

Fuel for the Body Glycolysis



GK-12 Theme Based Lesson
Molecules to Muscles

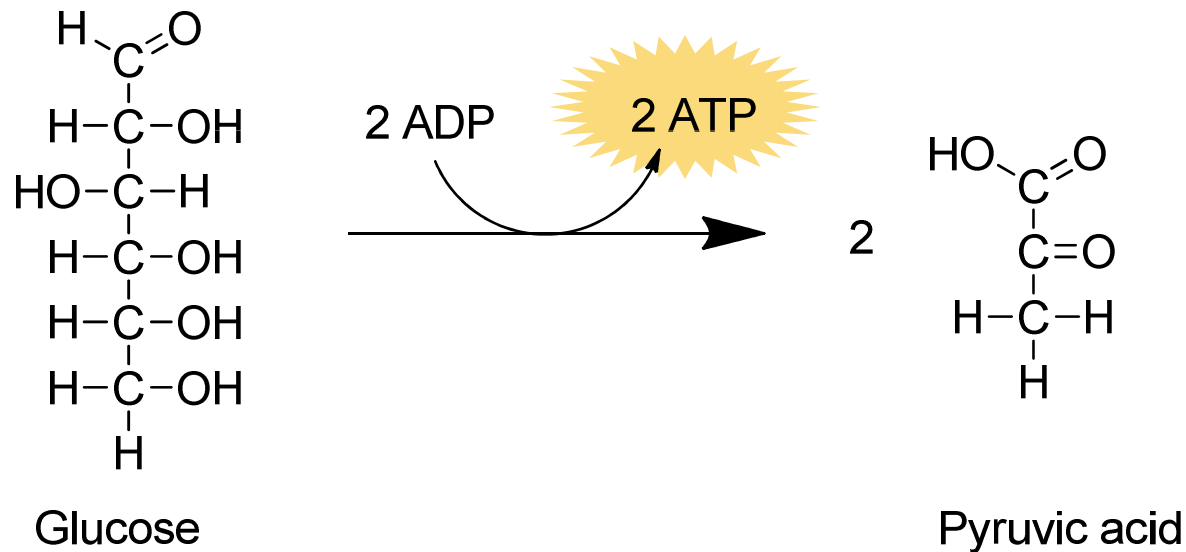
Vocabulary

- ▶ **Glycolysis** – the **breakdown of sugar** in the body
- ▶ **Isomers** – compounds with the **same chemical formula but different structures**
- ▶ **Phosphorylation** – addition of a **phosphate group (PO_3^{2-})** to a molecule
- ▶ **Fermentation** – breakdown of glucose in the **absence** of oxygen; **no ATP can be produced**
- ▶ **Respiration** – breakdown of glucose in the **presence** of oxygen; **ATP continues to be produced**



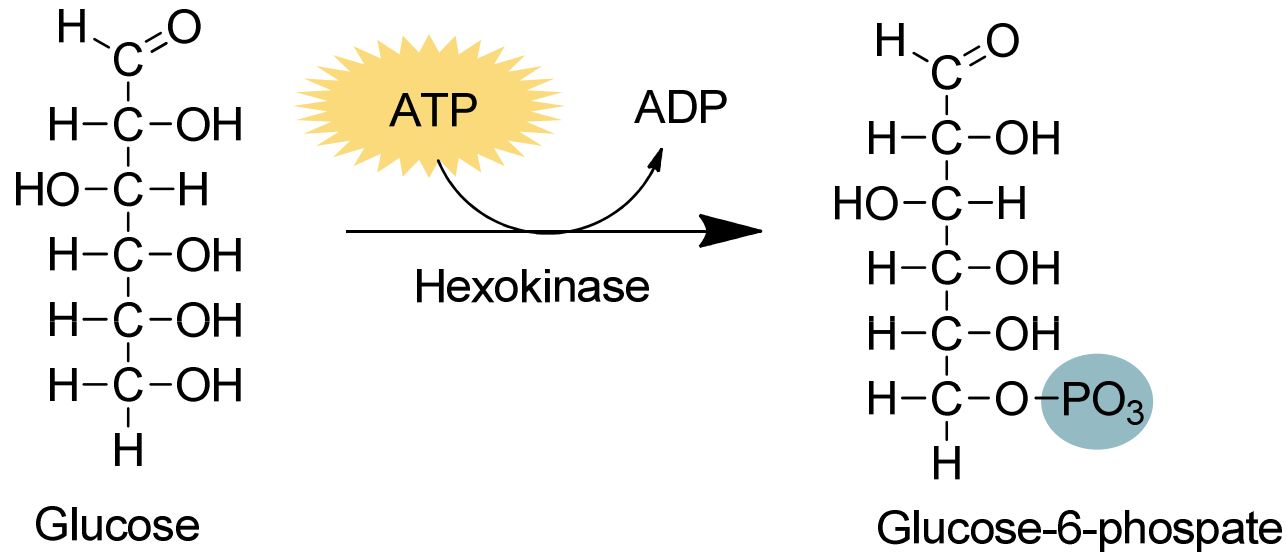
Glycolysis: Overall Picture (p. 873)

