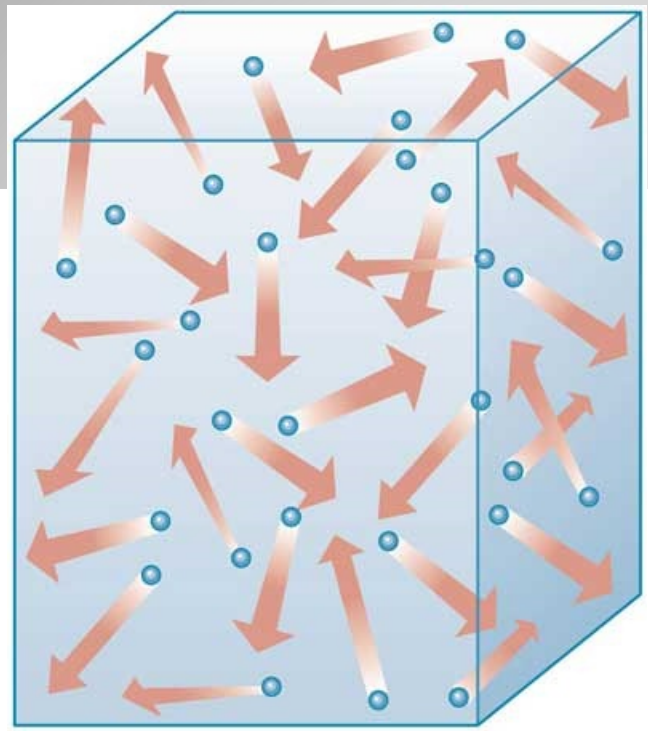
Kinetic Molecular Theory of GASES



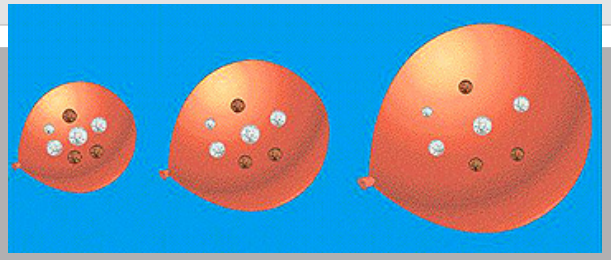
Kinetic Molecular Theory

Kinetic Theory is based on two ideas:

1) Particles of matter are always in motion
2) This motion has consequences (Properties)

