CELL LUMEN

CYTOSOL

**SCLERENCHYMA
CELLS**

FRUIT

C.S.



CELL LUMEN

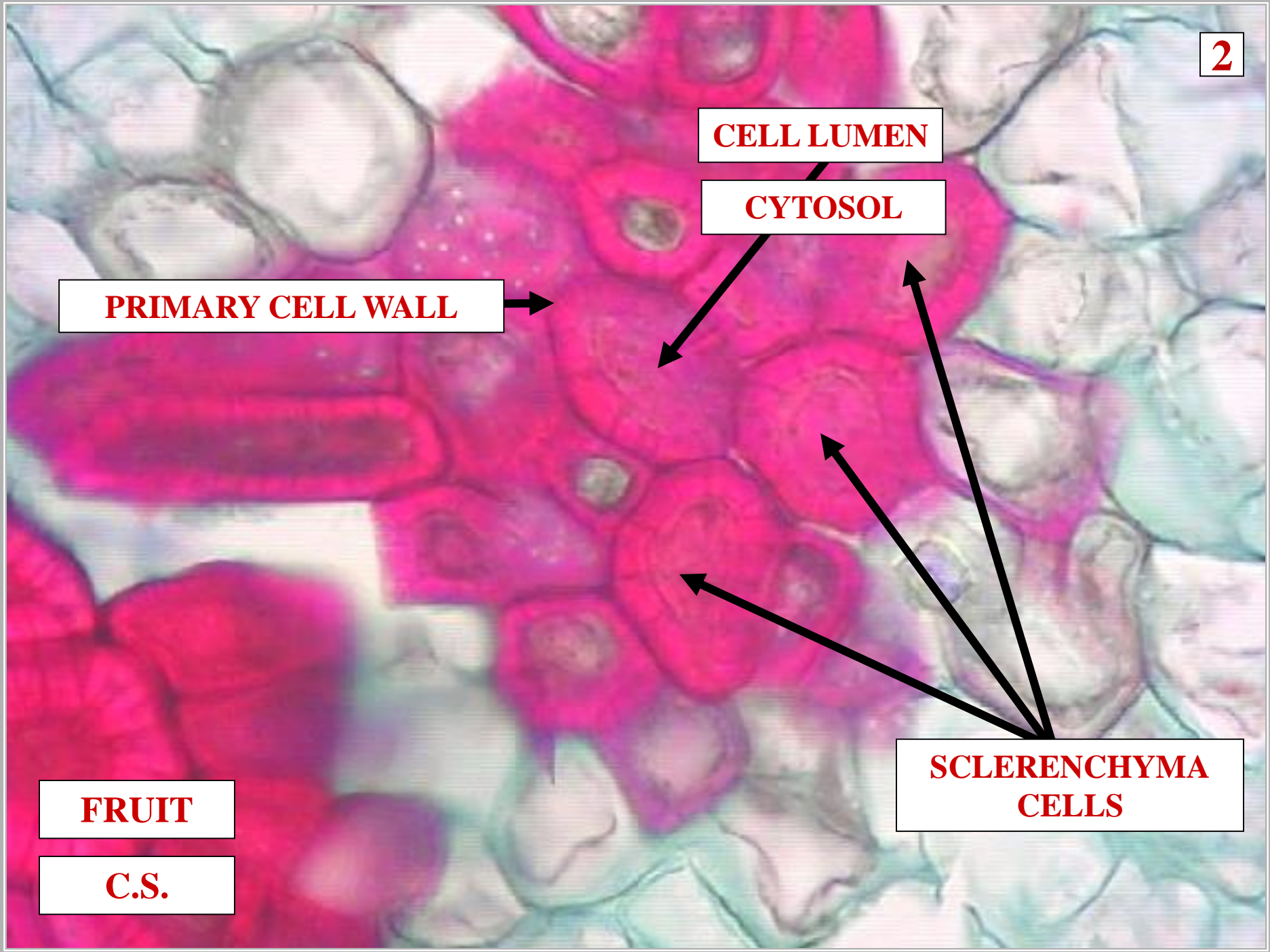
CYTOSOL

PRIMARY CELL WALL

SCLERENCHYMA CELLS

FRUIT

C.S.





CELL LUMEN

CYTOSOL

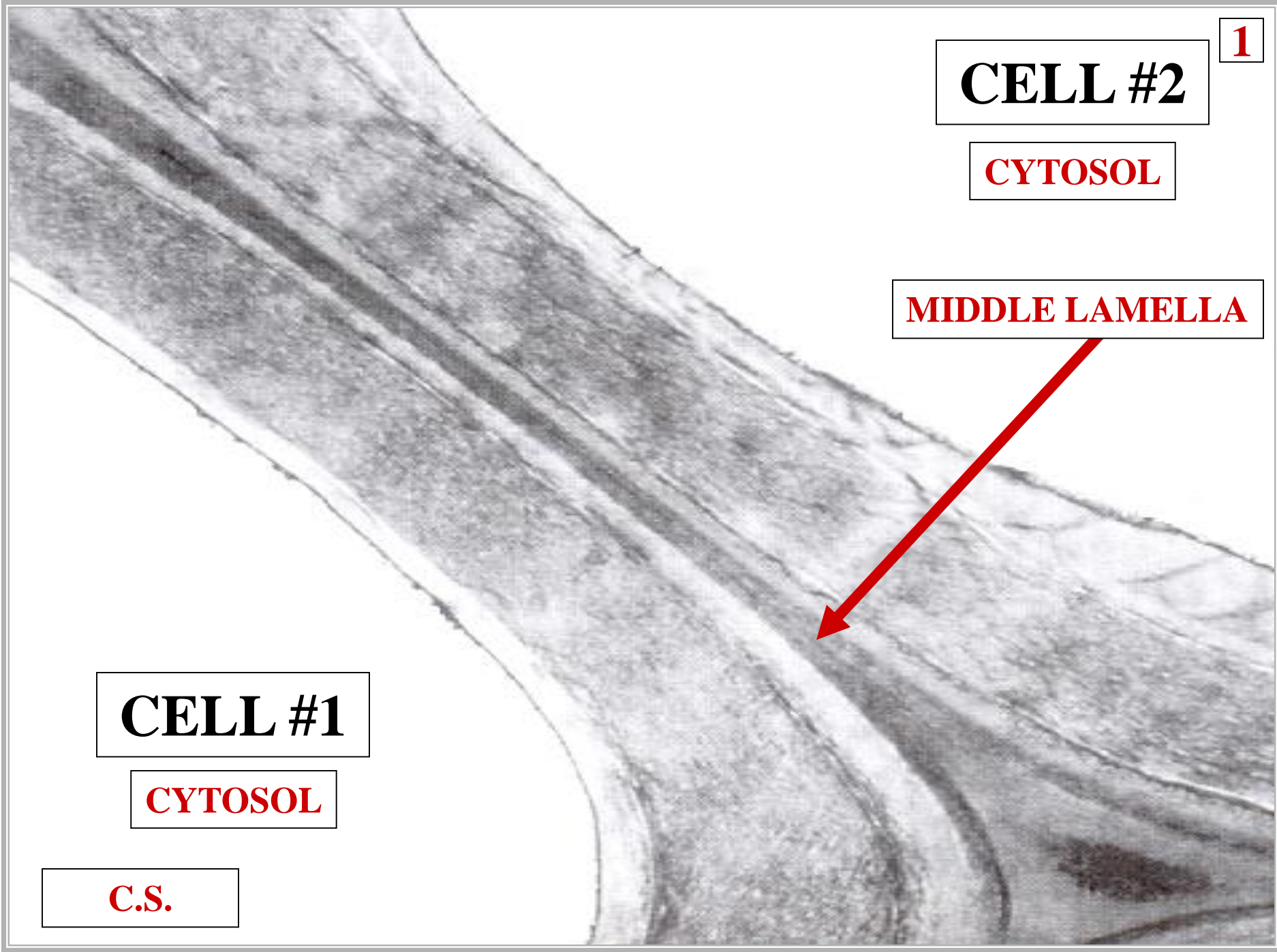
PRIMARY CELL WALL

SECONDARY CELL WALL

FRUIT

C.S.

**SCLERENCHYMA
CELLS**



1

CELL #2

CYTOSOL

MIDDLE LAMELLA

CELL #1

CYTOSOL

C.S.

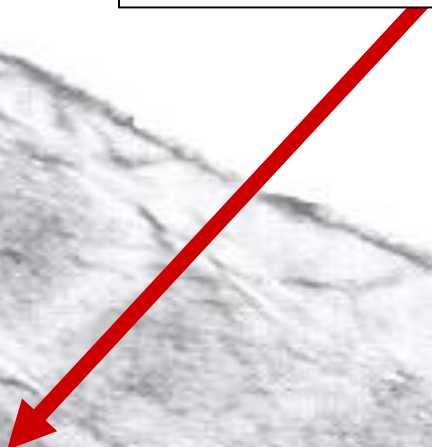
2

CELL #2

CYTOSOL

MIDDLE LAMELLA

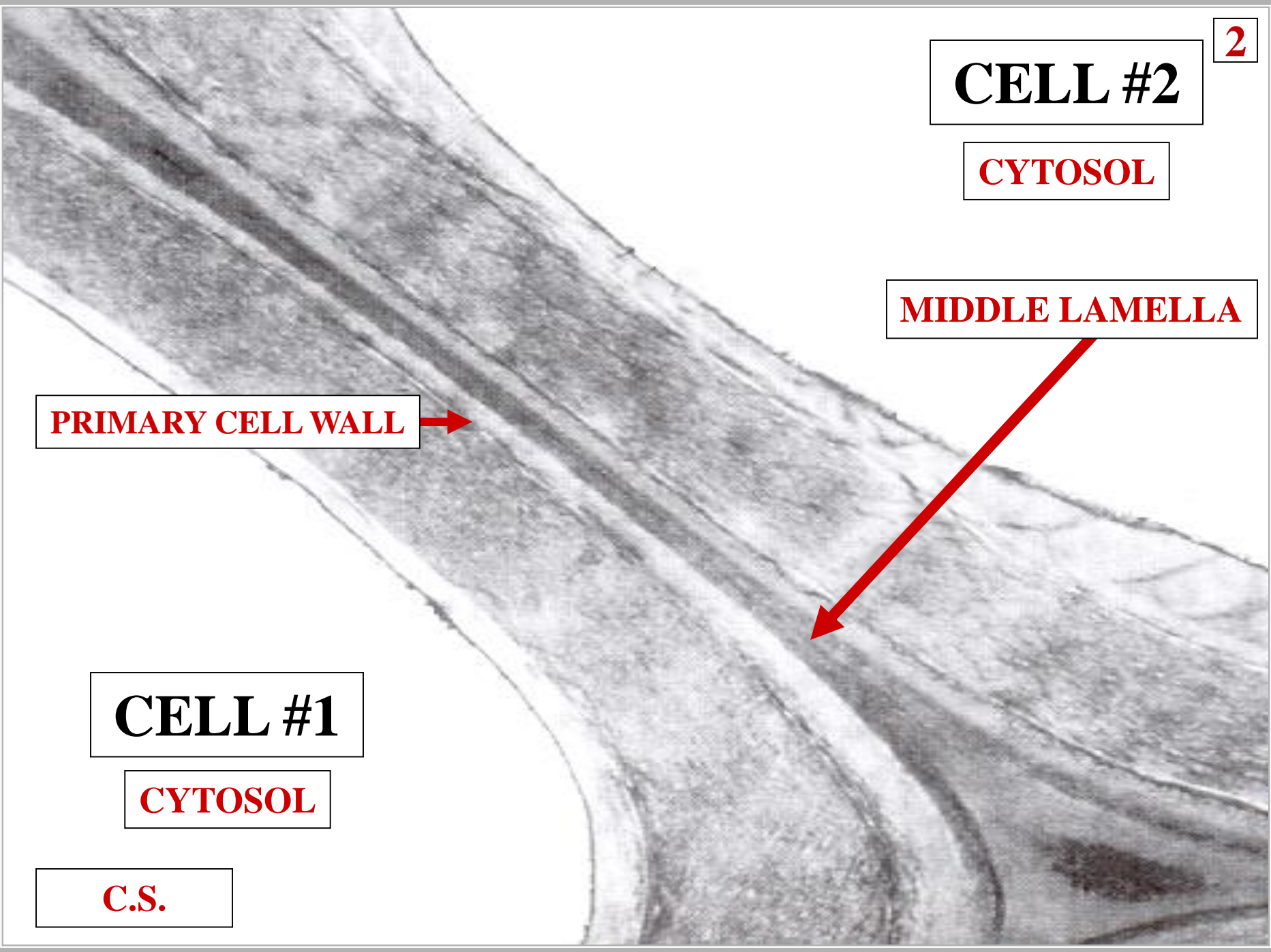
PRIMARY CELL WALL

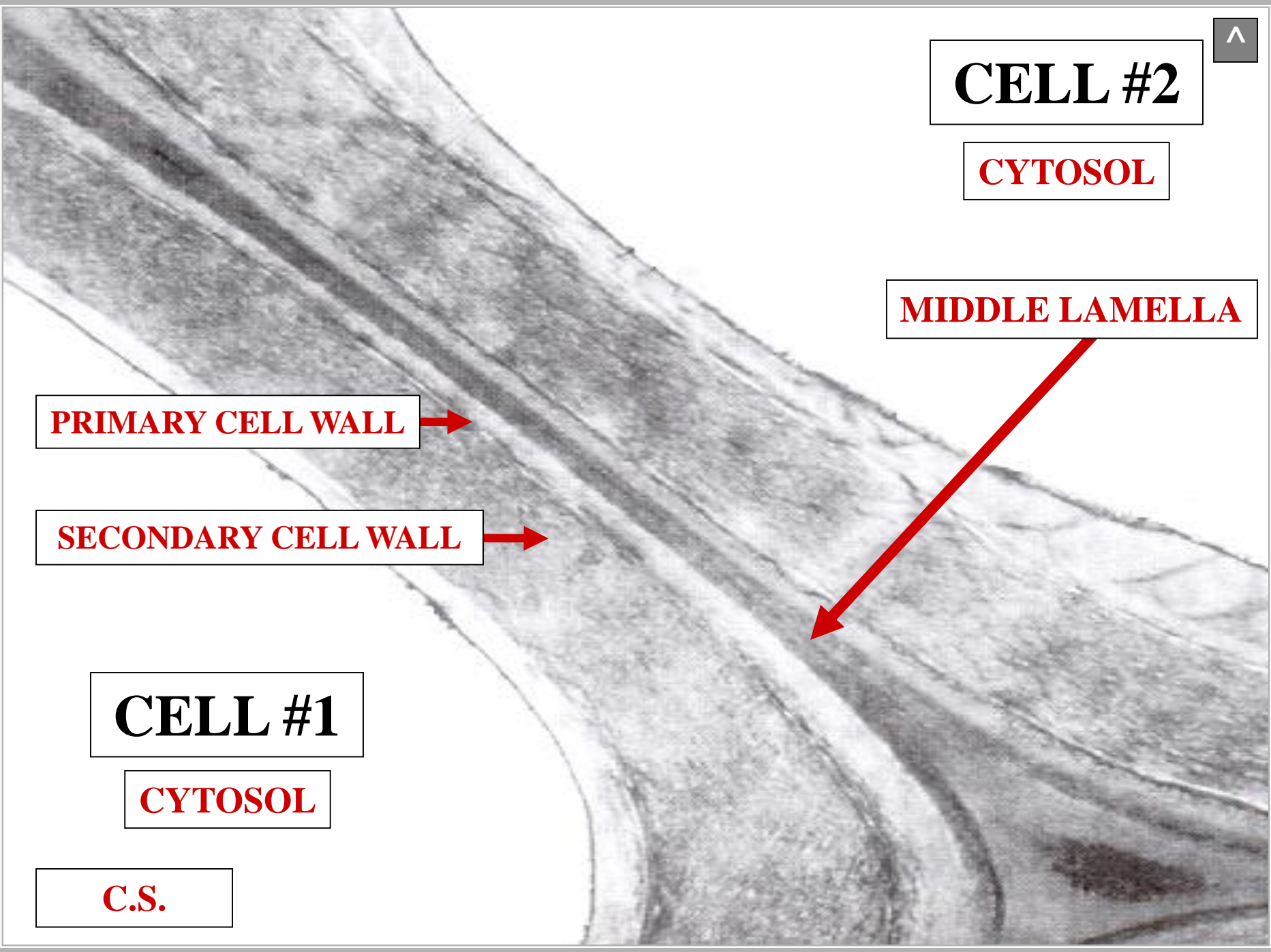


CELL #1

CYTOSOL

C.S.





CELL #2

CYTOSOL

MIDDLE LAMELLA

PRIMARY CELL WALL

SECONDARY CELL WALL

CELL #1

CYTOSOL

C.S.

PLASMODESMATA

PLASMODESMATA



PLASMODESMATA

PRIMARY WALL CONDUITS
BETWEEN ADJACENT CELLS

PLASMODESMATA



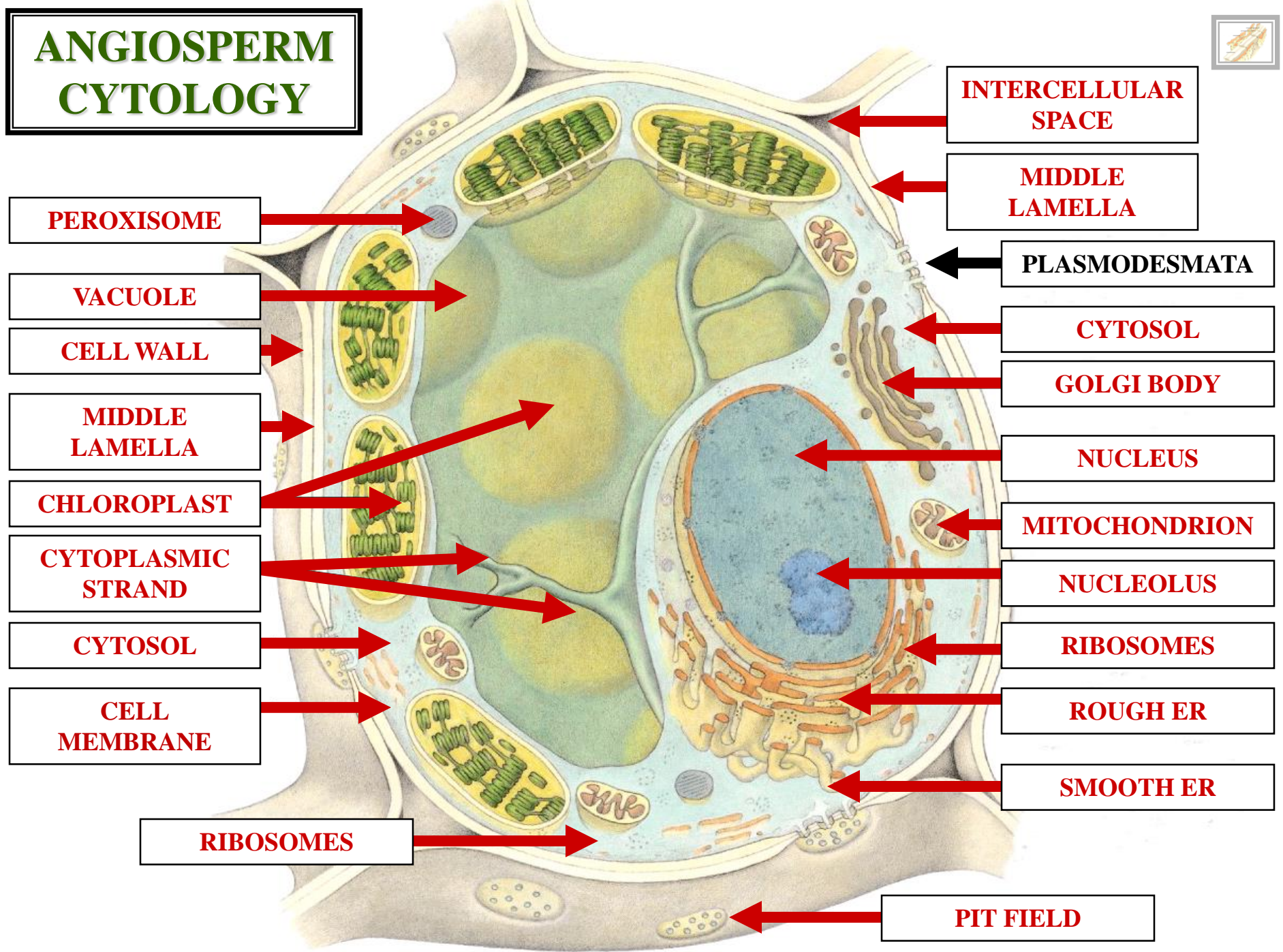
PLASMODESMATA

**PRIMARY WALL CONDUITS
BETWEEN ADJACENT CELLS**

**INTERCELLULAR
COMMUNICATION**

PLASMODESMATA

ANGIOSPERM CYTOLOGY



PEROXISOME

VACUOLE

CELL WALL

MIDDLE LAMELLA

CHLOROPLAST

CYTOPLASMIC STRAND

CYTOSOL

CELL MEMBRANE

RIBOSOMES

INTERCELLULAR SPACE

MIDDLE LAMELLA

PLASMODESMATA

CYTOSOL

GOLGI BODY

NUCLEUS

MITOCHONDRION

NUCLEOLUS

RIBOSOMES

ROUGH ER

SMOOTH ER

PIT FIELD

CELL #1

C
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**PRIMARY
CELL WALL**

[]

[]

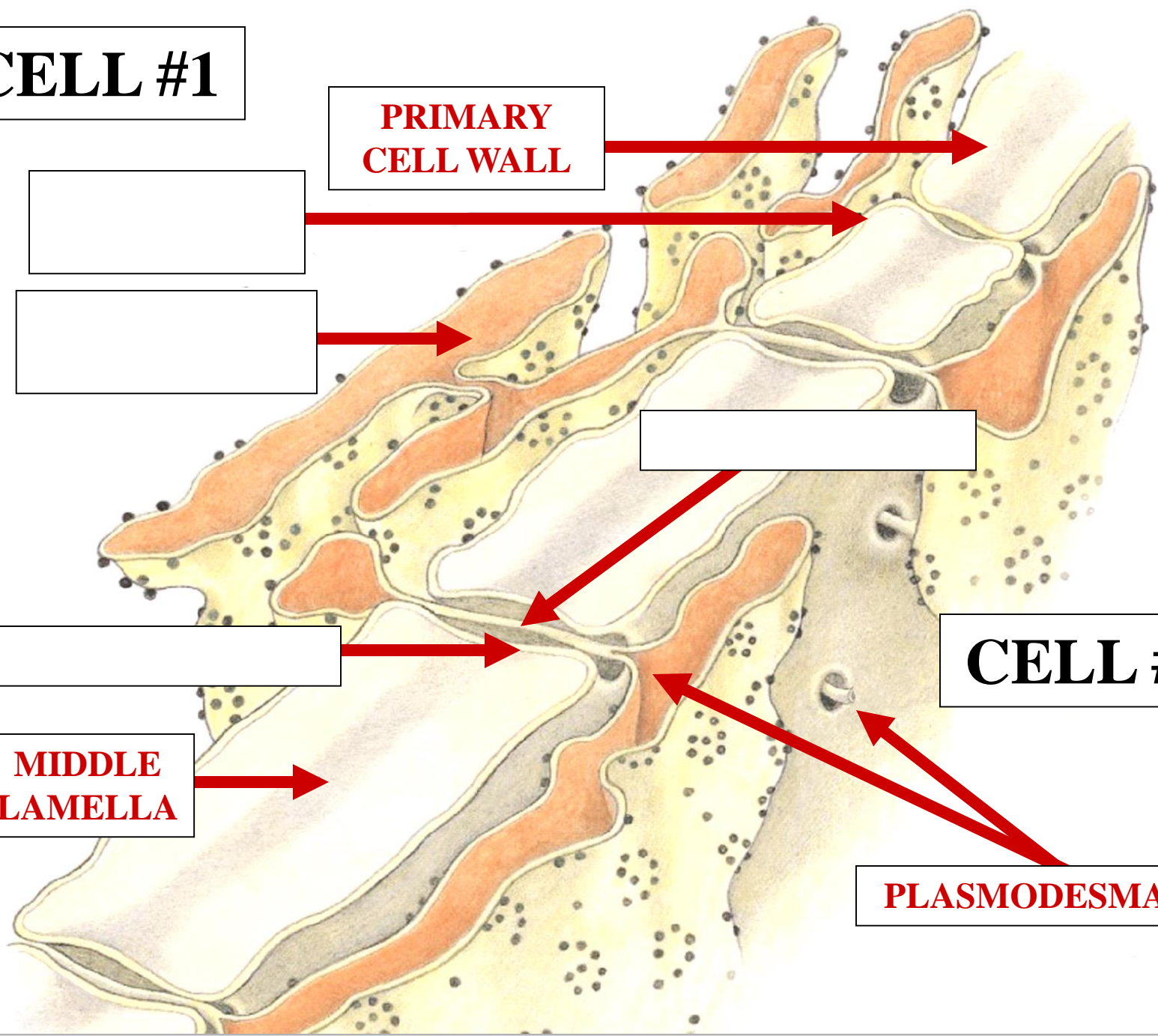
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CELL #2

