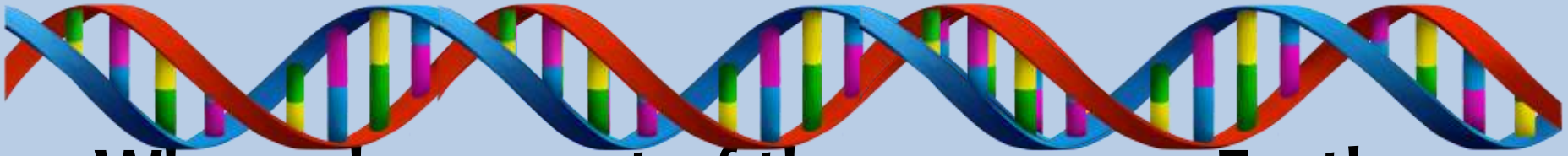
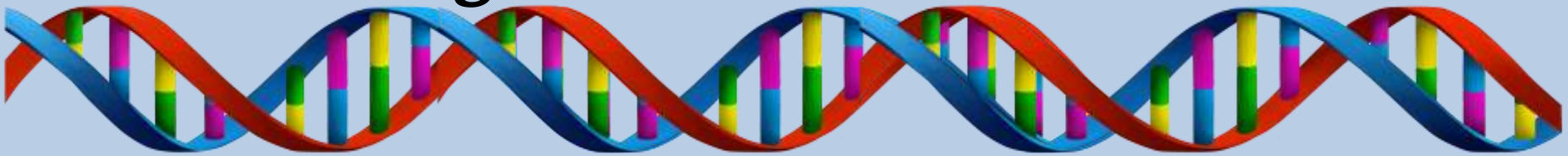


1. Where does most of the energy on Earth come from?
2. How does energy move through ecosystems?
3. How does matter move through ecosystems?
4. What molecule stores energy at the end of photosynthesis?
5. Why is drinking salt water dangerous?
6. Why does curing meat in salt/sugar keep it from rotting?



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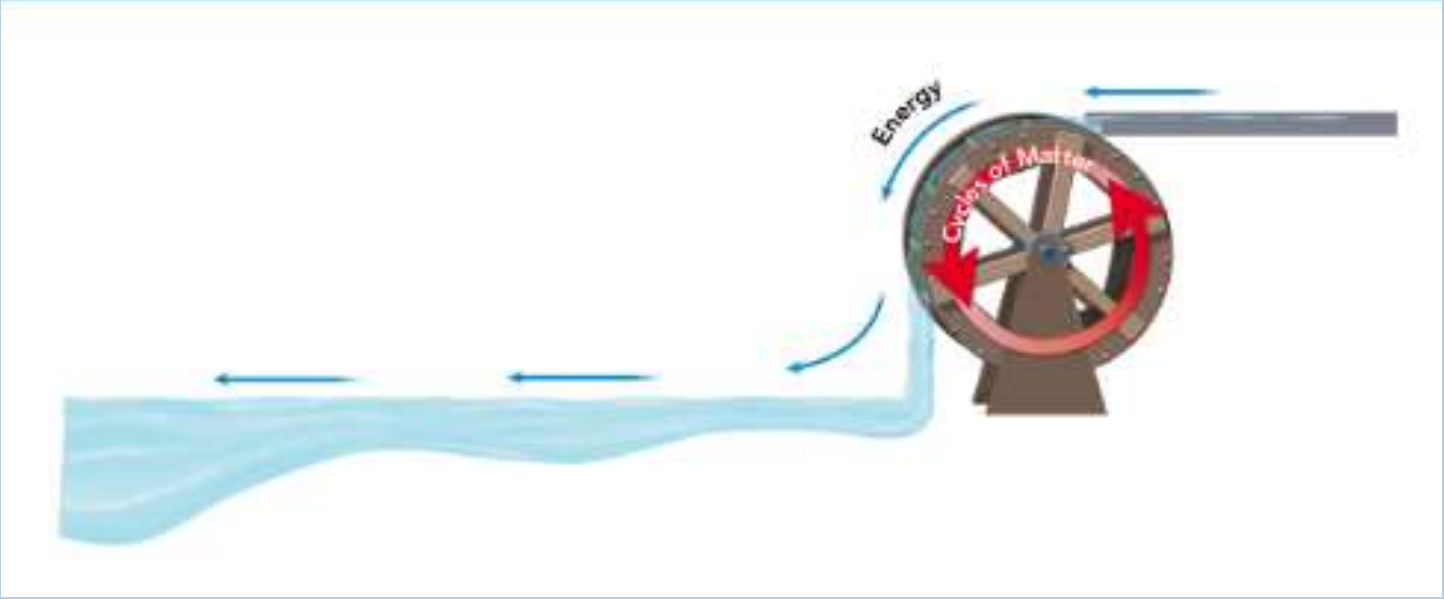
Energy Flow in Ecosystems

- **Energy and matter are transferred through ecosystems**

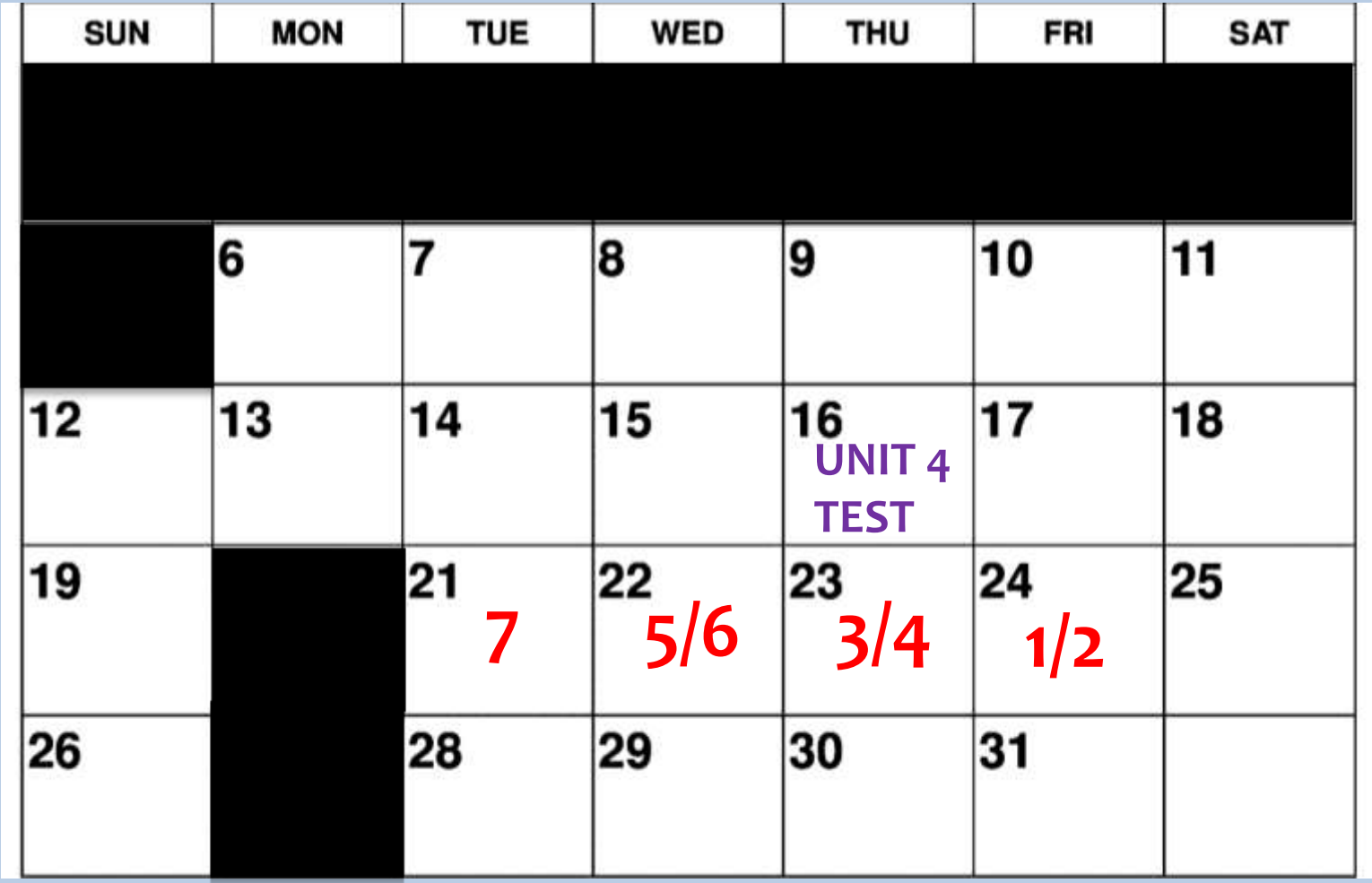
Figure 4-7 The Matter Mill

Nutrients are recycled through biogeochemical cycles. These cycles are powered by the one-way flow of energy through the biosphere, similar to water powering a mill's water wheel.



