

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

# **Glycolysis**

**By**

**Amr S. Moustafa, M.D.; Ph.D.**

**Assistant Prof. & Consultant, Medical Biochemistry Dept.  
College of Medicine, KSU  
[amrsm@hotmail.com](mailto:amrsm@hotmail.com)**

# Objectives

1. Major oxidative pathway of glucose
2. The main reactions of glycolytic pathway
3. The rate-limiting enzymes of glycolytic pathway
4. ATP production:
  - Aerobic
  - Anaerobic and RBCs
5. The biochemical basis of PKD hemolytic anemia

# Metabolic Pathway

**Definition**

**Site:**

**Cellular (tissue) and Subcellular**

**Reactions**

**Rate-limiting enzyme(s)**

**Regulatory mechanism(s):**

**Rapid, short-term:**

**Allosteric**

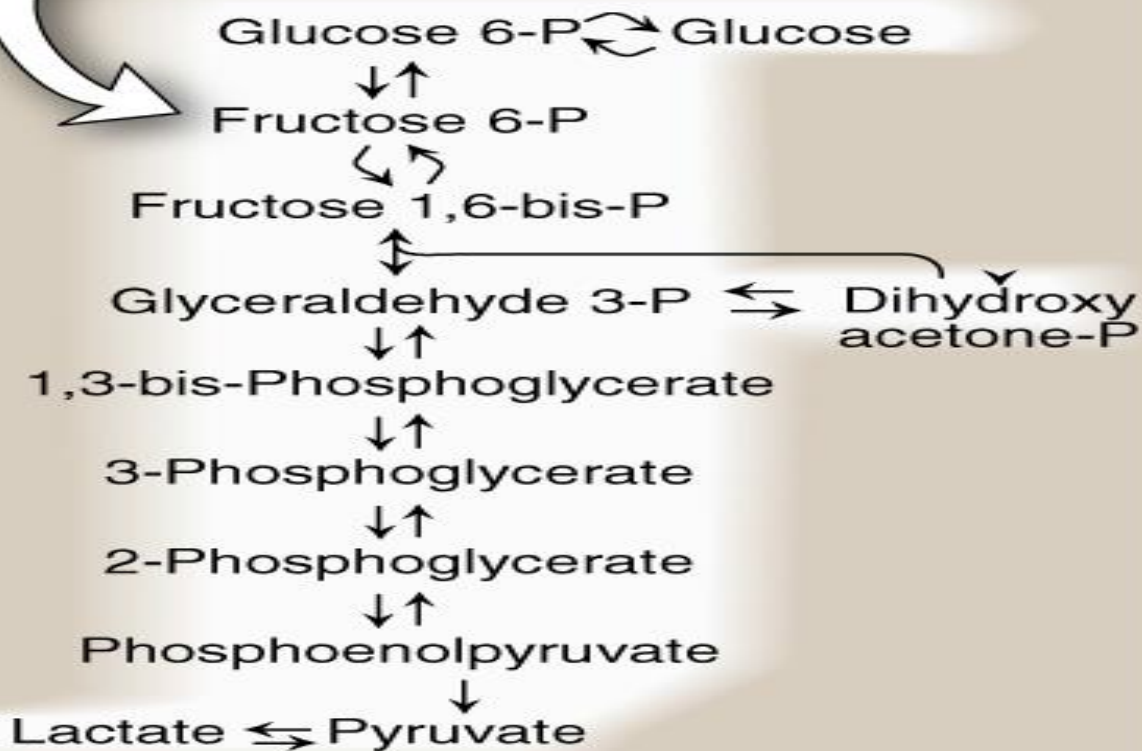
**Covalent modification**

**Slow, long-term:**

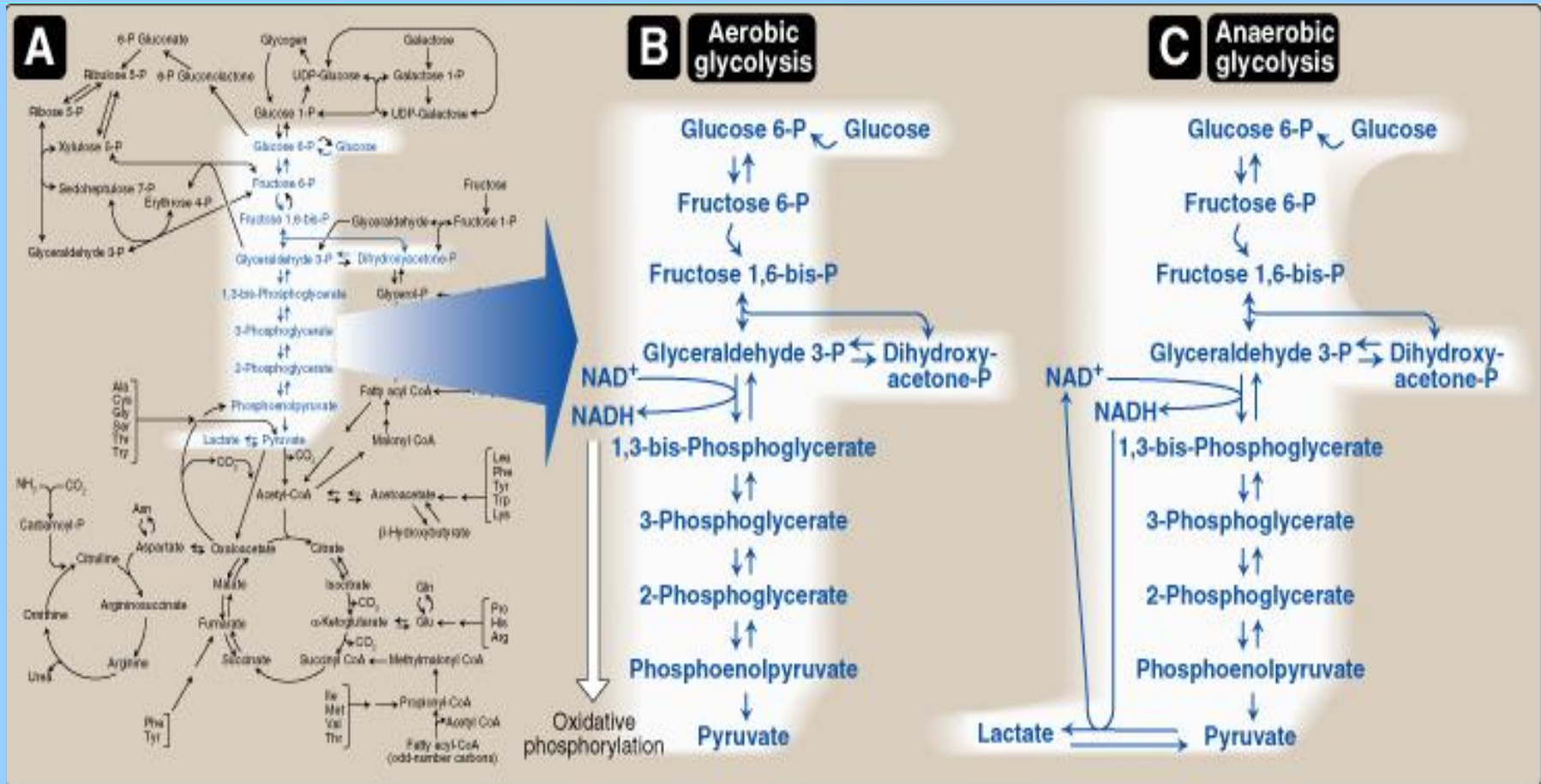
**Induction/repression**

# Glycolysis

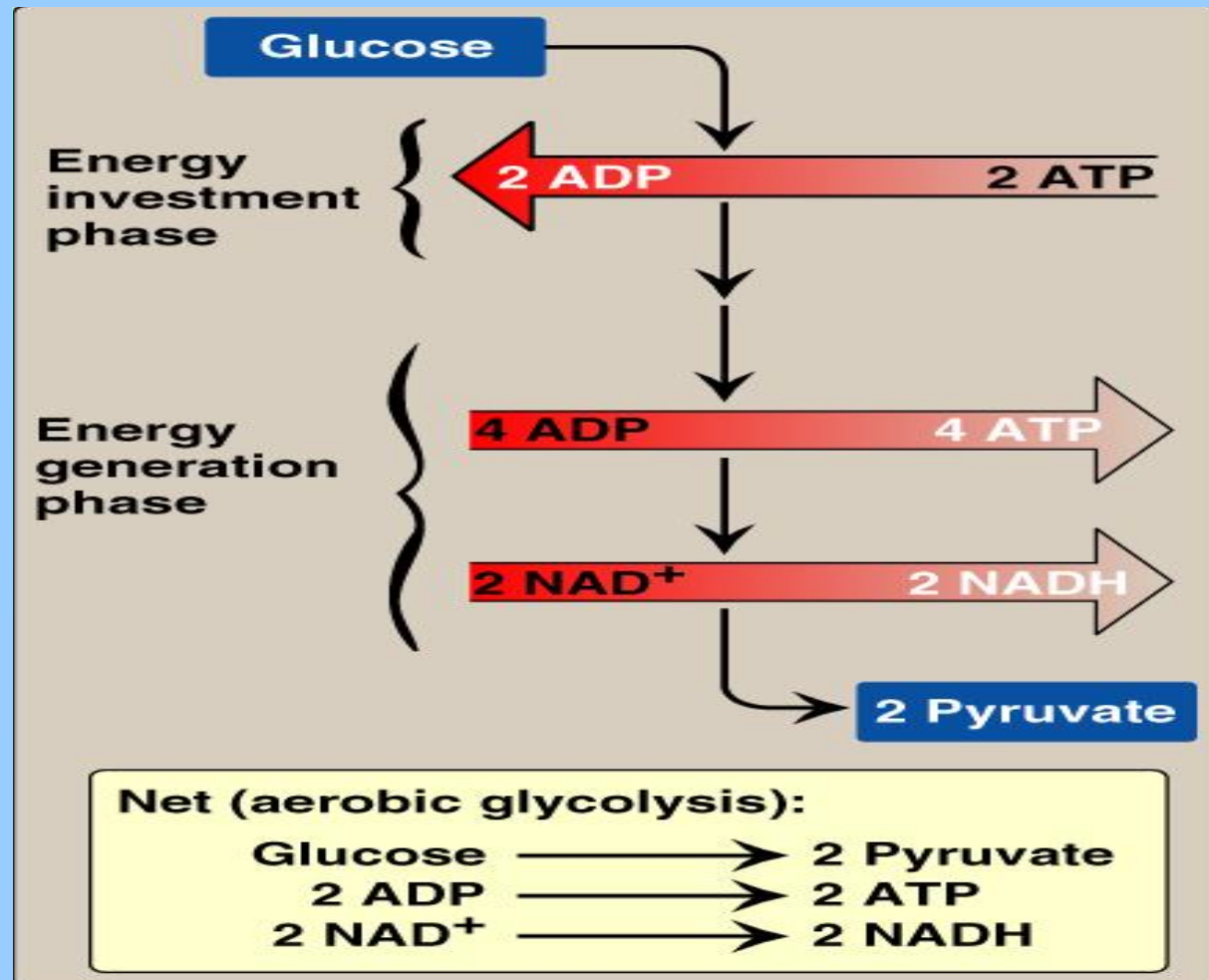
The product of one reaction is the substrate of the subsequent reaction.



