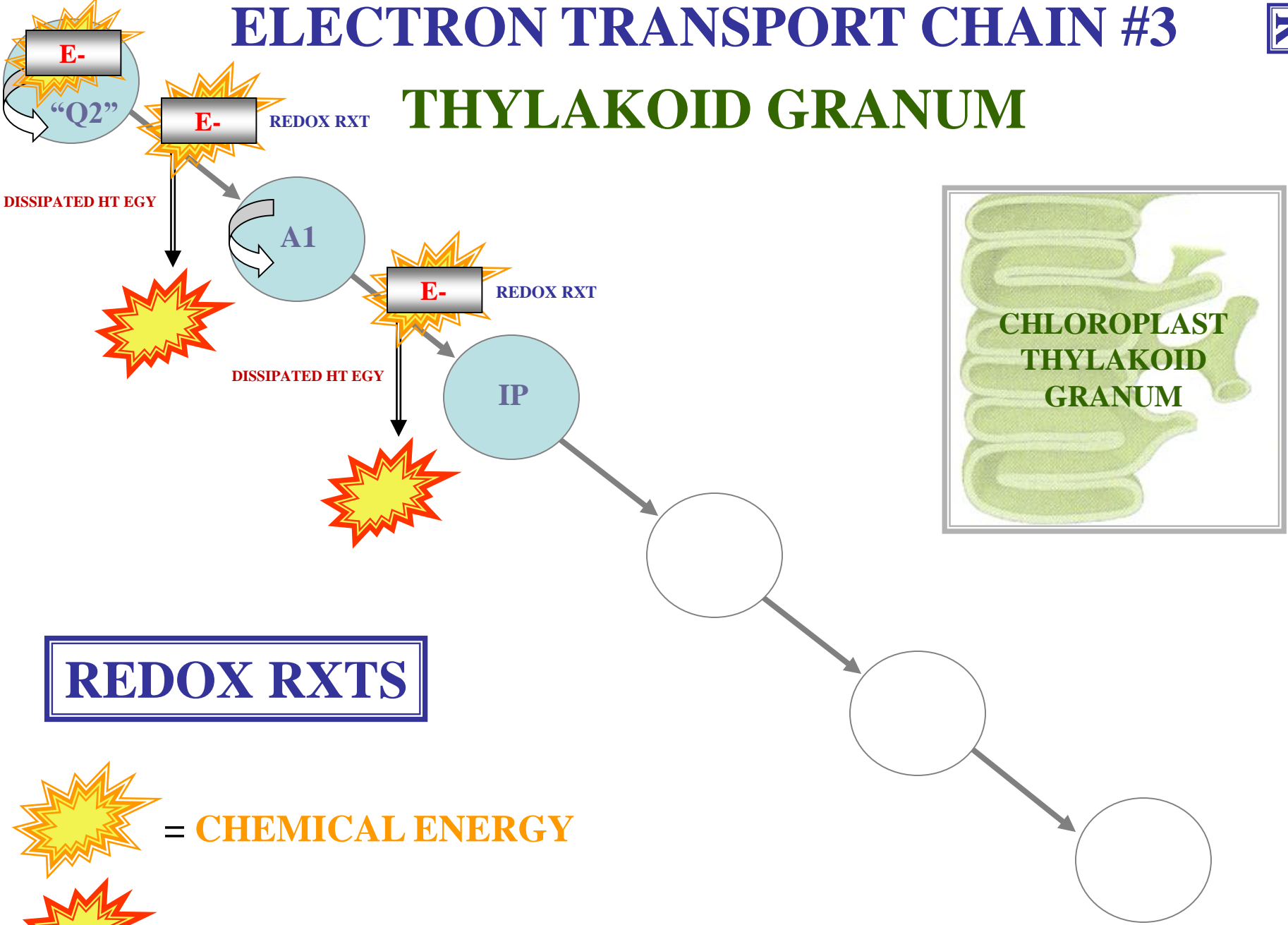


ELECTRON TRANSPORT CHAIN #3



THYLAKOID GRANUM



REDOX RXTS

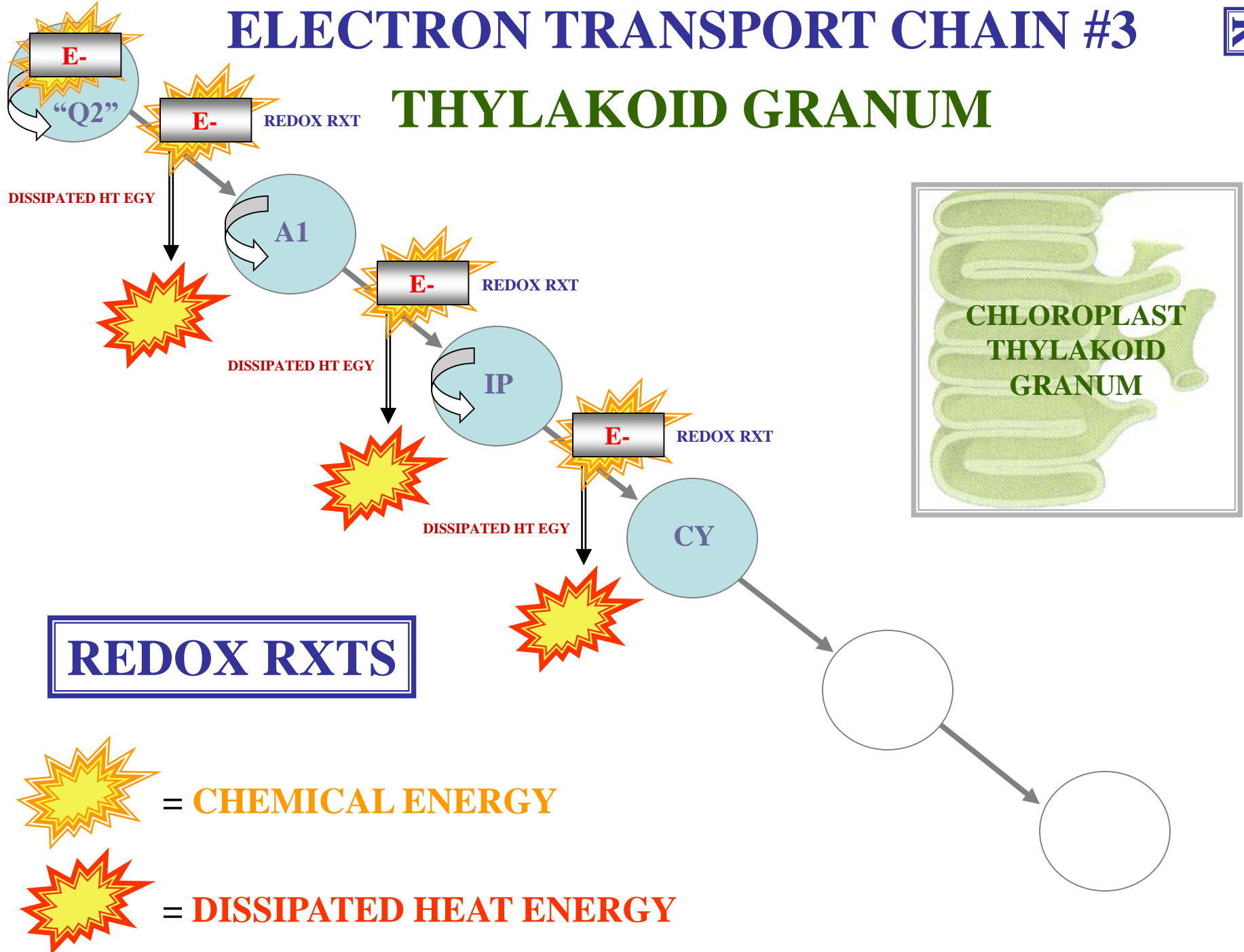
 = CHEMICAL ENERGY

 = DISSIPATED HEAT ENERGY

ELECTRON TRANSPORT CHAIN #3



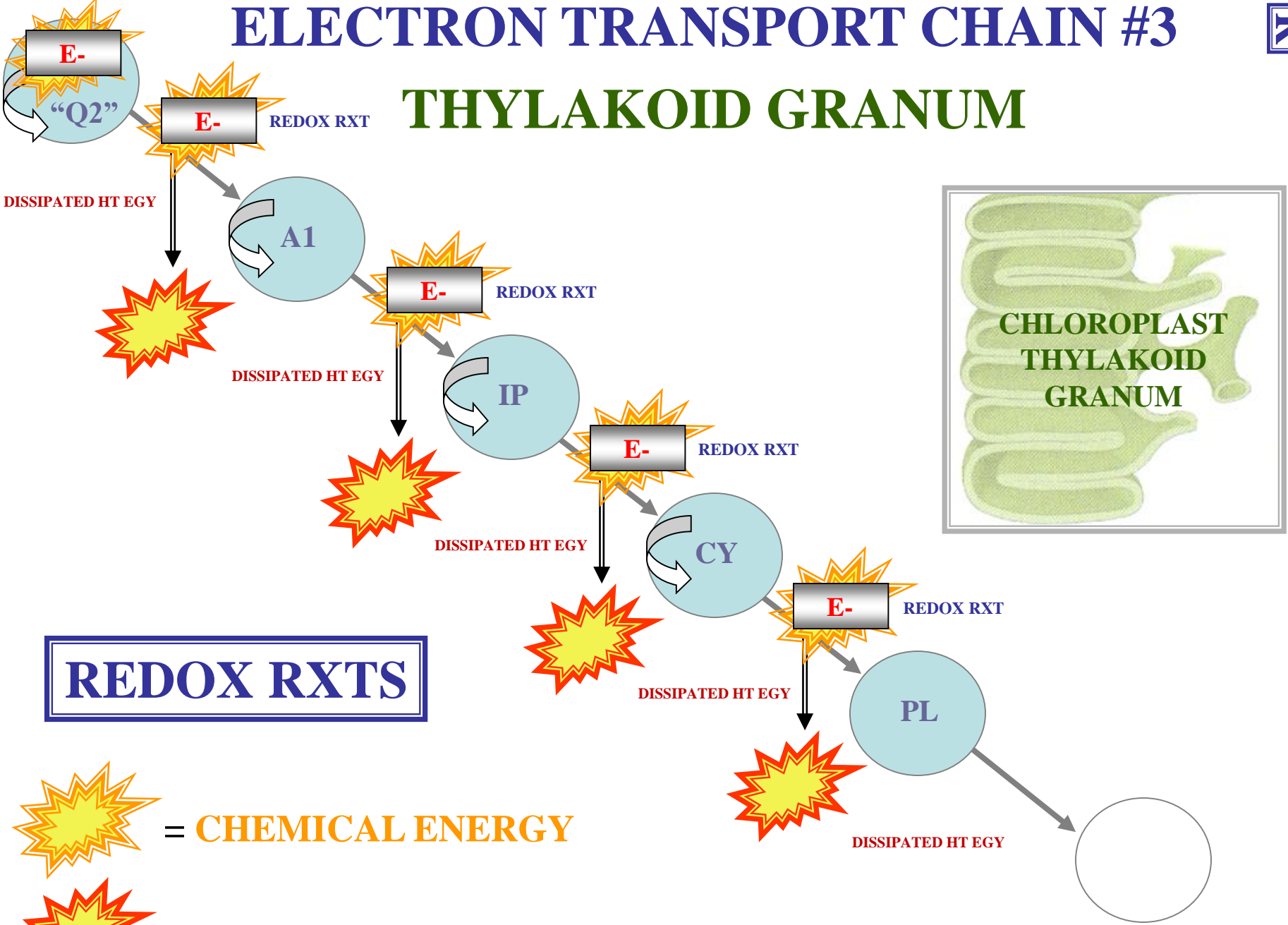
THYLAKOID GRANUM



ELECTRON TRANSPORT CHAIN #3



THYLAKOID GRANUM



REDOX RXTS

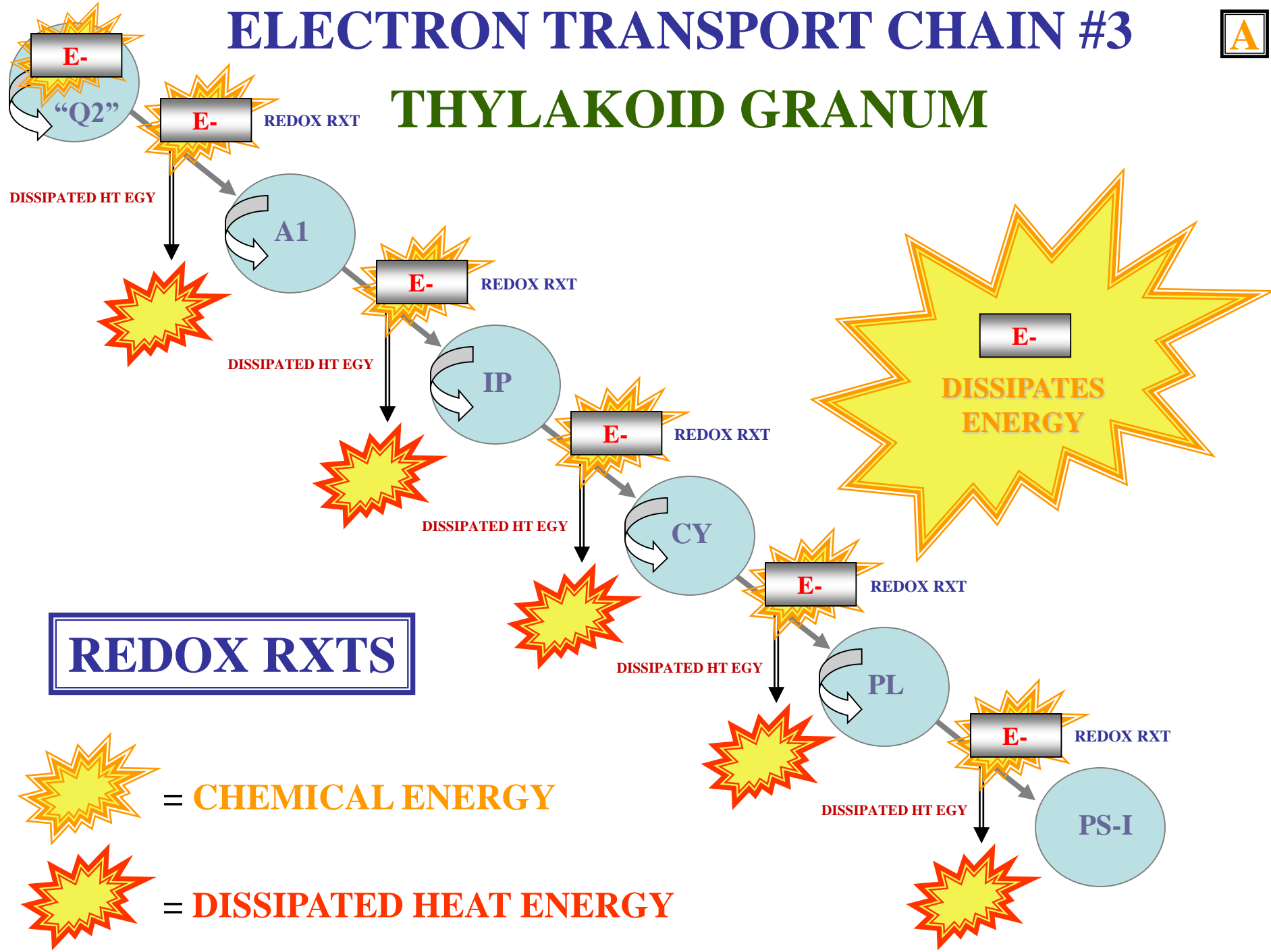
 = **CHEMICAL ENERGY**

 = **DISSIPATED HEAT ENERGY**

ELECTRON TRANSPORT CHAIN #3



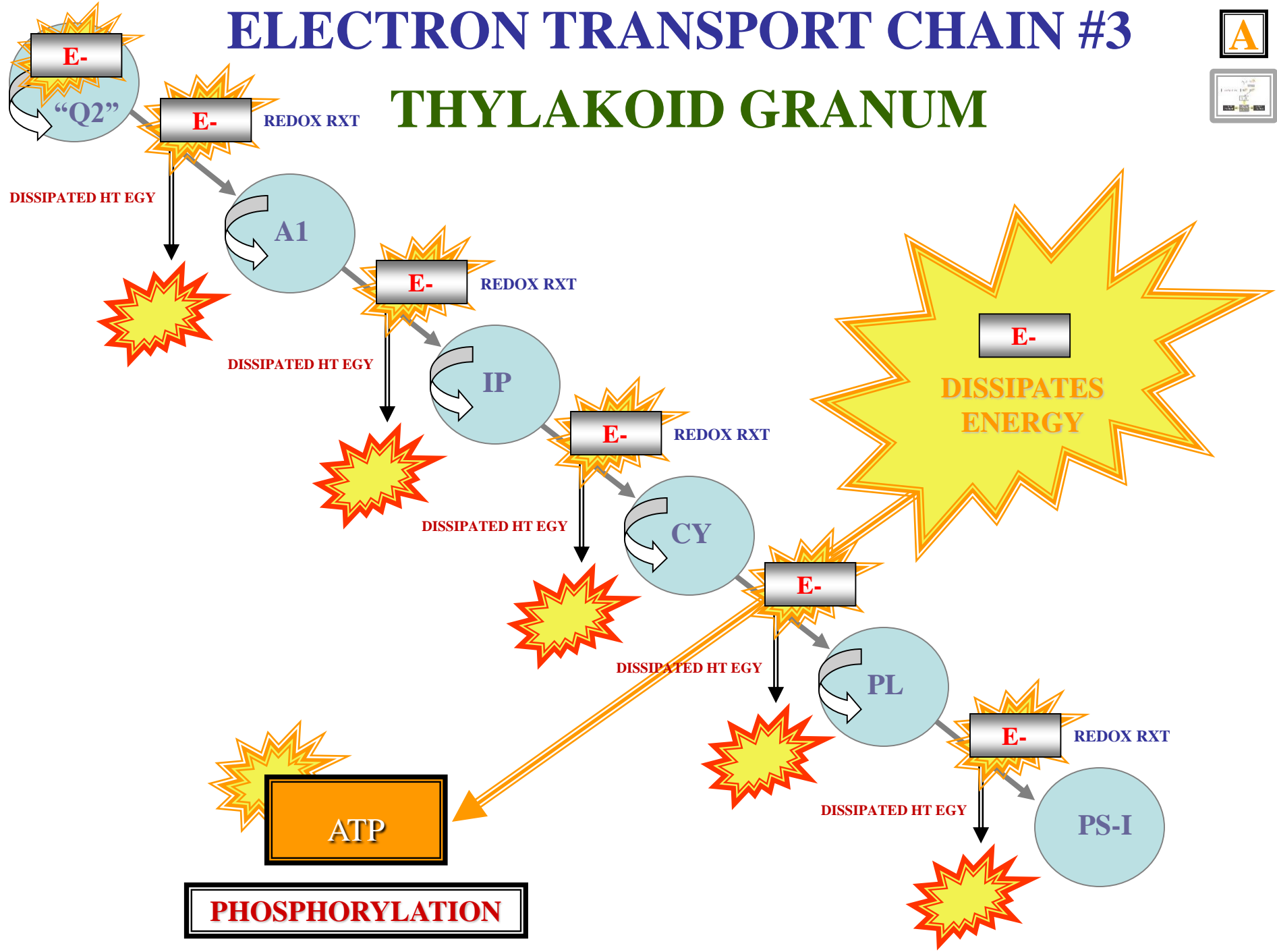
THYLAKOID GRANUM



ELECTRON TRANSPORT CHAIN #3



THYLAKOID GRANUM





CYCLIC P-P

LIGHT ENERGY

PS-I
ANTENNA
MOLECULES
CHL A+B
XANTHOPHYLLS
CAROTENES

LIGHT ENERGY

PS-I
RXT-CENTER
CHL-A P700

“Q2”

ETC #3

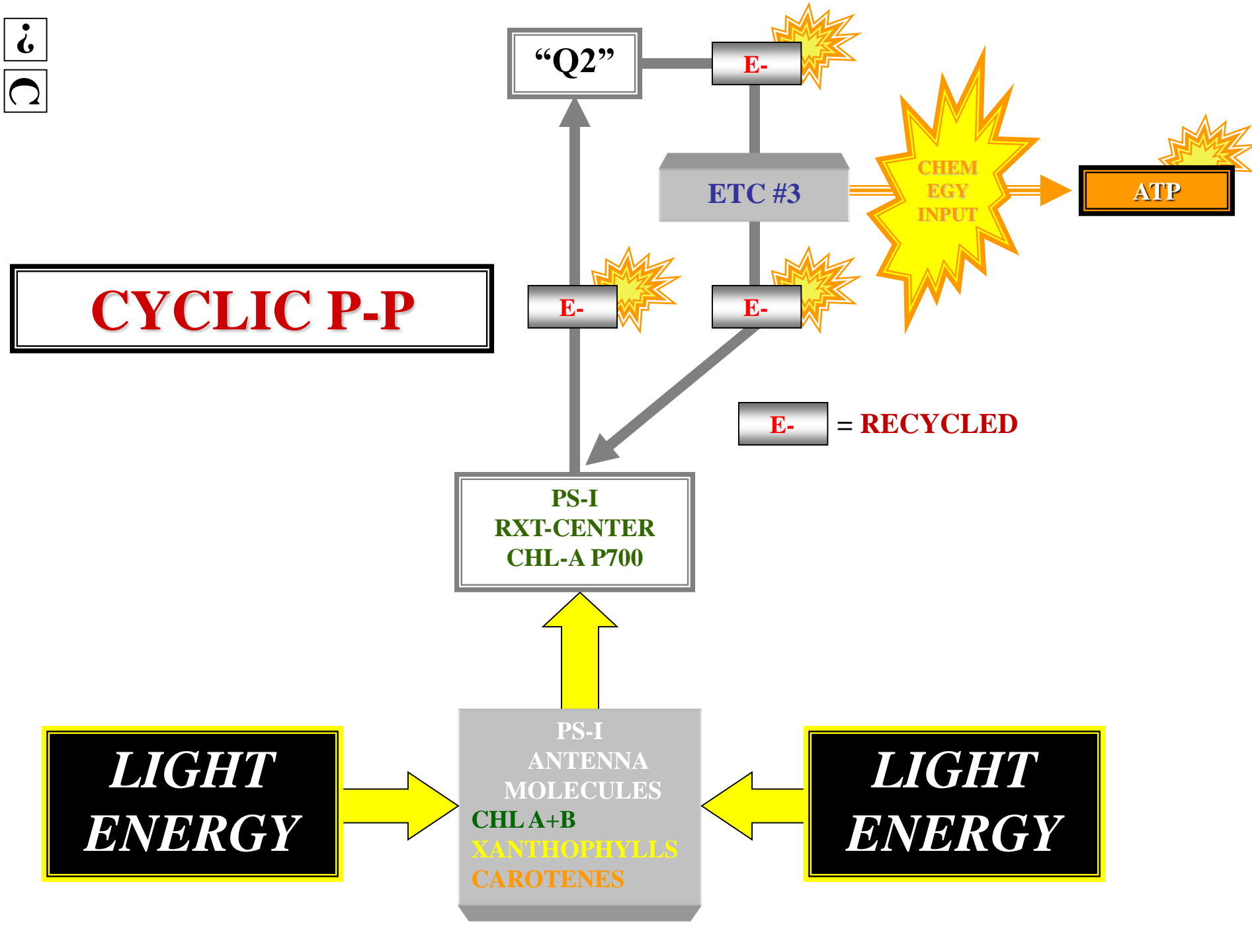
ATP

E-

E-

E- = RECYCLED

CHEM EGY INPUT

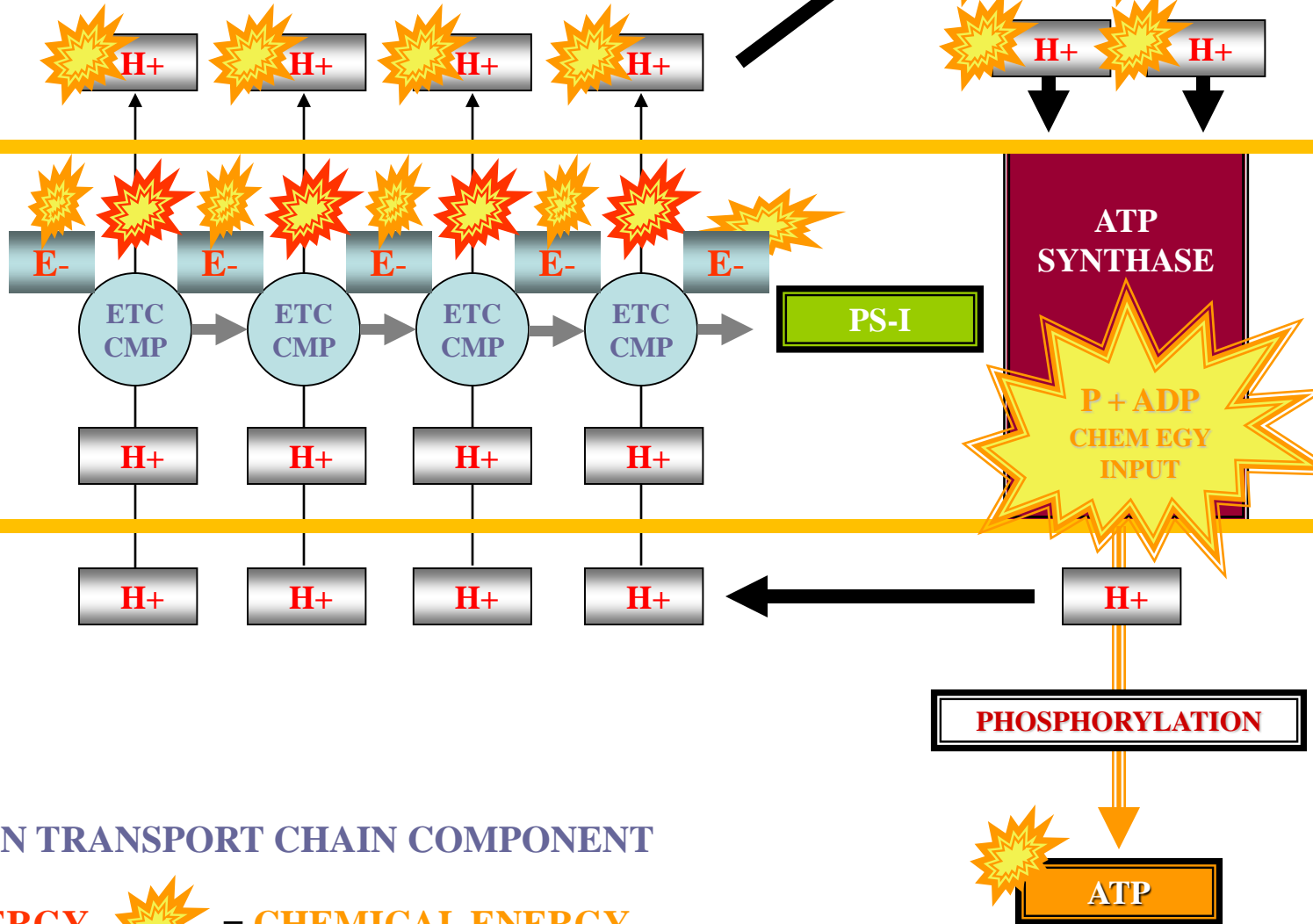


CHEMIOSMOTIC PHOSPHORYLATION MODEL

^ N PS
CHLOROPLAST THYLAKOID SPACE

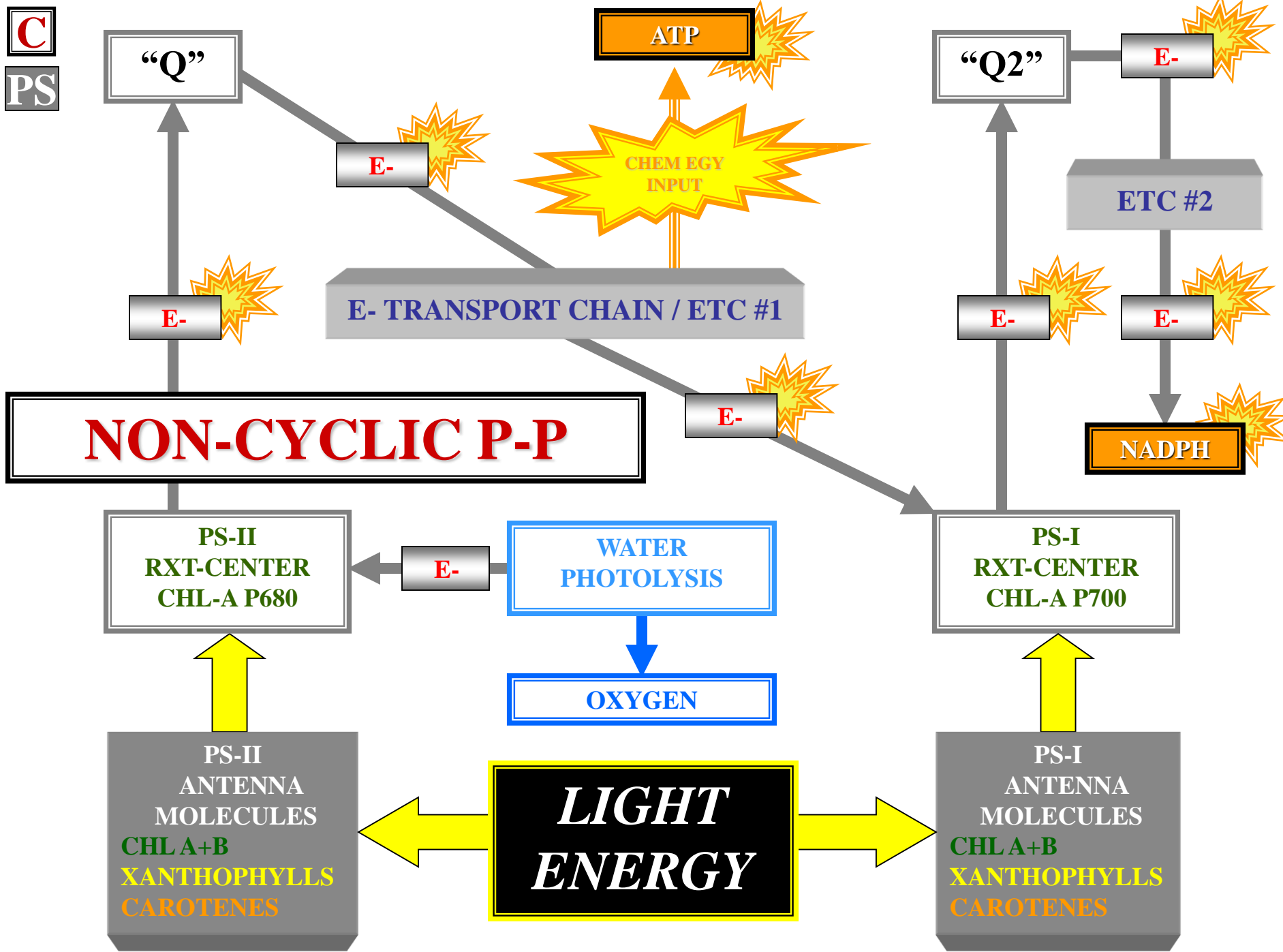
PS-II / PS-I
CHLOROPLAST THYLAKOID MEMBRANE

