

# QUESTION



LIGHT ENERGY MUST  
BE CONVERTED  
TO WHAT FORM OF  
ENERGY TO ENTER  
CELL METABOLISM?

# QUESTION



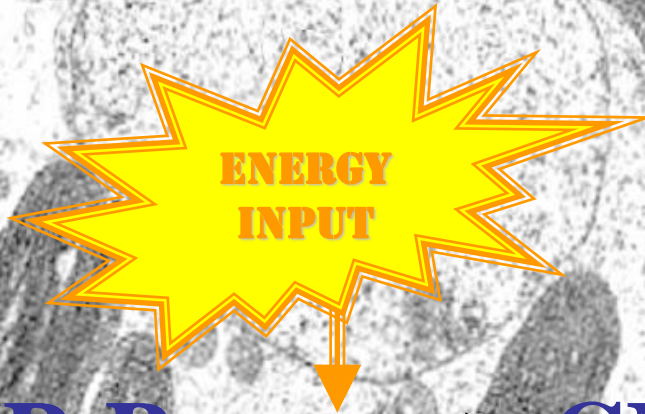
# CHEMICAL ENERGY

# BIOCHEMICAL REACTION



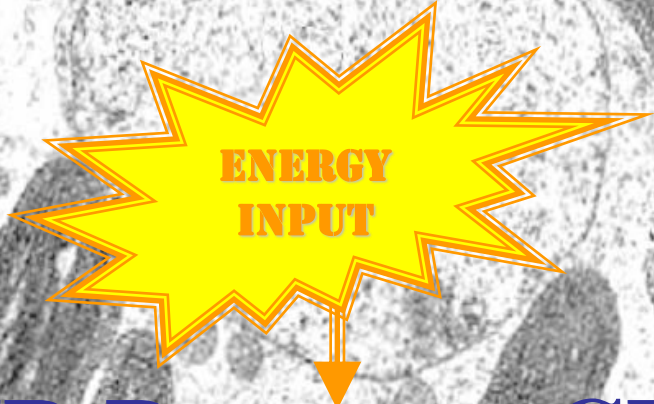
# BIOCHEMICAL REACTION

# BIOCHEMICAL REACTION



**REQUIRES  
ENERGY INPUT**

# BIOCHEMICAL REACTION



**ENDERGONIC REACTION  
REQUIRES  
ENERGY INPUT**

# BIOCHEMICAL REACTION



**CHEMICAL  
ENERGY**



**CHEMICAL ENERGY  
DRIVES**

**BIOCHEMICAL REACTIONS**



# BIOCHEMICAL REACTION



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



**QUESTION**

**WHAT ORGANISMS**

**CONVERT**

**LIGHT ENERGY**

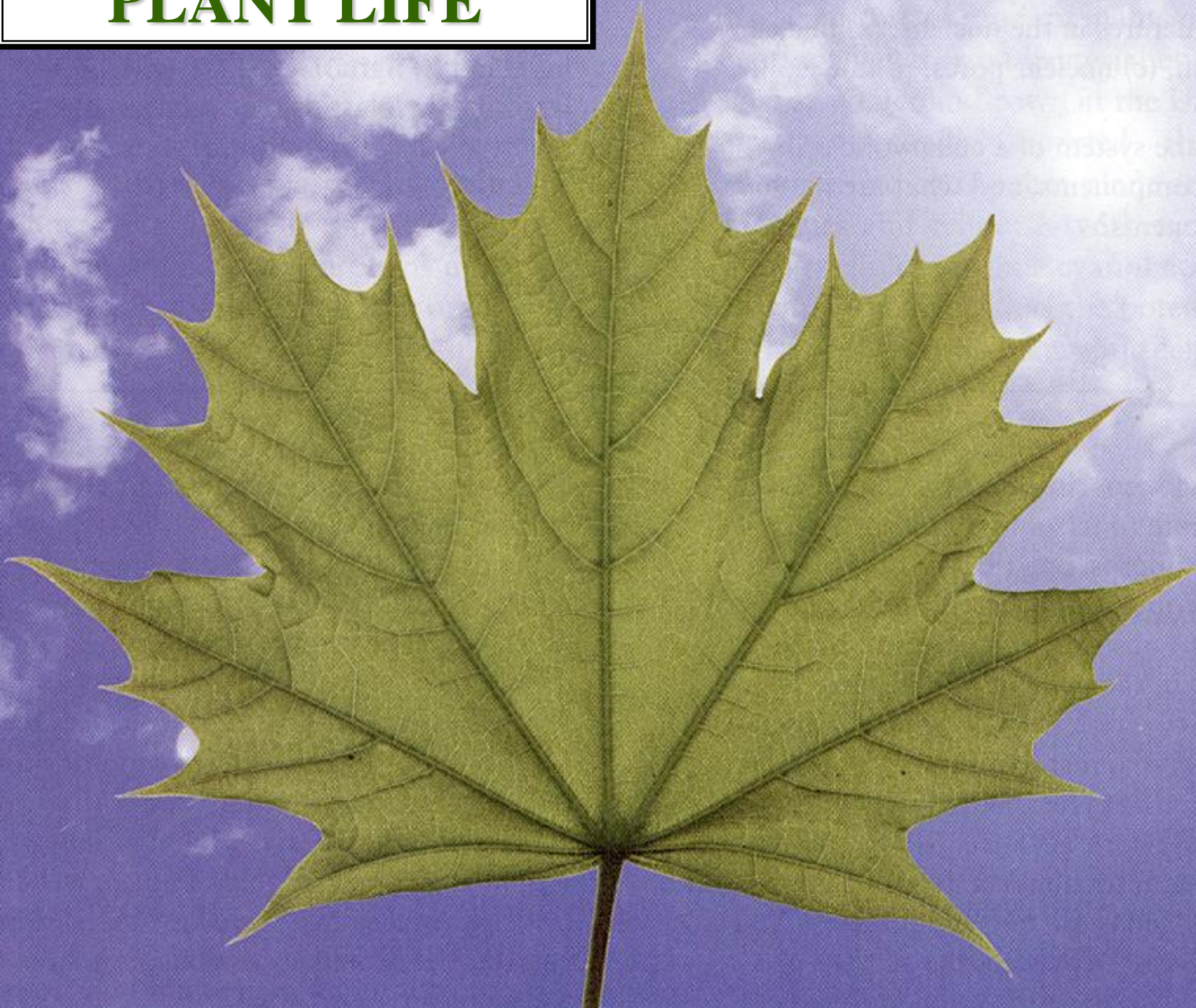
**TO**

**CHEMICAL ENERGY?**

**QUESTION**



# PLANT LIFE



# PLANT LIFE

^

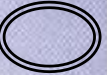
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# PHOTOSYNTHESIS



# PHOTOSYNTHESIS

A large, detailed photograph of a green maple leaf with prominent veins, set against a blue sky with white clouds. The leaf is the central focus of the slide.

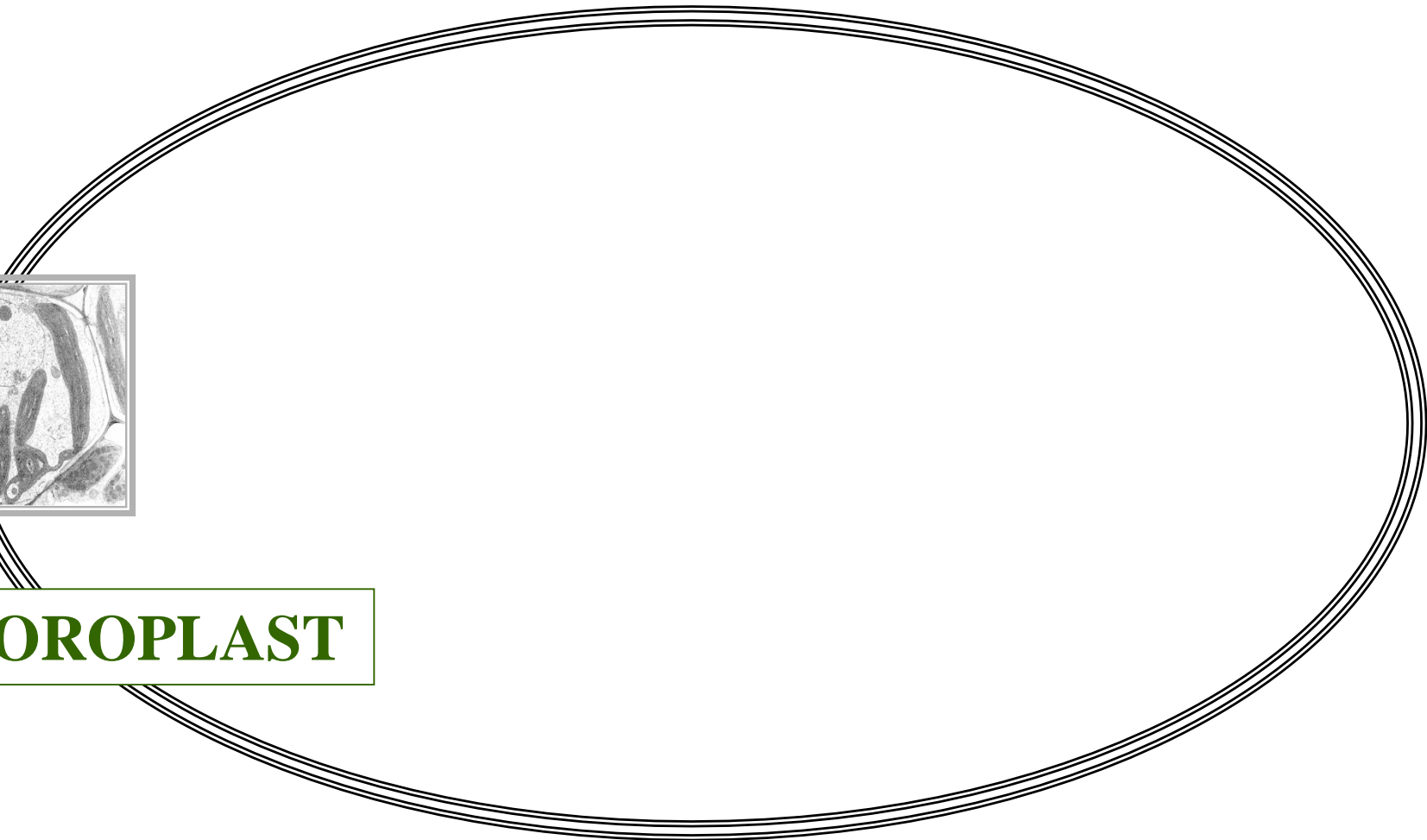
# PHOTOSYNTHESIS

# PHOTOSYNTHESIS

*LT*



**CHLOROPLAST**

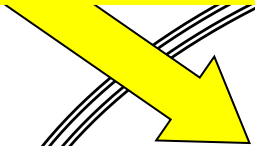


# PHOTOSYNTHESIS

LR



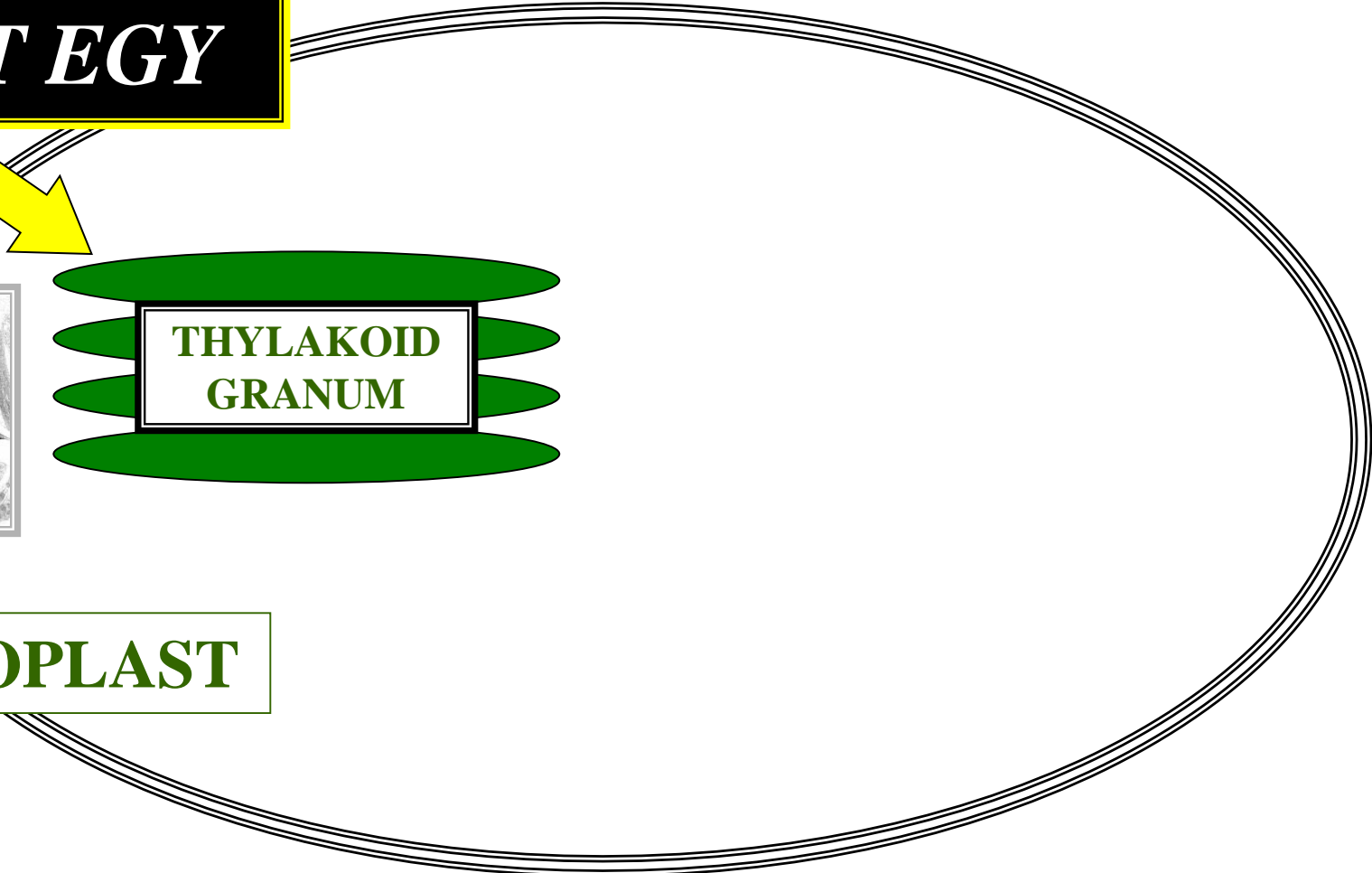
**LIGHT ENERGY**



**THYLAKOID  
GRANUM**



**CHLOROPLAST**



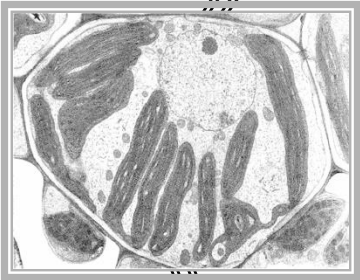
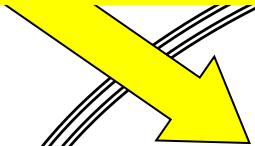
# PHOTOSYNTHESIS