PROPERTIES OF GASES

Physical Properties of Gases

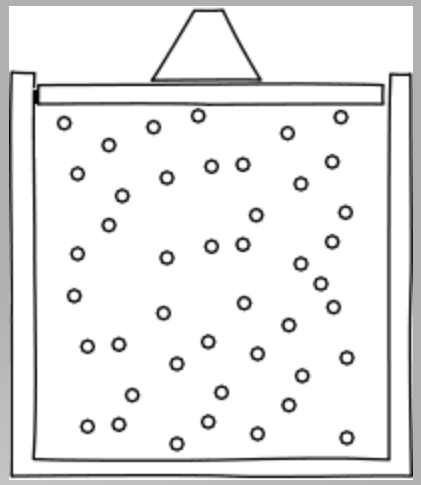


1) **Expansion (Expands)**

No definite shape or volume

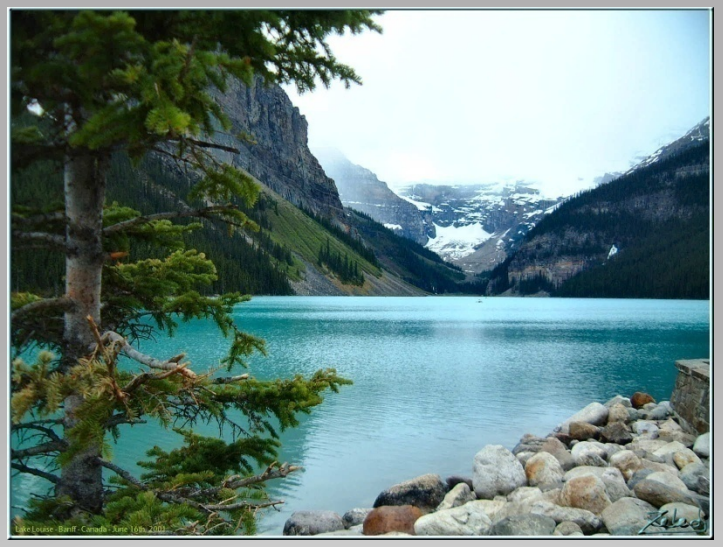
2) **Fluidity (Fluid)**

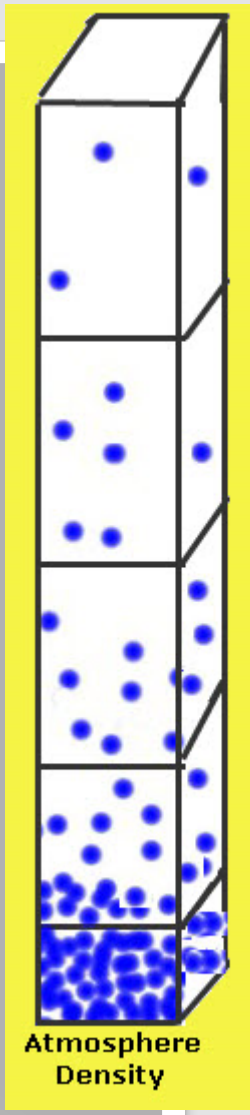
Gas particles glide easily past one another



3) **Low Density**

The density of a substance in the gaseous state is about 1/1000 the density of the same substance in the liquid or solid state





Physical Properties of Gases

Physical Properties of Gases

4) Compressibility (Highly Compressible)

During compression of a gas, gas particles are crowded close together

With sufficient compression, the volume of a gas can be decreased thousands of times

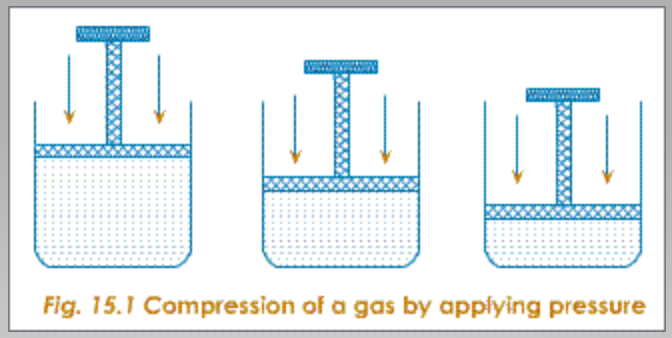
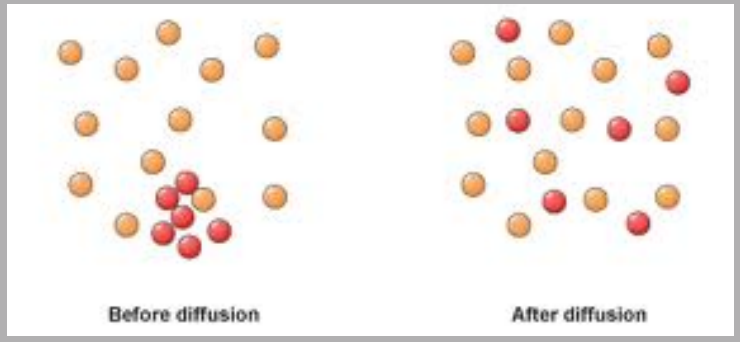


Fig. 15.1 Compression of a gas by applying pressure

5) Diffusion/Effusion

Diffusion = spontaneous mixing of the particles of two substances without being stirred



Rate of diffusion depends on:

- Speed of gas particles (Higher speed = Faster diffusion)
- Diameter of gas particles (Smaller = Faster Diffusion)
- Attraction Force between gas particles (Small attraction = Faster diffusion)

Physical Properties of Gases

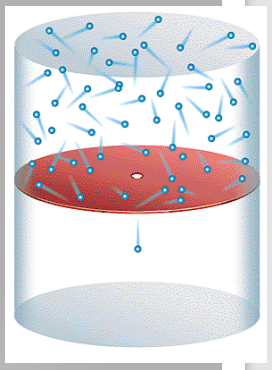
Physical Properties of Gases

5) Diffusion/Effusion

Effusion = gas particles under pressure pass through a very small opening from one container to another

Rates of effusion is directly proportional to velocity of particles

(Faster particles = faster effusion)



Kinetic Molecular Theory

Kinetic Molecular Theory (KMT) explains WHY gases have these properties.

