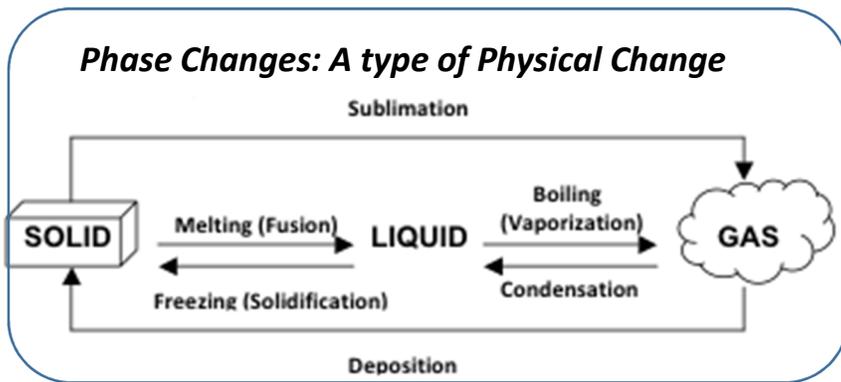


Changes we observe about matter can be categorized as either a physical or chemical change:

<p><b>Physical Change:</b> a change in which the chemical composition _____ _____!</p>	<p><b>Chemical Change:</b> a change in which the chemical composition _____ _____!</p>
<p><b>Signs of a Physical Change:</b></p>	<p><b>Signs of a Chemical Change:</b></p>
	
	
	
	
	
<p>***</p>	<p>***</p>



**Practice: Physical or Chemical Change?**

- Melting butter \_\_\_\_\_
- Cutting up food \_\_\_\_\_
- Digesting food \_\_\_\_\_
- Grating cheese \_\_\_\_\_

- Fermenting milk to make cheese  
\_\_\_\_\_
- Tearing a piece of Aluminum foil  
\_\_\_\_\_

Both physical and chemical changes can involve **changes in energy**

1. Consider an ice cube melting on a countertop

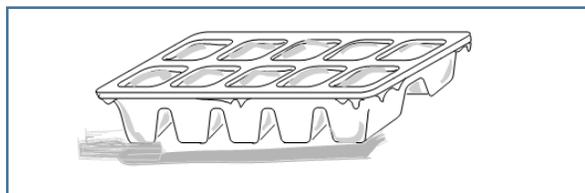
- a. Draw arrows showing which direction heat is transferred. Is heat being transferred:
- into the ice cube, or
  - out of the ice cube?



- b. When the ice cube melts, is it releasing heat or taking in (absorbing) heat from the surrounding air?

2. Consider water freezing in an ice cube tray in the freezer:

- a. Draw arrows showing which direction heat is being transferred when the ice cube tray is placed in the freezer. Is heat being transferred into or out of the water as it freezes into ice?



- b. When water freezes, is it releasing heat or taking in (absorbing) heat from the environment?

- c. In order to cool things in a refrigerator, heat must be transferred away from the food. Where do you think this heat ends up going?

- **endothermic**=when energy/heat is being \_\_\_\_\_ in a process
  - A reaction container will feel \_\_\_\_\_ due to heat being transferred into (heat is absorbed by) the reaction container
- **exothermic**=when energy/heat is being \_\_\_\_\_ in a process
  - A reaction container will feel \_\_\_\_\_ due to heat being transferred out of (heat is released by) the reaction container

The **rate of a physical or chemical change** depends on the following factors:

- **As the Temperature** \_\_\_\_\_
- **For solids: Surface Area of Reactant (Relative Particle Size)**
  - As the reactant particle size \_\_\_\_\_
- a.k.a:
  - As the surface area of the reactant \_\_\_\_\_
- **As the Concentration of the Reactants** \_\_\_\_\_
- **Presence of a Catalyst**
  - **Catalyst** = \_\_\_\_\_
  - Digestive enzymes are catalysts!

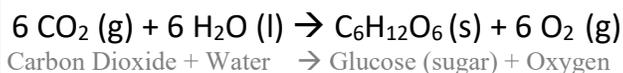
- 1) Given the balanced equation representing a reaction:  $\text{Zn(s)} + 2\text{HCl(aq)} \rightarrow \text{H}_2\text{(g)} + \text{ZnCl}_2\text{(aq)}$   
Which set of reaction conditions produces  $\text{H}_2\text{(g)}$  at the fastest rate?
- a) a 1.0-g lump of  $\text{Zn(s)}$  in 50 mL of 0.5 M  $\text{HCl(aq)}$  at 20 degrees Celsius
  - b) a 1.0-g lump of  $\text{Zn(s)}$  in 50 mL of 0.5 M  $\text{HCl(aq)}$  at 30 degrees Celsius
  - c) 1.0 g of powdered  $\text{Zn(s)}$  in 50 mL of 1.0 M  $\text{HCl(aq)}$  at 20 degrees Celsius
  - d) 1.0 g of powdered  $\text{Zn(s)}$  in 50 mL of 1.0 M  $\text{HCl(aq)}$  at 30 degrees Celsius
- 2) At 20°C, a 1.2-gram sample of Mg ribbon reacts rapidly with 10.0 milliliters of 1.0 M  $\text{HCl(aq)}$ .  
Which change in conditions would have caused the reaction to proceed more **slowly**?
- a) increasing the initial temperature to 25°C
  - b) decreasing the concentration of  $\text{HCl}$  to 0.1 M
  - c) using 1.2 g of powdered Mg
  - d) using 2.4 g of Mg ribbon

