Unit 4 - Gas Laws

Content Area: **Science**
Course(s):
Time Period: **Marking Period 2**
Length: **10 days**
Status: **Published**

Summary

Many elements exist as gases at standard temperature and pressure. The kinetic molecular theory describes how different factors, such as temperature and pressure, can influence the motion and collisions of gas particles. In this unit, students explore how gases behave under changing conditions of pressure, volume, and temperature, as well as exploring ideal gas law scenarios. By investigating the mathematical relationships between these variables, students develop a deeper understanding of matter at the molecular level and learn to predict and explain gas behavior in real-world contexts. This foundation prepares students for advanced chemistry and connects to practical applications in industry, medicine, and everyday life.

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P.3	Consider the environmental, social and economic impacts of decisions.
P.4	Demonstrate creativity and innovation.
P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
9.4.12.CT	Critical Thinking and Problem-solving
P.8	Use technology to enhance productivity increase collaboration and communicate effectively.
MA.A-SSE.B	Write expressions in equivalent forms to solve problems
P.9	Work productively in teams while using cultural/global competence.
MA.N-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
MA.N-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling.
MA.N-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
LA.RST.9-10.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
LA.RST.9-10.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
LA.RST.9-10.5	Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).
LA.RST.9-10.6	Determine the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.
LA.RST.9-10.7	Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
9.4.12.GCA	Global and Cultural Awareness
HS-PS1-3	Plan and conduct an investigation to gather evidence to compare the structure of

	substances at the bulk scale to infer the strength of electrical forces between particles.
9.4.12.IML	Information and Media Literacy
MA.A-CED.A	Create equations that describe numbers or relationships
LA.WHST.9-10.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
MA.A-REI.A	Understand solving equations as a process of reasoning and explain the reasoning
9.4.12.TL	Technology Literacy
HS-PS1-5	Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.
LA.WHST.9-10.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
HS-PS3-2	Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).
HS-ESS3-6	Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity (i.e., climate change).

Essential Questions/Enduring Understandings

Essential Questions

- How do pressure, volume, temperature, and moles relate to the behavior of gases?
- Why do gases behave predictably, and when do they deviate from predictions?
- What are the different gas laws, and when do we use them?
- How can we use mathematical models to predict and explain gas behavior?

Enduring Understandings

- Pressure, volume, temperature, and moles are all variables that affect the behavior of gases.
    - Boyle's Law relates pressure and volume indirectly.
    - Charles' Law relates temperature and volume directly.
    - Gay-Lussac's Law relates pressure and temperature directly.
    - The Ideal Gas Law relates the quantity of a substance (amount of moles) to its pressure, volume, and temperature.
- The gas laws help us understand how one or two variables affect each other, whereas the Ideal Gas Law connects all four variables at once.

Objectives

Students Will Be Skilled At

- Students will be skilled at identifying which variables are given, unknown, or held constant in a problem.
- Students will be skilled at selecting the appropriate form of the gas law (ideal gas law vs. Boyle's vs. Charles's) for a given scenario.
- Students will be skilled at converting units appropriately (pressure, volume, temperature, moles) before applying the equation.
- Students will be skilled at interpreting and explaining what happens to one variable when another changes.

Students Will Know

- Students will know how temperature, pressure, volume, and moles relate to each other when describing gas behavior.
- Students will know the components of the different gas law equations and what each variable represents.
- Students will know the units for each variable and how to convert from Celcius to Kelvin.
- Students will know the types of relationships that each variable has with each other (i.e. temperature and pressure have a direct relationship, pressure and volume have an indirect relationship)
- Students will know how to analyze a word problem to solve for missing variables.

Assessment

Summative Assessment

- Unit Quizzes
- Unit Tests
- Lab Reports

Formative Assessment

- Do Now Questions
- Exit Ticket Questions
- Whole Class Discussion Participation
- Small Group Discussion Participation
- Individual Student Questions/Responses
- Independent Tasks
    - Identify the given, unknown, and constant variables in a word problem.
    - Identify the correct gas law equation to use when presented with a word problem.
    - Describe the step-by-step process to solve each gas law equation.
- Lab Experiments

Benchmark Assessment

- CP Chemistry Midterm Exam

Alternative Assessment

- Explore gas behavior and document observations using a simulation.
- Analyze and plot the data of each different gas law to observe the relationship between variables (i.e. temperature vs. pressure, pressure vs. volume, etc.)
- Perform the Mass of a Gas Lab to examine the relationship between pressure, volume, and amount of moles in a gas.
- Obtaining data from experimentation and presenting in the most appropriate manner.

Learning Plan

- Preview essential questions and connect them to the concepts we will cover in the unit.
- Complete an introductory activity exploring the effects of temperature, pressure, and volume on the behavior of gases (i.e. What happens when you increase the temperature of a gas while keeping the volume the same?)
- Define Boyle's Charles', and Gay-Lussac's gas laws.
- Analyze word problems by identifying which variables are given, unknown, and held constant.
- Define the Ideal Gas Law and its variables.
- Analyze Ideal Gas Law word problems by identifying which variables are given, unknown, and held constant.
- Determine the appropriate units for each variable, and when to convert if necessary.
- Emulate an ideal gas law scenario to determine the mass of Hydrogen gas produced in an experiment.
- Apply the different gas laws to real-world scenarios and predict outcomes.

Materials

- SAVVAS Experience Chemistry 2021 Textbook Volumes 1 & 2
- Guided notes
- Teacher handouts
- Supplementary worksheets
- Lab Handouts (Mass of a Gas Lab, NOTE: Supplies for each lab included on handout.)
- Simulations:
    - "Gas Properties [https://phet.colorado.edu/en/simulations/gas-properties]
    - Gas Laws Simulation [https://teachchemistry.org/classroom-resources/the-gas-laws-simulation]
- Safety Supplies (specifics to when they are required included in lab handouts)

Integrated Accommodation and Modifications, Special Education students, English, Language Learners, At-Risk students, Gifted and Talented students, Career Education, and those with 504s

https://docs.google.com/spreadsheets/d/1mfe42JCam4Rlgd626vidMg54nDZ1ic055qKKGLvhcPg/edit?usp=sharing