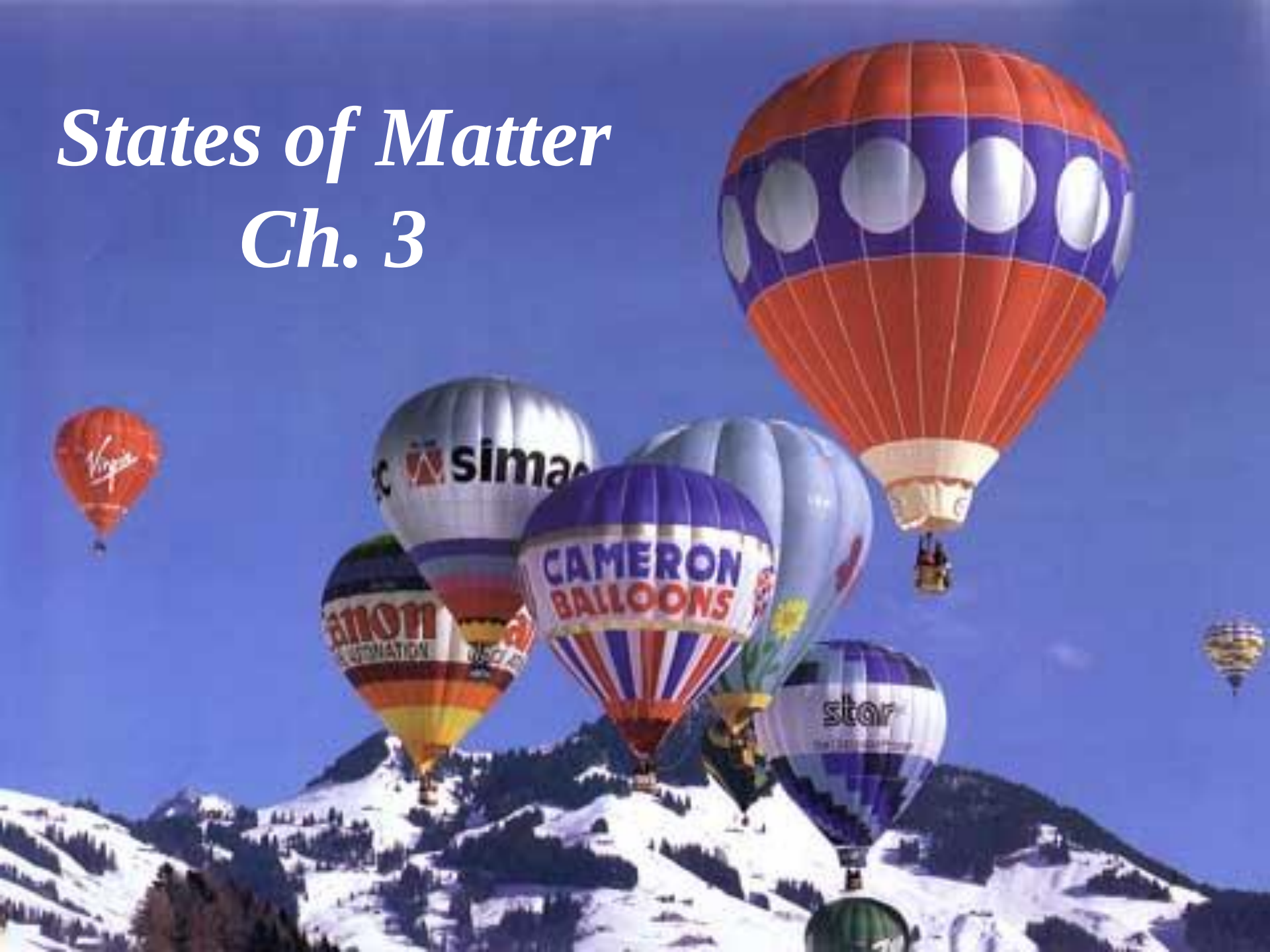
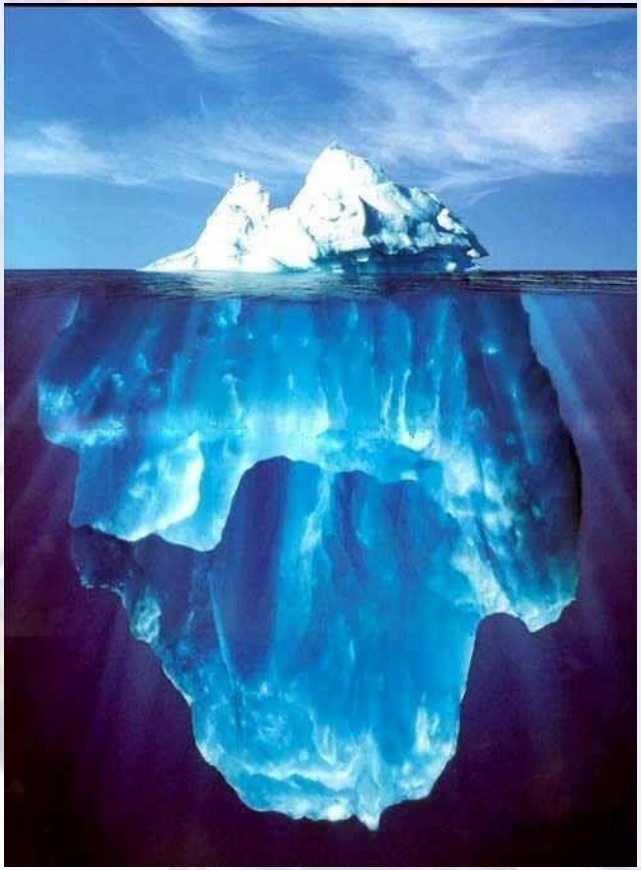
States of Matter
Ch. 3