Logistics

- Finals start January 21
  - START STUDYING *NOW*



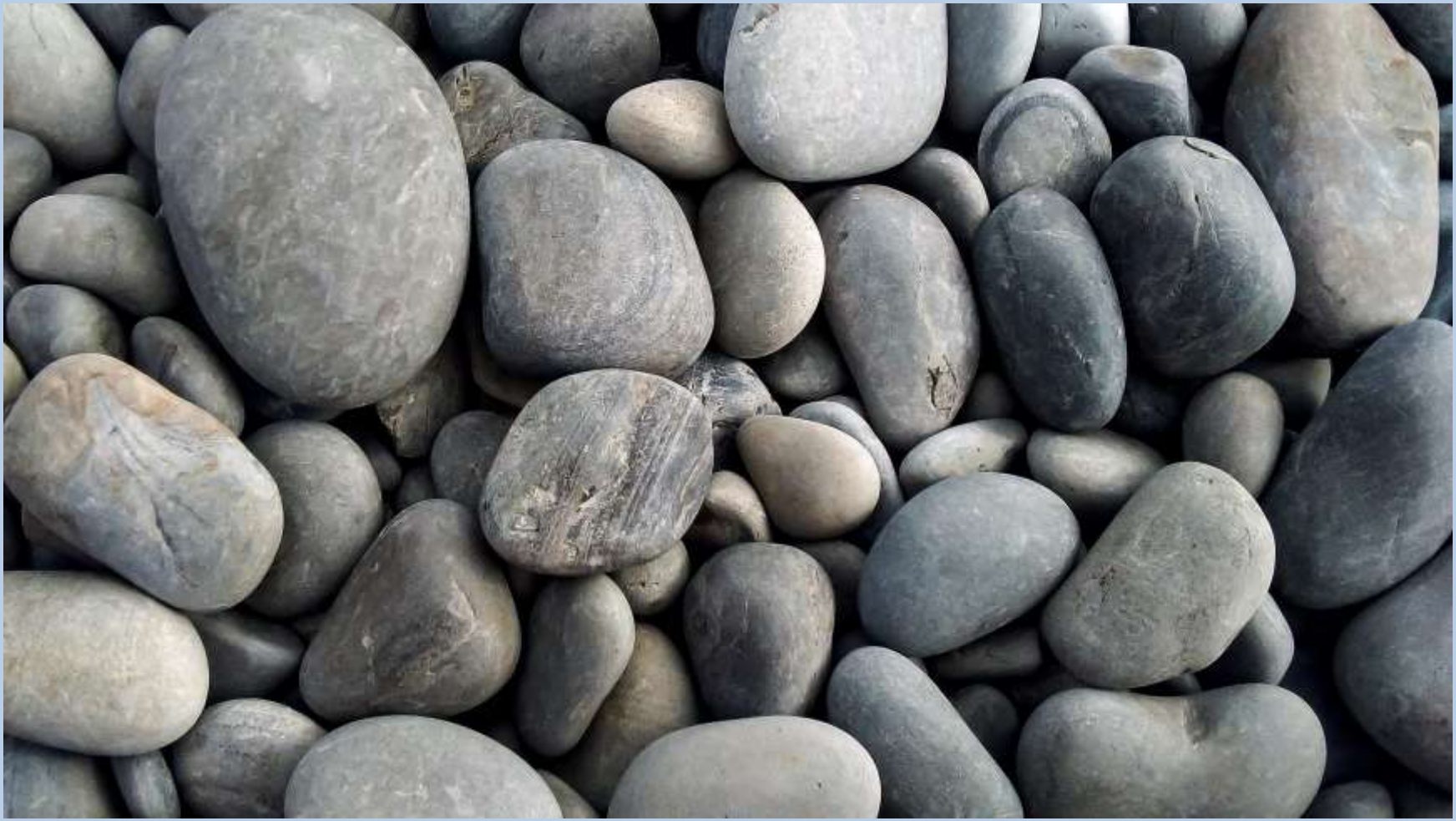
Energy

- What is energy?

Energy Picture Quiz

- Are the following items energy or matter?

Energy Picture Quiz



Energy Picture Quiz

Energy Picture Quiz

Energy Picture Quiz

Energy Picture Quiz

Energy Picture Quiz

Energy Picture Quiz

Energy vs Matter

- What is energy?

Energy vs Matter

- **What is matter?**

Energy vs Matter

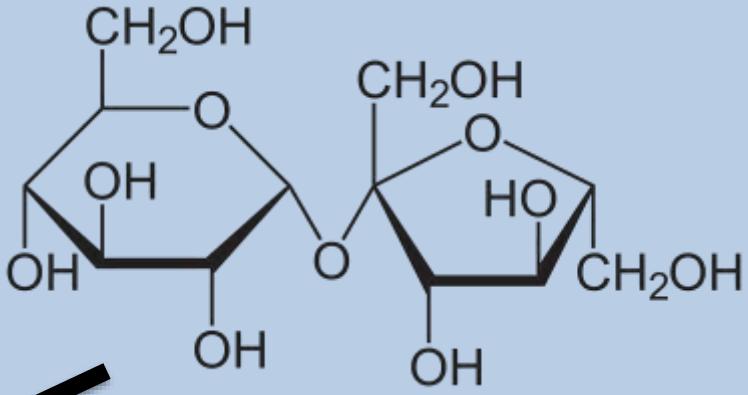
- **Matter: a physical substance made up of atoms**
- **Energy: the ability to do work; move or change matter**

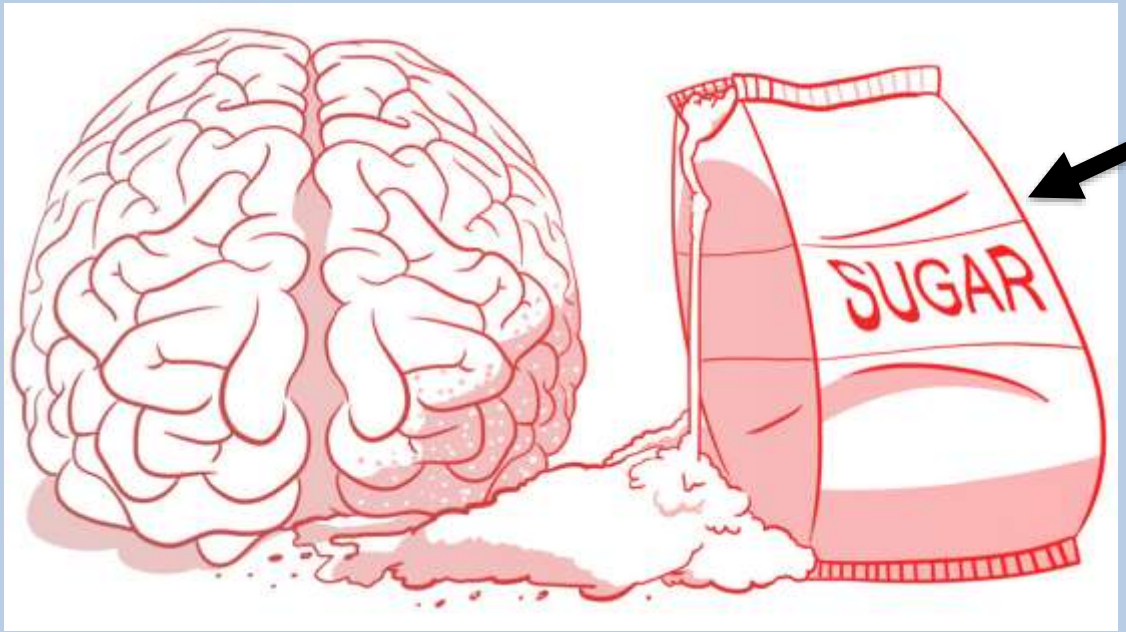
1. Make a Venn Diagram on page 41 to compare and contrast energy and matter

2. Include examples of each

Energy

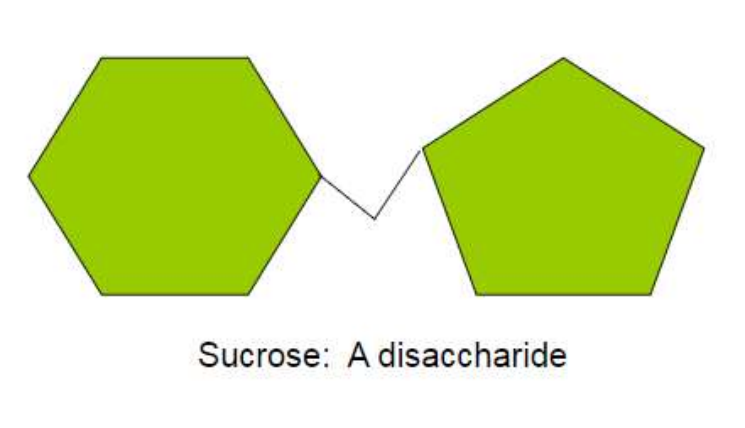
- **So how do molecules, which are made of *ATOMS*, give energy?**





