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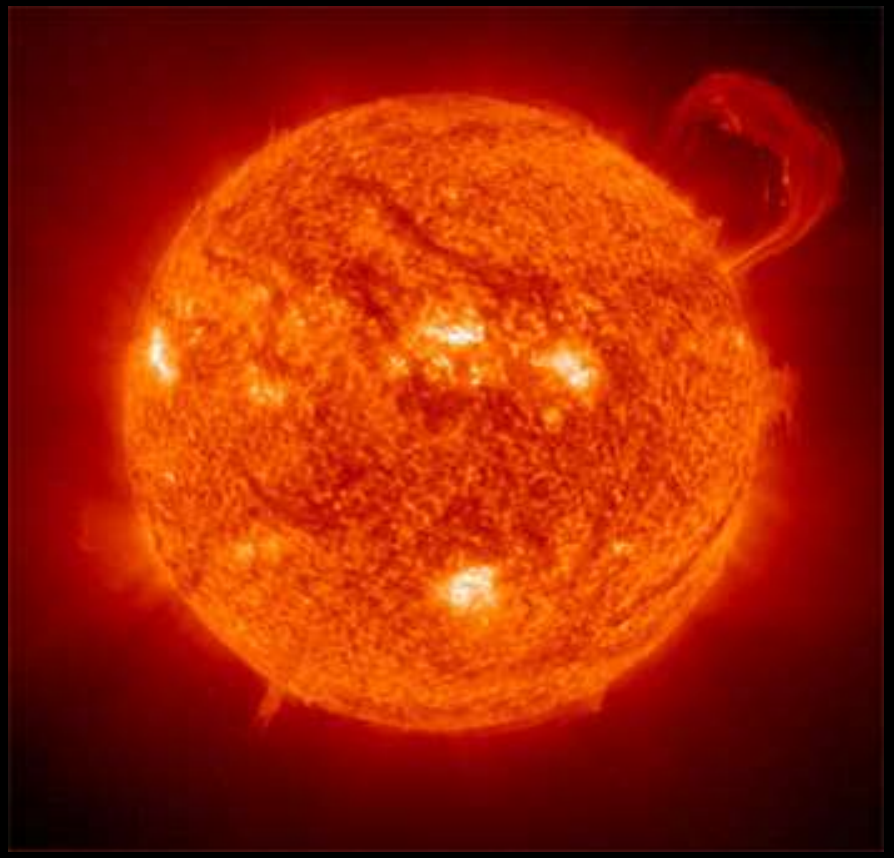
- List and define the three states of matter.

Chapter 3

States of Matter



- **SPS5 Students will compare and contrast the phases of matter as they relate to atomic and molecular motion.**

a. Compare and contrast the atomic/molecular motion of solids, liquids, gases, and plasmas.

b. Relate temperature, pressure, and volume of gases to the behavior of gases.

SPS7 Students will relate transformations and flow of energy within a system.

d. Explain the flow of energy in phase changes through the use of a phase diagram.

3.1 Solids, Liquids, and Gases

- How can shape and materials?
- How can kinetic theory and forces of attraction be used to explain the behavior of gases, liquids, and solids?

