

**MESOPHYLL**

**C4 LEAF**

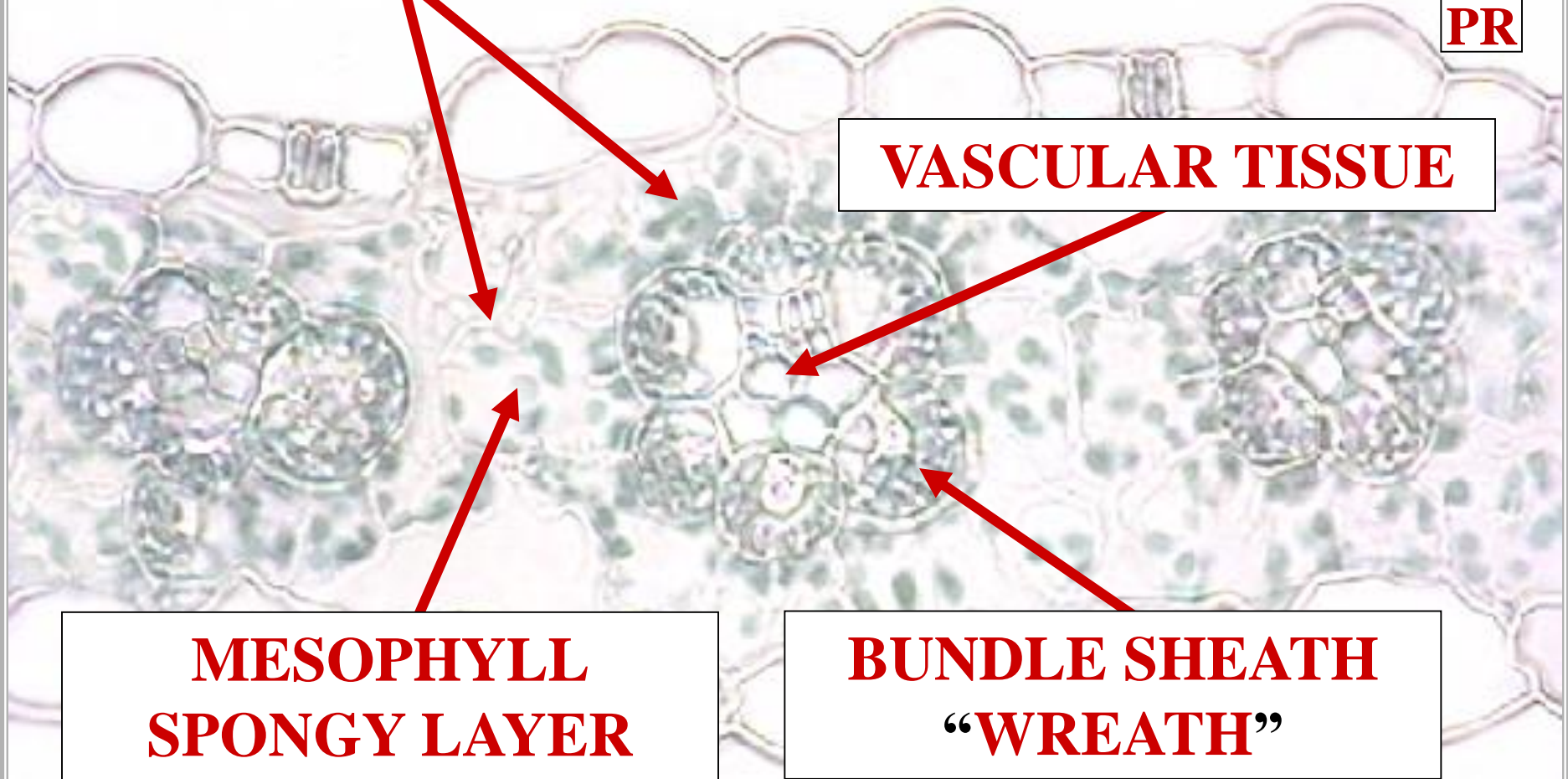
**PR**

**VASCULAR TISSUE**

**MESOPHYLL  
SPONGY LAYER**

**BUNDLE SHEATH  
“WREATH”**

**KRANTZ C4 LEAF ANATOMY**



**MESOPHYLL**

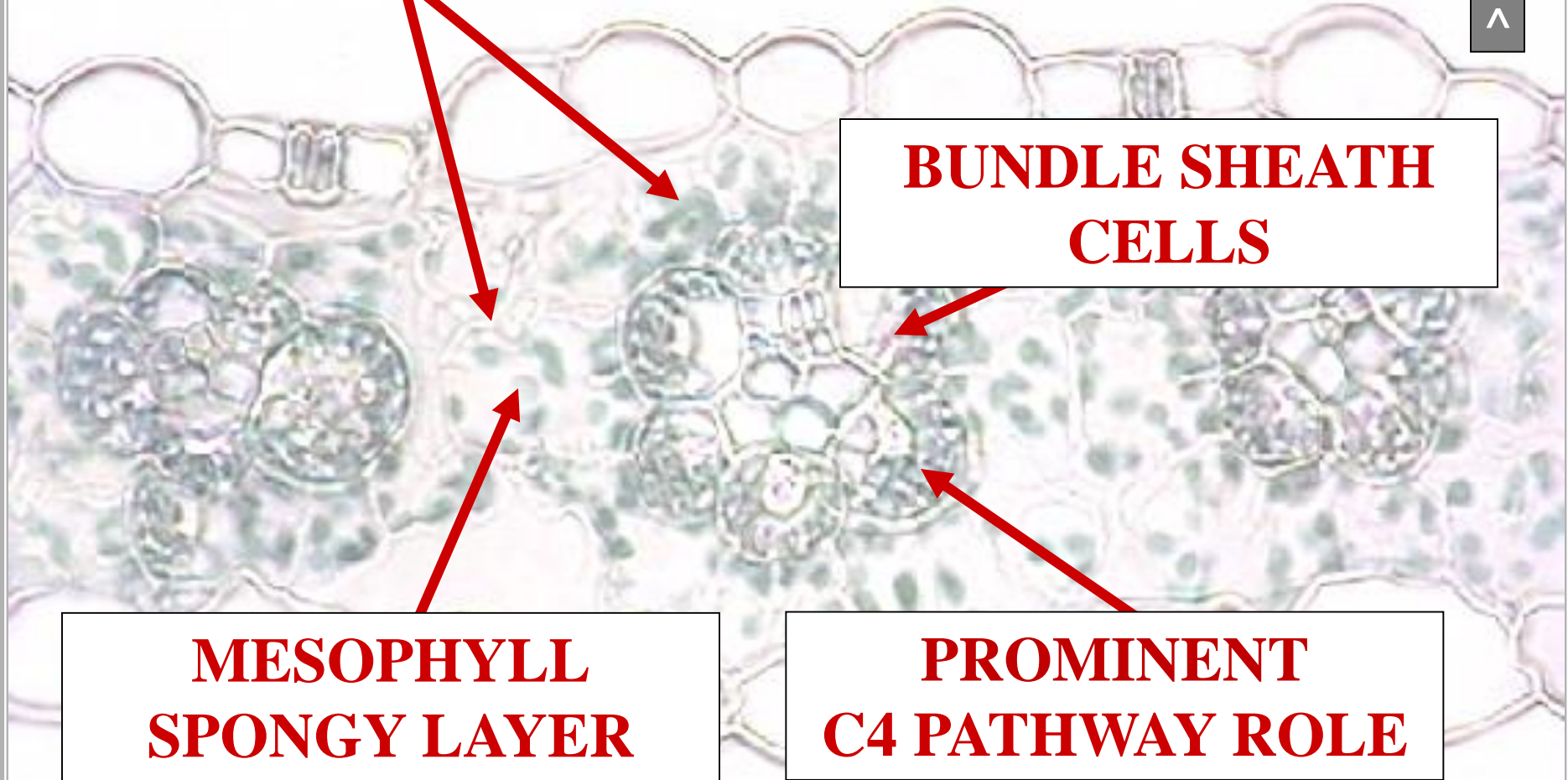
**C4 LEAF**

**BUNDLE SHEATH  
CELLS**

**MESOPHYLL  
SPONGY LAYER**

**PROMINENT  
C4 PATHWAY ROLE**

**KRANTZ C4 LEAF ANATOMY**





# C4 PATHWAY SPECIFICS



# C4 PATHWAY CORN PLANT





**C4**

**CORN**



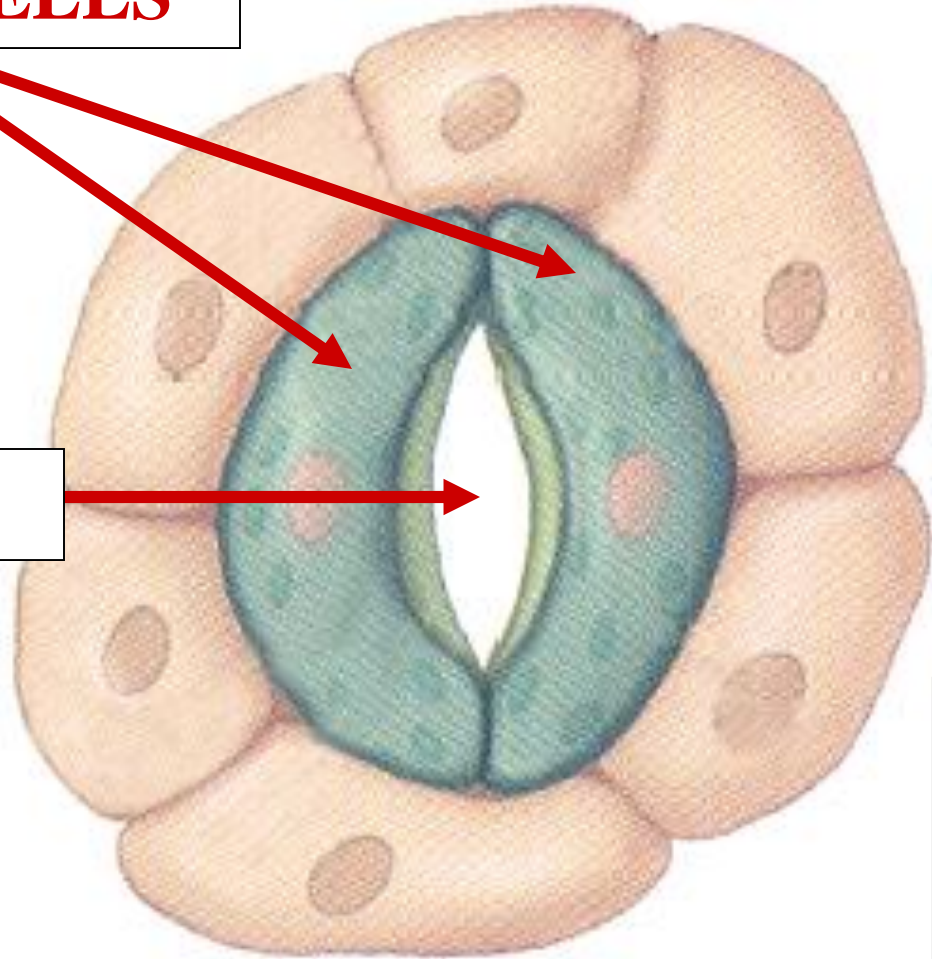
# LEAF STOMATE



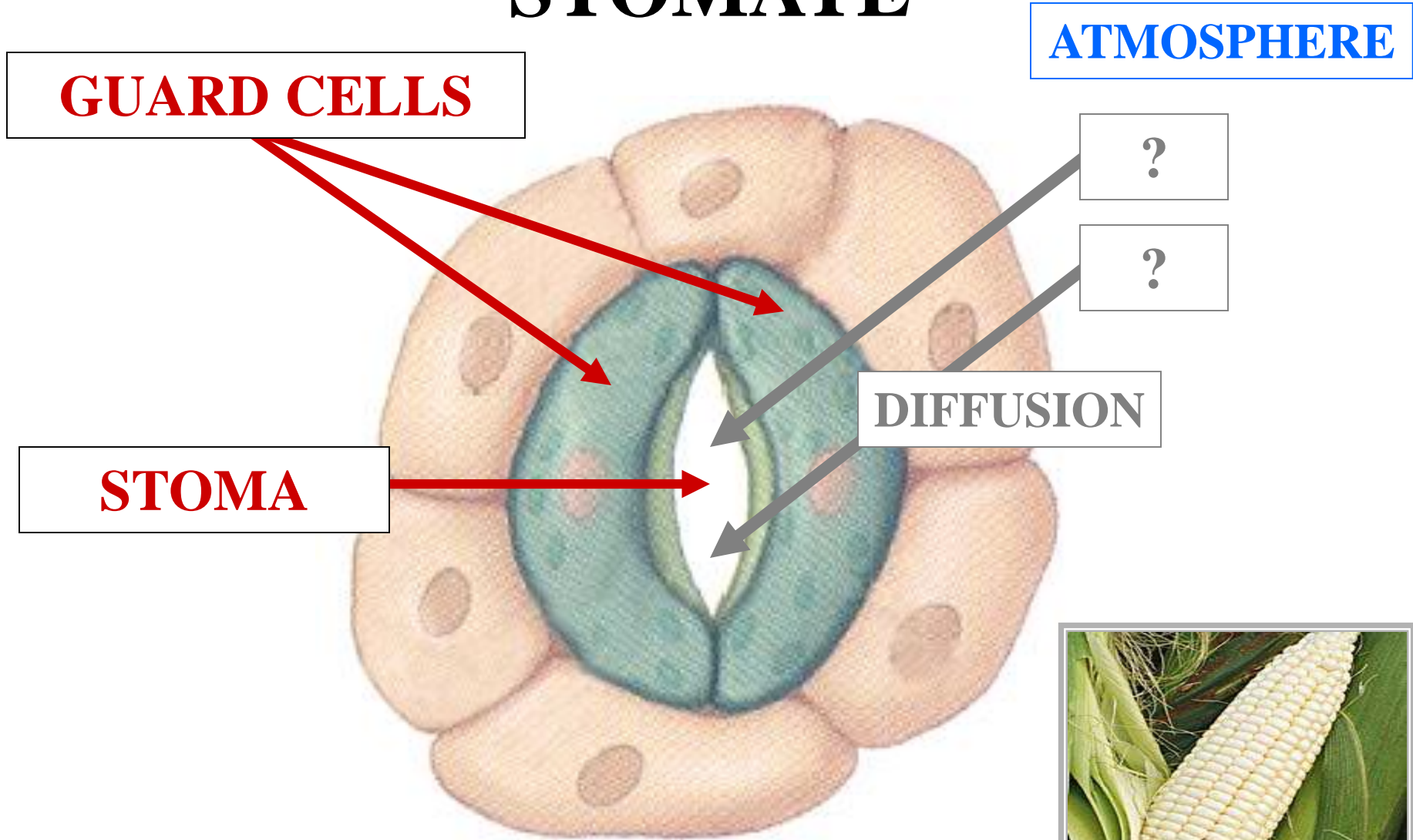
# LEAF STOMATE

**GUARD CELLS**

**STOMA**



# LEAF STOMATE



# LEAF STOMATE

**GUARD CELLS**

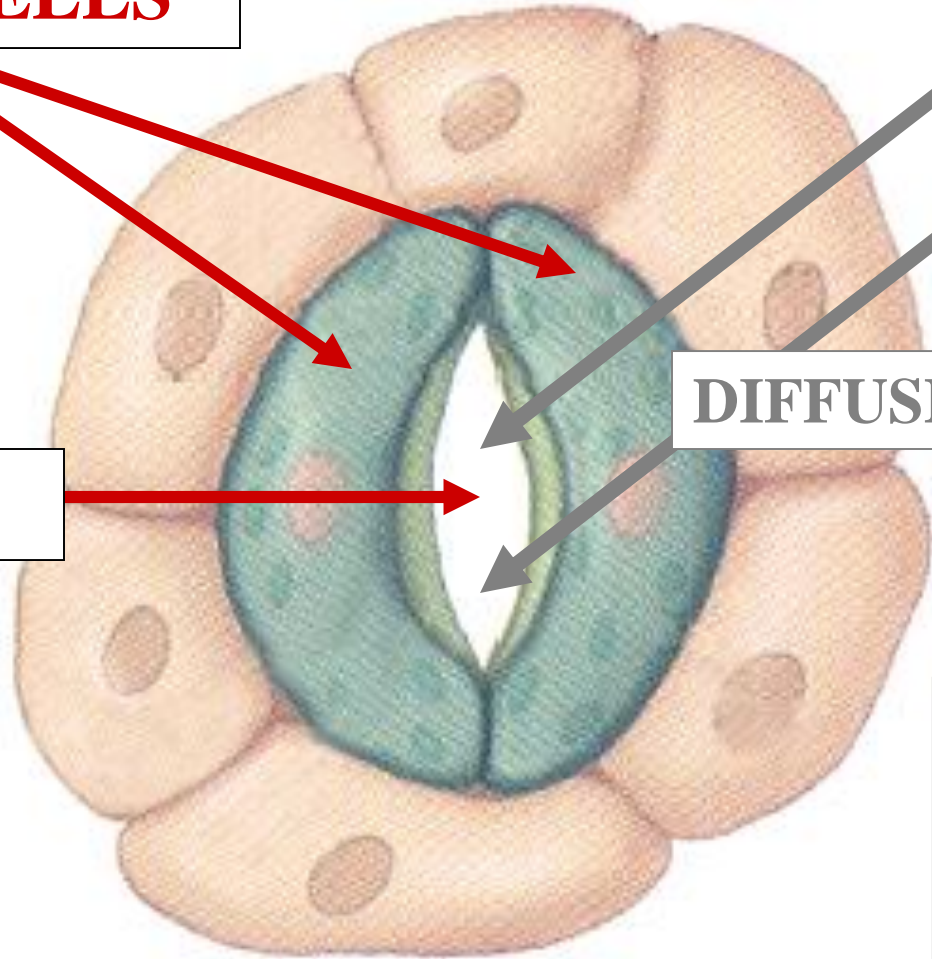
**ATMOSPHERE**

**CO<sub>2</sub>**

**CO<sub>2</sub>**

**DIFFUSION**

**STOMA**





# C4 PATHWAY CO<sub>2</sub> DIFFUSION



ATMOSPHERE

# LEAF STOMATE

ATMOSPHERE

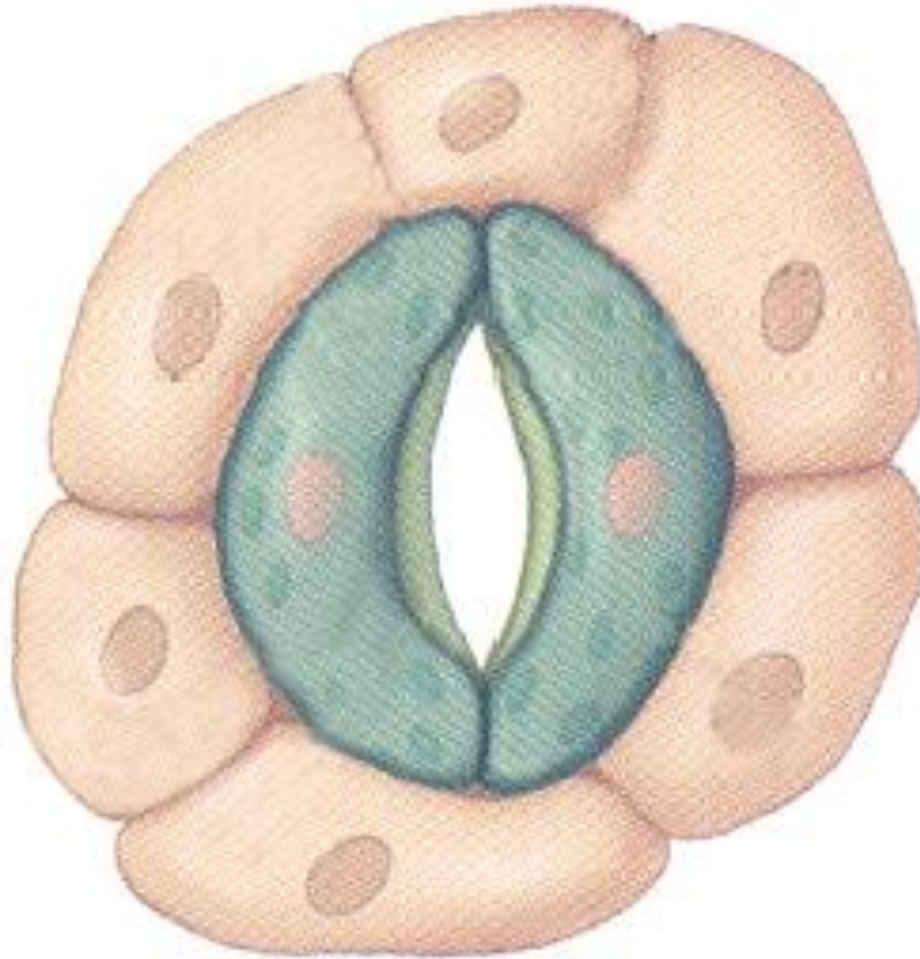
CO<sub>2</sub>

CO<sub>2</sub>



CO<sub>2</sub>

CO<sub>2</sub>



ATMOSPHERE

# LEAF STOMATE

ATMOSPHERE

CO<sub>2</sub>

DIFFUSION

CO<sub>2</sub>

DIFFUSION

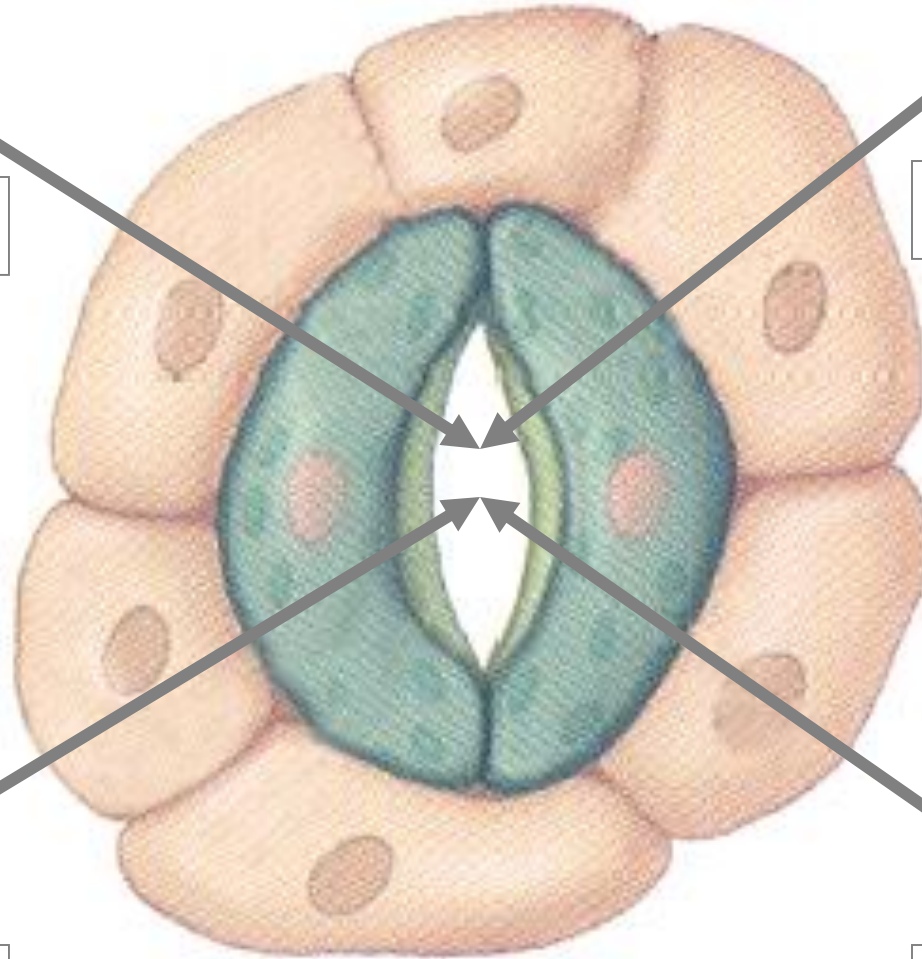


CO<sub>2</sub>

DIFFUSION

CO<sub>2</sub>

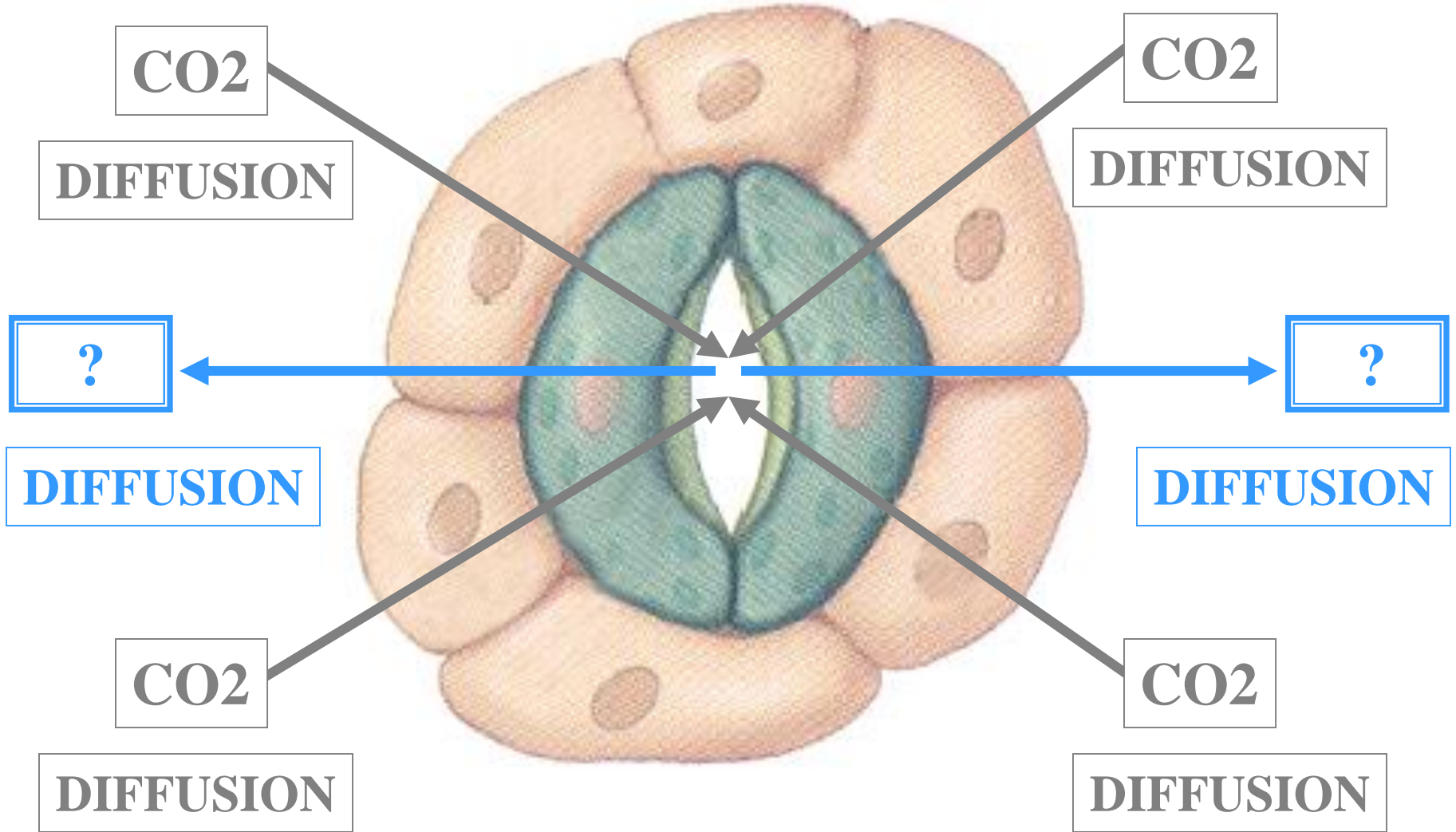
DIFFUSION



# LEAF STOMATE

ATMOSPHERE

ATMOSPHERE



CO2

DIFFUSION

CO2

DIFFUSION

?

DIFFUSION

?

