

# LACTIC ACID FERMENTATION

**PYRUVATE** + **NADH**

**GLYCOLYSIS**

# LACTIC ACID FERMENTATION



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**PYRUVATE** + **NADH**

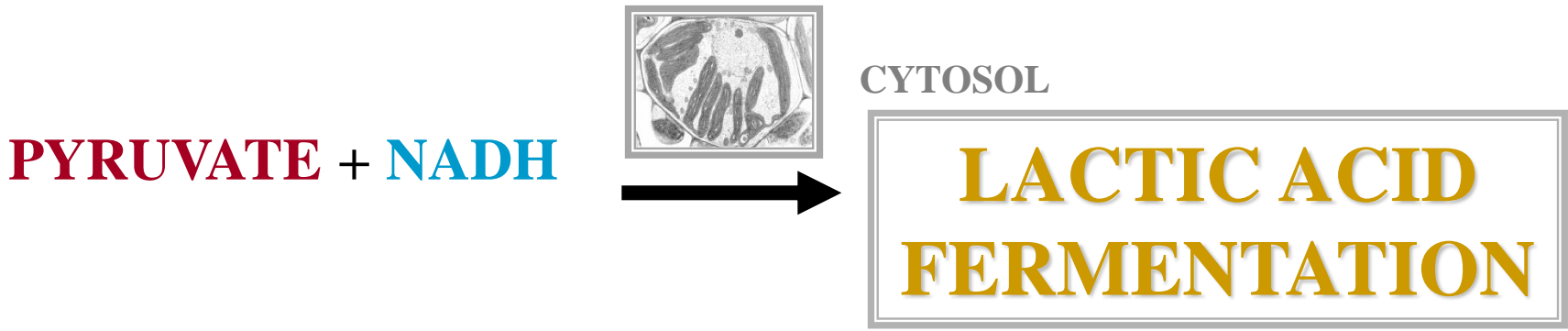


CYTOSOL



# LACTIC ACID FERMENTATION

# LACTIC ACID FERMENTATION



# LACTIC ACID FERMENTATION

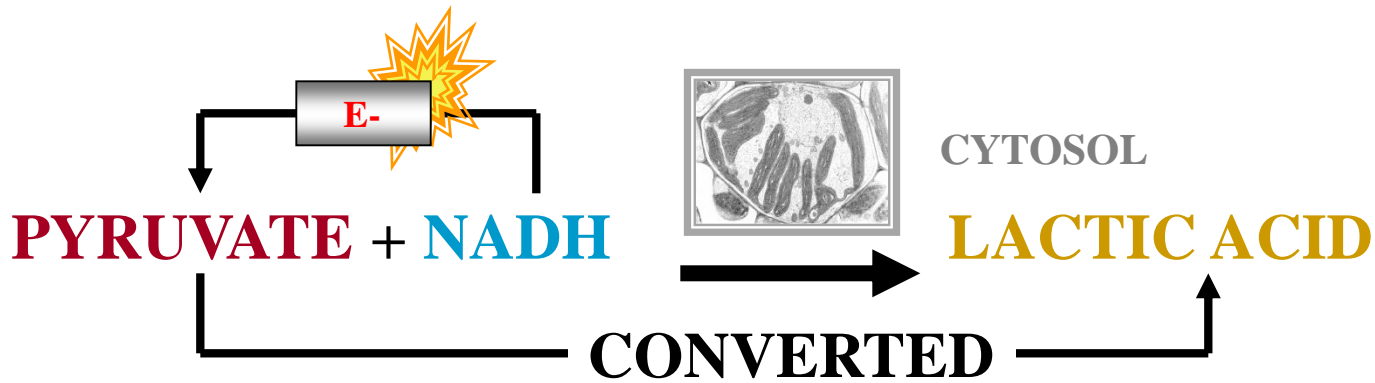
# LACTIC ACID FERMENTATION



# LACTIC ACID FERMENTATION

 = CHEMICAL ENERGY

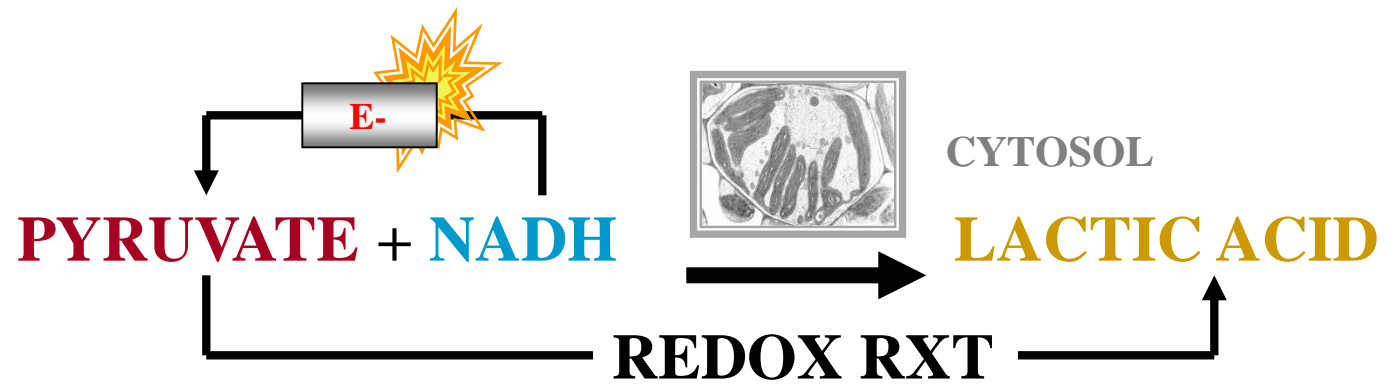
# LACTIC ACID FERMENTATION



# LACTIC ACID FERMENTATION

 = CHEMICAL ENERGY

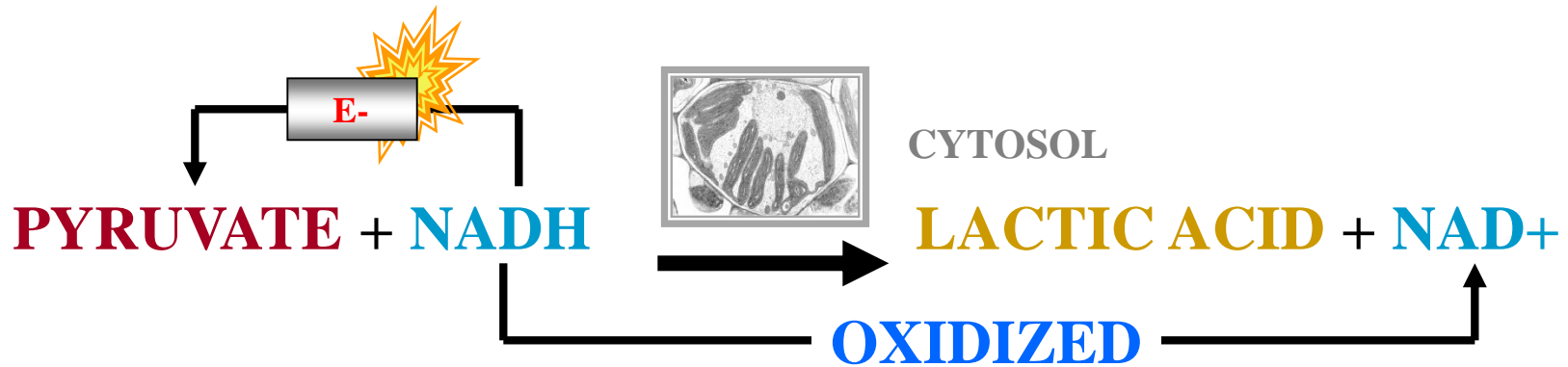
# LACTIC ACID FERMENTATION



# LACTIC ACID FERMENTATION

 = CHEMICAL ENERGY

# LACTIC ACID FERMENTATION

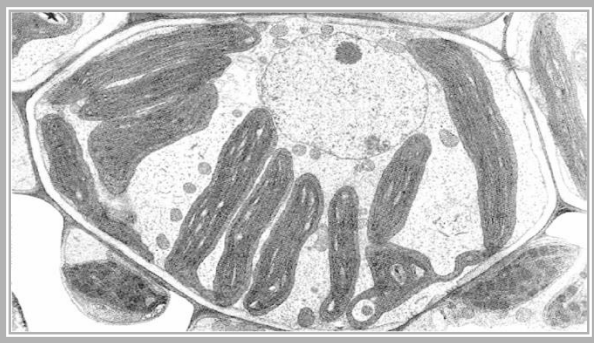


# LACTIC ACID FERMENTATION

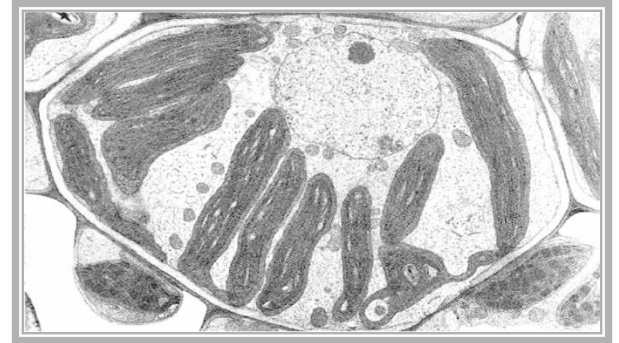
 = CHEMICAL ENERGY



# LACTIC ACID FERMENTATION



**NAD<sup>+</sup>**



# LACTIC ACID FERMENTATION





***LACTIC ACID  
FERMENTATION  
REGENERATES***

***NAD<sup>+</sup>***



# **FERMENTATION IMPORTANCE**



***NAD<sup>+</sup>***  
***REQUIRED***  
***ANAEROBIC***  
***GLYCOLYSIS***

*NAD<sup>+</sup>*

*LIMITED SUPPLY*

*WITHIN*

*CELL CYTOSOL*



**GLYCOLYSIS**



**NAD<sup>+</sup>**

**NAD<sup>+</sup>**

**NAD<sup>+</sup>**

**NAD<sup>+</sup>**

**NAD<sup>+</sup>**

**NAD<sup>+</sup>**

***NAD<sup>+</sup>***

***LIMITED***

***SUPPLY***

***WITHIN***

***CELL CYTOSOL***

**ANAEROBIC  
RESPIRATION**

# GLYCOLYSIS



NAD<sup>+</sup>

NAD<sup>+</sup>

NAD<sup>+</sup>

NAD<sup>+</sup>

NAD<sup>+</sup>

NAD<sup>+</sup>

*NAD<sup>+</sup>*

*LIMITED*

*SUPPLY*

*WITHIN*

*CELL CYTOSOL*

**ANAEROBIC  
RESPIRATION**



# GLYCOLYSIS



NAD<sup>+</sup>

NAD<sup>+</sup>

NAD<sup>+</sup>

NAD<sup>+</sup>

ANAEROBIC  
RESPIRATION

*NAD<sup>+</sup>*  
*LIMITED*  
*SUPPLY*  
*WITHIN*  
*CELL CYTOSOL*



# GLYCOLYSIS



NAD<sup>+</sup>

NAD<sup>+</sup>

ANAEROBIC  
RESPIRATION

NAD<sup>+</sup>  
**LIMITED  
SUPPLY  
WITHIN  
CELL CYTOSOL**



A grayscale electron micrograph of a cell, showing various organelles like mitochondria and the cytosol. The image is used as a background for text. There are several text boxes and labels overlaid on the image. A box at the top center contains the word 'GLYCOLYSIS'. A box at the top left contains the word 'GLUCOSE'. On the right side, there is a small box with the letter 'D'. In the center-right, there is a large text block: 'NAD+' in blue, followed by 'LIMITED SUPPLY WITHIN CELL CYTOSOL' in red. In the bottom left, there is a text block: 'ANAEROBIC RESPIRATION' in black.

**GLYCOLYSIS**

**D**

**GLUCOSE**

***NAD<sup>+</sup>***

***LIMITED***

***SUPPLY***

***WITHIN***

***CELL CYTOSOL***

**ANAEROBIC  
RESPIRATION**

A grayscale electron micrograph of a cell, showing various organelles like mitochondria and the cytosol. The image is used as a background for text overlays.

GLYCOLYSIS

3S

?

GLUCOSE

*NAD<sup>+</sup>*

*DEPLETED*

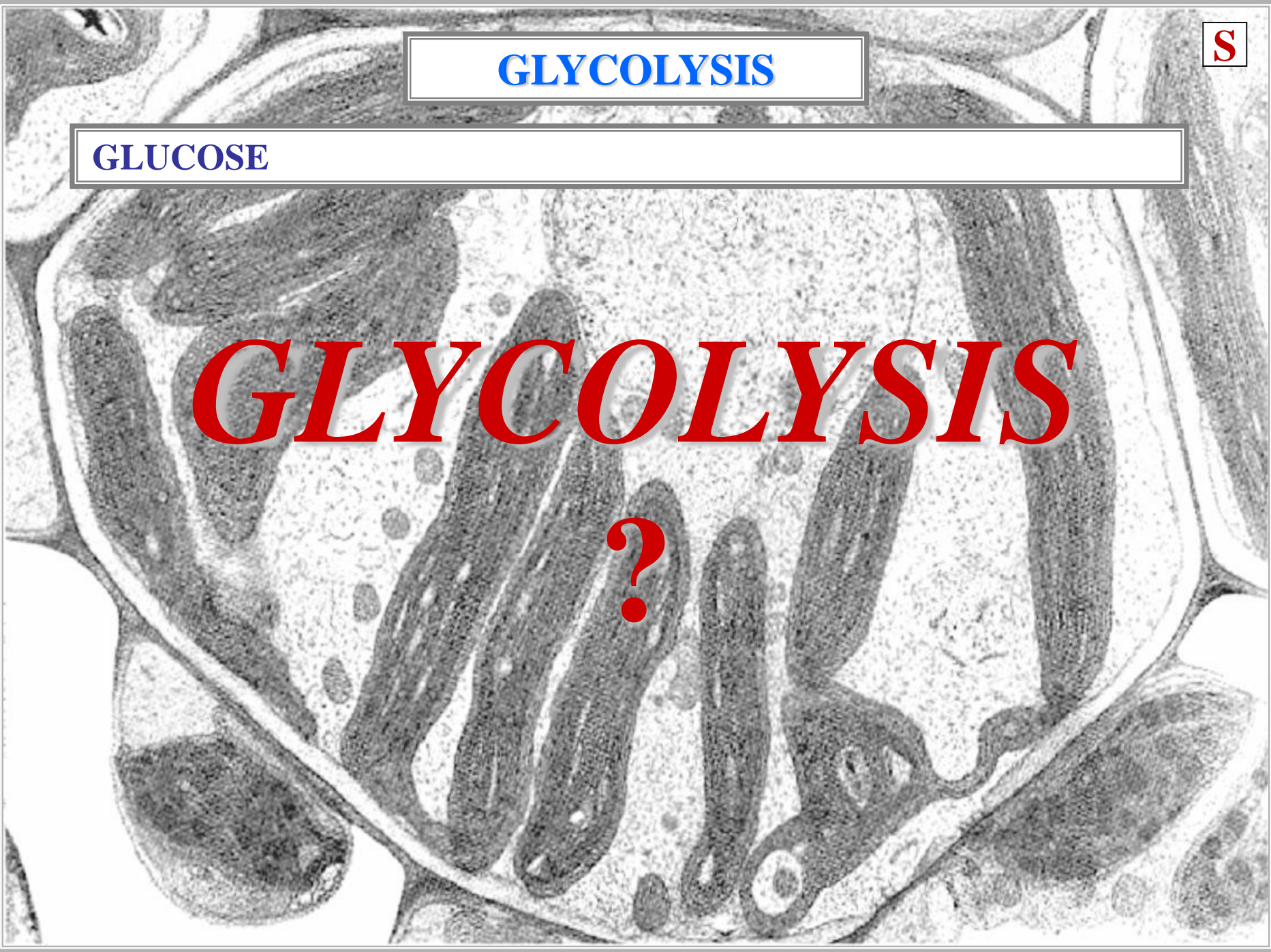
*WITHIN*

*CELL CYTOSOL*

GLYCOLYSIS

GLUCOSE

*GLYCOLYSIS*  
?



