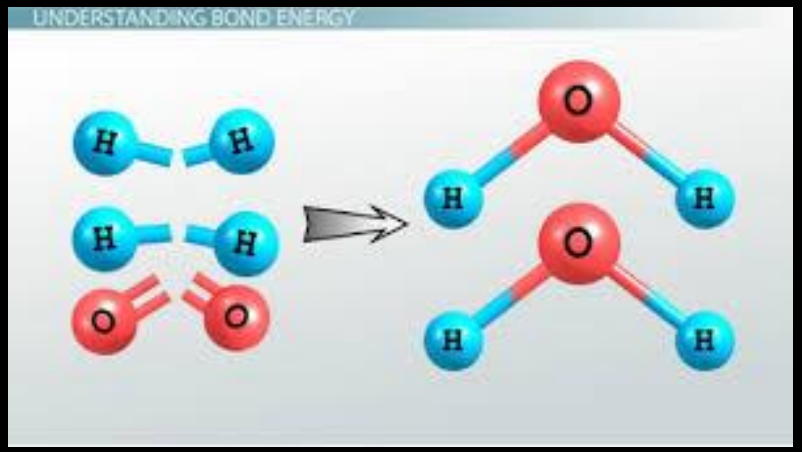
Exothermic and Endothermic Reactions

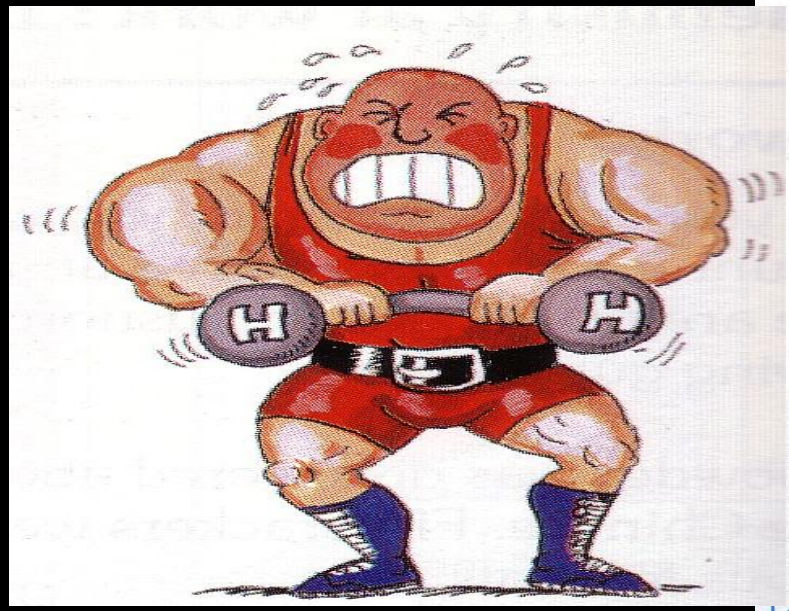
Energy and Chemical Reactions

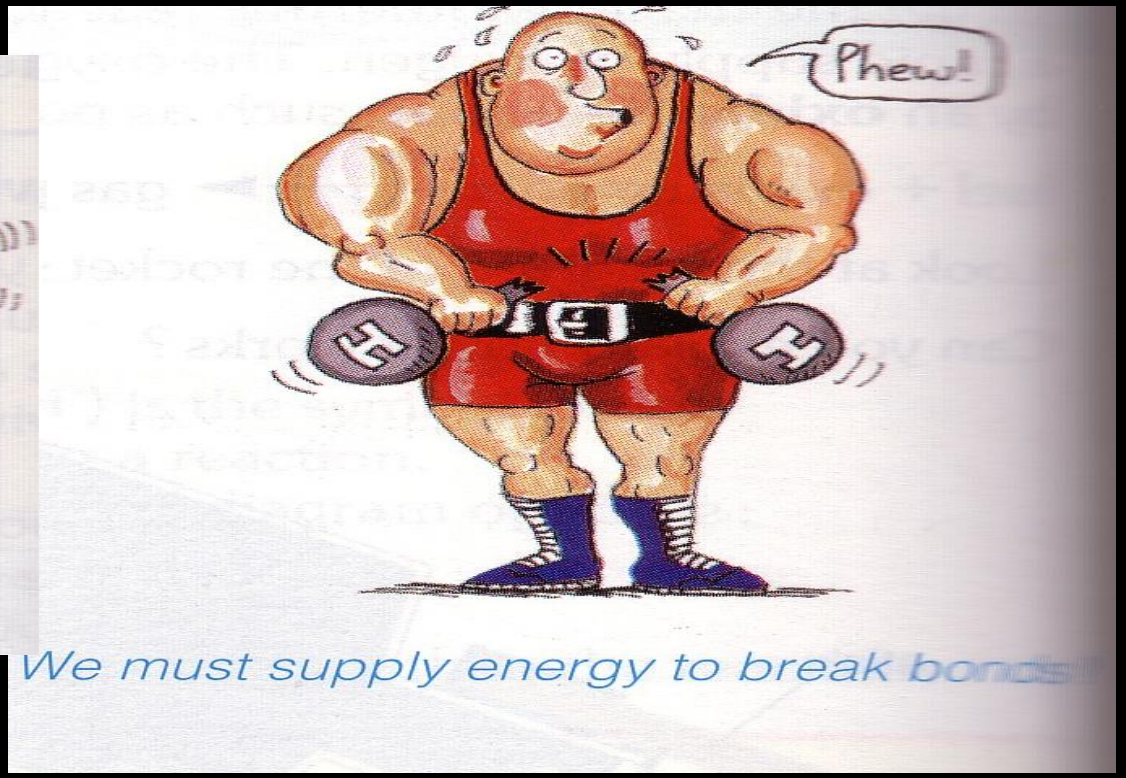
- Chemical Energy – Energy stored in the chemical bonds of a substance.
- Chemical reactions always involve energy changes.
