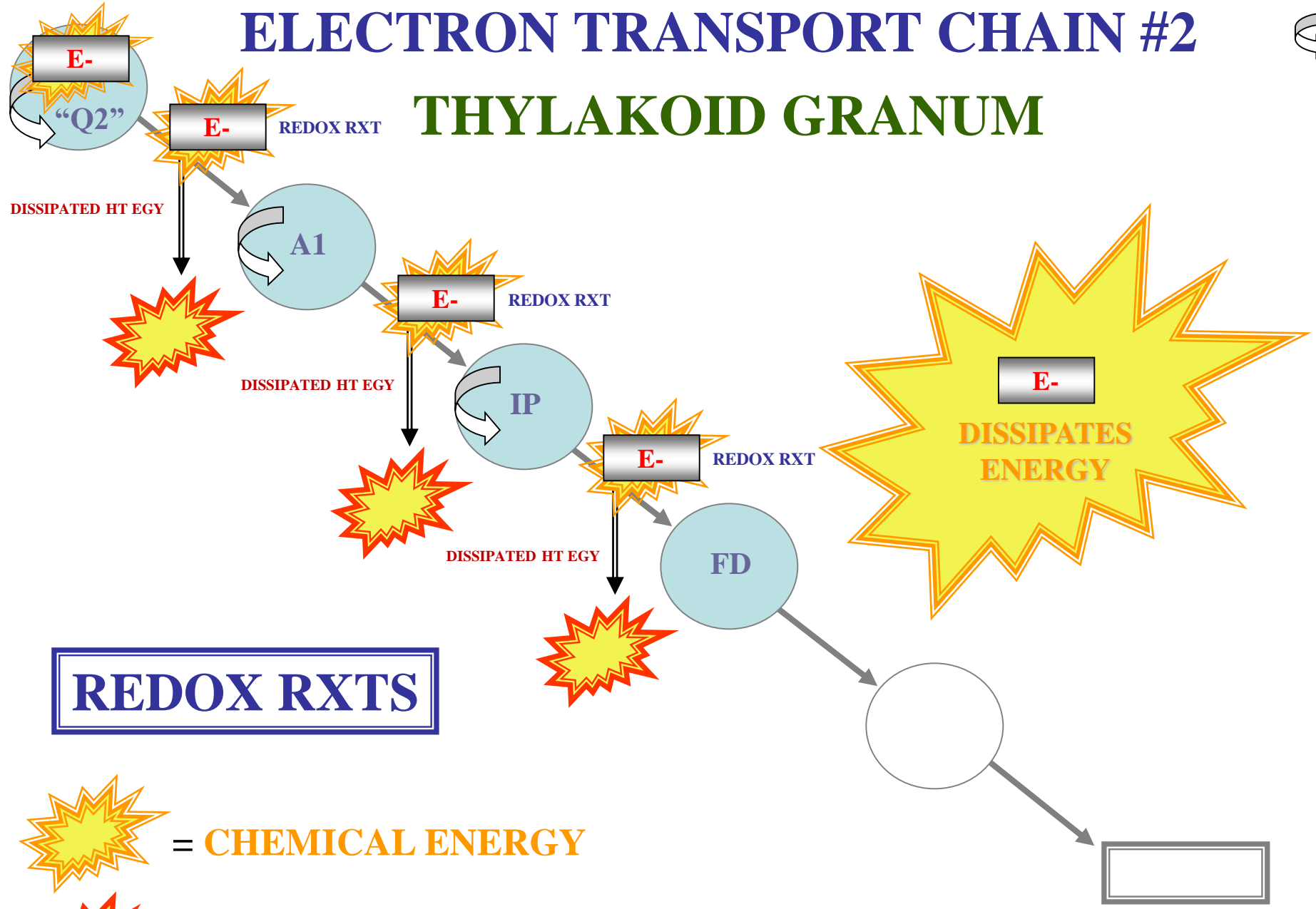


# ELECTRON TRANSPORT CHAIN #2



## THYLAKOID GRANUM



**REDOX RXTS**

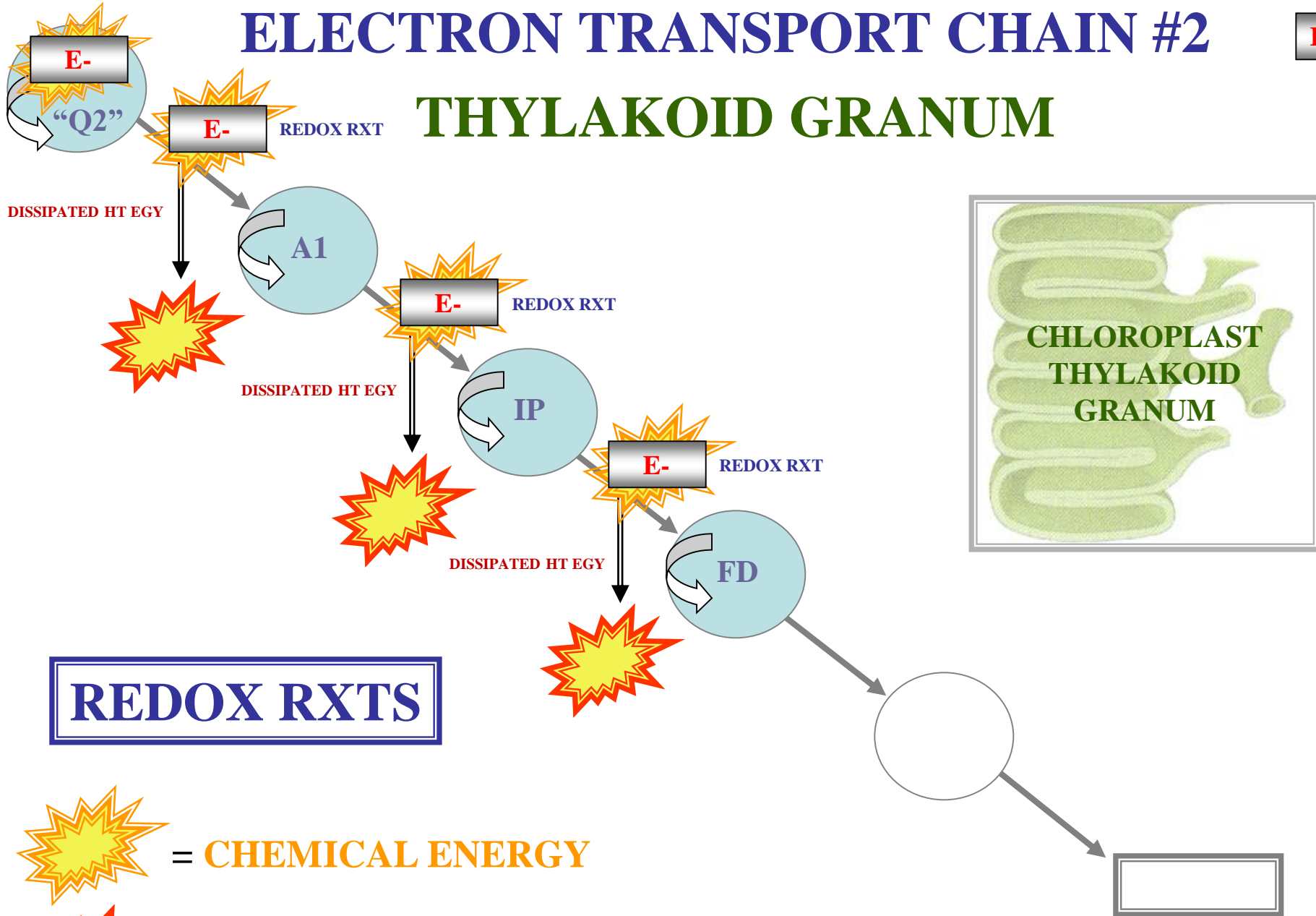
 = CHEMICAL ENERGY

 = DISSIPATED HEAT ENERGY

# ELECTRON TRANSPORT CHAIN #2

E-

## THYLAKOID GRANUM

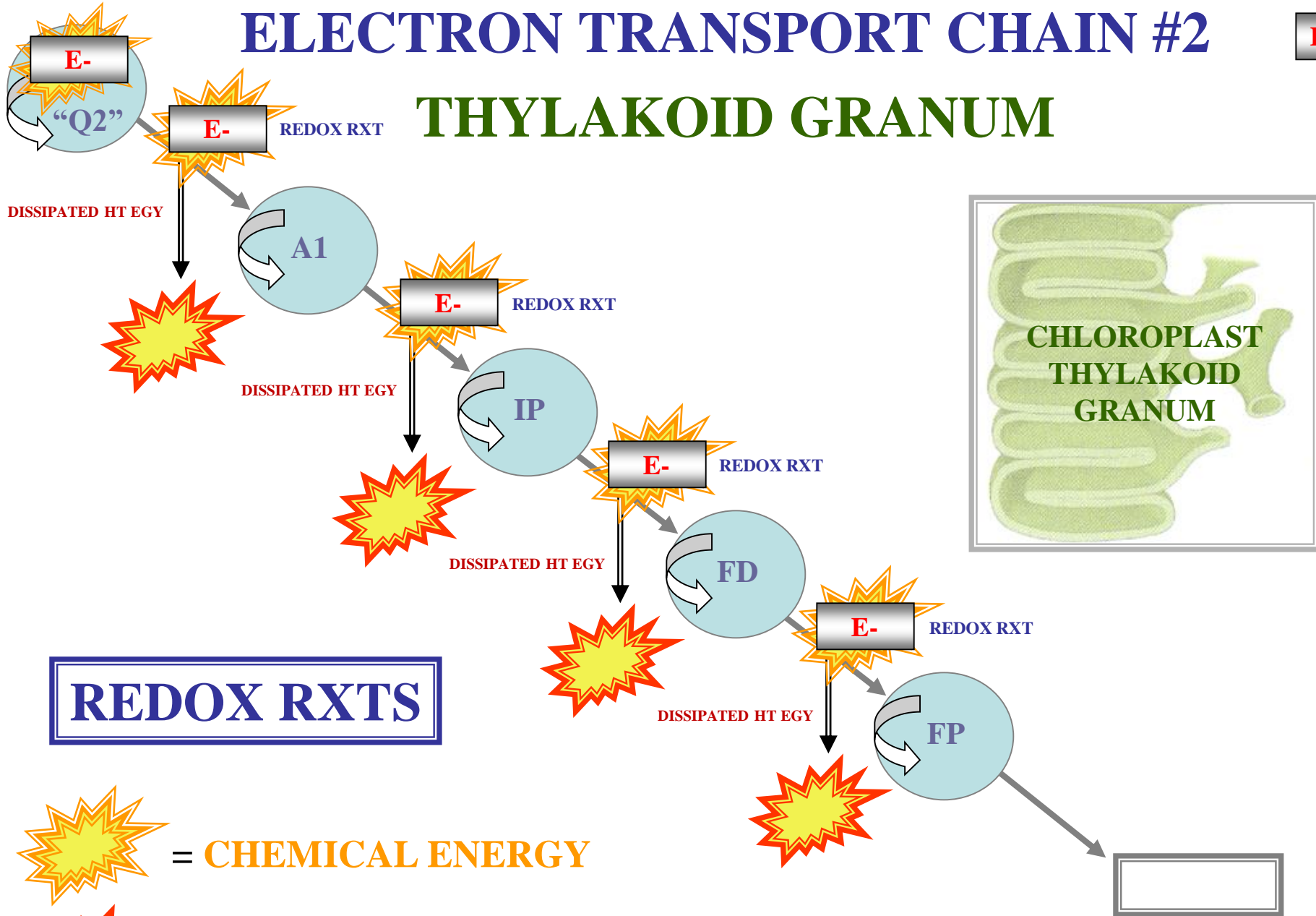




# ELECTRON TRANSPORT CHAIN #2

E-

## THYLAKOID GRANUM



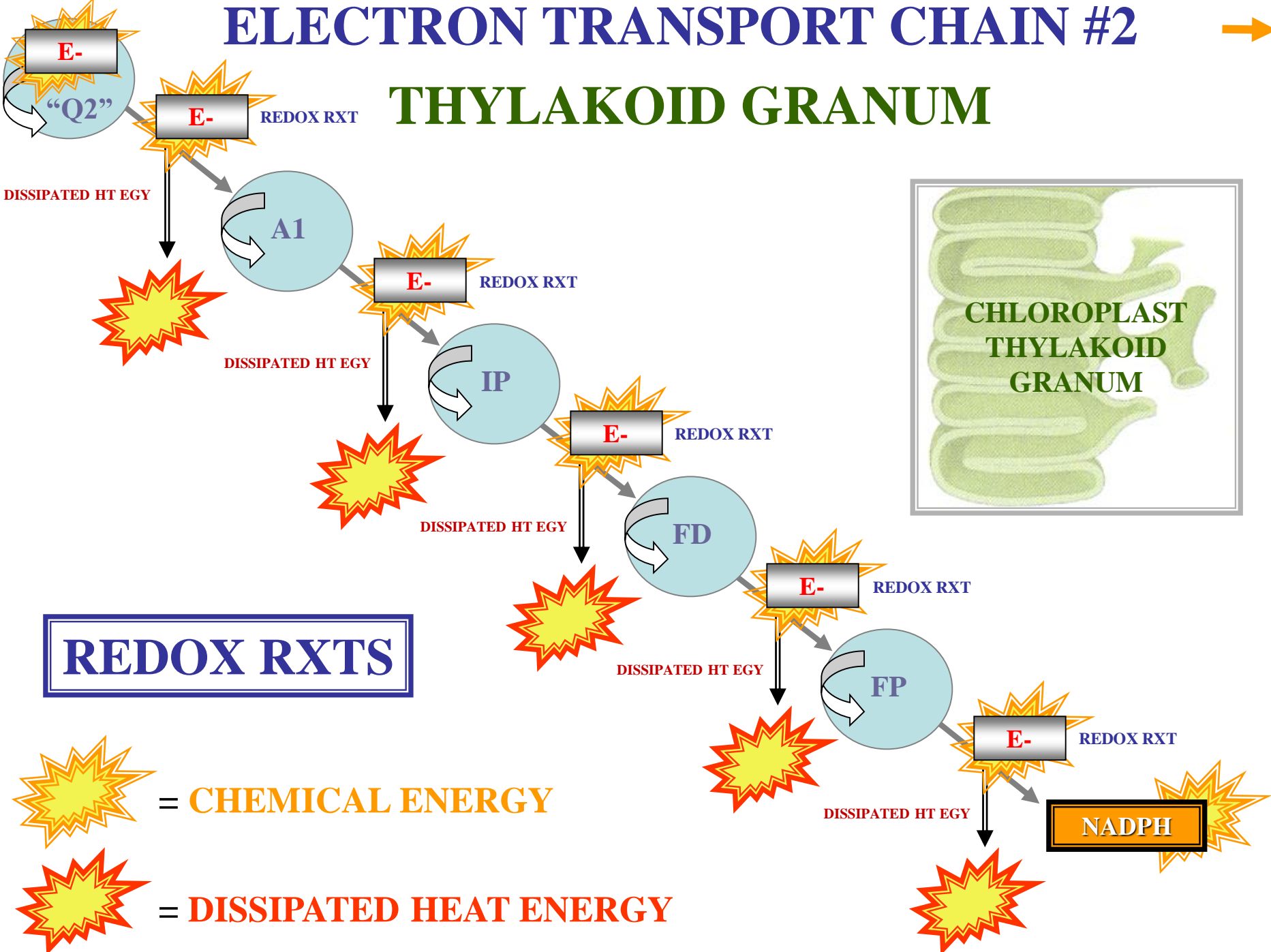
[Empty box]



# ELECTRON TRANSPORT CHAIN #2



## THYLAKOID GRANUM



# PHOTOSYNTHESIS

DK



WATER

**LIGHT ENERGY**

E-

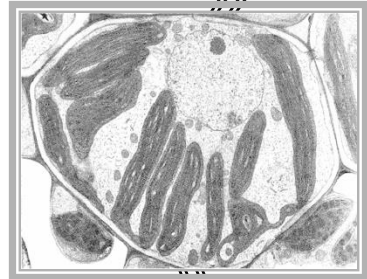
PHOTOLYSIS

LIGHT REACTION

THYLAKOID GRANUM

NADPH

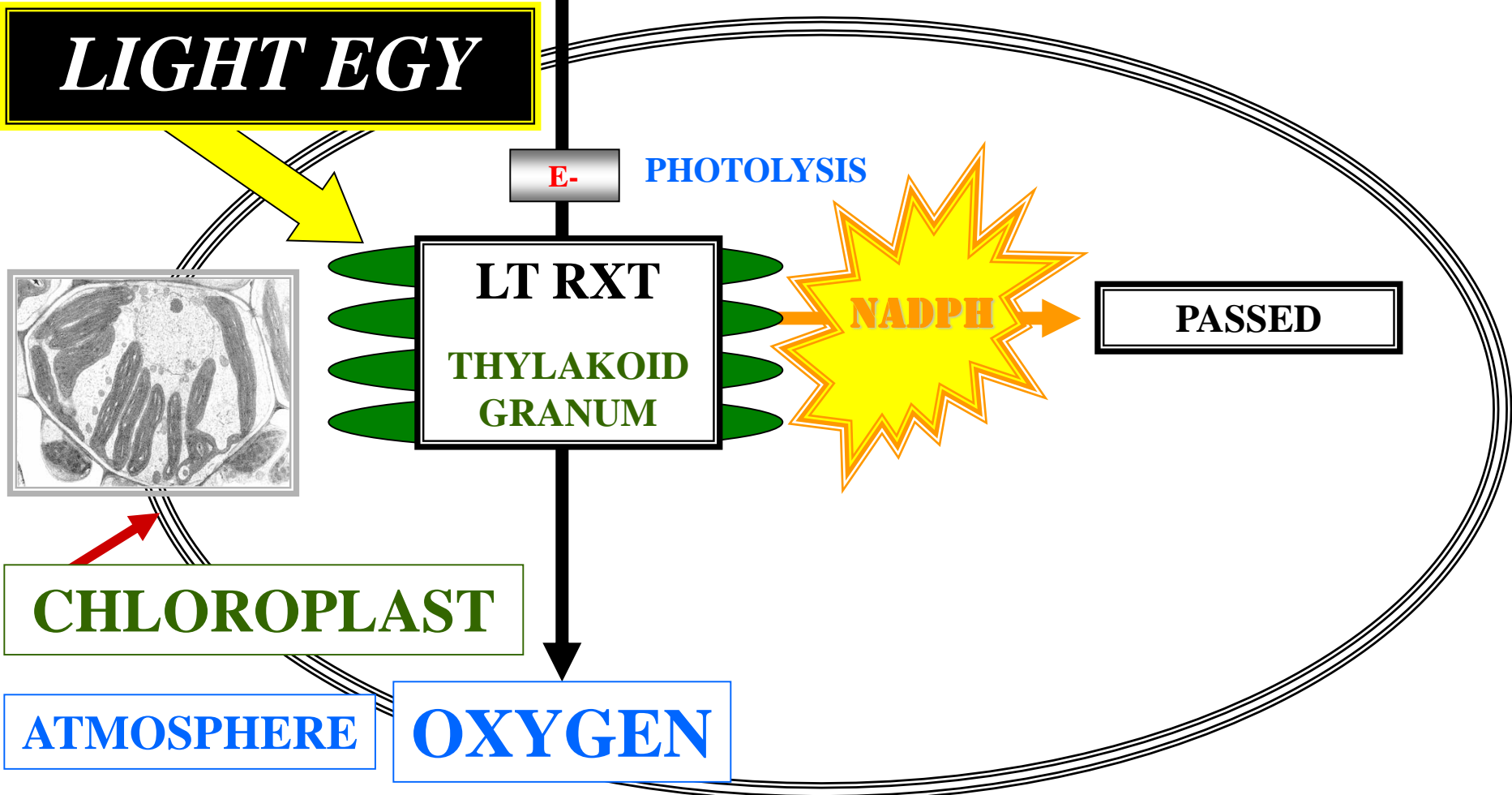
PASSED



CHLOROPLAST

ATMOSPHERE

OXYGEN



# PHOTOSYNTHESIS



N

+

WATER

**LIGHT ENERGY**

E-

PHOTOLYSIS

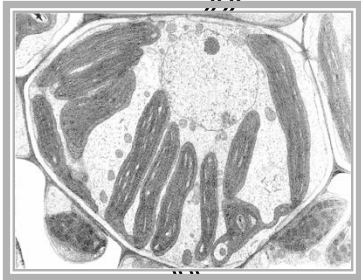
LT RXT

THYLAKOID  
GRANUM

NADPH

DK RXT

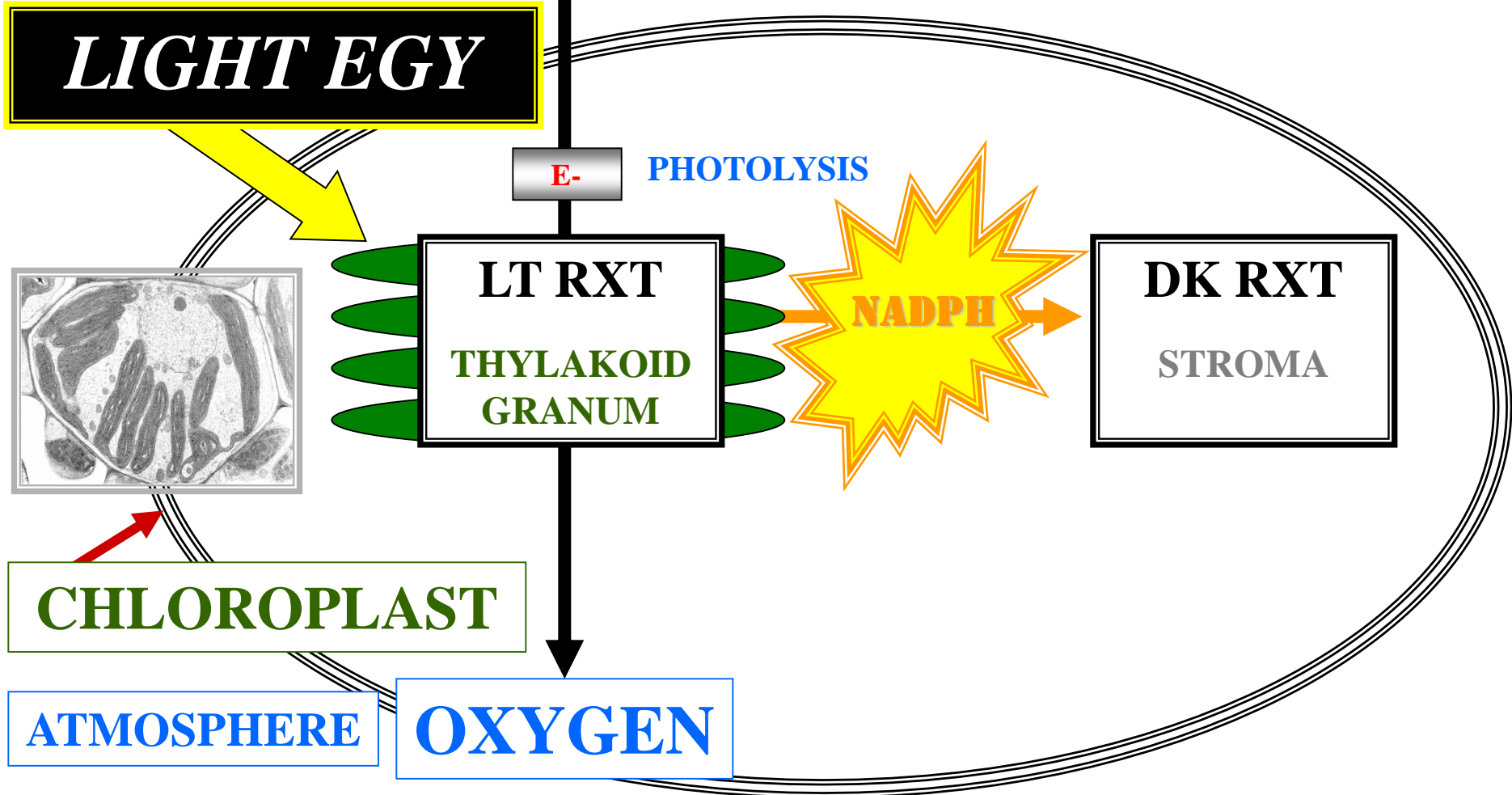
STROMA



CHLOROPLAST

ATMOSPHERE

OXYGEN



**NADPH**



**NADPH**

**NICOTINAMIDE ADENINE  
DINUCLEOTIDE PHOSPHATE**

**NADPH**



**NADPH**

**NICOTINAMIDE ADENINE  
DINUCLEOTIDE PHOSPHATE**

**---**

**ENERGY MOLECULE**

**NADPH**

**NADPH**

**NICOTINAMIDE ADENINE  
DINUCLEOTIDE PHOSPHATE**

---

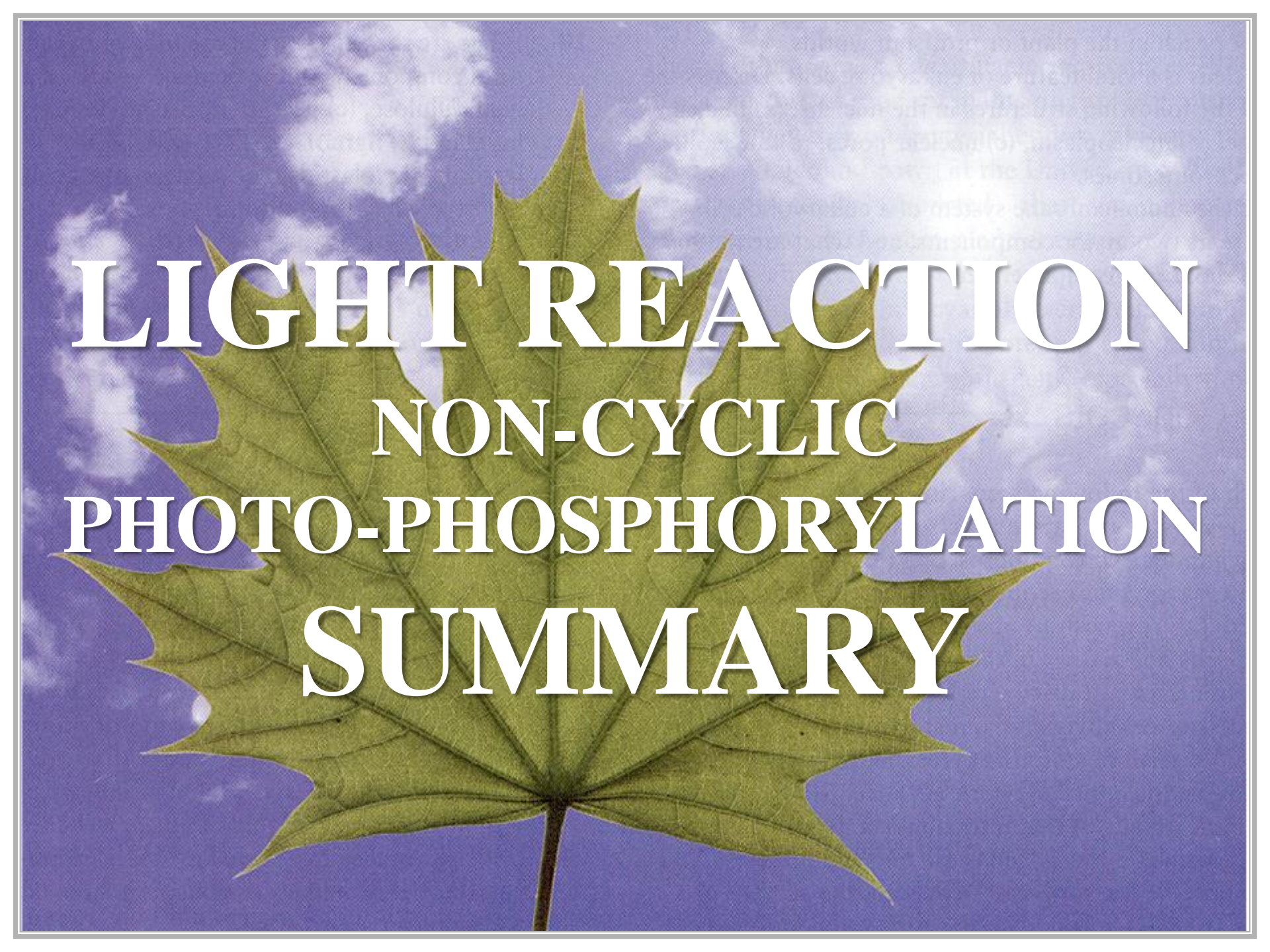
**ENERGY MOLECULE**

---

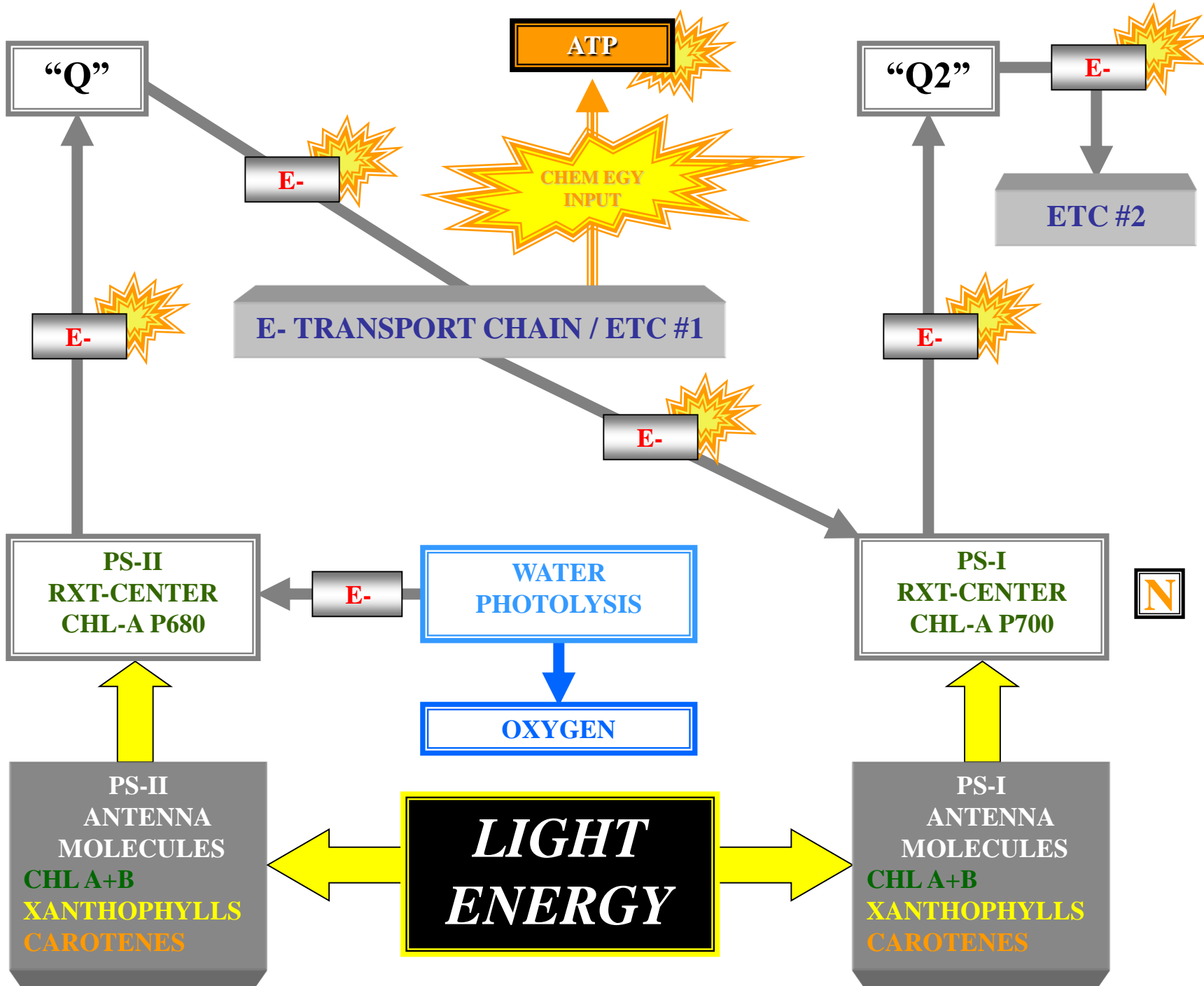
**E- DONOR**

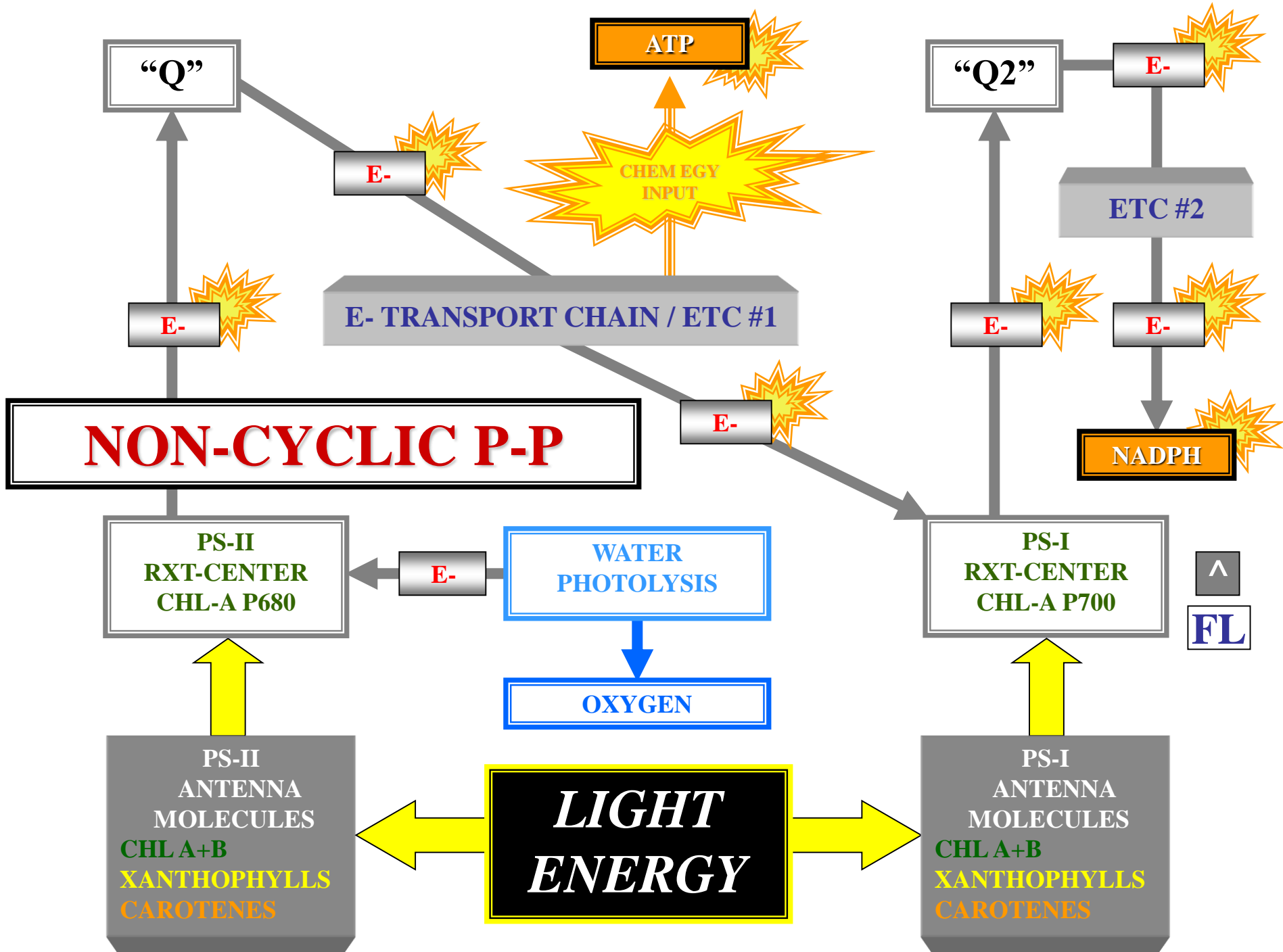
**NADPH**



A large, vibrant green maple leaf is the central focus, set against a background of a bright blue sky with scattered white clouds. The leaf's veins are clearly visible, and its stem extends downwards. The overall image has a slightly grainy texture.

