

States of Matter

The Particle Model of Matter & The Kinetic Molecular Theory

Lesson 23

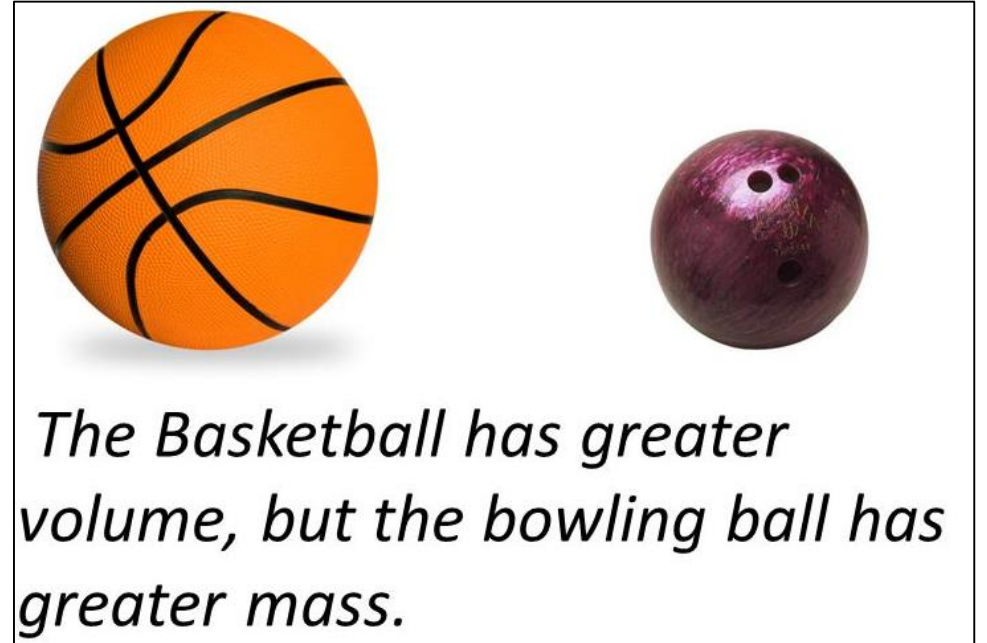
The **kinetic molecular theory** explains the characteristics of solids, liquids, and gases

- Glass is a marvelous substance. When it is cool and in solid form, it is rigid, clear and breakable. But when it is heated to about 1000°C , glass becomes molten and flows – it becomes a fluid. When it is a fluid, artists can shape it to create beautiful works of art. This process is not as easy as it sounds – you must practice for years in order to control the heating and flow of the glass.
- We are going to learn how the particles of matter behave and respond when energy is added to them or removed from them.