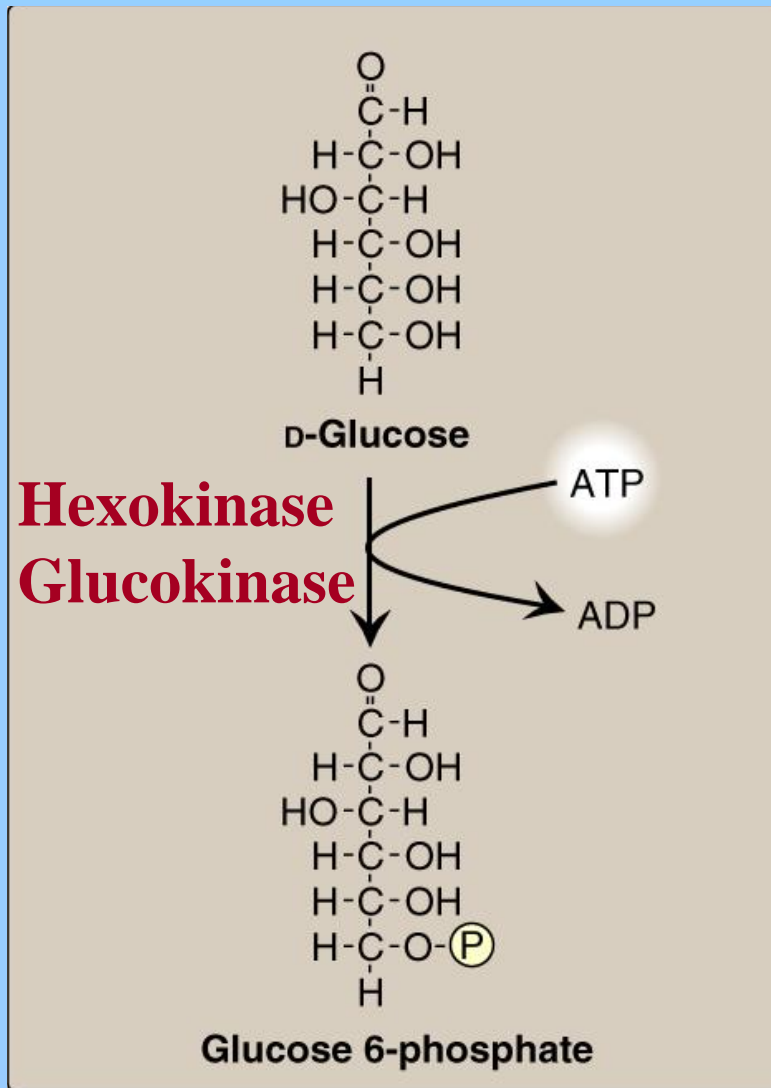
# Aerobic Vs Anaerobic Glycolysis



# Aerobic Glycolysis: Total Vs Net ATP Production



# Aerobic Glycolysis-1

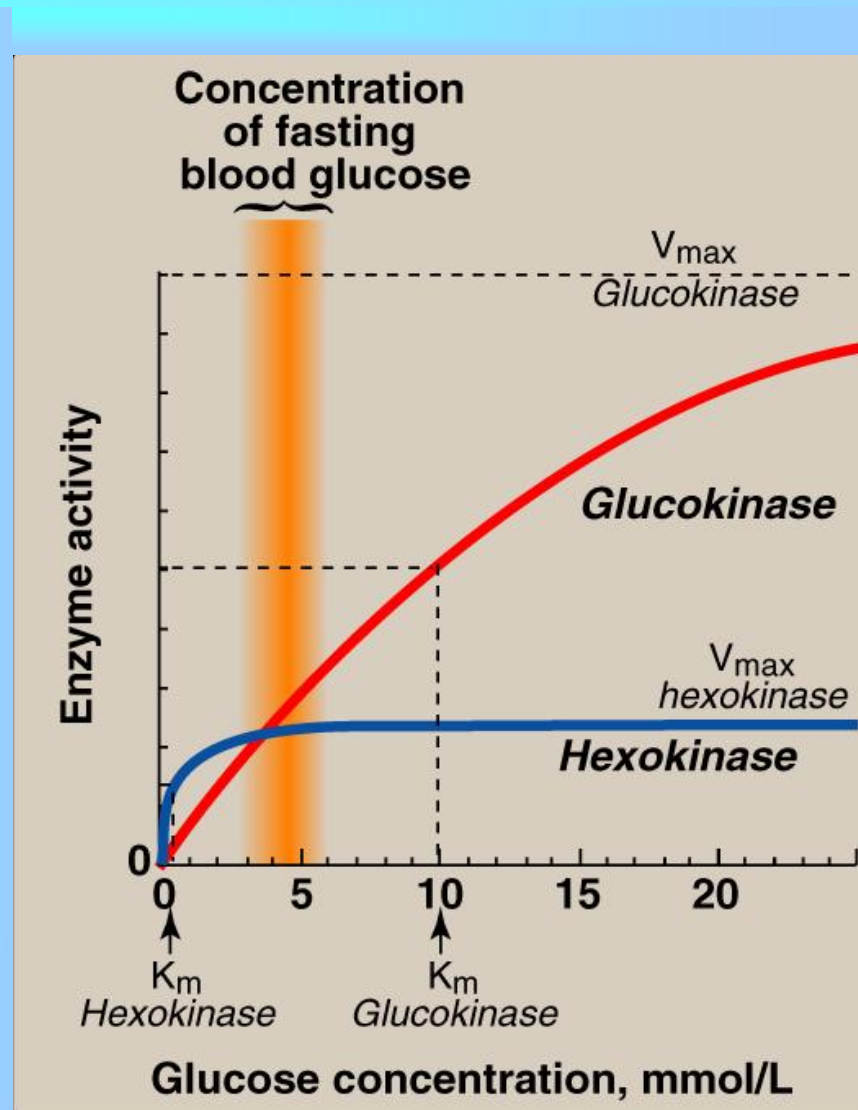