**MIDDLE
LAMELLA**

PLASMODESMATA



CELL #1

**PRIMARY
CELL WALL**

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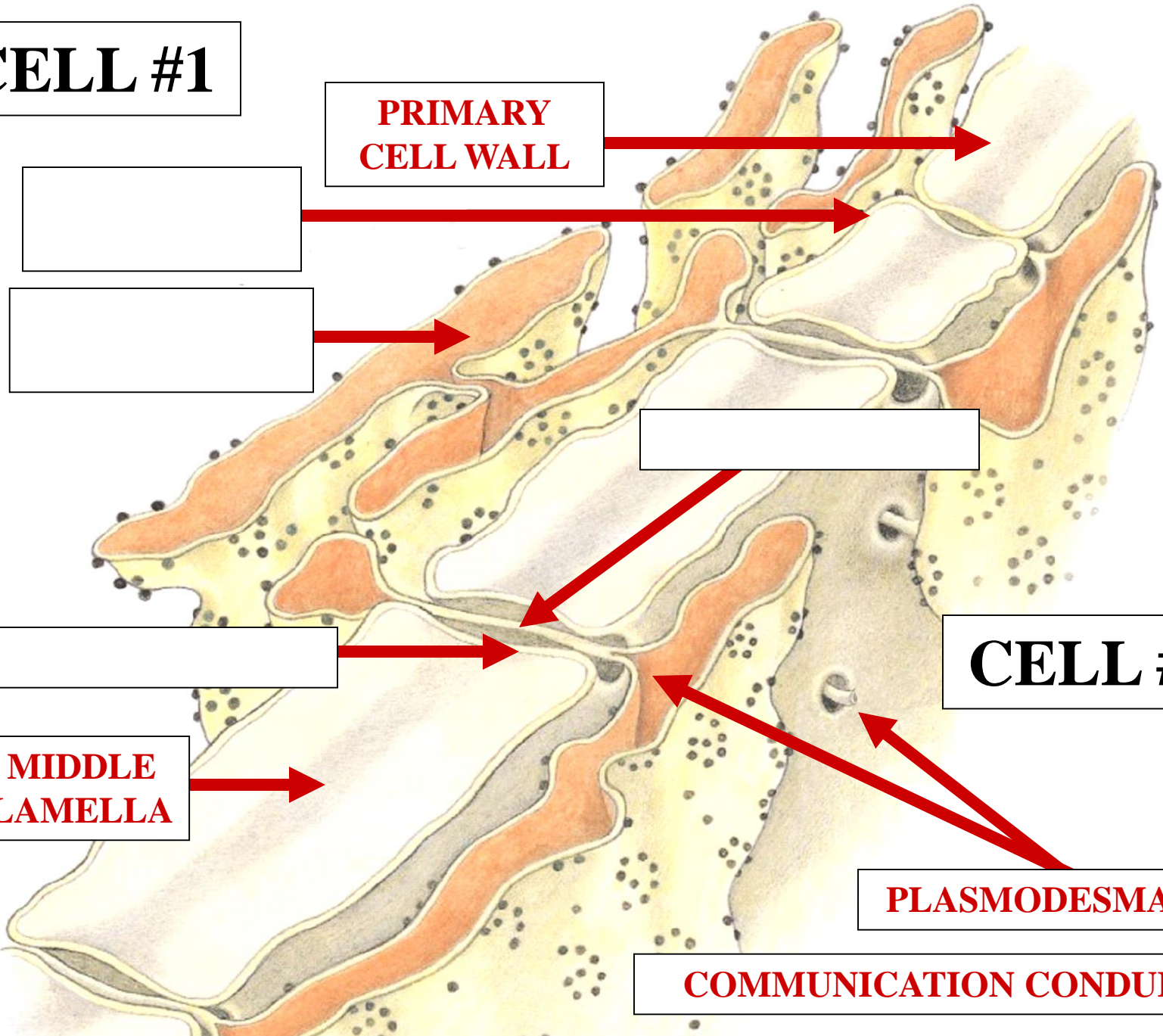
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CELL #2

**MIDDLE
LAMELLA**

PLASMODESMATA

**COMMUNICATION
CONDUIT**





PLASMODESMATA ULTRASTRUCTURE

CELL #1

**PRIMARY
CELL WALL**

[]

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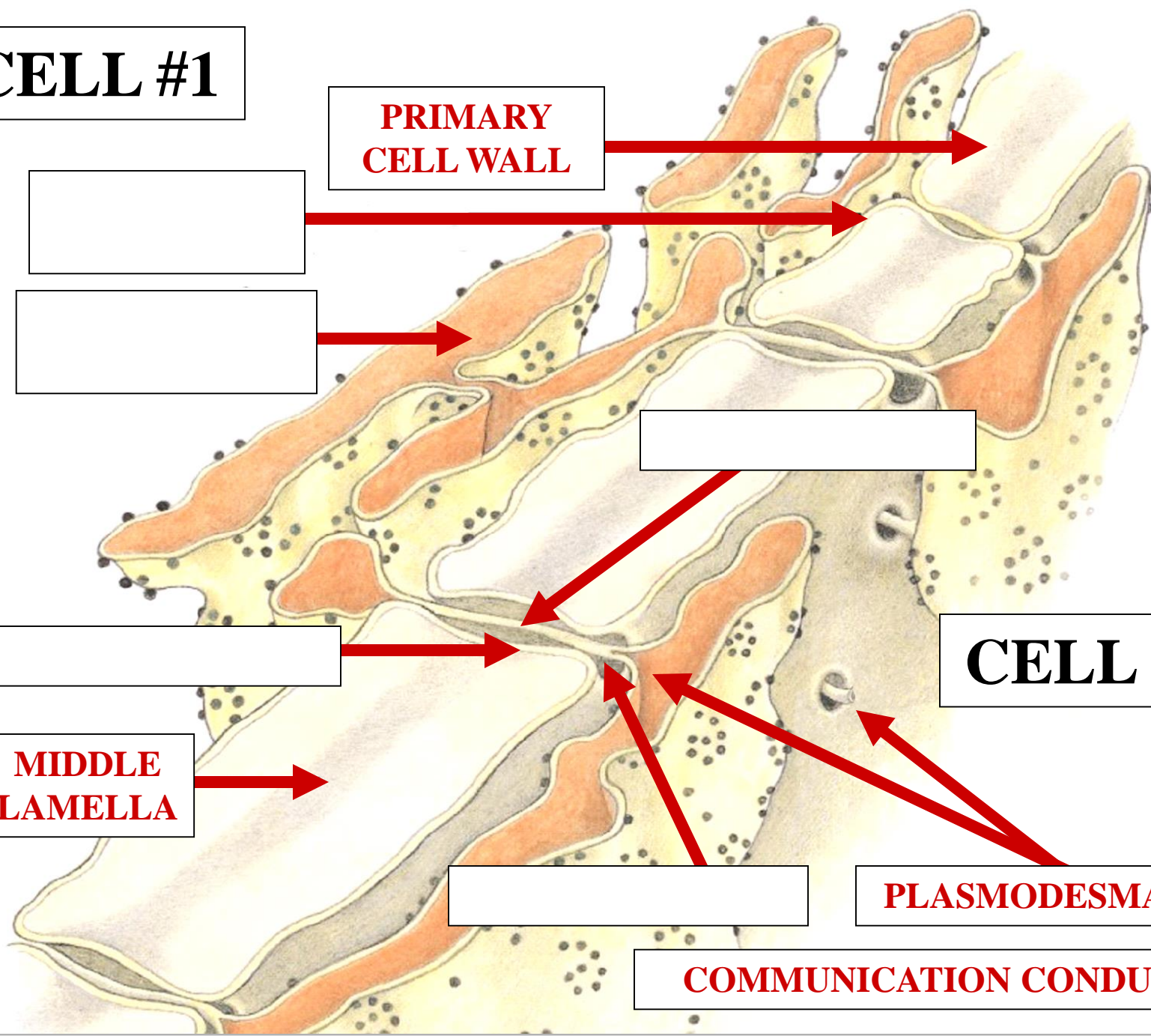
CELL #2

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**MIDDLE
LAMELLA**

PLASMODESMATA

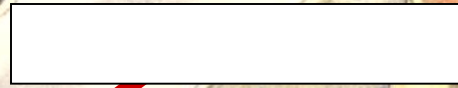
**COMMUNICATION
CONDUIT**



CELL #1

D

**PRIMARY
CELL WALL**

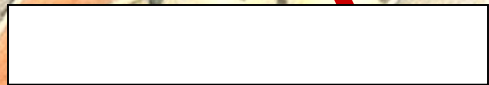


CELL MEMBRANE

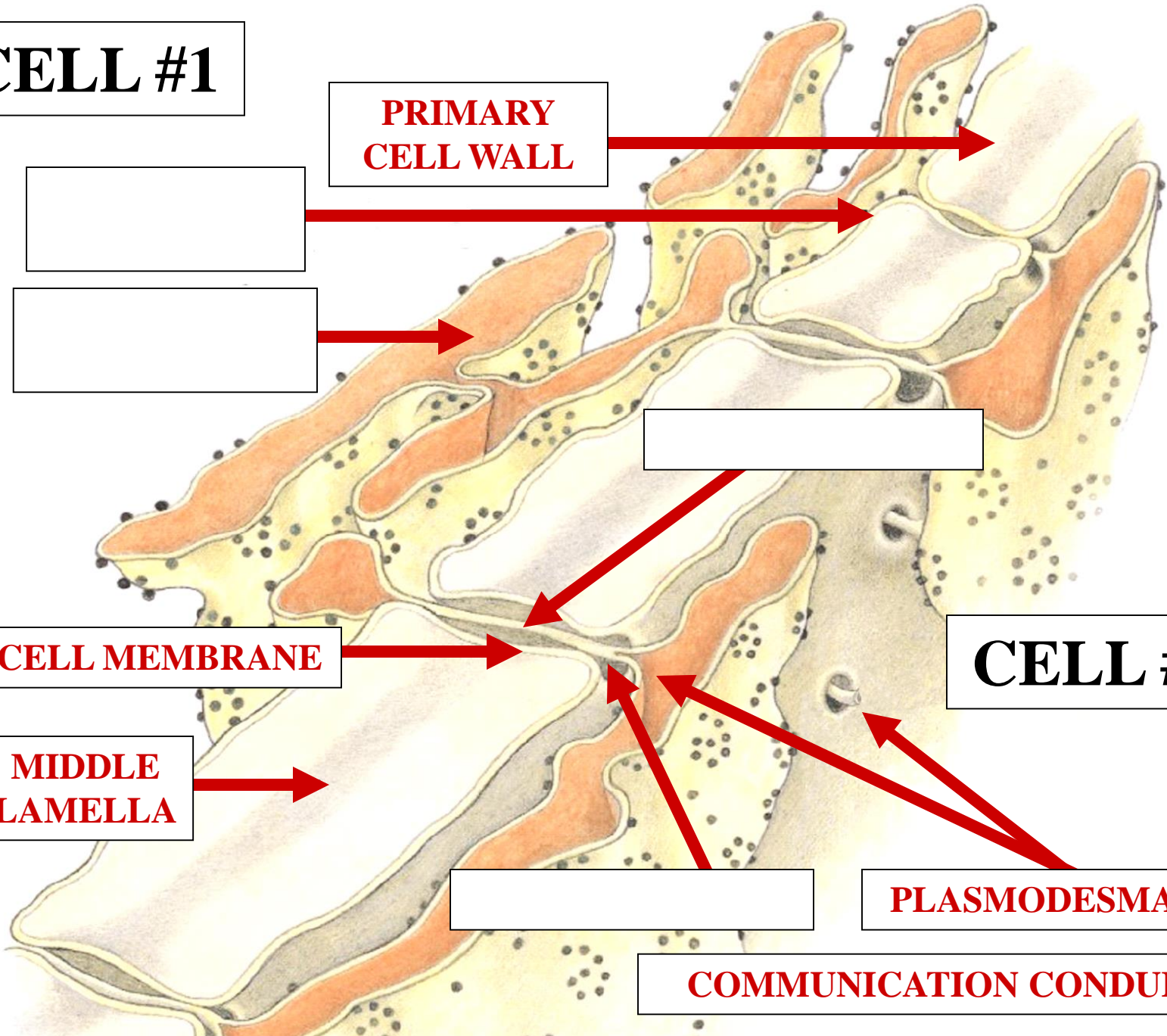
CELL #2

**MIDDLE
LAMELLA**

PLASMODESMATA



COMMUNICATION CONDUIT



CELL #1

D

**PRIMARY
CELL WALL**

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[Empty box]

DESMOTUBULE

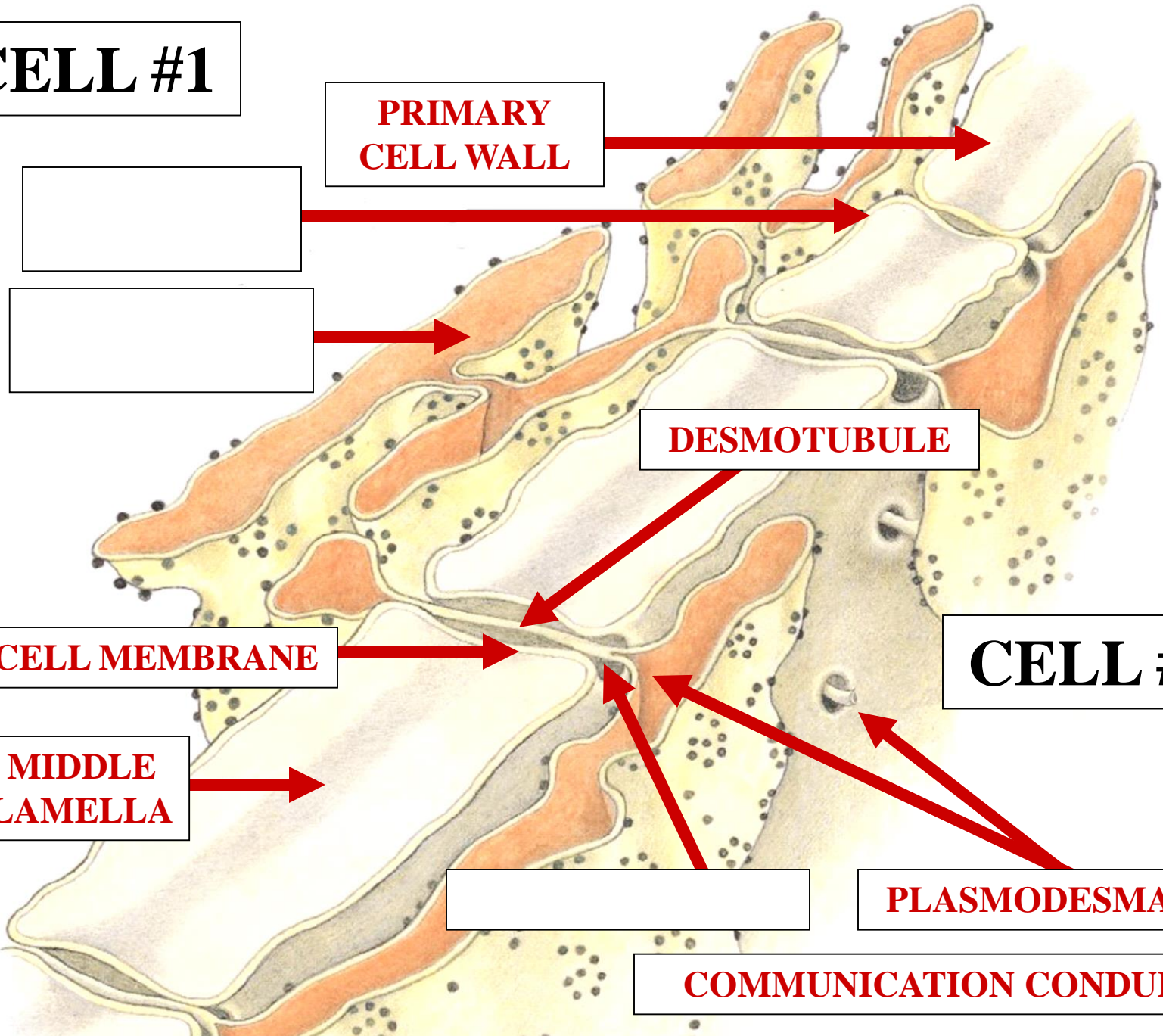
CELL MEMBRANE

CELL #2

**MIDDLE
LAMELLA**

PLASMODESMATA

COMMUNICATION CONDUIT



DESMOTUBULE

**PLASMODESMATA
DESMOTUBULE**



**ENDOPLASMIC RETICULUM
TUBULE**

**PLASMODESMATA
DESMOTUBULE**

CELL #1

ER

**PRIMARY
CELL WALL**

[]

[]

