Solids, Liquids, and Gases
Chemistry

The science that deals with the structure and behavior of matter
Scientific Models

• A *model* is a simplified approximation of reality.

• Scientific models are simplified but *useful* representations of something real.
Kinetic Molecular Theory

- All matter is composed of tiny particles.
- The particles are in constant motion.
- Increased temperature reflects increased motion of particles.
- Solids, liquids and gases differ in the freedom of motion of their particles and in how strongly the particles attract each other.
Solid

- Constant shape and volume
- The particles are constantly moving, colliding with other particles, and changing their direction and velocity.
- Each particle is trapped in a small cage whose walls are formed by other particles that are strongly attracted to each other.
The Nature of Solids

1. Friction of moving parts causes temperature to rise.
2. As temperature rises, particles move faster and bump harder.
3. Neighboring particles are pushed farther apart, and the solid expands.
4. If the lubricating or cooling system fails, engine expansion may cause a piston to jam in the cylinder.
5. Moving particles bump and tug one another but stay in the same small space.
Liquid

- Constant volume but variable shape
- The particles are moving fast enough to break the attractions between particles that form the walls of the cage that surround particles in the solid form.
- Thus each particle in a liquid is constantly moving from one part of the liquid to another.
Liquids

Particles move fast enough for attractions to be constantly broken and reformed.

Particles are less organized, with slightly more space between them than in the solid.

Particles move throughout the container.

Liquids
Evaporation

This particle is getting a sharp triple kick.

The kick propels the particle out of liquid.

It is traveling too fast for the attractions to the liquid particles to draw it back, so it is now a gas particle.
Gas

- Variable shape and volume
- Large average distances between particles
- Little attraction between particles
- Constant collisions between particles, leading to constant changes in direction and velocity
The Nature of Gases

Because particles are so far apart, there is usually no significant attraction between them.

Particles move in straight paths, changing direction and speed when they collide.
Description of Solid

- Particles constantly moving.
- Up to 70% of volume occupied by particles...30% empty.
- Strong attractions keep particles trapped in cage.
- Constant collisions that lead to changes in direction and velocity.
- Constant volume and shape due to strong attractions and little freedom of motion.
Description of Liquid

• Particles constantly moving.
• Up to 70% of volume occupied by particles…30% empty
• Attractions are strong but not strong enough to keep particles from moving throughout the liquid.
• Constant collisions that lead to changes in direction and velocity.
• Constant volume, due to significant attractions between the particles that keeps the particles at a constant average distance, but not constant shape, due to the freedom of motion.
**Description of Gas**

- Particles constantly moving in straight-line paths
- About 0.1% of volume occupied by particles…99.9% empty.
- Average distance between particles is about 10 times their diameter.
- No significant attractions or repulsions.
- Constant collisions that lead to changes in direction and velocity.
- Variable volume and shape, due to lack of attractions and a great freedom of motion.
- You can see an animation that shows the particle nature of solids, liquids, and gases at [https://preparatorychemistry.com/KMT_Canvas.html](https://preparatorychemistry.com/KMT_Canvas.html)