- ▶ 2 molecules of ATP produced for every molecule of glucose used
 - ▶ EXCELLENT energy source

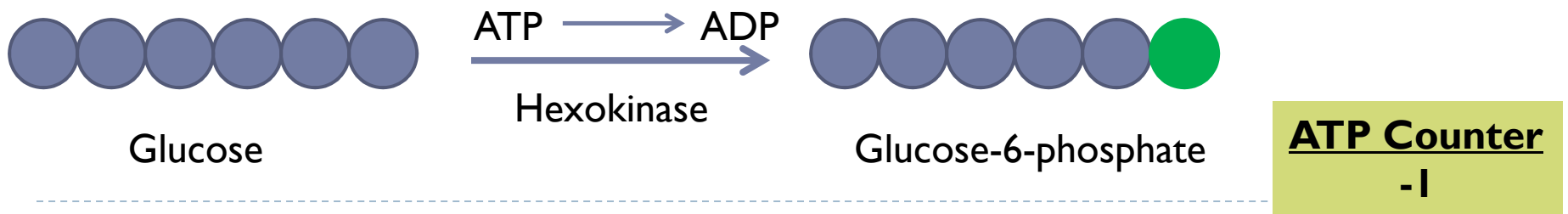


Glycolysis: Step 1

Add a phosphate group to carbon #6 (**phosphorylation**).



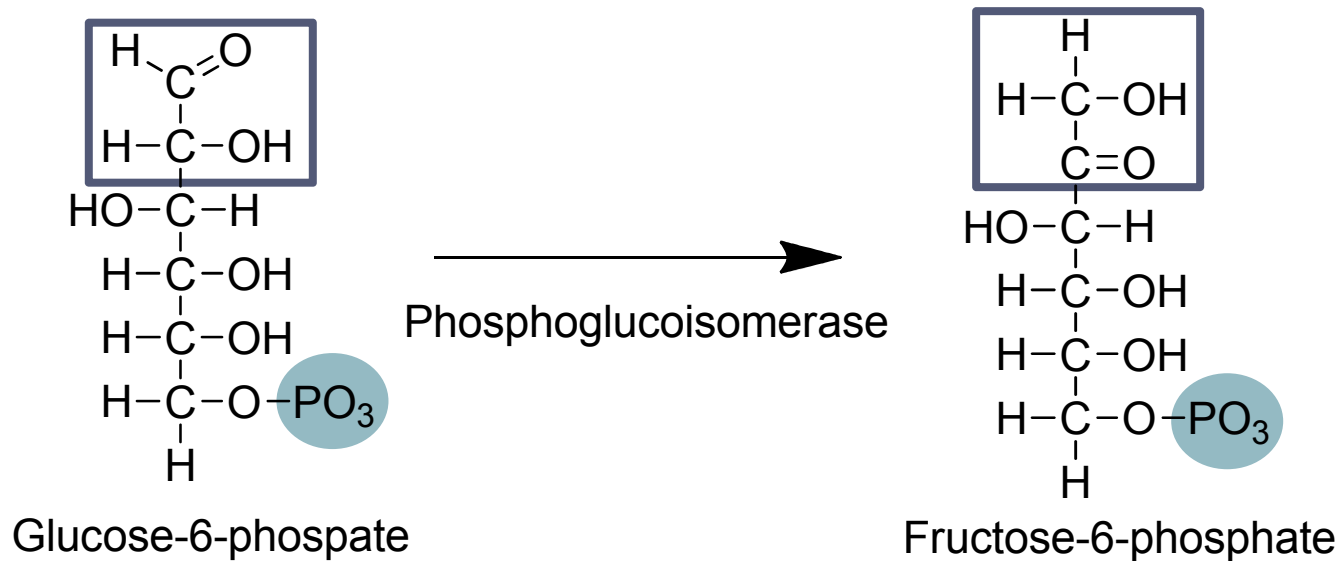
What you'll need to know for the test:



Each circle represents a carbon atom. The different color means the carbon is phosphorylated.