States of Matter

- Materials can be classified as solids, liquids, or gases based on whether their shapes and volumes are definite or variable (changing)
- Matter can change from one state to another without changing properties

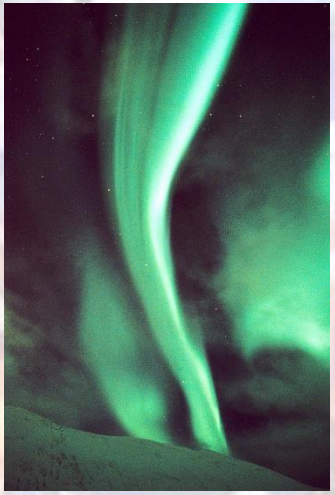


Solids, Liquids and Gases:

- Solid - definite shape and volume- atoms “stuck” in place
- Liquid – Definite volume, and shape of whatever they are in- “sticky” (cohesive) forces that keep atoms stuck together
- Gases – No definite shape or volume- atoms “bounce” around everywhere
- Animation

2 States of matter you didn't learn about in school…. Until now

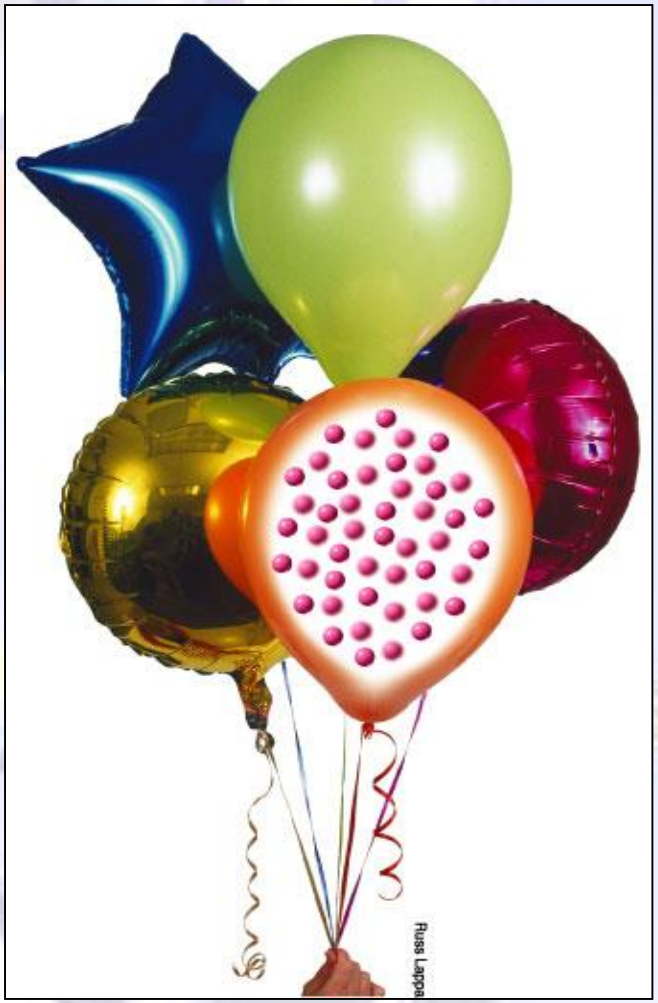
- Plasma
  When temperatures rise to 1000 Celsius and up you get plasmas
- Stars
- Aurora Borealis