- For any chemical reaction to occur, the reactants must collide with enough energy to break the bonds of the reactants.



Activation Energy

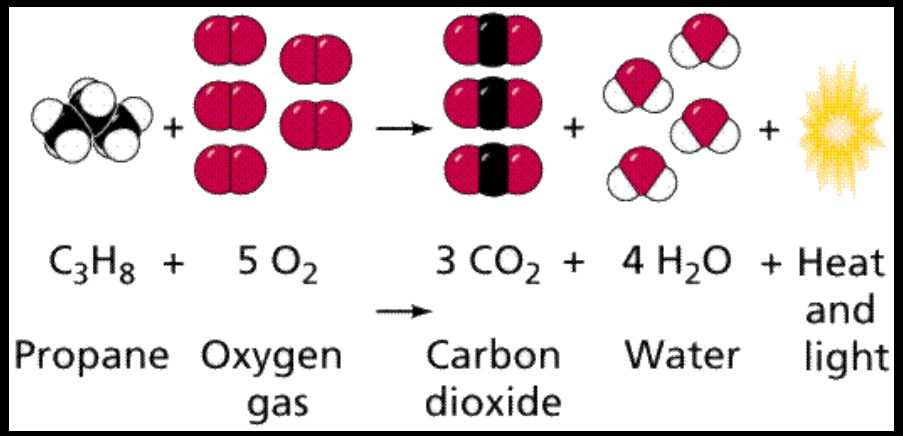
- The energy required to break the bonds in the reactants for a chemical reaction to occur.





Input of Energy

- Many chemical reactions require an initial input of energy
  - Ex: Lighting a BBQ



