# Glycolysis

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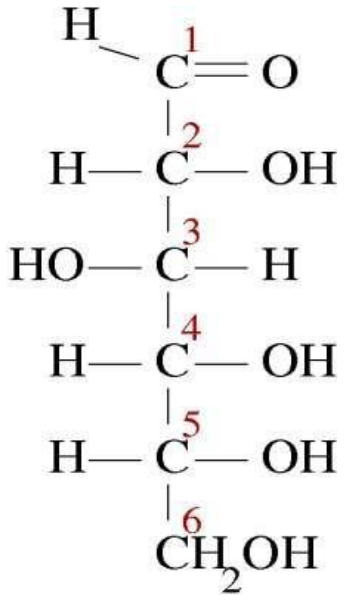
## Definition

- **Derived from Greek word**

Glykys = Sweet

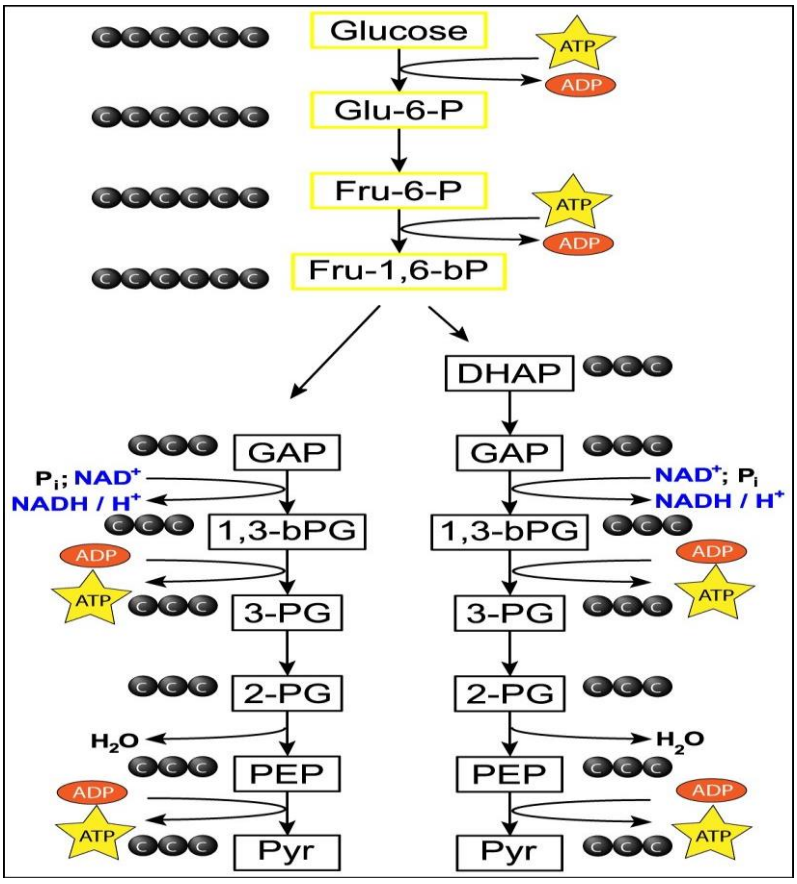
Lysis = splitting

- The process in cell metabolism by which carbohydrates and sugars, especially glucose, are broken down, producing ATP and pyruvic acid and two "high energy" electron carrying molecules of NADH.