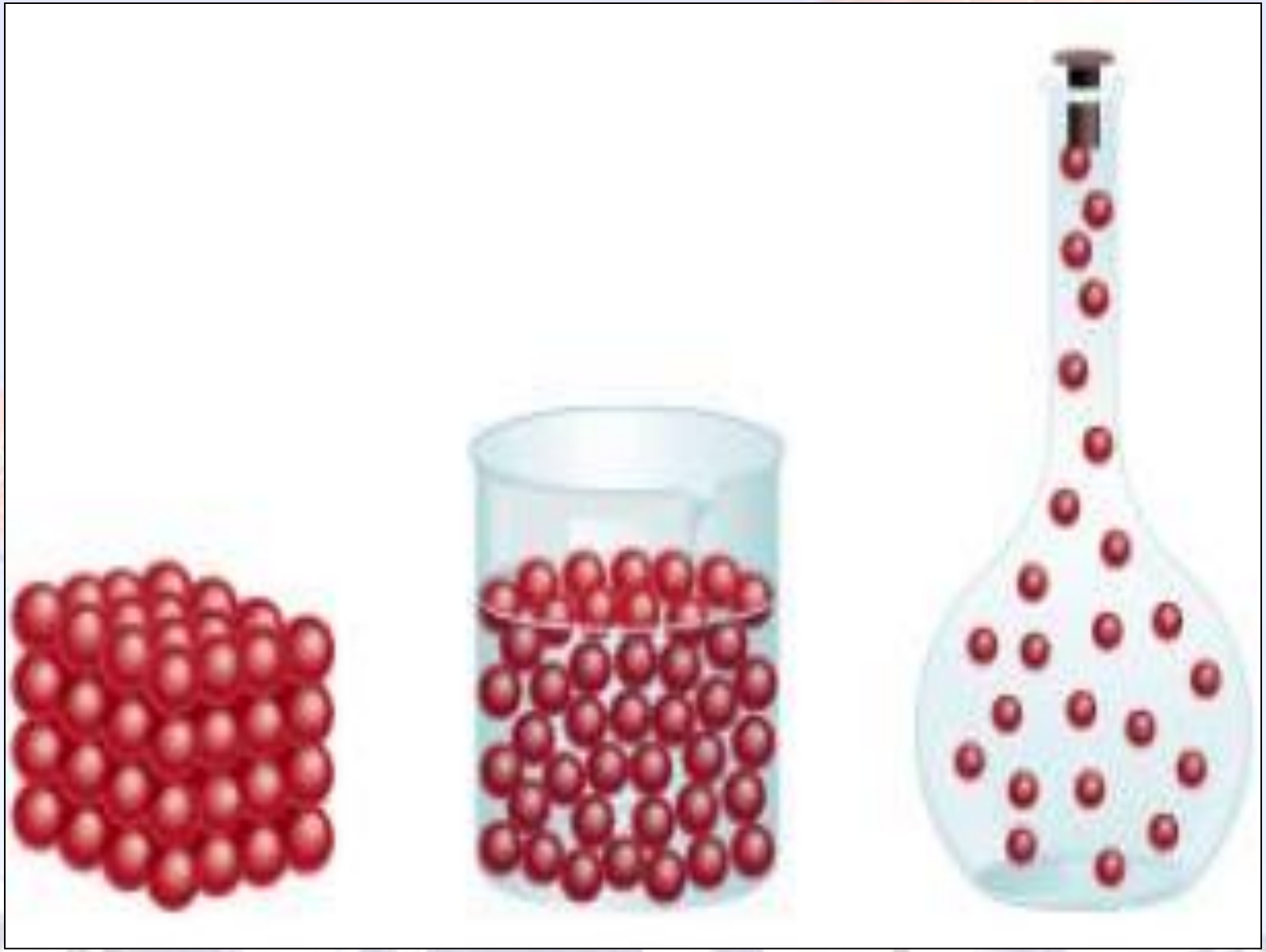


- Bose-Einstein
- Temperatures very close to absolute zero
- All atoms begin to act the same

Kinetic Molecular Theory

- All particles within an object are moving.
- Kinetic energy is the energy an object has due to motion.
- Atoms in **solids** simply vibrate in place.
- Atoms in **liquids** are free to flow from container to container.
- Atoms of **gases** fly within their given area.





Phases of Matter Rap

- Your goal→
- WRITE A RAP, SONG, OR POEM that illustrates the important concepts from 3.1 and 3.2 (Gas pressure).

- Lyrics should be written clearly and neatly on large white paper or construction paper.

Gas Pressure

- Force distributed over an area.
- The smaller the area, the greater the pressure (cleats).
- The collision of gas particles with themselves and their container causes gas pressure.