A grayscale electron micrograph of a cell, likely a muscle cell, showing various organelles such as mitochondria and sarcoplasmic reticulum. The text 'GLYCOLYSIS' is centered at the top in a blue box. Below it, 'GLUCOSE' is in a white box. In the top right corner, there are two small boxes: the top one contains '2S' and the bottom one contains a question mark. The main text 'GLYCOLYSIS STOPS' is written in large, bold, red, italicized letters across the center of the image.

**GLYCOLYSIS**

**2S**

**?**

**GLUCOSE**

***GLYCOLYSIS  
STOPS***

An electron micrograph of a muscle cell. The image shows several mitochondria with distinct cristae, sarcoplasmic reticulum, and myofibrils. The text is overlaid on this background.

**GLYCOLYSIS**

**S**

**GLUCOSE**

***ANAEROBIC  
RESPIRATION***

**?**

A grayscale electron micrograph of a cell, showing various organelles such as mitochondria with internal folds (cristae) and a nucleus. The image is used as a background for text.

**GLYCOLYSIS**

**1S**

**?**

**GLUCOSE**

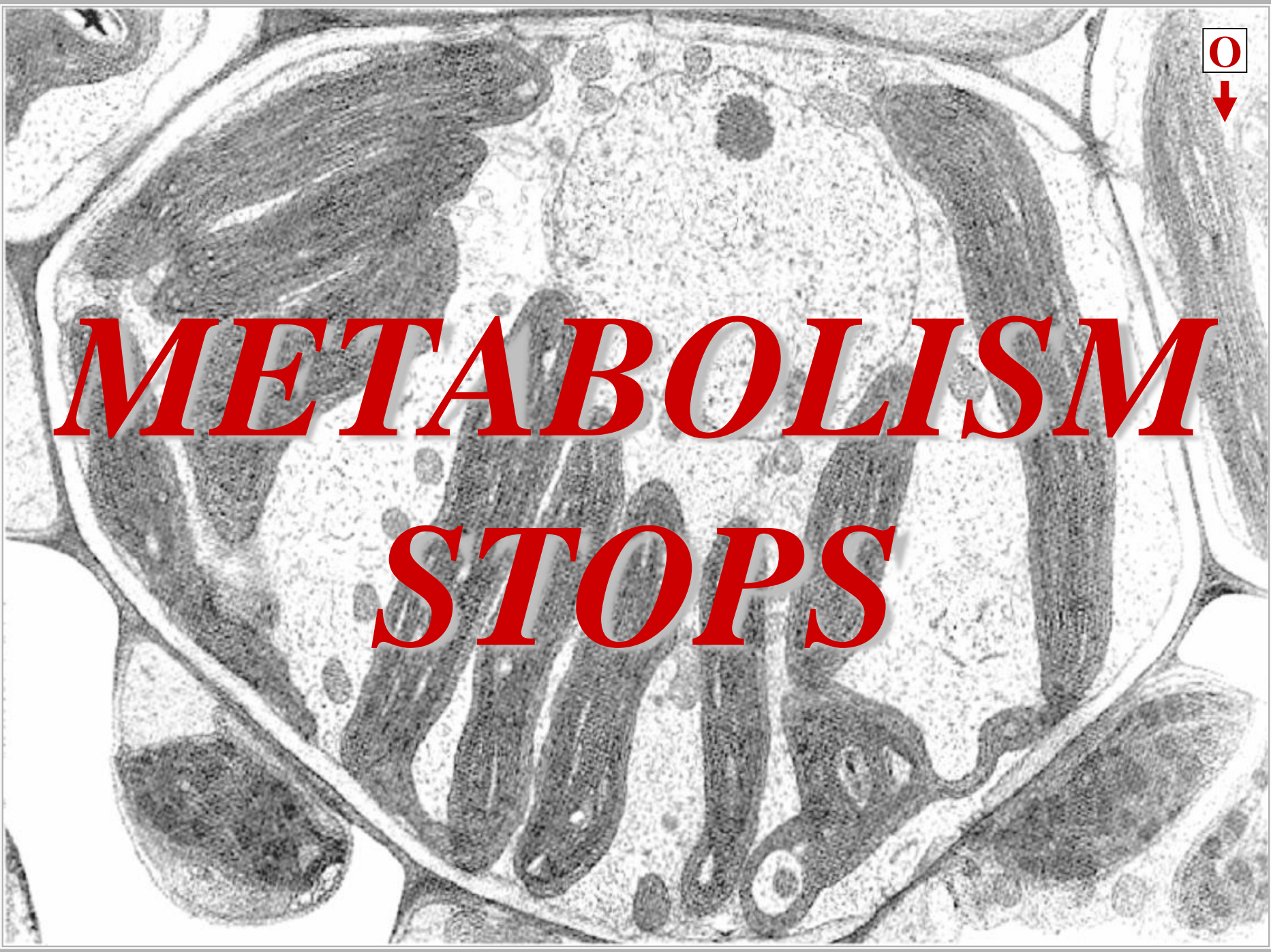
***ANAEROBIC  
RESPIRATION  
STOPS***

# ***METABOLISM***

?



***METABOLISM  
STOPS***





E



***ORGANIZATION  
DECREASES***



***ENTROPY  
INCREASES***

?

***HOMEOSTASIS  
DISRUPTED***



***WHAT  
MUST BE  
CONTINUALLY  
REGENERATED  
W/IN CYTOSOL?***

*NAD<sup>+</sup>*

*MUST BE*

*CONTINUALLY*

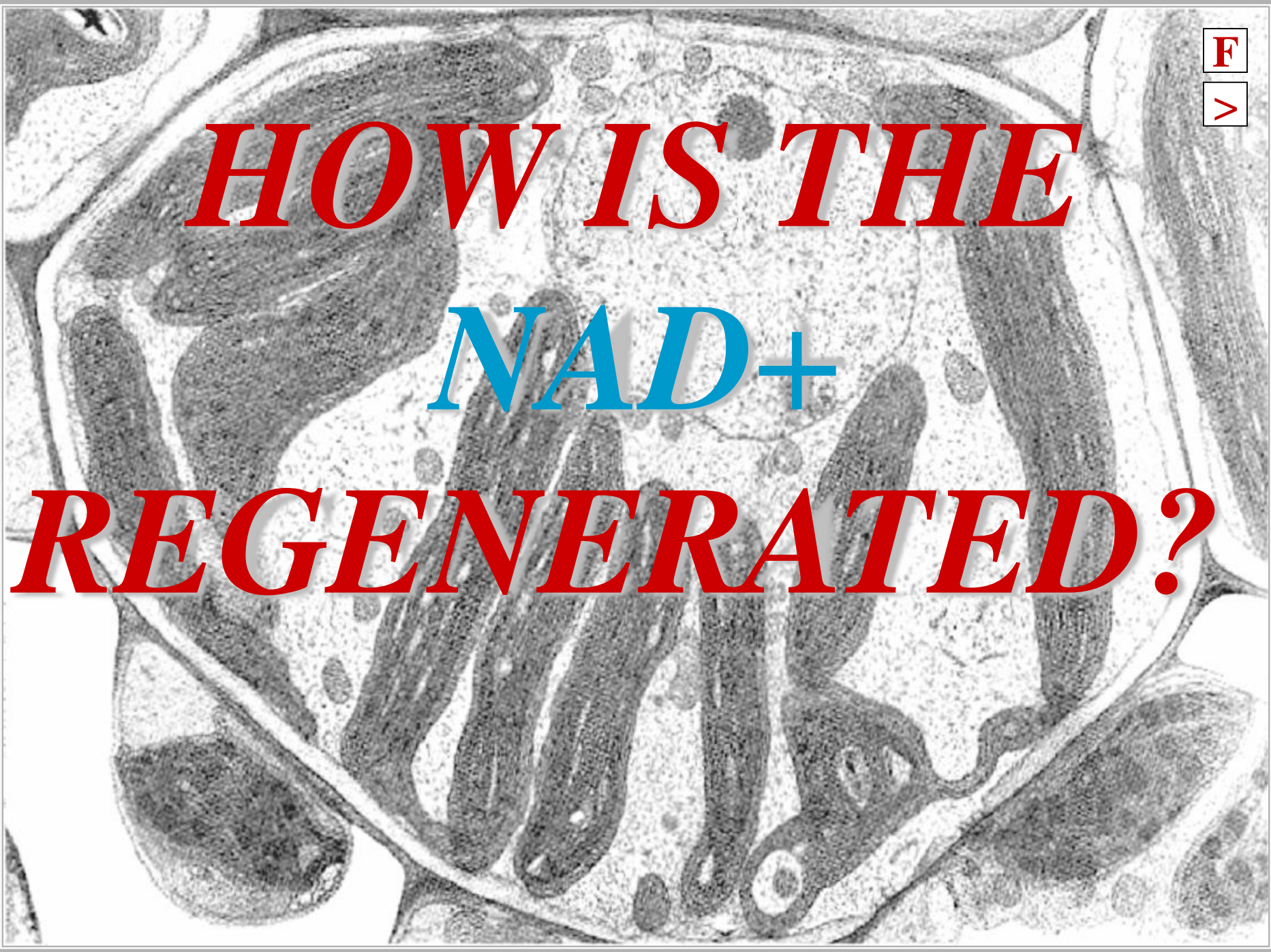
*REGENERATED*

*W/IN CYTOSOL*

*HOW IS THE*

*NAD<sup>+</sup>*

*REGENERATED?*



A grayscale electron micrograph of a cell, showing various organelles such as mitochondria, endoplasmic reticulum, and Golgi apparatus. The text is overlaid on the image.

+

AF

*HOW IS THE*

*NAD<sup>+</sup>*

*REGENERATED?*

*FERMENTATION*

A transmission electron micrograph (TEM) of liver tissue, showing several hepatocytes. The cells are arranged in cords and contain numerous mitochondria with visible cristae, as well as rough endoplasmic reticulum and glycogen granules. The overall structure is highly organized and typical of liver parenchyma.

+

LF

***ALCOHOLIC  
FERMENTATION  
REGENERATES***

***NAD<sup>+</sup>***



***LACTIC ACID  
FERMENTATION  
REGENERATES***

***NAD<sup>+</sup>***

A grayscale electron micrograph of a cell, showing various organelles like mitochondria and the cytosol. The image is used as a background for text. In the top right corner, there are two small boxes: one with the letter 'N' and one with a plus sign '+'.