Kinetic Molecular Theory states five assumptions…

Kinetic Molecular Theory

- Assumption # 1

Gases consist of large numbers of tiny particles that are far apart relative to their size

- Most of the volume occupied by a gas is empty space

Kinetic Molecular Theory

- Assumption # 2

Particles of a gas are in constant, rapid & random motion therefore possessing Thermal Energy

Thermal energy = energy of random motion

- Assumption # 3

Collisions between particles of a gas and between particles & container walls are **elastic collisions**

- Elastic collisions = no net loss or gain of thermal energy

Kinetic Molecular Theory

Kinetic Molecular Theory

- Assumption # 4

  There are no forces of attraction or repulsion between the particles of a gas

- They do not stick together but immediately bounce off of each other like billiard balls

Kinetic Molecular Theory

- Assumption # 5

The average thermal energy of the particles of a gas depends on the temperature

- If temperature goes up, E_{th} goes up (direct proportion)

$$E_{th} = \frac{1}{2} mv^2$$

m = mass v = velocity

- If same gas, mass is the same therefore E_{th} depends on velocity
- With different gases, low mass means higher average speeds

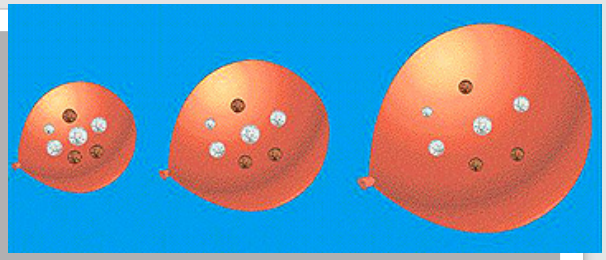
Using Kinetic Molecular Theory

to EXPLAIN properties

Explaining Properties

Explaining Properties

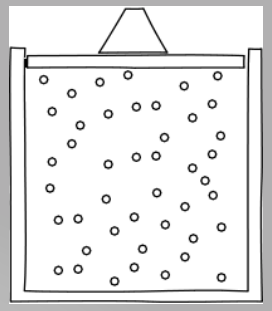
1) **Gases Expand because…**



- #2 Particles are in constant, random motion
- #4 There are no attractive forces between particles

2) **Gases act like Fluids because…**

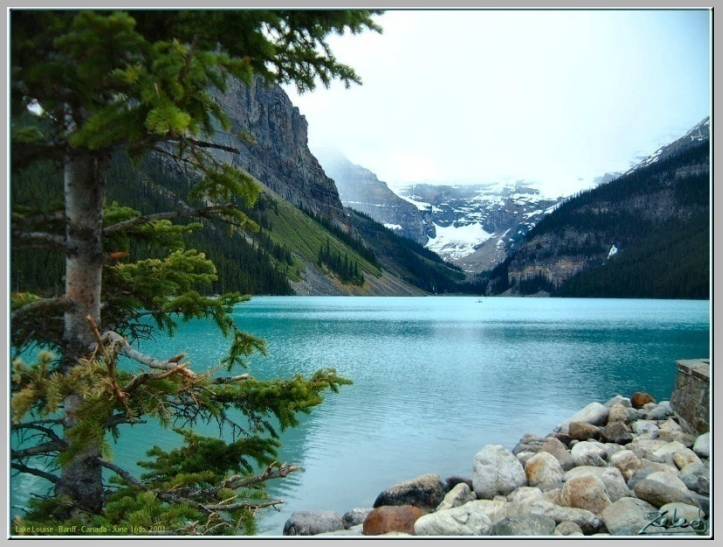
- #4 There are no attractive forces between particles