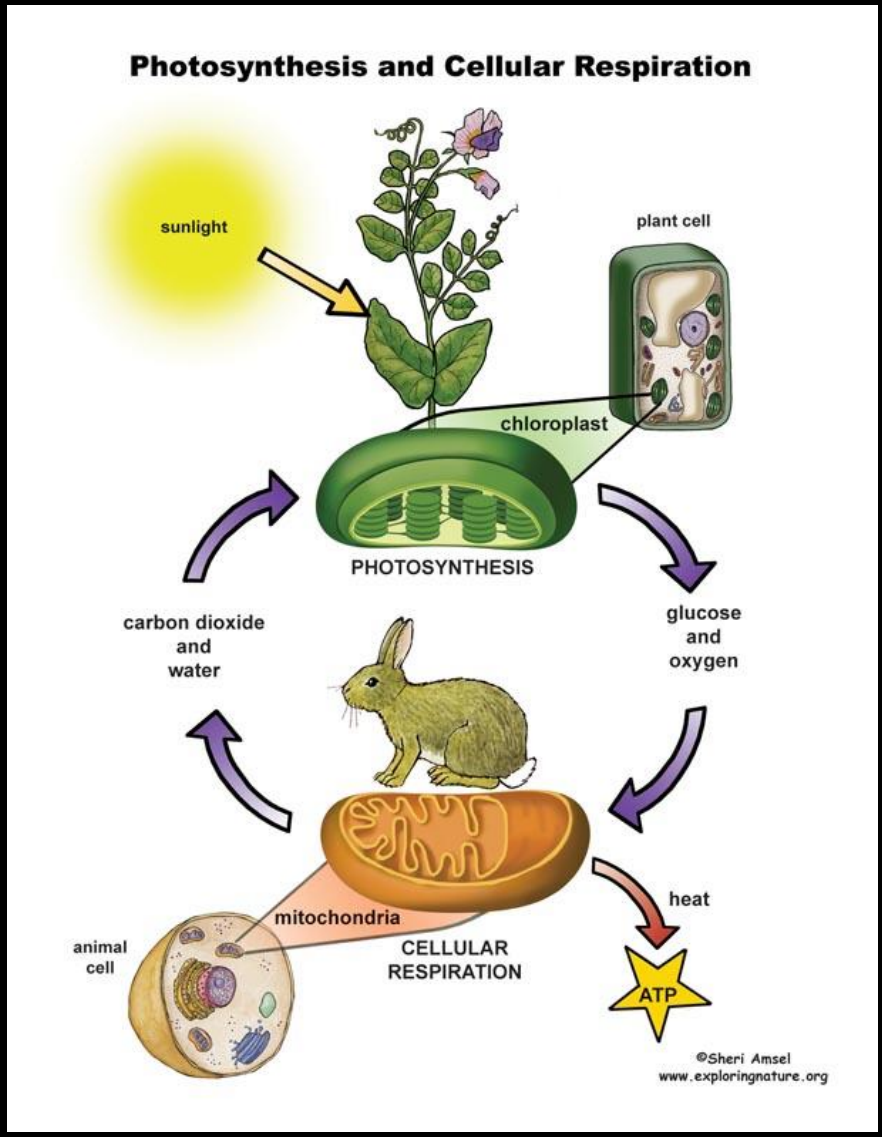
  - Imagine if no activation energy was required, what would happen?

Will the reaction continue?

- Once the propane is ignited, the reaction will continue until the energy is extinguished or reactants are removed(turning off propane)
  - The energy released during the reaction provides the energy needed to overcome the activation energy

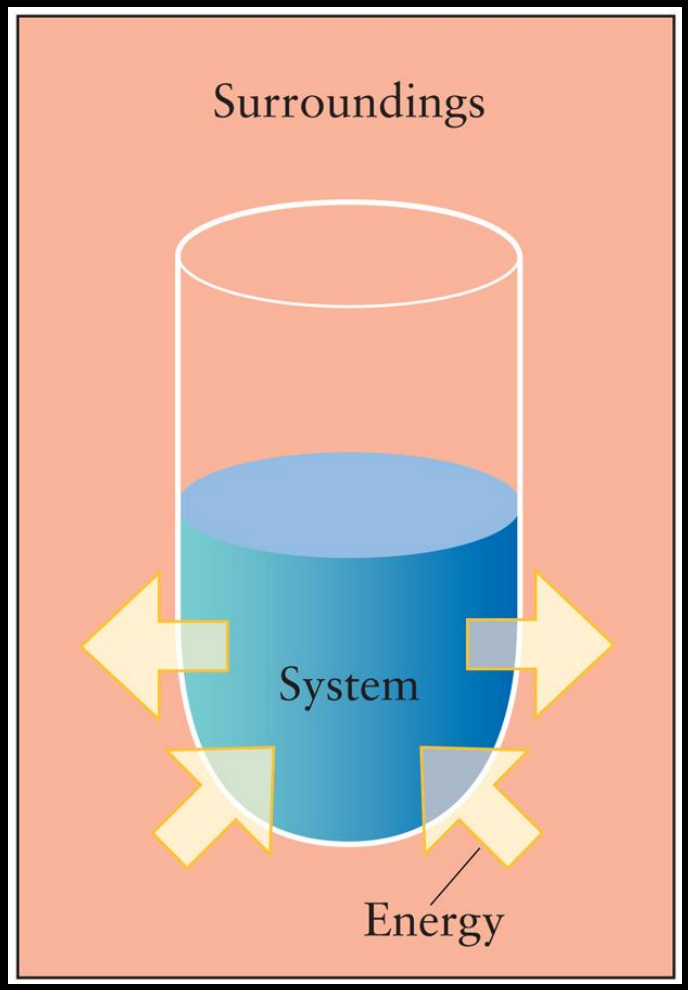
How is Energy Transferred?