CHLOROPLAST STROMA



● = ELECTRON TRANSPORT CHAIN COMPONENT
★ = HEAT ENERGY ★ = CHEMICAL ENERGY

C
PS



“Q”

E-

ATP

CHEM EGY
INPUT

“Q2”

E-

ETC #2

E- TRANSPORT CHAIN / ETC #1

E-

E-

NADPH

NON-CYCLIC P-P

PS-II
RXT-CENTER
CHL-A P680

WATER
PHOTOLYSIS

E-

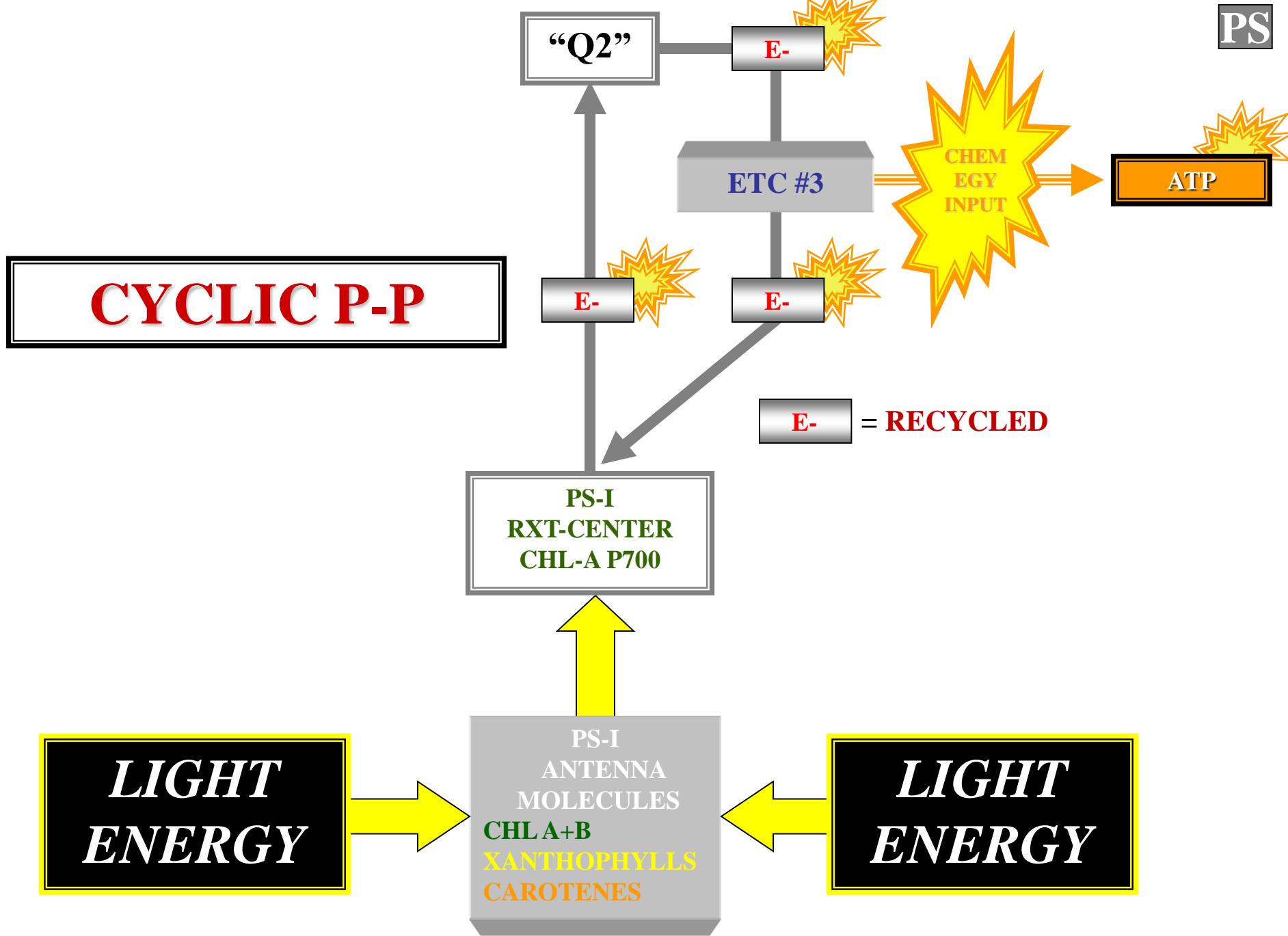
PS-I
RXT-CENTER
CHL-A P700

OXYGEN

PS-II
ANTENNA
MOLECULES
CHL A+B
XANTHOPHYLLS
CAROTENES

**LIGHT
ENERGY**

PS-I
ANTENNA
MOLECULES
CHL A+B
XANTHOPHYLLS
CAROTENES



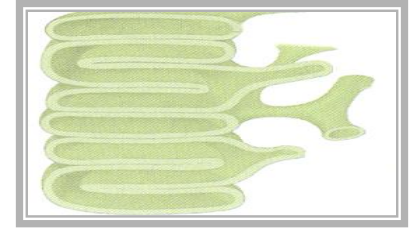
CHLOROPLAST

PS

THYLAKOID



**ANTENNA
MOLECULES**



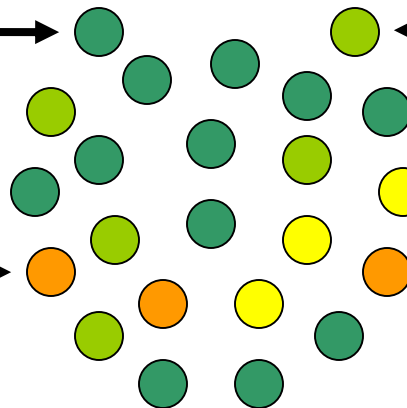
PHOTOSYSTEM

CHLOROPHYLL A

CHLOROPHYLL B

CAROTENES

XANTHOPHYLLS



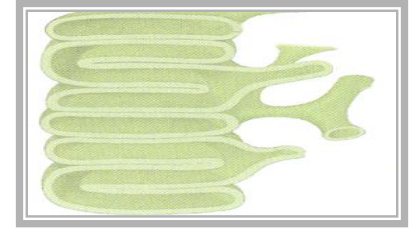
CHLOROPLAST

PS

THYLAKOID

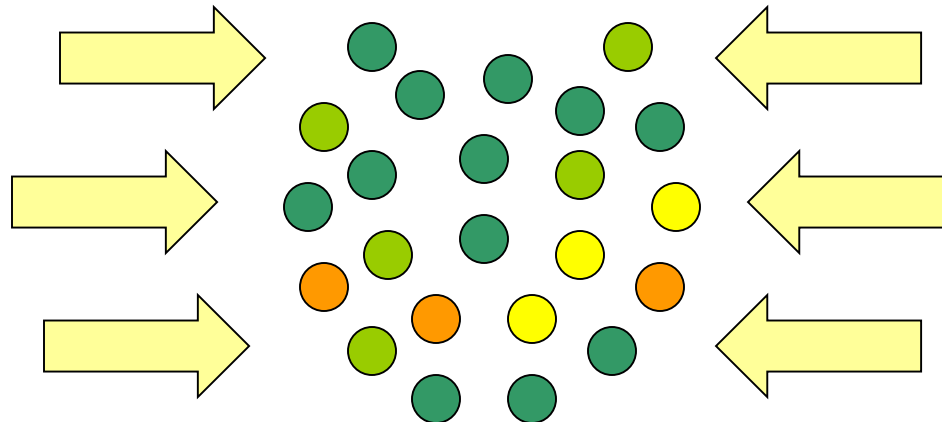


**ANTENNA
MOLECULES**



PHOTOSYSTEM

LTEGY



LTEGY

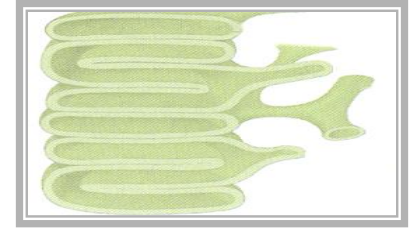
CHLOROPLAST

PS

THYLAKOID



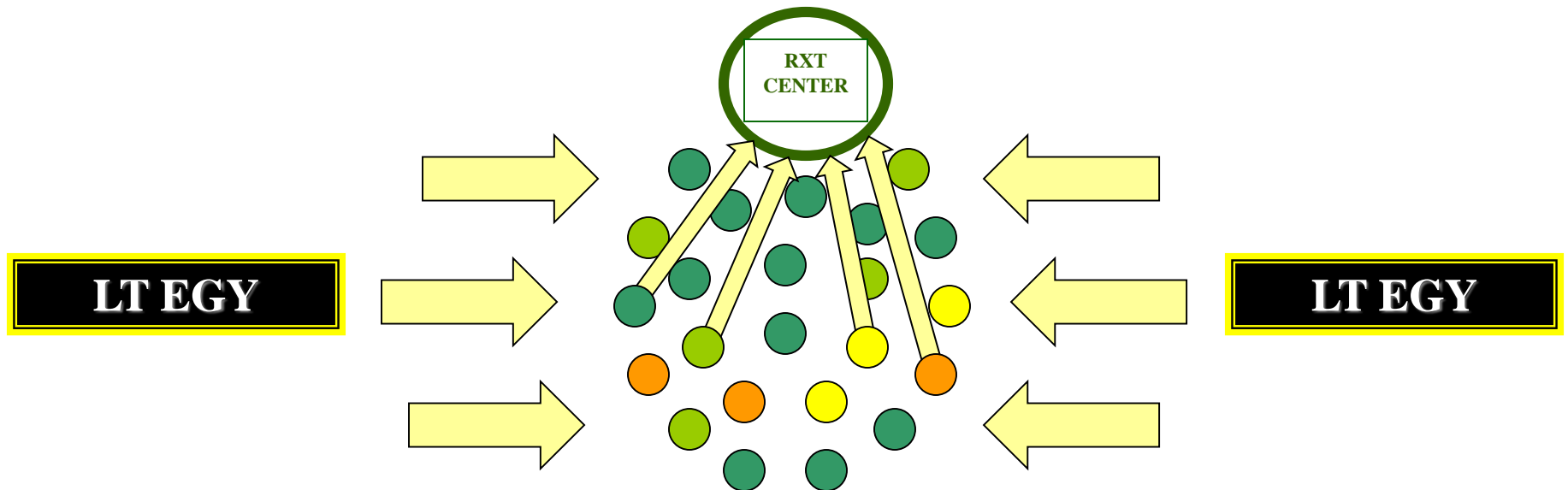
**ANTENNA
MOLECULES**



E-



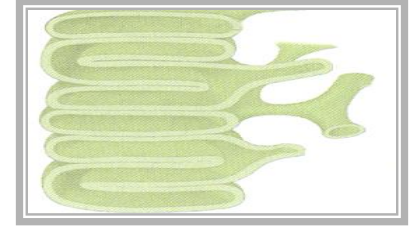
REACTION CENTER: ABSORBS SUFFICIENT LIGHT ENERGY



CHLOROPLAST

PS

THYLAKOID



E-

ENERGIZED E-

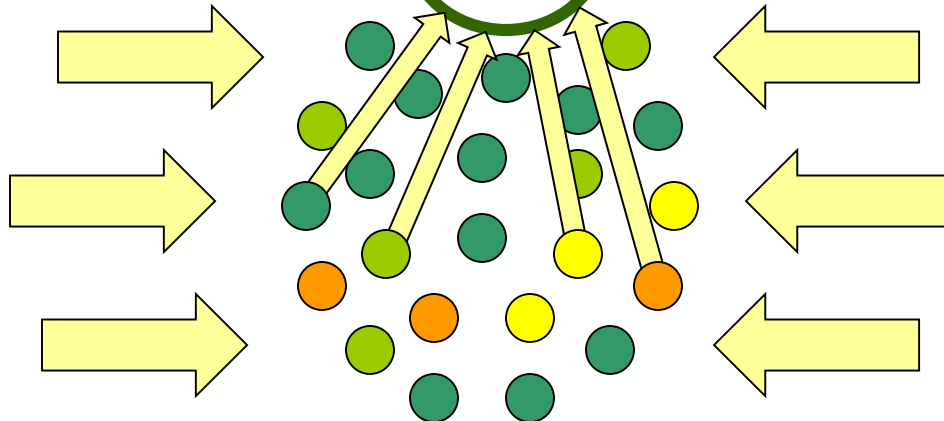
AC

= ENERGY

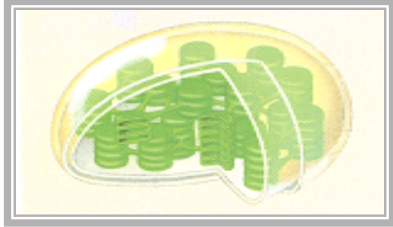
**RXT
CENTER**

LTEGY

LTEGY



CHLOROPLAST

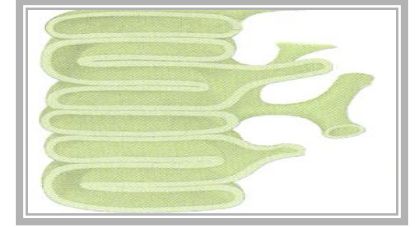


E- ACCEPTOR



LEGY

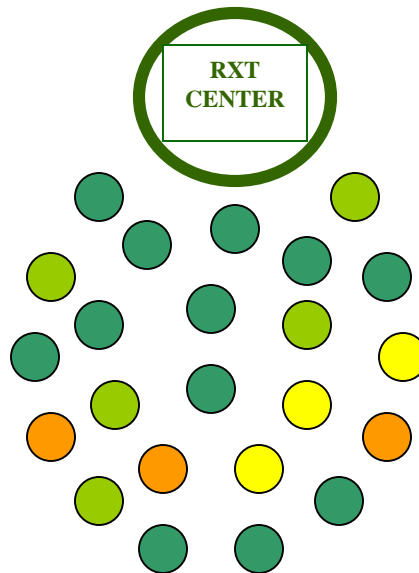
THYLAKOID



E- ACCEPTOR: **ACCEPTS ENERGIZED E-**

C

 = ENERGY



CHLOROPLAST

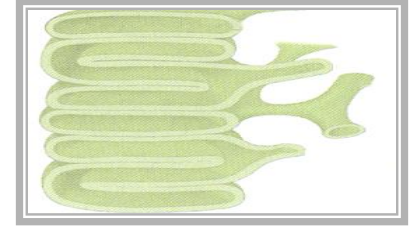


E- ACCEPTOR



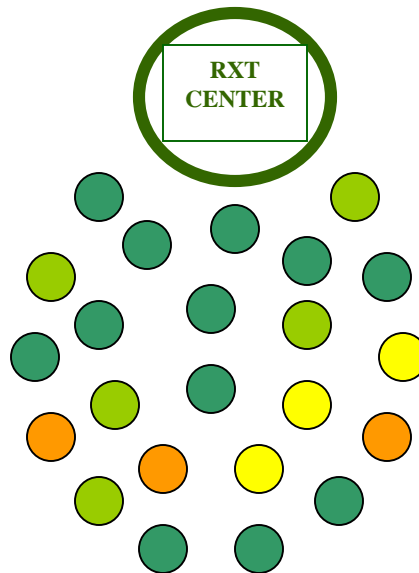
CHEM EGY

THYLAKOID



ETC

 = ENERGY



CHLOROPLAST

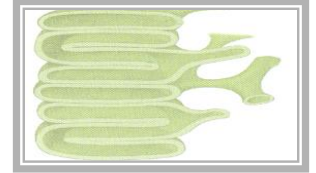


E- ACCEPTOR



CHEM EGY

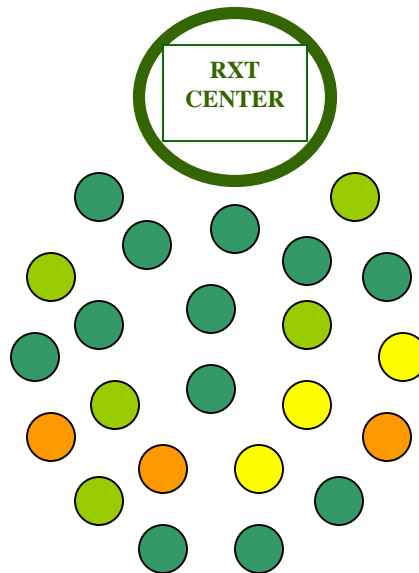
THYLAKOID



E- TRANSPORT CHAIN

E-

 = ENERGY



NON-CYCLIC P-P

CYCLIC P-P

R

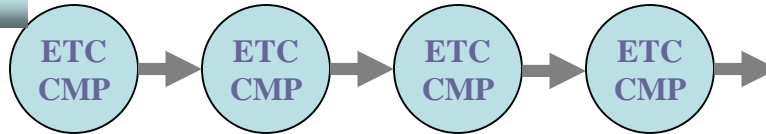
CHLOROPLAST
THYLAKOID
SPACE

PS-II / PS-I

CHLOROPLAST
THYLAKOID
MEMBRANE



CYTOCHROME COMPLEX



ATP
SYNTHASE

ETC

H+

H+

H+

H+

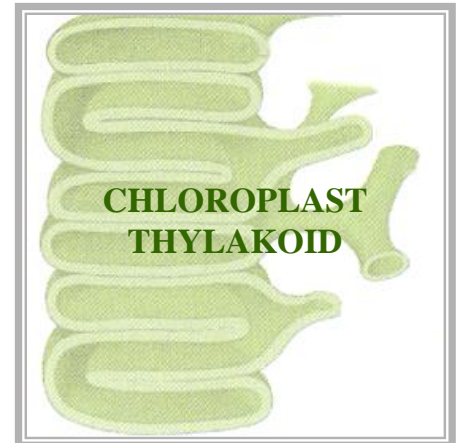
CHLOROPLAST
STROMA

CHLOROPLAST
THYLAKOID

 = ELECTRON TRANSPORT CHAIN COMPONENT

 = HEAT ENERGY

 = CHEMICAL ENERGY



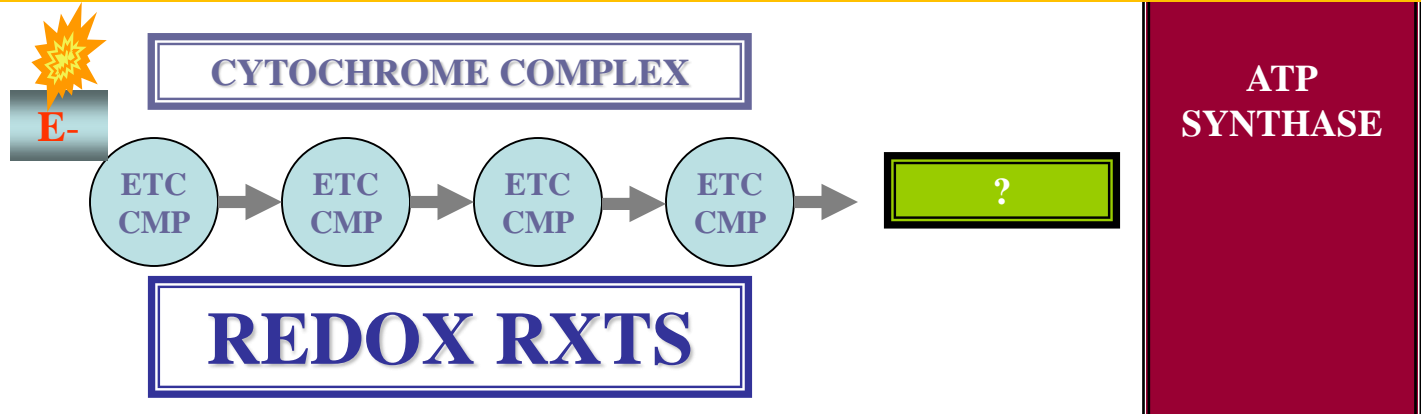
NON-CYCLIC P-P

CYCLIC P-P

CHLOROPLAST
THYLAKOID
SPACE

CHLOROPLAST
THYLAKOID
MEMBRANE

CHLOROPLAST
STROMA



H+

H+

H+

H+

CHLOROPLAST
THYLAKOID

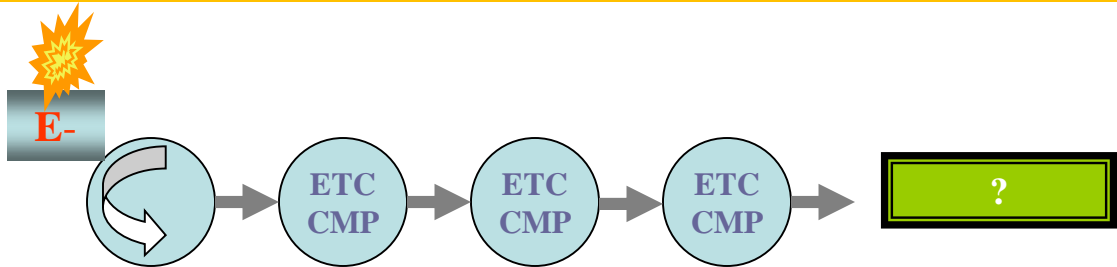
CHLOROPLAST
THYLAKOID
SPACE

NON-CYCLIC P-P

CYCLIC P-P



PS-II / PS-I
CHLOROPLAST
THYLAKOID
MEMBRANE



ATP
SYNTHASE

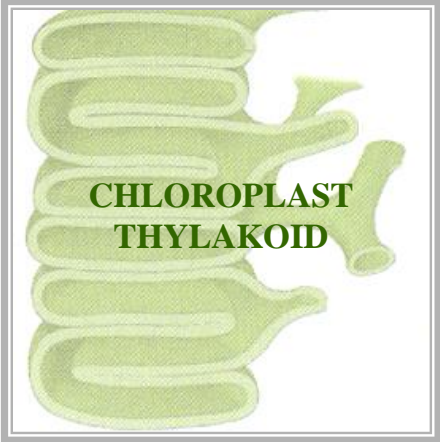
H+

H+

H+

H+

CHLOROPLAST
STROMA



● = ELECTRON TRANSPORT CHAIN COMPONENT

★ = HEAT ENERGY

★ = CHEMICAL ENERGY

NON-CYCLIC P-P

CYCLIC P-P

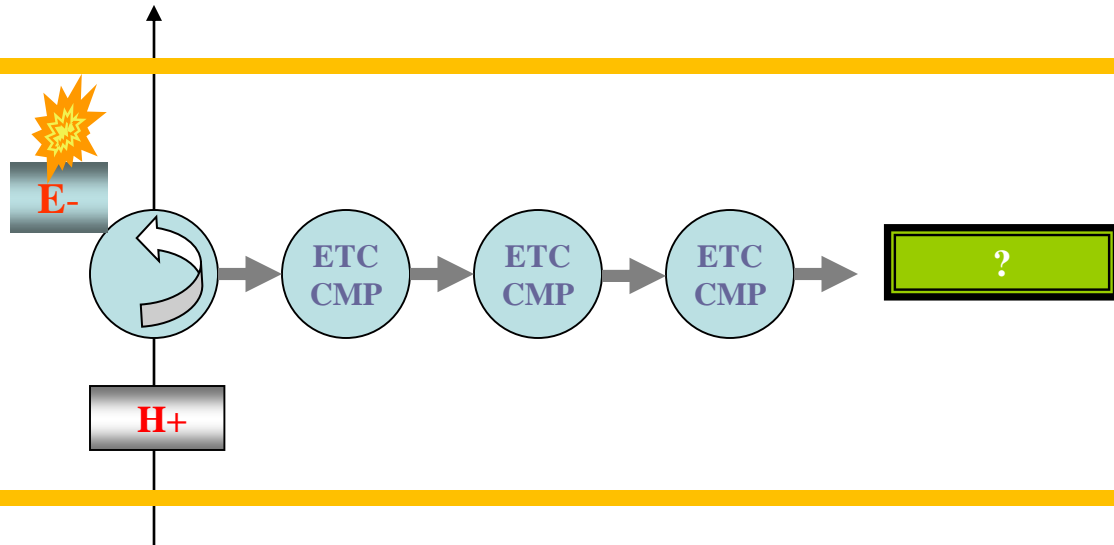
CHLOROPLAST
THYLAKOID
SPACE

H+

PS-II / PS-I

CHLOROPLAST
THYLAKOID
MEMBRANE

ATP
SYNTHASE



CHLOROPLAST
STROMA

H+

H+

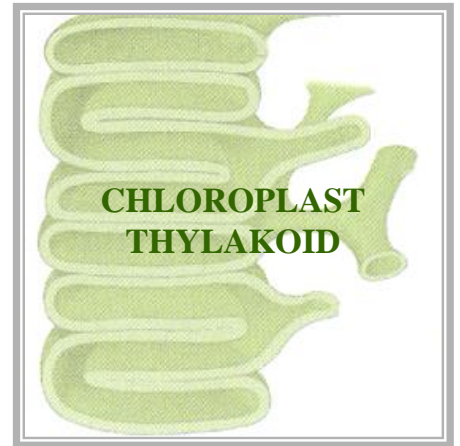
H+

● = ELECTRON TRANSPORT CHAIN COMPONENT

★ = HEAT ENERGY

★ = CHEMICAL ENERGY

CHLOROPLAST
THYLAKOID



NON-CYCLIC P-P

CYCLIC P-P

R

CHLOROPLAST
THYLAKOID
SPACE

PS-II / PS-I

CHLOROPLAST
THYLAKOID
MEMBRANE

ATP
SYNTHASE

?