Energy

- *Chemical energy* is stored in **BONDS** between atoms

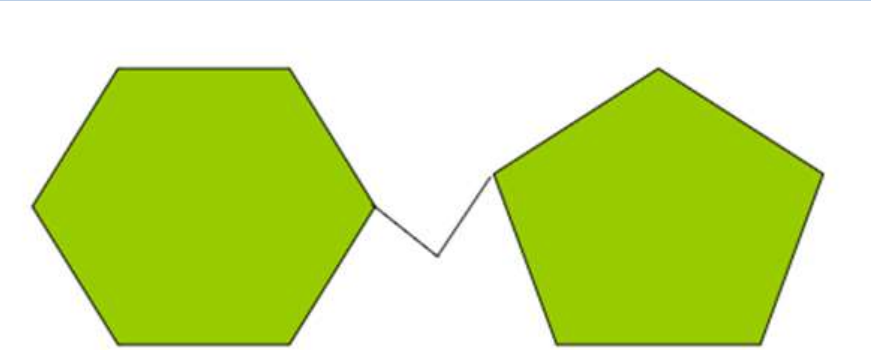


Sucrose: A disaccharide

- ***Molecules can be considered energy carriers***

Energy

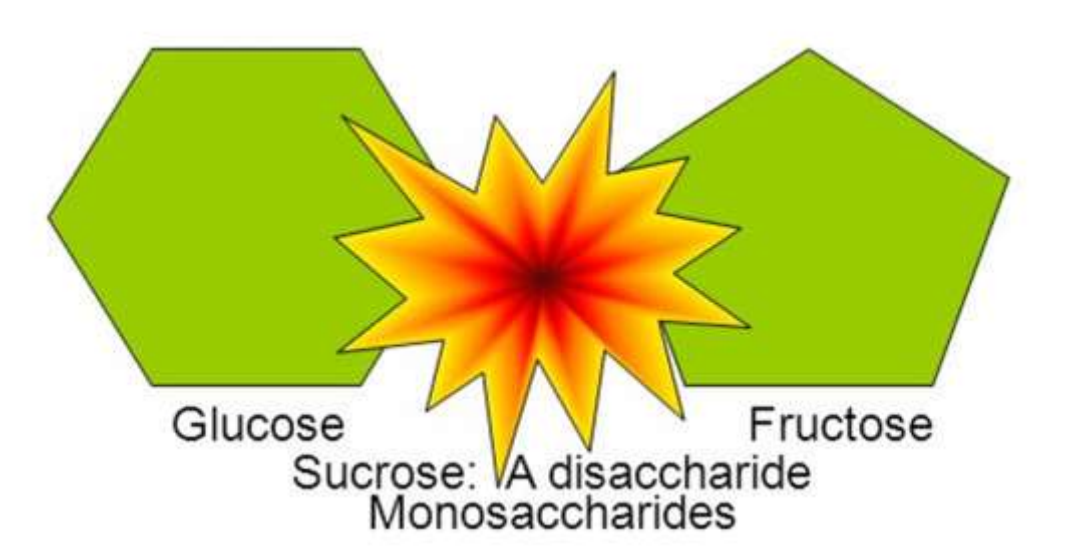
- So what happens when bonds are broken?



Sucrose: A disaccharide

Energy

- When bonds are broken energy can be released



Energy

- https://www.youtube.com/watch?v=enUBooHI5uY

Energy

- **What do the "fuels" mentioned in the video (fossil fuels, wood, food) all have in common?**

Energy

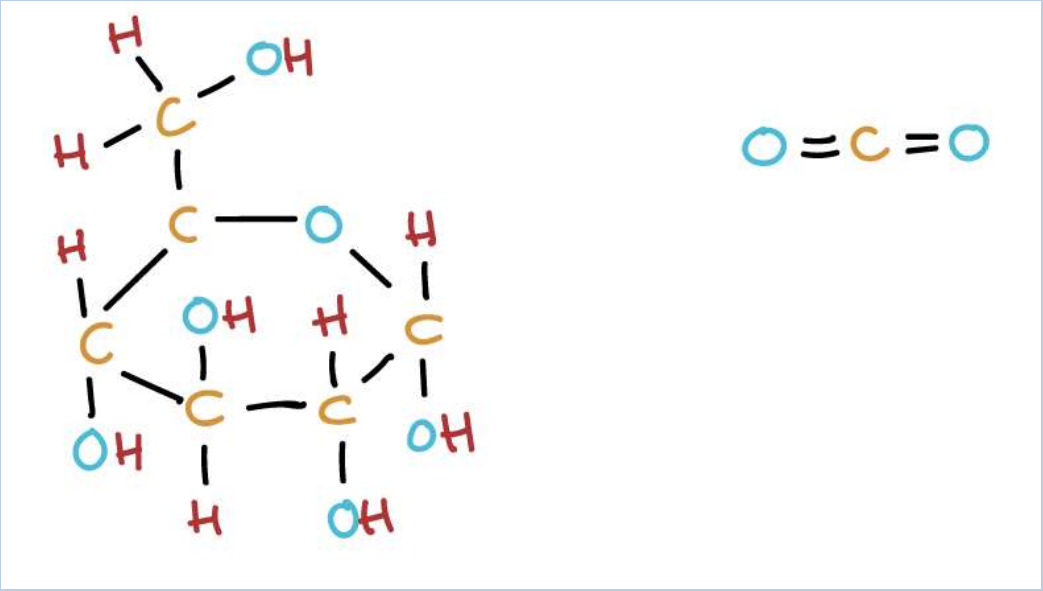
- **What are the elements that are found in all of the molecules of life?**

Energy

- Oxygen atoms do NOT bond to other oxygen atoms if they can bond to carbon or hydrogen instead
  - C-C and C-H bonds are high energy bonds
  - C-O and H-O bonds are low energy bonds

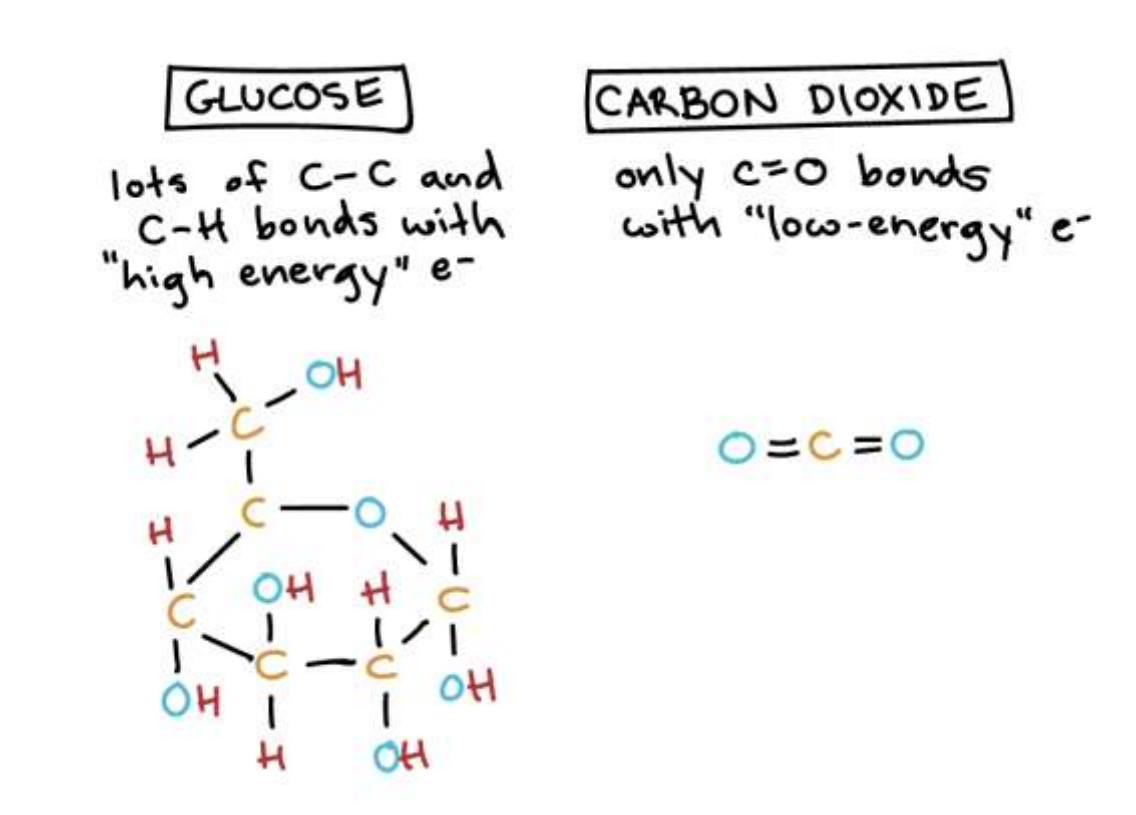
Energy

- C-C and C-H bonds are high energy bonds
- C-O and H-O bonds are low energy bonds



Energy

- **BRAIN BREAK: on page 41**
  - **Write a summary about energy and chemical bonds**

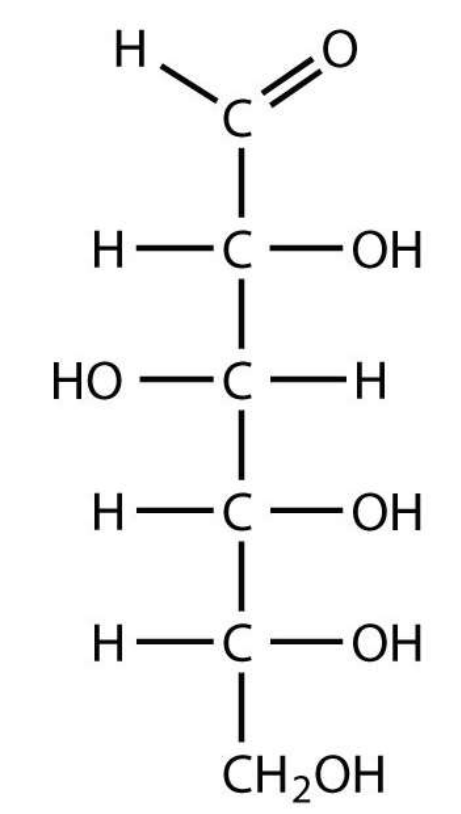


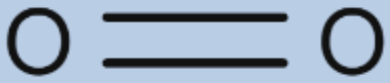
Energy

- What are the products of photosynthesis?

