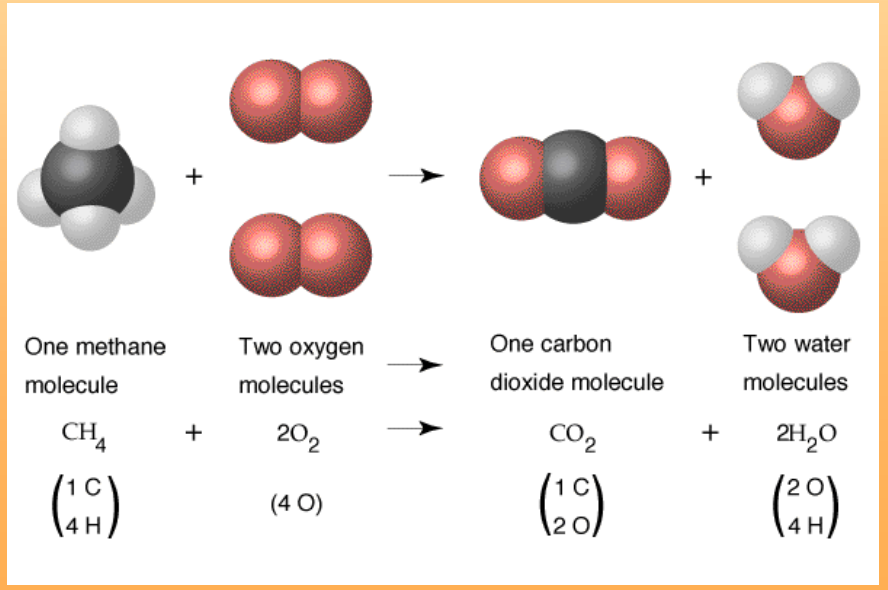
Chemical Reactions

How New Substances Are Made

What Is a Chemical Reaction?

- When two or more substances are mixed together, and a change happens that creates something NEW
- Atoms that were joined together have broken apart and rearranged to make new substances



What's The New Stuff That Forms??

- We call these new substances that form from a chemical reaction:

"products"

- The original substances were called reactants (because they react!)

Reactant + Reactant ----> Product

This means: produces, yields, or equals

Examples of Chemical Reactions

- A sparkler contains magnesium (Mg). When it is lit, it reacts with oxygen (O) in the air and produces light and heat

Mg + O ---> light + heat + MgO

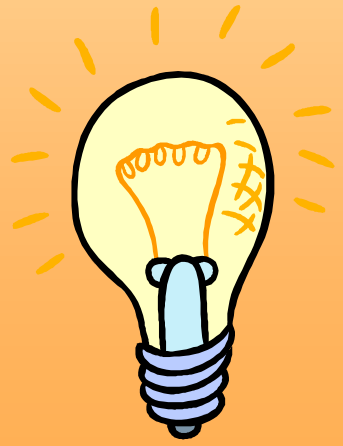
(magnesium oxide)

- Chemicals inside a rocket, when lit, react with oxygen in the air and produce heat, light and sound.

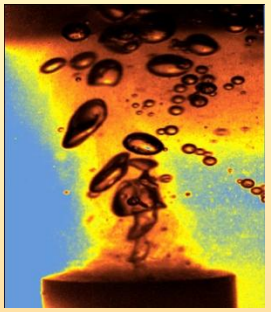
How Do You Know A Chemical Reaction Has Taken Place?

– Must show **EVIDENCES OF A CHEMICAL CHANGE!!!**

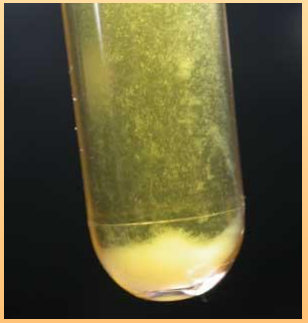
Remember: a chemical reaction causes a chemical change



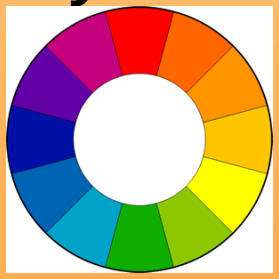
Evidences of a Chemical Change



1. Light/heat produced (energy)
2. Gas formed (bubbles!)
3. Precipitate formed (solid from two liquids)

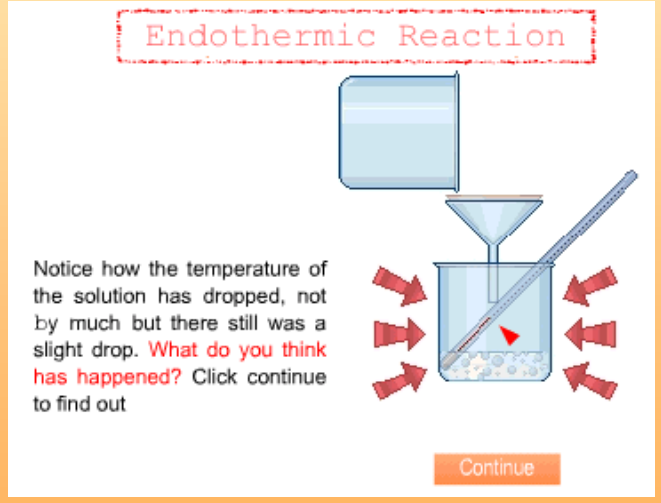


4. Unexpected change in color
5. Something new is formed that is very different from the old substances



Endo and Exothermic Reactions

- Exothermic Reactions
  - *Exo* = “out”
  - Gives off energy in the form of heat
  - Temperature increases
    - Example- A hot pack uses calcium chloride and water. When the pack is activated the 2 substances mix, and you get heat!

