Chemical Reactions

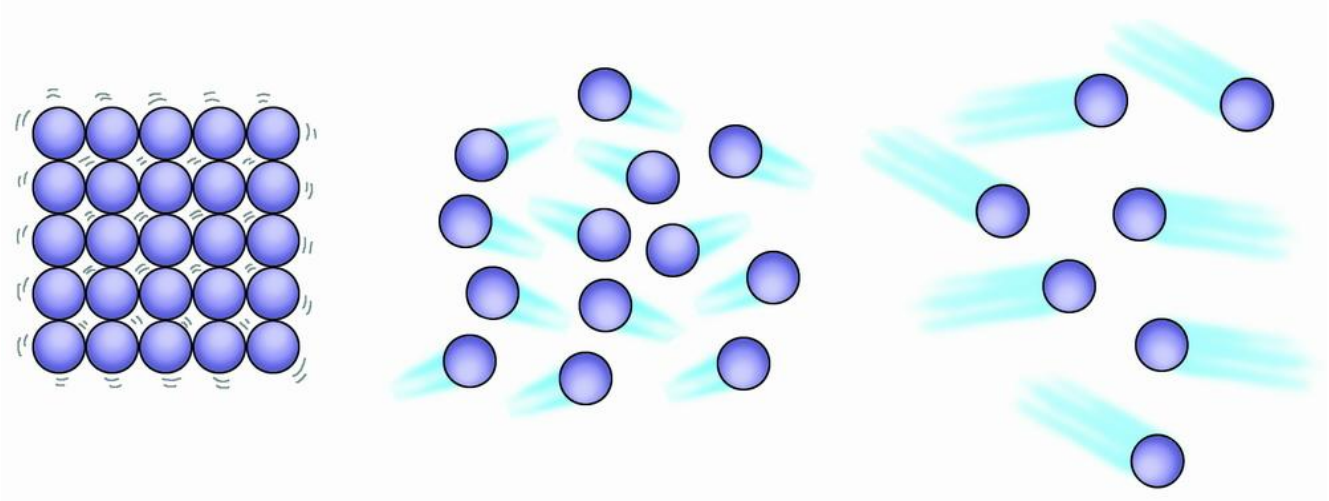
What are Physical Properties?

- Physical properties can be observed and measured without changing the identity of the substance.
- Phase Changes:
  - Melting Point: the temperature at which a substance melts (or freezes…they're just the reverse of each other, and it happens at the same temperature!). The freezing/melting point of water is 0 degrees C.
  - Boiling Point: the temperature at which a liquid boils (substances changes from a liquid to a gas). The boiling point of water is 100 degrees C.
  - Different substances melt and boil at different temperatures, so we can use this to identify an unknown substance.

- Density: mass ÷ volume; how much mass is in a given amount of space (volume). Every substance has a unique density that stays the same no matter how large or small the sample is, so we can use this to identify an unknown substance.
- Other physical properties: shape, size, color, smell, etc.

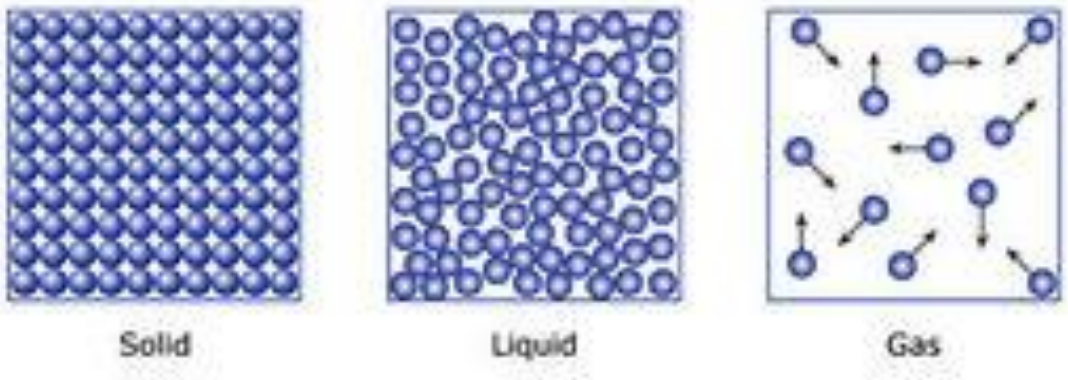
What do phases of matter look like at the atomic level: Solids

- Solids: atoms are packed tightly together in a rigid pattern. They still have some energy, so they vibrate in place (think: when you're stuck in your seat between all the other students in the class, you get "twitchy" and might tap your pencil or wiggle a little).



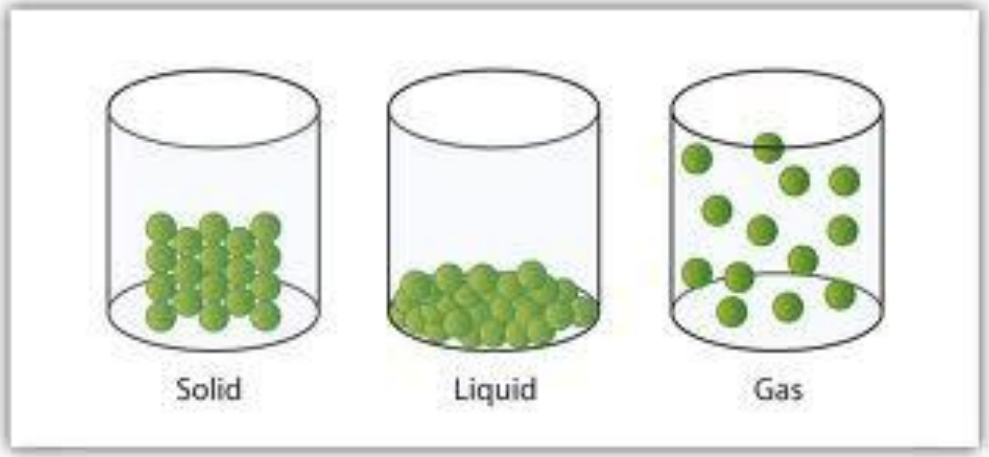
Phases of matter at the atomic level: Liquids

- Liquid: at the melting point, atoms acquire enough energy to move around; the pattern loosens up, and the substance can flow (once you have enough energy, you HAVE to get up and move around a little!)