Energy

- **How do we know that more energy is stored in the chemical bonds of glucose, rather than oxygen?**



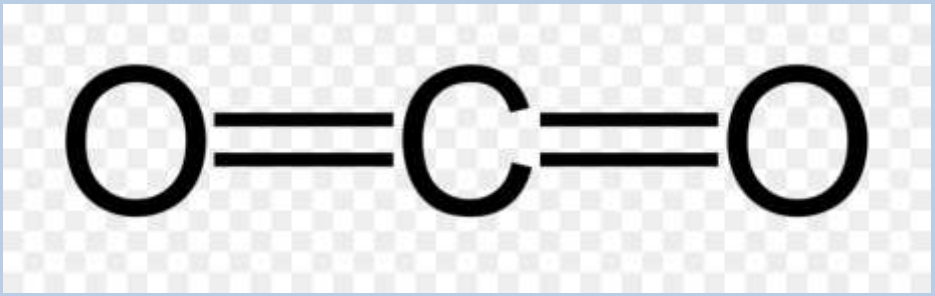


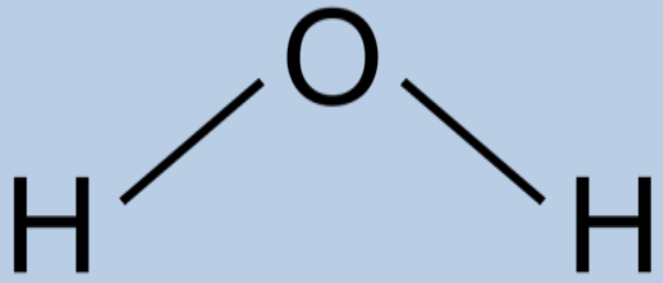
Energy

- What are the reactants of photosynthesis?

Energy

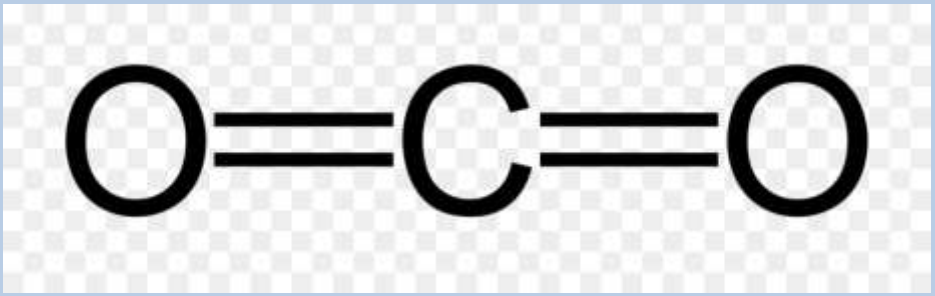
- How do we know that these chemicals do not give plants **ENERGY**?

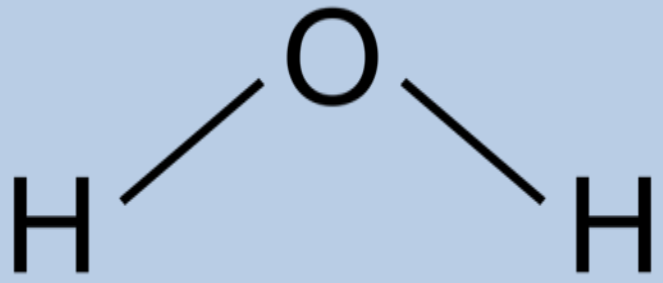




Energy

- So what do they give to plants?



