

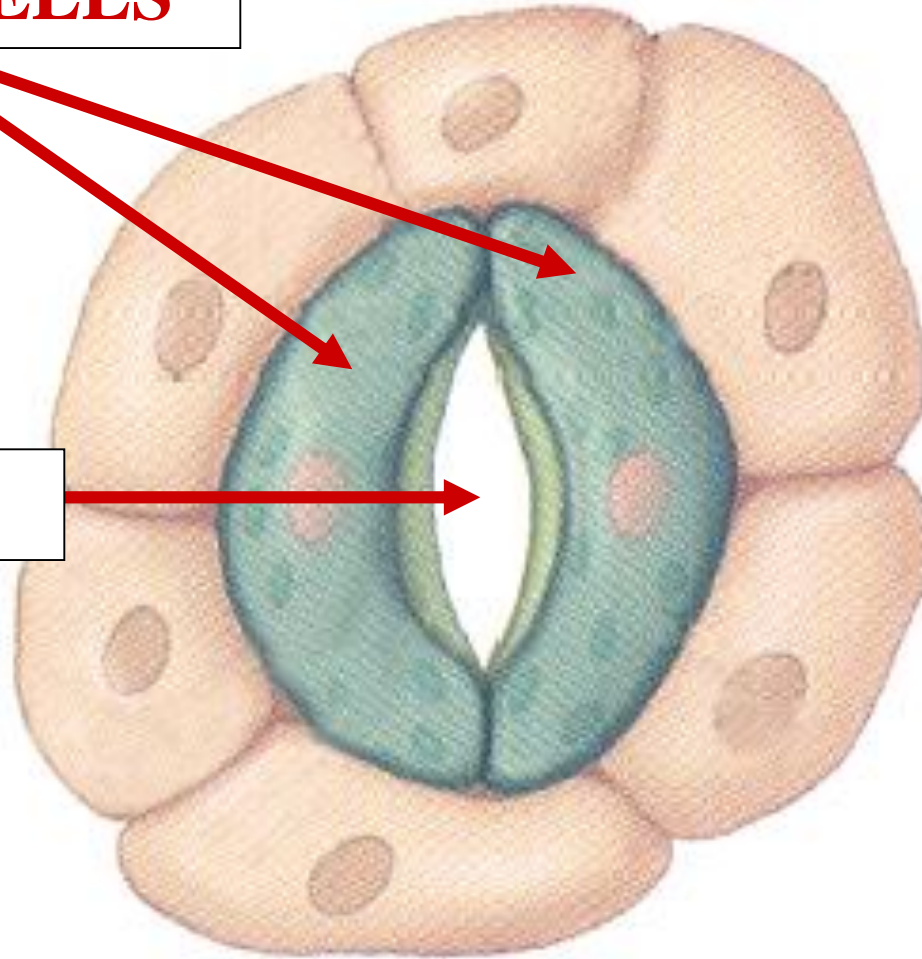


# LEAF STOMATE

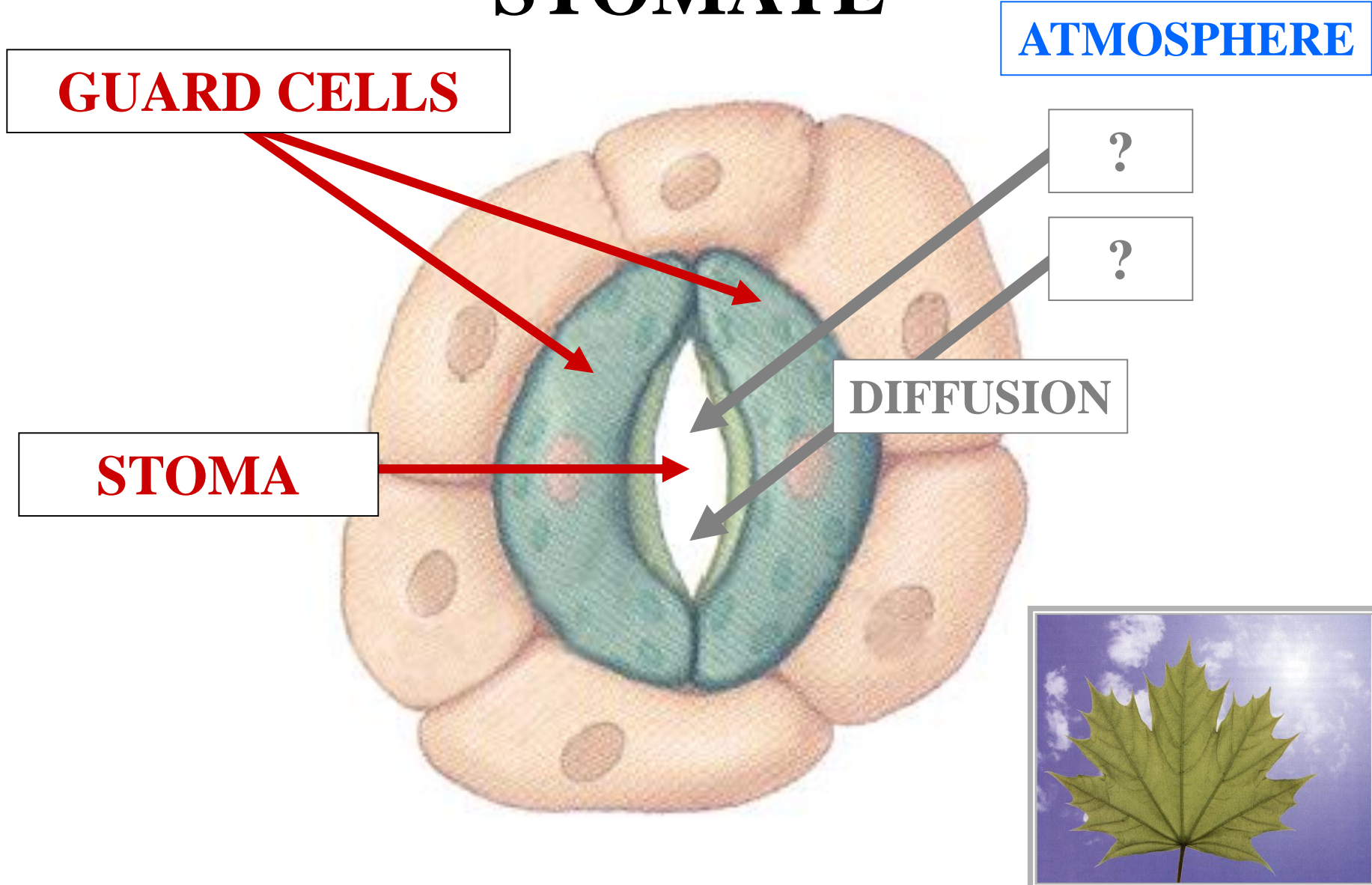
# LEAF STOMATE

**GUARD CELLS**

**STOMA**

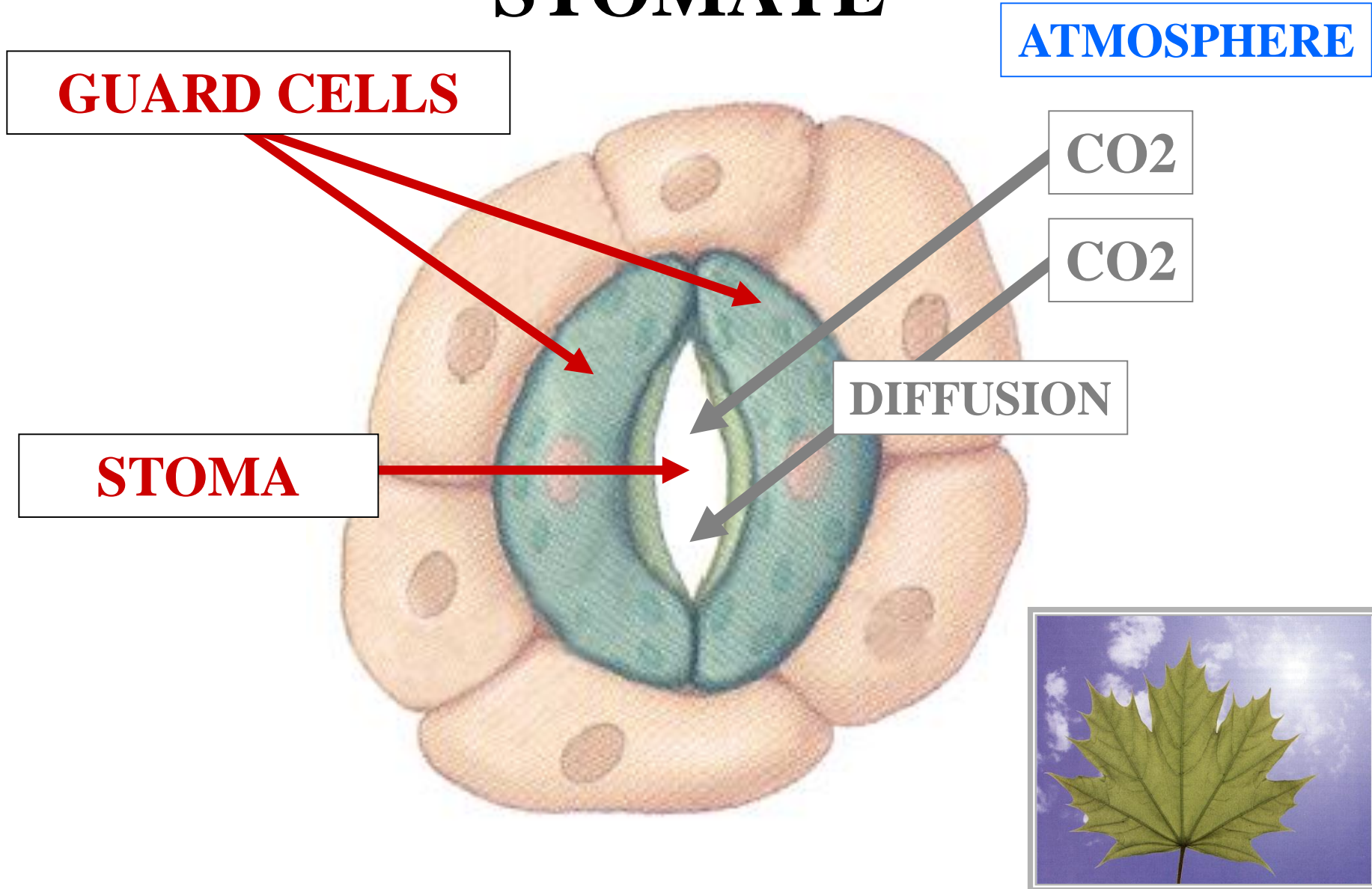


# LEAF STOMATE





# LEAF STOMATE





# C3

## PATHWAY

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

ATMOSPHERE

# LEAF STOMATE

ATMOSPHERE

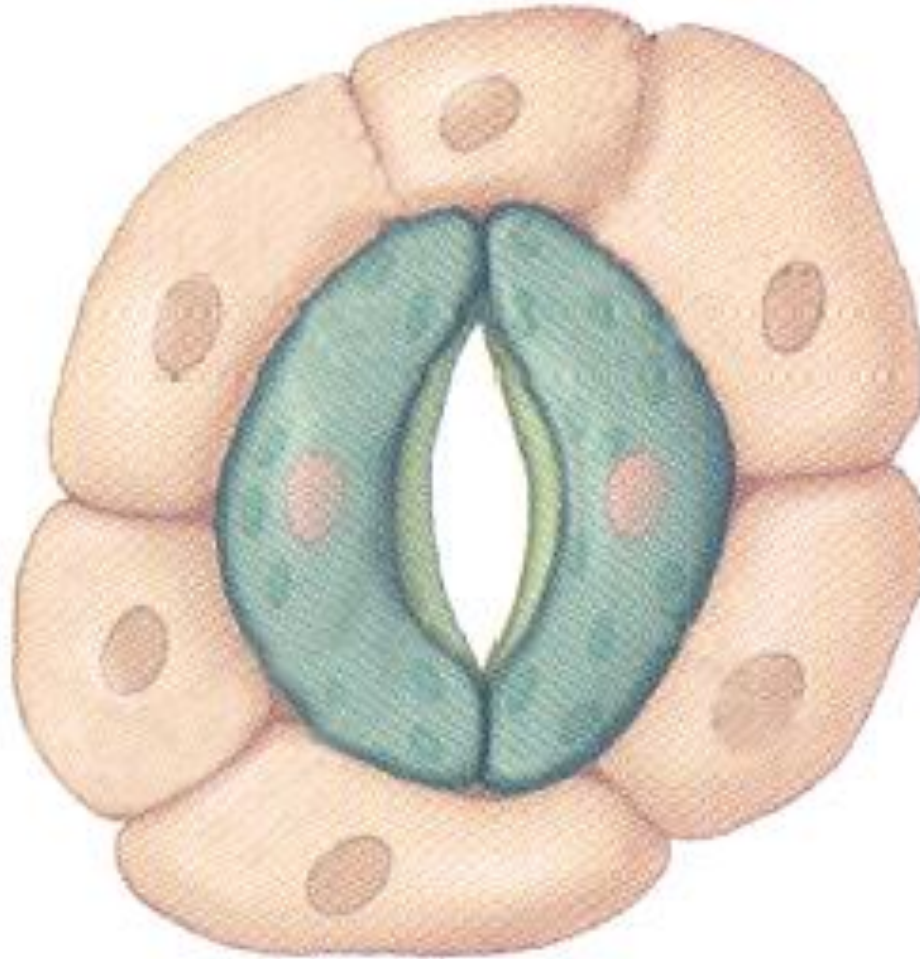
CO<sub>2</sub>

CO<sub>2</sub>



CO<sub>2</sub>

CO<sub>2</sub>



ATMOSPHERE

ATMOSPHERE

# LEAF STOMATE

CO<sub>2</sub>

CO<sub>2</sub>

DIFFUSION

DIFFUSION

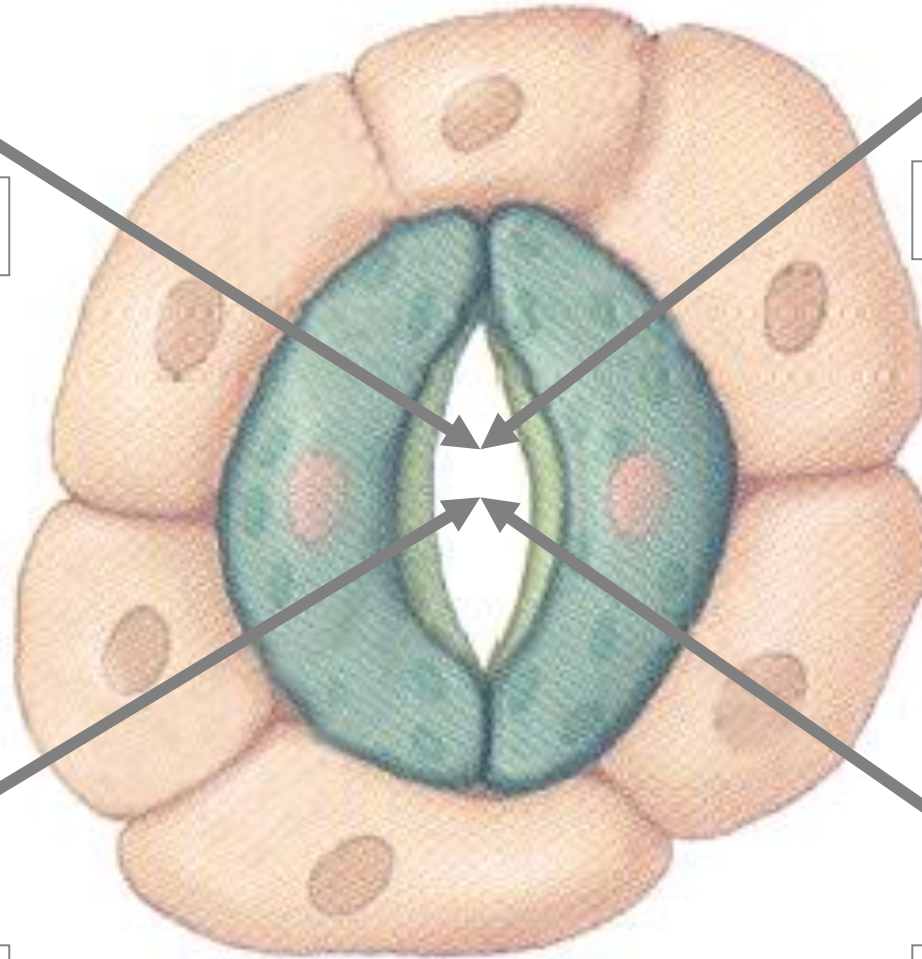


CO<sub>2</sub>

CO<sub>2</sub>

DIFFUSION

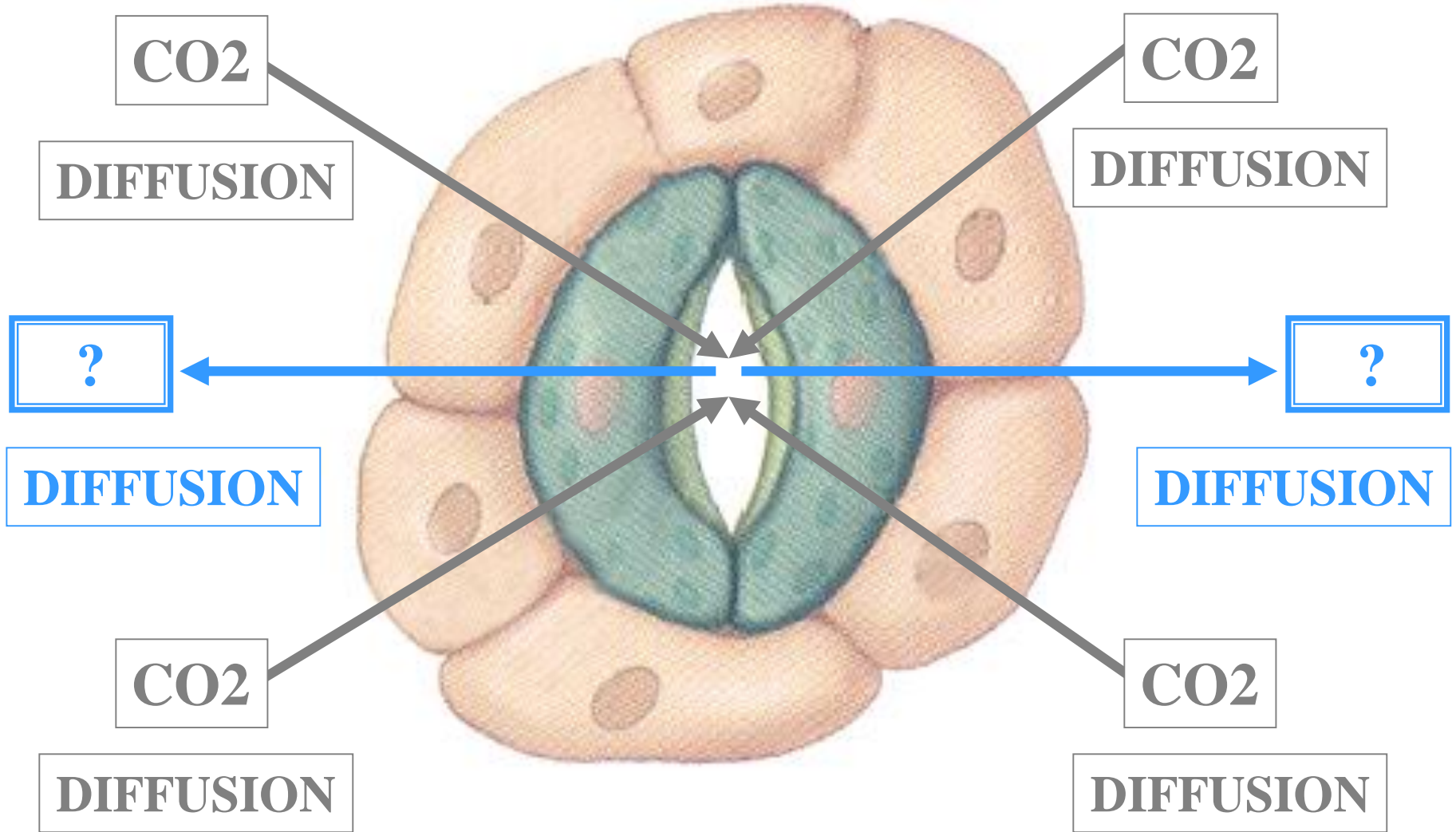
DIFFUSION



# LEAF STOMATE

ATMOSPHERE

ATMOSPHERE

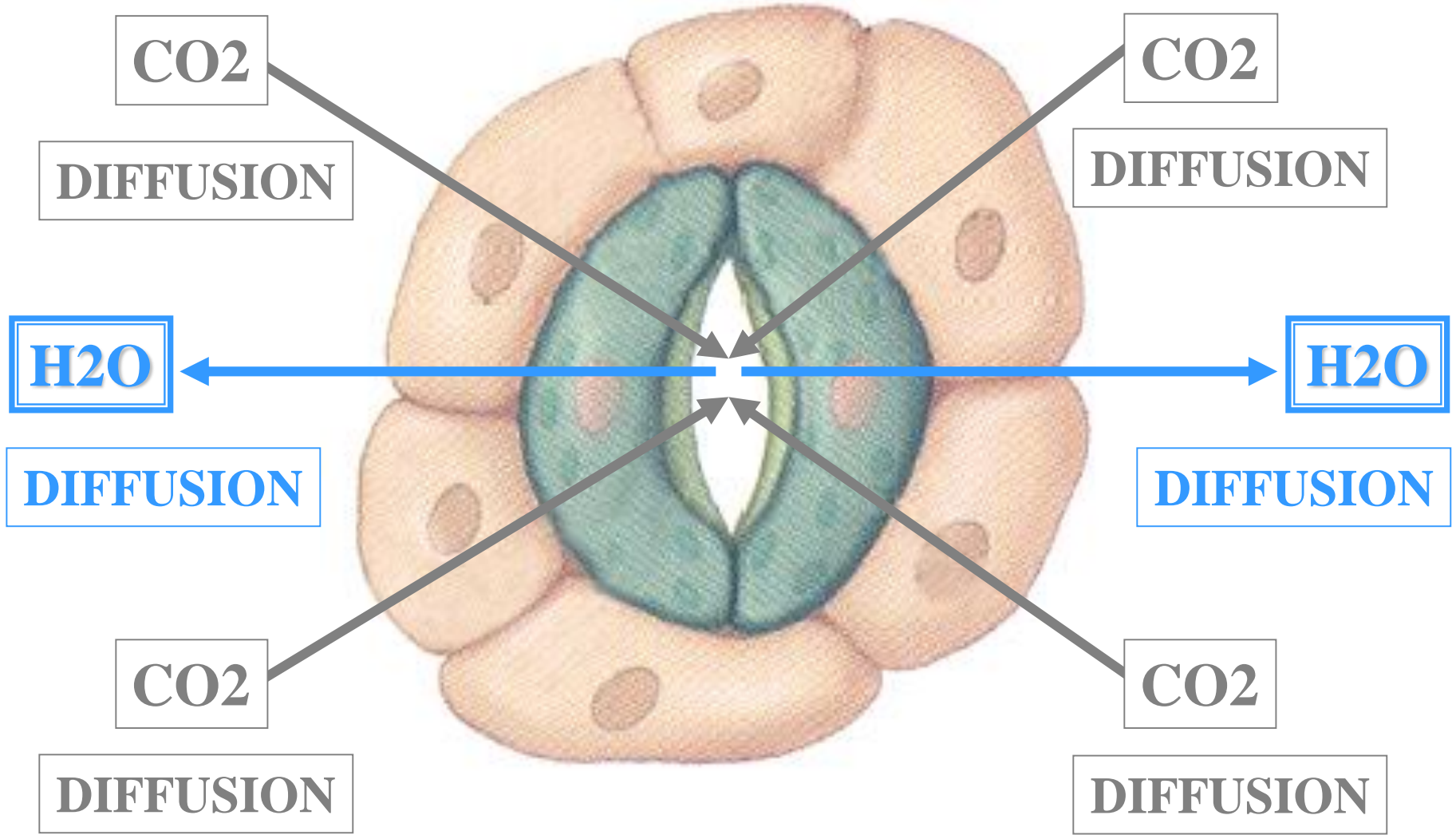




# LEAF STOMATE

ATMOSPHERE

ATMOSPHERE



CO<sub>2</sub>

DIFFUSION

CO<sub>2</sub>

DIFFUSION

H<sub>2</sub>O

DIFFUSION

H<sub>2</sub>O

DIFFUSION

CO<sub>2</sub>

DIFFUSION