DIFFUSION

CO2

DIFFUSION

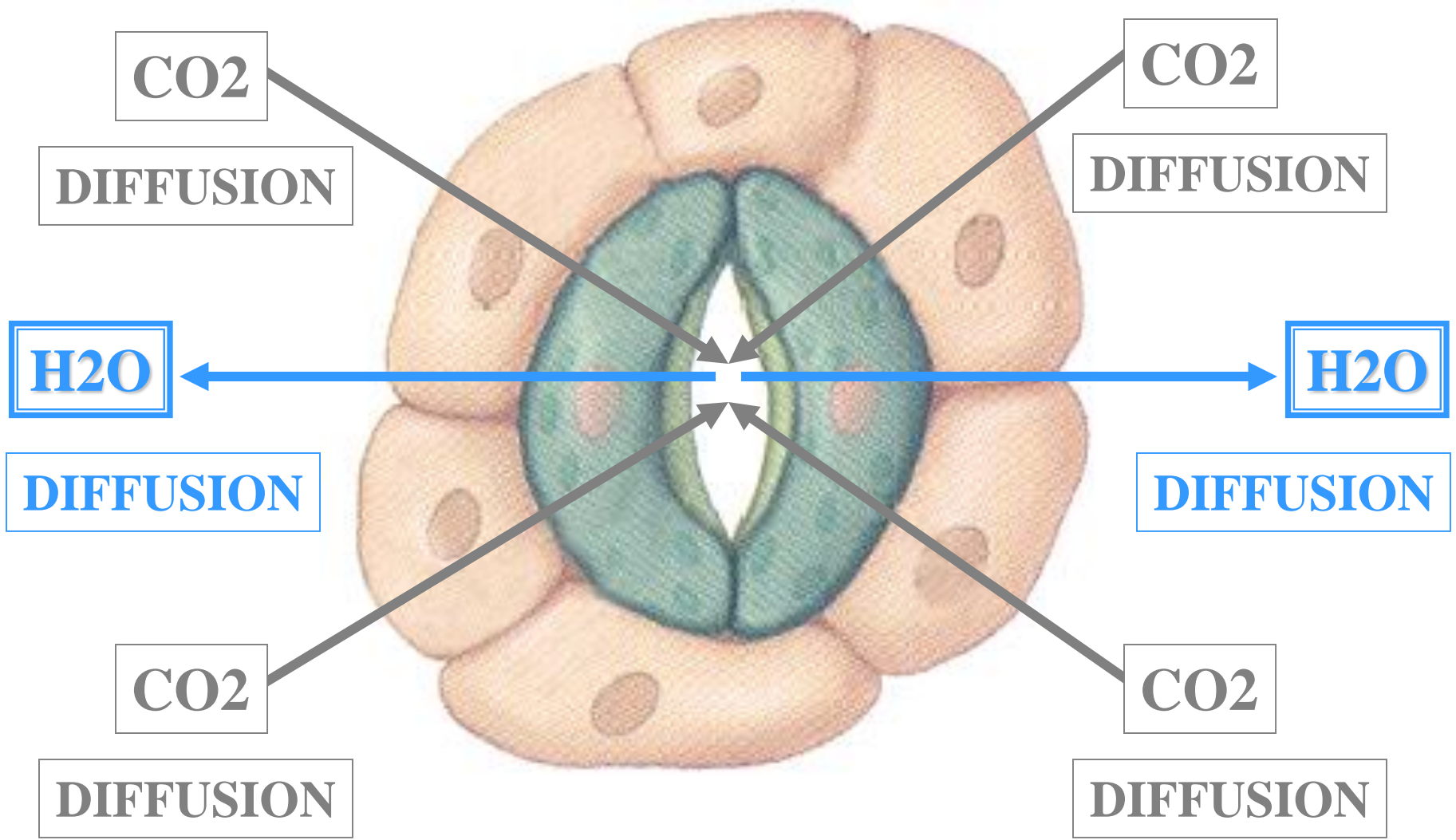
CO2

DIFFUSION

# LEAF STOMATE

ATMOSPHERE

ATMOSPHERE







# LEAF STOMATE

ATMOSPHERE

ATMOSPHERE

CO<sub>2</sub>

DIFFUSION

CO<sub>2</sub>

DIFFUSION

H<sub>2</sub>O

DIFFUSION

TRANSPIRATION

H<sub>2</sub>O

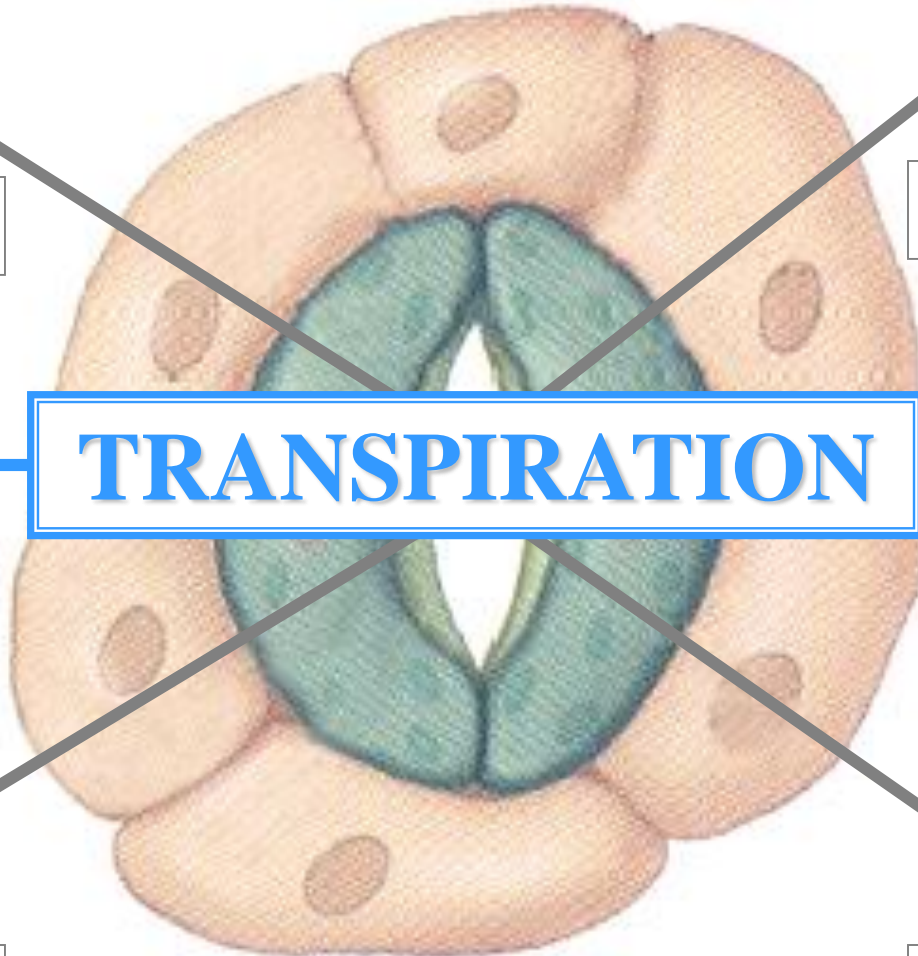
DIFFUSION

CO<sub>2</sub>

DIFFUSION

CO<sub>2</sub>

DIFFUSION





*WATER  
RETENTION  
VITAL*

**C4**

**CORN**





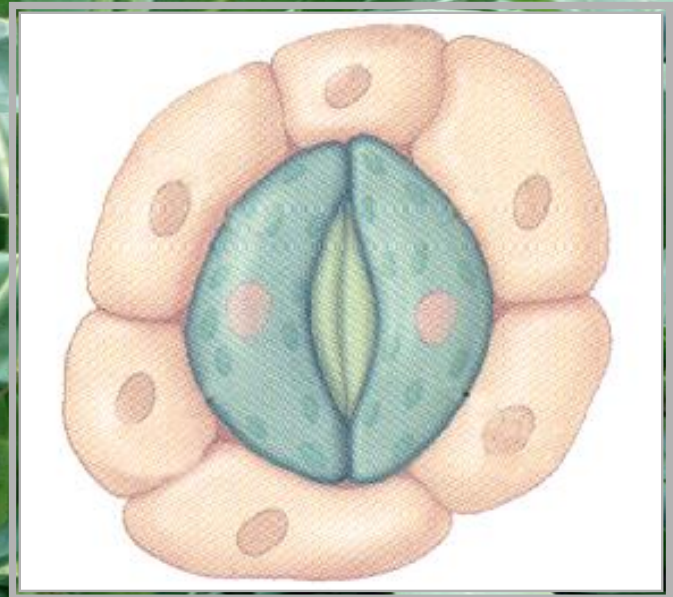
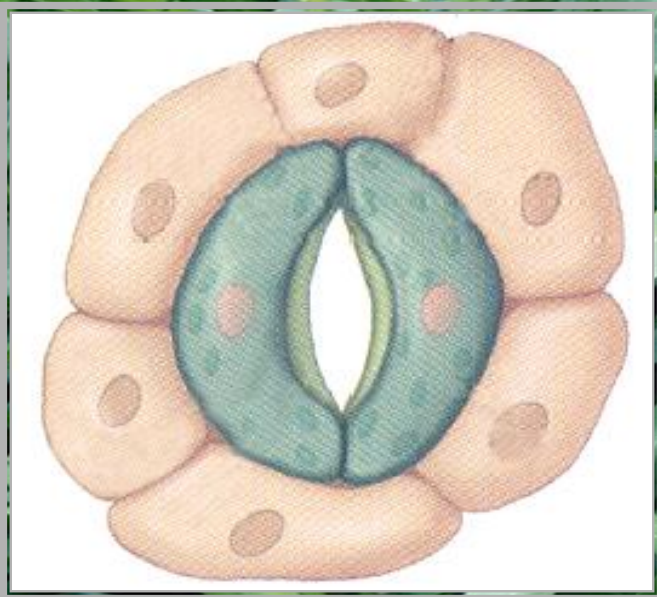
# C4

# WATER

# RETENTION

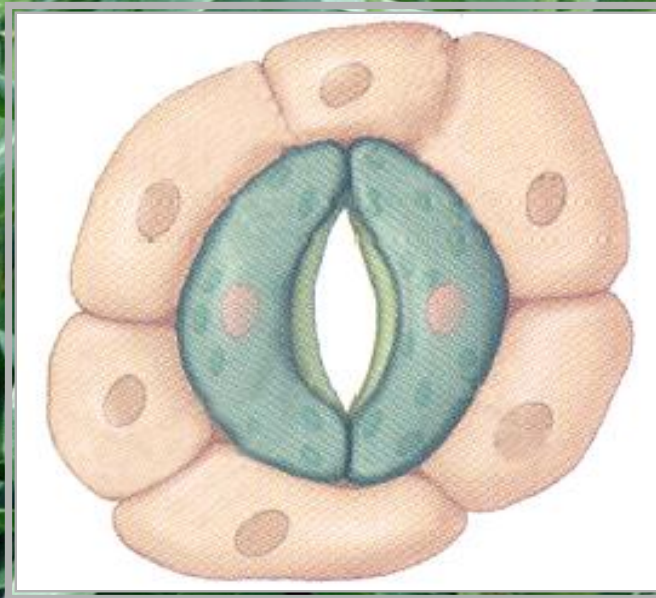
# APPLIED

# *COOL HUMID DAY*





# *COOL HUMID DAY*



ATMOSPHERE

# STOMATE OPEN

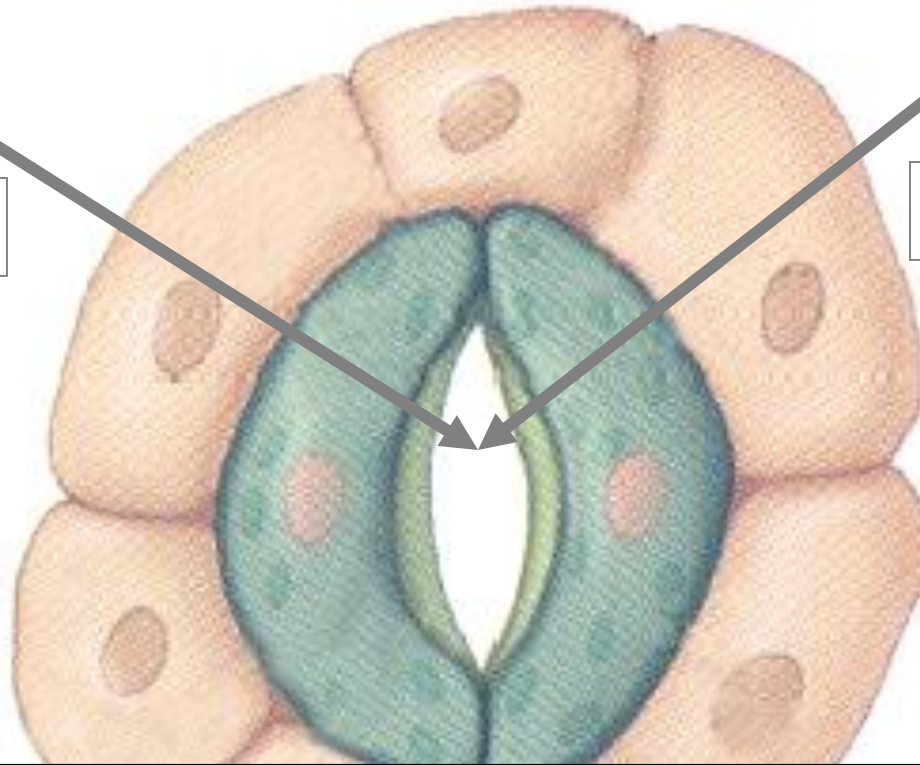
ATMOSPHERE

CO<sub>2</sub>

DIFFUSION

CO<sub>2</sub>

DIFFUSION



***COOL HUMID DAY***

**PLANT**

**ATMOSPHERE**

**SH**

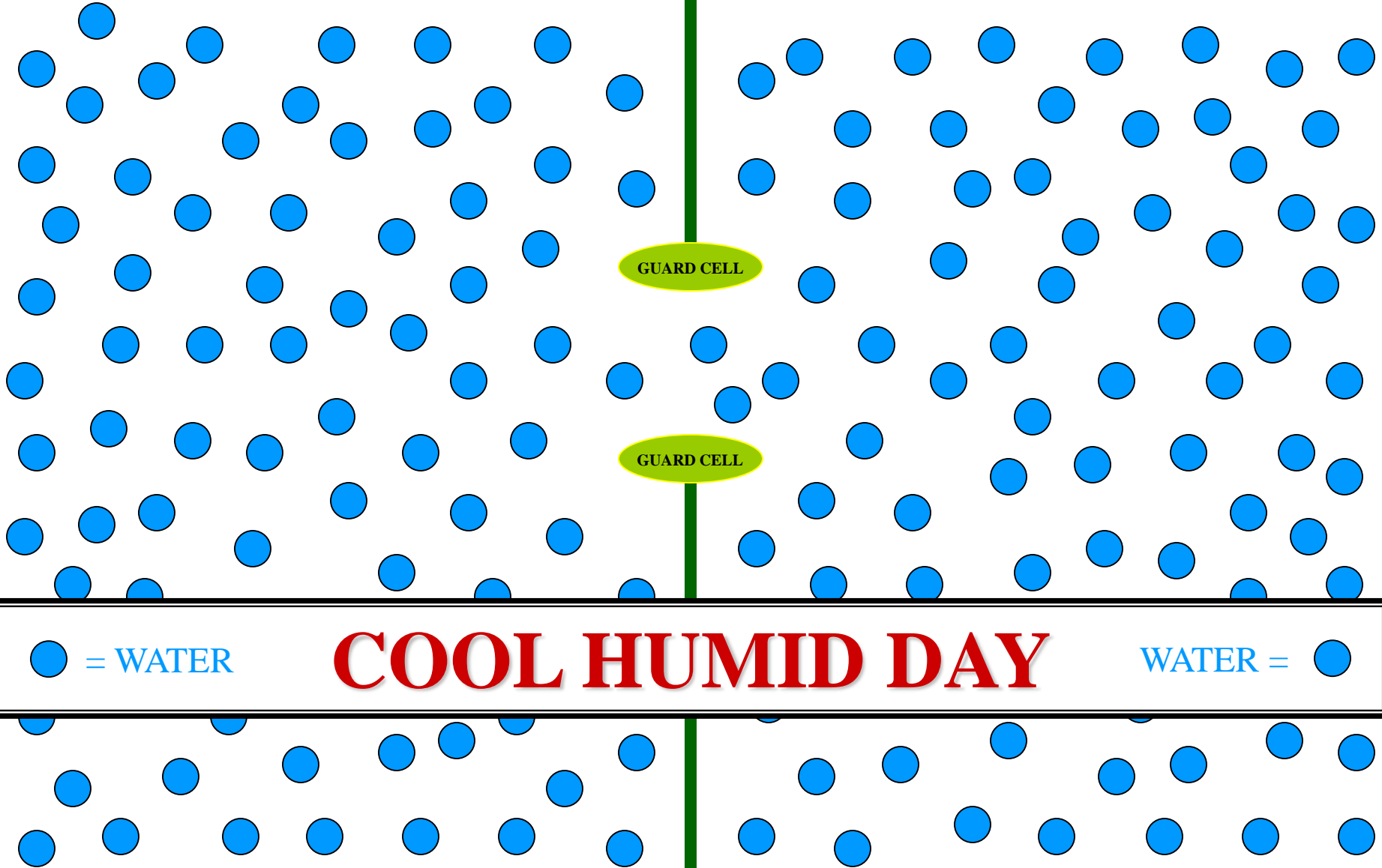
GUARD CELL

GUARD CELL

● = WATER

**COOL HUMID DAY**

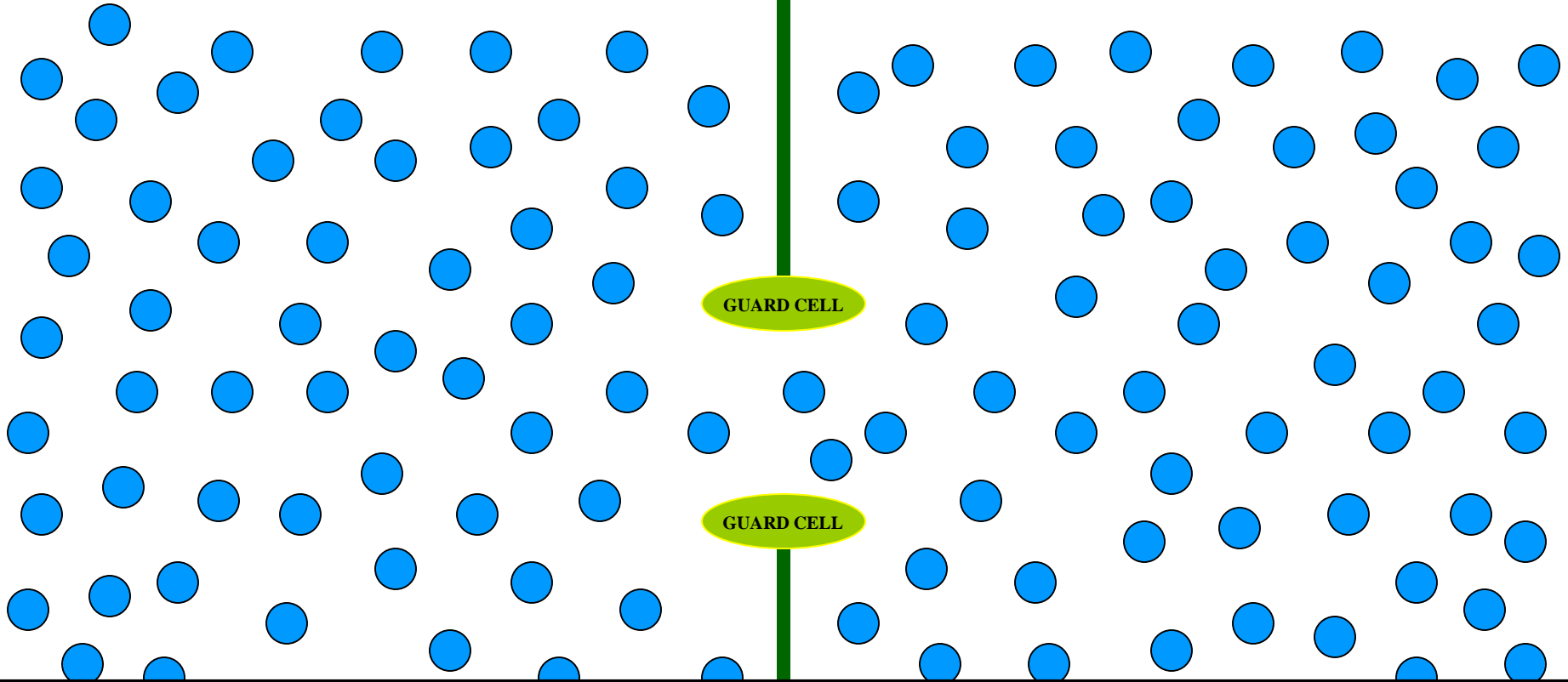
WATER = ●





# PLANT

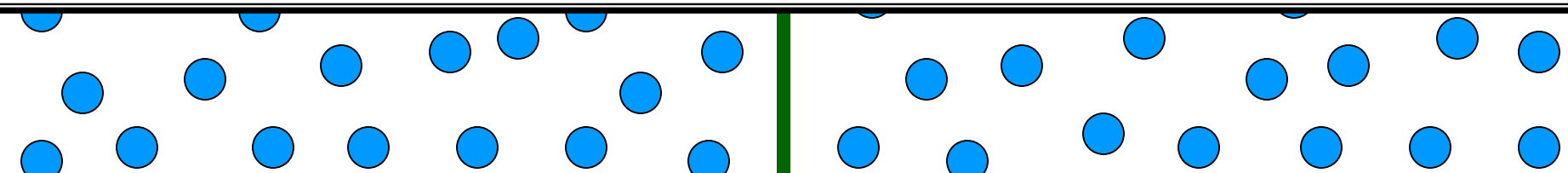
# ATMOSPHERE



● = WATER

# SHALLOW GRADIENT

WATER = ●





# LEAF STOMATE

ATMOSPHERE

ATMOSPHERE

CO<sub>2</sub>

CO<sub>2</sub>

DIFFUSION

DIFFUSION

H<sub>2</sub>O

TRANSPIRATION

H<sub>2</sub>O

DIFFUSION

DIFFUSION

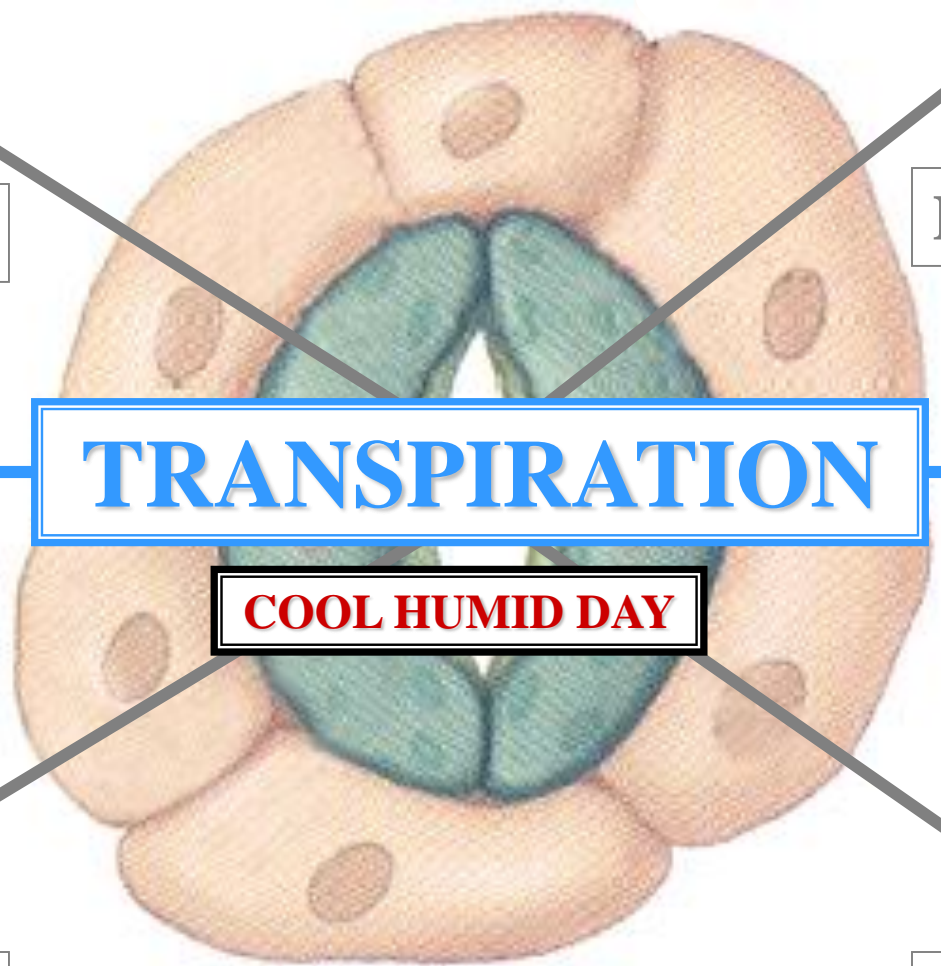
COOL HUMID DAY

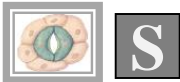
CO<sub>2</sub>

CO<sub>2</sub>

DIFFUSION

DIFFUSION





ATMOSPHERE

# LEAF STOMATE

ATMOSPHERE

CO<sub>2</sub>

CO<sub>2</sub>

COOL HUMID DAY

LOW

COOL HUMID DAY

TRANSPIRATION  
POTENTIAL



CO<sub>2</sub>

CO<sub>2</sub>

DIFFUSION

DIFFUSION

ATMOSPHERE

# STOMATE OPEN

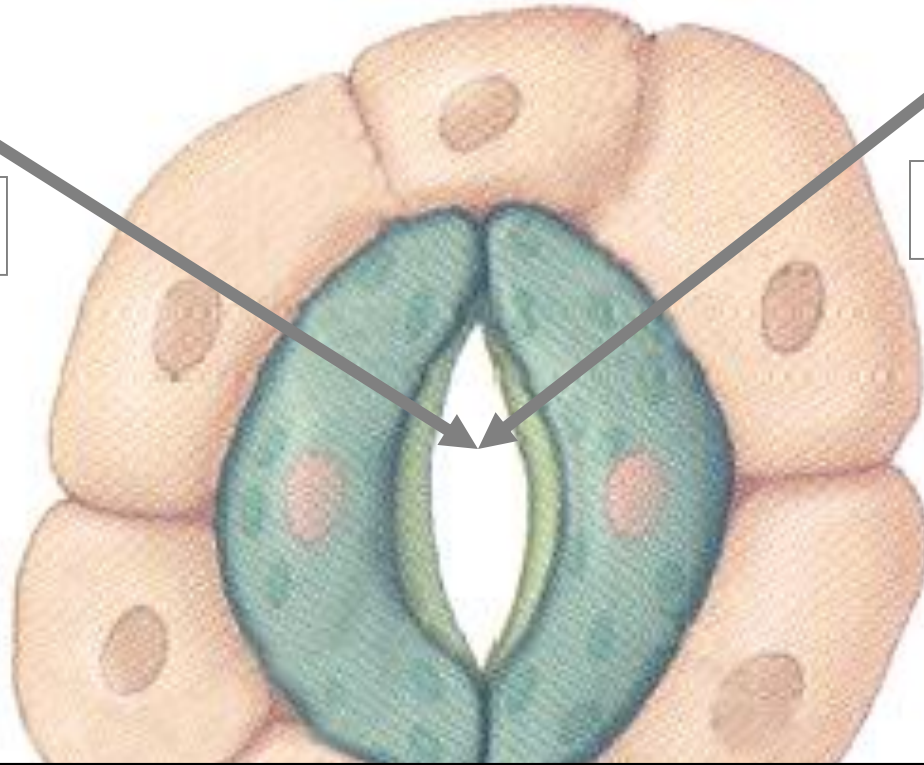
ATMOSPHERE

CO<sub>2</sub>

CO<sub>2</sub>

DIFFUSION

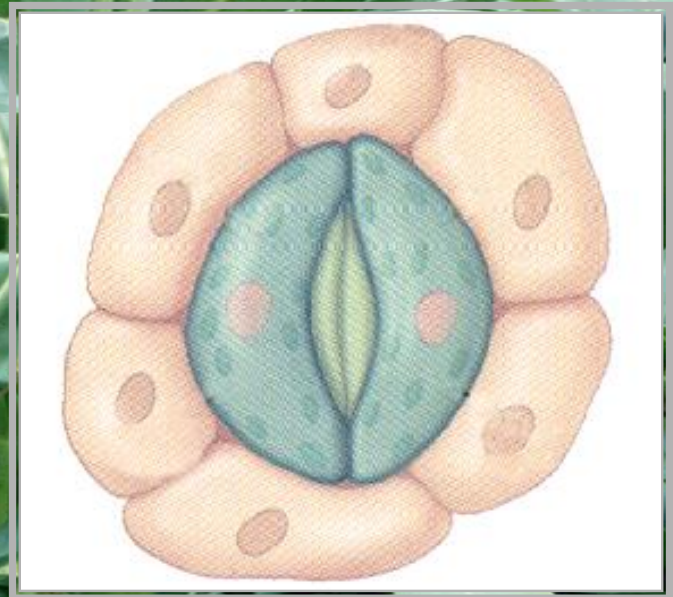
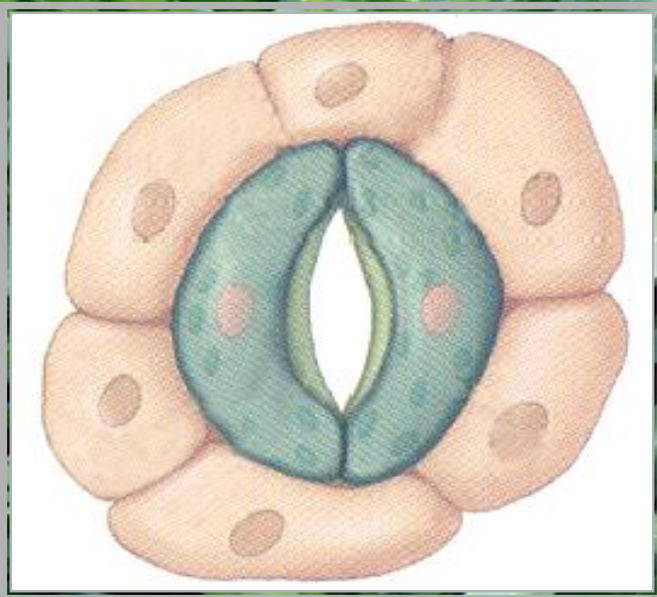
DIFFUSION



