APS Science Curriculum Unit Planner

Grade Level/Subject	Chemistry
Stage 1: Desired Results	
Enduring Understanding	
Topic 3: Kinetics: The Kinetic Theory can explain the phases of matter, the energetics of reactions, and the forces of attraction between particles.	
Correlations	
Unifying Understanding	Energy can be transferred or it can change form, but it cannot be created or destroyed.
VA SOL	CH.5 The student will investigate and understand that the phases of matter are explained by kinetic theory and forces of attraction between particles. Key concepts include a) pressure, temperature, and volume; b) partial pressure and gas laws; b) vapor pressure; c) phase changes; d) molar heats of fusion and vaporization; e) specific heat capacity; and f) colligative properties.
NSES (grade level)	
AAAS Atlas	
Essential Questions	
• How do features of the atom at the particle level explain the behavior of the atom? • How are temperature, pressure, and volume related to kinetic theory? • How does energy cause change? • Where does energy come from, and where does it go?	
Knowledge and Skills	
Students should know:	
• Atoms and molecules are in constant motion • The phase of a substance depends on temperature and pressure • Temperature is a measurement of the average kinetic energy in a cample. There is a direct relationship between temperature and average kinetic energy. • The kinetic molecular theory is a model for predicting and explaining gas behavior. • Gases have mass and occupy space. Gas practices are in constant, rapid, random motion and exert pressure as they collide with the walls of their containers. Gas molecules with the lightest mass travel fastest. Relatively large distances separate gas particles from each other. • Equal volumes of gases at the same temperature and pressure contain an equal number of particles. Pressure units include atm, kPa, and mm Hg.	

- An ideal gas does not exist, but this concept is used to model gas behavior. A real gas exisits, has intermolecular forces and particle volume, and can change state. The Ideal Gas Law states that PV= nRT.
- The pressure and volume of a sample of a gas at constant temperature are inversely proportional to each other (Boyle's Law: P1V1 = P2V2).
- At constant pressure, the volume of a fixed amount of gas is directly proportional to its absolute temperature (Charles' Law: V1/T1 = V2/T2),
- The Combined Gas Law (P1V1/T1 = P2V2/T2) Relates pressure, volume, and temperature of a gas.
- The sum of the partial pressures of all components in a gas mixture is equal to the total pressure of a gas mixture (Dalton's law of partial pressures).
- Forces of attraction (intermolecular forces) between molecules determine their state of matter at a given temperature. Forces of attraction include hydrogen bonding, dipole-dipole attraction and London dispersion (van der Waals) forces.
- Vapor pressure is the pressure of the vapor found directly above a liquid in a closed container. When the vapor pressure equals the atmospheric pressure, a liquid boils. Volatile liquids have high vapor pressures, weak intermolecular forces, and low boiling points. Nonvolatile liquids have low vapor pressures, strong intermolecular forces and high boiling points.
- Solid, liquid, and gas phases of a substance have different energy content. Pressure, temperature, and volume changes can cause a change in physical state. Specific amounts of energy are absorbed or released during pases changes.
- A fourth phase of matter is plasma. Plasma is formed when a gas is heated to a temperature at which its electrons dissociate from the nuclei.
- A heating curve graphically describes the relationship between temperature and energy (heat) It can be used to identify a substance's phase of matter at a given temperature as well as a temperature(s) at which is changes phase. It also shows the strength of the intermolecular fouces present in a substance.
- Molar heat of fusion is a property that describes the amount of energy needed to convert one mole of a substance between its solid and liquid states. Molar heat of vaporization is a property that describes the amount of energy needed to convert one mole of a substance between its liquid and gas states. Specific heat capacity is a property of a substances that tells the amount of energy needed to raise one gram of a substance by one depree Celsius. The values of these properties are related to the strength of their intermolecular forces.
- Polar substances dissolve ionic and polar substances, nonpolar substances dissolve nonpolar substances. The number of solute particles changes the freezing point and boiling point of a pure substance.
- A liquid's boiling point and freezing point are affected by changes in atmospheric pressure. A liquid's boiling point and freezing point are affected by the preseince of certain solutes.

Students should be able to:

- Explain the behavior of gases and the relationship between pressure and volume (Boyle's Law) and volume and temperature (Charles' Law).
- Solve problems and interpret graphs involving the gas laws.
- Identify how hydrogen bonding in water plays an important role in many physical, chemical , and biological phenomena.
- Interpret vapor pressure graphs.
- Graph and interpret a heating curve (temperature vs time).
- Interpret a phase diagram of water.
- Calculate energy changes, using molar heat of fusion and molar heat of vaporization.
- Calculate energy changes, using specific heat capacity.
- Examine the polarity of various solutes and solvents in solution formation.
- Classify processes as either endothermic or exothermic
- Solve for enthalpy changes in chemical reactions by using heats of reaction
- Draw endothermic and exothermic diagrams
- Identify activation energy
- Classify the enthalpy changes that occurs when substances undergo phase changes
- Distinguish between heat capacity and specific heat
- Calculate heat associated with a temperature change.
- Calculate heat of vaporization and fusion

Stage 2: Assessment Evidence

Prior Knowledge and Skills

- That atoms are composed of particles called protons, neutrons and electrons
- Atomic structure
- Describe simple properies of the three phases of matter
- Describe simple properties of metals and nonmetals
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Formative Assessment	Summative Assessment
• Student participation • Homework (readings, questions, and problems) • Laboratory assessment understanding models	• Laboratory Reports • Tests and Quizzes

