Reading & Comprehension Guide

Chapter 14: The Gas Laws

In Textbook Wilbraham, A. C., Staley, D. D., Matta, M. S., & Waterman, E. L. (2012). Pearson chemistry. Boston, MA: Pearson. **Pages** 448-468. **Grade Level** 10-11.
Estimated Reading Time: 2-3 hours (up to 4 with problem solving).

Heading	Page #
I. Pre-Reading Activities	1-2
Guiding Questions	1
Anticipation Guide	2
II. During Reading Activities	3-6
Vocabulary Activity: Fill-In Study Guide	3
Comprehension Activity: Explain to Another	4
Graphic Organizer 1: Gas Properties	5
Graphic Organizer 2: Ideal Gas Law Formula Chart	6
III. After Reading Activities	7-8
Extension Activity (Quiz Grade)	7-8
IV. Evaluation Plan	9-10
Grading Plan	9
Extension Activity Rubric	10

I. Pre-Reading Activities

Guiding Questions

Throughout this unit, you will develop answers to the following questions:

1. What are the four properties used to describe gases?
2. In a system where the amount of gas particles do not change, how do pressure and temperature relate? Volume and temperature? Volume and pressure?
3. Can you identify what each of the following stand for, and the appropriate units for each: P, V, T, and n?
4. What is the "Combined Gas Law," and under what circumstances can it be used?
5. What is the "Ideal Gas Law," and under what circumstances can it be used?
6. How do ideal gases act, according to Kinetic Molecular Theory (KMT)? How can we describe pressure, volume and temperature in terms of the motions of molecules?

Anticipation Guide

Before beginning this chapter, take a few minutes to read each statement and mark "Y" for agree or "N" for disagree. When you complete the reading, return to this table and evaluate the statements again. Compare your answers before and after, and consider what you learned while reading.

Before Reading (Y/N)	Statement	After Reading (Y/N)
	1. When pressure of a gas system increases, that means volume has decreased.	
	2. Temperature is related to either pressure or volume, but not both.	
	3. There are always linear relationships between Pressure & Volume, Volume & Temperature, and Pressure & Temperature.	
	4. The units "atm" and "kPa" are units of Volume.	
	5. The combined gas law can only describe a constant gas system, it can't describe changes in that system.	
	6. The combined gas law can explain why a balloon bursts when it rises high enough in the atmosphere.	
	7. All gas systems have 4 properties, and given 3 of the other properties, we can always determine the last.	
	8. We can pump gasoline into our cars because gas particles stick together.	
	9. "Temperature" is a measure of the number of collisions of individual gas particles with each other.	
	10. "Gas Pressure" results from the collisions of individual gas particles against the walls of a container.	

II. During Reading Activities

Vocabulary Activity: Fill-In Study Guide

1. _____ are perfect gas samples that obey KMT (Kinetic Molecular Theory).
    a. Unlike in solids and liquids, **gas particles are** _____ and _____ **each other** (they experience very little _____ force**)**.
2. _____ explains the known relationships between Temperature, Pressure, and Volumes of gases in terms of the _____.
3. _____ is explained by the average **speed** of gas particles, also called **average** _____.
    a. **SI Units** are _____. K = ℃ + 273 (ex: 25℃ = 25 + 273 = 298 K)
4. **Pressure** is explained by how hard and fast particles _____ or other boundaries.
    a. **High Pressure** = More or _____
    b. **Low Pressure** = Fewer or _____
    c. **SI Units** are _____ or _____.
5. **Volume** is explained by the _____ gas particles take up based on their temperature and pressure.
    a. **SI Units** of Volume are _____.
6. Relationships among Pressure, Volume and Temperature are as such:
    a. As pressure increases in a system, volume _____ proportionally. This relationship is described by a gas law called _____.
    b. As volume increases in a system, temperature _____ proportionally. This relationship is described by a gas law called _____.
    c. As pressure increases in a system, temperature _____ proportionally. This relationship is described by a gas law called _____.

Word & Phrase Bank		
potential energy kinetic energy Kinetic Molecular Theory harder collisions softer collisions increases decreases increases Boyle's Law	Ideal Gases kilopascals (kPa) intramolecular movements of gas particles collide with walls atmospheres (atm) Liters (L) Gay-Lussac's Law	Kelvin (K) far apart close together amount of space bounce off stick to Temperature Charles's Law

Comprehension Activity: Explain to Another

The only way to really know if we understand a concept is to explain it well to another person. As you read, consider not only what you're reading, but how you would explain it to *someone else*.