**GLYCOLYSIS**

**GLUCOSE**

***FERMENTATION  
REGENERATES***

***NAD<sup>+</sup>***

**ANAEROBIC  
RESPIRATION**

***W/IN CYTOSOL***



GLYCOLYSIS



FB

GLUCOSE

NAD<sup>+</sup>

NAD<sup>+</sup>

NAD<sup>+</sup>

NAD<sup>+</sup>

NAD<sup>+</sup>

NAD<sup>+</sup>

*FERMENTATION  
REGENERATES*

NAD<sup>+</sup>

ANAEROBIC  
RESPIRATION

*W/IN CYTOSOL*

# GLYCOLYSIS



GLUCOSE + 2 NAD<sup>+</sup>

FEEDBACK

NAD<sup>+</sup>

NAD<sup>+</sup>

NAD<sup>+</sup>

NAD<sup>+</sup>

NAD<sup>+</sup>

NAD<sup>+</sup>

*FERMENTATION  
REGENERATES*

NAD<sup>+</sup>

ANAEROBIC  
RESPIRATION

*W/IN CYTOSOL*

# GLYCOLYSIS

A



FEEDBACK

NAD<sup>+</sup>

NAD<sup>+</sup>

NAD<sup>+</sup>

NAD<sup>+</sup>

NAD<sup>+</sup>

NAD<sup>+</sup>

*FERMENTATION  
REGENERATES*

NAD<sup>+</sup>

**ANAEROBIC  
RESPIRATION**

*W/IN CYTOSOL*

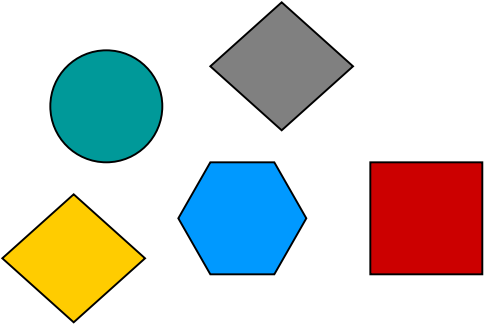
# METABOLISM

## GLUCOSE



**CATABOLIC  
METABOLISM**

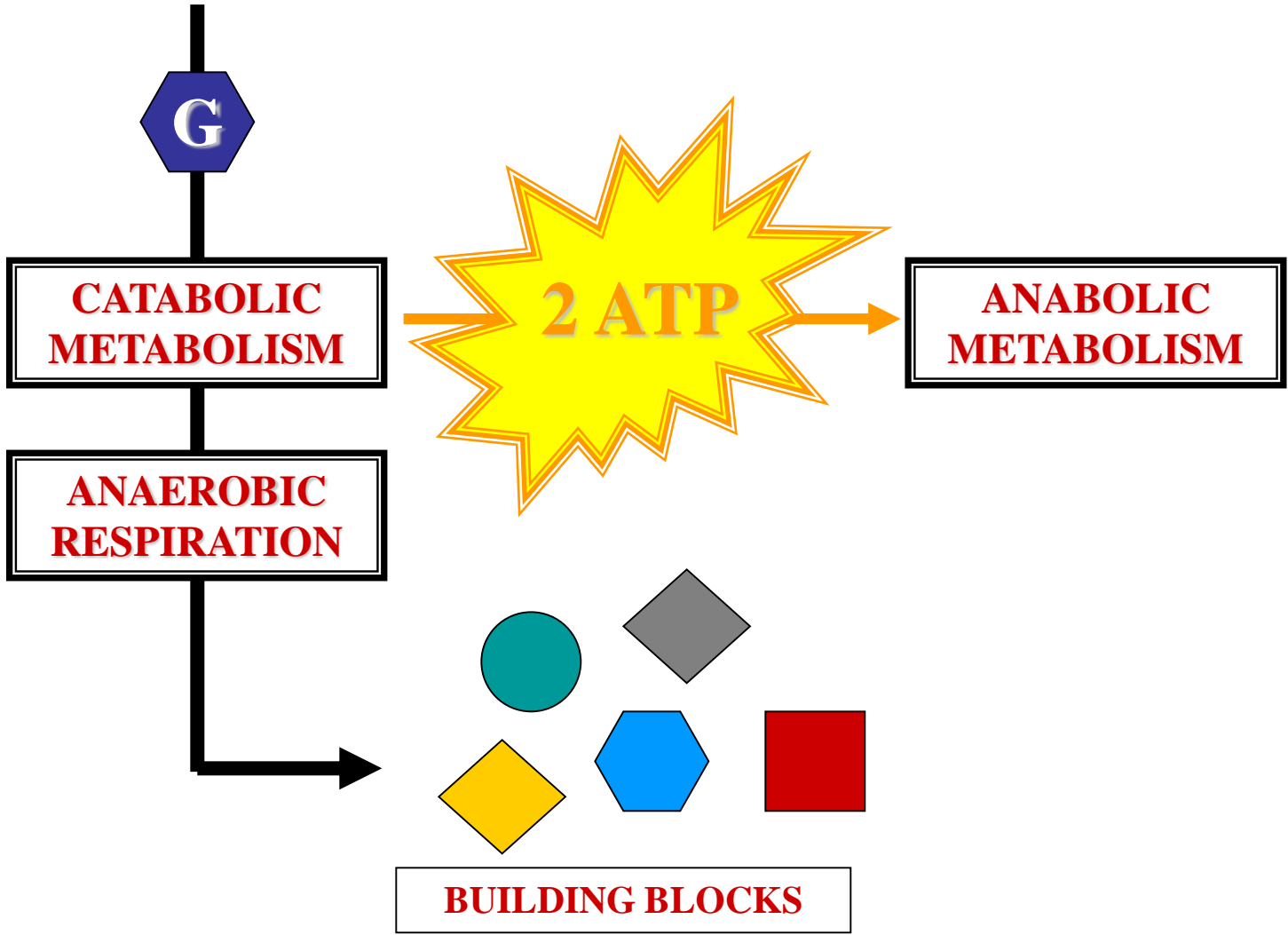
**ANAEROBIC  
RESPIRATION**



**BUILDING BLOCKS**

# METABOLISM

## GLUCOSE



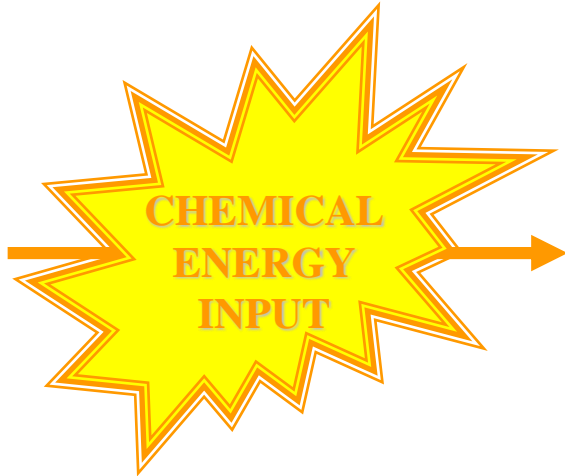
# METABOLISM

GLUCOSE

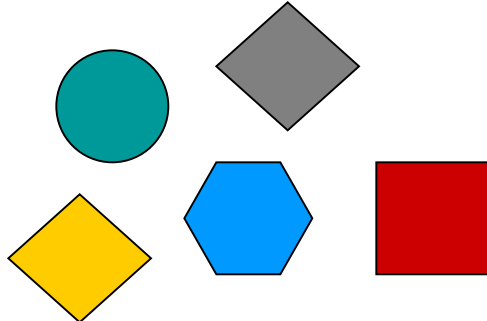
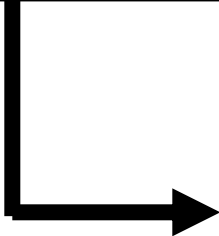