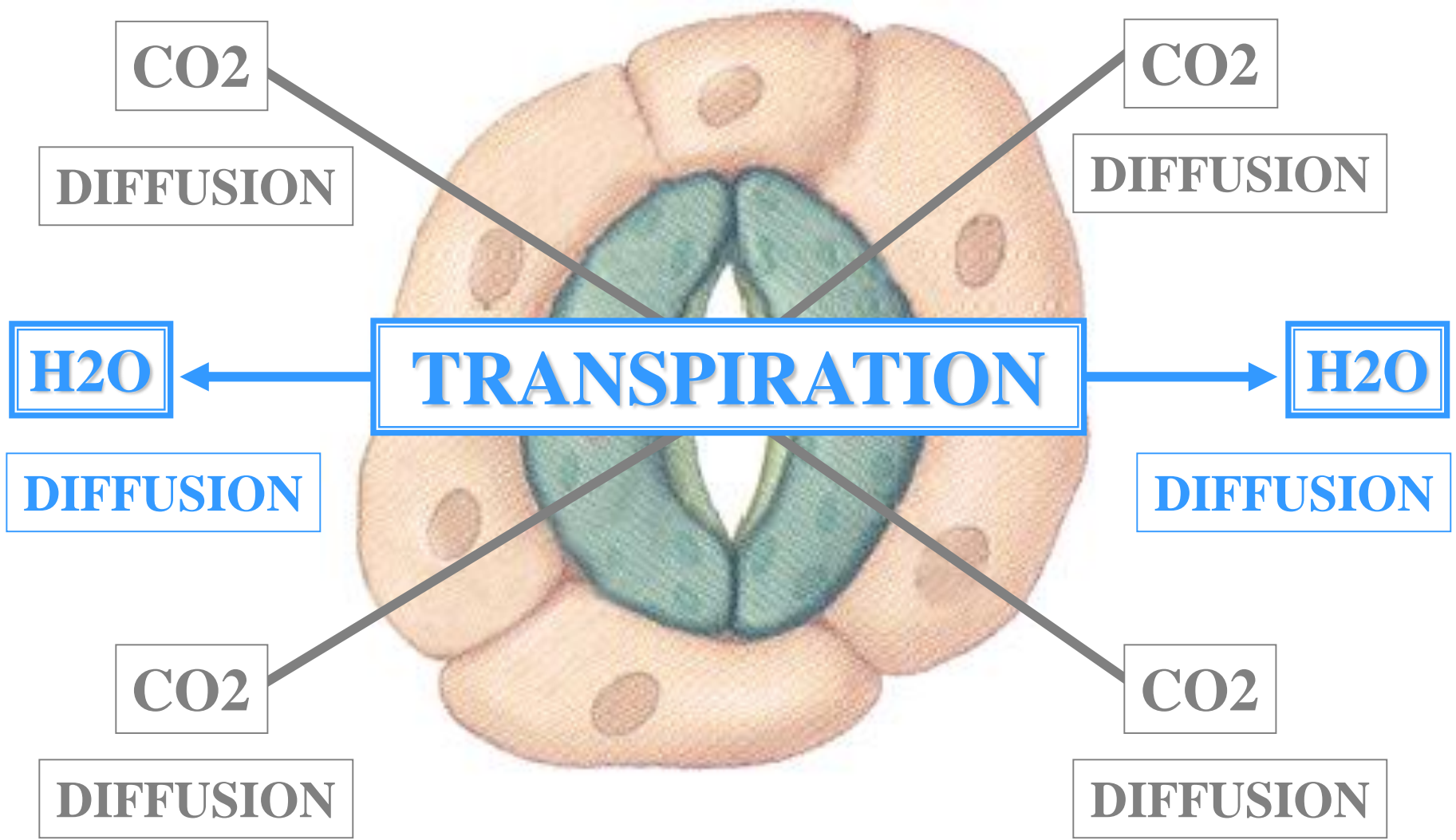
CO<sub>2</sub>

DIFFUSION

# LEAF STOMATE

ATMOSPHERE

ATMOSPHERE



CO<sub>2</sub>

DIFFUSION

CO<sub>2</sub>

DIFFUSION

H<sub>2</sub>O

TRANSPIRATION

H<sub>2</sub>O

DIFFUSION

DIFFUSION

CO<sub>2</sub>

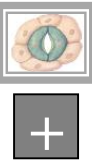
DIFFUSION

CO<sub>2</sub>

DIFFUSION

# **TRANSPIRATION**

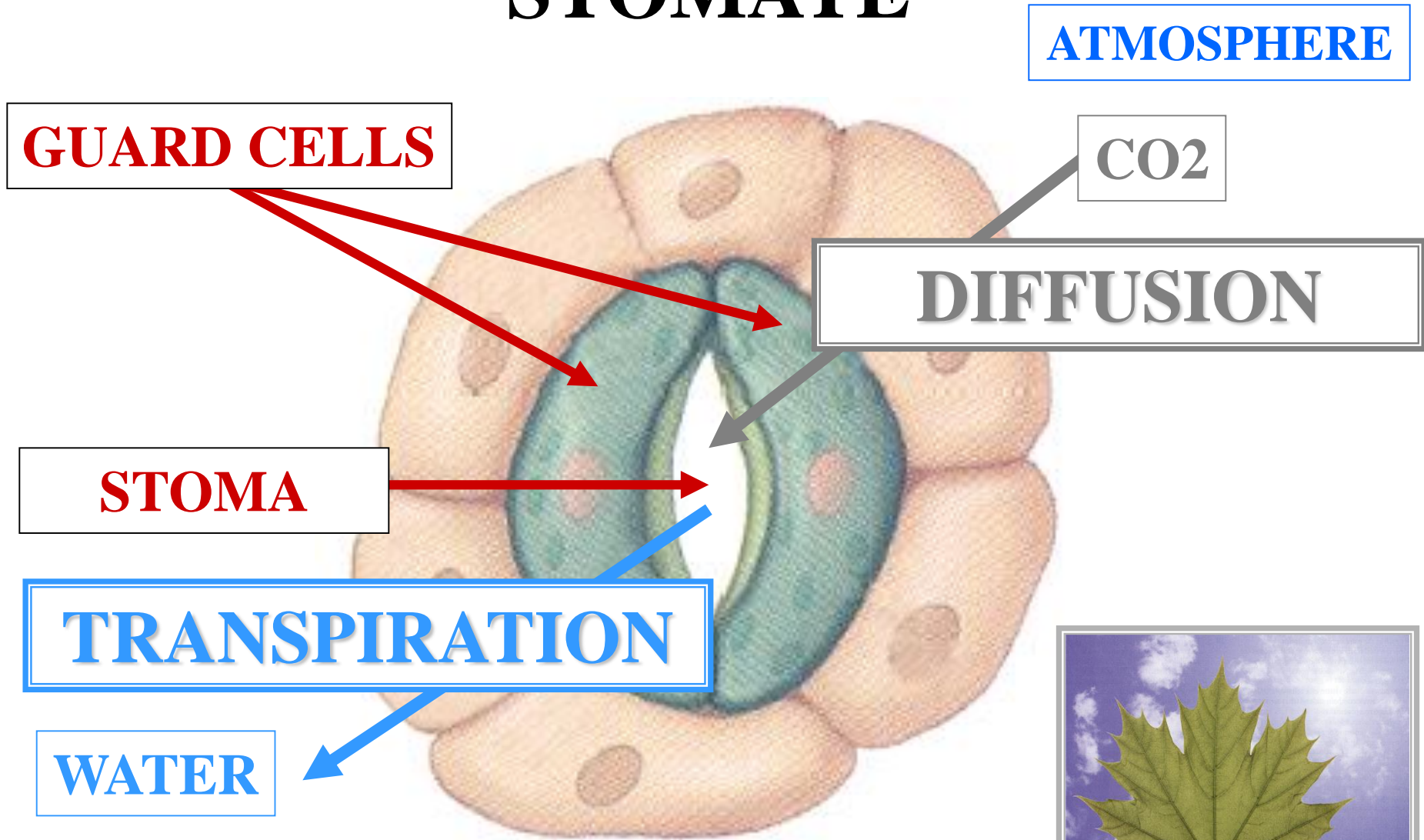
# TRANSPIRATION



WATER LOSS  
VIA STOMATES DURING  
PHOTOSYNTHESIS

TRANSPIRATION

# LEAF STOMATE





**CATABOLIC  
METABOLISM  
&  
ANABOLIC  
METABOLISM  
?**



**EXERGOIC  
REACTIONS  
&  
ENDERGOIC  
REACTIONS  
?**

**REDUCTION  
REACTIONS  
&  
OXIDATION  
REACTIONS  
?**





**LIGHT  
REACTION  
&  
DARK  
REACTION  
?**



# LEAF STOMATE

>

CP

ATMOSPHERE

GUARD CELLS

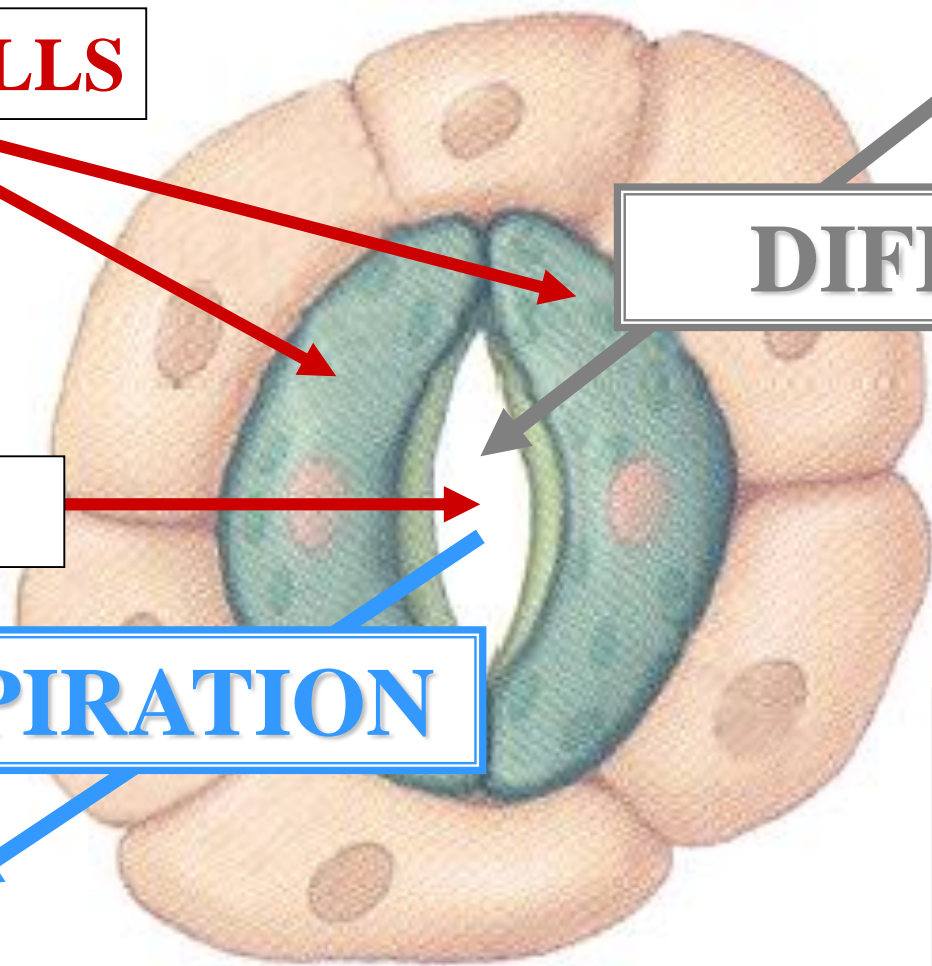
CO<sub>2</sub>

DIFFUSION

STOMA

TRANSPIRATION

WATER





*CO<sub>2</sub> DIFFUSION*  
&  
*H<sub>2</sub>O TRANSPIRATION*  
**!!!COUPLED!!!**