Consider: Would you use the same words the textbook did? Would you change it a little and use your own words? Do you have a good **analogy** you could use to help someone else understand? *(An analogy is when you compare an unfamiliar concept to a more familiar concept, like when we compared ionic bonds to puzzle pieces).*

In this chapter, you will be reading three sections: 14.1, 14.2 and 14.3. For this "Explain to Another" activity, you will select two questions among those given in each section (you may choose them yourself, but refer to the table for what type of question it should be). **Imagine you are helping a friend who gave an incorrect answer to the question; write out how you would explain to them what the correct answer is, and why.**

#	Section	Type of Question	Question is on Pg#	Question I chose:
1	14.1	Any		
2	14.1	LessonCheck	454	
3	14.2	Math		
4	14.2	LessonCheck	463	
5	14.3	Math		
6	14.3	LessonCheck	468	

Attach your six explanations on another piece of paper. You may add drawings if that is part of your explanation. For math problems, don't just solve the problem - write out a strategy in your own words. *Tip: Try choosing a question you originally got wrong! This will help you work out what you should focus on in your explanation.*

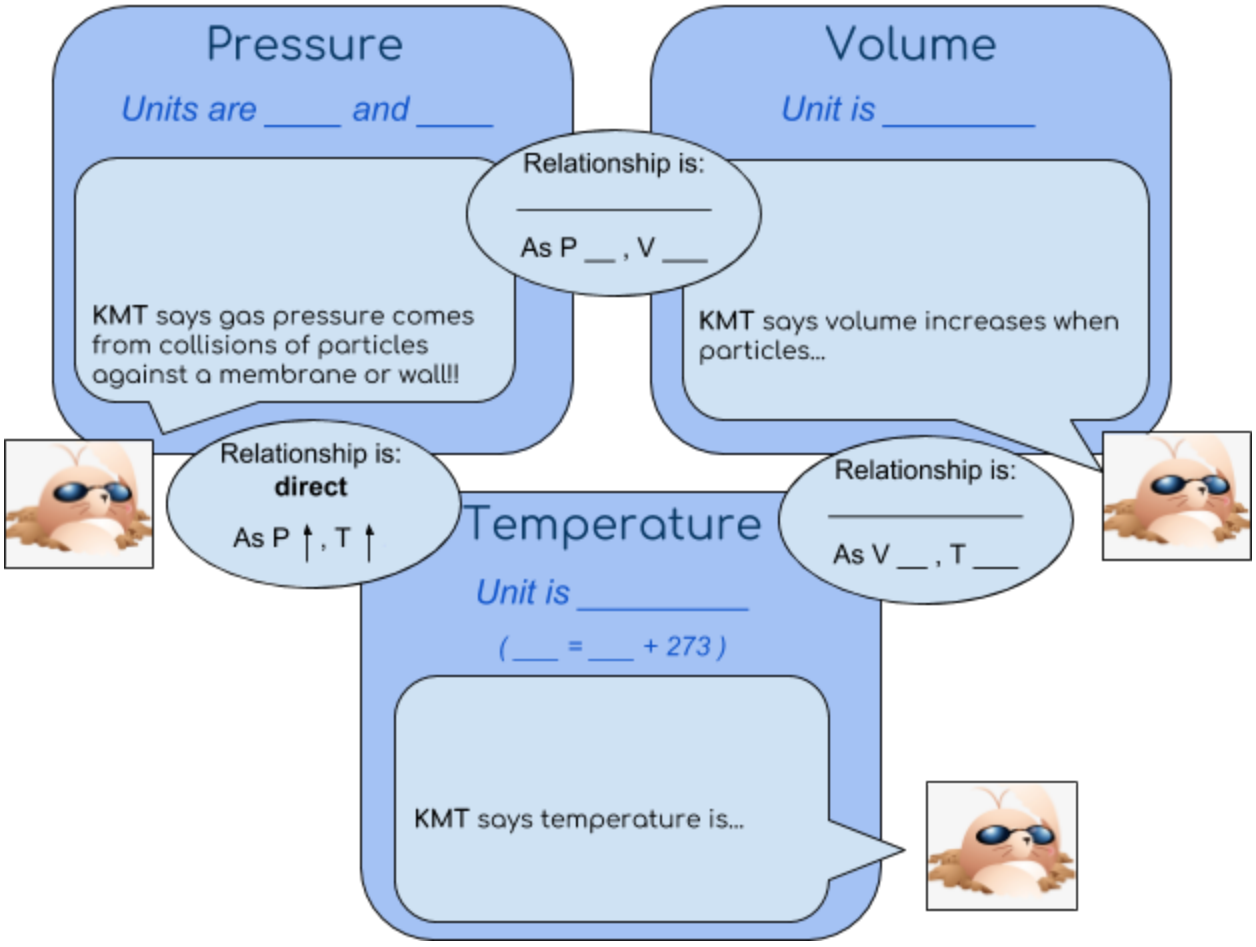
If you have the opportunity to try out these explanations on a friend or family member, try it! Then have them rate how clear the explanation was, from 1-5. This won't affect your grade.