H+

H+

H+

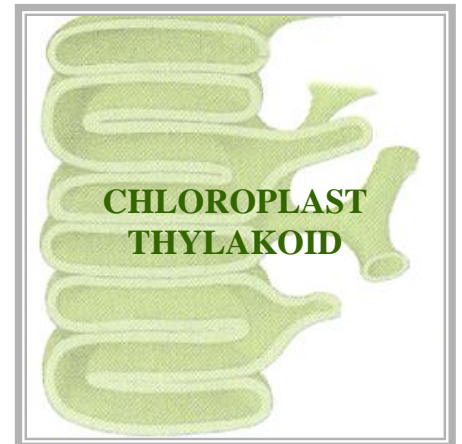
CHLOROPLAST
STROMA

CHLOROPLAST
THYLAKOID

● = ELECTRON TRANSPORT CHAIN COMPONENT

☀ = HEAT ENERGY

☀ = CHEMICAL ENERGY



CHLOROPLAST
THYLAKOID
SPACE

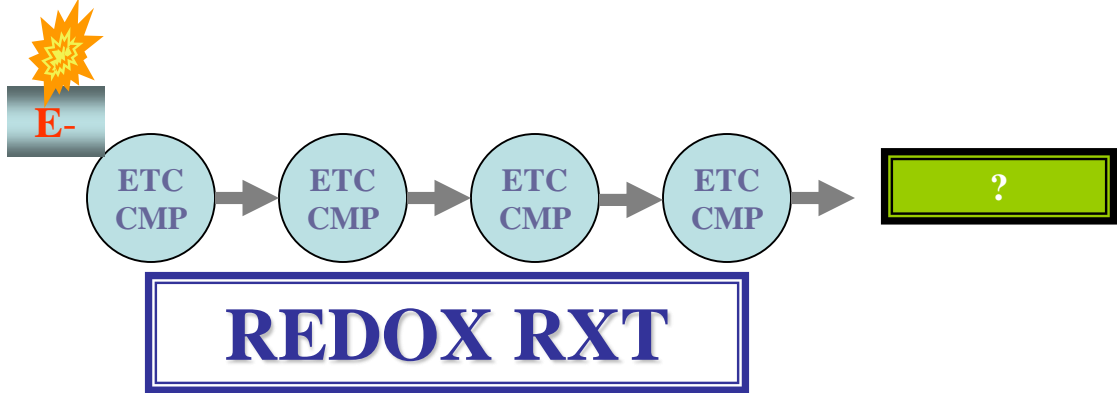
NON-CYCLIC P-P

CYCLIC P-P

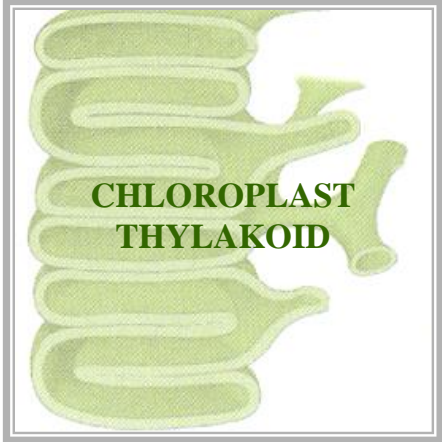


PS-II / PS-I

CHLOROPLAST
THYLAKOID
MEMBRANE



CHLOROPLAST
STROMA



● = ELECTRON TRANSPORT CHAIN COMPONENT

★ = HEAT ENERGY

★ = CHEMICAL ENERGY

CHLOROPLAST
THYLAKOID
SPACE

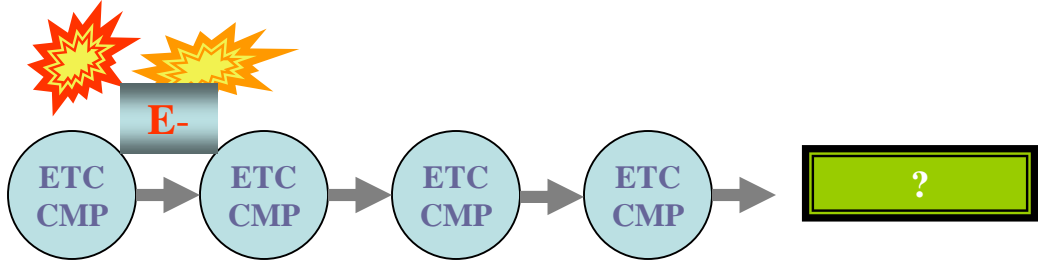
NON-CYCLIC P-P

CYCLIC P-P



PS-II / PS-I

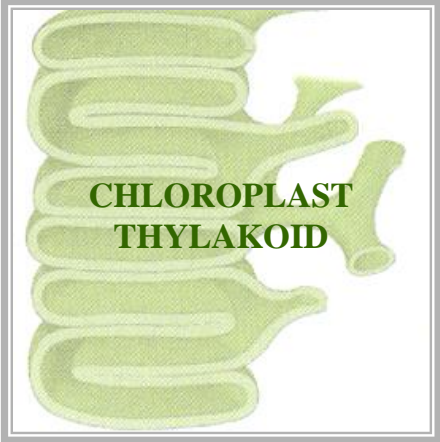
CHLOROPLAST
THYLAKOID
MEMBRANE



ATP
SYNTHASE



CHLOROPLAST
STROMA



● = ELECTRON TRANSPORT CHAIN COMPONENT

★ = HEAT ENERGY

★ = CHEMICAL ENERGY

CHLOROPLAST
THYLAKOID
SPACE

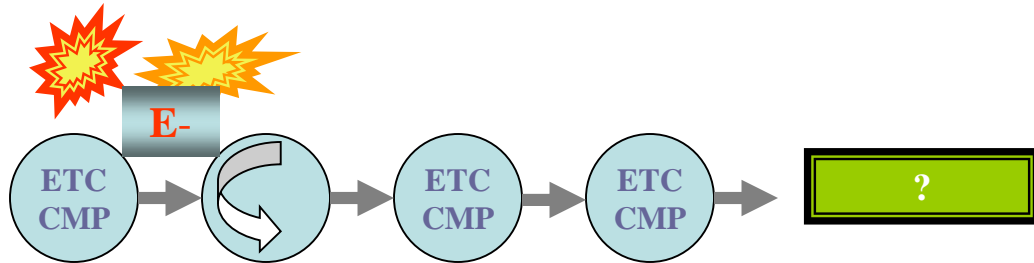
NON-CYCLIC P-P

CYCLIC P-P



PS-II / PS-I

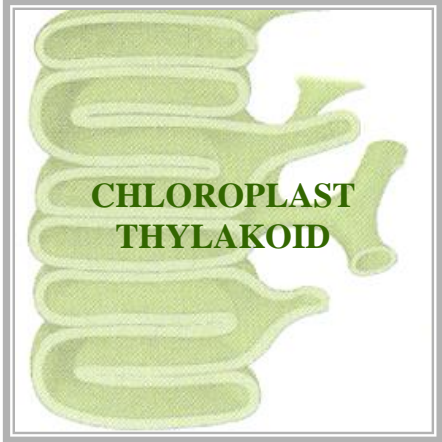
CHLOROPLAST
THYLAKOID
MEMBRANE



ATP
SYNTHASE



CHLOROPLAST
STROMA



● = ELECTRON TRANSPORT CHAIN COMPONENT

★ = HEAT ENERGY

★ = CHEMICAL ENERGY

CHLOROPLAST
THYLAKOID
SPACE

NON-CYCLIC P-P

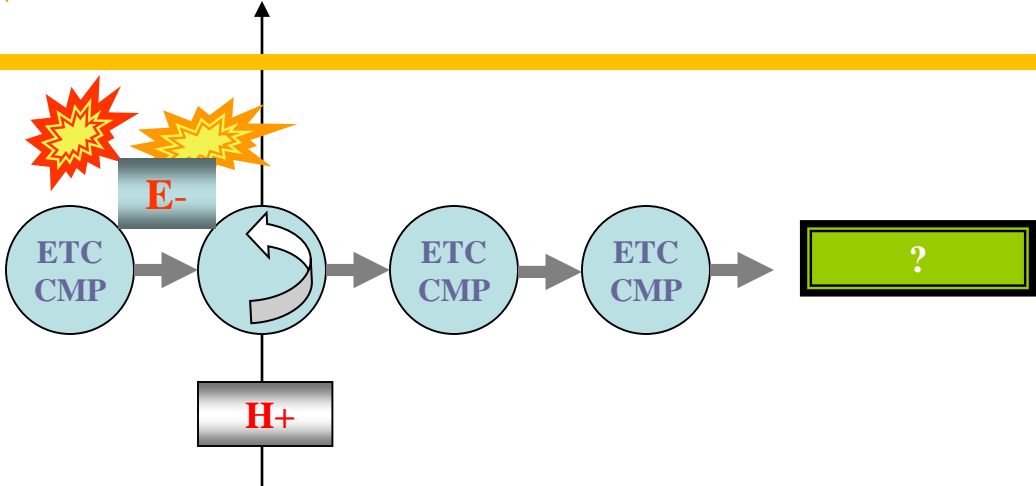
CYCLIC P-P

H⁺

H⁺

PS-II / PS-I

CHLOROPLAST
THYLAKOID
MEMBRANE

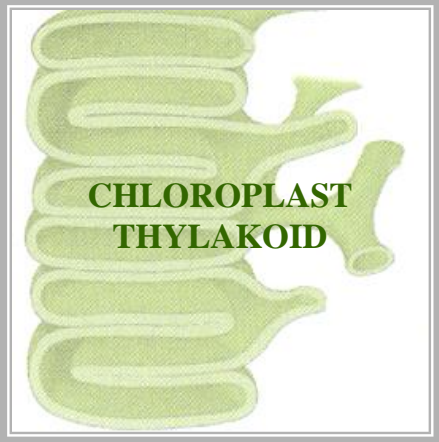


ATP
SYNTHASE

CHLOROPLAST
STROMA

H⁺

H⁺



● = ELECTRON TRANSPORT CHAIN COMPONENT

★ = HEAT ENERGY

★ = CHEMICAL ENERGY

NON-CYCLIC P-P

CYCLIC P-P

R

CHLOROPLAST
THYLAKOID
SPACE

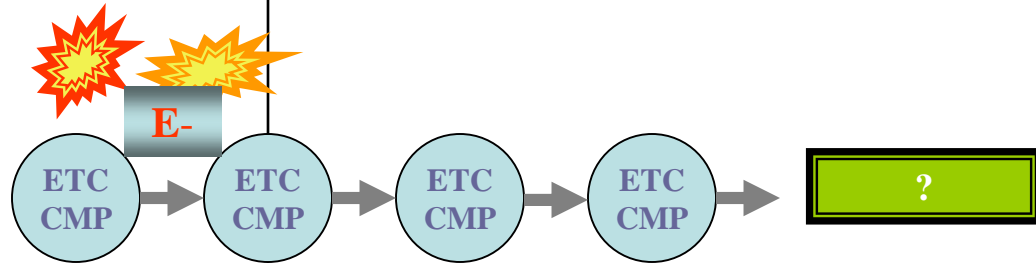
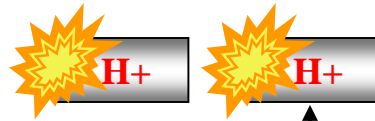
PS-II / PS-I

CHLOROPLAST
THYLAKOID
MEMBRANE

ATP
SYNTHASE

CHLOROPLAST
STROMA

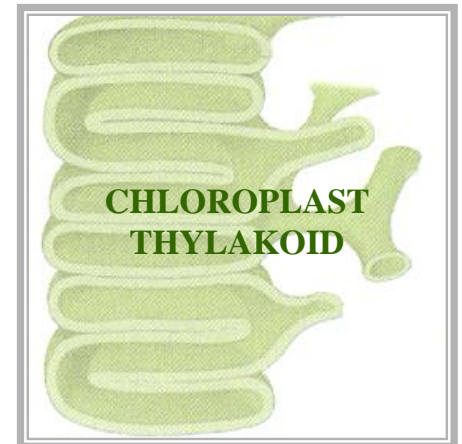
CHLOROPLAST
THYLAKOID



 = ELECTRON TRANSPORT CHAIN COMPONENT

 = HEAT ENERGY

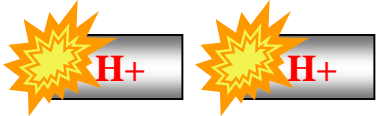
 = CHEMICAL ENERGY



CHLOROPLAST
THYLAKOID
SPACE

NON-CYCLIC P-P

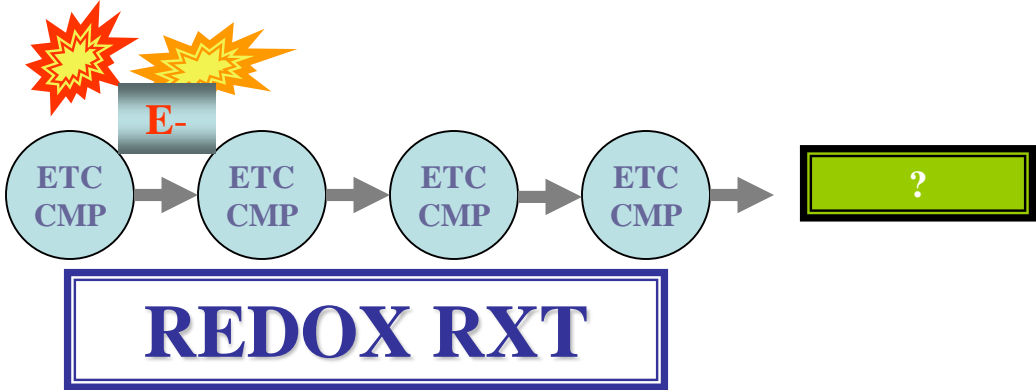
CYCLIC P-P



E-

PS-II / PS-I

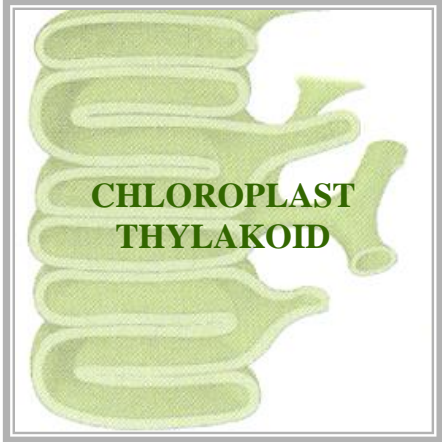
CHLOROPLAST
THYLAKOID
MEMBRANE



H+

H+

CHLOROPLAST
STROMA



● = ELECTRON TRANSPORT CHAIN COMPONENT

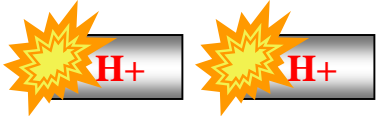
★ = HEAT ENERGY

★ = CHEMICAL ENERGY

CHLOROPLAST
THYLAKOID
SPACE

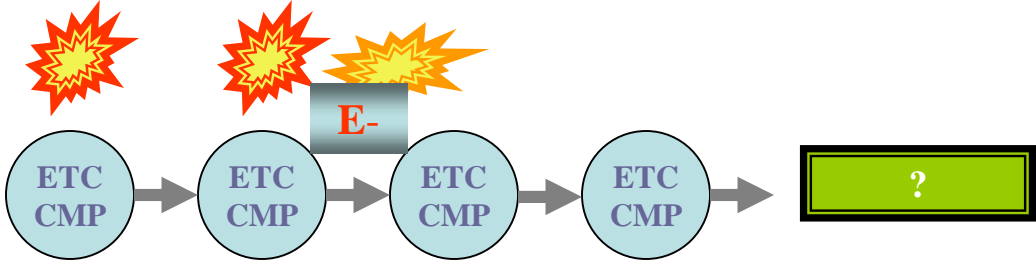
NON-CYCLIC P-P

CYCLIC P-P



PS-II / PS-I

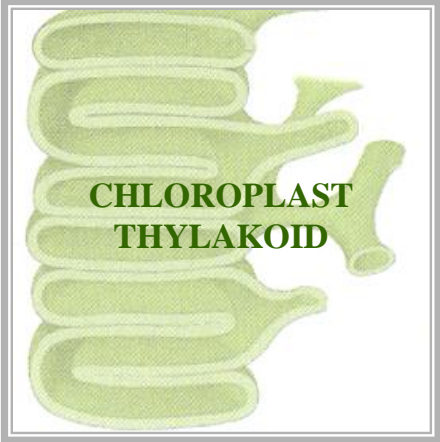
CHLOROPLAST
THYLAKOID
MEMBRANE



ATP
SYNTHASE



CHLOROPLAST
STROMA



● = ELECTRON TRANSPORT CHAIN COMPONENT

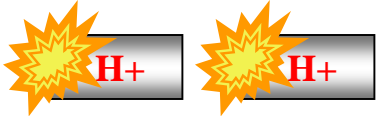
★ = HEAT ENERGY

★ = CHEMICAL ENERGY

CHLOROPLAST
THYLAKOID
SPACE

NON-CYCLIC P-P

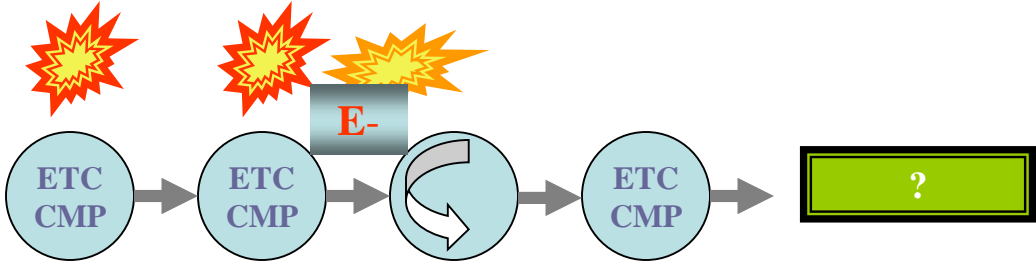
CYCLIC P-P



H+

PS-II / PS-I

CHLOROPLAST
THYLAKOID
MEMBRANE

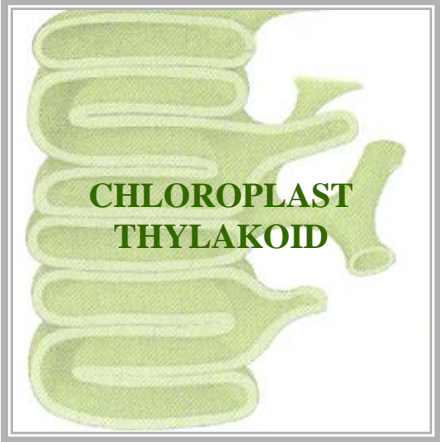


ATP
SYNTHASE

H+

H+

CHLOROPLAST
STROMA



● = ELECTRON TRANSPORT CHAIN COMPONENT

★ = HEAT ENERGY

★ = CHEMICAL ENERGY

CHLOROPLAST
THYLAKOID
SPACE

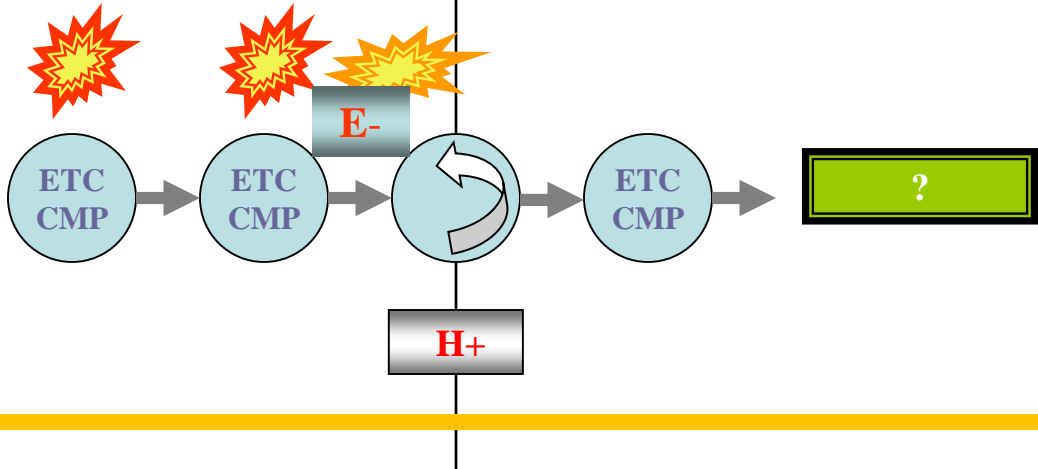
NON-CYCLIC P-P

CYCLIC P-P



PS-II / PS-I

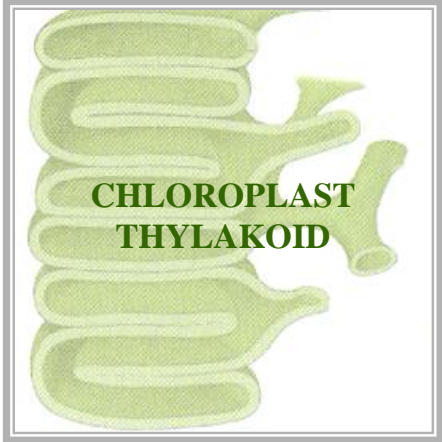
CHLOROPLAST
THYLAKOID
MEMBRANE



ATP
SYNTHASE

CHLOROPLAST
STROMA

H+



● = ELECTRON TRANSPORT CHAIN COMPONENT

★ = HEAT ENERGY

★ = CHEMICAL ENERGY

NON-CYCLIC P-P

CYCLIC P-P

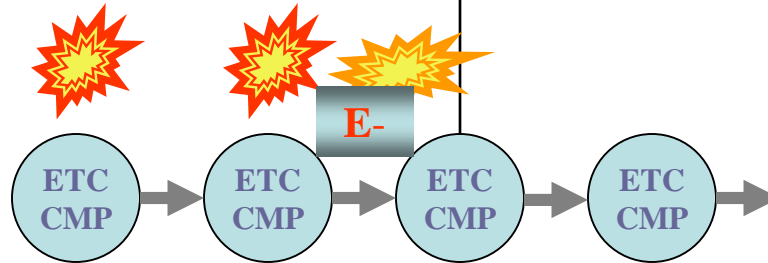
CHLOROPLAST
THYLAKOID
SPACE



R

PS-II / PS-I

CHLOROPLAST
THYLAKOID
MEMBRANE



ATP
SYNTHASE

CHLOROPLAST
STROMA

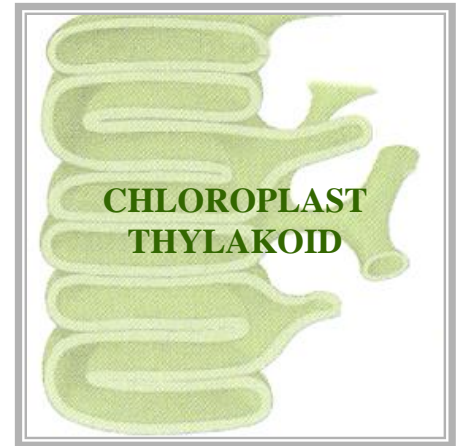
H^+

CHLOROPLAST
THYLAKOID

● = ELECTRON TRANSPORT CHAIN COMPONENT

★ = HEAT ENERGY

★ = CHEMICAL ENERGY



CHLOROPLAST
THYLAKOID
SPACE

NON-CYCLIC P-P

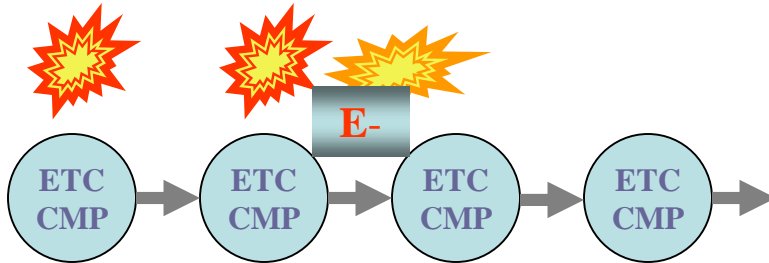
CYCLIC P-P



E⁻

PS-II / PS-I

CHLOROPLAST
THYLAKOID
MEMBRANE

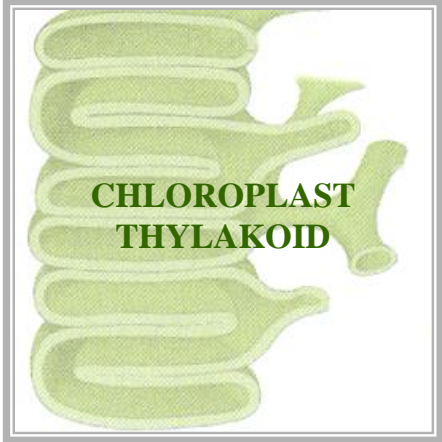


REDOX RXT

ATP
SYNTHASE

CHLOROPLAST
STROMA

H⁺



● = ELECTRON TRANSPORT CHAIN COMPONENT

★ = HEAT ENERGY

★ = CHEMICAL ENERGY

CHLOROPLAST
THYLAKOID
SPACE

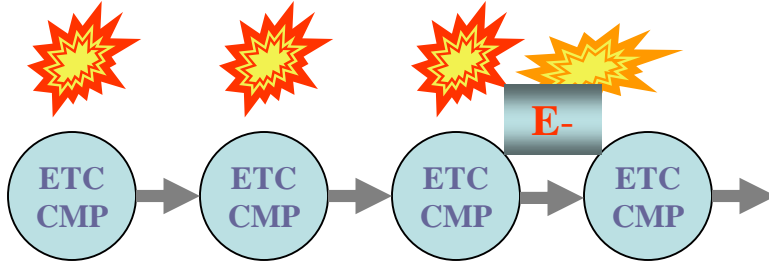
NON-CYCLIC P-P

CYCLIC P-P



PS-II / PS-I

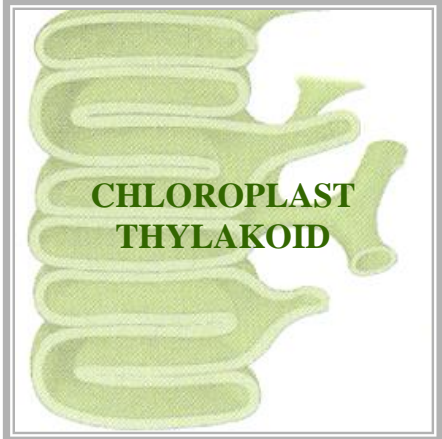
CHLOROPLAST
THYLAKOID
MEMBRANE



ATP
SYNTHASE

CHLOROPLAST
STROMA

H^+



● = ELECTRON TRANSPORT CHAIN COMPONENT

★ = HEAT ENERGY

★ = CHEMICAL ENERGY

CHLOROPLAST
THYLAKOID
SPACE

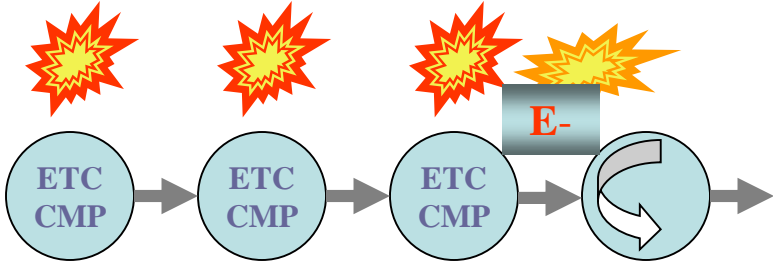
NON-CYCLIC P-P

CYCLIC P-P



PS-II / PS-I

CHLOROPLAST
THYLAKOID
MEMBRANE

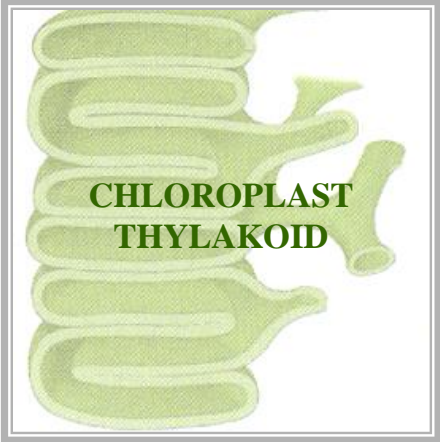


?