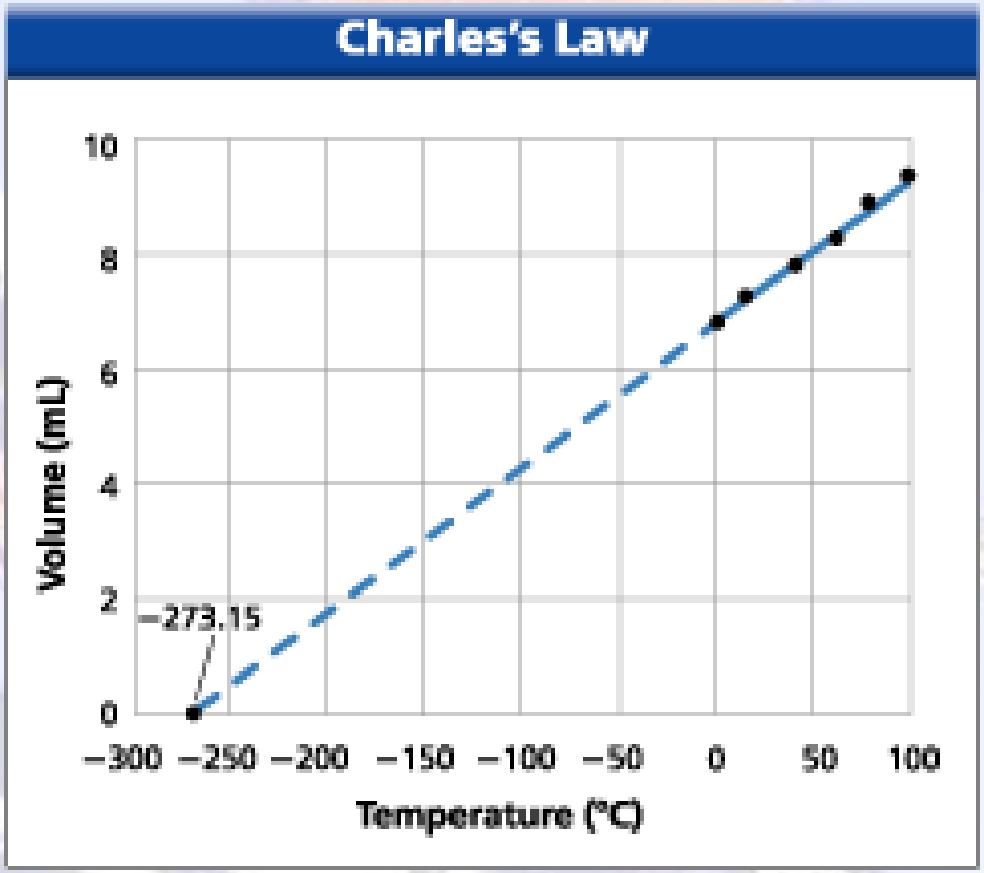
- Factors that affect gas pressure include:
  - Temperature (rise increases pressure)
  - Volume (reducing the amount of volume available increases pressure)
  - The number of particles (increasing the number of particles increase pressure).

- What is Oobleck??????
- Put all your belongings under desk!!!