3.1 Solids, Liq

How can shape and volume be us

- States of matter a
and volumes
-
-
-

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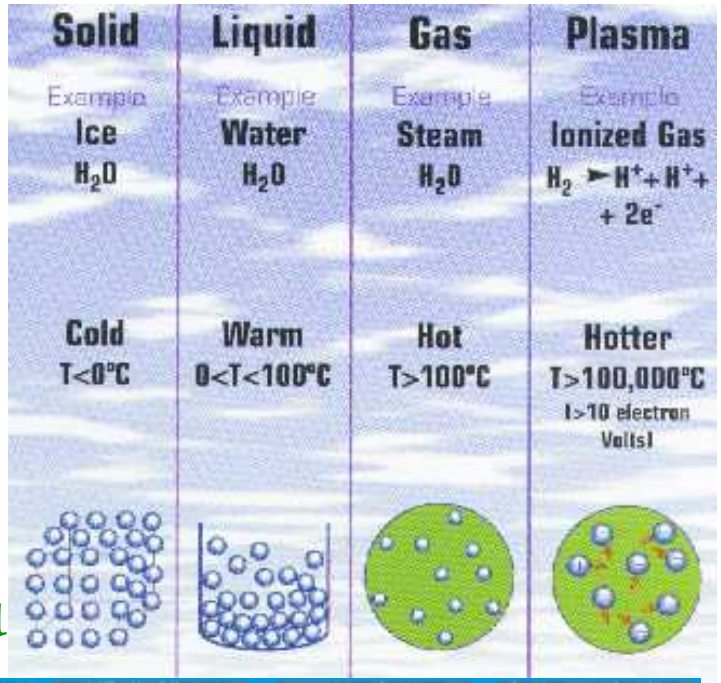
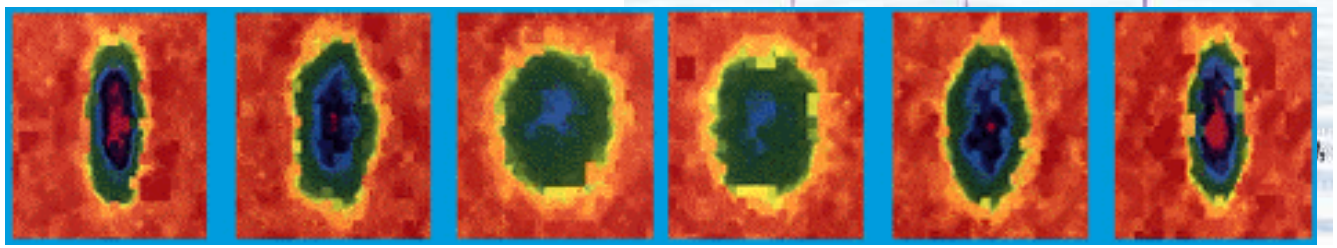
3.1 Solids, Liquids, and Gases

How can shape and volume be used to classify materials?

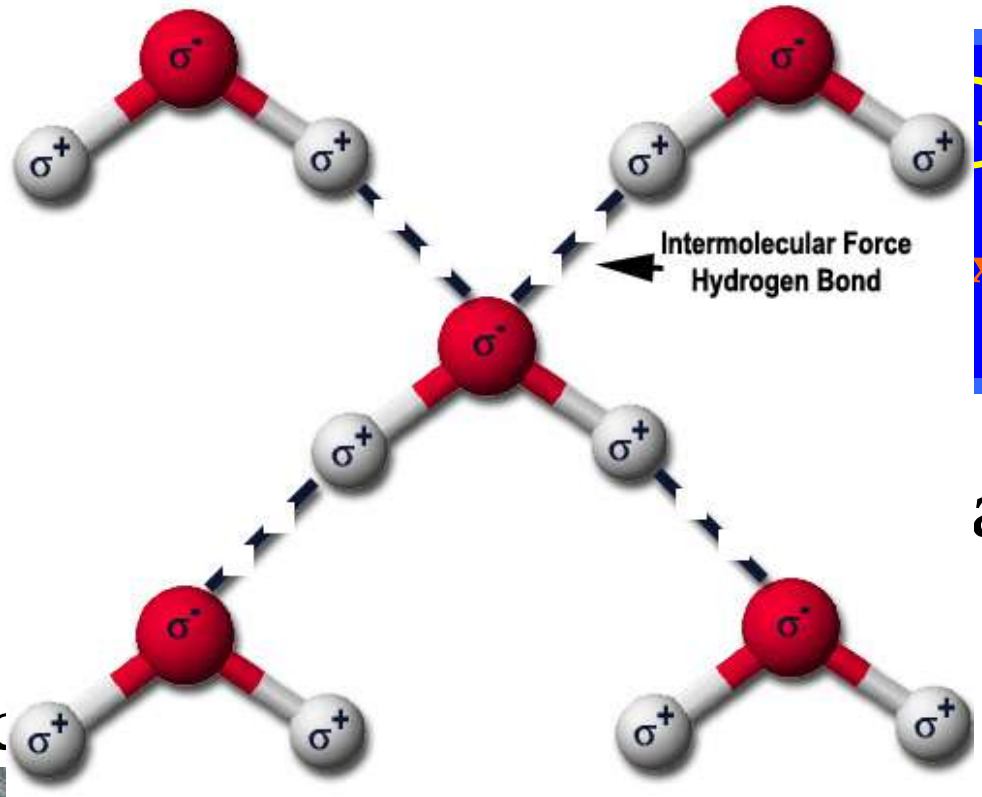
- Plasma – occur at very high temperatures
  - In excess of 200,000 K
  - Clouds of charged particles
- Boise-Einstein condensate low temperatures
  - Near 0 K
  - Groups of atoms act as thou particle





3.1 So Gases

How can kinet xplain the behavior of ga



- Kineti atter are in con
  - Kinetic
  - Stops °C)
  - Moti
    - By ster
      - netic energy
    - By es, more attr

3.1 Solids, Liquids, and Gases

How can kinetic theory and forces of attraction be use to explain the behavior of gases, liquids, and solids?