***COOL HUMID DAY***

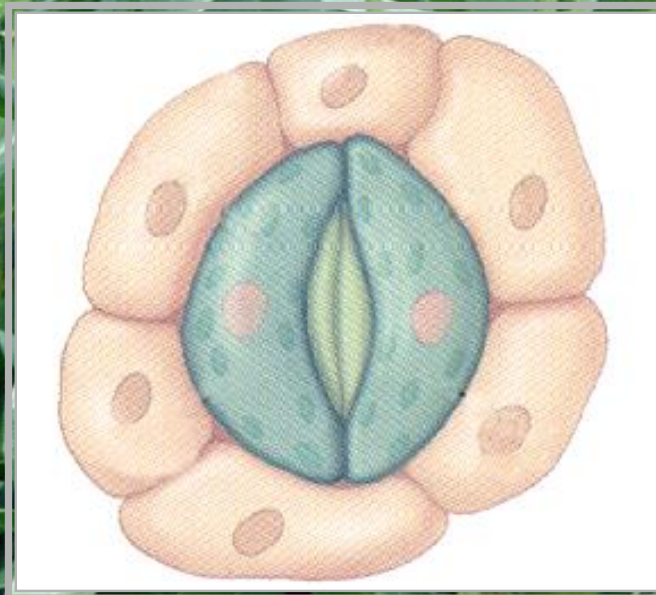


# ***HOT DRY DAY***





# ***HOT DRY DAY***



ATMOSPHERE

# STOMATE CLOSED

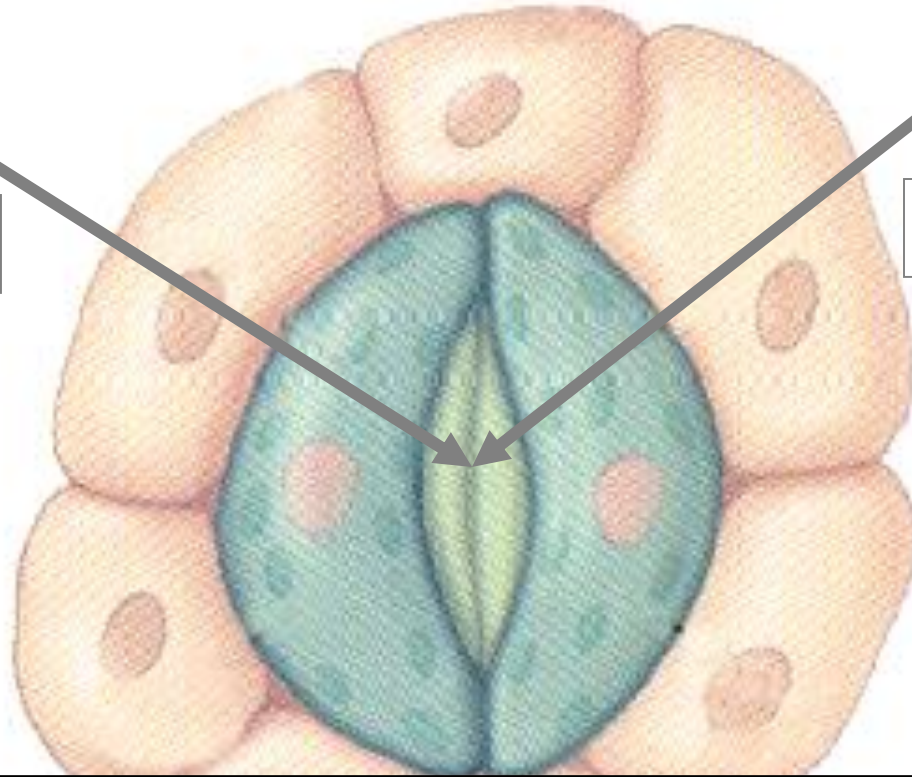
ATMOSPHERE

CO<sub>2</sub>

DIFFUSION

CO<sub>2</sub>

DIFFUSION



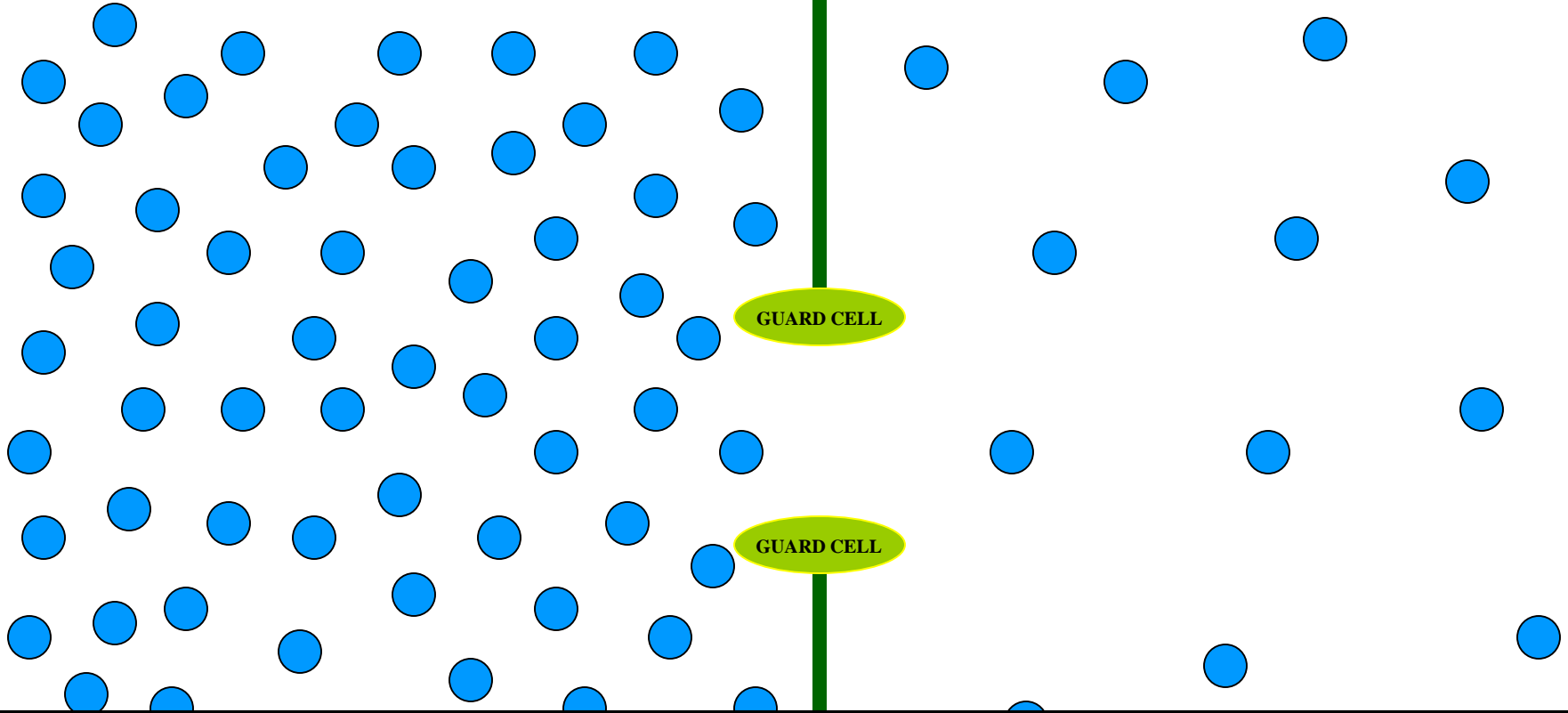
***HOT DRY DAY***



**PLANT**

**ATMOSPHERE**

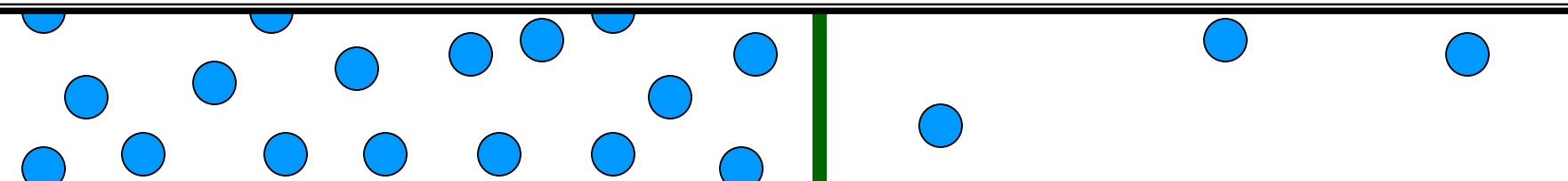
**ST**



● = WATER

**DRY HOT DAY**

WATER = ●



**PLANT**

**ATMOSPHERE**

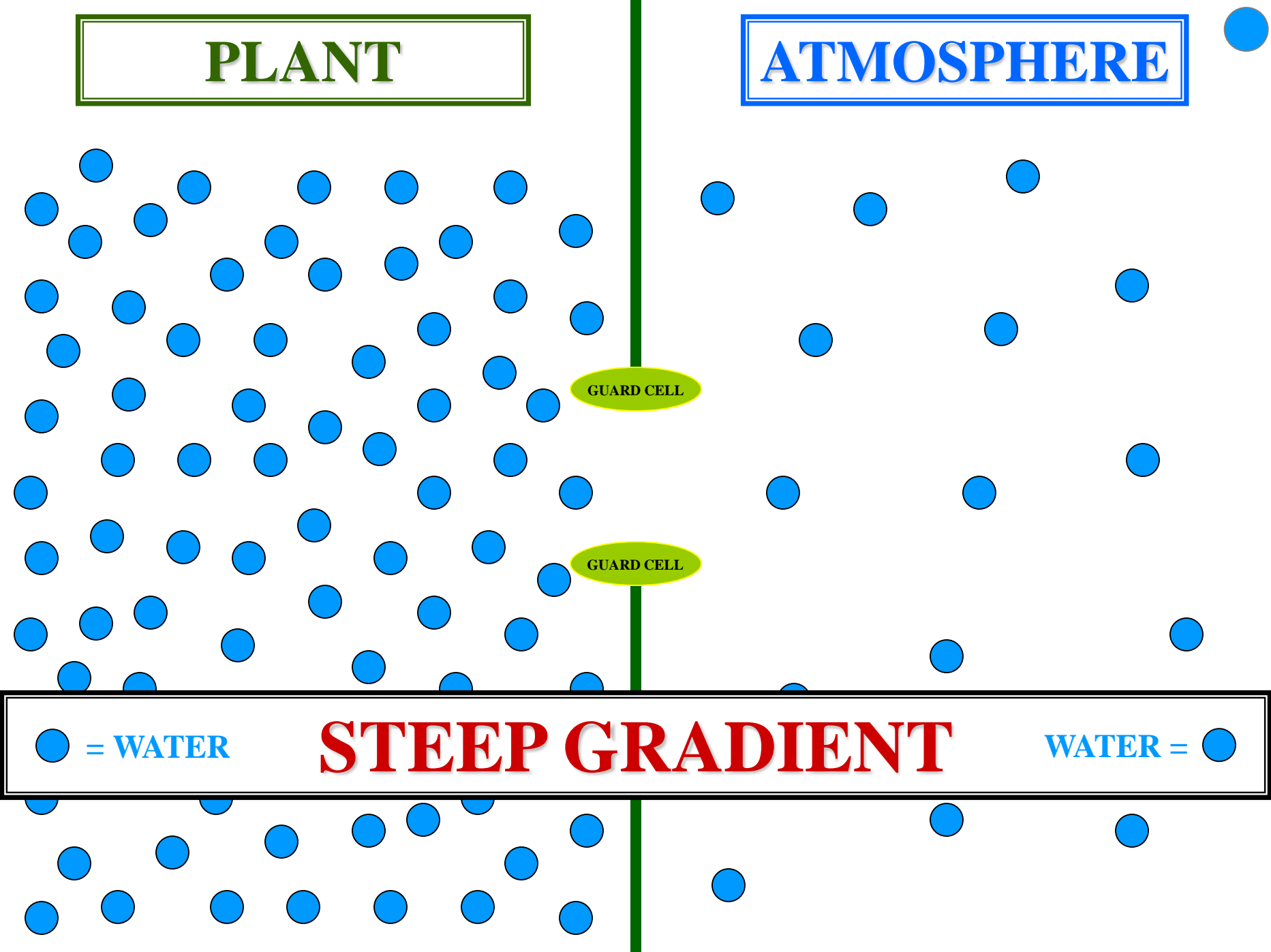
GUARD CELL

GUARD CELL

● = WATER

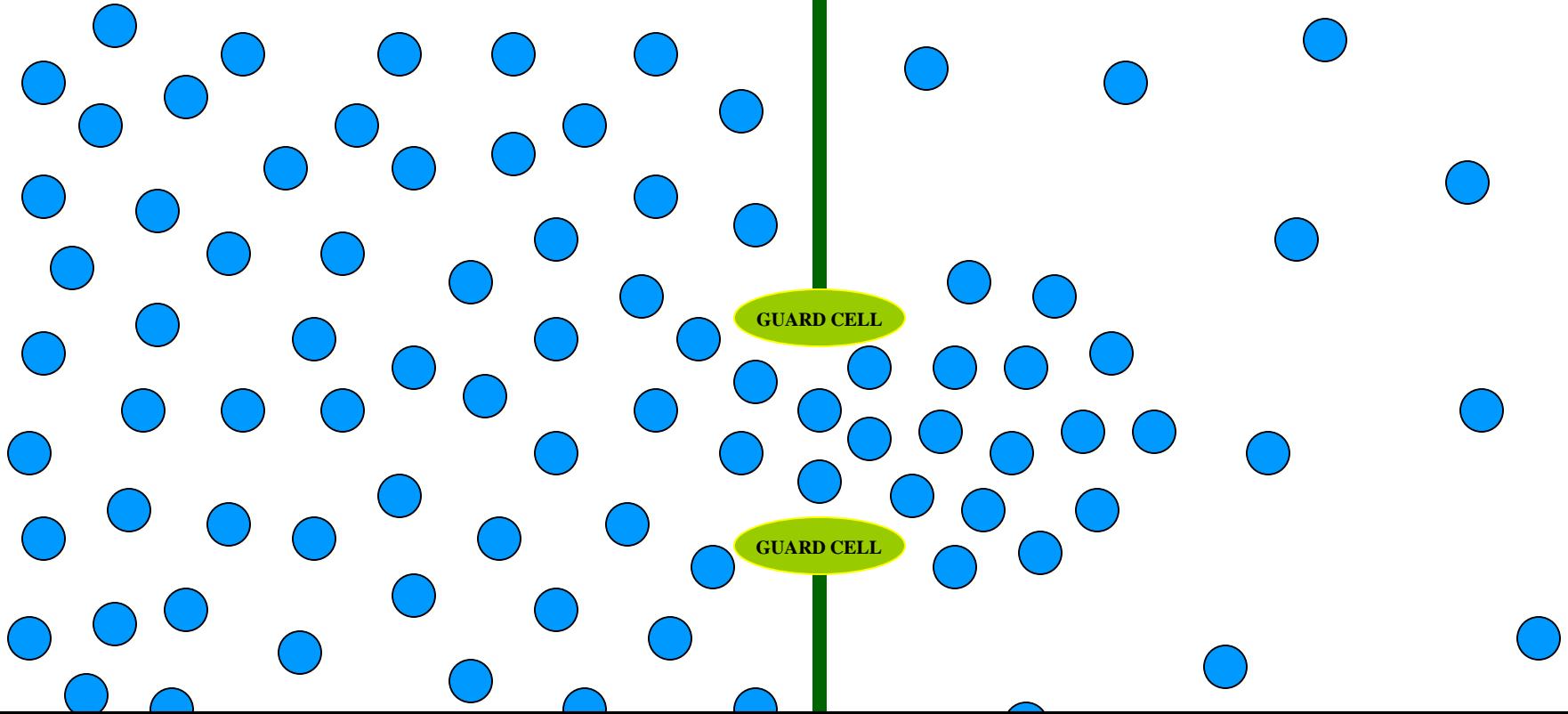
**STEEP GRADIENT**

WATER = ●



**PLANT**

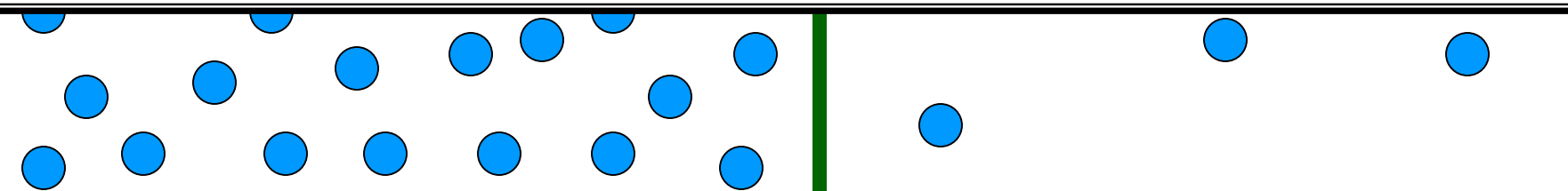
**ATMOSPHERE**



● = WATER

**STEEP GRADIENT**

WATER = ●





# LEAF STOMATE

ATMOSPHERE

ATMOSPHERE

CO<sub>2</sub>

CO<sub>2</sub>

DIFFUSION

DIFFUSION

H<sub>2</sub>O

TRANSPIRATION

H<sub>2</sub>O

DIFFUSION

DIFFUSION

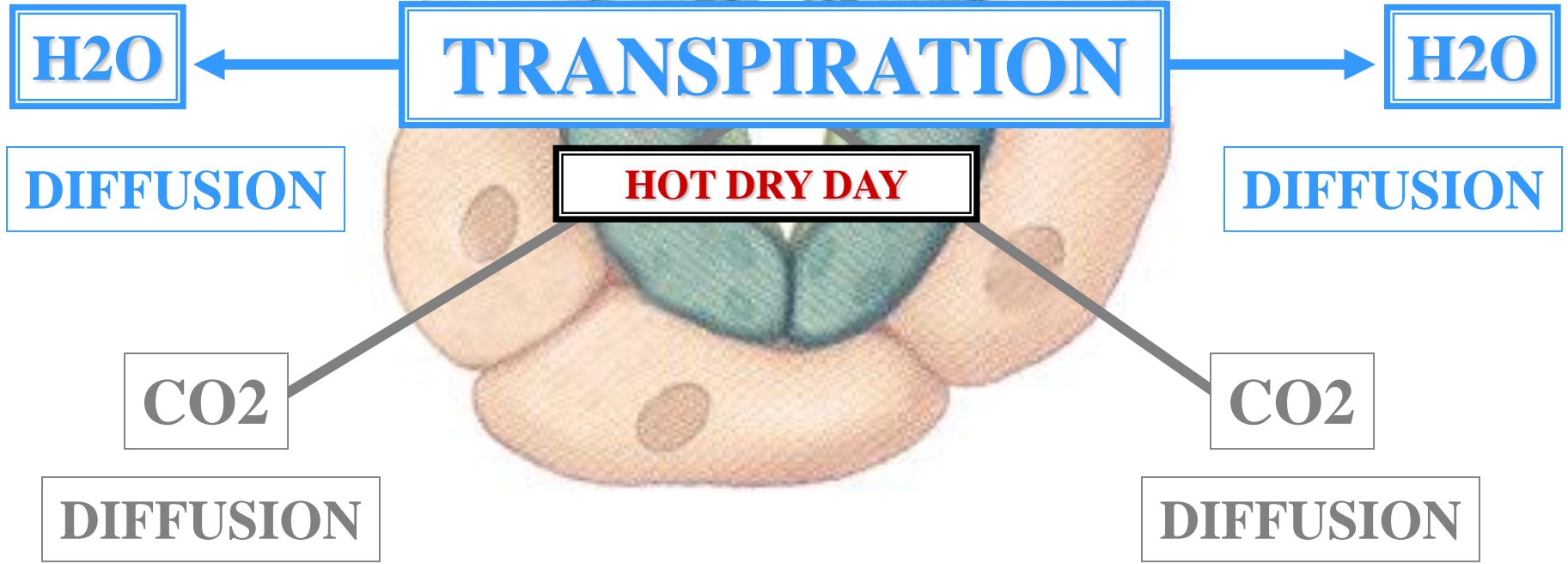
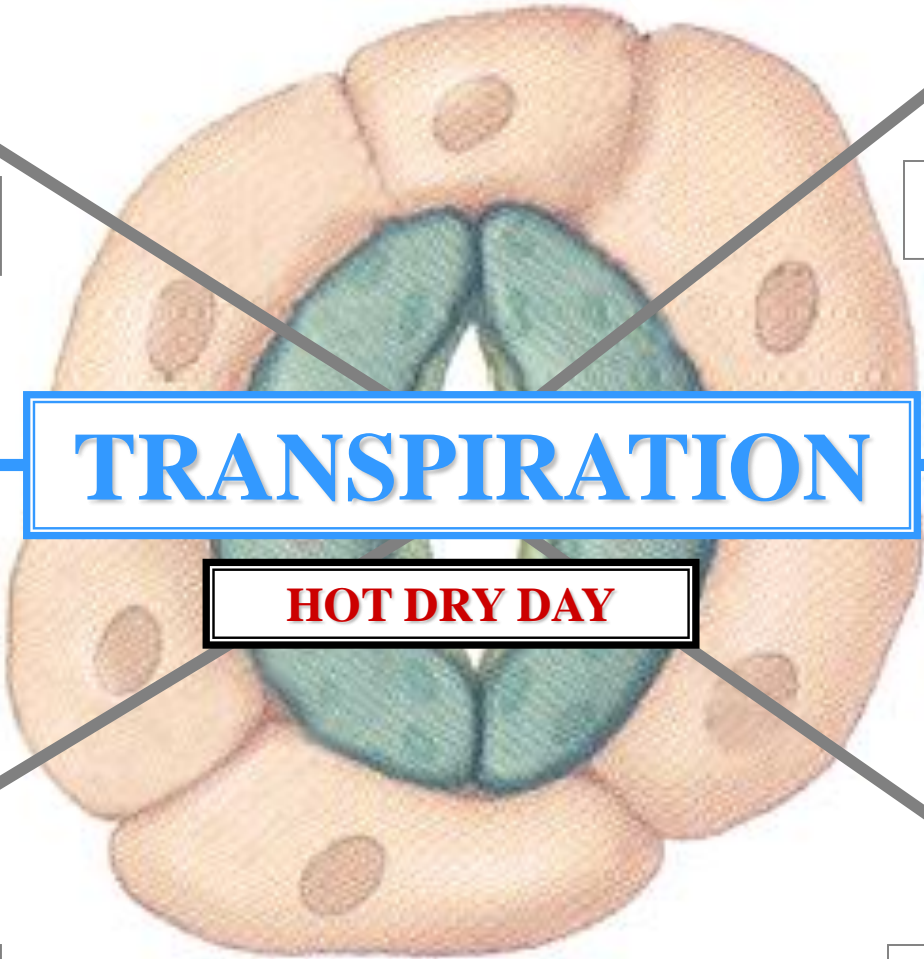
HOT DRY DAY

