Unit 06: Gases, Liquids, and Solids

Content Area: **Science**
Course(s):
Time Period: **Marking Period 3**
Length: **4-5 Weeks**
Status: **Published**

Brief Summary of Unit

In this unit, the relationship that exists among particle structure, interparticle forces, and physical properties of solids, liquids, and gases will be studied. Different phenomena related to gas-liquid equilibria, including vapor pressure, boiling behavior, and critical properties will be explored. Phase diagrams will enable students to predict the conditions necessary for the different states of matter and the energy associated between them. The kinetic molecular theory of gases will be used to explain the behavior of gases and calculations using the gas laws, stoichiometry of gaseous reactions, and Dalton's Law of partial pressure will be modeled. The effect of carbon dioxide specifically produced from farming and a possible solution to combat climate change will be discussed.

Revised June 2022

Standards

SCI.HS-PS1-1	Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.
LA.K-12.NJSLSA.R1	Read closely to determine what the text says explicitly and to make logical inferences and relevant connections from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
LA.K-12.NJSLSA.R8	Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.
LA.K-12.NJSLSA.W1	Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
SCI.HS.PS1.A	Structure and Properties of Matter
SCI.HS.PS1.B	Chemical Reactions
LA.K-12.NJSLSA.W4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
LA.K-12.NJSLSA.W6	Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.
LA.K-12.NJSLSA.W8	Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
SCI.HS-ETS1-1	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
SCI.HS.ETS1.B	Developing Possible Solutions
WRK.9.2.12.CAP.6	Identify transferable skills in career choices and design alternative career plans based on those skills.
TECH.9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a). Collaboration with individuals with diverse experiences can aid in the problem-solving process, particularly for global issues where diverse solutions are needed.

Essential Questions

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How does the behavior of atoms and molecules determine the physical properties of solids, liquids, and gases?

What factors influence the behavior of gases and what are the mathematical relationships between them?

How do intermolecular forces affect the properties of solids, liquids, and gases?

Enduring Understandings

The kinetic molecular theory governs the properties of solids, liquids, and gases.

There are both qualitative and quantitative relationships between the properties of a gas.

Students Will Know/Students Will be Skilled At

Students will know how kinetic molecular theory governs the properties of solids, liquids, and gases.

Students will know what measurements must be made to completely describe a gaseous substance.

Students will know how the quantitative properties of gases are related to each other.

Students will know the difference between a real gas and an ideal gas and what conditions result in deviations from ideal gas behavior.

Students will be skilled at using the ideal gas law and/or individual gas laws to solve for the unknown property of a gas.

Students will be skilled in calculating the density and molar mass of gas to determine its identity.

Students will know how Dalton's Law of Partial Pressure affects the collection of gas over water.

Students will be skilled at solving stoichiometry problems involving gases.

Students will know how to differentiate between the types of intermolecular forces and how they affect a substance's properties.

Students will know the concept of the equilibrium vapor pressure of a liquid and how it related to the boiling point.

Students will be skilled at interpreting phase diagrams and heating/cooling curves in terms of energy.

Learning Plan

Preview the essential questions and connect to learning throughout the unit.

Introduce the Kinetic Molecular Theory and how it explains the properties of a gas.

Discuss the meaning of temperature.

Differentiate between a real gas and an ideal gas and the conditions that result in a real gas.

Discuss the concept of pressure, how an early barometer works, and the different units of pressure.

Discuss the qualitative relationships between the gas properties and model the quantitative relationships.

Model how to use the ideal gas law in solving density, molar mass, and stoichiometry problems.

Discuss Dalton's Law of Partial Pressure and its effect on collecting gas over water.

Review phase changes in terms of energy.

Interpret phase diagrams and heating/cooling curves.

Differentiate between the types of intermolecular forces and how they affect properties such as the state of matter at room temperature, boiling point, melting point, surface tension, viscosity, and vapor pressure.

Students will read the Chem Matters article, "Cow Power" and complete the anticipation guide and/or comprehension questions that discuss the change on climate due to methane production from cows.

Labs/Activities:

The following PhET simulations can be utilized: exploring the gas laws, phase changes & IMFs.

Determining Absolute Zero Lab

Air Bag Lab (Stoichiometry with gases)

Collecting gas via water displacement (Applying Dalton's Law and stoichiometry)

Surface Tension Lab

Type of Intermolecular Forces Lab

Evidence/Performance Tasks

Formative

Quantitative analysis of gas properties.

Extrapolation of data for determining absolute zero.

Conceptually analyzing the flow of energy during phase changes.

Deduced relationships from Phet simulation on phase changes and IMF's.

Self Assessment problems during class.

Completed problems in CHEMFILE: MINI GUIDE TO PROBLEM SOLVING HOLT 1999

Assigned homework problems in CHEMISTRY 11 ED. CHANG MCGRAW HILL 2013

Summative

Unit Quizzes and Tests

Benchmark

Final Exam

Alternative

Lab Report for Collecting Gas via Water Displacement Lab

Project on Air Bag Lab (business proposal)

Persuasive Essay based on the Chem Matters article, Open for Discussion: Is Your Phone Sustainable?" (April 2020).

Materials

CHEMISTRY 11 ED. CHANG MCGRAW HILL 2013

CHEMFILE: MINI GUIDE TO PROBLEM SOLVING HOLT 1999

Approved Textbook Link

In addition to general lab and safety equipment as noted in lab handouts:

Mg metal

hydrochloric acid

acetic acid

sodium bicarbonate

ethylene glycol

isopropyl alcohol

Suggested Strategies for Modifications

FOR SPECIAL EDUCATION STUDENTS , ELL, AT RISK AND STUDENTS GIFTED STUDENTS

https://docs.google.com/spreadsheets/d/1pQwsQoD_QLot65BTdHFEHN5dXIiqS54iQ5iDL8C4q6o/edit?usp=sharing