ATP
SYNTHASE

H^+

CHLOROPLAST
STROMA



● = ELECTRON TRANSPORT CHAIN COMPONENT

★ = HEAT ENERGY

★ = CHEMICAL ENERGY

CHLOROPLAST
THYLAKOID
SPACE

NON-CYCLIC P-P

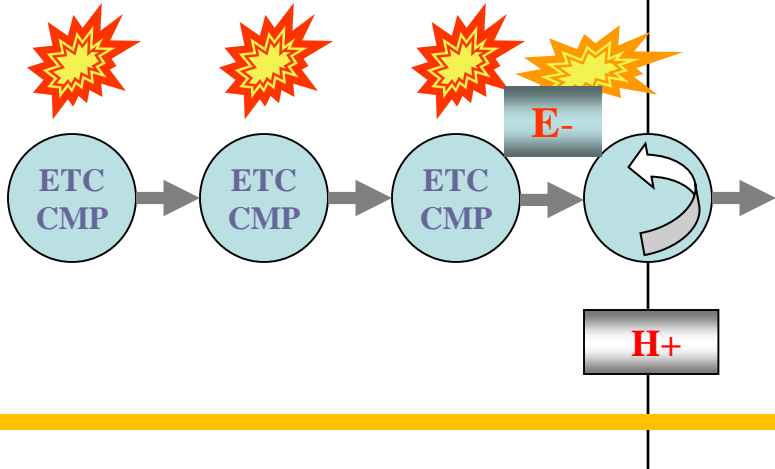
CYCLIC P-P



H^+

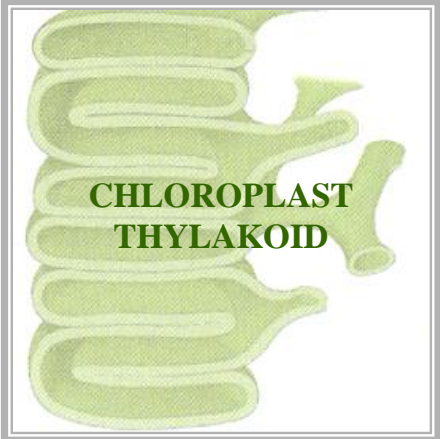
PS-II / PS-I

CHLOROPLAST
THYLAKOID
MEMBRANE



ATP
SYNTHASE

CHLOROPLAST
STROMA



● = ELECTRON TRANSPORT CHAIN COMPONENT

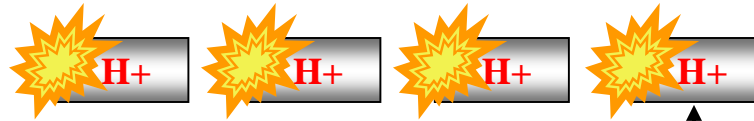
★ = HEAT ENERGY

★ = CHEMICAL ENERGY

NON-CYCLIC P-P

CYCLIC P-P

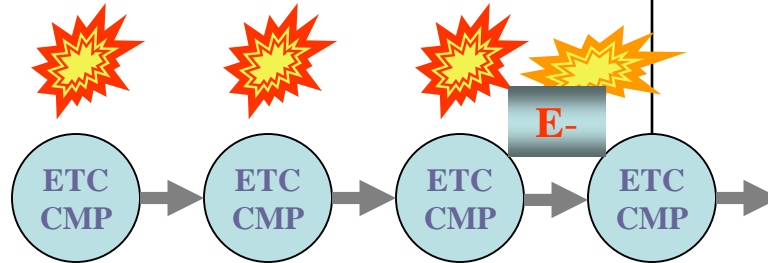
CHLOROPLAST
THYLAKOID
SPACE



R

PS-II / PS-I

CHLOROPLAST
THYLAKOID
MEMBRANE



ATP
SYNTHASE

CHLOROPLAST
STROMA

● = ELECTRON TRANSPORT CHAIN COMPONENT

★ = HEAT ENERGY

★ = CHEMICAL ENERGY

CHLOROPLAST
THYLAKOID

CHLOROPLAST
THYLAKOID
SPACE

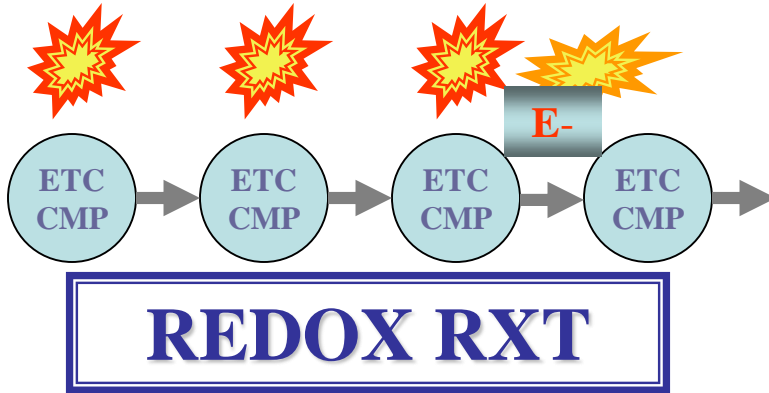
NON-CYCLIC P-P

CYCLIC P-P



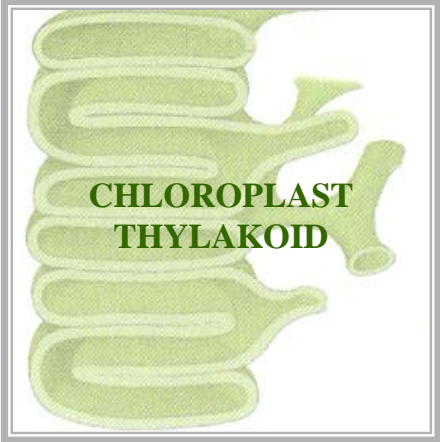
PS-II / PS-I

CHLOROPLAST
THYLAKOID
MEMBRANE



ATP
SYNTHASE

CHLOROPLAST
STROMA



● = ELECTRON TRANSPORT CHAIN COMPONENT

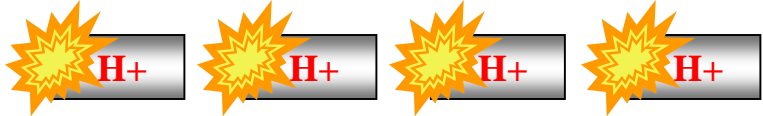
★ = HEAT ENERGY

★ = CHEMICAL ENERGY

CHLOROPLAST
THYLAKOID
SPACE

NON-CYCLIC P-P

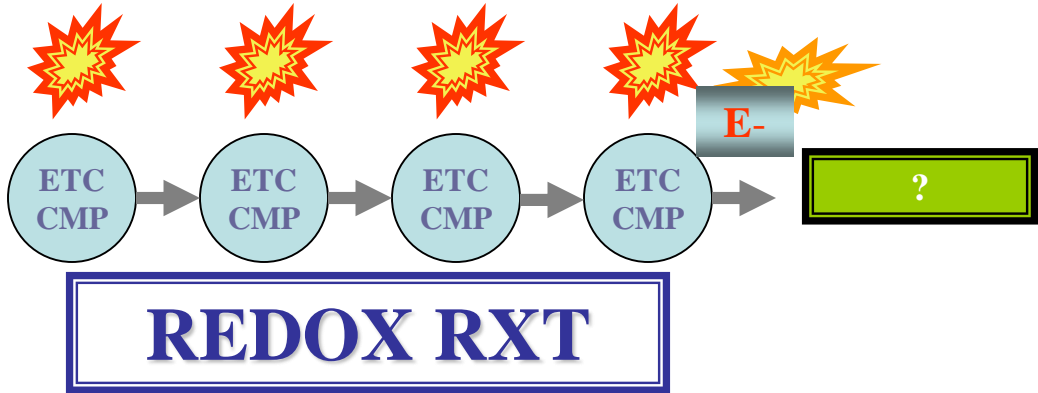
CYCLIC P-P



?
Z

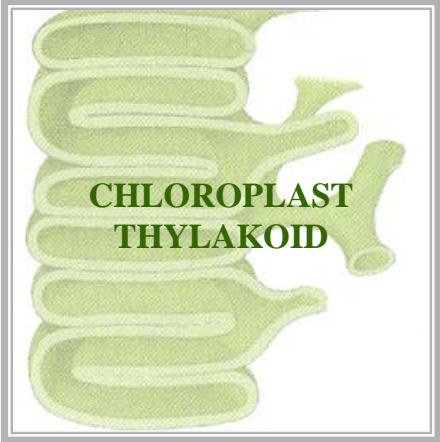
PS-II / PS-I

CHLOROPLAST
THYLAKOID
MEMBRANE



ATP
SYNTHASE

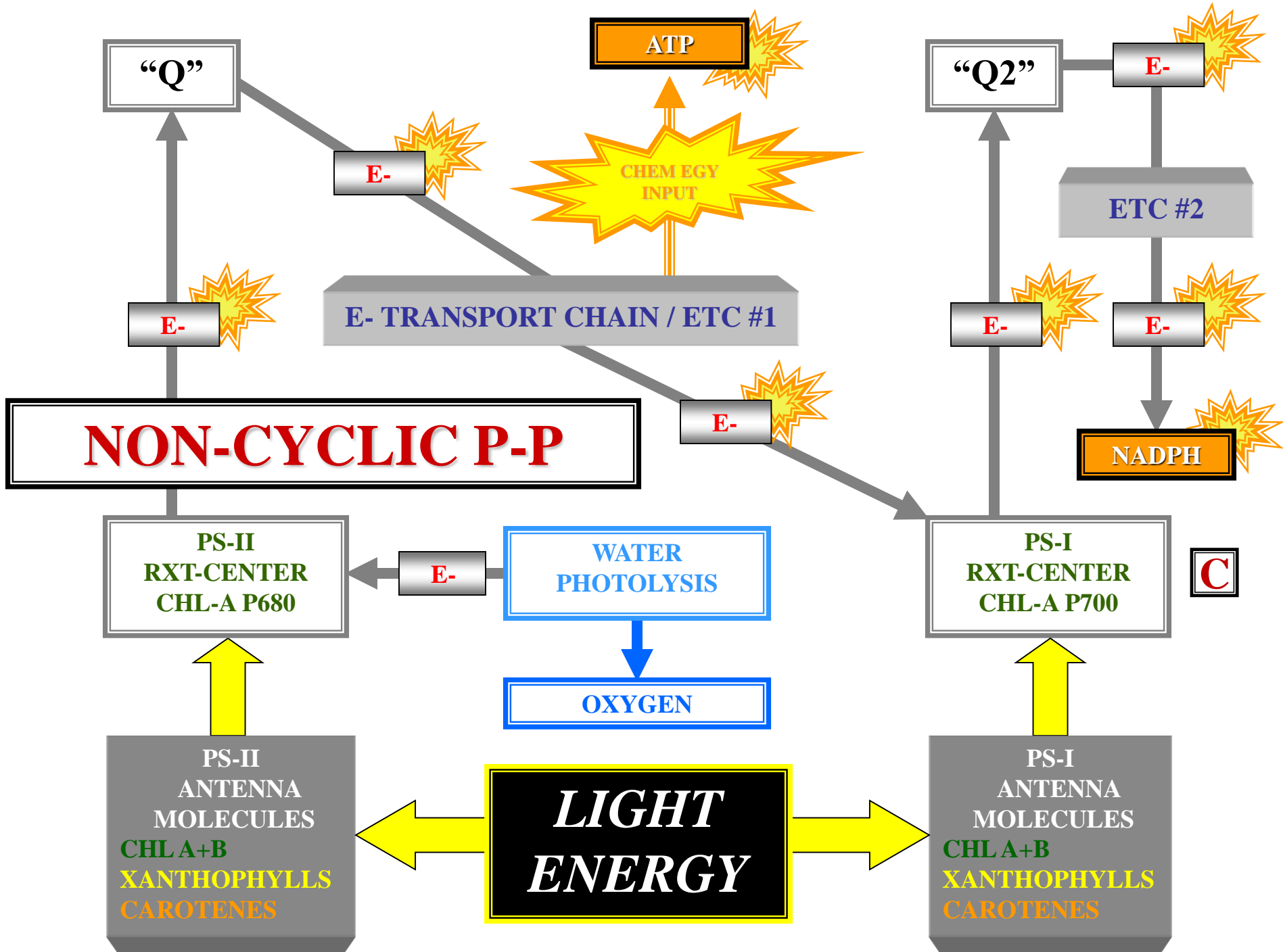
CHLOROPLAST
STROMA



● = ELECTRON TRANSPORT CHAIN COMPONENT

★ = HEAT ENERGY

★ = CHEMICAL ENERGY



CYCLIC P-P

“Q2”

E-

ETC #3

CHEM
EGY
INPUT

ATP

?