Glycolysis: Step 2

Isomerization



Both of these molecules have the chemical formula $C_6H_{11}O_{10}P$

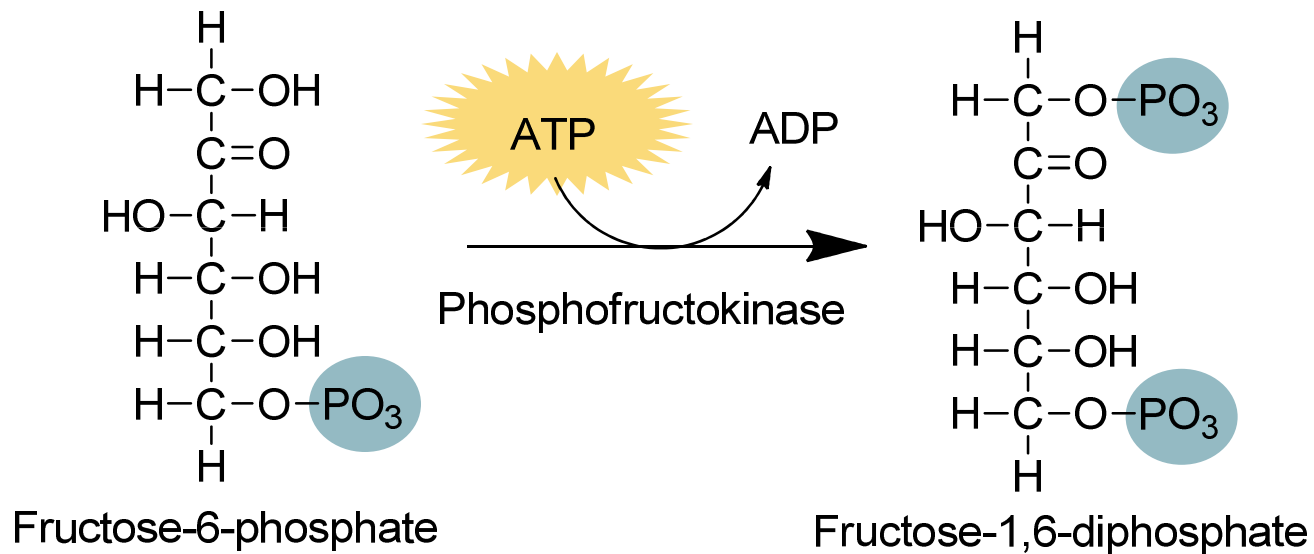
Question: Do you think these compounds would have similar properties?