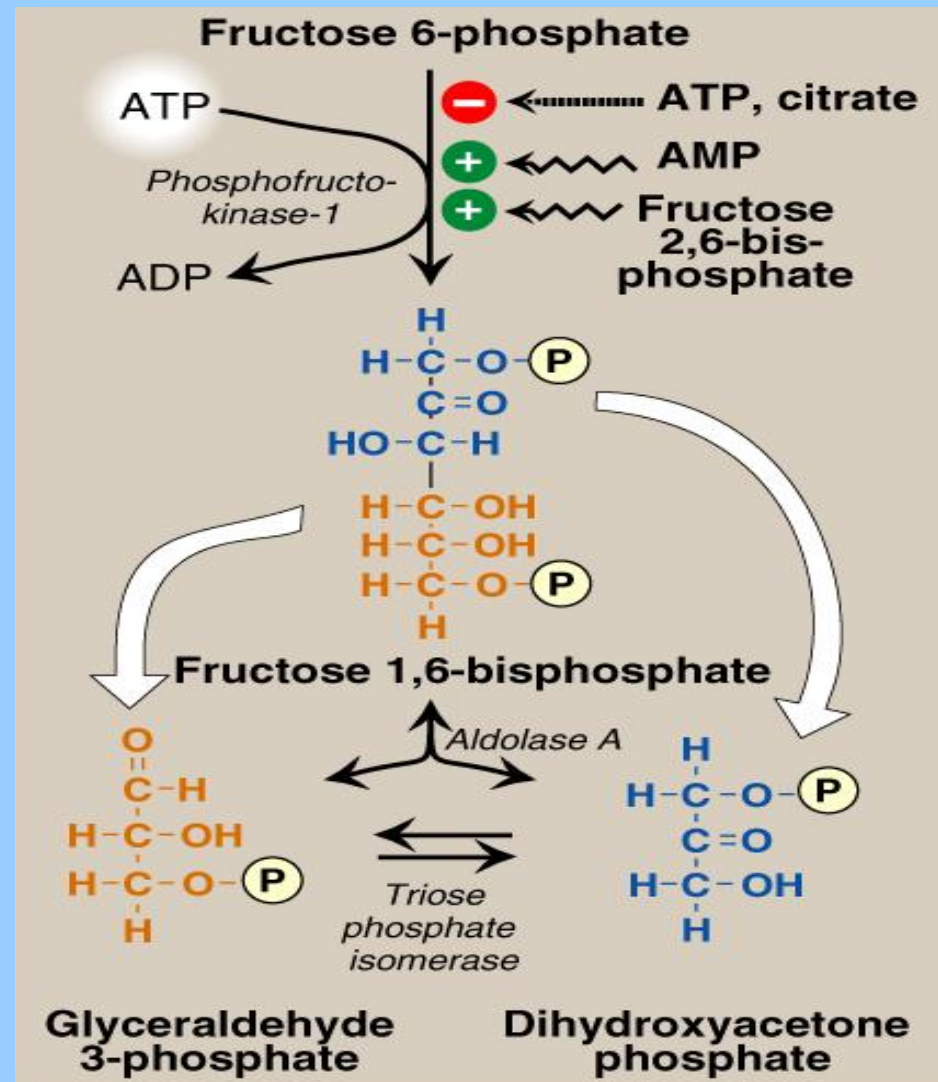
# Hexokinase Vs Glucokinase

	Hexokinase	Glucokinase
Site	Most tissues	Hepatocytes Islet cells (pancreas)
Kinetics	Low $K_m$ Low $V_{max}$	High $K_m$ High $V_{max}$