E-

E-

E- = RECYCLED

PS-I
RXT-CENTER
CHL-A P700

LIGHT
ENERGY

PS-I
ANTENNA
MOLECULES
CHL A+B
XANTHOPHYLLS
CAROTENES

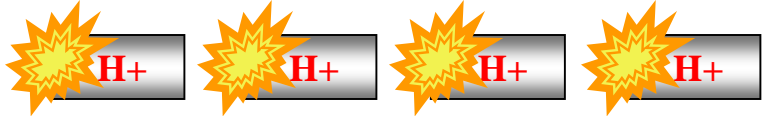
LIGHT
ENERGY

I

NON-CYCLIC P-P

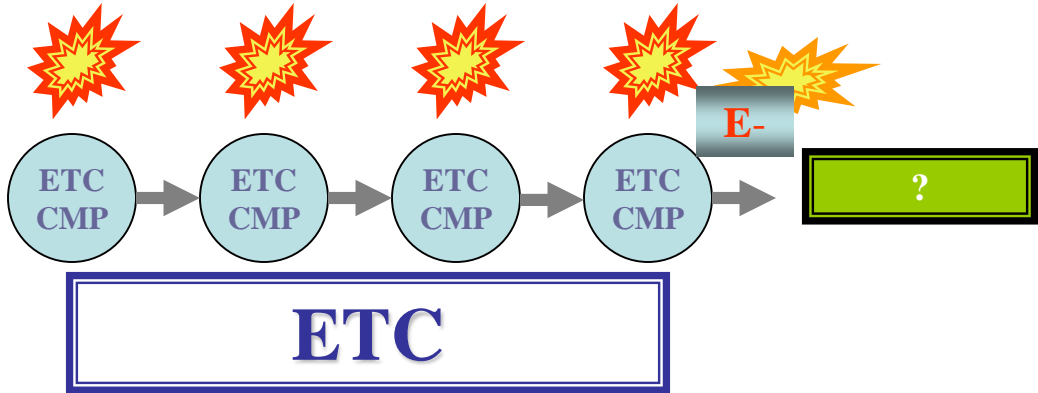
CYCLIC P-P

CHLOROPLAST
THYLAKOID
SPACE



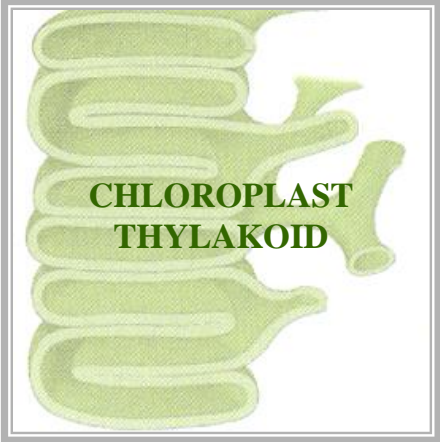
PS-II / PS-I

CHLOROPLAST
THYLAKOID
MEMBRANE



ATP
SYNTHASE

CHLOROPLAST
STROMA



● = ELECTRON TRANSPORT CHAIN COMPONENT

★ = HEAT ENERGY

★ = CHEMICAL ENERGY

S

NON-CYCLIC P-P

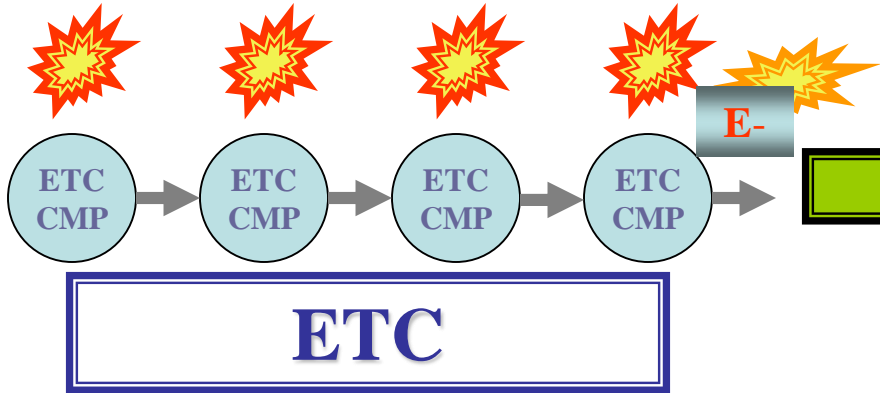
CYCLIC P-P

CHLOROPLAST
THYLAKOID
SPACE



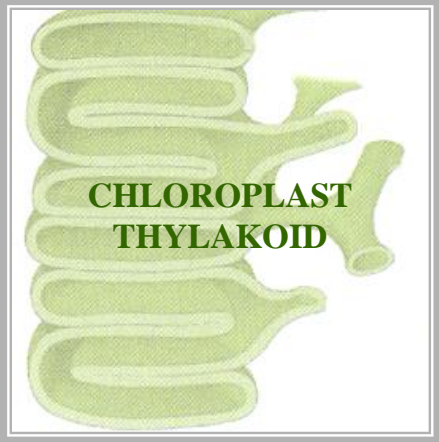
PS-II / PS-I

CHLOROPLAST
THYLAKOID
MEMBRANE



ATP
SYNTHASE

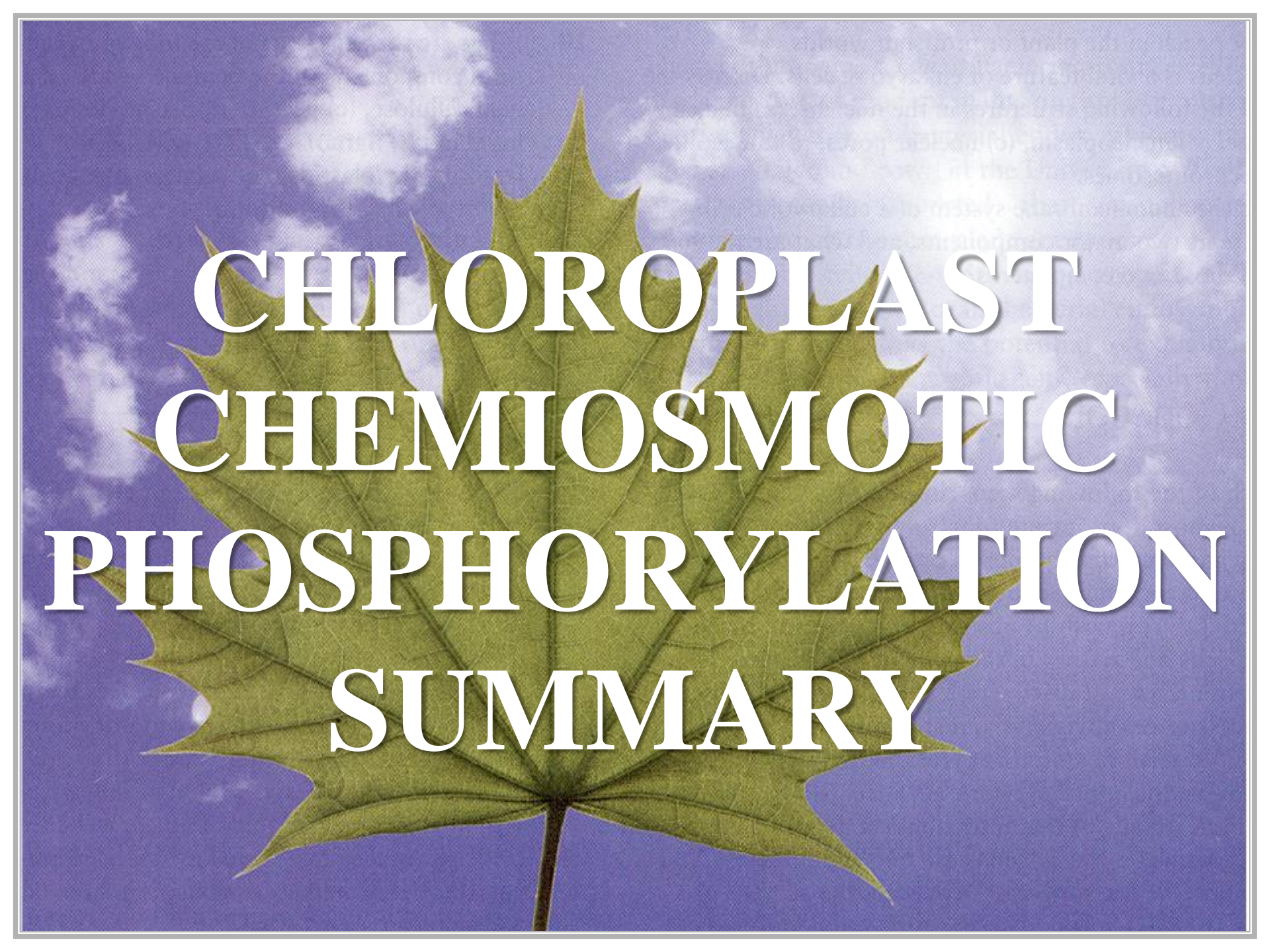
CHLOROPLAST
STROMA



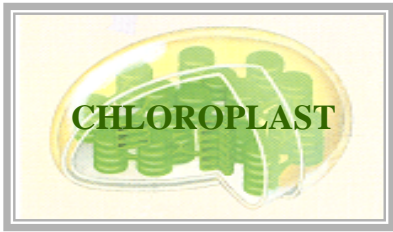
● = ELECTRON TRANSPORT CHAIN COMPONENT

★ = HEAT ENERGY

★ = CHEMICAL ENERGY



**CHLOROPLAST
CHEMIOSMOTIC
PHOSPHORYLATION
SUMMARY**

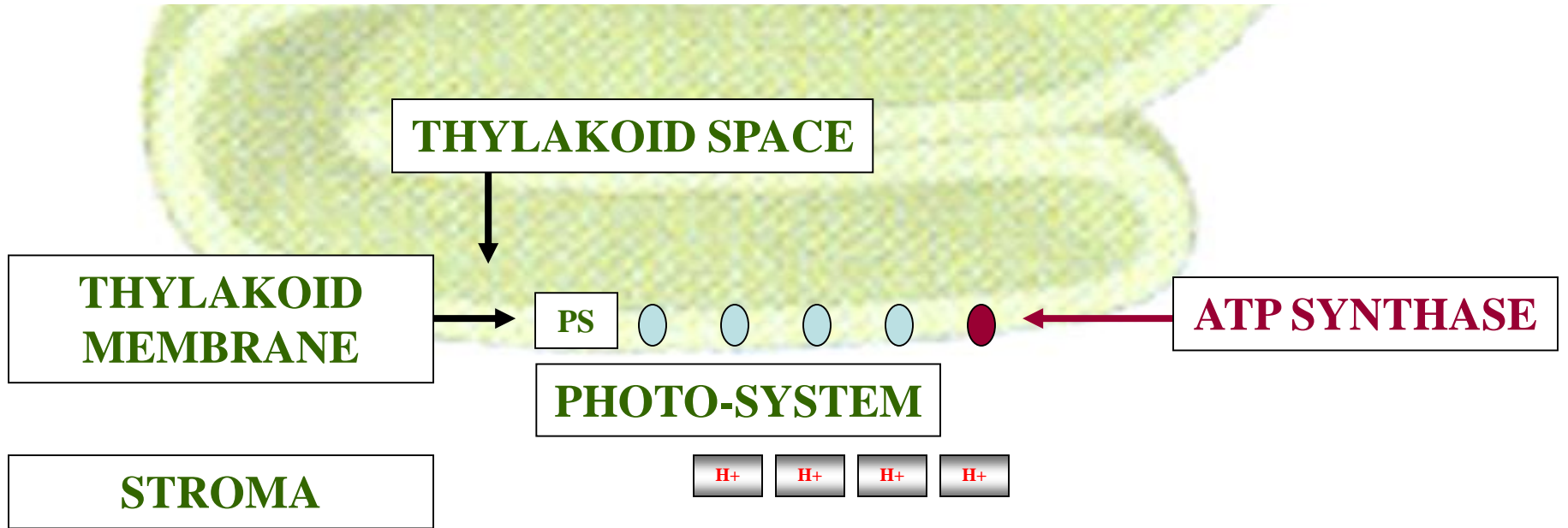


CHLOROPLAST CHEMIOSMOTIC



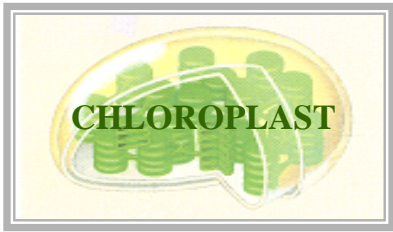
PHOSPHORYLATION

E-



 = POTENTIAL CHEMICAL ENERGY

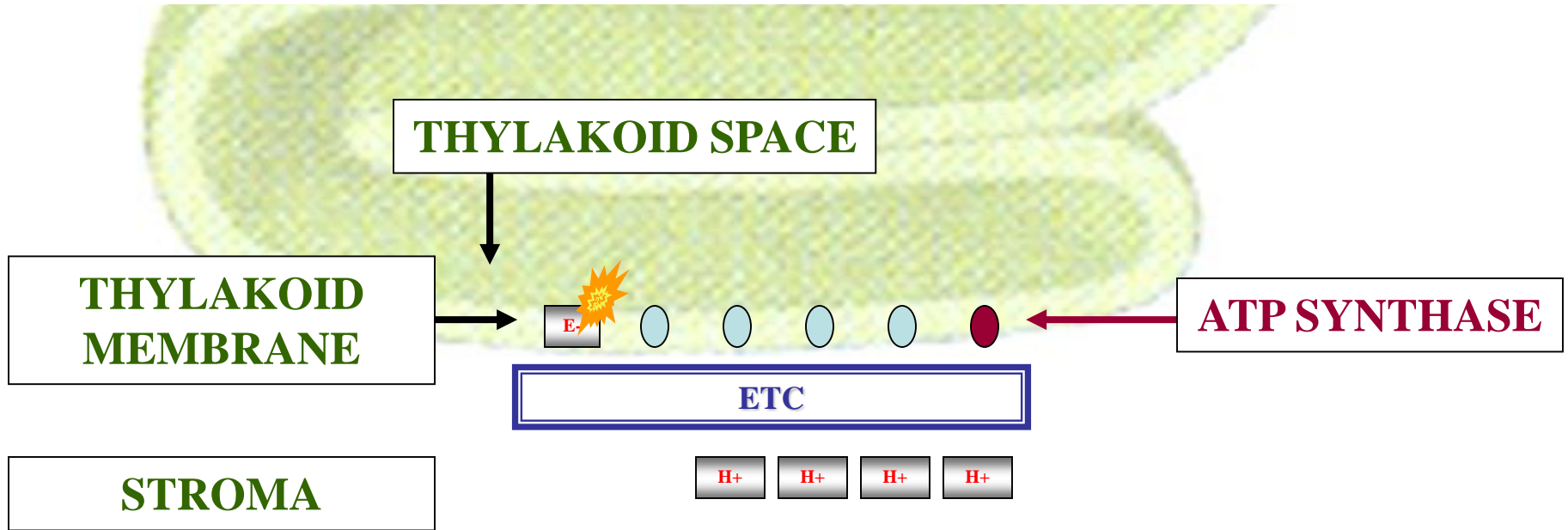
 = ELECTRON TRANSPORT CHAIN COMPONENT



CHLOROPLAST CHEMIOSMOTIC PHOSPHORYLATION

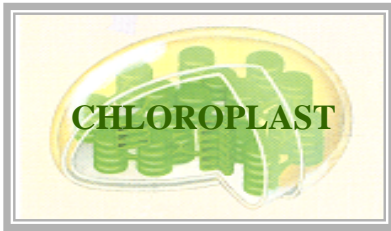


R



 = POTENTIAL CHEMICAL ENERGY

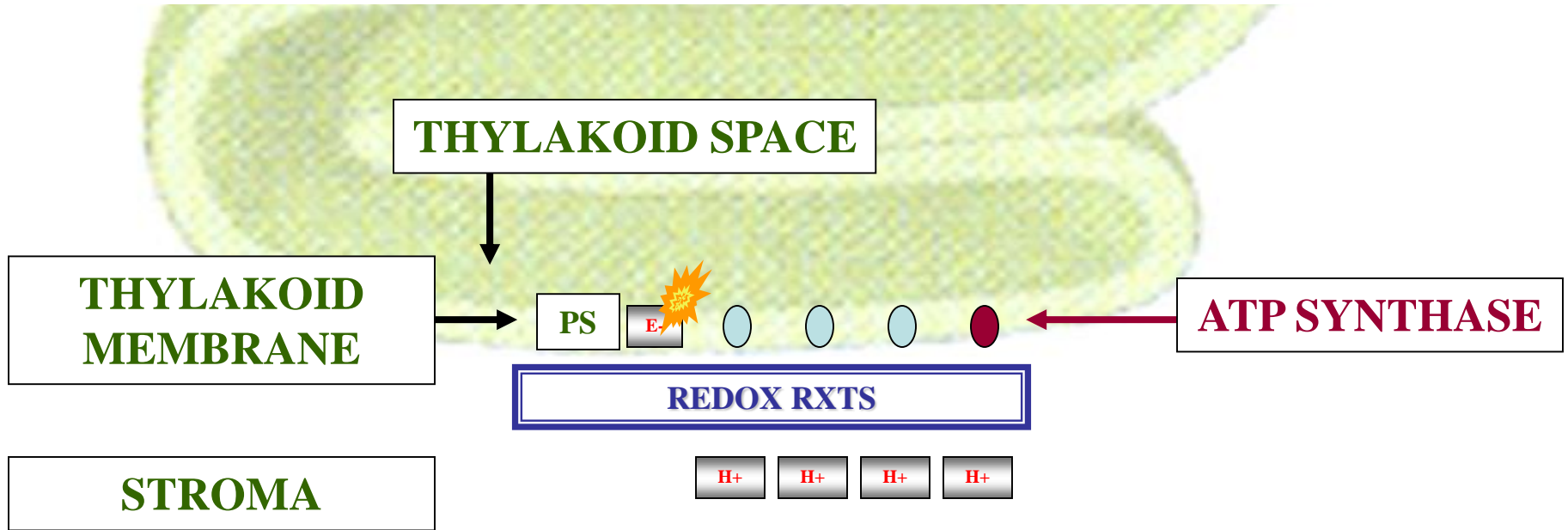
 = ELECTRON TRANSPORT CHAIN COMPONENT



CHLOROPLAST CHEMIOSMOTIC PHOSPHORYLATION

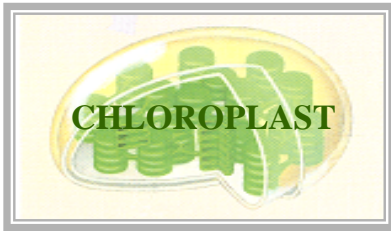


E-



 = POTENTIAL CHEMICAL ENERGY

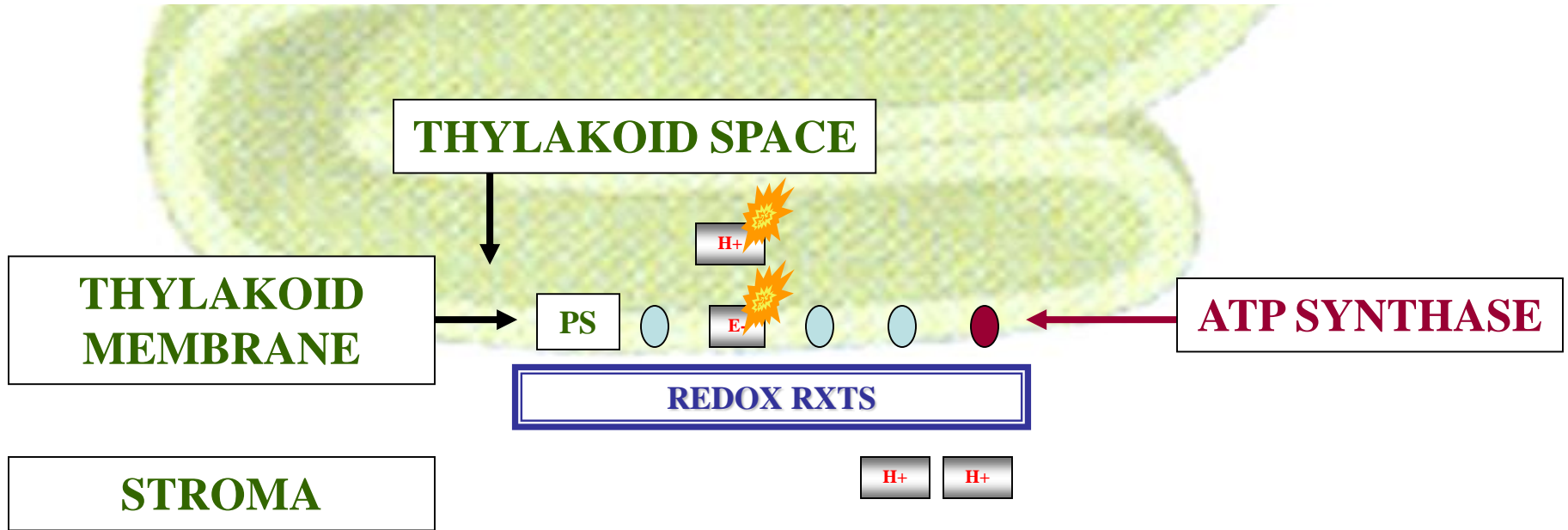
 = ELECTRON TRANSPORT CHAIN COMPONENT



CHLOROPLAST CHEMIOSMOTIC PHOSPHORYLATION

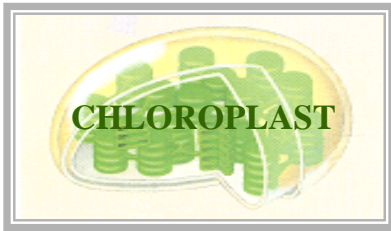


E-



 = POTENTIAL CHEMICAL ENERGY

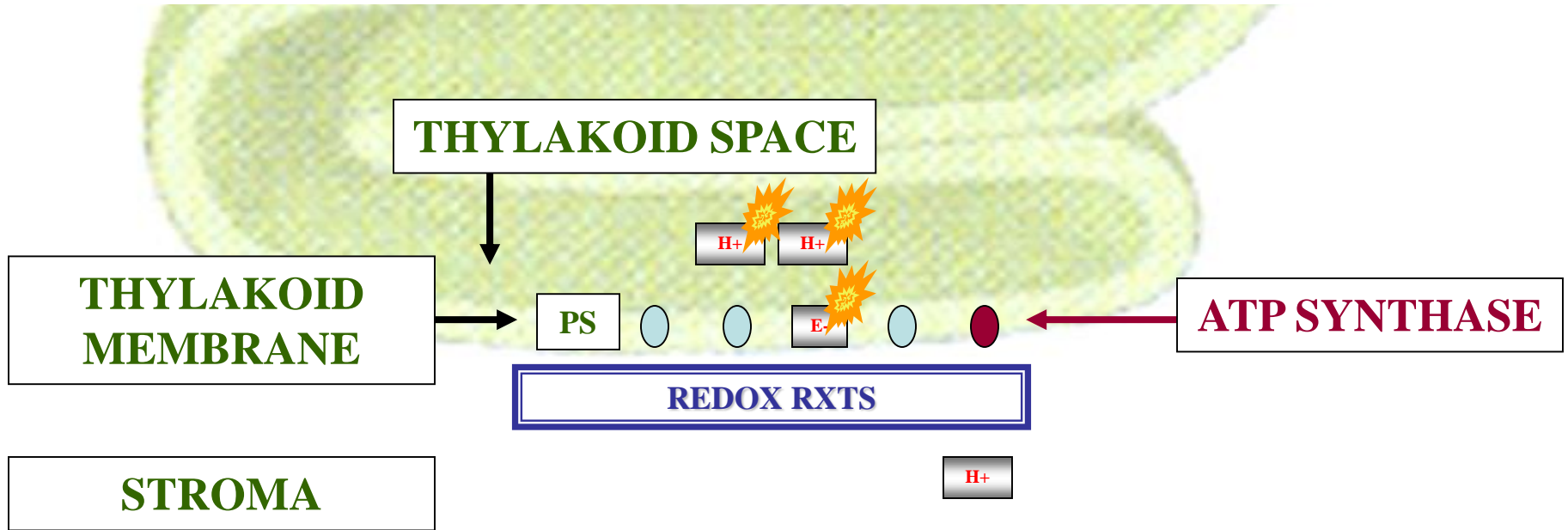
 = ELECTRON TRANSPORT CHAIN COMPONENT



CHLOROPLAST CHEMIOSMOTIC PHOSPHORYLATION

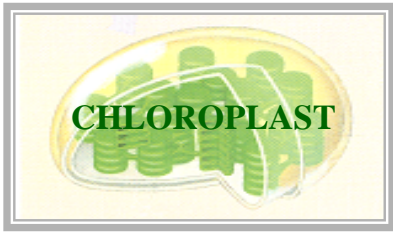


E-



 = POTENTIAL CHEMICAL ENERGY

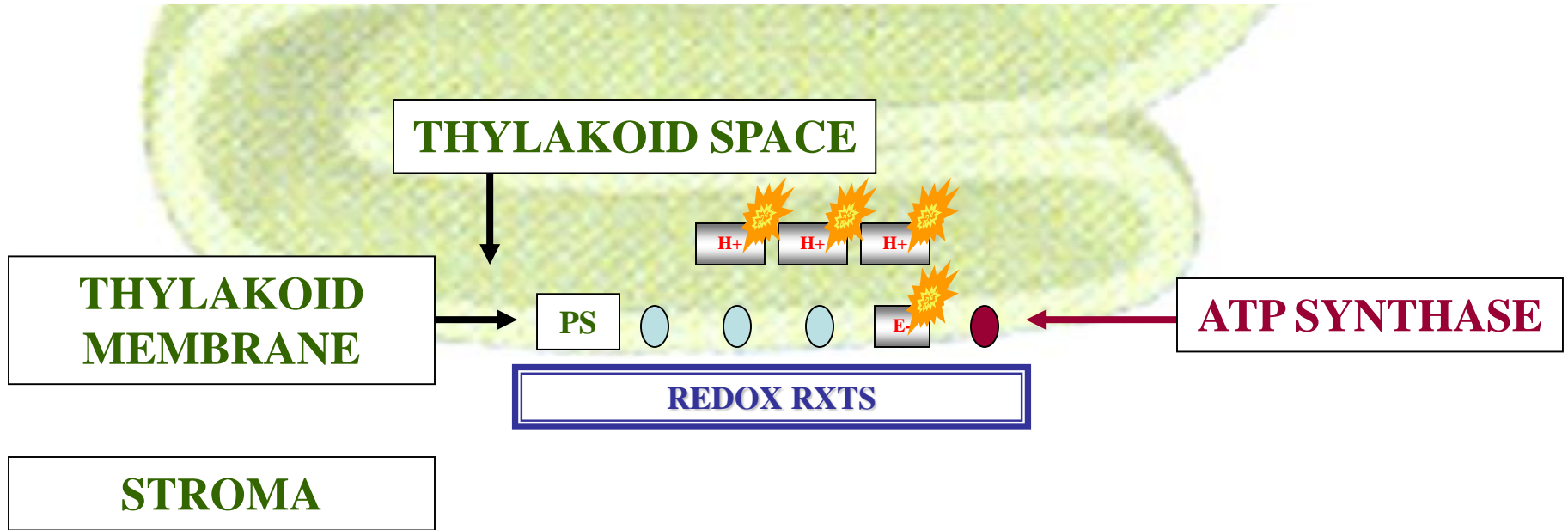
 = ELECTRON TRANSPORT CHAIN COMPONENT



CHLOROPLAST CHEMIOSMOTIC PHOSPHORYLATION

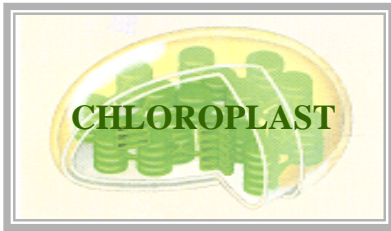


E-

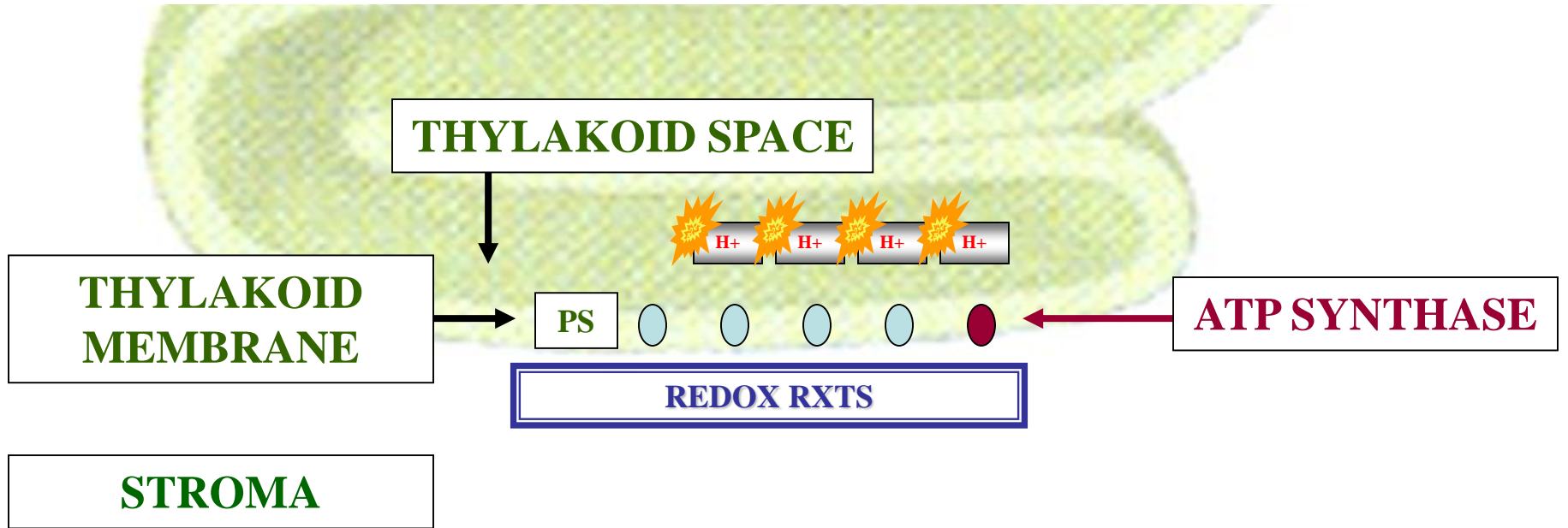


 = POTENTIAL CHEMICAL ENERGY

 = ELECTRON TRANSPORT CHAIN COMPONENT



CHLOROPLAST CHEMIOSMOTIC PHOSPHORYLATION



 = **POTENTIAL CHEMICAL ENERGY**

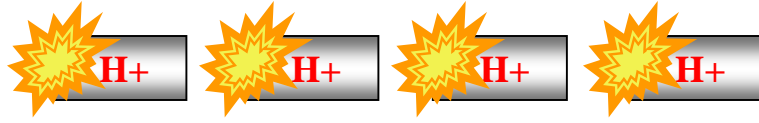
 = **ELECTRON TRANSPORT CHAIN COMPONENT**

A

NON-CYCLIC P-P

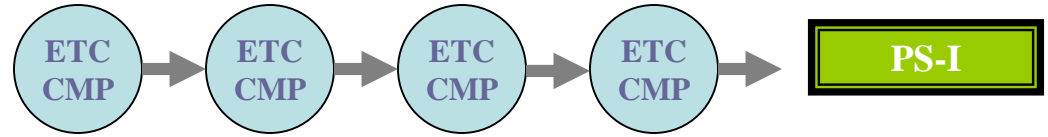
CYCLIC P-P

CHLOROPLAST
THYLAKOID
SPACE



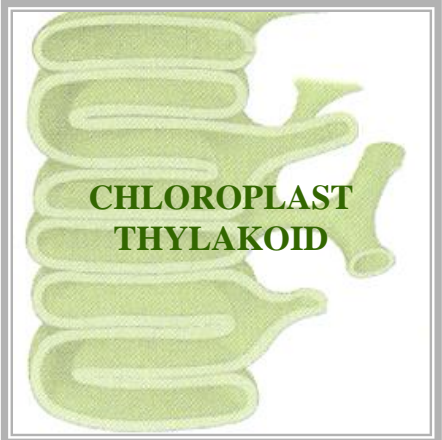
PS-II / PS-I

CHLOROPLAST
THYLAKOID
MEMBRANE



ATP
SYNTHASE

CHLOROPLAST
STROMA



● = ELECTRON TRANSPORT CHAIN COMPONENT

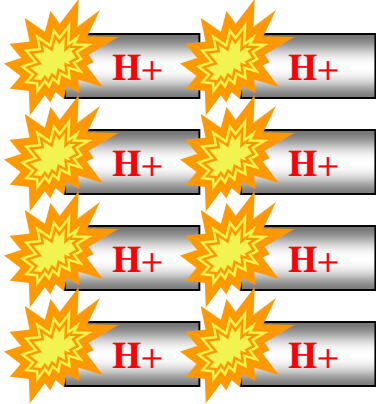
★ = HEAT ENERGY

★ = CHEMICAL ENERGY

P

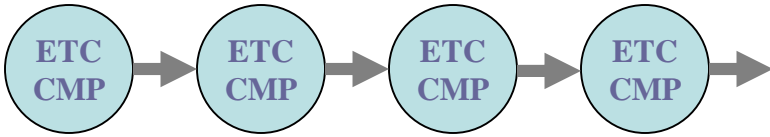
H+ ACCUMULATE BEHIND ATP-SYNTASE

**CHLOROPLAST
THYLAKOID
SPACE**



PS-II / PS-I

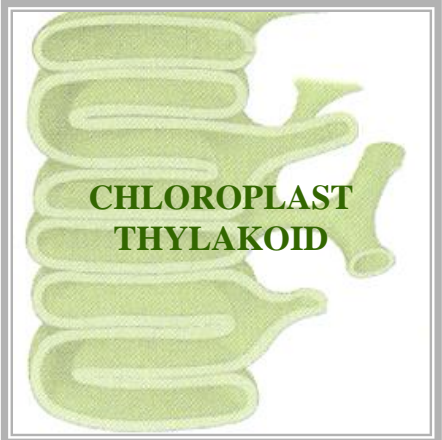
**CHLOROPLAST
THYLAKOID
MEMBRANE**



PS-I

**ATP
SYNTASE**

**CHLOROPLAST
STROMA**



● = ELECTRON TRANSPORT CHAIN COMPONENT

★ = HEAT ENERGY

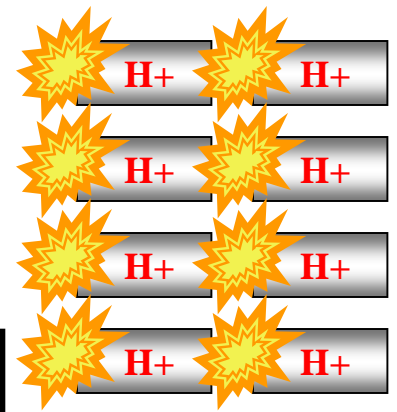
★ = CHEMICAL ENERGY



H⁺ ACCUMULATE BEHIND ATP-SYNTHASE

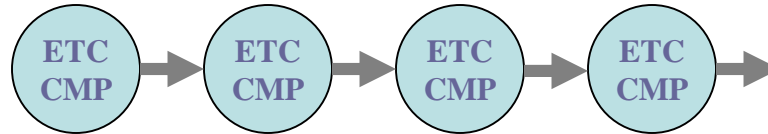
CHLOROPLAST
THYLAKOID
SPACE

POTENTIAL CHEM EGY



PS-II / PS-I

CHLOROPLAST
THYLAKOID
MEMBRANE



ATP
SYNTHASE

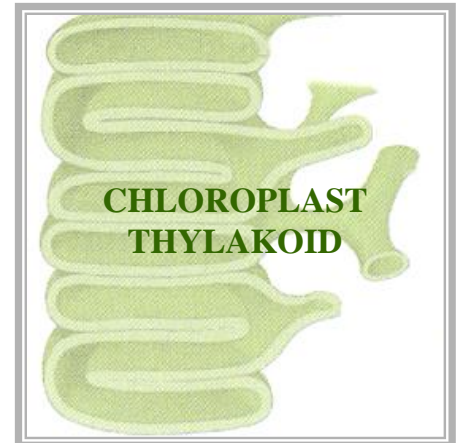
CHLOROPLAST
STROMA

CHLOROPLAST
THYLAKOID

● = ELECTRON TRANSPORT CHAIN COMPONENT

★ = HEAT ENERGY

★ = CHEMICAL ENERGY

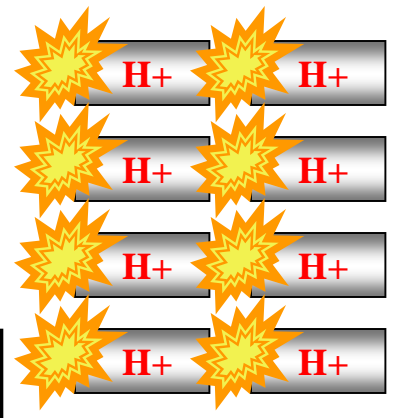




ANALOGY WATER & DAM

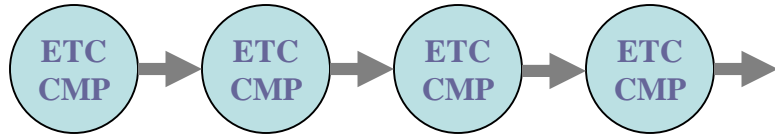
**CHLOROPLAST
THYLAKOID
SPACE**

POTENTIAL CHEM EGY



PS-II / PS-I

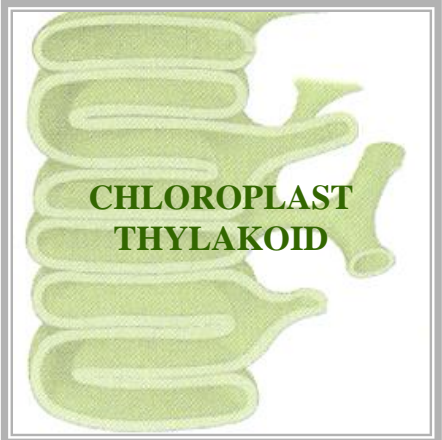
**CHLOROPLAST
THYLAKOID
MEMBRANE**



PS-I

**ATP
SYNTHASE**

**CHLOROPLAST
STROMA**



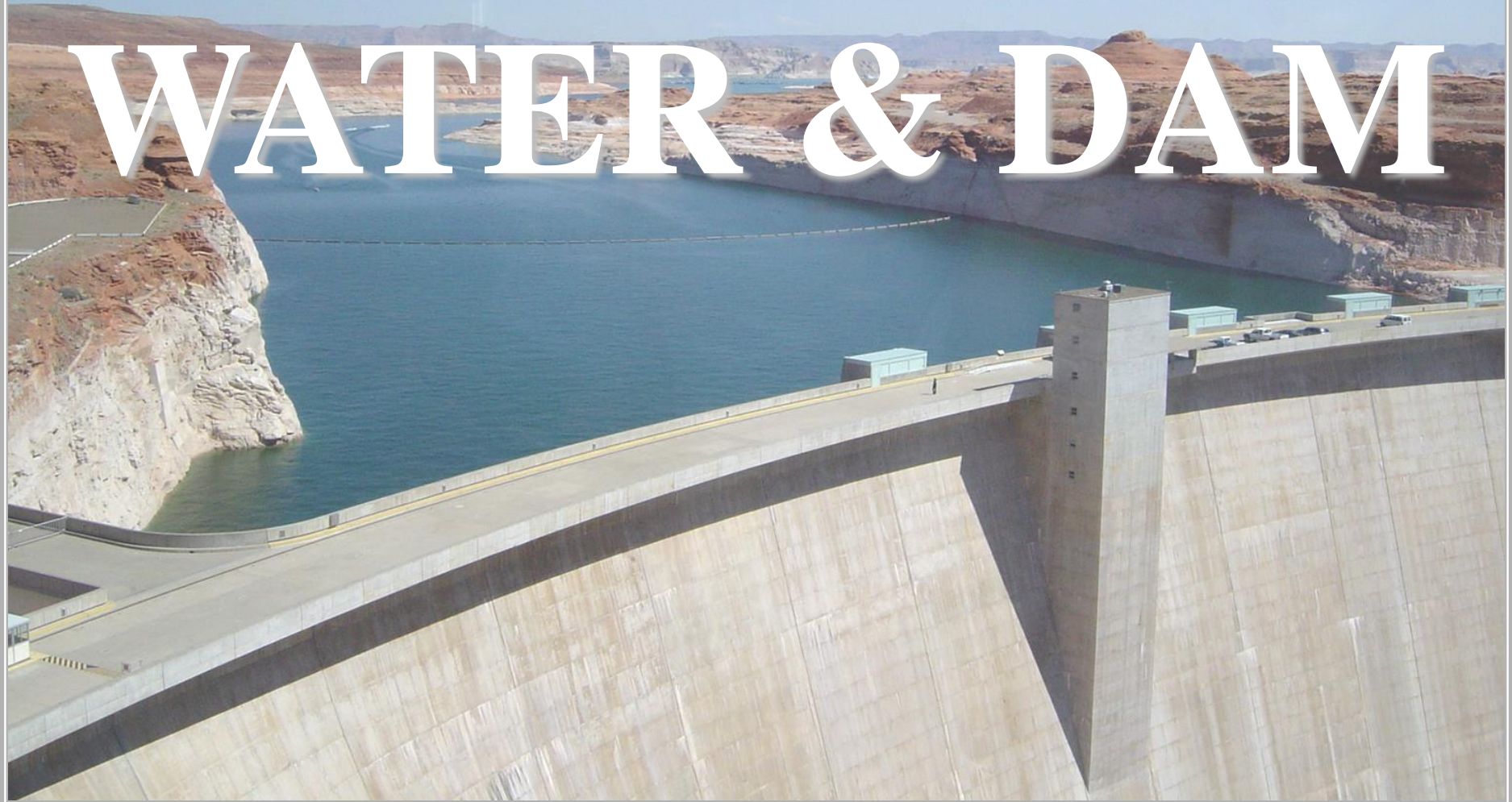
 = **ELECTRON TRANSPORT CHAIN COMPONENT**

 = **HEAT ENERGY**

 = **CHEMICAL ENERGY**



ANALOGY WATER & DAM



WATER = ?

H



WATER = H⁺

D



WATER = H⁺

DAM = ATP-SYNTHASE

!

DB

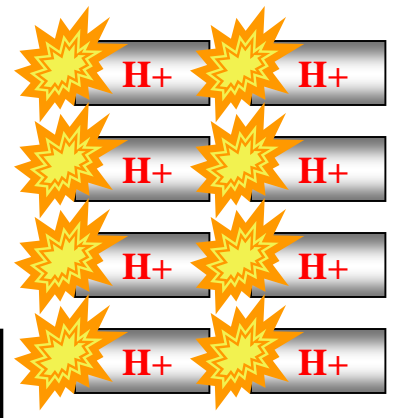




**CHLOROPLAST
THYLAKOID
SPACE**

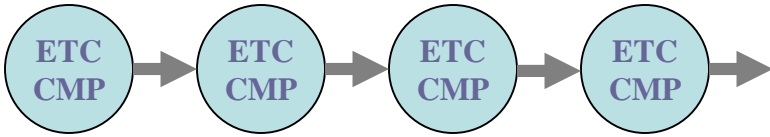
CRITICAL MASS H⁺ PASS VIA ATP SYNTHASE TO STROMA

POTENTIAL CHEM EGY



PS-II / PS-I

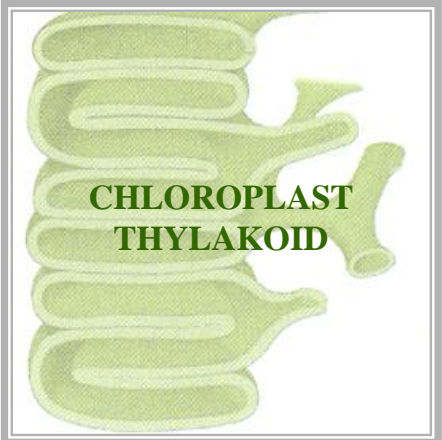
**CHLOROPLAST
THYLAKOID
MEMBRANE**



PS-I

**ATP
SYNTHASE**

**CHLOROPLAST
STROMA**



 = ELECTRON TRANSPORT CHAIN COMPONENT

 = HEAT ENERGY

 = CHEMICAL ENERGY



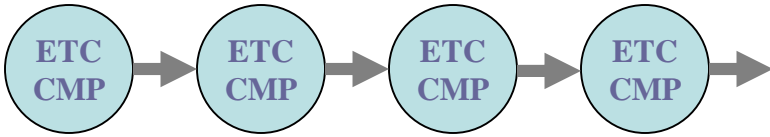
**CHLOROPLAST
THYLAKOID
SPACE**

CRITICAL MASS H⁺ PASS VIA ATP SYNTHASE TO STROMA

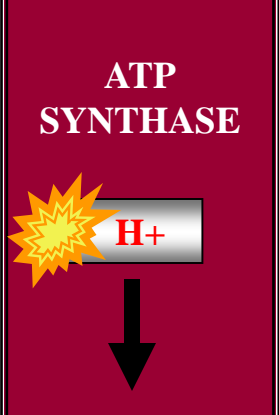
POTENTIAL CHEM EGY

PS-II / PS-I

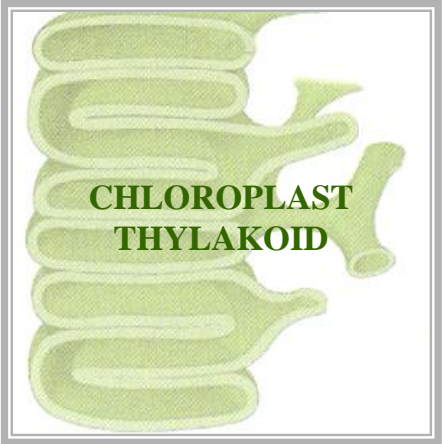
**CHLOROPLAST
THYLAKOID
MEMBRANE**



PS-I



**CHLOROPLAST
STROMA**



 = ELECTRON TRANSPORT CHAIN COMPONENT

 = HEAT ENERGY

 = CHEMICAL ENERGY



CRITICAL MASS

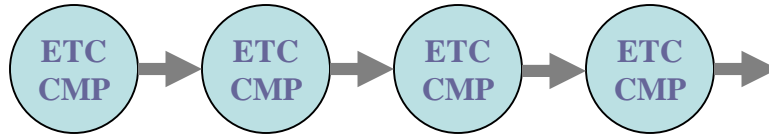
H⁺ PASS VIA ATP SYNTHASE TO STROMA

CHLOROPLAST THYLAKOID SPACE

POTENTIAL CHEM EGY

PS-II / PS-I

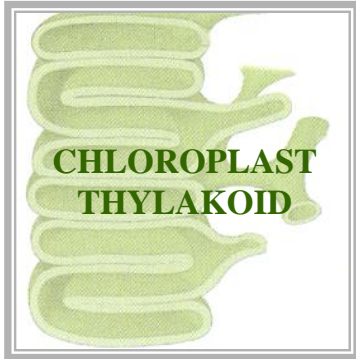
CHLOROPLAST THYLAKOID MEMBRANE



PS-I



CHLOROPLAST STROMA



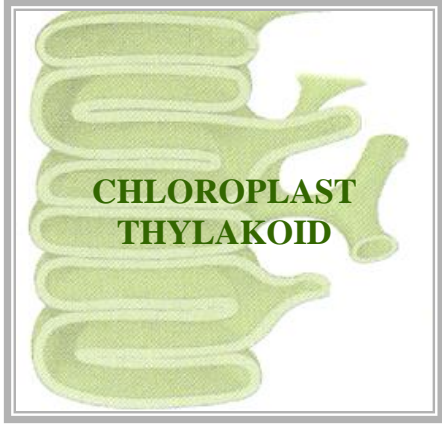
 = ELECTRON TRANSPORT CHAIN COMPONENT

 = HEAT ENERGY

 = CHEMICAL ENERGY

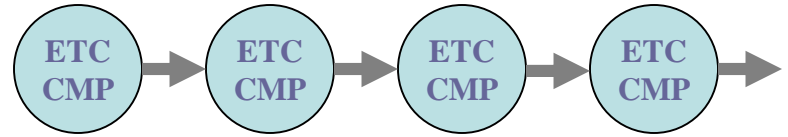
EX

**CHLOROPLAST
THYLAKOID
SPACE**



PS-II / PS-I

**CHLOROPLAST
THYLAKOID
MEMBRANE**



PS-I



POTENTIAL CHEMICAL ENERGY RELEASED



**CHLOROPLAST
STROMA**

 = **ELECTRON TRANSPORT CHAIN COMPONENT**

 = **HEAT ENERGY**

 = **CHEMICAL ENERGY**

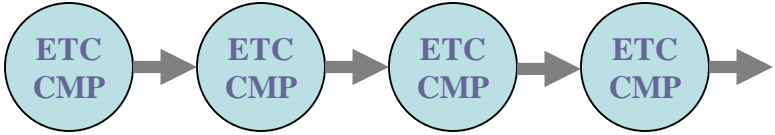
A

**CHLOROPLAST
THYLAKOID
SPACE**



PS-II / PS-I

**CHLOROPLAST
THYLAKOID
MEMBRANE**



PS-I

EXERGONIC RXT

**ATP
SYNTHASE**

**POTENTIAL
CHEMICAL EGY
RELEASED**



**CHLOROPLAST
STROMA**

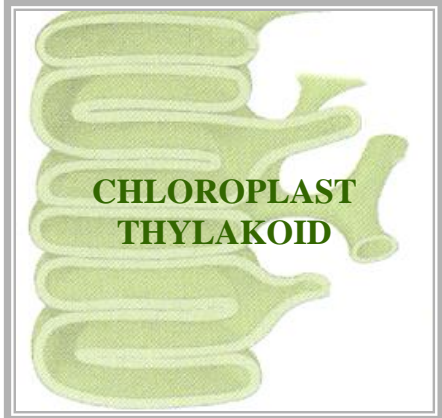
 = **ELECTRON TRANSPORT CHAIN COMPONENT**

 = **HEAT ENERGY**

 = **CHEMICAL ENERGY**

?