- Gases
  - Parti
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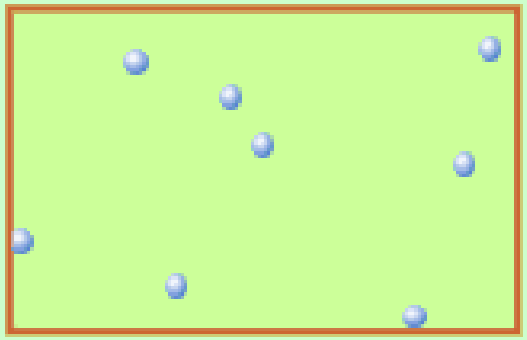
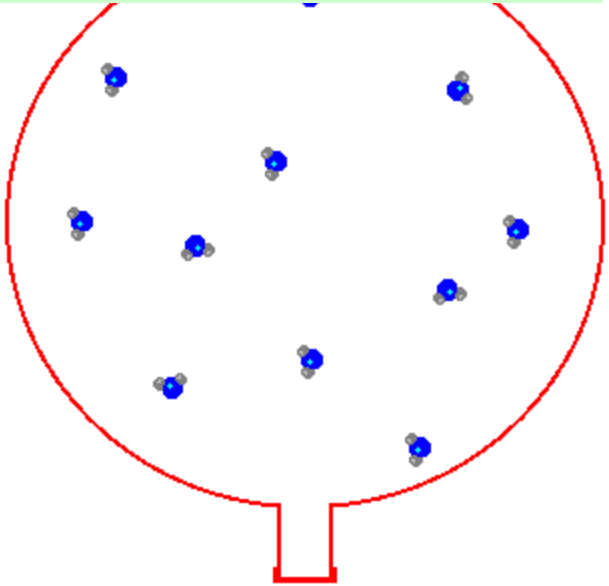
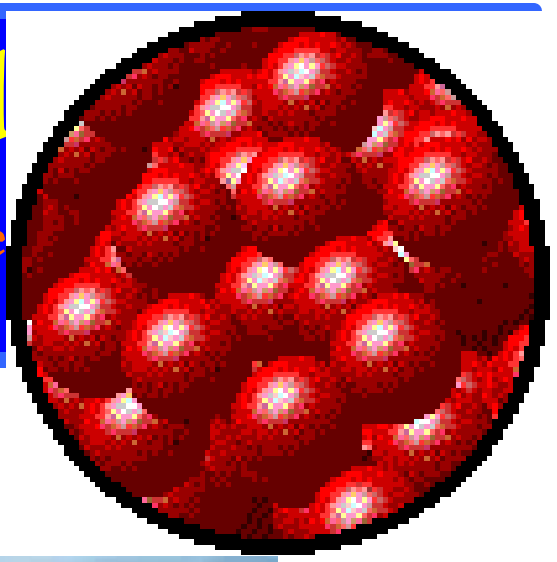
  - The
    moti
    - Fo
      pa
  - Forc





3.1 Solids, Liquids, and



How can kinetic theory and forces of attraction be use
behavior of gases, liquids, and solids?

- Liquids
  -
  -
  -

3.1 Solids, Liquids, and Gases

How can kinetic theory and forces of attraction be use to explain the behavior of gases, liquids, and solids?

- Solids
  - Partic
  - Force rticles in place
    - So nd to fill the

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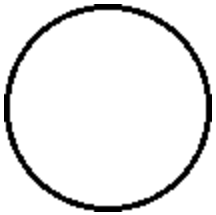
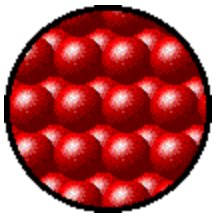
How can kinetic theory and forces of attraction be use to explain the behavior of gases, liquids, and solids?