ANAEROBIC  
RESPIRATION

EXERGONIC  
REACTIONS



ANABOLIC  
METABOLISM

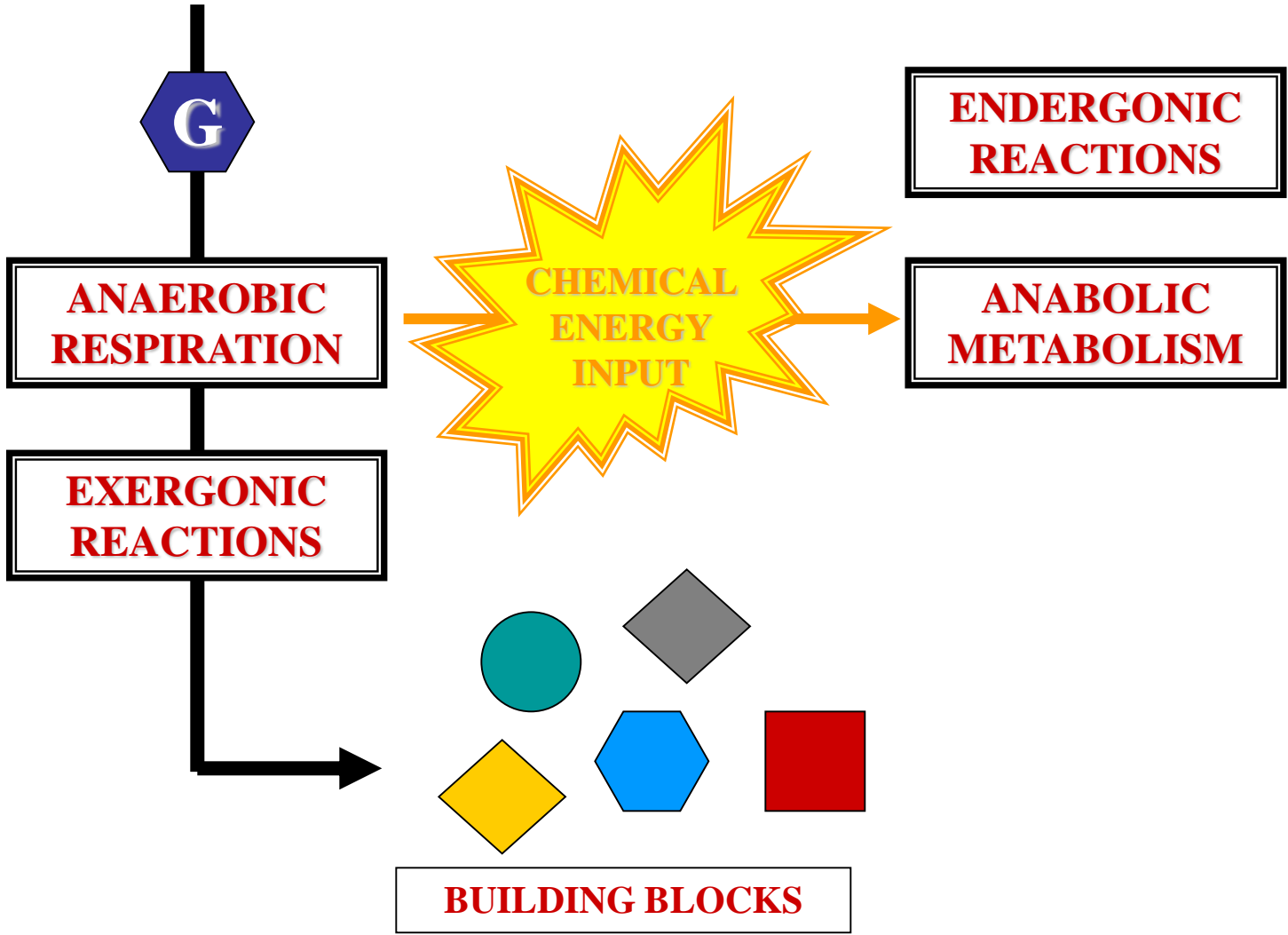


BUILDING BLOCKS



# METABOLISM

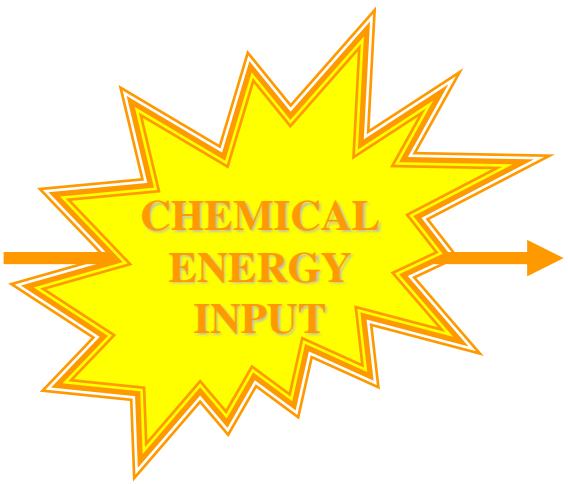
## GLUCOSE





# METABOLISM

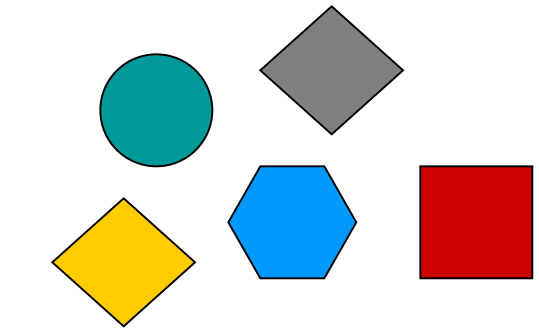
## GLUCOSE



**ENDERGONIC REACTIONS**

**ANABOLIC METABOLISM**

**BIOSYNTHESIS METABOLISM**



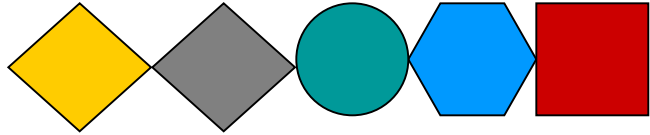
**BUILDING BLOCKS**



# METABOLISM

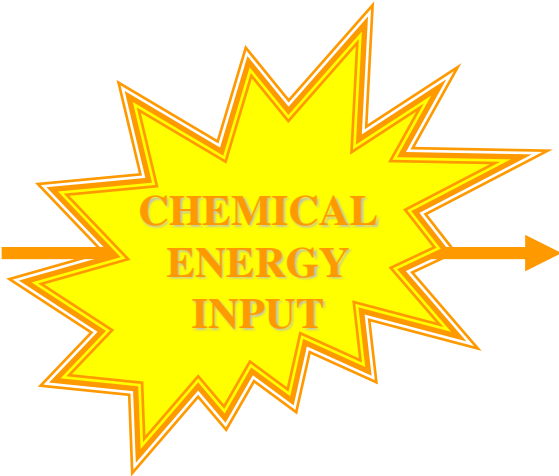
GLUCOSE

COMPLEX BIO-CHEM-CMPS



ANAEROBIC RESPIRATION

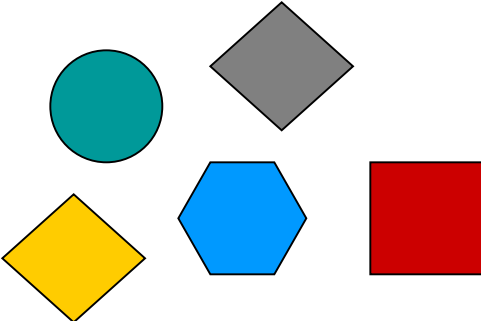
EXERGONIC REACTIONS



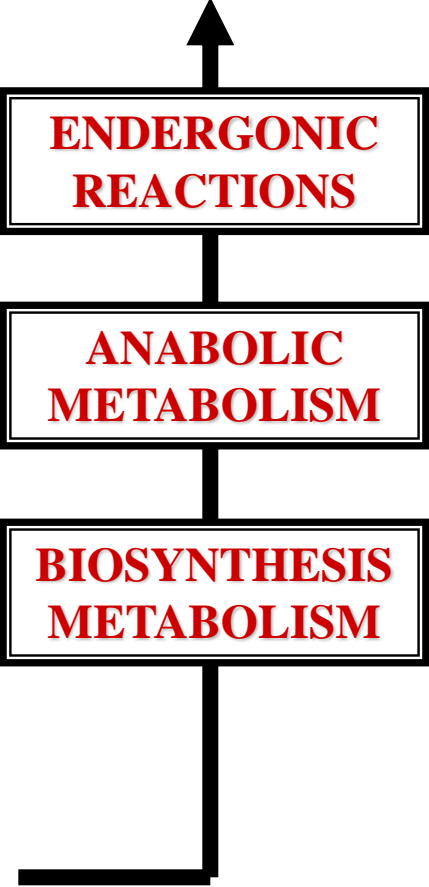
ENDERGONIC REACTIONS

ANABOLIC METABOLISM

BIOSYNTHESIS METABOLISM



BUILDING BLOCKS



***CELL  
GROWTH  
&  
MAINTENANCE***

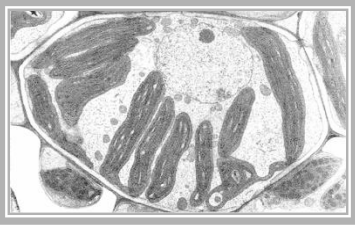


# *HOMEOSTASIS*

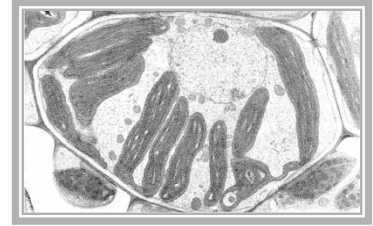
# ANAEROBIC RESPIRATION SPECIFICS



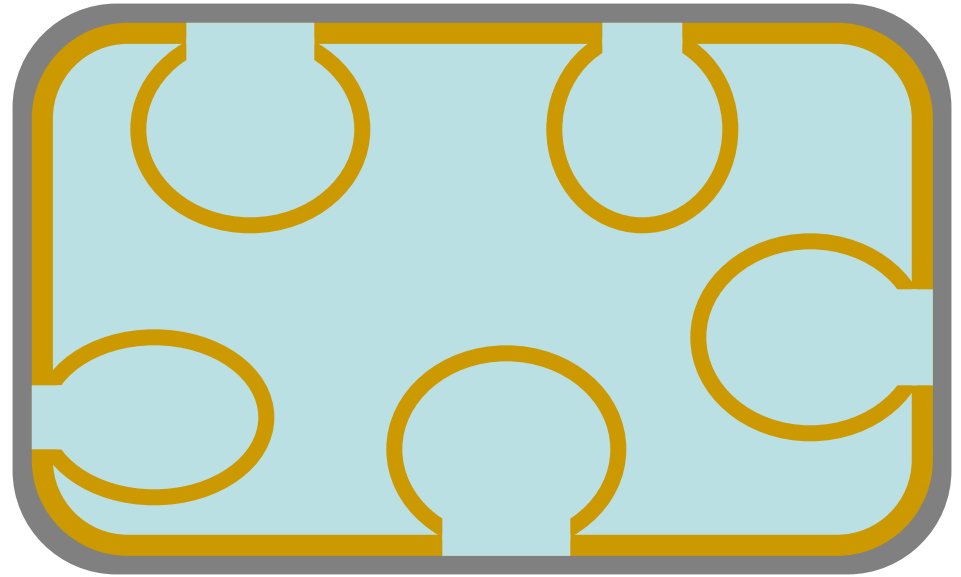
# ANAEROBIC RESPIRATION CELL LOCATION



# ANAEROBIC RESPIRATION



C

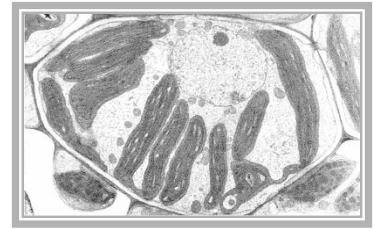


CELL





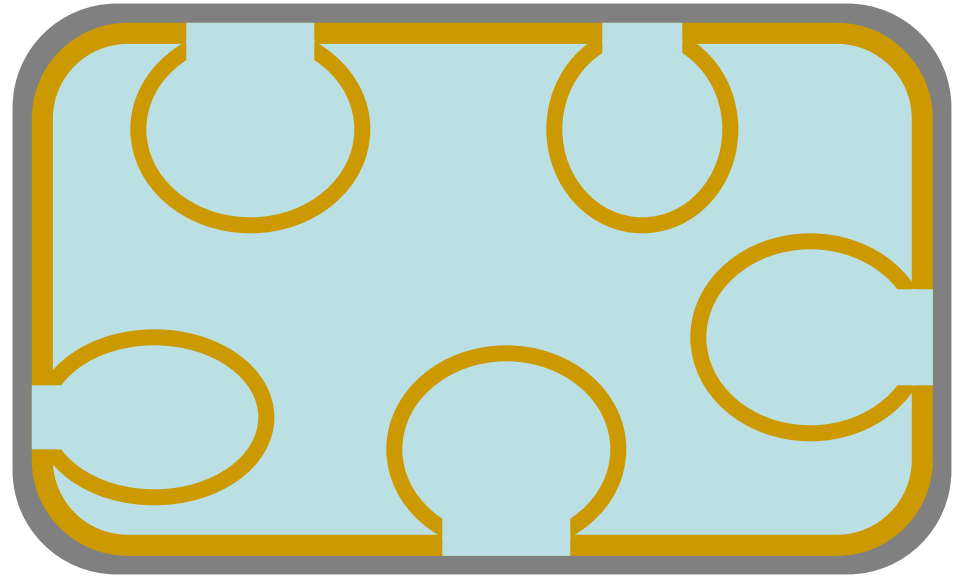
# ANAEROBIC RESPIRATION



G

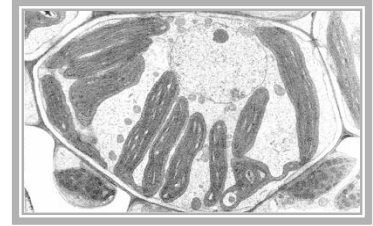
CYTOSOL

CELL

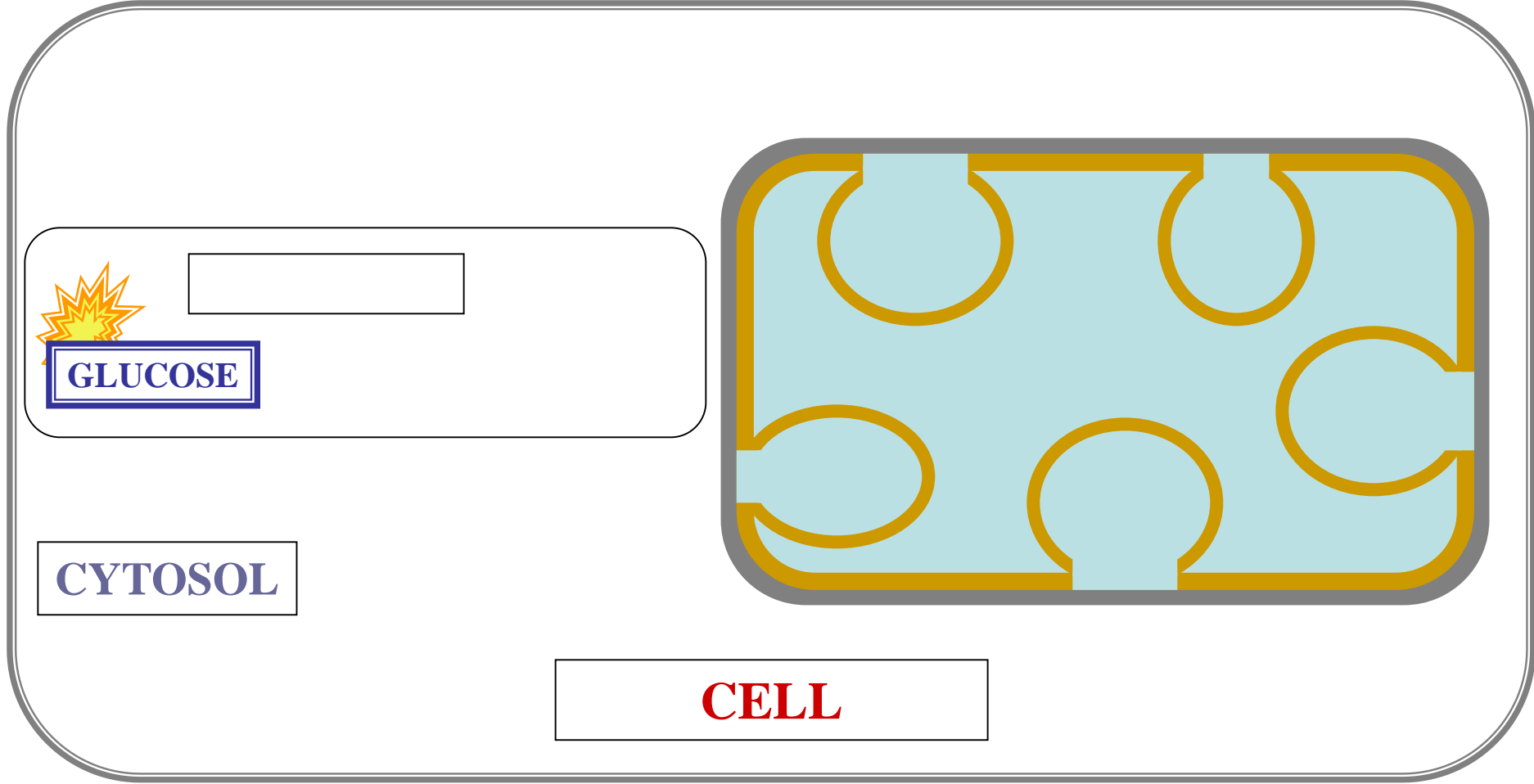




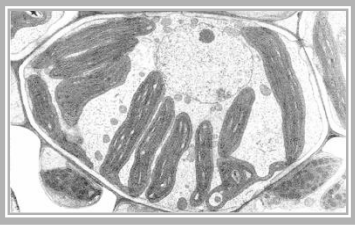
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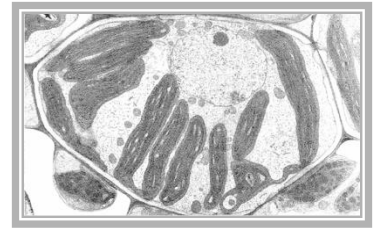
S



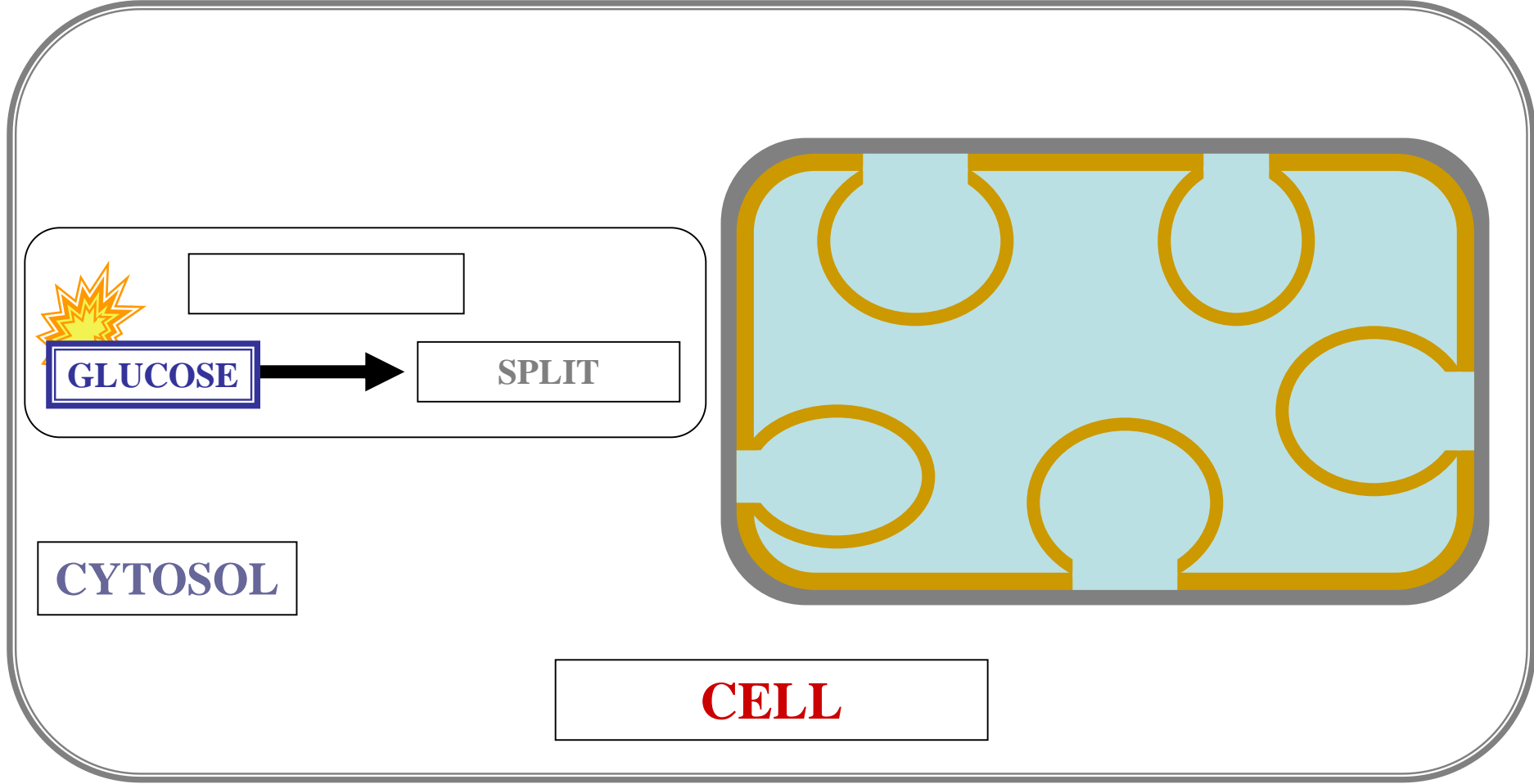
 = CHEMICAL ENERGY



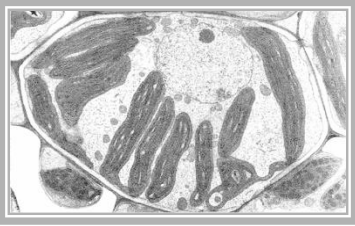
# ANAEROBIC RESPIRATION



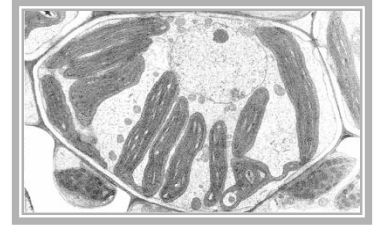
P



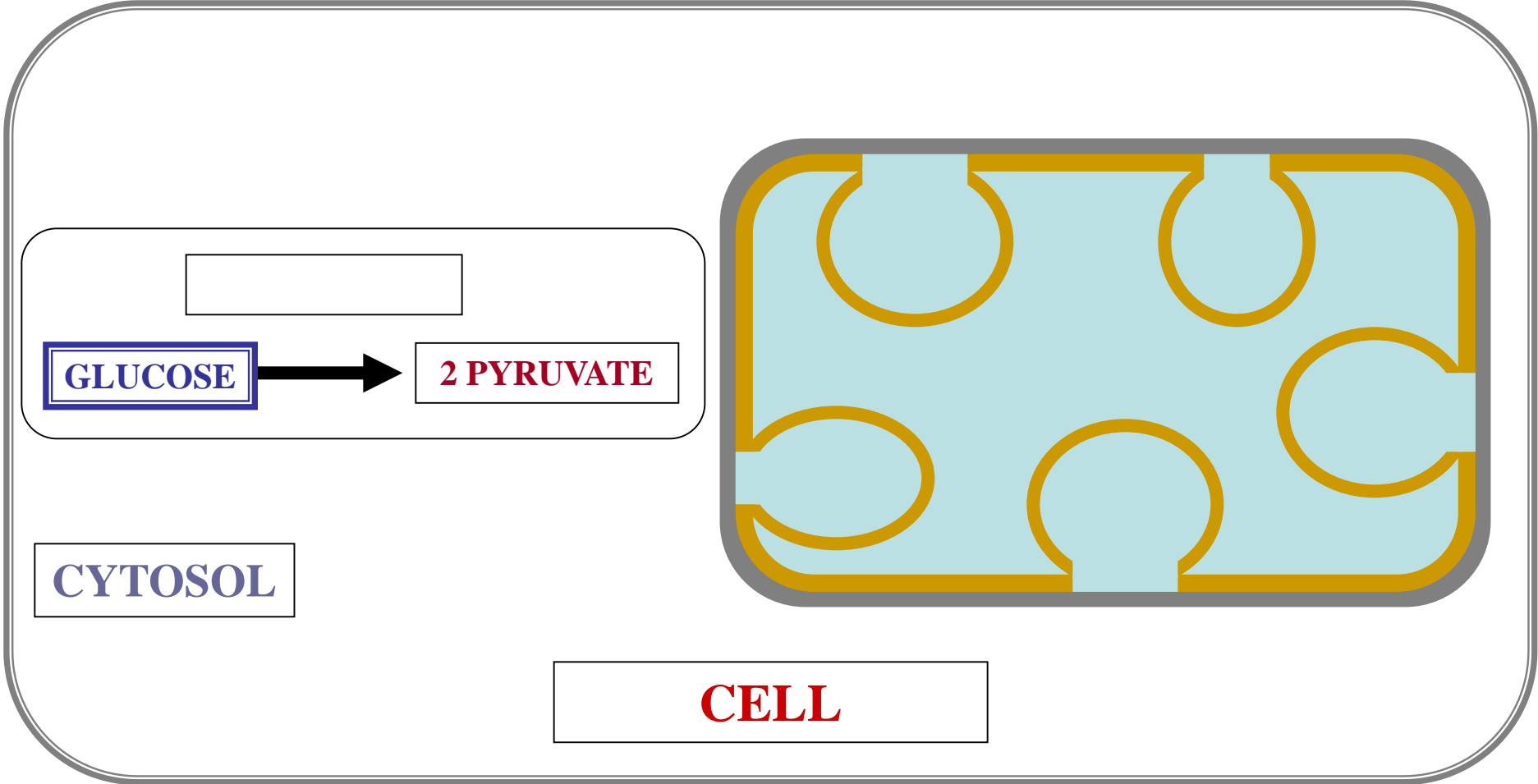
 = CHEMICAL ENERGY



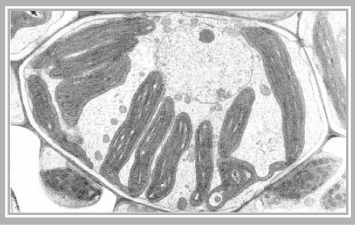
# ANAEROBIC RESPIRATION



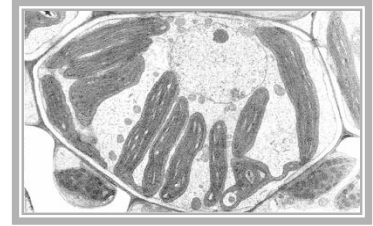
N



 = CHEMICAL ENERGY



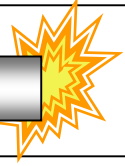
# ANAEROBIC RESPIRATION



A

2 NADH

E-



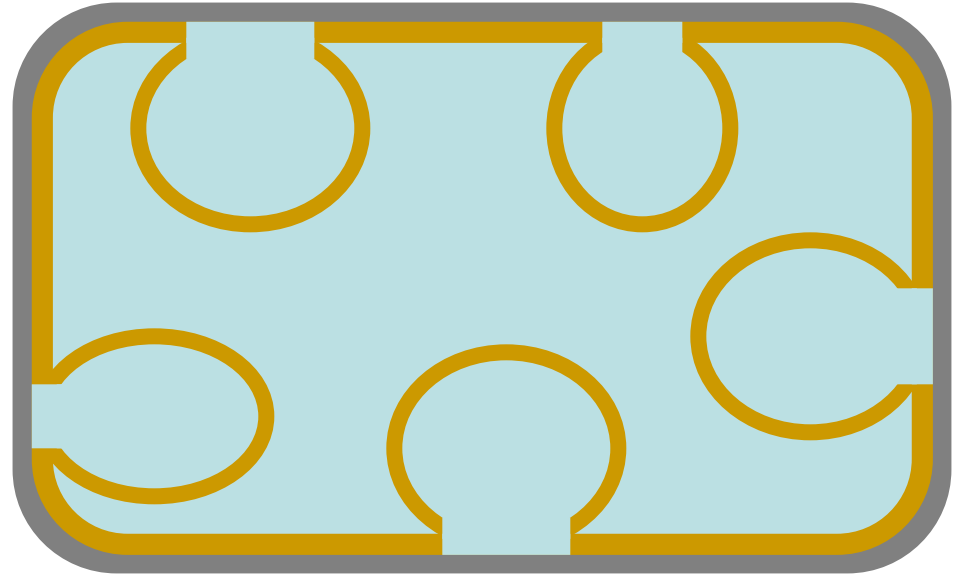
GLUCOSE



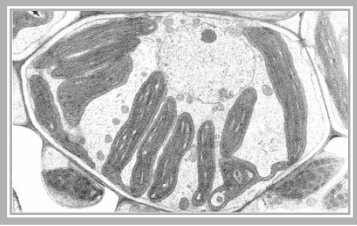
2 PYRUVATE

CYTOSOL

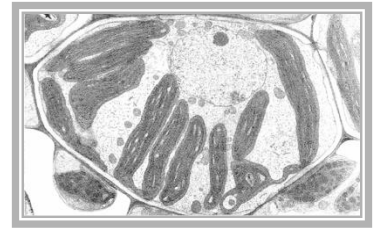
CELL



 = CHEMICAL ENERGY



# ANAEROBIC RESPIRATION



+

?