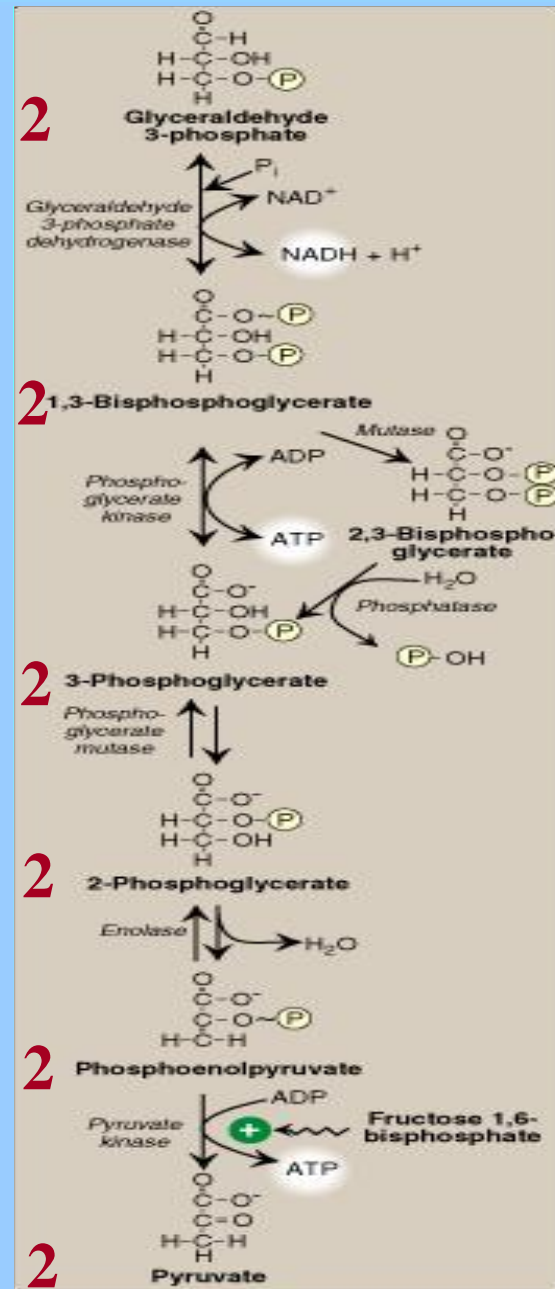
# Hexokinase Vs Glucokinase -2



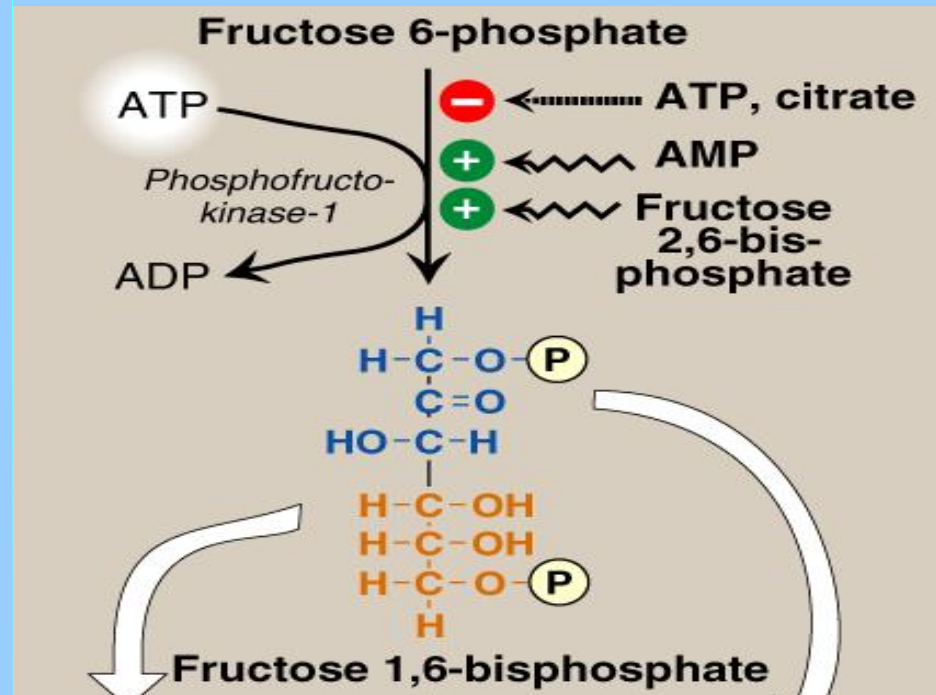
# Aerobic Glycolysis: 3-5



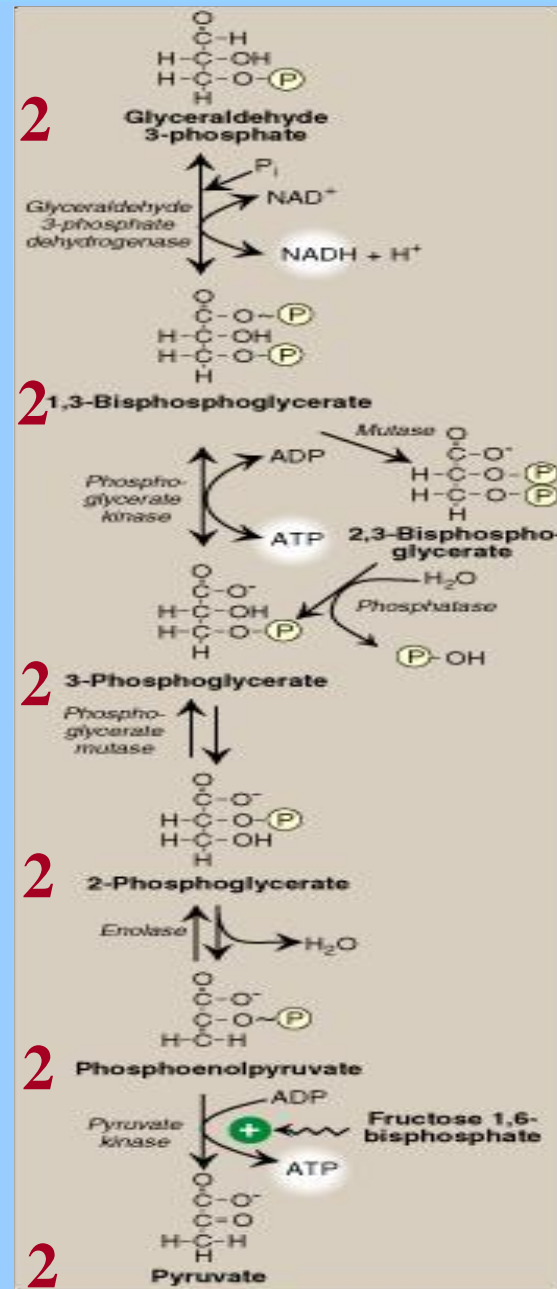
# Aerobic Glycolysis: 6-10



# PFK-1 : Regulation

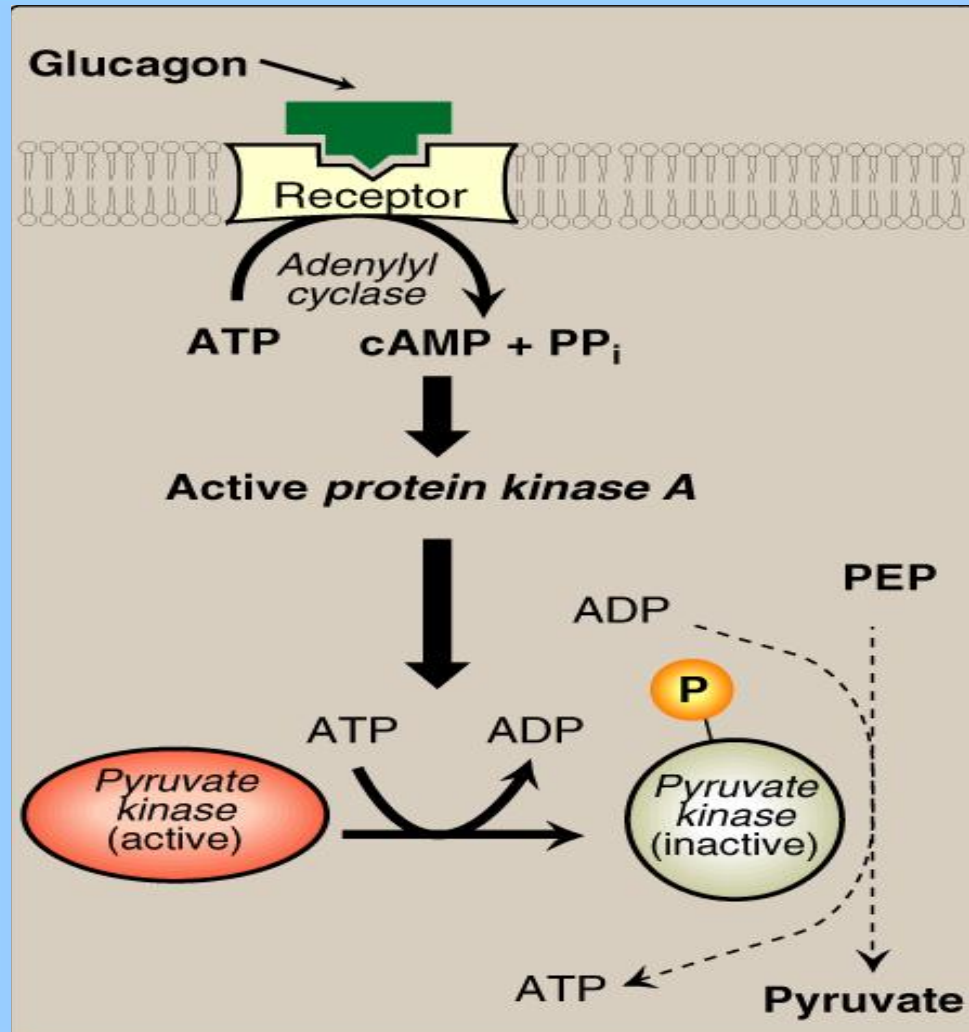


# Glyceraldehyde 3-Phosphate Dehydrogenase



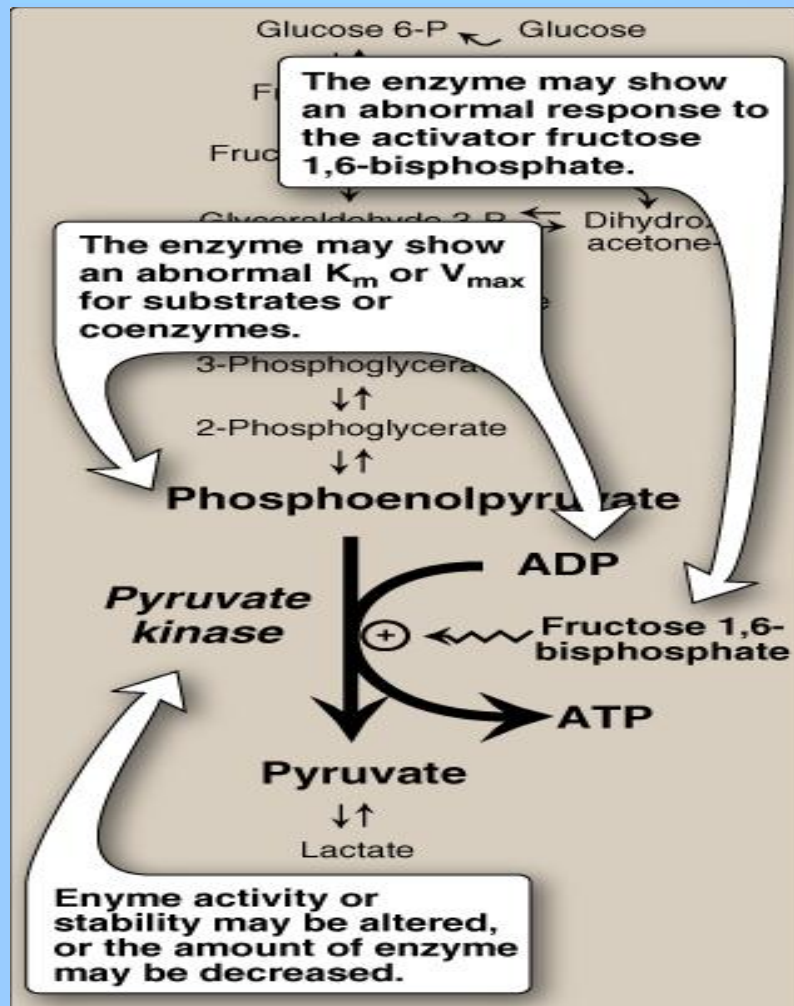