**LIGHT REACTION**  
**NON-CYCLIC**  
**PHOTO-PHOSPHORYLATION**  
**SUMMARY**





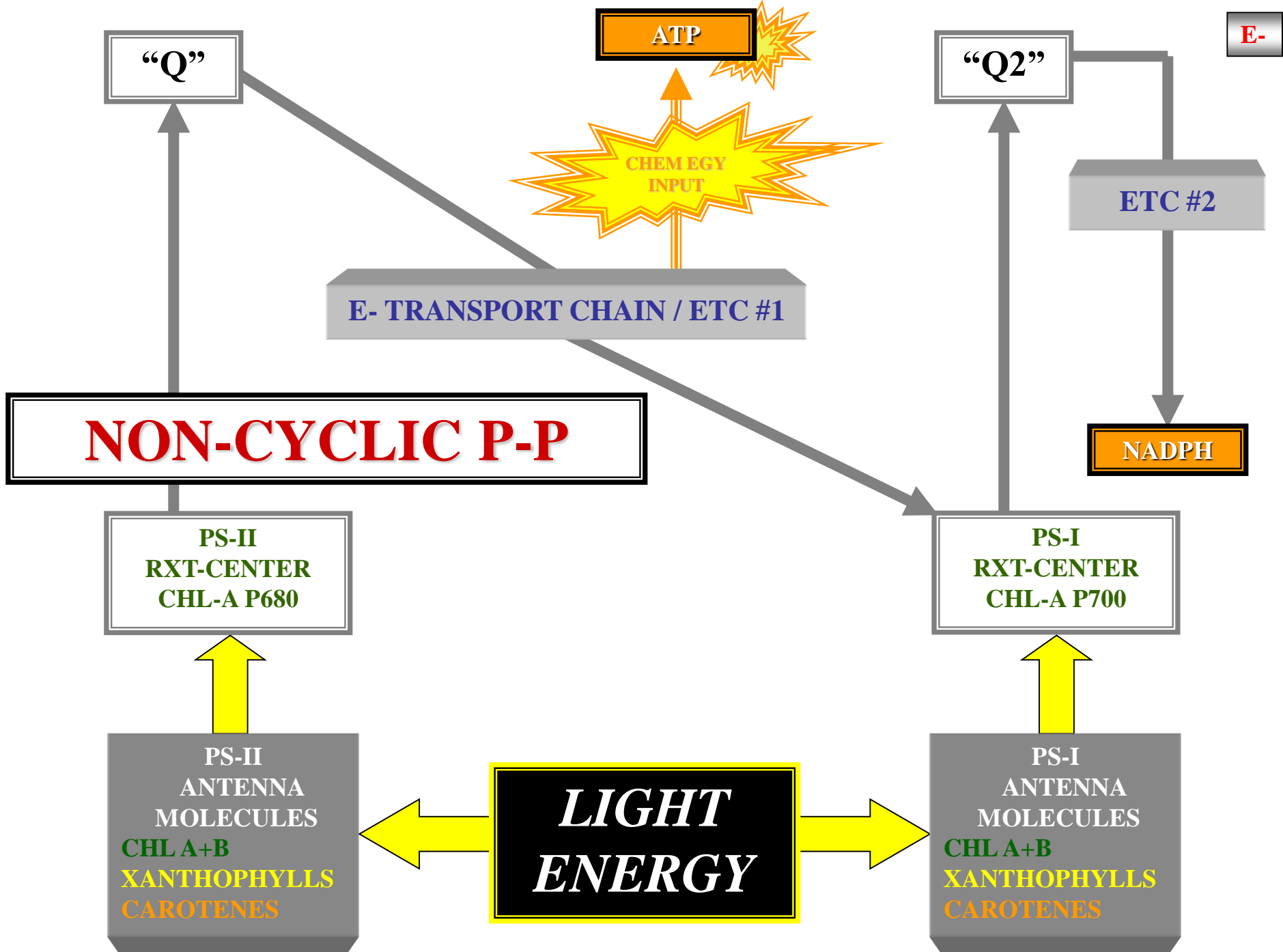


# LIGHT REACTION

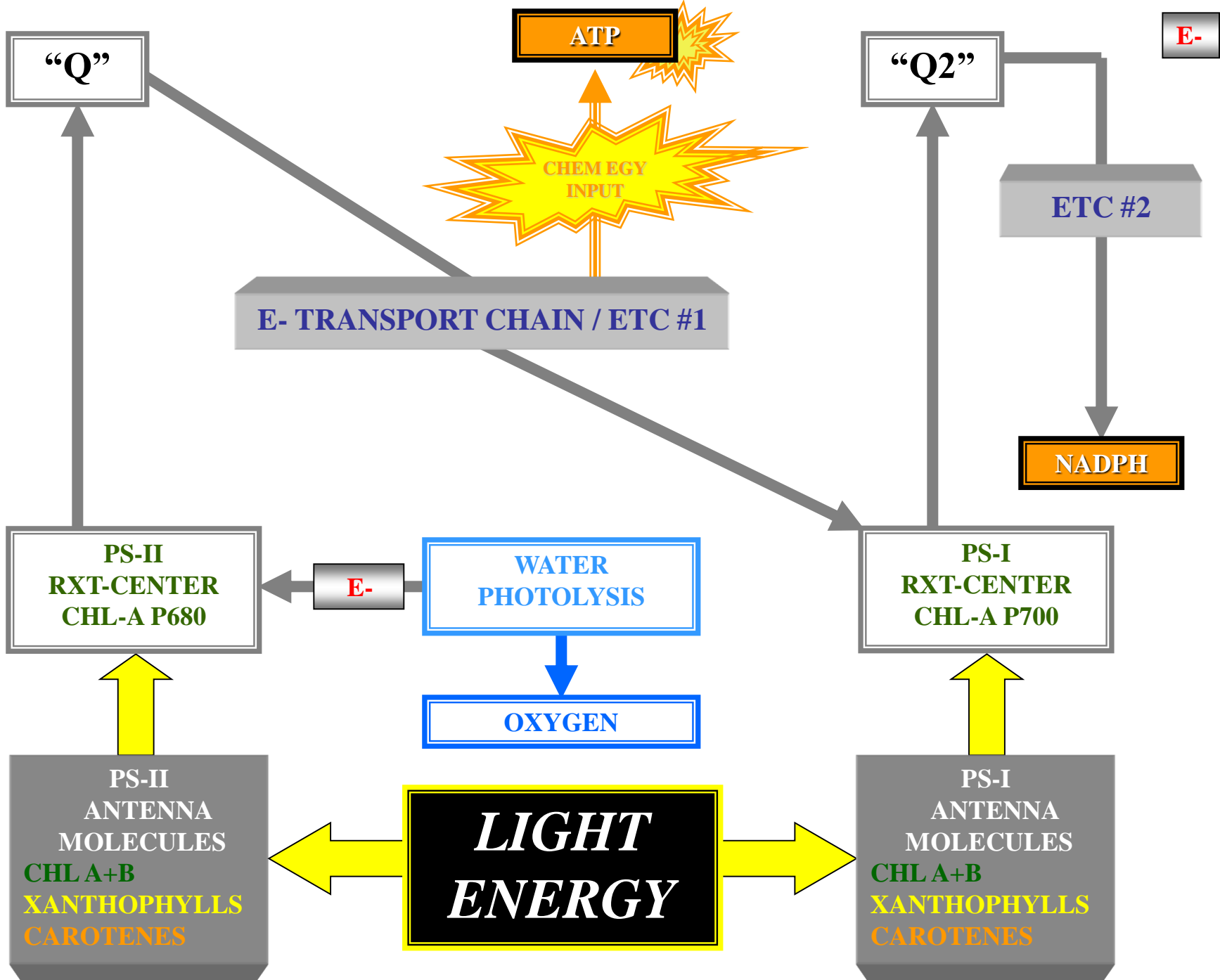
## NON-CYCLIC

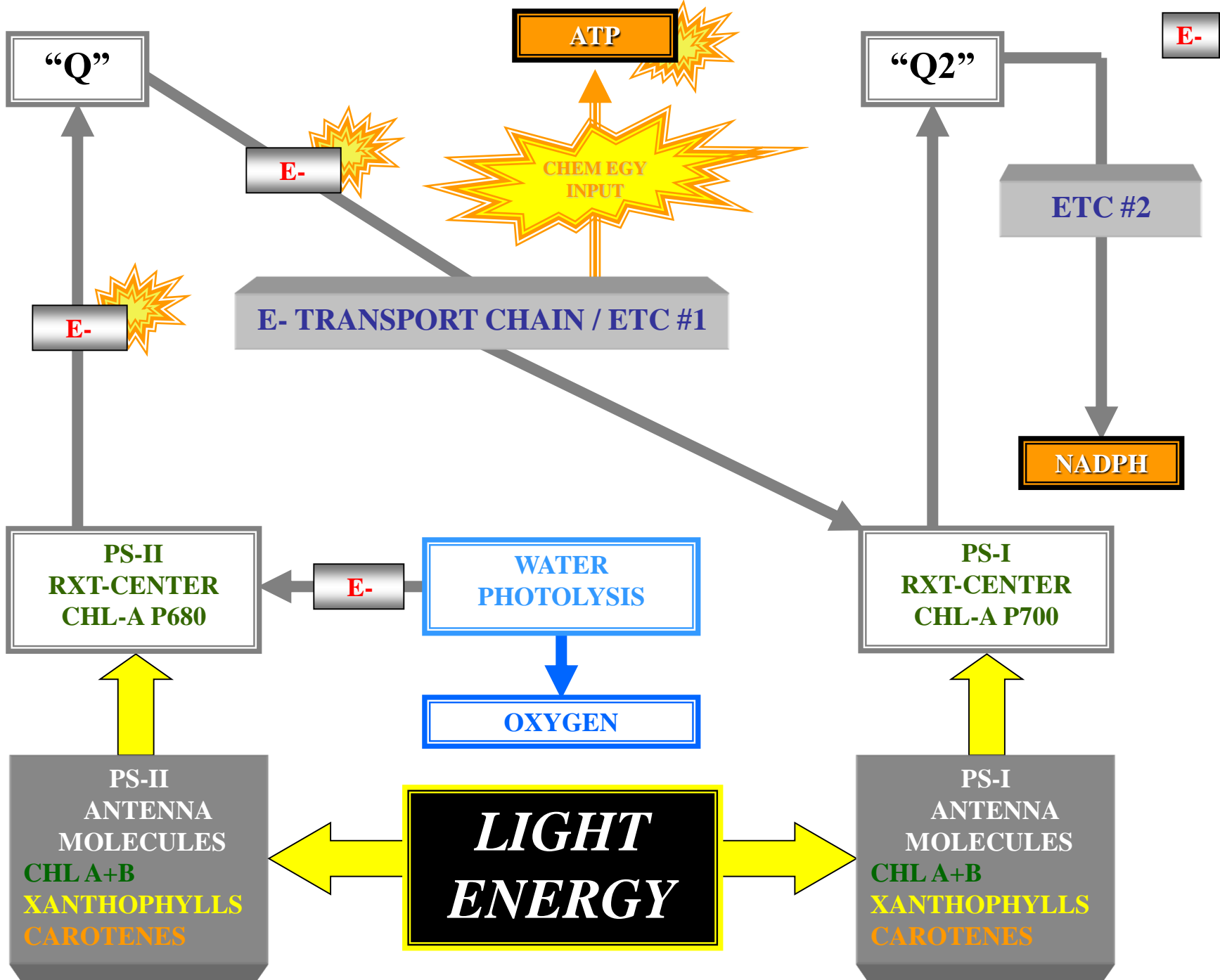
### PHOTO-PHOSPHORYLATION

#### E- FLOW

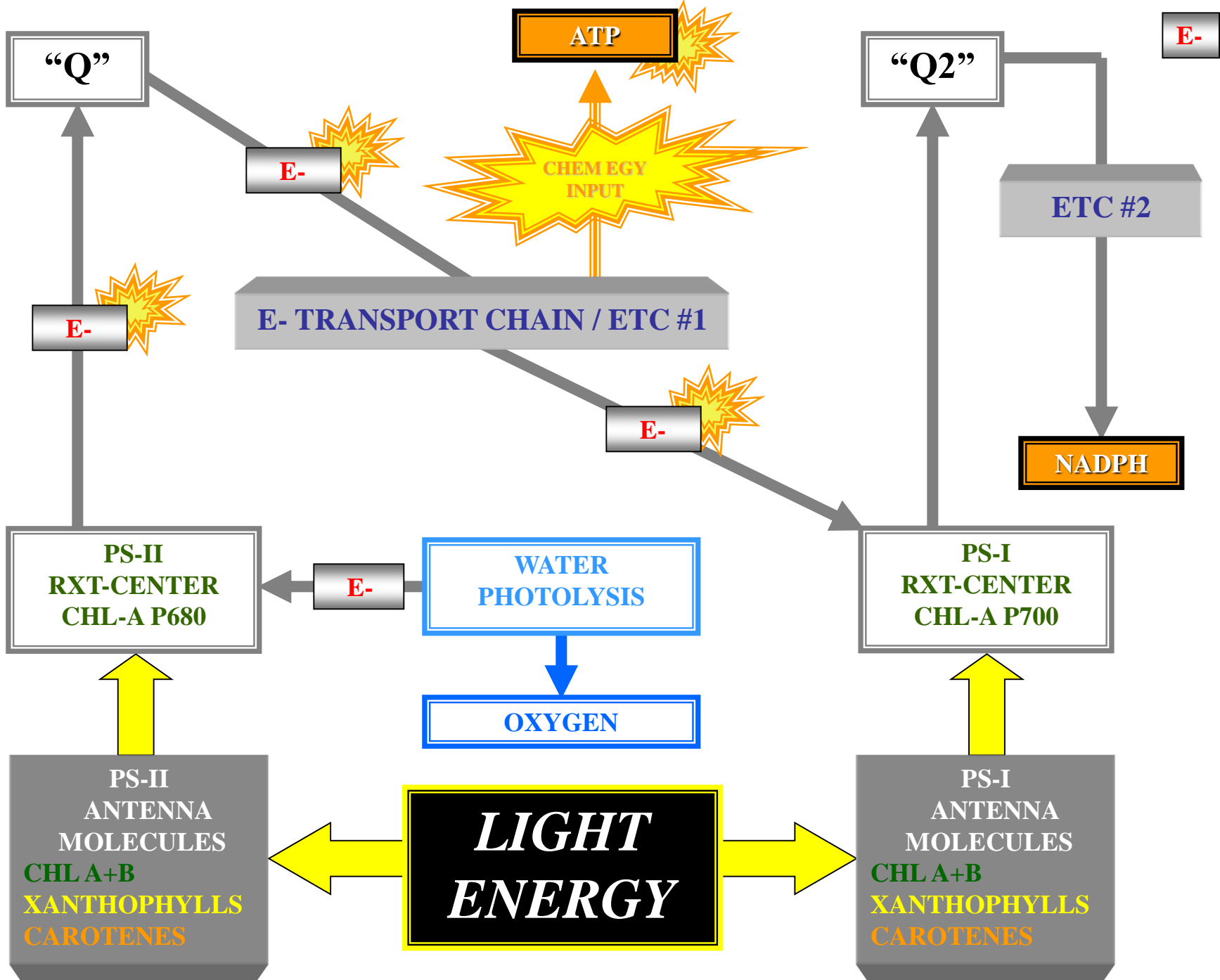


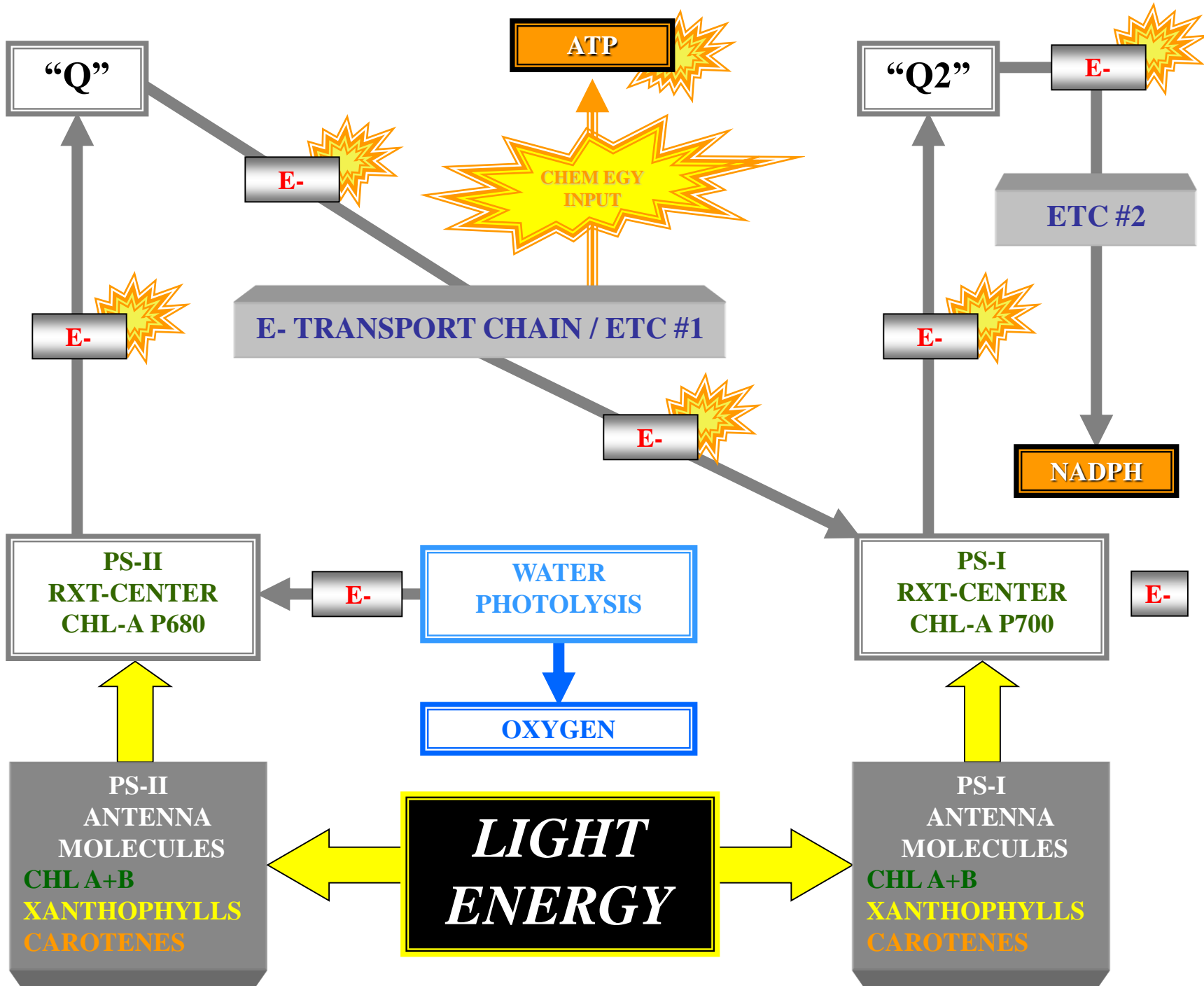


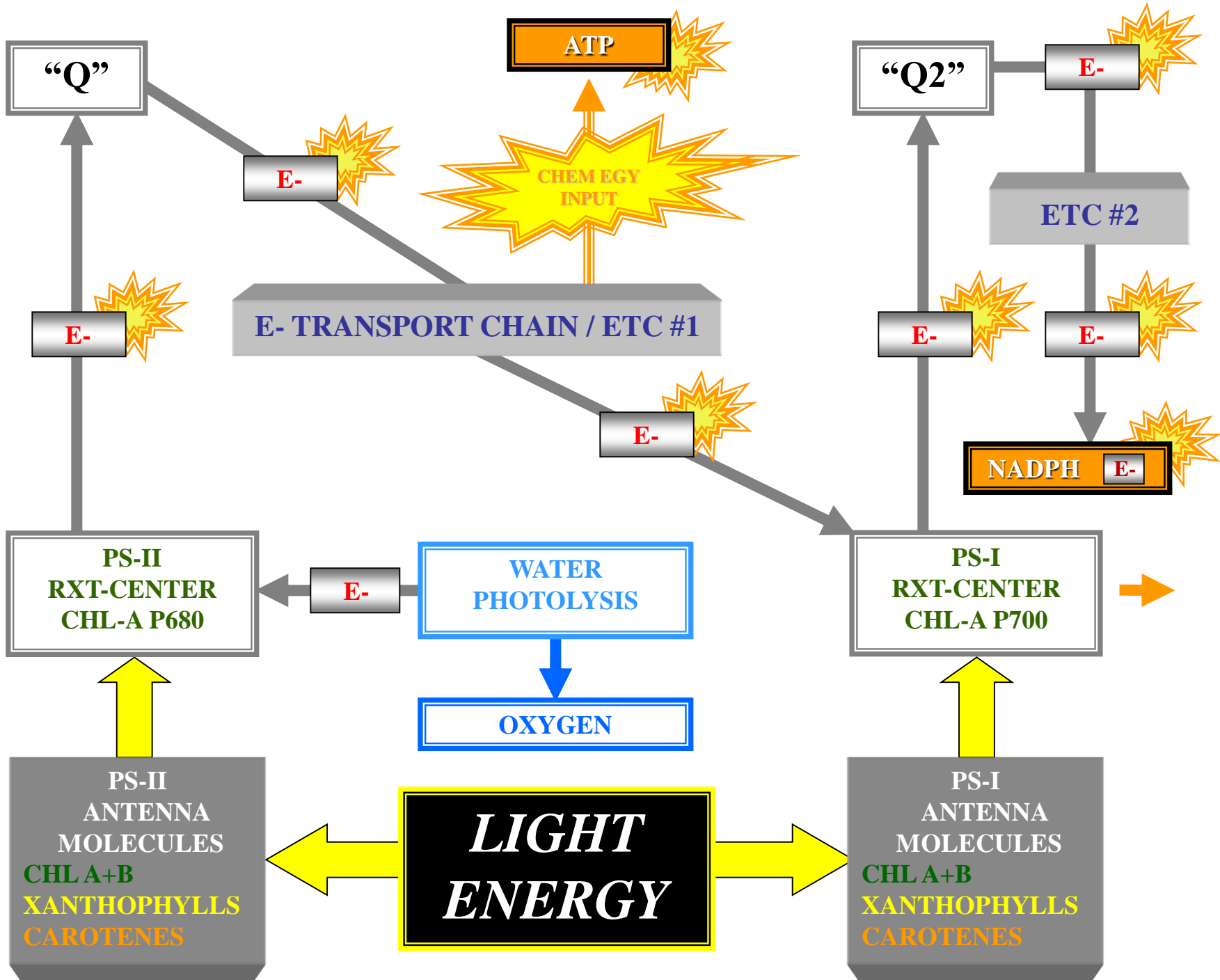












# PHOTOSYNTHESIS

DK



WATER

**LIGHT ENERGY**

E-

PHOTOLYSIS

LIGHT REACTION

THYLAKOID GRANUM

NADPH

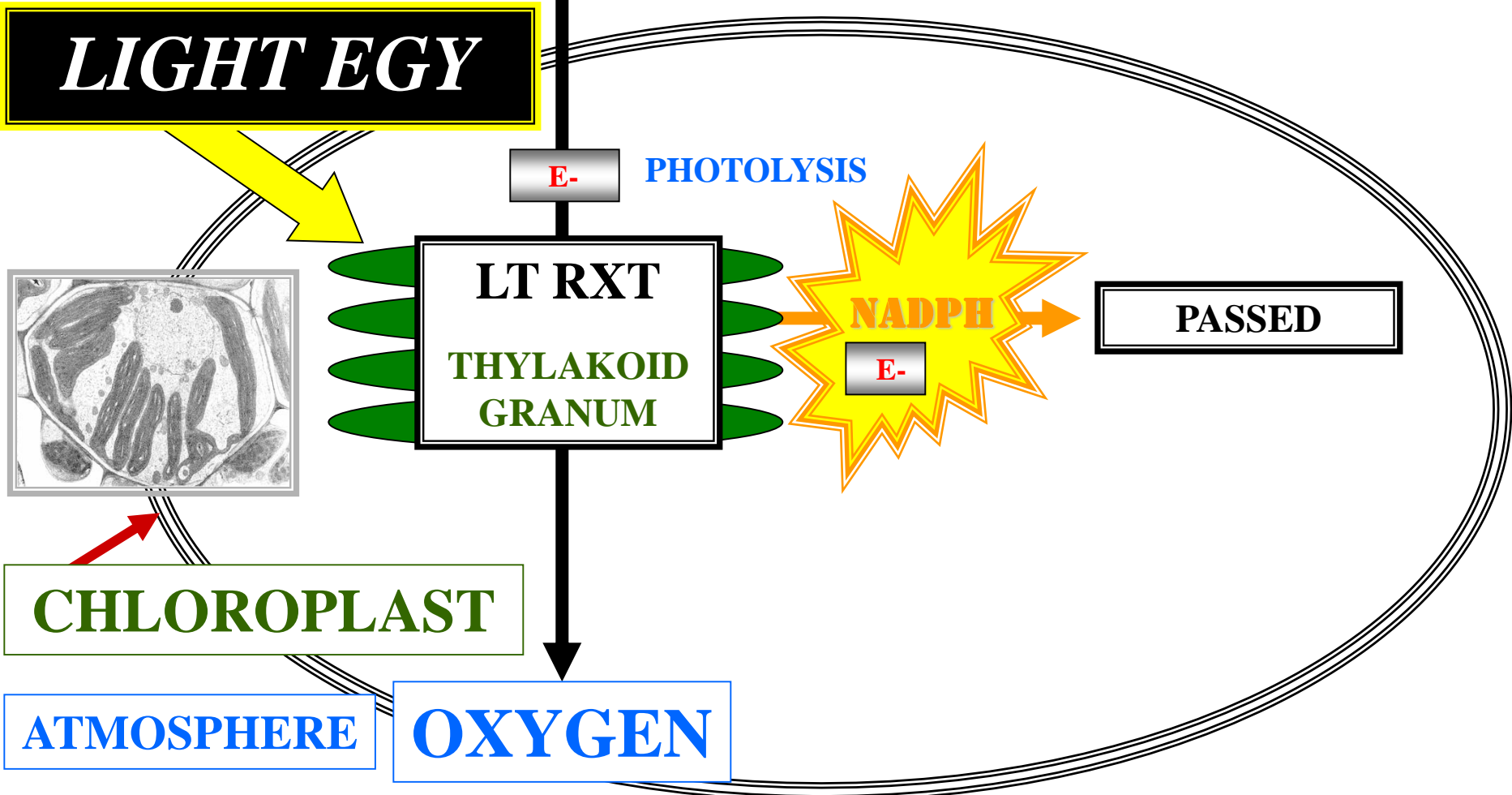
PASSED

E-

CHLOROPLAST

ATMOSPHERE

OXYGEN



# PHOTOSYNTHESIS



WATER

**LIGHT ENERGY**

E-

PHOTOLYSIS

LT RXT

THYLAKOID  
GRANUM

NADPH

E-

DK RXT

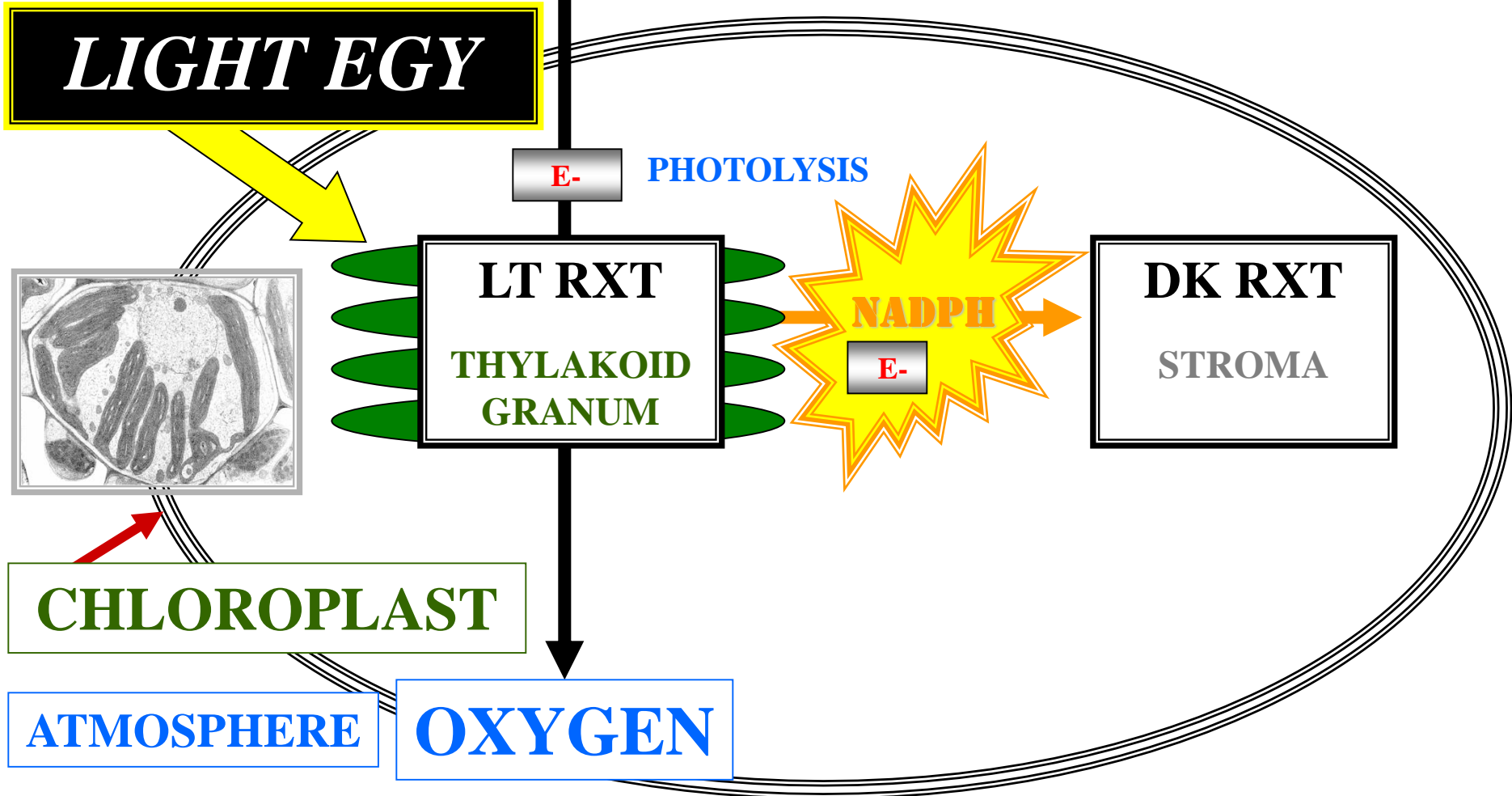
STROMA

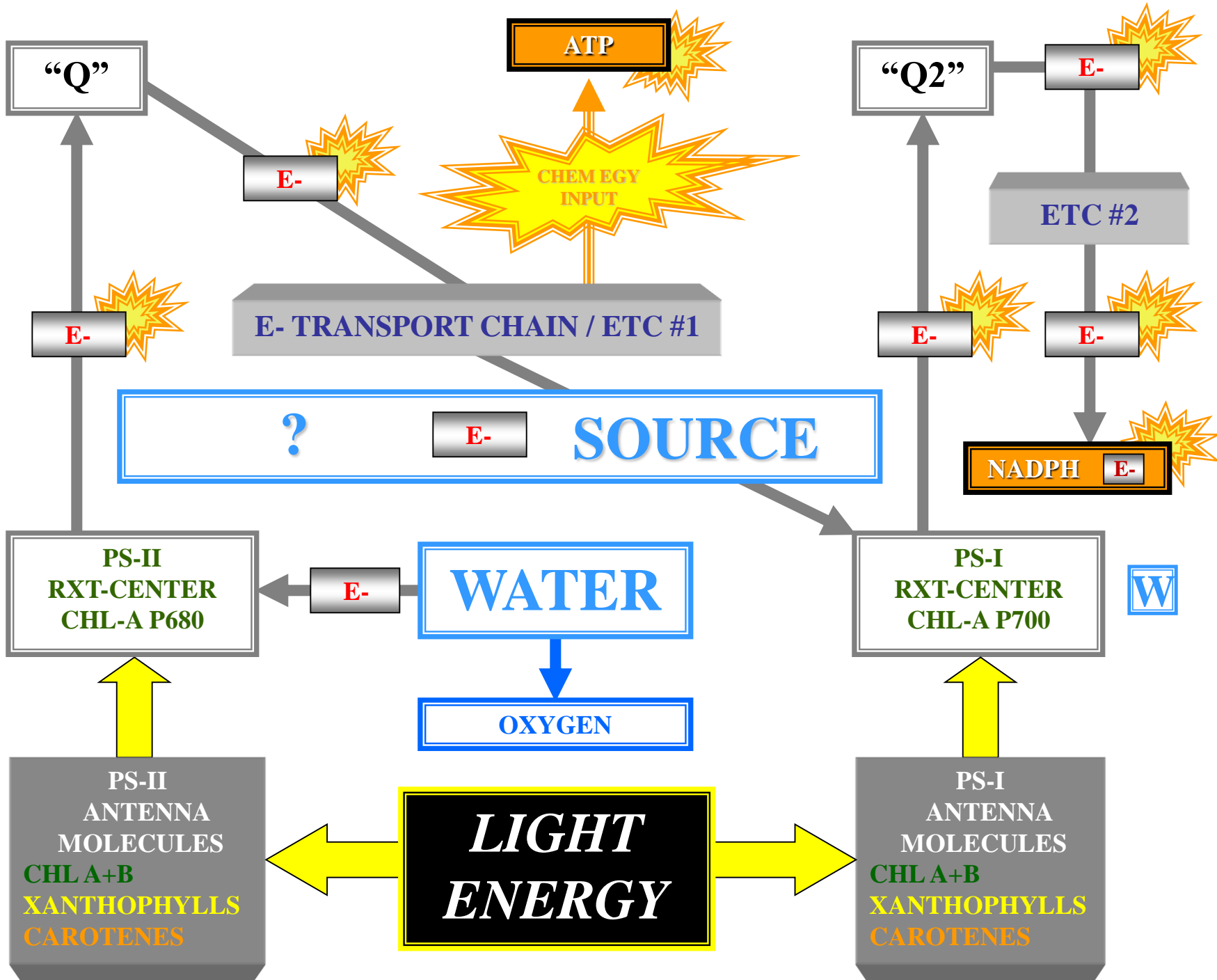


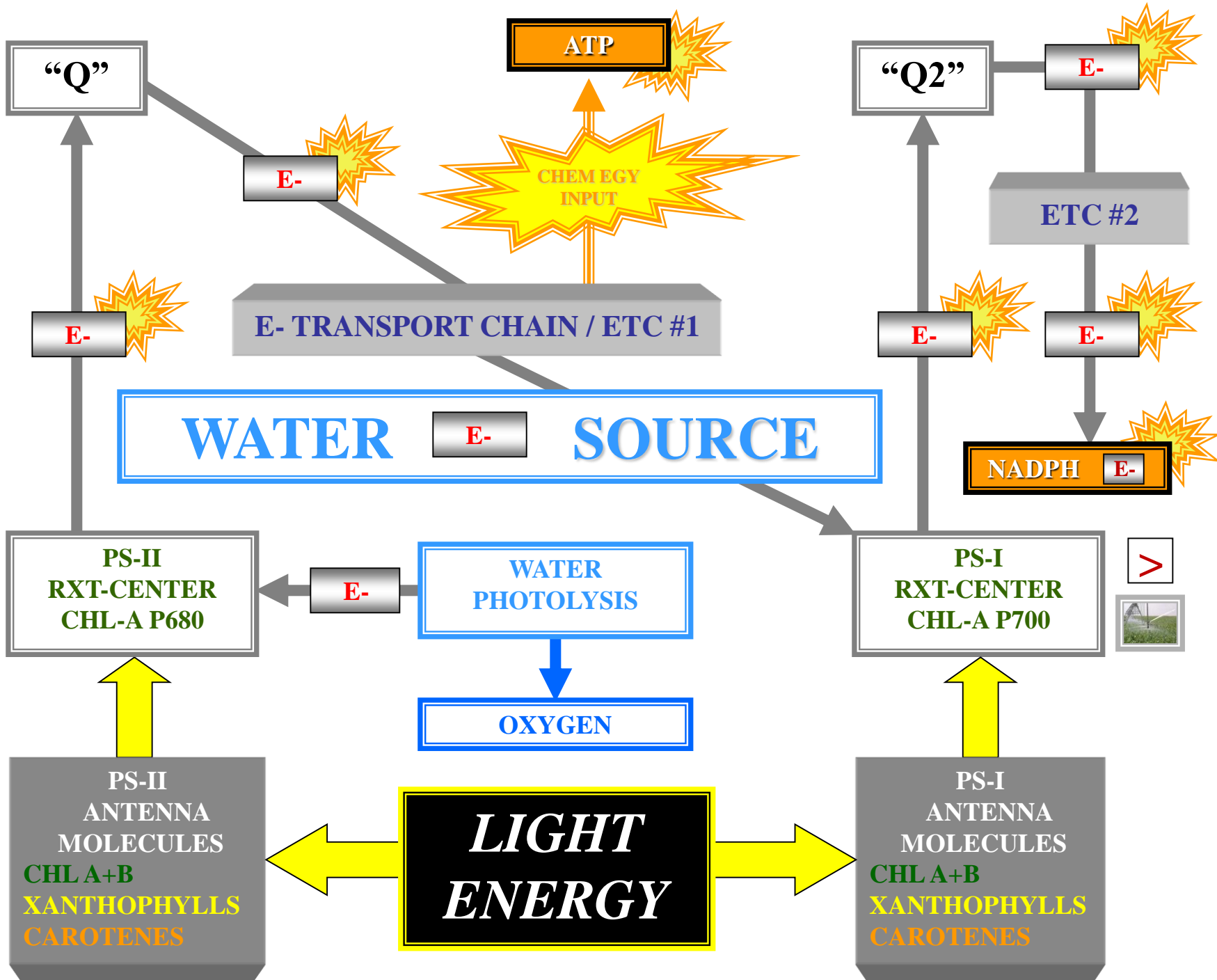
CHLOROPLAST

ATMOSPHERE

OXYGEN









E-

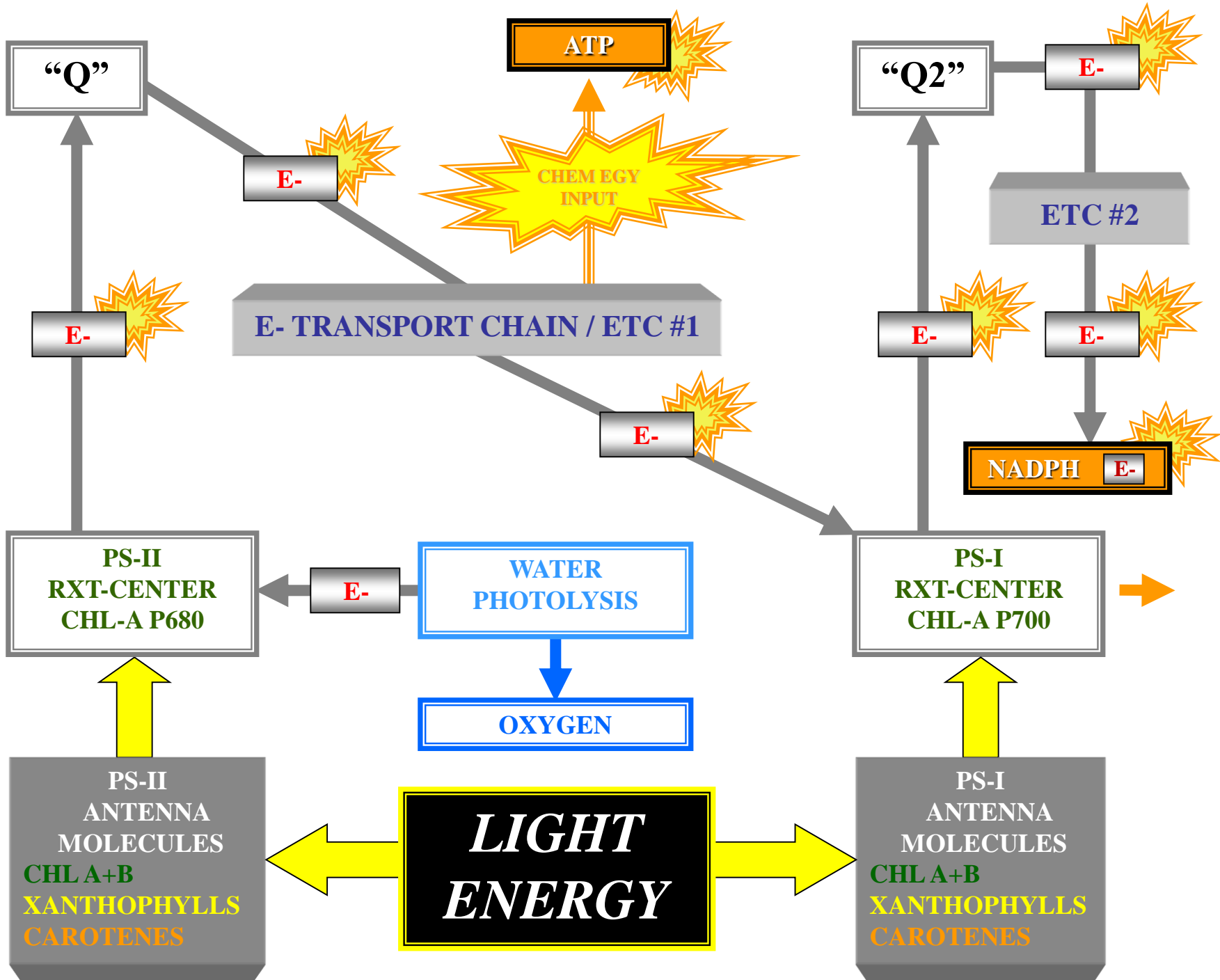


**NON-CYCLIC P-P**

**WATER**

E-