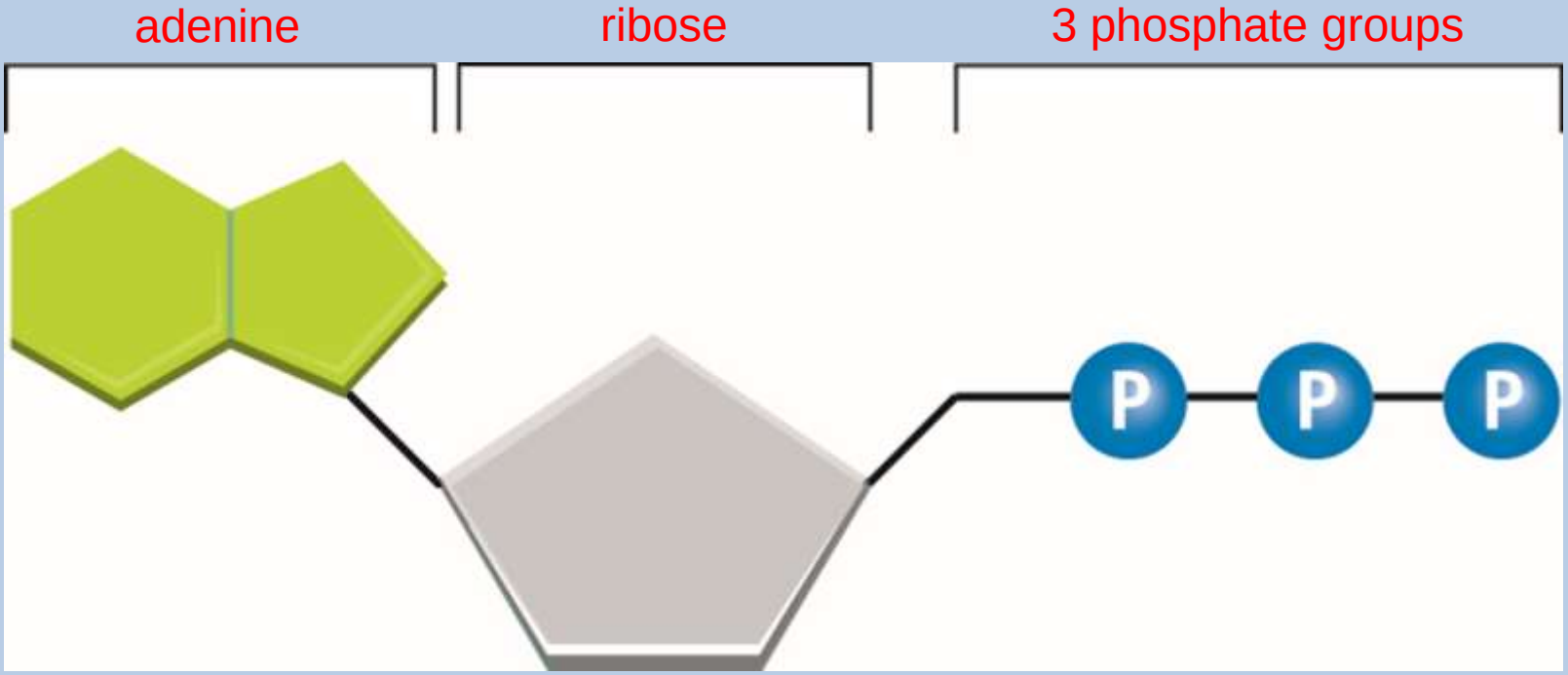


Energy

- What is the molecule of “usable” energy in most living things

Energy

- ATP!!!!
- aka Adenosine Triphosphate: Tape the model on page 41

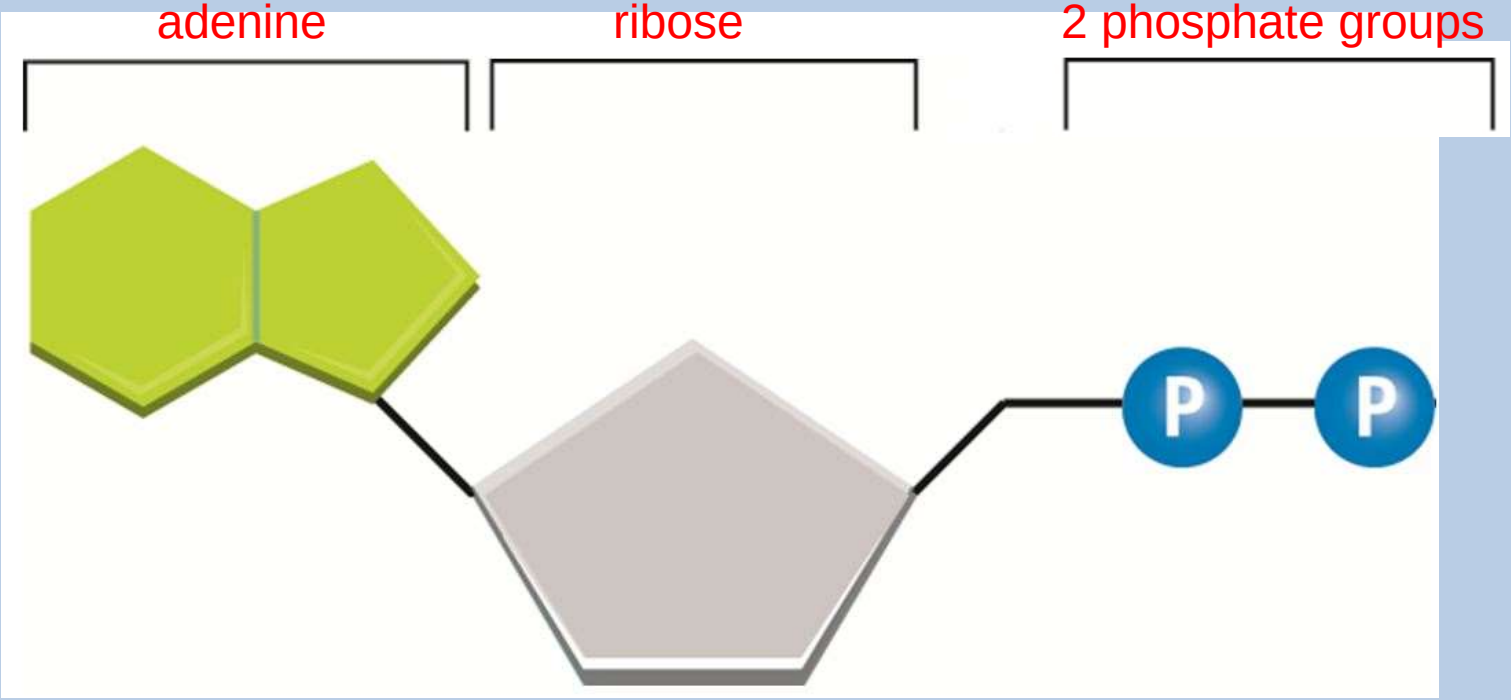


Energy

- **What would ADP look like?**

Energy

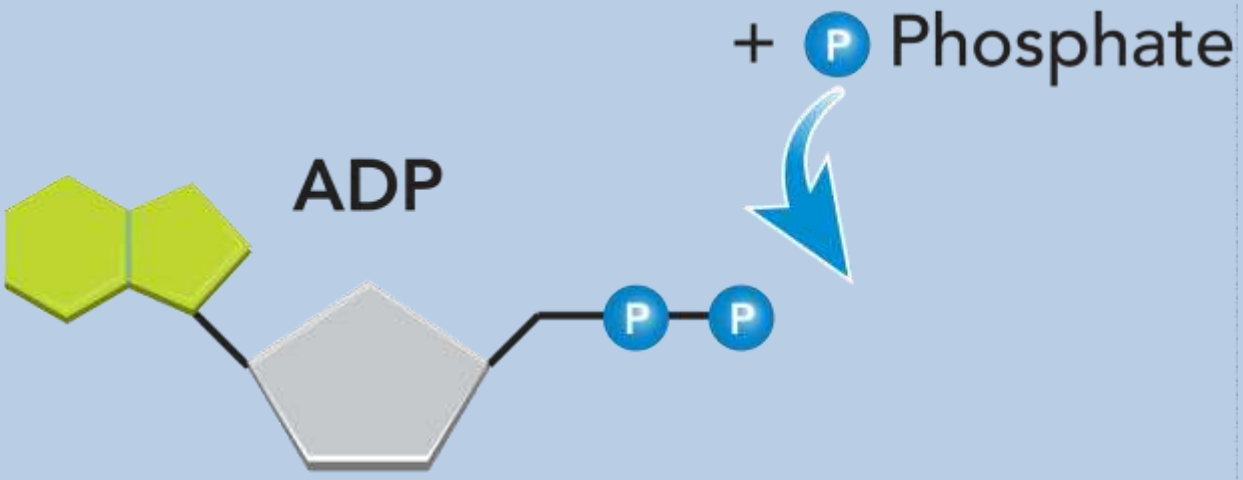
- **Adenosine diphosphate (ADP) has two phosphate groups instead of three:**



Energy

- **When a cell has energy available, it can store small amounts of it by adding phosphate groups to ADP molecules, producing ATP:**

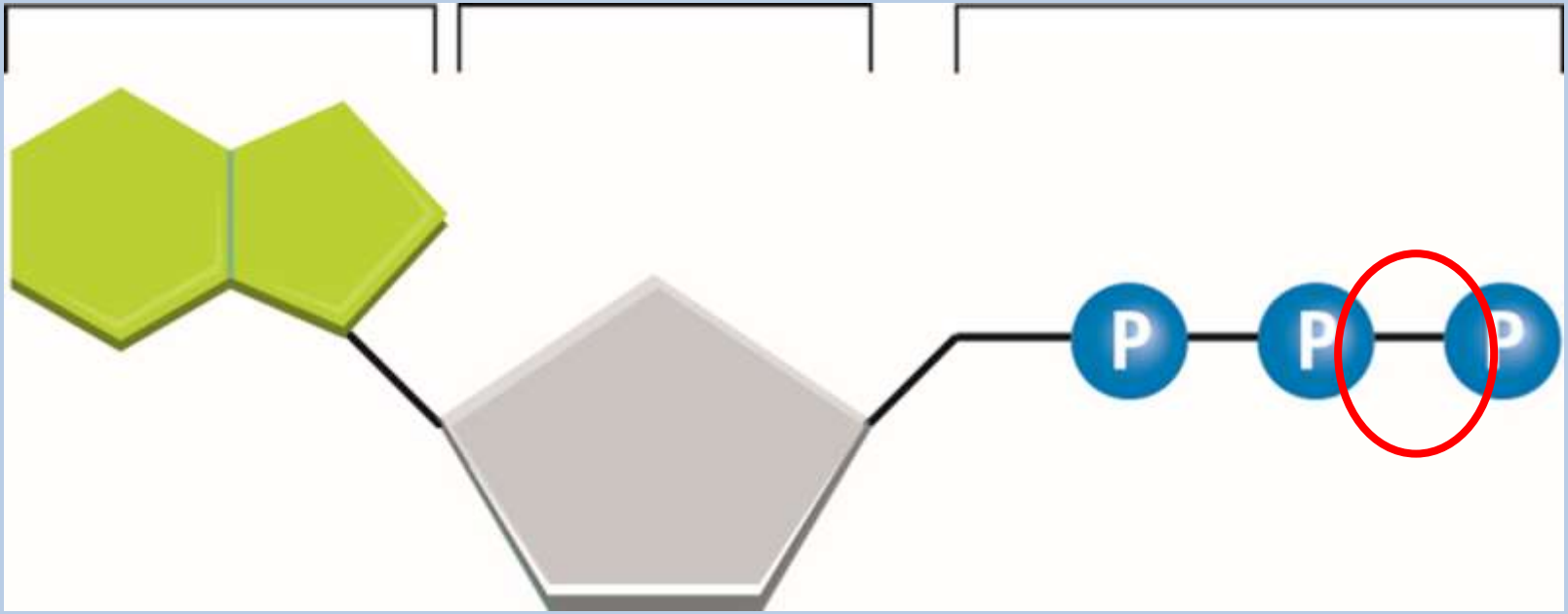
Partially Charged Battery



Adenosine Diphosphate (ADP)

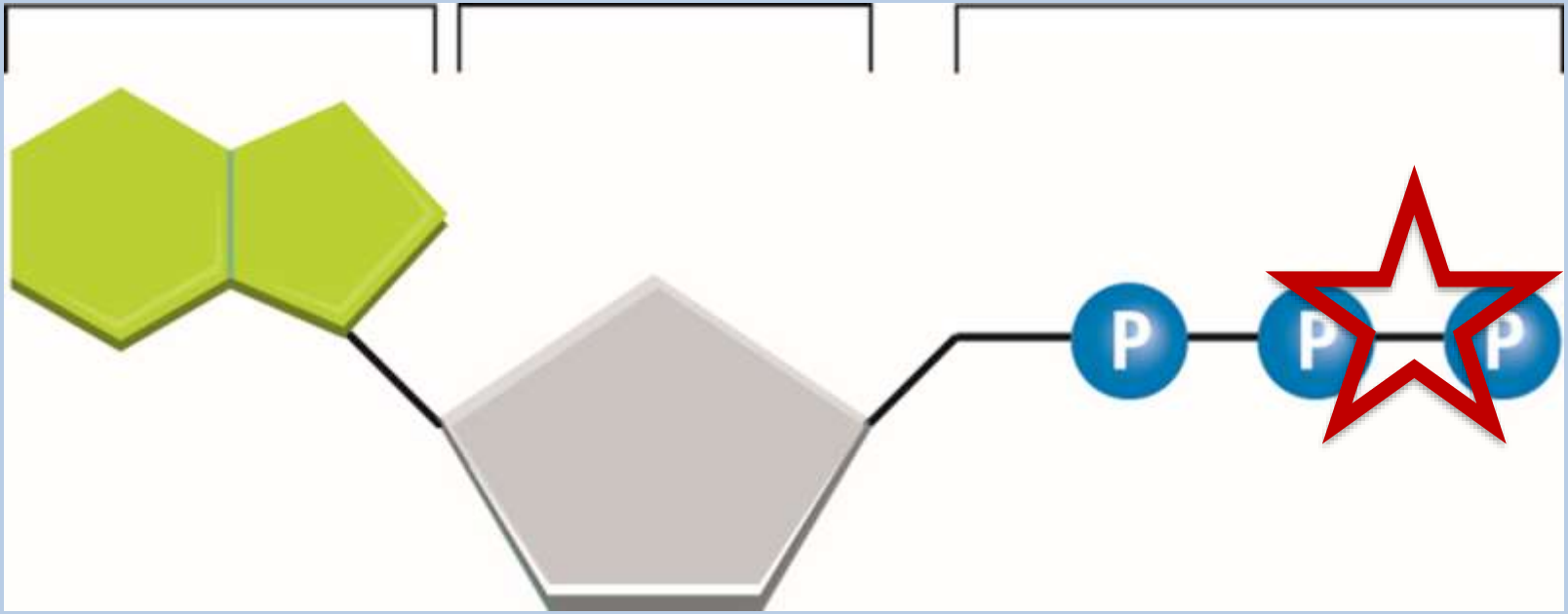
Energy

- What must be true of this newly created bond then?