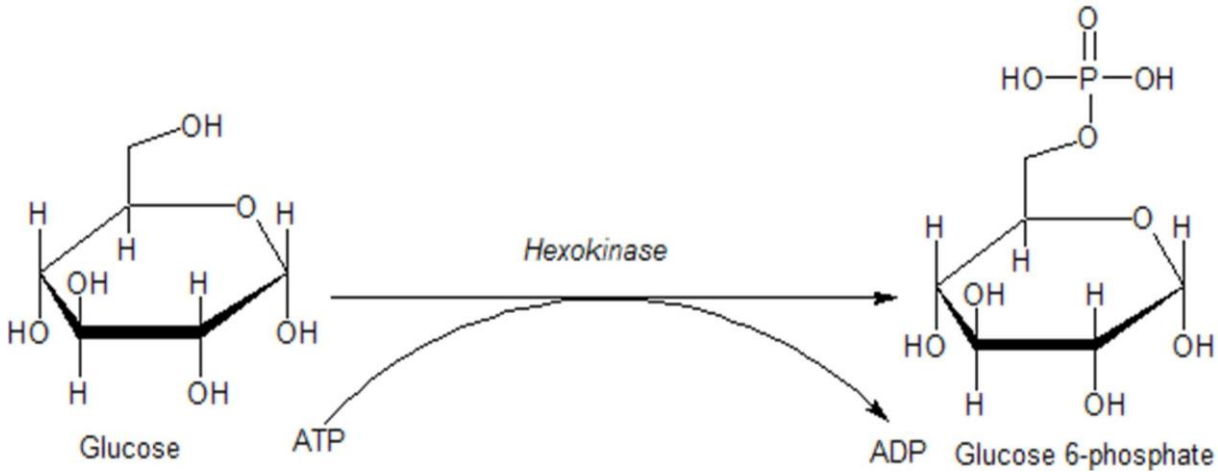

Glucose = ($C_6H_{12}O_6$)

# 10 Steps involves in Glycolysis



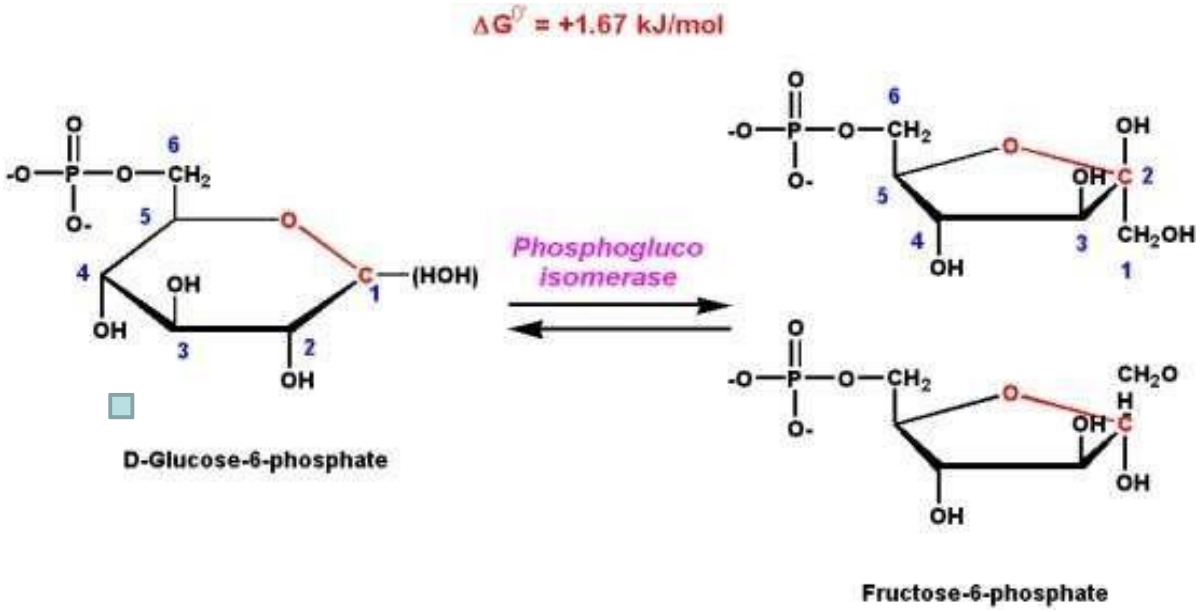

## Step 1

- The enzyme hexokinase phosphorylates (adds a phosphate group to) glucose in the cell's cytoplasm.