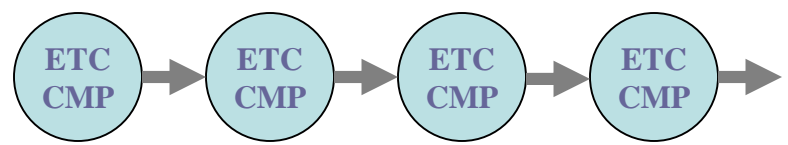
**CHLOROPLAST
THYLAKOID
SPACE**



**CHLOROPLAST
THYLAKOID**

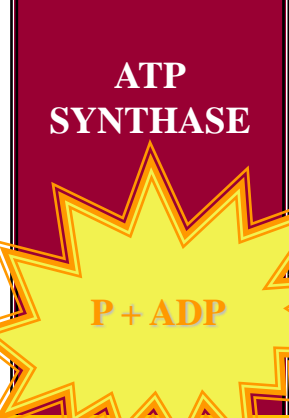
PS-II / PS-I

**CHLOROPLAST
THYLAKOID
MEMBRANE**



PS-I

EXERGONIC RXT



**ATP
SYNTHASE**

P + ADP



**CHLOROPLAST
STROMA**

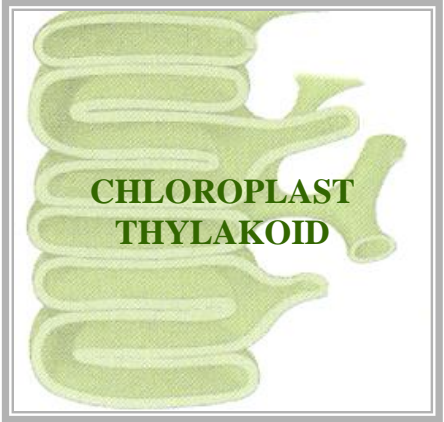
 = **ELECTRON TRANSPORT CHAIN COMPONENT**

 = **HEAT ENERGY**

 = **CHEMICAL ENERGY**

A

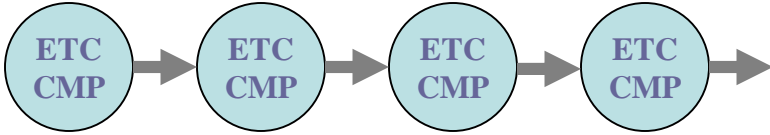
CHLOROPLAST
THYLAKOID
SPACE



CHLOROPLAST
THYLAKOID

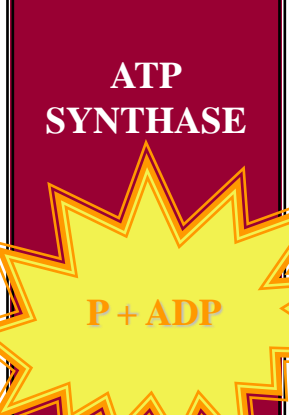
PS-II / PS-I

CHLOROPLAST
THYLAKOID
MEMBRANE



PS-I

EXERGONIC RXT



ATP
SYNTHASE

P + ADP



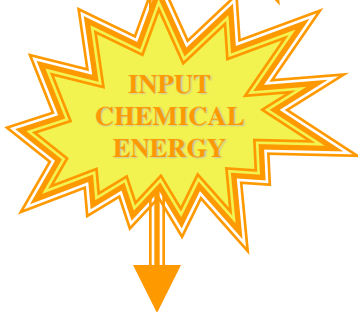
H+

H+

H+

H+

CHLOROPLAST
STROMA



INPUT
CHEMICAL
ENERGY

?

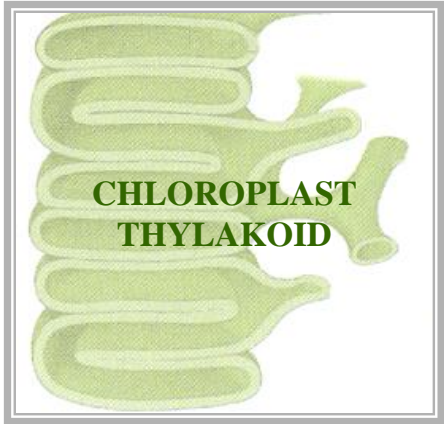
● = ELECTRON TRANSPORT CHAIN COMPONENT

★ = HEAT ENERGY

★ = CHEMICAL ENERGY

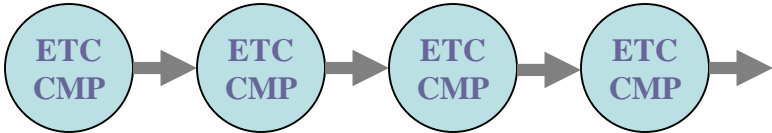
EN

**CHLOROPLAST
THYLAKOID
SPACE**



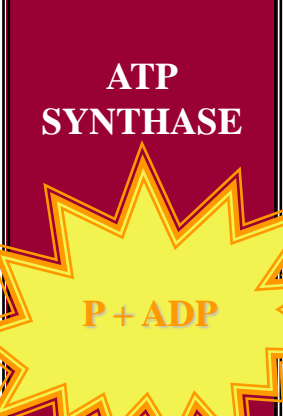
PS-II / PS-I

**CHLOROPLAST
THYLAKOID
MEMBRANE**

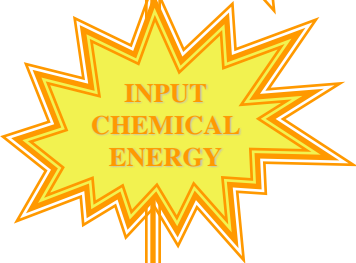


PS-I

EXERGONIC RXT



**CHLOROPLAST
STROMA**



ATP

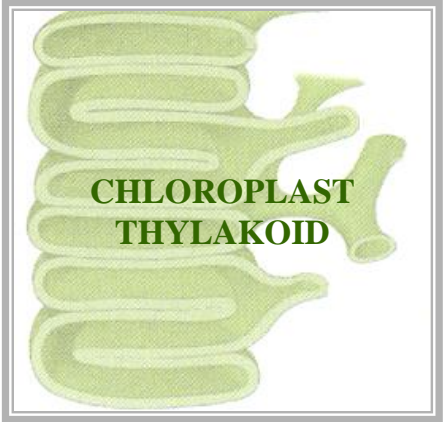
 = **ELECTRON TRANSPORT CHAIN COMPONENT**

 = **HEAT ENERGY**

 = **CHEMICAL ENERGY**

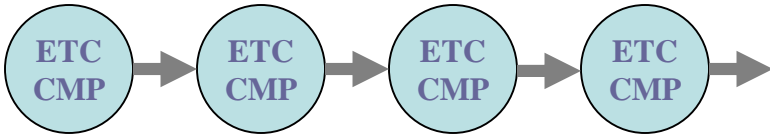
C

CHLOROPLAST THYLAKOID SPACE



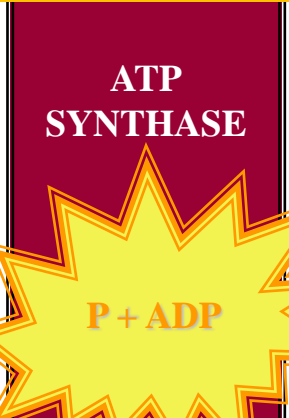
PS-II / PS-I

CHLOROPLAST THYLAKOID MEMBRANE



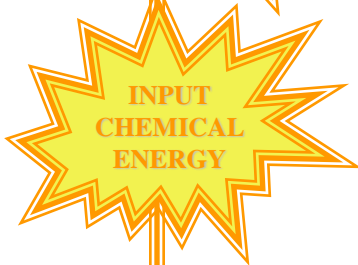
PS-I

EXERGONIC RXT



CHLOROPLAST STROMA

ENDERGONIC RXT

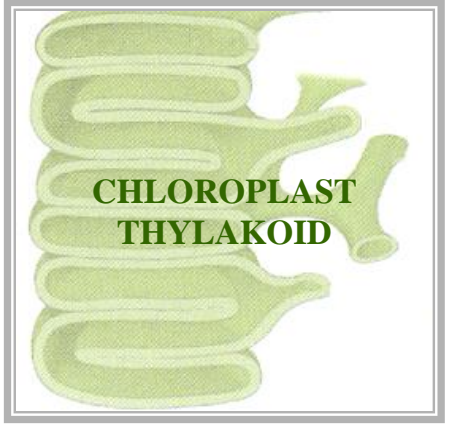


ATP

Legend: Blue circle = ELECTRON TRANSPORT CHAIN COMPONENT; Red starburst = HEAT ENERGY; Yellow starburst = CHEMICAL ENERGY

P

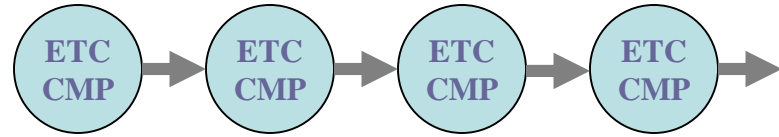
**CHLOROPLAST
THYLAKOID
SPACE**



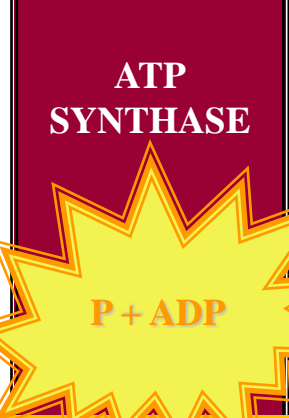
**CHLOROPLAST
THYLAKOID**

PS-II / PS-I

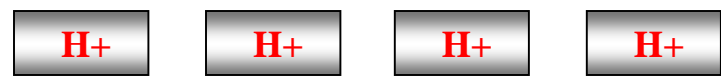
**CHLOROPLAST
THYLAKOID
MEMBRANE**



PS-I



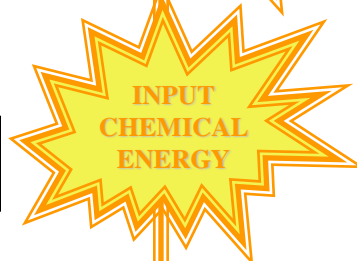
EXERGONIC RXT



COUPLED

ENDERGONIC RXT

**CHLOROPLAST
STROMA**



 = **ELECTRON TRANSPORT CHAIN COMPONENT**

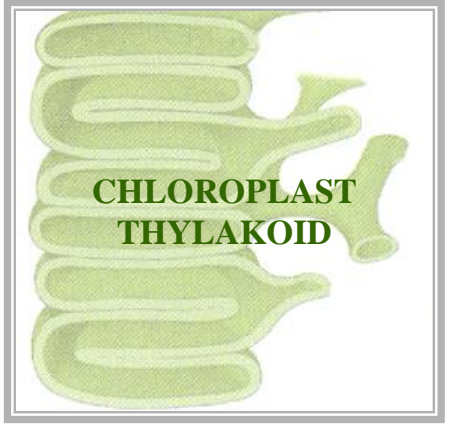
 = **HEAT ENERGY**

 = **CHEMICAL ENERGY**

ATP

S

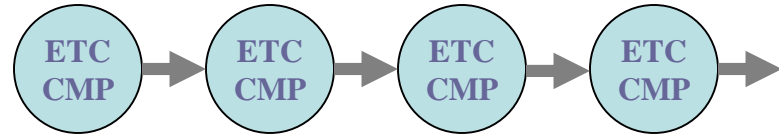
CHLOROPLAST
THYLAKOID
SPACE



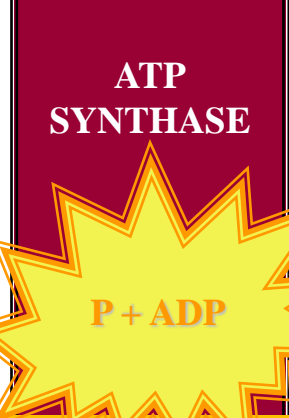
CHLOROPLAST
THYLAKOID

PS-II / PS-I

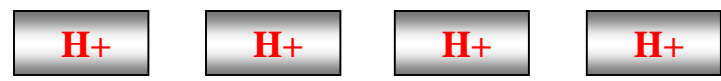
CHLOROPLAST
THYLAKOID
MEMBRANE



PS-I



EXERGONIC RXT

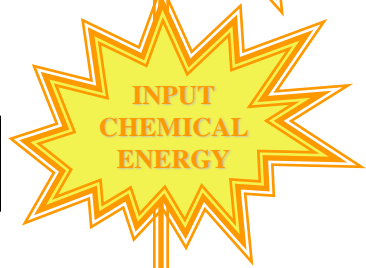


COUPLED

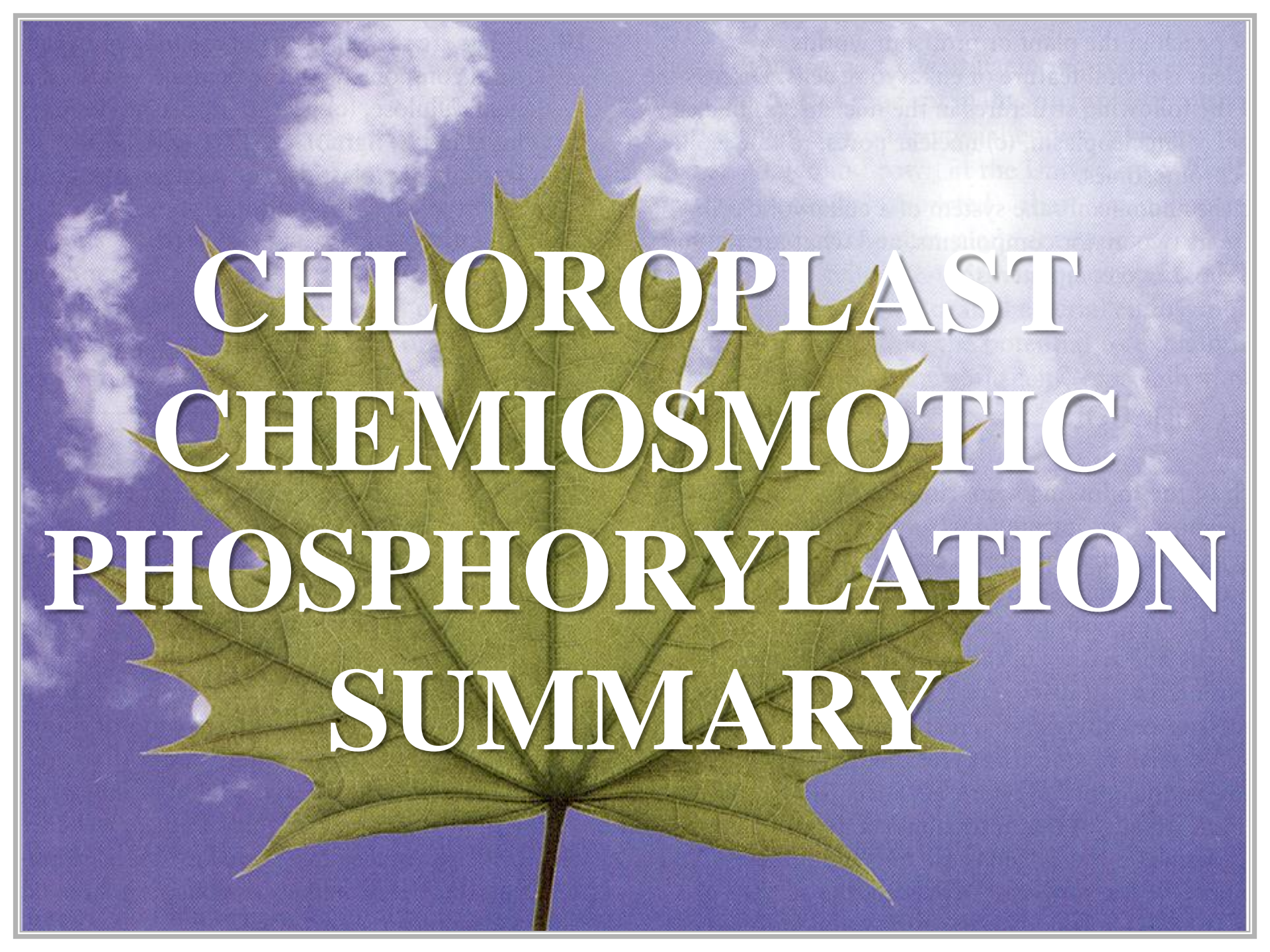
ENDERGONIC RXT

CHLOROPLAST
STROMA

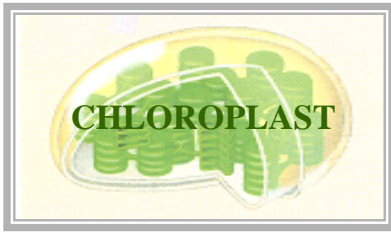
PHOSPHORYLATION



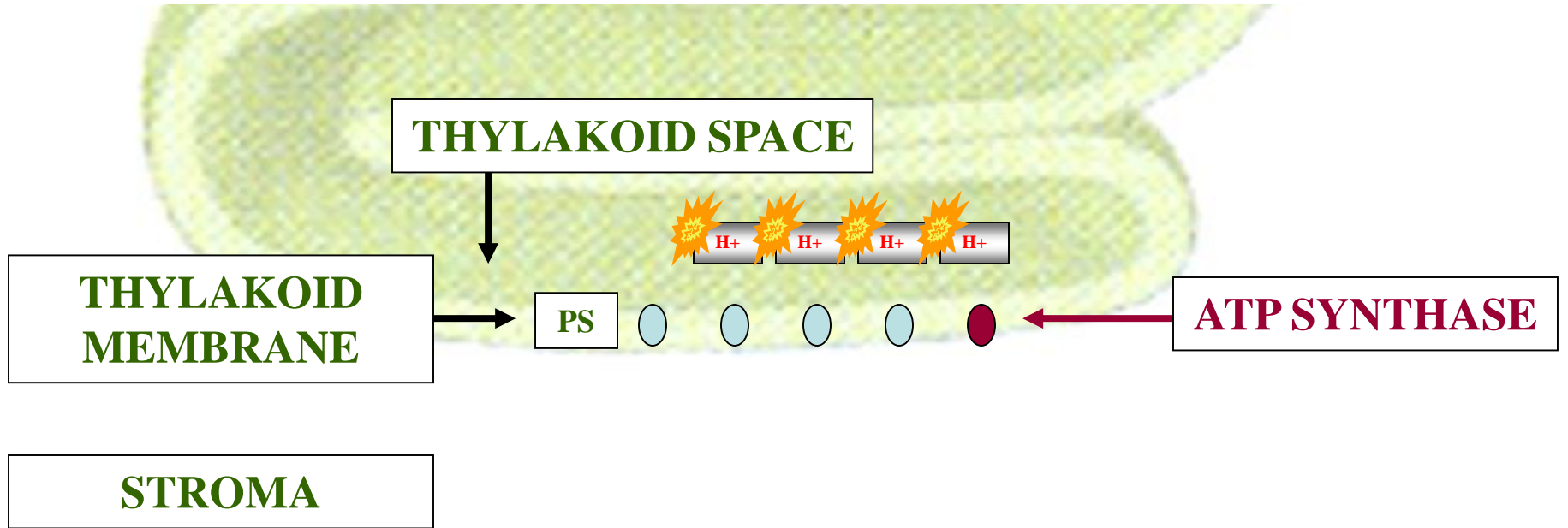
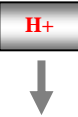
ATP