- Use the kinetic theory to explain the difference between solids, liquids, and gases.





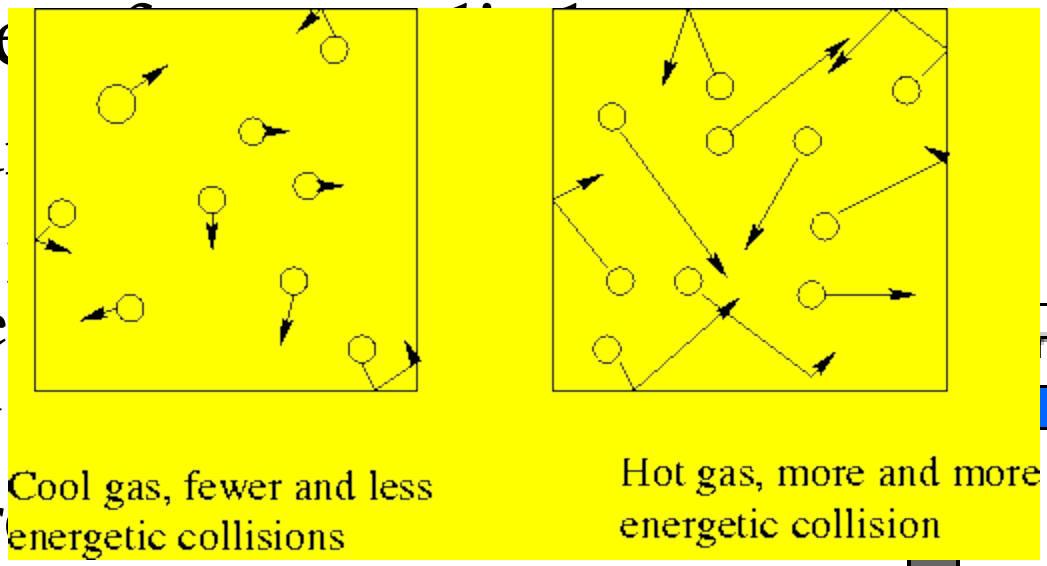
3.2 The Gas Laws

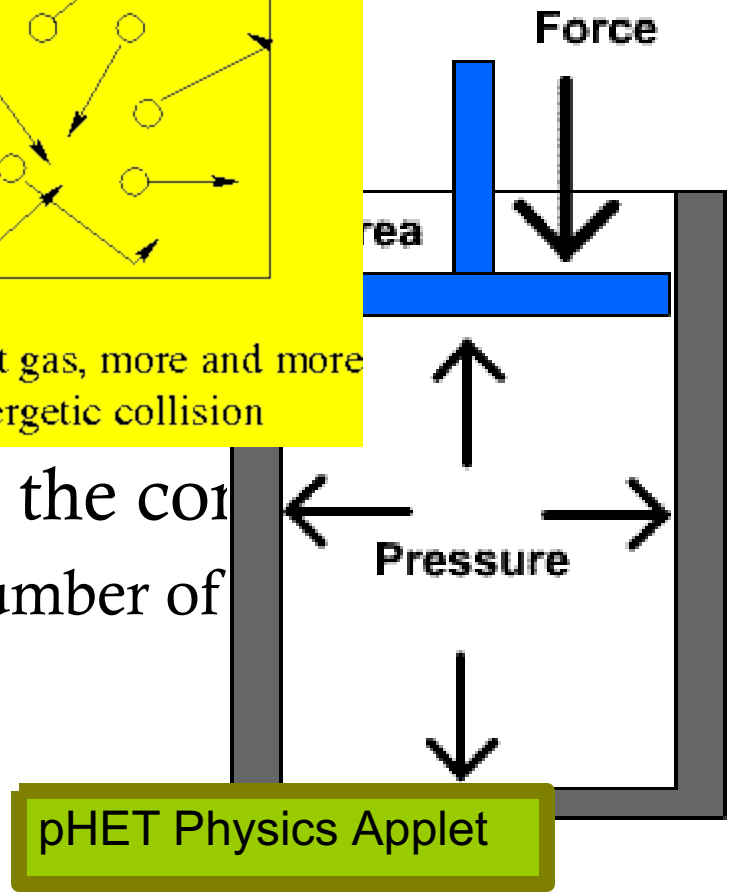
- What causes gas pressure in a closed container?
- What factors affect gas pressure?
- How are the temperature, volume, and pressure of a gas related?