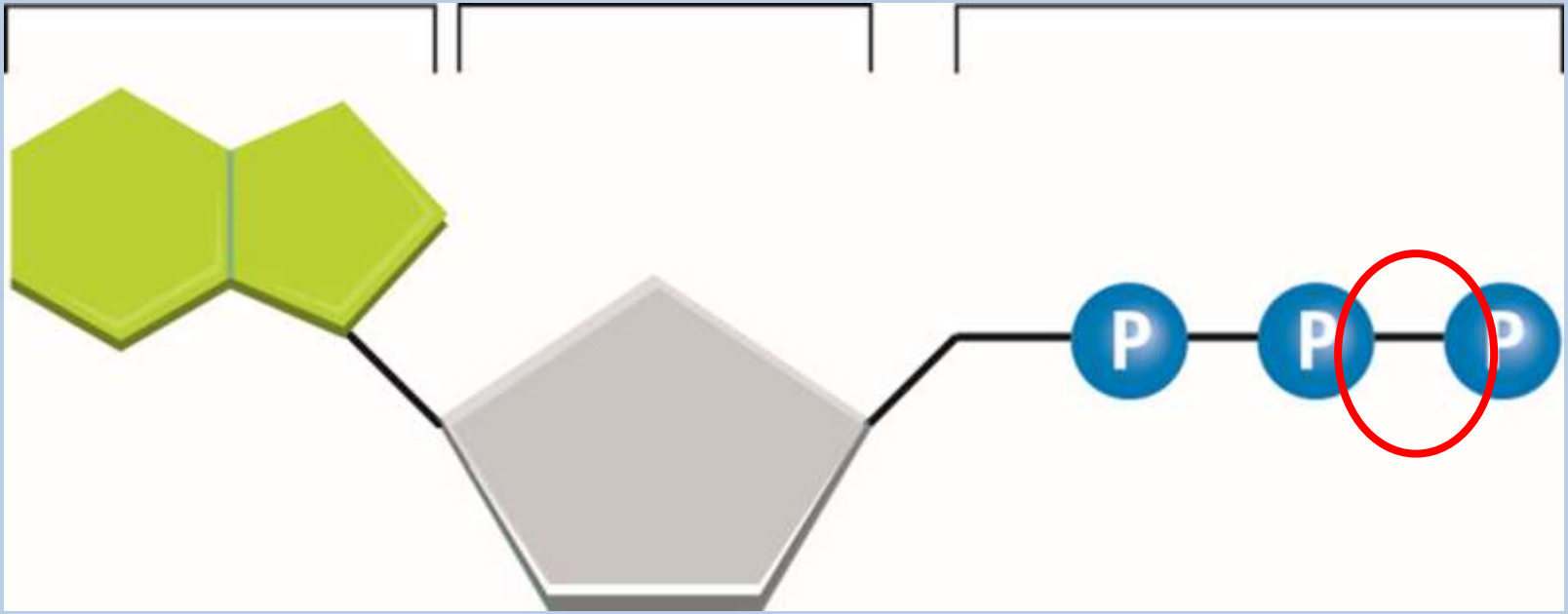
Energy

- **Label this high energy bond in your diagram on page 41**



Energy

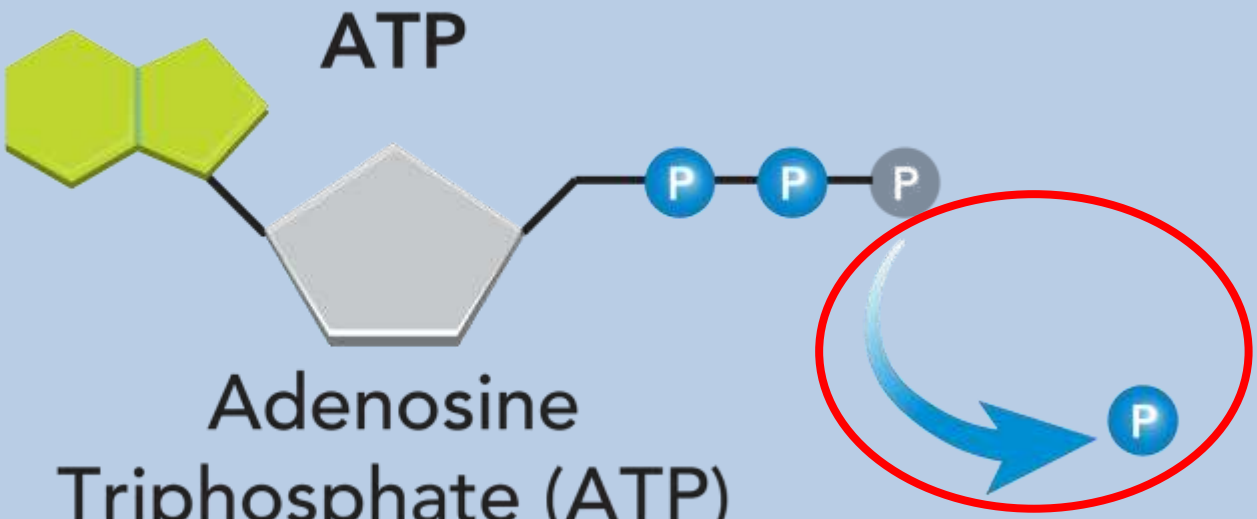
- So what will happen if it is broken?



Energy

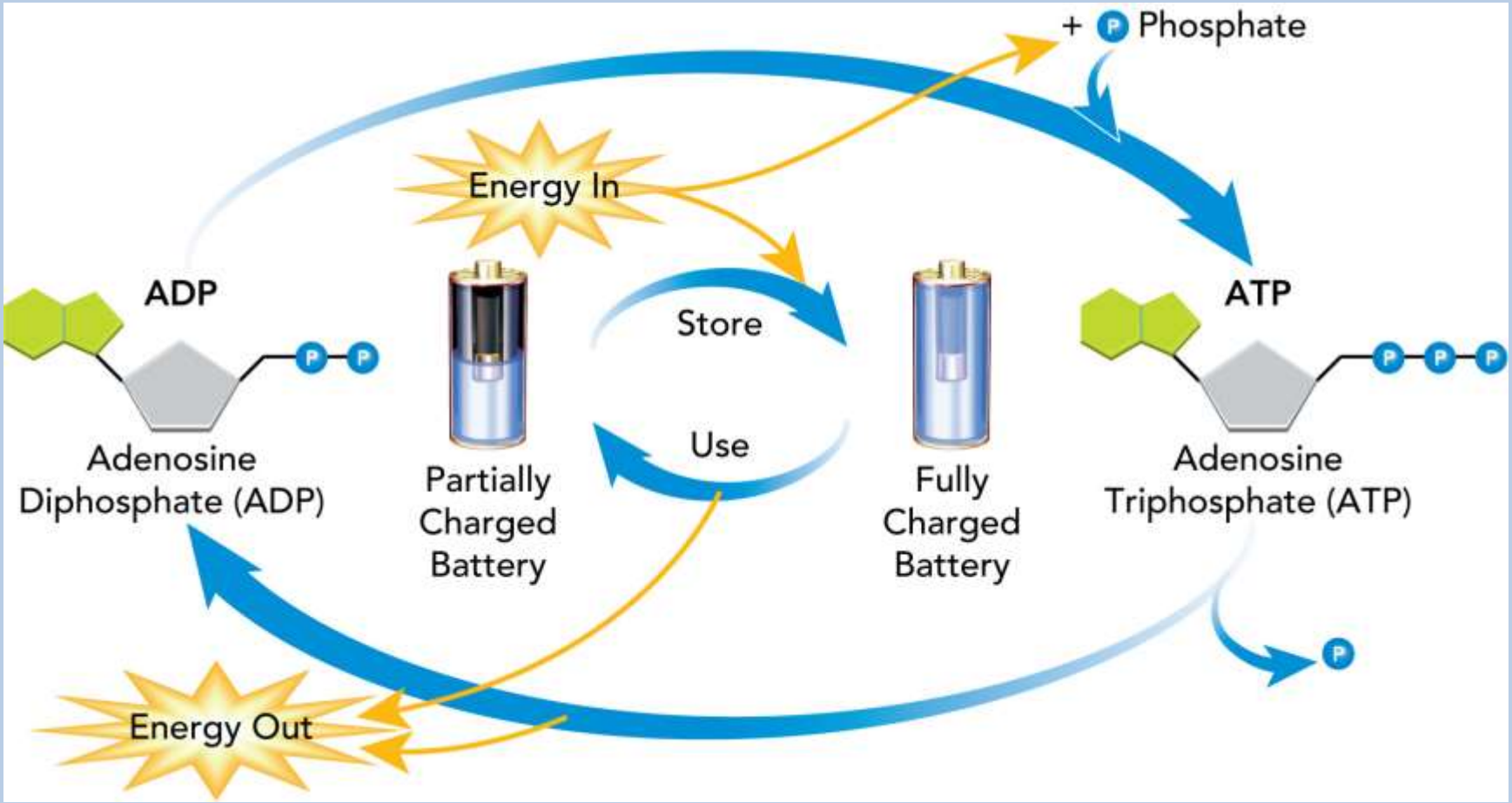
When a cell needs energy, it can release it by breaking the bond between the second and third phosphate groups in ATP:

Fully Charged Battery



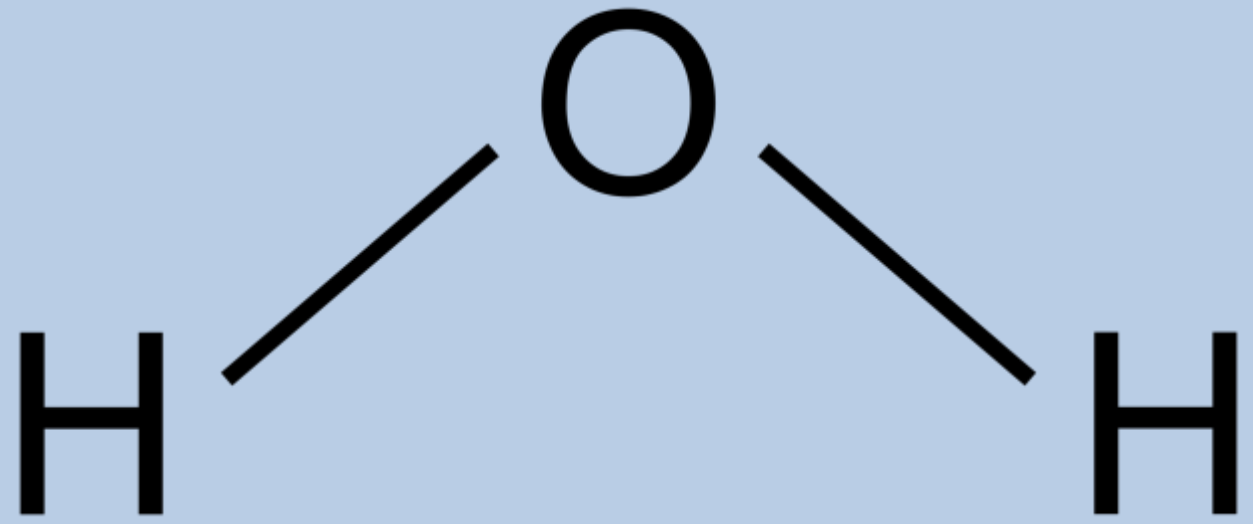
Adenosine Triphosphate (ATP)

Energy


+ P Phosphate
Energy In
ADP
Store
ATP
Use
Adenosine Diphosphate (ADP)
Partially Charged Battery
Fully Charged Battery
Adenosine Triphosphate (ATP)
P
Energy Out

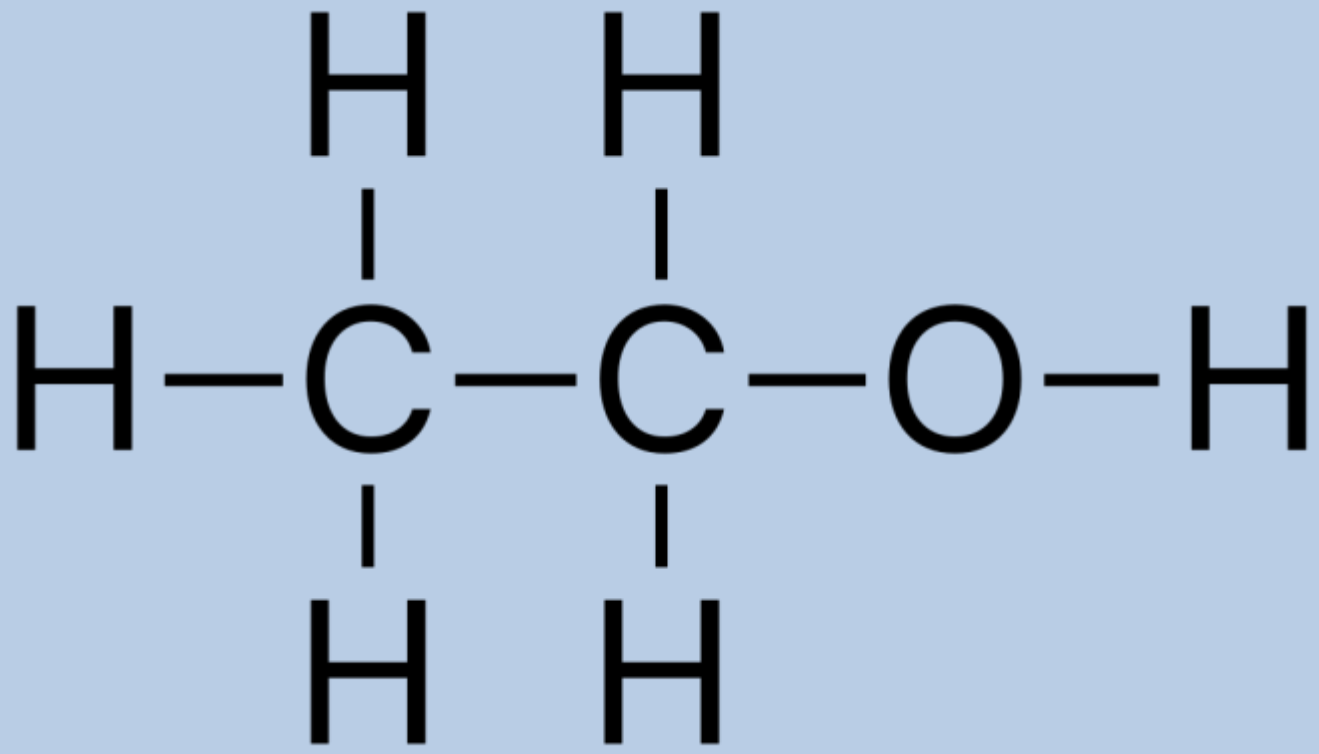
Energy

- What is this molecule?
- Does it have high energy bonds?



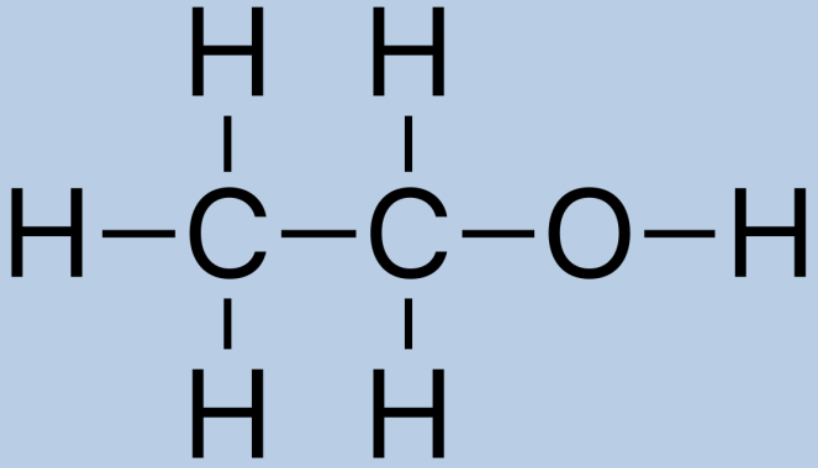
Energy

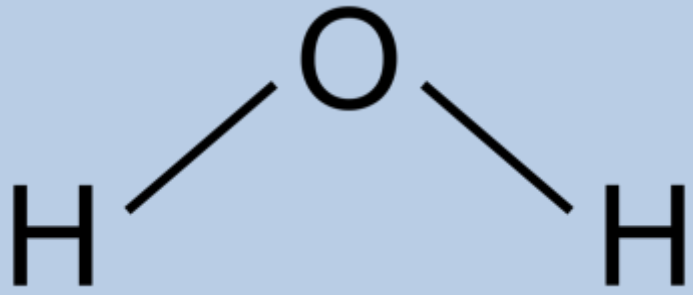
- This molecule is ethanol
- Does it have high energy bonds?



Energy

- **On page 41 make a predication:**
  - **Of these two molecules which one will light on fire, WHY?!!!**






INTERMISSION

Energy

- **Why did ethanol burn so easily?**

Energy

- **What made the reaction happen?**

Energy

- What were the reactants of the reaction?

Energy

- **What were the reactants of the reaction?**

$C_2H_5OH + 3O_2 \rightarrow$

Ethanol + Oxygen →

Energy

- **What were the products of the reaction?**

$C_2H_5OH + 3O_2 \rightarrow$

Ethanol + Oxygen →

Energy

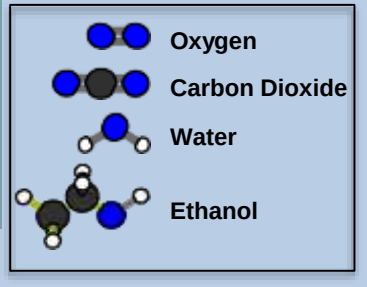
- **What were the products of the reaction?**