**SOURCE**



# PHOTOSYNTHESIS

DK



WATER

**LIGHT ENERGY**

E-

PHOTOLYSIS

LIGHT REACTION

THYLAKOID GRANUM

NADPH

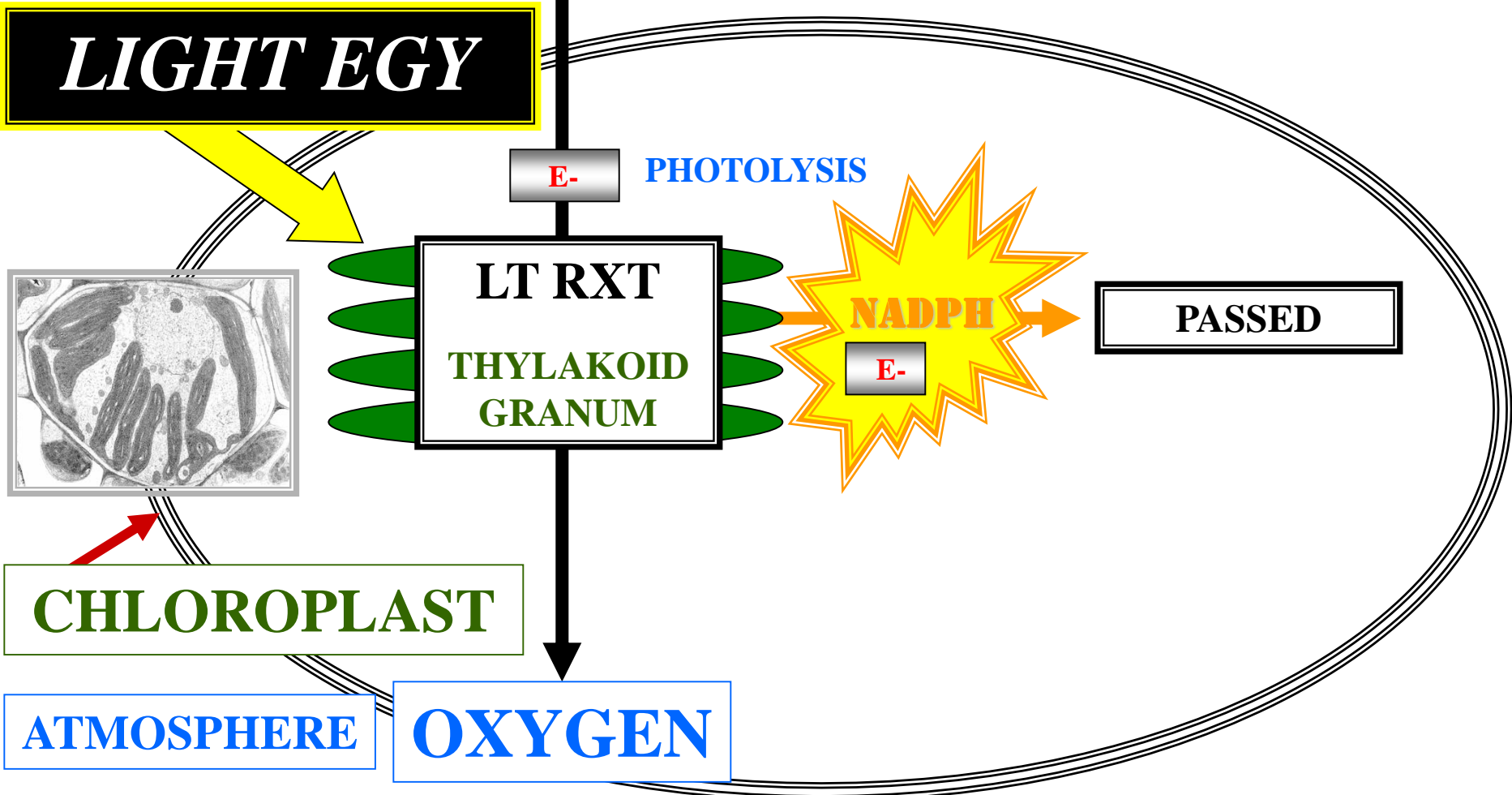
PASSED

E-

CHLOROPLAST

ATMOSPHERE

OXYGEN





# PHOTOSYNTHESIS



WATER

**LIGHT ENERGY**

E-

PHOTOLYSIS

LT RXT

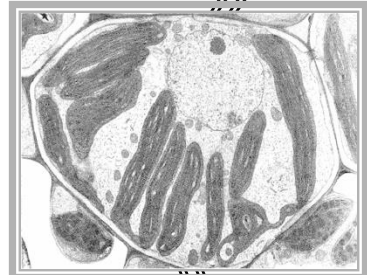
THYLAKOID  
GRANUM

NADPH

E-

DK RXT

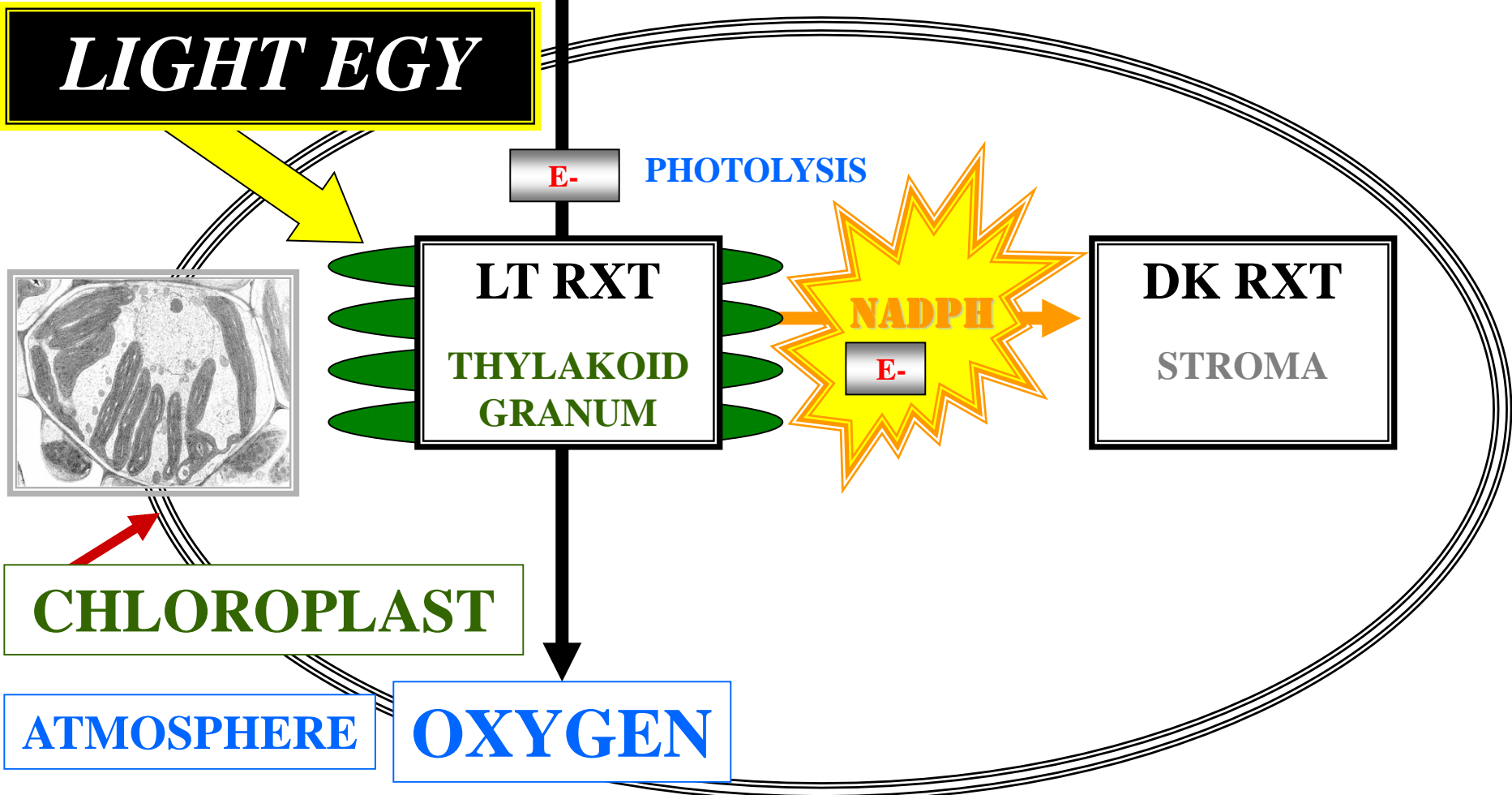
STROMA

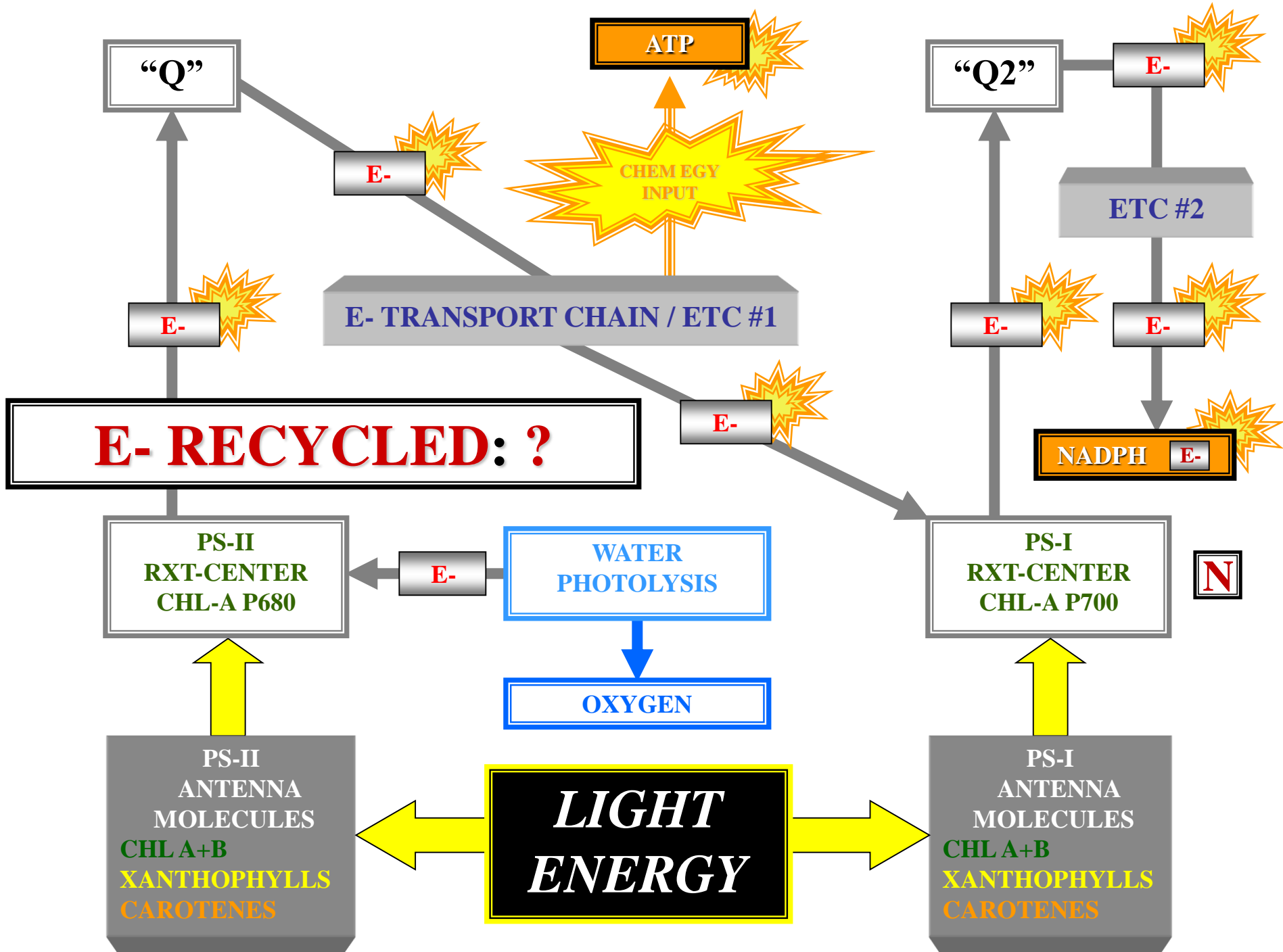


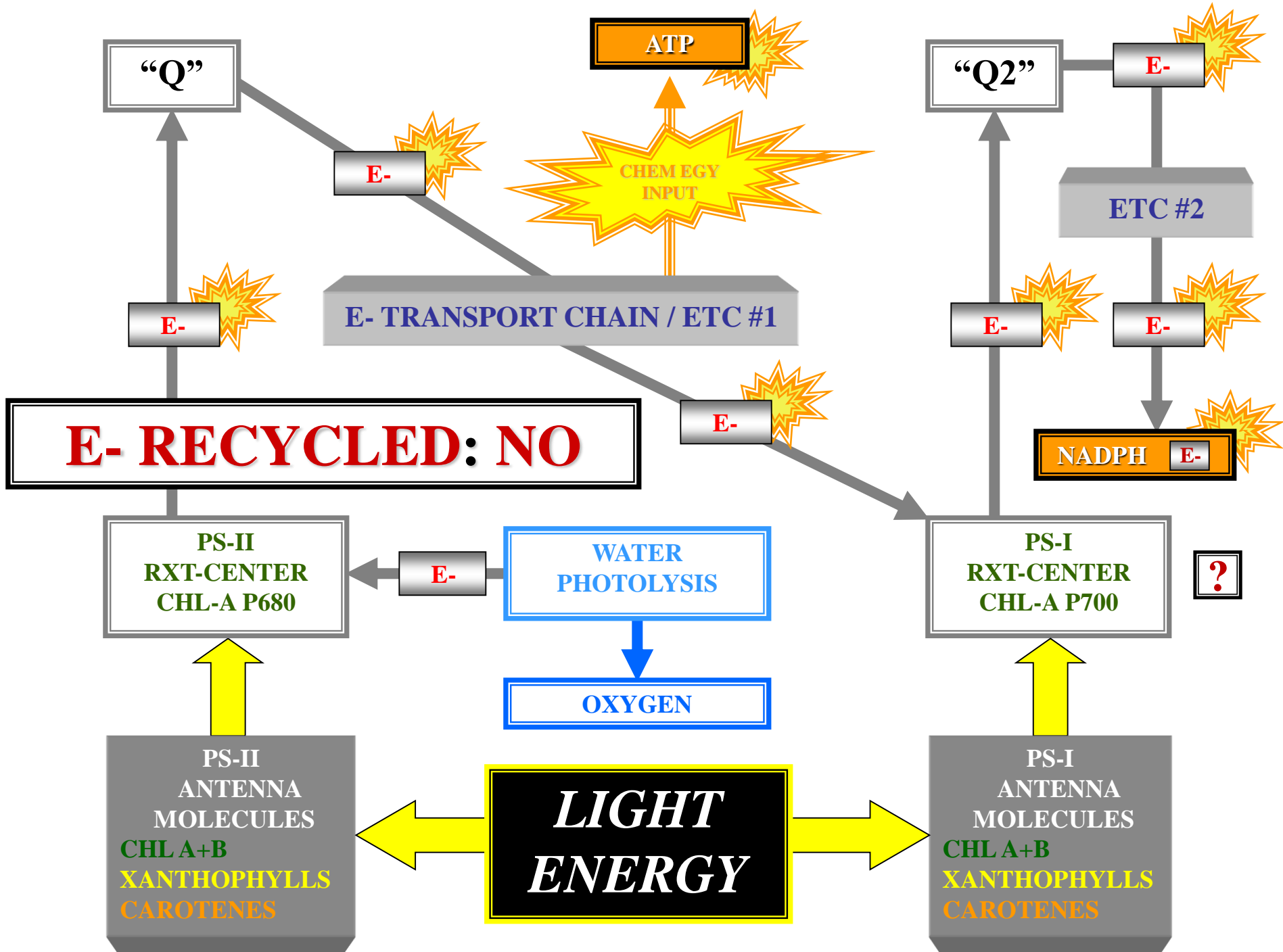
CHLOROPLAST

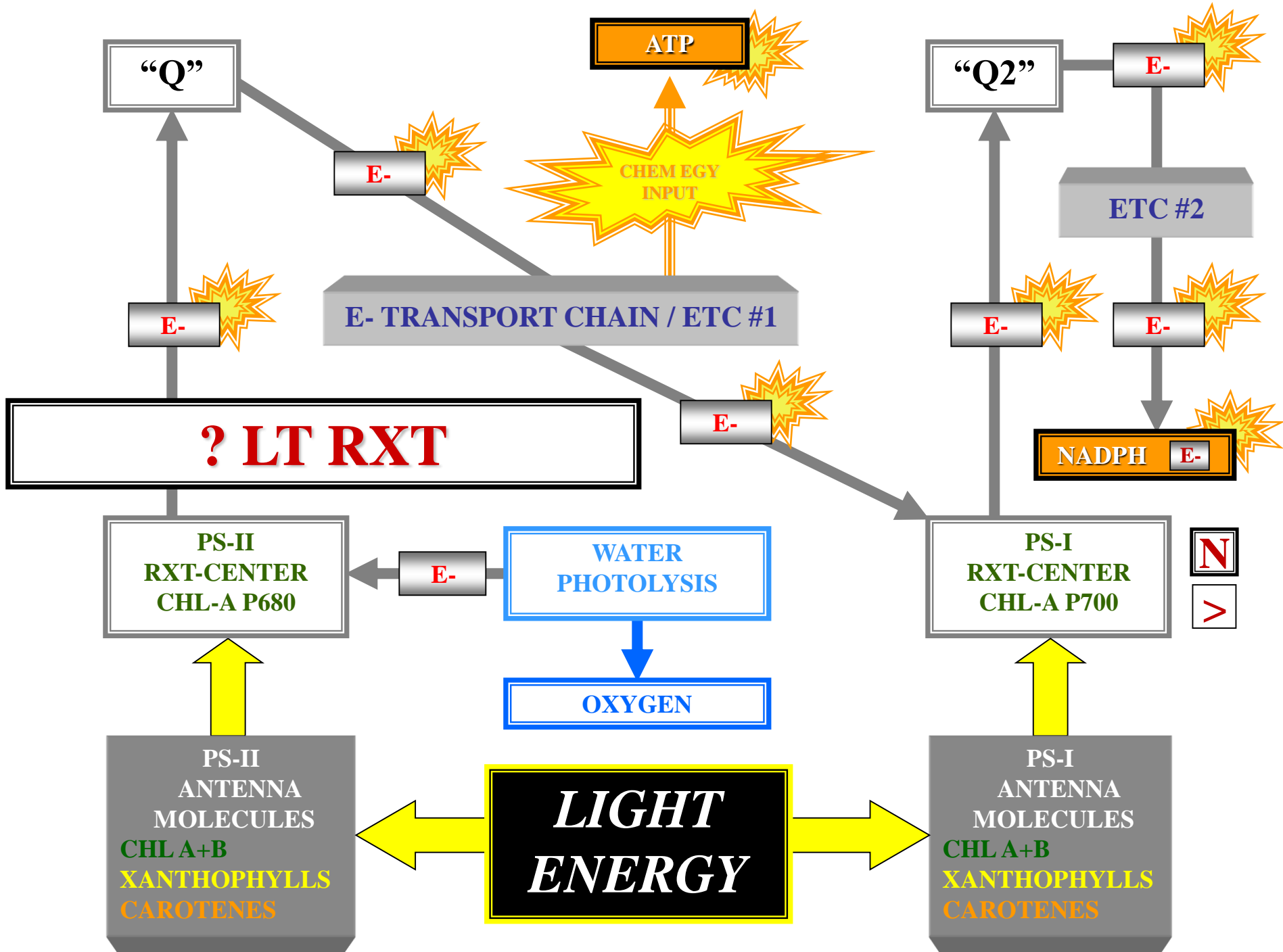
ATMOSPHERE

OXYGEN

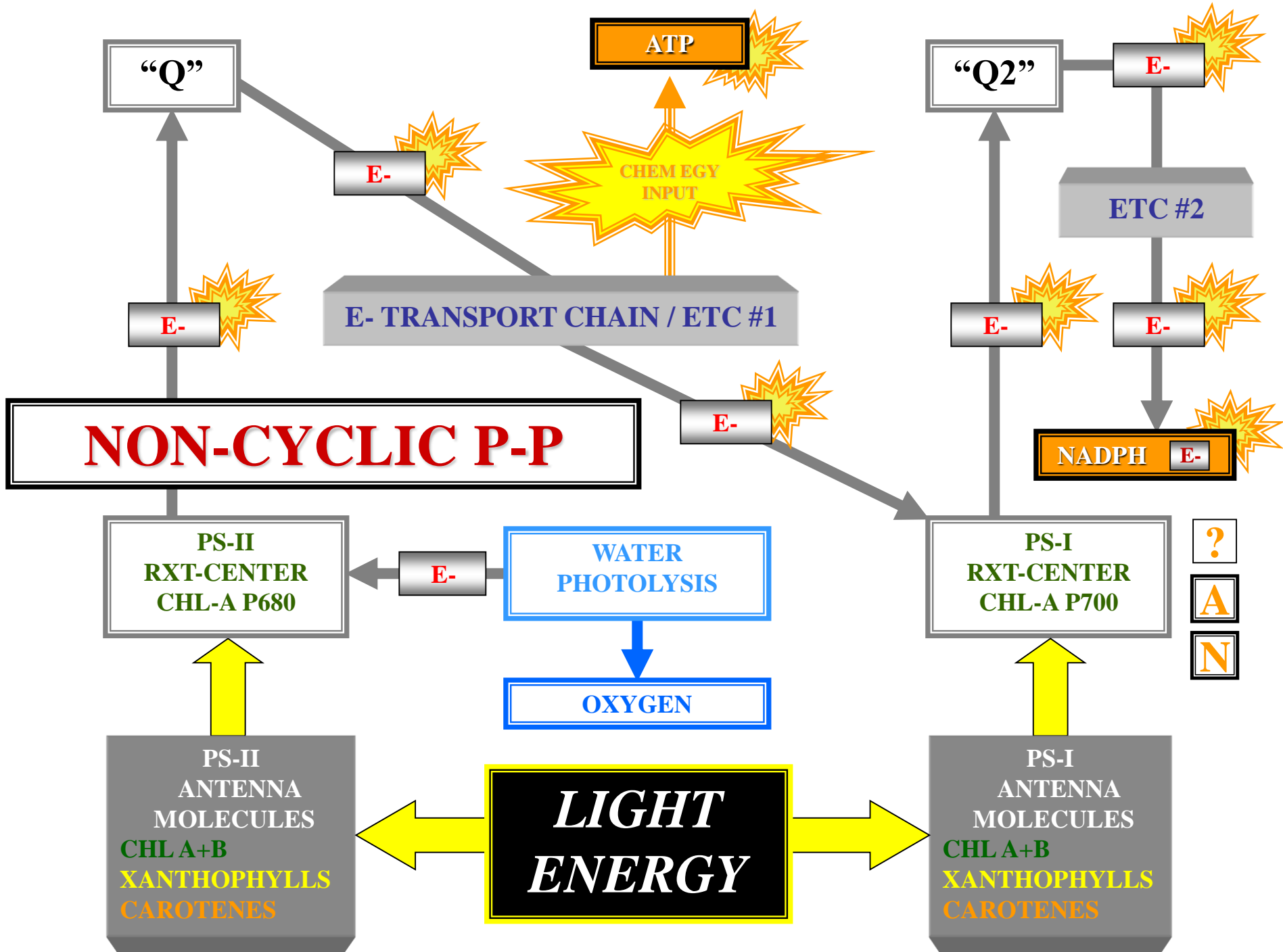












# PHOTOSYNTHESIS

A



WATER

**LIGHT ENERGY**

E-

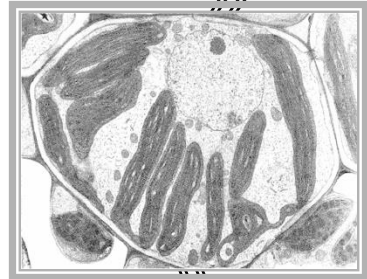
PHOTOLYSIS

LT RXT

THYLAKOID  
GRANUM

DK RXT

STROMA

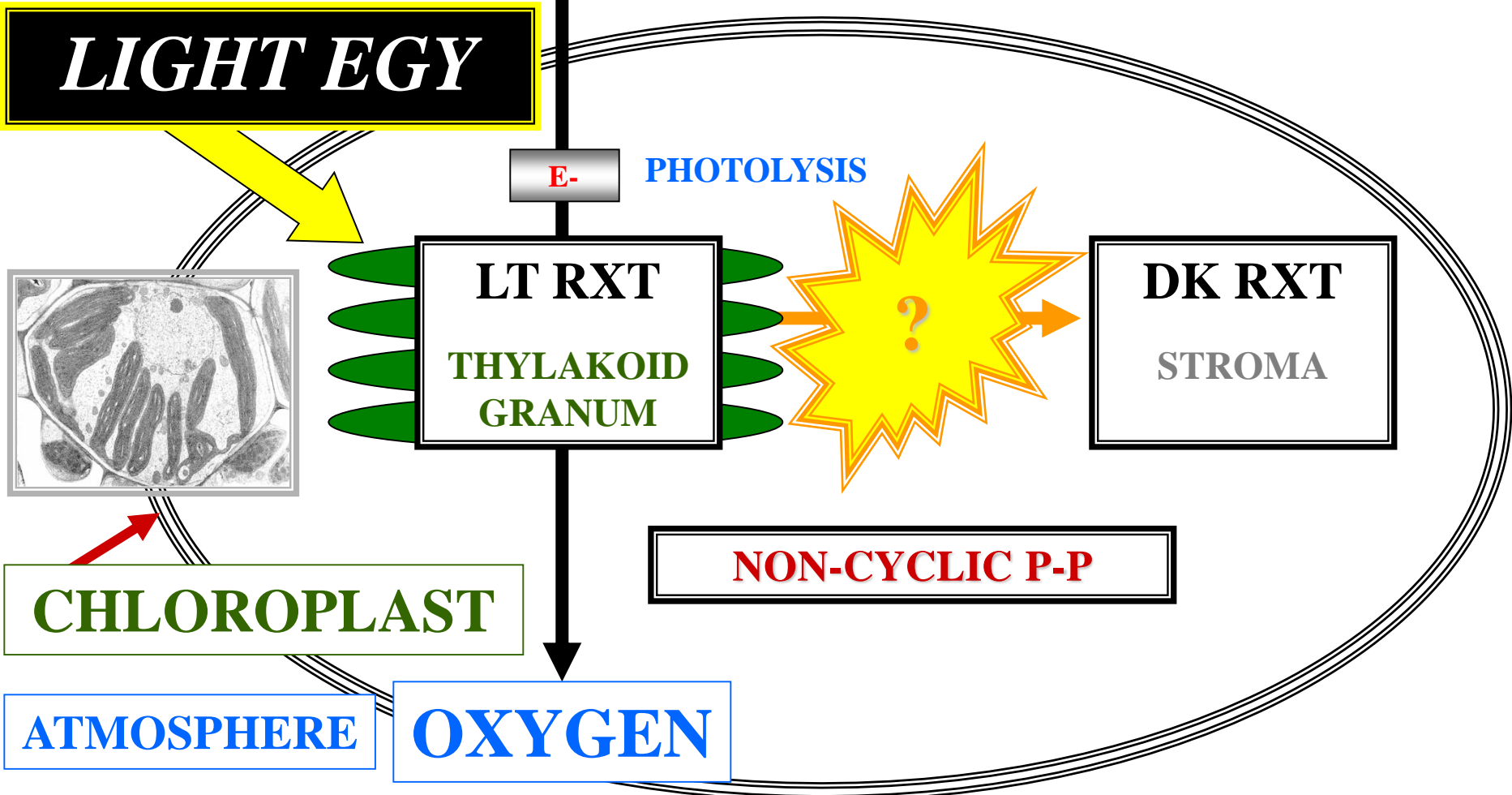


CHLOROPLAST

NON-CYCLIC P-P

ATMOSPHERE

OXYGEN



# PHOTOSYNTHESIS

N



WATER

**LIGHT ENERGY**

E-

PHOTOLYSIS

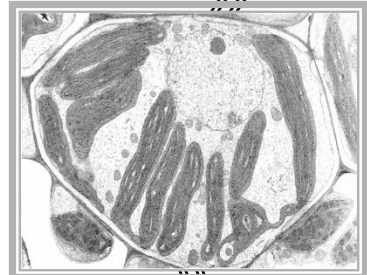
LT RXT

THYLAKOID  