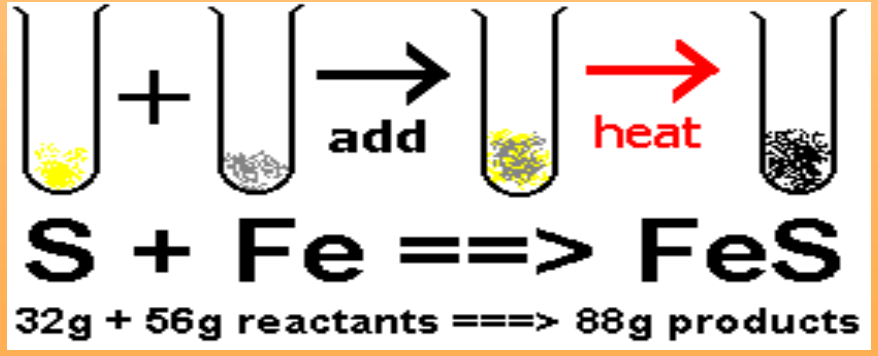


- Endothermic Reactions
  - *Endo* = “within”
  - Heat flows from the surrounding area into the reaction to convert reactants to products
  - Temperature decreases
    - Example- When you activate a cold pack the ammonium nitrate packet is broken & mixes with water

The Laws

- What does the Law of Conservation of Matter say?
  - **“Matter cannot be created or destroyed.”**
  - Since that is true, that means that chemical reactions have to follow another law

- The Law of Conservation of Mass:
  - **Mass of reactants = mass of products**



Examples of the Law of Conservation of Mass

- Chemical Reaction #1:

$$2\ H_2O \text{ ----> } 2\ H_2 + O_2$$

  - Label the reactants and products.
  - How many *atoms* of Hydrogen did I start with?
    - (hint: the number in front of the compound is the number of molecules…multiply by the number of atoms!)
  - How many did I end up with?
  - What about Oxygen?

Examples of the Law of Conservation of Mass

- Chemical Reaction #2:

$$2\ Na + 2\ HCl \text{ ----> } 2\ NaCl + H_2$$

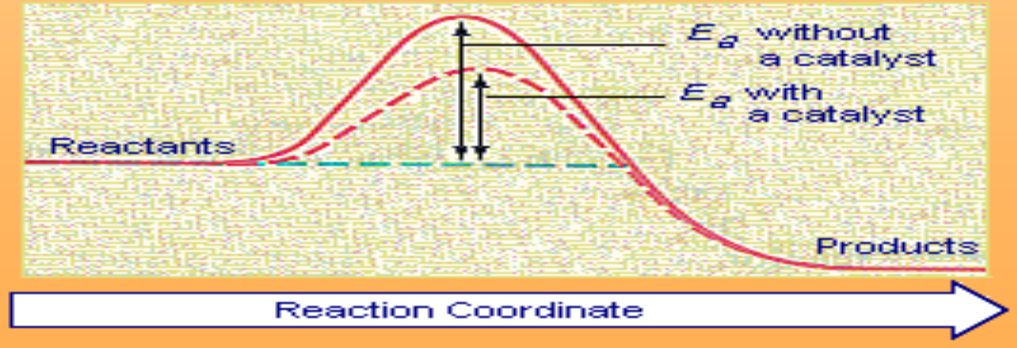
  - Label the reactants and products.
  - How many atoms of Sodium did I start with?
  - How many did I end up with?
  - What about Hydrogen?
  - What about Chlorine?

Moral of the Law

- What did you notice about the number of atoms on each side?
  - **REACTANTS = PRODUCTS**
  - The number of atoms on the left side equals the number of atoms on the right side…the atoms just switched places!
  - In other words, all equations are balanced too, the same number of atoms of elements are found on both sides of the equation

Rates of Reactions

- **Rate of Reaction:** the speed at which new particles form
- **Activation energy:** the smallest amount of energy that molecules need to react
  - If there is not enough energy, the reaction won't happen.



Factors That Affect Reaction Rates

- **Temperature**
  - The higher the temperature, the greater the kinetic energy, and the greater the collisions between molecules
- **Concentrations of Reactants**
  - When there are more molecules of reactants present there will be more collisions between them, and more bonds broken.
- **Catalysts**
  - Speeds up a reaction
  - Catalytic converters on cars are designed to force harmful pollutants to react with a catalyst of platinum and palladium and form a less harmful gas such as CO_2, N_2, O_2 & H_2O
- **Inhibitors**
  - These work to slow down a chemical reaction.
  - Used to make the reaction slower and more controlled if needed