$$C_2H_5OH + 3O_2 \rightarrow 2\,CO_2 + 3\,H_2O$$

Ethanol + Oxygen → Carbon Dioxide + Water

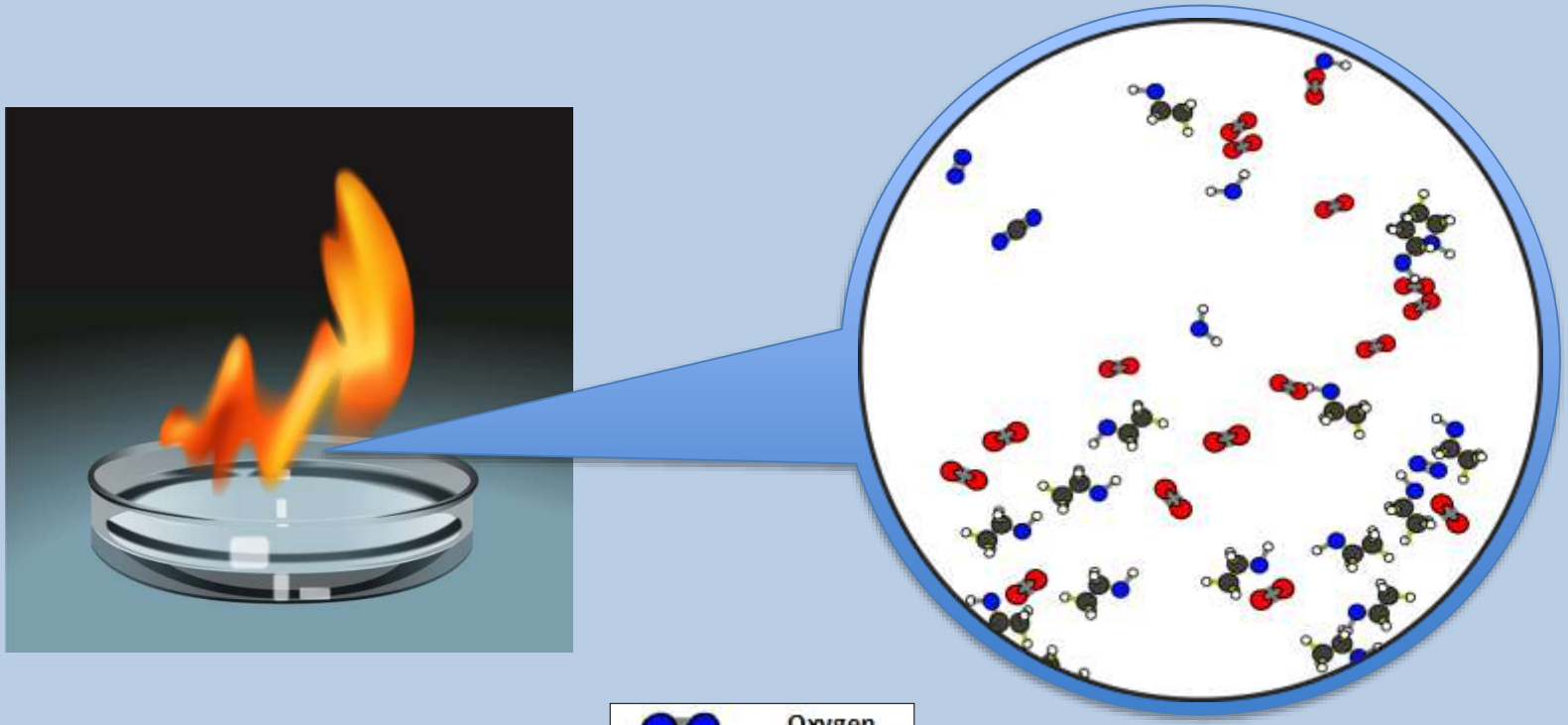
Energy

What's the hidden chemical change when ethanol burns?



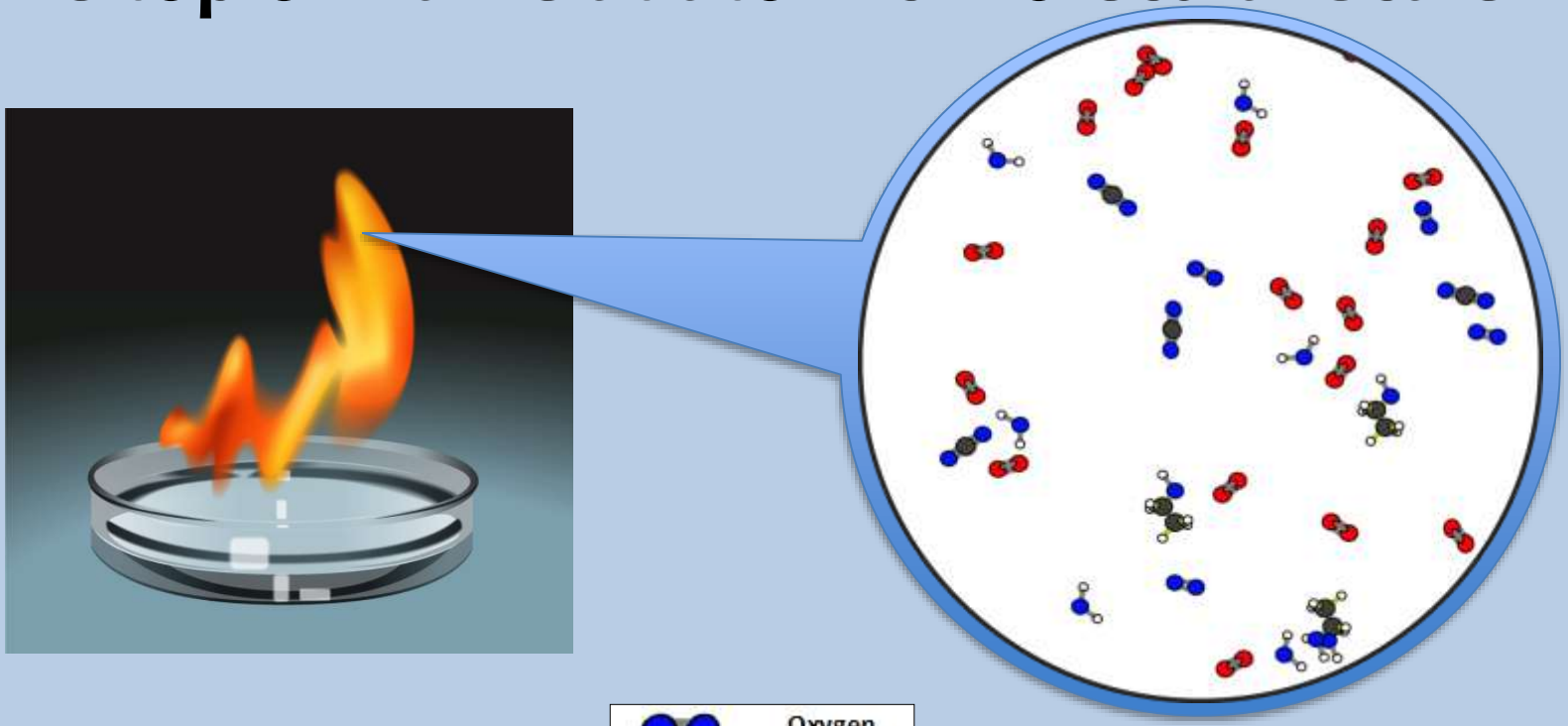
Energy

The bottom of flame at atomic-molecular scale:



Energy

The top of flame at atomic-molecular scale:



Energy and Reactions

- **Today you are going to model this reaction in order to *visualize what happens to energy during the reaction***

Energy and Reactions

- You will be using model kits

CARBON = BLACK

OXYGEN = BLUE

HYDROGEN = WHITE

BONDS = STRAWS

Energy and Reactions

- You will use pipe cleaners to label the high energy bonds

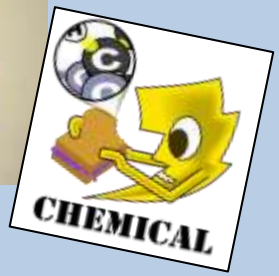
Energy and Reactions

- You will use pipe cleaners to label the high energy bonds:
  - C – C
  - C – H

Energy and Reactions

Start by making the molecules and energy units of the reactants and putting them on the reactants side, then rearrange the atoms and energy units to show the products.

Ethanol



Oxygen

Reactants

Chemical change

Products

Energy and Reactions

Remember:

- **Atoms last forever: so you can rearrange atoms into new molecules, but can't add or subtract atoms**
- **Energy lasts forever: so you can change forms of energy, but energy units can't appear or go away**

Energy and Reactions

- **When you are finished making the reactants, *put all extra pieces away***

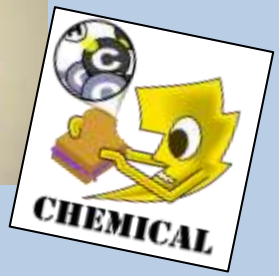
Energy and Reactions

- When you are dismissed:
  - Go to a lab station
  - Set up the reactants
  - Fill in the reactants part of the data
  - GET CHECKED OFF
  - *Use ONLY THE REACTANTS to make the products*
    - DO NOT LOSE PIECES
    - CLEAN UP AFTER YOURSELVES

Energy and Reactions

Start by making the molecules and energy units of the reactants and putting them on the reactants side, then rearrange the atoms and energy units to show the products.

Ethanol



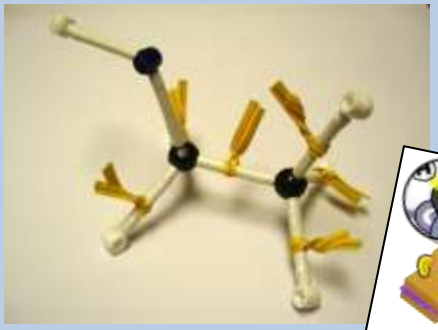
Chemical change

Oxygen

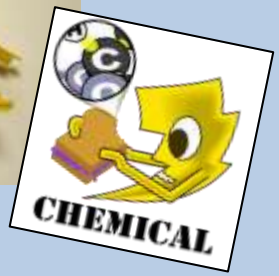
Reactants

Products

Energy and Reactions



Ethanol



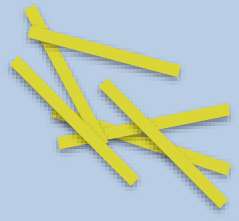
Oxygen

Reactants

Chemical change

Water

Carbon dioxide



Products

Energy and Reactions