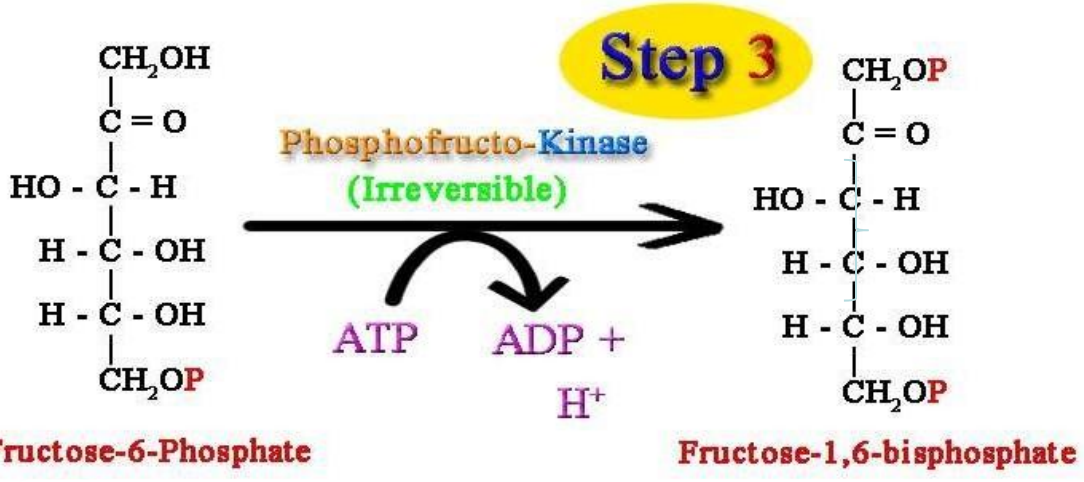
# Step 2

- The enzyme phosphoglucoisomerase converts glucose6-phosphate into its isomer fructose 6-phosphate.



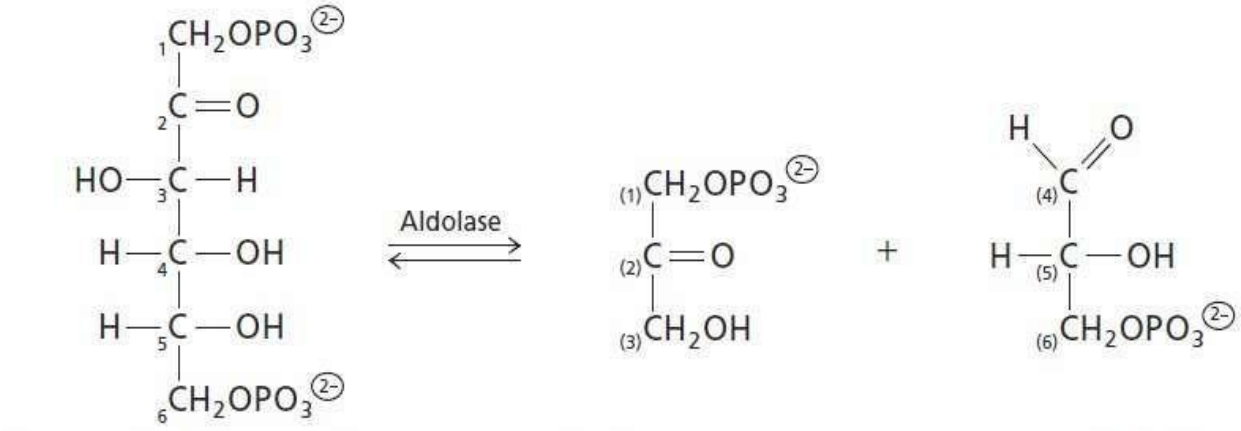

# Step 3

- The enzyme phosphofructokinase uses another ATP molecule to transfer a phosphate group to fructose 6-phosphate to form fructose 1, 6-bisphosphate.



# Step 4

- The enzyme aldolase splits fructose 1, 6-bisphosphate into two sugars that are isomers of each other. These two sugars are dihydroxyacetone phosphate and glyceraldehyde phosphate.

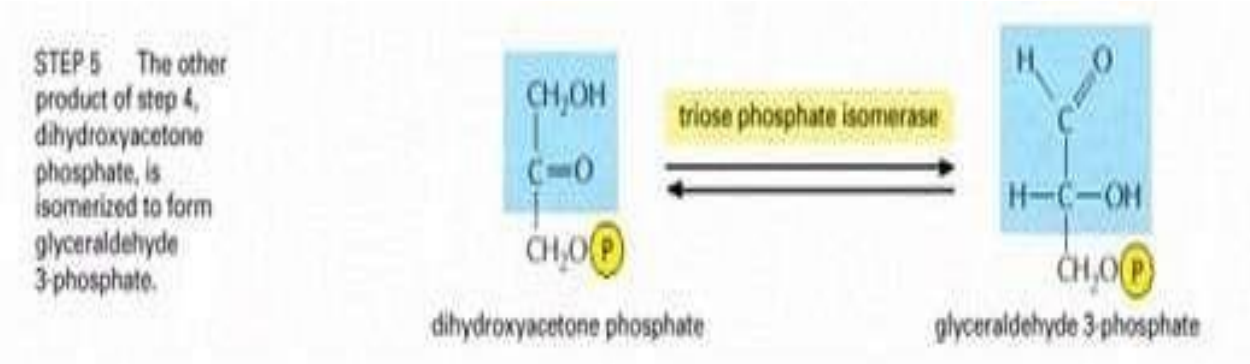



Fructose 1,6-*bis*phosphate | Dihydroxyacetone phosphate | Glyceraldehyde 3-phosphate