- All chemical reactions are accompanied by changes in energy
- These reactions are crucial to life
  - Photosynthesis and Cellular Respiration



Energy Changes

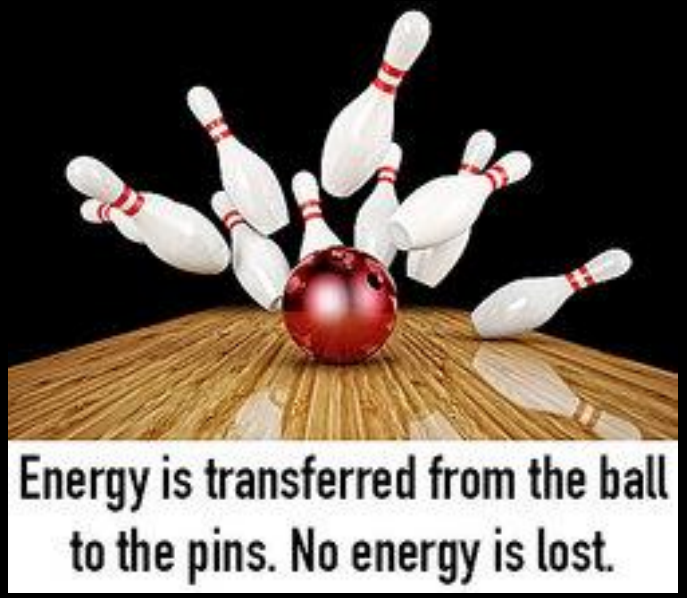
- Transfers between the system and the surroundings
  - System: materials involved with a chemical reaction
  - Surroundings: everything else in the universe



Law of Conservation of Energy

- Total energy of the universe is constant
  - Energy cannot be created or destroyed

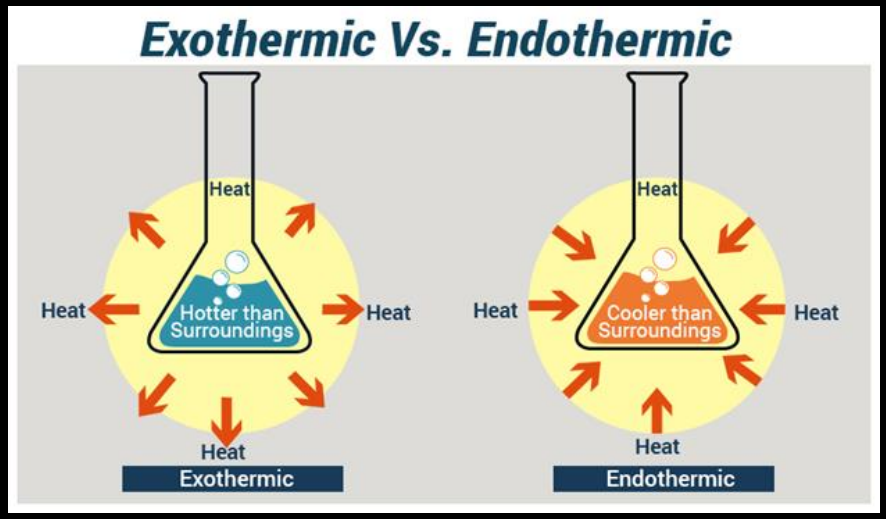
- Energy that leaves the system goes into the surroundings
- Energy that enters the system is from the surroundings



Endothermic and Exothermic Reactions

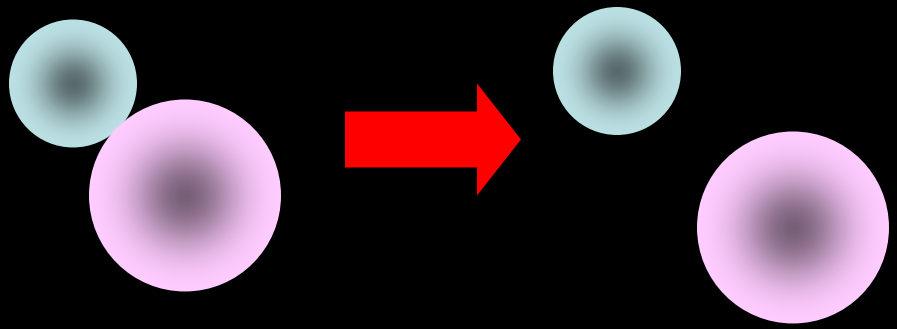
- Energy must be absorbed to break bonds
- Energy is released when bonds form