ATP Counter

-1

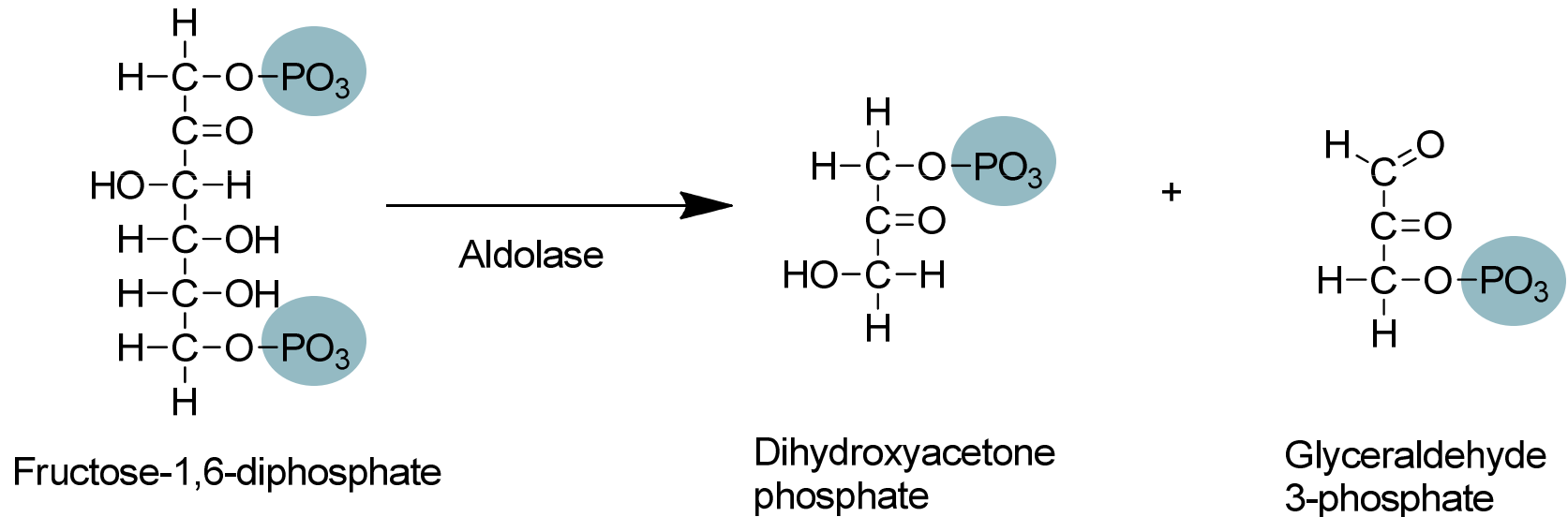
Glycolysis: Step 3

Add a phosphate group to carbon #1 (**phosphorylation**).



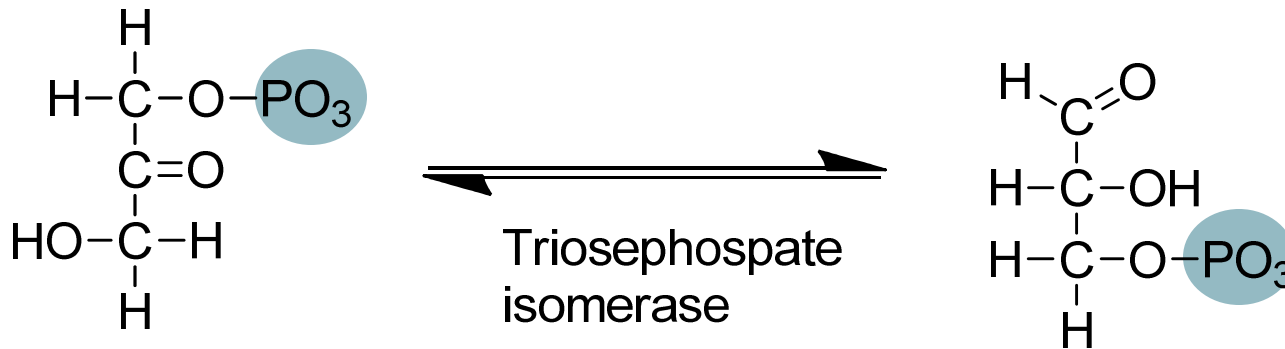
Glycolysis: Step 4

This is the step that gives us the name **glycolysis**. The fructose is split into two smaller molecules.



Glycolysis: Step 5

Isomerization



Dihydroxyacetone
phosphate

Glyceraldehyde
3-phosphate

Both of these molecules have the chemical formula $\text{C}_3\text{H}_5\text{O}_6\text{P}$

Only “G-3-P” is used in Step 6, so the isomerization equilibrium is pulled toward “G-3-P”

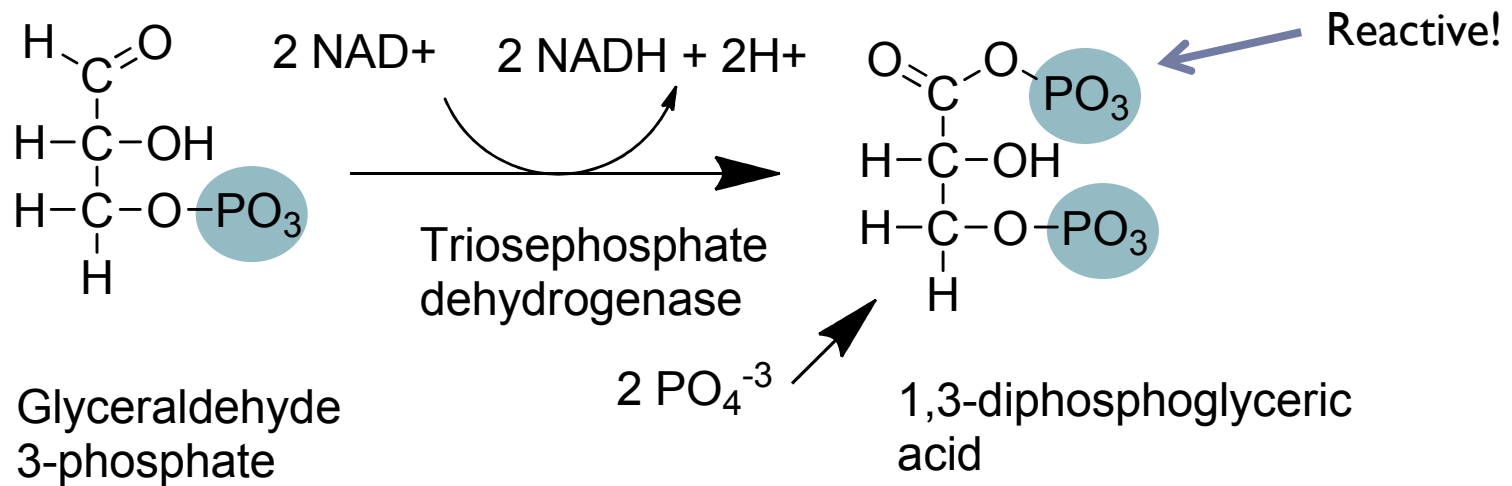
Question: What is this principle called?