3.2 The Gas Laws

What causes gas pressure in a closed container?

- Pressure
  - Measu
    - One
      mete
    - Very
  - Gas pr
    particles against the sides of the co
    - Pressure increases with the number of
      the speed of the collisions





3.2 The Gas Laws

What factors affect gas pressure?

- Temperature (T)
  - An increase in temperature increases the average speed of the particles
    - Hot days tire pressure increases
    - Cold days balls are a flat

pHET Physics Applet

- Volume (V)
  - With a larger area the particles must travel farther before running into a container
    - Squeezing a bottle decreases the volume, enough squeezing and the top will pop off

3.2 The Gas Laws

What factors affect gas pressure?

- Number of Particles (n)
  - Pressure increases with the number of particles
    - A gas cylinder is designed to hold a certain amount of gas
    - Walls must be very thick to withstand high pressure

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3.2 The Gas Laws

How are the temperature, volume, and pressure of a gas related?

- Charles's Law
  - Volume of a gas is directly proportional to the temperature
    - Pressure must not change
    - Number of particles must not change
    - Temperature is in Kelvin
      - Add 273 to Celsius temperature

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

3.2 The Gas Laws

How are the temperature, volume, and pressure of a gas related?

- Practice Problem – A gas starts with a temperature of 415 K and is cooled to 300 K. If the original volume was 25 mL, what is the new volume?
  - Equation?
  - Fill in variables
  - Solve

$$V_2 = 18.07 ml$$

3.2 The Gas Laws

How are the temperature, volume, and pressure of a gas related?

- Boyles Law
  - The volume of a gas is inversely proportional to the pressure
    - If pressure goes up, volume goes down
    - Number of particles must not change
    - If temperature stays constant

$$P_1V_1 = P_2V_2$$

3.2 The Gas Laws

How are the temperature, volume, and pressure of a gas related?

- Practice Problem – A cylinder has 118 L of gas in at a pressure of 792 kPa. What is the pressure if the volume is reduced to 41 L?
  - Equation?
  - Fill in variables
  - Solve

$$(792 \quad P_2 = 2279.41 kPa \quad 41L)$$

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How are the temperature, volume, and pressure of a gas related?

- A piston is compressed from 18 L to 7 L. The initial pressure was 218 kPa. What is the new pressure?

3.2 The Gas Laws

How are the temperature, volume, and pressure of a gas related?

- Combined Gas Law
  - Boyle's and Charles's law can be combined into a single equation

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

3.2 The Gas Laws

How are the temperature, volume, and pressure of a gas related?

- Practice Problem – A cylinder that contains air at 100 kPa has a volume of 0.75 L and a temperature of 298 K. If the pressure is increased to 300 kPa and the temperature drops to 119 K, what is the new volume?
  - Equation?
  - Fill in variables
  - Solve

$$\frac{(100kPa)(0.75L)}{298K} = \frac{(300kPa)V_2}{119K}$$

$$V_2 = 0.10L$$

3.3 Phase Changes

- What are six common phase changes?
- What happens to a substance's temperature and a system's energy during a phase change?
- How are evaporation and boiling different?

3.3 Phase Changes

What are six common phase changes?

- Phase Change – when a substance goes from one state of matter to another
  - Melting – solid to liquid
  - Freezing – liquid to solid
  - Vaporization – liquid to gas
  - Condensation – gas to liquid
  - Sublimation – solid to gas
  - Deposition – gas to solid