2 NADH

E-

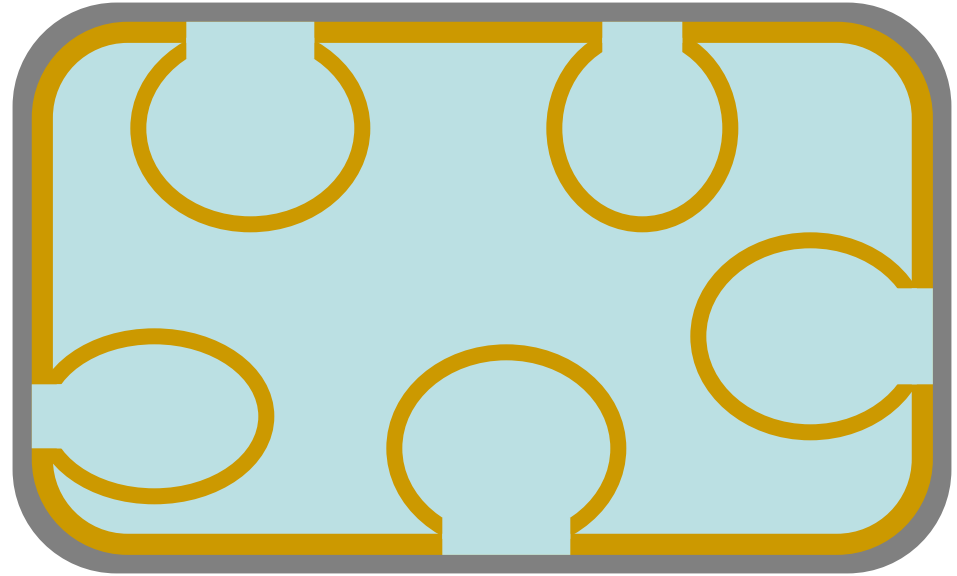
GLUCOSE

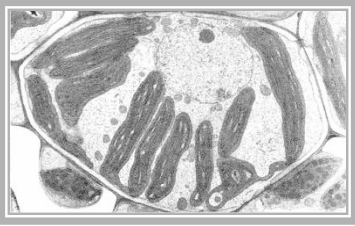
2 PYRUVATE

CYTOSOL

PHOSPHORYLATION

2 ATP





# ANAEROBIC RESPIRATION



G

2 NADH

E-

?

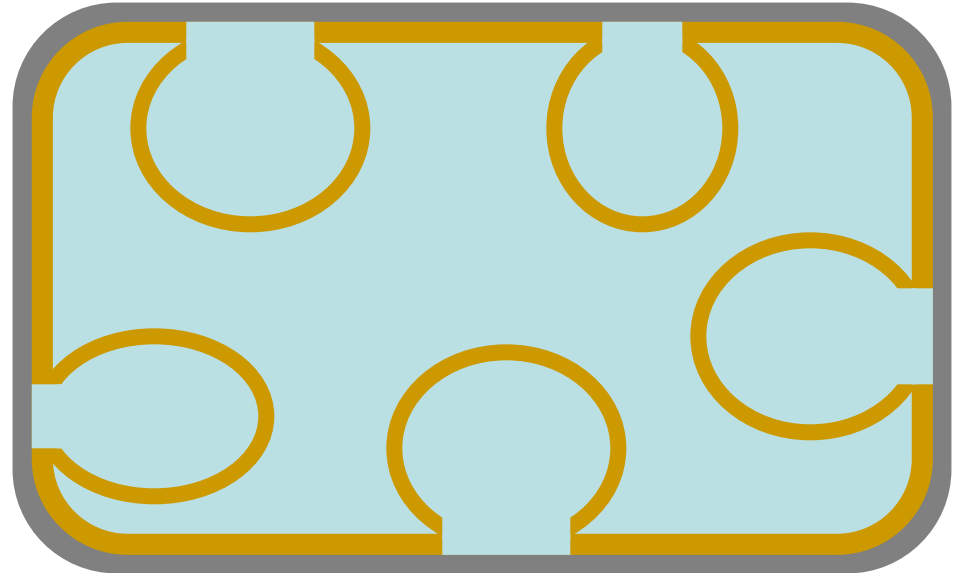
GLUCOSE

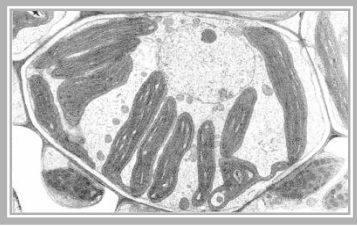
2 PYRUVATE

CYTOSOL

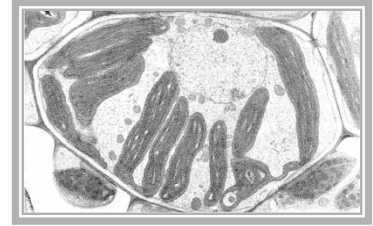
PHOSPHORYLATION

2 ATP





# ANAEROBIC RESPIRATION



2 NADH

E-

GLYCOLYSIS

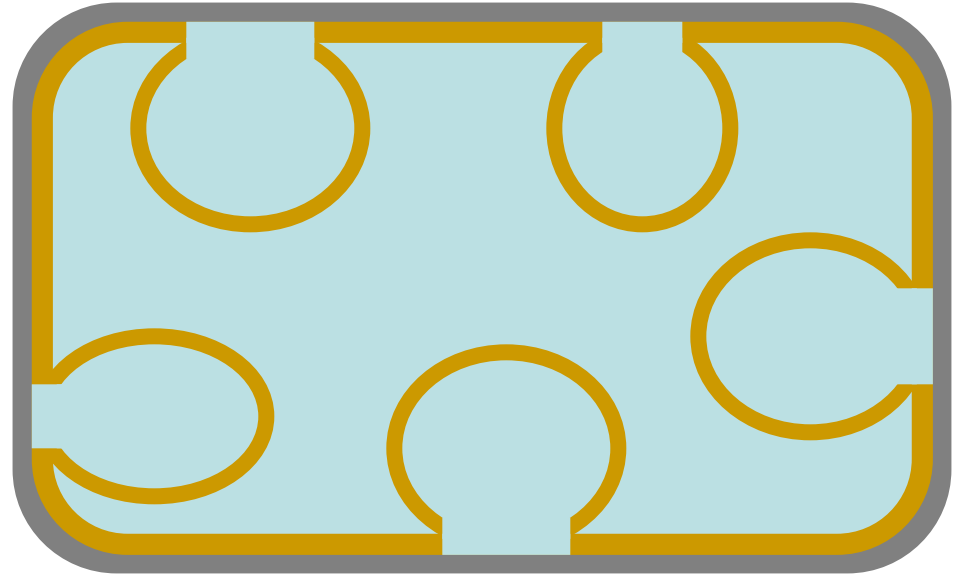
GLUCOSE

2 PYRUVATE

CYTOSOL

PHOSPHORYLATION

2 ATP







# GLYCOLYSIS OUTCOME



# GLYCOLYSIS

# OUTCOME

**OUTCOME / GLUCOSE:**

**2 ATP:**

**2 NADH:**

**2 PYRUVATE:**

# GLYCOLYSIS

# OUTCOME

**OUTCOME / GLUCOSE:**

**2 ATP:**



# GLYCOLYSIS

# OUTCOME

**OUTCOME / GLUCOSE:**

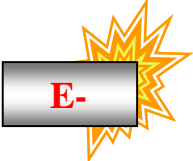
**2 ATP:                    →    METABOLISM**

# GLYCOLYSIS

# OUTCOME

**OUTCOME / GLUCOSE:**

**2 ATP:                      →      METABOLISM**

**2 NADH:    →**



# GLYCOLYSIS

# OUTCOME

**OUTCOME / GLUCOSE:**

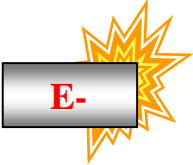

**2 ATP:                    →    METABOLISM**

**2 NADH:  →    ETC ?**

# GLYCOLYSIS OUTCOME

**OUTCOME / GLUCOSE:**

**2 ATP:                      →      METABOLISM**

**2 NADH:**  → 

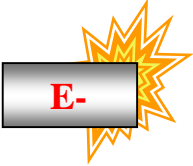
**ANAEROBIC ENVIRONMENT**

# GLYCOLYSIS

# OUTCOME

**OUTCOME / GLUCOSE:**

**2 ATP:                      →      METABOLISM**

**2 NADH:       →      BY PASS ETC**



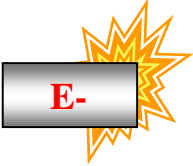


# GLYCOLYSIS

# OUTCOME

**OUTCOME / GLUCOSE:**

**2 ATP:                      →      METABOLISM**

**2 NADH:       →      **FERMENTATION****

# GLYCOLYSIS

# OUTCOME

**OUTCOME / GLUCOSE:**

**2 ATP:                    →    METABOLISM**

**2 NADH:     →    FERMENTATION**

**2 PYRUVATE:    →**



# GLYCOLYSIS OUTCOME

**OUTCOME / GLUCOSE:**

**2 ATP:                    →    METABOLISM**

**2 NADH:    →    **FERMENTATION****

**2 PYRUVATE:   →    KREBS CYCLE ?**

# GLYCOLYSIS OUTCOME

**OUTCOME / GLUCOSE:**

**2 ATP:                    →    METABOLISM**

**2 NADH:     →    **FERMENTATION****

**2 PYRUVATE:    →    ~~KREBS CYCLE~~**

**ANAEROBIC ENVIRONMENT**

# GLYCOLYSIS

# OUTCOME

**OUTCOME / GLUCOSE:**

**2 ATP:** → **METABOLISM**

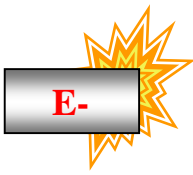
**2 NADH:**  → **FERMENTATION**

**2 PYRUVATE:** → **BY PASS KREBS CYCLE**

# GLYCOLYSIS OUTCOME

**OUTCOME / GLUCOSE:**

**2 ATP:                    →    METABOLISM**

**2 NADH:    →    FERMENTATION**

**2 PYRUVATE:   →    FERMENTATION**

# QUESTION

A

AF

WHAT ARE THE TYPES  
OF  
FERMENTATION?

QUESTION

**ANSWER**



**ALCOHOLIC  
FERMENTATION**

**ANSWER**





**ANSWER**

**ALCOHOLIC  
FERMENTATION**

**&**

**LACTIC ACID  
FERMENTATION**

**ANSWER**



# ALCOHOLIC FERMENTATION



**EXAMPLE**  
**ALCOHOLIC**  
**FERMENTATION**  
**YEAST CELLS**

# ALCOHOLIC FERMENTATION

**PYRUVATE**

**YEAST CELL**

**PYRUVATE**

?

