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The Four Phases of Matter and Phase Changes Notes

The **Kinetic Theory of Matter** says “Matter is made of tiny particles that are constantly moving.”

Matter – is any solid, liquid, gas, or plasma, and is made of atoms, or parts of atoms.

Matter can exist in 4 different phases (or states) of matter:

solid

liquid

gas

plasma

SOLID – Ex: a brick, a spoon, a penny, wire, powders, sand, clay, diamond

- a solid's particles are tightly packed and can't change positions
- the particles can *vibrate* in place, but can't move otherwise
- the particles have a certain shape that doesn't change (a *definite shape*)
 - a few solids (ex. silly putty) can't hold a shape, they are called **amorphous solids**.
- a solid takes up an amount of space that doesn't change (a *definite volume*)
- in some solids the particles are arranged in a *repeating pattern*.
 - When this happens it is called a **crystalline solid** (ex. salt)



LIQUIDS – Ex: water (at room temperature,) mercury (at room temperature), dishwashing soap, lava (molten rock)

- a liquid's particles are *loosely packed*. Very close together, but with enough room between them that they *can change position*. (They can squeeze past each other.)
- the particles move by *flowing* around each other (like people in a crowd)
- liquids can change their shape (*no definite shape*) They take the shape of their container.
- liquids take up an amount of space that doesn't change (a *definite volume*)



GAS

– Ex: helium, oxygen, carbon dioxide (all at room temp), steam, water vapor

- a gas's particles have space between each particle. They are *free to move about, can change position, and can get closer or spread farther away from each other.*
- the particles move by *flying* around
- gases can change their shape (*no definite shape*) They take the shape of their container.
- gases can be compressed (can take up less space) or expand (take up more space) so their volume can change (*no definite volume*)



PLASMA

– Ex: lightning, a nuclear fireball, welding arcs, the sun (and other stars)

- plasma particles are *pieces of atoms*
- plasma particles are highly energized and have space between each particle. They are *free to move about, can change position, and can get closer to or spread farther away from each other.*
- the particles move by *exploding* away from the atom they were in.
- plasmas can change their shape (*no definite shape*) They take the shape of their container.
- plasmas can be compress or expand so their volume can change (have *no definite volume*)



When Matter gains or loses motion energy, it can change phase.

For example, if an ice cube (solid water) is heated, it will change into a liquid (water), and if you continue to heat it, it will become steam (gaseous water.)



You could reverse this by cooling down steam (taking the energy away) and the steam would go back to liquid water. If you kept cooling it, the liquid water would become ice again.



THE PHASE CHANGES:

Phase changes: melting, freezing, sublimation, condensation, boiling, evaporation, sublimation, and deposition

Phase changes where energy is being gained:

boiling – a liquid is intentionally heated to become a gas (ex. the water when making Ramen noodles)

evaporation – a liquid becomes a gas through motion energy at its surface (ex. alcohol disappears quickly when spilled)

melting – a solid becomes a liquid (ex. ice cream cone on a hot day)

sublimation – a solid changes directly into a gas (ex. dry ice makes a fog)

Phase changes where energy is being lost:

condensation – a gas changes into a liquid (ex. warm water vapor from the shower cools and forms a coating on the bathroom mirror)

deposition – a gas transforms directly into a solid (ex. the CO₂ in a CO₂ cartridge forms icy frost on the cartridge)

freezing – a liquid becomes a solid. (ex. water in an ice cube tray in the freezer)

Thermal expansion – when matter is heated, it expands (takes up more space) (volume increases) and when matter is cooled, it contracts (takes up less space) (volume decreases)

This is why doors stick in the summer and bridges have “expansion” joints so they don’t self destruct with changes in temperature.