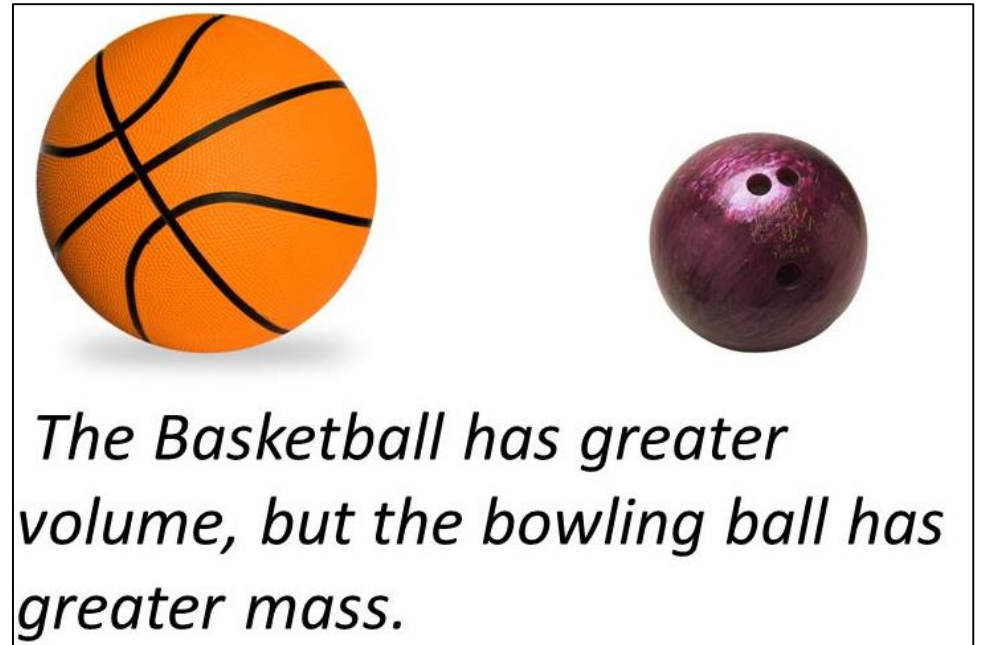
States of Matter

- Oxygen, glass, and water are all examples of matter
- **Matter** = anything that has **mass** and **volume**
- **Mass** = the quantity of matter that a substance or object contains
 - The more mass, the greater the matter
 - E.g. a bowling ball has more mass than a basketball
 - Mass is usually measured in grams (g) or kilograms (kg)



States of Matter

- **Volume** = the amount of space taken up by a substance or object
 - E.g. a basketball has a greater volume than a bowling ball
 - The volume of a liquid is usually measured in millilitres (mL), litres (L), or cubic centimetres (cm³)

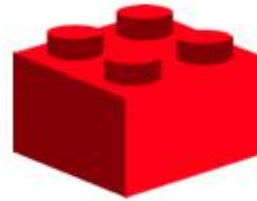


States of Matter

There are three familiar states (phases) of matter:

- **Solid** = the state of matter that has a definite shape and volume (e.g. a bowling ball)
- **Liquid** = the state of matter that has a definite volume, but its shape is determined by its surroundings (e.g. water in a beaker vs water in a bowl)
- **Gas** = the state of matter that has its volume and shape determined by its surroundings (e.g. helium in a balloon)

Solid



KEEPS its
shape

Liquid



TAKES the
shape of its
container

Gas

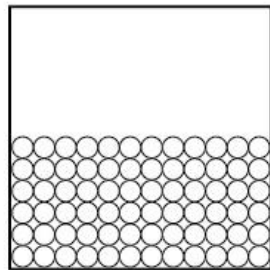


FILLS its
container

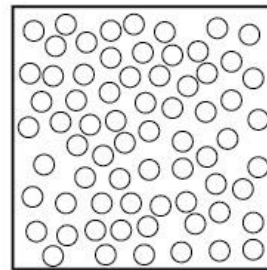
The Particle Model of Matter

All **matter** is made of up **particles**; these **particles** behave in different ways whether they are solid, liquid or gas.

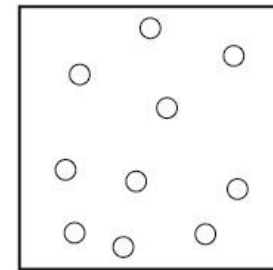
1. All matter is made up of very small particles which are much too small to observe with the naked eye or with a light microscope.
2. There are spaces between the particles. The amount of space between the particles is different for different states of matter. E.g. gases have much more space between particles than solids do.