CO<sub>2</sub>

CO<sub>2</sub>

DIFFUSION

DIFFUSION



ATMOSPHERE

# LEAF STOMATE

ATMOSPHERE

CO<sub>2</sub>

CO<sub>2</sub>

HOT DRY DAY

## HIGH

HOT DRY DAY

# TRANSPIRATION POTENTIAL

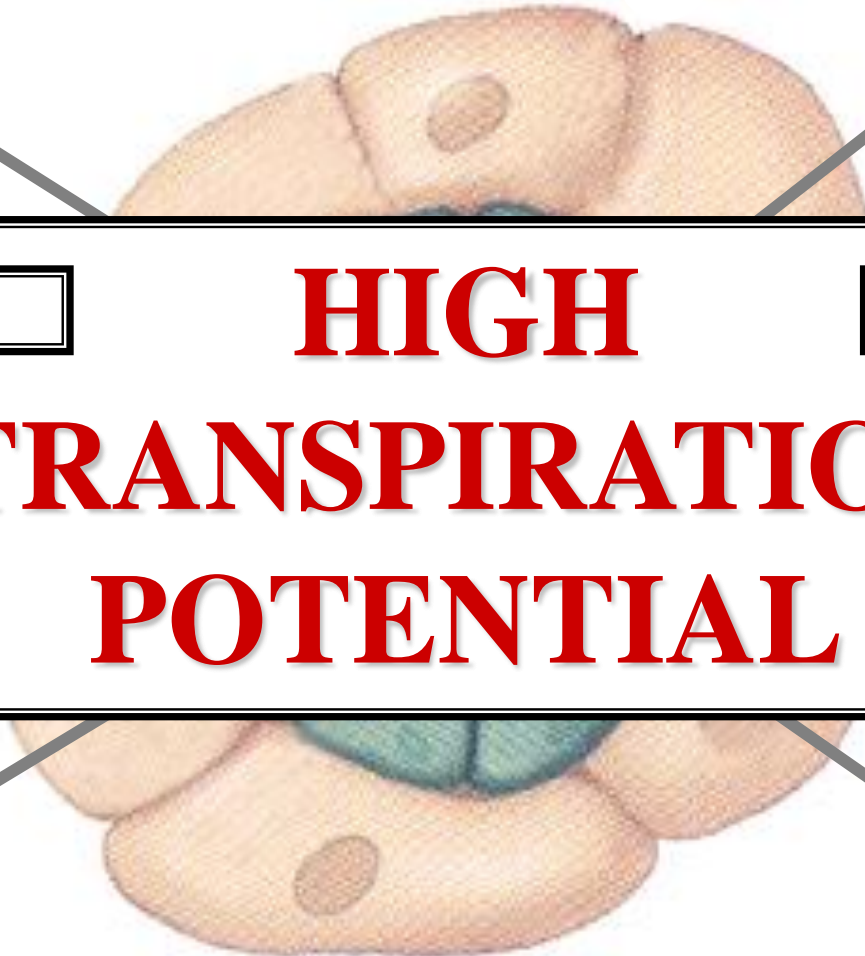


CO<sub>2</sub>

CO<sub>2</sub>

DIFFUSION

DIFFUSION



ATMOSPHERE

# STOMATE CLOSED

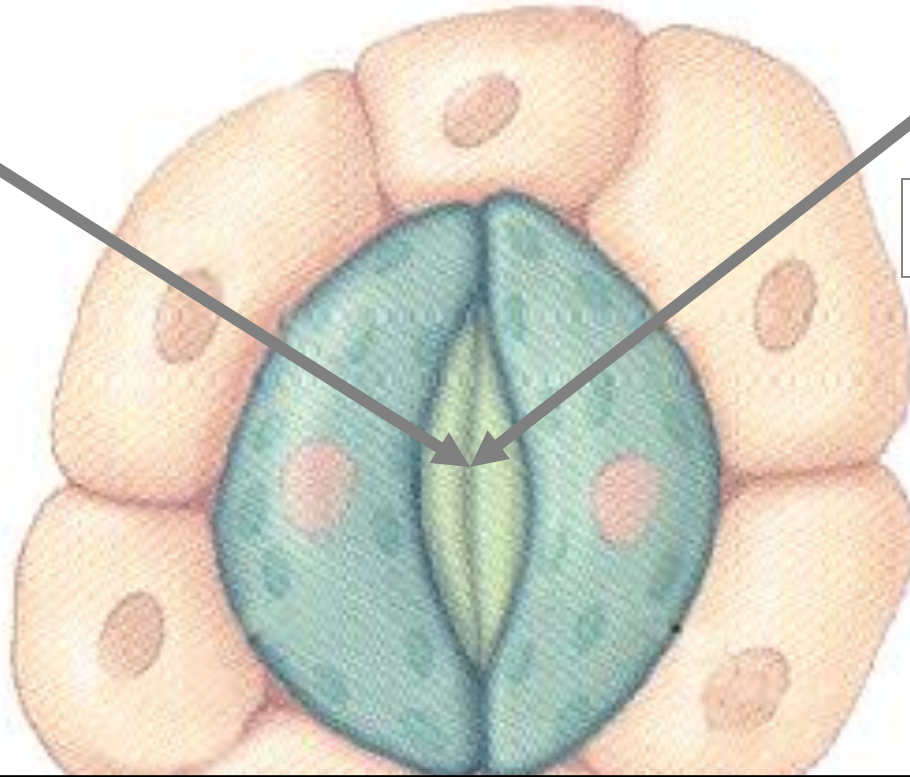
ATMOSPHERE

CO<sub>2</sub>

DIFFUSION

CO<sub>2</sub>

DIFFUSION



***HOT DRY DAY***





# C4 PLANTS



C4

CORN





*C4 PLANTS  
STOMATES OPEN  
SHORTER PERIODS  
THAN C3 PLANTS*





*C4 PLANTS  
MUCH LOWER  
TRANSPIRATION  
THAN C3 PLANTS*



*C4 PLANTS  
REQUIRE MORE  
ATP EXPENSE  
THAN C3 PLANTS*



# C4

# CO<sub>2</sub> DIFFUSION

# SUMMARY

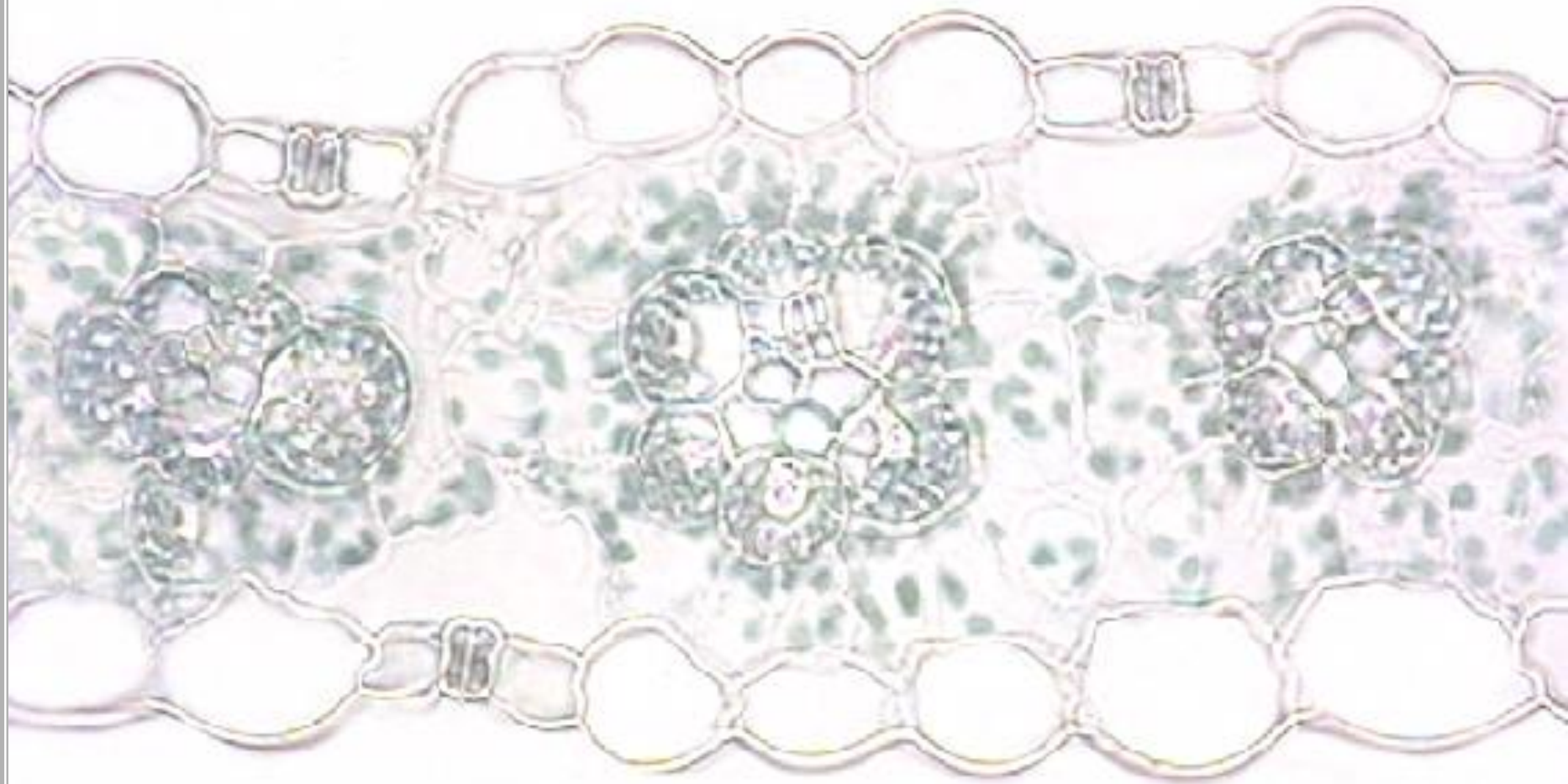


CO<sub>2</sub>

# ATMOSPHERE

CO<sub>2</sub>

D





CO<sub>2</sub>

ATMOSPHERE

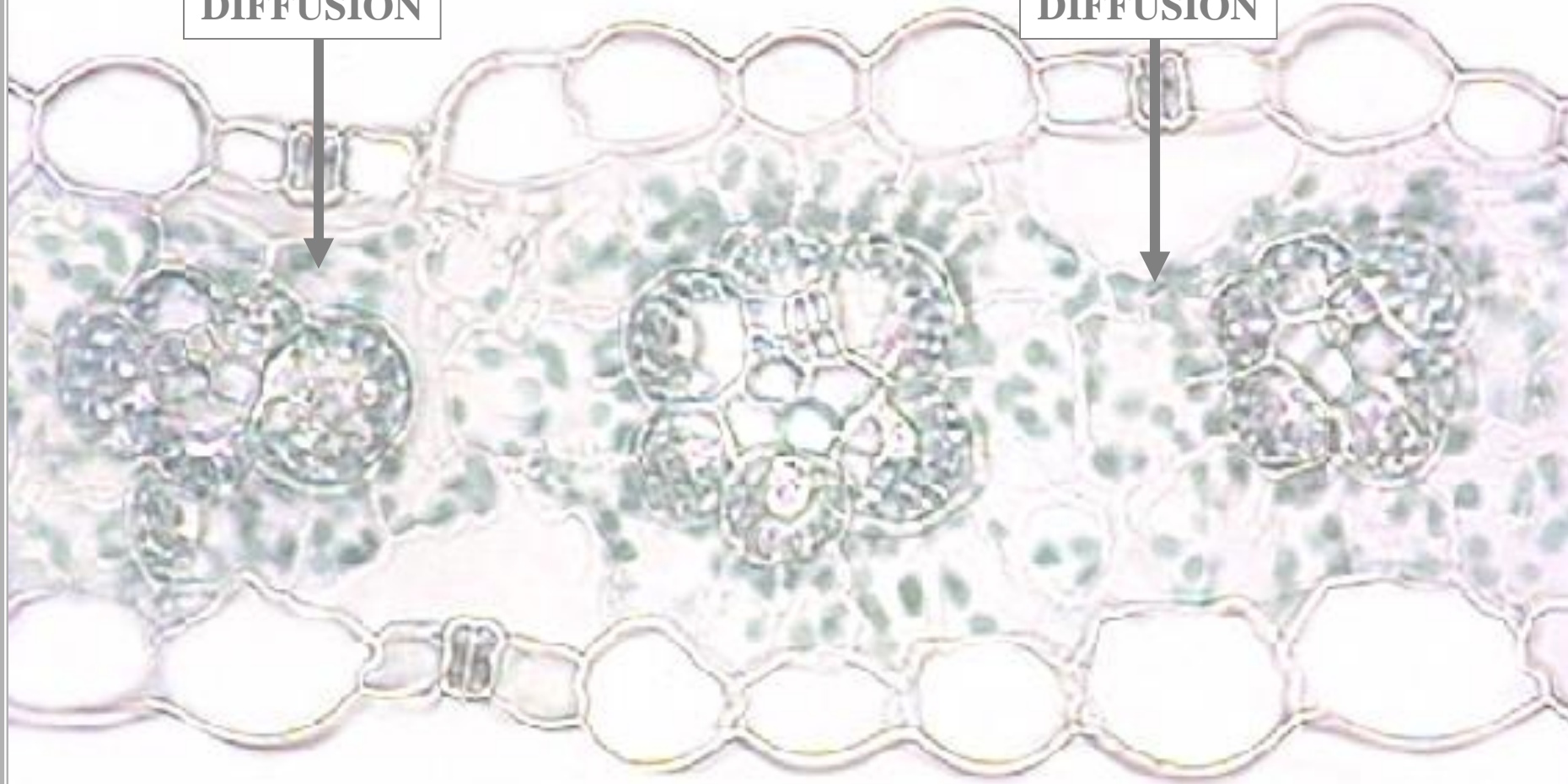
CO<sub>2</sub>

C

DIFFUSION

DIFFUSION

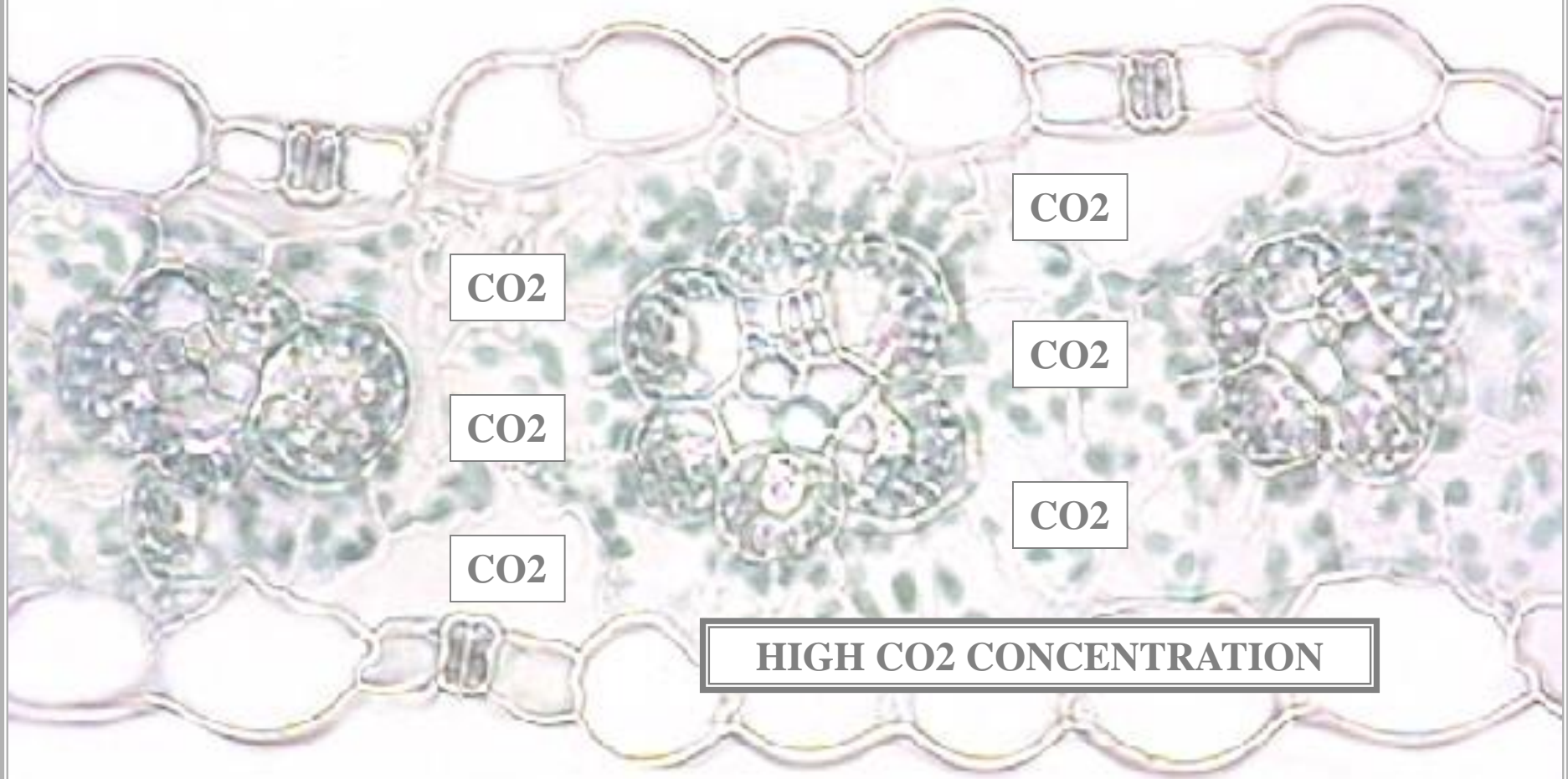
+



**SPONGY MESOPHYLL**

**ATMOSPHERE**

^



CO2

CO2

CO2

CO2

CO2

CO2

**HIGH CO2 CONCENTRATION**

**MESOPHYLL CELL - CYTOSOL**



# MESOPHYLL CELL CYTOSOL



# C4 LEAF



**HIGH CO<sub>2</sub>**

CO<sub>2</sub>

CO<sub>2</sub>

CO<sub>2</sub>

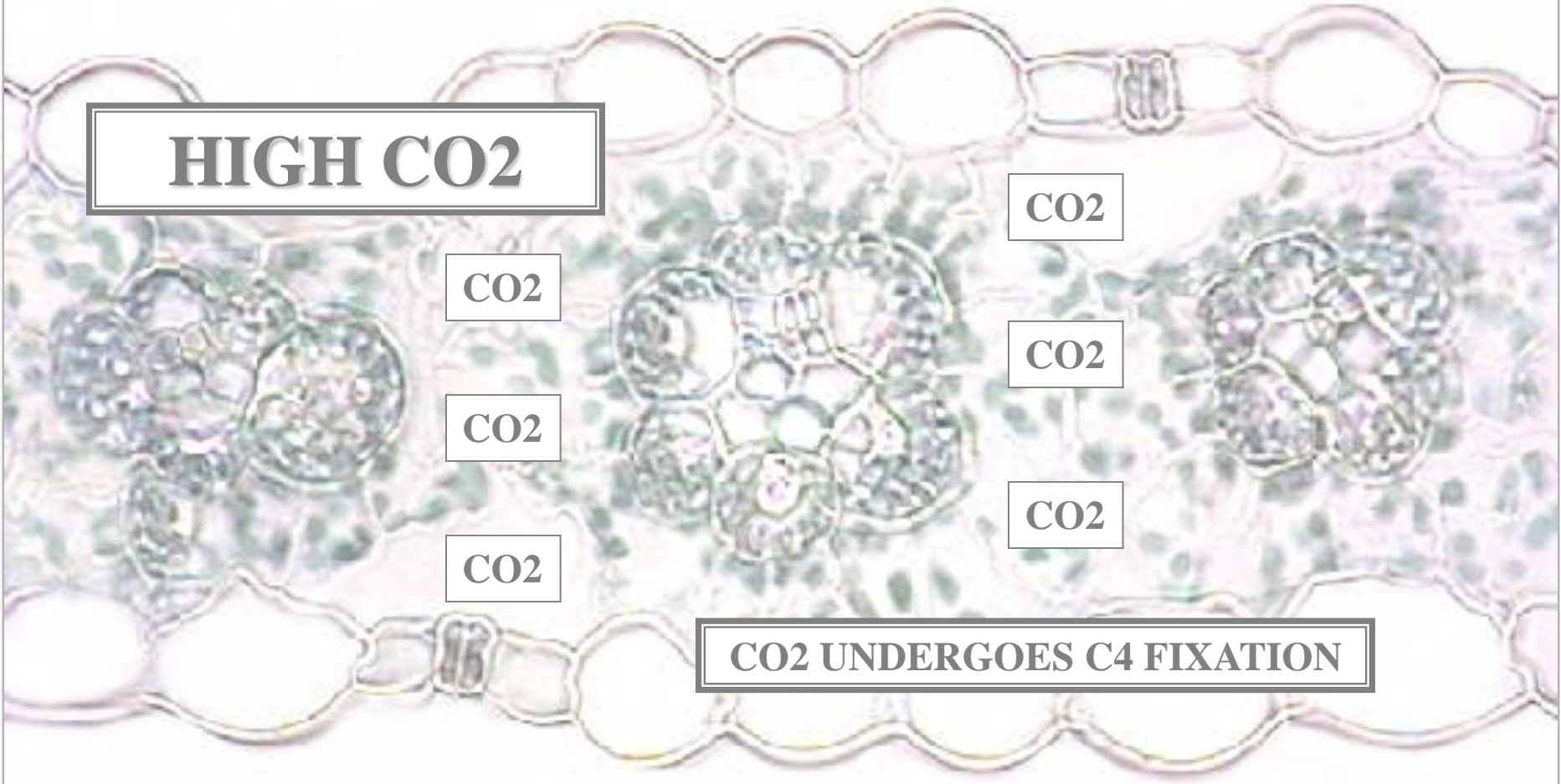
CO<sub>2</sub>

CO<sub>2</sub>

CO<sub>2</sub>

**CO<sub>2</sub> UNDERGOES C4 FIXATION**

**MESOPHYLL CELL - CYTOSOL**

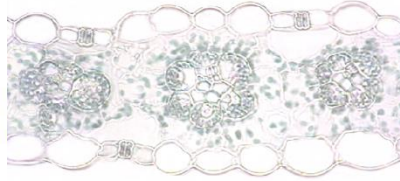




**C4  
PATHWAY  
CO<sub>2</sub> FIXATION**

**C4**

**CO<sub>2</sub>  
ENTERS  
MESOPHYLL CYTOSOL**



**C P**

# **HATCH & SLACK CYCLE**



**C4**

CO<sub>2</sub>  
ENTERS  
MESOPHYLL CYTOSOL



CO<sub>2</sub> + **PHOSPHOENOLPYRUVATE / (PEP)**



**0**

# HATCH & SLACK CYCLE

# C4

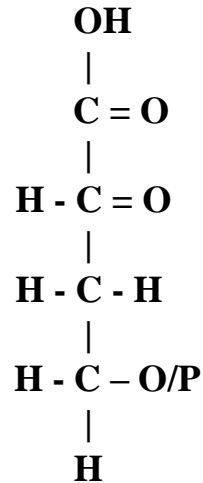
CO<sub>2</sub>  
ENTERS  
MESOPHYLL CYTOSOL

CO<sub>2</sub> + PHOSPHOENOLPYRUVATE / (PEP)

OXALOACETATE

1<sup>ST</sup> STABLE CMP = OXALOACETATE

## HATCH & SLACK CYCLE



OXALOACETATE



!

#

# C4

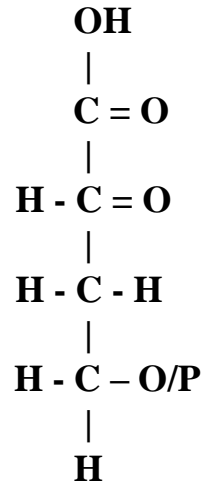
CO<sub>2</sub>  
ENTERS  
MESOPHYLL CYTOSOL

CO<sub>2</sub> + PHOSPHOENOLPYRUVATE / (PEP)

OXALOACETATE

1<sup>ST</sup> STABLE CMP = OXALOACETATE

## HATCH & SLACK CYCLE



4 CARBON CMP



C4



# C4

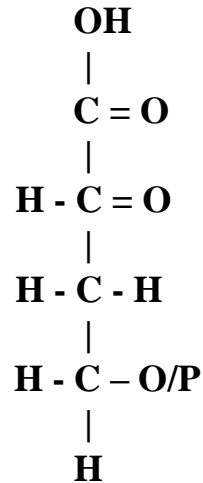
CO<sub>2</sub>  
ENTERS  
MESOPHYLL CYTOSOL

CO<sub>2</sub> + PHOSPHOENOLPYRUVATE / (PEP)

OXALOACETATE

1<sup>ST</sup> STABLE CMP = OXALOACETATE

## HATCH & SLACK CYCLE C4 PATHWAY



4 CARBON CMP



FXR



**C4**

CO<sub>2</sub>  
ENTERS  
MESOPHYLL CYTOSOL

CO<sub>2</sub> + PHOSPHOENOLPYRUVATE / (PEP)

C4 CO<sub>2</sub> FIXATION RXT

OXALOACETATE



**C3**

?

# HATCH & SLACK CYCLE

## C4 CO<sub>2</sub> FIXATION REACTION

**C3**

CO<sub>2</sub>  
ENTERS  
STROMA

CO<sub>2</sub> + RIBULOSE BIPHOSPHATE / (RUBP)

**C3** CO<sub>2</sub> FIXATION RXT

2 PHOSPHOGLYCERATE / (PGA)



**C4**

?

?

# CALVIN CYCLE

## **C3** CO<sub>2</sub> FIXATION REACTION



**C4**

CO<sub>2</sub>  
ENTERS  
MESOPHYLL CYTOSOL

CO<sub>2</sub> + PHOSPHOENOLPYRUVATE / (PEP)

**C4** CO<sub>2</sub> FIXATION RXT

OXALOACETATE



**EZ**

**HATCH & SLACK CYCLE**

**C4** CO<sub>2</sub> FIXATION REACTION

**C4**

CO<sub>2</sub>  
ENTERS  
MESOPHYLL CYTOSOL

CO<sub>2</sub> + PHOSPHOENOLPYRUVATE / (PEP)

ENZYME

OXALOACETATE



# HATCH & SLACK CYCLE

## C4 CO<sub>2</sub> FIXATION REACTION



# C4 PATHWAY CO<sub>2</sub> FIXATION ENZYME



**ENZYME**

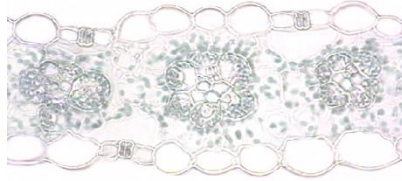


**PHOSPHOENOLPYRUVATE  
CARBOXYLASE  
(PEP-ASE)**

**ENZYME**

**C4**

**CO<sub>2</sub>  
ENTERS  
MESOPHYLL CYTOSOL**



**C P**

**PHOSPHOENOLPYRUVATE  
CARBOXYLASE  
(PEP-ASE)**

**C4**

CO<sub>2</sub>  
ENTERS  
MESOPHYLL CYTOSOL



CO<sub>2</sub> + **PHOSPHOENOLPYRUVATE / (PEP)**



**EZ**

# PHOSPHOENOLPYRUVATE CARBOXYLASE (PEP-ASE)



**C4**

CO<sub>2</sub>  
ENTERS  
MESOPHYLL CYTOSOL

CO<sub>2</sub> + **PHOSPHOENOLPYRUVATE / (PEP)**

**PHOSPHOENOLPYRUVATE  
CARBOXYLASE  
(PEP-CARBOXYLASE)**



**O**

**PHOSPHOENOLPYRUVATE  
CARBOXYLASE  
(PEP-ASE)**

# C4

CO<sub>2</sub>  
ENTERS  
MESOPHYLL CYTOSOL

CO<sub>2</sub> + PHOSPHOENOLPYRUVATE / (PEP)

PHOSPHOENOLPYRUVATE  
CARBOXYLASE  
(PEP-CARBOXYLASE)

OXALOACETATE

C4 CO<sub>2</sub> FIXATION RXT



FXE

>

# PHOSPHOENOLPYRUVATE CARBOXYLASE (PEP-ASE)

**C4**

CO<sub>2</sub>  
ENTERS  
MESOPHYLL CYTOSOL

CO<sub>2</sub> + PHOSPHOENOLPYRUVATE / (PEP)

PHOSPHOENOLPYRUVATE  
CARBOXYLASE  
(PEP-CARBOXYLASE)

OXALOACETATE

**C4** CO<sub>2</sub> FIXATION RXT



**C3**

?

**EZ**

**PHOSPHOENOLPYRUVATE  
CARBOXYLASE**

**C4** CO<sub>2</sub> FIXATION ENZYME



**C3**

CO<sub>2</sub>  
ENTERS  
STROMA



CO<sub>2</sub> + **RIBULOSE BISPHPHATE / (RUBP)**

**RIBULOSE BISPHPHATE  
CARBOXYLASE  
(RUBP-CARBOXYLASE)**

**2 PHOSPHOGLYCERATE / (PGA)**

**C3** CO<sub>2</sub> FIXATION RXT



**RIBULOSE BISPHPHATE  
CARBOXYLASE**

**C3** CO<sub>2</sub> FIXATION ENZYME

**C3**

CO<sub>2</sub>  
ENTERS  
STROMA



CO<sub>2</sub> + **RIBULOSE BISPHOSEPHATE / (RUBP)**

**RIBULOSE BISPHOSEPHATE  
CARBOXYLASE  
(RUBP-CARBOXYLASE)**

**C4**

**EZ**

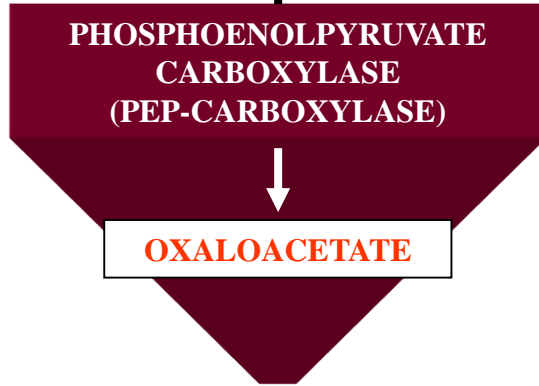
**2 PHOSPHOGLYCERATE / (PGA)**

**INEFFICIENT  
ENZYME**

**C4**

CO<sub>2</sub>  
ENTERS  
MESOPHYLL CYTOSOL

CO<sub>2</sub> + PHOSPHOENOLPYRUVATE / (PEP)



**E**

**>**

**PHOSPHOENOLPYRUVATE  
CARBOXYLASE**

**C4 CO<sub>2</sub> FIXATION ENZYME**



# C4

CO<sub>2</sub>  
ENTERS  
MESOPHYLL CYTOSOL

CO<sub>2</sub> + PHOSPHOENOLPYRUVATE / (PEP)

PHOSPHOENOLPYRUVATE  
CARBOXYLASE  
(PEP-CARBOXYLASE)

OXALOACETATE



# EFFICIENT ENZYME



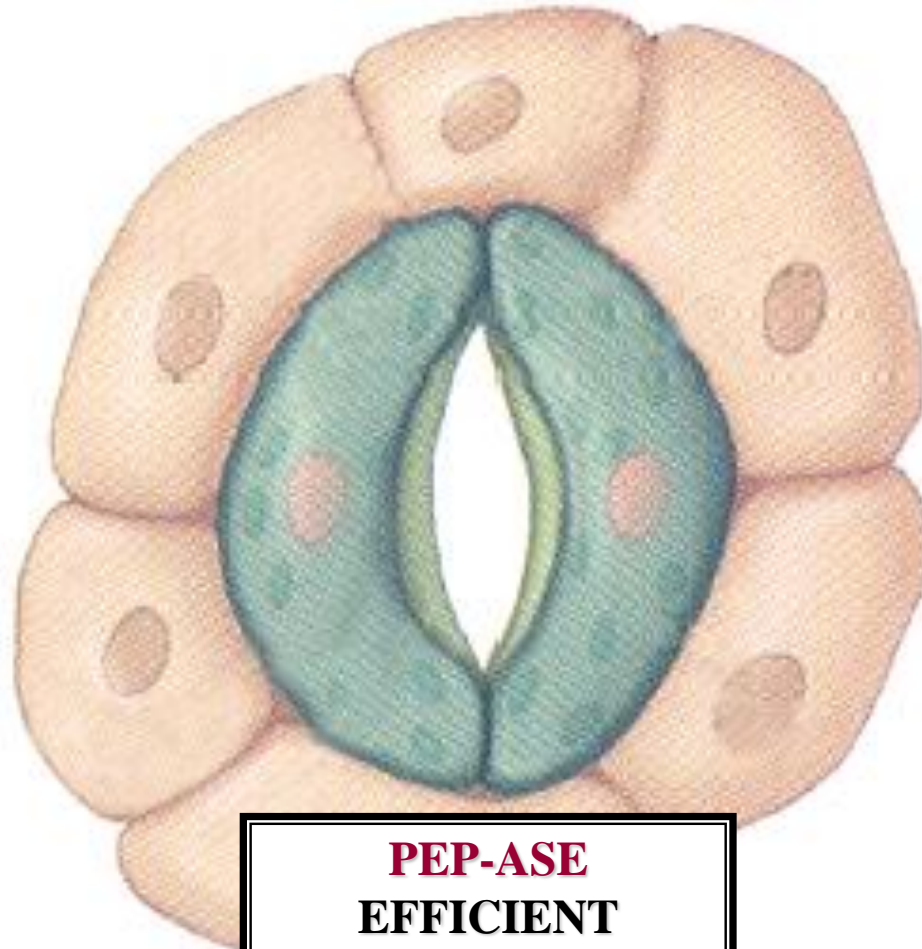
ATMOSPHERE

# LEAF STOMATE

ATMOSPHERE

CO<sub>2</sub>

CO<sub>2</sub>



CO<sub>2</sub>

CO<sub>2</sub>

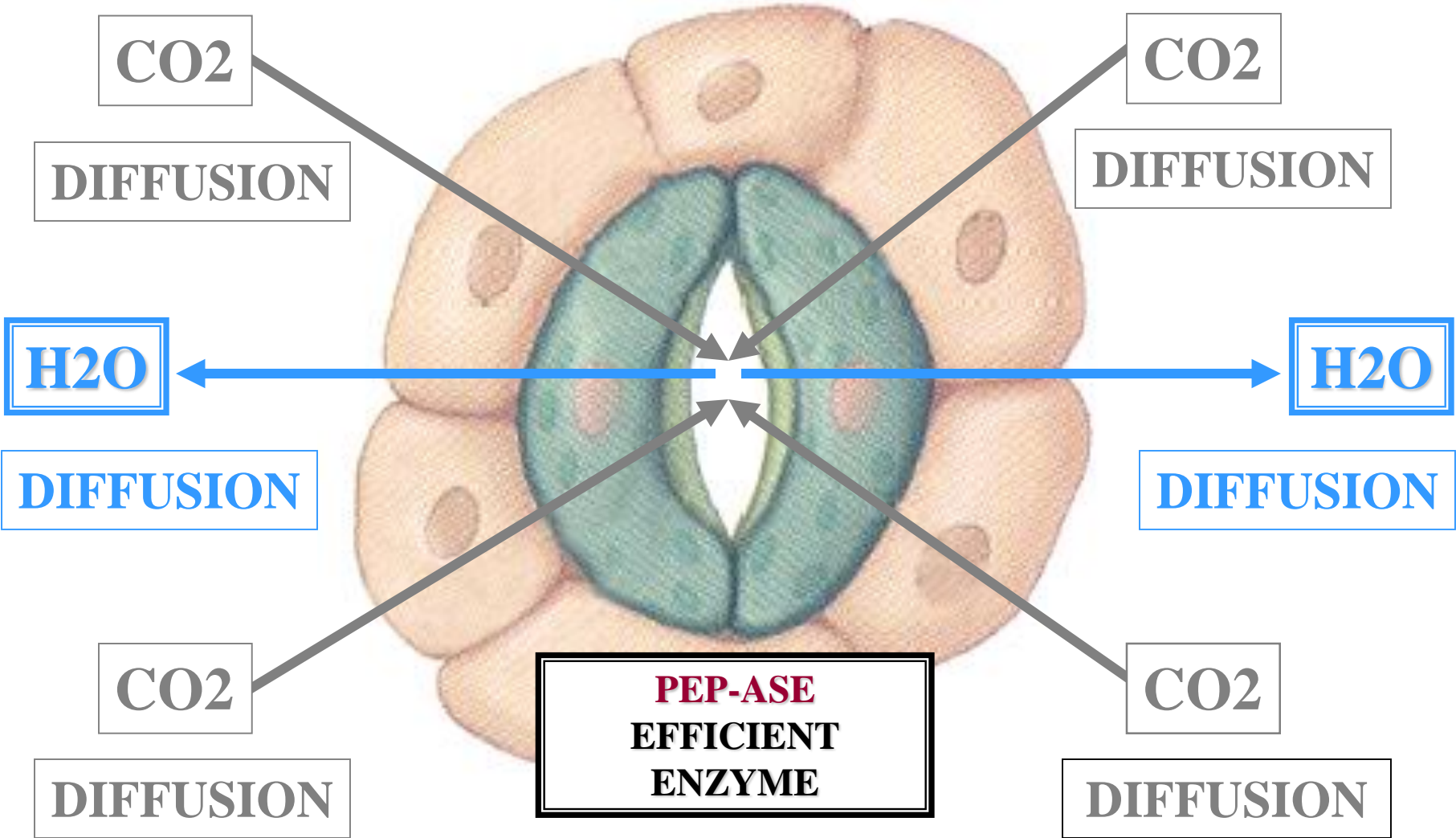
**PEP-ASE**  
**EFFICIENT**  
**ENZYME**