- By comparing the total energy used to break bonds, to the total energy released when bonds form, you can determine what type of chemical reaction has occurred

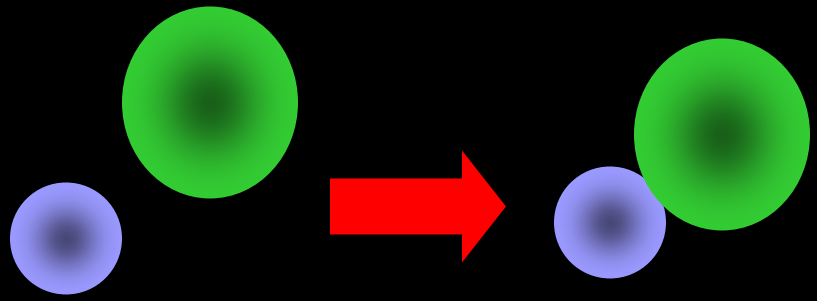


Endothermic and Exothermic reactions

Step 1: Energy must be SUPPLIED to break chemical bonds of reactants:



Step 2: Energy is RELEASED when new chemical bonds are made in the products:



Classification

EXOTHERMIC : If more energy is **RELEASED** to the surroundings than absorbed by the system

- More energy released from formation of bonds

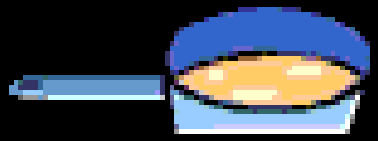
ENDOTHERMIC: If more energy is **absorbed by the system** than is **RELEASED** to the surroundings

- More energy required to break bonds

Temperature

- **Exothermic**:
  - energy is *released*
  - Exo- = “exit”
  - Burning of gasoline

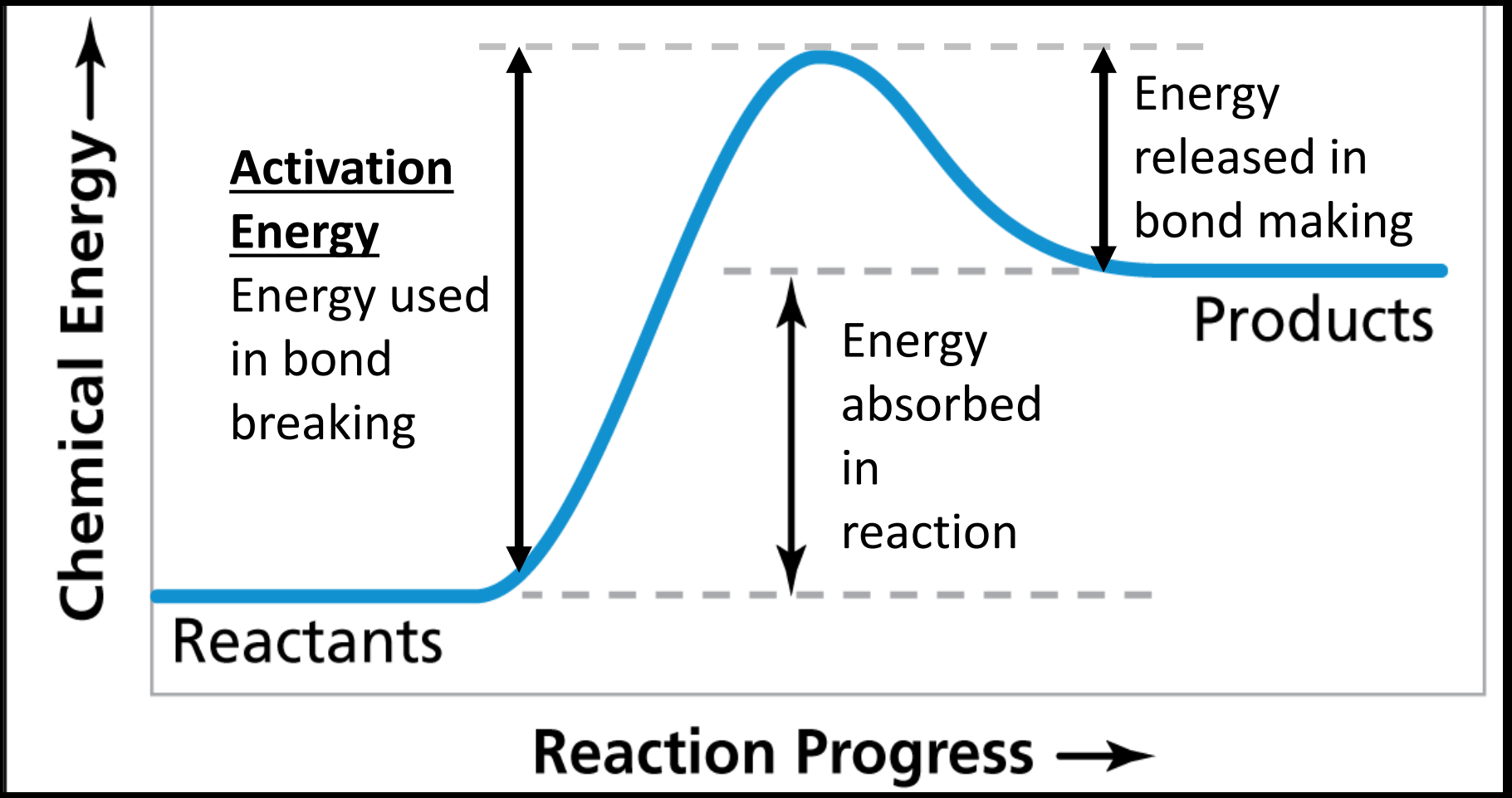
- **Endothermic**:
  - energy is *absorbed*
  - Endo- = “into”
  - Cooking of pancakes