# 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

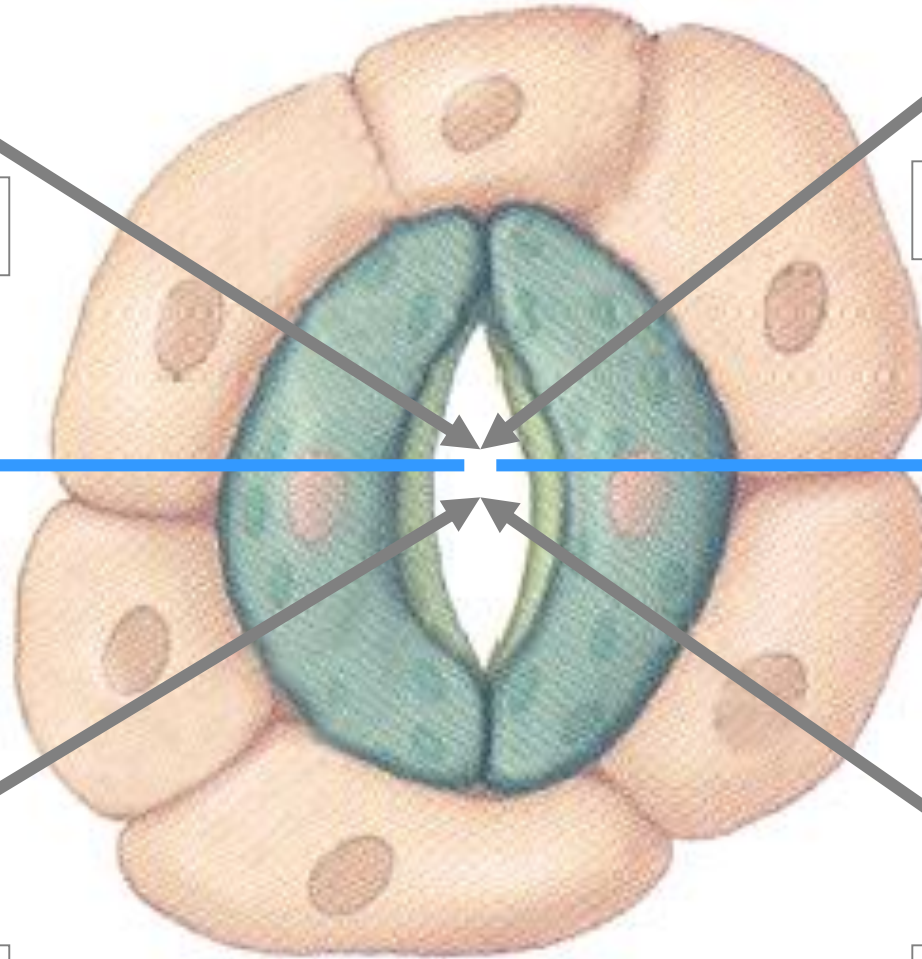
DIFFUSION

CO<sub>2</sub>

CO<sub>2</sub>

DIFFUSION

DIFFUSION



# C3 LEAF

LEAF MESOPHYLL

D

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>

CO<sub>2</sub>



# C3 LEAF

## LEAF MESOPHYLL



CO<sub>2</sub>

CO<sub>2</sub>

CO<sub>2</sub>

DIFFUSION

DIFFUSION

DIFFUSION

CO<sub>2</sub>

CO<sub>2</sub>

CO<sub>2</sub>

DIFFUSION

DIFFUSION

DIFFUSION

CO<sub>2</sub>

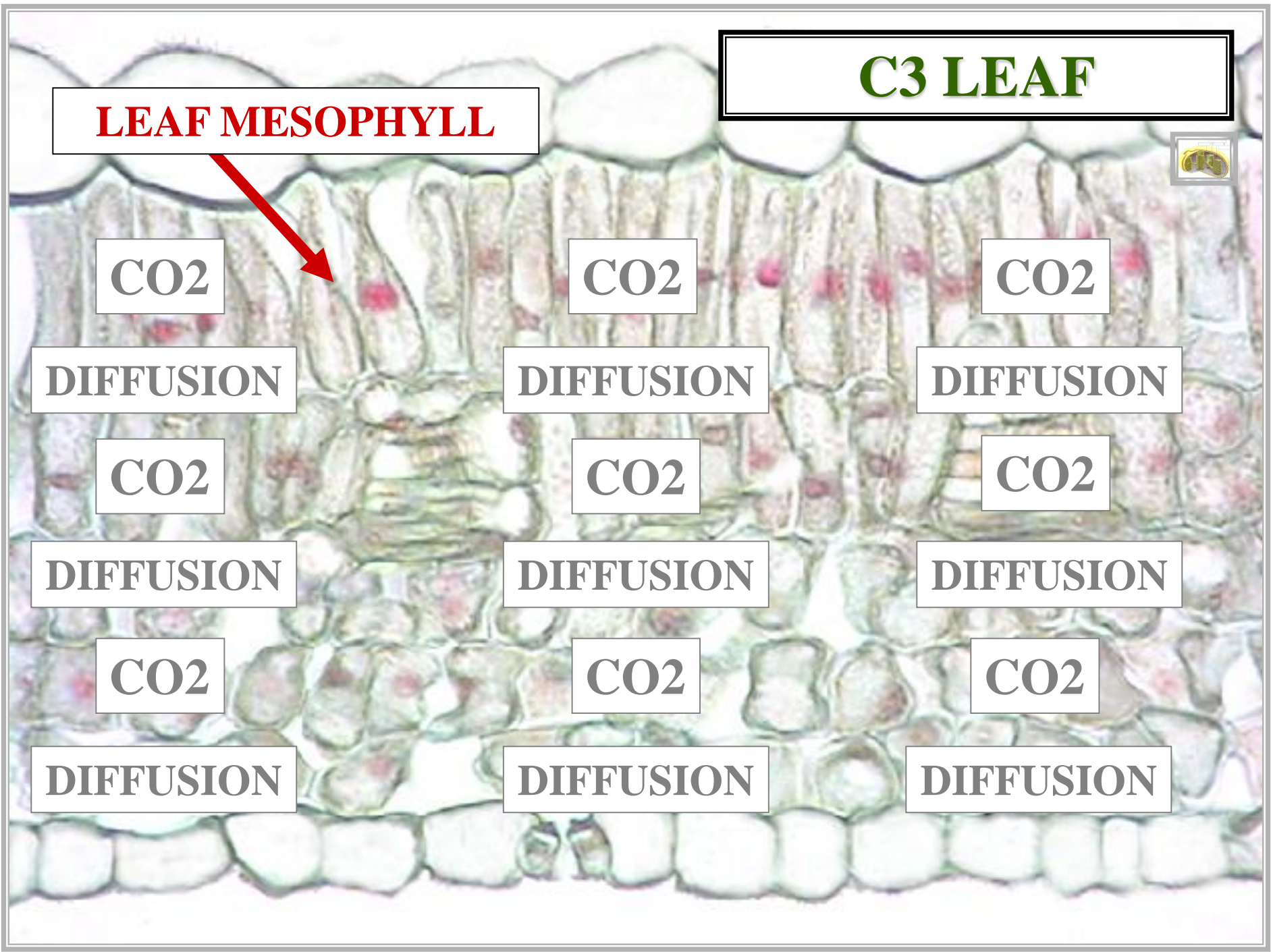
CO<sub>2</sub>

CO<sub>2</sub>

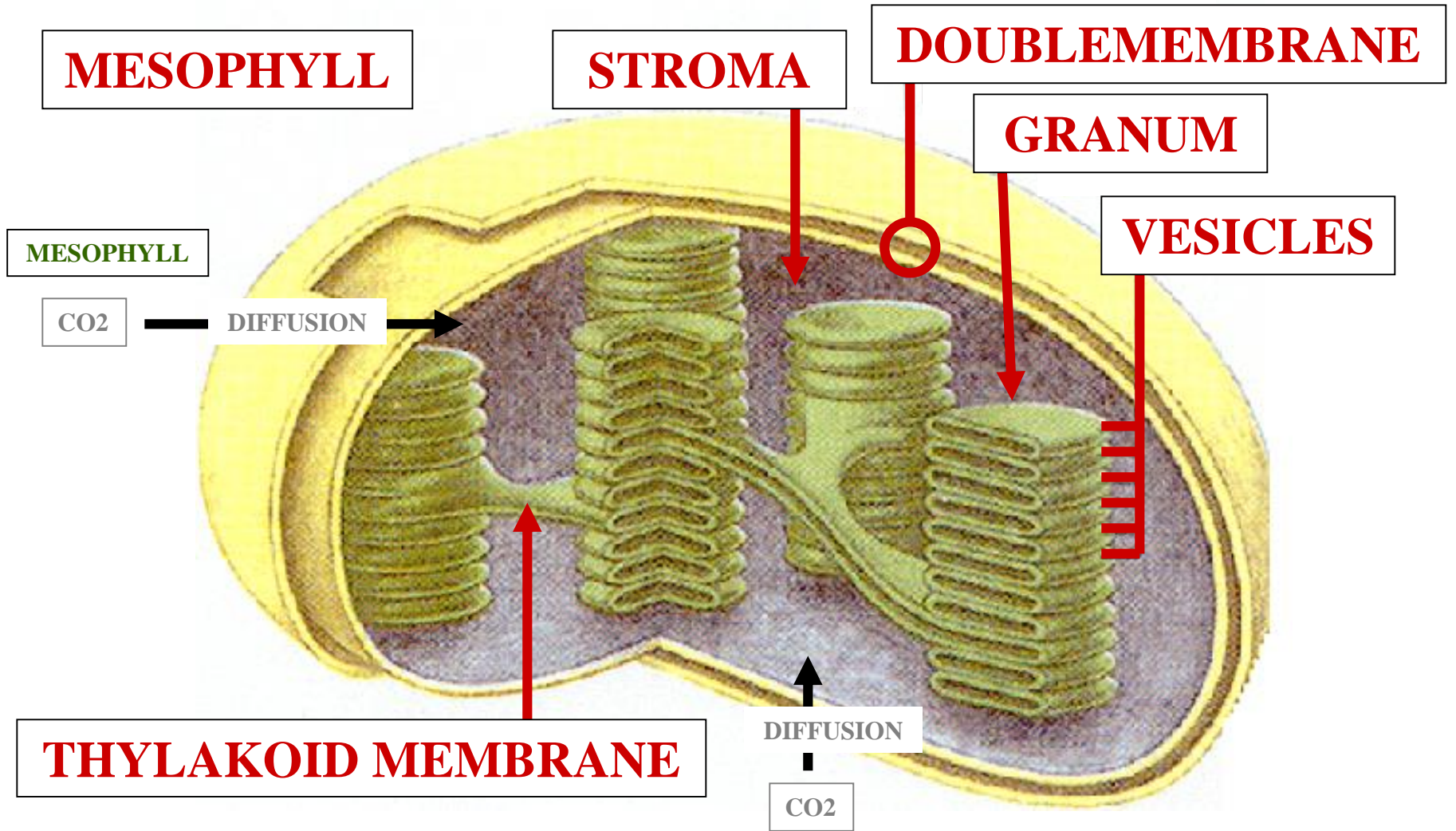
DIFFUSION

DIFFUSION

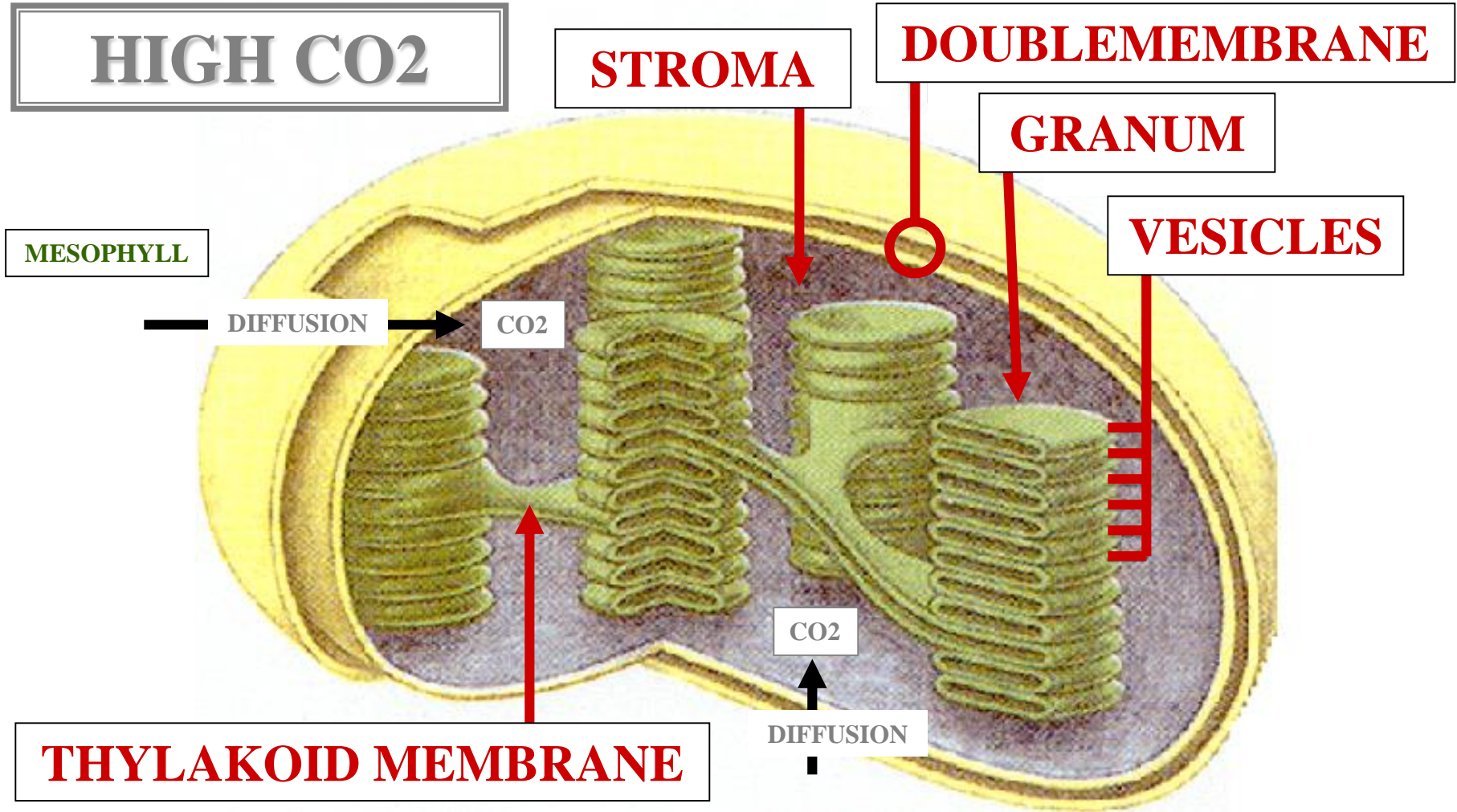
DIFFUSION



# CHLOROPLAST ULTRASTRUCTURE



# CHLOROPLAST ULTRASTRUCTURE



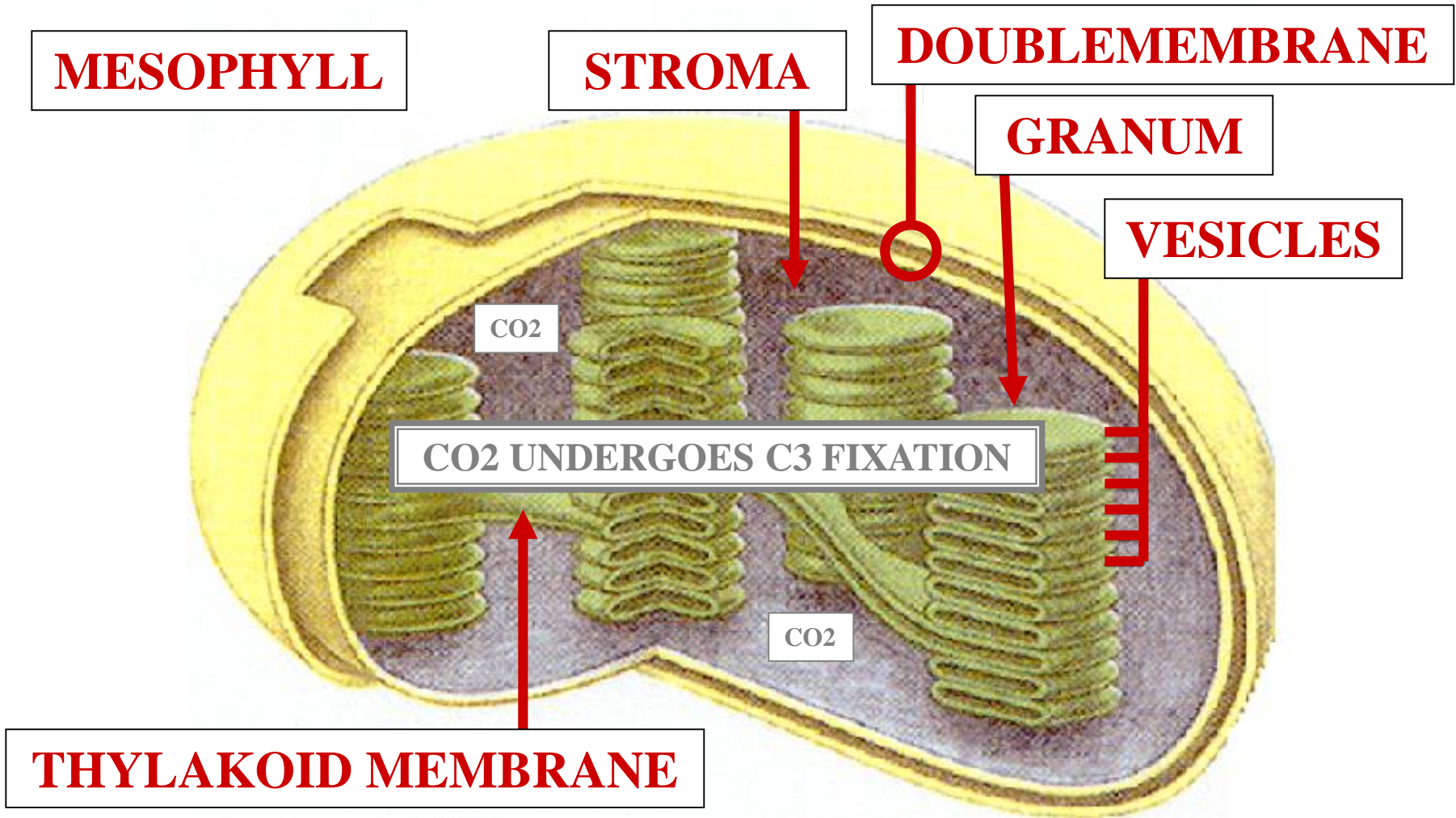




C

# CHLOROPLAST STROMA

# CHLOROPLAST ULTRASTRUCTURE



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

**FIXATION**



**FIXATION**

**PHOTOSYNTHESIS**

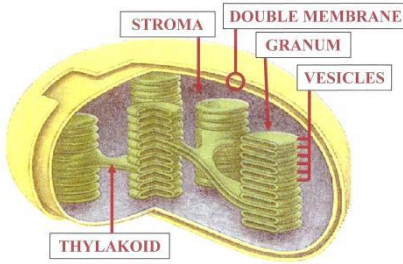
**CO<sub>2</sub>**

**CAPTURE**

**FIXATION**

C3

CO<sub>2</sub>  
ENTERS  
STROMA



C R

# CALVIN CYCLE

**C3**

CO<sub>2</sub>  
ENTERS  
STROMA



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



**6**

# CALVIN CYCLE

**C3**

CO<sub>2</sub>  
ENTERS  
STROMA

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

**UNSTABLE 6C COMPOUND**



**FXR**

**>**

# CALVIN CYCLE



**C3**

CO<sub>2</sub>  
ENTERS  
STROMA

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

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

**UNSTABLE 6C COMPOUND**



**EZ**

+

# CALVIN CYCLE

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

**C3**

CO<sub>2</sub>  
ENTERS  
STROMA

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

ENZYME

UNSTABLE 6C COMPOUND



# CALVIN CYCLE

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



**C3 PATHWAY  
CO2 FIXATION  
ENZYME**

**ENZYME**

C

+

**RIBULOSE BISPHTOSPHATE  
CARBOXYLASE  
(RUBP-ASE = RUBISCO)**

**ENZYME**

**CARBOXYLASE**



**CARBOXYLASE**

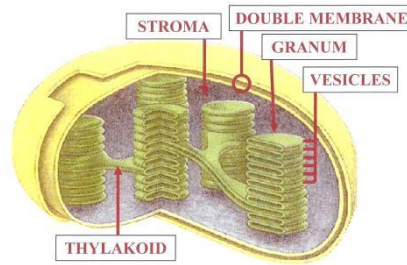
**ENZYME**

**ADDS CO<sub>2</sub> TO SUBSTRATE**

**CARBOXYLASE**

C3

CO<sub>2</sub>  
ENTERS  
STROMA



C R

# RIBULOSE BISPHOSEPHATE CARBOXYLASE (RUBP-ASE)

**C3**

CO<sub>2</sub>  
ENTERS  
STROMA



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



**EZ**

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



**C3**

**CO<sub>2</sub>  
ENTERS  
STROMA**

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

**RIBULOSE BISP HOSPHATE  
CARBOXYLASE  
(RUBP-CARBOXYLASE)**



**6**

# **RIBULOSE BISP HOSPHATE CARBOXYLASE (RUBP-ASE)**

**C3**

CO<sub>2</sub>  
ENTERS  
STROMA



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

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

**FXE**

**>**

**UNSTABLE 6C COMPOUND**

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

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

**C3**

CO<sub>2</sub>  
ENTERS  
STROMA



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

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