# LEAF STOMATE

ATMOSPHERE

ATMOSPHERE





# LEAF STOMATE

ATMOSPHERE

ATMOSPHERE



CO<sub>2</sub>

CO<sub>2</sub>

DIFFUSION

DIFFUSION

H<sub>2</sub>O

H<sub>2</sub>O

DIFFUSION

DIFFUSION

CO<sub>2</sub>

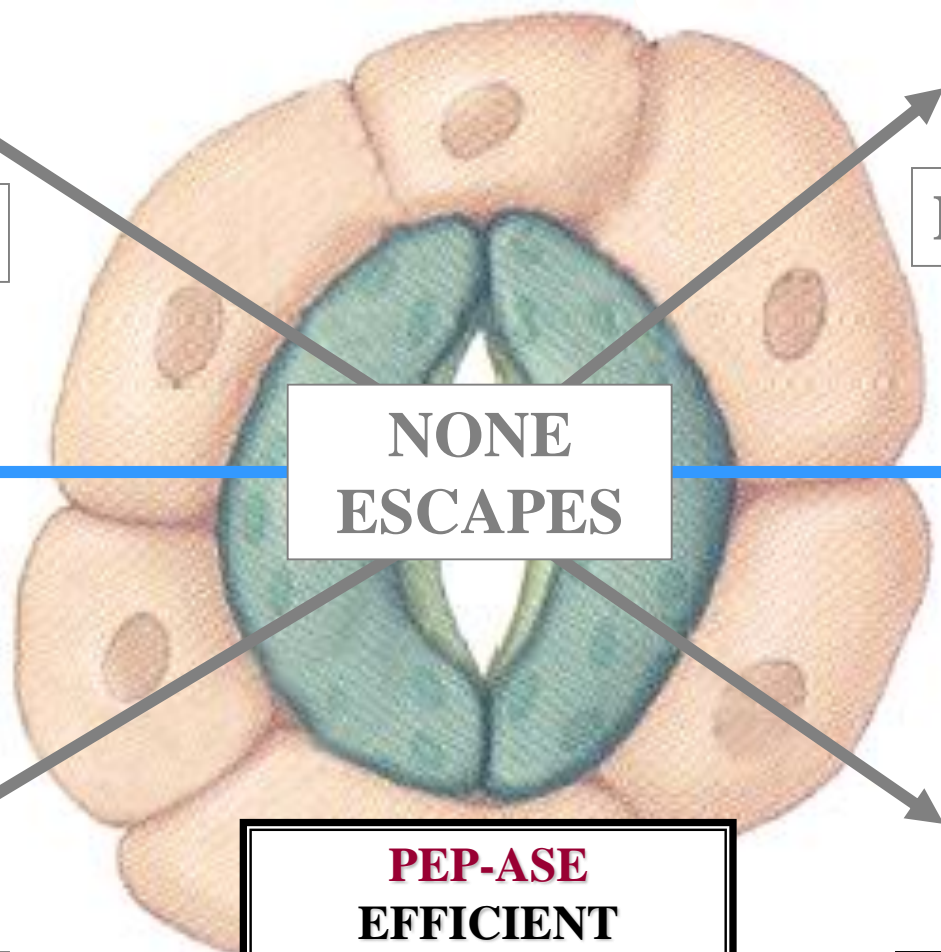
CO<sub>2</sub>

DIFFUSION

DIFFUSION

NONE  
ESCAPES

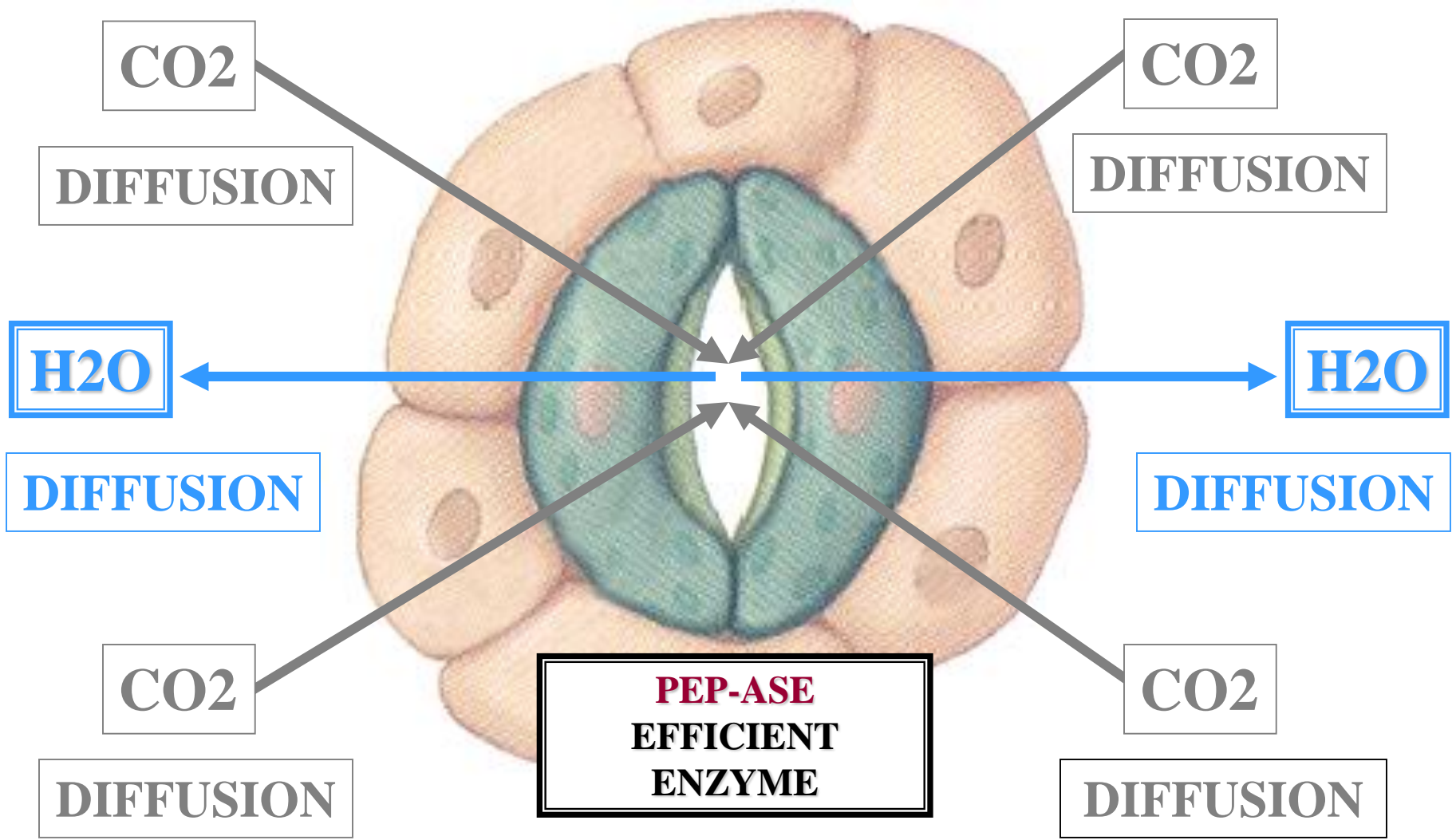
**PEP-ASE**  
EFFICIENT  
ENZYME



# LEAF STOMATE

ATMOSPHERE

ATMOSPHERE



ATMOSPHERE

# LEAF STOMATE

ATMOSPHERE

CO<sub>2</sub>

CO<sub>2</sub>

**OPEN SHORT PERIODS**

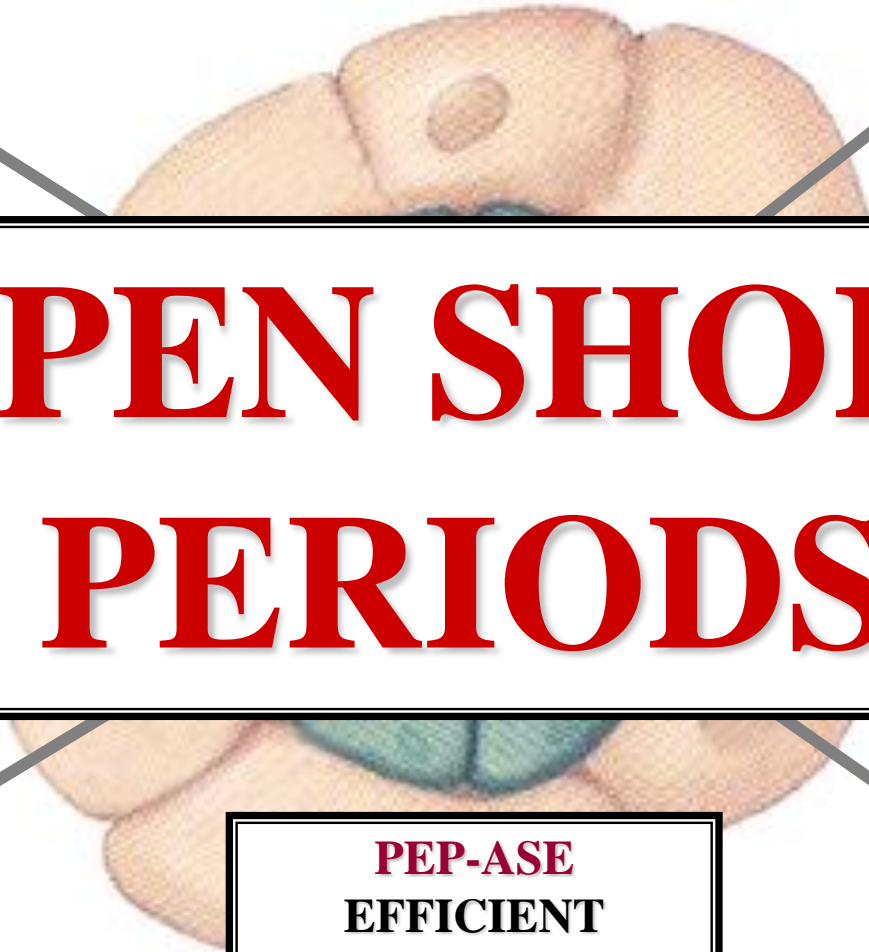
C<sub>4</sub>

C<sub>4</sub>

CO<sub>2</sub>

CO<sub>2</sub>

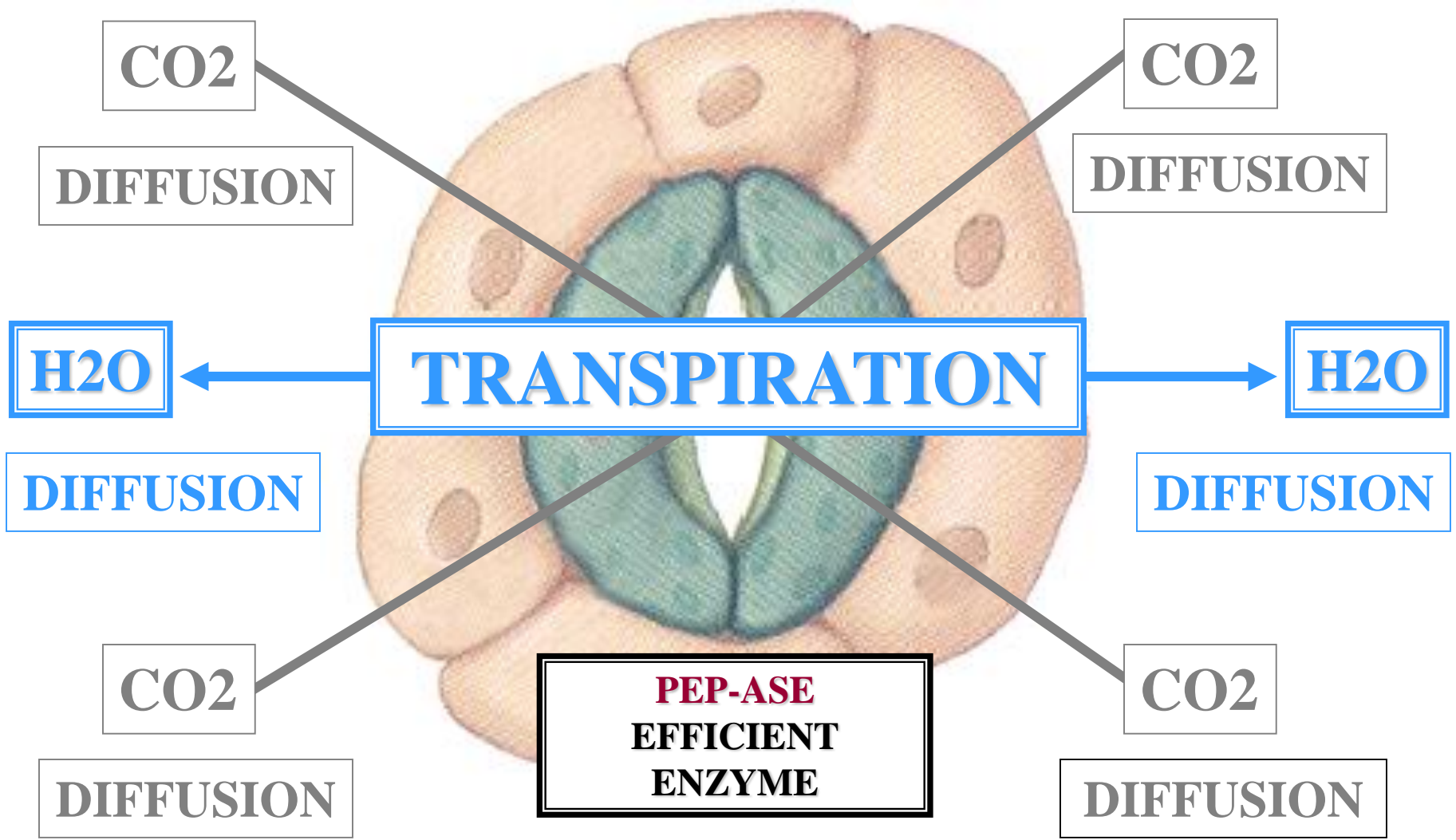
**PEP-ASE  
EFFICIENT  
ENZYME**



# LEAF STOMATE

ATMOSPHERE

ATMOSPHERE



CO2

DIFFUSION

CO2

DIFFUSION

H2O

TRANSPIRATION

H2O

DIFFUSION

DIFFUSION

CO2

DIFFUSION

PEP-ASE  
EFFICIENT  
ENZYME

CO2

DIFFUSION





ATMOSPHERE

ATMOSPHERE

# LEAF STOMATE

CO<sub>2</sub>

CO<sub>2</sub>

C<sub>4</sub>

C<sub>4</sub>

LOW

TRANSPIRATION

CO<sub>2</sub>

CO<sub>2</sub>

PEP-ASE  
EFFICIENT  
ENZYME

# *C4 PLANTS REQUIRE*



**CORN**



*C4 PLANTS  
REQUIRE LESS  
WATER  
THAN C3 PLANTS*

# C4

# CO<sub>2</sub> FIXATION

## SUMMARY

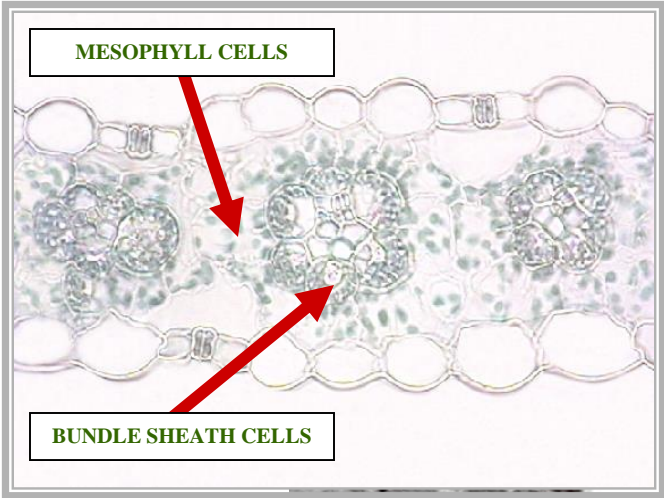


# HATCH & SLACK CYCLE



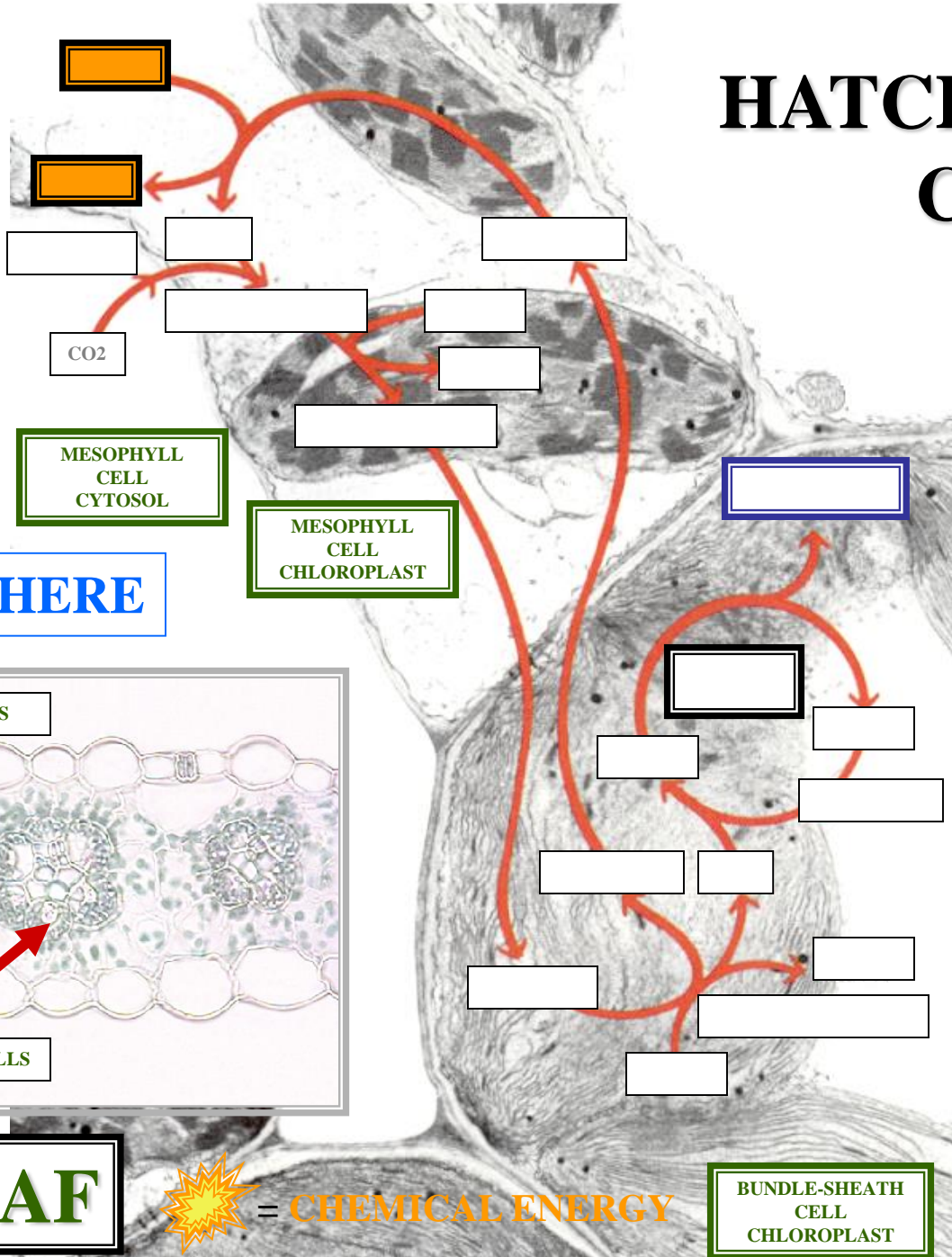
**CORN**

**ATMOSPHERE**



**C4 LEAF**

 = CHEMICAL ENERGY



**ALL RXTS  
REQUIRE  
A SPECIFIC  
ENZYME**

**C4**

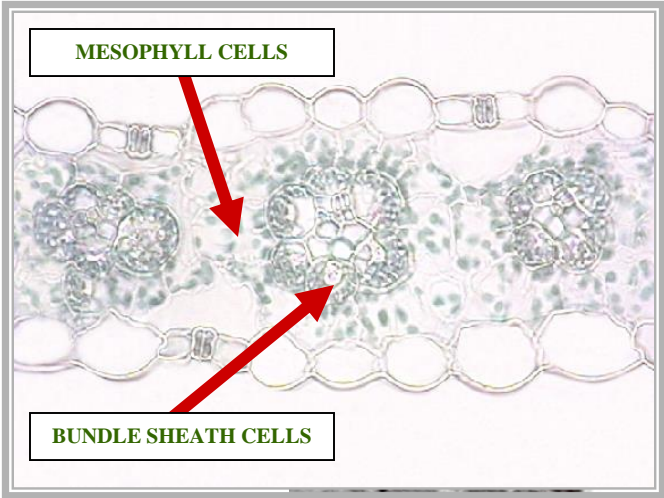
**BUNDLE-SHEATH  
CELL  
CHLOROPLAST**

# HATCH & SLACK CYCLE



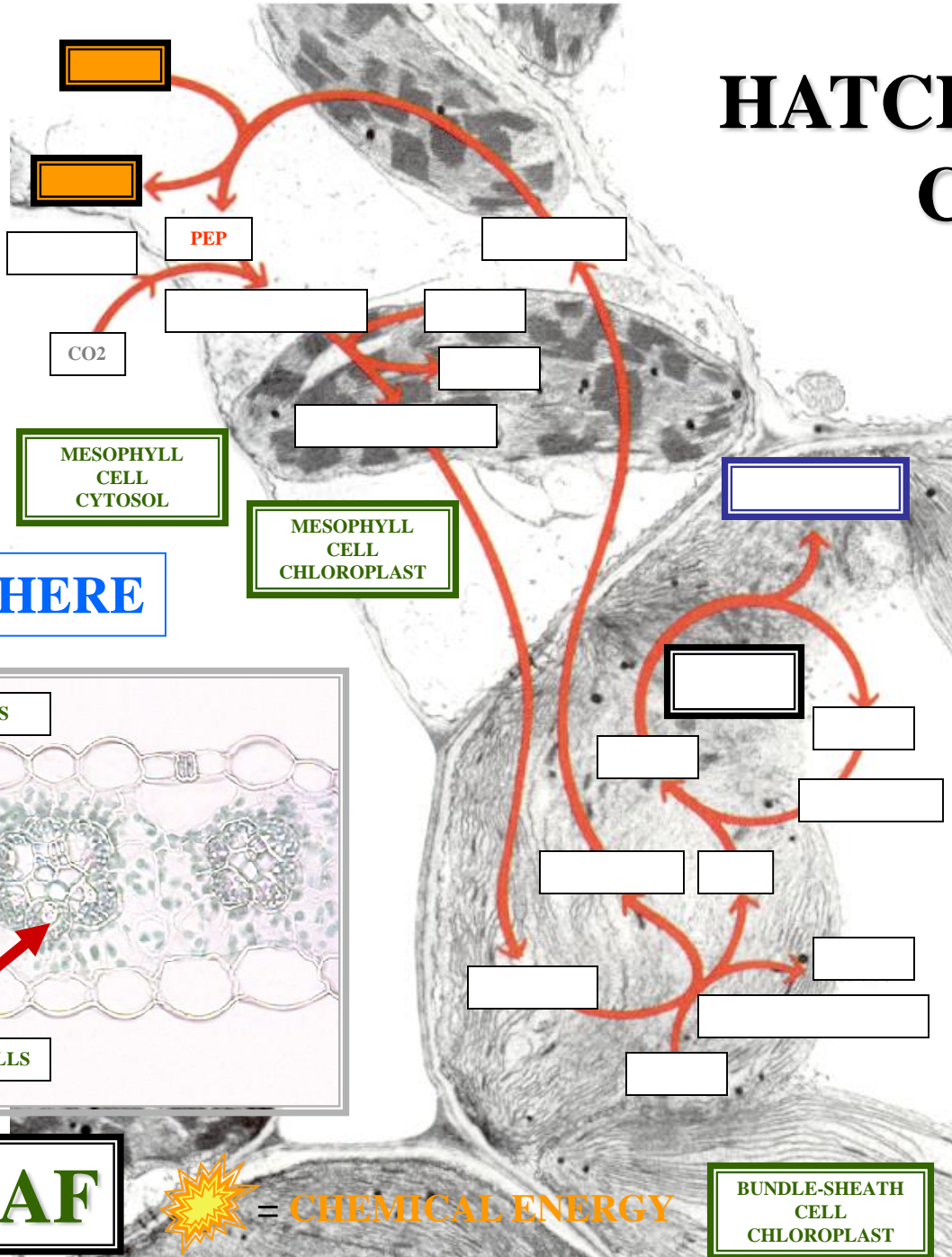
**CORN**

**ATMOSPHERE**



**C4 LEAF**

= CHEMICAL ENERGY



[ ]

PEP

[ ]

CO<sub>2</sub>

[ ]

[ ]

[ ]

[ ]

MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

[ ]

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BUNDLE-SHEATH CELL CHLOROPLAST