**CHLOROPLAST
CHEMIOSMOTIC
PHOSPHORYLATION
SUMMARY**

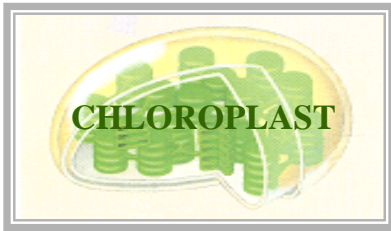


CHLOROPLAST CHEMIOSMOTIC PHOSPHORYLATION



 = POTENTIAL CHEMICAL ENERGY

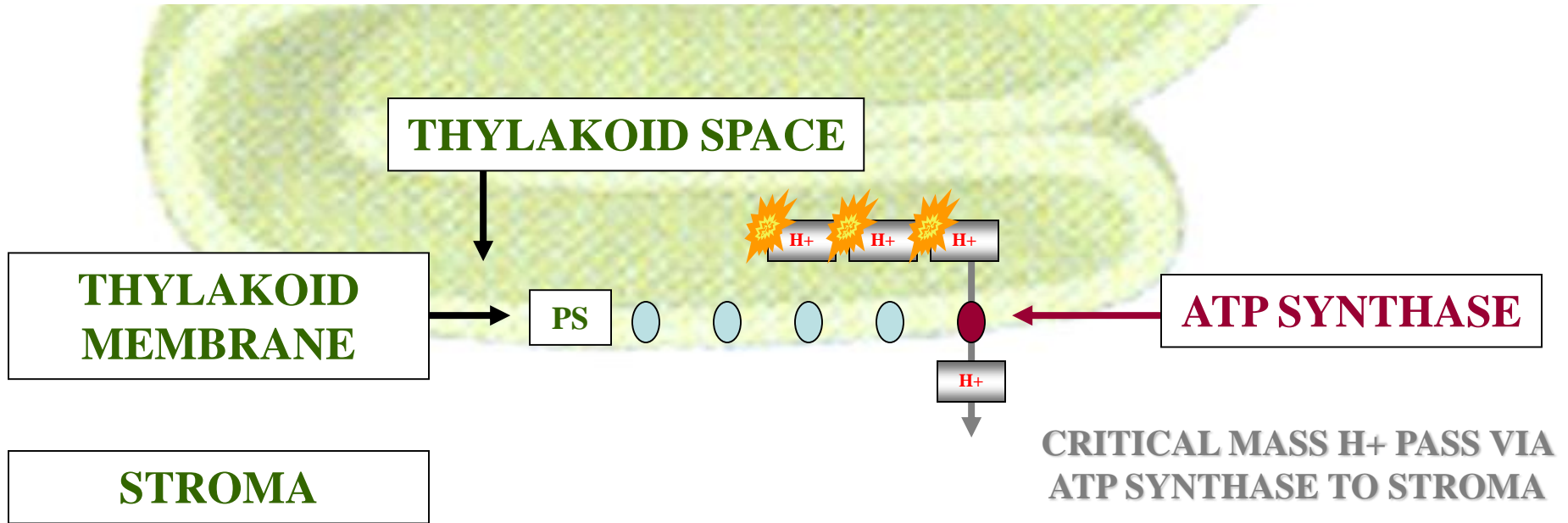
 = ELECTRON TRANSPORT CHAIN COMPONENT



CHLOROPLAST CHEMIOSMOTIC PHOSPHORYLATION

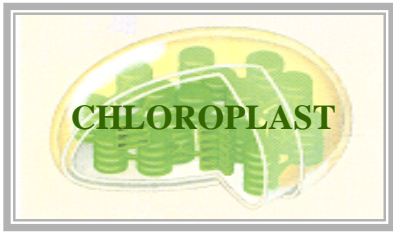


H⁺

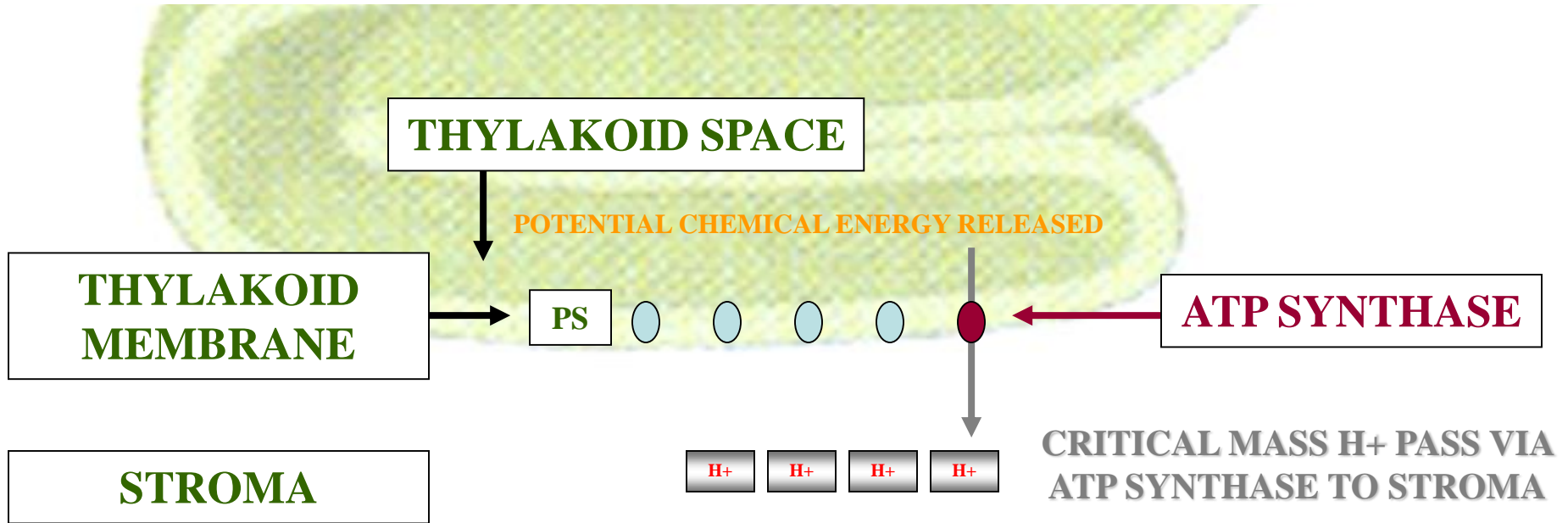


 = POTENTIAL CHEMICAL ENERGY

 = ELECTRON TRANSPORT CHAIN COMPONENT

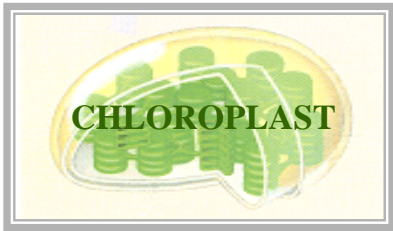


CHLOROPLAST CHEMIOSMOTIC PHOSPHORYLATION



 = POTENTIAL CHEMICAL ENERGY

 = ELECTRON TRANSPORT CHAIN COMPONENT

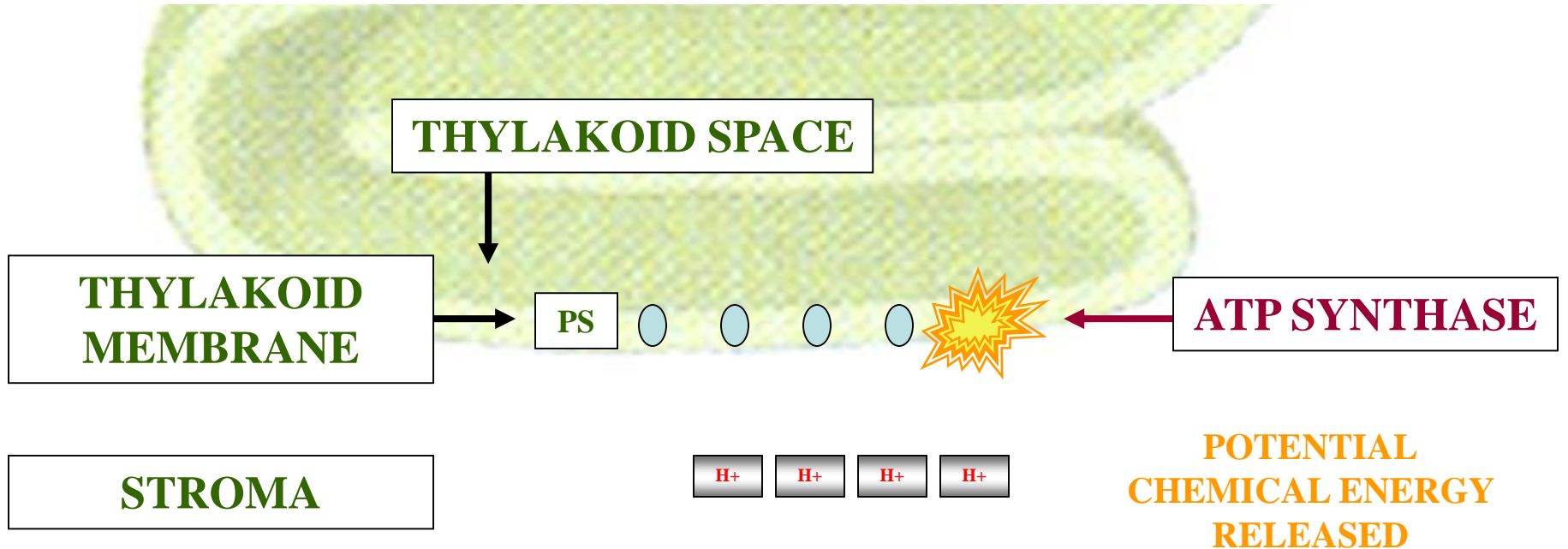


CHLOROPLAST CHEMIOSMOTIC PHOSPHORYLATION



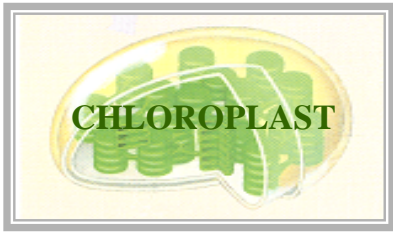
A

P



 = CHEMICAL ENERGY

 = ELECTRON TRANSPORT CHAIN COMPONENT

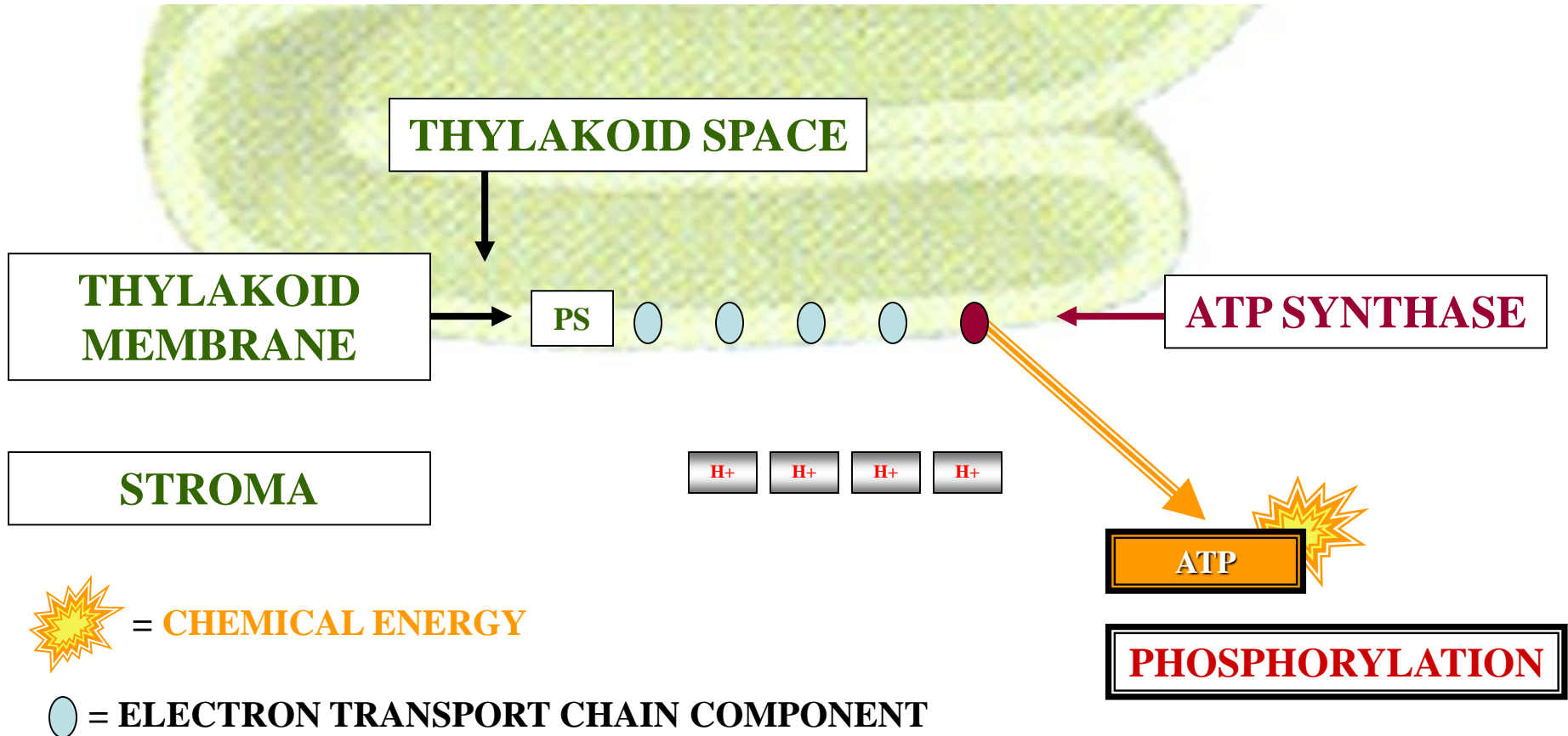


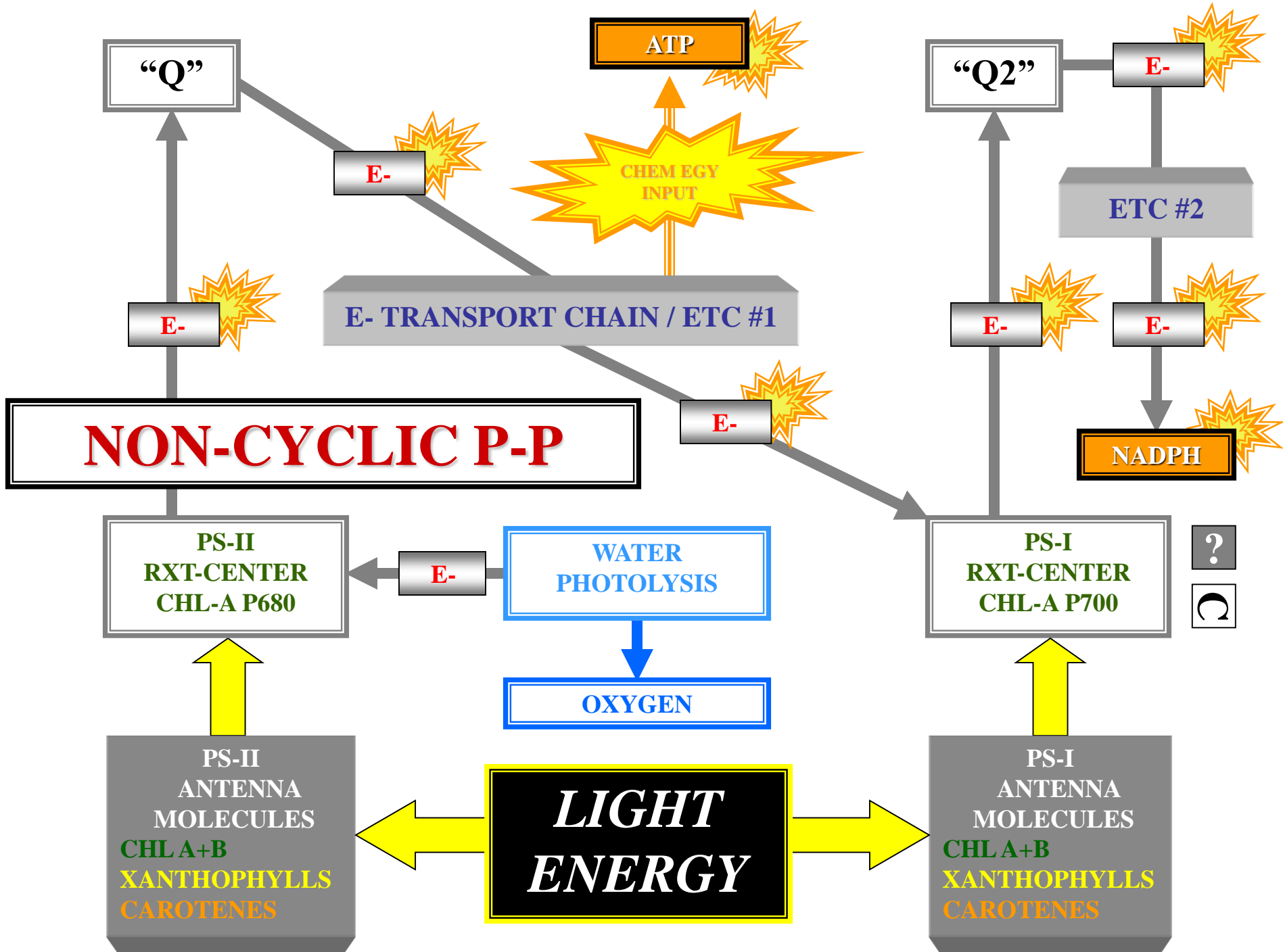
CHLOROPLAST CHEMIOSMOTIC PHOSPHORYLATION



A

N

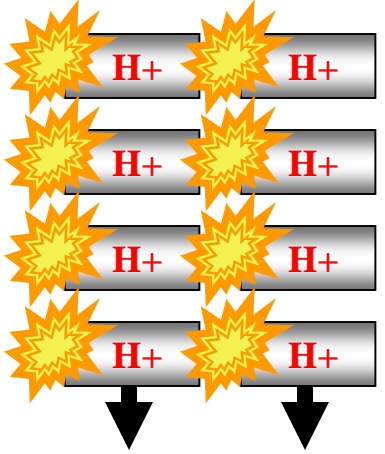




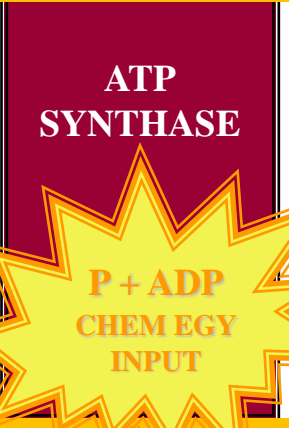
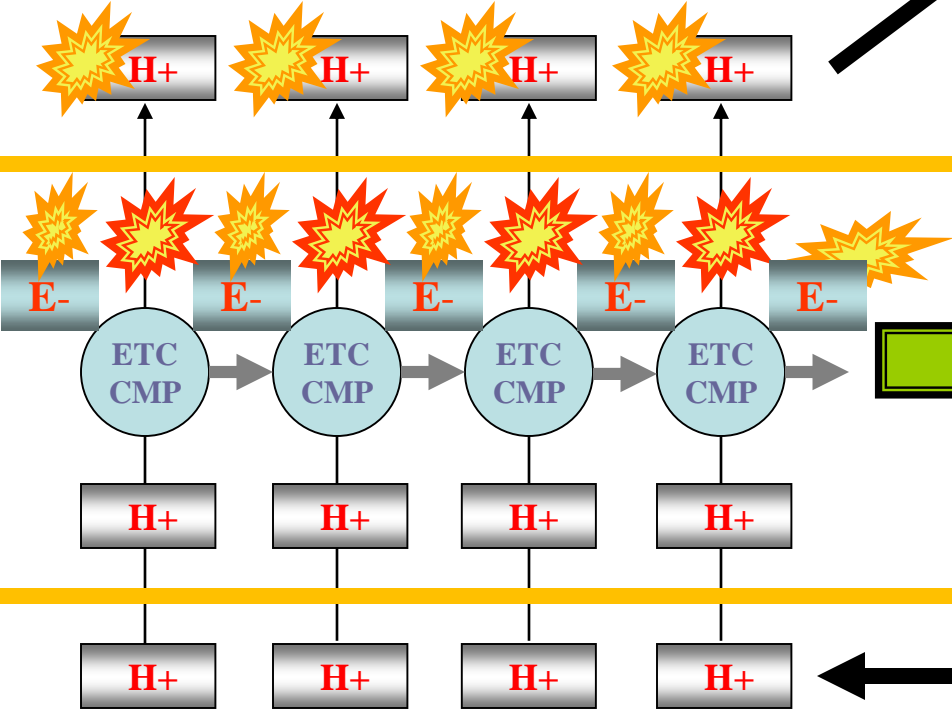


**CHLOROPLAST
THYLAKOID
SPACE**

?



PS-II / PS-I
**CHLOROPLAST
THYLAKOID
MEMBRANE**



**CHLOROPLAST
STROMA**

PHOSPHORYLATION



● = ELECTRON TRANSPORT CHAIN COMPONENT
 ★ = HEAT ENERGY ★ = CHEMICAL ENERGY

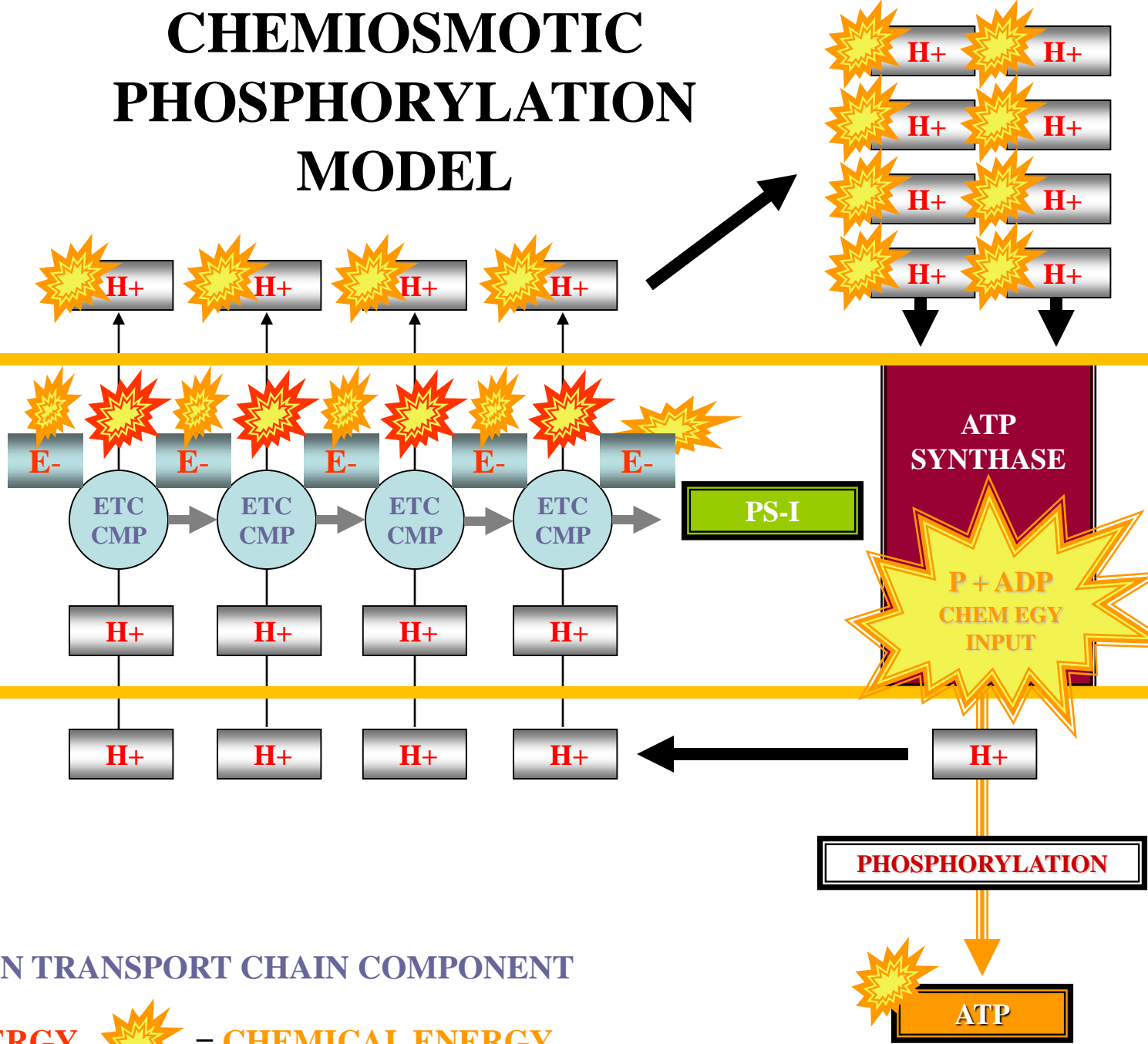
^ +

CHEMIOSMOTIC PHOSPHORYLATION MODEL

CHLOROPLAST THYLAKOID SPACE

PS-II / PS-I
CHLOROPLAST THYLAKOID MEMBRANE

CHLOROPLAST STROMA

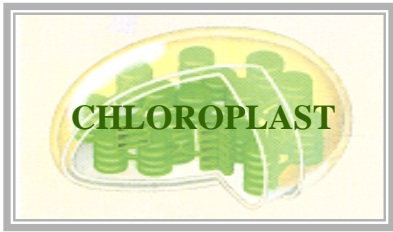


● = ELECTRON TRANSPORT CHAIN COMPONENT

★ = HEAT ENERGY ★ = CHEMICAL ENERGY

PHOSPHORYLATION

ATP

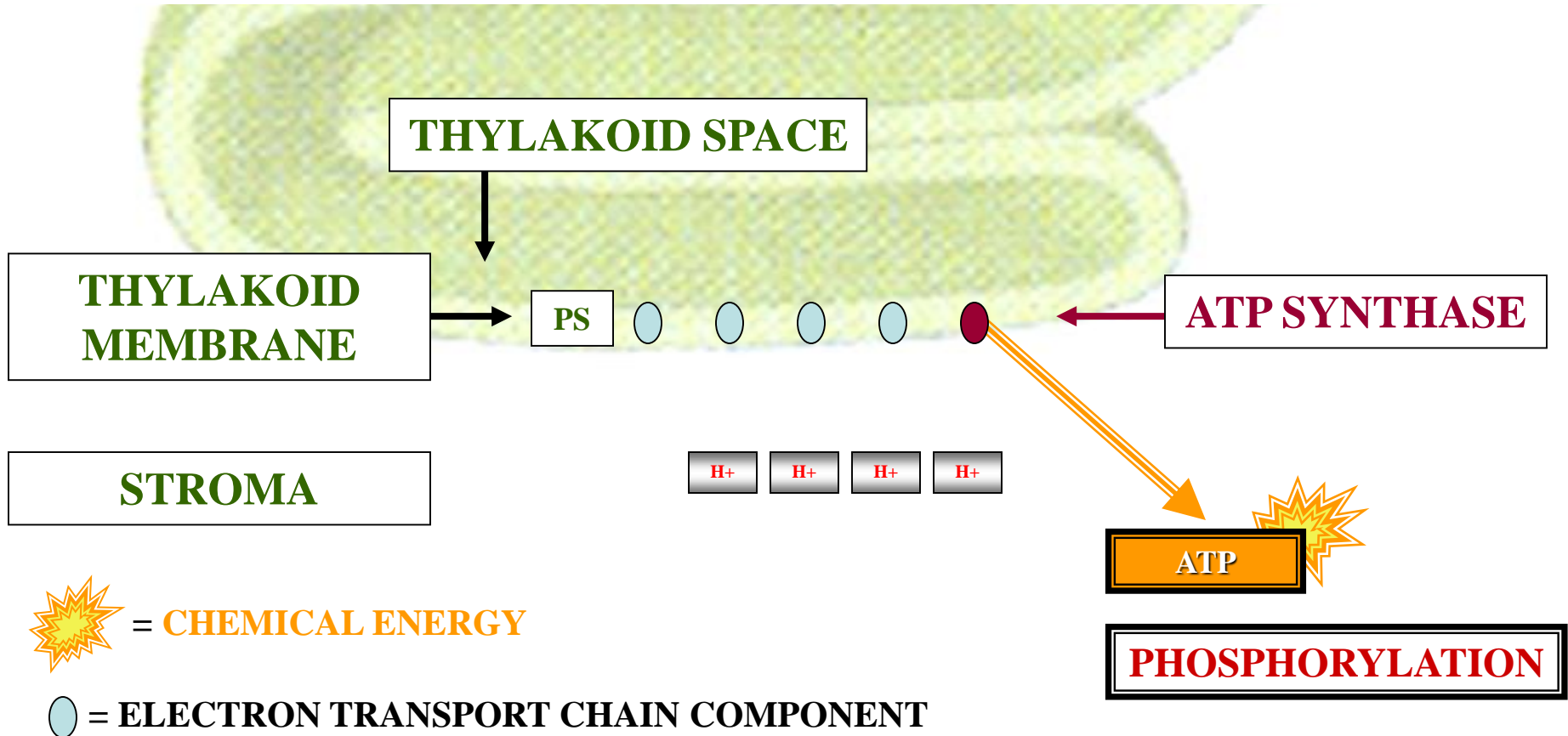


CHLOROPLAST CHEMIOSMOTIC PHOSPHORYLATION



A

C





CYCLIC P-P

LIGHT ENERGY

PS-I
ANTENNA
MOLECULES
CHL A+B
XANTHOPHYLLS
CAROTENES

LIGHT ENERGY

PS-I
RXT-CENTER
CHL-A P700

“Q2”