ATP Counter
-2

▶ **Answer:** LeChatelier’s Principle

Glycolysis: Step 6 (2 molecules)

Oxidation of carbon #1 AND phosphorylation



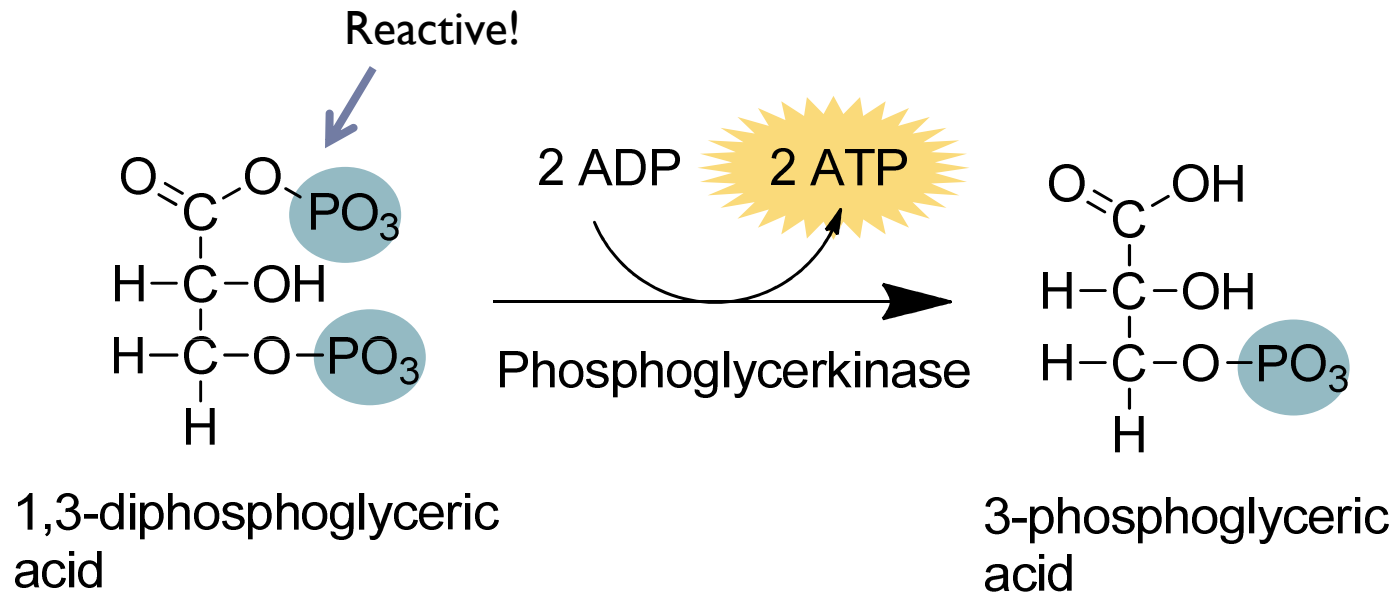
The phosphate comes from inorganic phosphate, which is always floating around in the cell

Question: Why don't cells just use inorganic

▶ phosphate to produce energy?

Glycolysis: Step 7 (2 molecules)

Production of ATP (finally!)



Our ATP counter is now officially at ZERO.