**I**

**>**

**UNSTABLE 6C COMPOUND**

**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)**



**UNSTABLE 6C COMPOUND**

**INEFFICIENT  
ENZYME**



ATMOSPHERE

# LEAF STOMATE

ATMOSPHERE

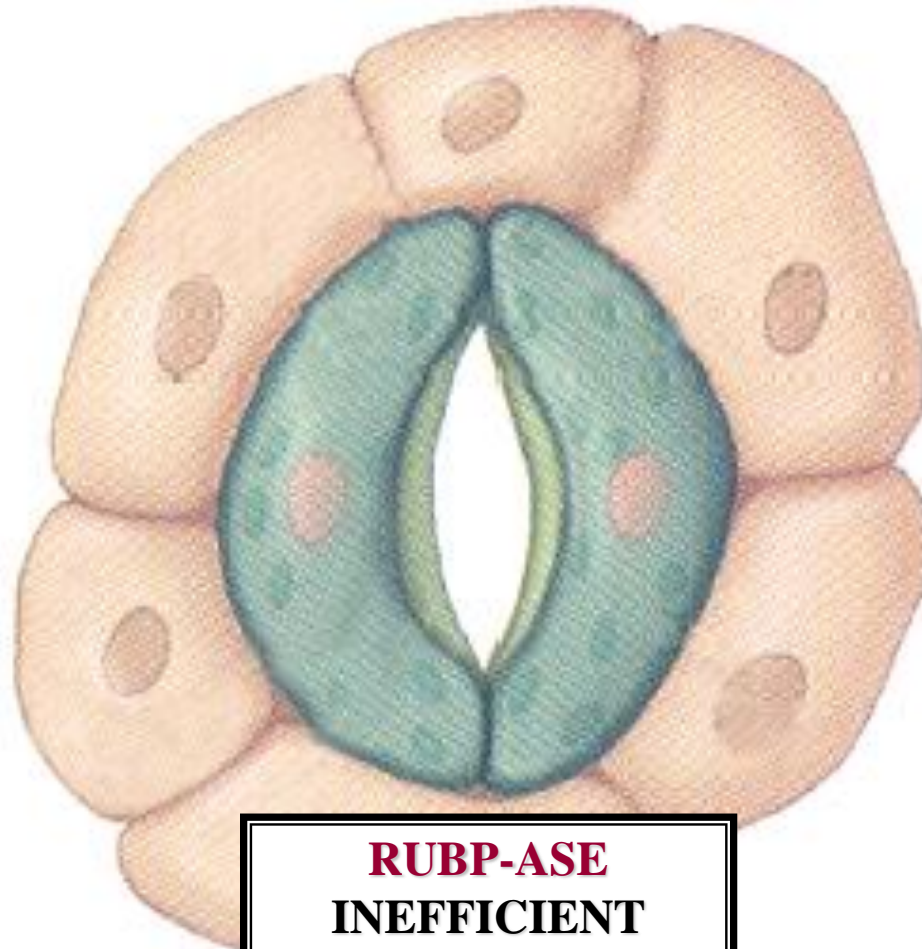
CO<sub>2</sub>

CO<sub>2</sub>



CO<sub>2</sub>

CO<sub>2</sub>



**RUBP-ASE**  
**INEFFICIENT**  
**ENZYME**



# 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

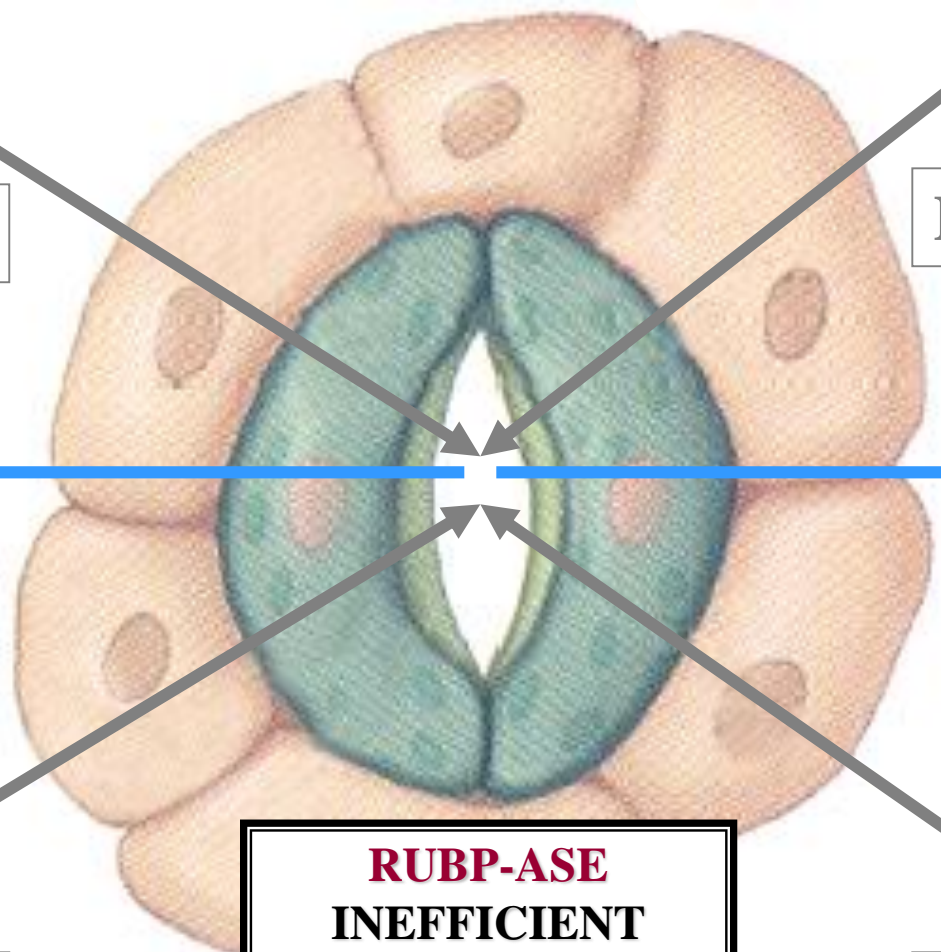
CO<sub>2</sub>

CO<sub>2</sub>

DIFFUSION

DIFFUSION

**RUBP-ASE**  
**INEFFICIENT**  
**ENZYME**



# LEAF STOMATE

ATMOSPHERE

ATMOSPHERE + →

CO<sub>2</sub>

DIFFUSION

CO<sub>2</sub>

DIFFUSION

H<sub>2</sub>O

DIFFUSION

CO<sub>2</sub>  
ESCAPES

H<sub>2</sub>O

DIFFUSION

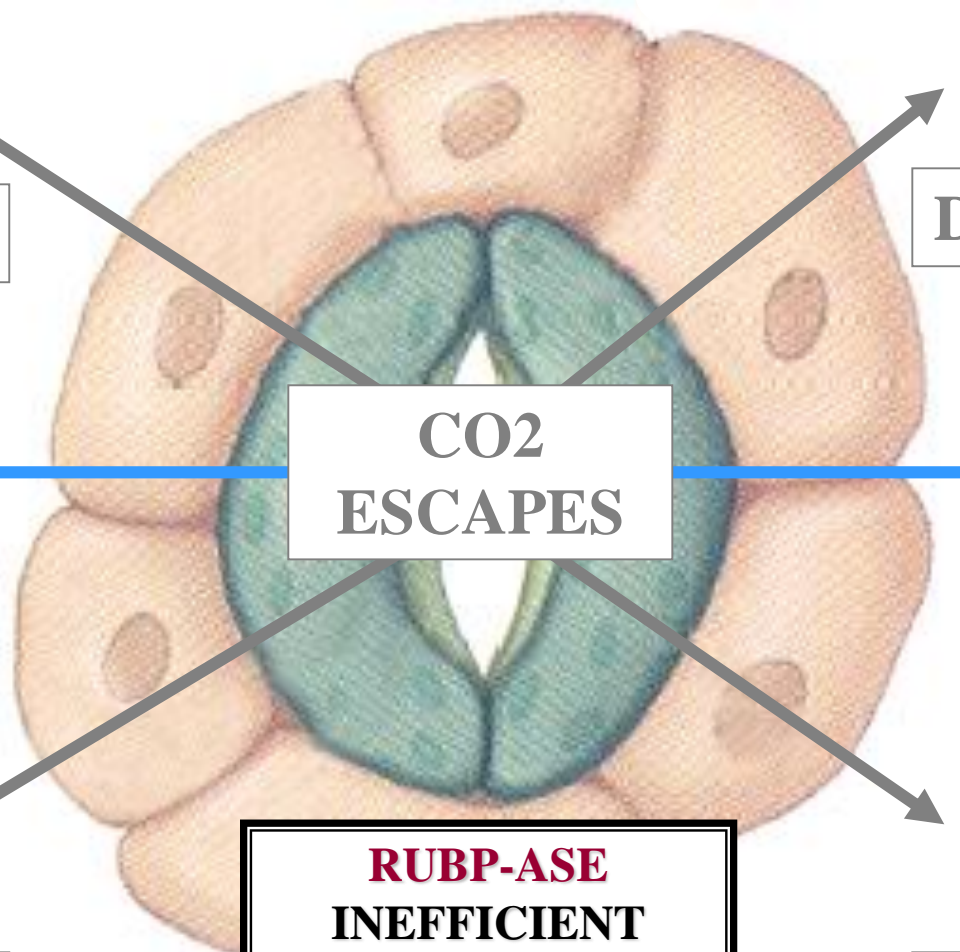
CO<sub>2</sub>

DIFFUSION

**RUBP-ASE**  
**INEFFICIENT**  
**ENZYME**

CO<sub>2</sub>

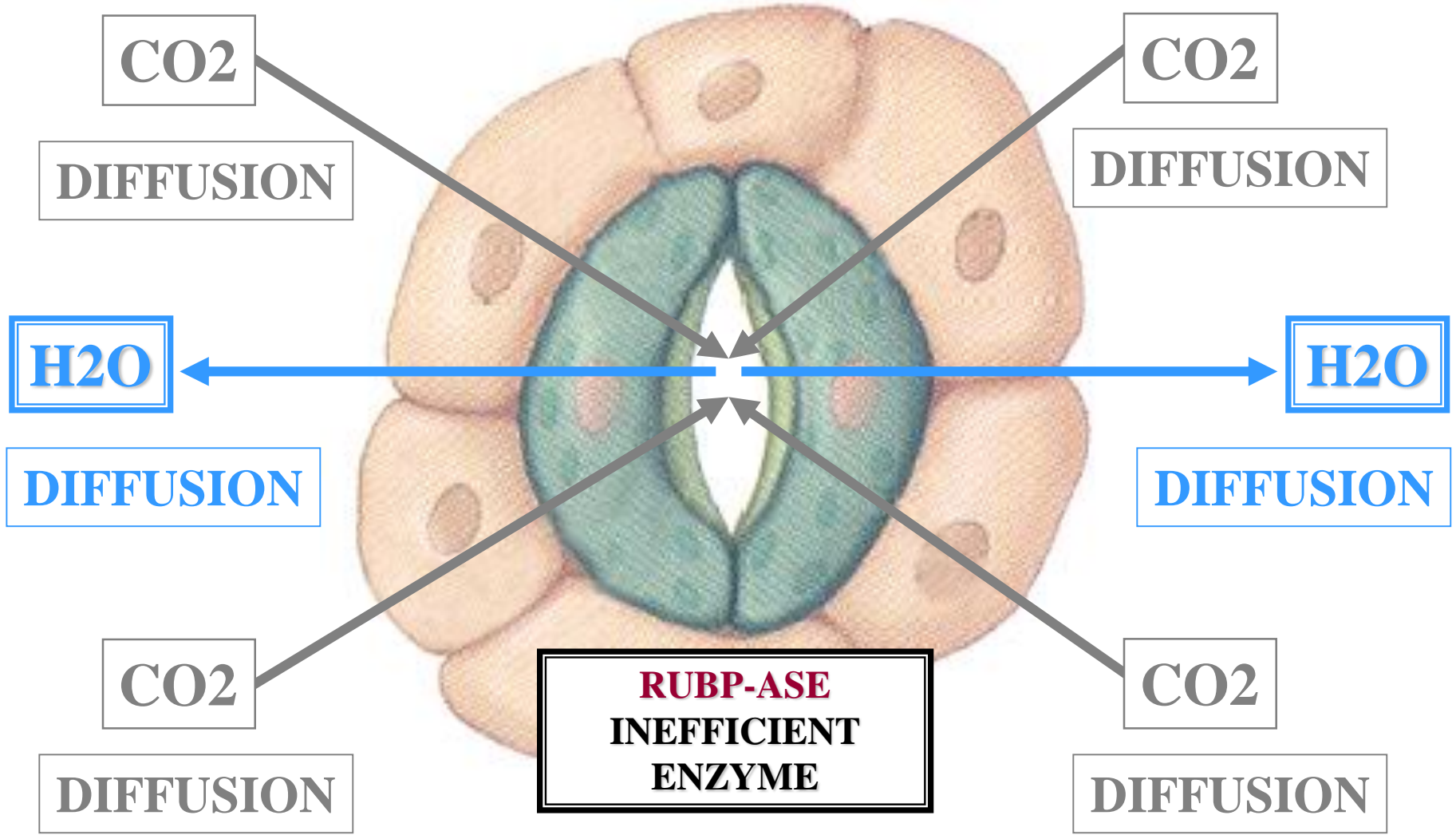
DIFFUSION



# LEAF STOMATE

ATMOSPHERE

ATMOSPHERE





ATMOSPHERE

ATMOSPHERE

# LEAF STOMATE

CO<sub>2</sub>

CO<sub>2</sub>

**OPEN LONG PERIODS**

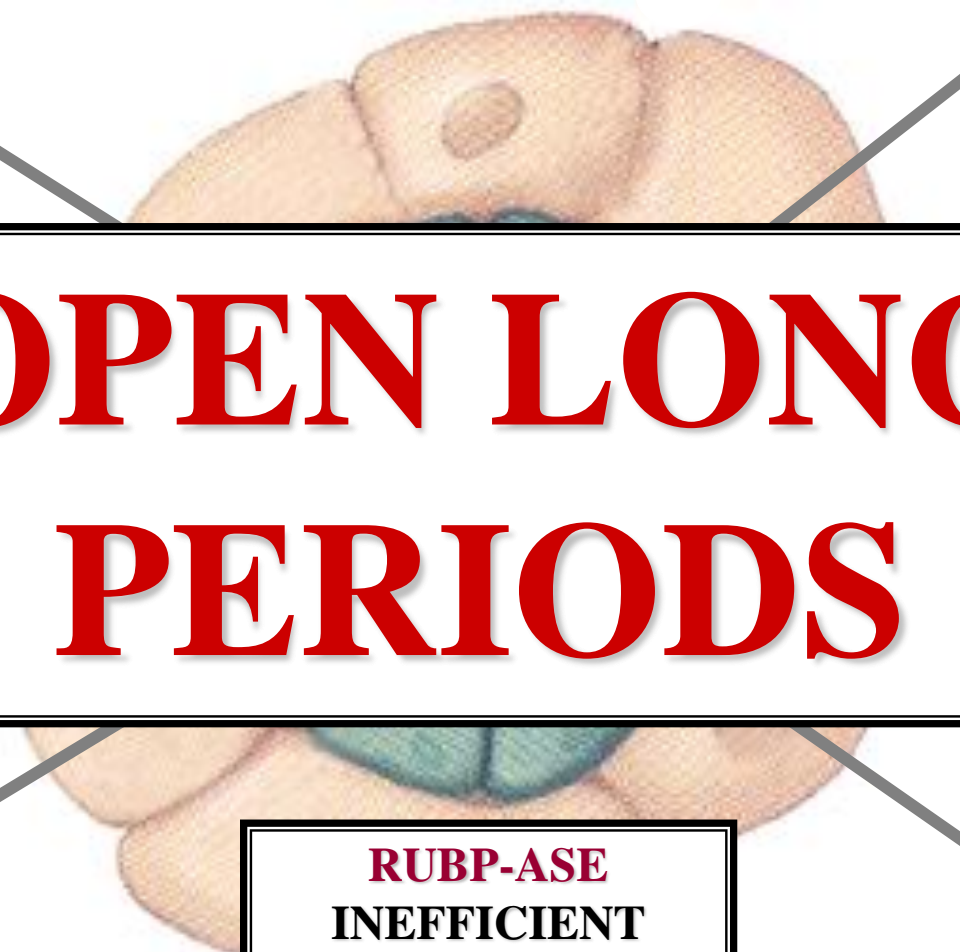
C<sub>3</sub>

C<sub>3</sub>

CO<sub>2</sub>

CO<sub>2</sub>

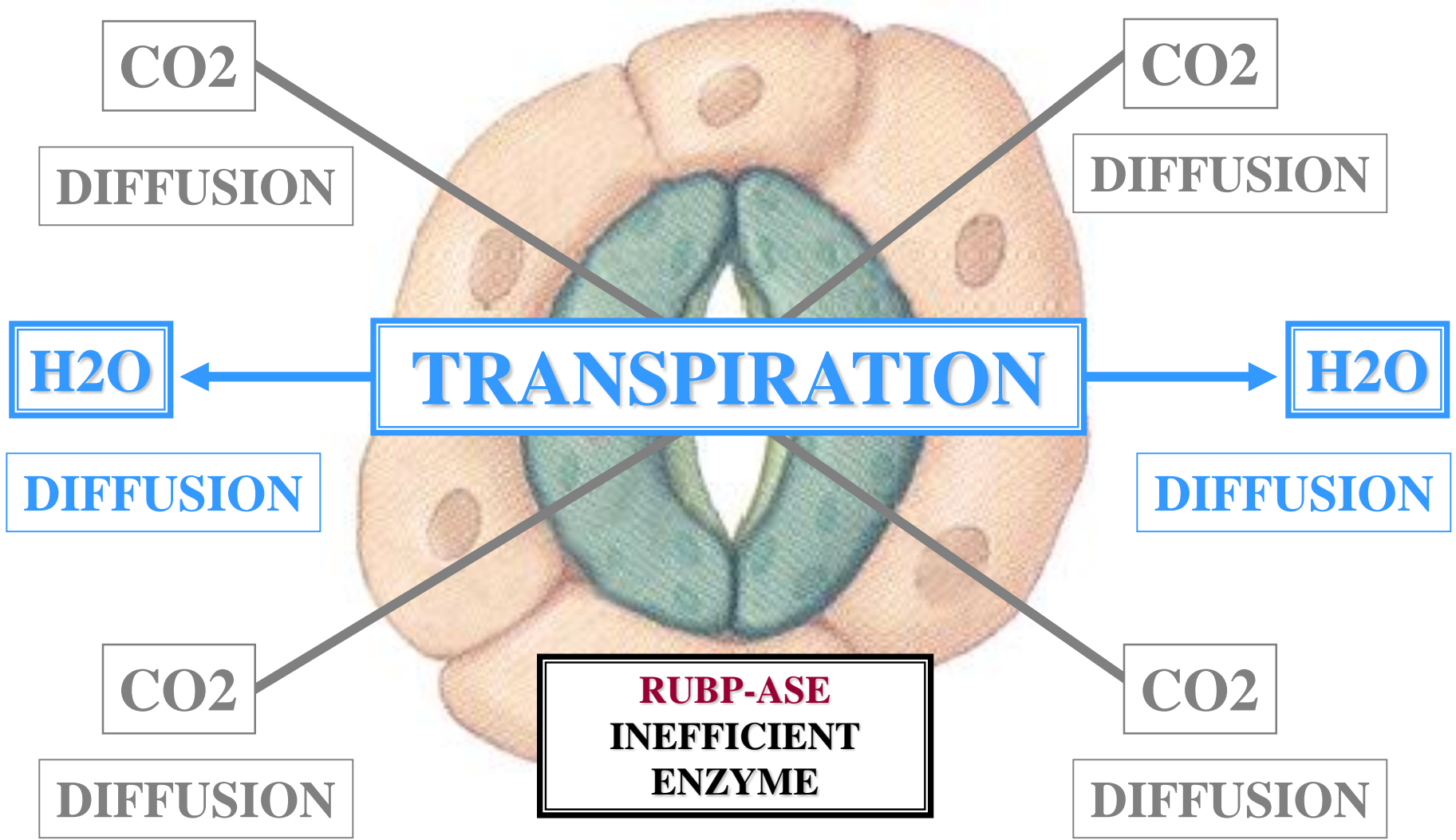
**RUBP-ASE  
INEFFICIENT  
ENZYME**



# LEAF STOMATE

ATMOSPHERE

ATMOSPHERE



CO2

CO2

DIFFUSION

DIFFUSION

H2O

TRANSPIRATION

H2O

DIFFUSION

DIFFUSION

CO2

CO2

DIFFUSION

DIFFUSION

RUBP-ASE  
INEFFICIENT  
ENZYME



ATMOSPHERE

# LEAF STOMATE

ATMOSPHERE

CO<sub>2</sub>

CO<sub>2</sub>

C<sub>3</sub>

HIGH

C<sub>3</sub>

TRANSPIRATION

CO<sub>2</sub>

CO<sub>2</sub>

RUBP-ASE  
INEFFICIENT  
ENZYME



**C3**

**MAPLE**

\$

S

*C3 PLANTS  
REQUIRE  
ADEQUATE  
WATER*

**C3**

**MAPLE**



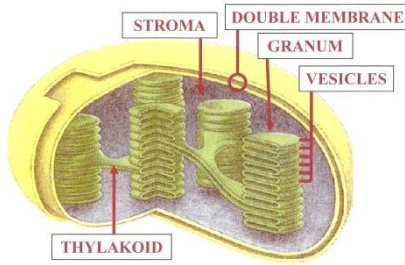
# **C3**

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

# **SUMMARY**

C3

CO<sub>2</sub>  
ENTERS  
STROMA



C R

# CALVIN CYCLE

**C3**

CO<sub>2</sub>  
ENTERS  
STROMA



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



**EZ**

# CALVIN CYCLE



**C3**

CO<sub>2</sub>  
ENTERS  
STROMA



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



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



**6**

# CALVIN CYCLE

**C3**

**CO<sub>2</sub>  
ENTERS  
STROMA**

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

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

**UNSTABLE 6C COMPOUND**



**2**

# **CALVIN CYCLE**

**C3**

**CO2  
ENTERS  
STROMA**



**CO2 + RIBULOSE BISPHOSEPHATE / (RUBP)**

**PE**

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

**PHOSPHOGLYCERATE / (PGA)**

**UNSTABLE 6C COMPOUND**

**PHOSPHOGLYCERATE / (PGA)**

**PGA = 1<sup>ST</sup> STABLE CMP**

**H2O**

**PGA = 1<sup>ST</sup> STABLE CMP**

# CALVIN CYCLE

**C3**

**CO2  
ENTERS  
STROMA**



**CO2 + RIBULOSE BISPHOSEPHATE / (RUBP)**

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

**C**

**PHOSPHOGLYCERATE / (PGA)**

**UNSTABLE 6C COMPOUND**

**PHOSPHOGLYCERATE / (PGA)**

**PGA = 1<sup>ST</sup> STABLE CMP**

**PGA = 1<sup>ST</sup> STABLE CMP**

**H2O**

# CALVIN CYCLE

**PHOTOSYNTHESIS  
EQUATION**



**C3**

CO<sub>2</sub>  
ENTERS  
STROMA



CO<sub>2</sub> + RIBULOSE BISP<sup>H</sup>OSPHATE / (RUBP)