GRANUM

ATP

DK RXT

STROMA

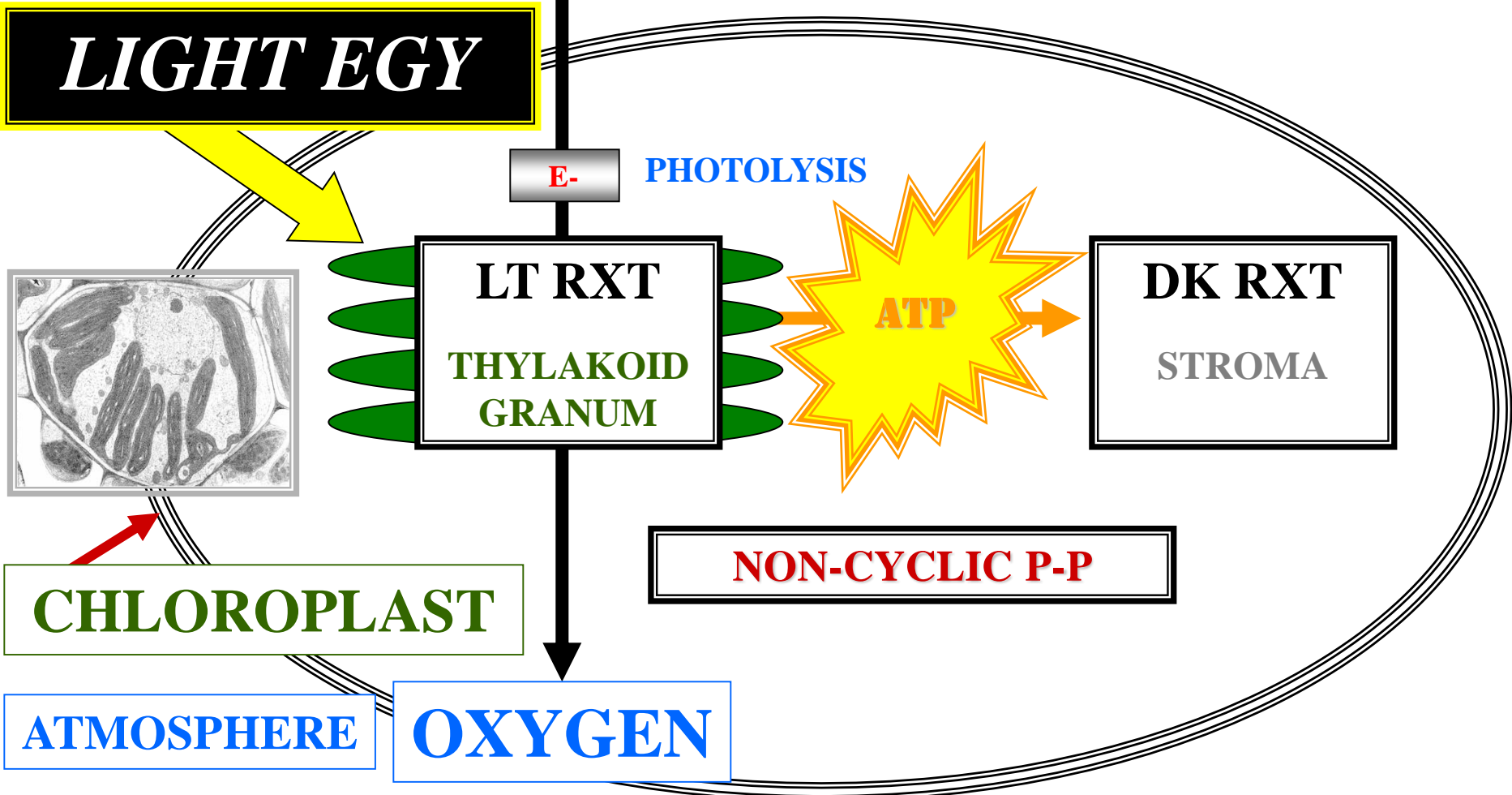


CHLOROPLAST

NON-CYCLIC P-P

ATMOSPHERE

OXYGEN



# PHOTOSYNTHESIS



WATER

**LIGHT ENERGY**

E-

PHOTOLYSIS

LT RXT

THYLAKOID  
GRANUM

NADPH

DK RXT

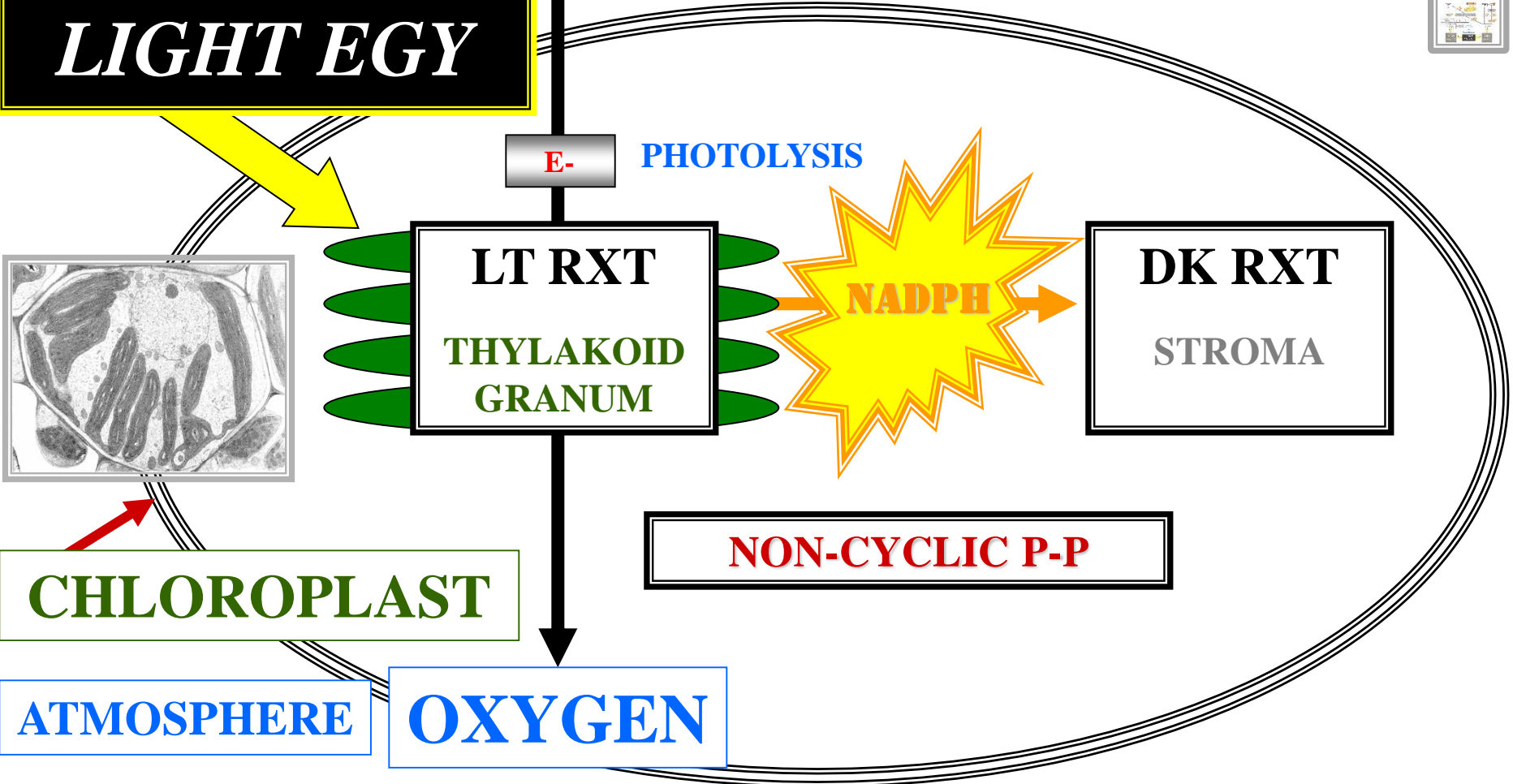
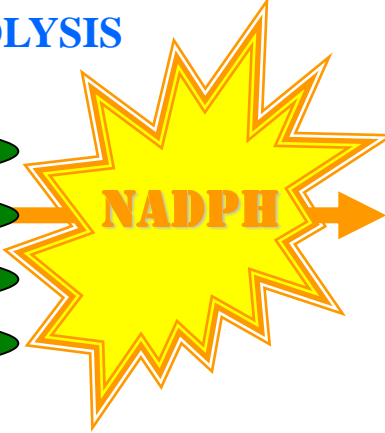
STROMA

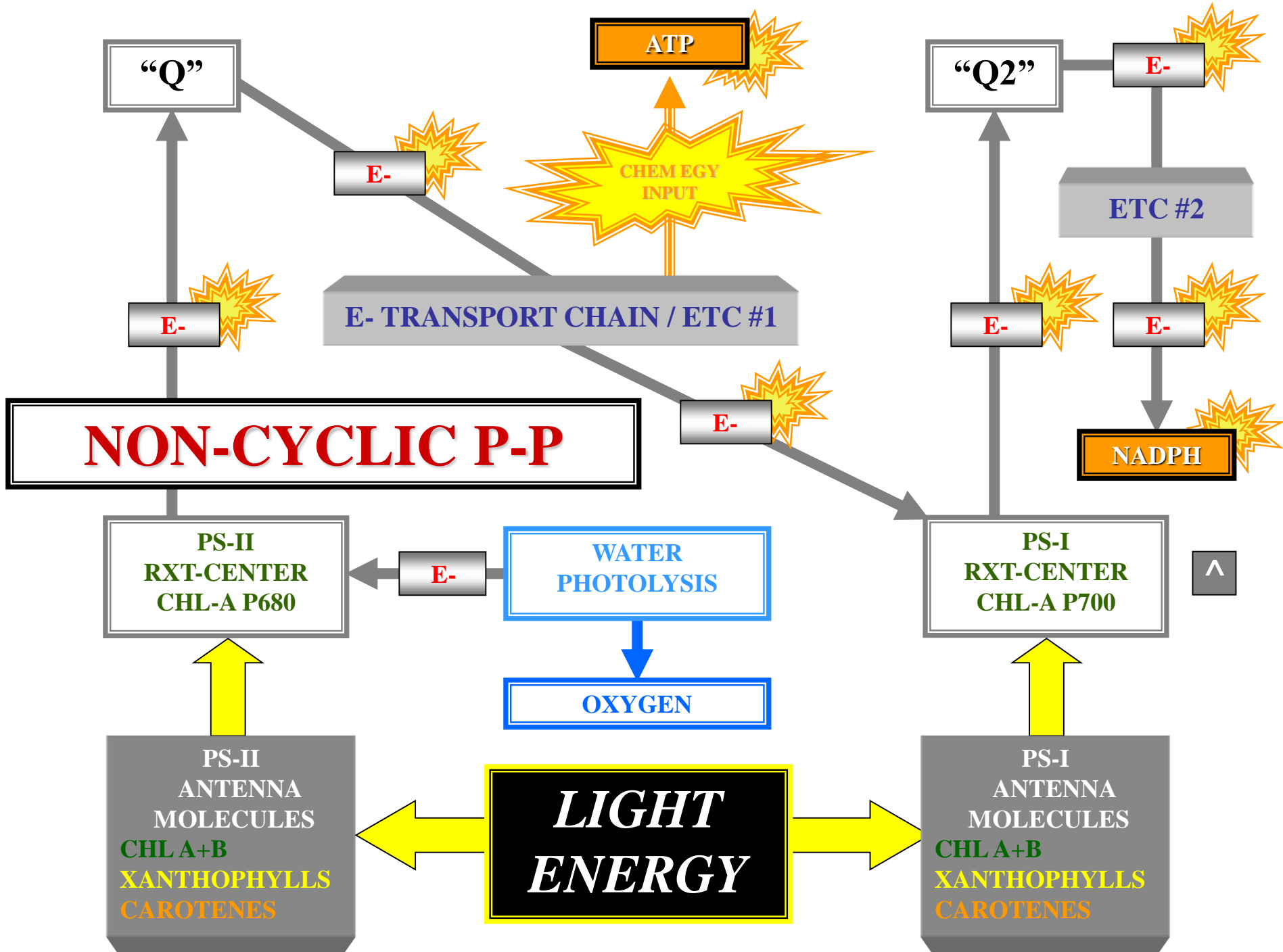
NON-CYCLIC P-P

CHLOROPLAST

ATMOSPHERE

OXYGEN







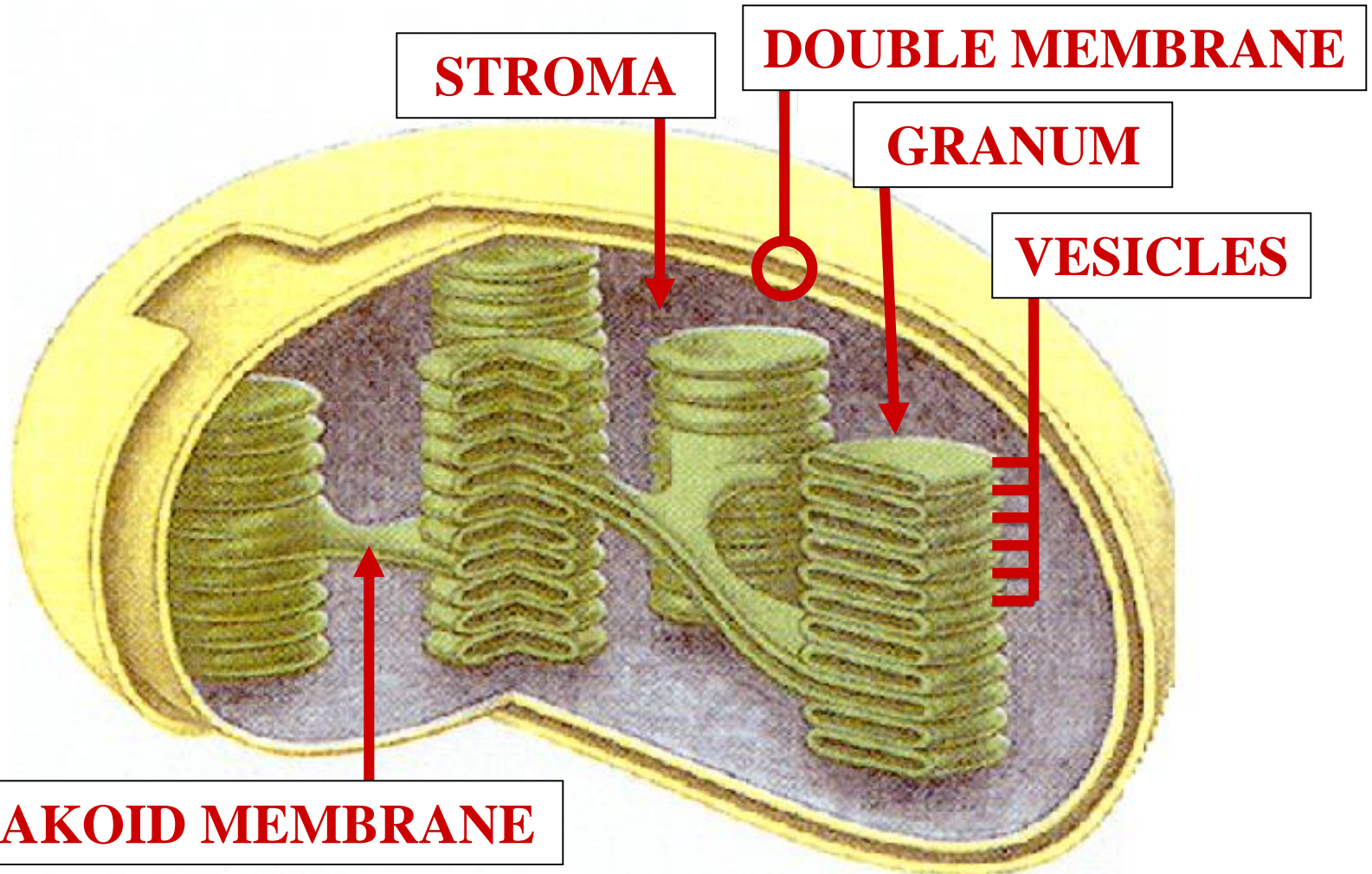
# **LIGHT REACTION**

## **CYCLIC**

# **PHOTO-PHOSPHORYLATION**



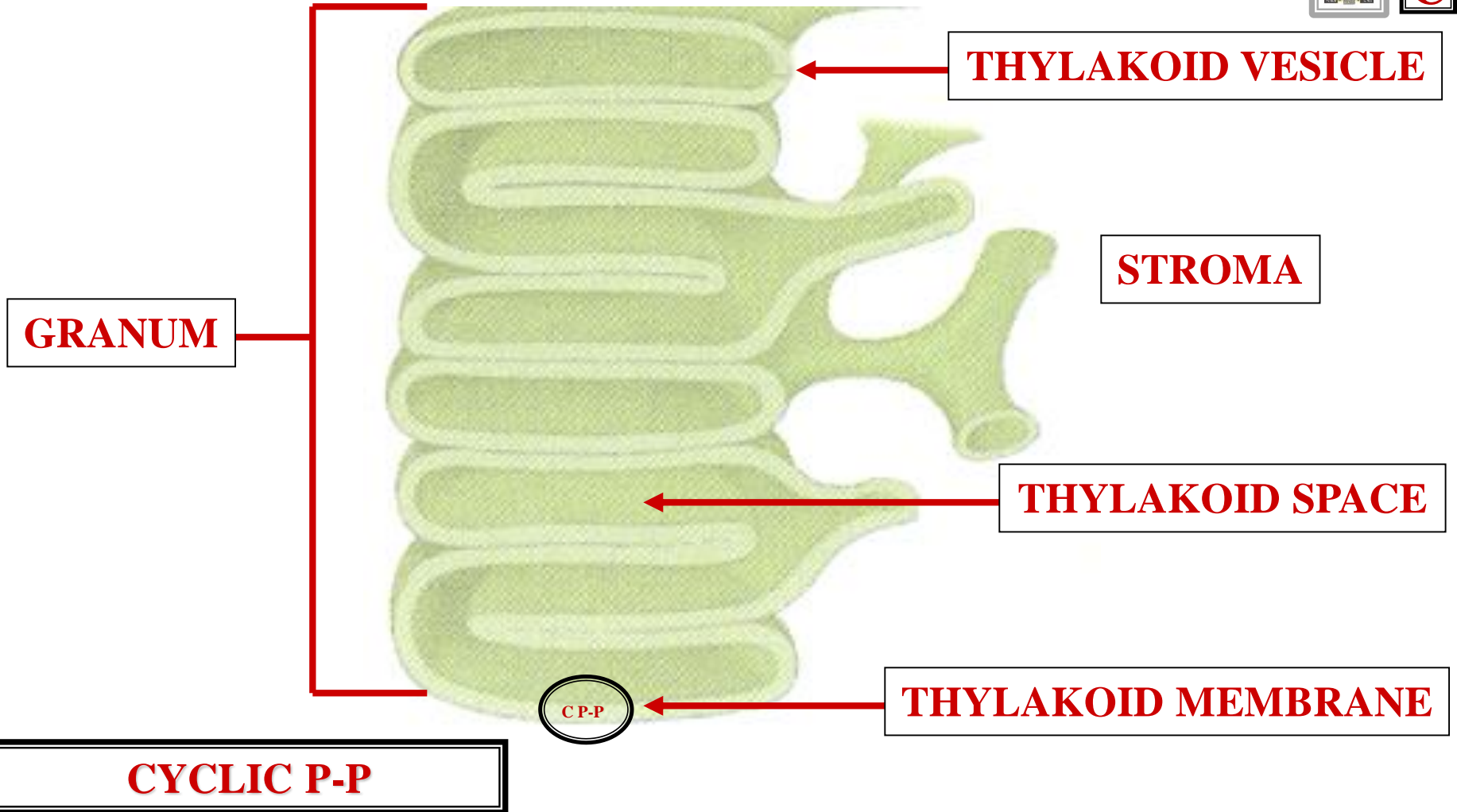
# CHLOROPLAST ULTRASTRUCTURE







# CHLOROPLAST THYLAKOID



**THYLAKOID VESICLE**

**STROMA**

**GRANUM**

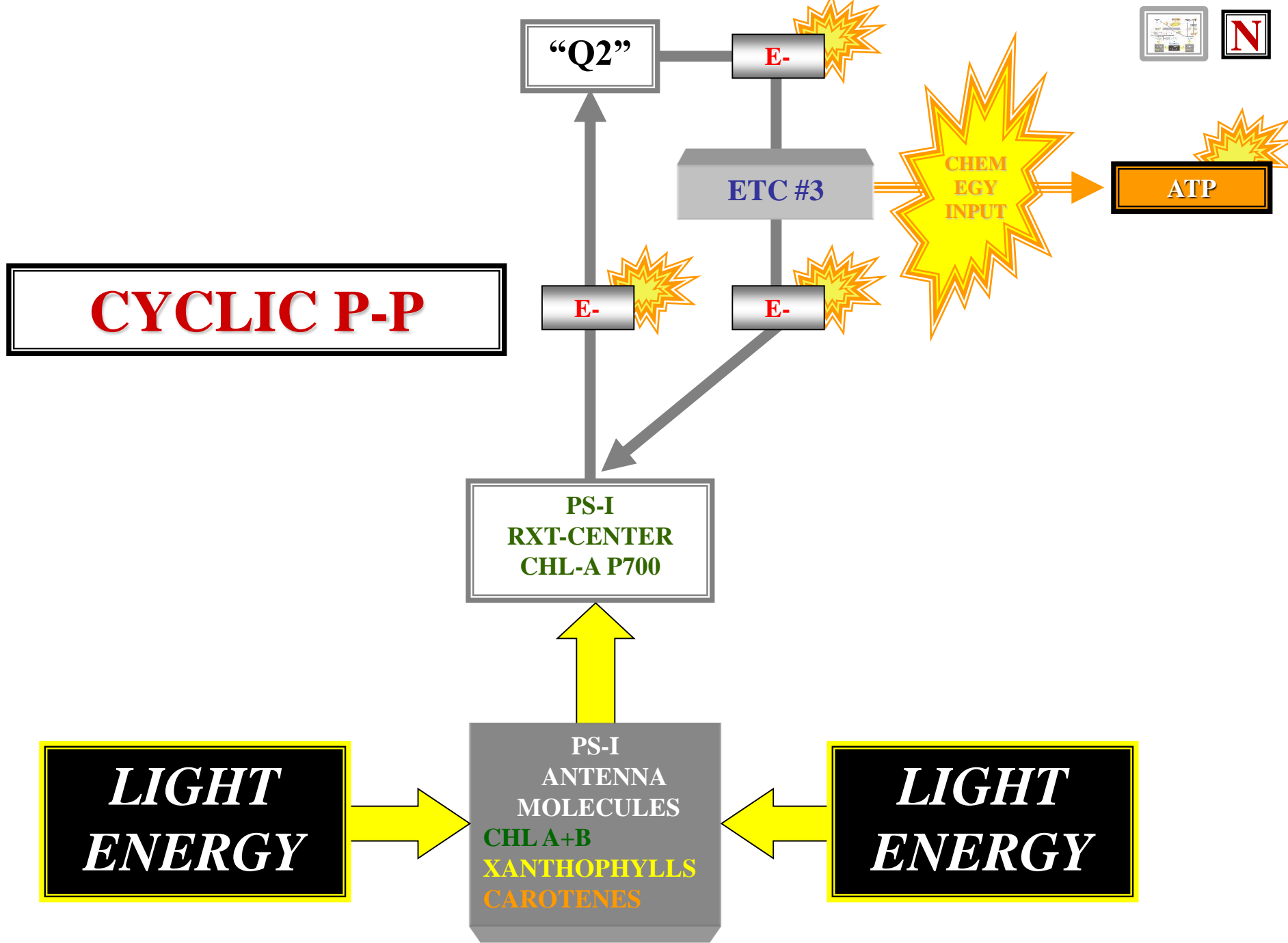
**THYLAKOID SPACE**

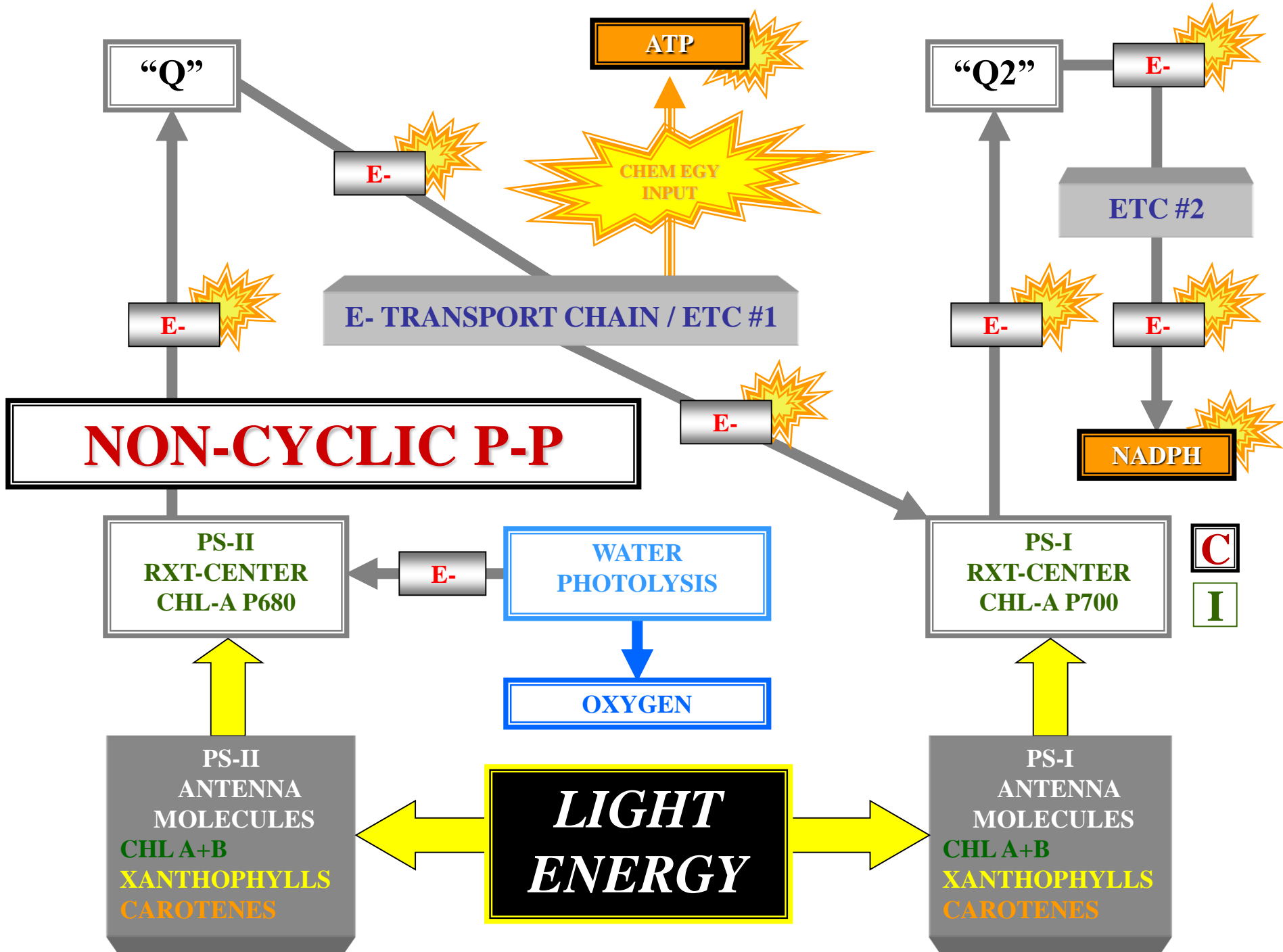
**THYLAKOID MEMBRANE**

**CP-P**

**CYCLIC P-P**







# CYCLIC P-P

**LIGHT ENERGY**

PS-I  
ANTENNA  
MOLECULES  
CHL A+B  
XANTHOPHYLLS  
CAROTENES

**LIGHT ENERGY**

PS-I  
RXT-CENTER  
CHL-A P700

“Q2”