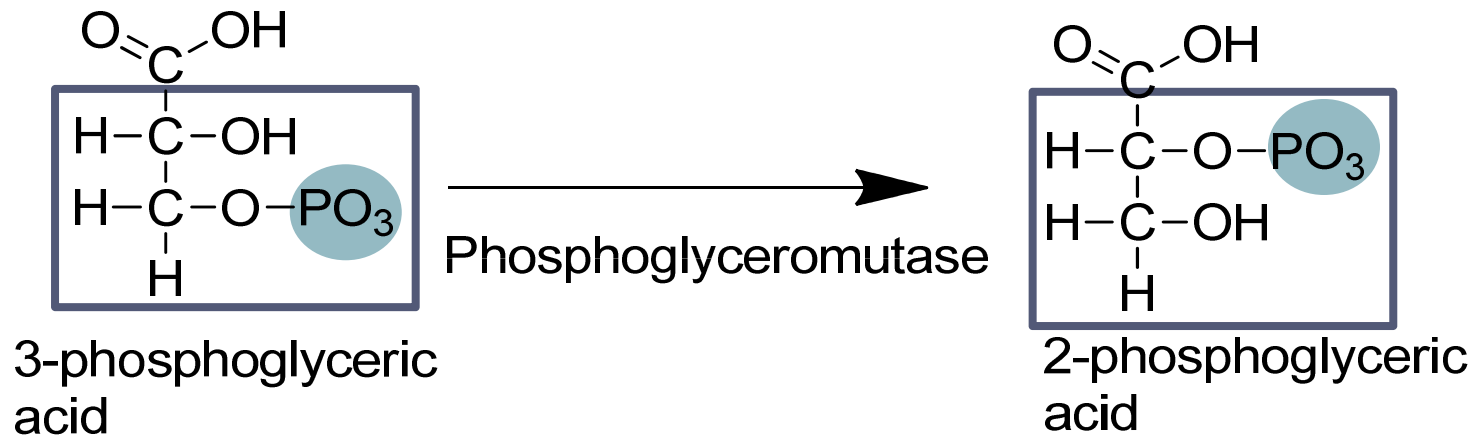
Question: Is the *production* of ATP energetic?

Or is it the later *use*?

ATP Counter
0

Glycolysis: Step 8 (2 molecules)

Isomerization



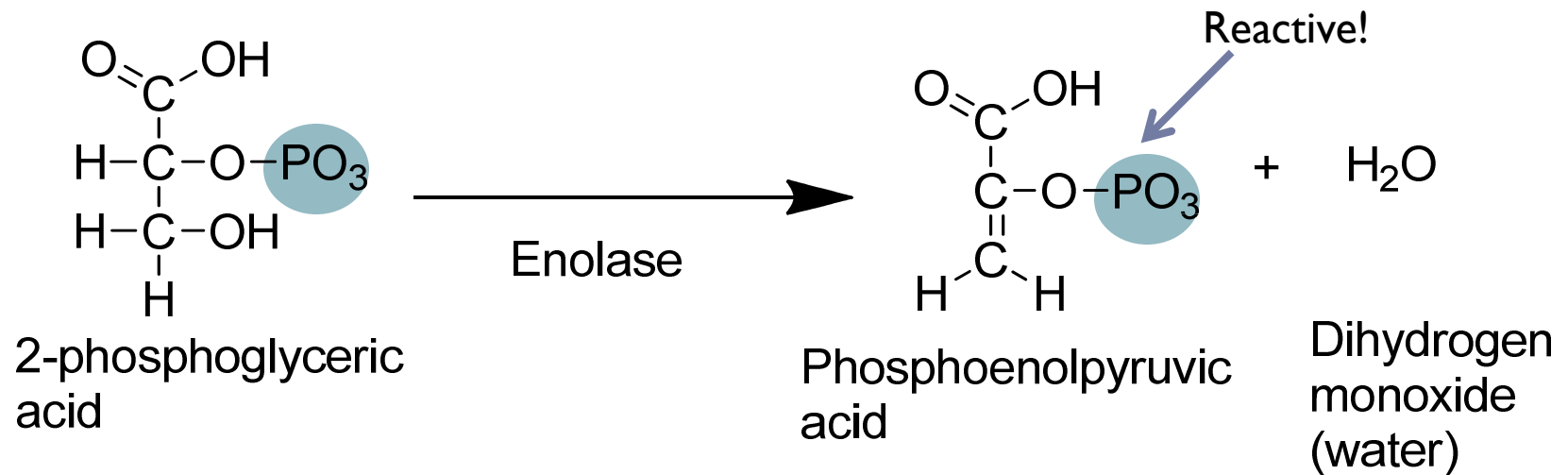
Both of these molecules have the chemical formula $C_3H_5O_8P$

ATP Counter

0

Glycolysis: Step 9 (2 molecules)

Dehydration to produce an enol (alcohol + alkene in the same molecule)