DESMOTUBULE

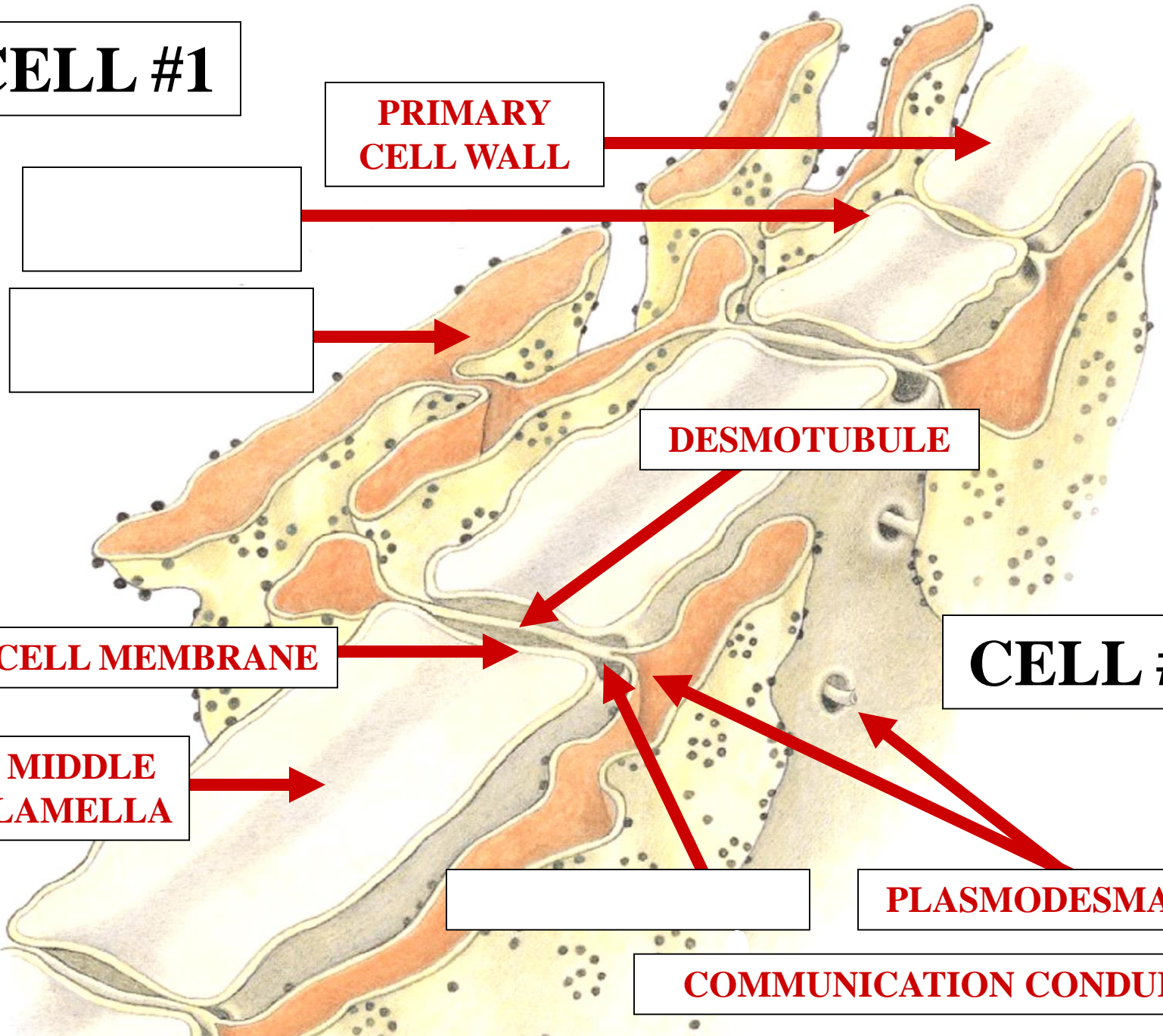
CELL MEMBRANE

CELL #2

**MIDDLE
LAMELLA**

PLASMODESMATA

COMMUNICATION CONDUIT



CELL #1

C

**PRIMARY
CELL WALL**

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**ENDOPLASMIC
RETICULUM**

DESMOTUBULE

CELL MEMBRANE

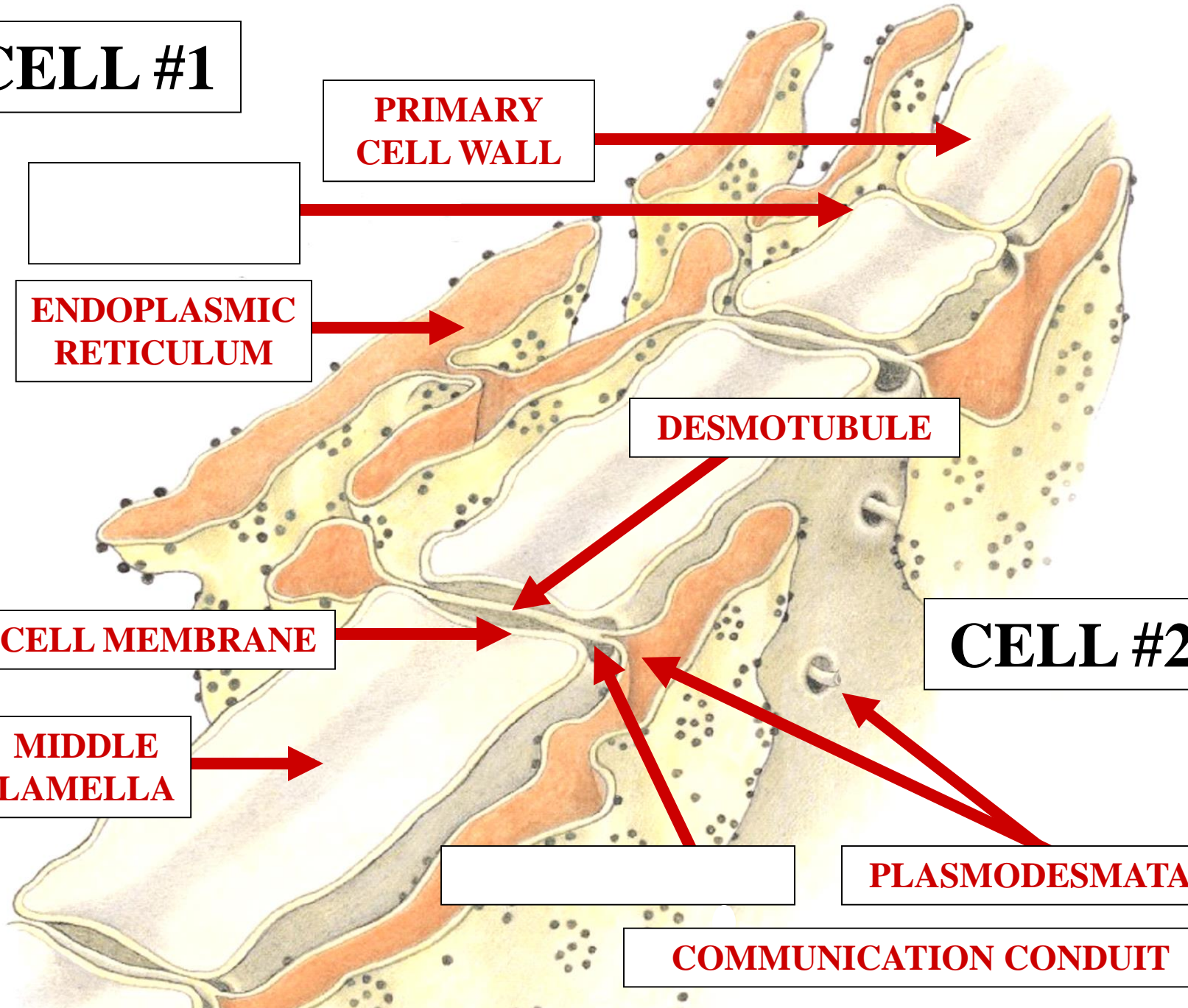
CELL #2

**MIDDLE
LAMELLA**

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PLASMODESMATA

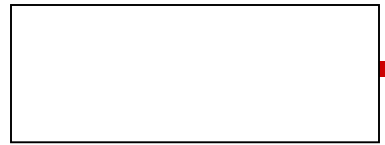
COMMUNICATION CONDUIT



CELL #1



**PRIMARY
CELL WALL**



**ENDOPLASMIC
RETICULUM**

DESMOTUBULE

CELL MEMBRANE

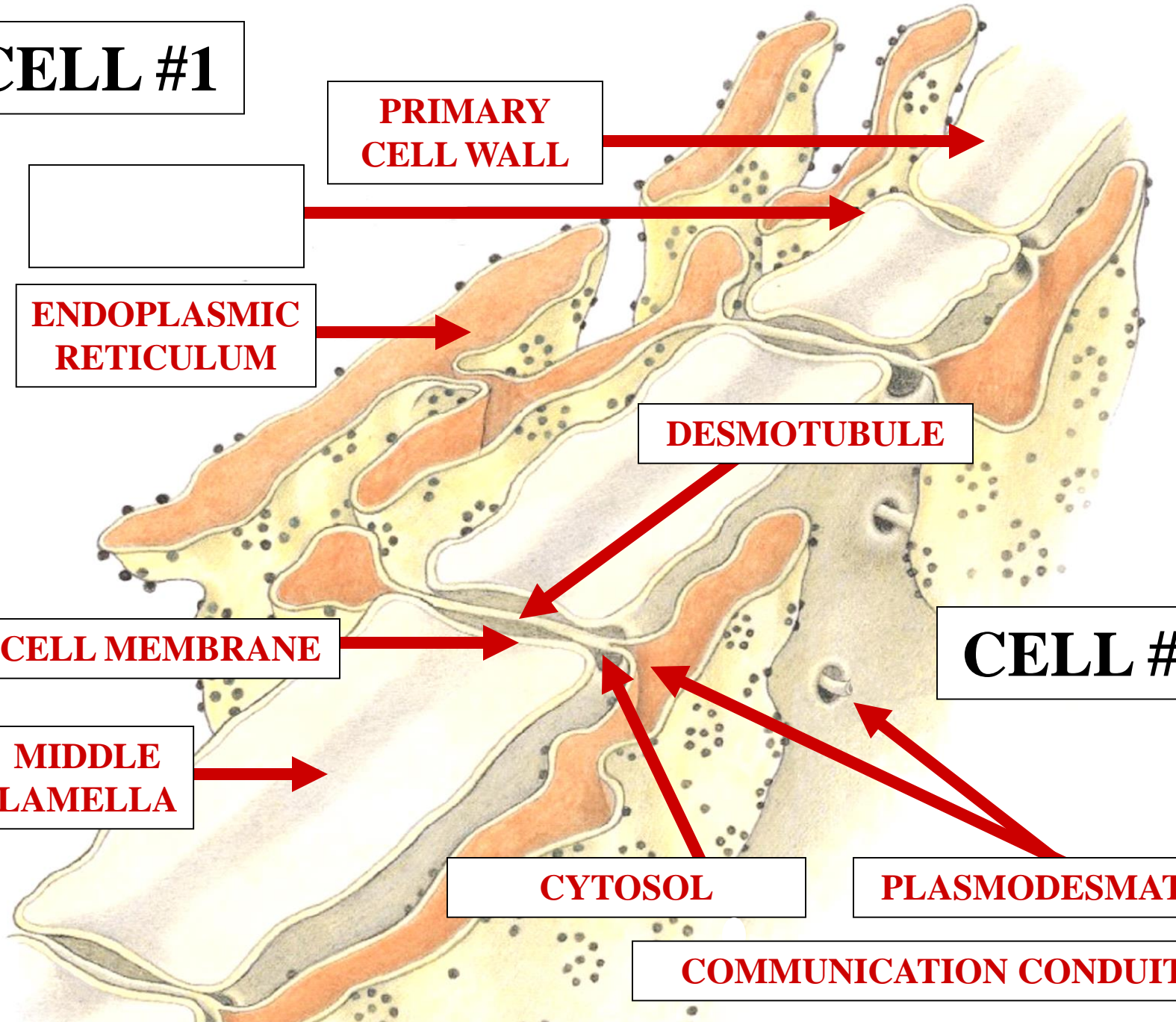
CELL #2

**MIDDLE
LAMELLA**

CYTOSOL

PLASMODESMATA

**COMMUNICATION
CONDUIT**

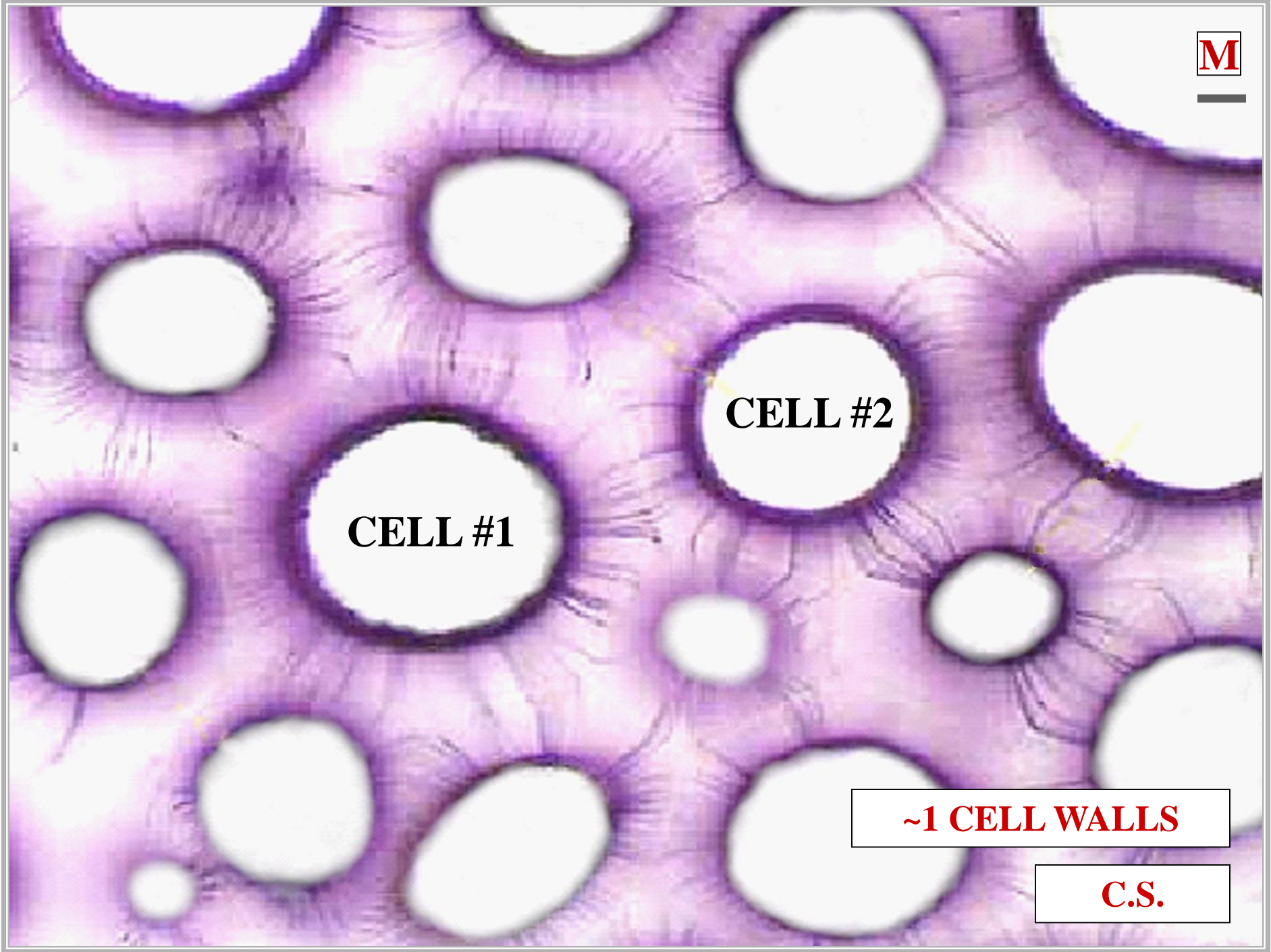


CELL #1

CELL #2

~1 CELL WALLS

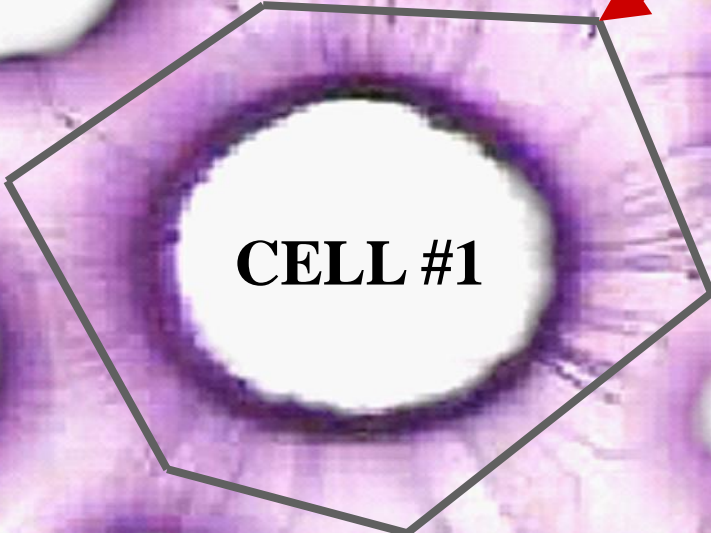
C.S.



~1

MIDDLE LAMELLA

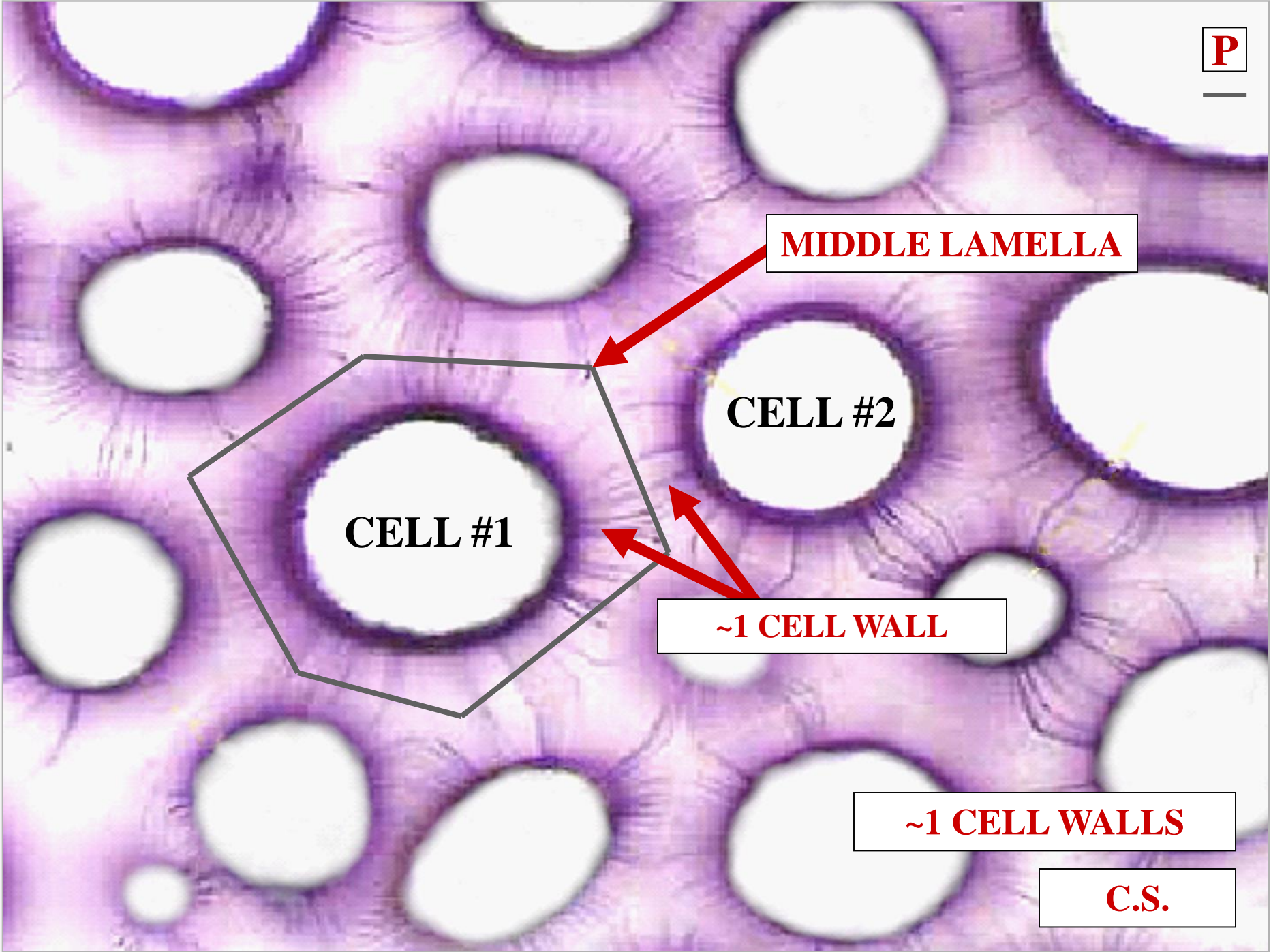
CELL #2



CELL #1

~1 CELL WALLS

C.S.



MIDDLE LAMELLA

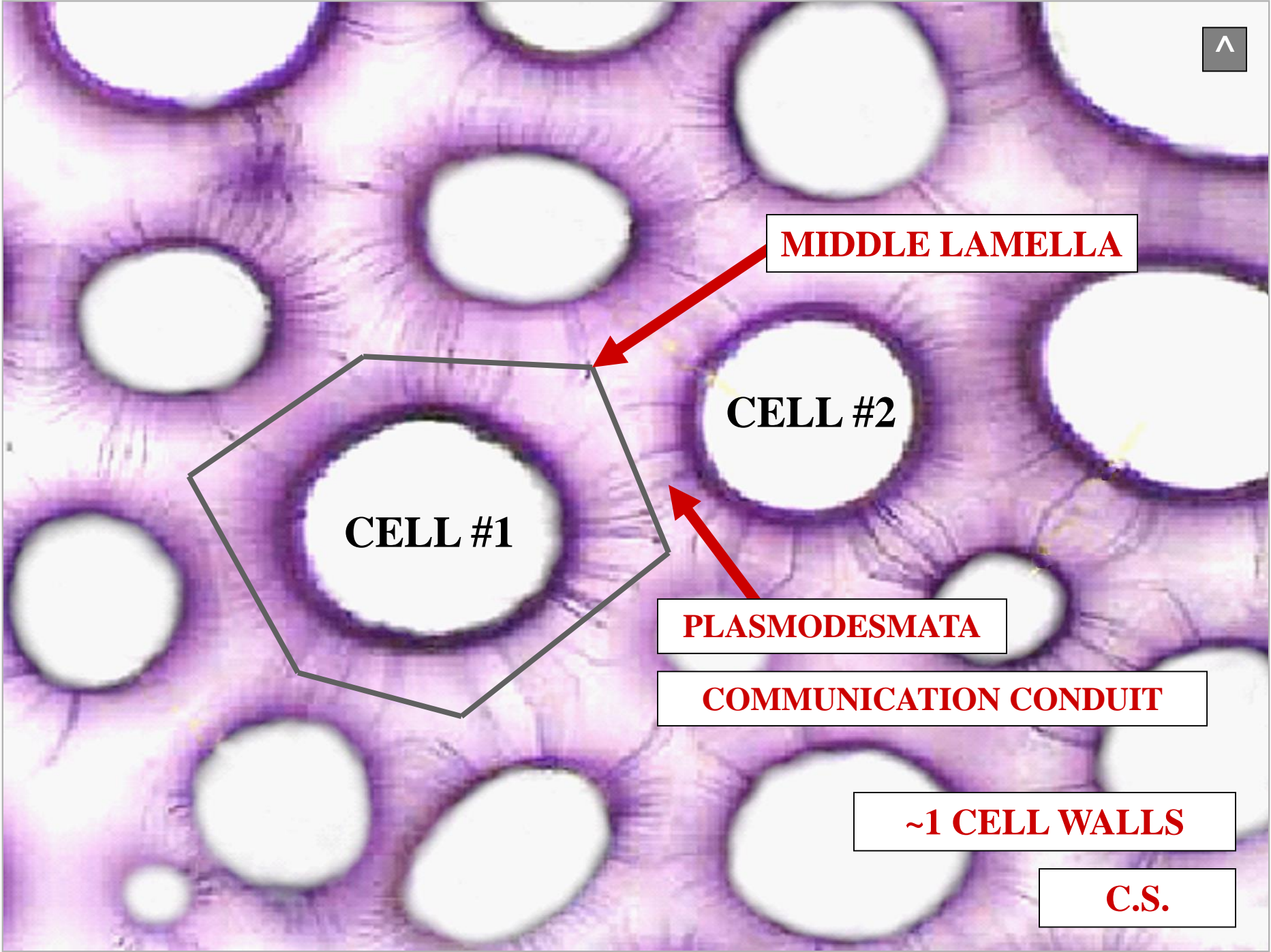
CELL #2

CELL #1

~1 CELL WALL

~1 CELL WALLS

C.S.



MIDDLE LAMELLA

CELL #2

CELL #1

PLASMODESMATA

COMMUNICATION CONDUIT

~1 CELL WALLS

C.S.

PRIMARY PIT FIELD

PRIMARY PIT FIELD

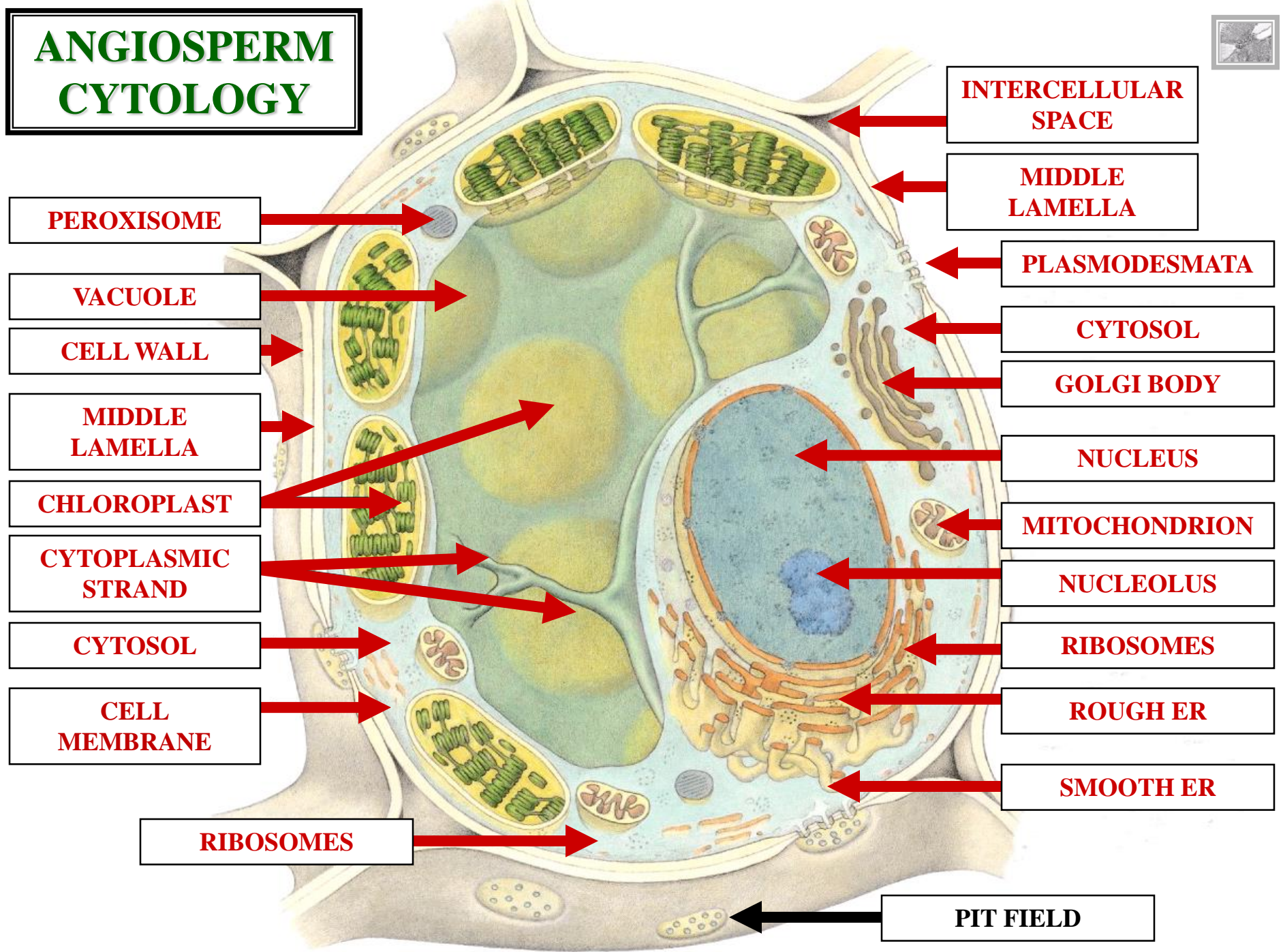


PRIMARY PIT FIELD

**PRIMARY WALL
PLASMODESMATA
CLUSTER**

PRIMARY PIT FIELD

ANGIOSPERM CYTOLOGY



PEROXISOME

VACUOLE

CELL WALL

MIDDLE LAMELLA

CHLOROPLAST

CYTOPLASMIC STRAND

CYTOSOL

CELL MEMBRANE

RIBOSOMES

INTERCELLULAR SPACE

MIDDLE LAMELLA

PLASMODESMATA

CYTOSOL

GOLGI BODY

NUCLEUS

MITOCHONDRION

NUCLEOLUS

RIBOSOMES

ROUGH ER

SMOOTH ER

PIT FIELD

CELL #1

**PRIMARY
CELL WALL**

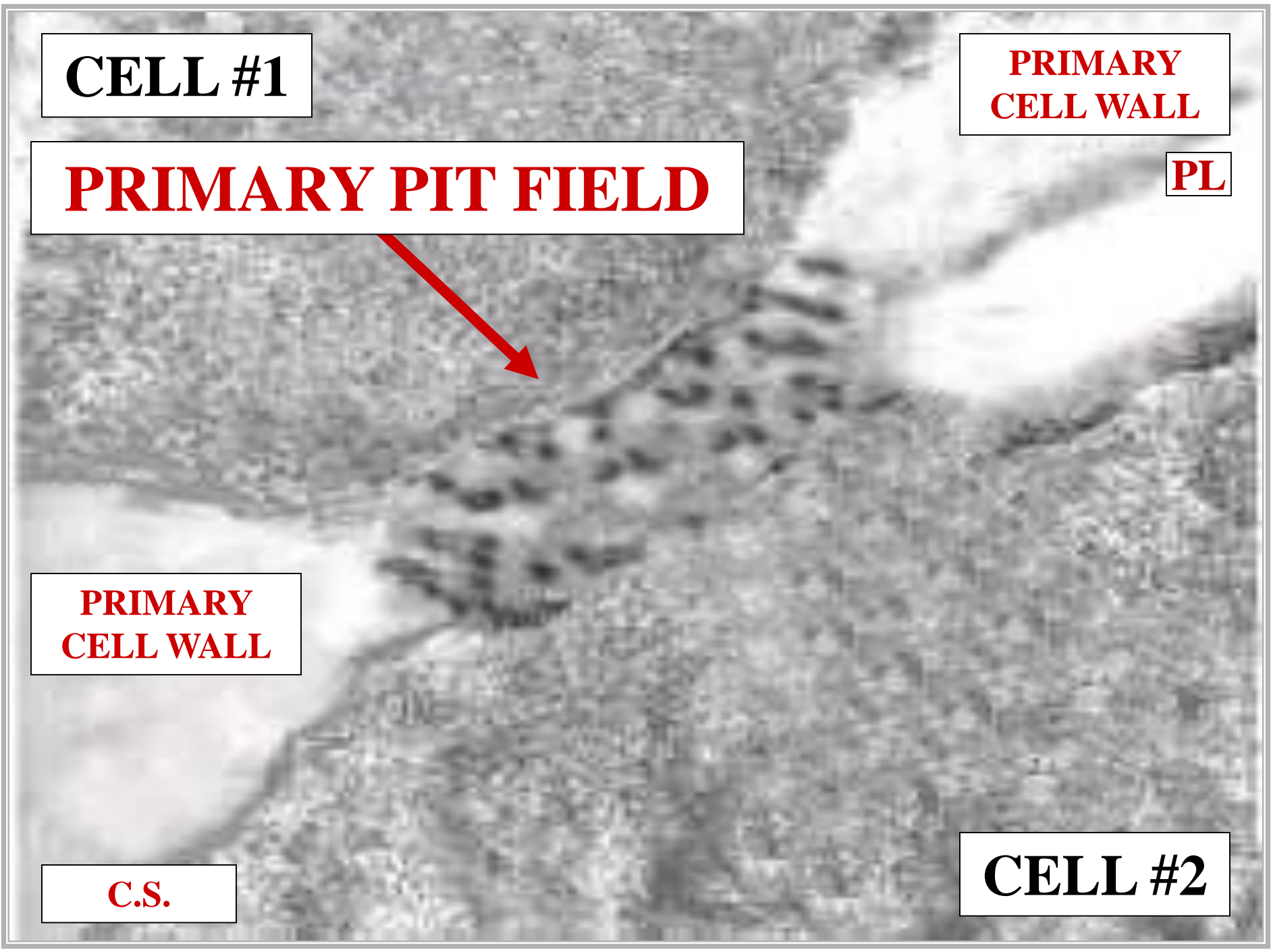
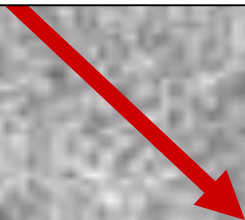
PRIMARY PIT FIELD

PL

**PRIMARY
CELL WALL**

C.S.