E-

ETC #3

E-

E-

CHEM  
EGY  
INPUT

ATP

^

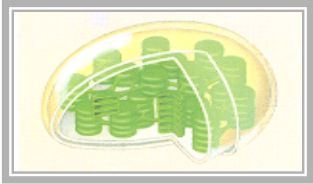


# PHOTOSYSTEM I

**CHLOROPLAST**

**PS-I**

**THYLAKOID**



**GRANUM**

**THYLAKOID VESICLE**

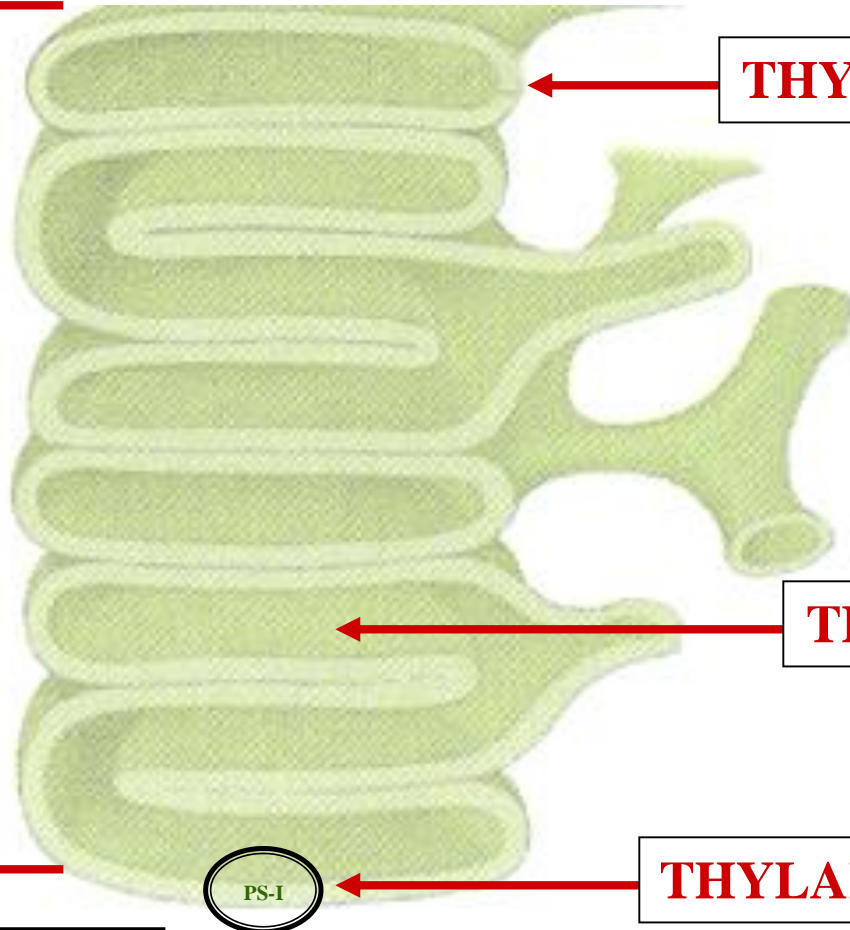
**STROMA**

**THYLAKOID SPACE**

**THYLAKOID MEMBRANE**

PS-I

**CYCLIC P-P**



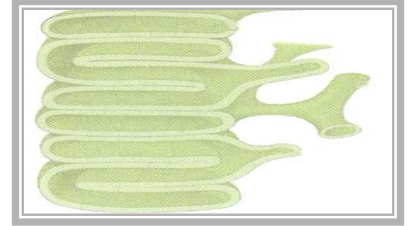
**CHLOROPLAST**

**PS-I**

**THYLAKOID**



**PIGMENT  
MOLECULES**



**A**

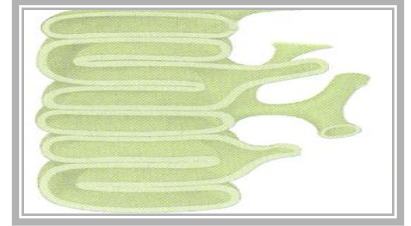
**CHLOROPLAST**

**PS-I**

**THYLAKOID**



**ANTENNA  
MOLECULES**



**A**

# **ANTENNA MOLECULES**



**ANTENNA MOLECULES**

**ABSORB LIGHT ENERGY**



**ANTENNA MOLECULES**

**ANTENNA MOLECULES**

AM



**ABSORB LIGHT ENERGY**



**REACTION CENTER**

**ANTENNA MOLECULES**

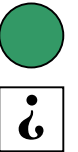
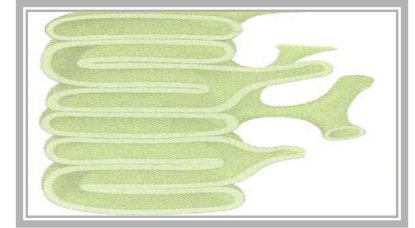
**CHLOROPLAST**

**PS-I**

**THYLAKOID**



**ANTENNA  
MOLECULES**



**ANTENNA MOLECULES**  
**=**  
**PRIMARY & SECONDARY**  
**PHOTOSYNTHETIC**  
**PIGMENTS**

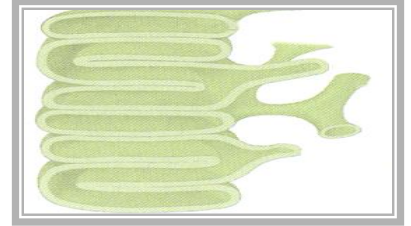
**CHLOROPLAST**

**PS-I**

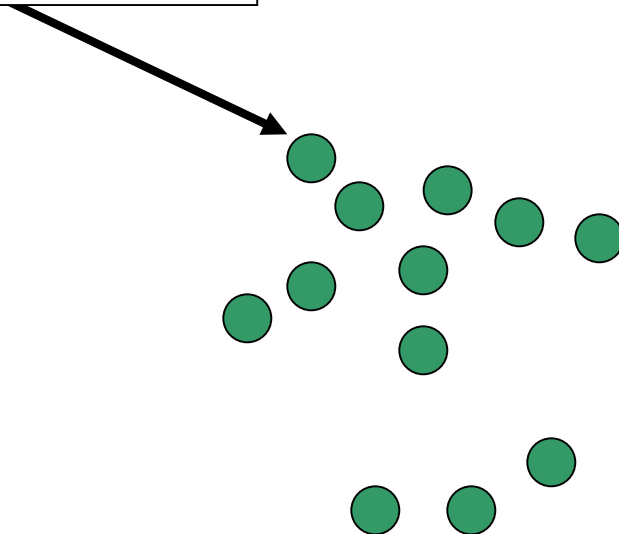
**THYLAKOID**



**ANTENNA  
MOLECULES**



**CHLOROPHYLLA**



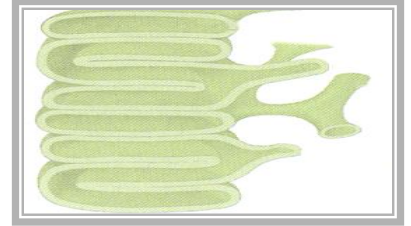
**CHLOROPLAST**

**PS-I**

**THYLAKOID**

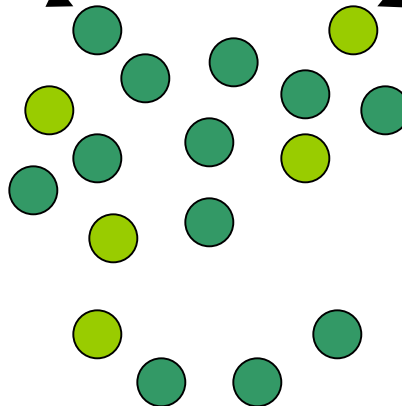


**ANTENNA  
MOLECULES**



**CHLOROPHYLL A**

**CHLOROPHYLL B**



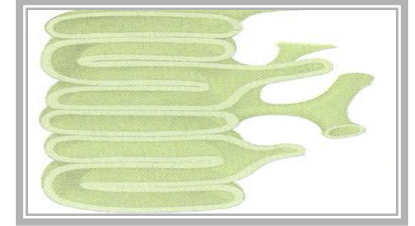
**CHLOROPLAST**

**PS-I**

**THYLAKOID**



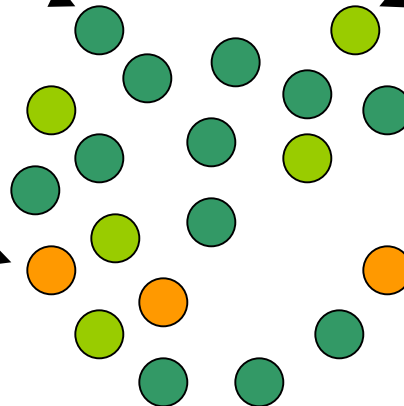
**ANTENNA  
MOLECULES**



**CHLOROPHYLL A**

**CHLOROPHYLL B**

**CAROTENES**



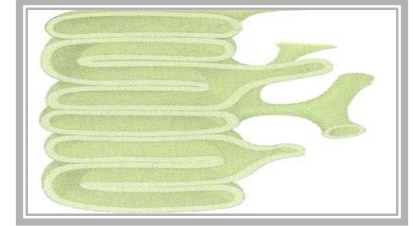
**CHLOROPLAST**

**PS-I**

**THYLAKOID**



**ANTENNA  
MOLECULES**

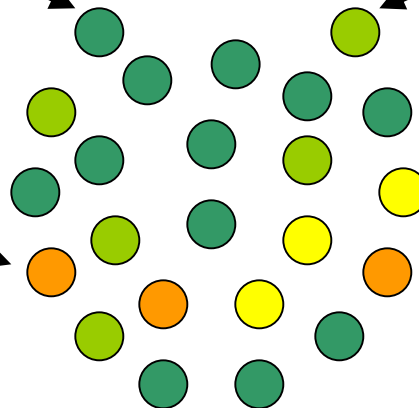


**CHLOROPHYLL A**

**CHLOROPHYLL B**

**CAROTENES**

**XANTHOPHYLLS**



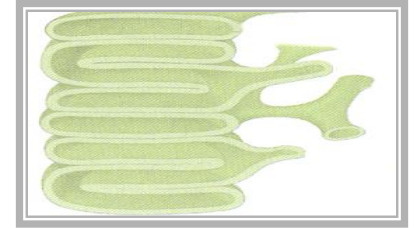
**CHLOROPLAST**

**PS-I**

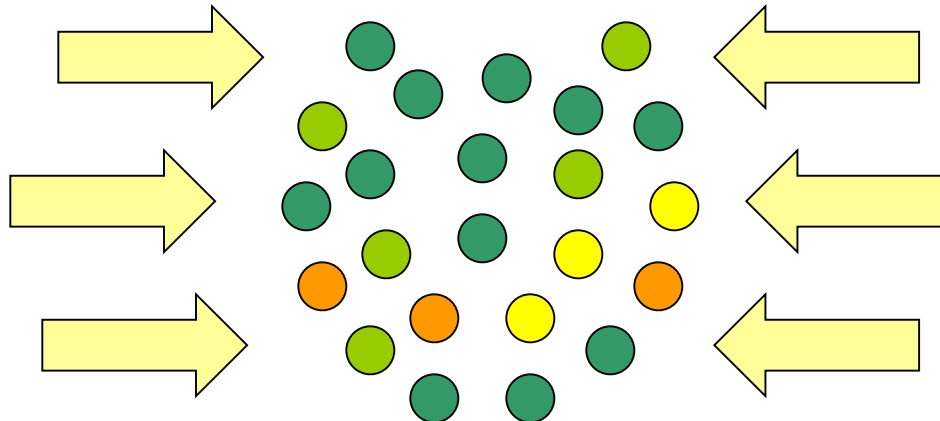
**THYLAKOID**



**ANTENNA  
MOLECULES**



**LTEGY**



**LTEGY**



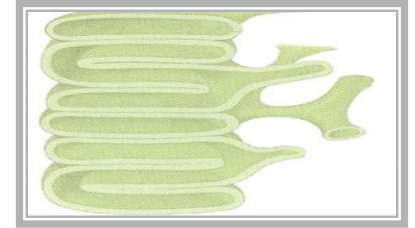
**CHLOROPLAST**

**PS-I**

**THYLAKOID**



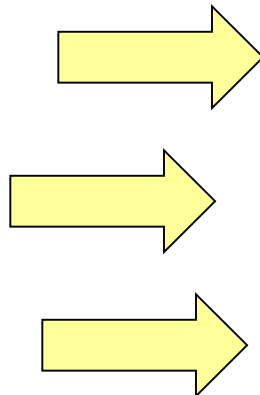
**ANTENNA  
MOLECULES**



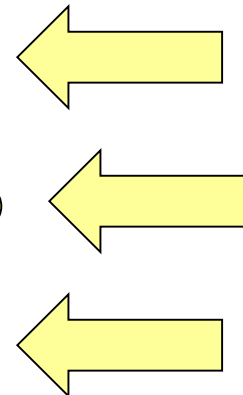
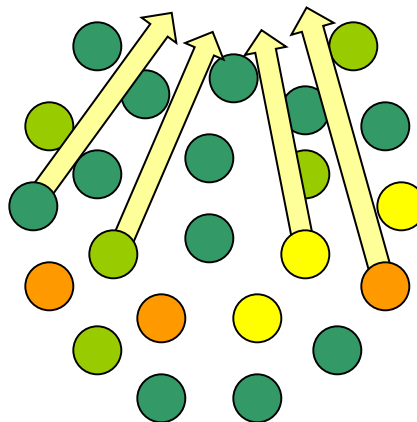
**RC**



**LTEGY**



**LTEGY**



**LTEGY**

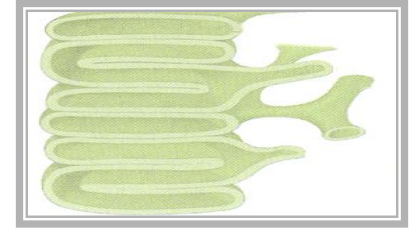
**CHLOROPLAST**

**PS-I**

**THYLAKOID**



**ANTENNA  
MOLECULES**

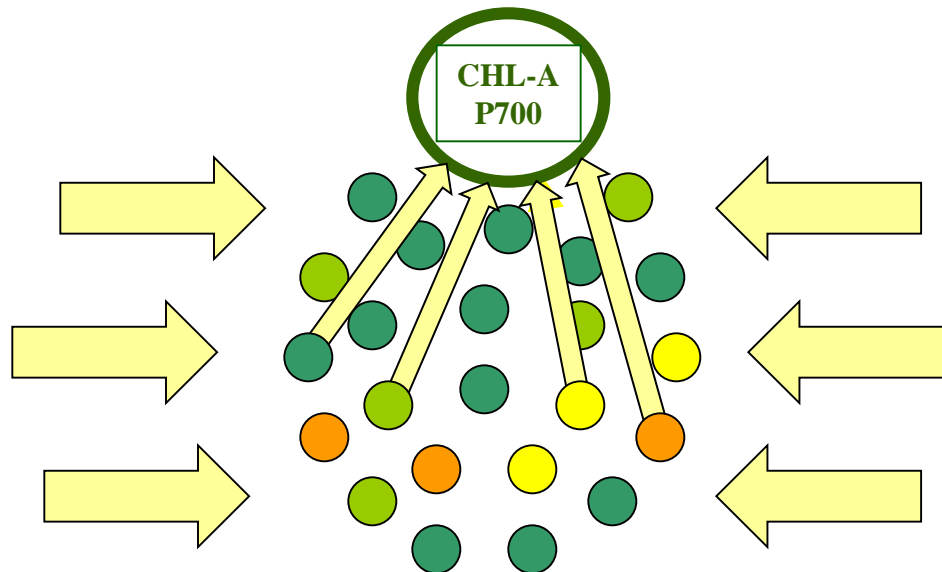


**R**

**REACTION CENTER**



**LTEGY**



**LTEGY**

**REACTION  
CENTER  
PS-I**



# REACTION CENTER PS-I

CHL A/PROTEIN COMPLEX

PIGMENT 700

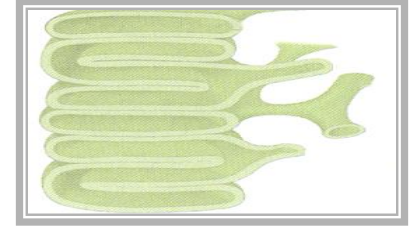
P700

REACTION CENTER PS-I

**CHLOROPLAST**

**PS-I**

**THYLAKOID**



**E-**



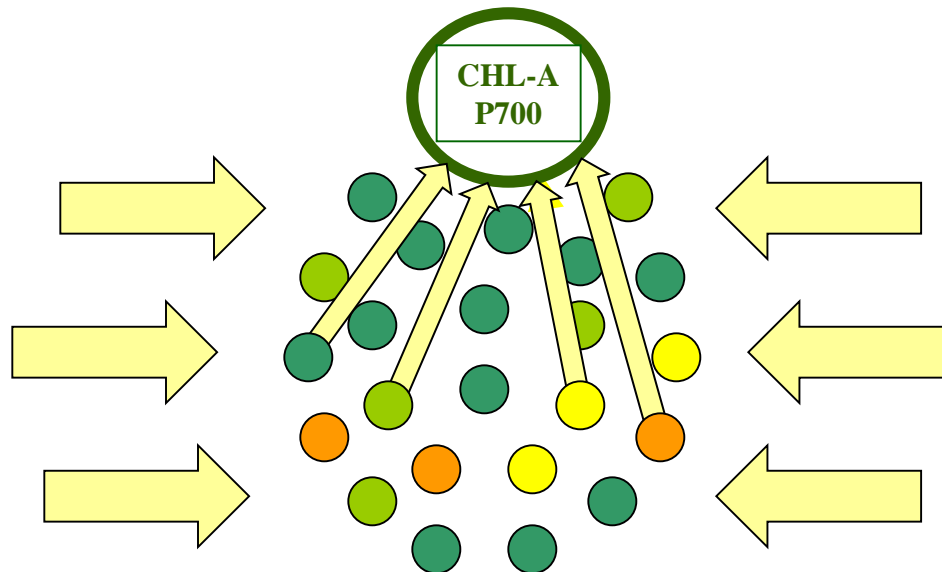
**REACTION CENTER: ABSORBS SUFFICIENT LIGHT ENERGY**

**REACTION CENTER**



**LTEGY**

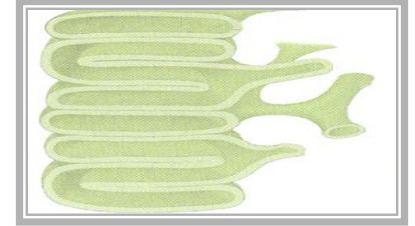
**LTEGY**



**CHLOROPLAST**

**PS-I**

**THYLAKOID**



**ENERGIZED E-**

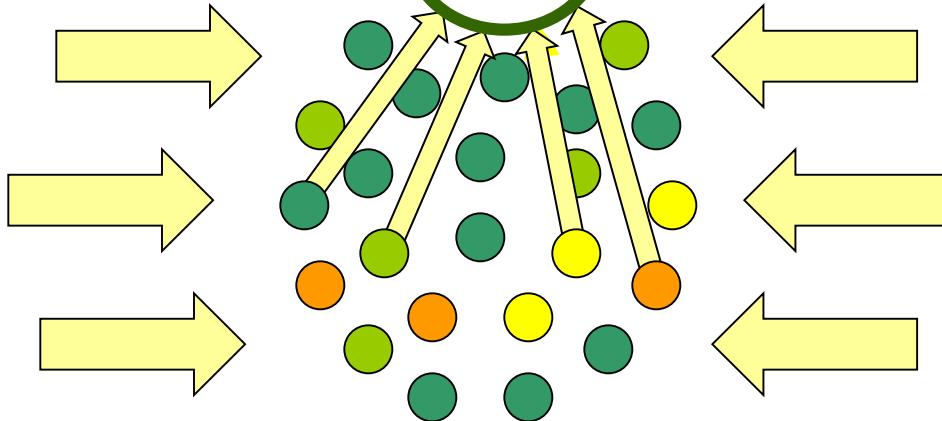
**AC**  
**Q2**

**CHL-A  
P700**



**LTEGY**

**LTEGY**



# CHLOROPLAST

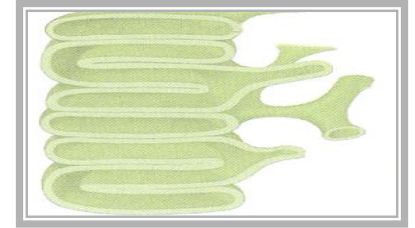


E- ACCEPTOR "Q2"

E-

LTEGY

# THYLAKOID



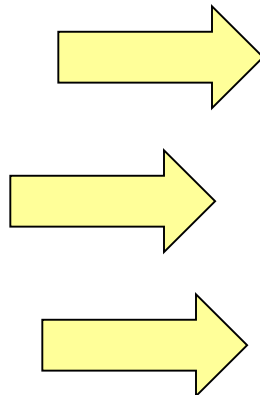
E- ACCEPTOR "Q2": ACCEPTS ENERGIZED E-

C

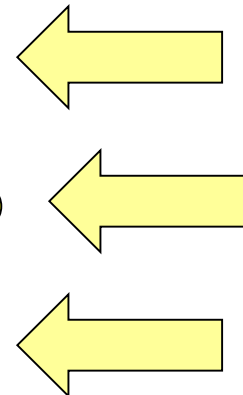
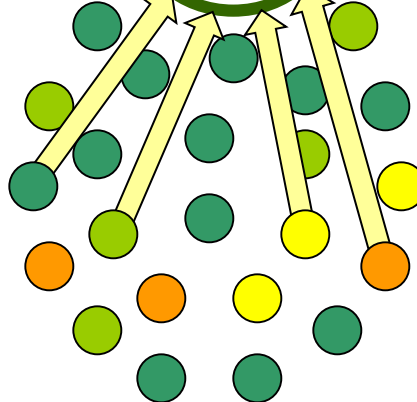
 = ENERGY



LTEGY



CHL-A  
P700



LTEGY



# CHLOROPLAST

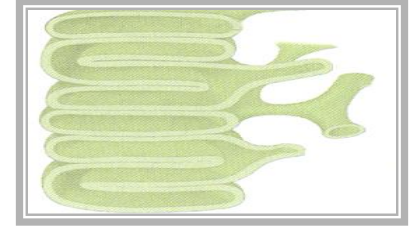


E- ACCEPTOR "Q2"



CHEM EGY

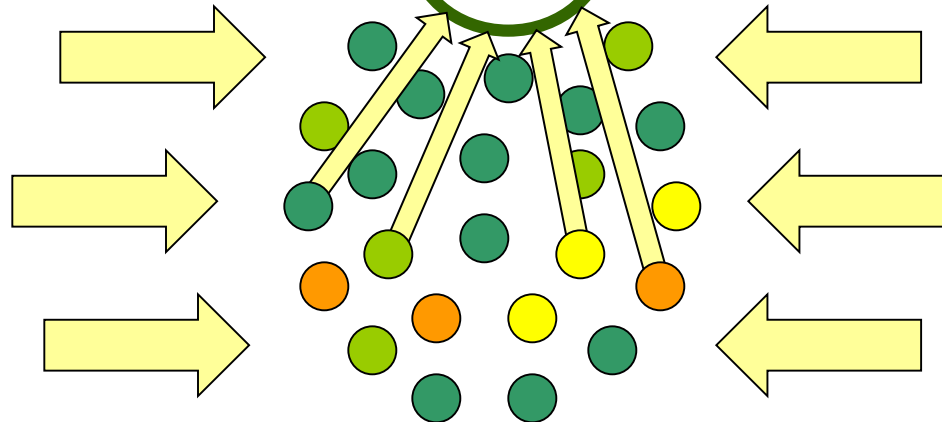
# THYLAKOID



E- ACCEPTOR "Q2": ACCEPTS ENERGIZED E-



LTEGY



LTEGY



# P700

# REDOX RXT

# CHLOROPLAST

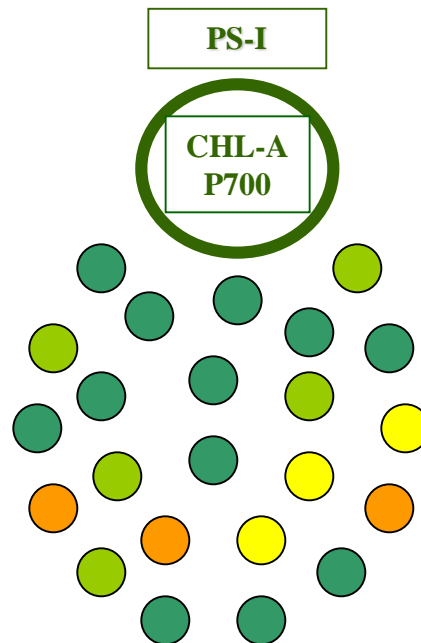
E- ACCEPTOR "Q2"



CHEM EGY

# THYLAKOID

R



# CHLOROPLAST

E- ACCEPTOR "Q2"

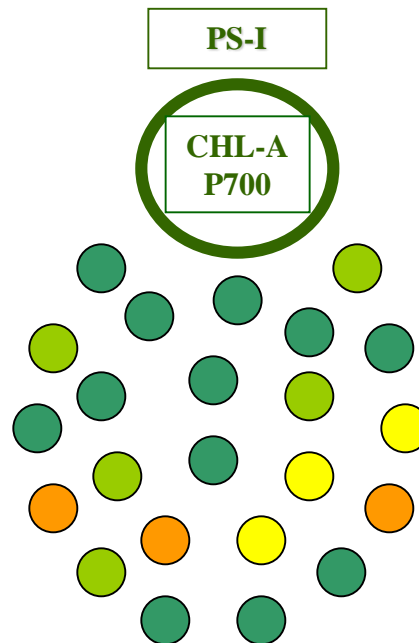


CHEM EGY

# THYLAKOID

"Q2" REDUCED

O



# CHLOROPLAST

E- ACCEPTOR "Q2"



CHEM EGY

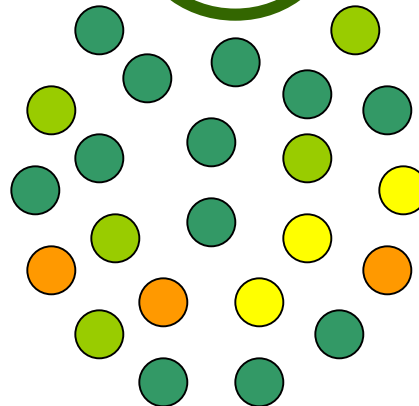
# THYLAKOID

"Q2" REDUCED

C

PS-I

CHL-A  
P700



P700 OXIDIZED

# CHLOROPLAST

E- ACCEPTOR "Q2"



CHEM EGY

# THYLAKOID

"Q2" REDUCED

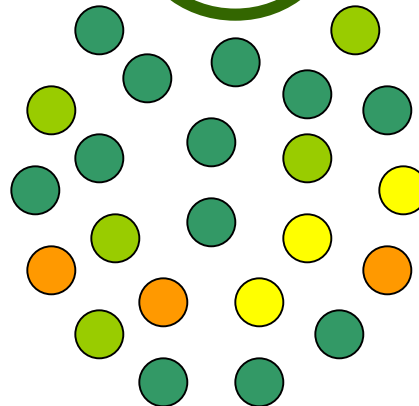


COUPLED

P700 OXIDIZED

PS-I

CHL-A  
P700



**CHLOROPLAST**

**E- ACCEPTOR "Q2"**



**CHEM EGY**

**THYLAKOID**

**ETC1**

?

