CHEMICAL REACTIONS
- A chemical reaction occurs when a substance or multiple substances are transformed into another substance.
- If the physical properties of the product are different than that of the reactants, a chemical reaction has occurred.
- Evidence of a chemical reaction includes:
  - Change in color
  - Change in temperature (energy)
  - Light given off
  - Precipitate formation – solid forms
  - Bubbles – gas forms

CHEMICAL REACTIONS
- For each of the following equations, name the products and reactants and list their states:
  1. $\text{CH}_4(s) + \text{O}_2(g) \rightarrow \text{CO}_2(g) + \text{H}_2\text{O}(l) + \text{energy}$
  2. $\text{C}_6\text{H}_6 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$
  3. $2 \text{Na}_2\text{HCO}_3 \rightarrow \text{Na}_2\text{CO}_3 + \text{H}_2\text{O} + \text{CO}_2$

REACTANTS AND PRODUCTS
- Reactants: substances present before a chemical reaction takes place – by convention, reactants are written on the left side of chemical equations.
- Products: substances that are formed during a chemical reaction and are present at the end of the reaction – by convention, products are written on the right side of chemical equations.

TYPES OF CHEMICAL REACTIONS
- Combustion Reactions
- Synthesis Reactions
- Decomposition Reactions
- Single Replacement Reactions
- Double Replacement Reactions

CHEMICAL REACTION CONVENTIONS
- States of matter for reactants and products are written as SUBSCRIPT letters
  - $X_{(s)}$ = solid
  - $X_{(l)}$ = liquid
  - $X_{(g)}$ = gas
  - $X_{(aq)}$ = aqueous (dissolved in water)
- $\rightarrow$ yields / produces
- $\leftrightarrow$ reactions go both forwards and reverse

COMBUSTION REACTIONS
- Combustion involves an oxidation reaction (loss of electrons to oxygen to form oxides) of an organic compound in which heat is released.
- If carbon dioxide and water are the products of a reaction that produces heat, it is likely a combustion reaction.
  - $\text{CH}_4 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O} + \text{energy}$
  - Methane combusts

DECOMPOSITION REACTIONS
- Decomposition occurs when a larger molecule breaks down to form simpler products.
  - Example: $A + B \rightarrow AB$
  - $\text{H}_2\text{O} \rightarrow \text{H}_2 + \text{O}_2$

SINGLE REPLACEMENT REACTIONS
- Single replacement occurs when a more reactive atom replaces another.
  - An "activity series" is a chart showing which atoms are more reactive.
  - Example: $\text{AB} + \text{C} \rightarrow \text{CB} + \text{A}$
  - $\text{H}_2\text{O}_2 \rightarrow \text{H}_2 + \text{O}_2$

SYNTHESIS REACTIONS
- Synthesis occurs when 2 or more reactants join together to make a larger molecule.
  - Example: $A + B \rightarrow AB$
  - $\text{Cu}_2\text{O} + \text{O}_2 \rightarrow 2\text{CuO}$
  - $\text{2CO}_2 + \text{3H}_2\text{O} \rightarrow \text{C}_2\text{H}_2\text{O}_4 + \text{6O}_2$

REACTANTS

PRODUCTS

Yields
DOUBLE REPLACEMENT REACTIONS

- Double replacement occurs when two atoms switch places with one another.

Example:
1. AB + CD → AD + CB
2. Mg(OH)₂ + HCl → MgCl₂ + H₂O

SUCCESS CRITERIA: I will be able to classify types of reactions based on products produced and balance reactions to fulfill the Law of Conservation of Mass.

Warm-Up:
1. What are the 5 types of chemical reactions?
2. What type of reaction is represented by each of the following equations?
   - a. C₃H₈ + O₂ → CO₂ + H₂O
   - b. 2 NaClO₃ → Na₂ClO₄ + 3 O₂

BALANCING EQUATIONS

- The Law of Conservation of Mass says that in a chemical reaction, mass is neither created nor destroyed. The total mass of the reactants is equal to the total mass of the products.

Equations must be balanced in order to fulfill the Law of Conservation of Mass.

Steps to Balancing Equations:
1. Write the unbalanced equation.
2. Count the number of each type of atom on both sides of an equation.
3. Add coefficients (big numbers in front of the compound) until the number of each type of atom are equal.
4. Do not add subscripts as this will change the identity of the compounds.

Combustion of propane

Propane and oxygen yields carbon dioxide and water

\[ \text{C}_3\text{H}_8 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O} \]

# in Reactants Atom # in Products

<table>
<thead>
<tr>
<th>Initial</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>3</td>
</tr>
<tr>
<td>H</td>
<td>8</td>
</tr>
<tr>
<td>O</td>
<td>2</td>
</tr>
</tbody>
</table>

Combustion of glucose

(CELLULAR RESPIRATION)

- \( \text{C}_6\text{H}_12\text{O}_6 + 6 \text{O}_2 \rightarrow 6 \text{CO}_2 + 6 \text{H}_2\text{O} \)

# in Reactants Atom # in Products

<table>
<thead>
<tr>
<th>Initial</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>6</td>
</tr>
<tr>
<td>H</td>
<td>12</td>
</tr>
<tr>
<td>O</td>
<td>6</td>
</tr>
</tbody>
</table>