CELL #2



CELL #1

**PRIMARY
CELL WALL**

PRIMARY PIT FIELD

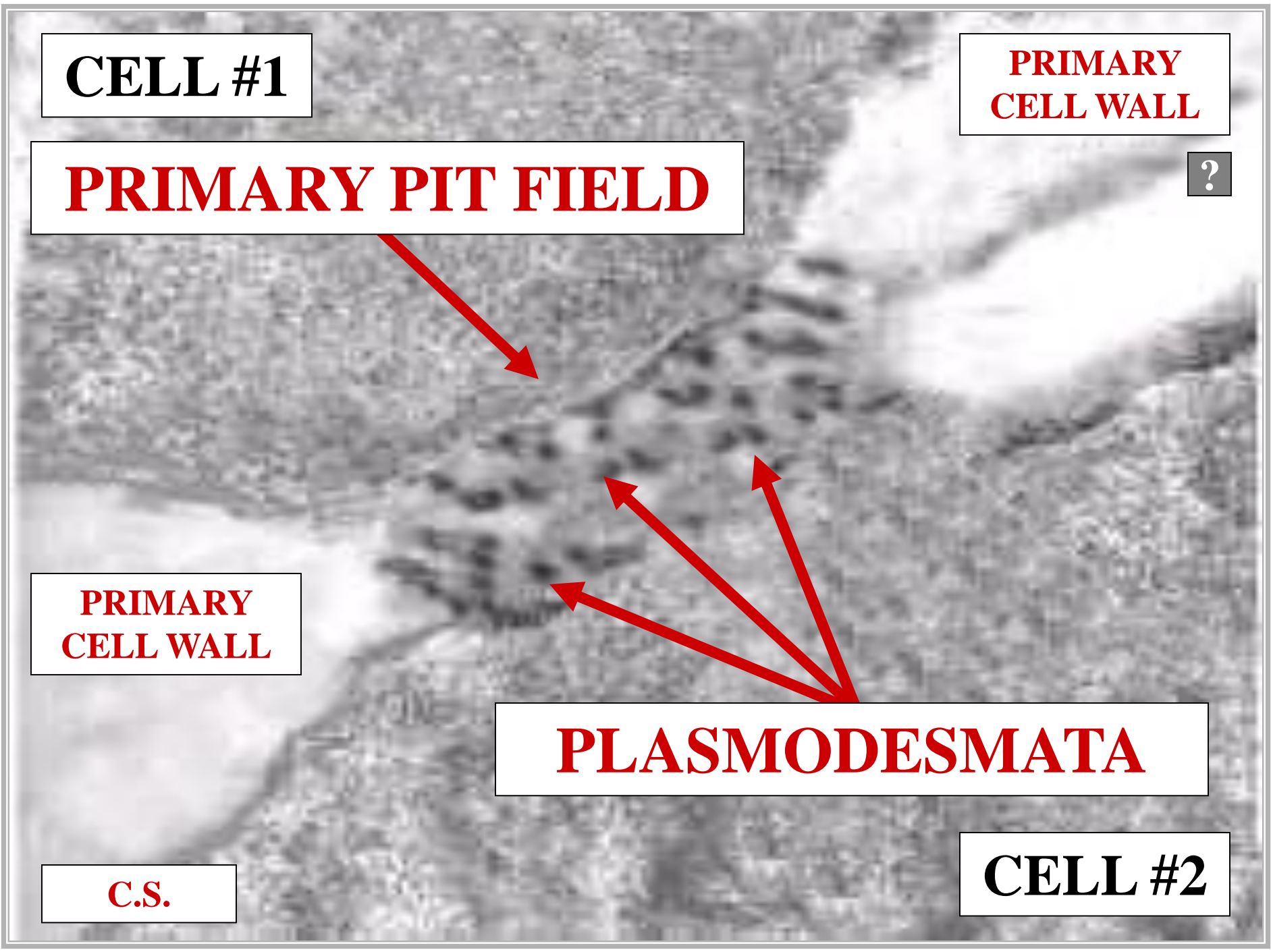
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**PRIMARY
CELL WALL**

PLASMODESMATA

C.S.

CELL #2



CELL #1

PRIMARY PIT FIELD

**PRIMARY
CELL WALL**

M

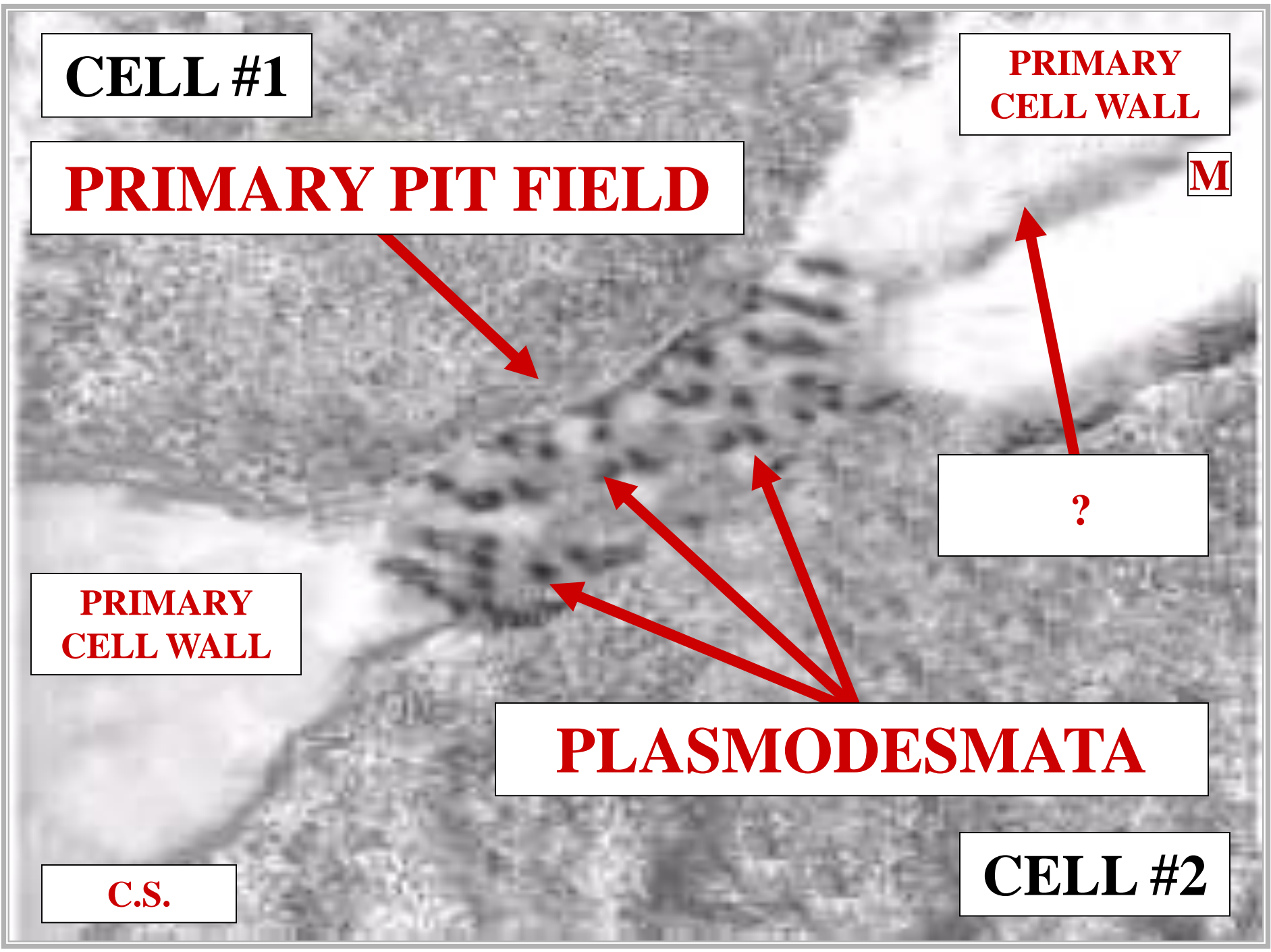
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**PRIMARY
CELL WALL**

PLASMODESMATA

C.S.

CELL #2



CELL #1

PRIMARY PIT FIELD

**PRIMARY
CELL WALL**



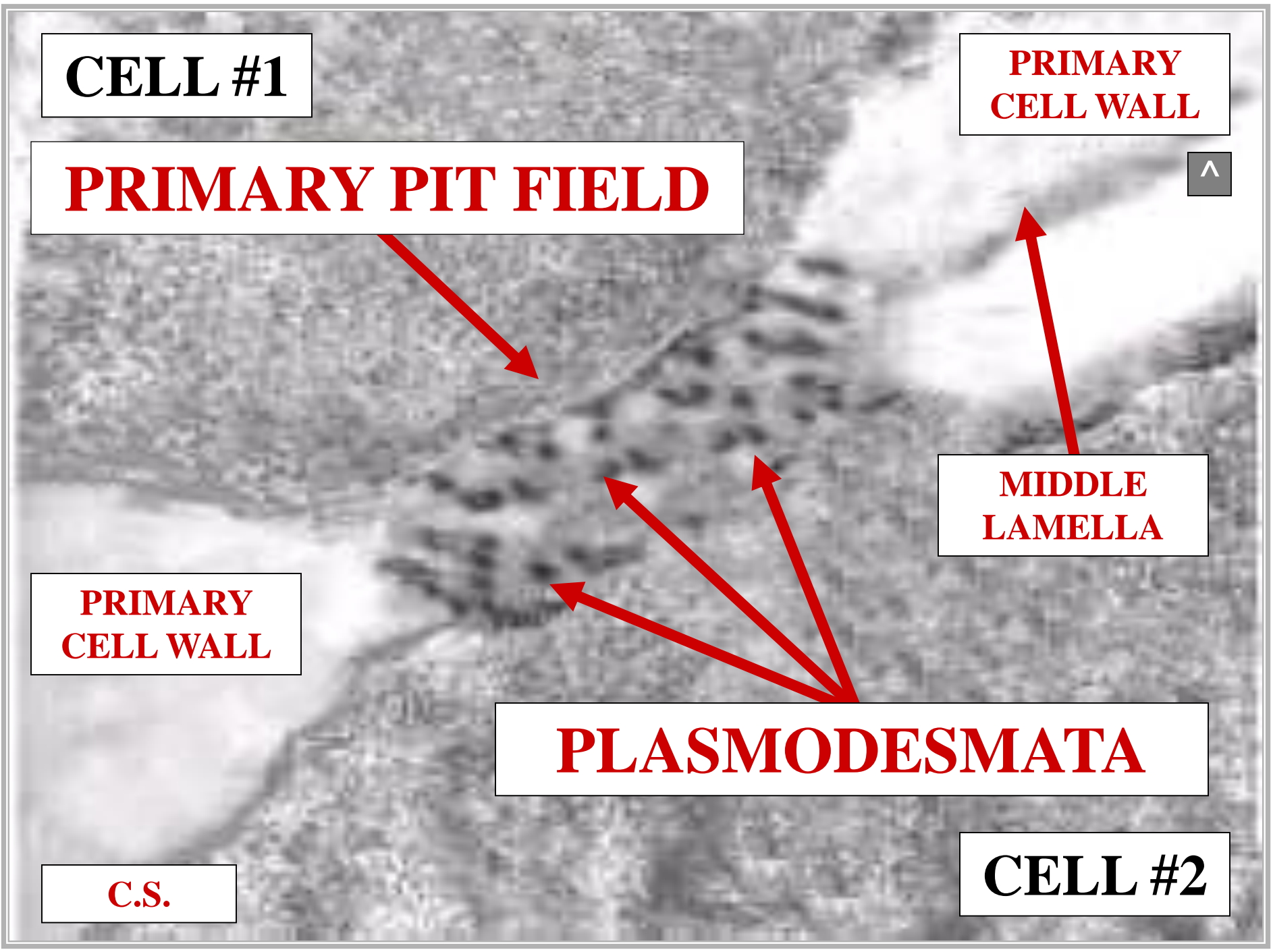
**MIDDLE
LAMELLA**

**PRIMARY
CELL WALL**

PLASMODESMATA

C.S.

CELL #2



**SECONDARY
CELL WALL
PIT PAIR**

**SECONDARY
CELL WALL
PIT PAIR**

SECONDARY CELL WALL PIT PAIR



**SECONDARY WALL CONDUIT BETWEEN
ADJACENT CELLS**

SECONDARY CELL WALL PIT PAIR

SECONDARY CELL WALL



PIT PAIR

**SECONDARY WALL CONDUIT BETWEEN
ADJACENT CELLS**

INTERCELLULAR COMMUNICATION

SECONDARY CELL WALL

PIT PAIR

SECONDARY CELL WALL



PIT PAIR

**SECONDARY WALL CONDUIT BETWEEN
ADJACENT CELLS**

INTERCELLULAR COMMUNICATION

**ARISE OVER
PRIMARY PIT FIELD**

SECONDARY CELL WALL

PIT PAIR

CELL #1

PRIMARY PIT FIELD

**PRIMARY
CELL WALL**

PP

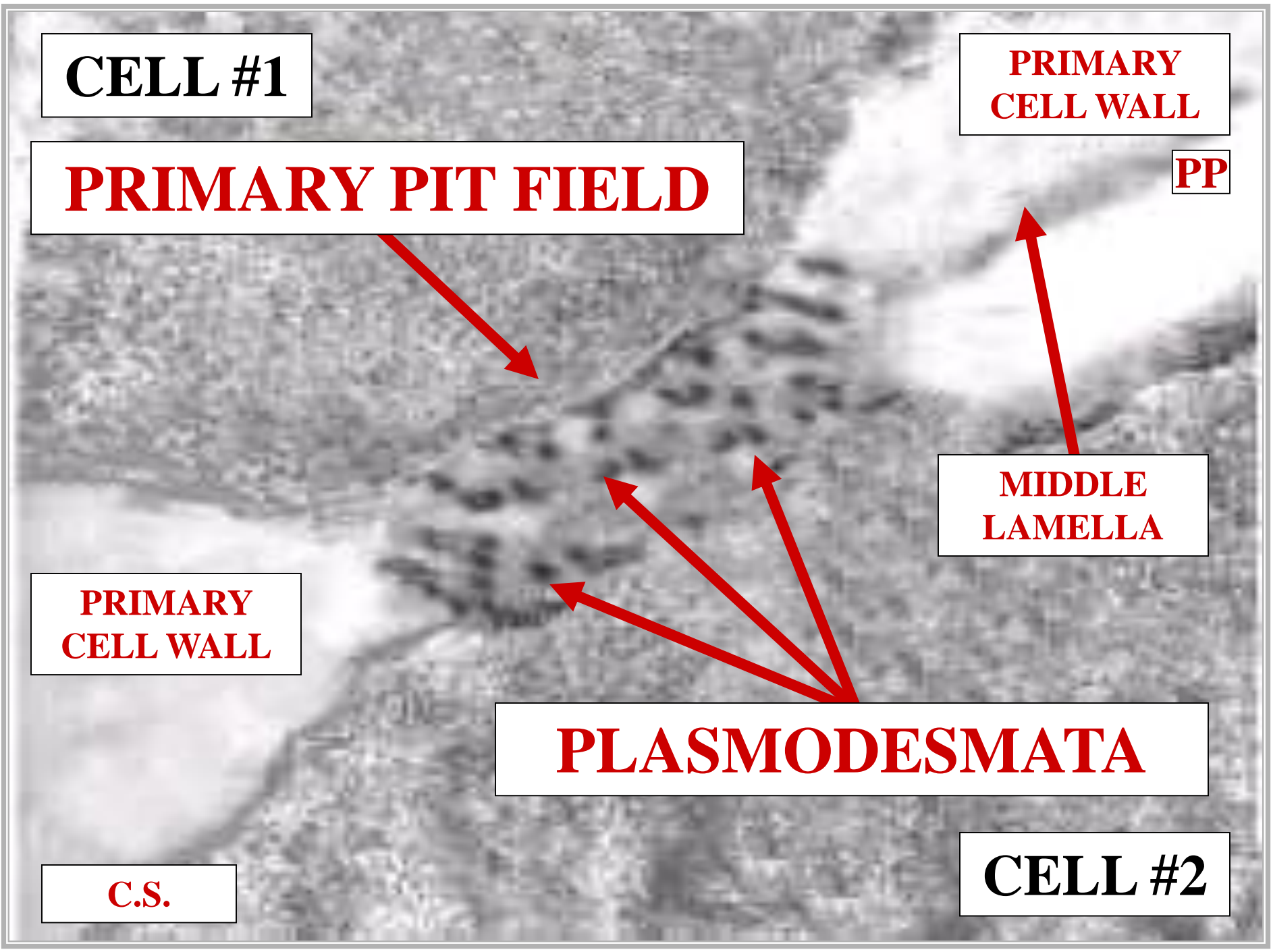
**MIDDLE
LAMELLA**

**PRIMARY
CELL WALL**

PLASMODESMATA

C.S.

CELL #2

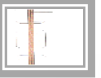


CELL #1

**PRIMARY
CELL WALL**

PIT PAIR

?



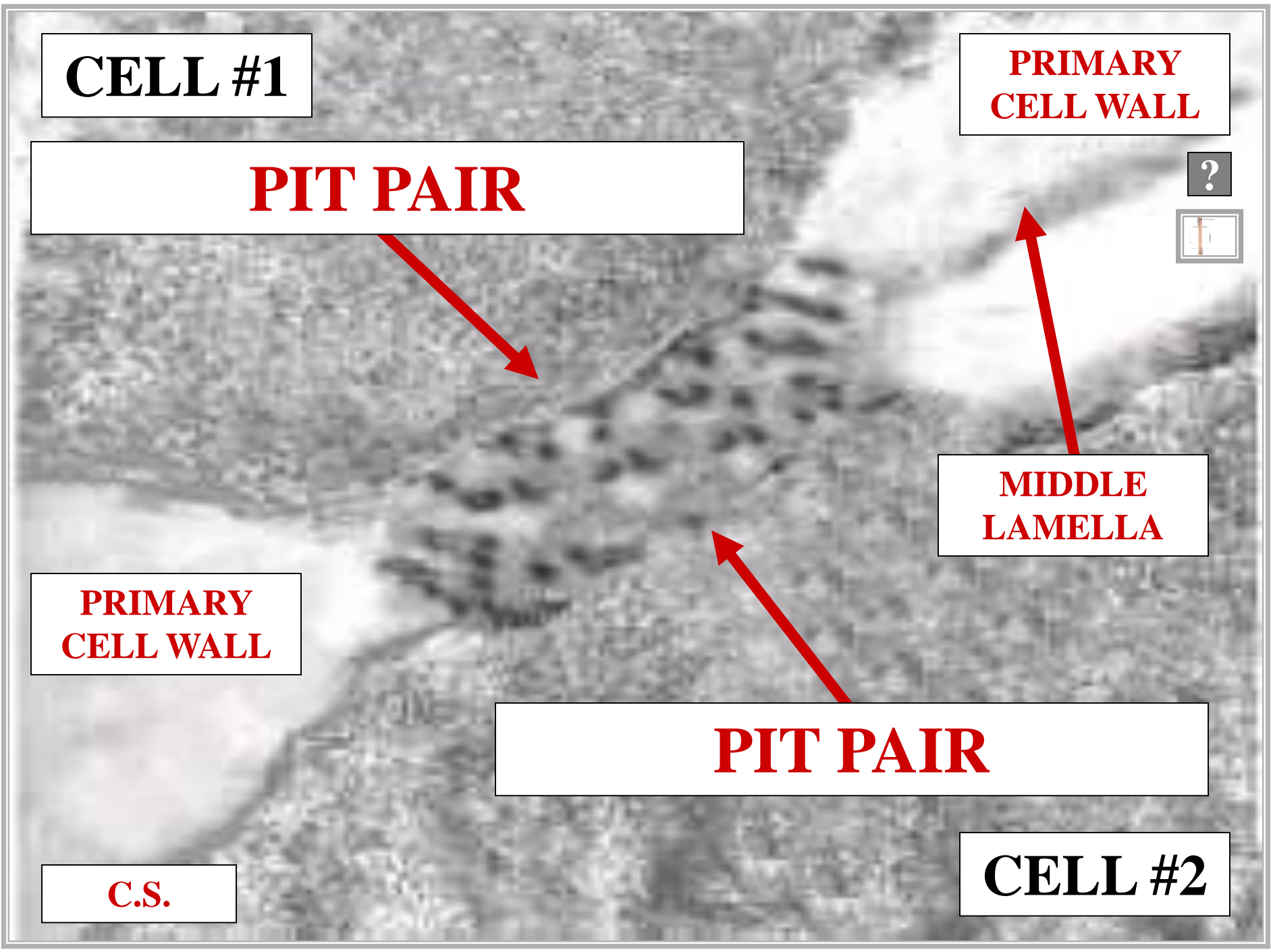
**MIDDLE
LAMELLA**

**PRIMARY
CELL WALL**

PIT PAIR

C.S.