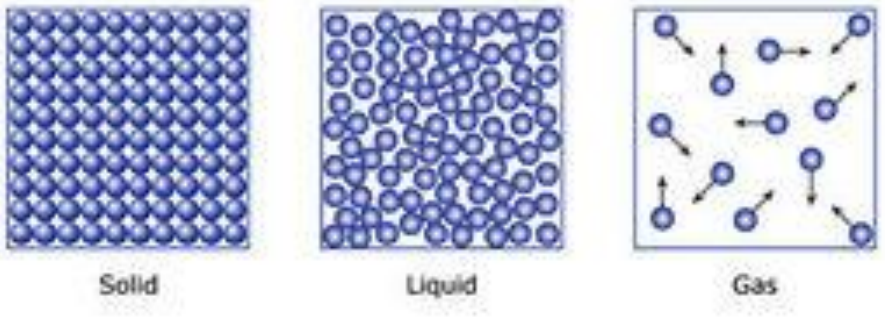
Phases of matter at the atomic level: Gases

- Gas: at the boiling point, atoms have enough energy to change to a gas. In a gas the atoms or molecules move about freely and collide randomly with the walls of a container and with each other. The distance between molecules in a gas is much larger than that in a solid or a liquid. (In a gas, the particles have LOTS of energy and bounce off the walls!)



Phases of matter at the atomic level: Density

- As a substance goes from a solid to a liquid to a gas, the density of the substance DECREASES. This is because as the pattern gets looser, the atoms/molecules get farther apart.
- The exception is water: ice floats on liquid water, meaning ice (a solid) is less dense than water (a liquid)



What are Chemical Properties?

- Chemical properties can be observed only when substances react or do not react chemically with one another; that is, when they undergo a change in chemical composition. A chemical property of one substance usually involves its ability to react or not react with another specific substance.

- Examples:
  - Reacting with Oxygen: The ability of a substance to burn is a chemical property that involves a substance reacting **quickly** with oxygen to produce light and heat (FIRE). Reacting with oxygen **slowly** occurs when iron rusts.
  - Reacting with an acid: some metals react with acids to form compounds, while basic solutions (we'll talk about later) react with acids to form neutral solutions.

Chemical Properties

- Does it dissolve in water?
  - Water is often called the "universal solvent" because so many substances can dissolve in it.
- Solutions can be acidic, basic, or neutral.
  - Substances that form acids and bases must be dissolved in water before you can tell if they're acids or bases. Once dissolved in water, the substances release ions.
  - pH: a measure of how acidic or basic a solution is.
    - The pH scale goes from 1 to 14. A pH of 7 is a neutral solution (neither an acid nor a base), a pH less than 7 is an acid, and a pH greater than 7 is a base.

Substances can Change

- Substances change in 2 ways:
  - Physical Change: a change that occurs that does not change the identity of the substance (it's still the same "stuff")
    - Shape change, phase change, change in size, change in other physical properties
  - Chemical Change: a change that occurs that changes the identity of the substance (turns it into something else). Results in the formation of a new substance.
    - Burning paper, digesting food, change in chemical properties
    - When a chemical change occurs, it is called a chemical reaction.

What is a Chemical Reaction?

- Chemical Reaction: when 2 or more substances react (interact) to form a new substance.
  - Happens when substances (compounds or elements) collide (hit each other) and interact.
- In a chemical reaction, a chemical change takes place (the substances you start with become new substances).
- Reactants react to form products.
  - Reactants: the substances you start with
  - Products: the substances you end with
- Abbreviation for reaction: rxn.

How do I know if a Chemical Change or Reaction has occurred?

- Evidence of a chemical reaction:
  1. Color Change
     - Iron turns red-brown when it reacts with Oxygen (rust)
     - exceptions: food coloring or painting something
  2. Temperature Change
     - Wood burning—increased temperature
     - Exceptions: boiling water, sunshine heating water in a lake

3. Formation of a Gas
    - Bubbles form
    - Exception: boiling liquid
4. Formation of a Precipitate
    - Precipitate: a solid that forms from combining 2 liquids

What is a Reaction Rate?

- Reaction Rate: how long it takes for the reaction to occur.
  - Reactions occur at different rates, from very slow to very fast.
- The reaction rate can be changed by:
  1. Changing the concentration of the reactants
     - As concentration increases, reaction rate increases (speeds up)
     - Increase in concentration means more particles present that can react, leading to a bigger and/or faster reaction.

2. Changing the temperature of the reaction mixture

- As temperature increases, reaction rate increases
- Increased temperature makes the particles of a substance move faster. This increase in motion allows reactants to collide and interact more frequently (increased reaction rate).

3. Surface Area of the reactants
   - Increased surface area=increased reaction rate
   - If there's more surface area, there's more particles that can collide and interact
4. Presence of a Catalyst
   - Catalyst: something that affects a reaction, but is not changed in the reaction.