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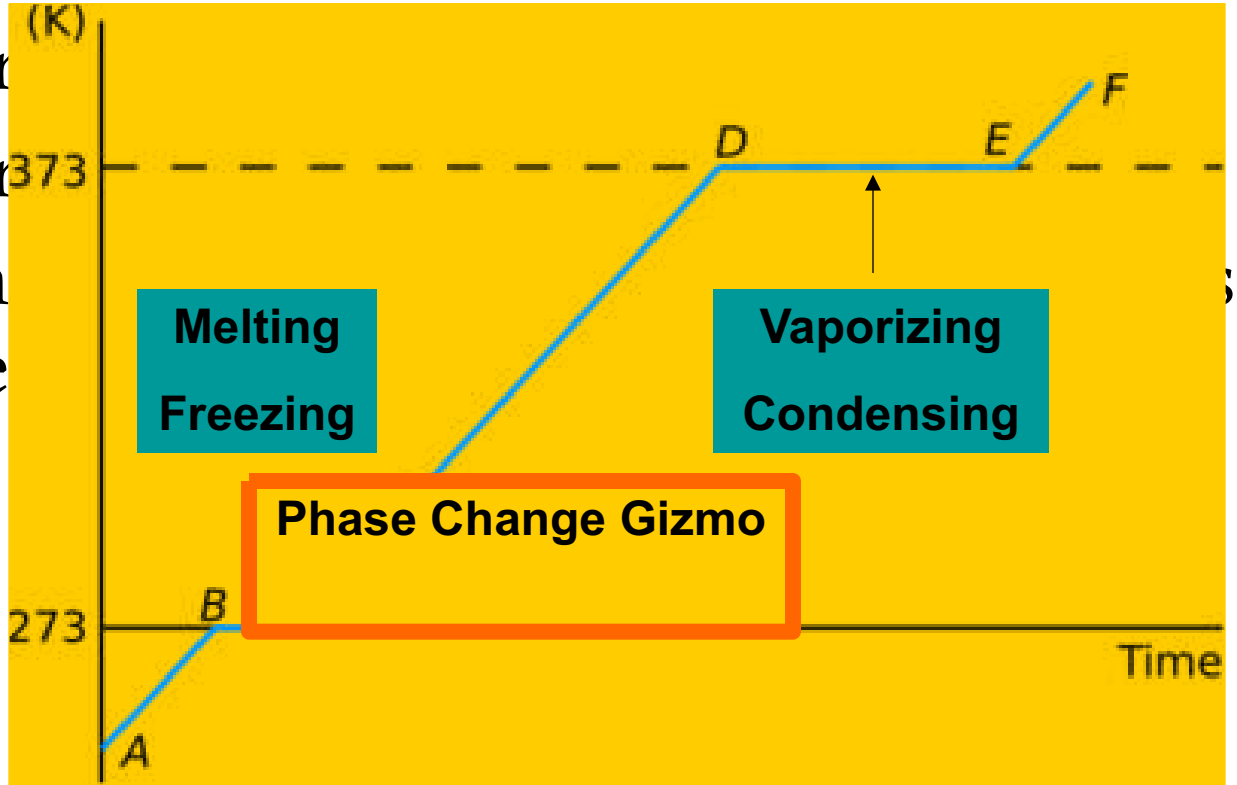
What are six common phase changes?

- List and explain the six phases of matter.

3.3 Phase Changes

What happens to a substance's temperature and a systems energy during a phase change?

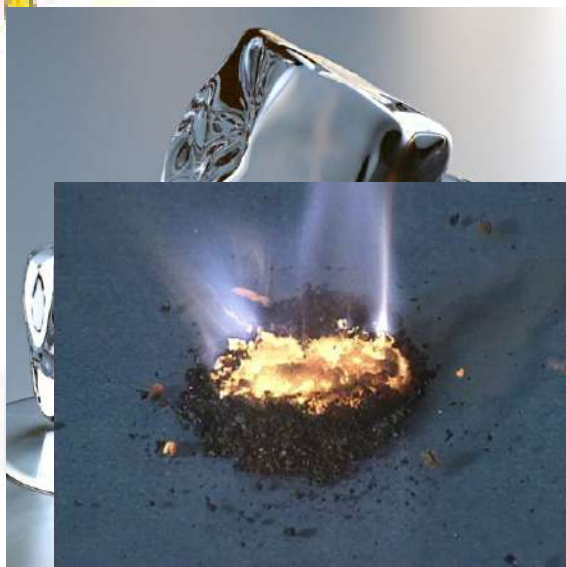
- Temperature – does not change during a phase change
  - Water
  - Water
  - The h
    betwe



3.3 Phase Changes

What happens to a substance's temperature and a systems energy during a phase change?

- Energy is absorbed or released in a phase change
  - Endothe… …gy
    - It take… …f water
    - Called…
  - Exother…
    - Produ…
    - (glyce…



3.3 Phase Changes

How are evaporation and boiling different?

- Both evaporation and boiling
vaporization.
  - Evap
belo
    - Sl
    - Fa
  - Boil
    - Ph
    - So

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