RIBULOSE BISP<sup>H</sup>OSPHATE  
CARBOXYLASE  
(RUBP-CARBOXYLASE)

**H**

PHOSPHOGLYCERATE / (PGA)

UNSTABLE 6C COMPOUND

PHOSPHOGLYCERATE / (PGA)

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

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

H<sub>2</sub>O

# CALVIN CYCLE

**PHOTOSYNTHESIS  
EQUATION**



**C3**

CO2  
ENTERS  
STROMA



CO2 + **RIBULOSE BISPHOSEPHATE / (RUBP)**

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

?

**PGA**

**PHOSPHOGLYCERATE / (PGA)**

**UNSTABLE 6C COMPOUND**

**PHOSPHOGLYCERATE / (PGA)**

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

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

**H2O**

# CALVIN CYCLE

**PHOTOSYNTHESIS  
EQUATION**



**C3**

**CO2  
ENTERS  
STROMA**



**CO2 + RIBULOSE BISPHOSEPHATE / (RUBP)**

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

**3**

**#**

**PHOSPHOGLYCERATE / (PGA)**

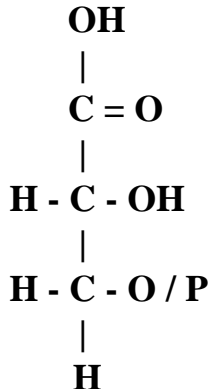
**UNSTABLE 6C COMPOUND**

**PHOSPHOGLYCERATE / (PGA)**

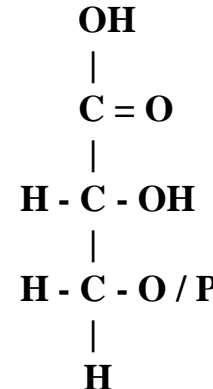
**PGA = 1<sup>ST</sup> STABLE CMP**

**PGA = 1<sup>ST</sup> STABLE CMP**

# CALVIN CYCLE



**PHOSPHOGLYCERATE / (PGA)**



**PHOSPHOGLYCERATE / (PGA)**

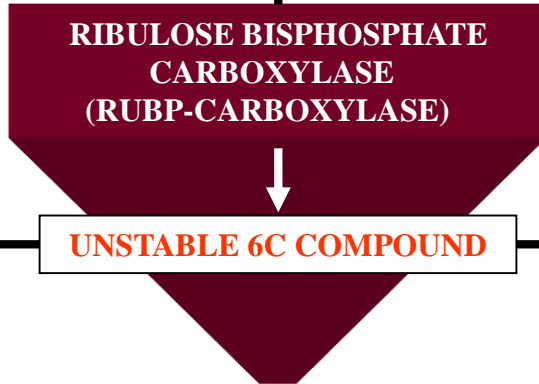
**C3**

CO<sub>2</sub>  
ENTERS  
STROMA



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

**C3**



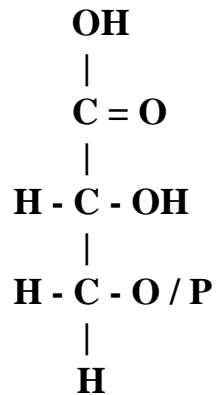
**PHOSPHOGLYCERATE / (PGA)**

**PHOSPHOGLYCERATE / (PGA)**

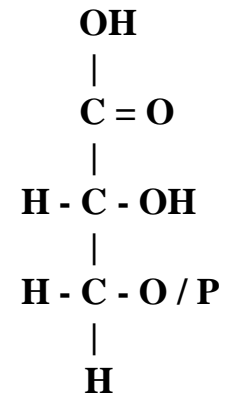
PGA = 1<sup>ST</sup> STABLE CMP

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

# CALVIN CYCLE



3 CARBON CMP



3 CARBON CMP

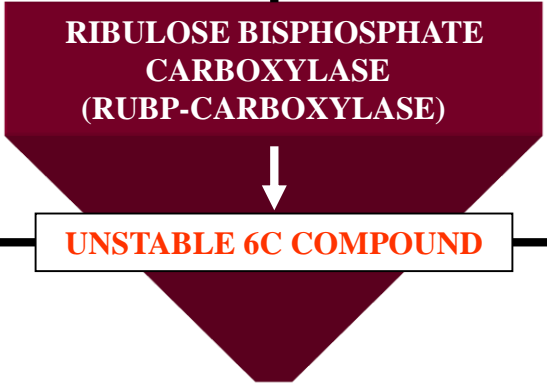


**C3**

CO<sub>2</sub>  
ENTERS  
STROMA



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



**2**

**PGA**

**PHOSPHOGLYCERATE / (PGA)**

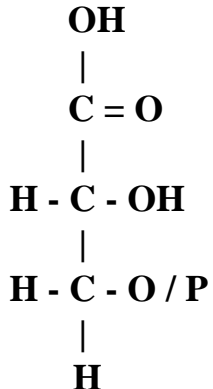
**UNSTABLE 6C COMPOUND**

**PHOSPHOGLYCERATE / (PGA)**

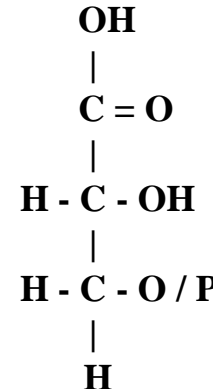
PGA = 1<sup>ST</sup> STABLE CMP

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

**CALVIN CYCLE  
C3 PATHWAY**



3 CARBON CMP



3 CARBON CMP

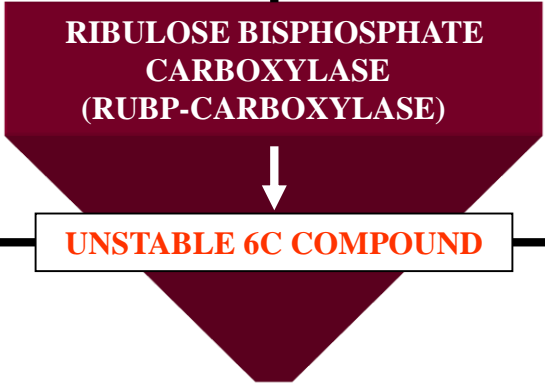
**C3**

**CO<sub>2</sub>  
ENTERS  
STROMA**



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

**2**



**PHOSPHOGLYCERATE / (PGA)**

**UNSTABLE 6C COMPOUND**

**PHOSPHOGLYCERATE / (PGA)**

**ALL RXTS  
REQUIRE  
A SPECIFIC  
ENZYME**

# **CALVIN CYCLE**

**C3**

**CO<sub>2</sub>  
ENTERS  
STROMA**



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

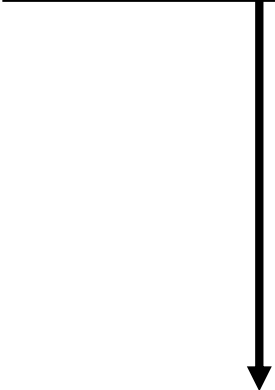
**RIBULOSE BISPHOSEPHATE  
CARBOXYLASE  
(RUBP-CARBOXYLASE)**