CELL #2

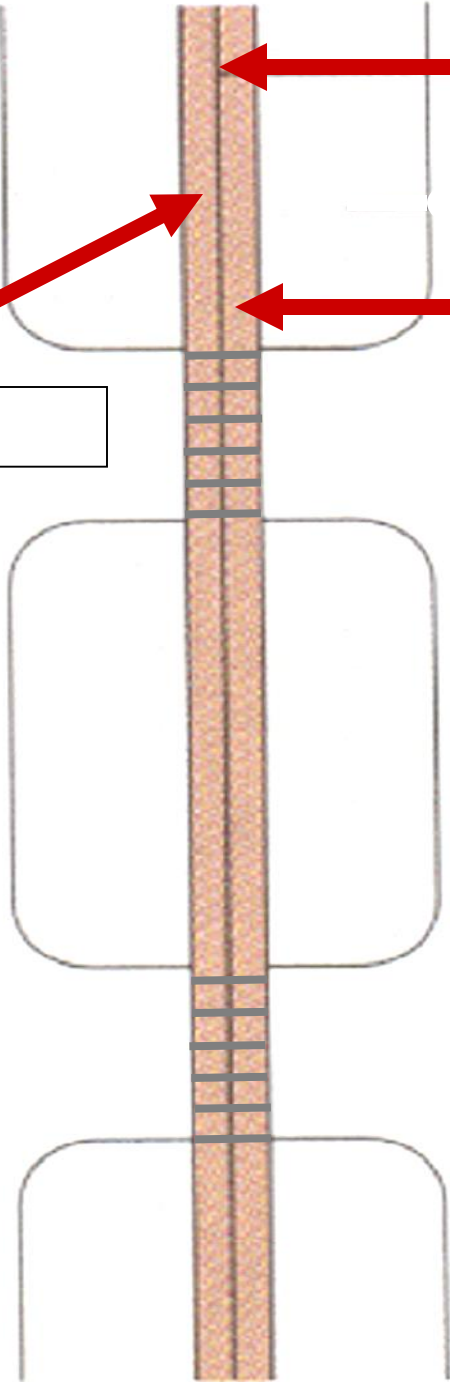


CELL #1

MIDDLE LAMELLA

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CELL #2

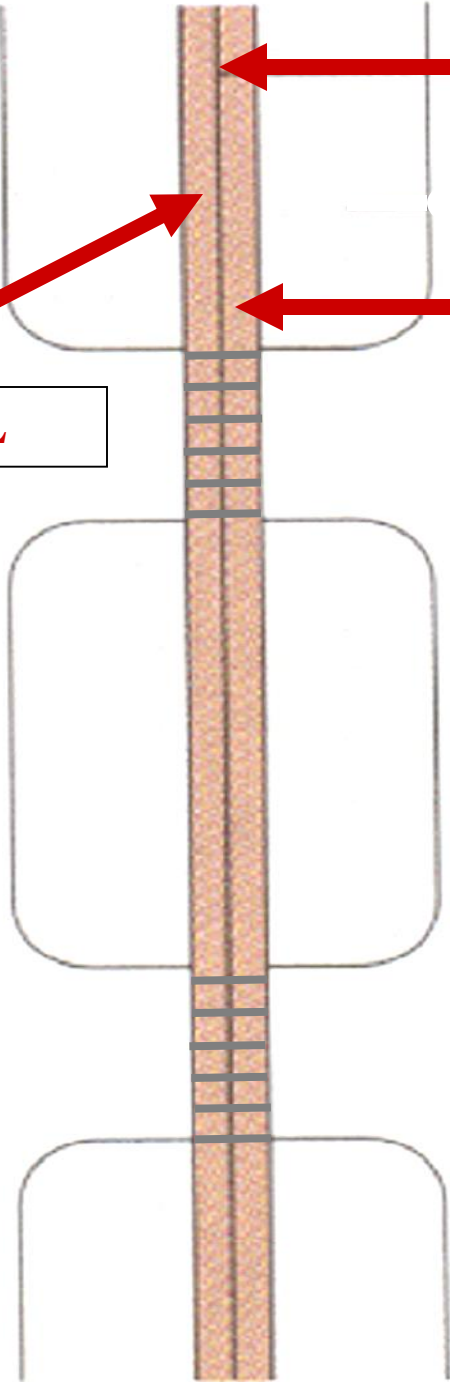


CELL #1

MIDDLE LAMELLA

PRIMARY WALL

PRIMARY WALL



CELL #2

CELL #1

MIDDLE LAMELLA

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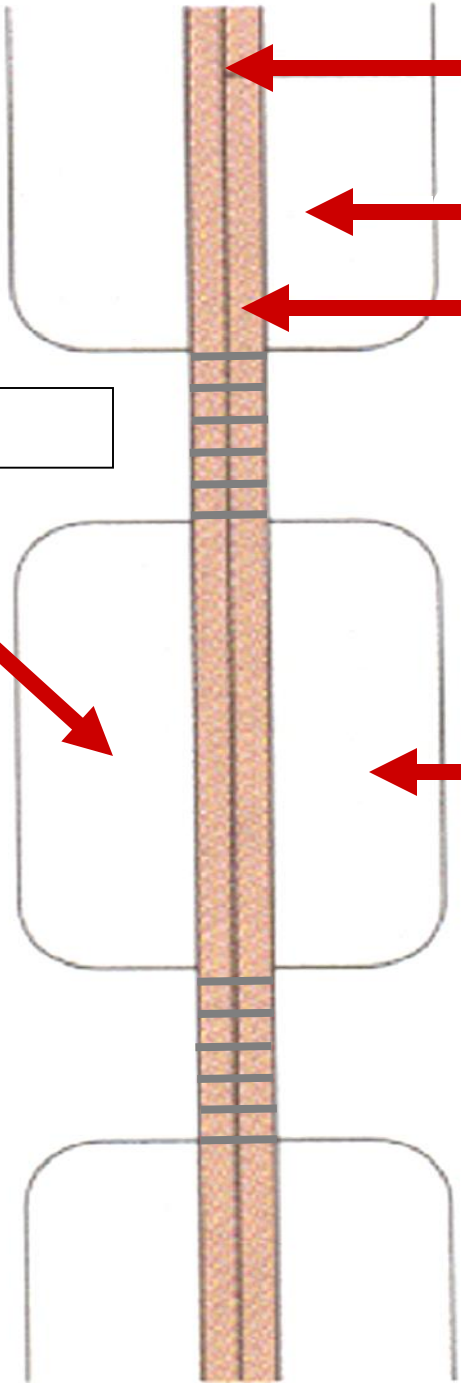
PRIMARY WALL

?



?

CELL #2



CELL #1

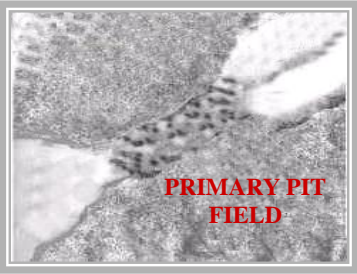
MIDDLE LAMELLA

PF

SECONDARY WALL

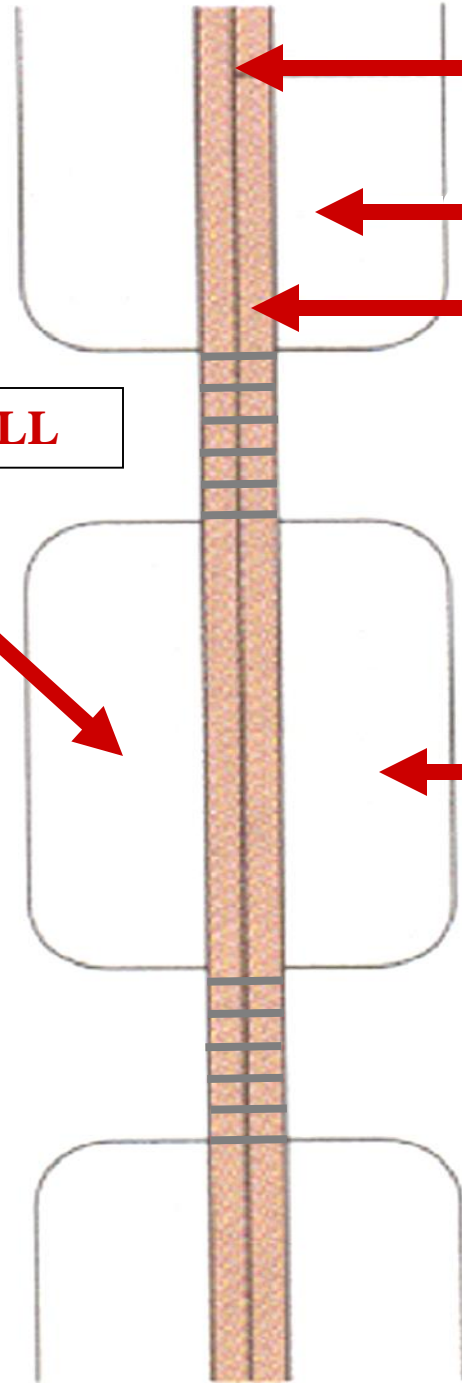
PRIMARY WALL

SECONDARY WALL

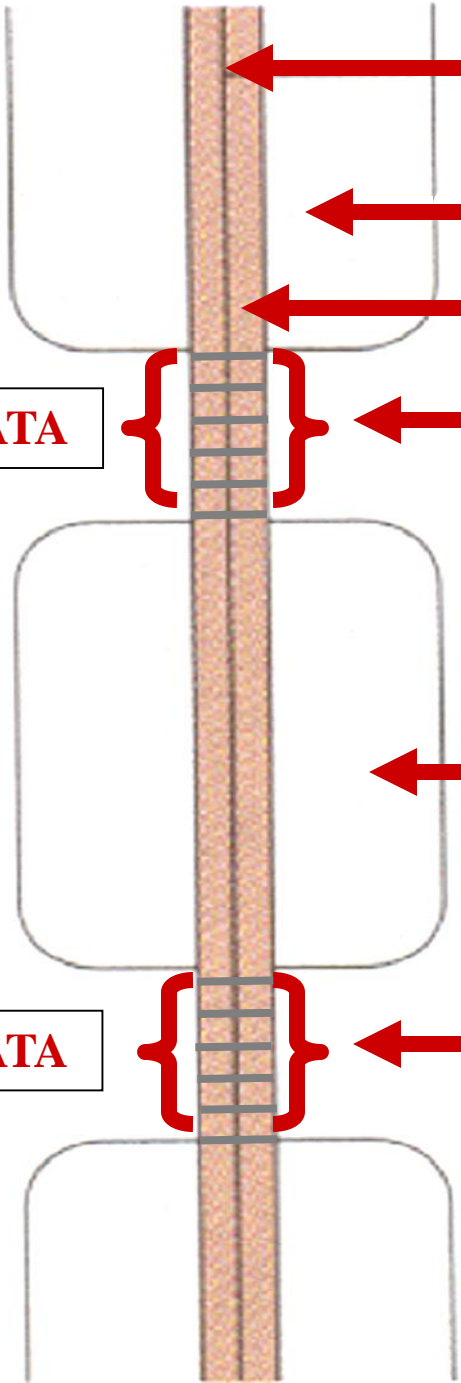


SECONDARY WALL

CELL #2



CELL #1



MIDDLE LAMELLA

SECONDARY WALL

PRIMARY WALL

PRIMARY PIT FIELD

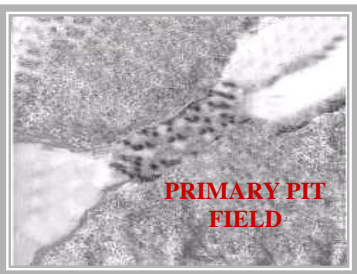
SECONDARY WALL

PRIMARY PIT FIELD

CELL #2

PLASMODESMATA

PLASMODESMATA



PRIMARY PIT FIELD

CELL #1

PP

PLASMODESMATA

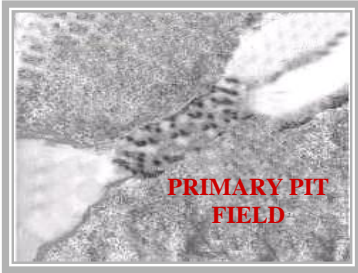
MIDDLE LAMELLA

SECONDARY WALL

PRIMARY WALL

**PRIMARY PIT
FIELD**

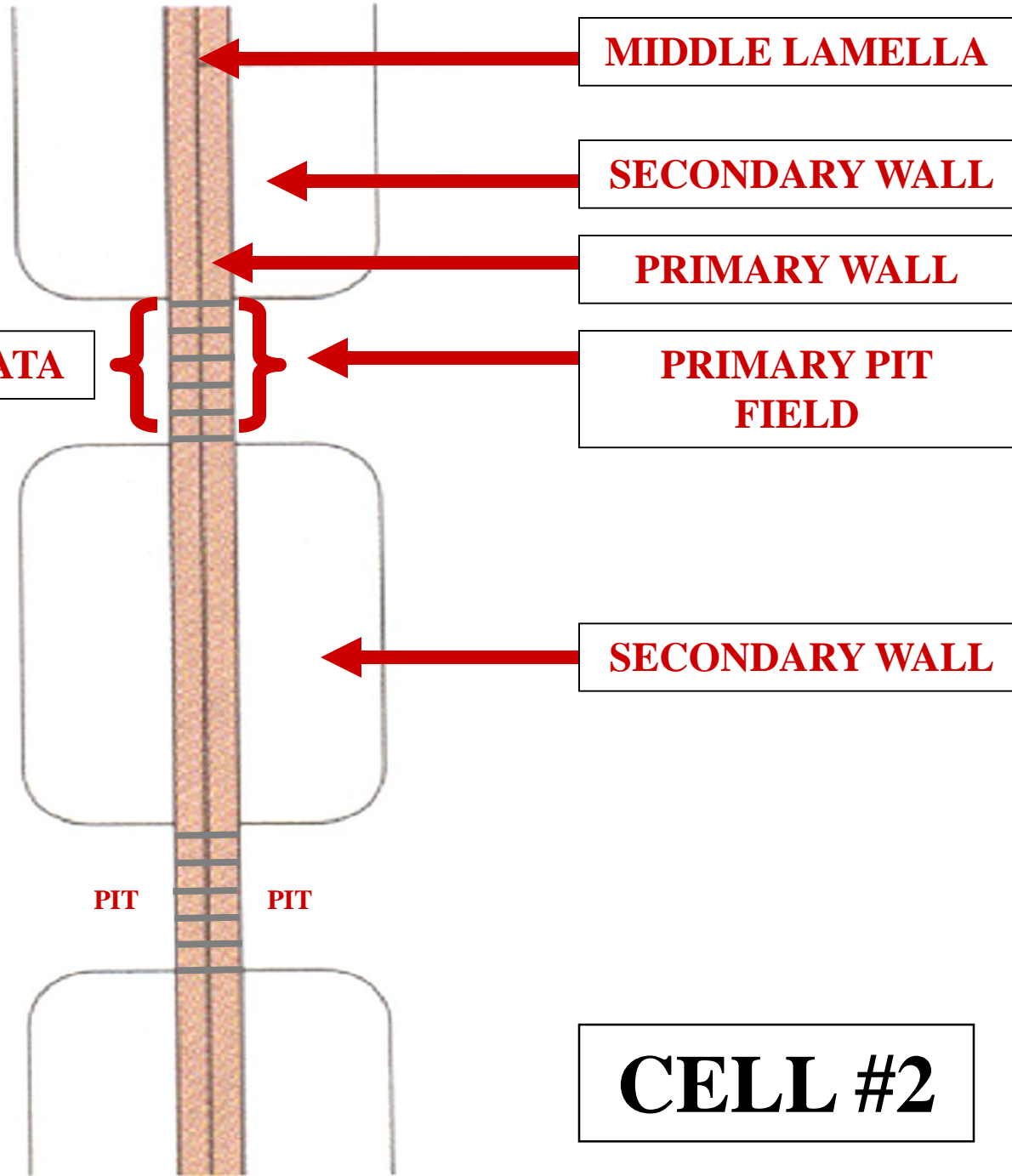
SECONDARY WALL



PIT

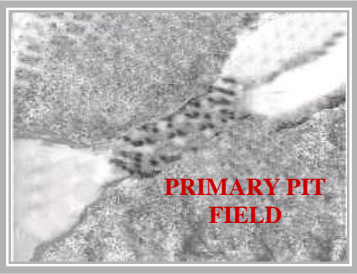
PIT

CELL #2



CELL #1

PLASMODESMATA



PIT PAIR

PIT

PIT

PIT PAIR

MIDDLE LAMELLA

SECONDARY WALL

PRIMARY WALL

PRIMARY PIT FIELD

SECONDARY WALL

CELL #2





PIT PAIR



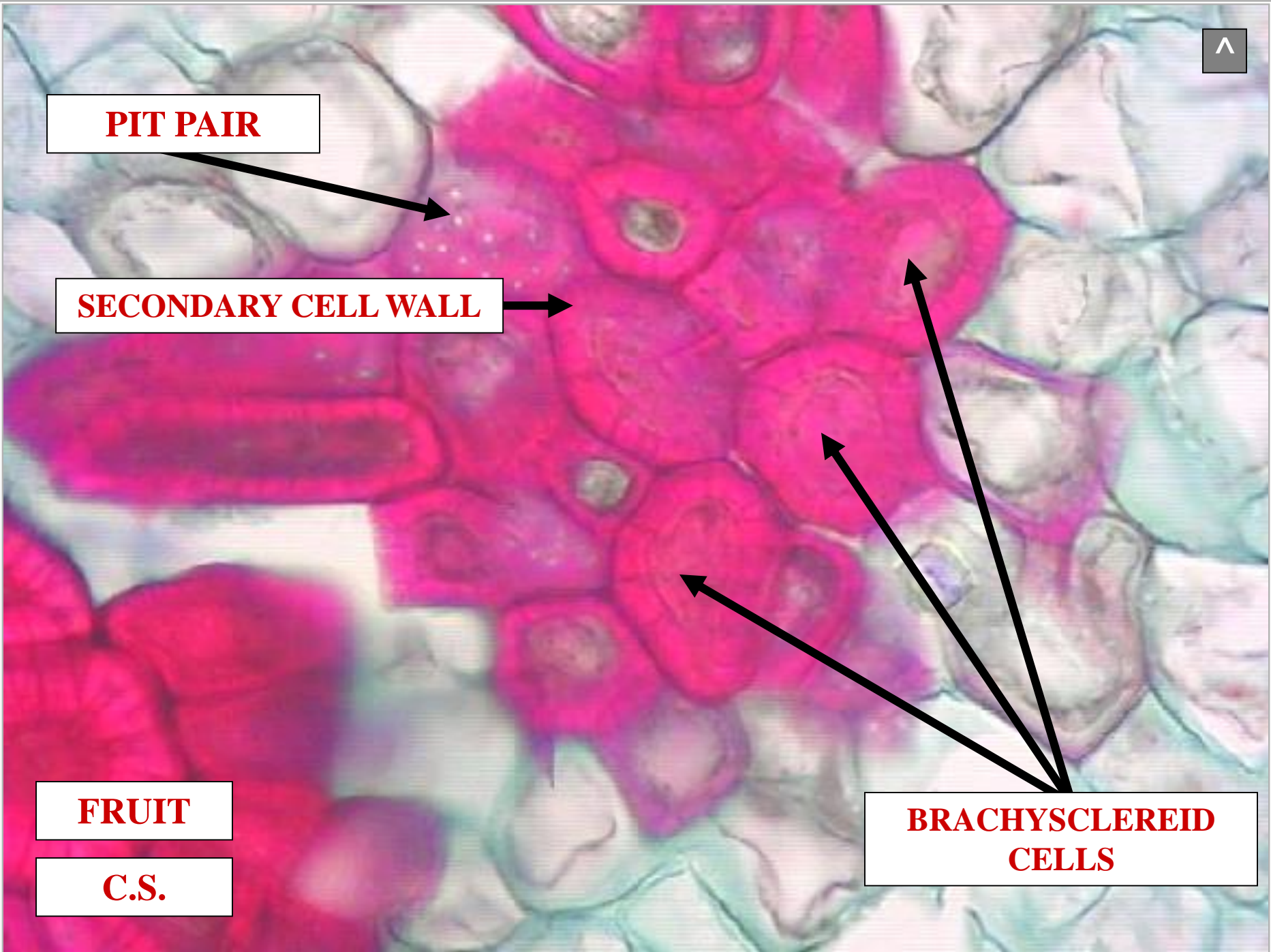
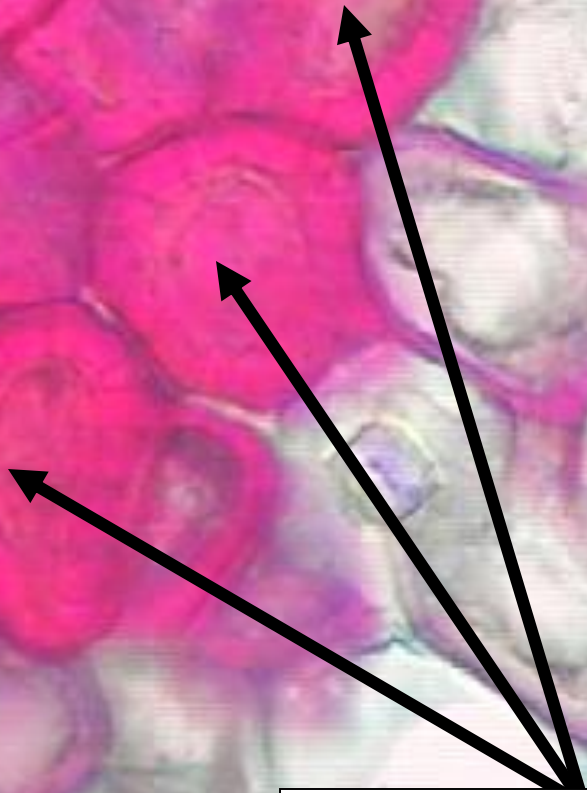
SECONDARY CELL WALL



FRUIT

C.S.