C



**LIGHT ENERGY**



**CHLOROPLAST**



# PHOTOSYNTHESIS

DR



WATER

**LIGHT ENERGY**

E-

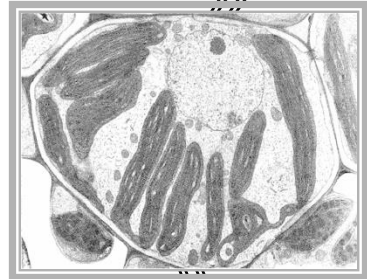
PHOTOLYSIS

LT RXT

THYLAKOID  
GRANUM

CHEMICAL  
ENERGY

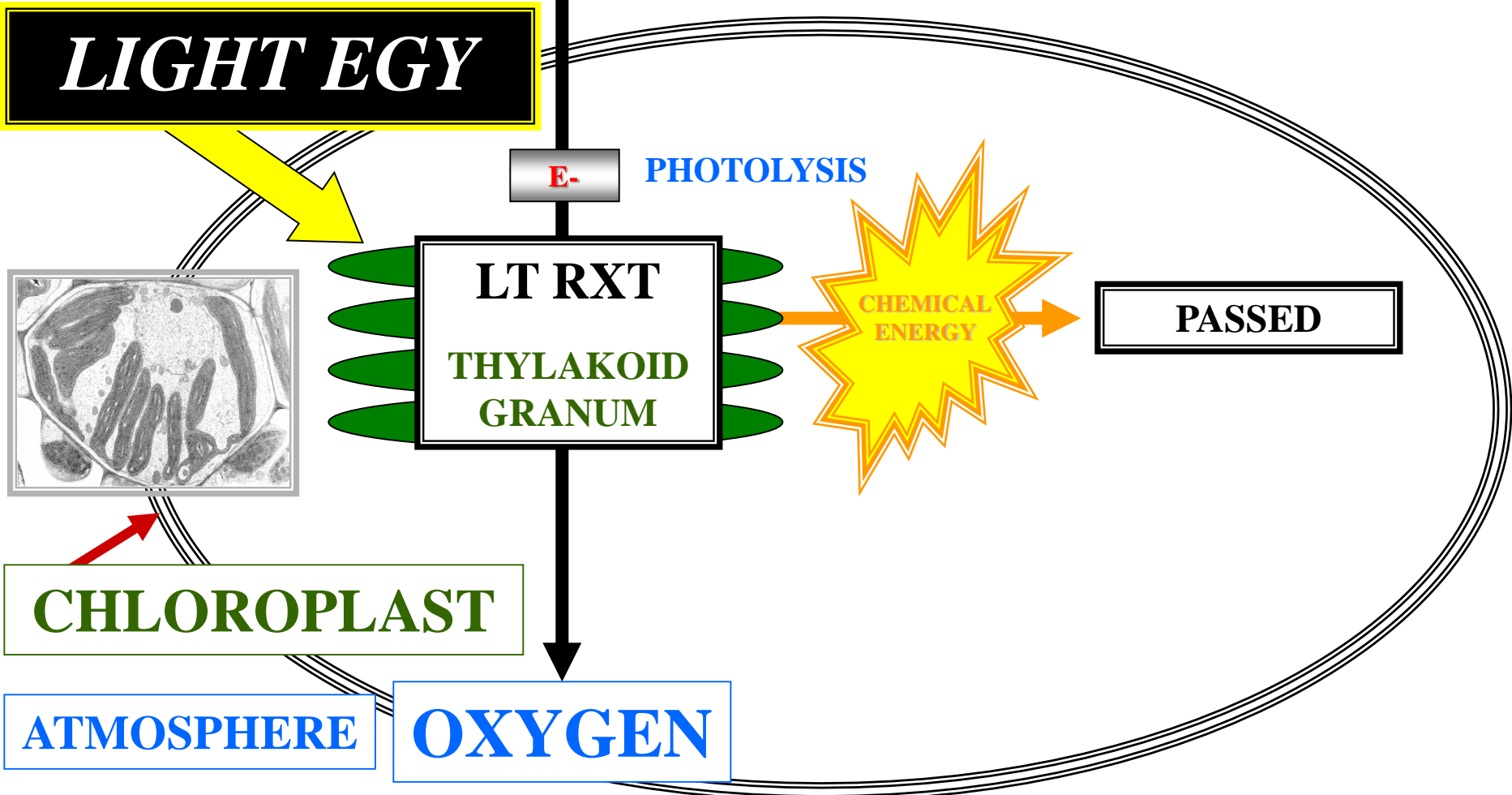
PASSED



CHLOROPLAST

ATMOSPHERE

OXYGEN





# PHOTOSYNTHESIS

C



WATER

**LIGHT ENERGY**

E-

PHOTOLYSIS

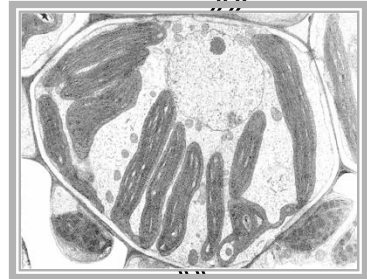
LT RXT

THYLAKOID  
GRANUM

CHEMICAL  
ENERGY

DK RXT

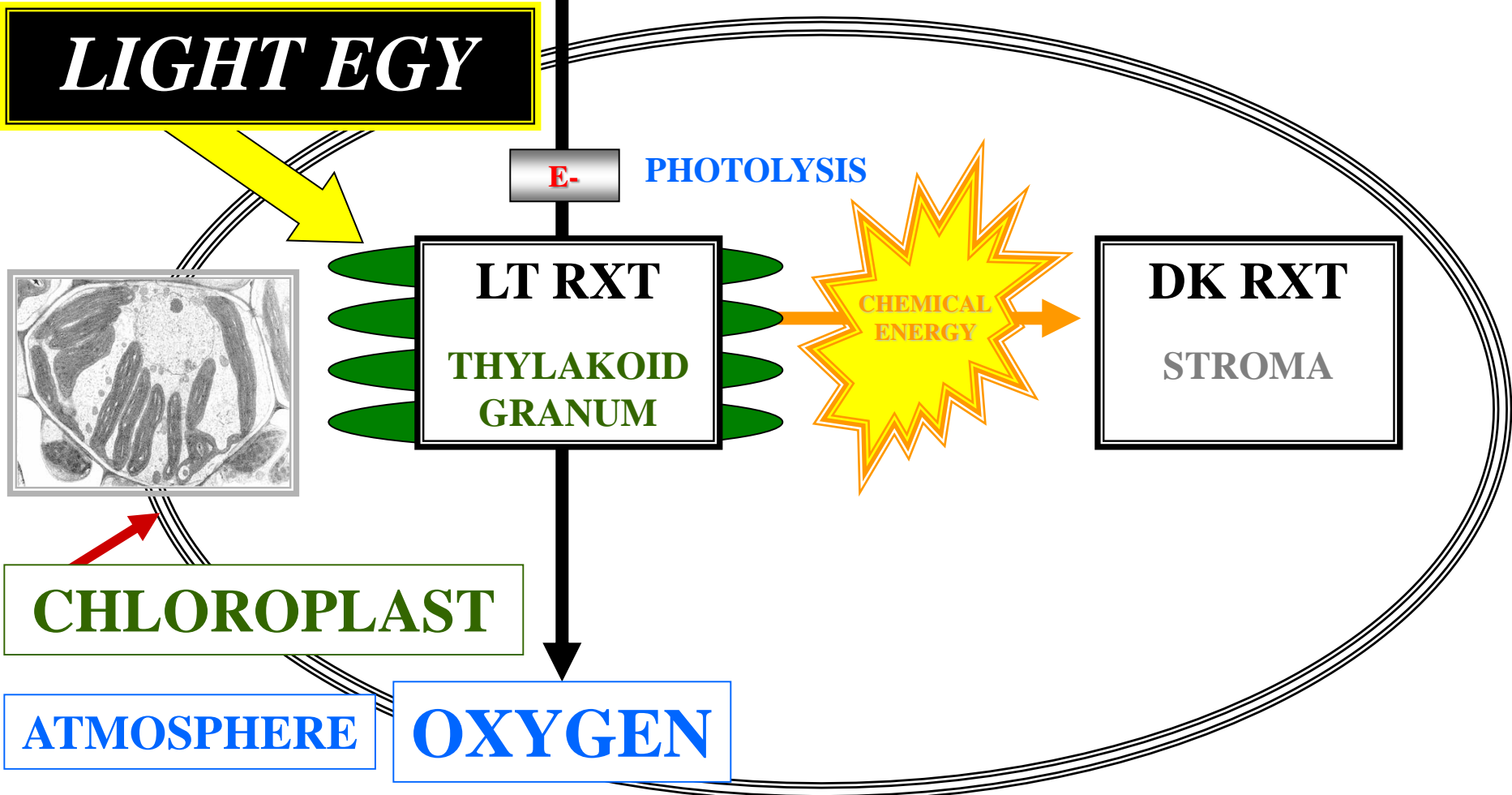
STROMA



CHLOROPLAST

ATMOSPHERE

OXYGEN



# PHOTOSYNTHESIS

G



WATER

CO<sub>2</sub>

**LIGHT ENERGY**

ATMOSPHERE

E-

PHOTOLYSIS

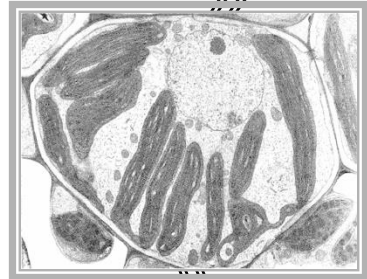
LT RXT

THYLAKOID  
GRANUM

CHEMICAL  
ENERGY

DK RXT

STROMA

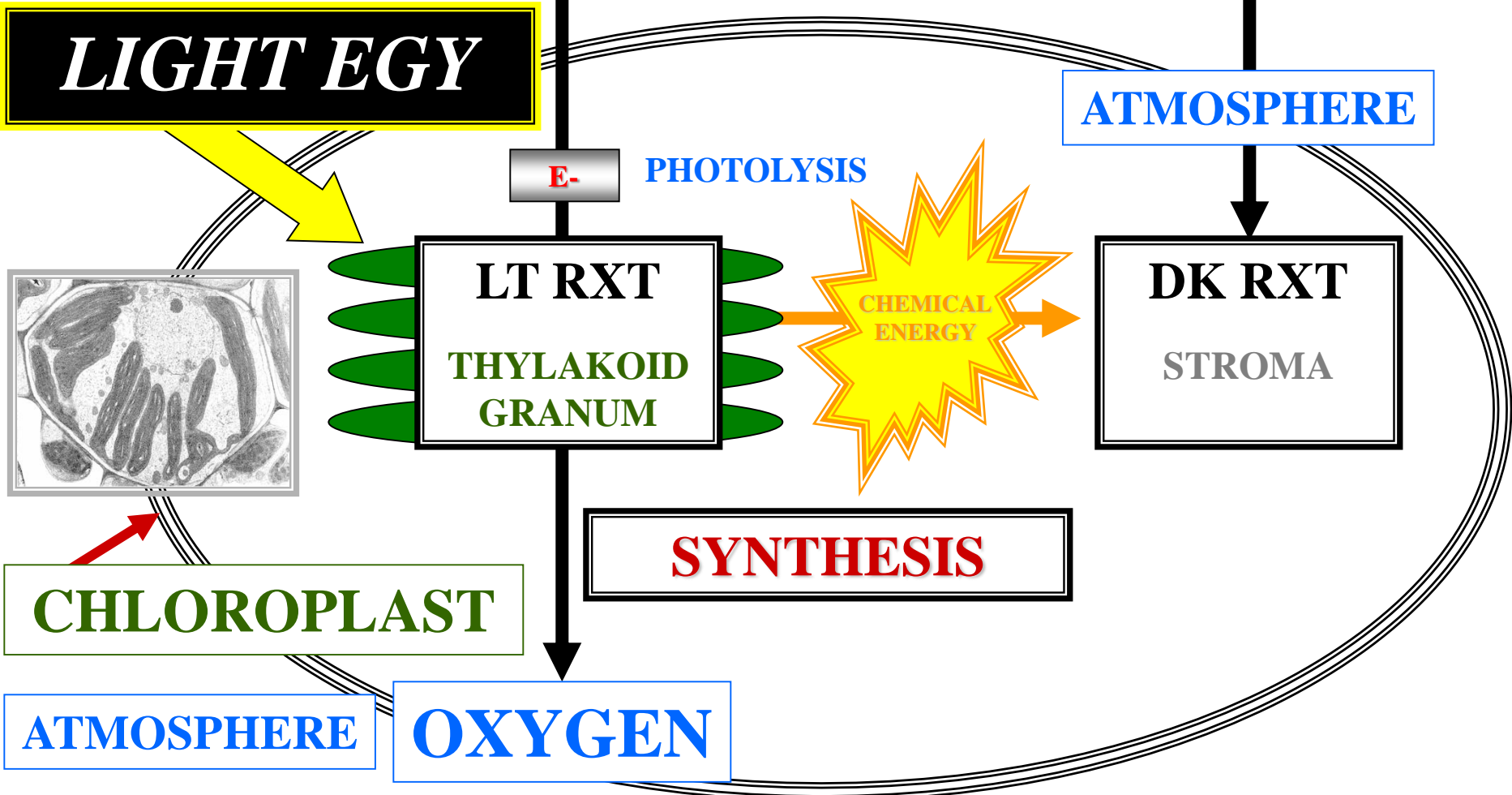


**SYNTHESIS**

CHLOROPLAST

ATMOSPHERE

OXYGEN



# PHOTOSYNTHESIS

AP



WATER

CO<sub>2</sub>

**LIGHT ENERGY**

ATMOSPHERE

**E-** PHOTOLYSIS



LT RXT  
THYLAKOID  
GRANUM

CHEMICAL  
ENERGY

DK RXT  
STROMA

CHLOROPLAST

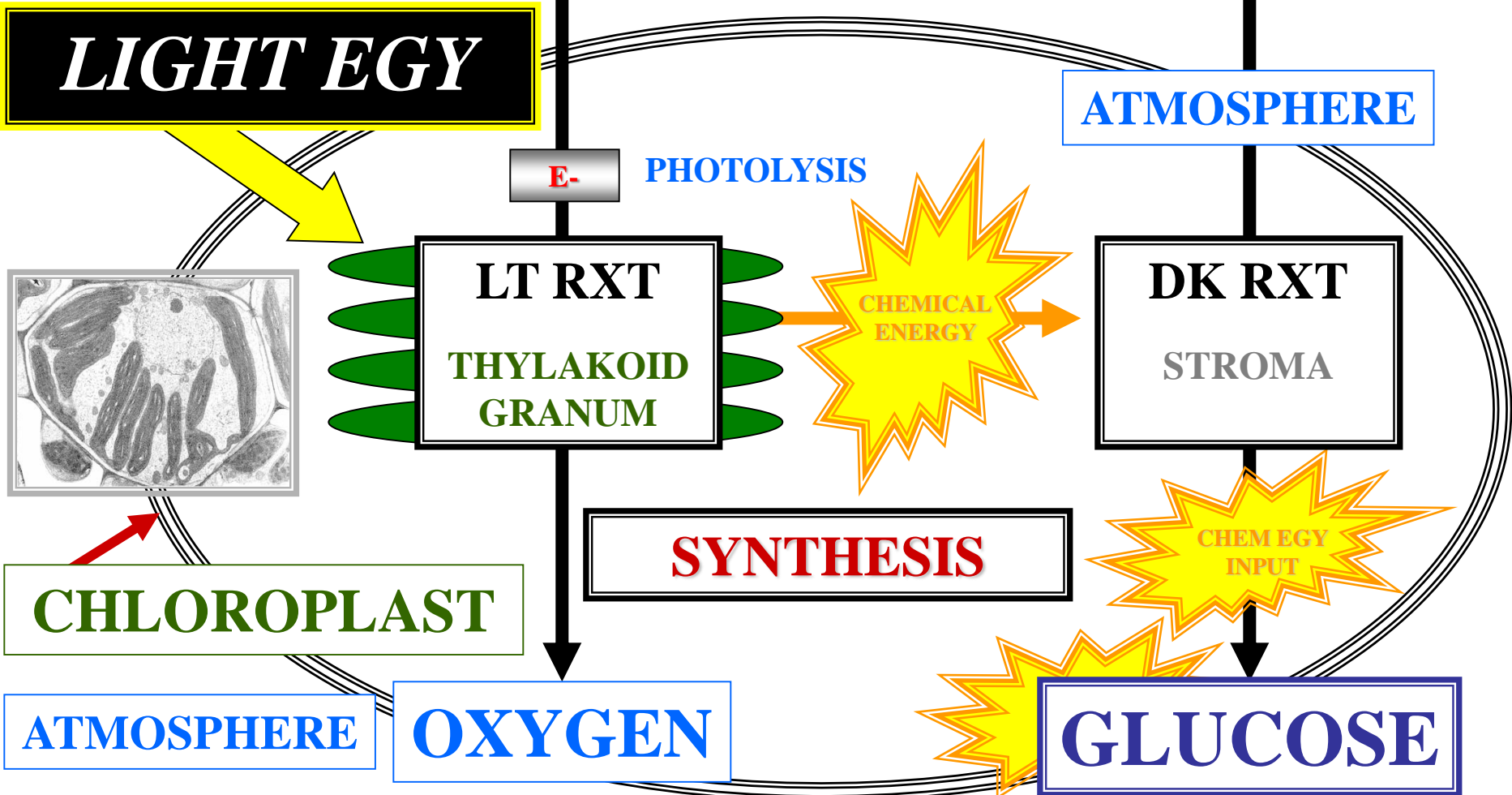
SYNTHESIS

CHEMICAL  
INPUT

ATMOSPHERE

OXYGEN

GLUCOSE





# PHOTOSYNTHESIS

## ANABOLIC PATHWAY

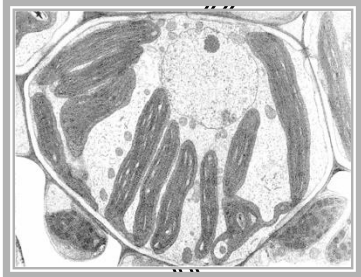
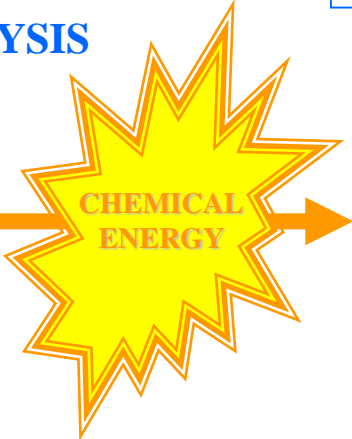
**LIGHT ENERGY**