G

**NADH**

**NADH**

# **ALCOHOLIC FERMENTATION**

PYRUVATE

YEAST CELL

PYRUVATE

E-

NADH

NADH

GLYCOLYSIS



# ALCOHOLIC FERMENTATION

PYRUVATE

YEAST CELL

PYRUVATE

E  
C

NADH

E-

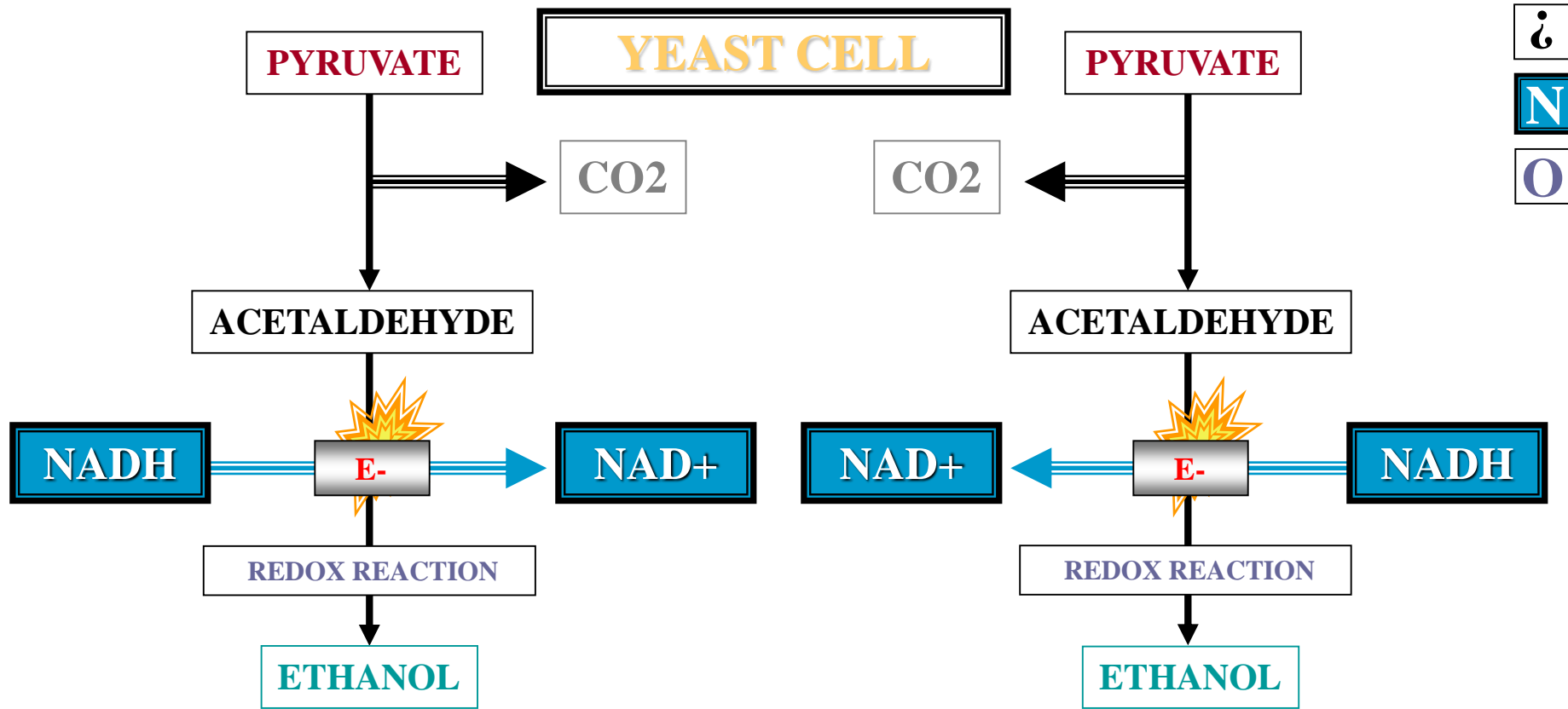
REDOX REACTION

E-

NADH

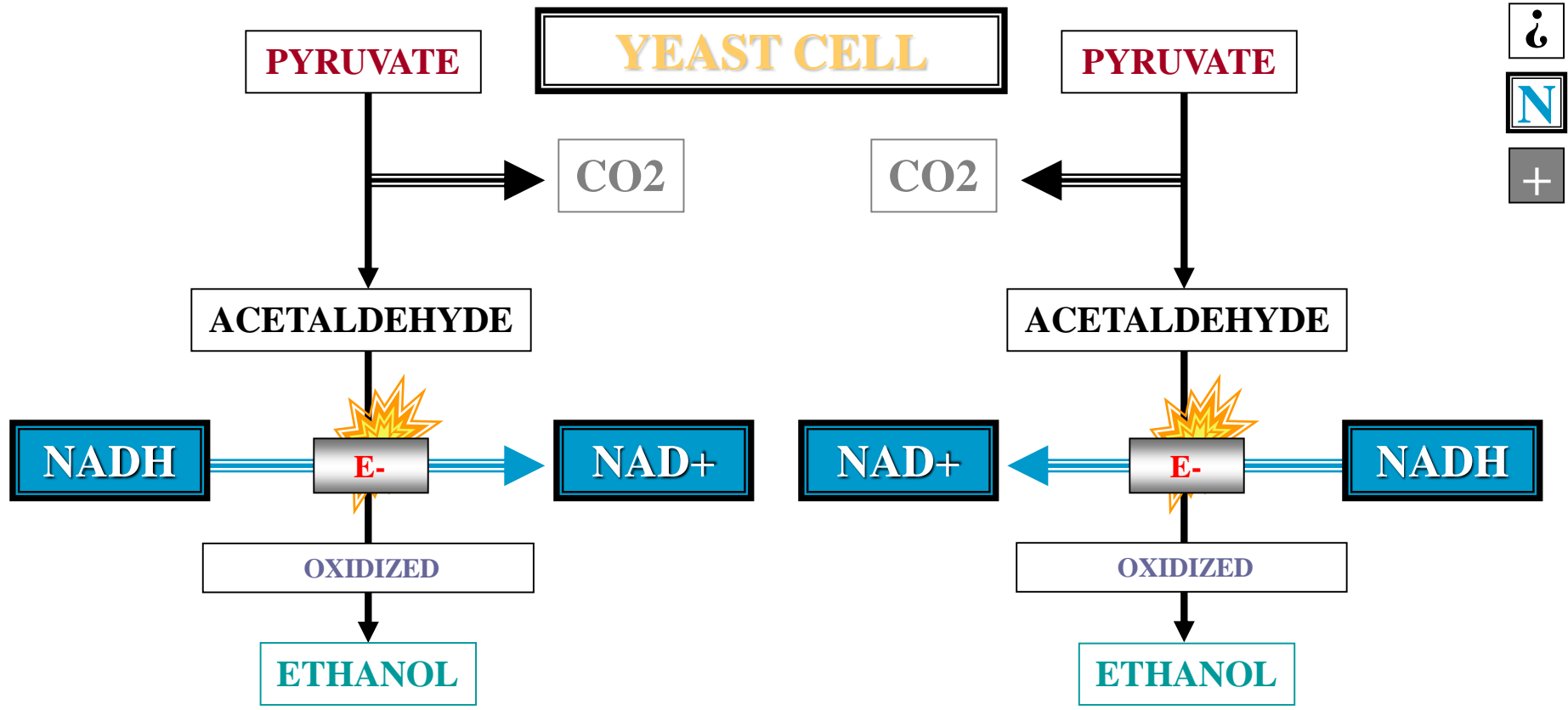
REDOX REACTION

# ALCOHOLIC FERMENTATION

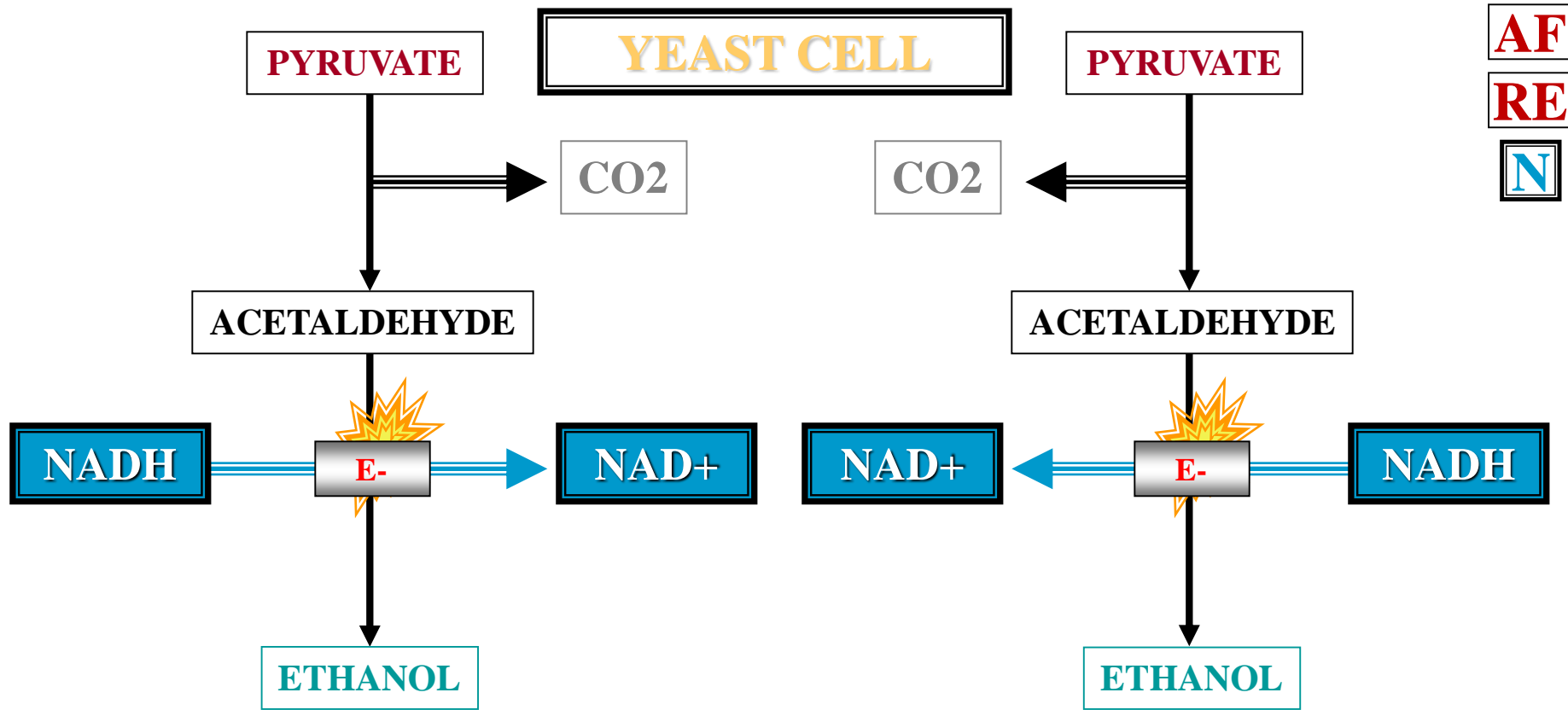


# ALCOHOLIC FERMENTATION



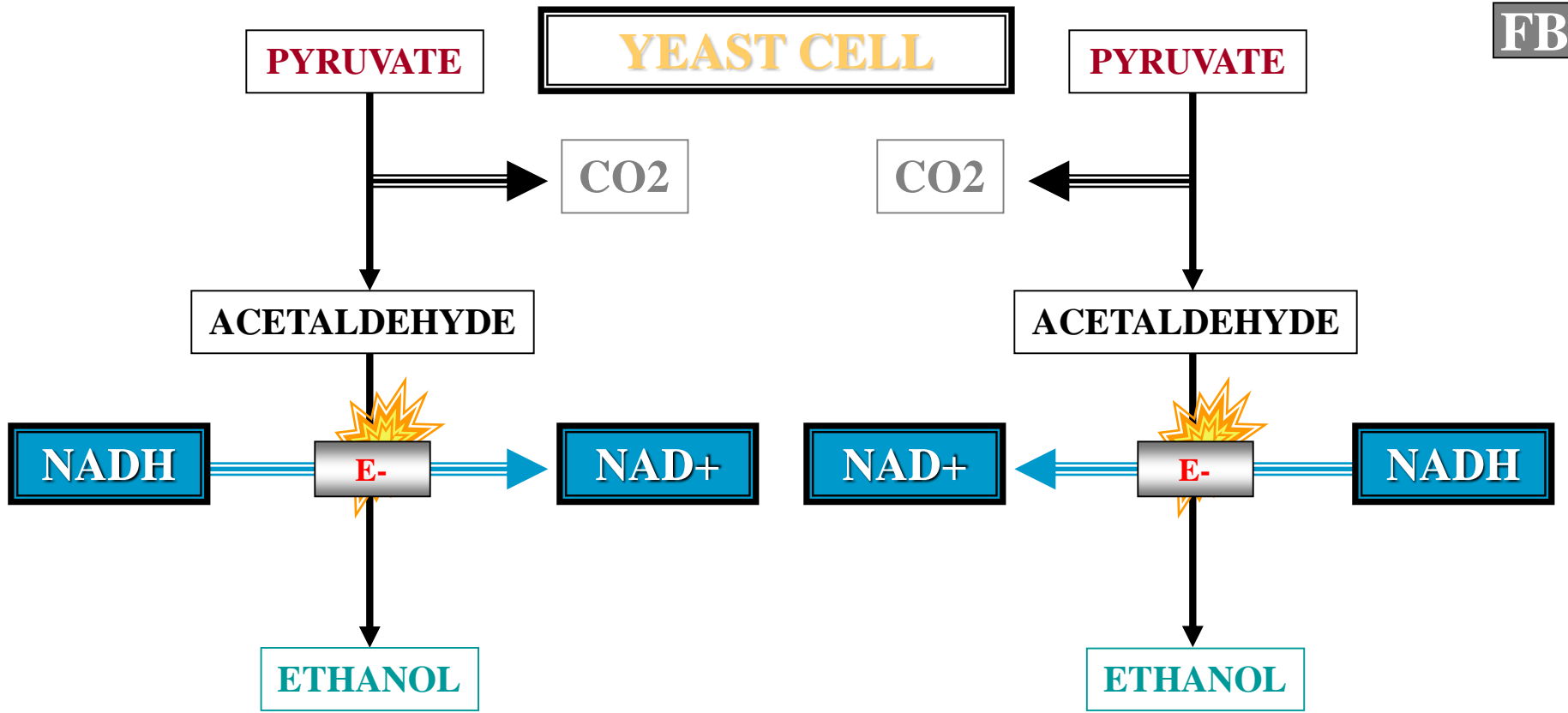


# ALCOHOLIC FERMENTATION



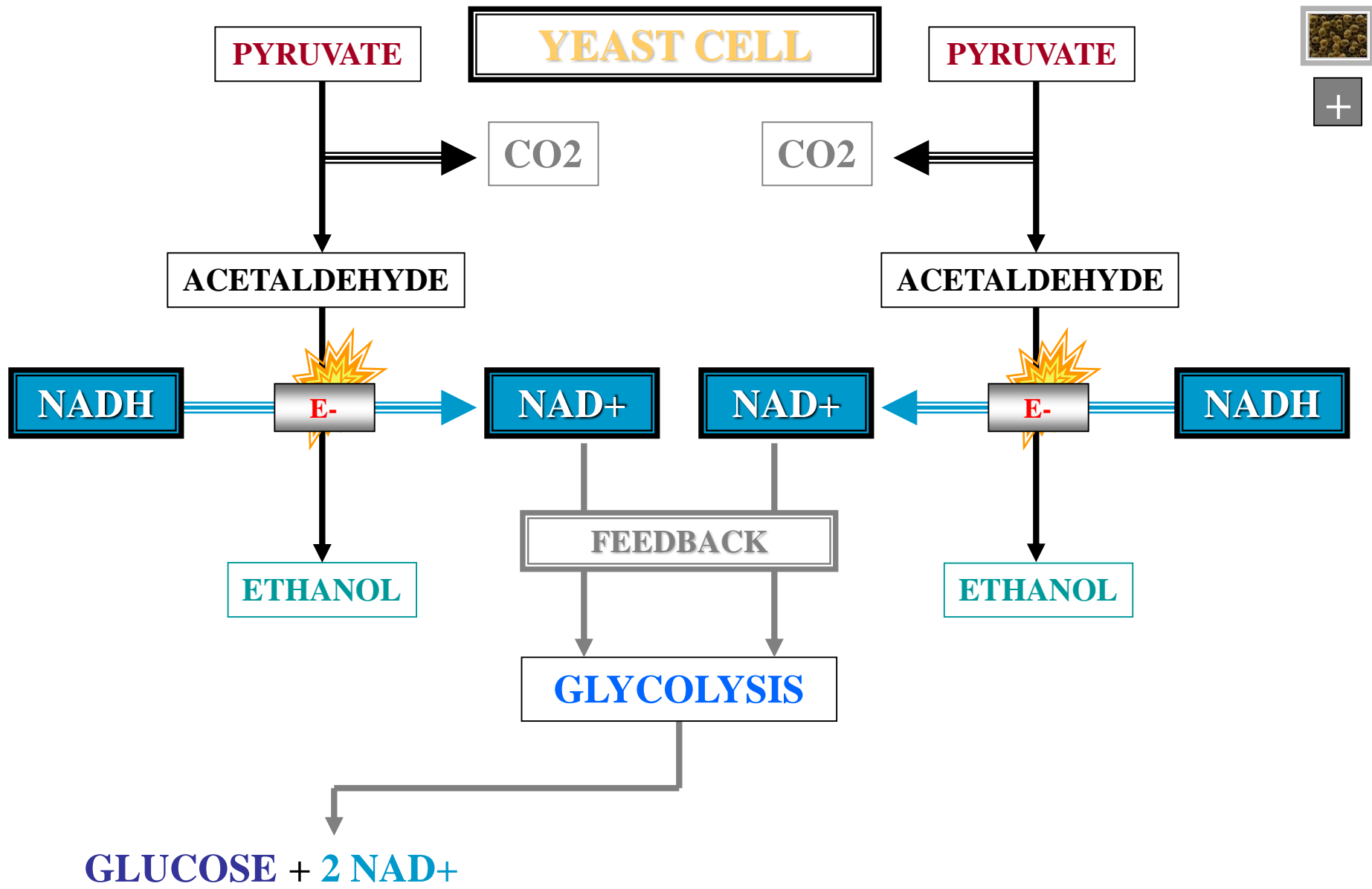
*NAD<sup>+</sup> LIMITED SUPPLY WITHIN CELL CYTOSOL*