Graphic Organizer 1: Gas Properties

As you read through 14.1, help the "Cool Chemistry Mole" explain Pressure, Volume and Temperature.

He'll need to explain for each:

1. The units
2. The relationships between them (direct or indirect)
3. A few important facts, including how each is explained using "Kinetic Molecular Theory" (KMT).



"Cool Chemistry Mole" from https://pngtree.com/freepng/bespectacled-cartoon-mole_2656648.html
(free for non-commercial use)

Graphic Organizer 2: Ideal Gas Law Formula Chart

Directions for use: As you work through the problems in 14.3, refer to this chart. Use it to help you as you begin practicing these problems.

- Row 1 (Pre-Filled): The Ideal Gas Law formula
- Row 2: Fill in the names of each variable (*for example, "R" is gas constant, "T" is Temperature, etc.*).
- Row 3 (Pre-Filled): Units to look for in the word problem
- Row 4: Fill in values from the problem (see "Steps to Solve Chemistry Math Problems" below the chart)

P	V	=	n	R	T
_____	_____		_____	gas constant	_____
atm ***kPa***	***L (Liters)***		***mols*** $(g * \frac{mol}{g} = mol)$	***unit not important***	***K (Kelvin)*** $(K=^{\circ}C+273)$
		=		*value changes when using atm or kPa.* atm use: 0.0821 kPa use: 8.31	

Steps to Solve Chemistry Math Problems

Read the problem through once to get a general idea.

Read again and mark up the question:
Circle each unit you see.
Box the numbers that go with each unit.
Underline what the question asks you to find.

Fill in the chart:
Decide what is the unknown, and write in "x".
Fill in the numbers for each other variable.
Convert when necessary (ex. from g to mol or from °C to K)

Solve for x.

Check *by plugging the value back into the original equation.*
Do both sides equal the same value?

III. After Reading Activities

Extension Activity (Quiz Grade)

As a quiz grade, choose one enrichment activity to complete on your own, after reading all assigned sections (14.1, 14.2 and 14.3). This will act to show that you've done the reading and understand the concepts within.

This assignment is **due the day before our unit review**. If you have questions that develop as you are completing your enrichment activity, submit them in the question box in class, and we'll be sure to go over it on review day.

1. **The Visual Student** - Create your own graphic organizer (A chart, note table, flowchart, diagram, poster, infographic, etc.) that either organizes one of the concepts in the chapter, or summarizes the chapter.
2. **Sports & Chemistry** - Deep-sea scuba diving is a popular sport and recreational activity. Scuba divers have to be very aware of the gas laws; why is that? Describe the problem scuba divers face, what it has to do with the gas laws, and what safety precautions they must take as a result.
3. **Young Laboratory Scientist** - Before designing experiments, scientists begin by reading up on the subject in question, and then use what they've read to develop predictions and experiments to test those predictions. Based on your reading, develop the procedure for an experiment to test either the relationships between pressure, volume and temperature, or to test if the ideal gas law works in real life. Be specific about the steps you would take, the materials you would use, and what you predict the results would be. *Optionally, you may carry out the experiment (if it is safe to do so and you have the materials) and then report the results.*
4. **Artist's Interpretation** - Do you have an artistic talent, either as a writer or visual artist? Use your skill to compose a short story, long-form poem, or visual art piece based on the reading. In your work (or your explanation), make sure to make a meaningful connection with a concept from the text. You may be as creative as you like, but please accompany your work with at one paragraph explaining what it is meant to describe.
5. **Media Medley** - Are you interested in video production, acting, singing, or rapping? Use your talent to write and record a 3-to-5 minute clip (audio or video with audio) of a song, animation, or video that you created based on the reading. In writing, submit a one-paragraph summary of the work. *This may be a group project with up to 2 other students, as long as everyone's contribution is clear.*
6. **Engineer in Training** - Engineers are people who use math and science principles to solve real-world problems. Consider a real-world problem involving the use of gases to which you can apply the combined gas law or the ideal gas law. Do some research on your own, and in at least two paragraphs, describe the problem, and the way an engineer

would go about thinking about or working on it. Some ideas might be: the production of safe airbags for cars, the production of ammonia, and the safe combustion of fuels.

