

Phase Changes

Physical Science

2.2

Matter can change from state to another.

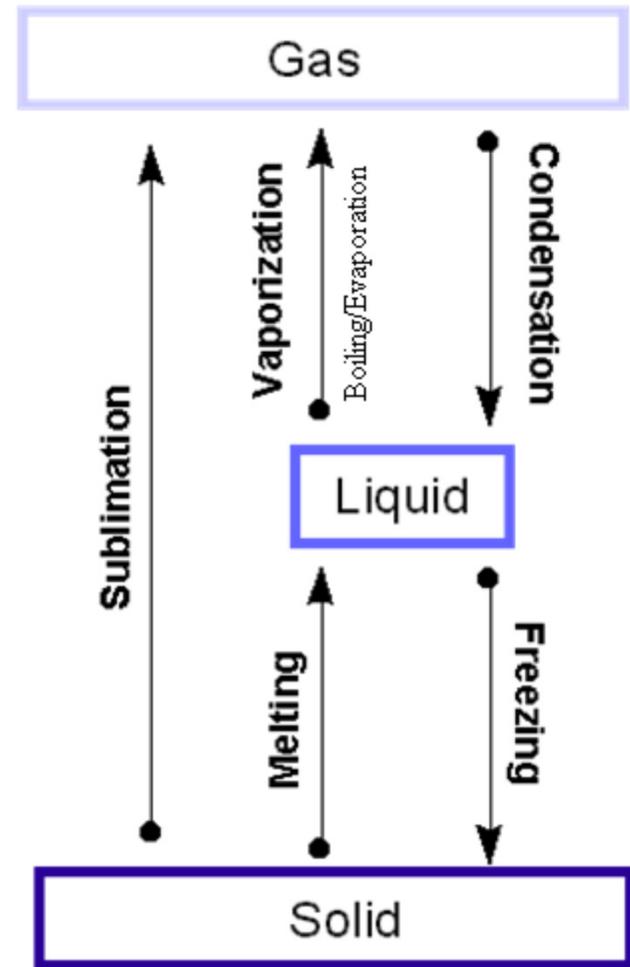
- The three states of matter: solid, liquid, gas.
- Remember all atoms are in constant motion- but how fast, freely they move determines the state of matter.
- The state of matter is determined by its kinetic energy (the energy of motion)

Kinetic Theory

- How particles in matter behave
 1. All matter is composed of tiny particles (atoms)
 2. The particles move in constant, random motion
 3. The particles collide with each other and with the walls of any container they are contained
 4. The amount of energy that the particles lose from these collisions is negligible, or so small it does not affect the behavior of the matter

Phase Changes

- Matter can change from one state to another
- Happens when particles either gain or lose thermal energy.



Freezing

- The process of changing phases from the liquid phase to the solid phase
- **Freezing Point** -the temperature at which a liquid turns into a solid
- *Heat of Fusion* is the energy required to change a substance from a liquid to a solid



Melting



- The process of changing phases from the solid phase to the liquid phase
- **Melting Point** -the temperature at which a solid becomes a liquid; same temperature as the freezing point (just a different name)
- *Heat of Fusion* is the energy required to change a substance from solid to liquid (it is the same, just in reverse)

Vaporization

- The process of changing phases from the liquid phase to the gas phase
- Boiling Point –the temperature at which a liquid changes into a gas
- *Heat of Vaporization* is the energy required to change a substance from a liquid to a gas
- Vaporization can occur in two ways:
 - **Boiling**
 - **Evaporation**



Vaporization

Boiling

- Occurs *throughout* a liquid at a specific temperature depending on the pressure on the surface of the liquid

Evaporation

- Occurs at the surface of a liquid
- •Happens at temperatures below the liquid's boiling point

Condensation

- The process of changing phases from the gas phase to the liquid phase
- It happens at the same temperature as the boiling point
- *Heat of Vaporization* is the same moving from a gas to a liquid; just in reverse