Temperature Change

- By monitoring changes in temperature you can determine what type of reaction is occurring

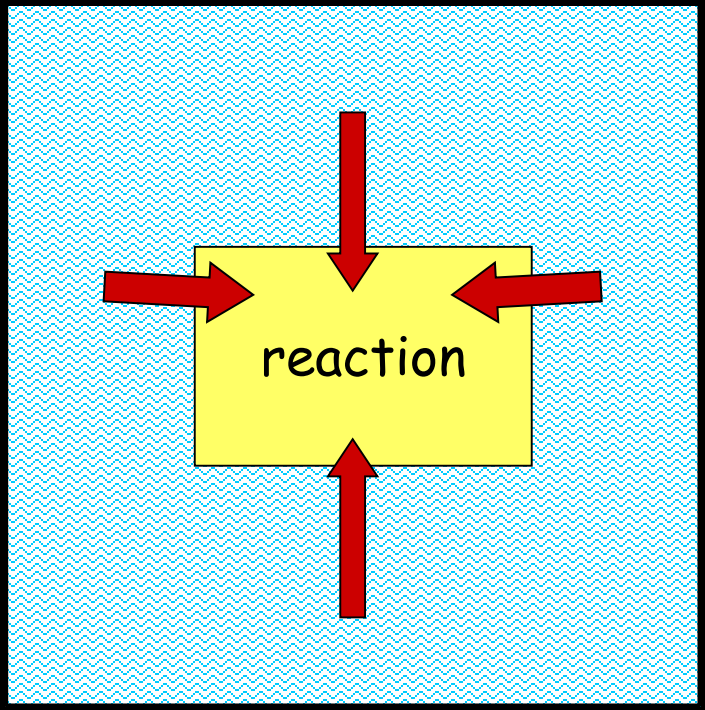
Endothermic Diagram

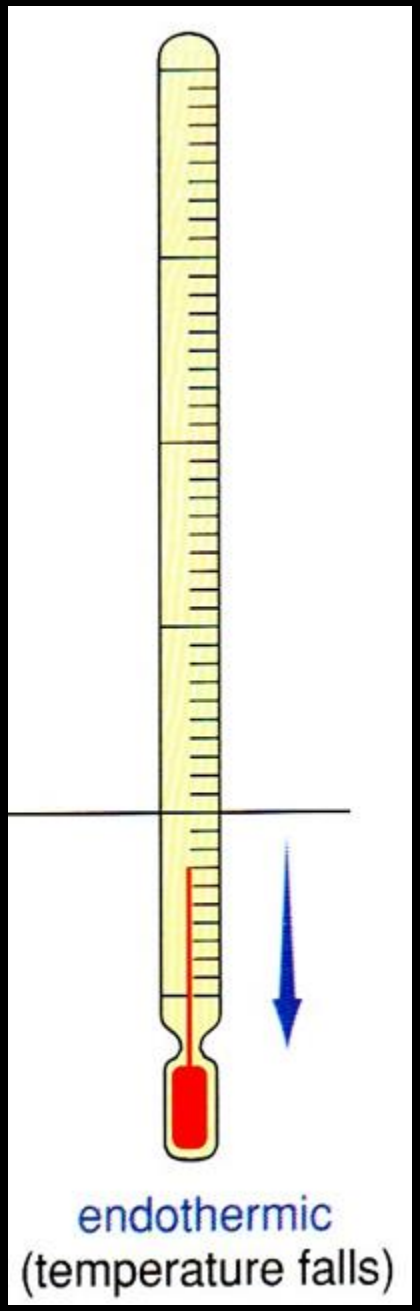


Endothermic – more energy is taken in to break