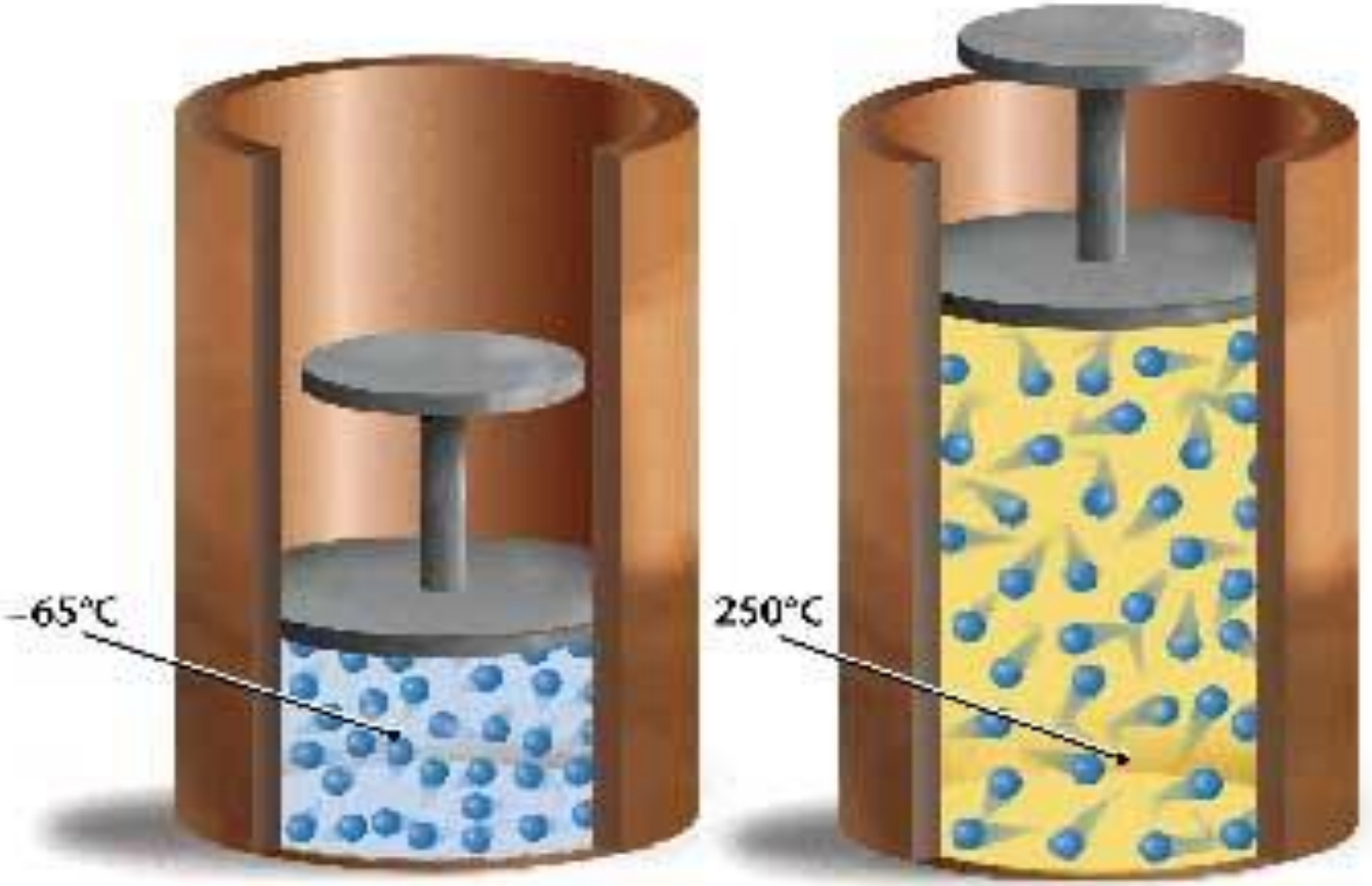
Charles's Law

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

- Volume = cm^3
- Temp. = Kelvins (K)
- As the temp. increases, a gas will try to occupy a greater volume of space.



Charles's Law



Charles Law Practice

- Gas stored in a tank has a volume 30.0 L at 273 K. The temperature of the tank increases to 305 K, what is the new volume of the gas?
- **V_1= 30.0 L T_1= 273K T_2= 305 K**
- **V_2= ?**
- **Equation:** $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

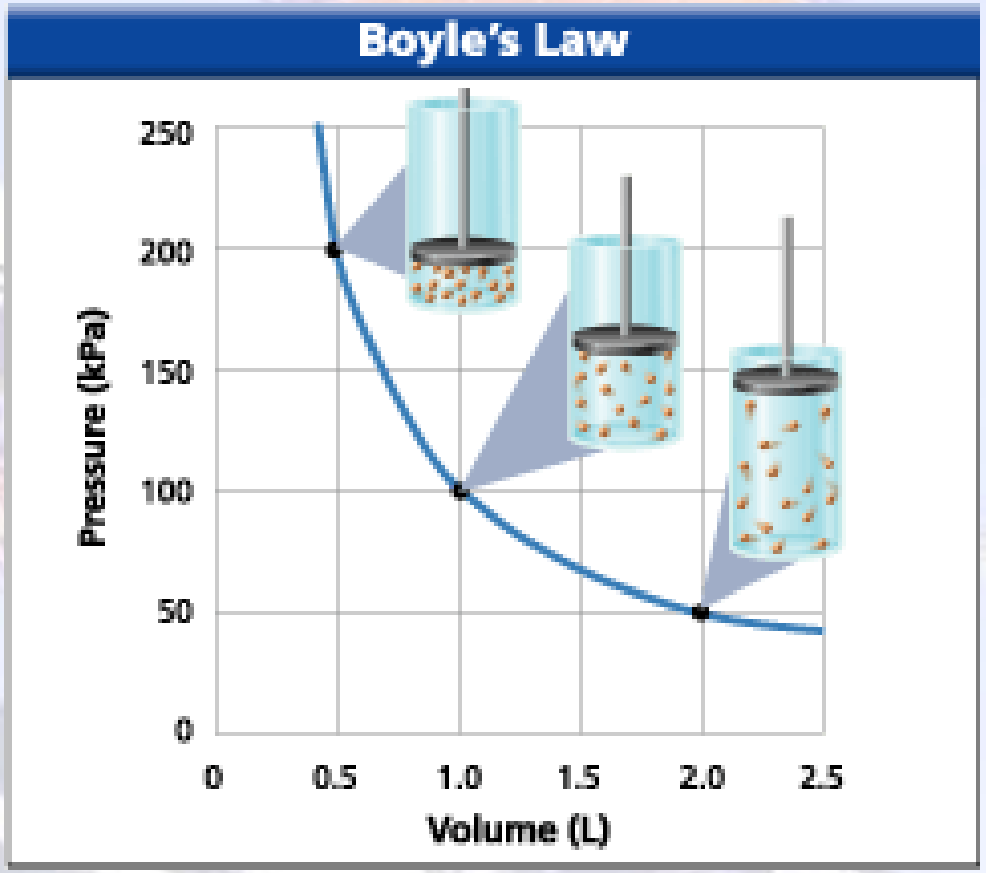
- Solve: $\frac{30.0\ L}{273\ K} = \frac{V_2}{305\ K}$