# Step 5

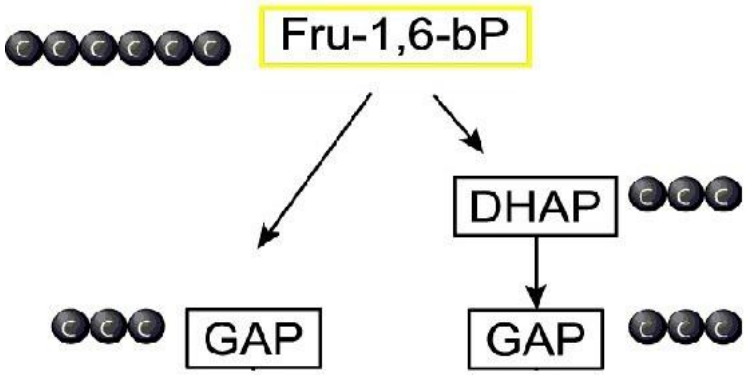
- The enzyme triose phosphate isomerase rapidly inter-converts the molecules dihydroxyacetone phosphate and glyceraldehyde phosphate.

- Glyceraldehyde phosphate is removed / used in next step of Glycolysis.



- Net result for steps 4 and 5:

Fructose 1, 6-bisphosphate↔ 2 molecules of Glyceraldehyde phosphate ($C_3H_5O_3P_1$)




# Step 6

- enzyme triose phosphate dehydrogenase

- enzyme transfers a hydrogen ($H^-$) from glyceraldehyde phosphate to ($NAD^+$) to form NADH.

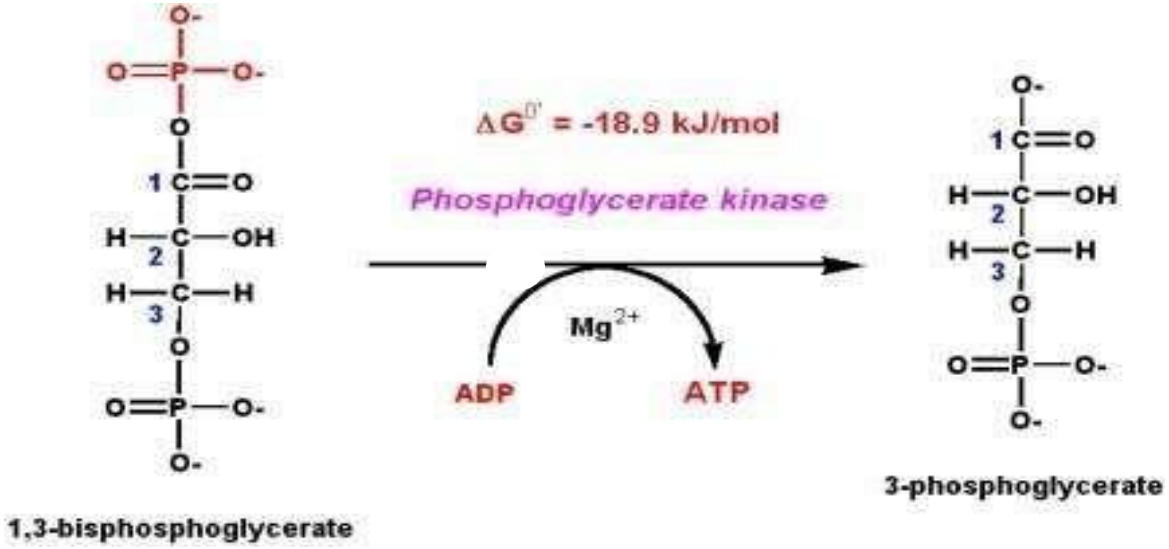
- Triose phosphate dehydrogenase + 2 H- + 2 NAD+ → 2 NADH + 2 H+

- Next triose phosphate dehydrogenase adds a phosphate (P) from the cytosol to the oxidized glyceraldehyde phosphate to form
- 1, 3-bisphosphoglycerate.