the bonds in the reactants than released by the bonds being formed in the products. Therefore, energy is absorbed.

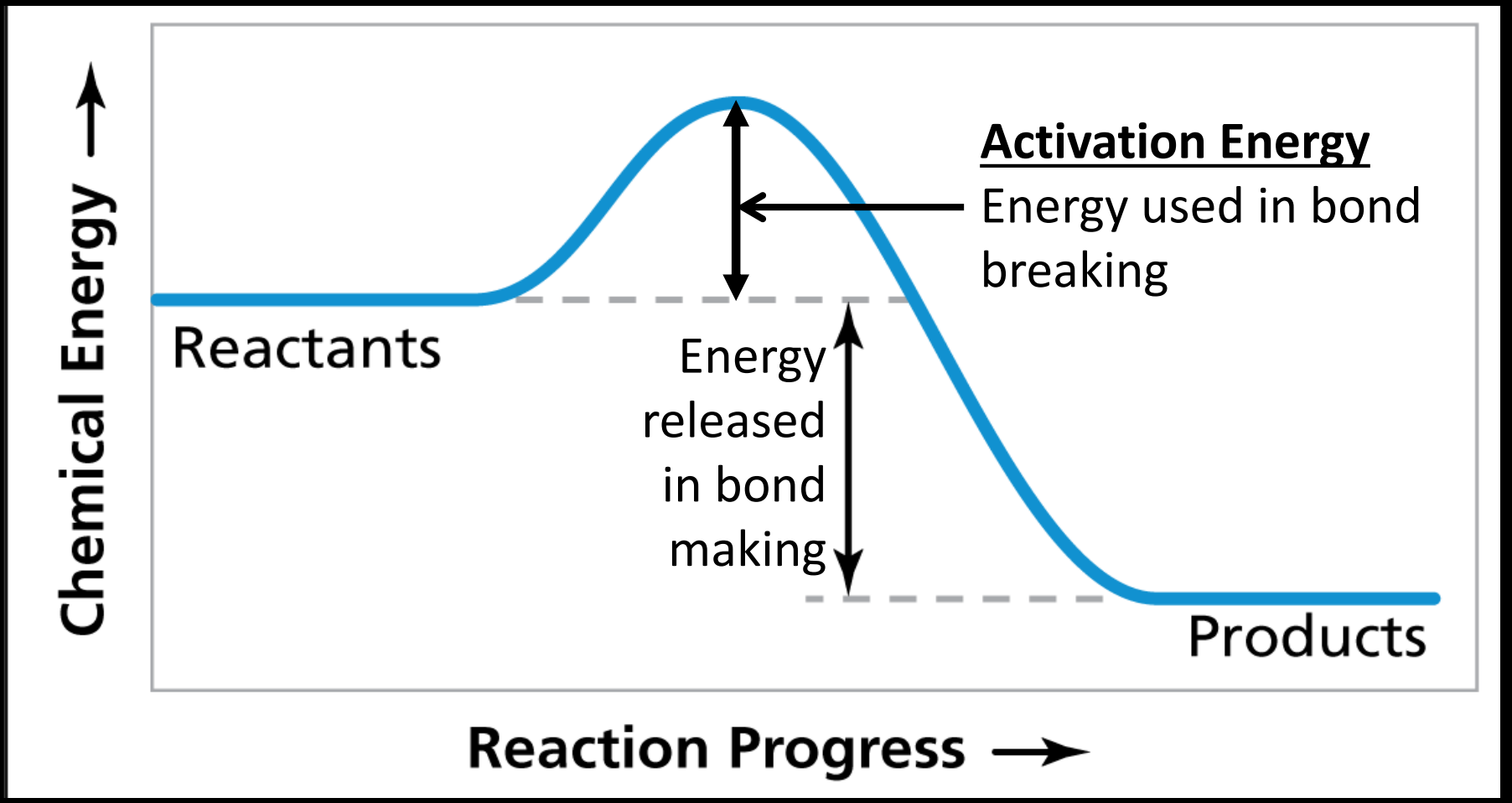
Endothermic

- Heat (energy) taken in
- Temperature of the substance drops
- Products feel **COLD**