**EN**

**ATMOSPHERE**

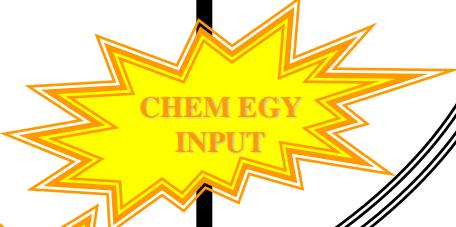
**E-**

**PHOTOLYSIS**



**CHLOROPLAST**

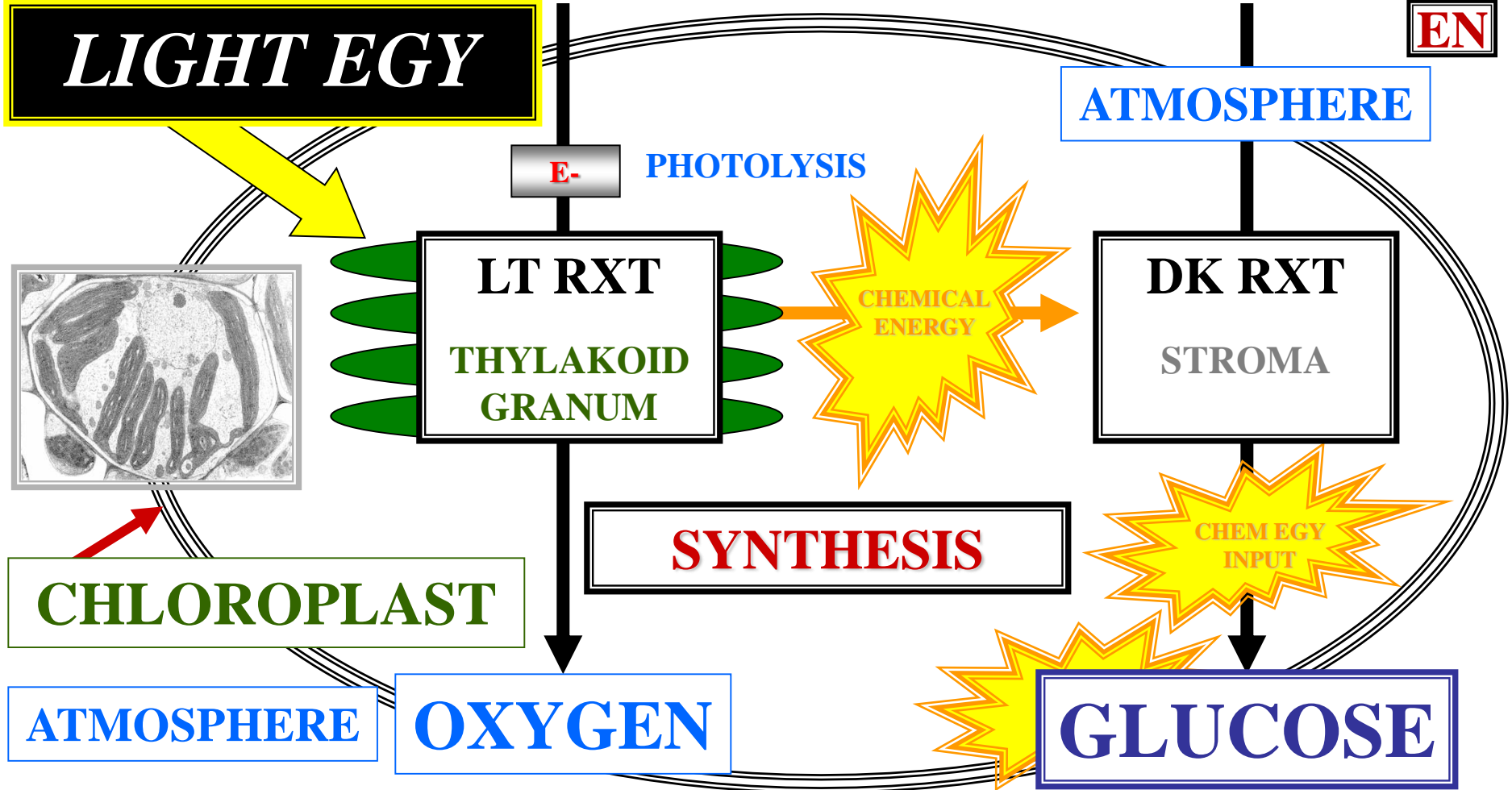
**SYNTHESIS**



**ATMOSPHERE**

**OXYGEN**

**GLUCOSE**

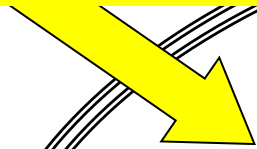




# PHOTOSYNTHESIS

## ENDERGONIC REACTIONS

**LIGHT ENERGY**



**CHLOROPLAST**

**ATMOSPHERE**

**OXYGEN**

**E-**

**PHOTOLYSIS**

**LT RXT**  
**THYLAKOID**  
**GRANUM**



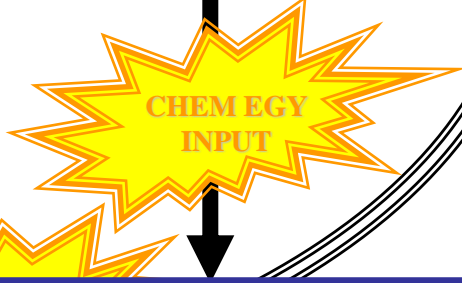
**SYNTHESIS**

**ATMOSPHERE**

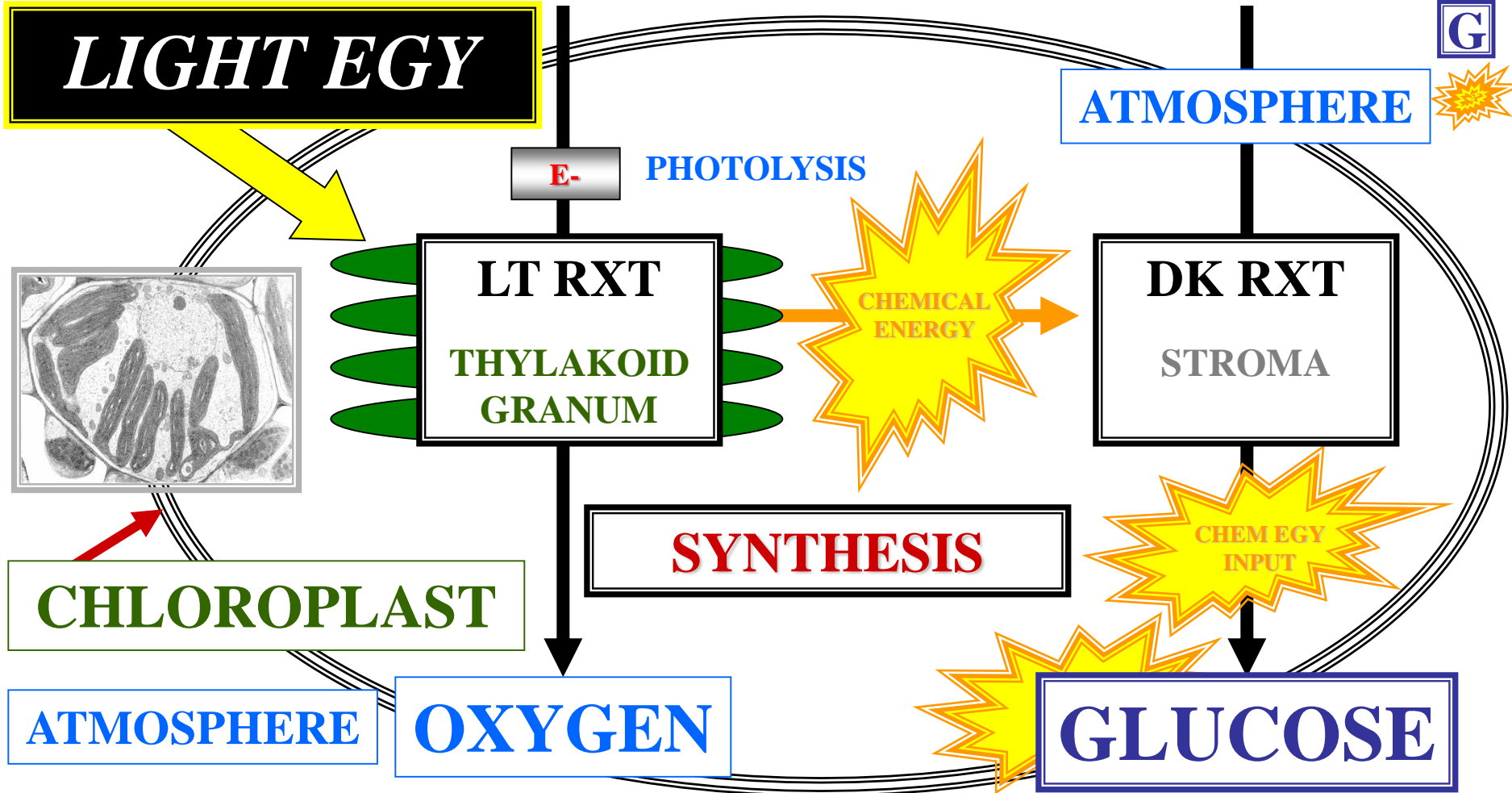
**G**



**DK RXT**  
**STROMA**



**GLUCOSE**



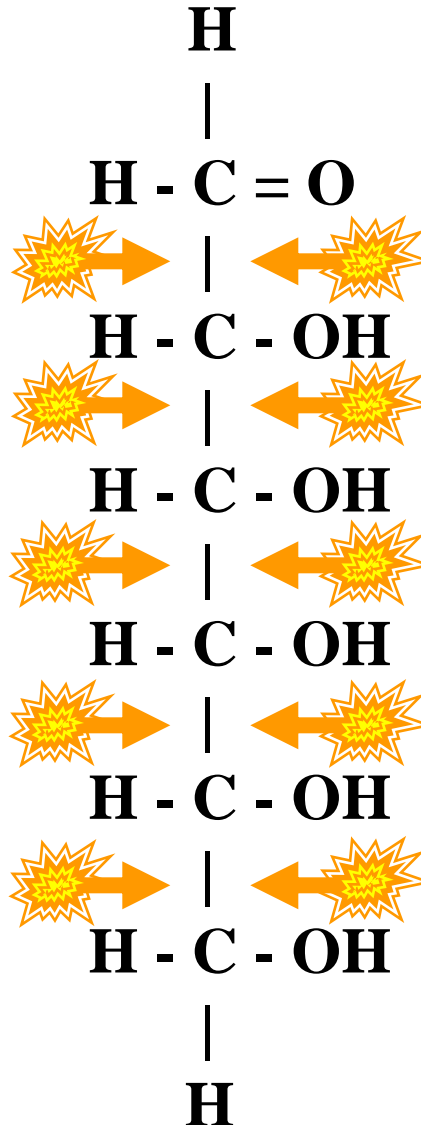


# GLUCOSE

**STORES  
CHEMICAL  
ENERGY**

**STORES  
CHEMICAL  
ENERGY**

**CHEMICAL  
ENERGY**



**CHEMICAL  
ENERGY**

**STORES  
CHEMICAL  
ENERGY**

**STORES  
CHEMICAL  
ENERGY**



**GLUCOSE**

**GLUCOSE**



G



**GLUCOSE**



# GLUCOSE

**ENTERS  
METABOLISM**

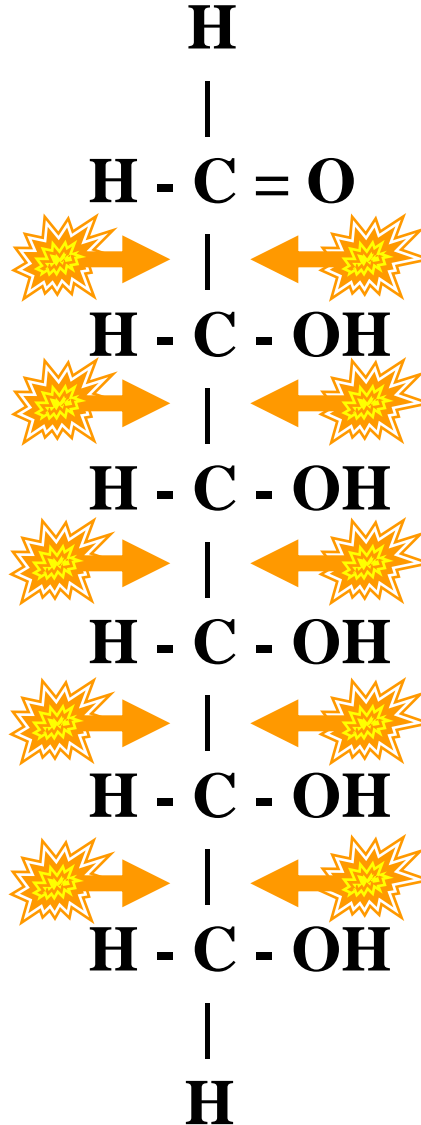
**ENTERS  
METABOLISM**

**CHEMICAL  
ENERGY**

**CHEMICAL  
ENERGY**

**ENTERS  
RESPIRATION**

**ENTERS  
RESPIRATION**





# RESPIRATION

**RESPIRATION**

**GLUCOSE**

**RESPIRATION**

+

 = CHEM ENERGY

**RED = ENZYME**

**RESPIRATION**

**GLUCOSE**

**RESPIRATION**

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

**HEXOKINASE**

**ATP**

**EGY**

**ADP**

**GLUCOSE-6-PHOSPHATE**

**PHOSPHOGLUCOISOMERASE**

**FRUCTOSE-6-PHOSPHATE**

**PHOSPHOFRUCTOKINASE**

**ATP**

**EGY**

**ADP**

**FRUCTOSE-1-6-PHOSPHATE**

 = **CHEM ENERGY**

**RED = ENZYME**

3-PHOSPHOGLYCERATE - PGA

ENOLASE

3-PHOSPHOENOLPYRUVATE

PYRUVATE KINASE

ADP



ATP

PYRUVATE

3-PHOSPHOGLYCERATE - PGA

CP

ENOLASE

3-PHOSPHOENOLPYRUVATE

PYRUVATE KINASE

ATP



ADP

PYRUVATE

RESPIRATION

GLUCOSE BREAK-DOWN TO CO<sub>2</sub>  
CO<sub>2</sub> IS RELEASED

3-PHOSPHOGLYCERATE - PGA

ENOLASE

3-PHOSPHOENOLPYRUVATE

PYRUVATE KINASE



PYRUVATE

3-PHOSPHOGLYCERATE - PGA

ENOLASE



3-PHOSPHOENOLPYRUVATE

PYRUVATE KINASE



PYRUVATE

RESPIRATION

CATABOLIC PATHWAY

3-PHOSPHOGLYCERATE - PGA

ENOLASE

3-PHOSPHOENOLPYRUVATE

PYRUVATE KINASE

ADP



ATP

PYRUVATE

3-PHOSPHOGLYCERATE - PGA

EX

ENOLASE

3-PHOSPHOENOLPYRUVATE

PYRUVATE KINASE

ATP



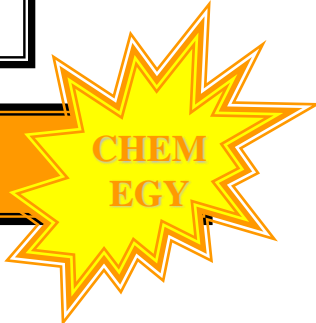
ADP

PYRUVATE

RESPIRATION

CATABOLIC PATHWAY

CHEMICAL ENERGY IS RELEASED



3-PHOSPHOGLYCERATE - PGA

ENOLASE

3-PHOSPHOENOLPYRUVATE

PYRUVATE KINASE



PYRUVATE

3-PHOSPHOGLYCERATE - PGA

?