**A**

**PHOSPHOGLYCERATE / (PGA)**

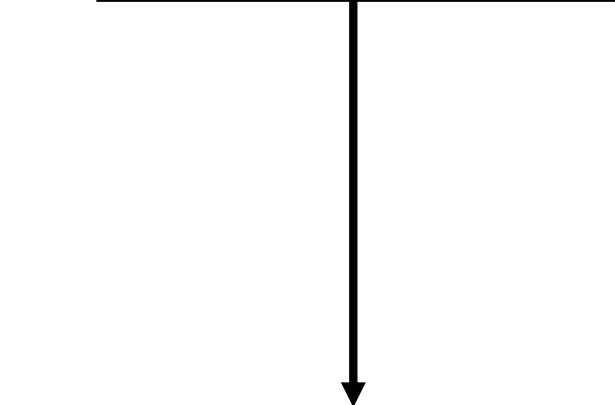
**UNSTABLE 6C COMPOUND**

**PHOSPHOGLYCERATE / (PGA)**



**BISPHOSPHOGLYCERATE / (BIPGA)**

**ALL RXTS  
REQUIRE  
A SPECIFIC  
ENZYME**



**BISPHOSPHOGLYCERATE / (BIPGA)**

**CALVIN CYCLE**

**C3**

**CO<sub>2</sub>  
ENTERS  
STROMA**



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

**RIBULOSE BISPHOEPHATE  
CARBOXYLASE  
(RUBP-CARBOXYLASE)**

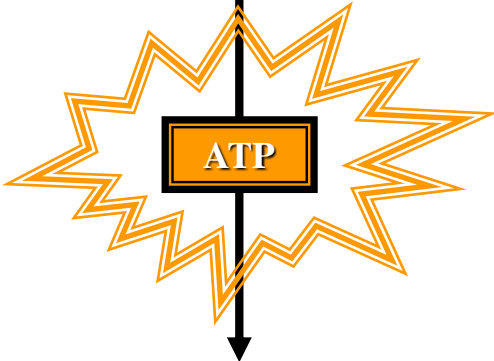
**LR**



**PHOSPHOGLYCERATE / (PGA)**

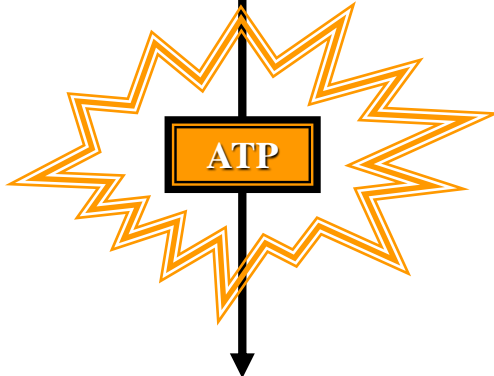
**UNSTABLE 6C COMPOUND**

**PHOSPHOGLYCERATE / (PGA)**



**BISPHOEPHOGLYCERATE / (BIPGA)**

**ALL RXTS  
REQUIRE  
A SPECIFIC  
ENZYME**



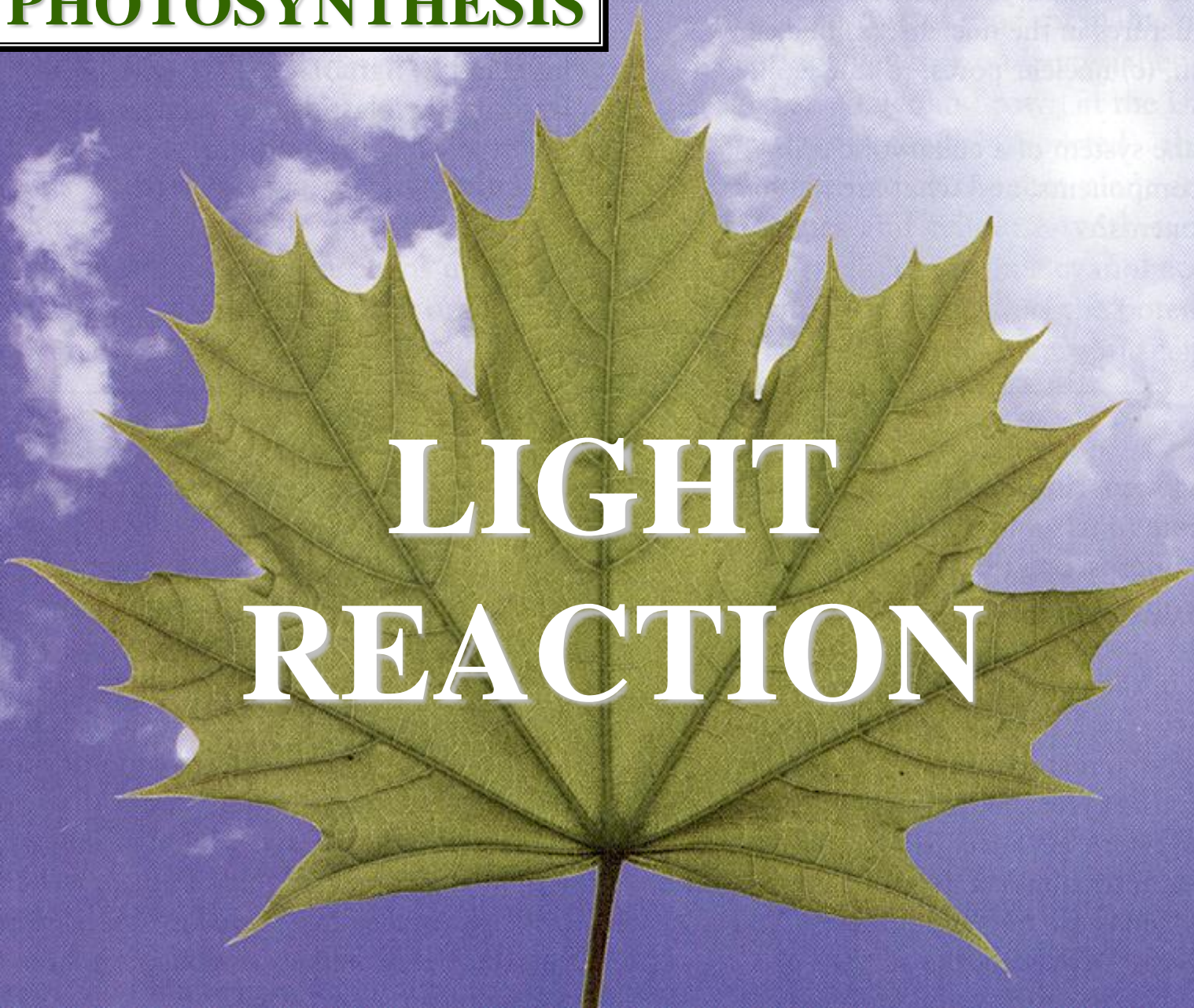
**BISPHOEPHOGLYCERATE / (BIPGA)**

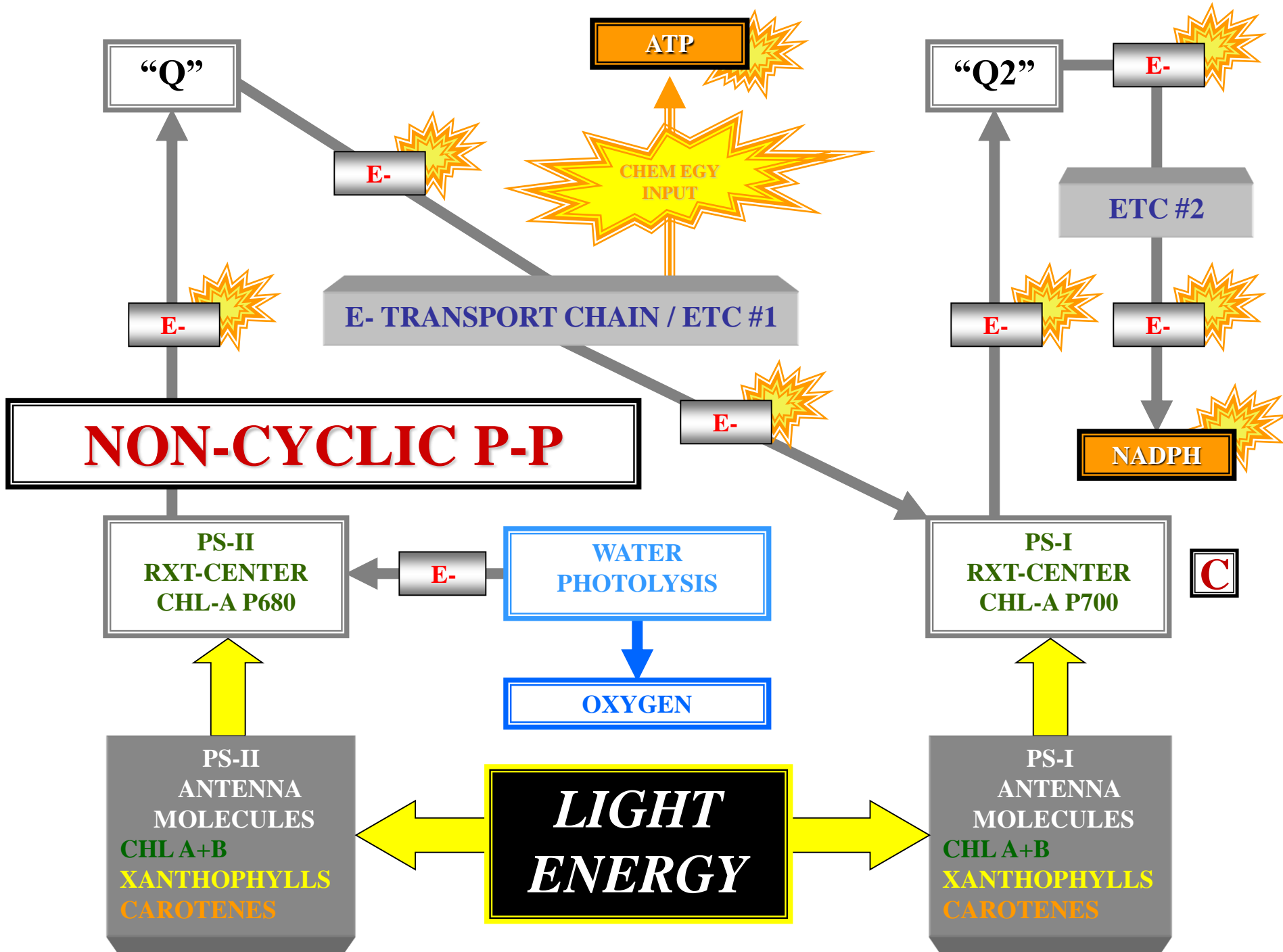
# **CALVIN CYCLE**

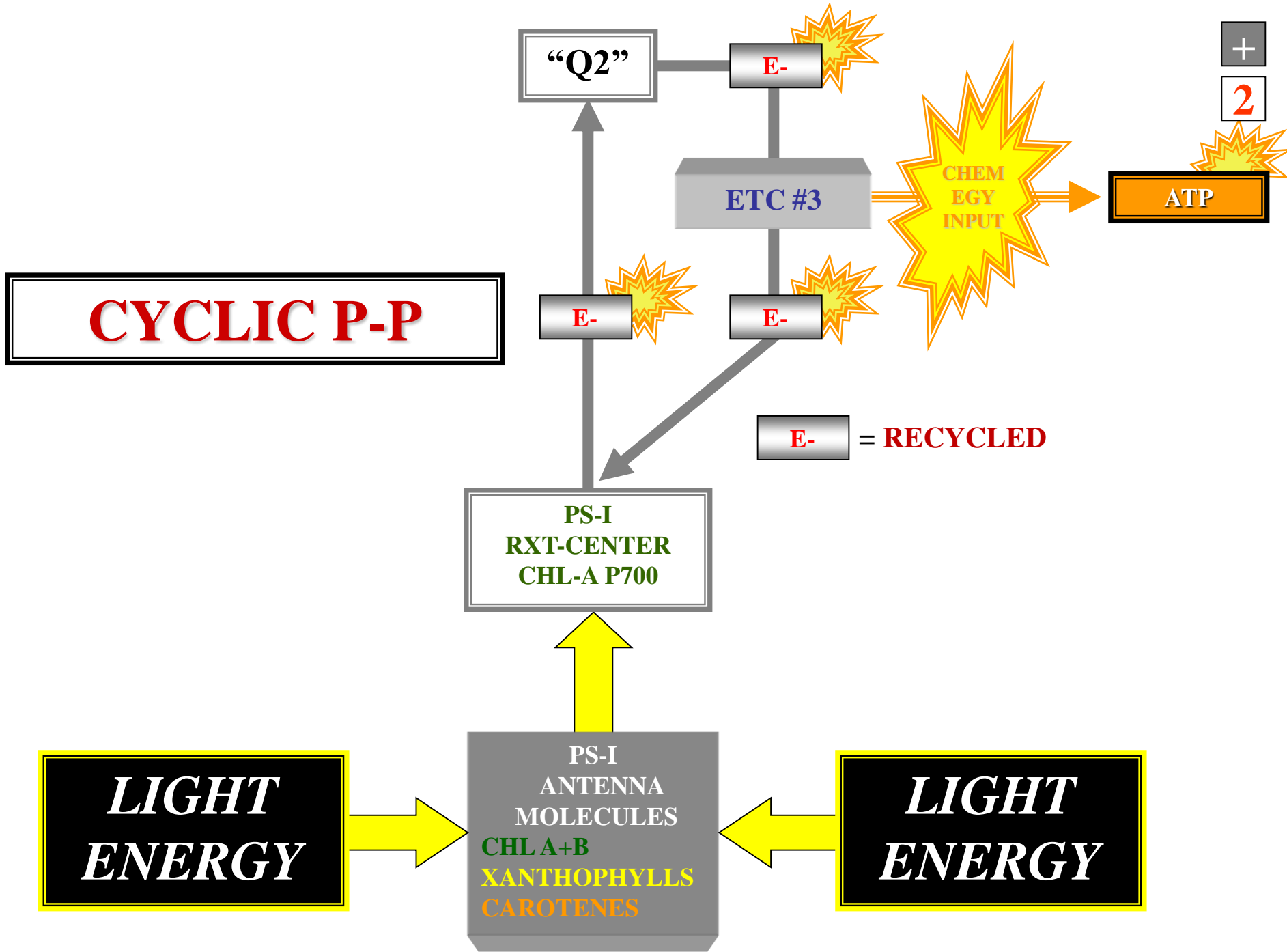
# PHOTOSYNTHESIS



# LIGHT REACTION







**C3**

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



**RIBULOSE BIPHOSPHATE  
CARBOXYLASE  
(RUBP-CARBOXYLASE)**

**PHOSPHOGLYCERATE / (PGA)**

**UNSTABLE 6C COMPOUND**

**PHOSPHOGLYCERATE / (PGA)**

**ATP**

**ATP**

**2**

**BIPHOSPHOGLYCERATE / (BIPGA)**

**ALL RXTS  
REQUIRE  
A SPECIFIC  
ENZYME**

**BIPHOSPHOGLYCERATE / (BIPGA)**

# **C3 PATHWAY CALVIN CYCLE**



**C3**

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



**RIBULOSE BIPHOSPHATE  
CARBOXYLASE  
(RUBP-CARBOXYLASE)**

**PHOSPHOGLYCERATE / (PGA)**

**UNSTABLE 6C COMPOUND**

**PHOSPHOGLYCERATE / (PGA)**

**ATP**

**ATP**

**N**

**BIPHOSPHOGLYCERATE / (BIPGA)**

**ALL RXTS  
REQUIRE  
A SPECIFIC  
ENZYME**

**BIPHOSPHOGLYCERATE / (BIPGA)**

**PHOSPHOGLYCERALDEHYDE / (PGAL)**

**PHOSPHOGLYCERALDEHYDE / (PGAL)**

**C3 PATHWAY  
CALVIN CYCLE**

**C3**

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



**RIBULOSE BIPHOSPHATE  
CARBOXYLASE  
(RUBP-CARBOXYLASE)**

**PHOSPHOGLYCERATE / (PGA)**

**UNSTABLE 6C COMPOUND**

**PHOSPHOGLYCERATE / (PGA)**

**ATP**

**ATP**

**LR**

**BIPHOSPHOGLYCERATE / (BIPGA)**

**BIPHOSPHOGLYCERATE / (BIPGA)**



**NADPH**

**NADPH**

**PHOSPHOGLYCERALDEHYDE / (PGAL)**

**PHOSPHOGLYCERALDEHYDE / (PGAL)**

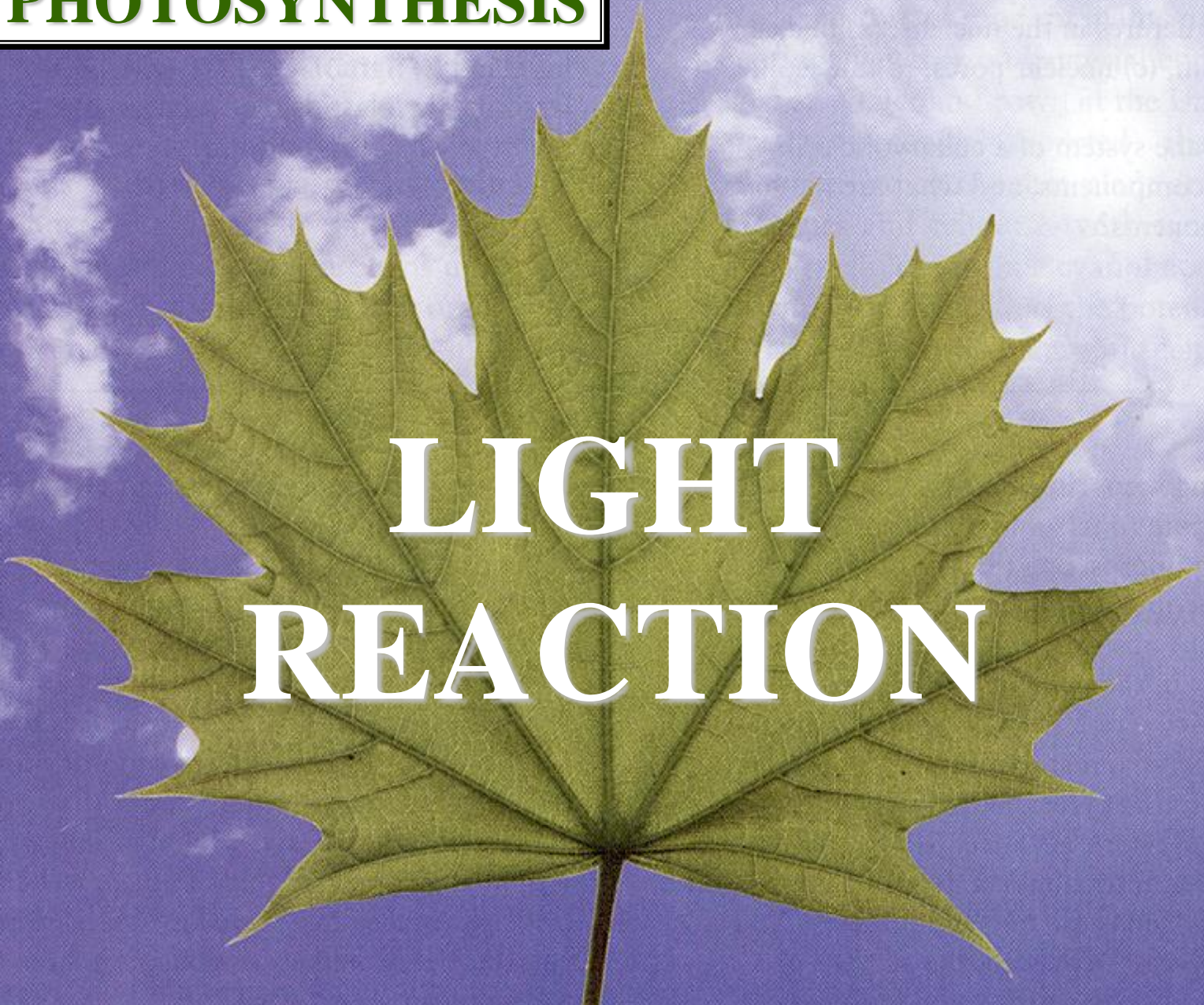
**ALL RXTS  
REQUIRE  
A SPECIFIC  
ENZYME**