**NON-CYCLIC P-P**

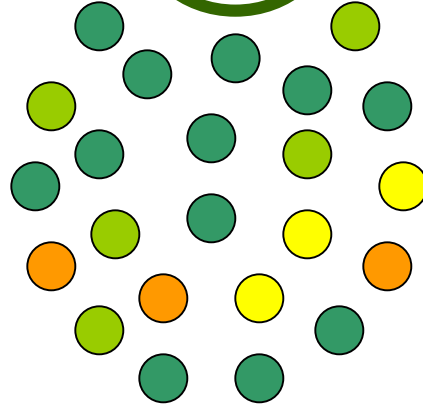
**E-**



**PS-I**

**CHL-A  
P700**

**P700 OXIDIZED**



**CHLOROPLAST**

**E- ACCEPTOR "Q2"**



**CHEM EGY**

**THYLAKOID**

**ETC1**

**+**

**E- TRANSPORT CHAIN #1**

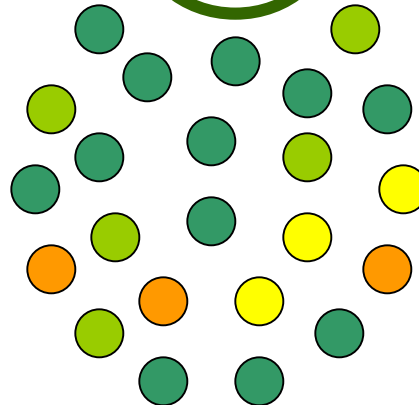
**NON-CYCLIC P-P**

**E-**

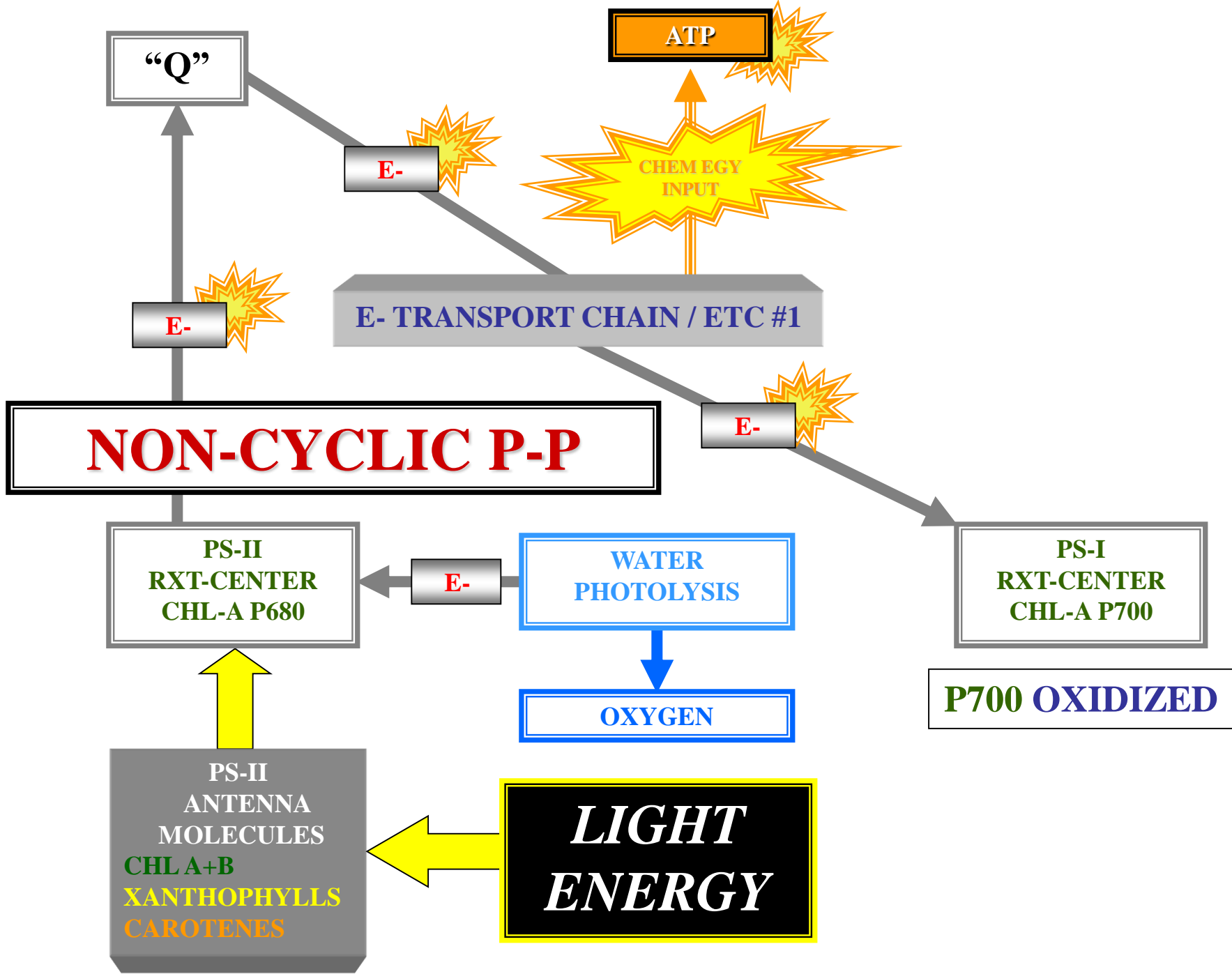
**PS-I**

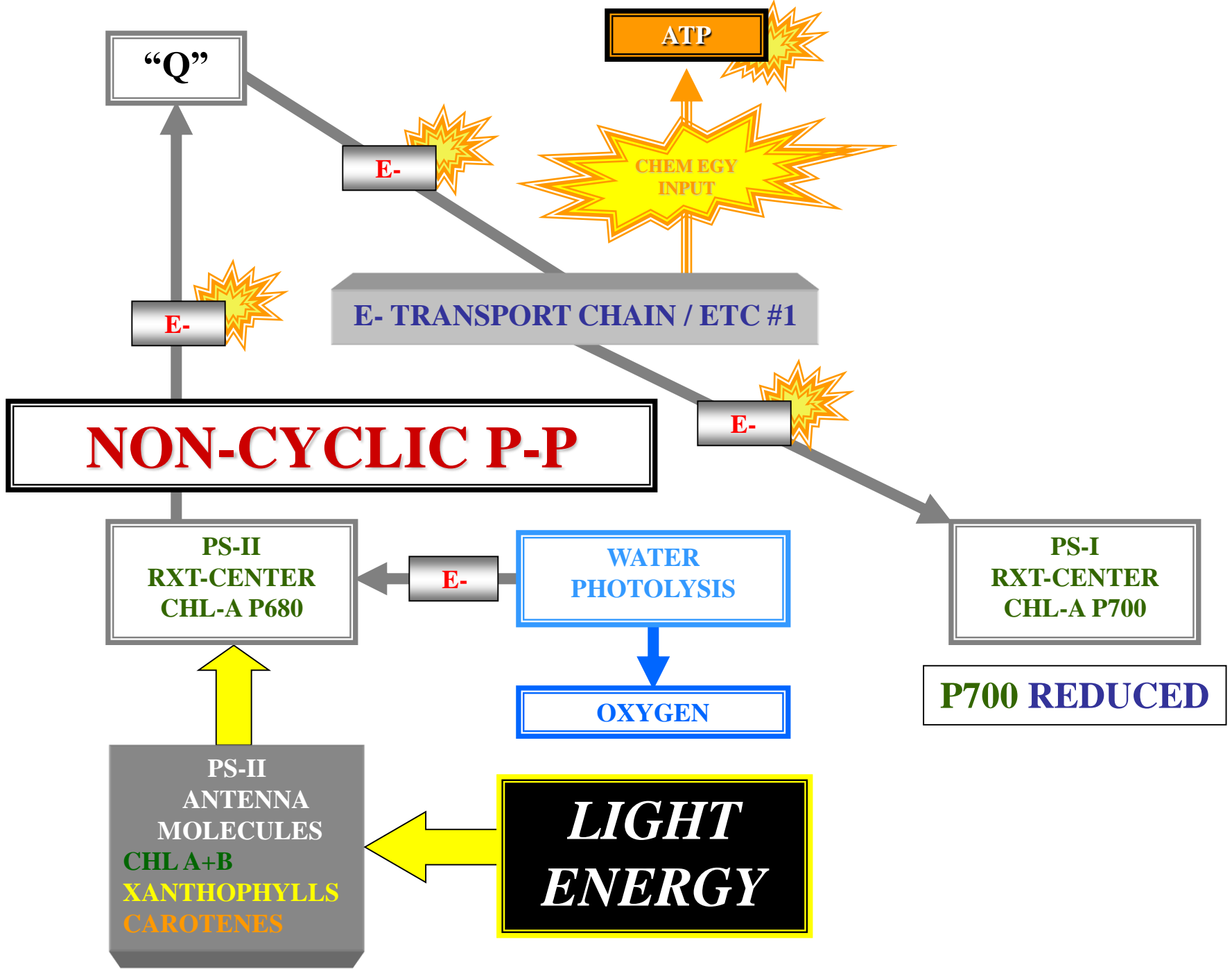
**CHL-A  
P700**

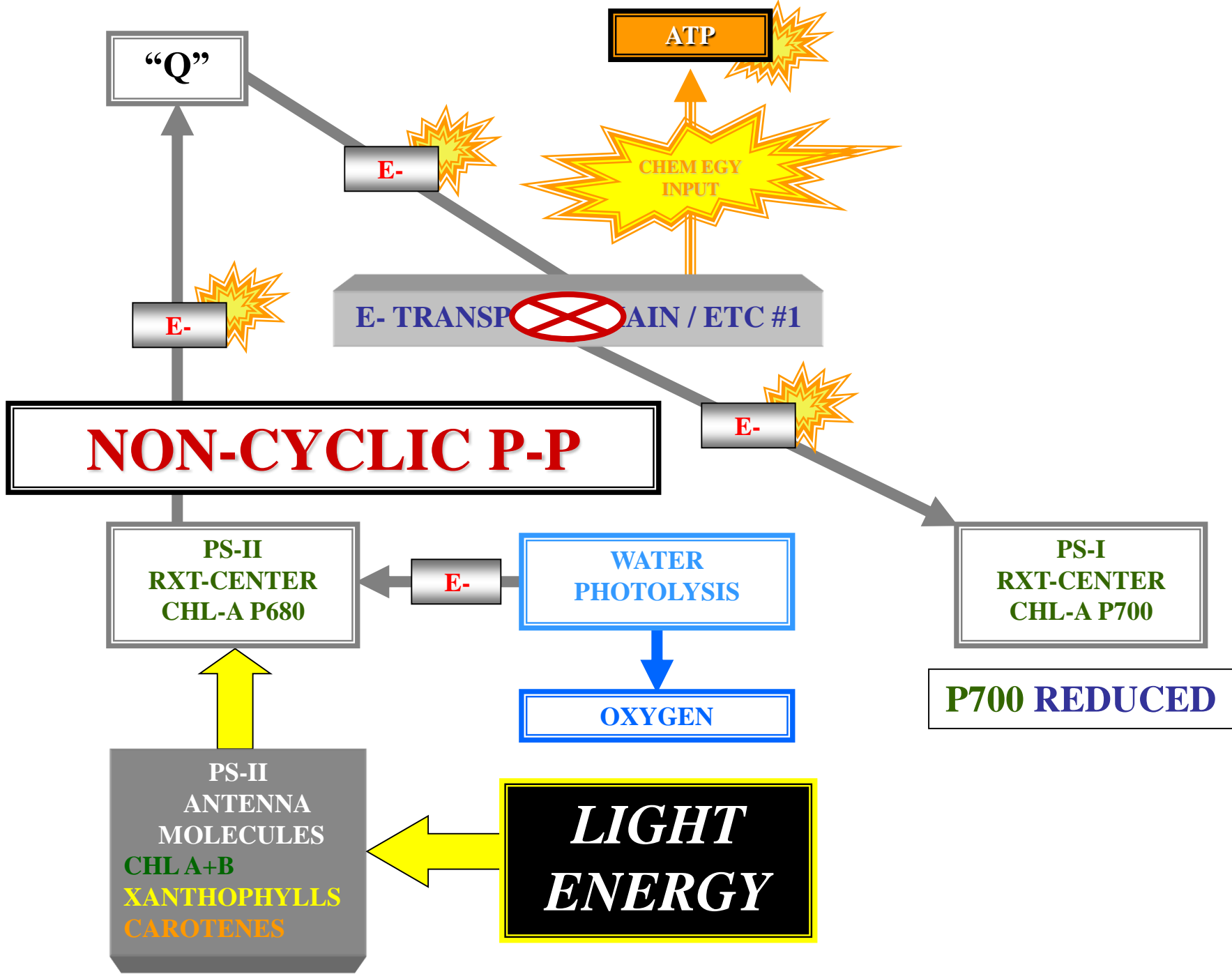
**P700 OXIDIZED**







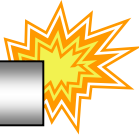




**CYCLIC P-P**

**“Q2”**

**E-**

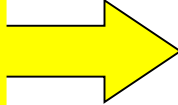


**ENERGIZED E-**

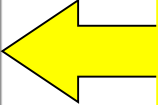
**PS-I  
RXT-CENTER  
CHL-A P700**

**P700 OXIDIZED**

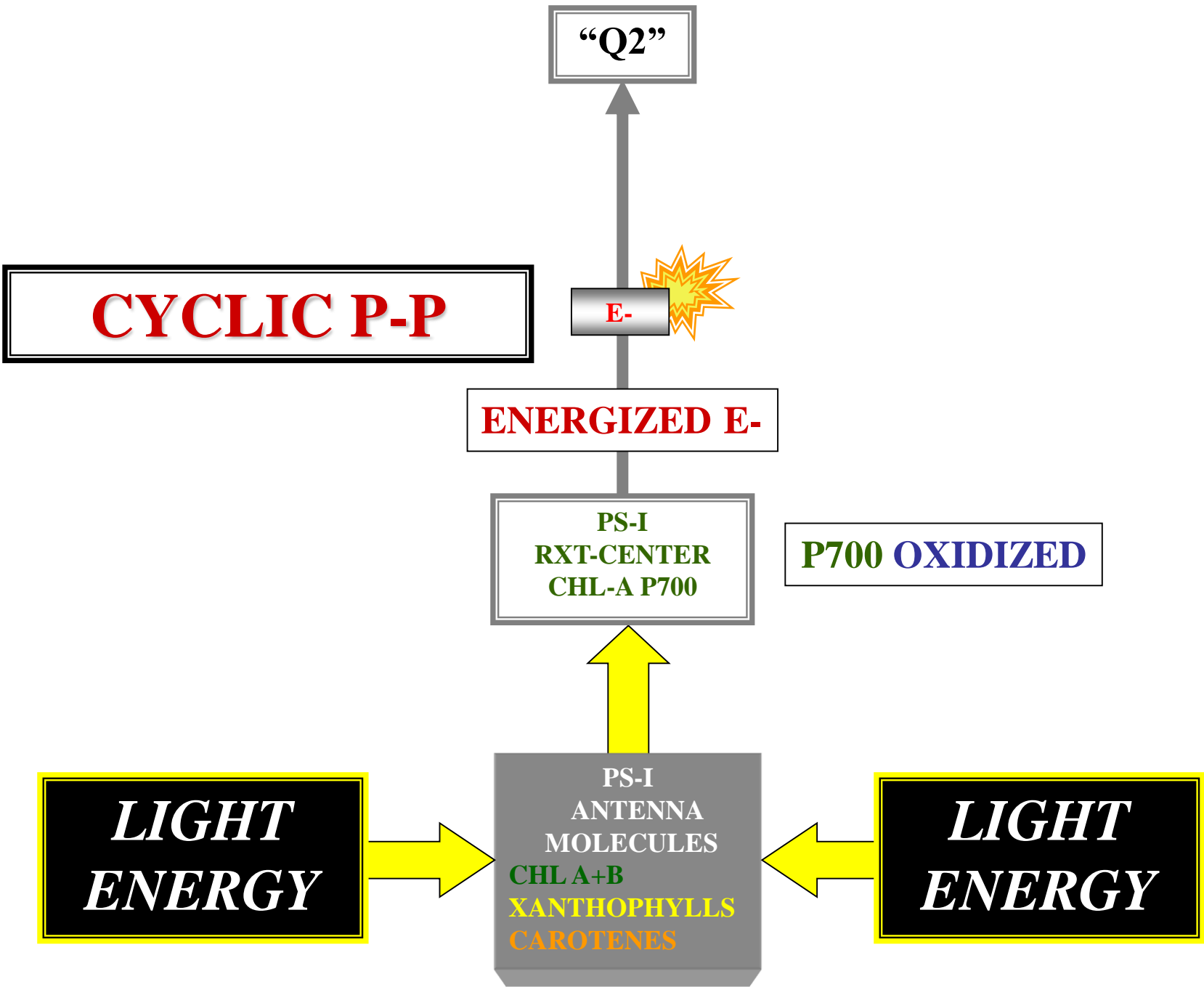
**LIGHT  
ENERGY**

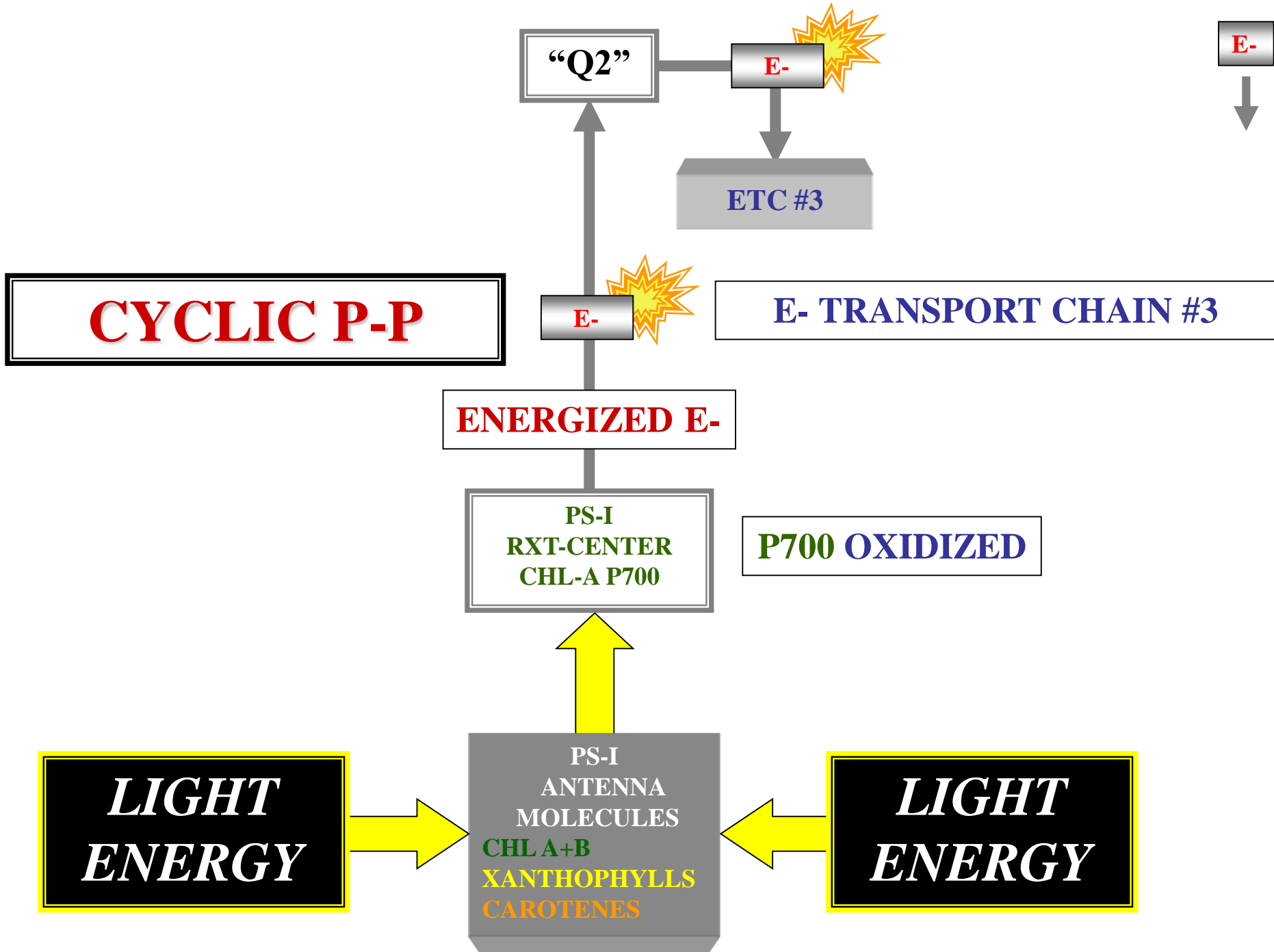


**PS-I  
ANTENNA  
MOLECULES  
CHL A+B  
XANTHOPHYLLS  
CAROTENES**



**LIGHT  
ENERGY**





**CYCLIC P-P**

**“Q2”**

**E-**

**ETC #3**

**E-**

**E-**

**E- TRANSPORT CHAIN #3**

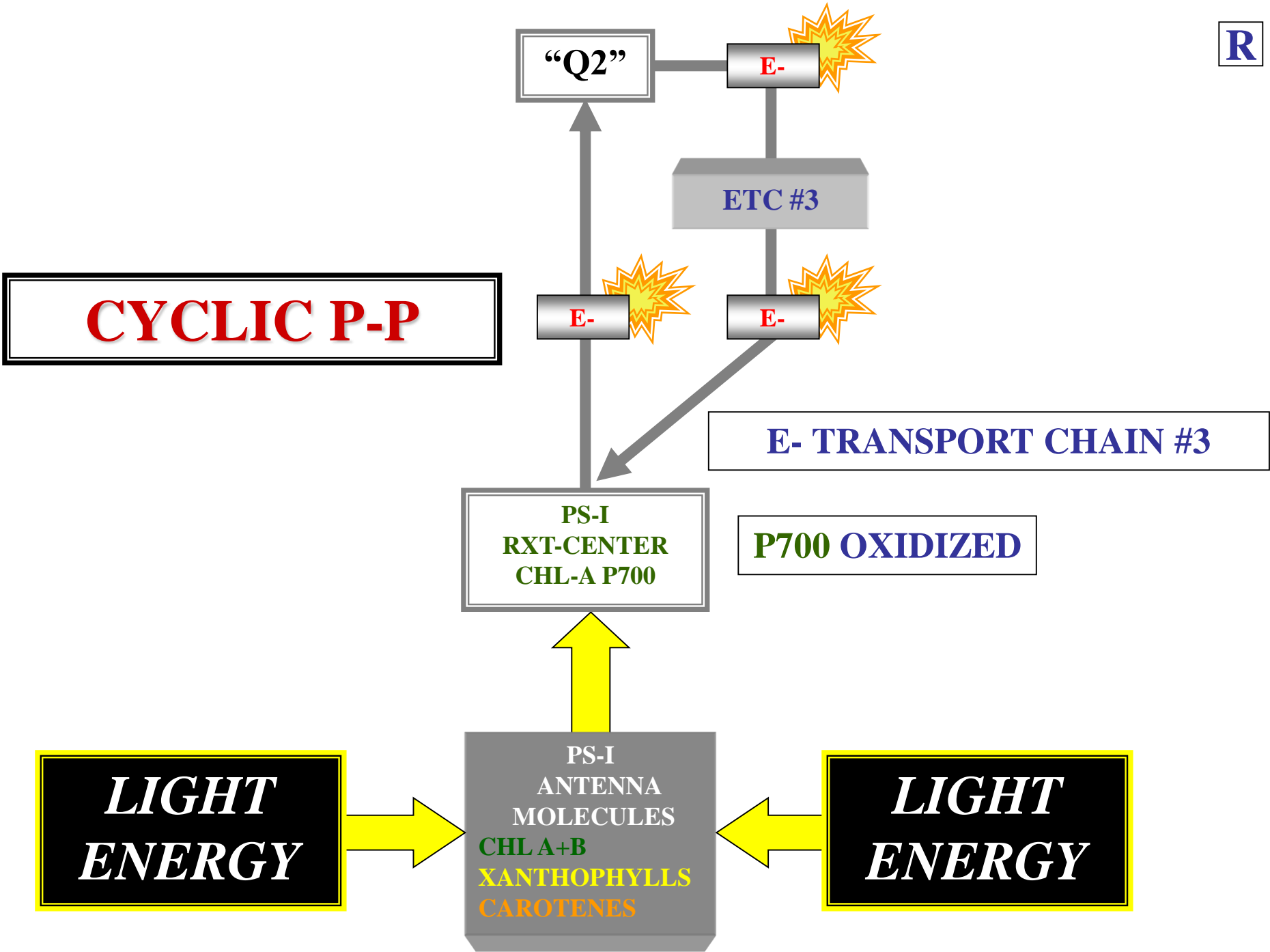
**PS-I  
RXT-CENTER  
CHL-A P700**

**P700 OXIDIZED**

**LIGHT  
ENERGY**

**PS-I  
ANTENNA  
MOLECULES  
CHL A+B  
XANTHOPHYLLS  
CAROTENES**

**LIGHT  
ENERGY**



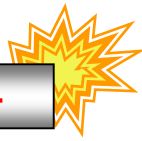
\$

C

**CYCLIC P-P**

“Q2”

E-

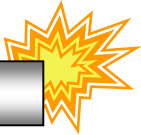


ETC #3

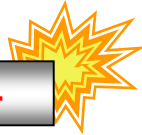


REMEMBER

E-



E-

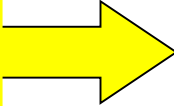


E- TRANSPORT CHAIN #3

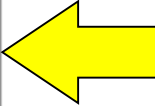
PS-I  
RXT-CENTER  
CHL-A P700

P700 REDUCED

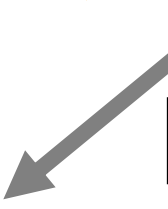
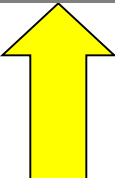
**LIGHT ENERGY**



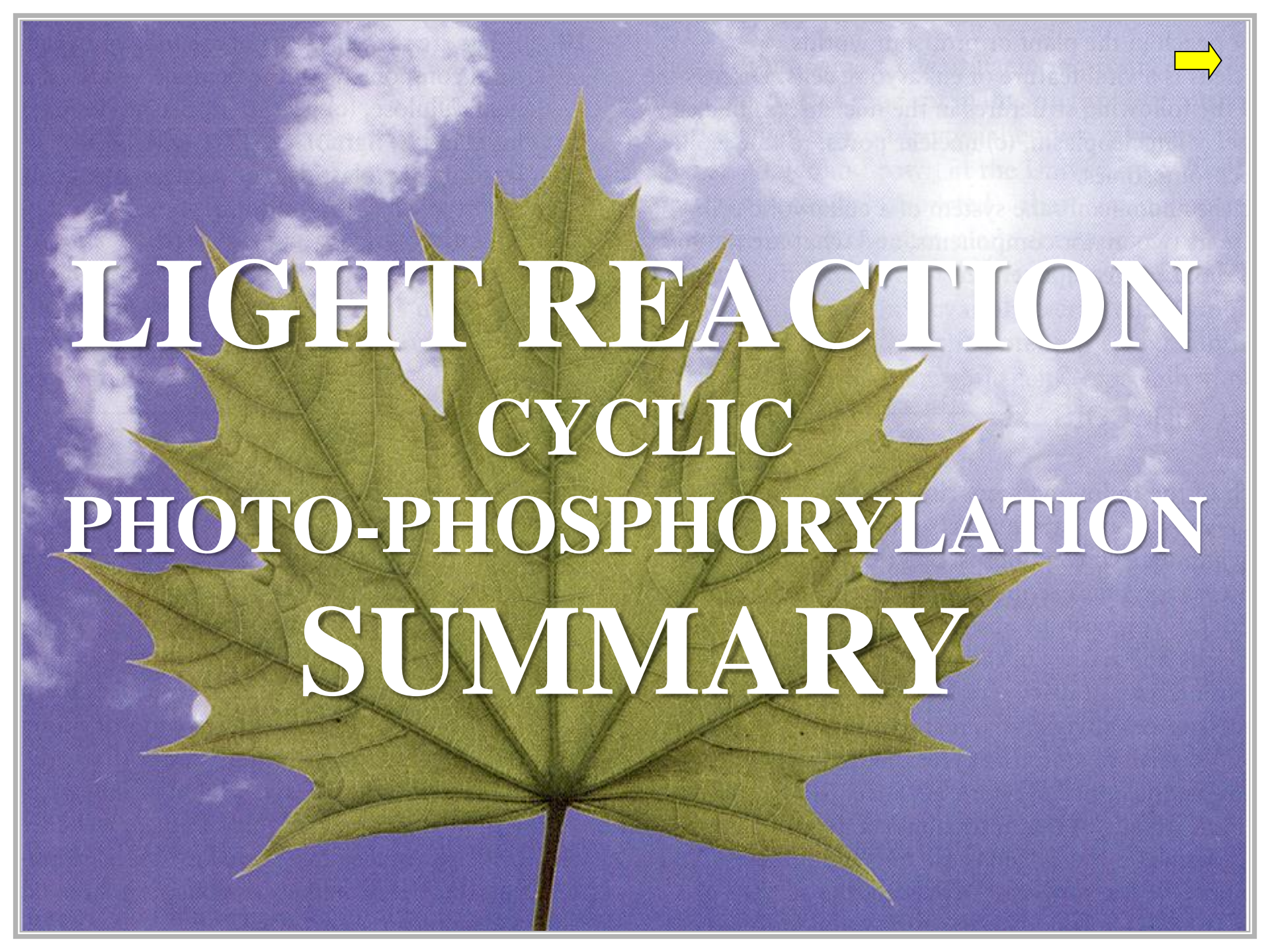
PS-I  
ANTENNA  
MOLECULES  
CHL A+B  
XANTHOPHYLLS  
CAROTENES



**LIGHT ENERGY**





A large green maple leaf is centered on a blue sky with white clouds. The text is overlaid on the leaf.