ENOLASE

3-PHOSPHOENOLPYRUVATE

PYRUVATE KINASE

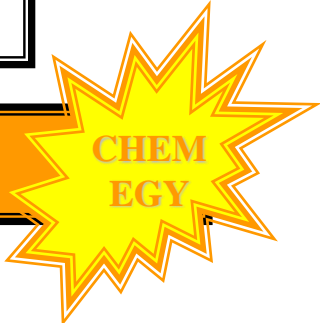


PYRUVATE

RESPIRATION

EXERGONIC REACTIONS

CHEMICAL ENERGY IS RELEASED





**PHOTOSYNTHESIS  
PATHWAY  
&  
RESPIRATION  
PATHWAY  
?**

**PHOTOSYNTHESIS  
PATHWAY  
&  
RESPIRATION  
PATHWAY**

**!!!INVERSE!!!**

**PHOTOSYNTHESIS  
PATHWAY  
&  
RESPIRATION  
PATHWAY  
?**

**PHOTOSYNTHESIS  
PATHWAY  
&  
RESPIRATION  
PATHWAY**

**!!!COUPLED!!!**

**ANABOLIC  
METABOLISM  
&  
CATABOLIC  
METABOLISM  
?**

**ANABOLIC  
METABOLISM  
&  
CATABOLIC  
METABOLISM  
*!!!COUPLED!!!***

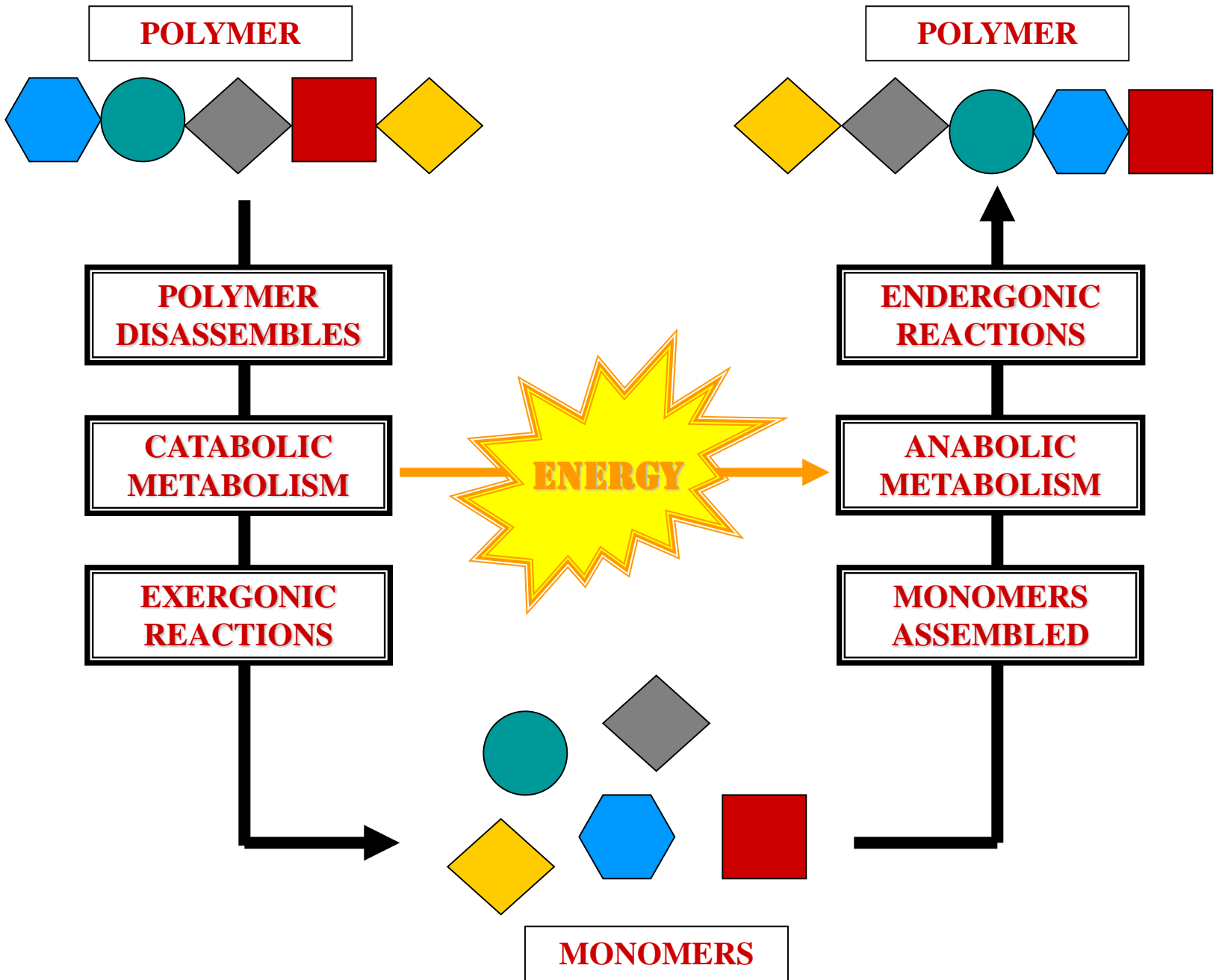
**ENDERGONIC  
REACTIONS  
&  
EXERGONIC  
REACTIONS  
?**

# ENDERGONIC REACTIONS & EXERGONIC REACTIONS

**!!!COUPLED!!!**







**ENERGY**

# QUESTION

WHAT IS THE  
BIOLOGY ENERGY  
MOLECULE?

# QUESTION



**ATP**

***BIOLOGICAL***

***ENERGY***

***MOLECULE***

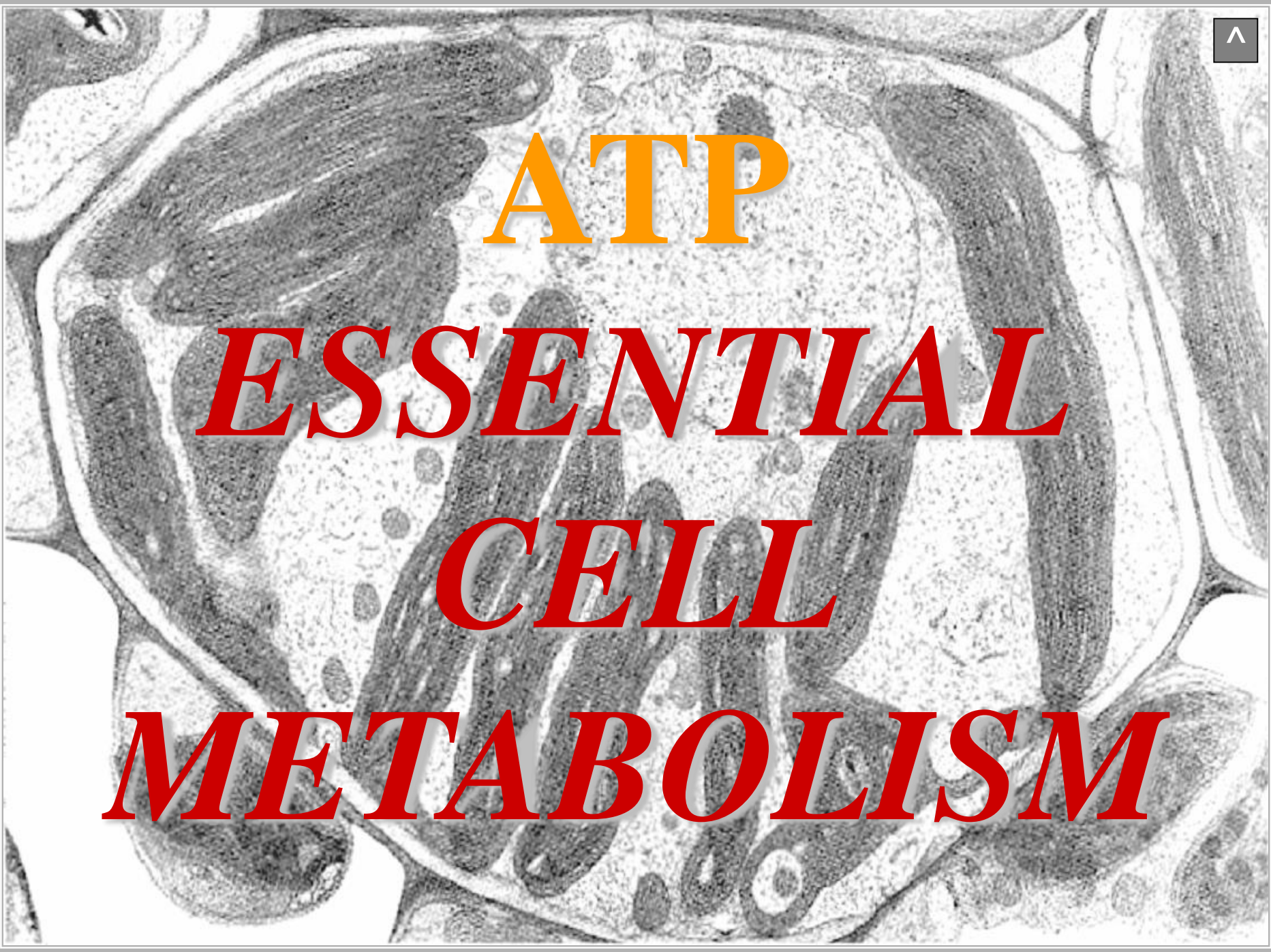


**ATP**

***ESSENTIAL***

***CELL***

***METABOLISM***



**ATP**  
**ADENOSINE**  
**TRIPHOSPHATE**

**ATP**

**ADENOSINE**

**TRIPHOSPHATE**



**ADENOSINE TRIPHOSPHATE**

**ATP**

**DELIVERS CHEM-EGY**

**TO**

**BIO-CHEM RXTS**

**ATP**

**ADENOSINE TRIPHOSPHATE**



An electron micrograph of a cell, showing various organelles such as mitochondria, endoplasmic reticulum, and a nucleus. The image is overlaid with text and a small graphic.