Volume: 33.5 L

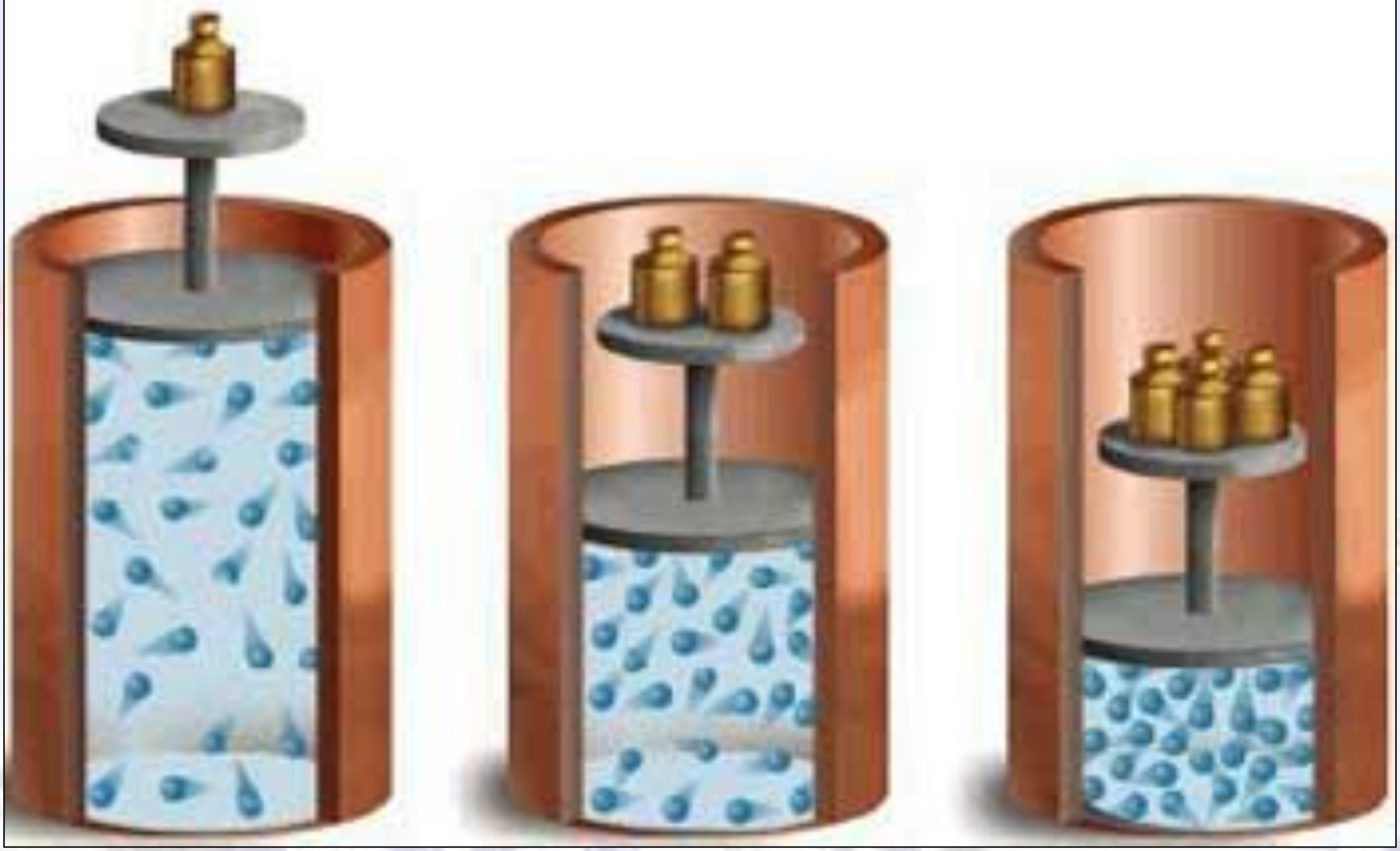
Boyle's Law

$$P_1V_1 = P_2V_2$$

- $P_1V_1=P_2V_2$
- As the volume of a container decreases, the pressure the gas exerts of the container increases.