TPD+ 2P + 2 glyceraldehyde phosphate → <u>2 molecules of 1,3-bisphosphoglycerate</u>

# Step 7

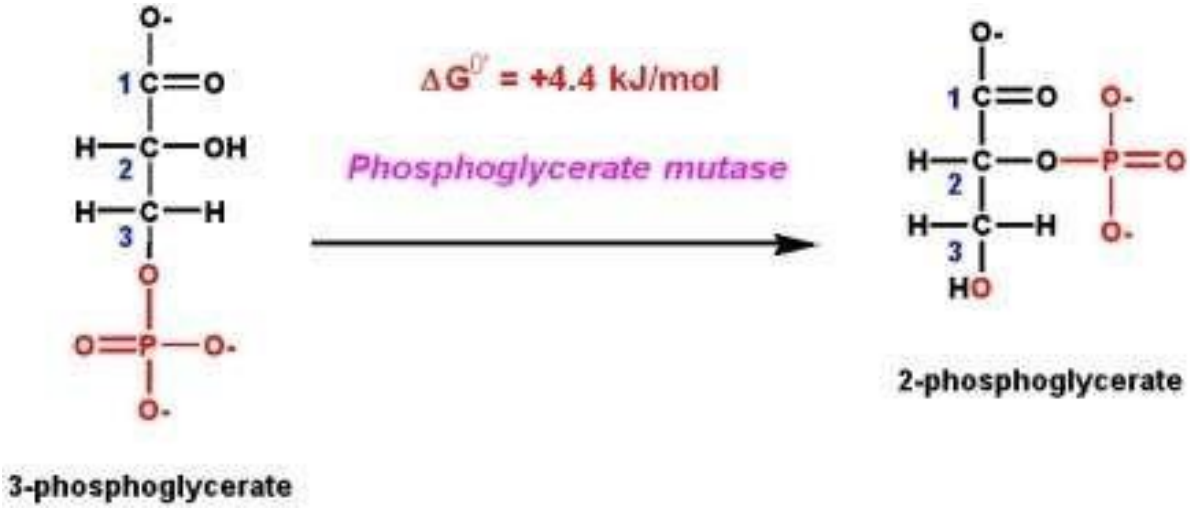
- The enzyme phosphoglycerokinase transfers a P from 1,3-bisphosphoglycerate to a molecule of ADP to form ATP
- This happen for each molecule of 1,3-biphosphoglycerate




Result in step 6: ➡ 2 molecules of 3-phosphoglycerate ($C_3H_5O_4P_1$) + 2 ATP

# Step 8

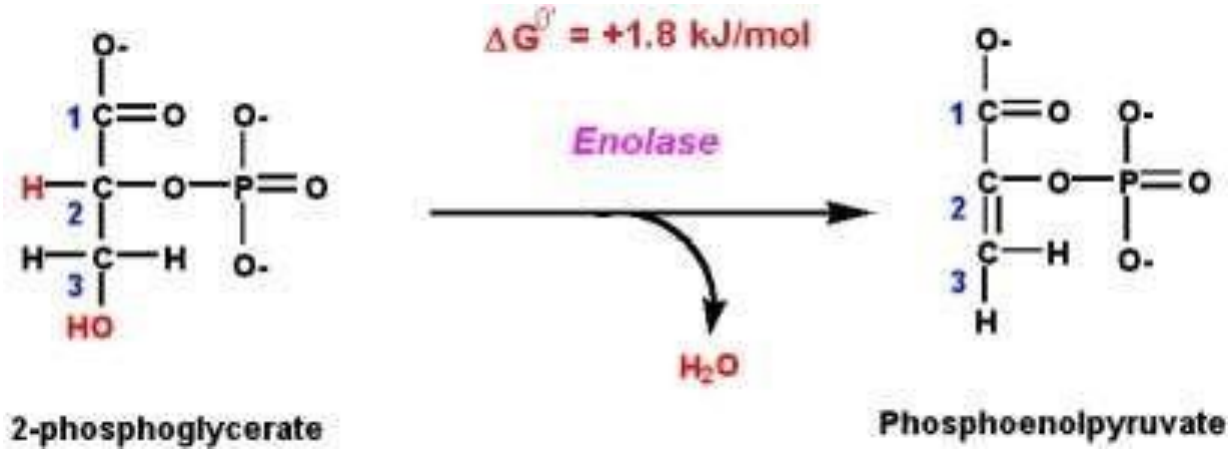
- The enzyme phosphoglyceromutase relocates the P from 3-phosphoglycerate from the 3rd carbon to the 2nd carbon to form -2phosphoglycerate.