**CELL  
METABOLISM**



**BIOCHEMICAL REACTION**

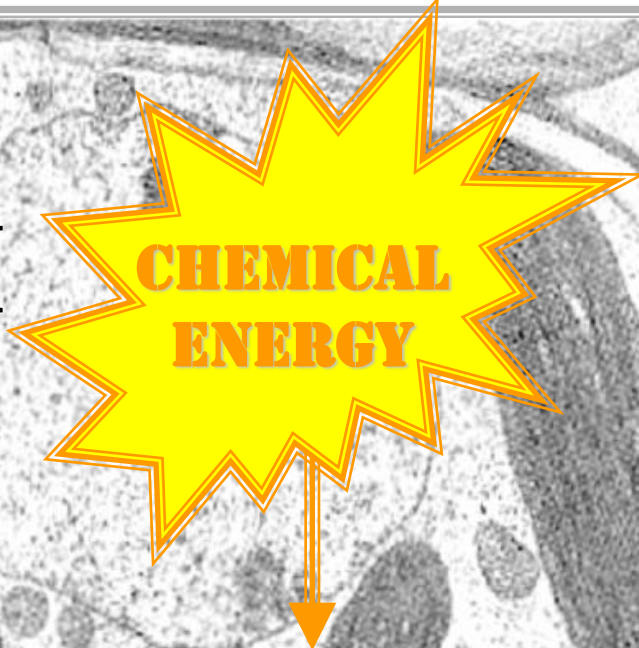
# CELL METABOLISM

ENERGY  
INPUT



REQUIRES  
ENERGY INPUT

# CELL METABOLISM



**CHEMICAL ENERGY INPUT**

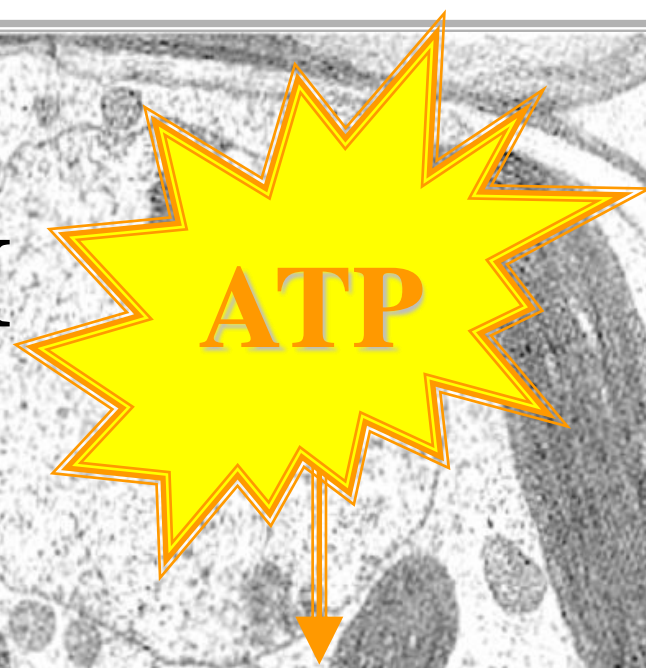
# CELL METABOLISM

**CHEMICAL  
ENERGY**



**ENDERGONIC  
BIOCHEMICAL REACTIONS**

# CELL METABOLISM



**ATP DELIVERS CHEM-EGY  
TO  
ENDERGONIC  
BIOCHEMICAL REACTIONS**

# CELL METABOLISM



ATP



ATP

DRIVES

ENDERGONIC REACTIONS

TO A PRODUCT



# ATP STRUCTURE

# ATP STRUCTURAL COMPONENTS



# **ATP STRUCTURAL COMPONENTS**

**RIBOSE**

# **ATP STRUCTURE COMPONENTS**

# **ATP STRUCTURAL COMPONENTS**

**RIBOSE**

**ADENINE**

**ATP STRUCTURE  
COMPONENTS**

# **ATP STRUCTURAL COMPONENTS**



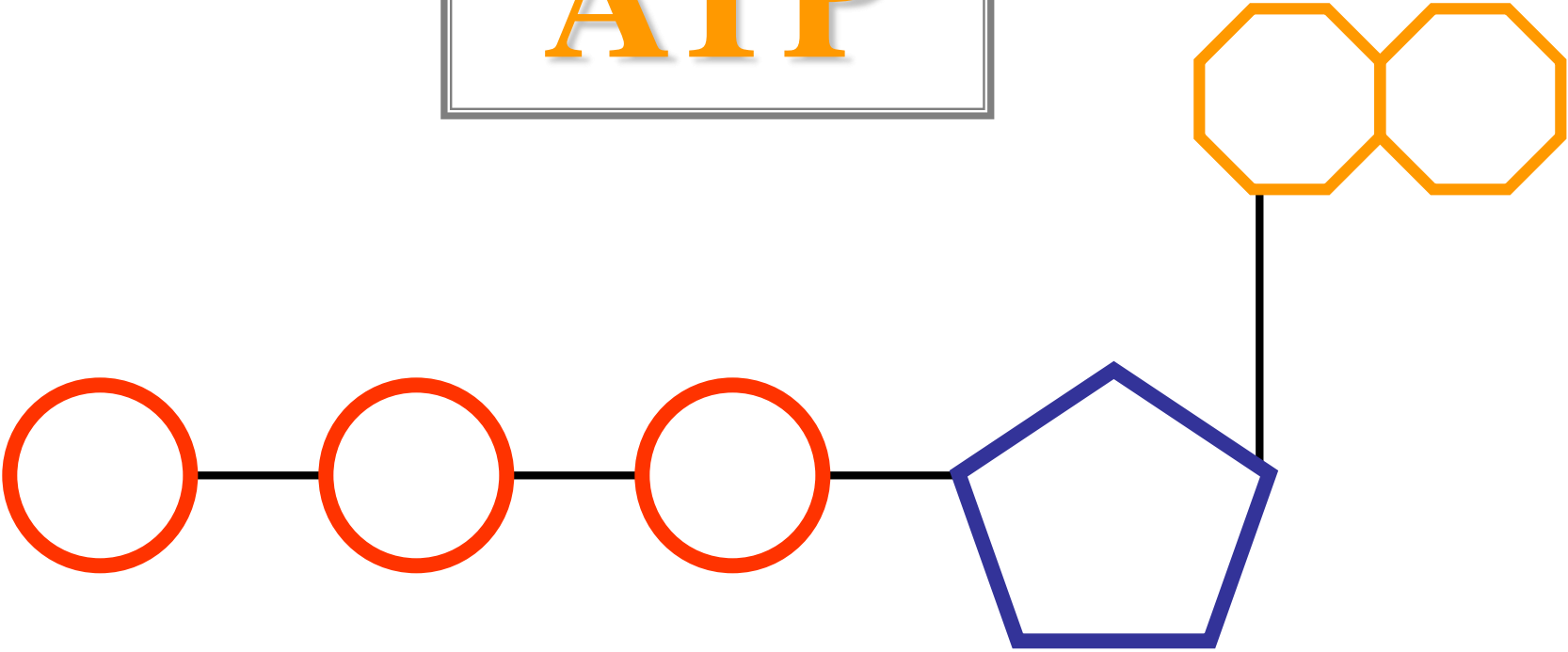
**RIBOSE**

**ADENINE**

**3 PHOSPHATE GROUPS**

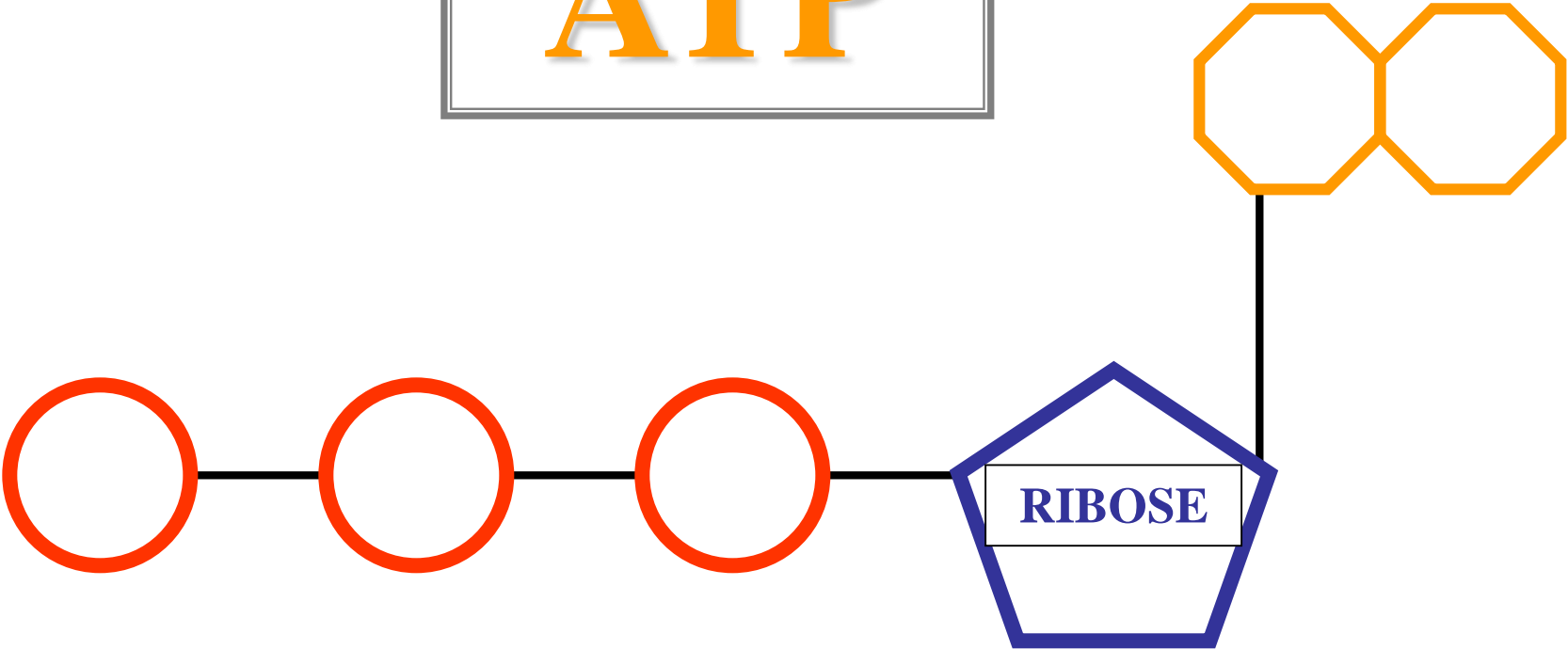
# **ATP STRUCTURE COMPONENTS**

ATP



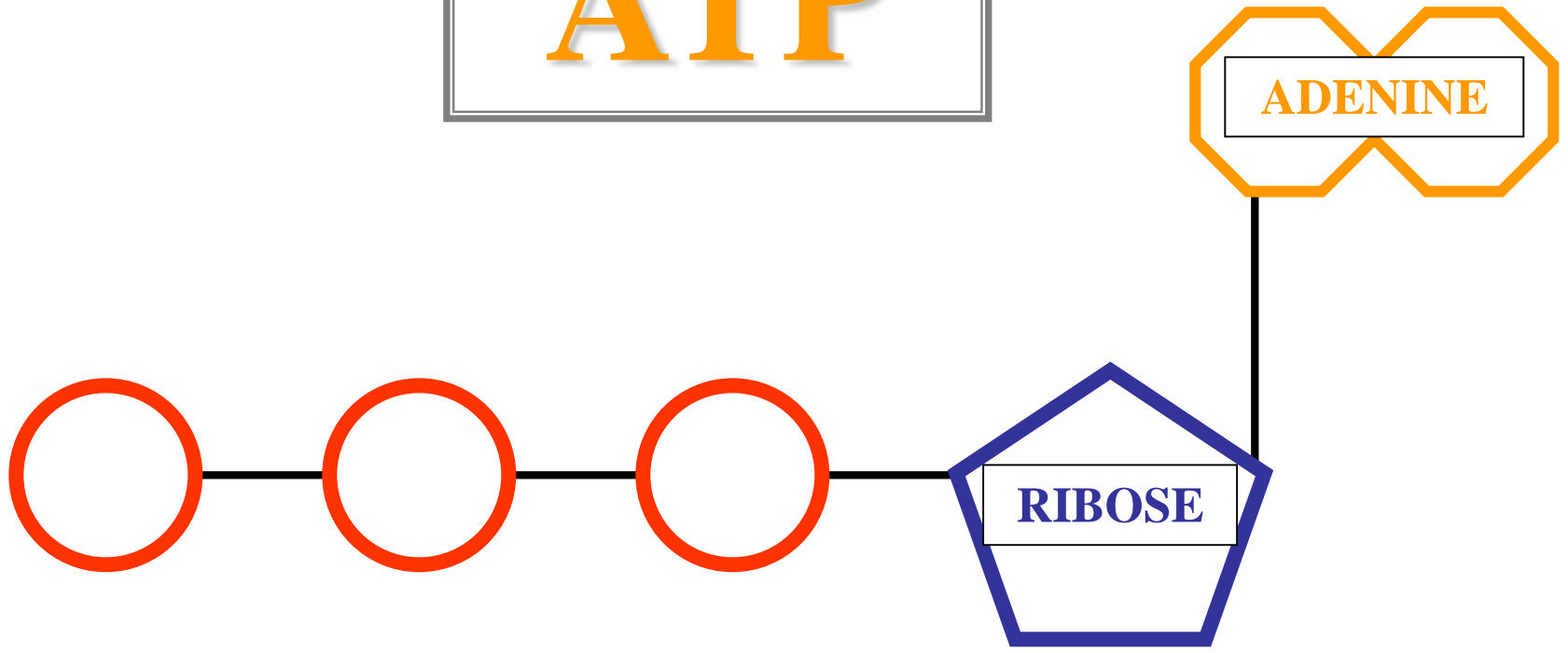
**ATP**  
**STRUCTURE**

ATP



**ATP**  
**STRUCTURE**

ATP



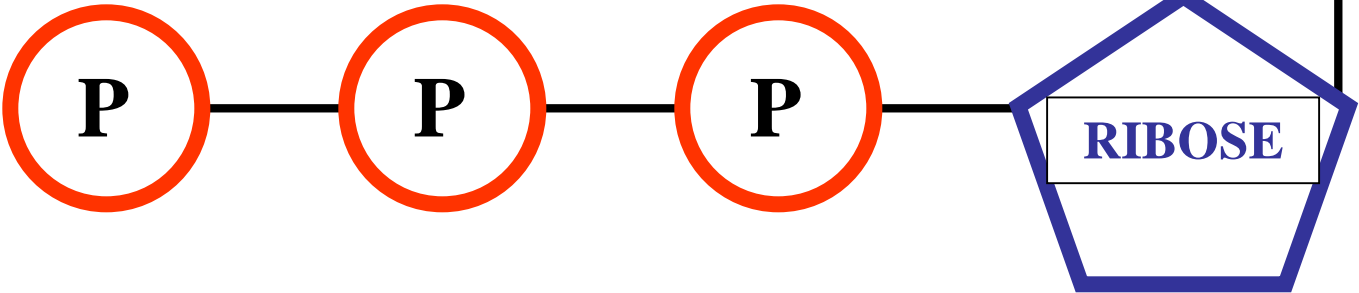
ATP  
STRUCTURE



**ATP**



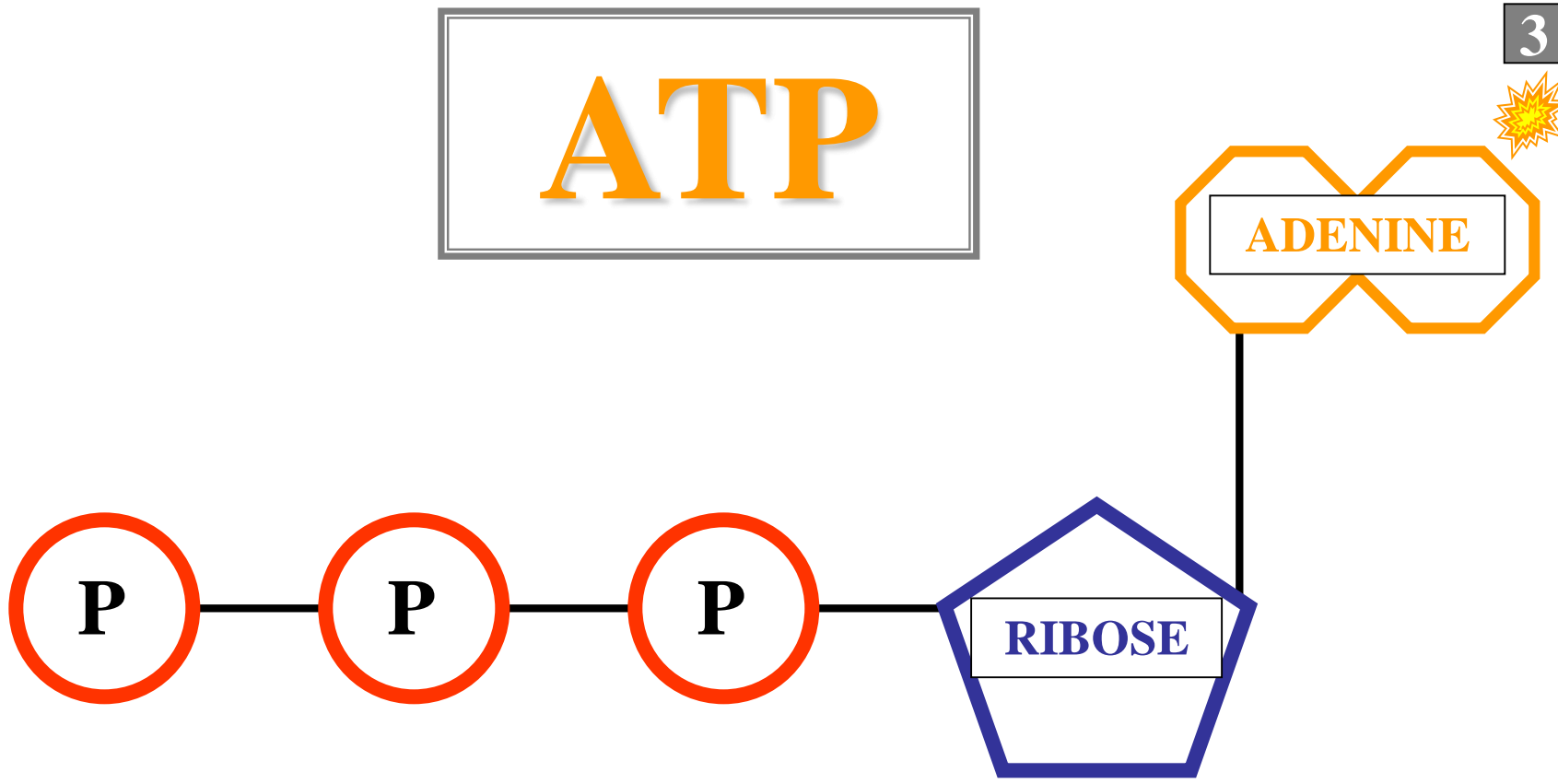
**3 PHOSPHATE GROUPS**



**ATP**  
**STRUCTURE**

# ATP HYDROLYSIS REACTION



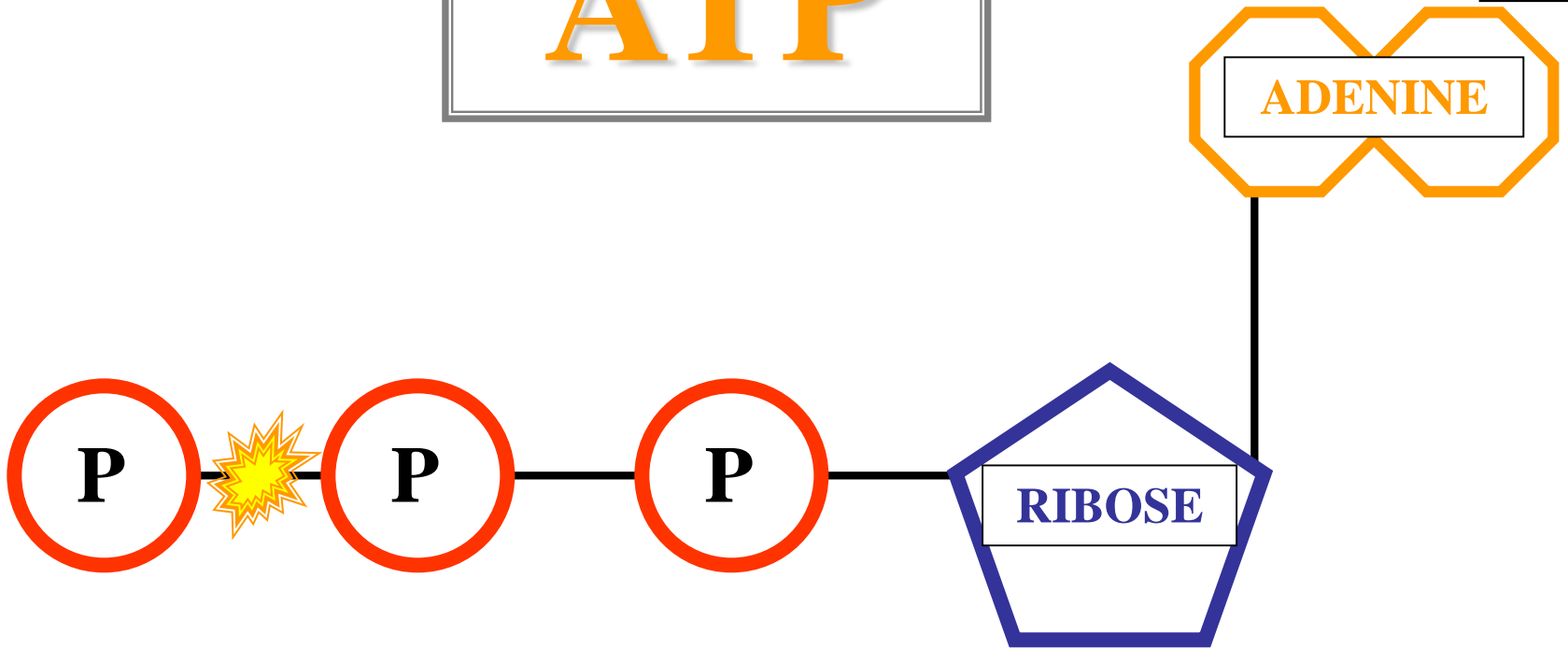


# ATP HYDROLYSIS


# ATP



HR



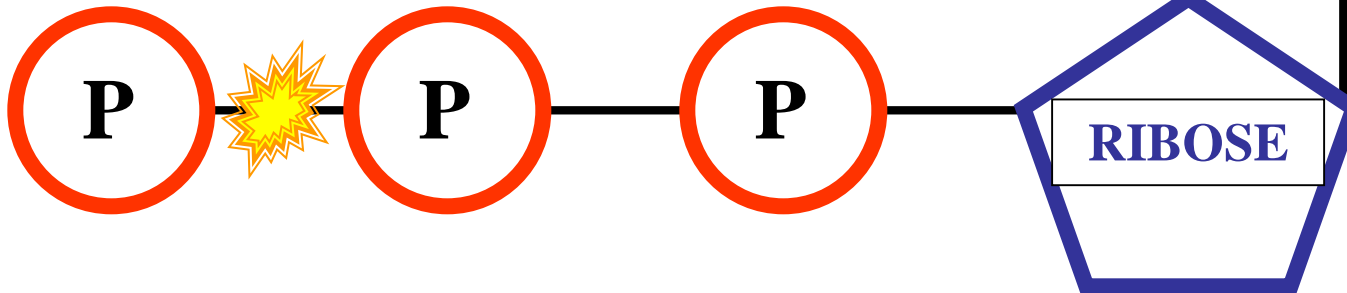
**3RD PHOSPHATE BOND  
HOLDS BIOCHEMICAL ENERGY**