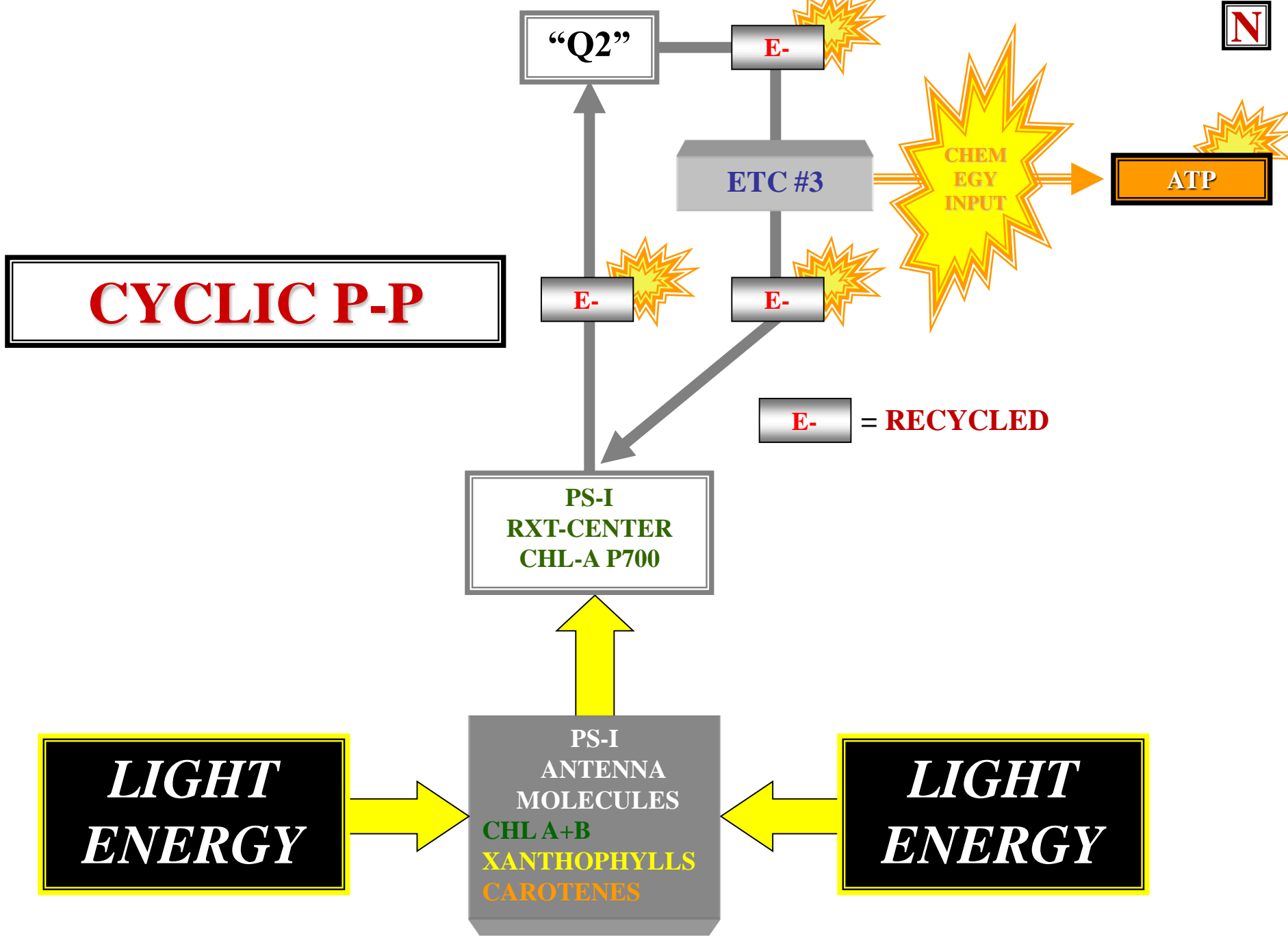
**C3 PATHWAY  
CALVIN CYCLE**

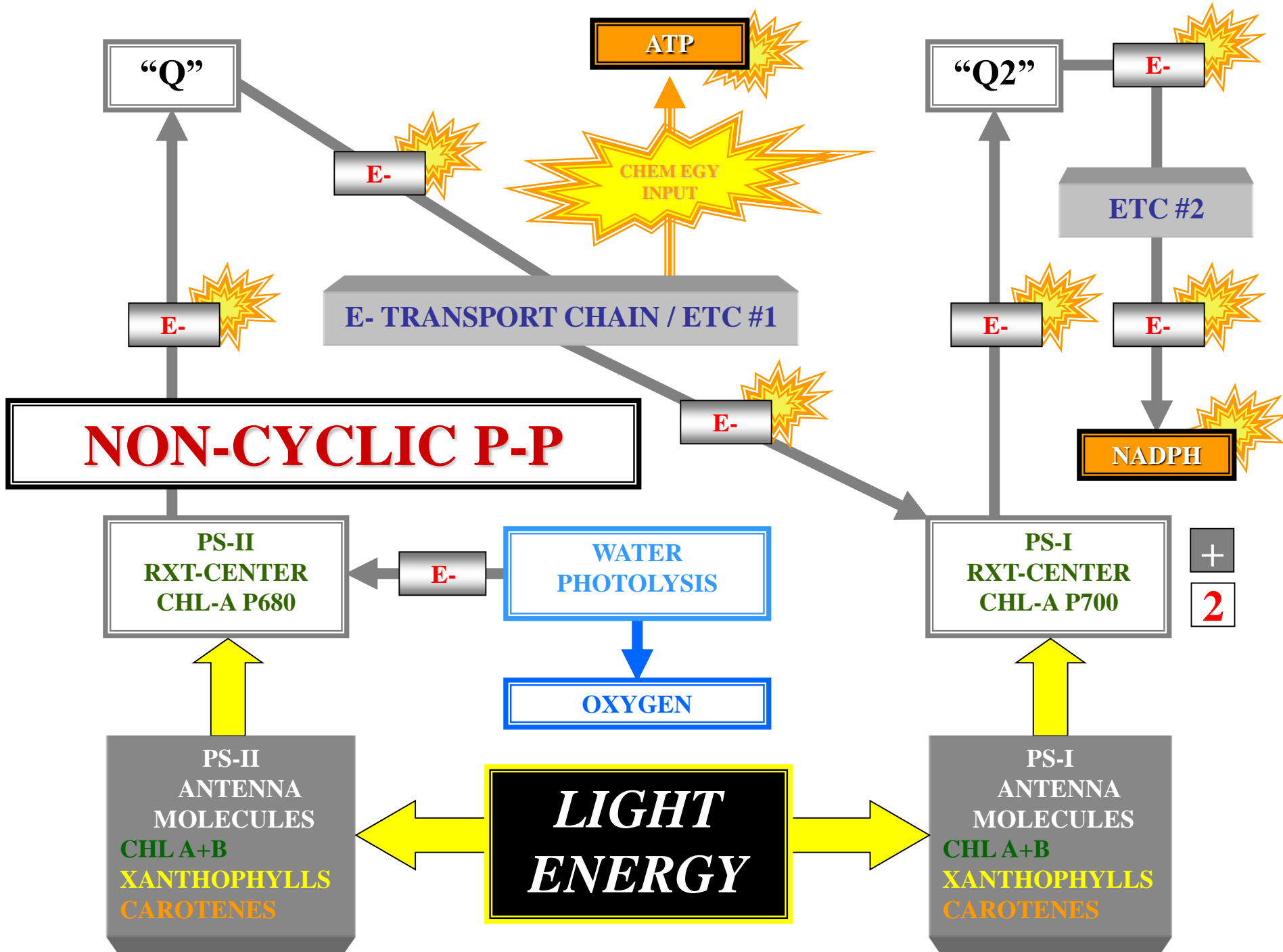
# PHOTOSYNTHESIS



## LIGHT REACTION







**C3**

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



**RIBULOSE BIPHOSPHATE  
CARBOXYLASE  
(RUBP-CARBOXYLASE)**

**UNSTABLE 6C COMPOUND**

**PHOSPHOGLYCERATE / (PGA)**

**PHOSPHOGLYCERATE / (PGA)**

**ATP**

**ATP**

**E  
2**

**BIPHOSPHOGLYCERATE / (BIPGA)**

**BIPHOSPHOGLYCERATE / (BIPGA)**

**NADPH**

**NADPH**

**ALL RXTS  
REQUIRE  
A SPECIFIC  
ENZYME**

**PHOSPHOGLYCERALDEHYDE / (PGAL)**

**PHOSPHOGLYCERALDEHYDE / (PGAL)**

**C3 PATHWAY  
CALVIN CYCLE**

**C3**

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



**RIBULOSE BIPHOSPHATE  
CARBOXYLASE  
(RUBP-CARBOXYLASE)**

**PHOSPHOGLYCERATE / (PGA)**

**UNSTABLE 6C COMPOUND**

**PHOSPHOGLYCERATE / (PGA)**

**ATP**

**ATP**

**?**

**G**

**BIPHOSPHOGLYCERATE / (BIPGA)**

**BIPHOSPHOGLYCERATE / (BIPGA)**

**NADPH**

**NADPH**

**PHOSPHOGLYCERALDEHYDE / (PGAL)**

**PHOSPHOGLYCERALDEHYDE / (PGAL)**

**ALL RXTS  
REQUIRE  
A SPECIFIC  
ENZYME**

**ENTERS  
INDEPENDENT  
ROUTE**

**ENTERS  
INDEPENDENT  
ROUTE**

# **C3 PATHWAY CALVIN CYCLE**

**C3**

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



**RIBULOSE BIPHOSPHATE  
CARBOXYLASE  
(RUBP-CARBOXYLASE)**

**UNSTABLE 6C COMPOUND**

**PHOSPHOGLYCERATE / (PGA)**

**PHOSPHOGLYCERATE / (PGA)**

**ATP**

**ATP**

**G**

**PE**

**BIPHOSPHOGLYCERATE / (BIPGA)**

**BIPHOSPHOGLYCERATE / (BIPGA)**

**NADPH**

**NADPH**

**ALL RXTS  
REQUIRE  
A SPECIFIC  
ENZYME**

**PHOSPHOGLYCERALDEHYDE / (PGAL)**

**PHOSPHOGLYCERALDEHYDE / (PGAL)**

**COMPLEX SERIES  
CHEMICAL RXTS  
(CSCR)**



# **C3 PATHWAY CALVIN CYCLE**



**C3**

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



**RIBULOSE BIPHOSPHATE  
CARBOXYLASE  
(RUBP-CARBOXYLASE)**

**PHOSPHOGLYCERATE / (PGA)**

**UNSTABLE 6C COMPOUND**

**PHOSPHOGLYCERATE / (PGA)**

**ATP**

**ATP**

**G**

**BIPHOSPHOGLYCERATE / (BIPGA)**

**BIPHOSPHOGLYCERATE / (BIPGA)**

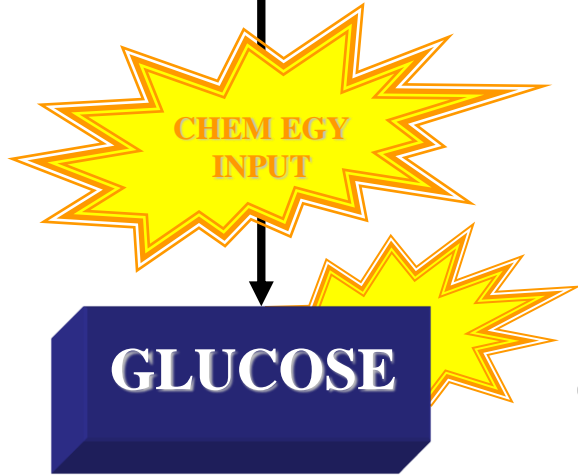
**NADPH**

**NADPH**

**PHOSPHOGLYCERALDEHYDE / (PGAL)**

**PHOSPHOGLYCERALDEHYDE / (PGAL)**

**ALL RXTS  
REQUIRE  
A SPECIFIC  
ENZYME**



**PHOTOSYNTHESIS  
EQUATION**



**C3**

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



**RIBULOSE BIPHOSPHATE  
CARBOXYLASE  
(RUBP-CARBOXYLASE)**

**PHOSPHOGLYCERATE / (PGA)**

**UNSTABLE 6C COMPOUND**

**PHOSPHOGLYCERATE / (PGA)**

**ATP**

**ATP**



**BIPHOSPHOGLYCERATE / (BPGA)**

**BIPHOSPHOGLYCERATE / (BPGA)**

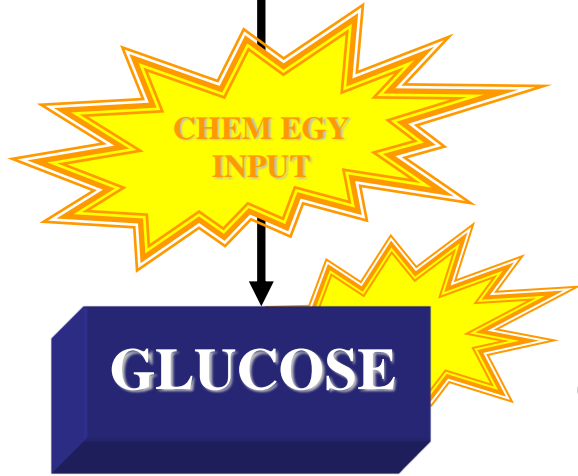
**NADPH**

**NADPH**

**PHOSPHOGLYCERALDEHYDE / (PGAL)**

**PHOSPHOGLYCERALDEHYDE / (PGAL)**

**ALL RXTS  
REQUIRE  
A SPECIFIC  
ENZYME**



**PHOTOSYNTHESIS  
EQUATION**



**C3**

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



**RIBULOSE BIPHOSPHATE  
CARBOXYLASE  
(RUBP-CARBOXYLASE)**

**PHOSPHOGLYCERATE / (PGA)**

**UNSTABLE 6C COMPOUND**

**PHOSPHOGLYCERATE / (PGA)**

**ATP**

**ATP**

**+**

**G**

**BIPHOSPHOGLYCERATE / (BIPGA)**

**BIPHOSPHOGLYCERATE / (BIPGA)**

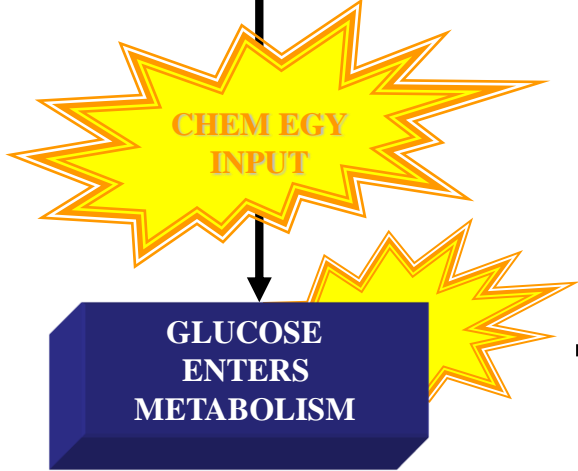
**NADPH**

**NADPH**

**ALL RXTS  
REQUIRE  
A SPECIFIC  
ENZYME**

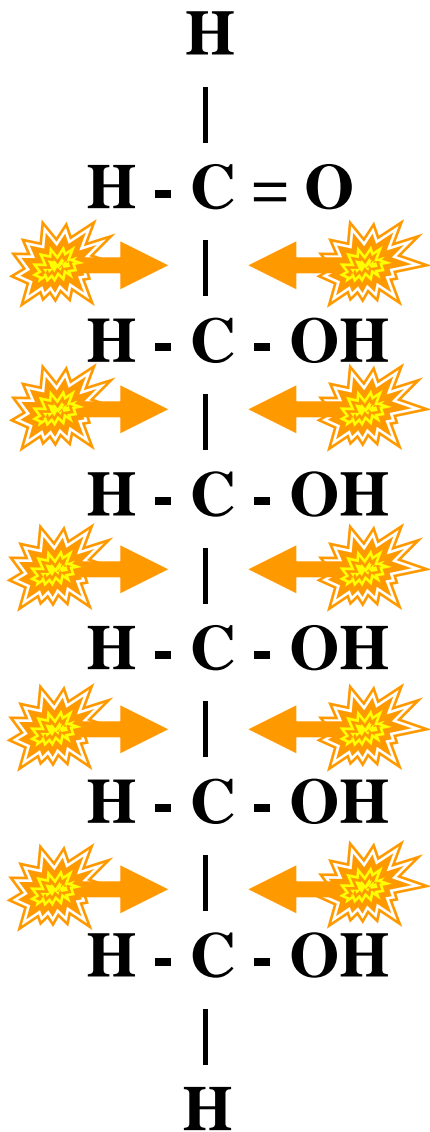
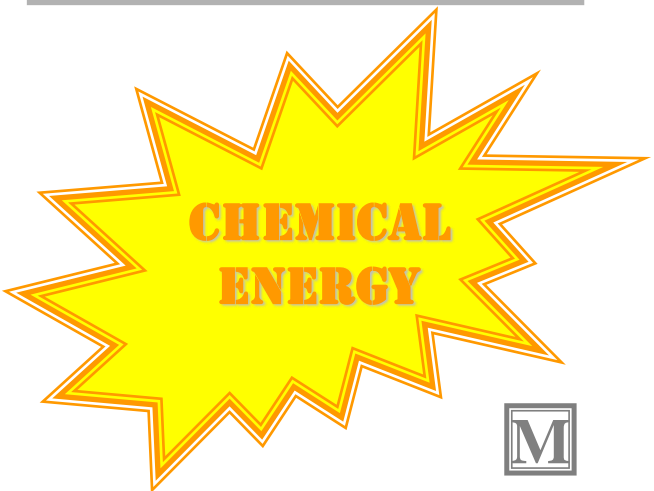
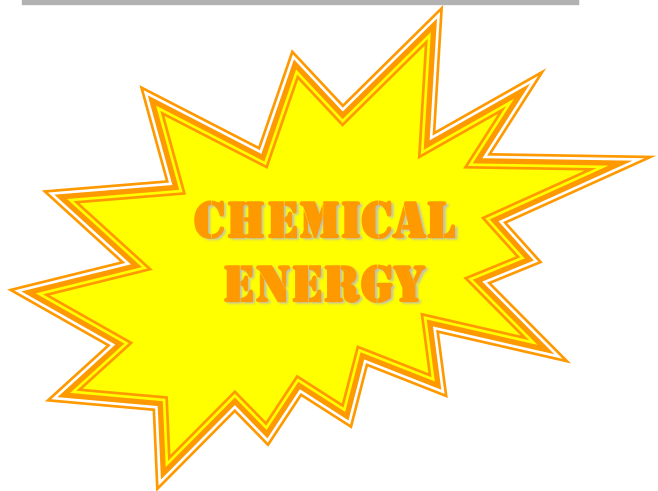
**PHOSPHOGLYCERALDEHYDE / (PGAL)**

**PHOSPHOGLYCERALDEHYDE / (PGAL)**



**ENTERS  
METABOLISM**

# GLUCOSE



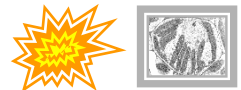
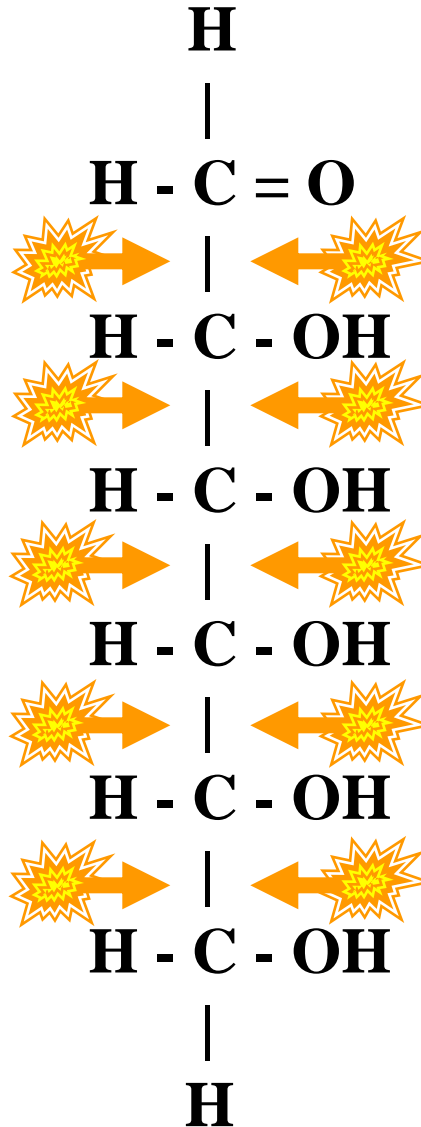


# GLUCOSE



ENTERS  
METABOLISM

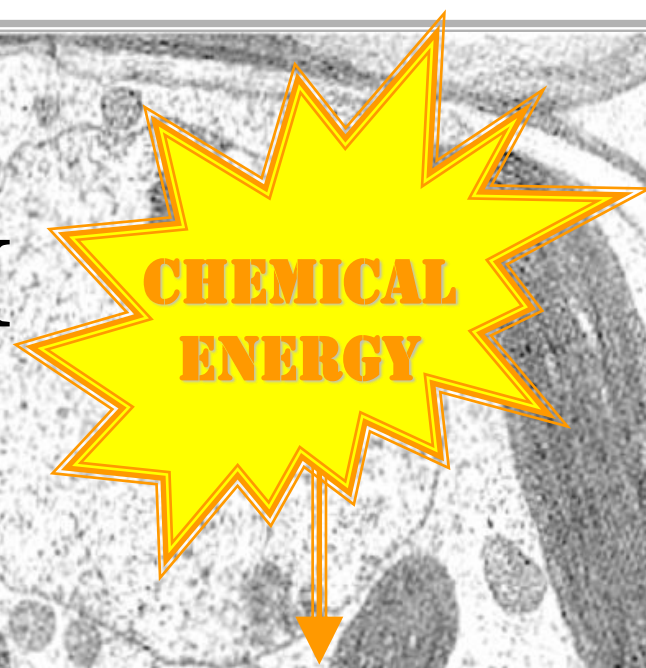
ENTERS  
METABOLISM



# CELL METABOLISM

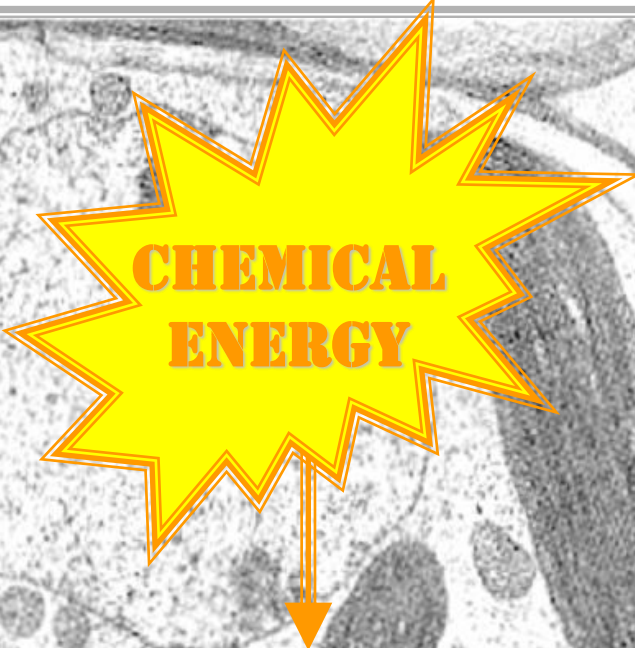
?