# Pyruvate Kinase

## Covalent Modification



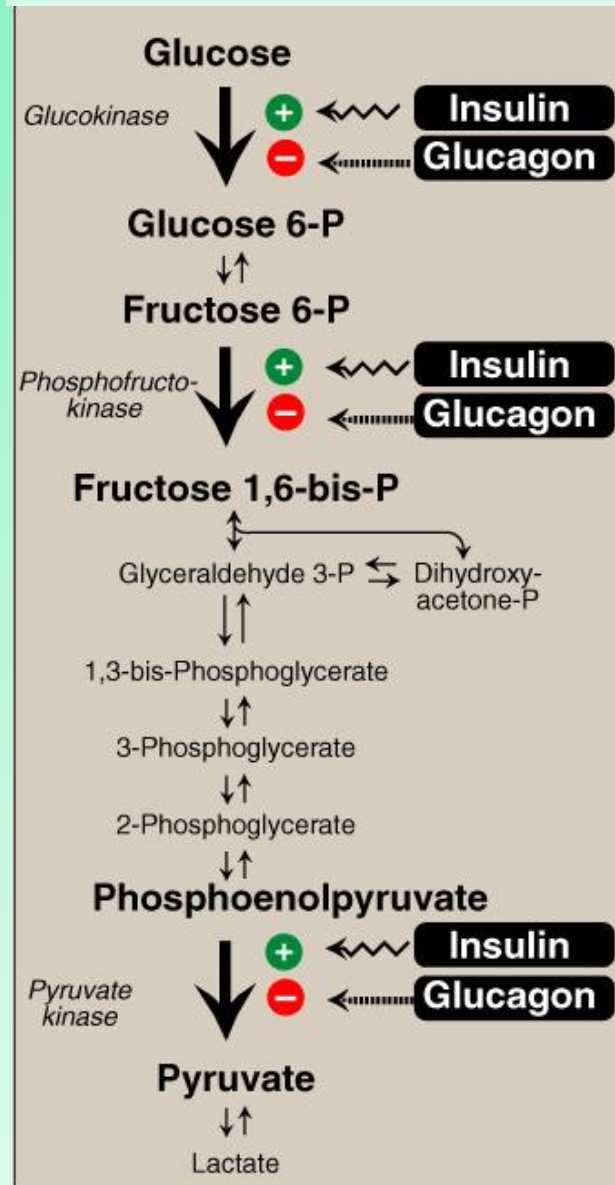
# Pyruvate Kinase Deficiency

## Hemolytic Anemia





# Regulation of Glycolysis: Induction & Repression



# **Summary: Regulation of Glycolysis**

## **Regulatory Enzymes (Irreversible reactions):**

**Glucokinase/hexokinase**

**PFK-1**

**Pyruvate kinase**

## **Regulatory