# LIGHT REACTION

## CYCLIC

### PHOTO-PHOSPHORYLATION

# SUMMARY





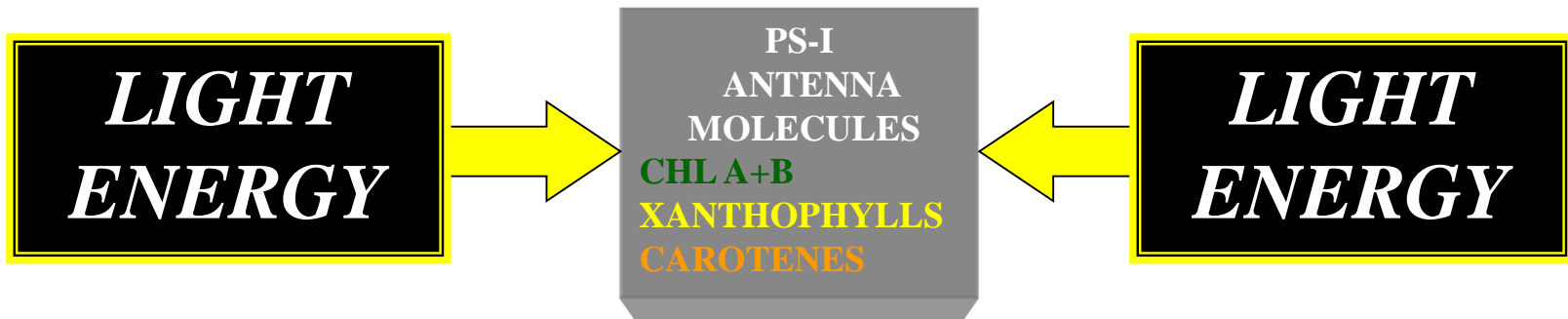
# CYCLIC P-P

*LIGHT  
ENERGY*

*LIGHT  
ENERGY*



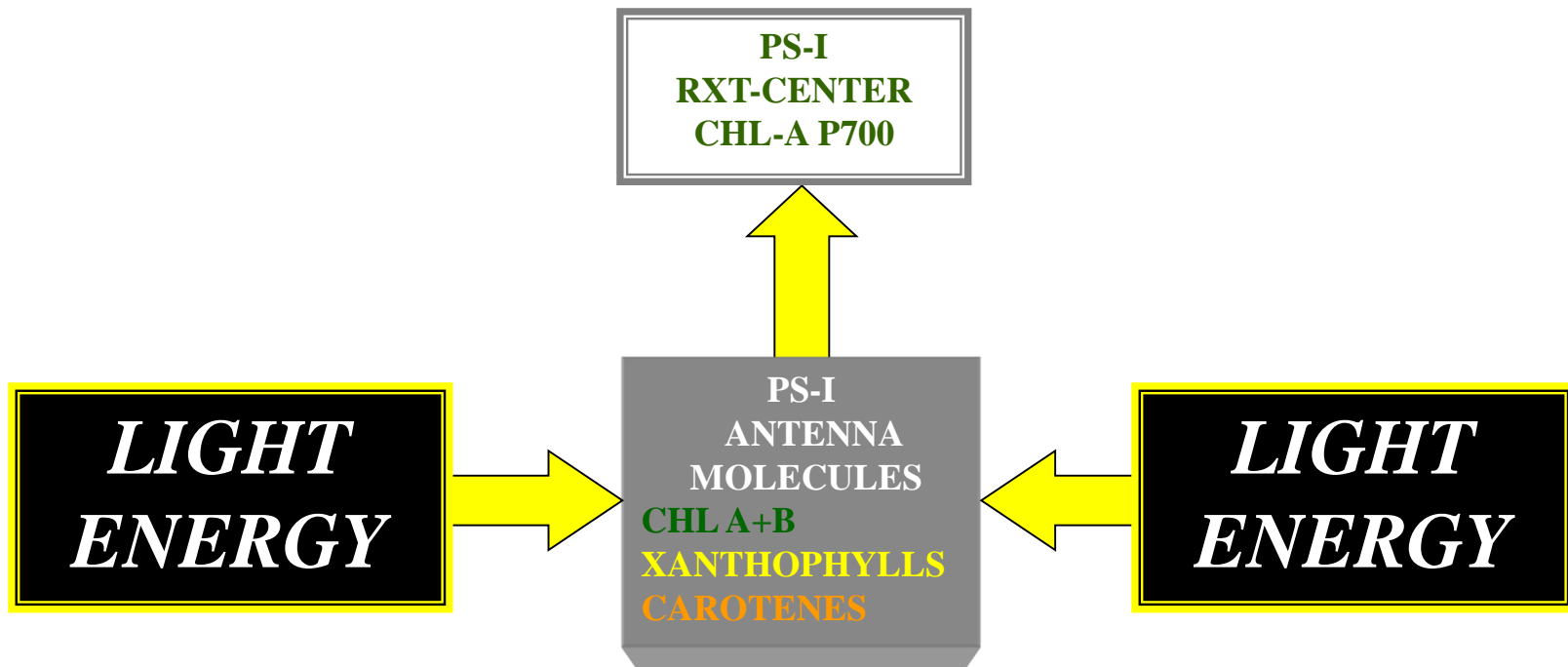
# CYCLIC P-P

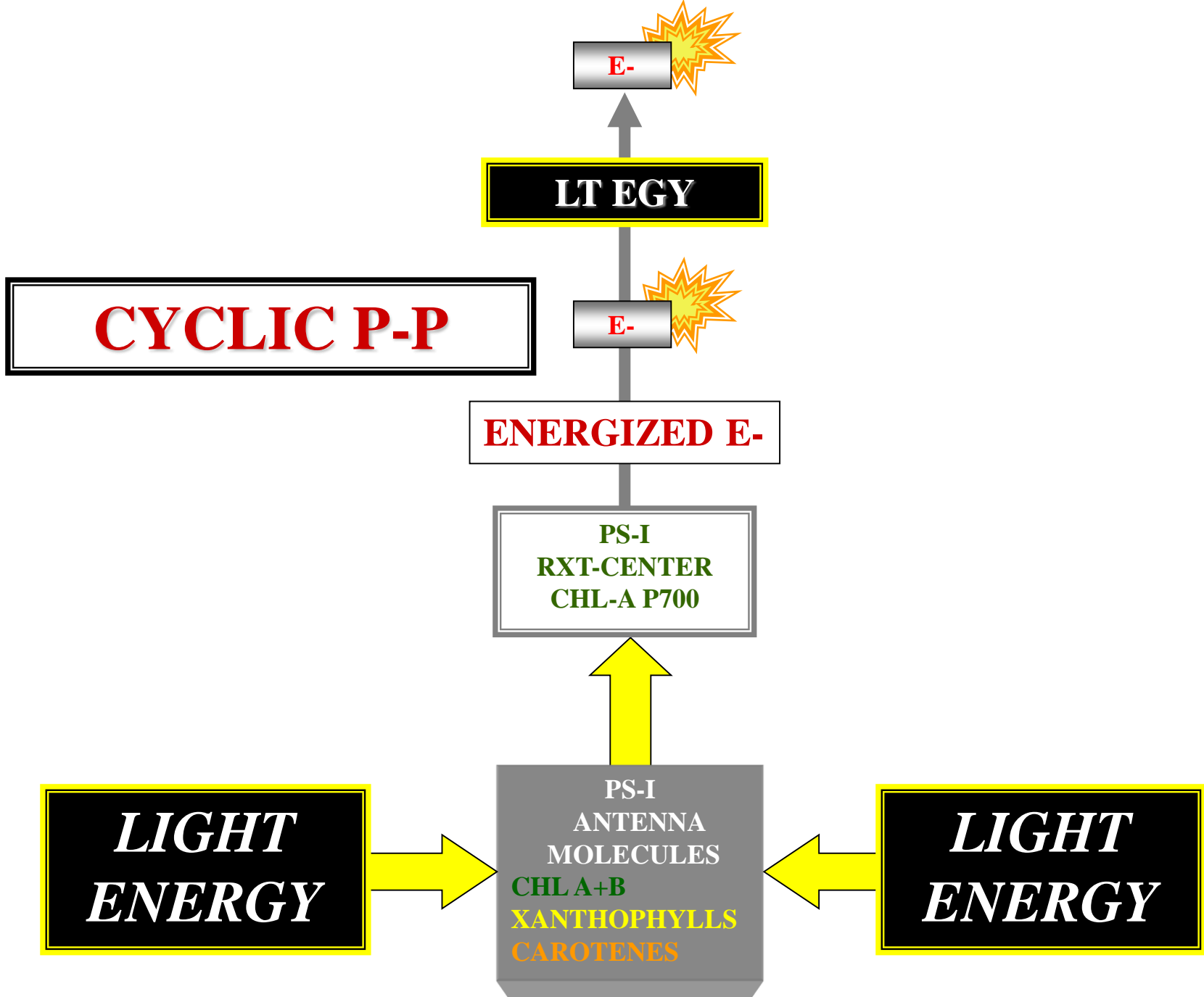


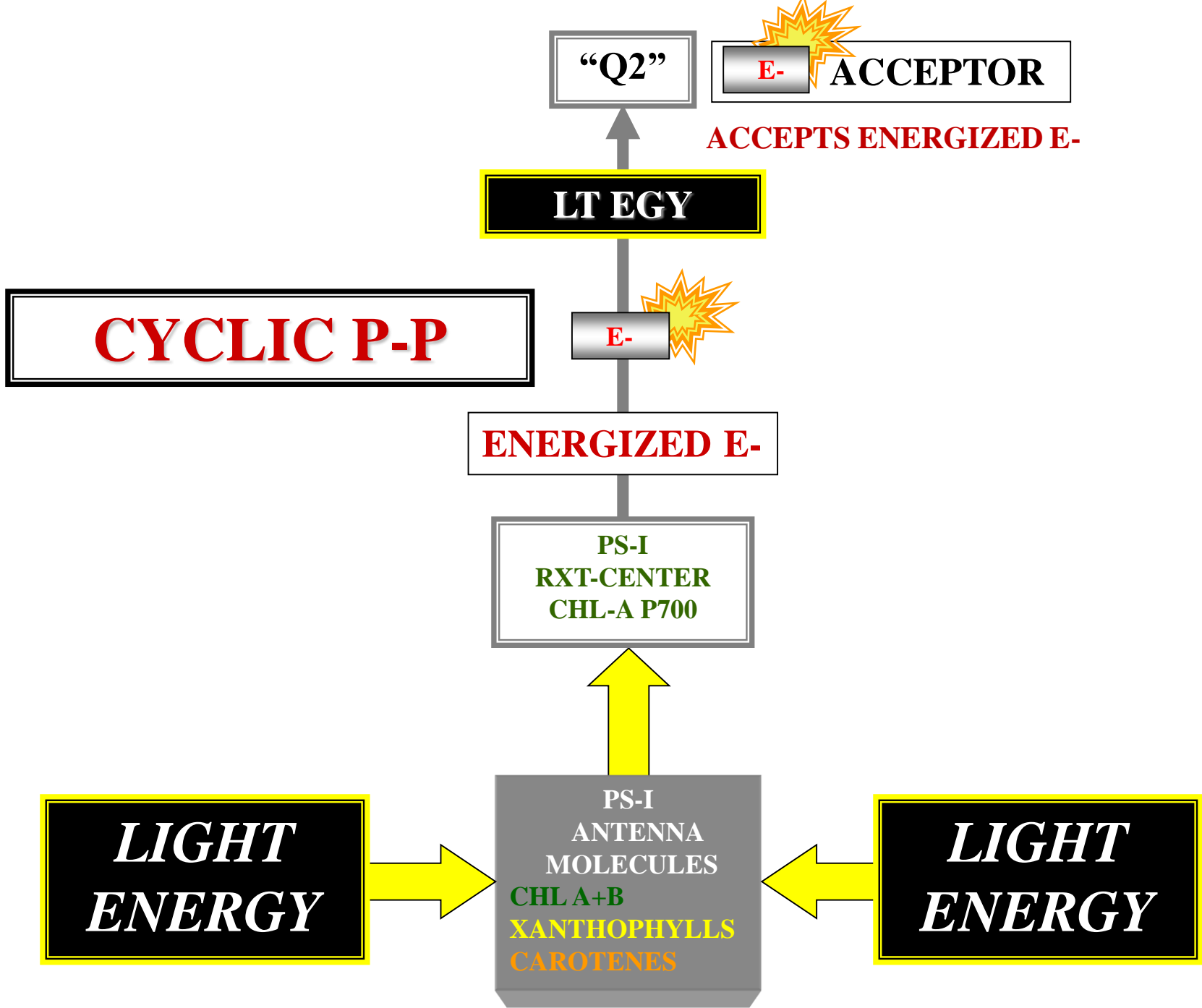


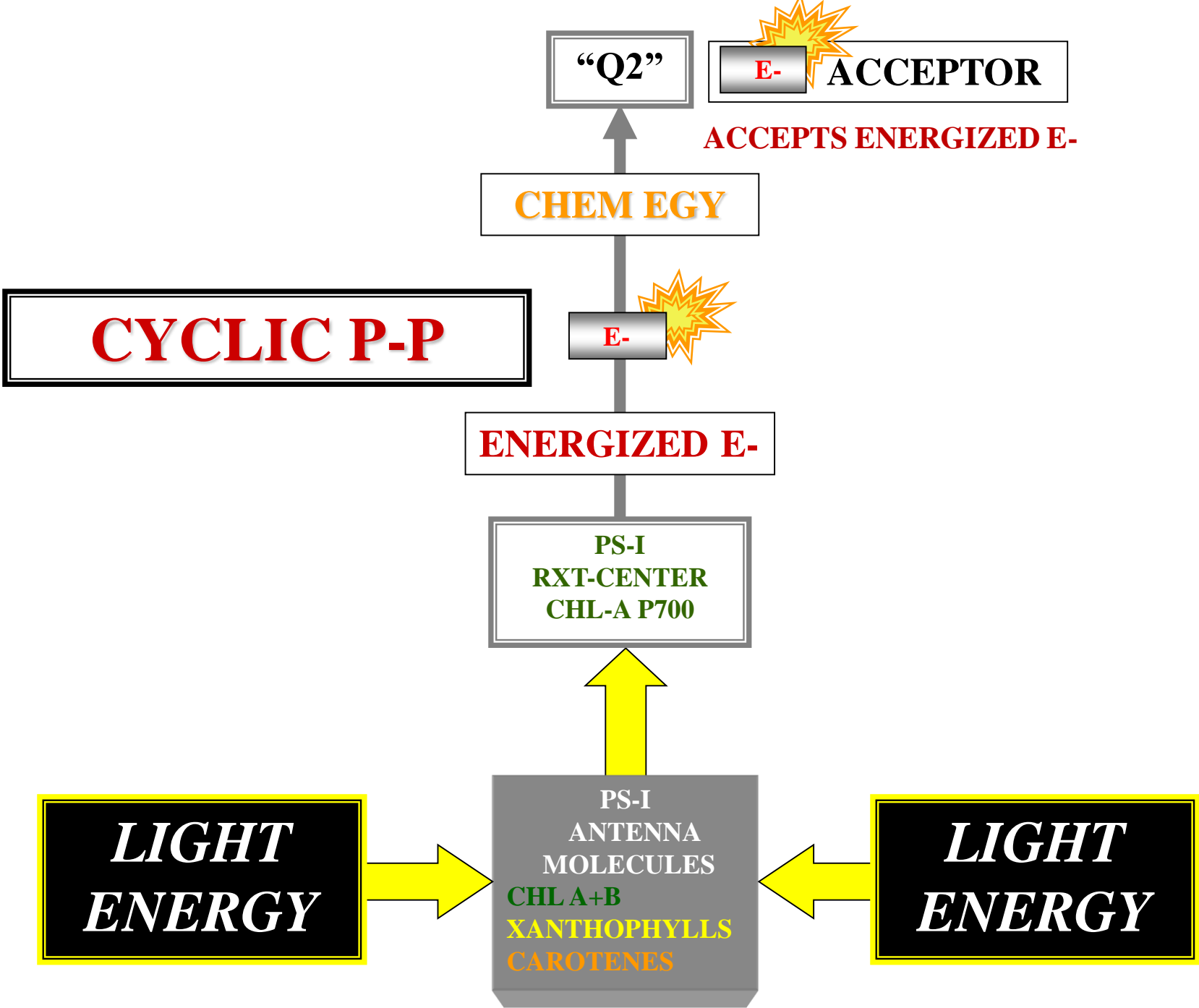
# CYCLIC P-P

REACTION CENTER: **ABSORBS SUFFICIENT LIGHT ENERGY**



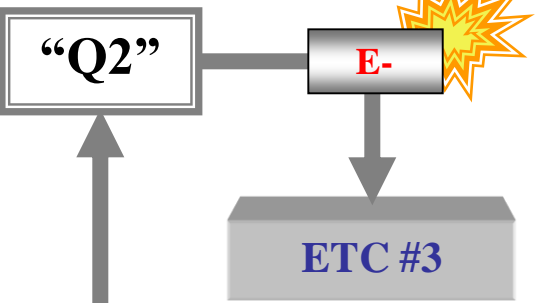








**CYCLIC P-P**



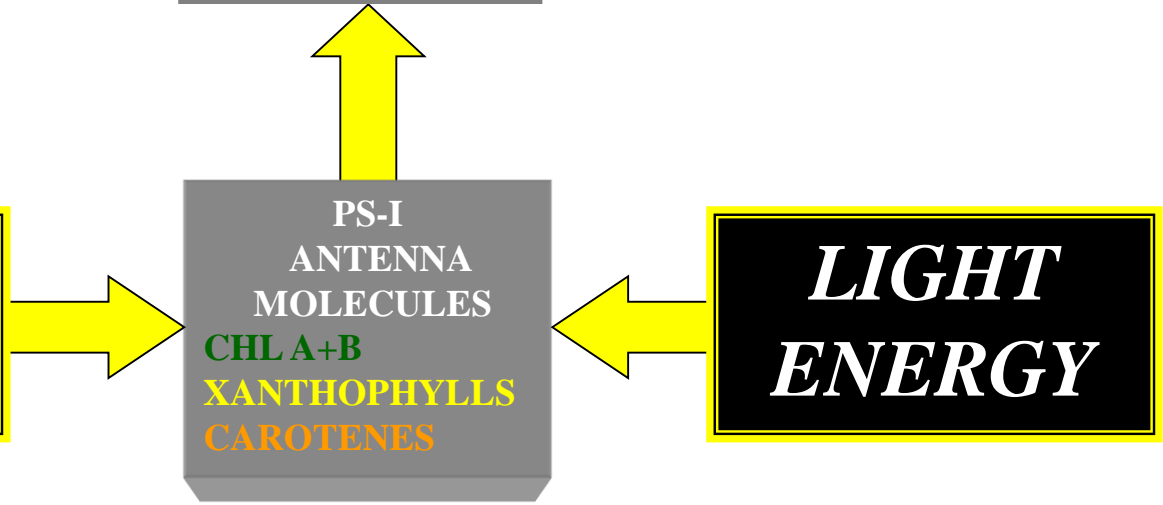
**ENERGIZED E-**

**PS-I  
RXT-CENTER  
CHL-A P700**

**LIGHT  
ENERGY**

**PS-I  
ANTENNA  
MOLECULES  
CHL A+B  
XANTHOPHYLLS  
CAROTENES**

**LIGHT  
ENERGY**



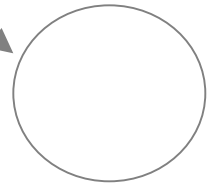
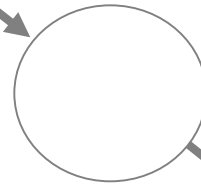
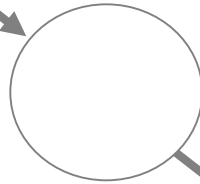
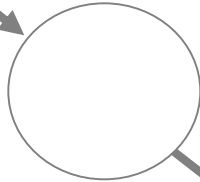
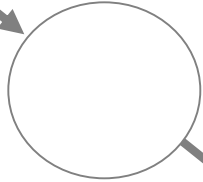
# ELECTRON TRANSPORT CHAIN #3



