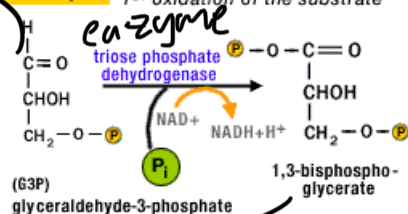


# Glycolysis: The Energy Payoff

explains biophosphorylation

- Review: The energy investment phase of **glycolysis** involves the investment of two **ATP** molecules and results in the formation of two molecules of **glyceraldehyde phosphate**.
- The **energy payoff phase** of glycolysis consists of five additional steps and results in the formation of **four ATP**, **two NADH + H<sup>+</sup>**, and two **pyruvate** molecules. **glucose → 2 pyruvate**
- Substrate level phosphorylation** is the process by which ATP is produced from the transfer of a phosphate group from a substrate molecule in a **metabolic pathway**. **need 2 understand concept; path involving energy change?**

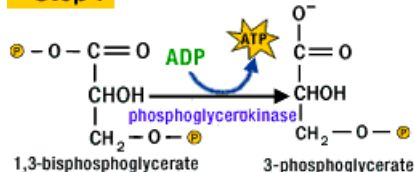
## Step 6 1st oxidation of the substrate



Step 6: Glyceraldehyde phosphate is **oxidized** (NAD<sup>+</sup> is reduced) and phosphorylated by the enzyme **triose phosphate dehydrogenase** to produce **1,3-bisphosphoglycerate**. Two molecules of **NADH + H<sup>+</sup>** are produced. **redox → phosphate bond**

This is an example of a **coupled reaction**. The highly **exergonic redox reaction** fueled the **endergonic formation** of the phosphate bond.

## Step 7

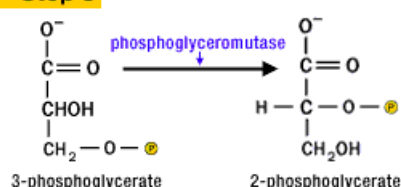


phosphorylation (substrate → ADP)

Step 7: A phosphate group is removed from each 1,3-bisphosphoglycerate to make **two ATP** and **3-phosphoglycerate**. This reaction is mediated by the enzyme **phospho-glycerokinase**.

This reaction is an example of **substrate level phosphorylation**. A phosphate group was removed from a substrate molecule and added to ADP to make ATP.

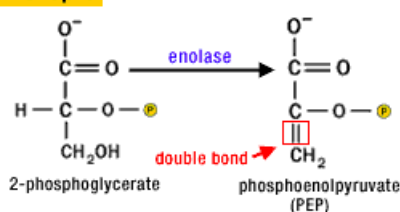
## Step 8



Step 8: The remaining phosphate group is transferred to the middle carbon by the enzyme **phosphoglyceromutase**. This reaction will **energize** the molecule and make it **less stable**. **2-phosphoglycerate** results.

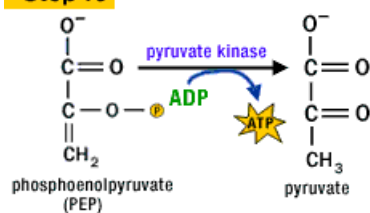
H swaps w/ phos. group

## Step 9



Step 9: A water molecule is removed and a double bond is added to both 2-phosphoglycerate molecules to produce two **phosphoenolpyruvate** (also known as **PEP**) molecules. **dehydration**

## Step 10



Step 10: Both **PEP** molecules are **dephosphorylated** by pyruvate kinase to produce two **pyruvates** and two **ATP**.

phosphorylation: removal of a phosphate group for ADP → ATP conversion

6. coupled reaction
7. phosphorylation (substrate)
8.  $\text{O} \rightleftharpoons \text{H}$
9. dehydration
10. dephosphorylation

cycles between phosphorylation, dehydration, + coupled reaction