**ALL RXTS REQUIRE A SPECIFIC ENZYME**

**C4**

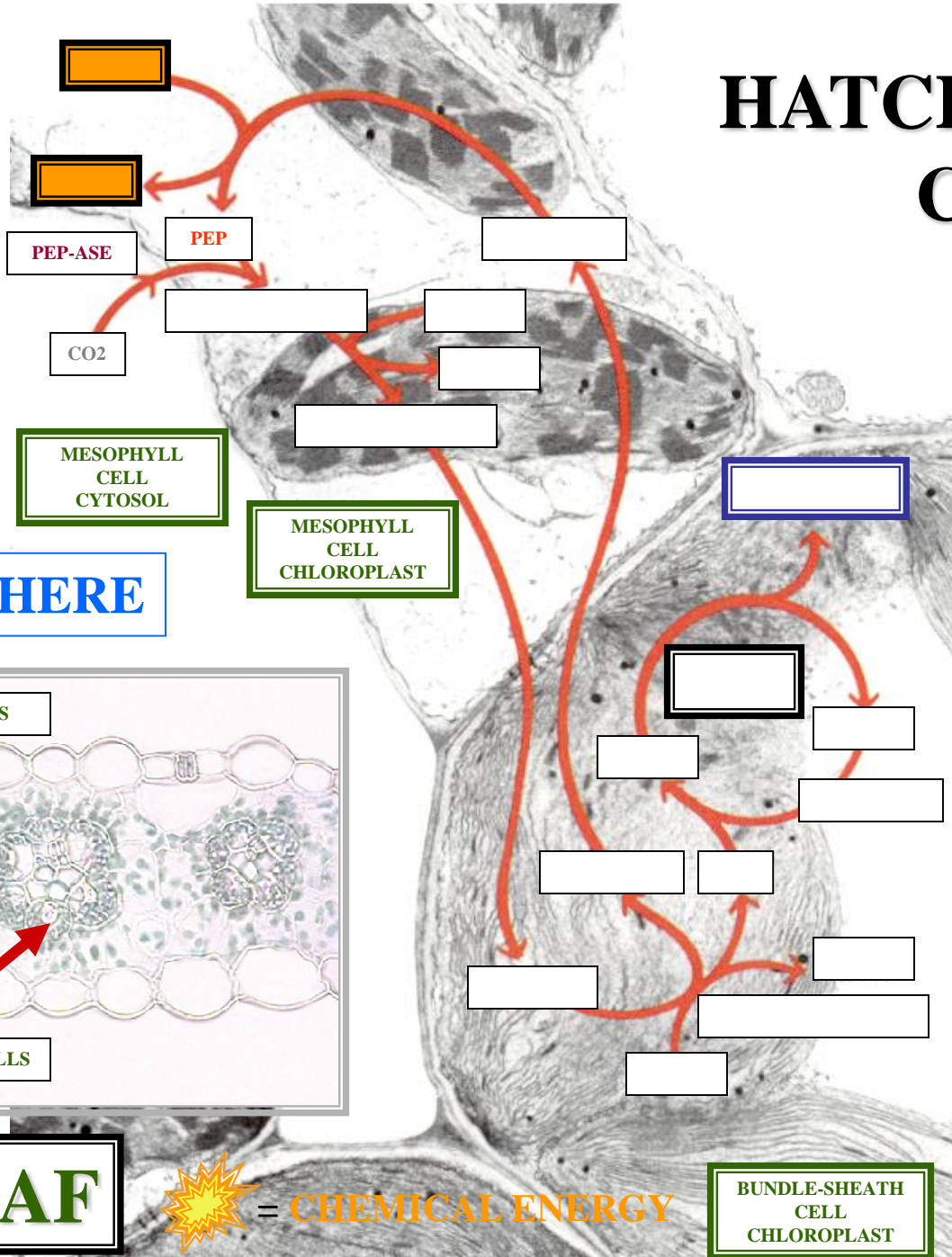
**EZ**



# HATCH & SLACK CYCLE



**CORN**



PEP-ASE

PEP

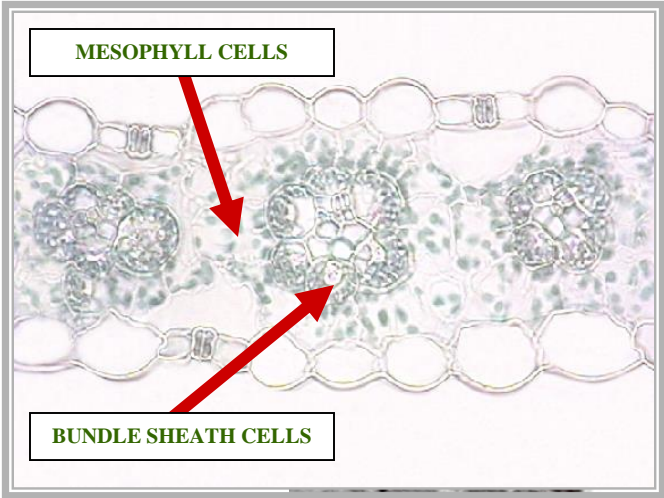
CO<sub>2</sub>

MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

BUNDLE-SHEATH CELL CHLOROPLAST

ATMOSPHERE



**C4 LEAF**

= CHEMICAL ENERGY

ALL RXTS REQUIRE A SPECIFIC ENZYME

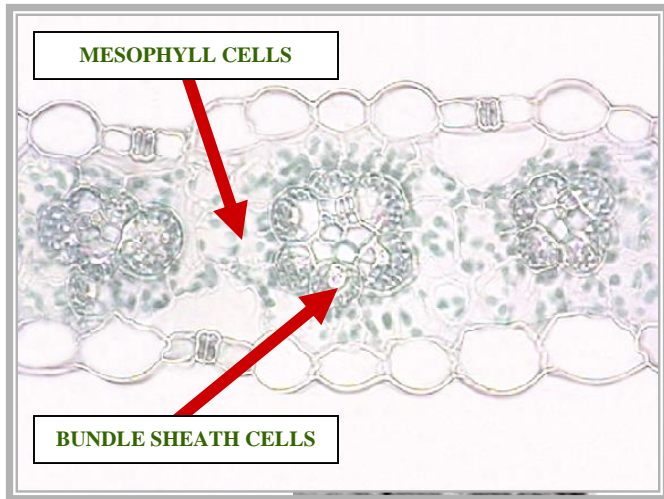
**C4**

# HATCH & SLACK CYCLE



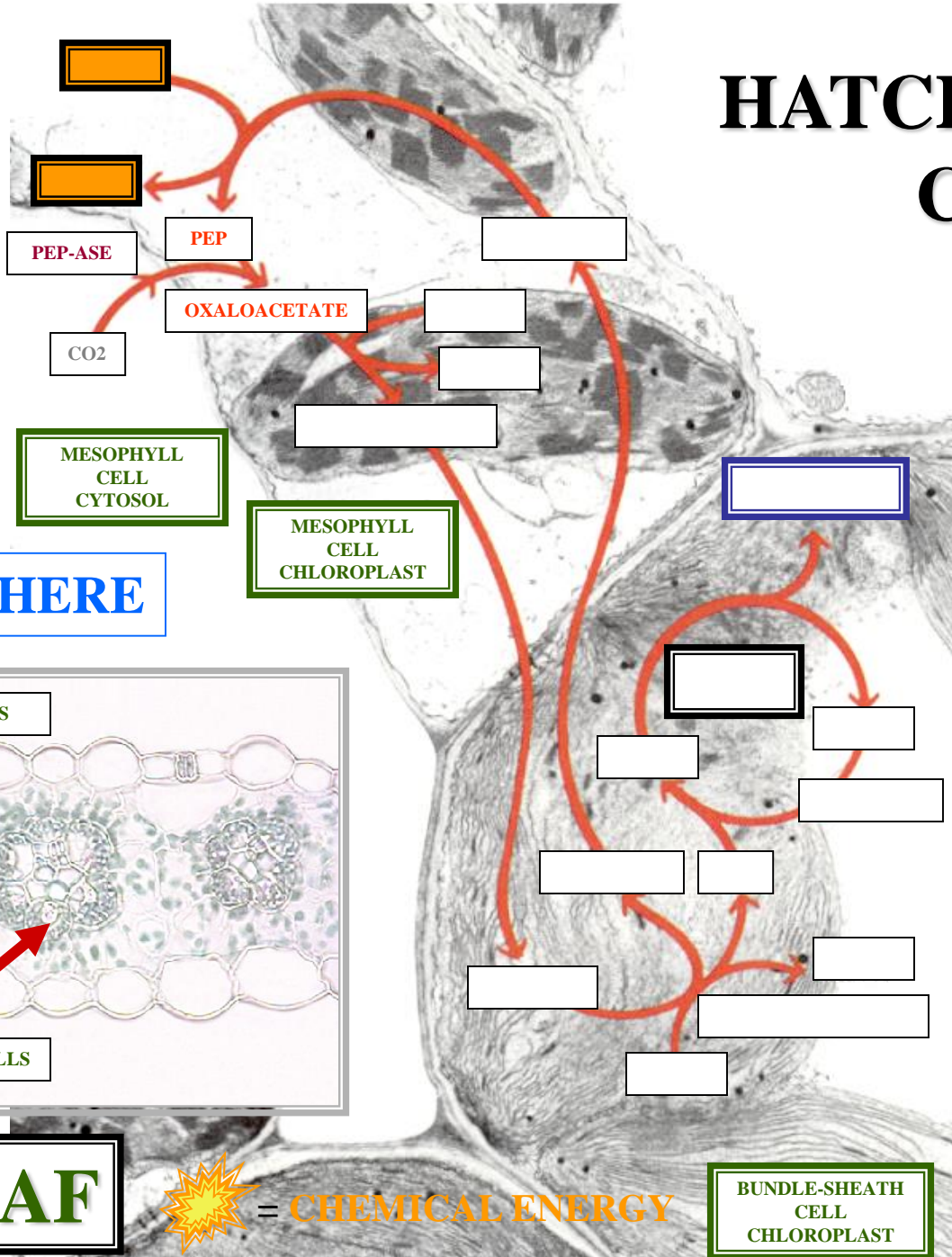
**CORN**

**ATMOSPHERE**



**C4 LEAF**

= CHEMICAL ENERGY



**ALL RXTS  
REQUIRE  
A SPECIFIC  
ENZYME**

**C4**

**BUNDLE-SHEATH  
CELL  
CHLOROPLAST**



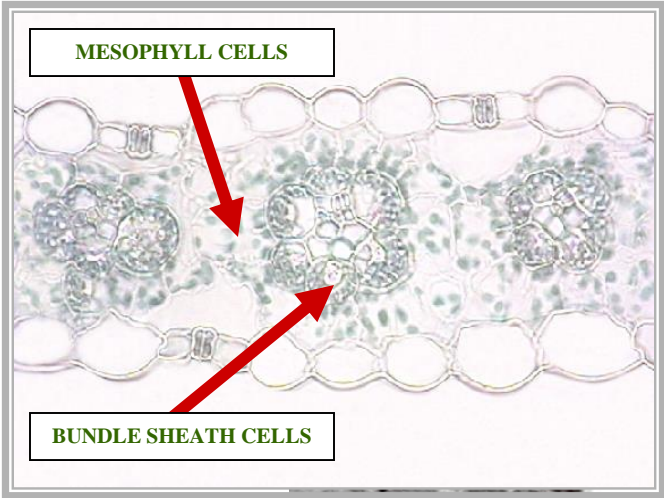


# HATCH & SLACK CYCLE



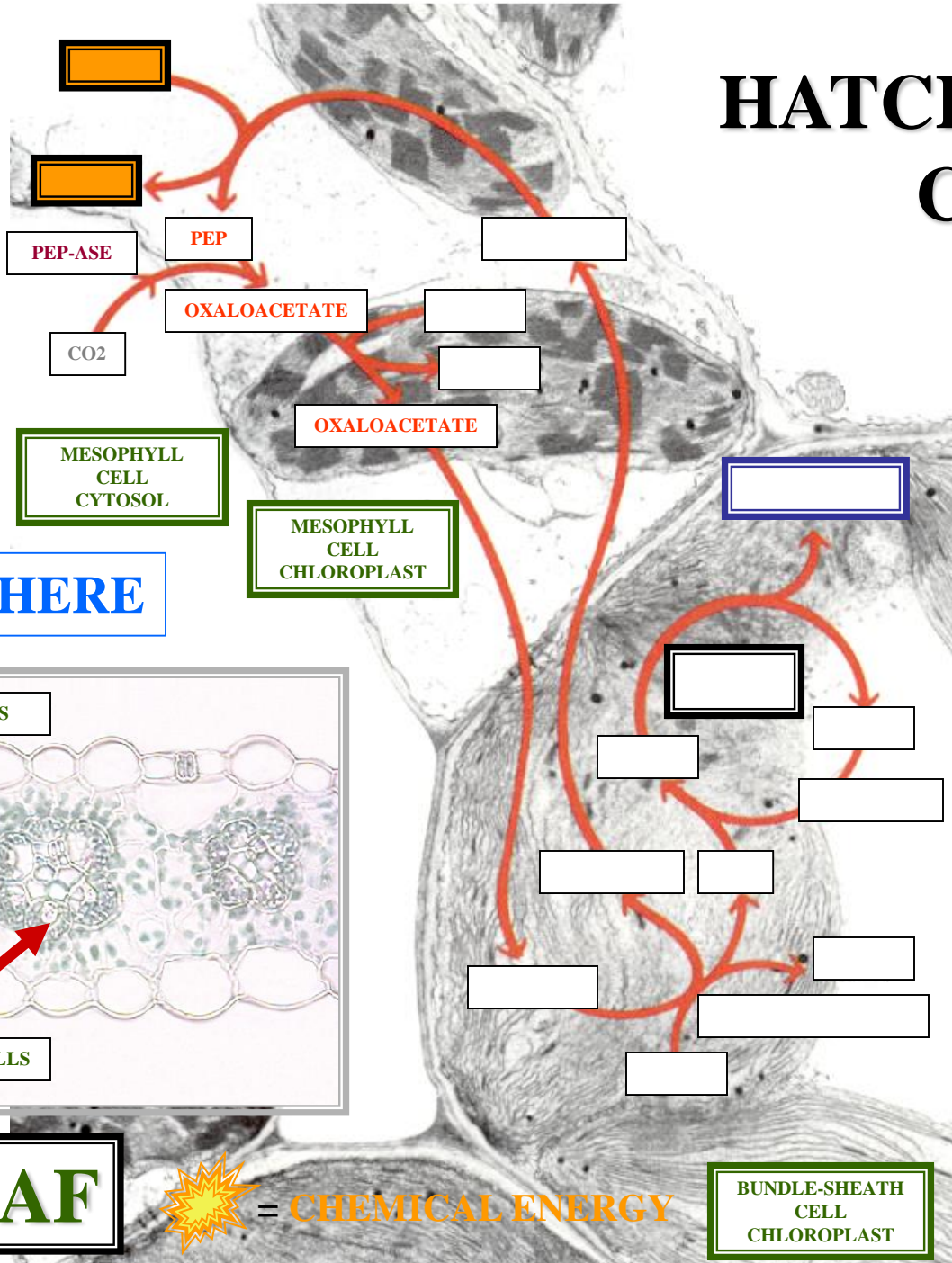
**CORN**

**ATMOSPHERE**



**C4 LEAF**

 = CHEMICAL ENERGY



**ALL RXTS  
REQUIRE  
A SPECIFIC  
ENZYME**

**C4**

**BUNDLE-SHEATH  
CELL  
CHLOROPLAST**

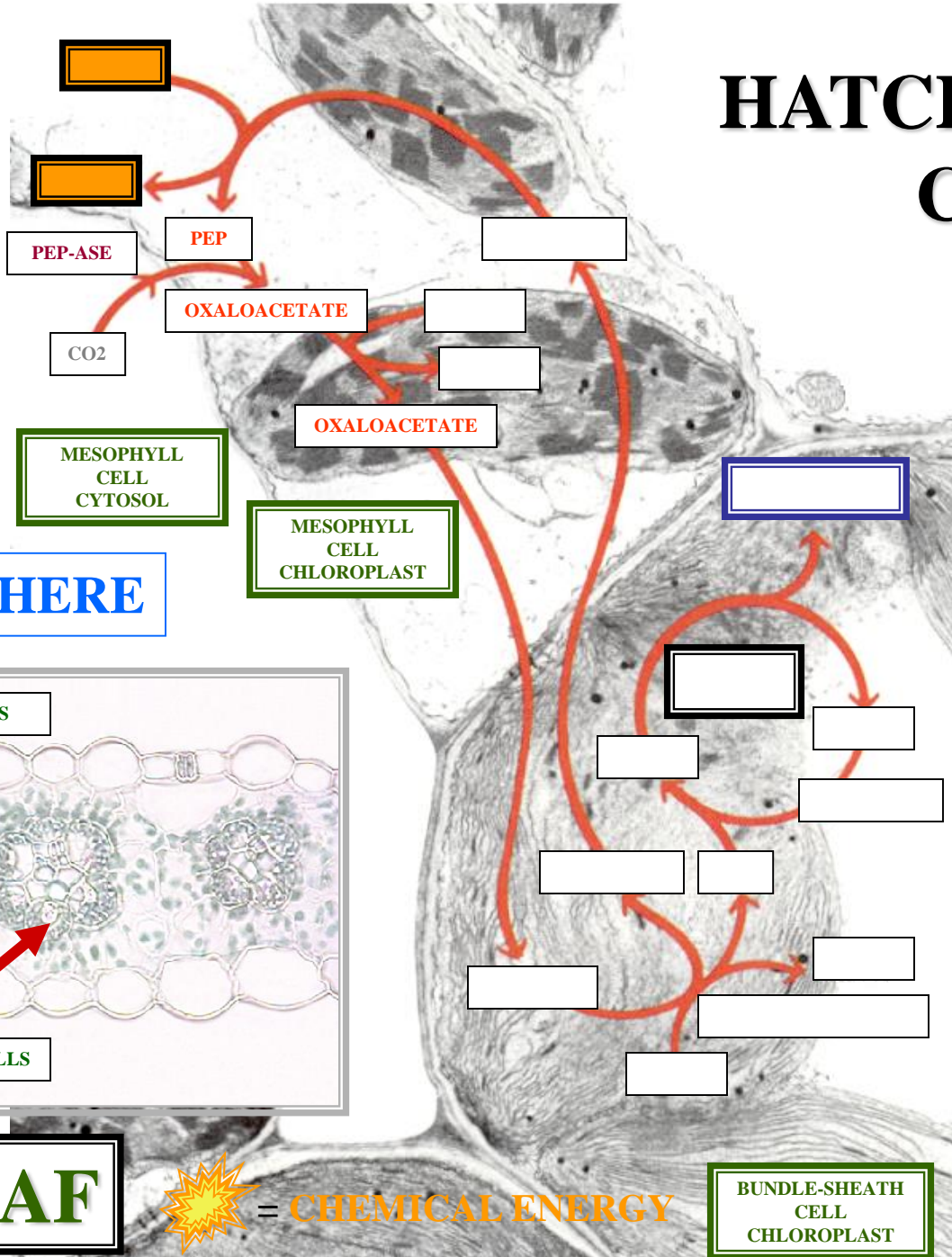


# MESOPHYLL CELL CHLOROPLAST

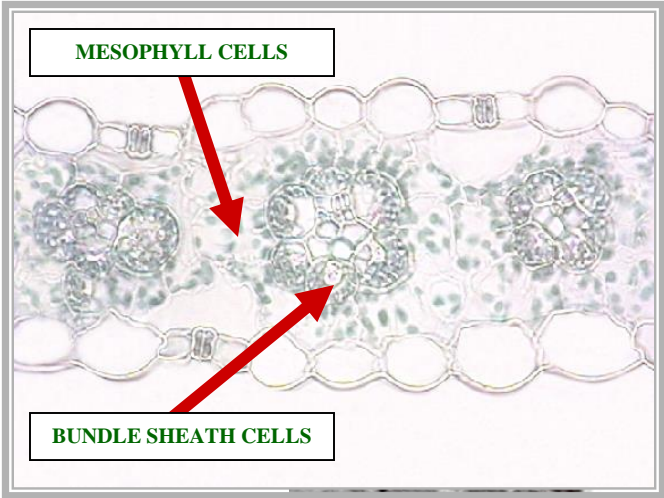
# HATCH & SLACK CYCLE



**CORN**



**ATMOSPHERE**



**C4 LEAF**

 = CHEMICAL ENERGY

**BUNDLE-SHEATH CELL CHLOROPLAST**

**ALL RXTS REQUIRE A SPECIFIC ENZYME**

**C4**

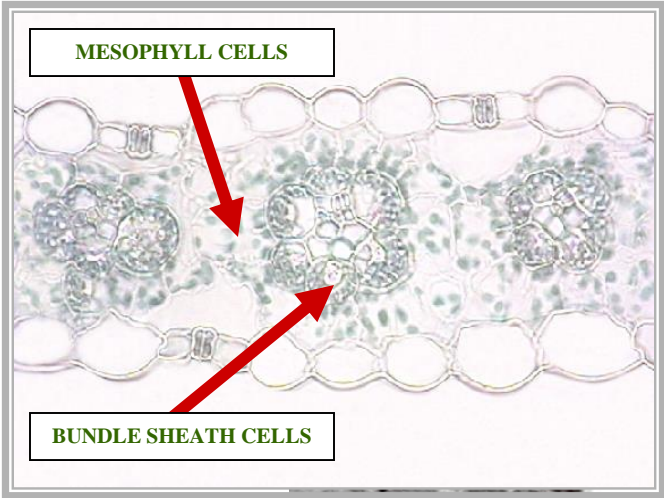