# ALCOHOLIC FERMENTATION



***ALCOHOLIC FERMENTATION REGENERATES NAD+***

# ALCOHOLIC FERMENTATION



**!!!NAD<sup>+</sup> REQUIRED ANAEROBIC GLYCOLYSIS!!!**



**GLYCOLYSIS**

**N**  
**+**

**GLUCOSE**

***ALCOHOLIC  
FERMENTATION  
REGENERATES***

**ANAEROBIC  
RESPIRATION**

***NAD<sup>+</sup>***

***W/IN CYTOSOL***

# GLYCOLYSIS

GLUCOSE

NAD<sup>+</sup>

NAD<sup>+</sup>

NAD<sup>+</sup>

NAD<sup>+</sup>

NAD<sup>+</sup>

NAD<sup>+</sup>

*ALCOHOLIC  
FERMENTATION  
REGENERATES*

ANAEROBIC  
RESPIRATION

NAD<sup>+</sup>

*W/IN CYTOSOL*



# GLYCOLYSIS

GLUCOSE + 2 NAD<sup>+</sup>

FEEDBACK

NAD<sup>+</sup>

NAD<sup>+</sup>

NAD<sup>+</sup>

NAD<sup>+</sup>

NAD<sup>+</sup>

NAD<sup>+</sup>

*ALCOHOLIC  
FERMENTATION  
REGENERATES*

ANAEROBIC  
RESPIRATION

NAD<sup>+</sup>

*W/IN CYTOSOL*

# GLYCOLYSIS



FEEDBACK

NAD<sup>+</sup>

NAD<sup>+</sup>

NAD<sup>+</sup>

NAD<sup>+</sup>

NAD<sup>+</sup>

NAD<sup>+</sup>

*ALCOHOLIC  
FERMENTATION  
REGENERATES*

ANAEROBIC  
RESPIRATION

NAD<sup>+</sup>

*W/IN CYTOSOL*



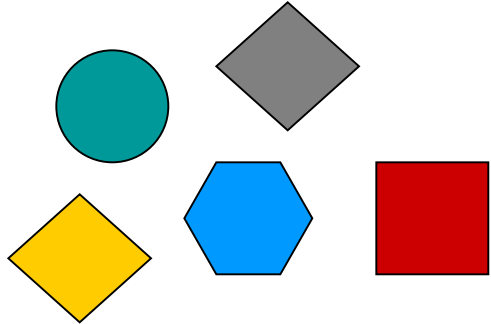
# METABOLISM

## GLUCOSE



**CATABOLIC  
METABOLISM**

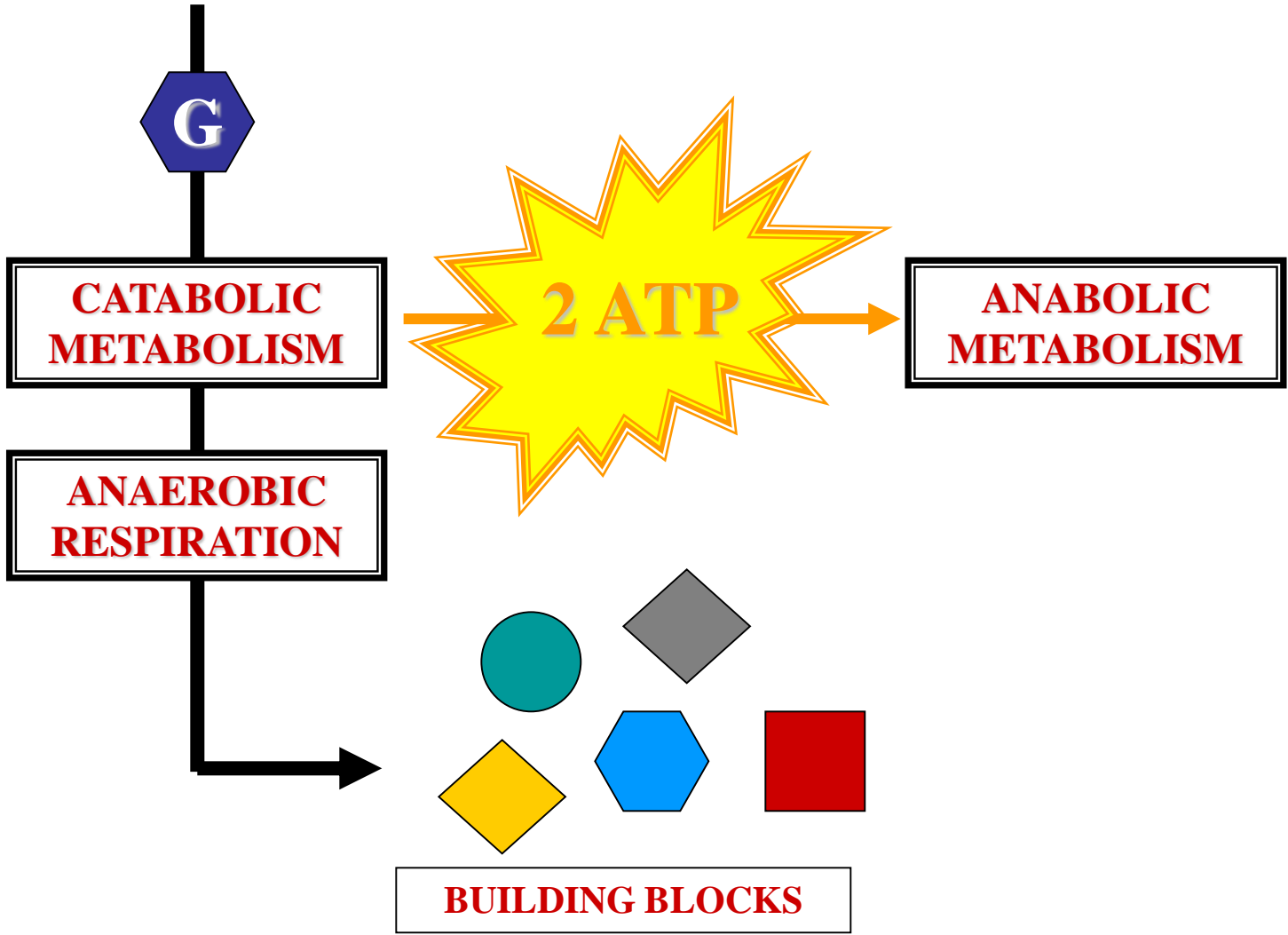
**ANAEROBIC  
RESPIRATION**



**BUILDING BLOCKS**

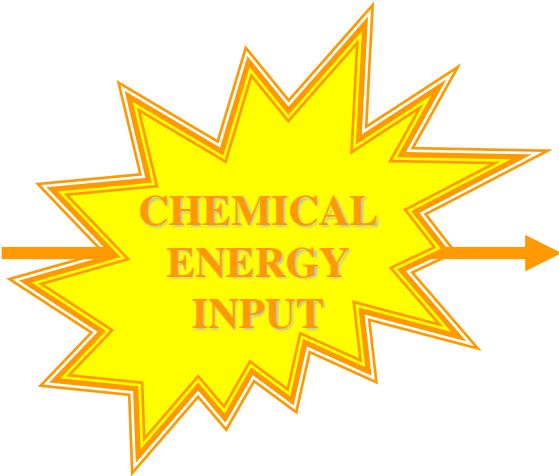
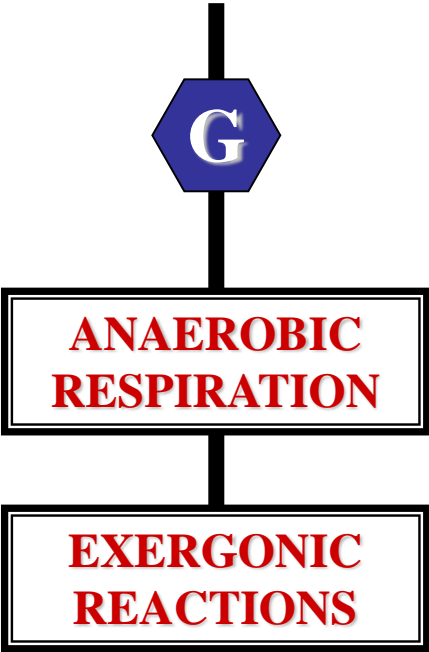
# METABOLISM

## GLUCOSE

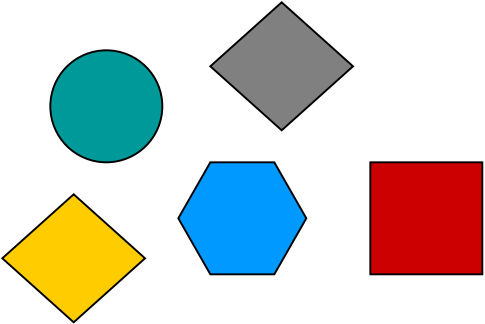
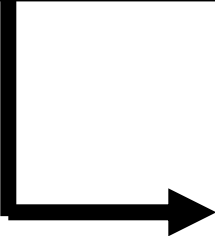