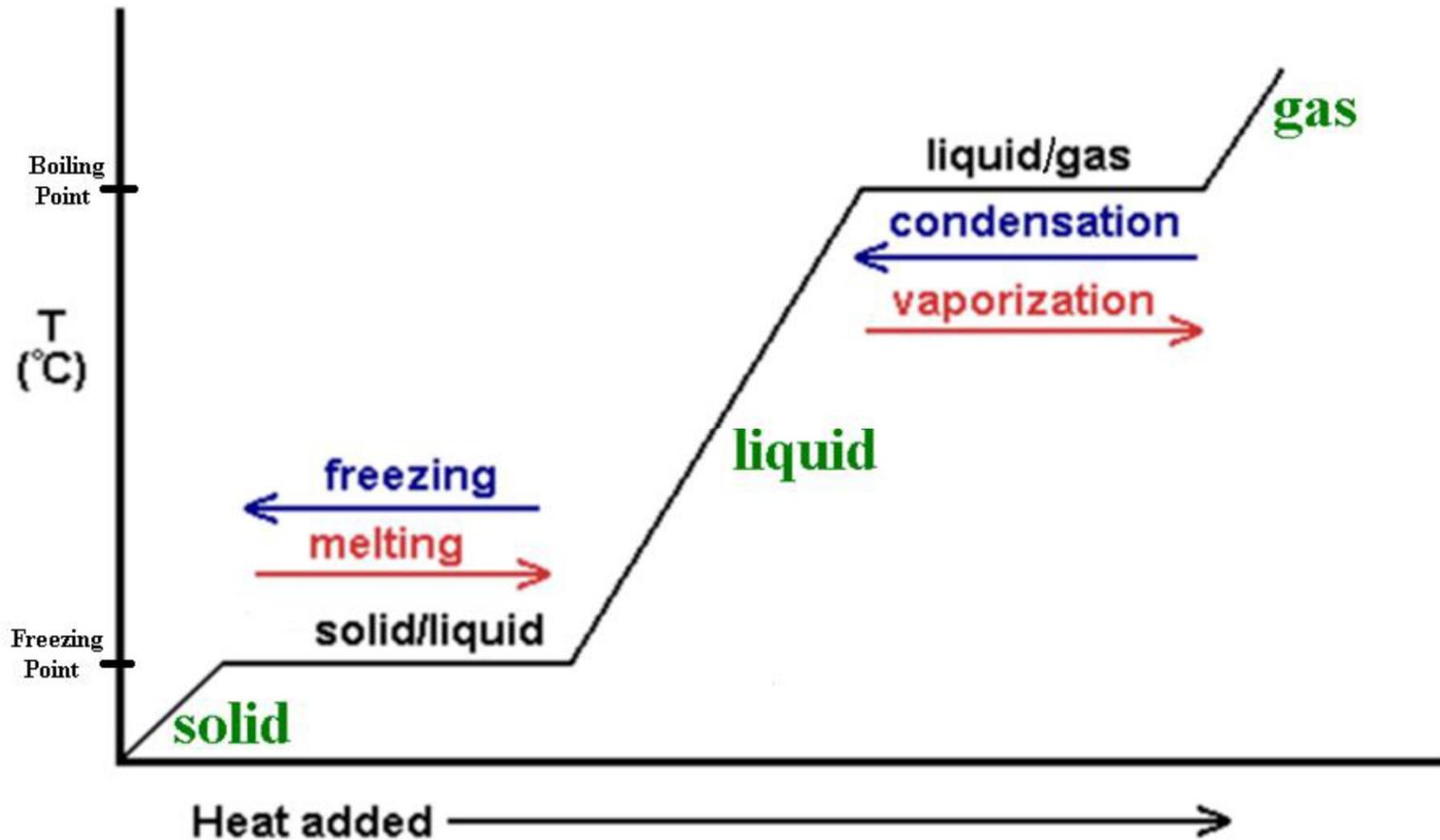


Sublimation

- The process of changing phases from the solid phase directly to the gas phase
- Under some circumstances, solids can turn directly into a gas without going through the liquid phase
- Ex. -Dry Ice

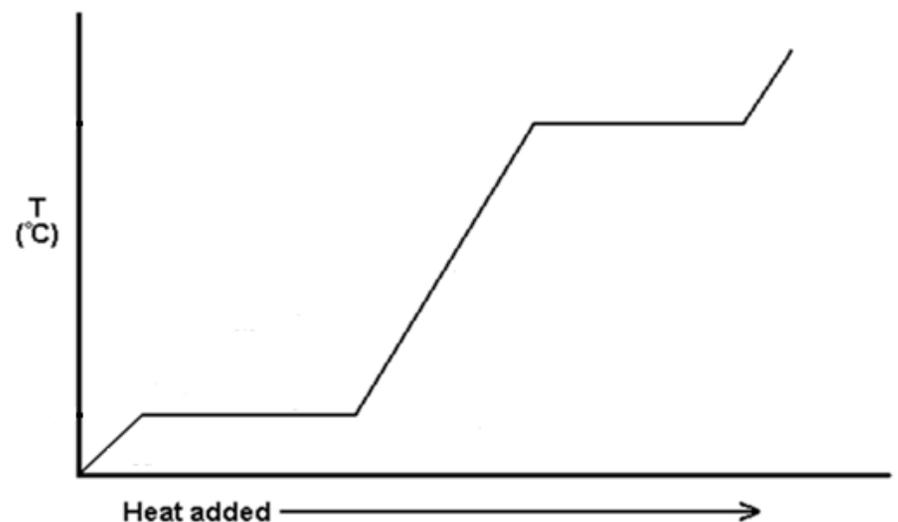


Heating Curves



Heating Curve

- Notice two areas on the graph where the temperature does not change
- Whenever there is a change in state of matter, the temperature stays the same until all of the matter has changed state
- The temperature remains constant during melting and vaporizing



Thermal Expansion

- Particles move faster and *separate* as the temperature rises
- Results in an *expansion* of the entire object
- Expansion of liquids is what makes a thermometer work (the *warmer* the liquid is, the further up the thermometer the liquid goes)
- Expansion in gases is what makes a hot air balloon rise (as the air is heated, it expands, becoming less *dense* and rises relative to the air in the atmosphere)