Stage 3: Learning Plan

References to Adopted Materials

Prentice Hall Chemistry:
Text:

- Chapter 13: States of Matter
- Chapter 14: Behavoir of Gases
- Chapter 17: Thermochemistry

Highlighted Sections and Activities in these Chapters:

- Read pg 385-389 Nature of Gases
- Pg 386 Figure 13.1 and 13.2
- Practice Problems 1 and 2 on pg 387
- Section Assessment Questions 3-7 on pg 389
- Read pg 390-395 The Nature of Liquids
- Figures 13.5 on pg 390, 13.6 on pg 391, 13.8 on pg394
- Figure 13.9- Interpreting graph questions a, b, and c on pg 394
- Section Assessment Questions 8-14 on pg 395
- Read pg 396 A Model for Solids, Crystal Structure and Unit Cell first two paragraphs
- Figure 13.10 on pg 13.10
- Pg 398 Allotropes
- Figure 13.13 on pg 399
- Section Assessment Questions 15, 17-19
- Read pg 401-403 Changes of State
- Figure 13.14 on pg 401, 13.16 on pg 403
- Figure 13.15- Interpreting graph questions a, b, and c on pg 403
- Section Assessment Questions 21-25 on pg 404
- Read pg 413-434 The Behavior of Gases
- Figure 14.2 on page 414, 14.4 on pg 415, 14.5 and 14.6 on pg 416, 14. 9 on pg 420 14.11 on pg 422, 14.16 on pg 433,
- Figure 14.8- Interpreting graphs questions a, b, and c on pg 418
- Figure 14.10- Interpreting graphs questions a, b, and c on pg 420
- Figure 14.15- Interpreting graphs questions a, b, and c on pg 429
- Section Assessment Questions 1-6 on pg 417, 15-22 on pg 425, 25-30 on pg 429
- Practice Problems 31-32 on pg 434
- Read pg 505-524 Thermochemistry
- Figure 17.2 on pg 506, 17.4 on pg 509, 17.5 on pg 511, 17.7 on pg 515, 17.9 on pg 520,
- Figure 17.10- Interpreting graphs questions a, b, and c on pg 523
- Section Assessment Questions 5-11 on pg 510, 16-19 on pg 517. 27,28,30 a, b, c, e, 31

Guided Reading and Study Guide:

- Chapter 13 States of Matter pg 137-141, pg 143-145
- Chapter 14 The Behavior of Gases pg 147-154, pg 156-157

Chapter 17 Thermochemistry pg 183-188, pg 191-192

Holt Chemistry:

Text:

- Chapter 10 Causes of Change
- Chapter 11 States of Matter and Intermolecular Forces
- Chapter 12 Gases

Highlighted Sections and Activities in these Chapters

- pg 381 - Temperature, Energy, and State
- pg 381 - Figure 5

- Read pg 378 – 380 – States of Matter
- Read pg 382 – 383 (Note the key terms highlighted)
- Do pg 384 – Problems # 1, 4, 6, 11, & 15.
- Read pg 40 – Endothermic and Exothermic Processes
- Do pg 45 # 5
- Read pg 590 – Reaction Pathways and Activation Energy
- Do pg 595 # 9
- Read pg 42-43 – Heat
- Do pg 45 # 3, 6, 7, 8, 12

Study Guide

- Chapter 10 pp. 77-84
- Chapter 11 pp.85-93
- Chapter 12 pp.93-103

Suggested Investigations

- Dissociation of Calcium Chloride Lab - Students record the temperature changes during the dissociation of calcium chloride in water and determine if the reaction is endothermic or exothermic.
- Exploding Gummy Bear Lab - Students determine if the combustion reaction of potassium iodate is endothermic or exothermic and draw the corresponding energy diagram.
- Phase Changes of Water Lab - Students record and graph the temperature changes of water as it changes from ice to water to steam
- Molar Volume of a Gas Lab : Using the Reaction of Mg and HCl to calculate the volume of a gas at STP
- Boyle's Law Lab: Using Vernier Probeware to collect data to deduce Boyle's Law
- Specific Heat of Selected Metals – Calorimetry is used to determine the specific heat of metal samples
- Molar Heat of Fusion of Water

Prentice Hall Activities

- *Lab 22: Changes in Physical State*
- *Quick Lab p.428 Carbon Dioxide from Antacid Tablets*

Outdoor Education Applications

- None currently noted

Resources

Web Sites

Explorelearning.com

- Phases Changes
- Temperature and Particle Motion
- Boyles Law
- Charles Law

Videos

Prentice Hall "Chemistry Alive! Field Trips"

- Measuring the Energy Content of Food
- The Kinetics of Airbags

Prentice Hall "Chemistry Alive! Labs"

- Big Burner
- Exploding Balloons
- Thermite Reaction

Discovery Education (www.discoveryeducation.com)

- Standard Deviants High School Chemistry: Heat (8 segments 24:49)
- Chemistry Connections: Molar Enthalpy of Solutions (4 segments 24:09)
- Hydrogen Oxygen Reaction (8:45)
- The Ideal Gas Law (2:45)

Field Trips

- None currently noted

Other

Holt Chemistry:

- Chapter Resources on CD- ROM pg 79- 80 Concept Review: Energy Transfer
- Chapter Resources on CD- ROM pg 81 Concept Review: Enthalpy