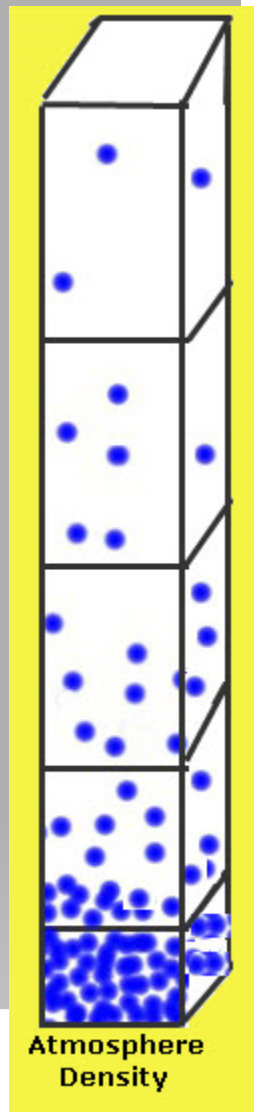


3) Gases have a low density because…

-#1 Gases consist of tiny particles that are far apart

- #4 There are no attractive forces between particles





Explaining Properties

4) **Gases are highly compressible because...**

-#1 Gases consist of tiny particles that are far apart

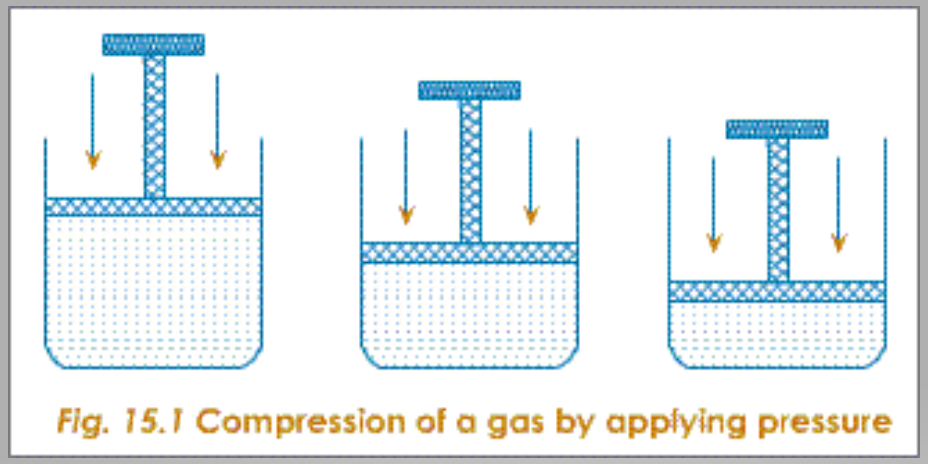
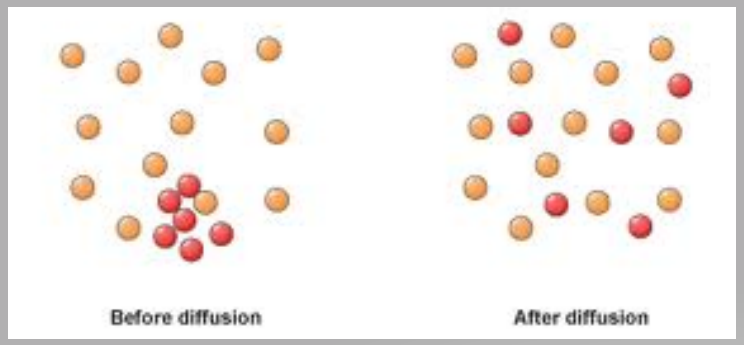


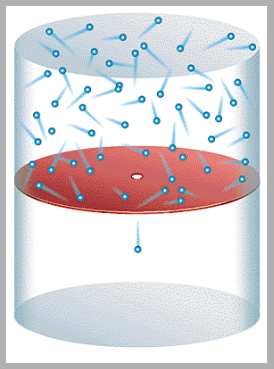
Fig. 15.1 Compression of a gas by applying pressure

Explaining Properties

5) Gases diffuse & effuse because …

- #2 Particles are in constant, random motion





Explaining Properties

Ideal Gas = imaginary gas that conforms perfectly to all assumptions of the Kinetic Molecular Theory

Real Gas = a gas that does not completely obey all the assumptions of the Kinetic Molecular Theory (KMT)

Ideal Versus Real Gases

Ideal Versus Real Gases

Real gases deviate from ideal gases because…

1) Particles of real gases occupy space
2) Particles of real gases exert attractive forces on each other

Real gases behave like ideal gases when..

1) Particles are very far apart
2) Particles have high thermal energies
3) Particles have a weak attraction to each other

Ideal Versus Real Gases

- Measureable quantities of gases:

1) Volume
2) Temperature
3) Pressure
4) Quantity or number of moles

Describe the volume, temperature & pressure needed for a gas to

a) Act most like an ideal gas
b) Deviate the most from an ideal gas