7. **Young Mathematician** - Are you great with math? Solve 5 math problems from the end of chapter, showing all your steps. Write notes for any tricky procedures or conversions you had to perform. Then, create your own math problem for a fellow student to solve.
8. **Medicine & Chemistry** - Doctors, nurses and other medical providers often work with gases. One example of this is when a patient uses a CPAP machine to help with sleep apnea, or when a patient must breathe with the assistance of an oxygen tank. Use one of these examples or research your own. Using that example, explain why it would be helpful for a medical professional to understand the gas laws. Describe a way in which a patient could suffer if the professional doesn't understand the gas laws.
9. **The Cooking Chemist** - How does a pressure cooker work? Draw a diagram of a pressure cooker and explain how it works, using the gas laws. Choose a dish you might want to prepare in a pressure cooker. Explain the temperature and pressure the cooker would need to reach in order to properly cook the dish. Explain any safety precautions you'd need to take when using a pressure cooker, and why.
10. **Mind your Business** - You have a shipping business and you own a fleet of trucks. A very cold winter is predicted, and you need to make sure that all your vehicles are in top condition. One of your employees suggests buying an automatic tire inflator. Why does your employee suggest this? S/he assures you that no trucks currently have leaks or low pressure. Write a memo to your employees explaining why you have purchased the automatic tire inflator. Include instructions on when your drivers should check their tire pressure, and if they should do so when the vehicle has been driven recently or has been parked for awhile. Use the gas laws to explain your reasoning.

IV. Evaluation Plan

Grading Plan

Quiz grades are generally worth 15 points, and there are about 2 in-class quizzes per unit, so this would be the third unit quiz grade. Small grades (inquiry and graded exit tickets) are worth 5 points each. Some units also have a lab grade (20 points). Altogether, these grades account for 50% of the student class grade, with the summative exam counting for the other 50%.

Weighing: The Gas Laws unit has 2 in-class quizzes (one conceptual and one math-based with multiple choice), 1 inquiry grade, and 1 lab grade. With the addition of this extension activity, that is 70 points total. Therefore, this extension activity is worth approximately 20% of their formative grade, and 10% of their overall unit grade.

Ungraded formatives: In addition to the graded formatives, students have ungraded mid-lecture quizzes (multiple choice conceptual, multiple choice solving, identifying errors, true/false statements), with Nearpod any time there is a lecture (5 days of the unit include some form of lecture and ungraded formative). No additional exit tickets are used unless students have demonstrated difficulty with a certain misconception, or if the multiple choice formative scores were confusing and I need a free-response to better gauge student understanding.

Extension Activity Rubric

For any chosen extension activity, students should demonstrate the following:

	3 points	2 points	1 point	0 points
Understanding of gas laws from the chapter reading	Student work displays complete comprehension of gas laws.	Student work displays good comprehension of gas laws with one or two minor errors.	Student work displays some comprehension of gas laws with two or more major errors.	No comprehension about gas laws from reading is evident.
Student-provided example appropriate to chosen activity	Student provides and example that is appropriate to the topic and meets the requirements of the extension activity.	Student provides an example that is only mostly appropriate to the topic, or misses some requirement of the extension activity.	Student provides an example that is mostly irrelevant to the topic, but stretches to make the connection.	Student provides no original example or an example that is irrelevant to the topic.
Well-reasoned application of a gas law to the chosen problem or situation	Student work clearly connects to the gas law or laws that are appropriate. Reasoning is present and clear.	Student work connects work to a gas law or laws, but there is an error or some reasoning is unclear..	Student work connects to the incorrect gas law or laws, and/or no reasoning is present.	Student work in no way connects a gas law or laws to their work, and no reasoning is present.
Appropriate length and/or scope	The student's work meets or exceeds the minimum requirements for length and scope.	The student's work falls just short of the minimum requirements for length and scope.	The student's work falls significantly short of length and scope.	The student's work is much too brief and/or incomplete.
Appropriate language, spelling and grammar.	Student uses clear, appropriate language with detailed attention to spelling and grammar appropriate to an academic work.	Student uses clear, appropriate language with reasonable attention to spelling and grammar appropriate to an academic work. Some minor errors may be present.	Student uses appropriate language but no attention to spelling and grammar is evident; several major errors are present which may confuse the reader.	Student uses inappropriate language.