EN



## BIOCHEMICAL REACTION

# CELL METABOLISM



## ENDERGONIC BIOCHEMICAL REACTIONS

# CELL METABOLISM



**CHEMICAL  
ENERGY**



**CHEMICAL ENERGY  
DRIVES  
ENDERGONIC REACTIONS  
TO A PRODUCT**



# PHOTOSYNTHESIS



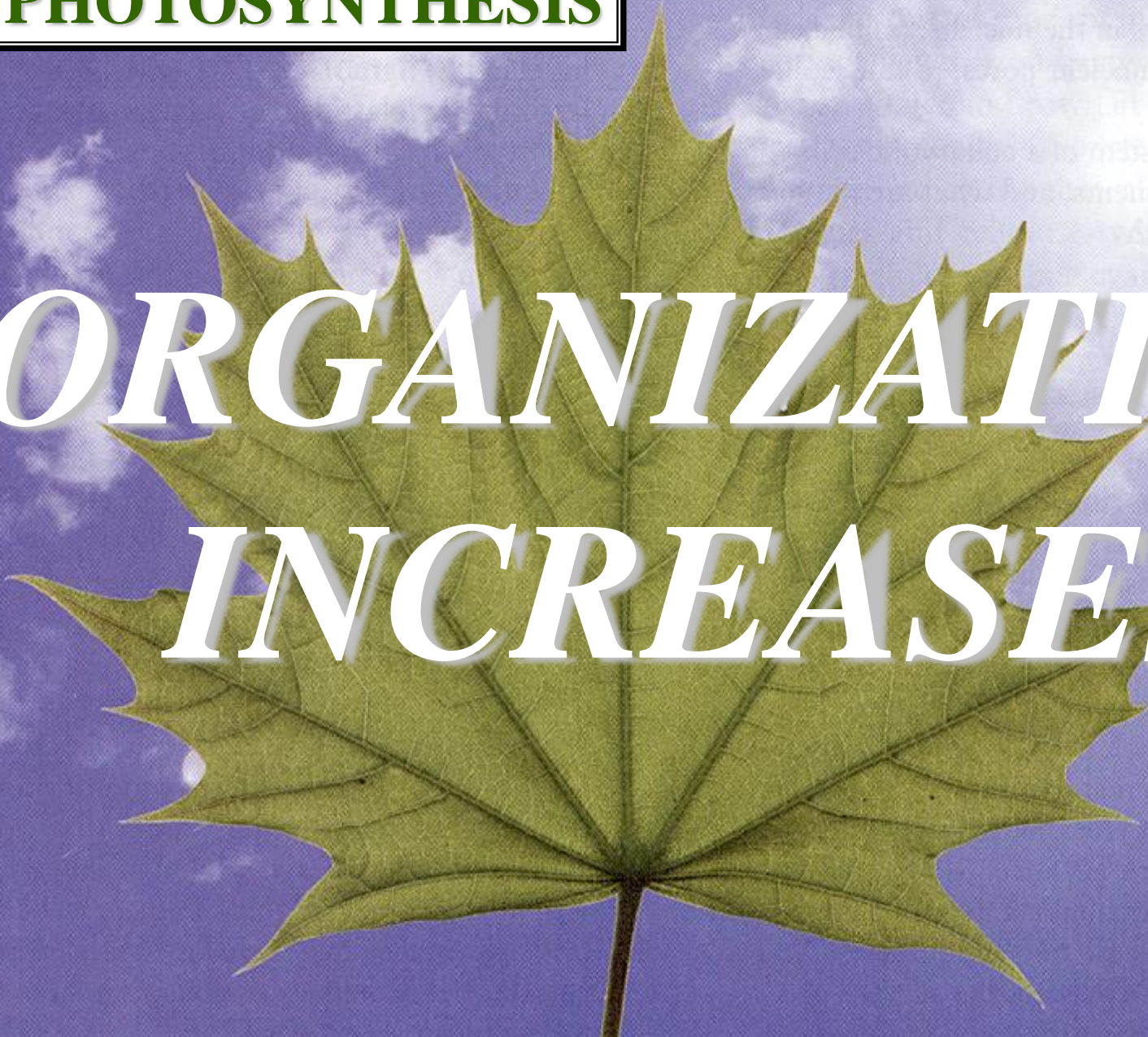
*EFFICIENT  
METABOLISM*

# PHOTOSYNTHESIS

E



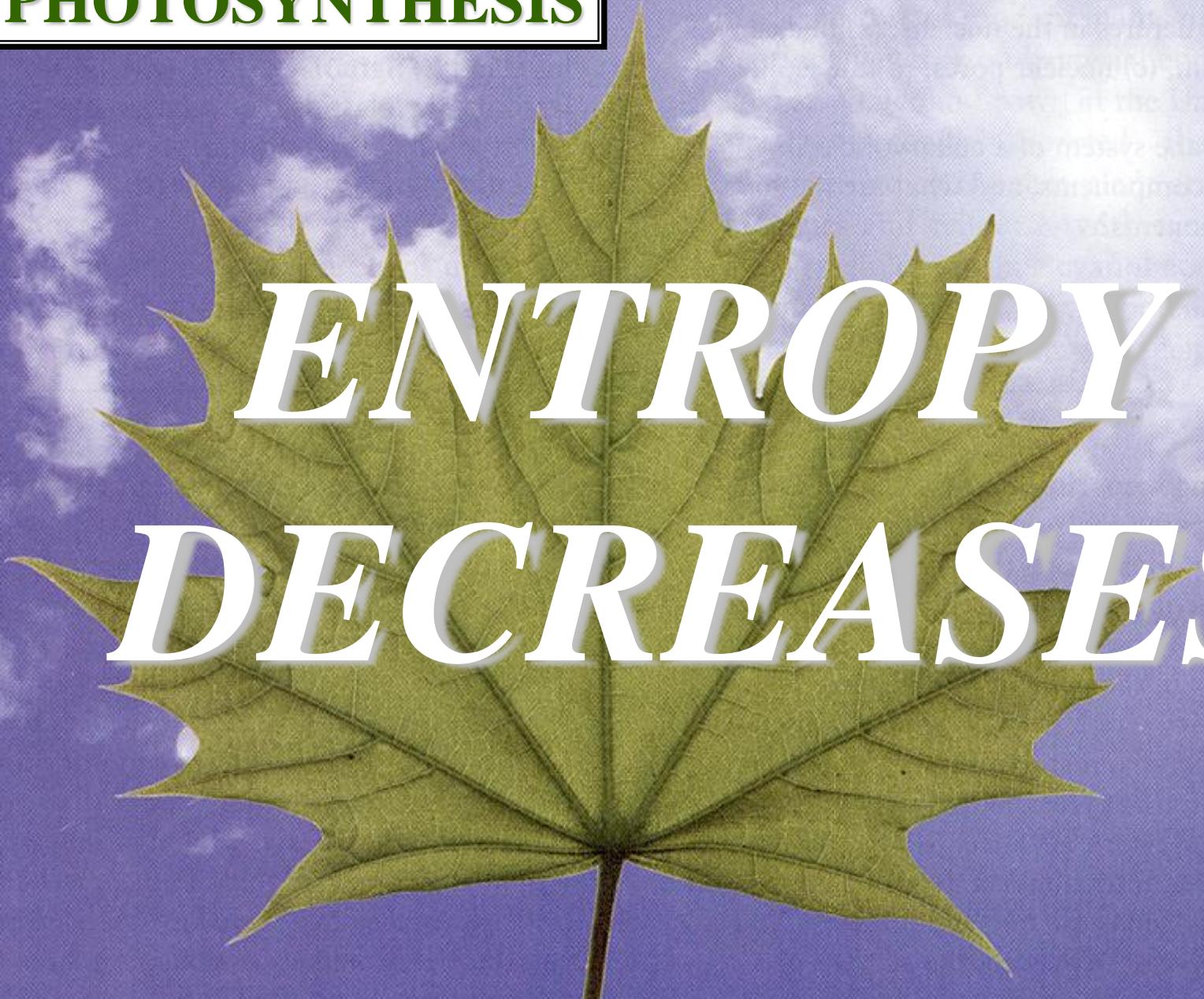
*ORGANIZATION  
INCREASES*



**PHOTOSYNTHESIS**

H

*ENTROPY  
DECREASES*



**PHOTOSYNTHESIS**

^

+

*HOMEOSTASIS*



**C3**

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



**RIBULOSE BIPHOSPHATE  
CARBOXYLASE  
(RUBP-CARBOXYLASE)**

**UNSTABLE 6C COMPOUND**

**PHOSPHOGLYCERATE / (PGA)**

**PHOSPHOGLYCERATE / (PGA)**

**ATP**

**ATP**

**R**

**BIPHOSPHOGLYCERATE / (BIPGA)**

**BIPHOSPHOGLYCERATE / (BIPGA)**

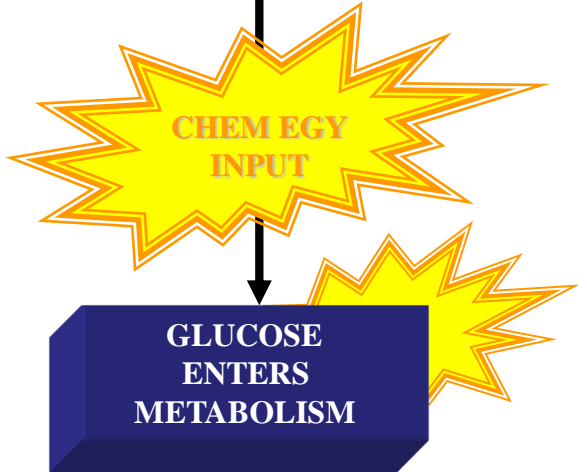
**NADPH**

**NADPH**

**PHOSPHOGLYCERALDEHYDE / (PGAL)**

**PHOSPHOGLYCERALDEHYDE / (PGAL)**

**ALL RXTS  
REQUIRE  
A SPECIFIC  
ENZYME**



# **C3 PATHWAY CALVIN CYCLE**

**C3**

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



**RIBULOSE BIPHOSPHATE  
CARBOXYLASE  
(RUBP-CARBOXYLASE)**

**UNSTABLE 6C COMPOUND**

**PHOSPHOGLYCERATE / (PGA)**

**PHOSPHOGLYCERATE / (PGA)**

**ATP**

**ATP**

**A**

**BIPHOSPHOGLYCERATE / (BIPGA)**

**BIPHOSPHOGLYCERATE / (BIPGA)**

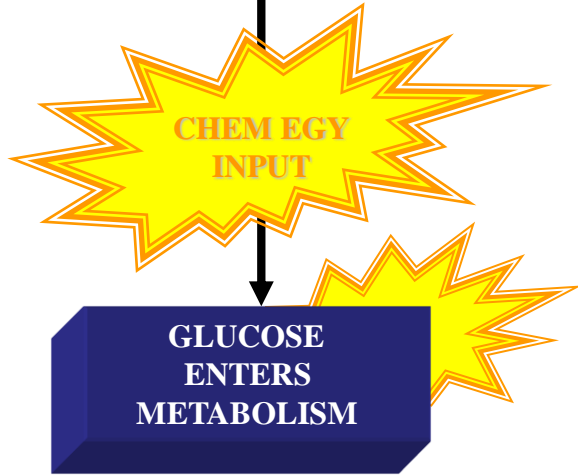
**NADPH**

**NADPH**

**ALL RXTS  
REQUIRE  
A SPECIFIC  
ENZYME**

**PHOSPHOGLYCERALDEHYDE / (PGAL)**

**PHOSPHOGLYCERALDEHYDE / (PGAL)**



**COMPLEX SERIES  
CHEMICAL RXTS  
(CSCR)**

**RIBULOSE BIPHOSPHATE / (RUBP)**

# **C3 PATHWAY CALVIN CYCLE**

**C3**

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



**RIBULOSE BIPHOSPHATE  
CARBOXYLASE  
(RUBP-CARBOXYLASE)**

**UNSTABLE 6C COMPOUND**

**PHOSPHOGLYCERATE / (PGA)**

**PHOSPHOGLYCERATE / (PGA)**

**ATP**

**ATP**

**LR**



**BIPHOSPHOGLYCERATE / (BIPGA)**

**BIPHOSPHOGLYCERATE / (BIPGA)**

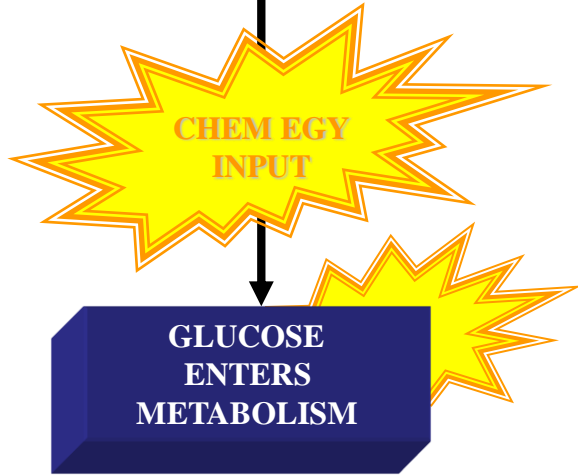
**NADPH**

**NADPH**

**ALL RXTS  
REQUIRE  
A SPECIFIC  
ENZYME**

**PHOSPHOGLYCERALDEHYDE / (PGAL)**

**PHOSPHOGLYCERALDEHYDE / (PGAL)**



**COMPLEX SERIES  
CHEMICAL RXTS  
(C3CR)**

**ATP**

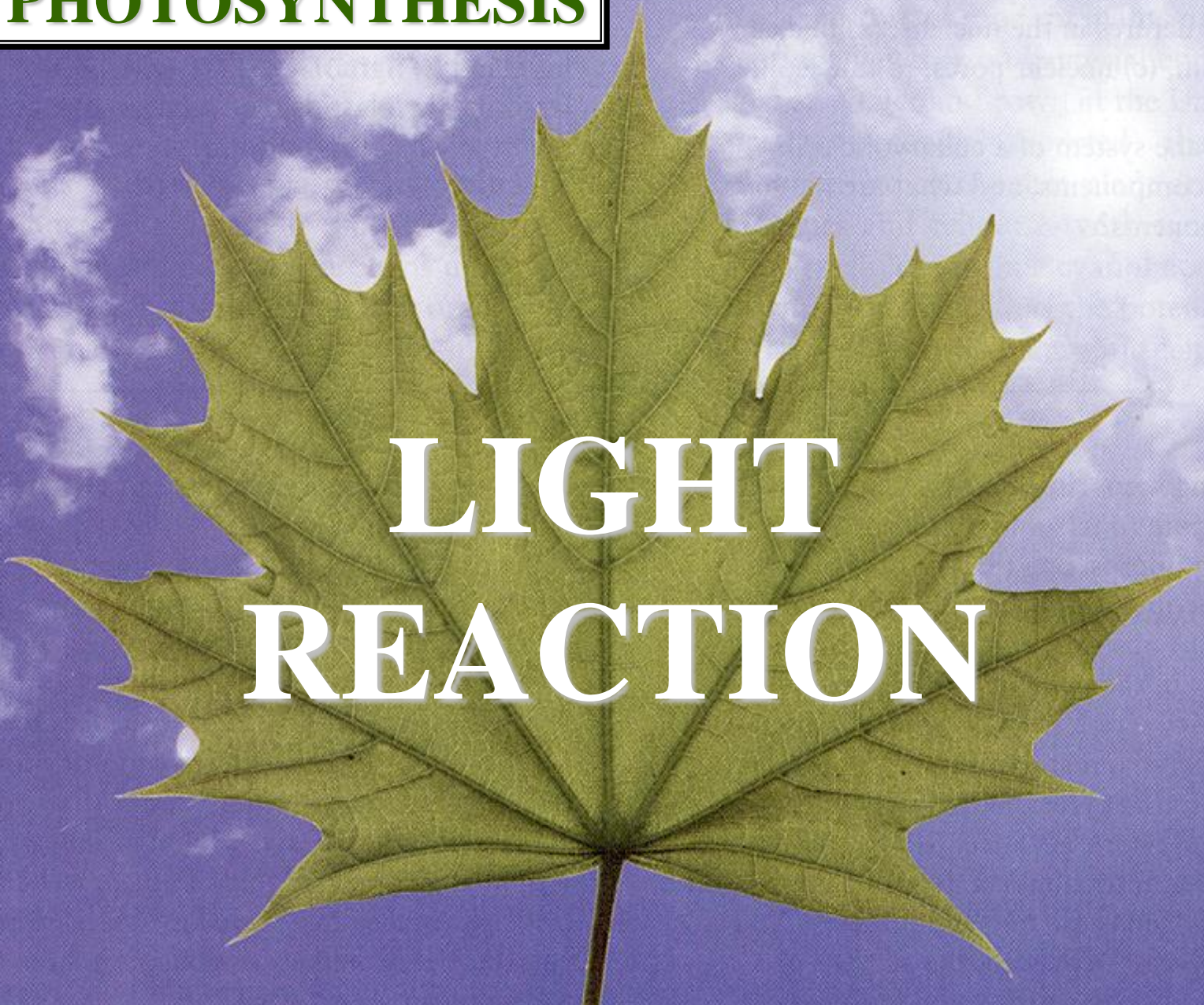
**RIBULOSE BIPHOSPHATE / (RUBP)**

# C3 PATHWAY CALVIN CYCLE

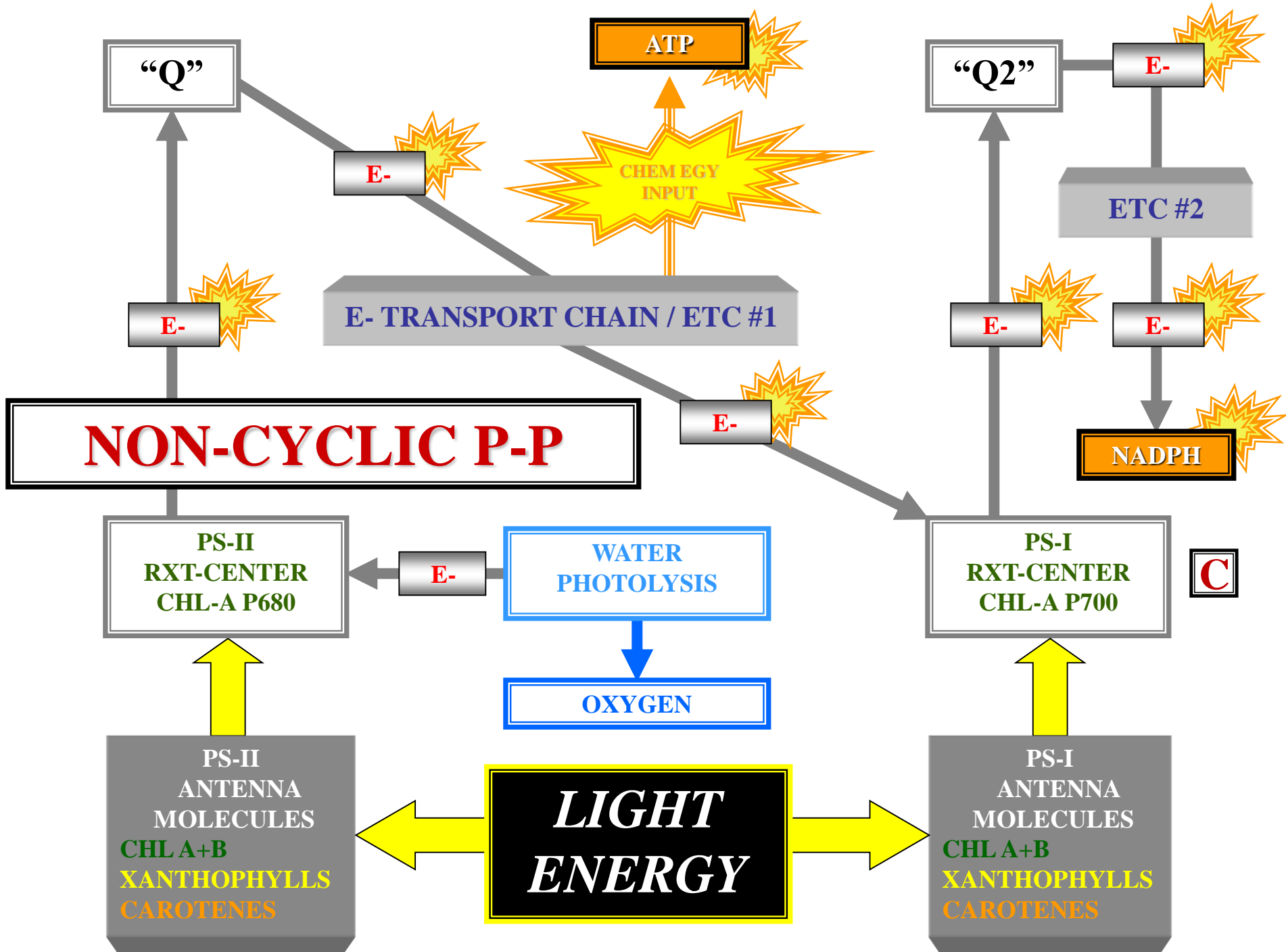
# PHOTOSYNTHESIS



# LIGHT REACTION







# CYCLIC P-P

“Q2”

E-

ETC #3

E-

E-

CHEM  
EGY  
INPUT

ATP

i R

E- = RECYCLED

PS-I  
RXT-CENTER  
CHL-A P700

LIGHT  
ENERGY

PS-I  
ANTENNA  
MOLECULES  
CHL A+B  
XANTHOPHYLLS  
CAROTENES

LIGHT  
ENERGY

**C3**

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



**RIBULOSE BIPHOSPHATE  
CARBOXYLASE  
(RUBP-CARBOXYLASE)**

**UNSTABLE 6C COMPOUND**

**PHOSPHOGLYCERATE / (PGA)**

**PHOSPHOGLYCERATE / (PGA)**

**ATP**

**ATP**

**RE**

**BIPHOSPHOGLYCERATE / (BIPGA)**

**BIPHOSPHOGLYCERATE / (BIPGA)**

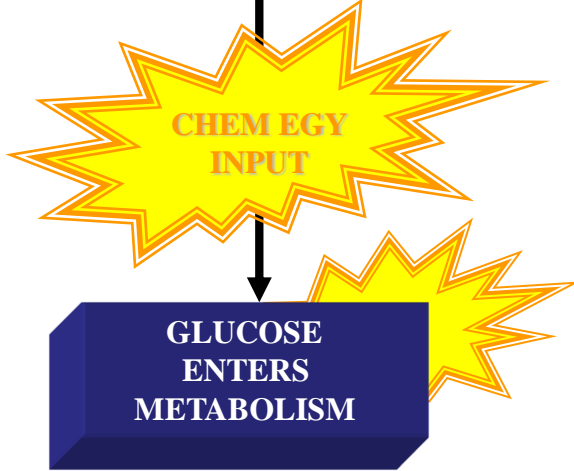
**NADPH**

**NADPH**

**ALL RXTS  
REQUIRE  
A SPECIFIC  
ENZYME**

**PHOSPHOGLYCERALDEHYDE / (PGAL)**

**PHOSPHOGLYCERALDEHYDE / (PGAL)**



**COMPLEX SERIES  
CHEMICAL RXTS  
(CSCR)**

**ATP**

**RIBULOSE BIPHOSPHATE / (RUBP)**

# C3 PATHWAY CALVIN CYCLE

# C3

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

REGENERATED

RIBULOSE BISPHOEPHATE  
CARBOXYLASE  
(RUBP-CARBOXYLASE)

UNSTABLE 6C COMPOUND

PHOSPHOGLYCERATE / (PGA)

PHOSPHOGLYCERATE / (PGA)

ATP

ATP

BISPHOEPHOGLYCERATE / (BIPGA)

BISPHOEPHOGLYCERATE / (BIPGA)

NADPH

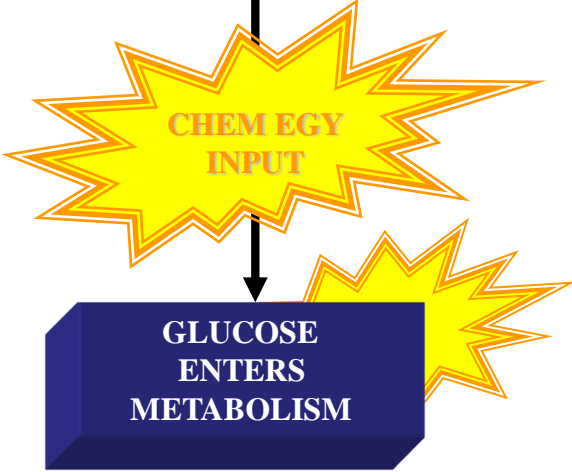
NADPH

PHOSPHOGLYCERALDEHYDE / (PGAL)

PHOSPHOGLYCERALDEHYDE / (PGAL)

ALL RXTS  
REQUIRE  
A SPECIFIC  
ENZYME

COMPLEX SERIES  
CHEMICAL RXTS  
(CSCR)



## C3 PATHWAY CALVIN CYCLE

ATP

FB

RIBULOSE BISPHOEPHATE / (RUBP)