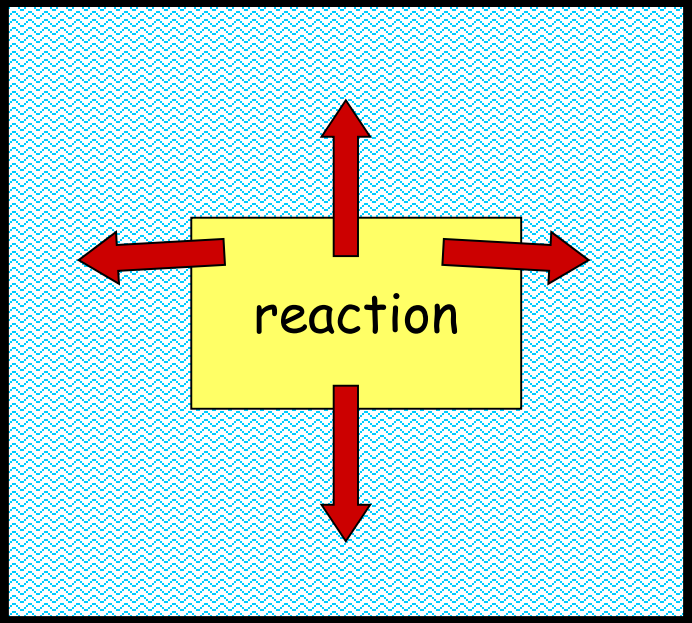
Exothermic Diagram

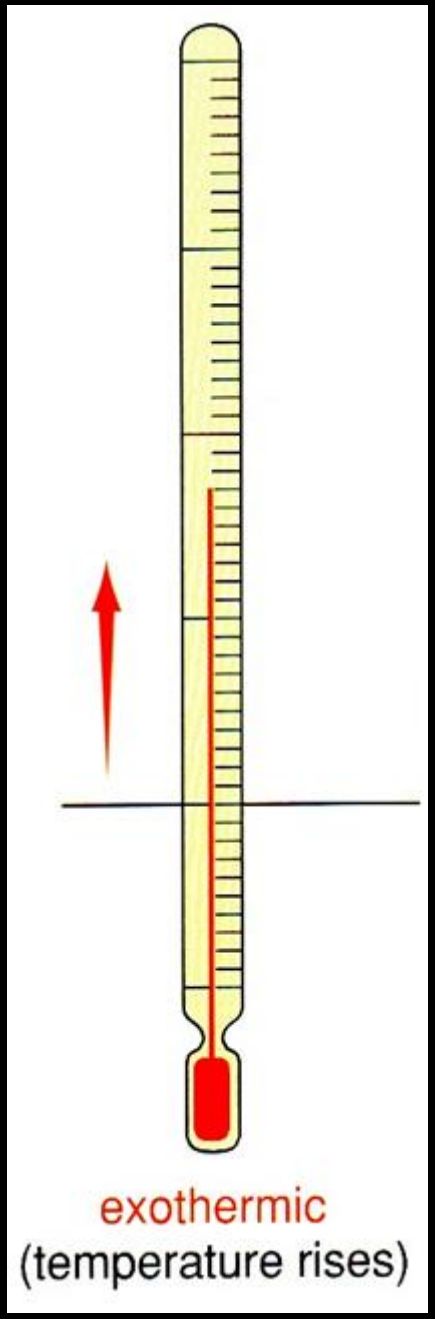


Exothermic – More energy is released when the products where formed than energy was used to break bonds in the reactants. Therefore, a net release of energy.

Exothermic

- Heat (energy) given off
- Temperature of the substance rises
- Products feel **HOT**





ENDOTHERMIC OR EXOTHERMIC?

$6CO_2 + 6H_2O + Energy \rightarrow C_6H_{12}O_6 + 6O_2$

ENDOTHERMIC!

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O + Energy$

EXOTHERMIC!

Lets Try Them

- Investigation 2-D Pg 151 of New Textbook