2 molecules of 2-Phosphoglycerate ($C_3H_5O_4P_1$)

# Step 9

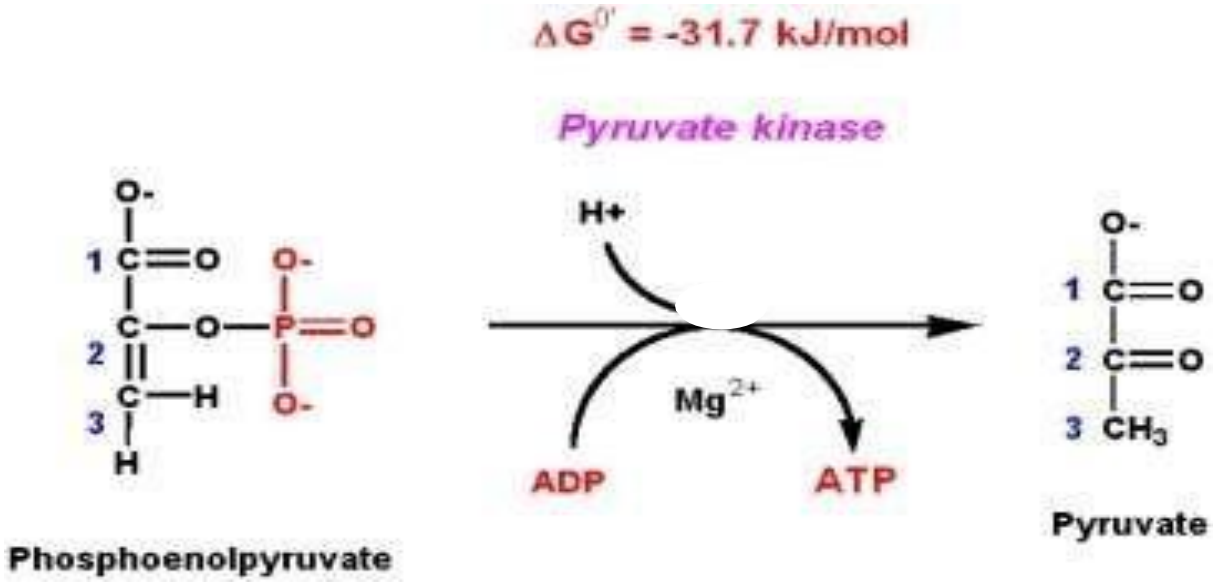
- The enzyme enolase removes a molecule of water from 2-phosphoglycerate to form phosphoenolpyruvic acid (PEP).




Result: 2 molecules of $C_3H_3O_3P_1$

# Step 10

- The enzyme pyruvate kinase transfers a P from PEP to ADP to form pyruvic acid and ATP




Result in step 10: 2 molecules of 2 ATP + 2NADH

# Energy Production of Glycolysis

| | ATP produced | ATP utilized | Net energy |
|---|---|---|---|
| In absence of oxygen (anaerobic glycolysis) | 4 ATP (Substrate level phosphorylation) 2ATP from 1,3 DPG. 2ATP from phosphoenol pyruvate | 2ATP From glucose to glucose -6-p. From fructose -6-p to fructose 1,6 p. | 2 ATP |
| In presence of oxygen (aerobic glycolysis) | 4 ATP (substrate level phosphorylation) 2ATP from 1,3 BPG. 2ATP from phosphoenol pyruvate. | 2ATP -From glucose to glucose -6-p. From fructose -6-p to fructose 1,6 p. | 6 ATP Or 8 ATP |
| | 4 +ATP or 6ATP )from oxidation of 2 NADH + H in mitochondria.( | | |

THANK YOU for YOUR ATTENTION