Solid



Liquid

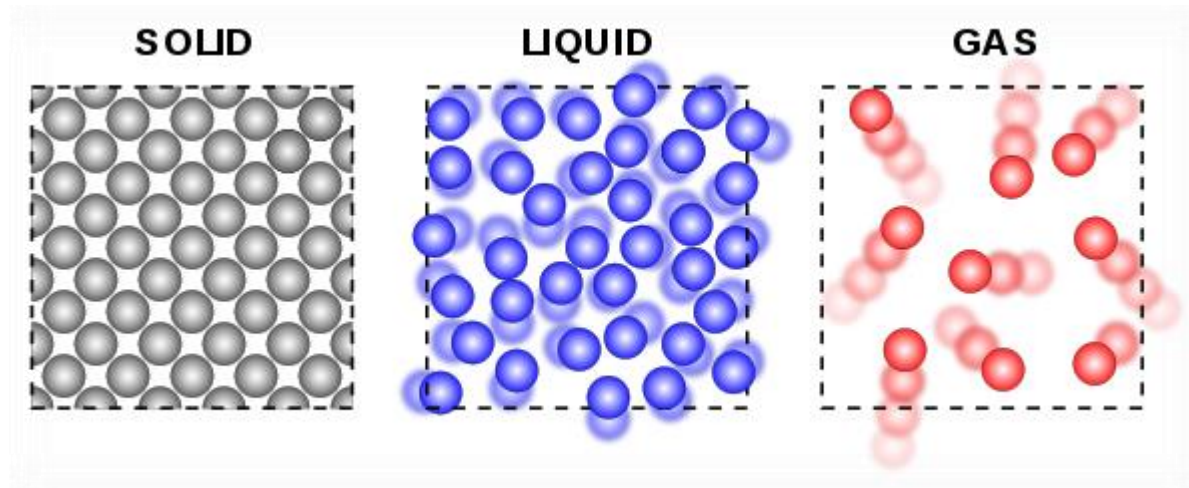


Gas

The Particle Model of Matter

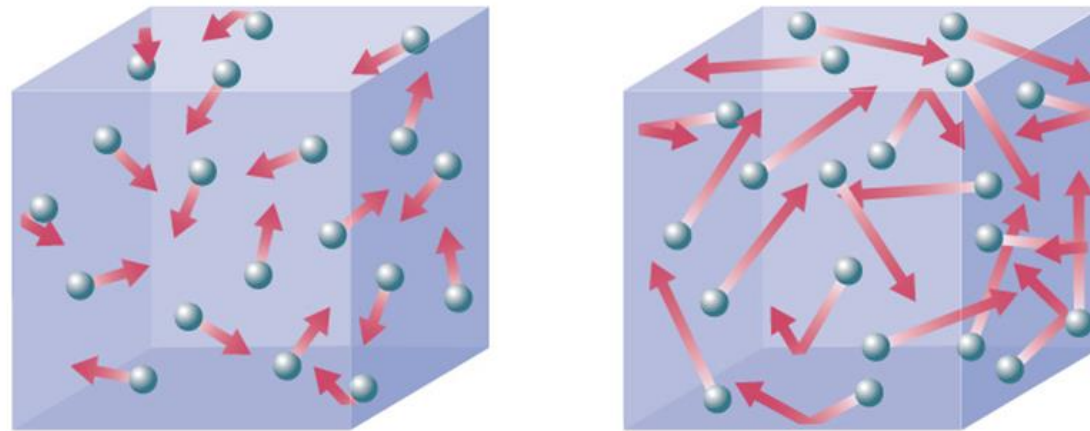
All **matter** is made of up **particles**; these **particles** behave in different ways whether they are solid, liquid or gas.

3. The particles that make up matter are always moving.
4. The particles are attracted to one another. The strength of the attraction depends on the type of particle.



The Kinetic Molecular Theory

- **Kinetic energy** is the energy of motion
- All particles in every solid, liquid, and gas are always moving, so they have **kinetic energy**
- Scientists have expanded the **particle model of matter** and developed the **kinetic molecular theory**
 - To explain what happens to matter when the kinetic energy of particles change

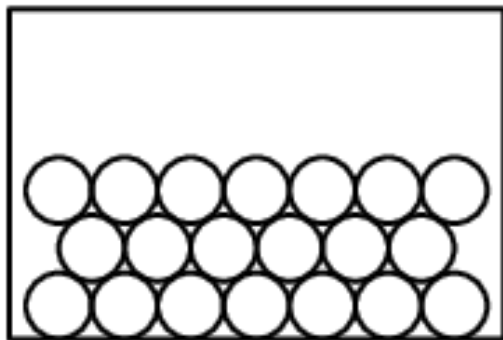


Longer arrows mean higher average speed.