**Writing Chemical Equations:** Representing a physical or chemical change

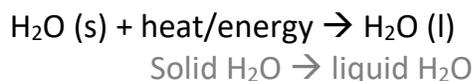
For chemical changes, there are two terms you need to be familiar with:

- **Reactants**= the substances that you \_\_\_\_\_ in a chemical reaction
- **Products**= the substances that you \_\_\_\_\_ in a chemical reaction

**Example: Photosynthesis**



**Example: melting of ice**



\*Note: don't use the word "reactant" or "product" here as no new substance was formed.

### **Important Symbols in Chemical Equations:**

<b>Symbol</b>	<b>Meaning</b>
	Separates 2 or more reactants or products (“and” or “combine” or “reacts”)
	Separates reactants from products (“yield/produce”)
	Refers to a substance in a solid state
	Refers to a substance in a liquid state
	Refers to a substance in gas state
	Refers to a substance that is dissolved in water (aqueous solution)

### **Practice Writing Chemical Equations: Don't forget to include energy/heat is a reactant/product and the phases of each substance! Also, don't forget about your diatomic elements!**

- 1) When sodium metal reacts with iron (III) chloride ( $\text{FeCl}_3$ ), iron metal and sodium chloride ( $\text{NaCl}$ ) are formed.
- 2) The Haber Process is an exothermic reaction in which nitrogen ( $\text{N}_2$ ) and hydrogen ( $\text{H}_2$ ) gas are combined to produce ammonia ( $\text{NH}_3$ ) gas
- 3) When dissolved barium chloride ( $\text{BaCl}_2$ ) reacts with dissolved potassium sulfate ( $\text{K}_2\text{SO}_4$ ) in water, barium sulfate ( $\text{BaSO}_4$ ) precipitates and aqueous potassium chloride ( $\text{KCl}$ ) is made.
- 4) When sucrose ( $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ ) burns in oxygen gas ( $\text{O}_2$ ), carbon dioxide, water and heat are produced.
- 5) Hydrogen peroxide ( $\text{H}_2\text{O}_2$ ) breaks down to form water and oxygen gas ( $\text{O}_2$ ).
- 6) When dissolved calcium hydroxide ( $\text{Ca}(\text{OH})_2$ ) reacts with sulfuric acid ( $\text{H}_2\text{SO}_4$ ), a calcium sulfate ( $\text{CaSO}_4$ ) precipitate is formed along with water and heat
- 7) When dry ice ( $\text{CO}_2$ ) is placed on a countertop at room temperature, it sublimates.

## Homework

- 1) Decide whether the following are physical changes (PC) or chemical changes (CC)
- |   |  |
|---|--|
| a) Salt dissolves in water _____  | f) Ethyl alcohol evaporates _____                        |
| b) Hydrochloric acid reacts with magnesium to produce hydrogen gas ____ | g) Paper burns _____                                     |
| c) A piece of copper is cut in half _____                               | h) Fireworks explode _____                               |
| d) A sugar cube is ground up _____                                      | i) Sodium and potassium react violently with water _____ |
| e) Iron rusts _____   | j) Water freezes _____                                   |

- 2) Which of the following phase changes are endothermic?
- |                            |                                 |
|----------------------------|---------------------------------|
| A. Melting and freezing    | C. Condensation and sublimation |
| B. Melting and evaporating | D. Condensation and deposition  |

- 3) A 5.0-gram sample of zinc and a 50-milliliter sample of hydrochloric acid are used in a chemical reaction. Which combination of these samples has the fastest reaction rate?
- |                                   |                                  |
|-----------------------------------|----------------------------------|
| A. a zinc strip and 1.0 M HCl(aq) | C. zinc powder and 1.0 M HCl(aq) |
| B. a zinc strip and 3.0 M HCl(aq) | D. zinc powder and 3.0 M HCl(aq) |

\*\*Name another factor that could increase the rate of this reaction: \_\_\_\_\_

- 4) **Write out the chemical equation** for the following reactions.

- a) When a solution of  $\text{BeCl}_2$  reacts with an  $\text{AgNO}_3$  solution, aqueous  $\text{Be}(\text{NO}_3)_2$  and  $\text{AgCl}$  powder are made.
- b) When isopropanol ( $\text{C}_3\text{H}_8\text{O}$ ) burns in oxygen gas ( $\text{O}_2$ ), carbon dioxide, water, and heat are produced.
- c) When dissolved  $\text{NaOH}$  reacts with  $\text{H}_2\text{SO}_4$ , an exothermic reaction occurs in which aqueous sodium sulfate ( $\text{Na}_2\text{SO}_4$ ) and water are formed.
- d) When fluorine gas ( $\text{F}_2$ ) is put into contact with calcium metal,  $\text{CaF}_2$  powder is created in an exothermic reaction.
- e) When sodium metal reacts with  $\text{FeCl}_2$ , iron metal and sodium chloride are formed.