Mechanisms:**

**Rapid, short-term:**

**Allosteric**

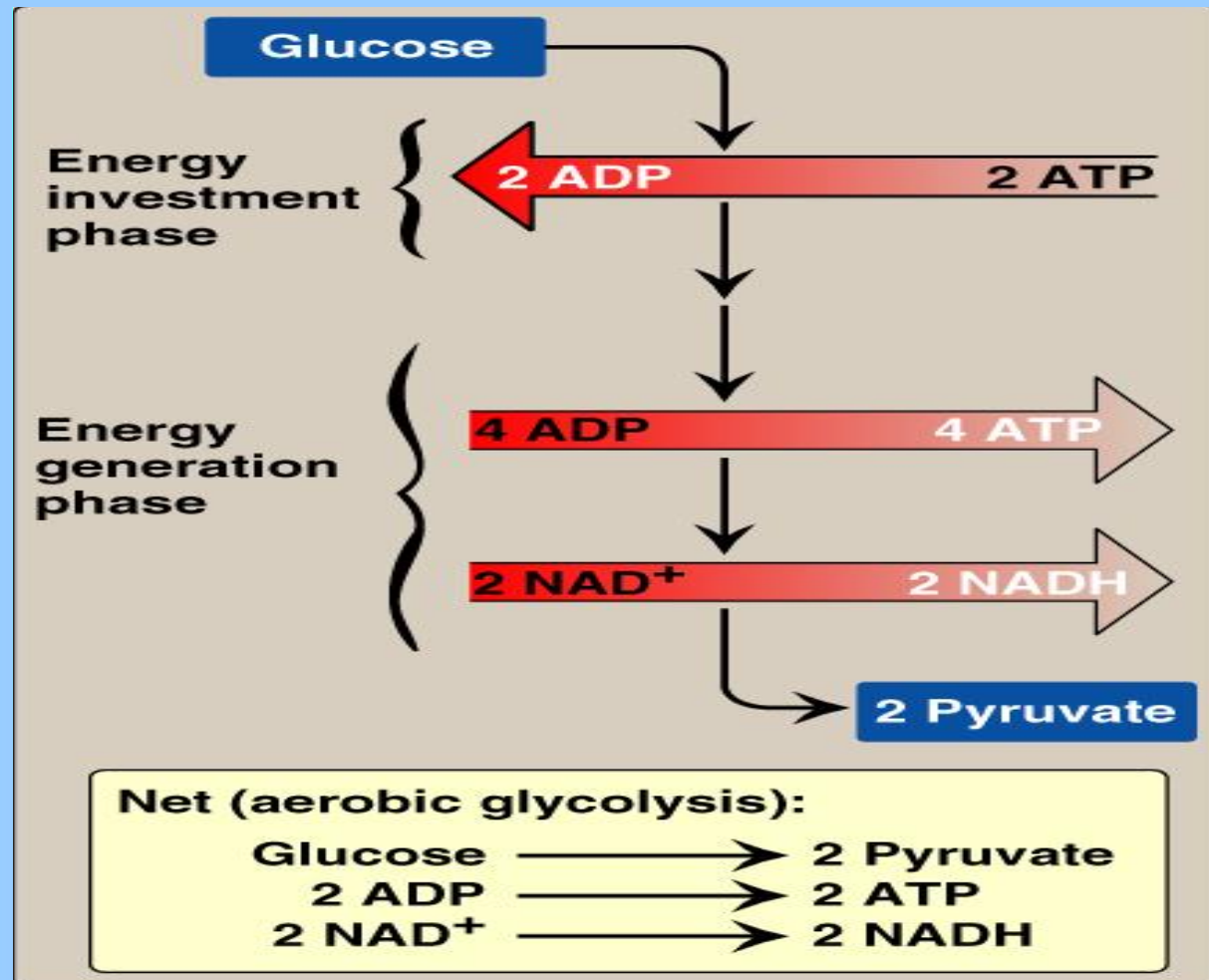
**Covalent modifications**

**Slow, long-term:**

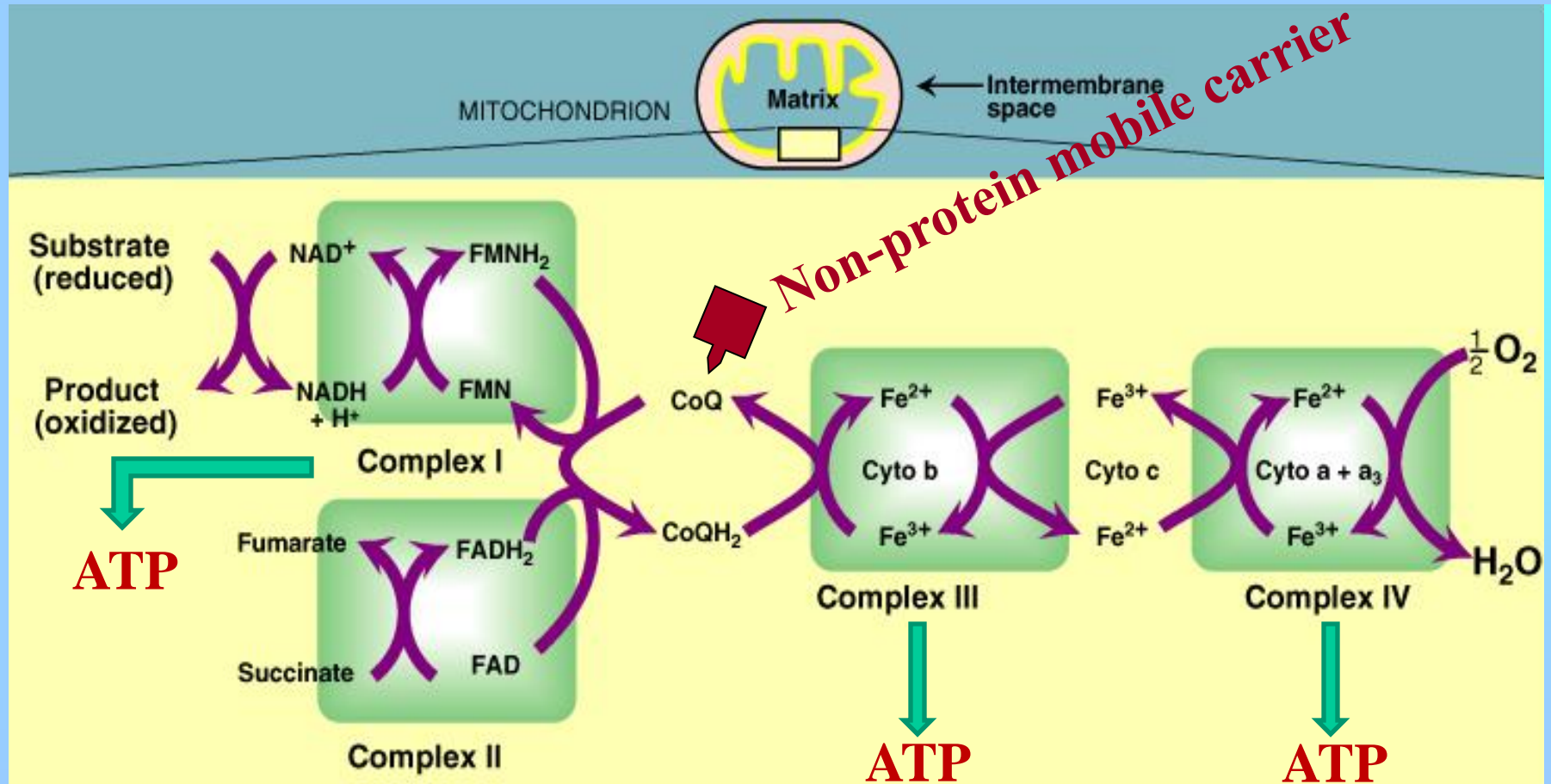
**Induction/repression**

**Apply the above mechanisms for each enzyme where applicable**

# Oxidative and Substrate Level Phosphorylation

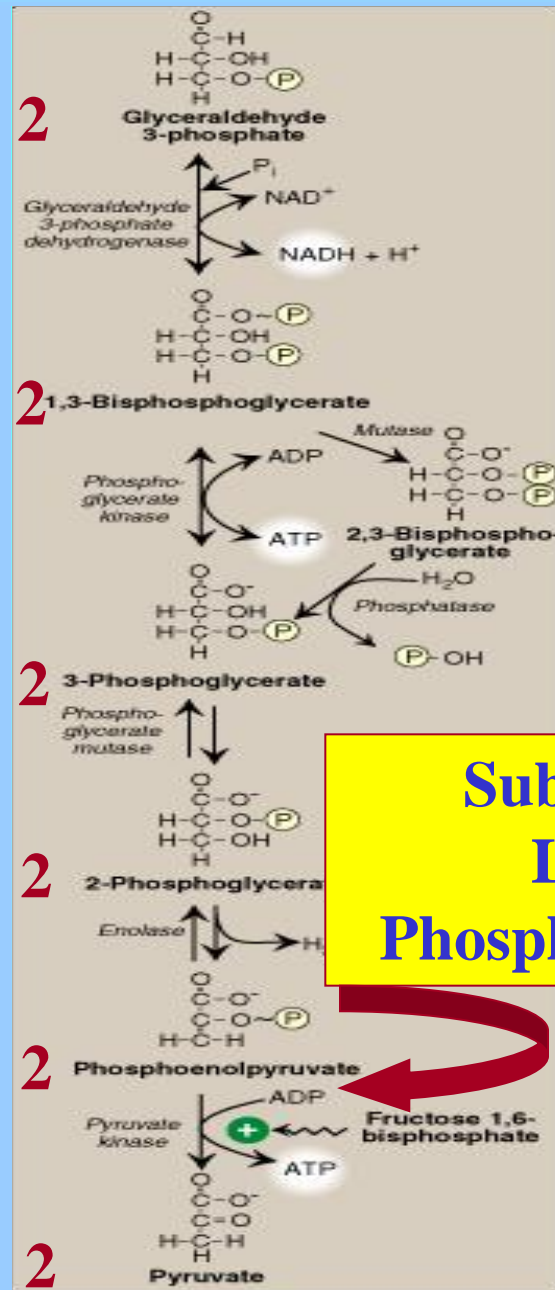


# Oxidative Phosphorylation



Electron transport and ATP synthesis are tightly coupled processes

# Pyruvate Kinase



# Aerobic Glycolysis: ATP Production

**ATP Consumed:**

**2      ATP**

**ATP Produced:**

**Substrate-level      2 X 2 =      4      ATP**

**Oxidative-level      2 X 3 =      6      ATP**

**Total      10      ATP**

**Net:      10 – 2 =      8      ATP**