# ELECTRON TRANSPORT CHAIN #3



## THYLAKOID GRANUM



 = ELECTRON TRANSPORT CHAIN COMPONENT

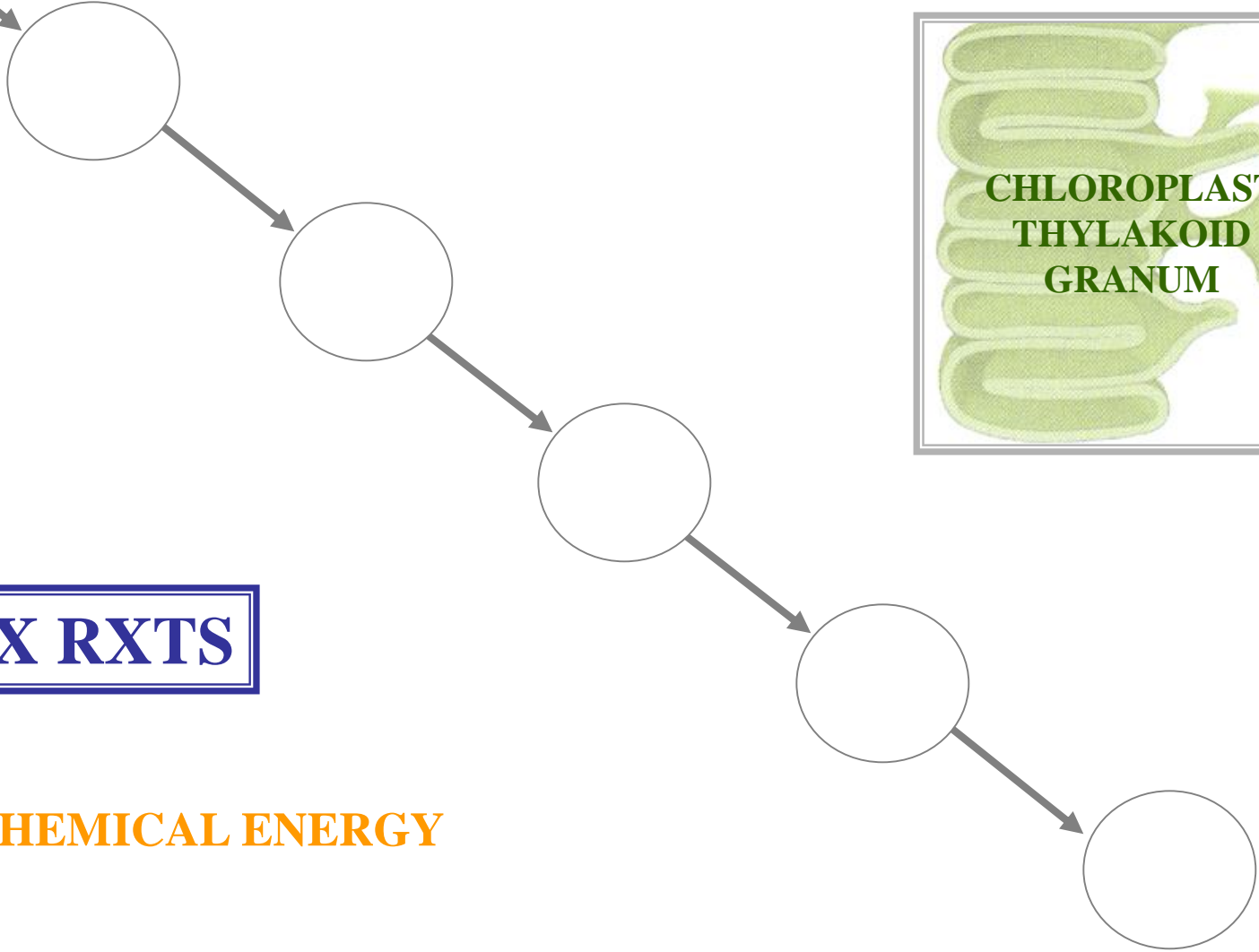
 = CHEMICAL ENERGY

 = DISSIPATED HEAT ENERGY

# ELECTRON TRANSPORT CHAIN #3



## THYLAKOID GRANUM



**REDOX RXTS**



= **CHEMICAL ENERGY**

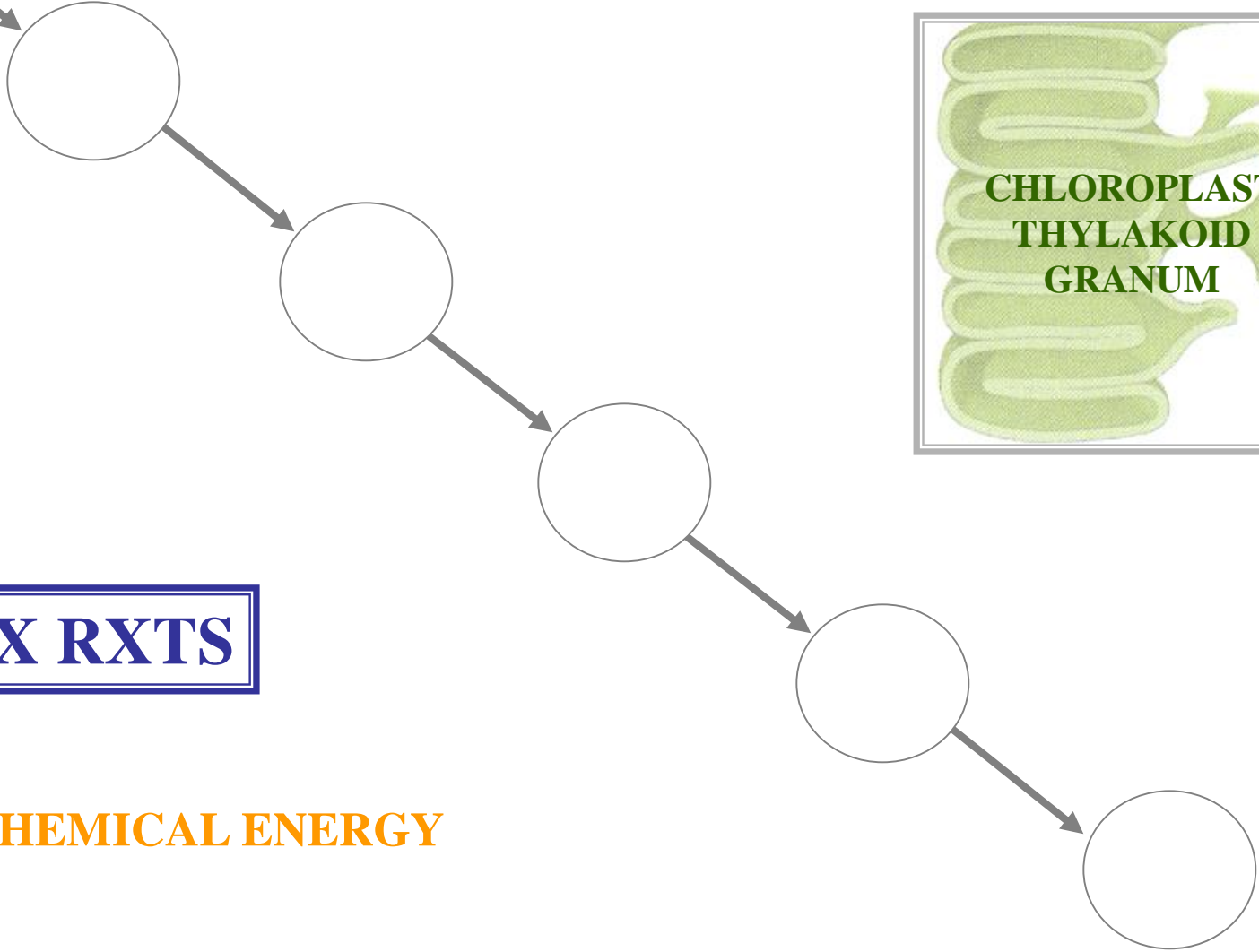


= **DISSIPATED HEAT ENERGY**

# ELECTRON TRANSPORT CHAIN #3

E-

## THYLAKOID GRANUM



**REDOX RXTS**

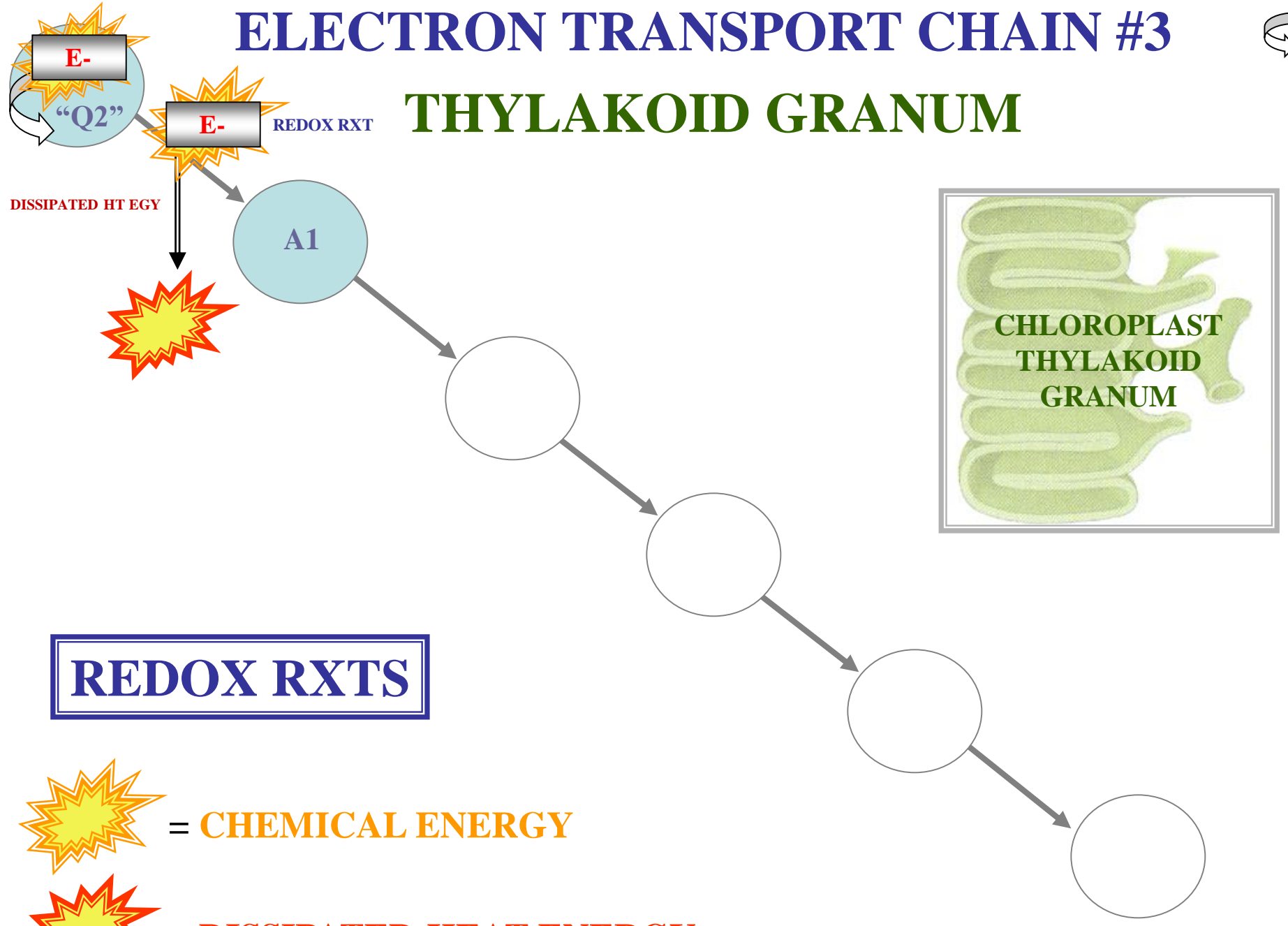
 = CHEMICAL ENERGY

 = DISSIPATED HEAT ENERGY

# ELECTRON TRANSPORT CHAIN #3



## THYLAKOID GRANUM



**REDOX RXTS**

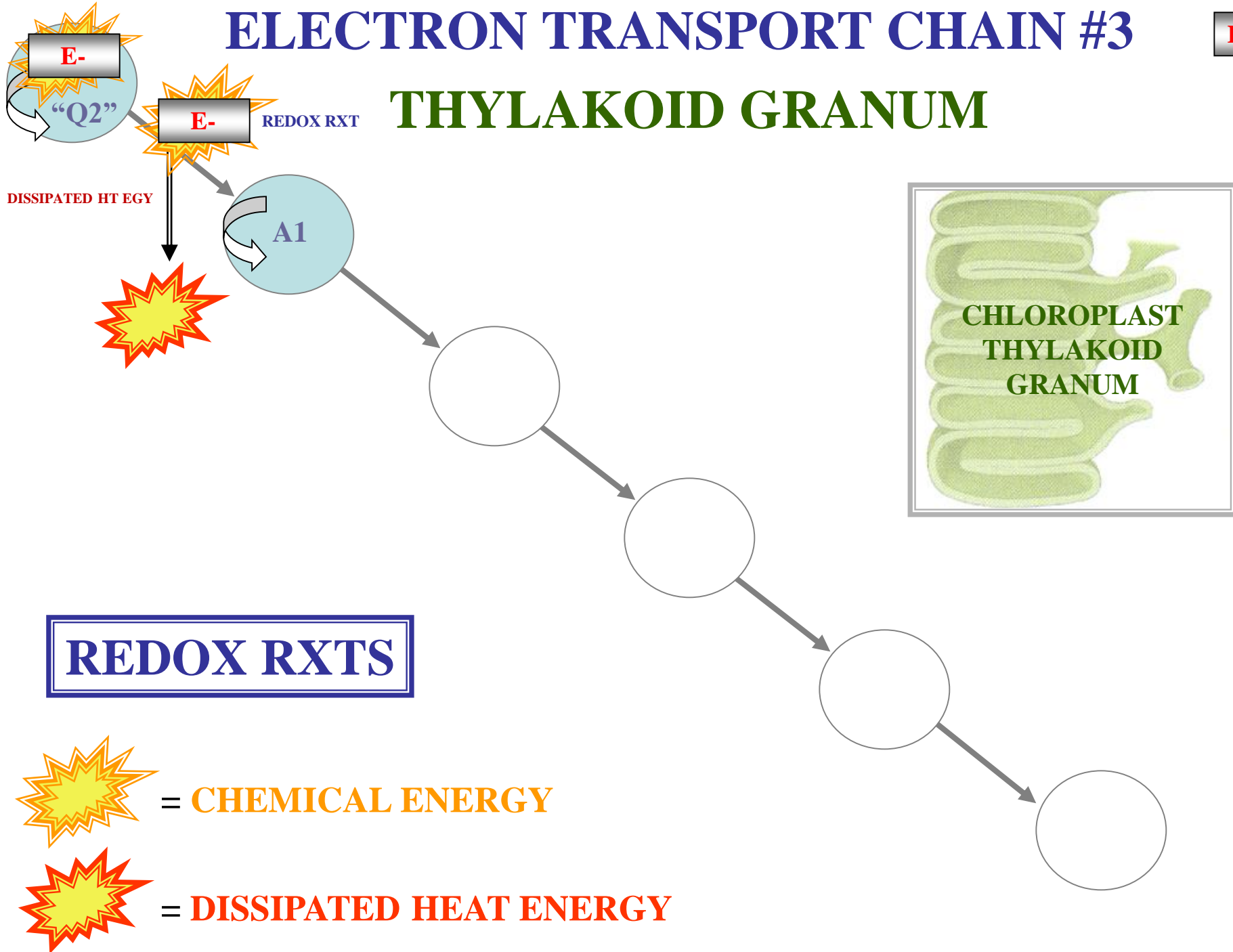
 = CHEMICAL ENERGY

 = DISSIPATED HEAT ENERGY

# ELECTRON TRANSPORT CHAIN #3

E-

## THYLAKOID GRANUM



**REDOX RXTS**

 = CHEMICAL ENERGY

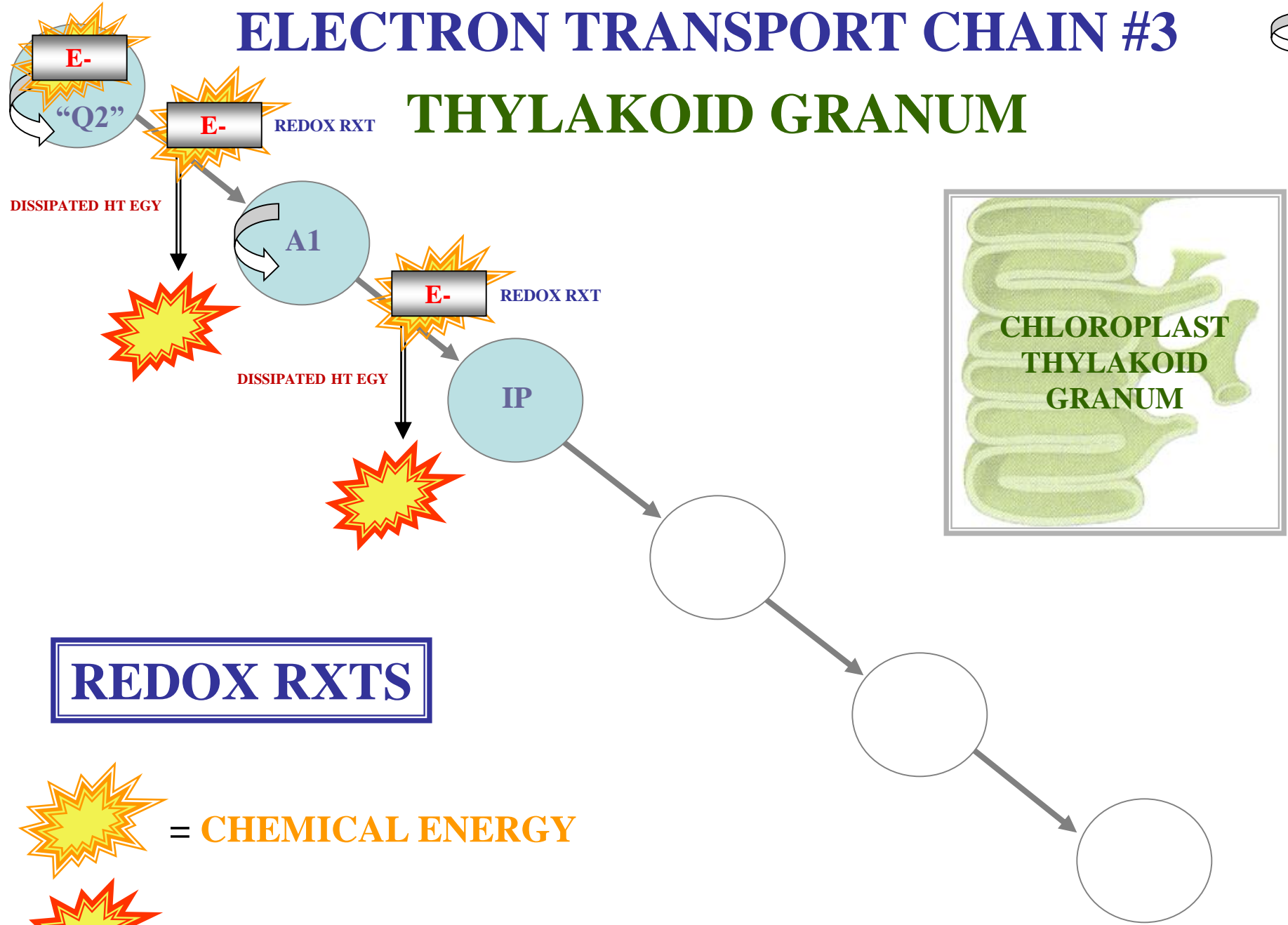
 = DISSIPATED HEAT ENERGY



# ELECTRON TRANSPORT CHAIN #3



## THYLAKOID GRANUM



**REDOX RXTS**

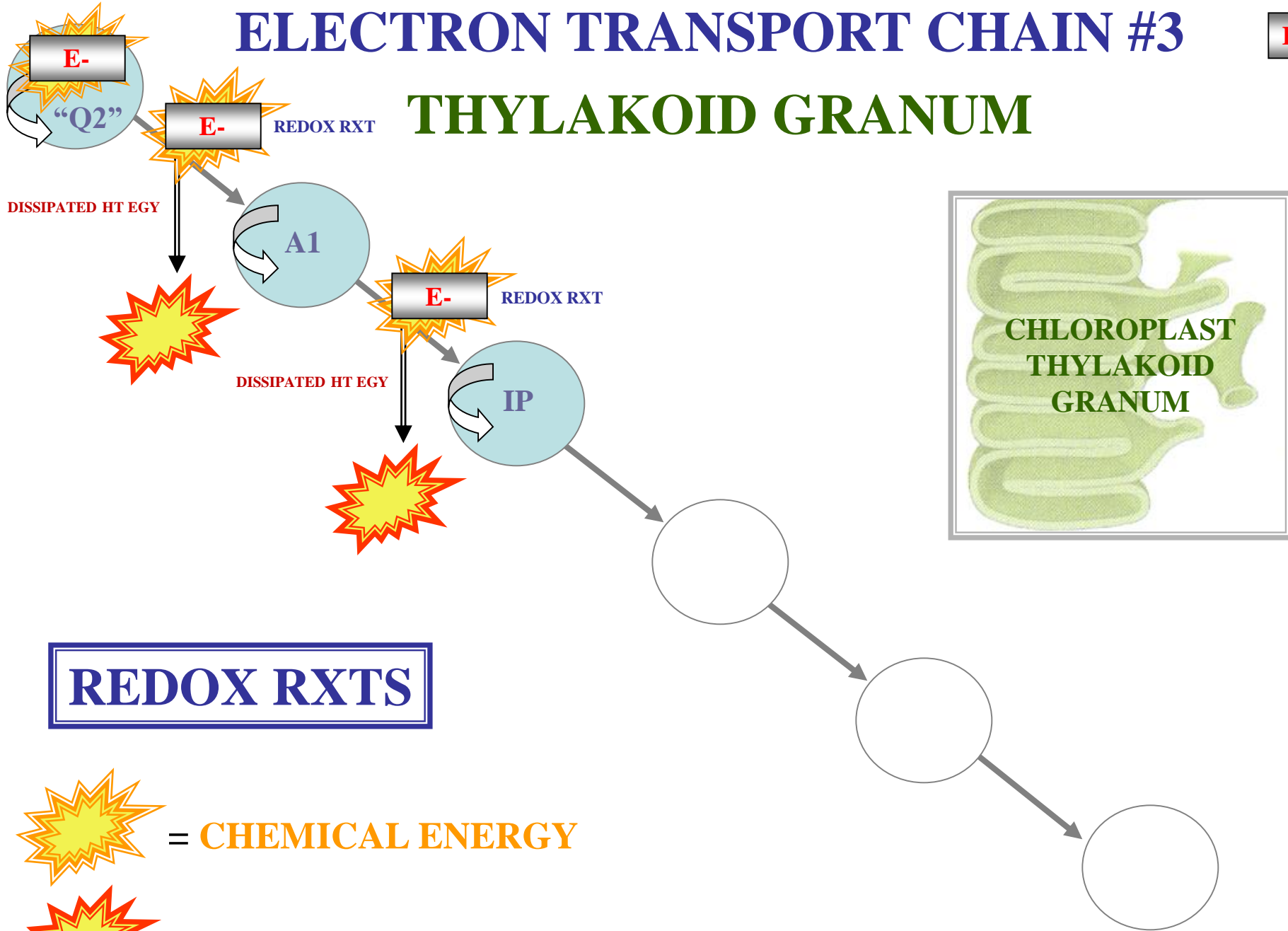
 = CHEMICAL ENERGY

 = DISSIPATED HEAT ENERGY

# ELECTRON TRANSPORT CHAIN #3

E-

## THYLAKOID GRANUM



**REDOX RXTS**

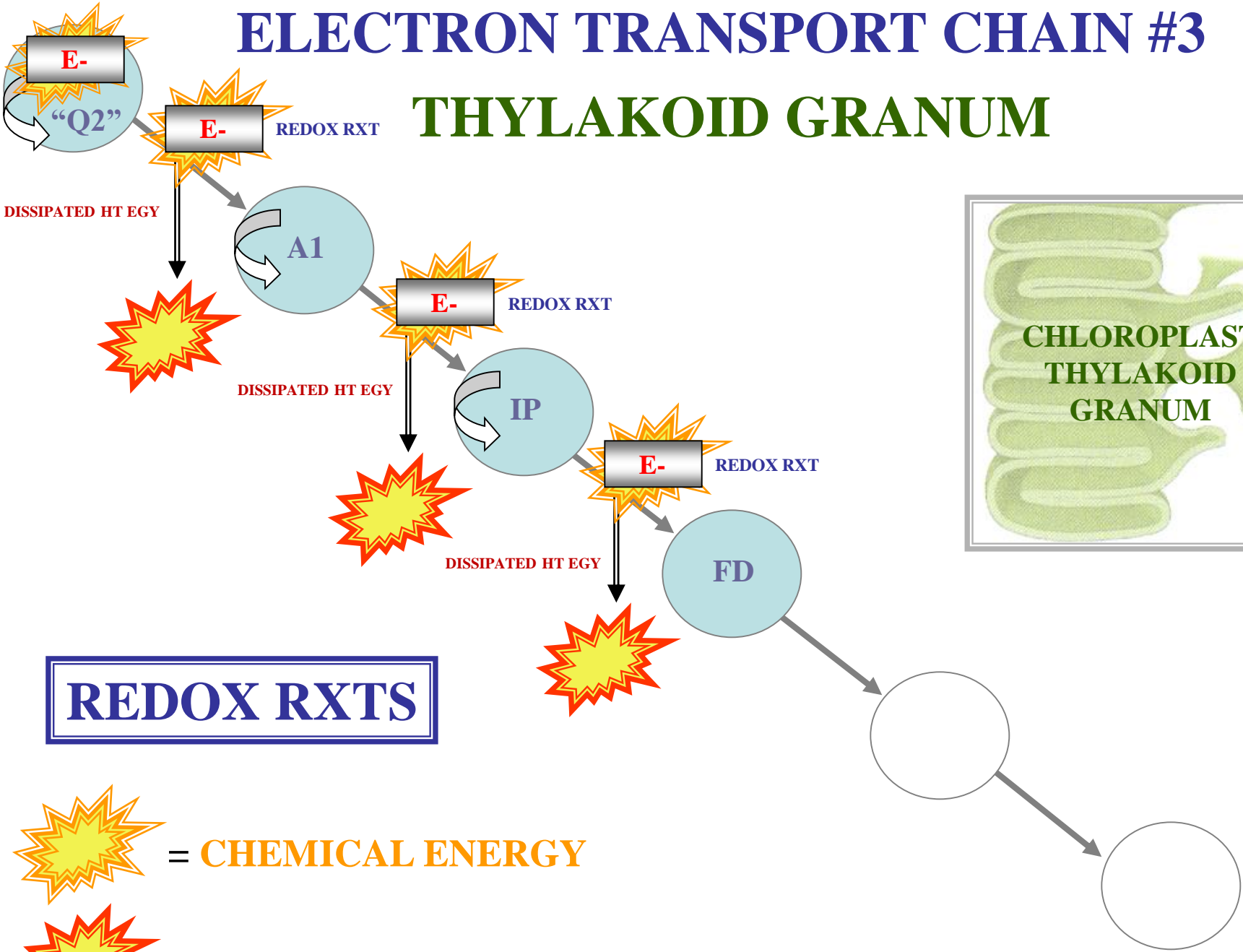
 = CHEMICAL ENERGY

 = DISSIPATED HEAT ENERGY

# ELECTRON TRANSPORT CHAIN #3

E-

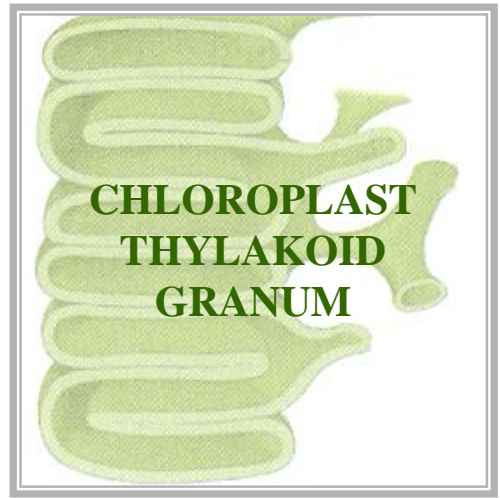
## THYLAKOID GRANUM



**REDOX RXTS**

 = CHEMICAL ENERGY

 = DISSIPATED HEAT ENERGY

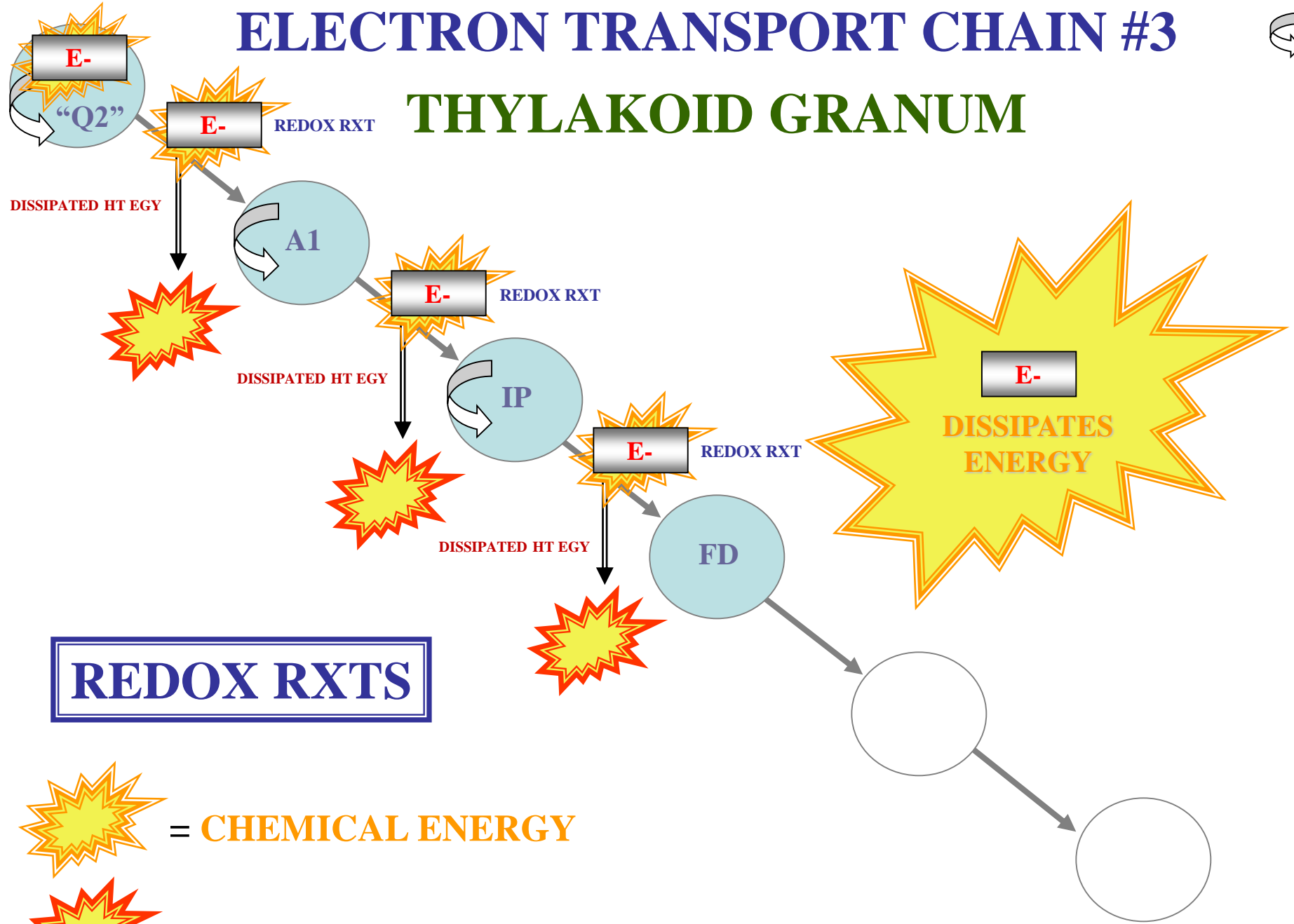




# ELECTRON TRANSPORT CHAIN #3



## THYLAKOID GRANUM



**REDOX RXTS**

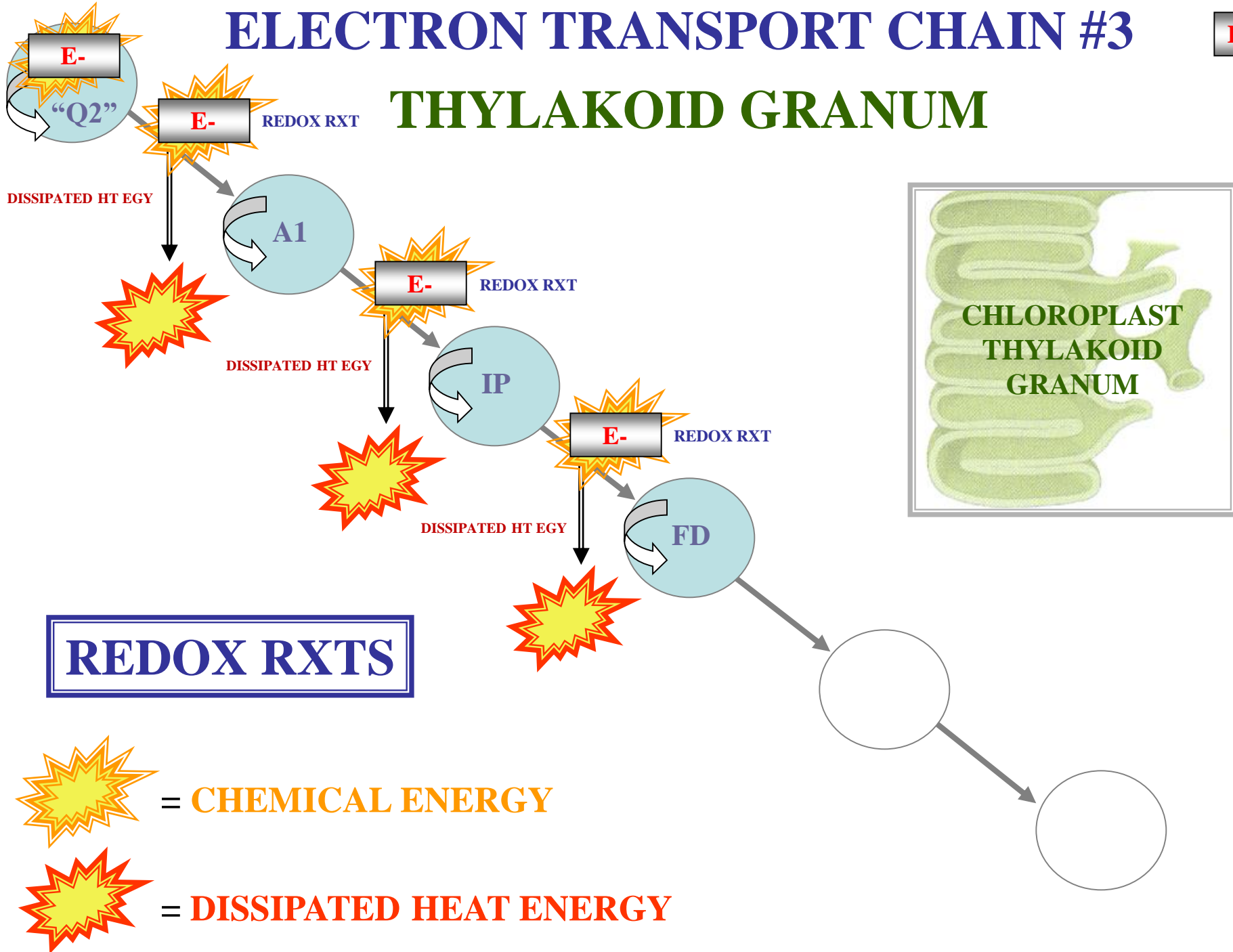
 = CHEMICAL ENERGY

 = DISSIPATED HEAT ENERGY

# ELECTRON TRANSPORT CHAIN #3

E-

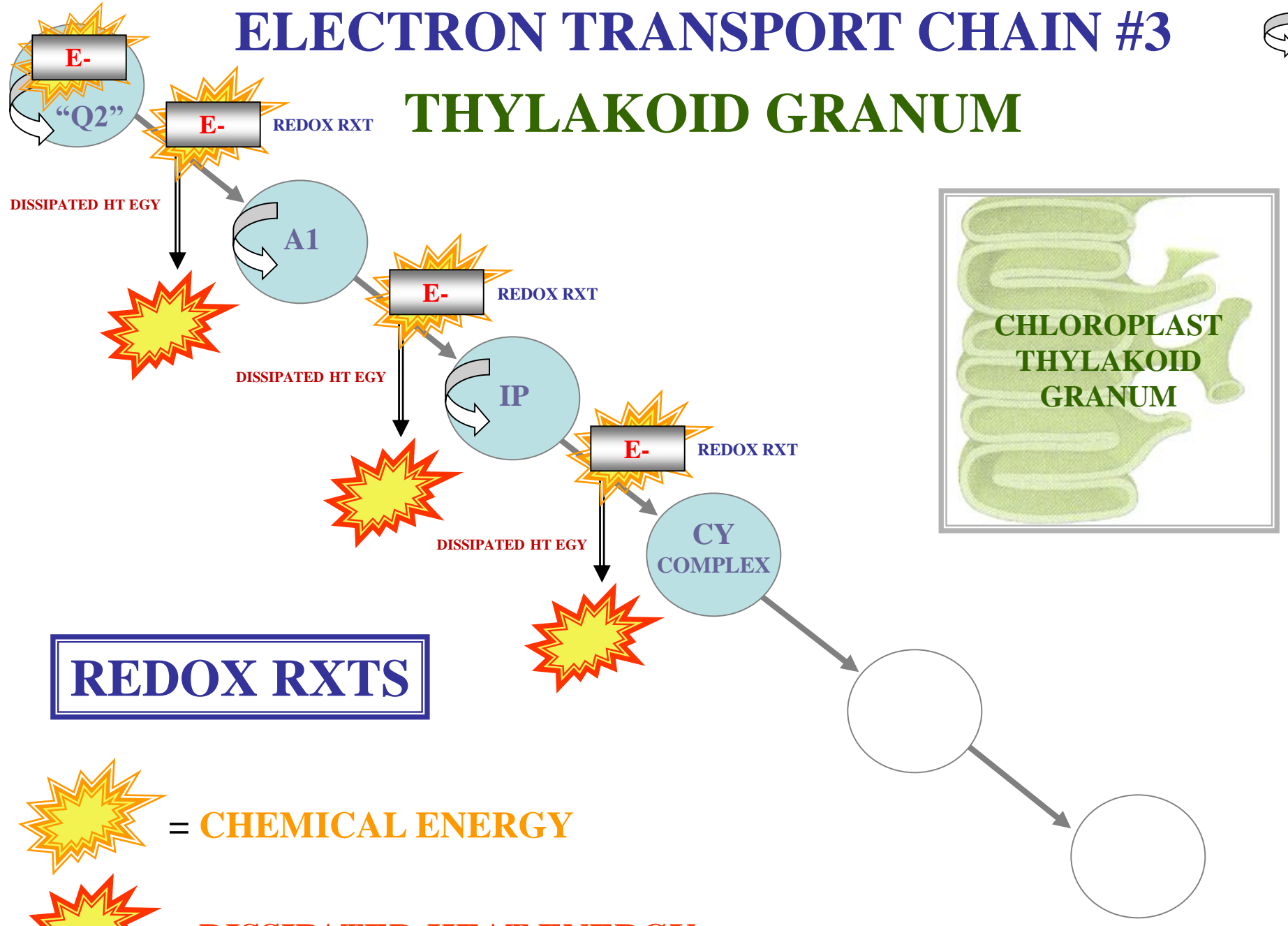
## THYLAKOID GRANUM



# ELECTRON TRANSPORT CHAIN #3



## THYLAKOID GRANUM



**REDOX RXTS**

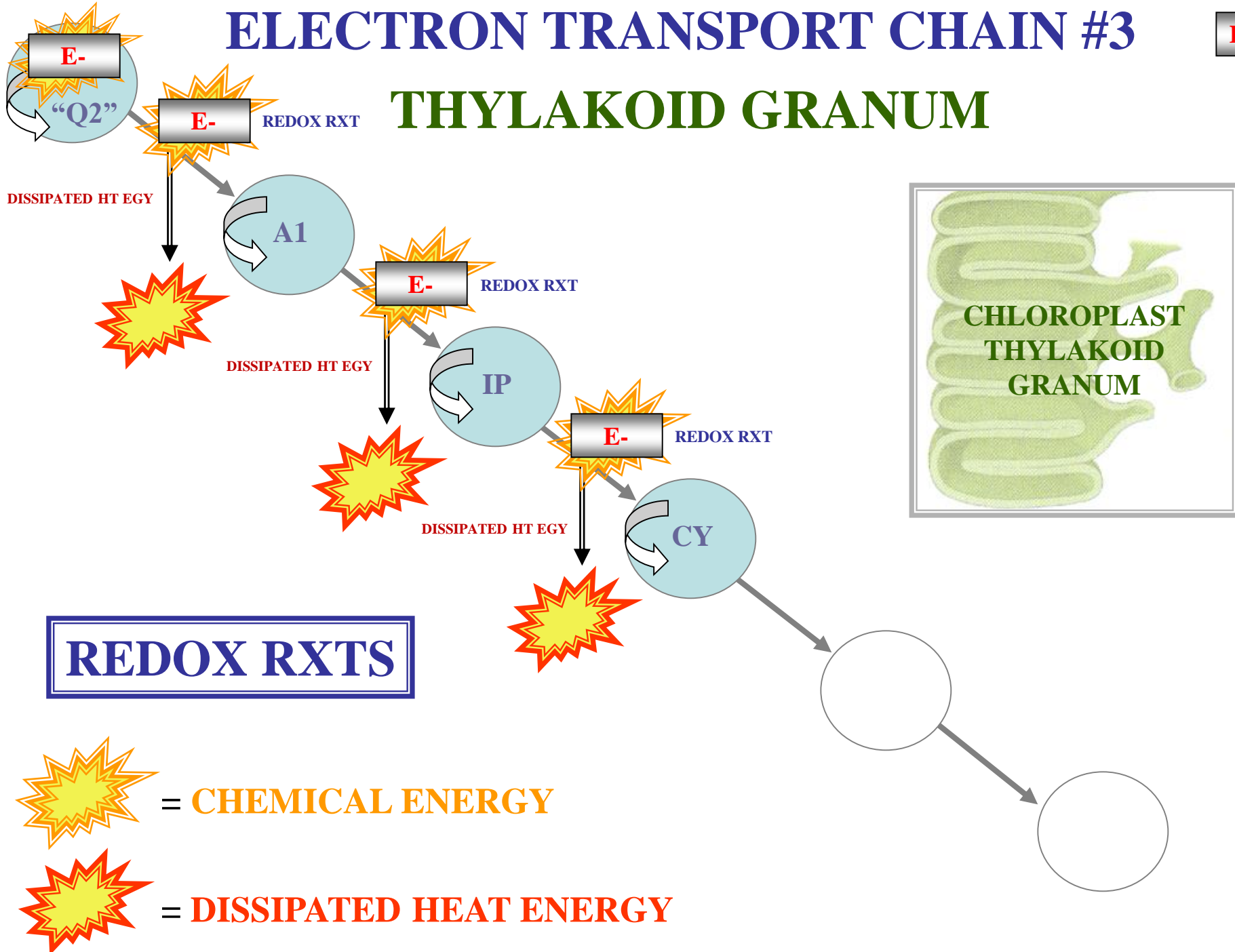
 = CHEMICAL ENERGY

 = DISSIPATED HEAT ENERGY

# ELECTRON TRANSPORT CHAIN #3

E-

## THYLAKOID GRANUM



**REDOX RXTS**

 = CHEMICAL ENERGY

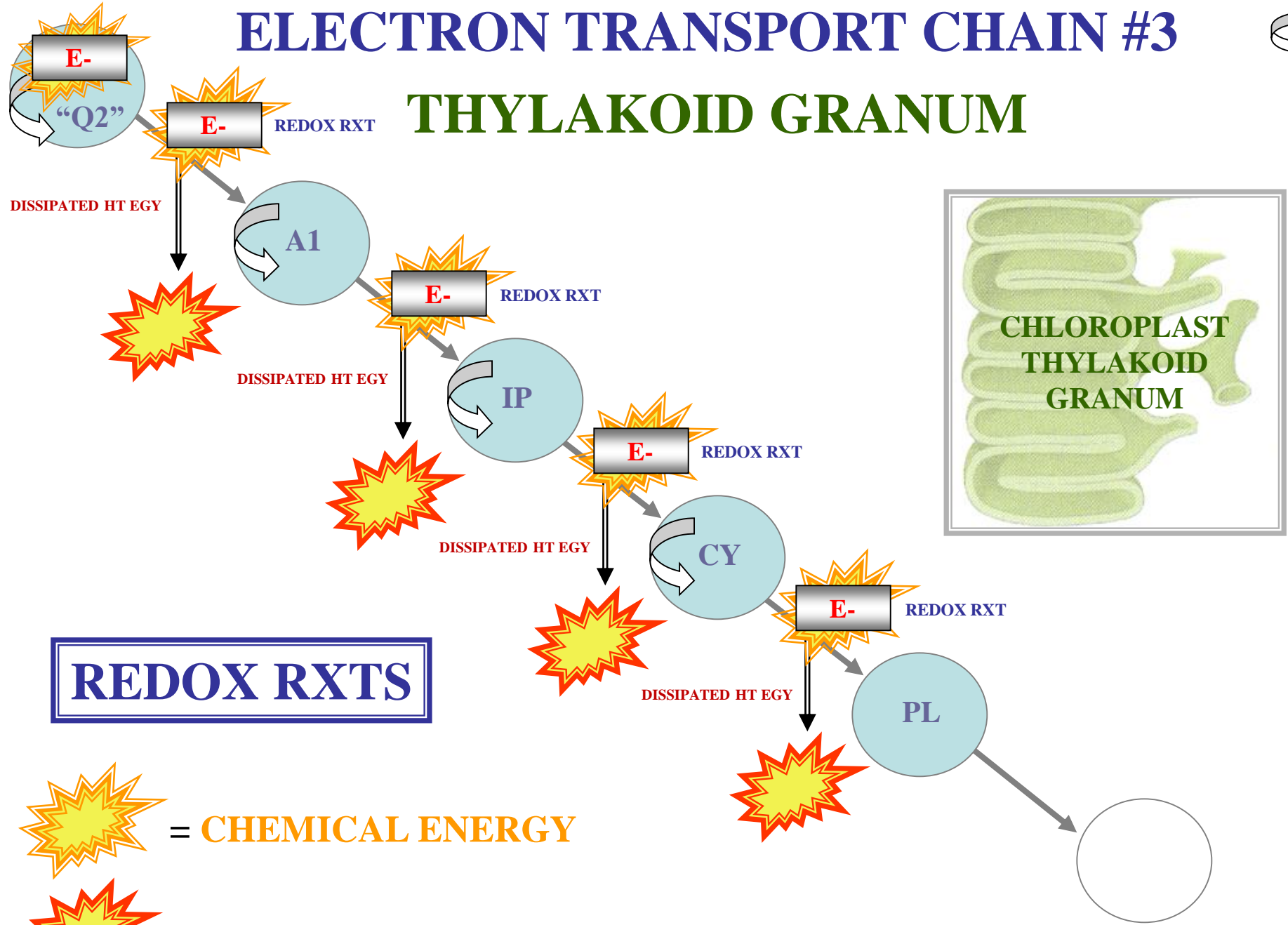
 = DISSIPATED HEAT ENERGY



# ELECTRON TRANSPORT CHAIN #3



## THYLAKOID GRANUM



**REDOX RXTS**

 = CHEMICAL ENERGY

 = DISSIPATED HEAT ENERGY



CHLOROPLAST  
THYLAKOID  
GRANUM