# HATCH & SLACK CYCLE

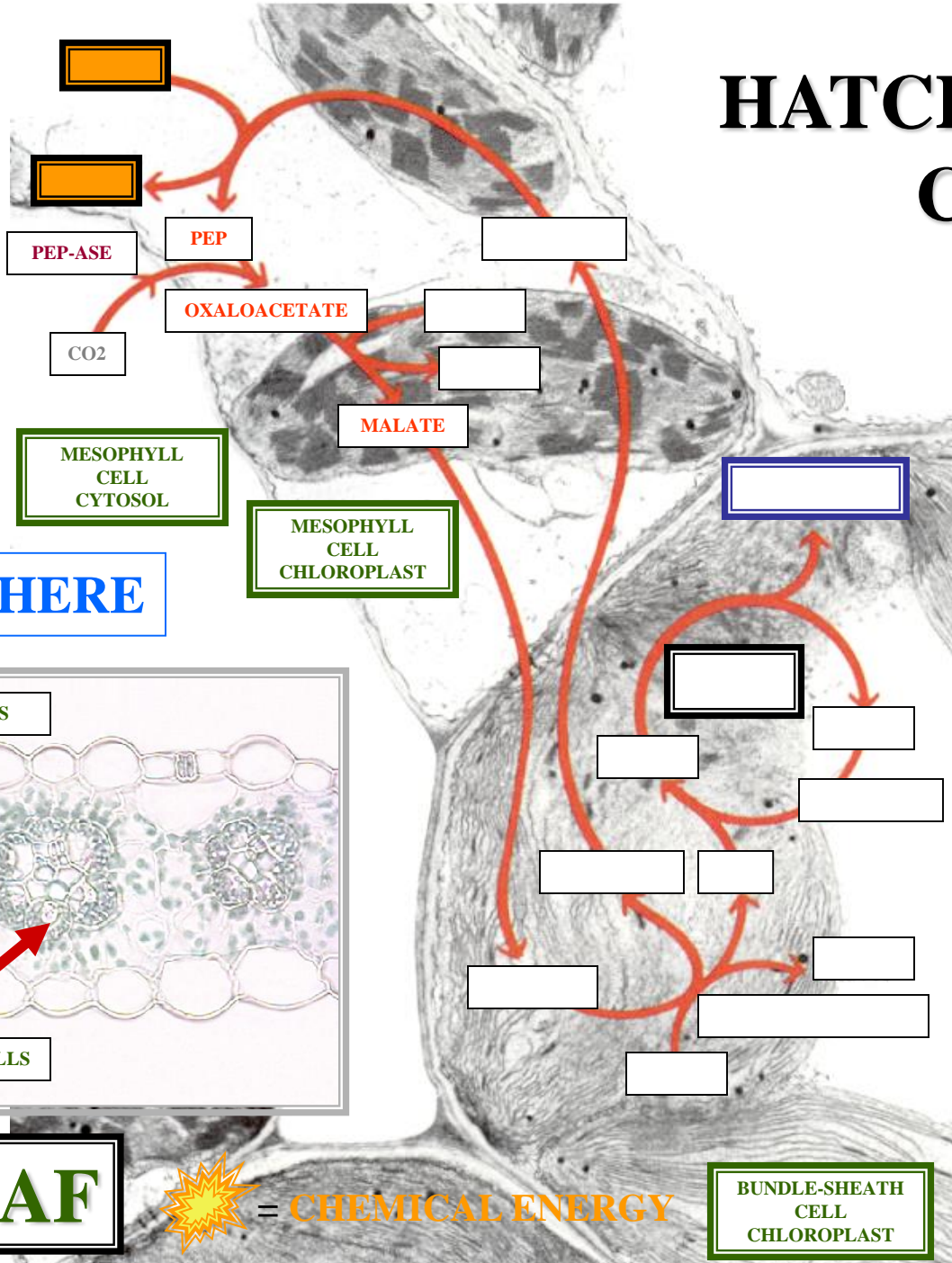


**CORN**

**ATMOSPHERE**



**C4 LEAF**



**ALL RXTS  
REQUIRE  
A SPECIFIC  
ENZYME**

**C4**

= CHEMICAL ENERGY

**BUNDLE-SHEATH  
CELL  
CHLOROPLAST**



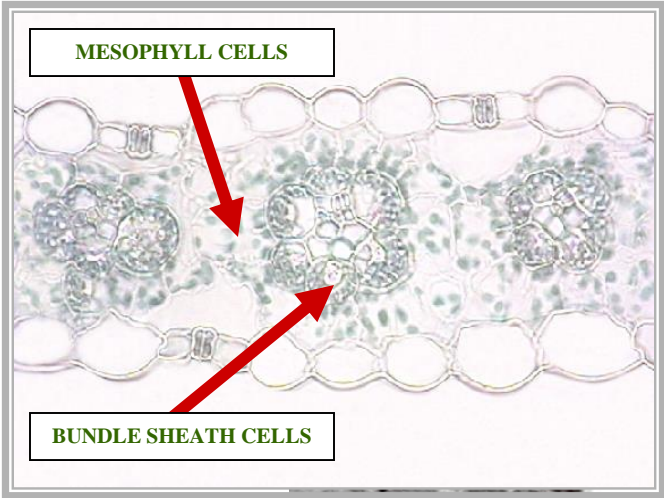


# HATCH & SLACK CYCLE

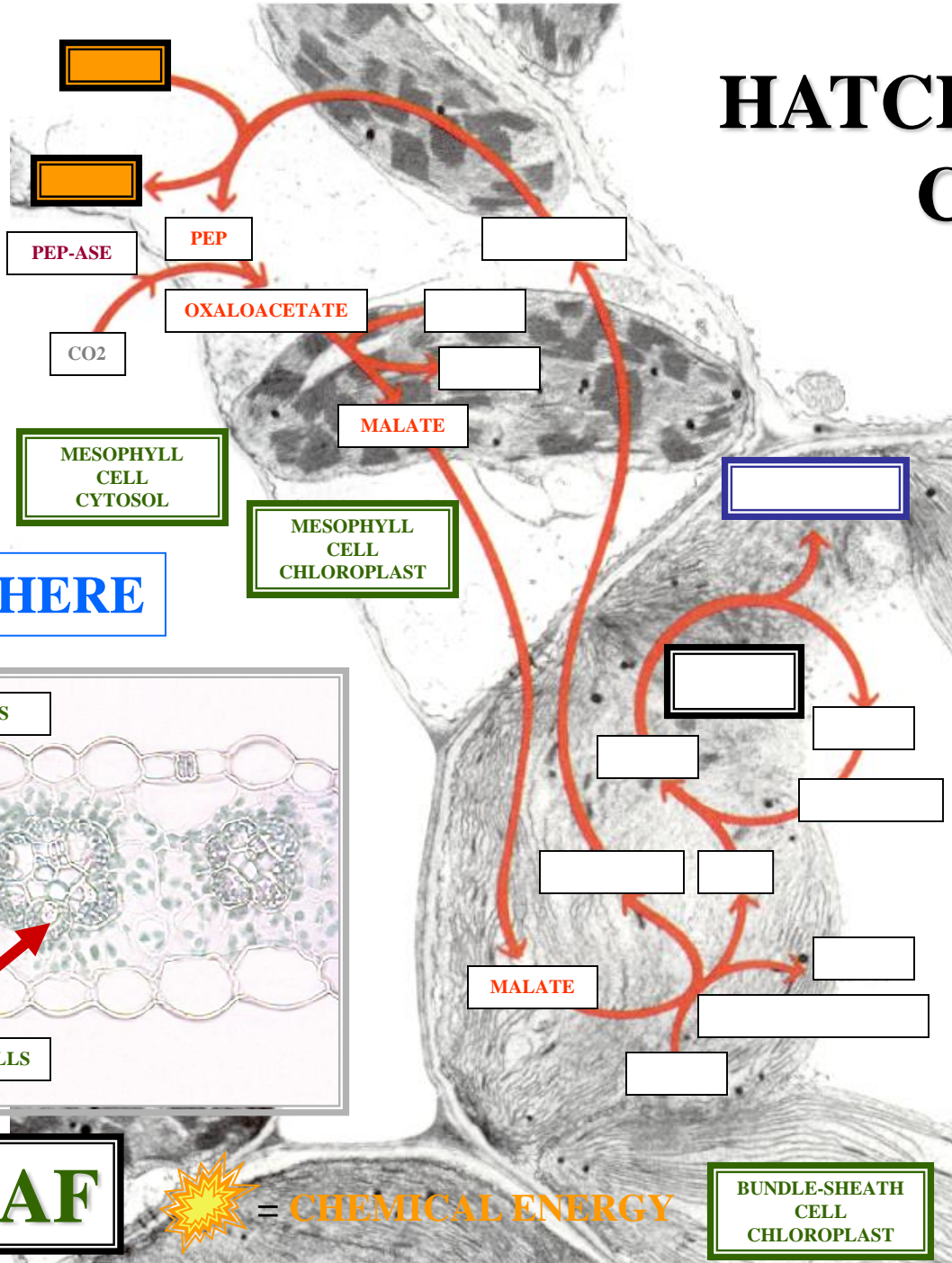


**CORN**

**ATMOSPHERE**



**C4 LEAF**



**ALL RXTS  
REQUIRE  
A SPECIFIC  
ENZYME**

**C4**

= **CHEMICAL ENERGY**

**BUNDLE-SHEATH  
CELL  
CHLOROPLAST**



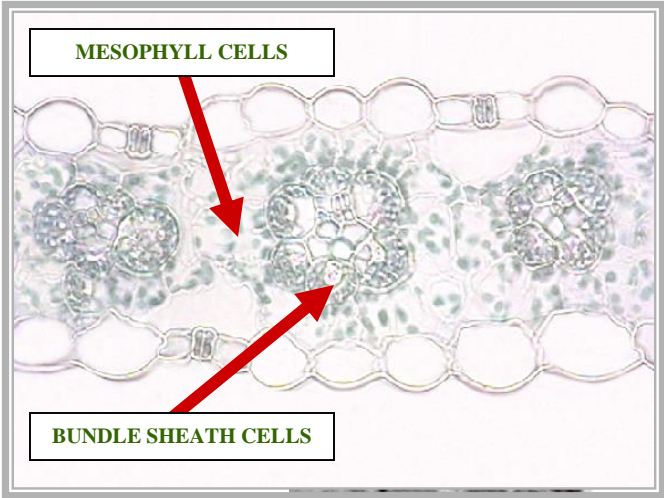
# BUNDLE-SHEATH CELL CHLOROPLAST

# HATCH & SLACK CYCLE

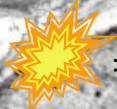


**CORN**

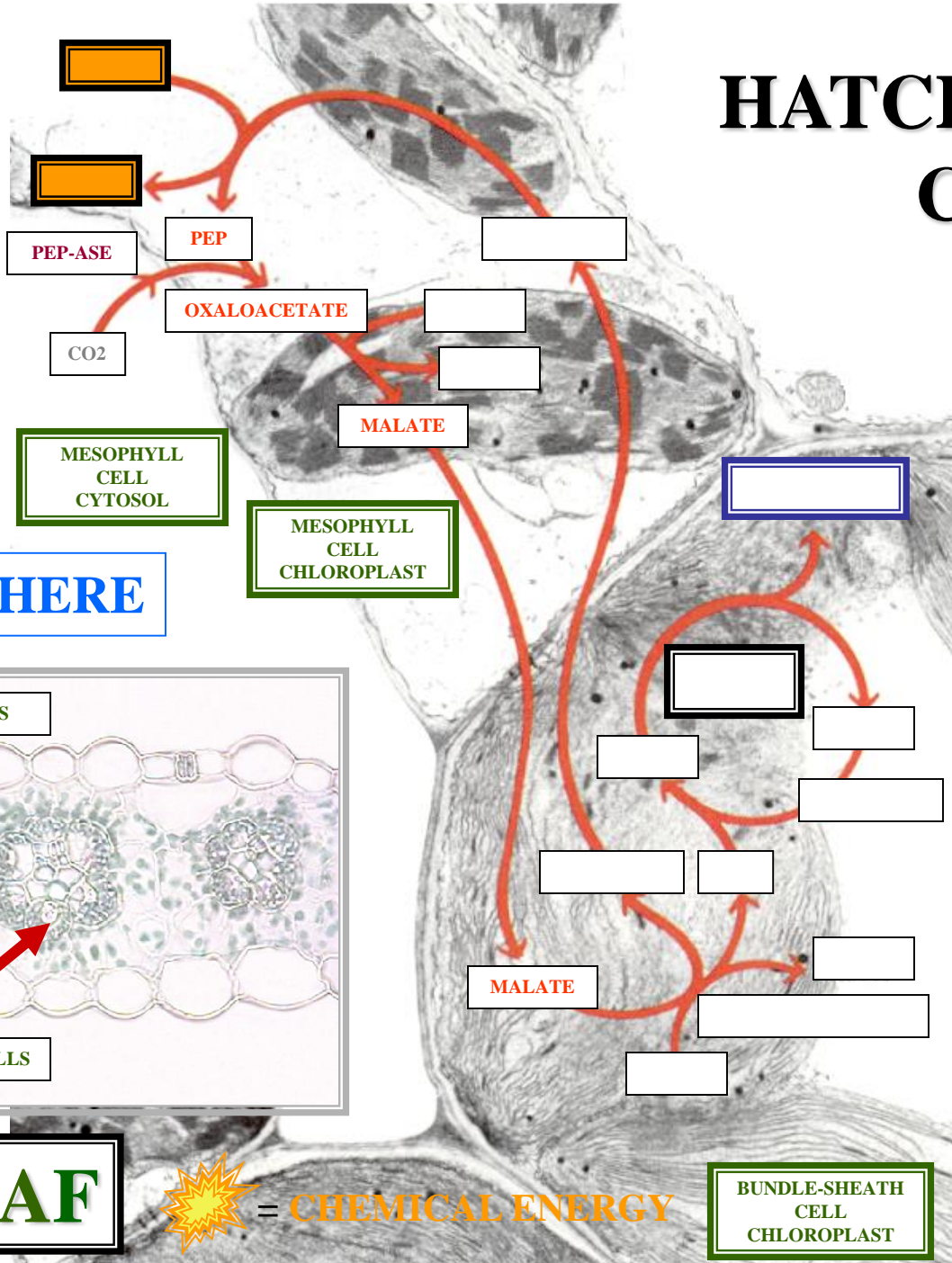
**ATMOSPHERE**



**C4 LEAF**



= CHEMICAL ENERGY



**ALL RXTS  
REQUIRE  
A SPECIFIC  
ENZYME**

**C4**

**BUNDLE-SHEATH  
CELL  
CHLOROPLAST**

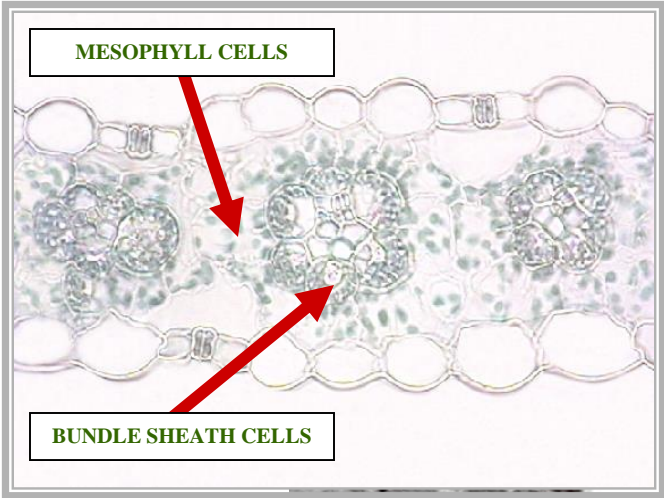


# HATCH & SLACK CYCLE

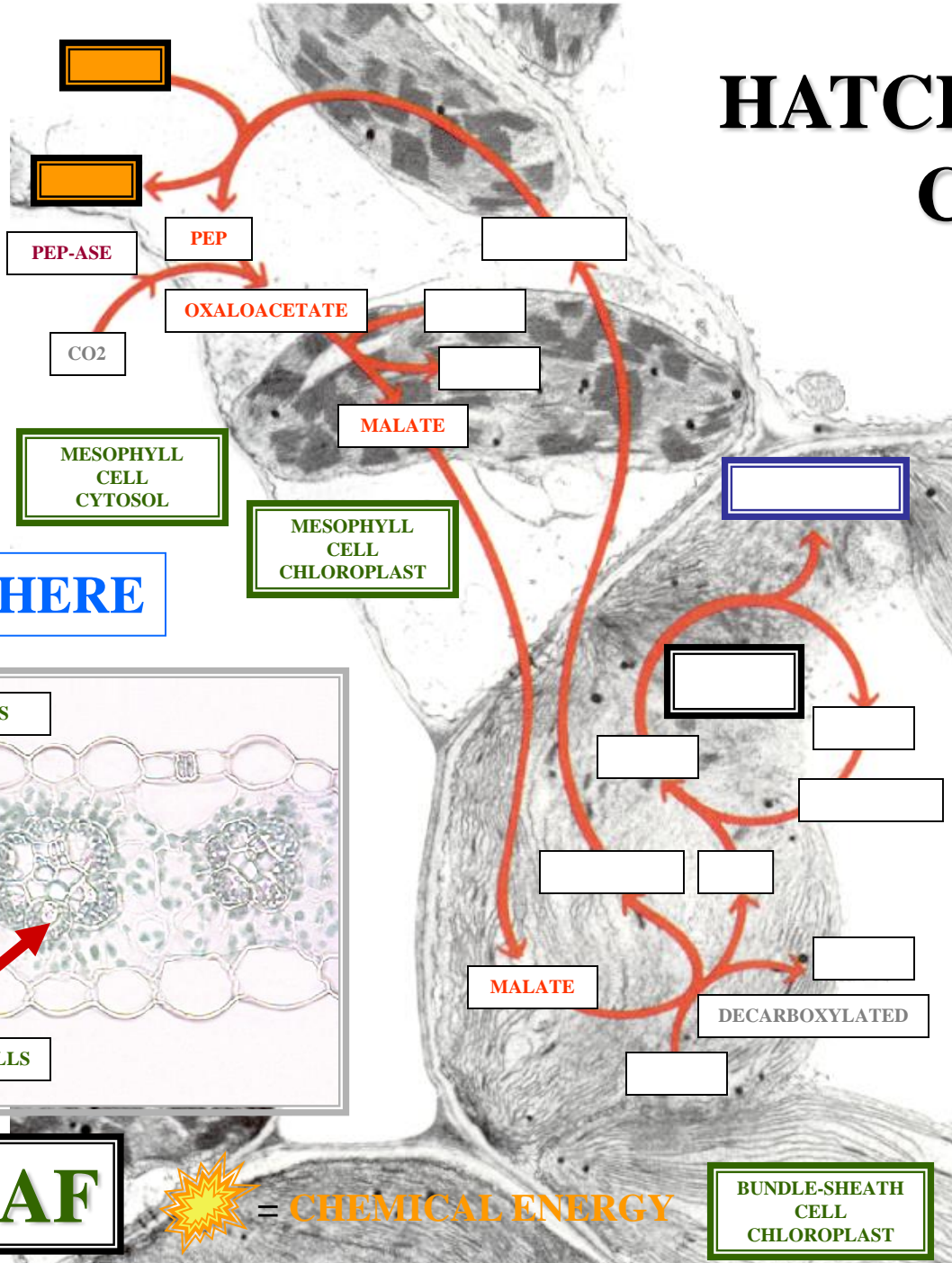


**CORN**

**ATMOSPHERE**



**C4 LEAF**



**ALL RXTS  
REQUIRE  
A SPECIFIC  
ENZYME**

**C4**

= **CHEMICAL ENERGY**

**BUNDLE-SHEATH  
CELL  
CHLOROPLAST**



**DECARBOXYLATED**



**DECARBOXYLATED**

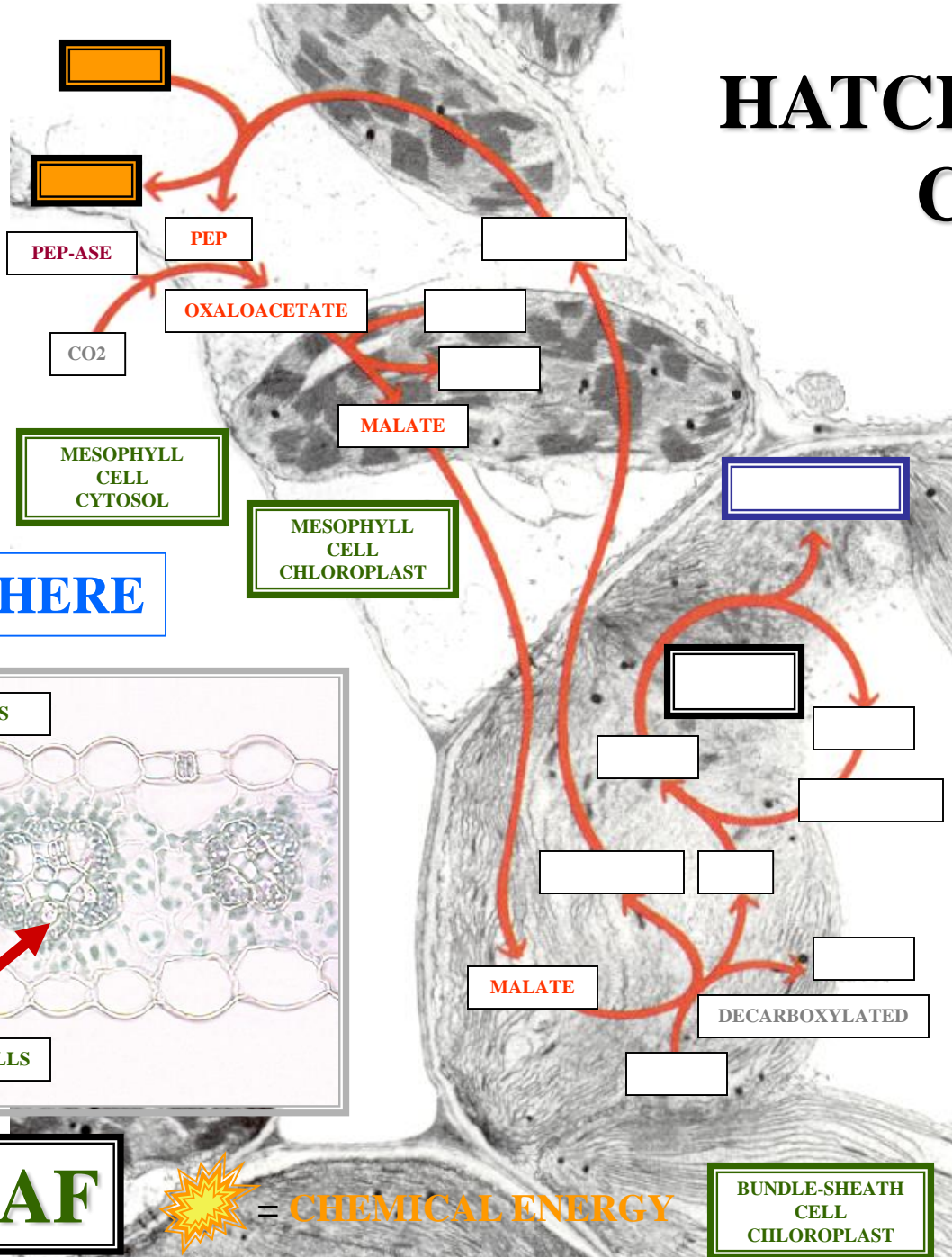
**CO<sub>2</sub> IS RELEASED  
FROM  
COMPOUND**