Boyle's Law



Boyle's Law Practice

- The pressure in a gas tank is 10 kPa and the volume is 1.0 liter. The tank can hold a capacity of 4.0 liters. What is the pressure at this volume?
- P_1= 10 kPa V_1= 1.0 l V_2= 4.0 L
- P_2= ?
- $P_1V_1=P_2V_2$

- Solve: (10kPa) (1.0 L)= (P_2) (4.0 L)
- P= 2.5 L

The Combined Gas Law

- If Charles' and Boyle's laws are combined, you get:

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

- **1.** A gas has a volume of 5.0 L at a pressure of 50 kPa. What happens to the volume when the pressure is increased to 125 kPa?

- **2.** Gas stored in a tank at 273 K has a pressure of 388 kPa. The safe limit for the pressure is 825 kPa. At what temperature will the gas reach this pressure?

- **3.** At 10°C, the gas in a cylinder has a volume of 0.250 L. The gas is allowed to expand to 0.285 L. What must the final temperature be for the pressure to remain constant? (*Hint:* Convert from degrees Celsius to kelvins using the expression °C + 273 = K.)

Phase Change of matter

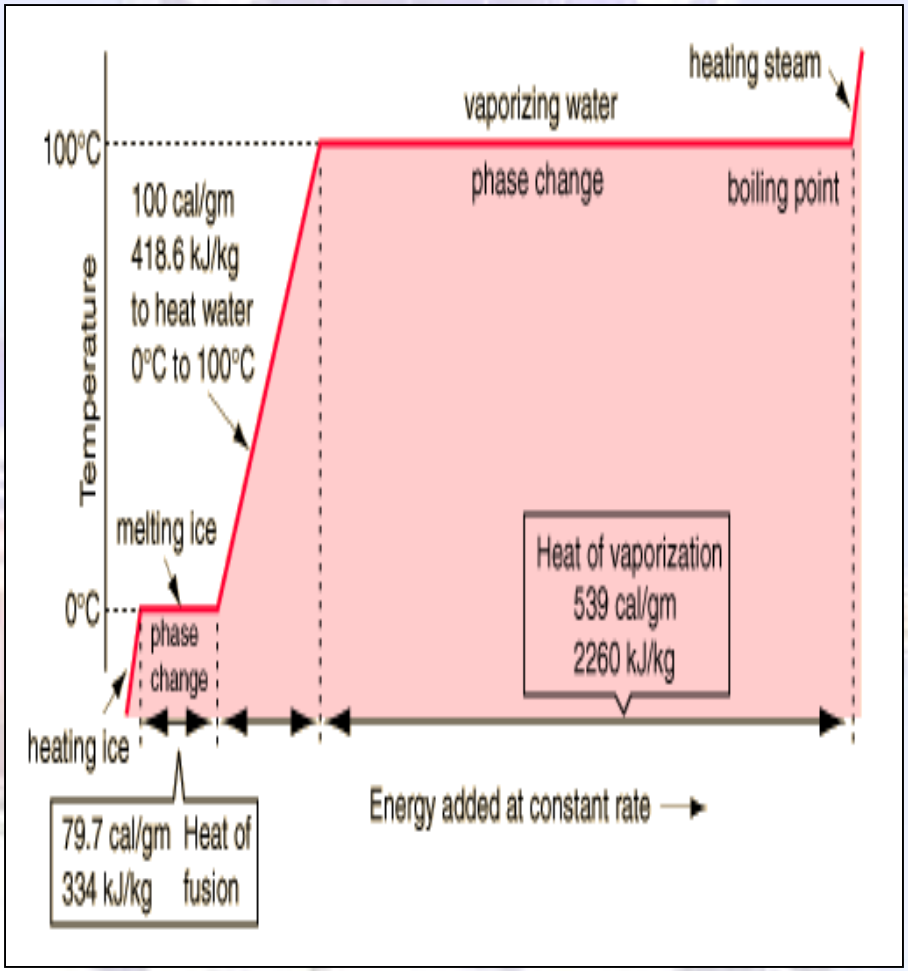
- Is the reversible physical change that occurs when a substance changes from one state of matter to another
- Ex: Melting, freezing, vaporization, condensation, sublimation, deposition.

Endothermic VS Exothermic

- Endothermic
  - Absorbs energy
  - Solid to liquid
  - Liquid to gas
  - Solid to gas
- Exothermic
  - Releases energy
  - Liquid to solid
  - Gas to liquid
  - Gas to a solid

Temperature change

- During a phase change the temperature does not change.
- When a solid is heated the temperature will slowly rise until it reaches the melting point.
- When all melting is complete then the temperature will rise again until the boiling point is reached.