 = **HOLDS BIO-CHEM ENERGY**

# ATP

ADENINE

## HYDROLYSIS RXT



**3RD PHOSPHATE BOND**

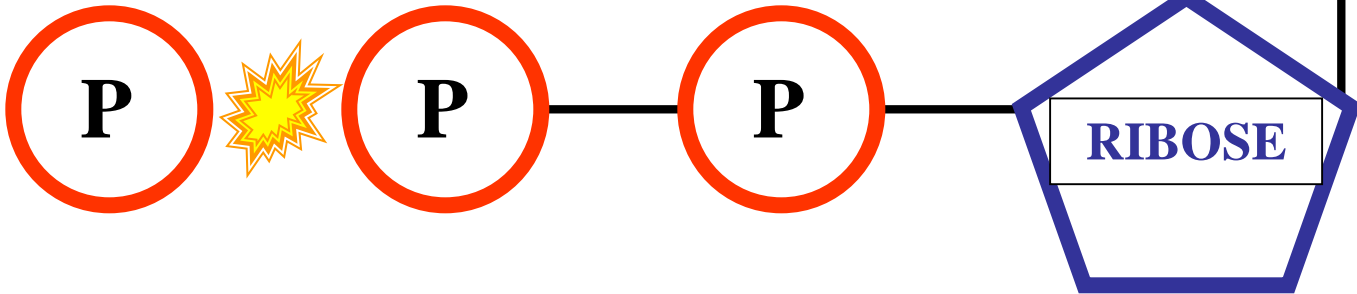
**HOLDS BIOCHEMICAL ENERGY**

 = **HOLDS BIO-CHEM ENERGY**

# ATP



## HYDROLYSIS RXT



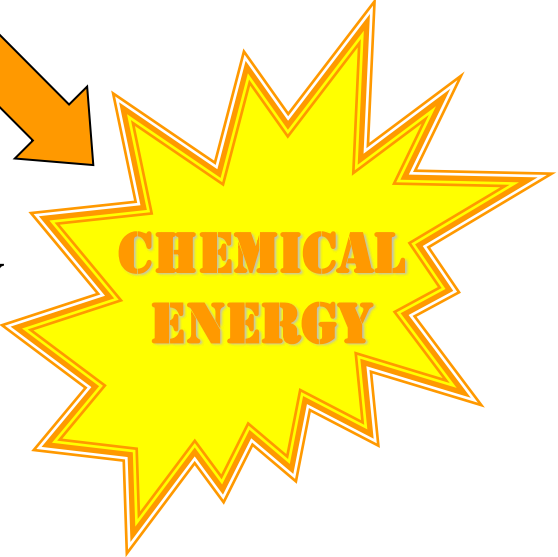
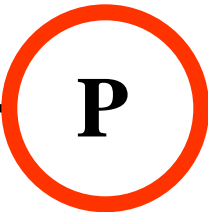
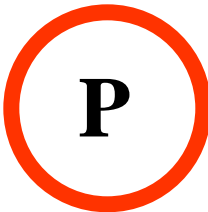
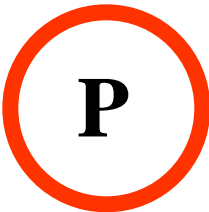
**3RD PHOSPHATE BOND BREAKS**



**= HOLDS BIO-CHEM ENERGY**

# ATP

## HYDROLYSIS RXT

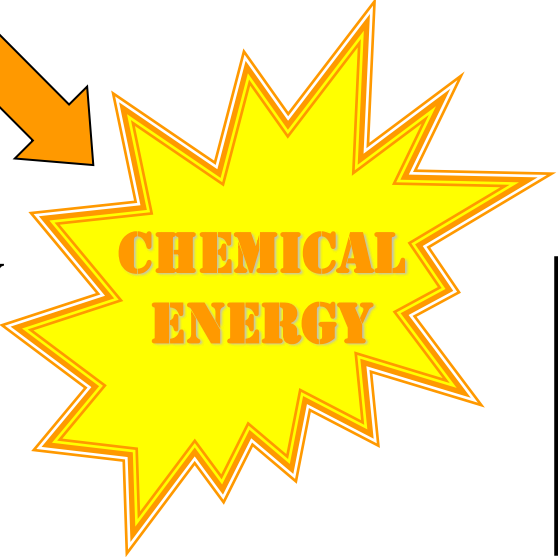
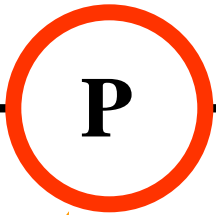
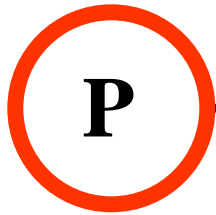