# METABOLISM

GLUCOSE



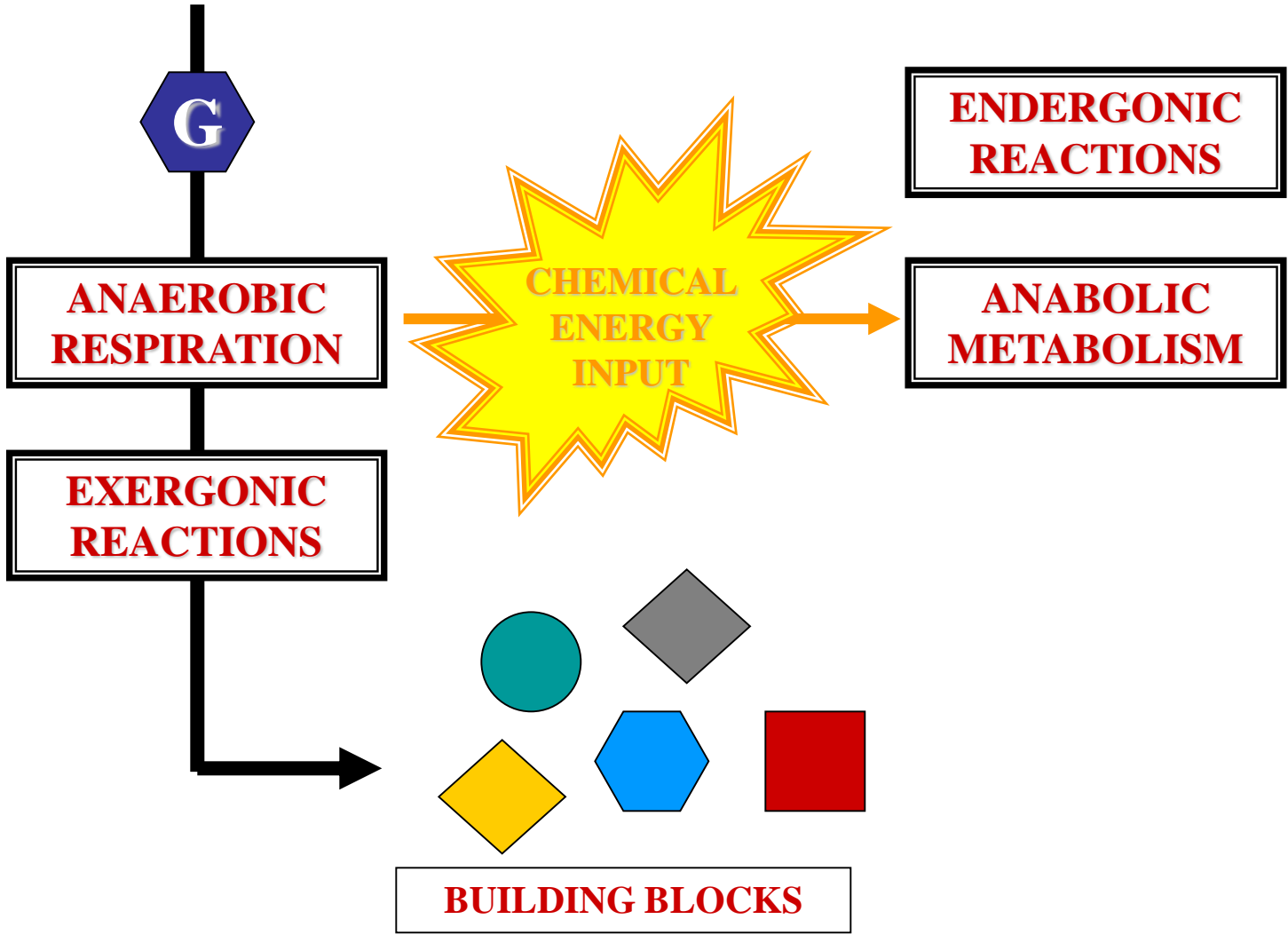
ANABOLIC METABOLISM



BUILDING BLOCKS

# METABOLISM

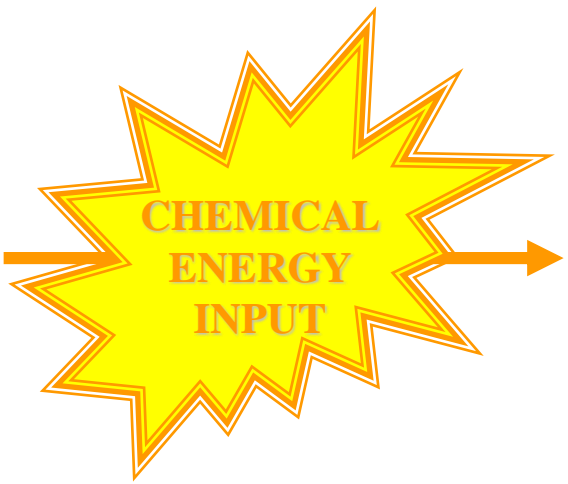
## GLUCOSE





# METABOLISM

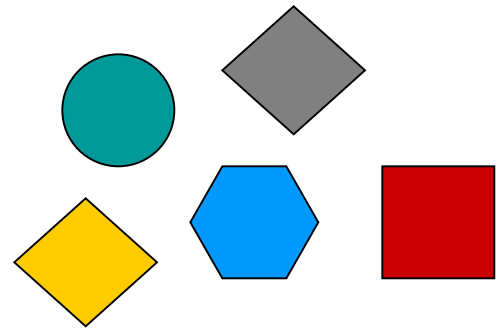
## GLUCOSE



ENDERGONIC REACTIONS

ANABOLIC METABOLISM

BIOSYNTHESIS METABOLISM

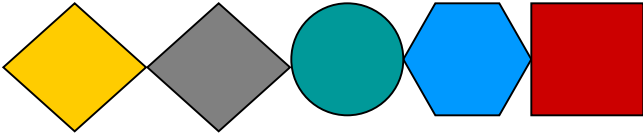


BUILDING BLOCKS

# METABOLISM

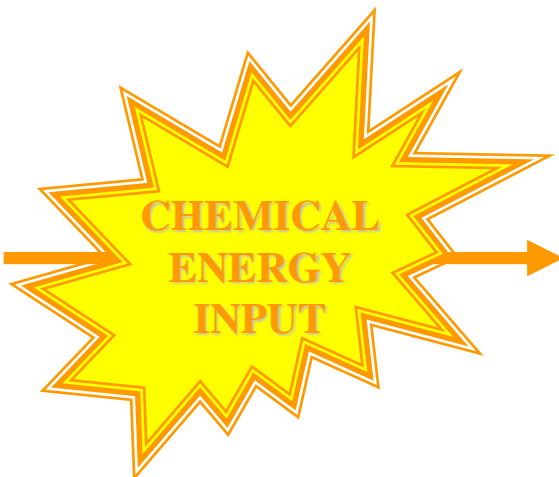
GLUCOSE

COMPLEX BIO-CHEM-CMPS



ANAEROBIC RESPIRATION

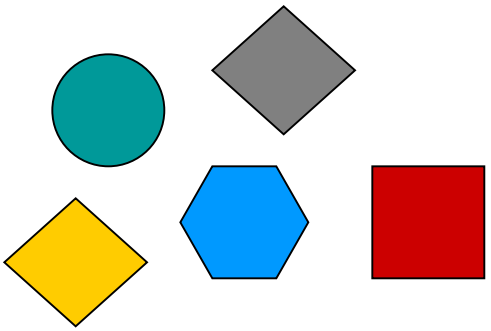
EXERGONIC REACTIONS



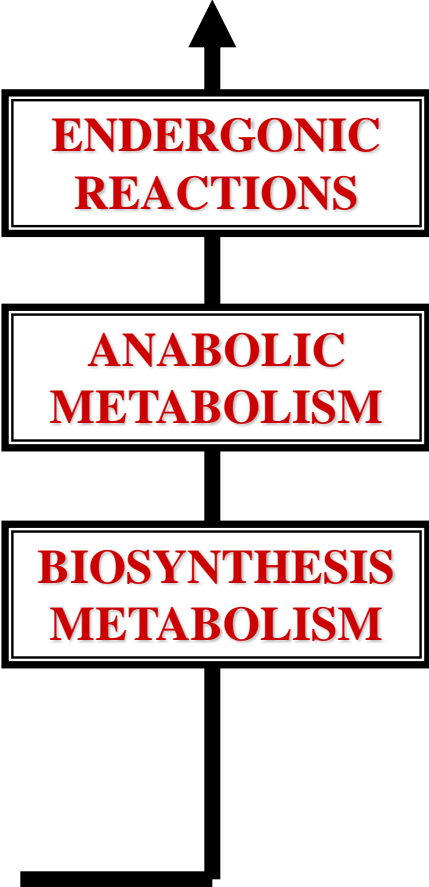
ENDERGONIC REACTIONS

ANABOLIC METABOLISM

BIOSYNTHESIS METABOLISM

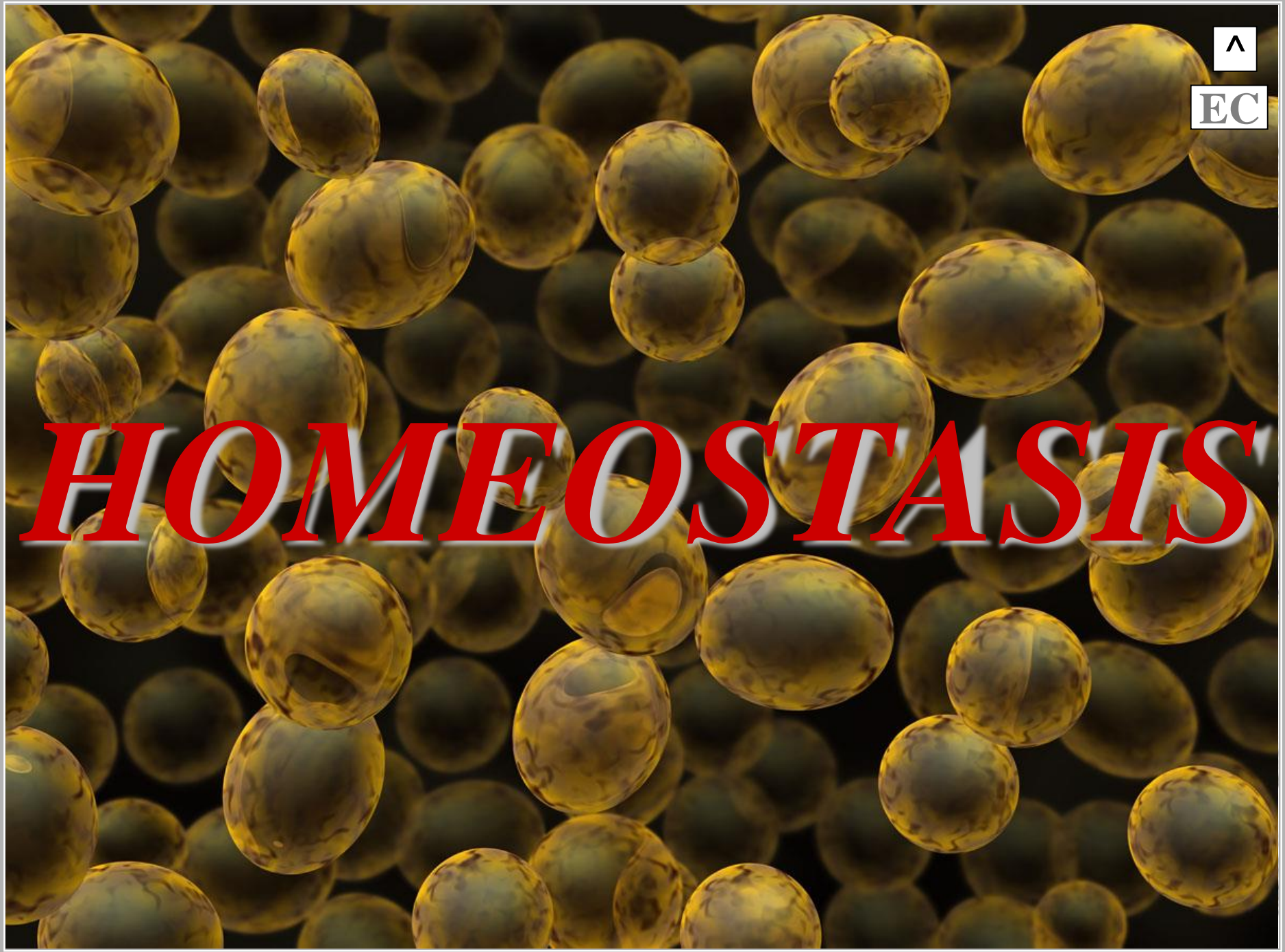


BUILDING BLOCKS



*CELL  
GROWTH  
&  
MAINTENANCE*

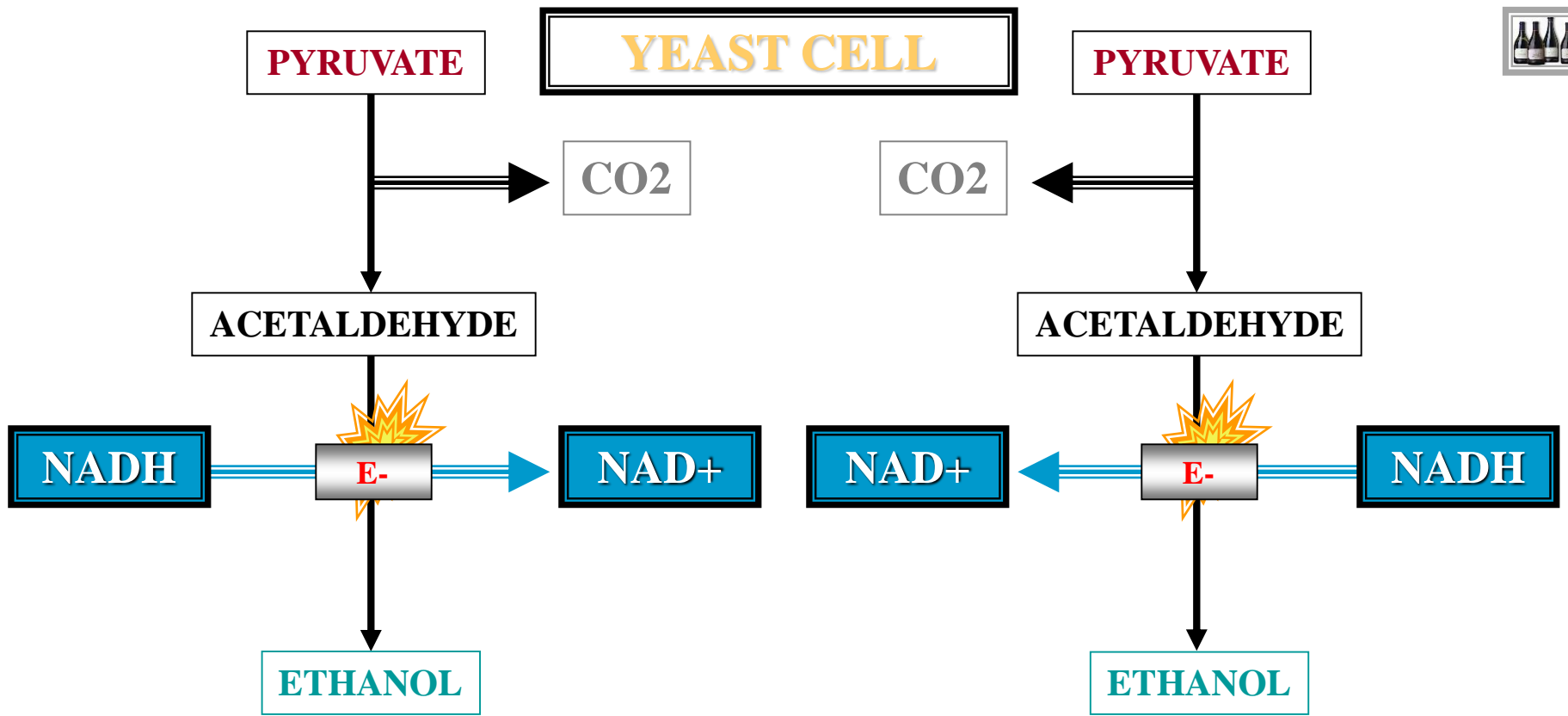
# *HOMEOSTASIS*



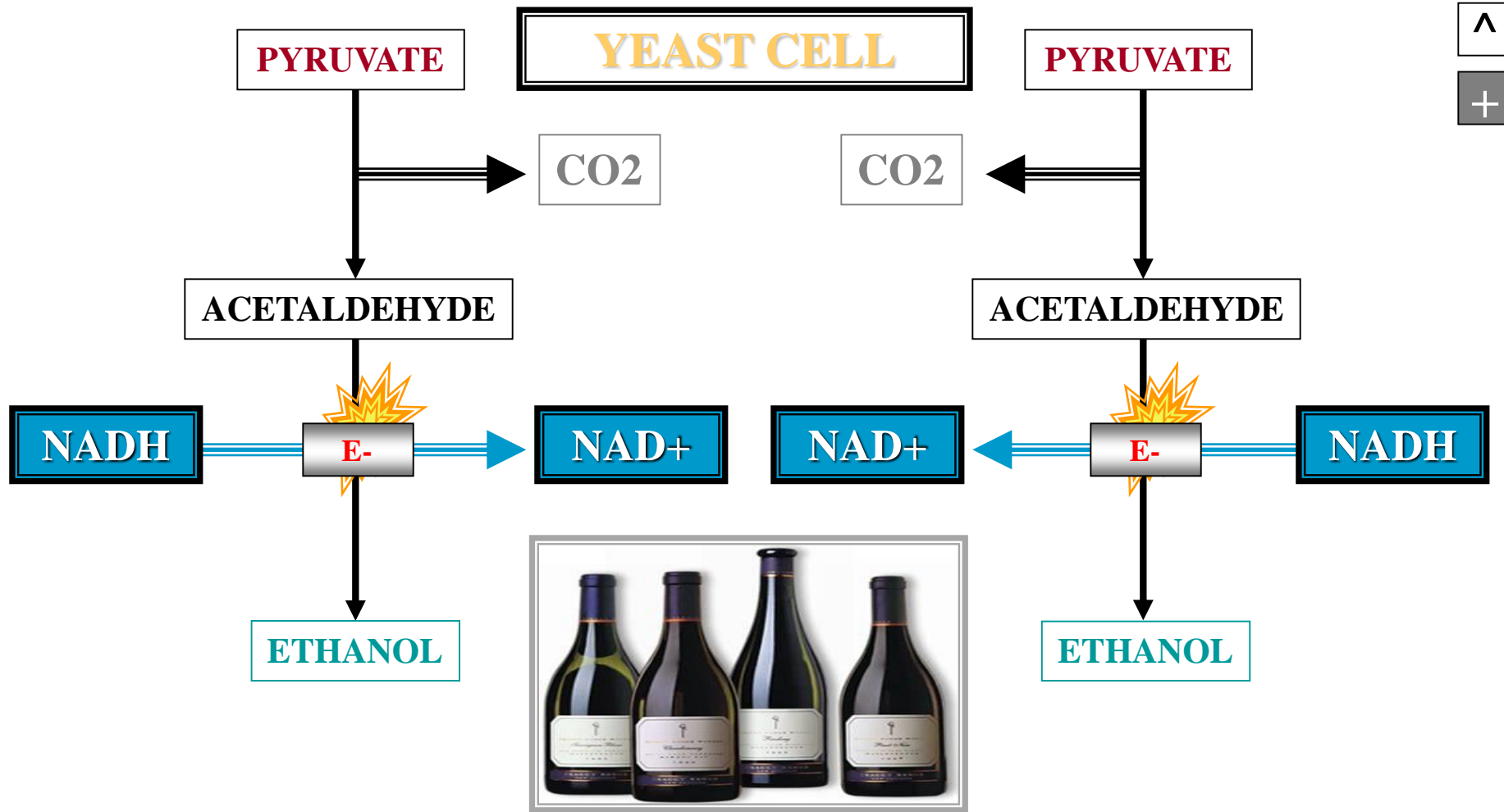




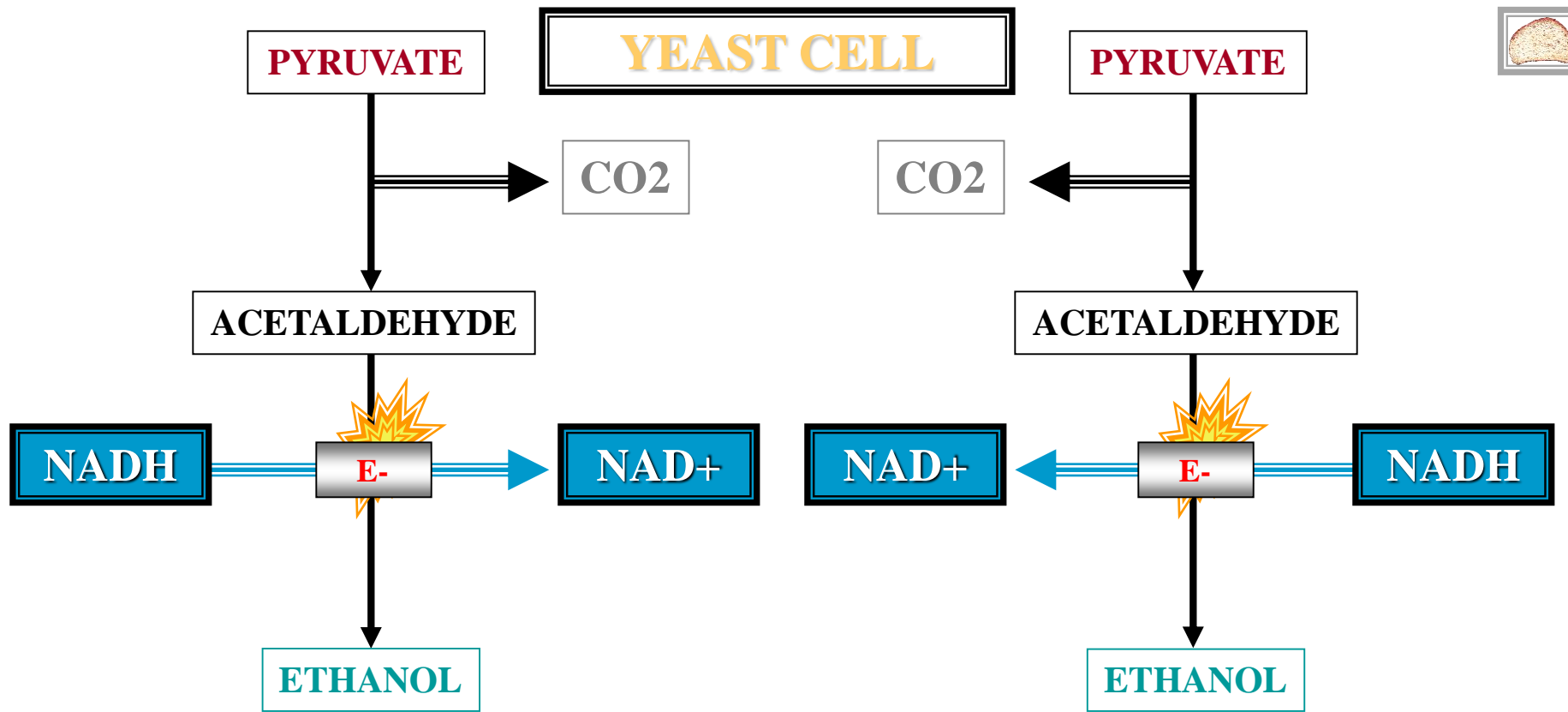
**ALCOHOLIC  
FERMENTATION  
ECONOMICS**



# ALCOHOLIC FERMENTATION



# ALCOHOLIC FERMENTATION



# ALCOHOLIC FERMENTATION