BRACHYSCLEREID CELLS



PROTOPLAST

PROTOPLAST

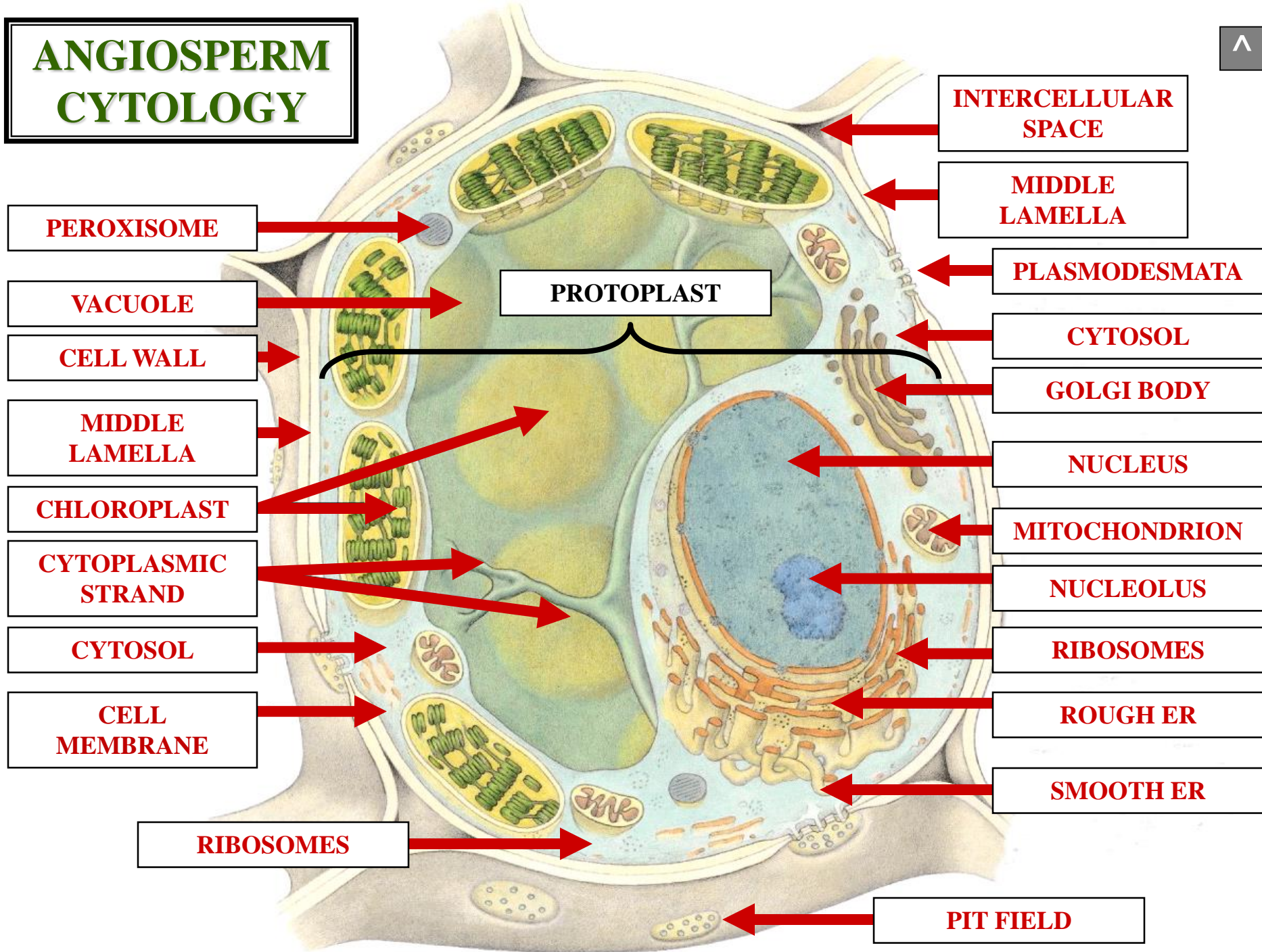


PROTOPLAST

**LIVING CONTENT
BEYOND
CELL WALL**

PROTOPLAST

ANGIOSPERM CYTOLOGY



CELL MEMBRANE

CELL MEMBRANE



CELL MEMBRANE

**OUTER PROTOPLAST
BOUNDARY**

CELL MEMBRANE



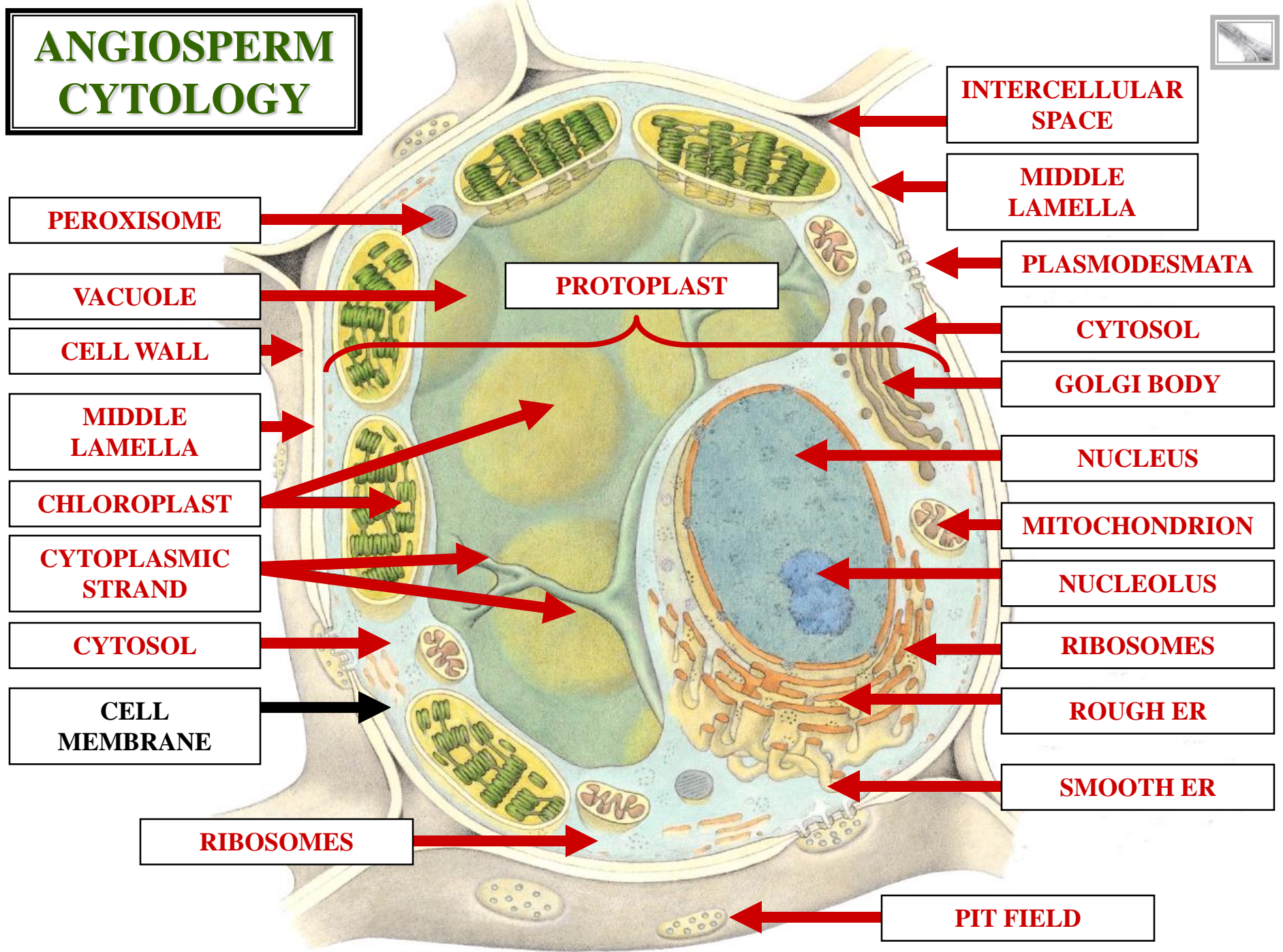
CELL MEMBRANE

**OUTER PROTOPLAST
BOUNDARY**

**MEDIATES TRANSPORT
INTO & OUT OF CELL**

CELL MEMBRANE

ANGIOSPERM CYTOLOGY



PEROXISOME

VACUOLE

CELL WALL

MIDDLE LAMELLA

CHLOROPLAST

CYTOPLASMIC STRAND

CYTOSOL

CELL MEMBRANE

RIBOSOMES

PROTOPLAST

INTERCELLULAR SPACE

MIDDLE LAMELLA

PLASMODESMATA

CYTOSOL

GOLGI BODY

NUCLEUS

MITOCHONDRION

NUCLEOLUS

RIBOSOMES

ROUGH ER

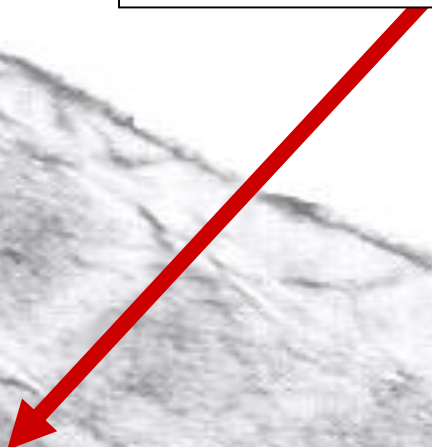
SMOOTH ER

PIT FIELD

CELL #2

CYTOSOL

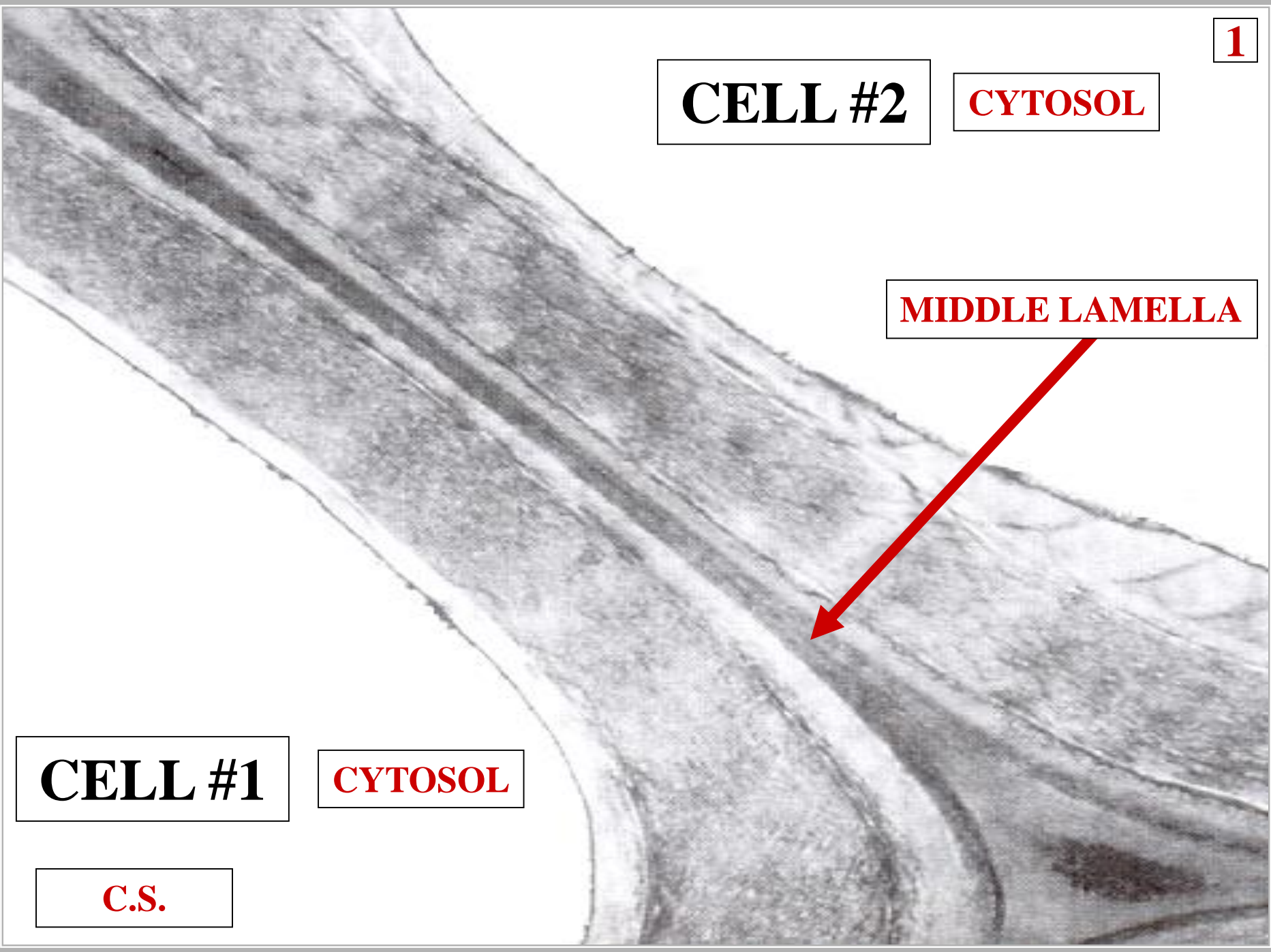
MIDDLE LAMELLA



CELL #1

CYTOSOL

C.S.

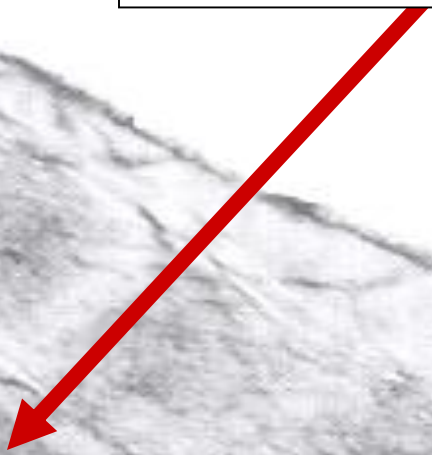


CELL #2

CYTOSOL

MIDDLE LAMELLA

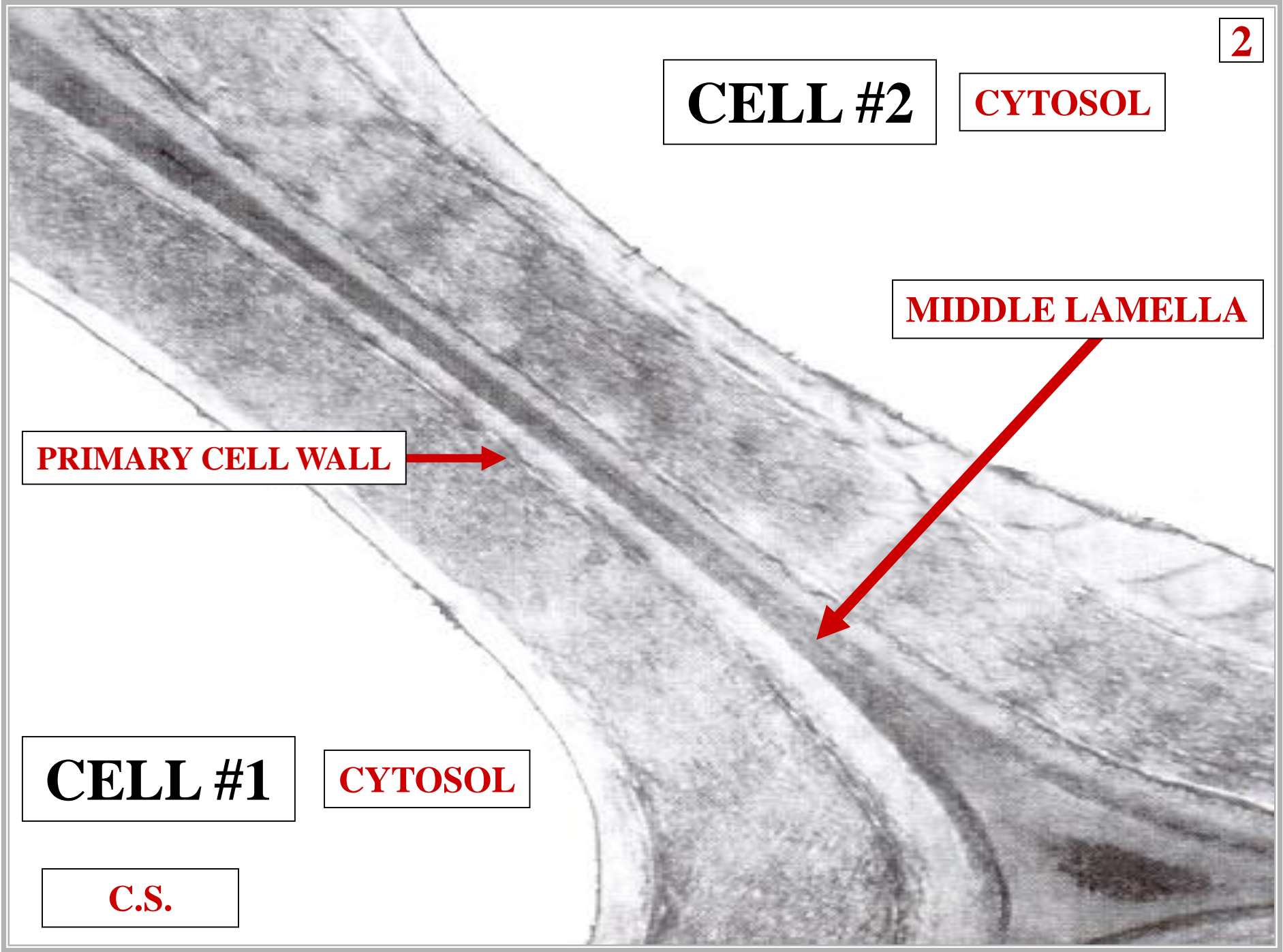
PRIMARY CELL WALL



CELL #1

CYTOSOL

C.S.



M

CELL #2

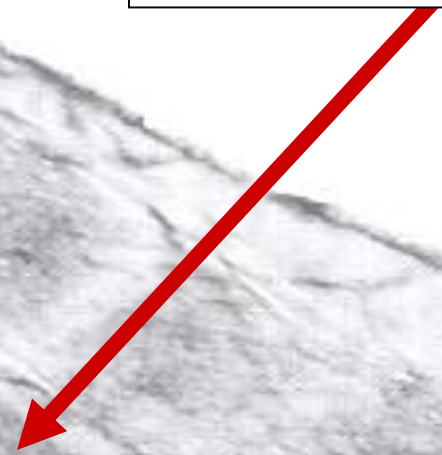
CYTOSOL

MIDDLE LAMELLA

PRIMARY CELL WALL



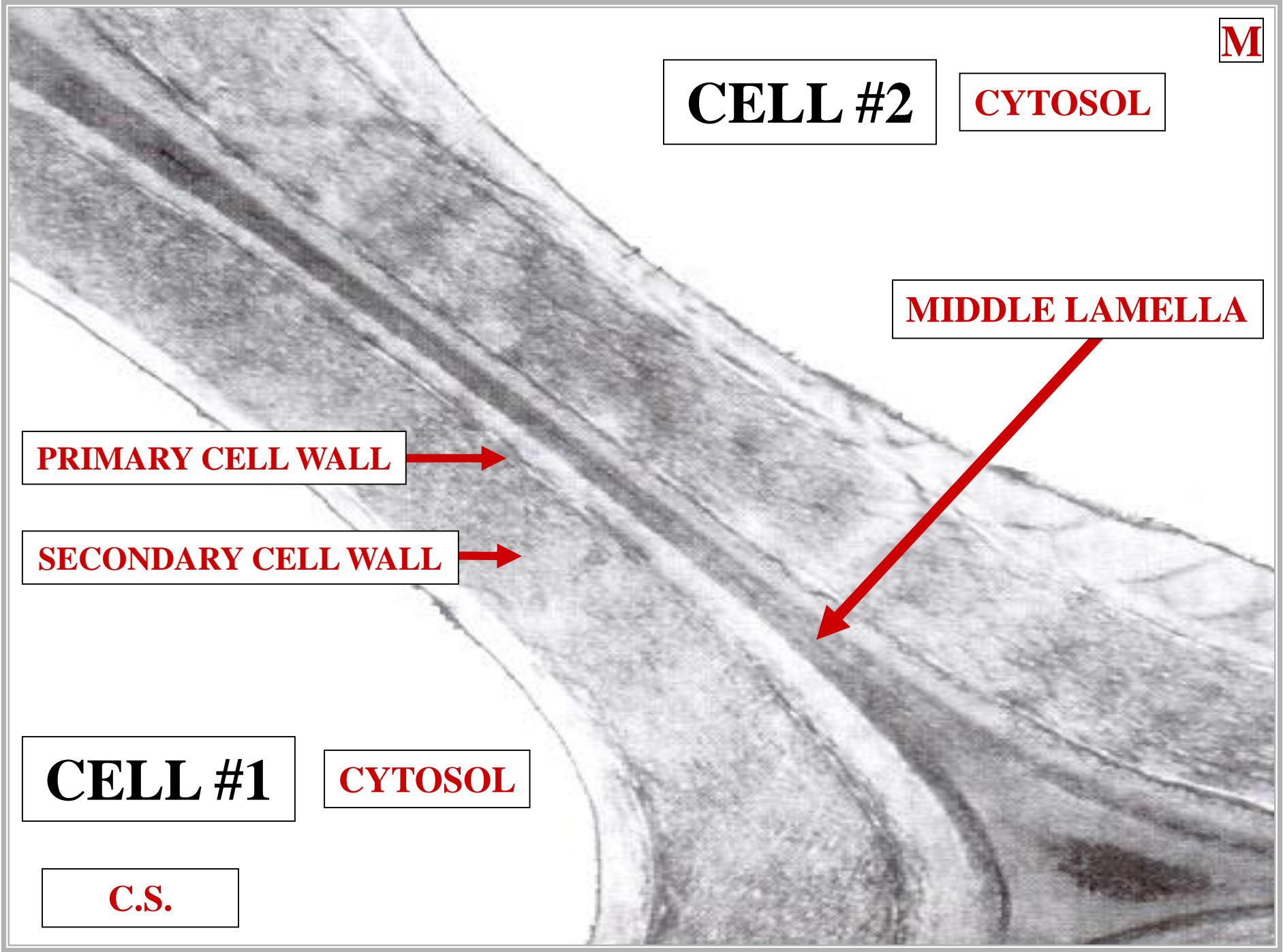
SECONDARY CELL WALL



CELL #1

CYTOSOL

C.S.





CELL #2

CYTOSOL

MIDDLE LAMELLA

PRIMARY CELL WALL



SECONDARY CELL WALL



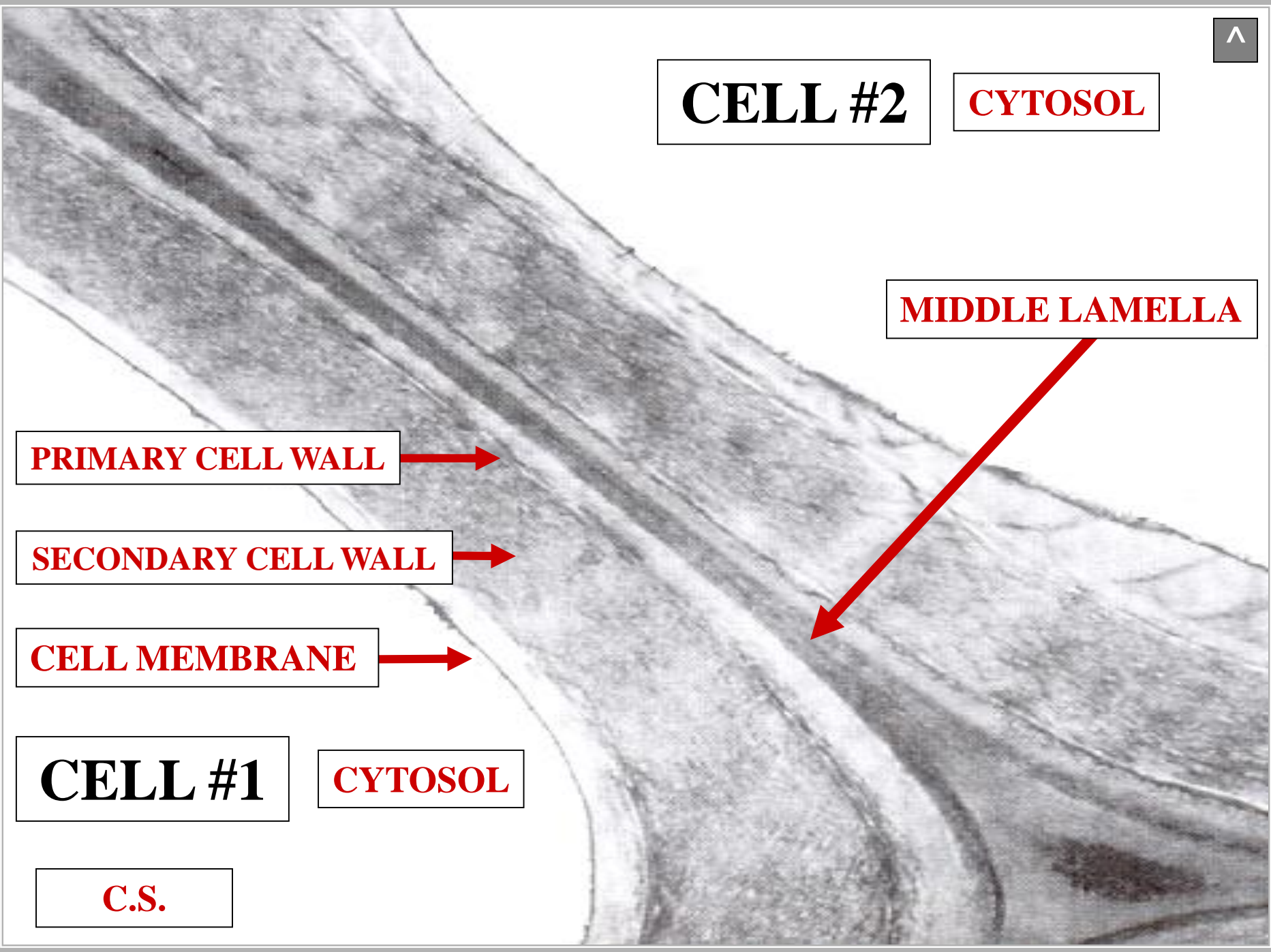
CELL MEMBRANE



CELL #1

CYTOSOL

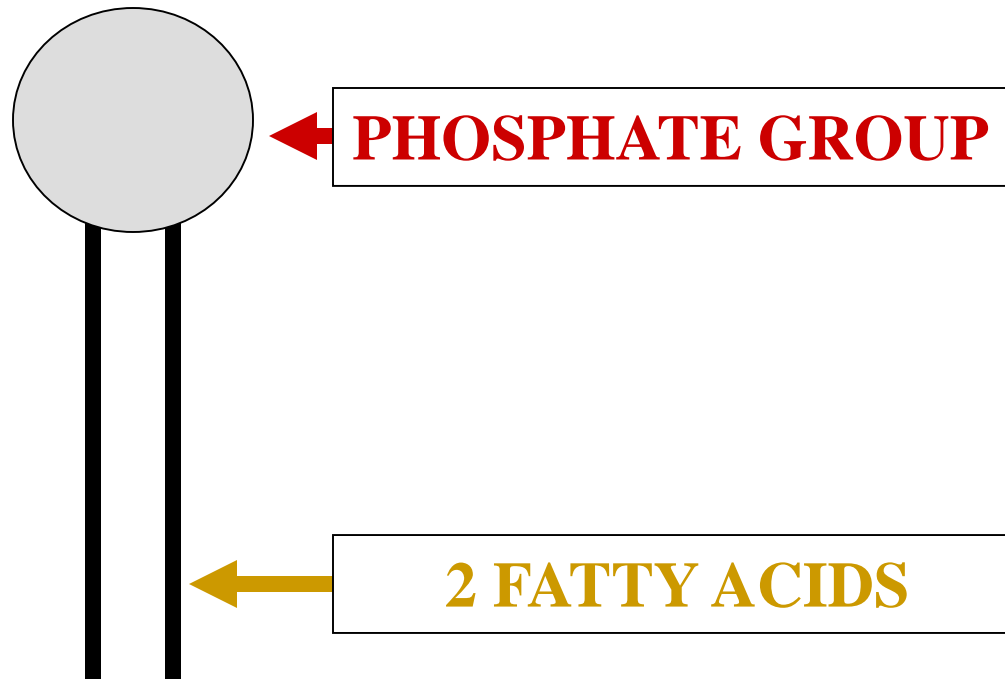
C.S.