CHEMICAL ENERGY  
RELEASED

# ATP



## HYDROLYSIS RXT



CHEMICAL ENERGY  
RELEASED

## EXERGONIC RXT

# EXERGONIC RXT



**CHEMICAL  
ENERGY**



**BIOCHEMICAL REACTION**

**EXERERGONIC  
RXT**



**CHEMICAL  
ENERGY**

**CMP-A + CMP-B → CMP-C**

**ENDERERGONIC  
RXT**



# CELL METABOLISM

AT

AD

**CHEMICAL  
ENERGY**



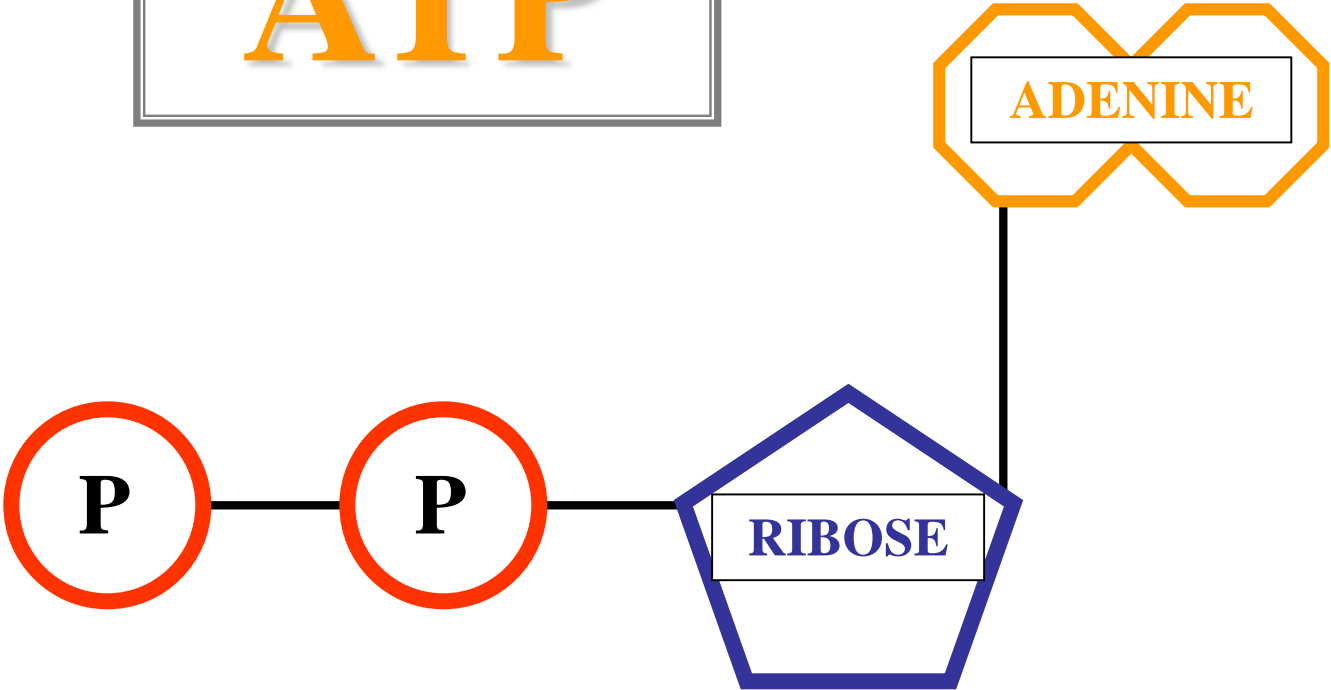
**ATP**

**DRIVES**

**ENDERGONIC REACTIONS**

**TO A PRODUCT**

ATP



**ATP**  
**HYDROLYSIS**

**ADP**

**A**

**+**

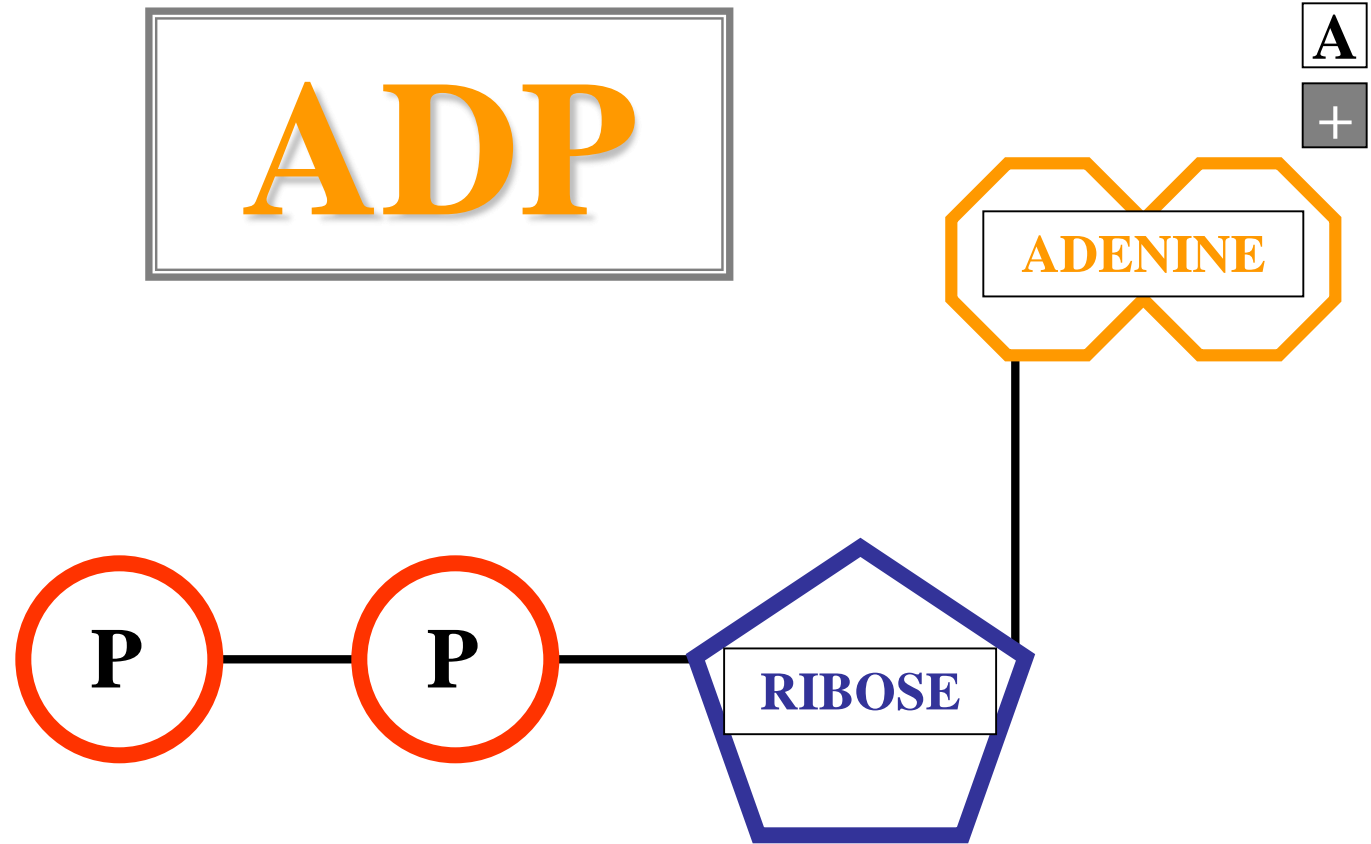
**ADENINE**

**P**

**P**

**RIBOSE**

**ADENOSINE DIPHOSPHATE**



**ADP**

**ADENOSINE**

**DIPHOSPHATE**

**ADENOSINE DIPHOSPHATE<sup>+</sup>**

**ADP**

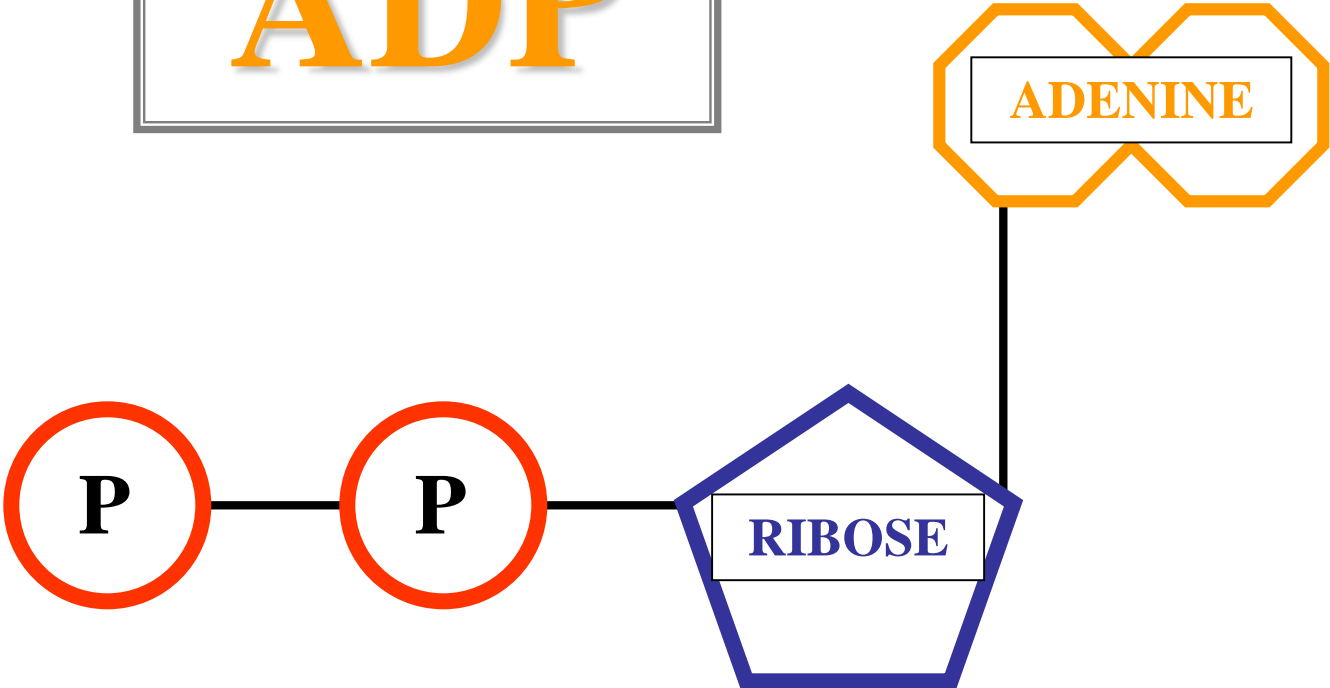
**2 PHOSPHATE GROUPS**

**ADP**

**ADENOSINE DIPHOSPHATE**

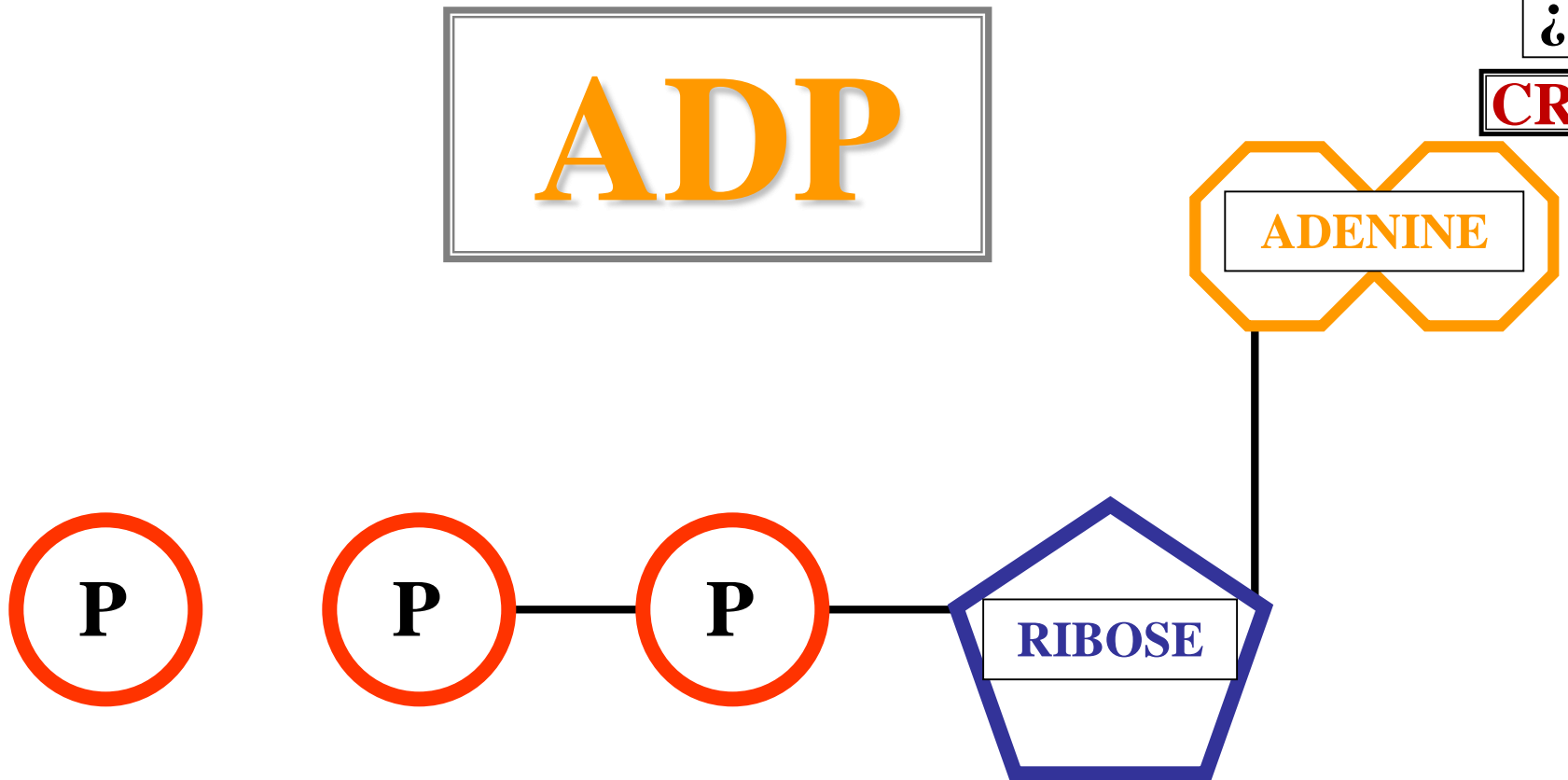
**ADP**

**P**



**ADP**

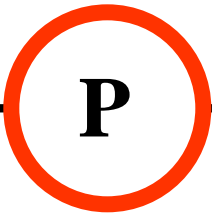
**ADENOSINE DIPHOSPHATE**



**REESTABLISH  
THE 3RD HIGH ENERGY  
PHOSPHATE BOND**



**ADP**

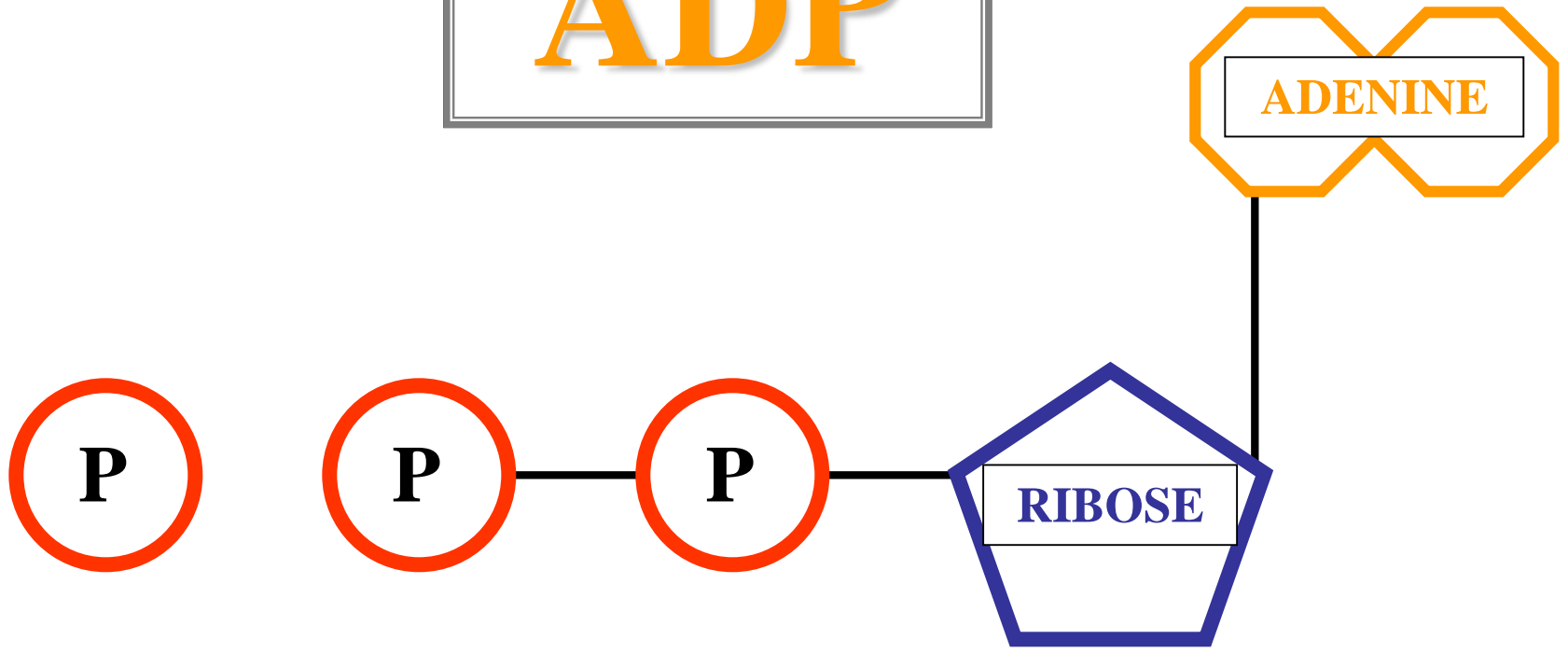


**CONDENSATION  
REACTION**

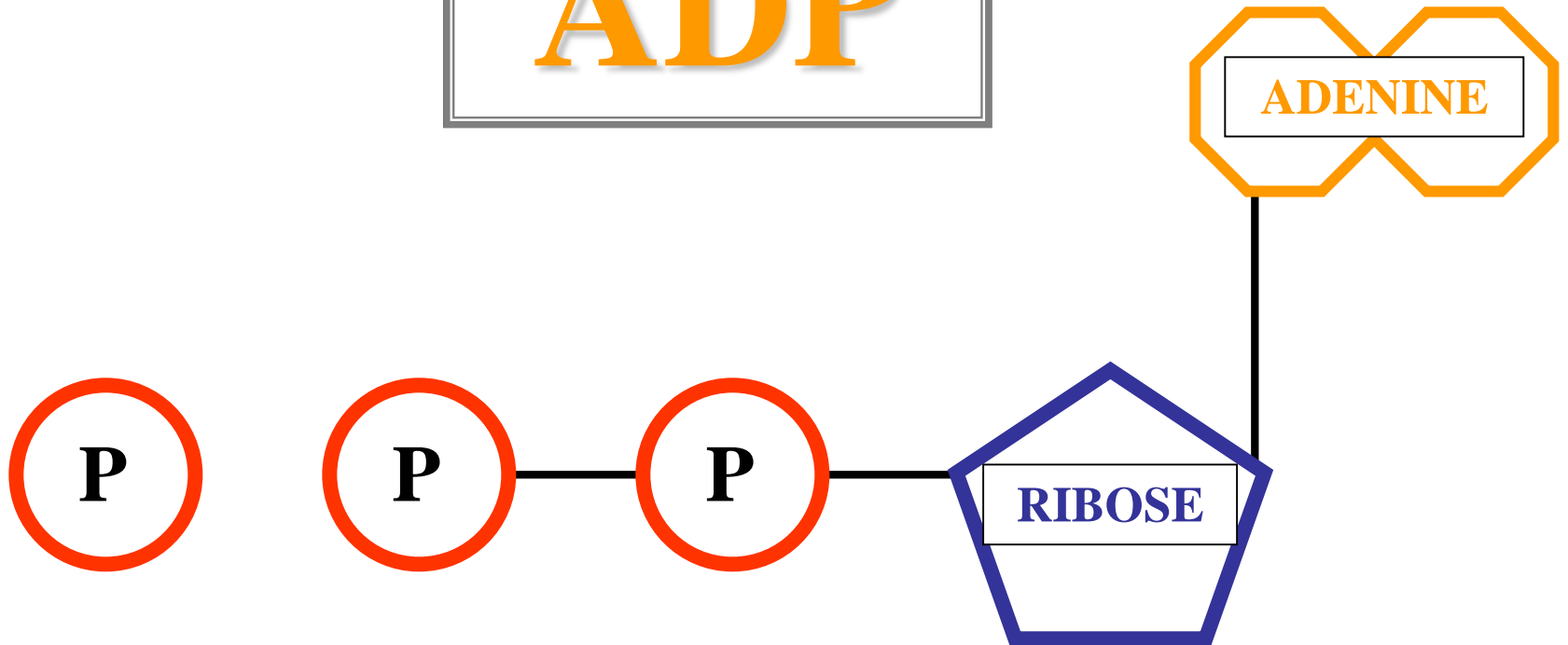


# ADP CONDENSATION REACTION

ADP



ADP

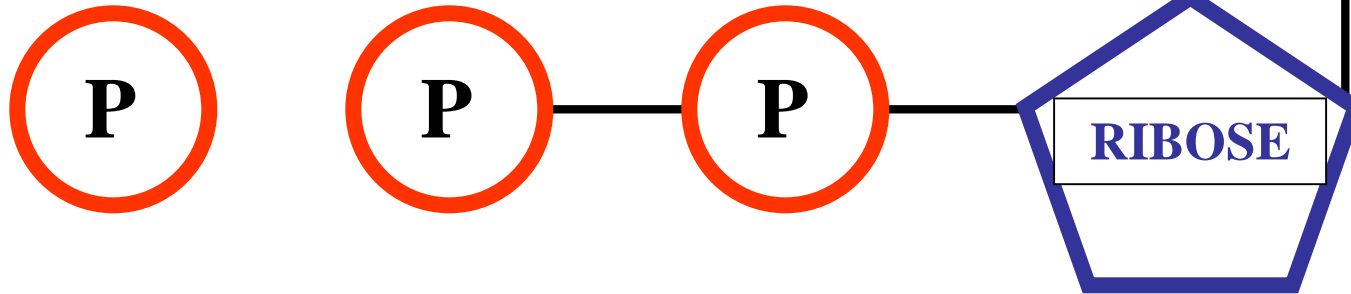


**3RD PHOSPHATE BOND  
HOLDS BIOCHEMICAL ENERGY**

**ADP**

**ADENINE**

**CONDENSATION RXT**



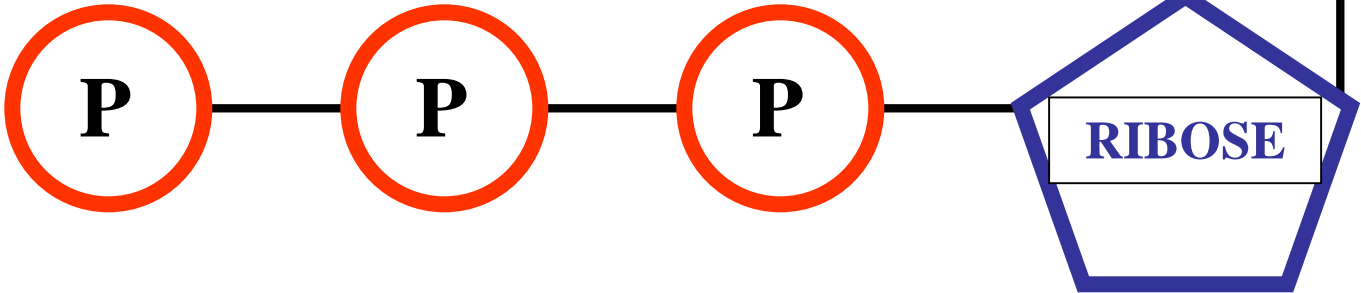
**3RD PHOSPHATE BOND**

**HOLDS BIOCHEMICAL ENERGY**



**ADP**

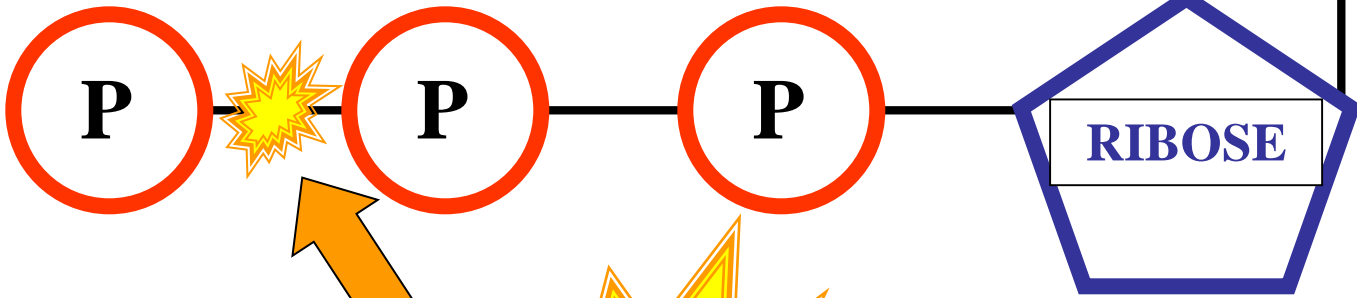
**CONDENSATION RXT**



**3RD PHOSPHATE BOND FORMS**

ADP

CONDENSATION RXT