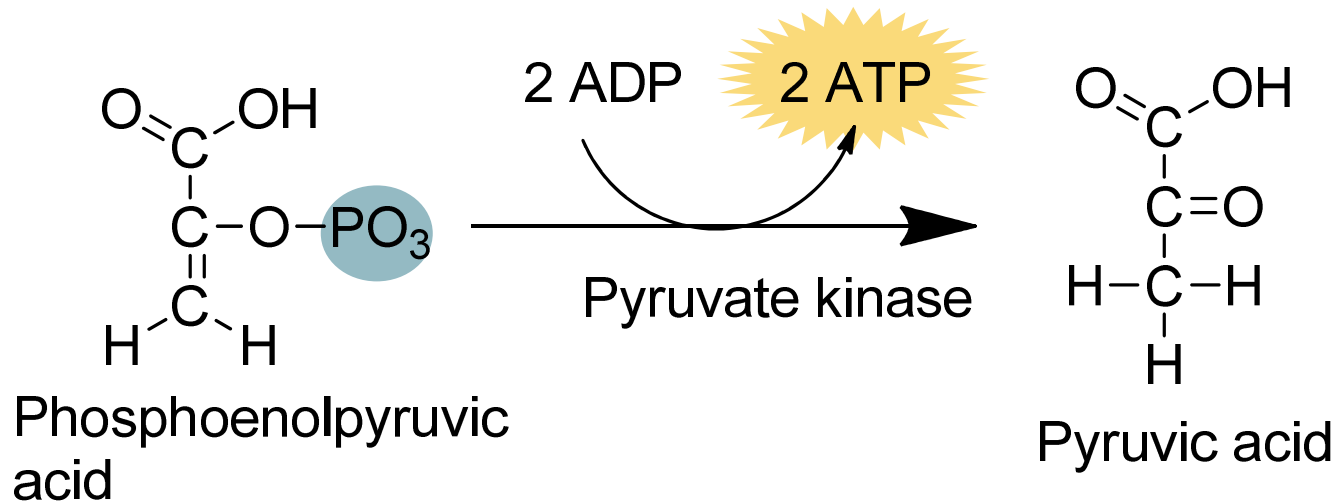
Identify the alkene and the alcohol (actually a carboxylic acid)

What is dehydration?

ATP Counter
0

Glycolysis: Step 10 (2 molecules)

Final production of ATP

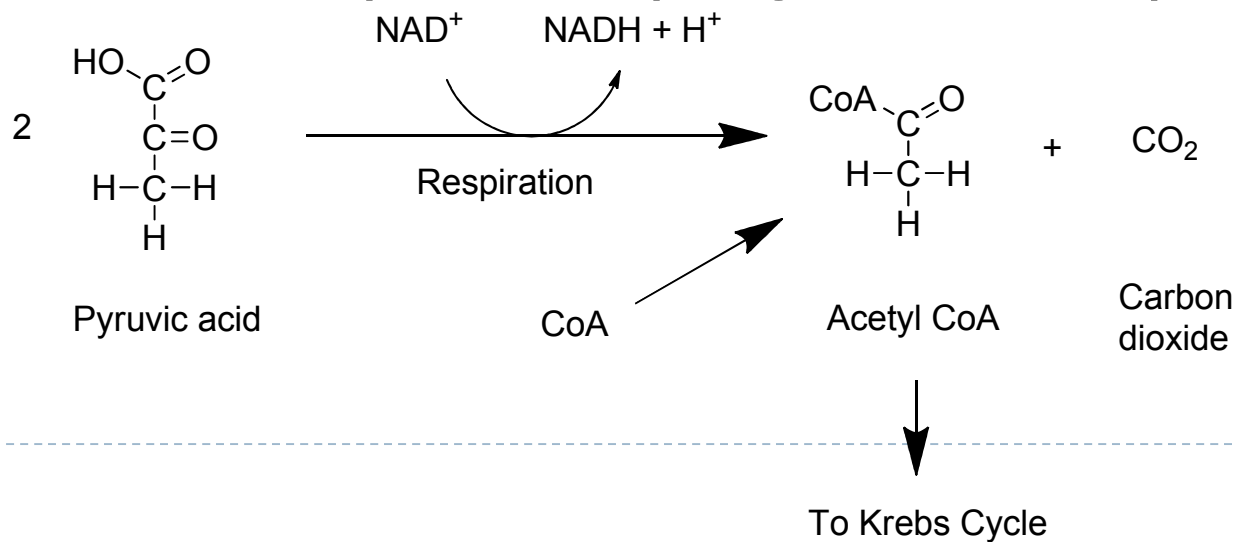


It took 10 steps to show a gain of ATP!