ETC # 3

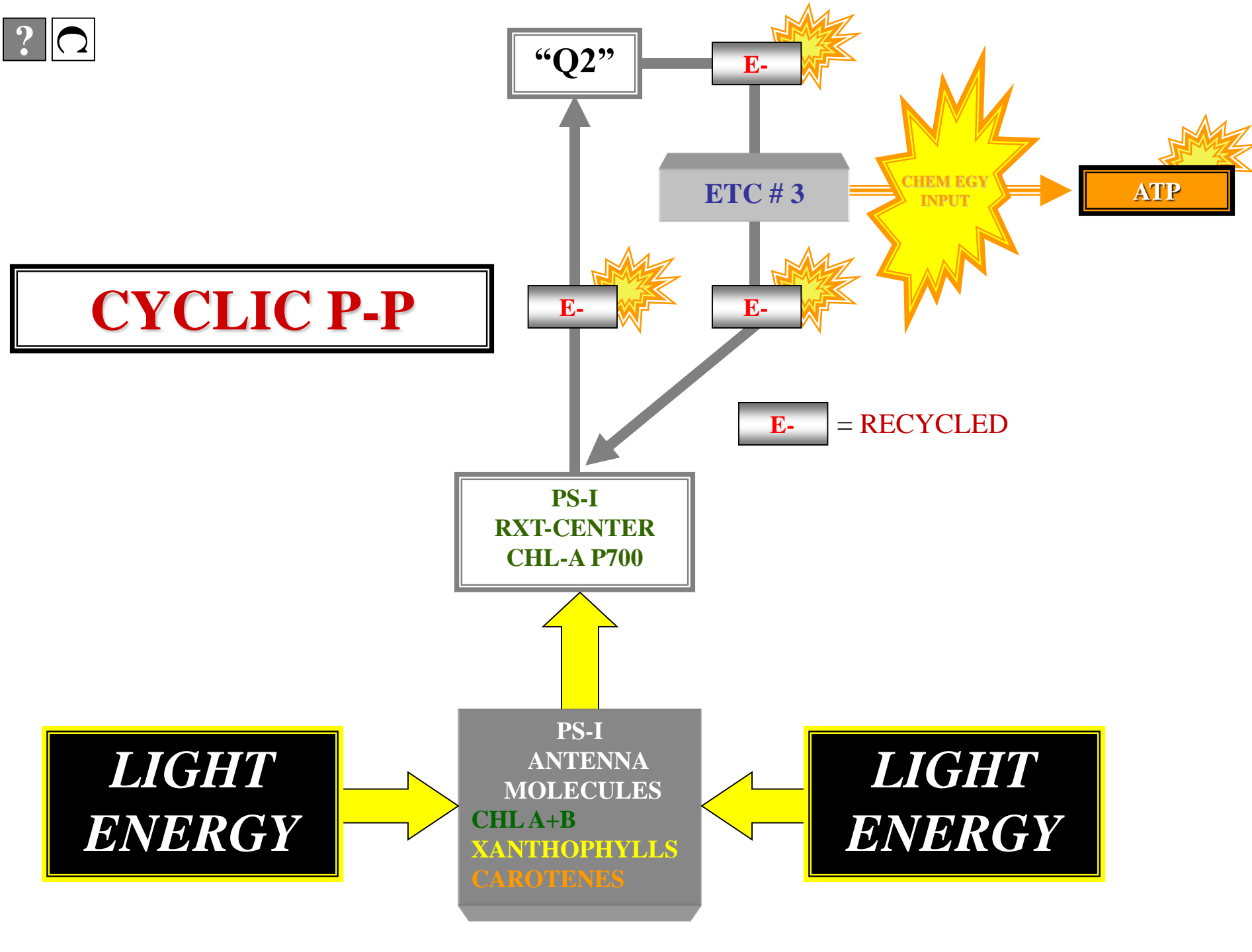
ATP

E-

E-

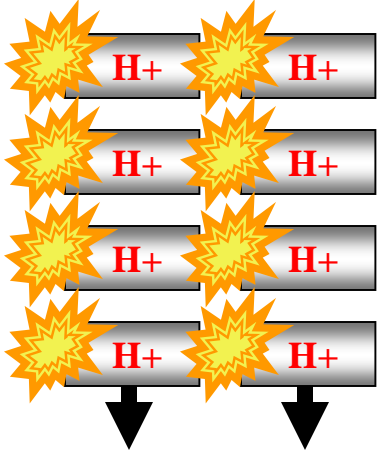
E- = RECYCLED

CHEM EGY
INPUT

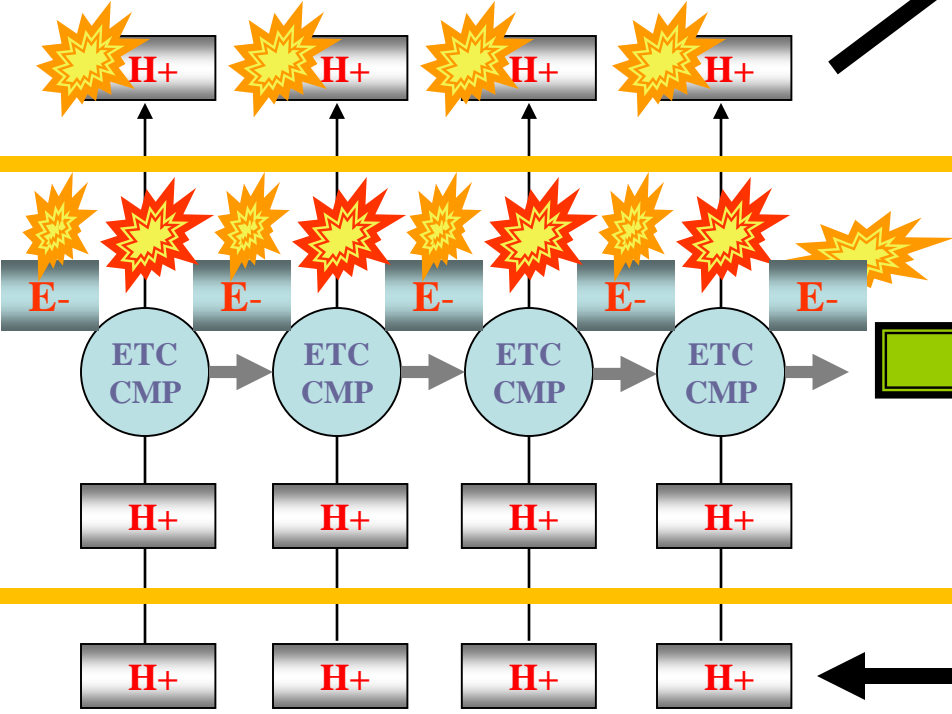




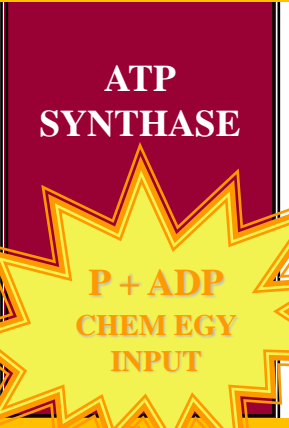
CHLOROPLAST THYLAKOID SPACE



PS-II / PS-I
CHLOROPLAST THYLAKOID MEMBRANE



CHLOROPLAST STROMA



PHOSPHORYLATION



● = ELECTRON TRANSPORT CHAIN COMPONENT
 ★ = HEAT ENERGY ★ = CHEMICAL ENERGY

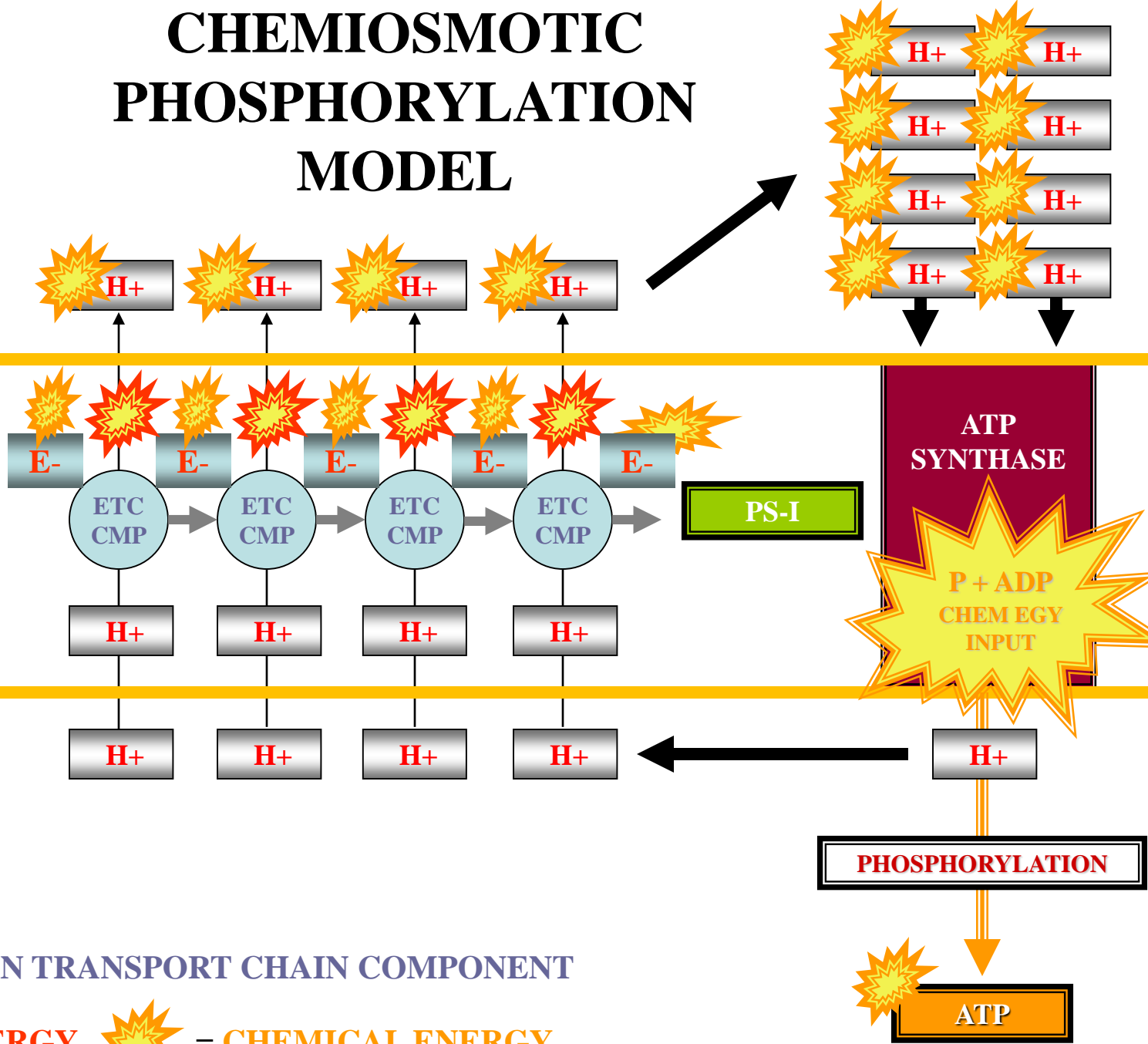
? A N

CHEMIOSMOTIC PHOSPHORYLATION MODEL

CHLOROPLAST THYLAKOID SPACE

PS-II / PS-I
CHLOROPLAST THYLAKOID MEMBRANE

CHLOROPLAST STROMA



● = ELECTRON TRANSPORT CHAIN COMPONENT

★ = HEAT ENERGY ★ = CHEMICAL ENERGY

PHOSPHORYLATION

ATP

PHOTOSYNTHESIS

A

N

WATER

LIGHT ENERGY

E-

PHOTOLYSIS

LT RXT

THYLAKOID
GRANUM

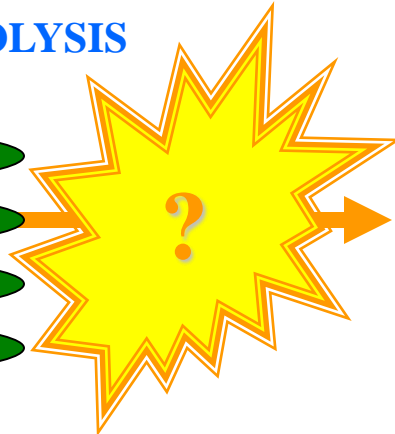
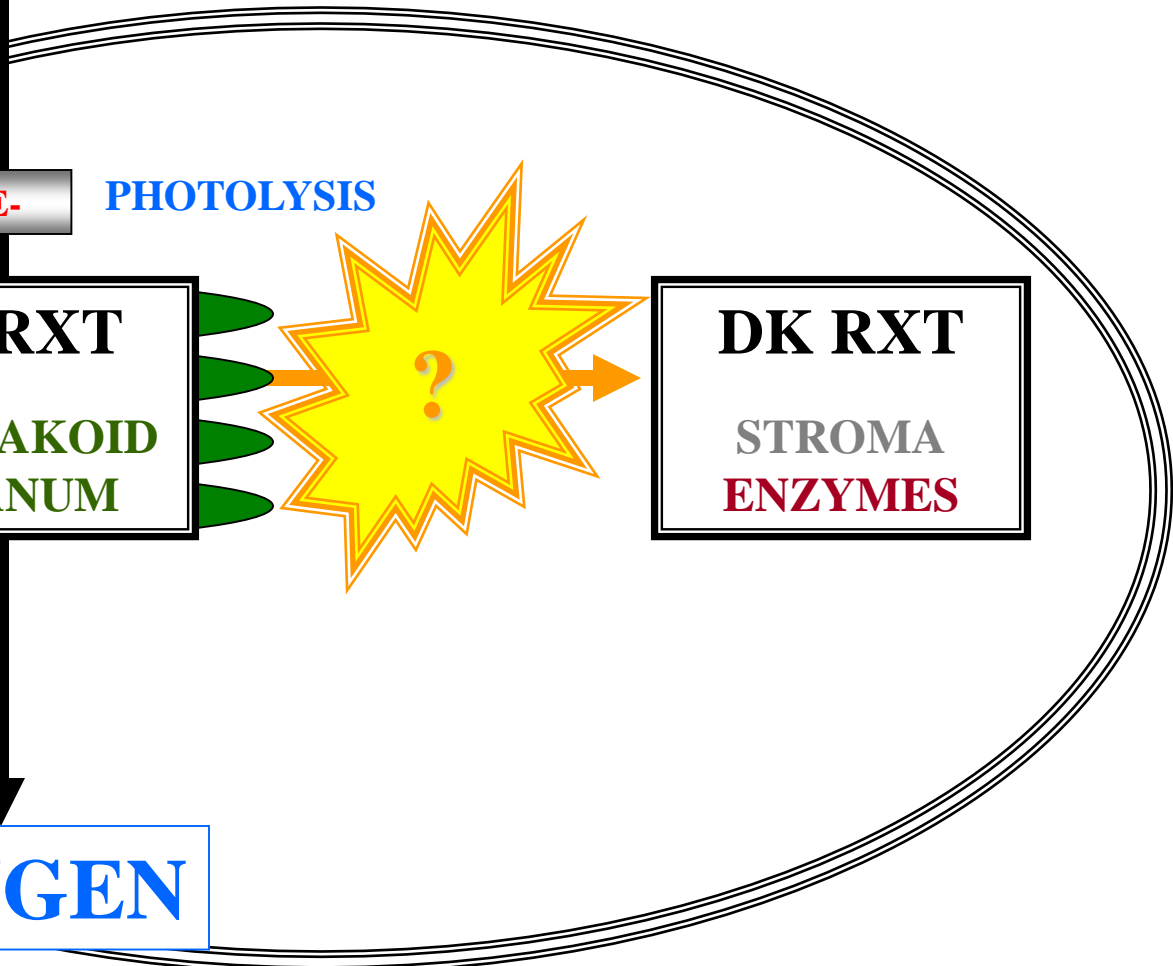
DK RXT

STROMA
ENZYMES

CHLOROPLAST

ATMOSPHERE

OXYGEN



PHOTOSYNTHESIS

N

WATER

LIGHT ENERGY

E-

PHOTOLYSIS

LT RXT

THYLAKOID
GRANUM

ATP

DK RXT

STROMA
ENZYMES

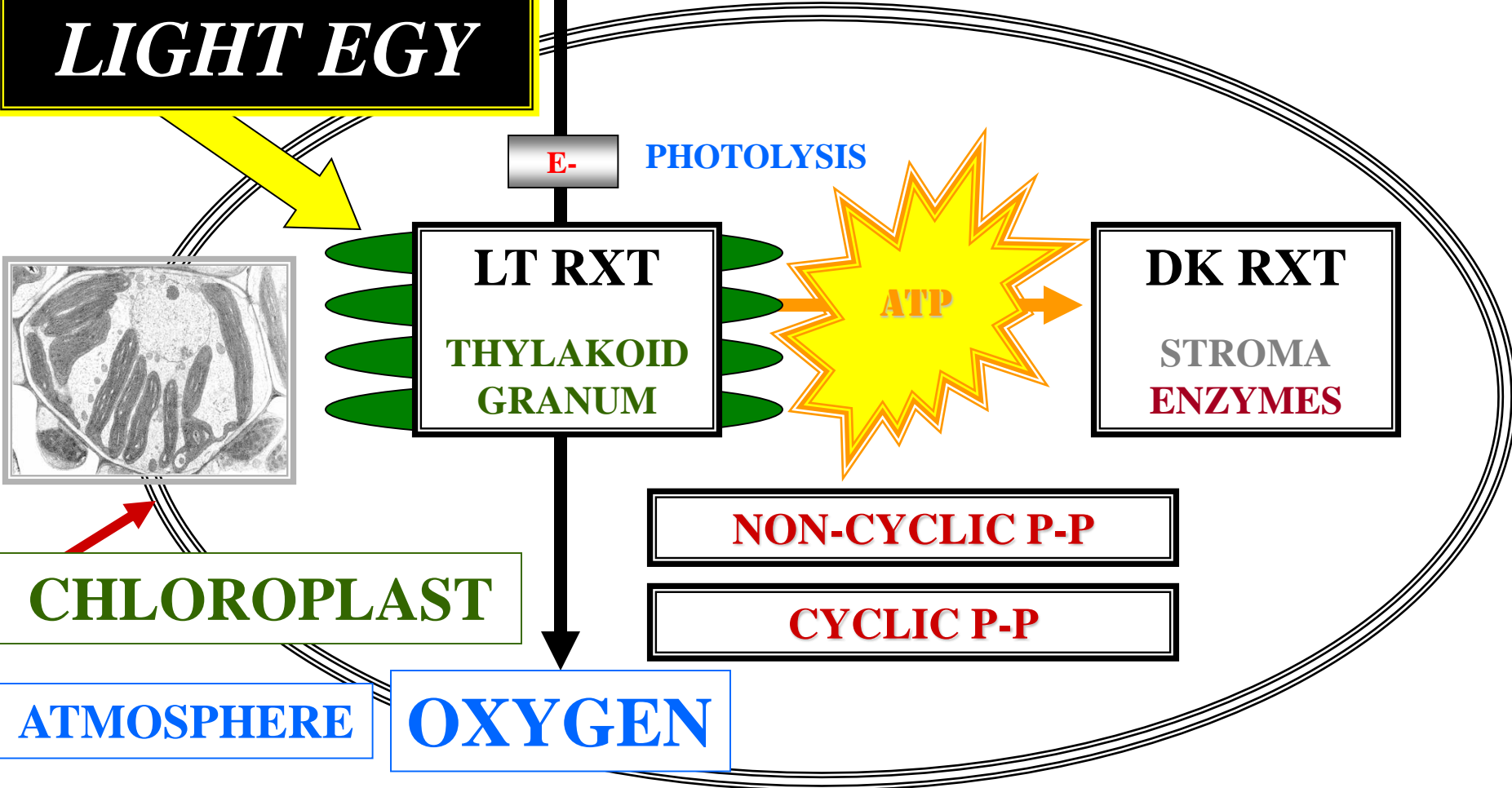
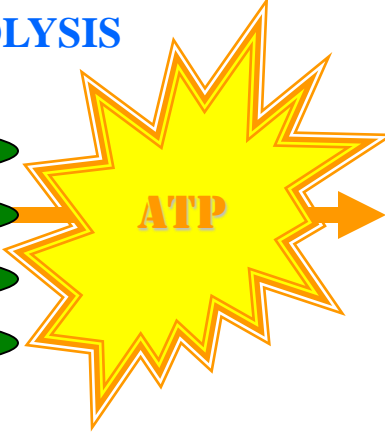
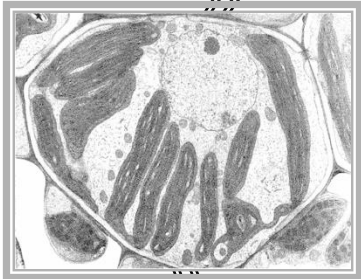
NON-CYCLIC P-P

CYCLIC P-P

CHLOROPLAST

ATMOSPHERE

OXYGEN



PHOTOSYNTHESIS



WATER

LIGHT ENERGY

E-

PHOTOLYSIS

LT RXT

THYLAKOID
GRANUM

DK RXT

STROMA
ENZYMES

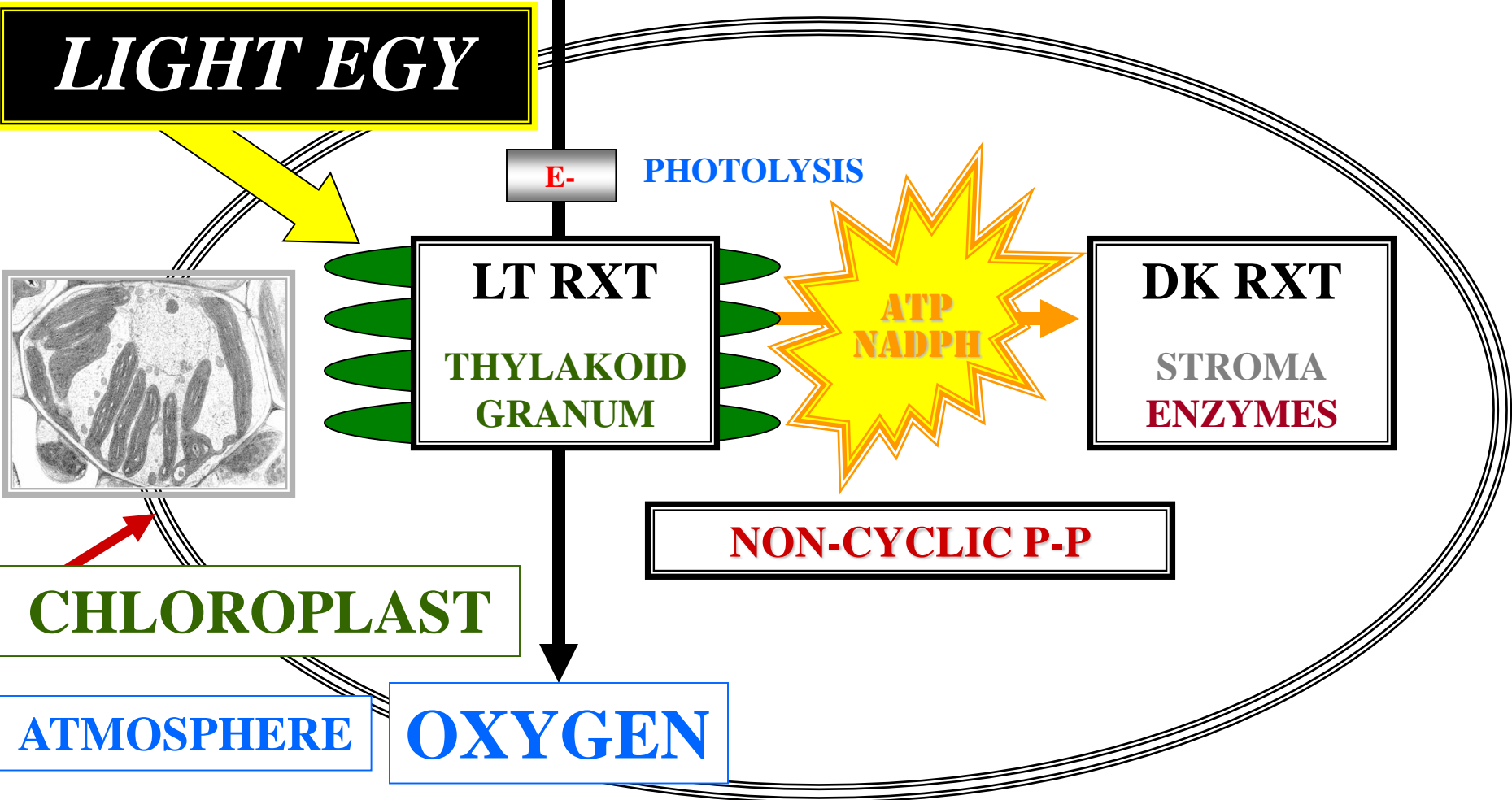
ATP
NADPH

NON-CYCLIC P-P

CHLOROPLAST

ATMOSPHERE

OXYGEN



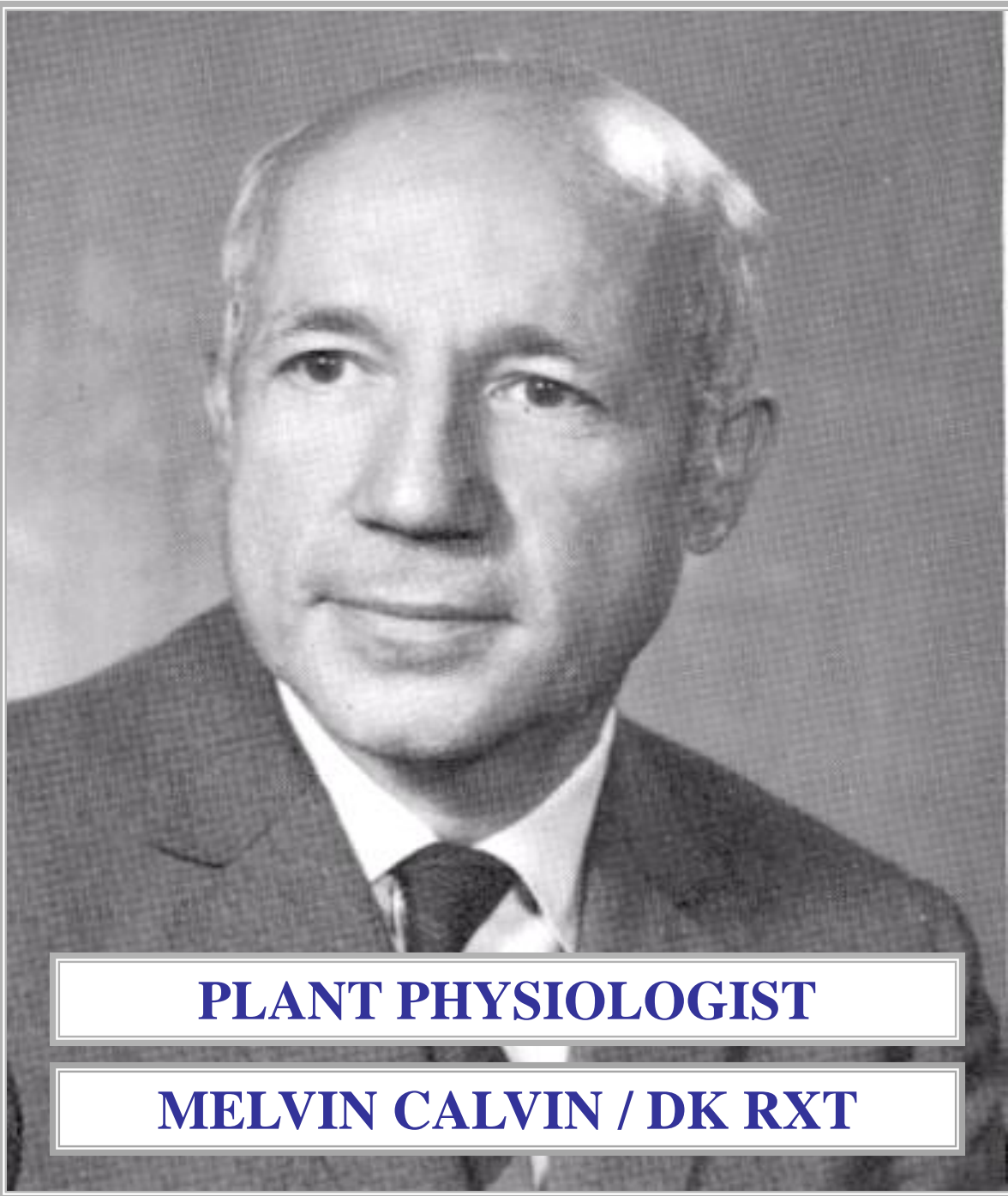


DARK REACTION SPECIFICS



DR

+



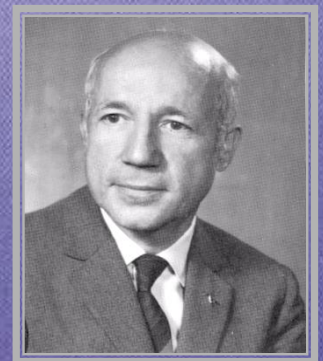
PLANT PHYSIOLOGIST

MELVIN CALVIN / DK RXT

PHOTOSYNTHESIS

L

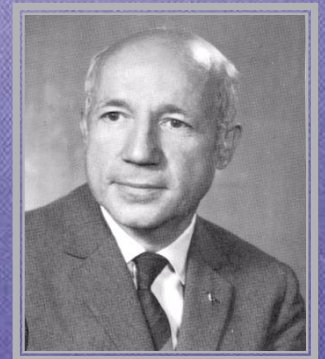
DARK REACTION



PHOTOSYNTHESIS

S

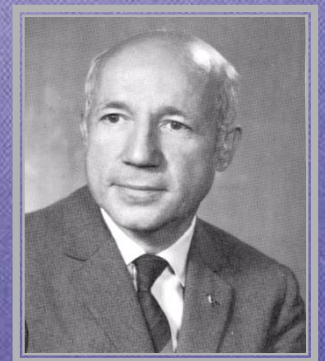
DARK RXT
LIGHT
INDEPENDENT
REACTION



PHOTOSYNTHESIS



DARK RXT SYNTHESIS REACTION



PHOTOSYNTHESIS

EZ



WATER

CO₂

LIGHT ENERGY

PHOTO

ATMOSPHERE

E-

PHOTOLYSIS

LT RXT

THYLAKOID
GRANUM

ATP
NADPH

DK RXT

STROMA
ENZYMES

SYNTHESIS

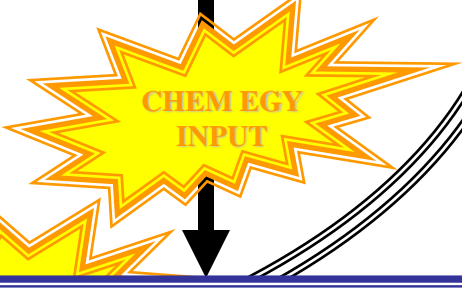
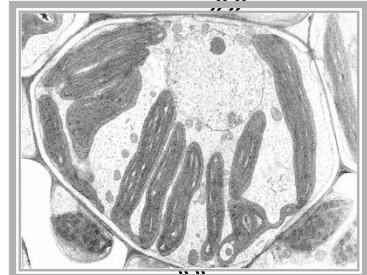
CHEMICAL
INPUT

CHLOROPLAST

ATMOSPHERE

OXYGEN

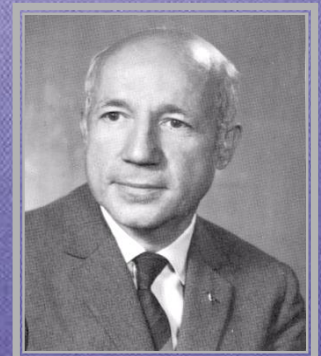
GLUCOSE



PHOTOSYNTHESIS



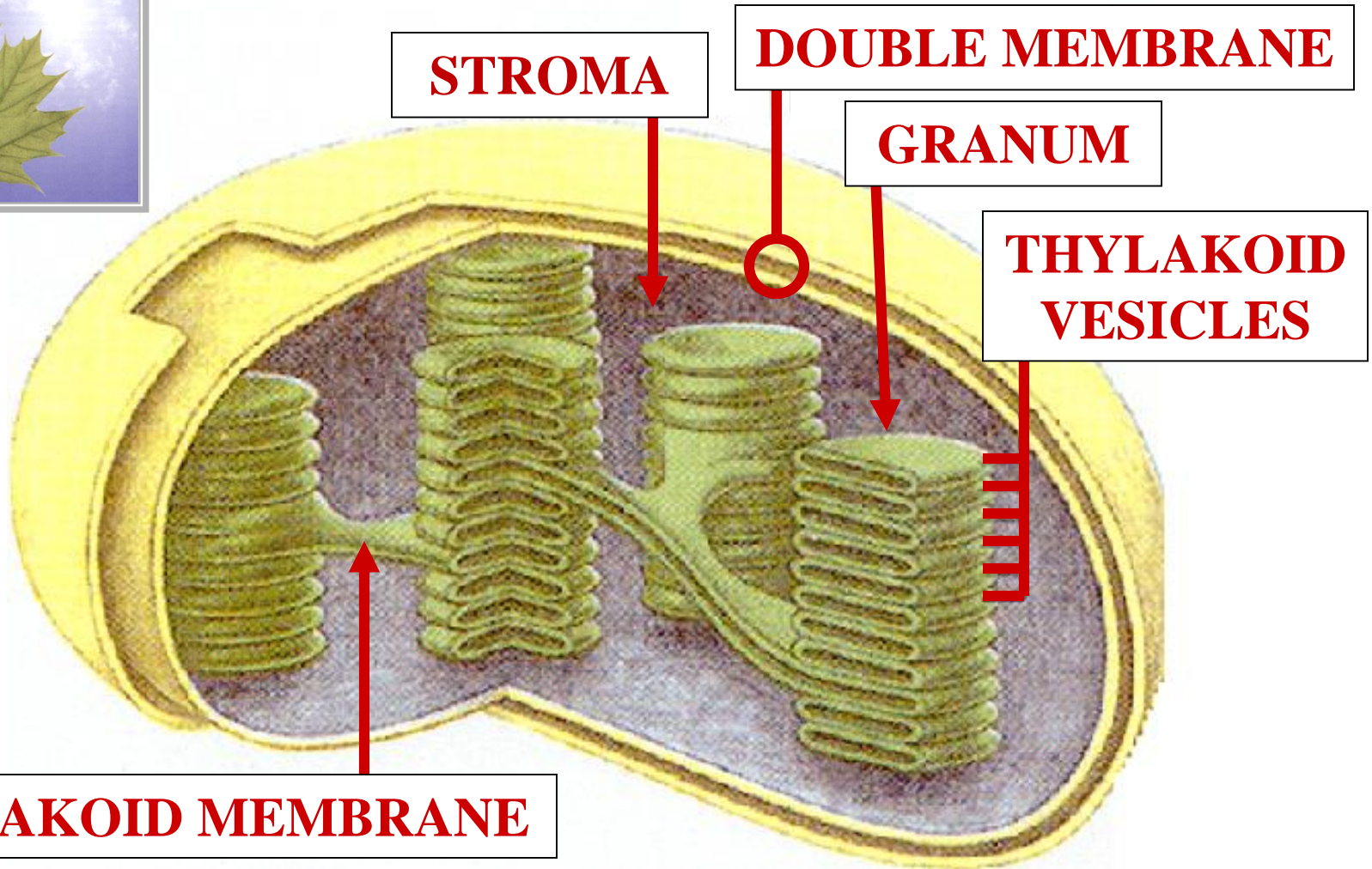
**DARK RXT
CONSISTS
ENZYMATIC
REACTIONS**





S

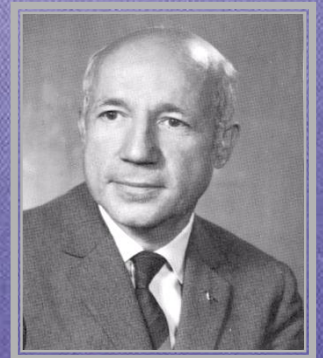
CHLOROPLAST ULTRASTRUCTURE



PHOTOSYNTHESIS



**DARK RXT
OCCURS W/IN
STROMA**



DARK REACTION TYPES

PHOTOSYNTHESIS

DARK REACTIONS

CALVIN CYCLE

PHOTOSYNTHESIS

DARK REACTIONS

PHOTOSYNTHESIS

DARK REACTIONS

CALVIN CYCLE
HATCH & SLACK CYCLE

PHOTOSYNTHESIS

DARK REACTIONS

PHOTOSYNTHESIS

DARK REACTIONS



CALVIN CYCLE

HATCH & SLACK CYCLE

CRASSULACEAN ACID METABOLISM

PHOTOSYNTHESIS

DARK REACTIONS

DARK REACTION

CALVIN CYCLE