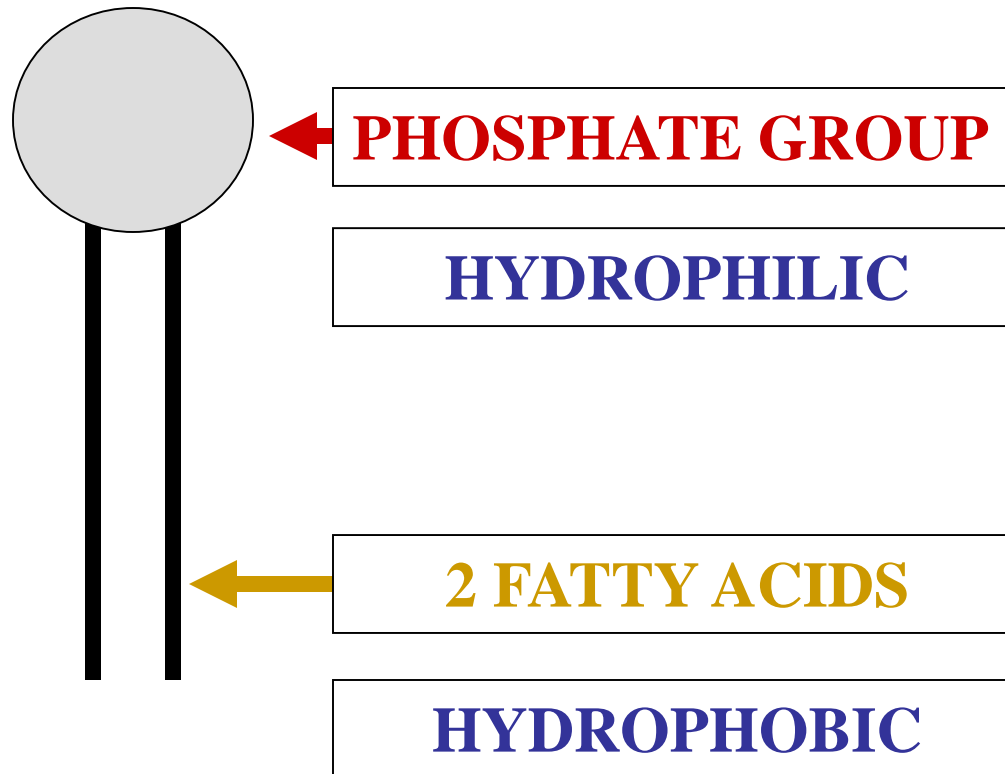
CELL MEMBRANE COMPOSITION

CELL MEMBRANE COMPOSITION



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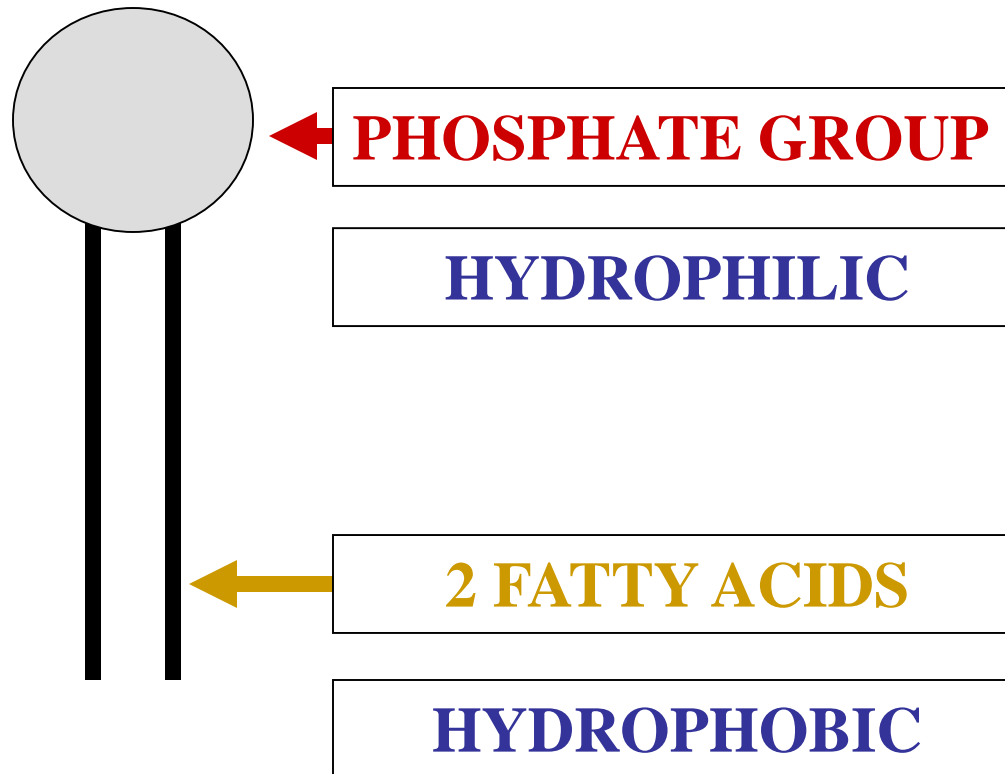
CELL MEMBRANE COMPOSITION