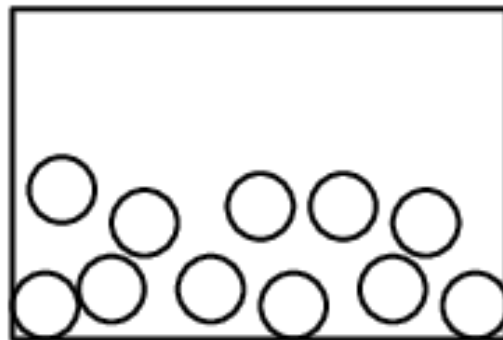
The Kinetic Molecular Theory

The main points of the kinetic molecular theory:

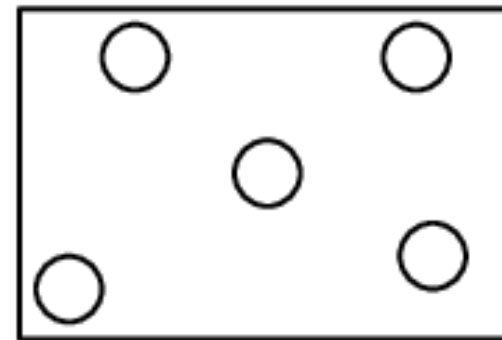
1. All matter is made up of very small particles (atoms and molecules).
2. There is empty space between particles.



solid



liquid

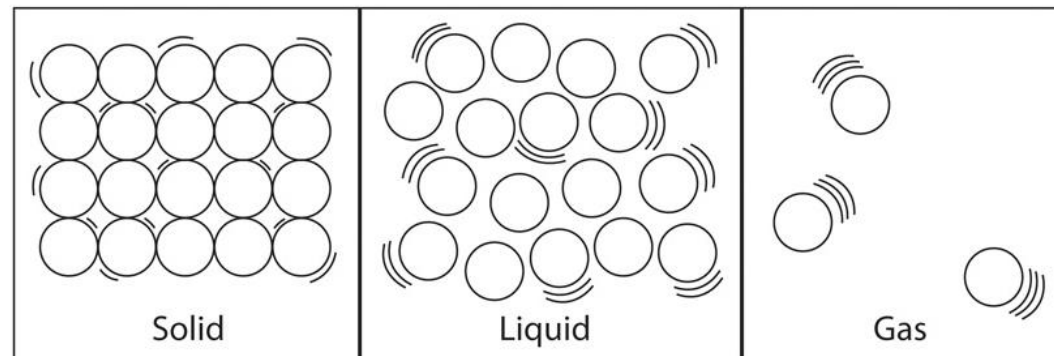


gas

The Kinetic Molecular Theory

The main points of the kinetic molecular theory:

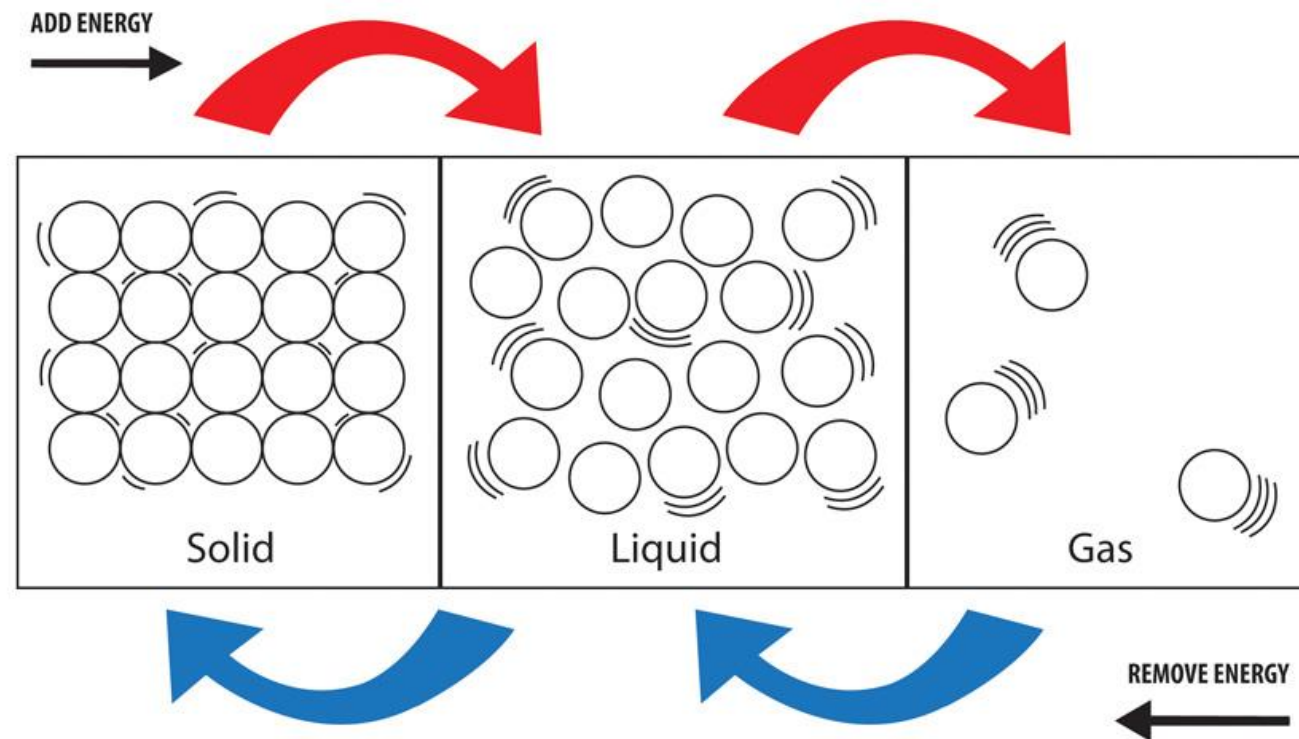
3. Particles are constantly moving. The particles are colliding with each other and the walls of their container.
 - a) Particles of a **solid** are so tightly packed together they cannot move around freely. They can only **vibrate**.
 - b) Particles of a **liquid** are farther apart and they can move by **sliding** past each other.
 - c) Particles of a **gas** are very far apart and they **move** around **quickly**.



The Kinetic Molecular Theory

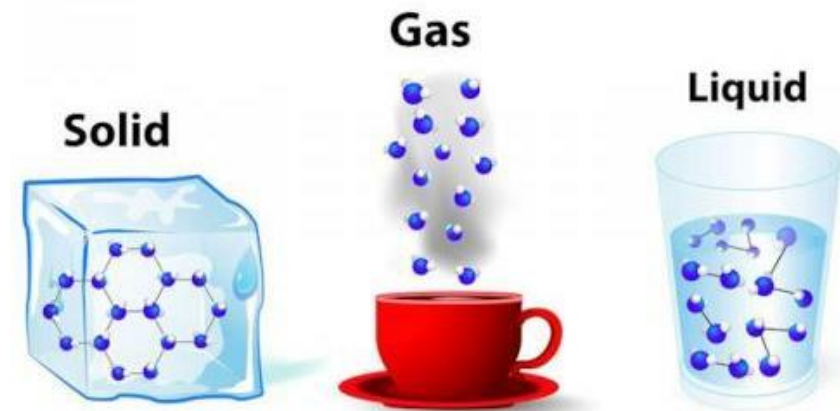
The main points of the kinetic molecular theory:

4. Energy makes particles move. The more energy the particles have, the faster they can move and the farther apart they can get.



Summary – States of Matter

- All matter is made up of very small particles that are constantly moving
- The more energy the particles have → the faster they can move and the farther apart they can get
- Matter expands when its temperature is raised and contracts when its temperature is lowered
- If enough energy is added to or removed from matter → the matter changes from one state to another



Check your understanding!

1. How is a solid different from a liquid in shape and volume?
2. How are liquids and gases similar/different in shape and volume?
3. How are liquids and gases different in the amount of space between particles?
4. How does the behavior of particles change as energy is added to them? How does the behavior change as energy is lost?
5. How does the space between particles change as energy is added to them? How does the space change as energy is lost?

Answer the above questions for **Tues. Feb. 4, 2020**