ATP Counter
+2

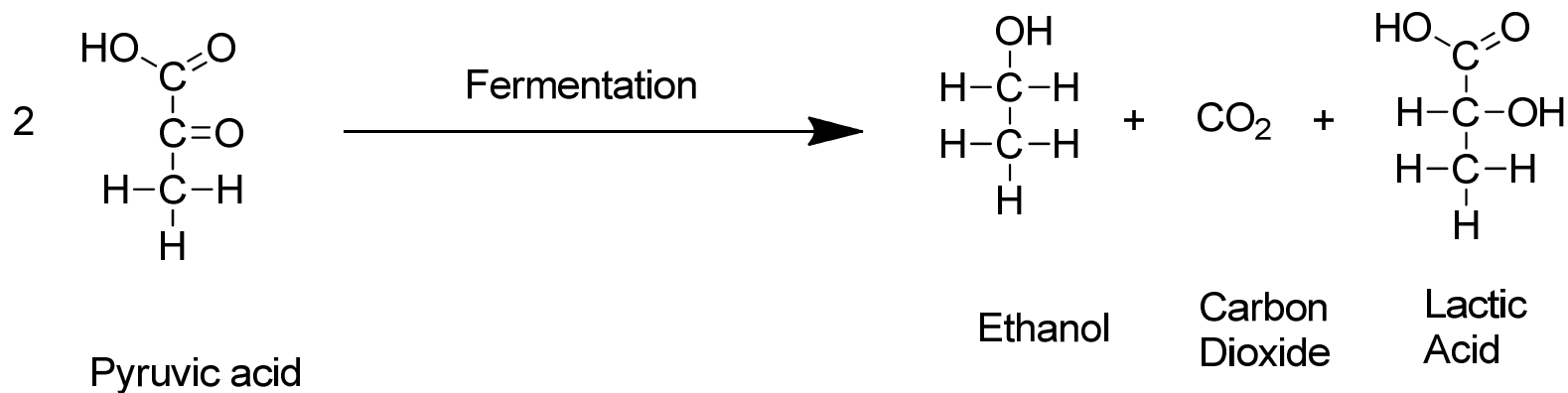
Respiration

- ▶ **Respiration** - breakdown of glucose in the **presence** of oxygen; **ATP continues to be produced**
- ▶ **Slow, continuous** movements
 - ▶ Breathing
 - ▶ Slow walking
 - ▶ Paced exercise
- ▶ **30 ATP molecules produced per glucose in respiration!!**



Fermentation

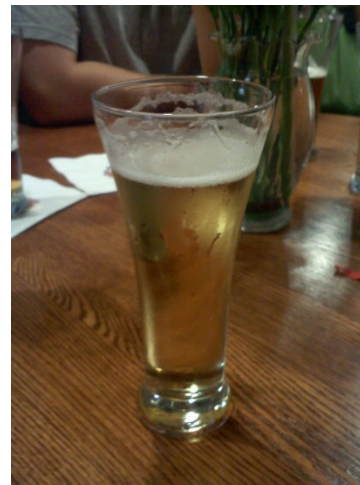
- ▶ **Fermentation** – breakdown of glucose in the **absence** of oxygen; **no ATP can be produced**
- ▶ **Fast, quick bursts** of movement
 - ▶ Sprinting
 - ▶ Weightlifting (usually)
- ▶ Fermentation causes the “burn” felt during intense exercise (lactic acid)



FEEL THE BURN!

Importance of Fermentation

- ▶ **BEER!**
- ▶ Yeast ferments “wort” to produce alcohol and CO₂
- ▶ Other applications in food:
 - ▶ Wines
 - ▶ Cheese
 - ▶ Bread (especially sourdough)



Homework (kinda...)

- ▶ Hold a piece of UNCOOKED pasta in your mouth for about 15 minutes. What happens to the flavor after a while?
 - ▶ Pasta (starch in general) is a polymer of glucose units. Your saliva will eventually break the bonds between glucose units, liberating single glucose molecules. This is what produces the sweet flavor.
 - ▶ Ironically, cellulose is an **isomer** of starch. Only one connection is changed, and that renders it inedible.



Questions?

- ▶ Why does sour cream have an expiration date?
- ▶ What is the speed of dark?
- ▶ When will all the rhetorical questions end?
- ▶ How much deeper would the ocean be without sponges?
- ▶ What was the best thing before sliced bread?
- ▶ Where can I buy powdered water?
- ▶ If you're in a car travelling at the speed of light and you turn your headlights on, what happens?
- ▶ Does PetsMart sell dognip?