**DECARBOXYLATED**

# HATCH & SLACK CYCLE



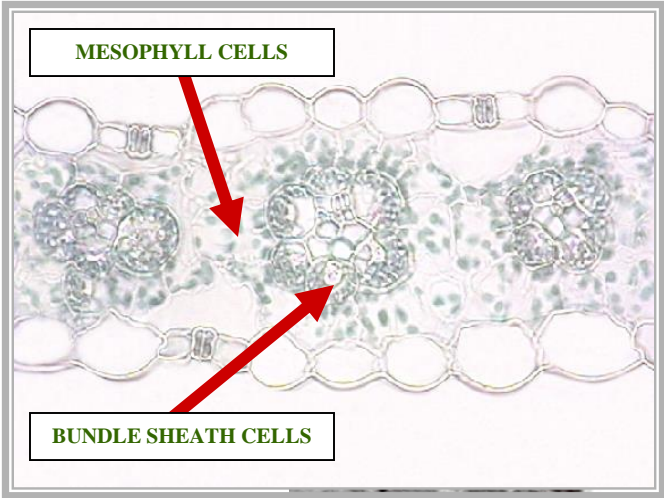
**CORN**



**ALL RXTS  
REQUIRE  
A SPECIFIC  
ENZYME**

**C4**

**ATMOSPHERE**



**C4 LEAF**

 = **CHEMICAL ENERGY**

**BUNDLE-SHEATH  
CELL  
CHLOROPLAST**

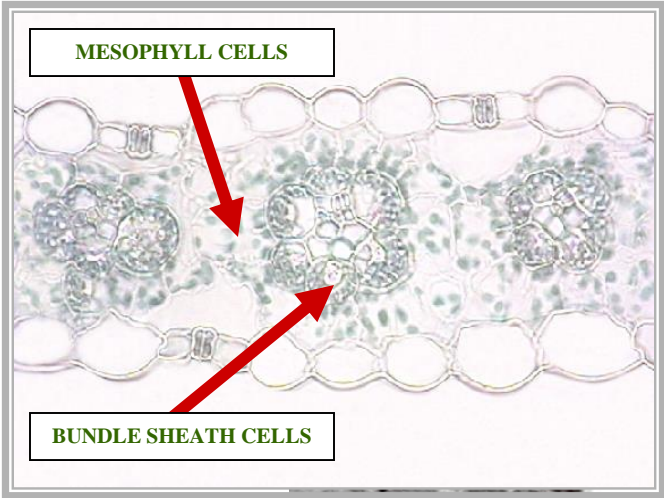


# HATCH & SLACK CYCLE



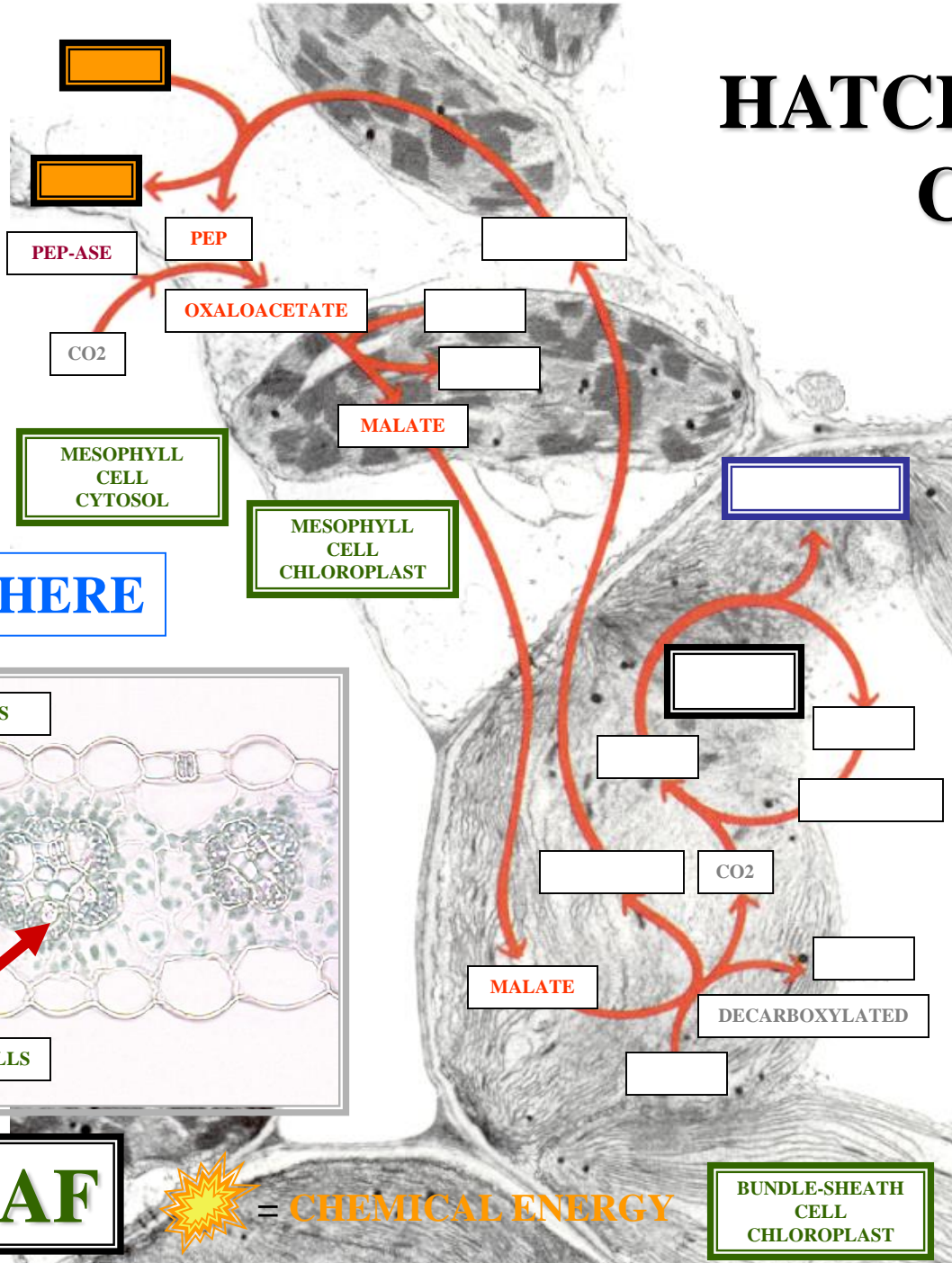
**CORN**

**ATMOSPHERE**



**C4 LEAF**

= CHEMICAL ENERGY



**ALL RXTS  
REQUIRE  
A SPECIFIC  
ENZYME**

**C4**

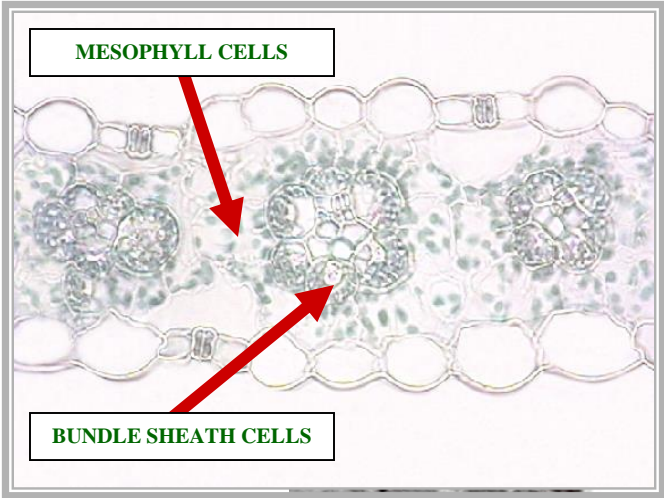
**BUNDLE-SHEATH  
CELL  
CHLOROPLAST**

# HATCH & SLACK CYCLE



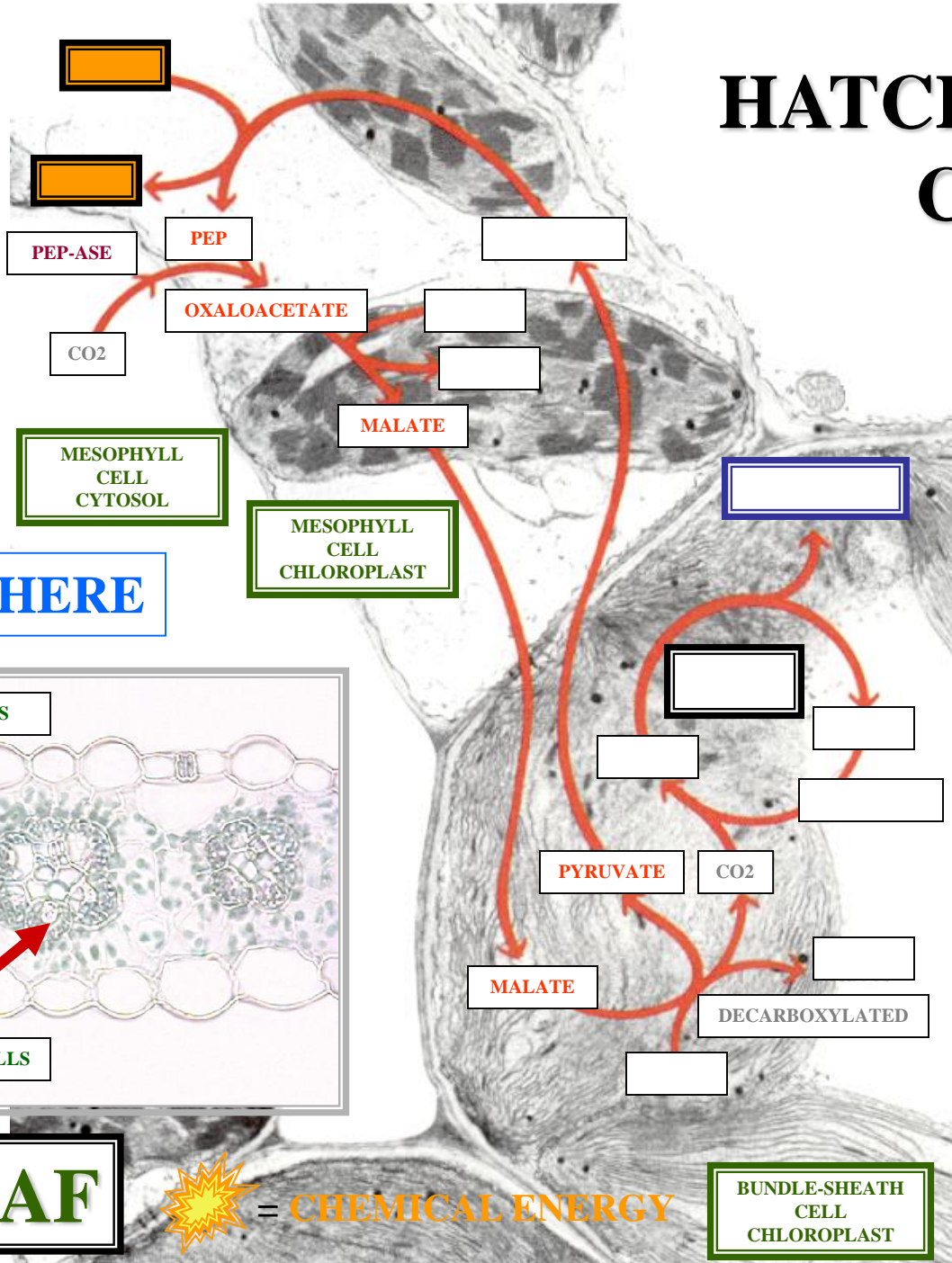
**CORN**

**ATMOSPHERE**



**C4 LEAF**

= CHEMICAL ENERGY



**ALL RXTS  
REQUIRE  
A SPECIFIC  
ENZYME**

**C4**



**CO<sub>2</sub>**

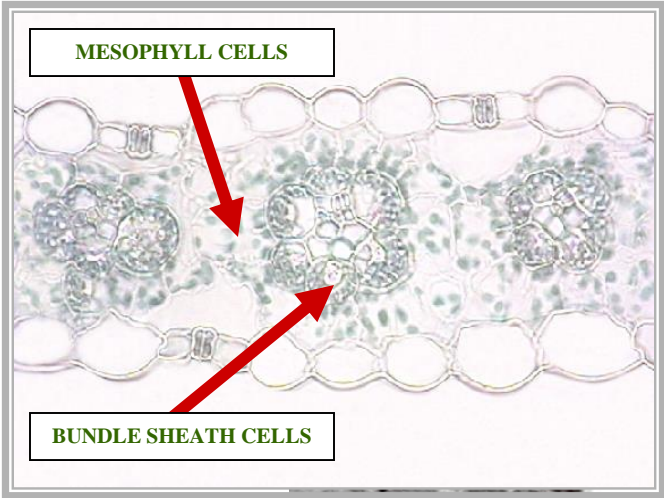


# HATCH & SLACK CYCLE



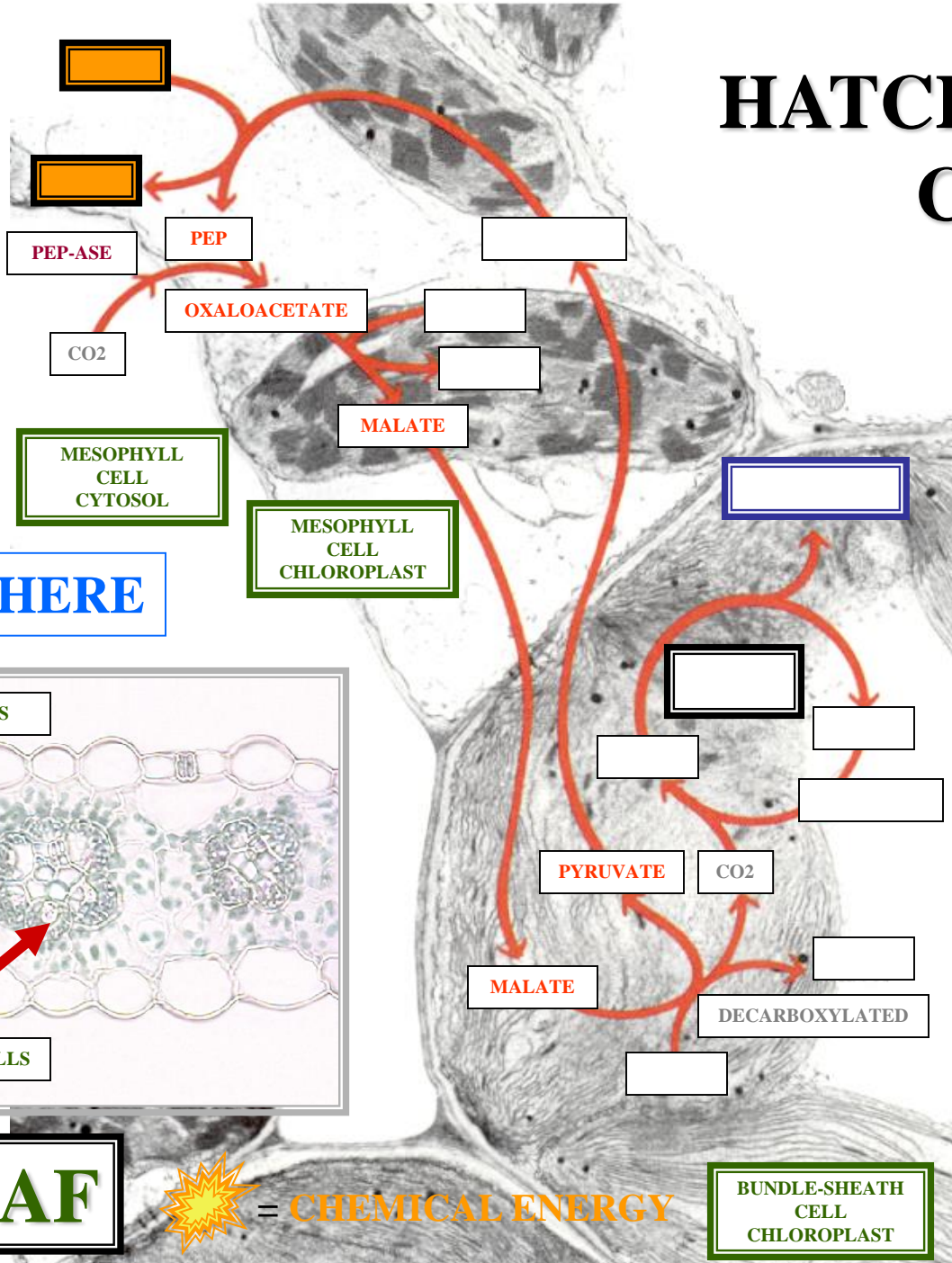
**CORN**

**ATMOSPHERE**



**C4 LEAF**

 = CHEMICAL ENERGY



**ALL RXTS  
REQUIRE  
A SPECIFIC  
ENZYME**

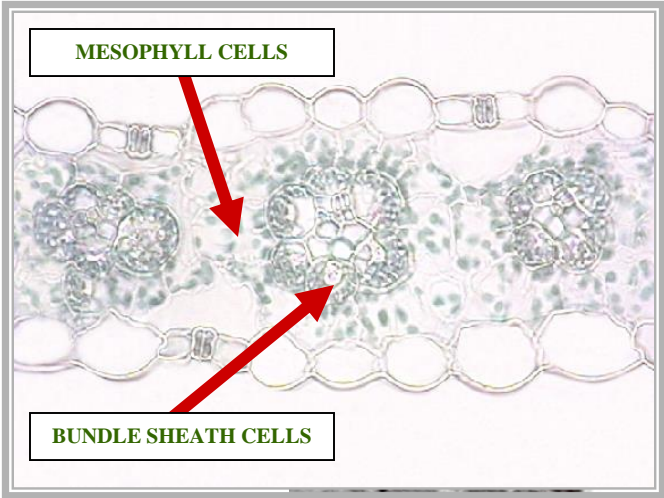
**C4**

# HATCH & SLACK CYCLE



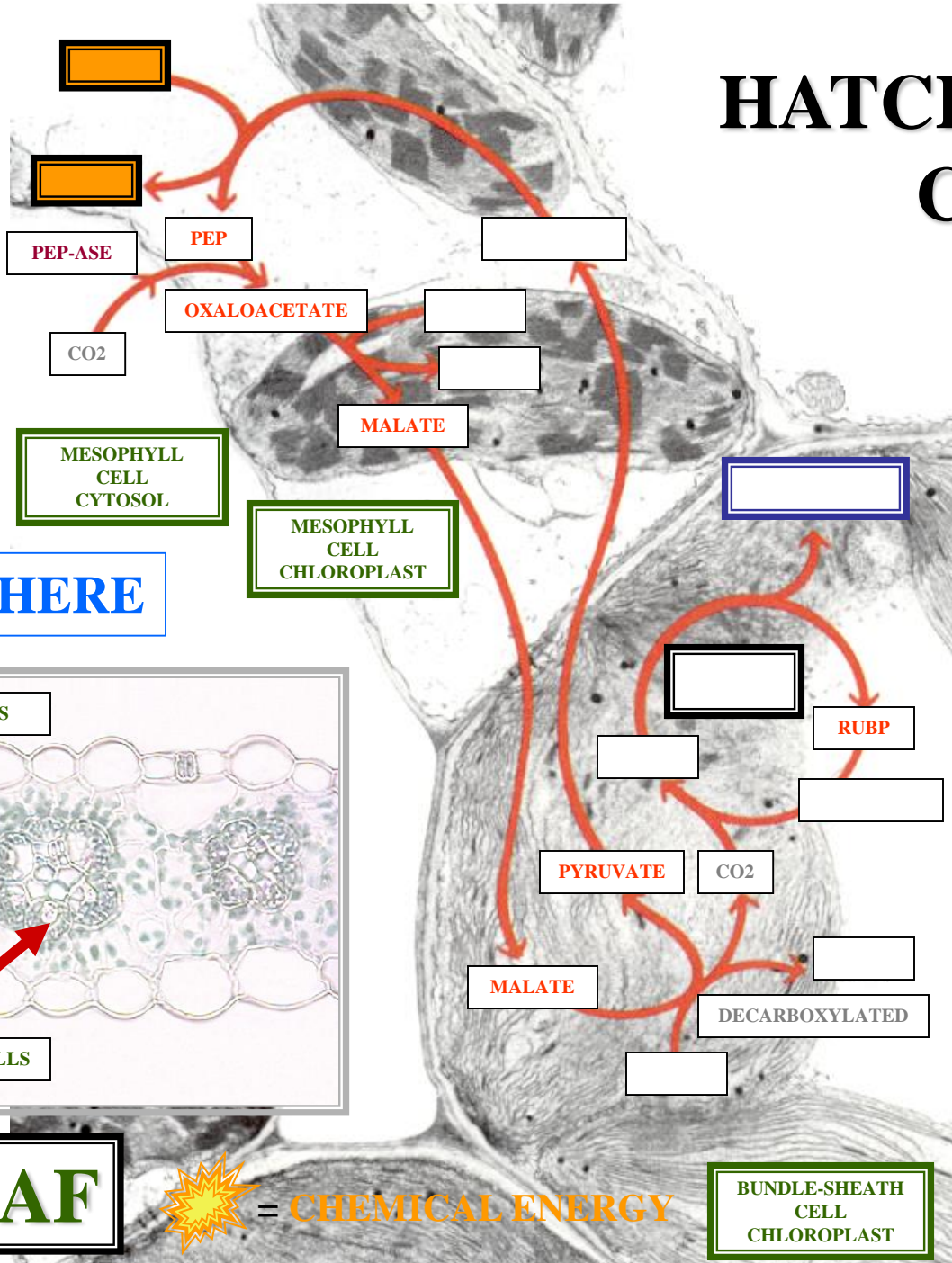
**CORN**

**ATMOSPHERE**



**C4 LEAF**

= CHEMICAL ENERGY



**ALL RXTS  
REQUIRE  
A SPECIFIC  
ENZYME**

**C4**

**BUNDLE-SHEATH  
CELL  
CHLOROPLAST**

**EZ**

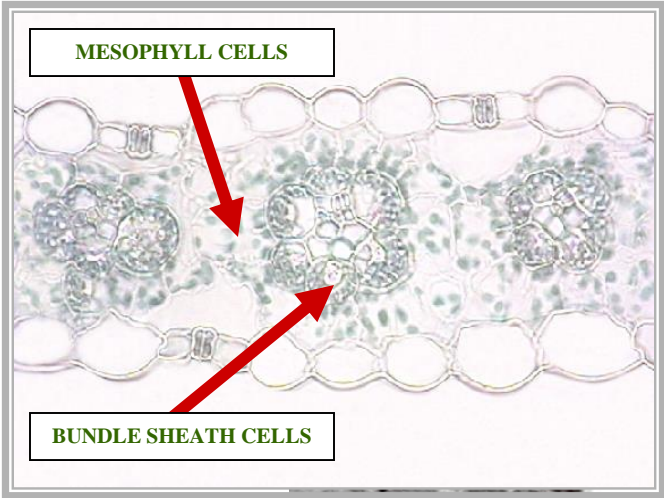


# HATCH & SLACK CYCLE

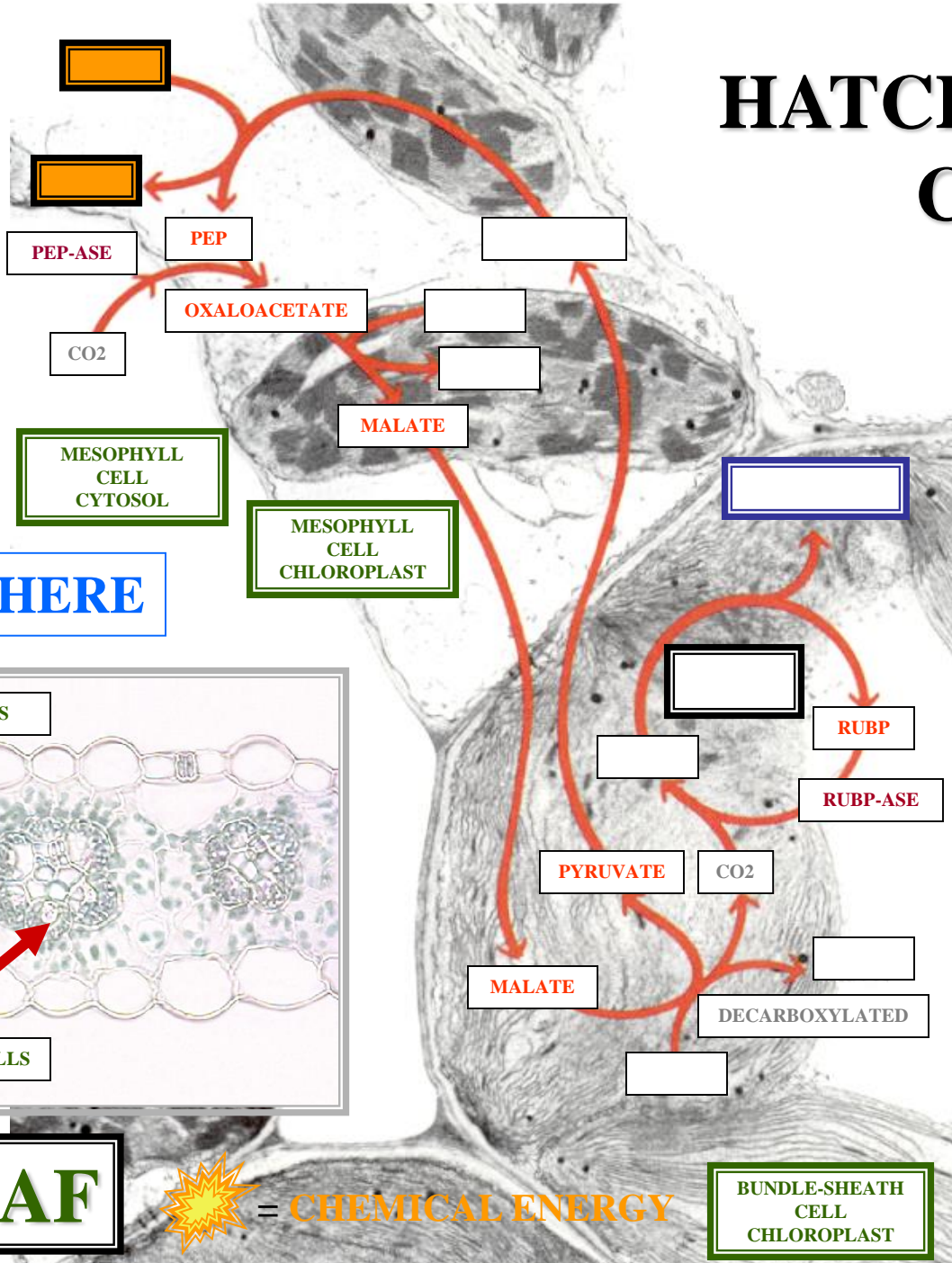


**CORN**

**ATMOSPHERE**



**C4 LEAF**



**ALL RXTS  
REQUIRE  
A SPECIFIC  
ENZYME**

**C4**

= CHEMICAL ENERGY

**BUNDLE-SHEATH  
CELL  
CHLOROPLAST**

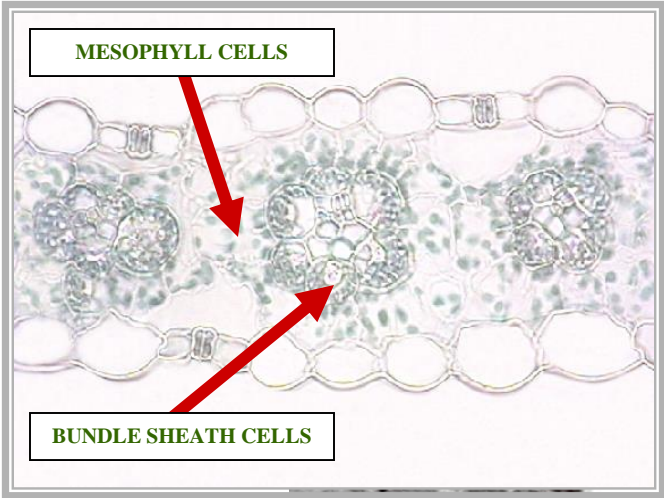


# HATCH & SLACK CYCLE

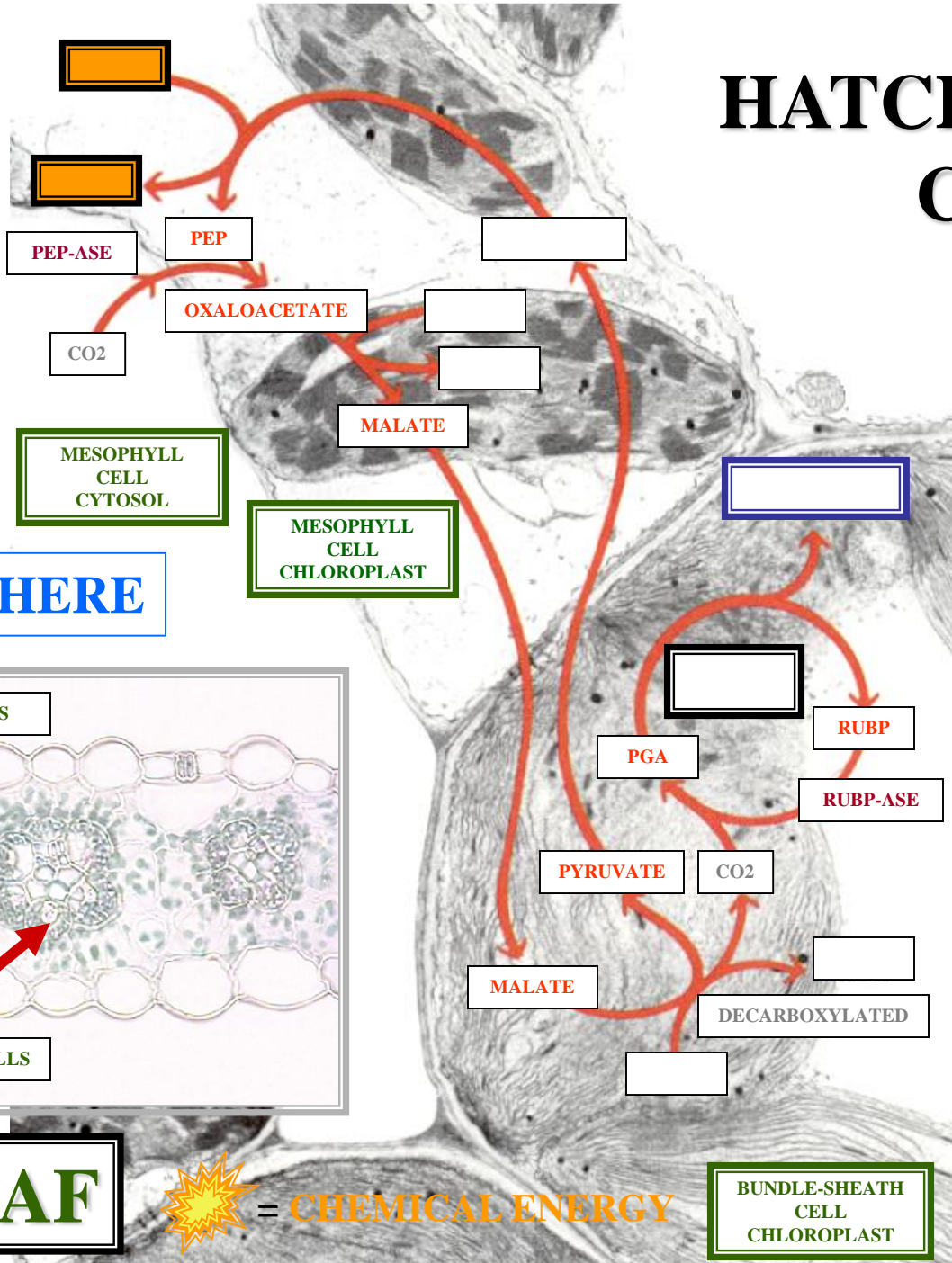


**CORN**

**ATMOSPHERE**



**C4 LEAF**



**ALL RXTS REQUIRE A SPECIFIC ENZYME**

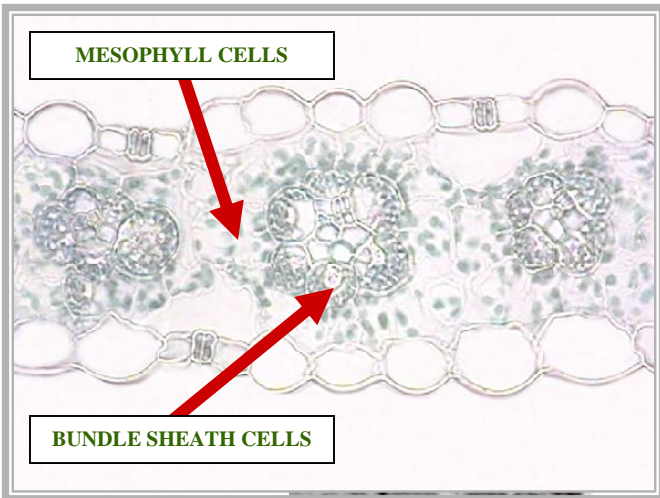
**C4**

# HATCH & SLACK CYCLE

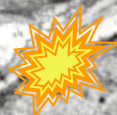


**CORN**

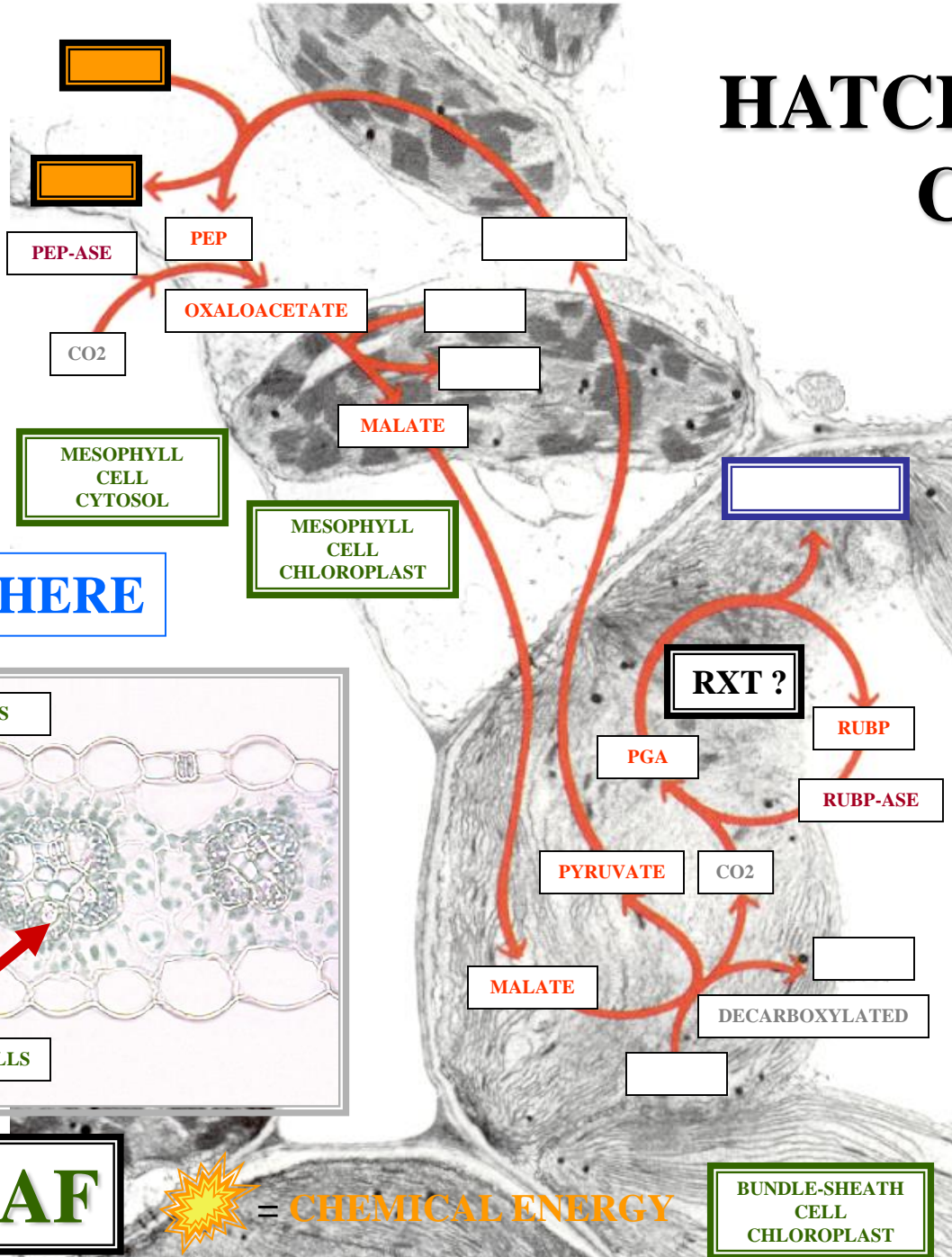
**ATMOSPHERE**



**C4 LEAF**



= **CHEMICAL ENERGY**



**ALL RXTS  
REQUIRE  
A SPECIFIC  
ENZYME**

**C4**

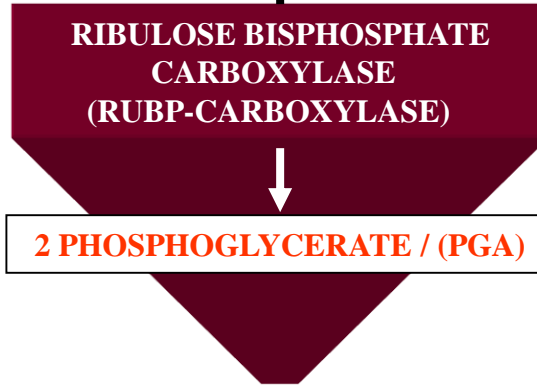
**C3**

**C3**

CO<sub>2</sub>  
ENTERS  
STROMA



CO<sub>2</sub> + **RIBULOSE BISPSPHATE / (RUBP)**



**2 PHOSPHOGLYCERATE / (PGA)**



# CALVIN CYCLE

## **C3** CO<sub>2</sub> FIXATION REACTION

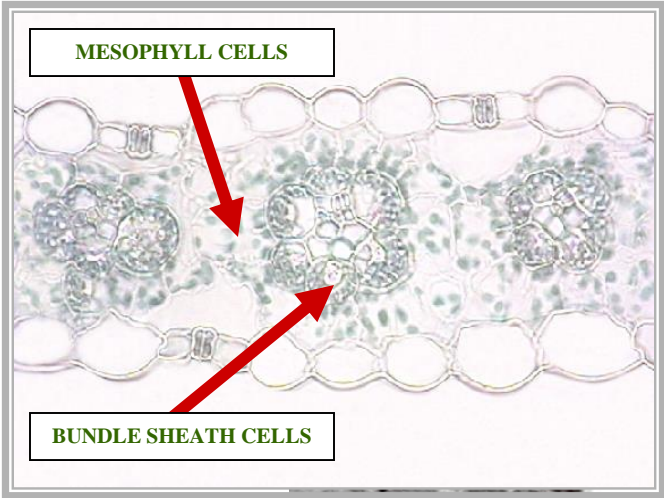


# HATCH & SLACK CYCLE

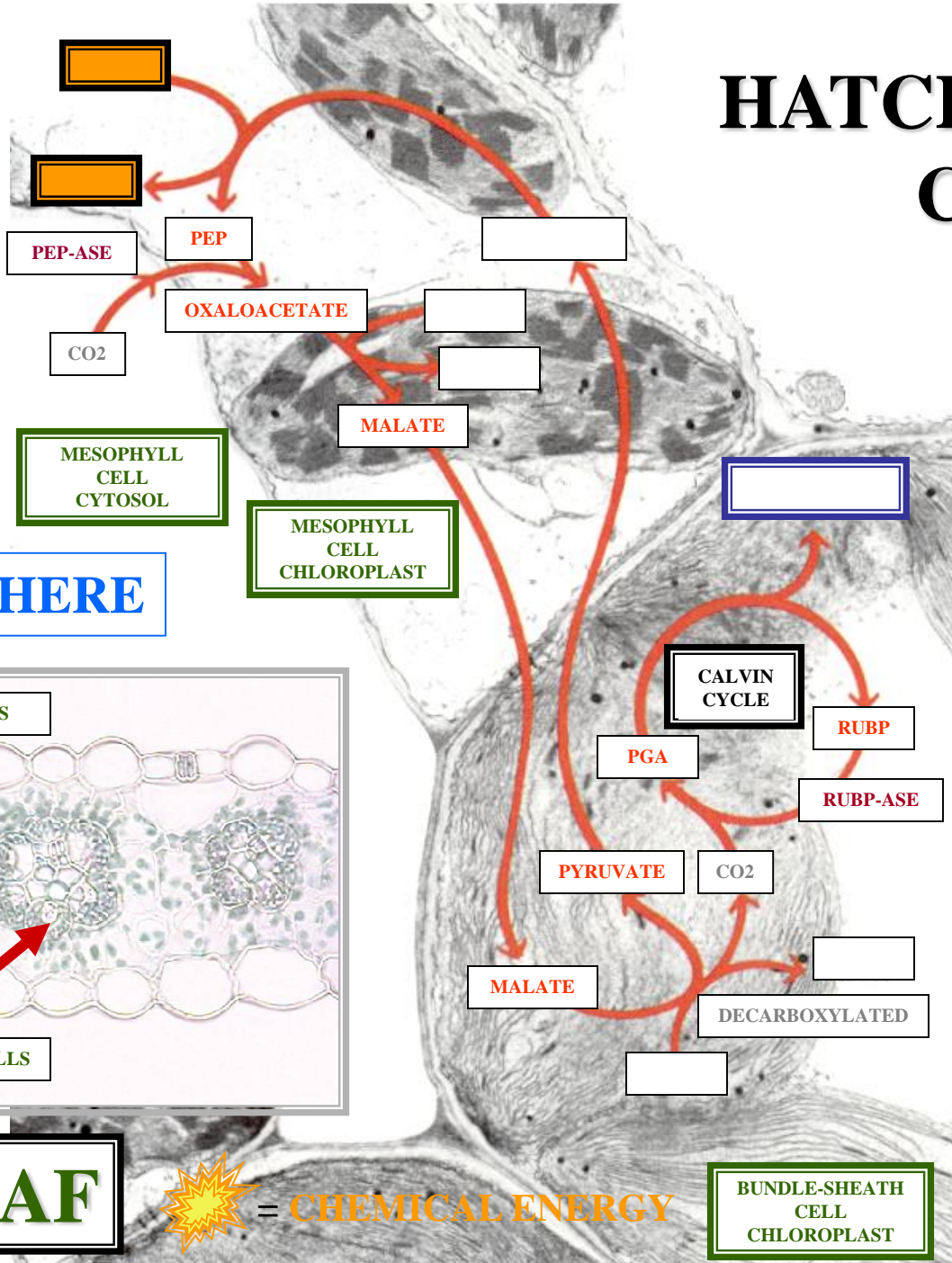


**CORN**

**ATMOSPHERE**



**C4 LEAF**



**ALL RXTS  
REQUIRE  
A SPECIFIC  
ENZYME**

**C4**

= CHEMICAL ENERGY

**BUNDLE-SHEATH  
CELL  
CHLOROPLAST**

**C3**