PHOSPHOLIPID



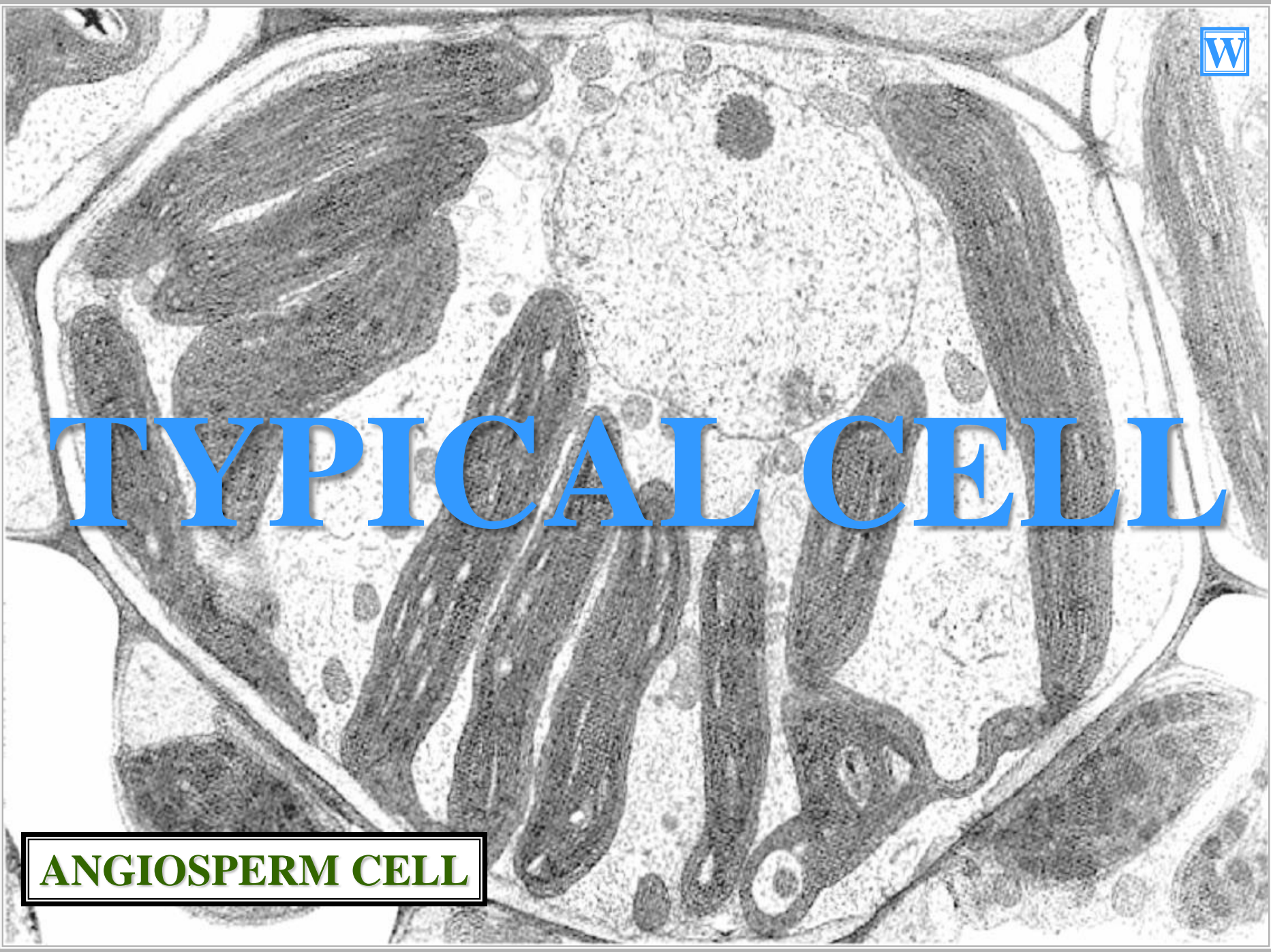
CELL MEMBRANE COMPOSITION



PHOSPHOLIPID: AMPHIPATHIC

TYPICAL CELL

ANGIOSPERM CELL





WATER BIOLOGY SOLVENT

ANGIOSPERM CELL

TYPICAL CELL

70% - 90%

WATER

ANGIOSPERM CELL



TYPICAL CELL AQUEOUS SOLUTION

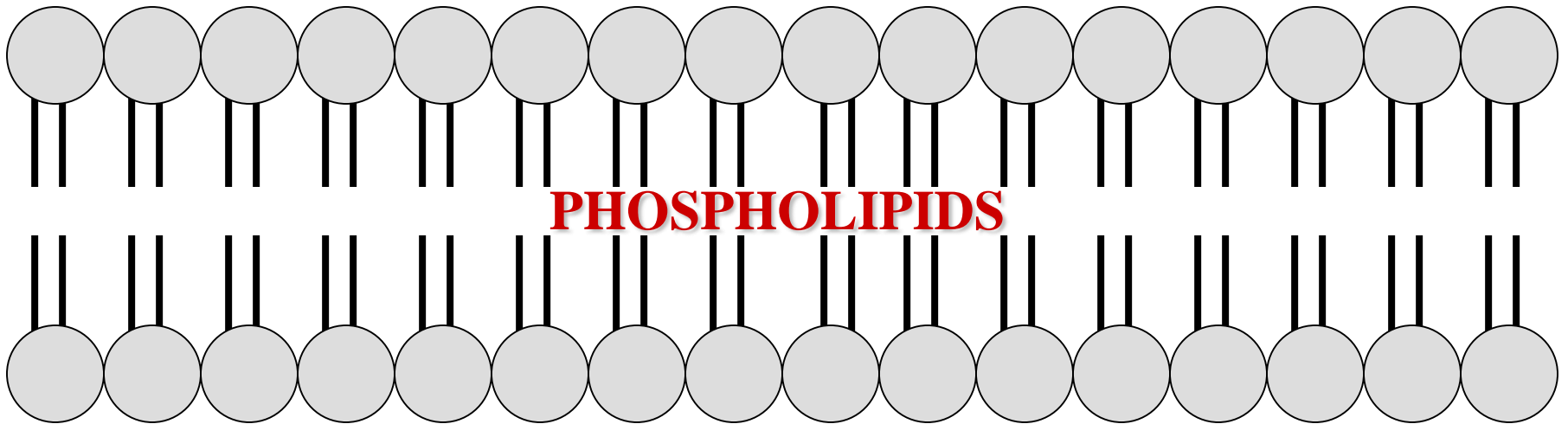
ANGIOSPERM CELL

CELL MEMBRANE COMPOSITION

WATER

WATER

WATER



WATER

WATER

WATER

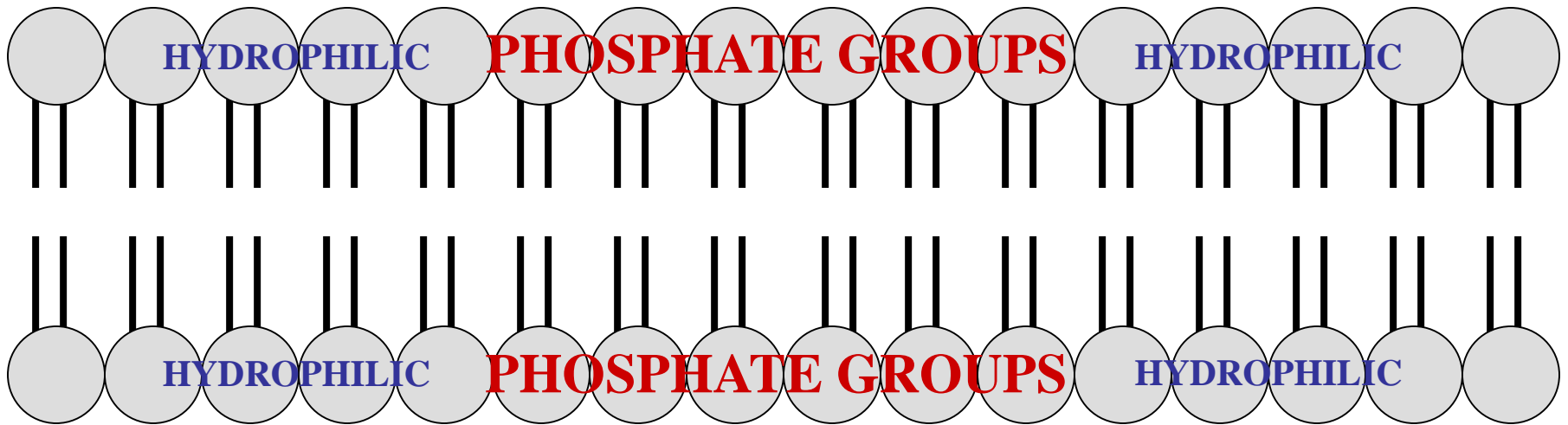
CELL MEMBRANE COMPOSITION

CELL MEMBRANE COMPOSITION

WATER

WATER

WATER



WATER

WATER

WATER

CELL MEMBRANE COMPOSITION

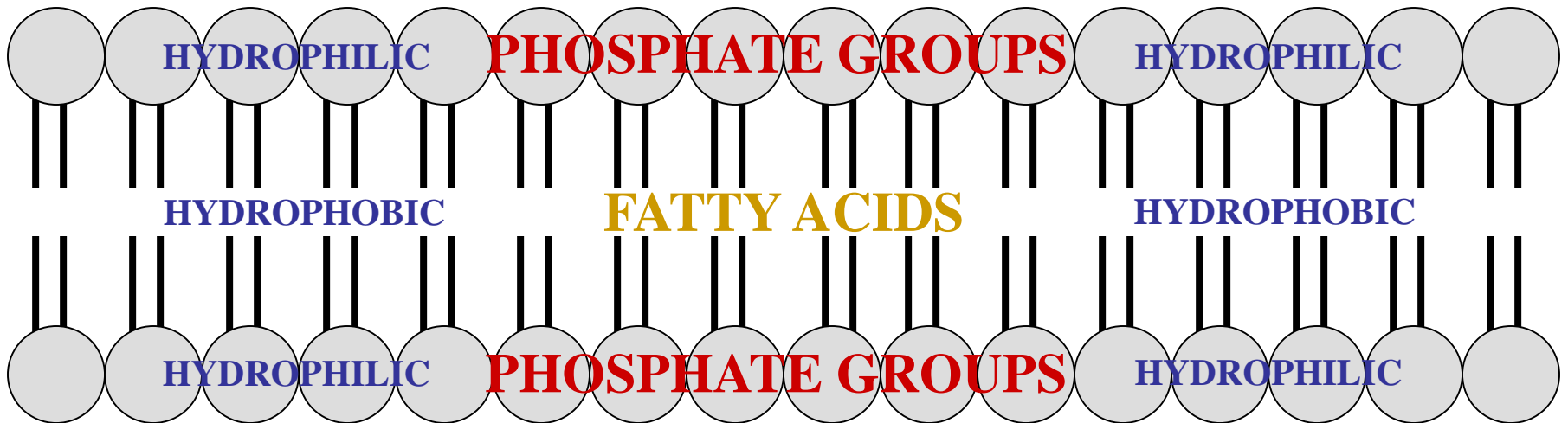
CELL MEMBRANE COMPOSITION



WATER

WATER

WATER



WATER

WATER

WATER

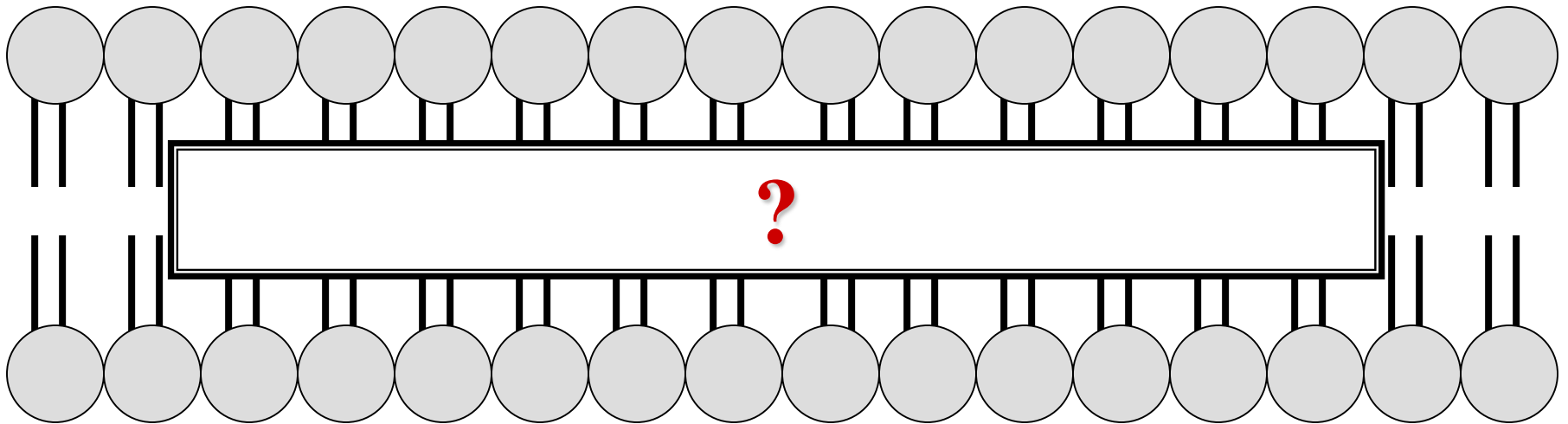
CELL MEMBRANE COMPOSITION

CELL MEMBRANE COMPOSITION

WATER

WATER

WATER



WATER

WATER

WATER

CELL MEMBRANE COMPOSITION

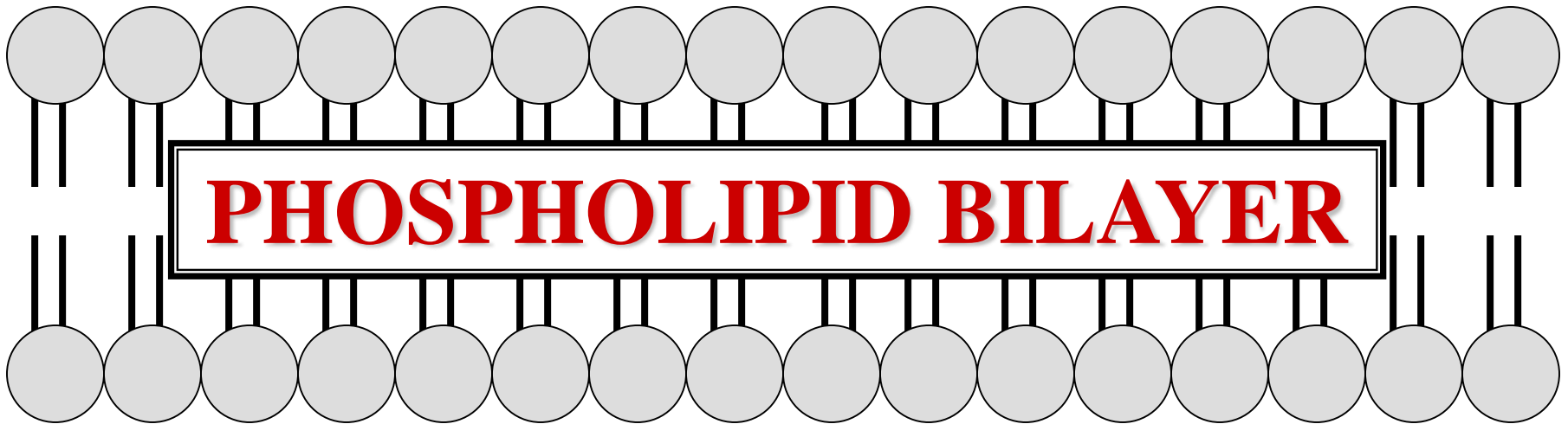
CELL MEMBRANE COMPOSITION



WATER

WATER

WATER



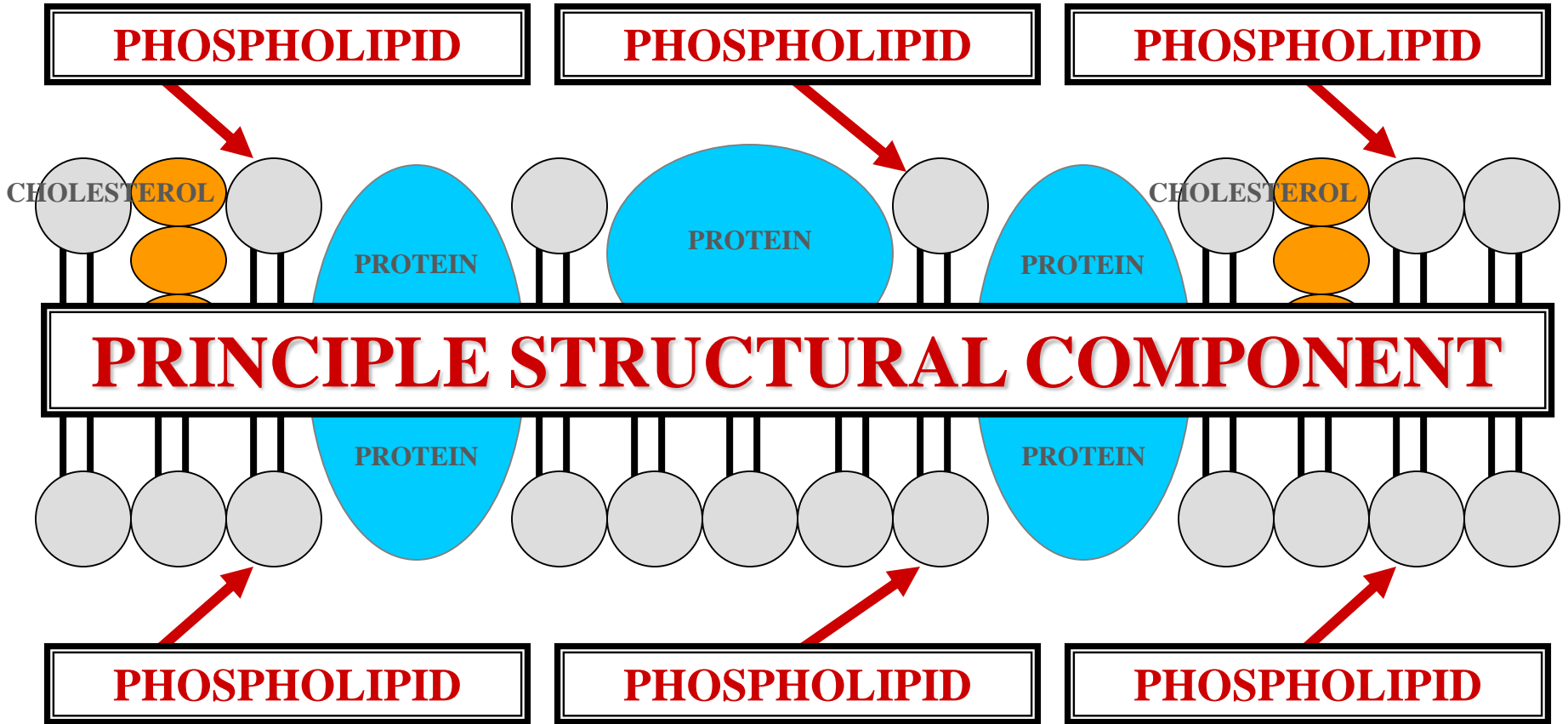
WATER

WATER

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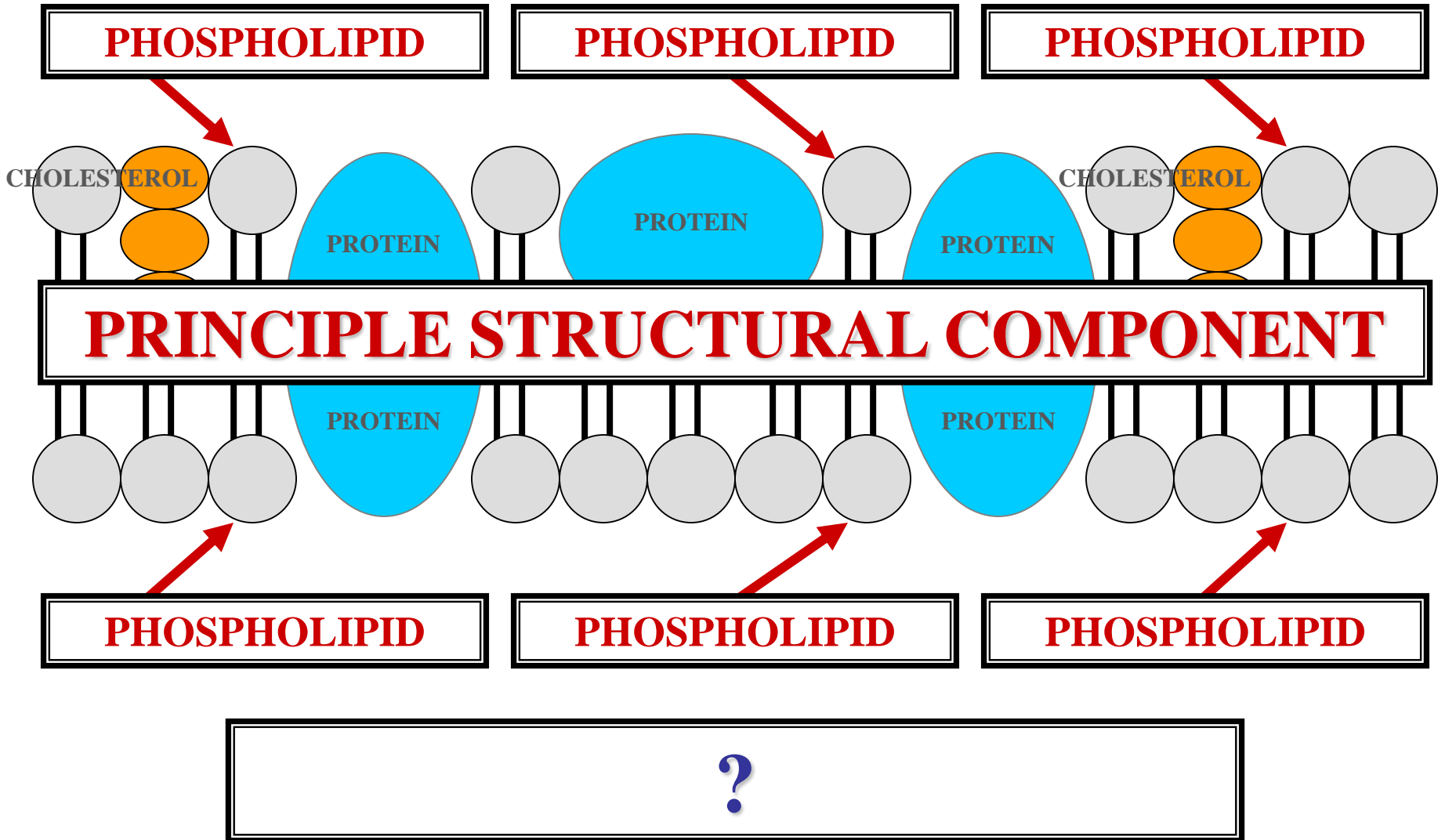
CELL MEMBRANE COMPOSITION

BIO-MEMBRANE STRUCTURE



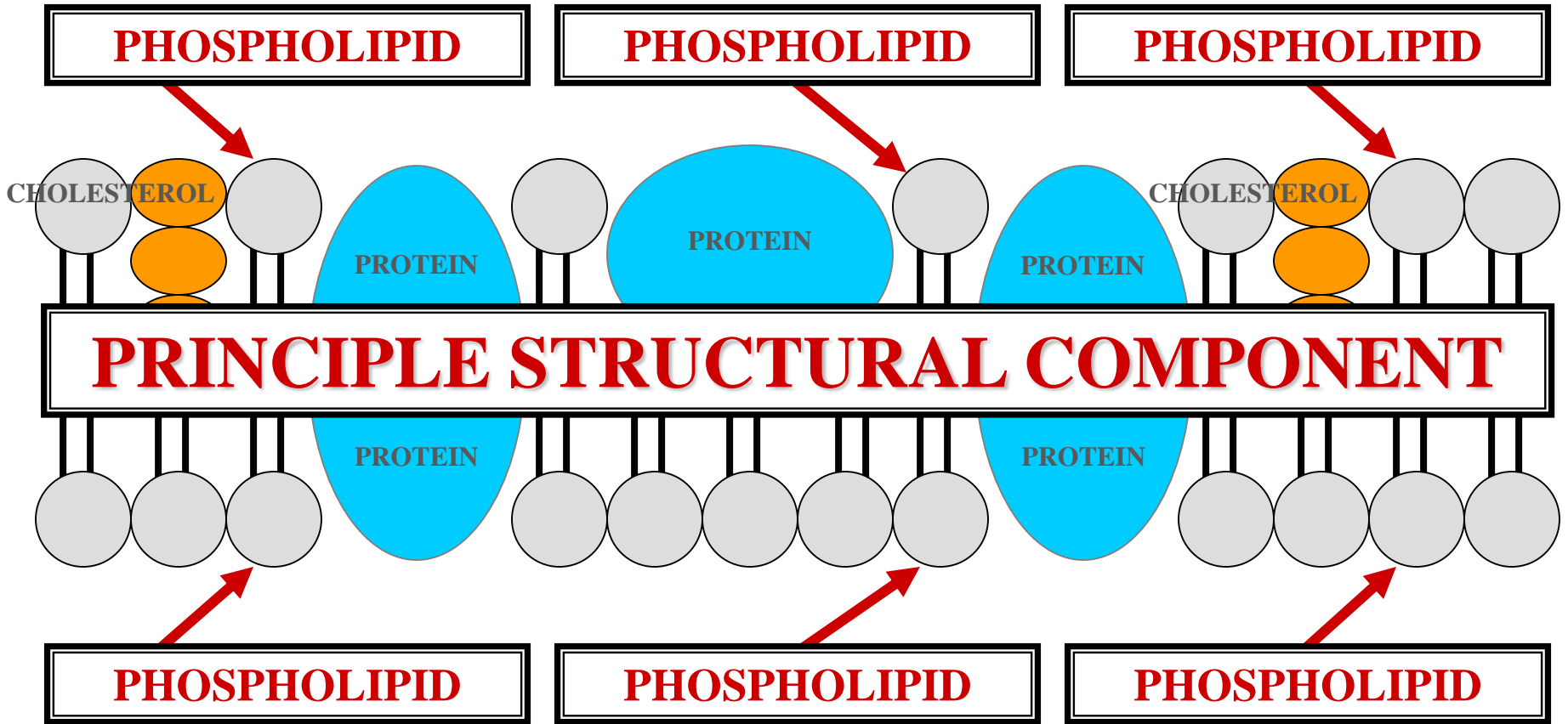
BIO-MEMBRANE STRUCTURE

BIO-MEMBRANE STRUCTURE





BIO-MEMBRANE STRUCTURE



FLUID MOSAIC MODEL

CYTOPLASM

CYTOPLASM



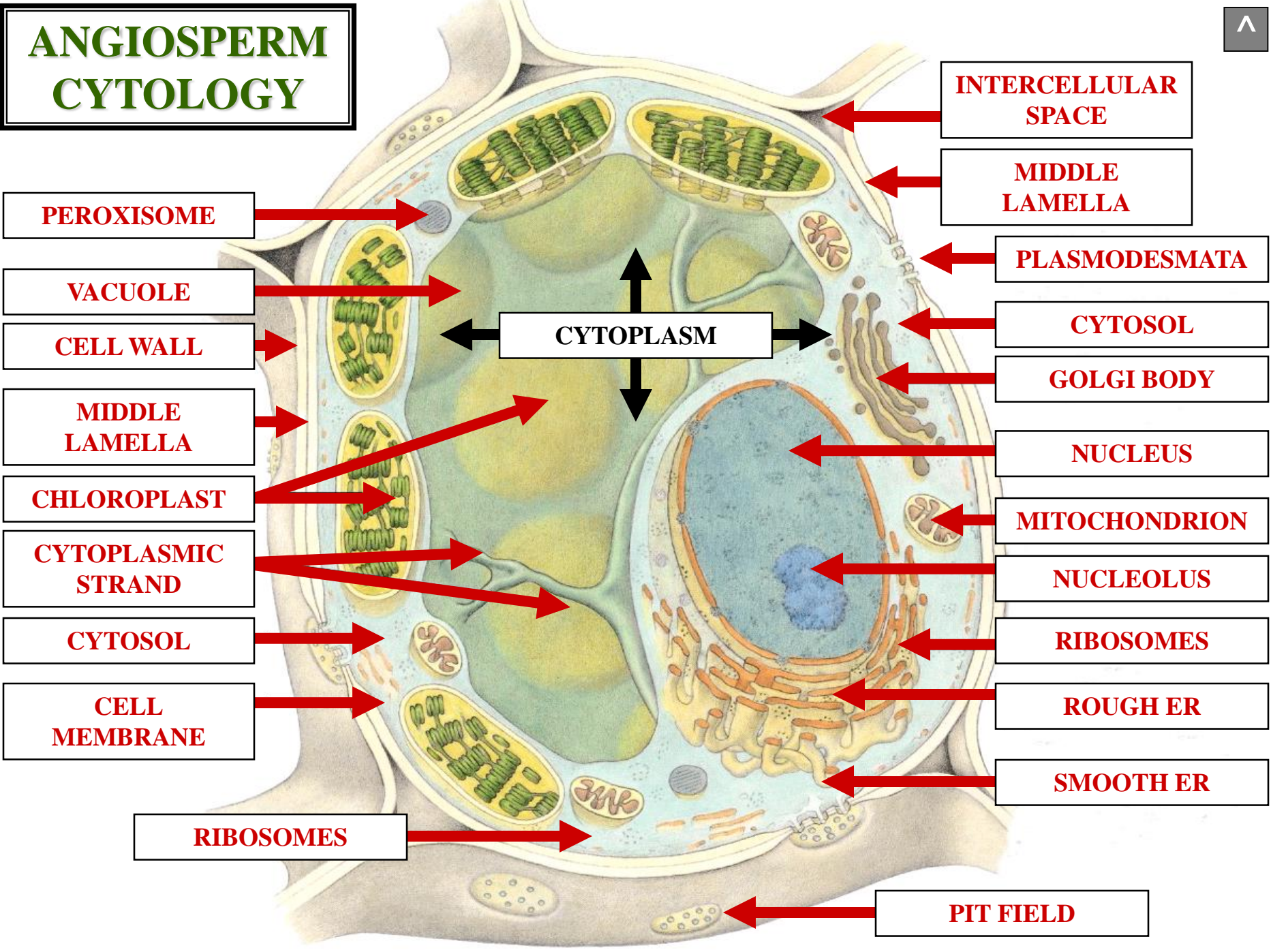
CYTOPLASM

**CONTENT BEYOND
CELL MEMBRANE**

CYTOPLASM



ANGIOSPERM CYTOLOGY



PEROXISOME

VACUOLE

CELL WALL

MIDDLE LAMELLA

CHLOROPLAST

CYTOPLASMIC STRAND

CYTOSOL

CELL MEMBRANE

RIBOSOMES

INTERCELLULAR SPACE

MIDDLE LAMELLA

PLASMODESMATA

CYTOSOL

GOLGI BODY

NUCLEUS

MITOCHONDRION

NUCLEOLUS

RIBOSOMES

ROUGH ER

SMOOTH ER

PIT FIELD

CYTOPLASM

CYTOPLASM COMPONENTS

CYTOPLASM COMPONENTS

CYTOSOL

CYTOPLASM COMPONENTS

CYTOPLASM COMPONENTS

**CYTOSOL
ORGANELLES**

CYTOPLASM COMPONENTS

CYTOSOL

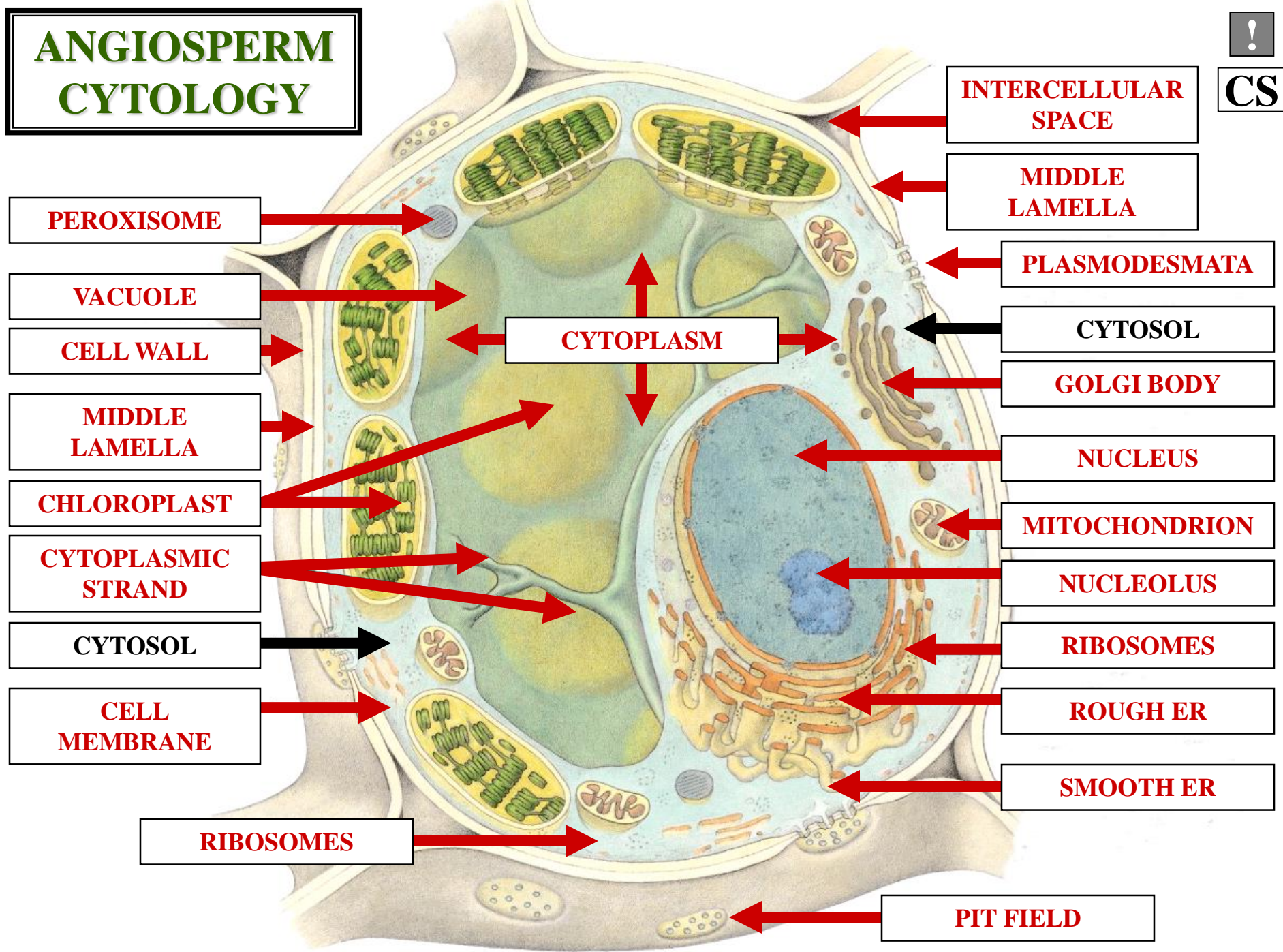


CYTOSOL

FLUID MATRIX

CYTOSOL

ANGIOSPERM CYTOLOGY



PEROXISOME

VACUOLE

CELL WALL

MIDDLE LAMELLA

CHLOROPLAST

CYTOPLASMIC STRAND

CYTOSOL

CELL MEMBRANE

RIBOSOMES

INTERCELLULAR SPACE

MIDDLE LAMELLA

PLASMODESMATA

CYTOSOL

GOLGI BODY

NUCLEUS

MITOCHONDRION

NUCLEOLUS

RIBOSOMES

ROUGH ER

SMOOTH ER

PIT FIELD

CYTOPLASM

CS



CYTOPLASMIC STREAMING



CYCLOSIS

**CYTOPLASMIC
STREAMING**

SYNONYMOUS

CYCLOSIS

CYTOPLASMIC STREAMING CYCLOSIS



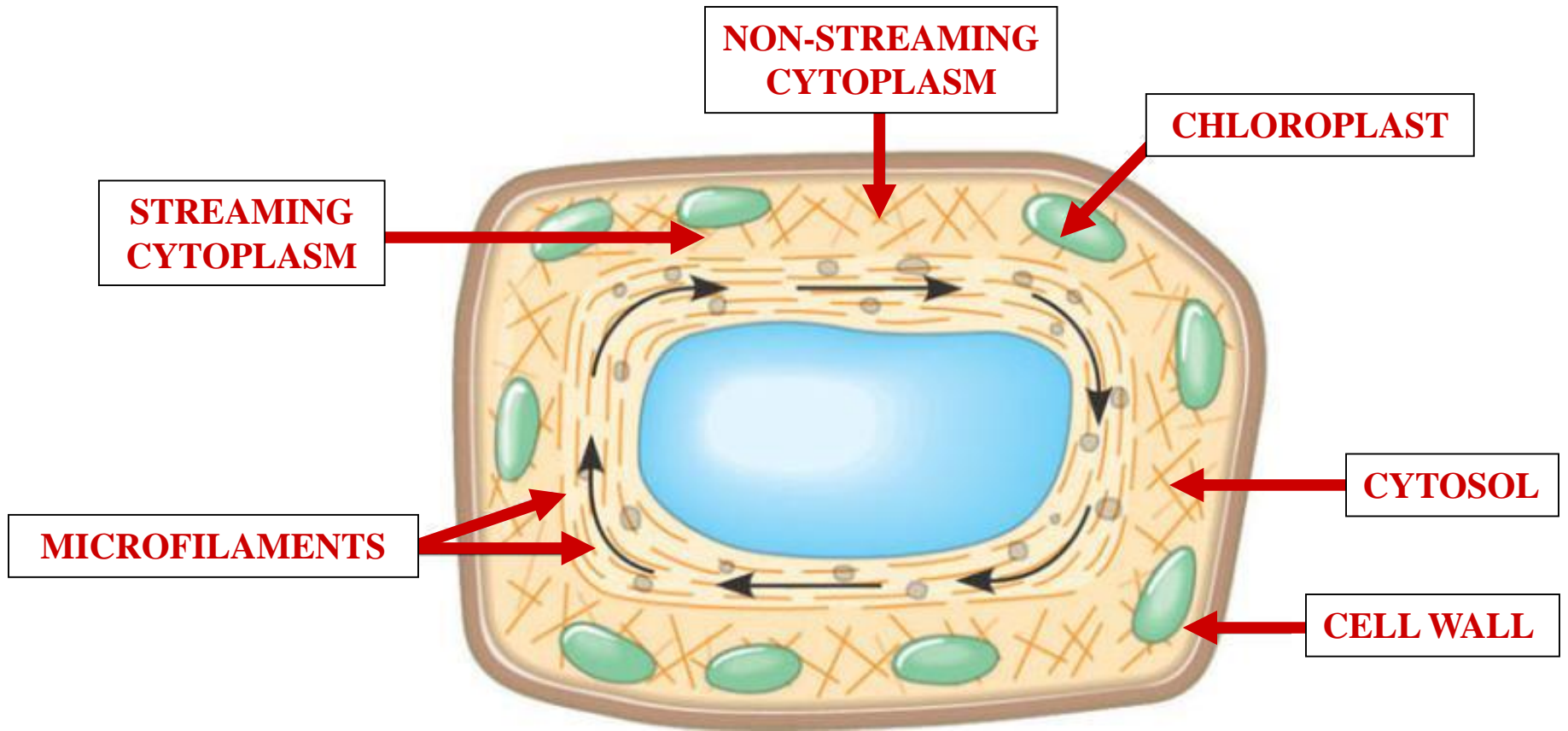
CYTOSOL MOVEMENT
OUTCOME
MIXES METABOLITES

CYTOPLASMIC STREAMING CYCLOSIS

CYTOPLASMIC STREAMING



MX



CYTOPLASMIC STREAMING = CYCLOSIS

***CYTOPLASMIC
STREAMING
EQUALLY MIXES
METABOLITES***

***EFFICIENT
METABOLISM***