These Reaction Cause A Phase Change

- Freezing
- Sublimation
- Condensation
- Melting
- Vaporization
- Deposition

Melting and freezing

- Melting- solid to liquid
- The arrangement of water molecules become less orderly (messy) as water melts.
- Endothermic
- Freezing- liquid to solid
- And more orderly (neater) as water freezes.
- exothermic

Freezing does not have to happen at cold temperatures.
Silicon freezes at 1412°C (2574°F).
Remember freezing and melting points are the same temperature.

Vaporization

- Vaporization→ change from liquid into a gas.
  - Endothermic process
  - Molecules moving faster

  Evaporation takes place at the surface of a liquid and at a temeprature below the boiling point.

  Some molecules at the surface will move fast enough to escape as a gas.

  Boiling → as temperature is increased the molecules move faster and faster

Condensation

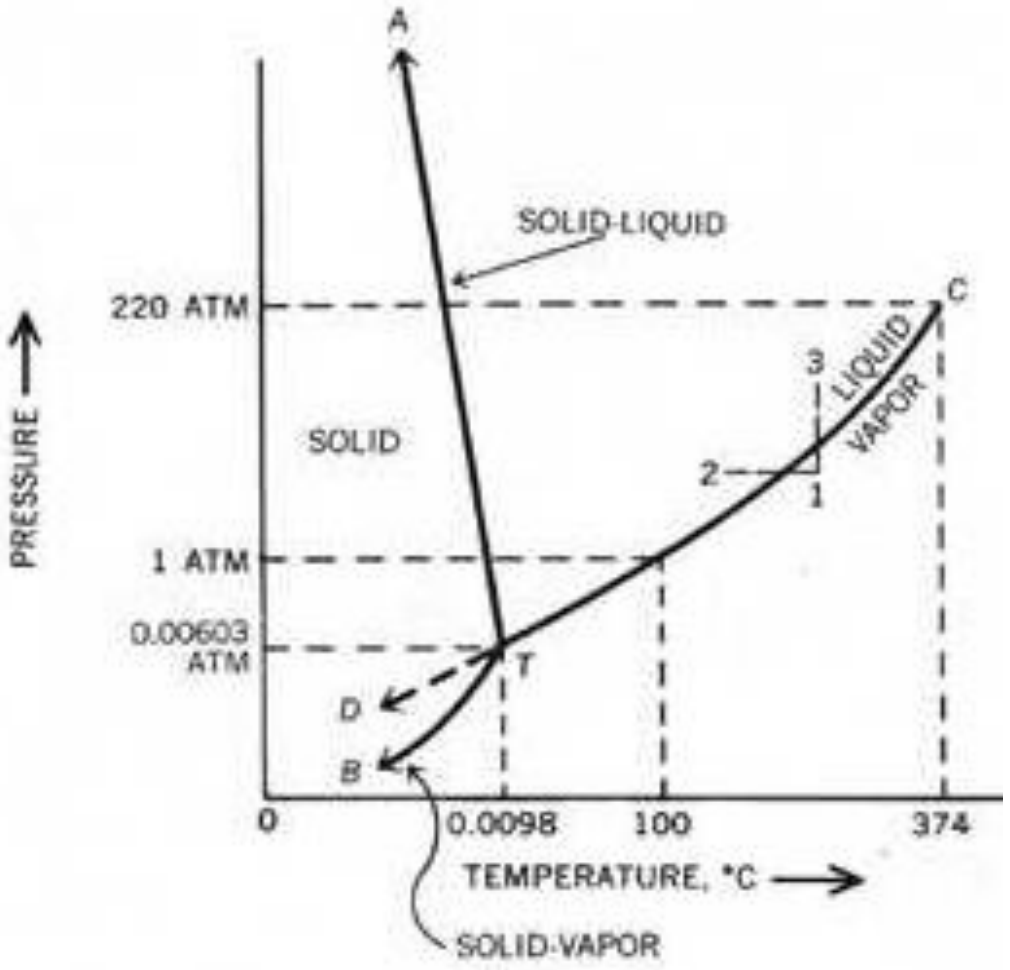
- Phase change from a gas to a liquid.
- Exothermic
- Molecules slowing down
- Ex:
  - morning dew
  - clouds

Sublimation and Deposition

- **Sublimation** is the phase change in which a substance changes from a solid to a gas without becoming a liquid.
- Endothermic
- Fast/ Messy
- Ex: Dry ice
- **Deposition** when a gas becomes a solid without becoming a liquid.
- Exothermic
- Become very orderly/ move slow
  - Frost that forms on windshields→ water vapor hits the cold windshield and immediately becomes ice.

Triple Point

- For every substance there is a specific temperature and pressure in which all three states of matter can exist at the same time.
- By changing temperature and pressure you can find the triple point.



How to Read a Phase Change Graph