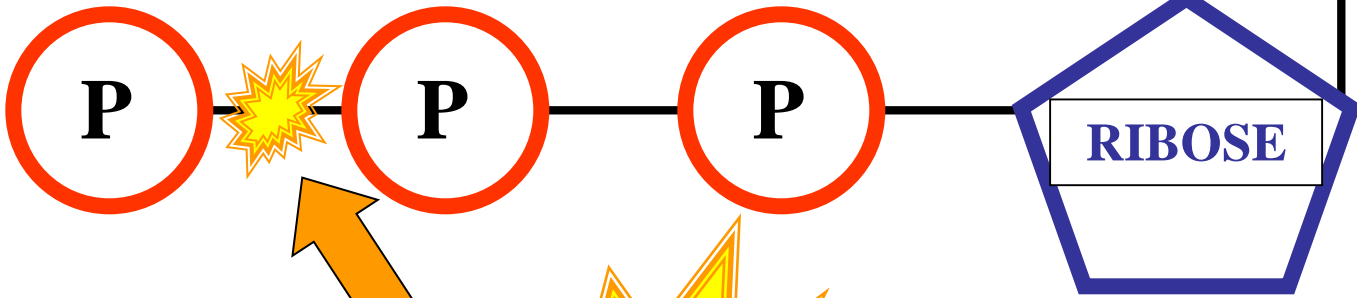
CHEMICAL ENERGY INPUT

AT

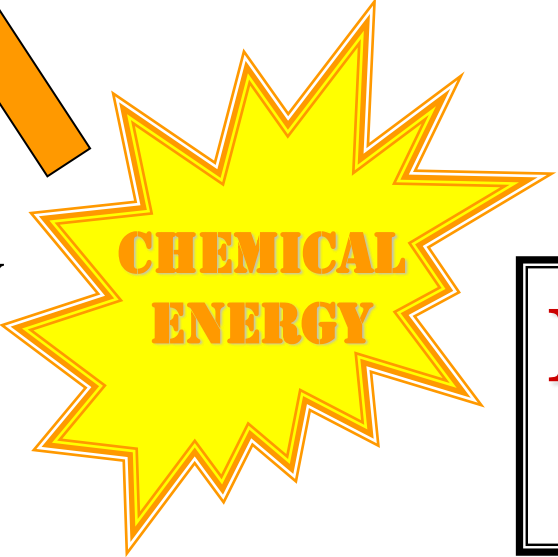
ADP



CONDENSATION RXT

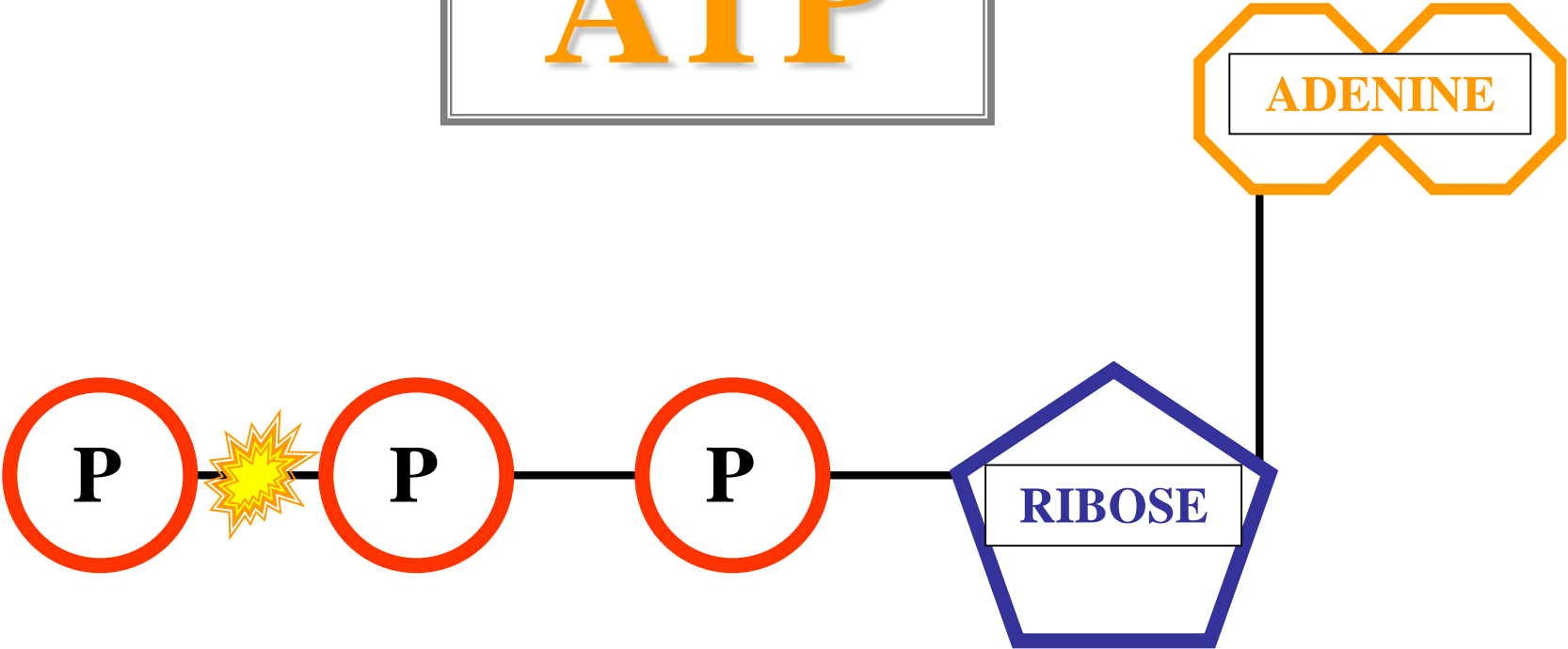


CHEMICAL ENERGY INPUT



ENDERGONIC RXT

# ATP



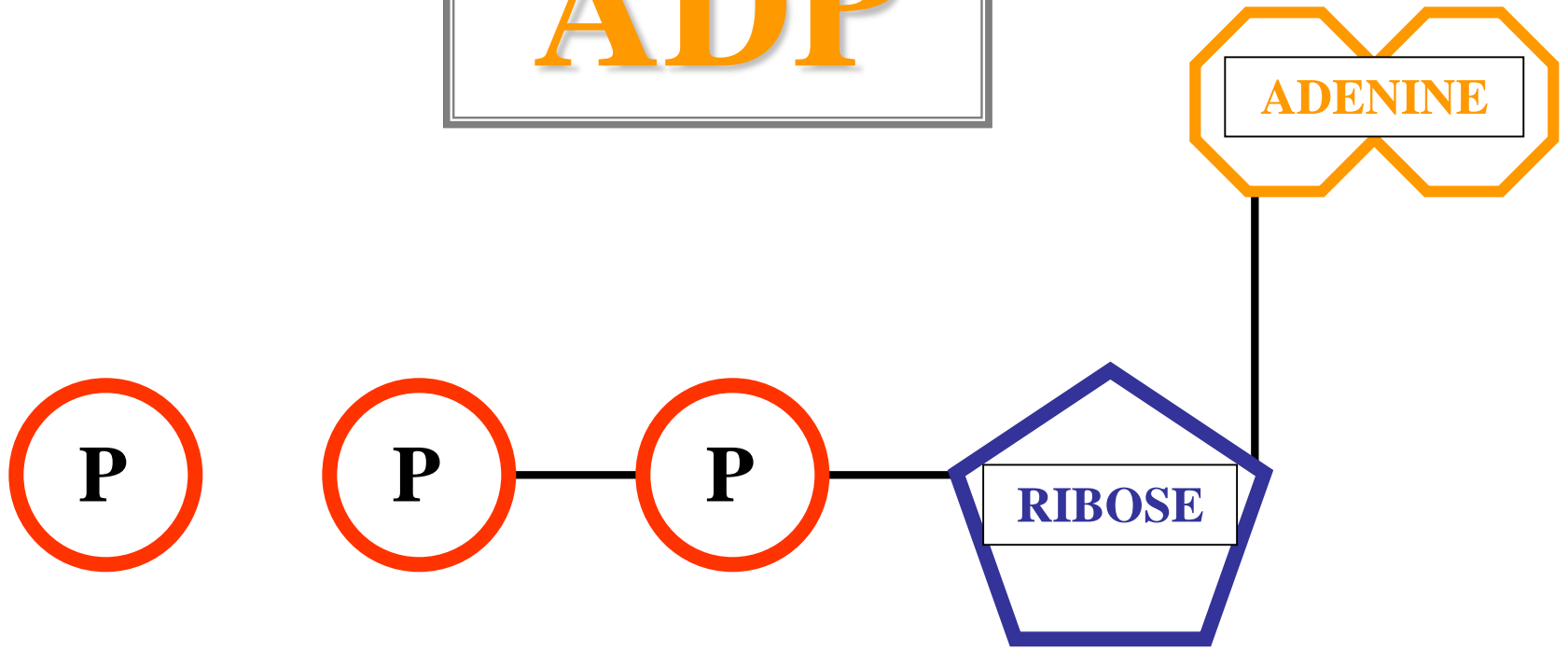
# ADENOSINE TRIPHOSPHATE

 = **HOLDS BIO-CHEM ENERGY**



**ADP  
CONDENSATION  
REACTION  
SUMMARY**

ADP



**ADP**

**ADENINE**

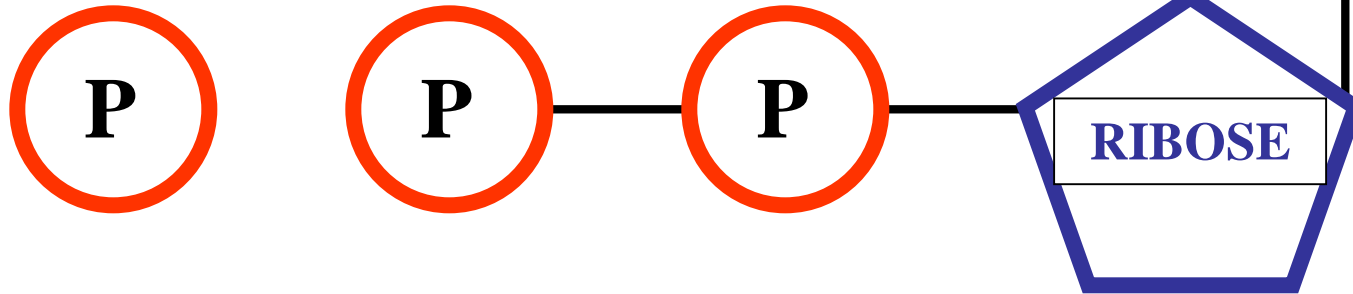
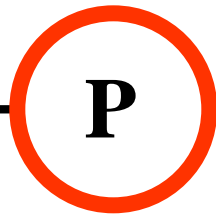
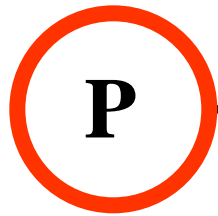
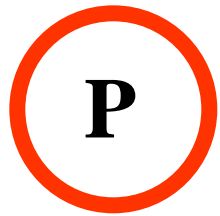
**CONDENSATION RXT**

**P**

**P**

**P**

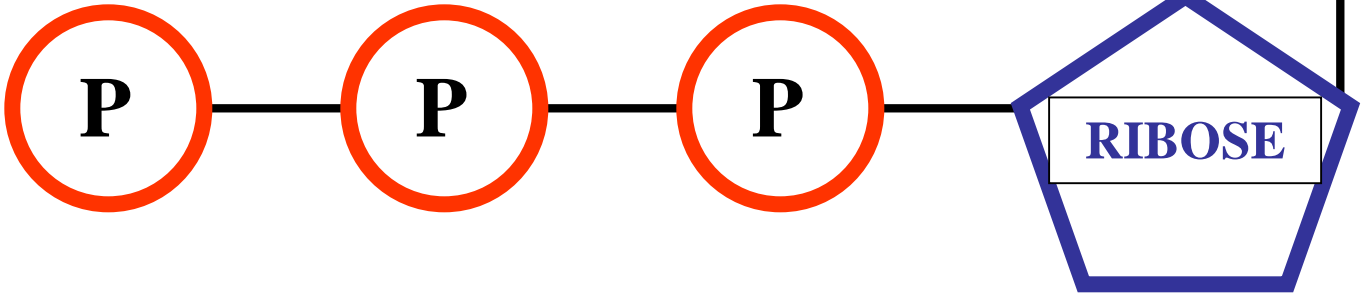
**RIBOSE**





**ADP**

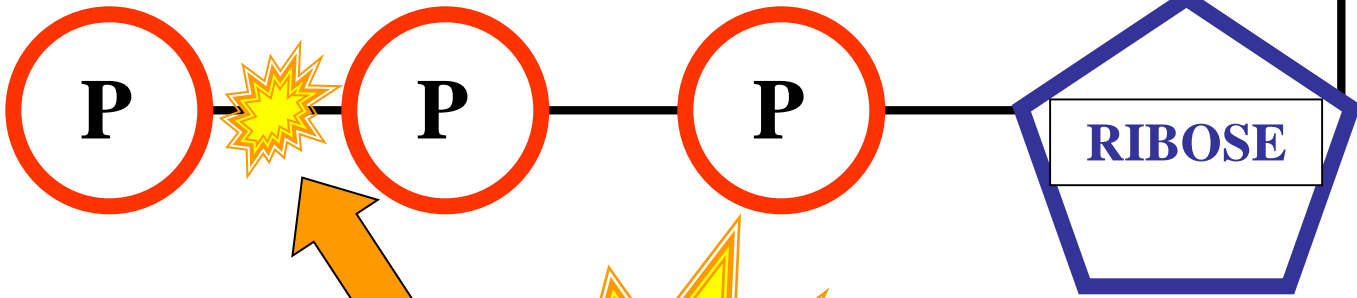
**CONDENSATION RXT**



**3RD PHOSPHATE BOND FORMS**

ADP

CONDENSATION RXT



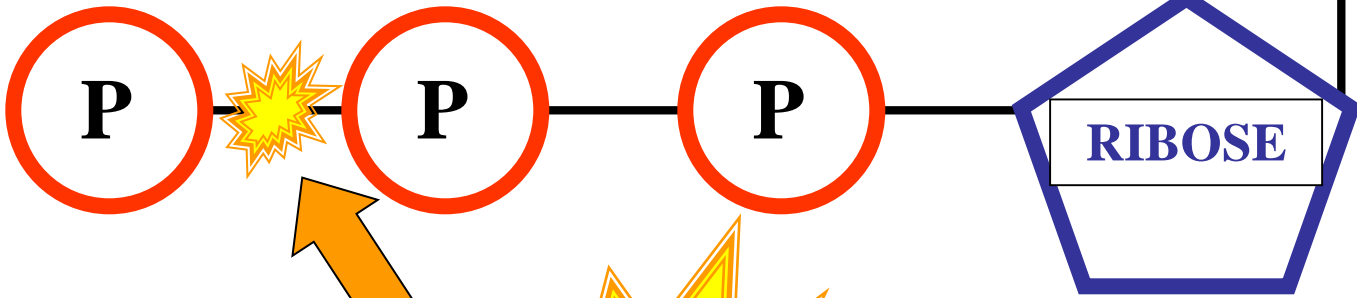
CHEMICAL ENERGY INPUT

AT

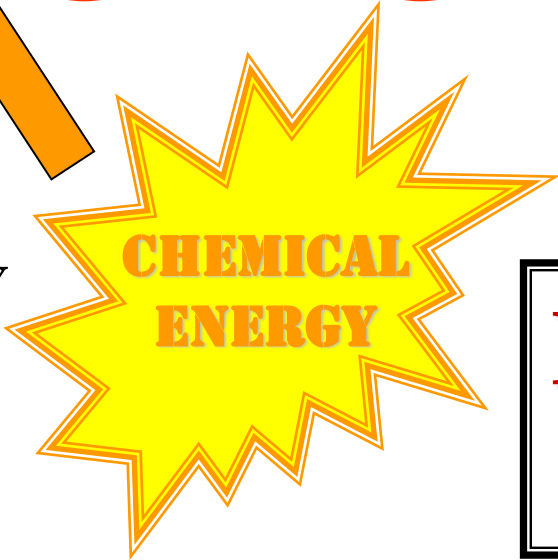
ADP



CONDENSATION RXT



CHEMICAL ENERGY INPUT



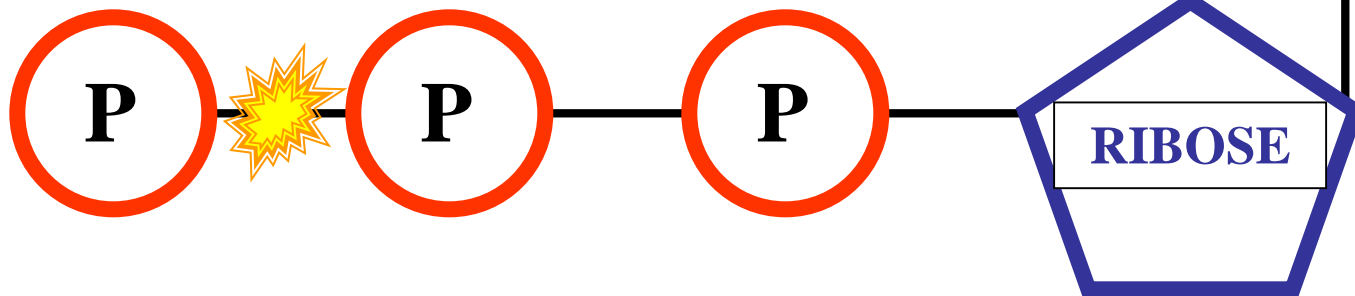
ENDERGONIC RXT

# ATP

AD  
+

ADENINE

## CONDENSATION RXT



# ADENOSINE TRIPHOSPHATE

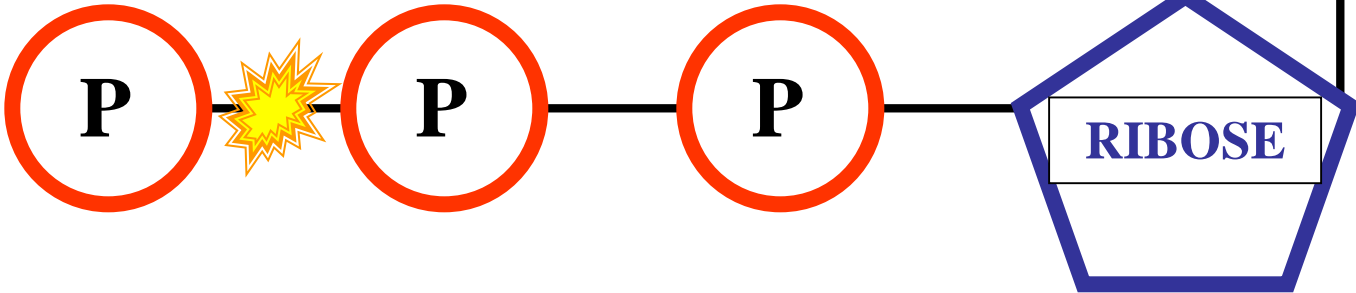
 = HOLDS BIO-CHEM ENERGY

# ATP

P  
=



## CONDENSATION RXT

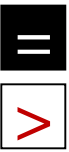


## ADP CONDENSATION

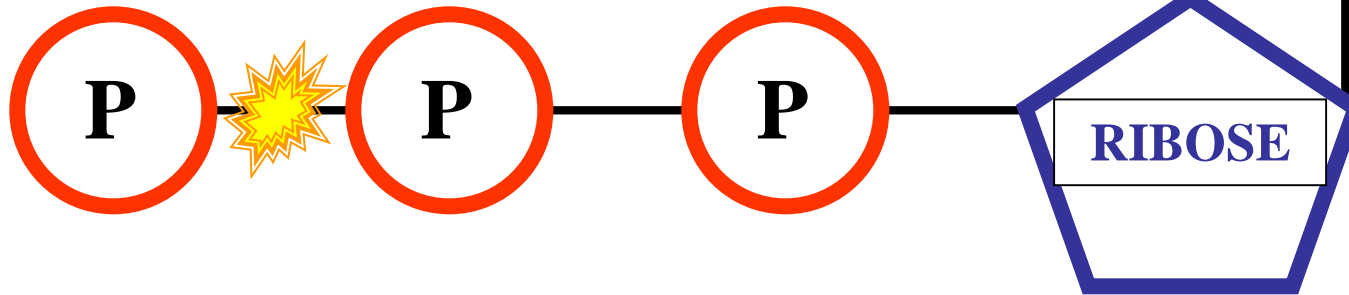
 = HOLDS BIO-CHEM ENERGY




# ATP



## CONDENSATION RXT



## PHOSPHORYLATION

 = HOLDS BIO-CHEM ENERGY



**ADP CONDENSATION**

**SYNONYMOUS**

**PHOSPHORYLATION**



# PHOSPHORYLATION

**ATP**

***PHOSPHORYLATION***

***ESSENTIAL***

***CELL METABOLISM***