Connected Chemistry

Gas Laws Unit

Lesson 1: Introduction to Gases

Student's Lesson at a Glance

Lesson Summary

This lesson contains four activities. Students explore the air composing the Earth's atmosphere to learn that the atmosphere is a heterogeneous mixture, while the air on ground level is a homogeneous mixture of many gases. Students classify gases as monatomic, diatomic, or molecular in structure. Students examine the density of gases and how gases create homogeneous mixtures. Students also utilize the periodic table to help identify trends for gases. The next activity in the lesson walks students through the physical properties of air with simulation and sketching activities about the compression, volume, and diffusion of gases. The final activity requires students to defend their small group's answers for three different claims about gases.

SWBAT (Student will be able to)

- Understand that gases can exist as pure compounds or as a mixture of compounds
- Understand that the air surrounding the Earth is a mixture of gases
- Determine the major components of air

Essential Vocabulary

Keep a list of all important words from this lesson. This list, in addition to the lists from other lessons, will make studying easier and improve scientific communication skills. The essential vocabulary from the unit is in **bold**. Additional words that will expand your scientific vocabulary are in *italics*.

CCC Reminder

- Mixtures do not necessarily need to be made up of liquids and solids. Mixtures can also be made up of gases.
- You may need to refer back to the Matter unit to review how solids and liquids are represented at the submicroscopic level.
- Many questions ask you to write down what you think, to make predictions, or to explain why you think the way you do. The only wrong answer is an answer that is left blank.
- Make sure to include keys for your sketches. A periodic table is available in the back of your workbook to use.

Notes

Homework

Upcoming Quizzes/ Tests

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Activity 1: Connecting

On the Earth, there is a natural resource that is necessary to support life for many organisms, yet this resource is often invisible to the naked eye. The *atmosphere* that surrounds Earth is unique to our planet; it has life-sustaining qualities not found elsewhere in our solar system. Some people assume that the atmosphere surrounding Earth consists of only oxygen because many organisms need this gas to survive. Instead, the atmosphere is a *homogeneous* mixture of several different kinds of gases. These gases easily mix with one another, because unlike liquids and solids, large spaces exist between the molecules in a gas.

The table below shows the six major components of air. In the highlighted column, make an educated guess about what percentage of each gas is present in the air. For your sketch, assume twenty total molecules. For example, if you estimate air is 50% carbon dioxide, 50% of twenty is ten, so draw ten molecules of CO_2.

Gas	% Estimate of Composition	Actual %	Sketch a submicroscopic representation of air based on your estimation of percentages
Nitrogen			
Oxygen			
Argon			
Carbon Dioxide			
Neon			
Other Gases			
	Total: 100%		
Key			

1. Your teacher will provide you with the correct percentages. Were you surprised by the data your teacher provided? *Explain your thinking.*

Some of the gases that were previously mentioned are a cause of concern for the livelihood of the planet. For the past 30 years, scientists have been researching the consequences of climate change.

The unique properties and behavior of certain gases has helped sustain life on Earth for millions of years. *Greenhouse gases* trap the energy provided by the sun. When greenhouse gases such as carbon dioxide, methane, ozone, and water vapor are in proper ratios, these gases help make Earth habitable. However, the exponential growth of a fossil fuel-reliant population has upset the balance of optimal levels of greenhouse gases and caused the average global temperature to rise. This change in global climate is known as *climate change*.

2. Why do you think the gases responsible for climate change are called "greenhouse gases"?

3. What do you think are the consequences if air were composed of a heterogeneous mixture?

4. Gas is one state of matter. From the submicroscopic perspective, how does gas differ in terms of the arrangement of its molecules, compared to a solid or a liquid?

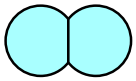
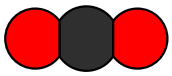
5. What are some characteristics of gases that other states of matter do not have? *Hint: Think about water in all three states of matter.*

Activity 2: Questions to Think About - Structure of Gases

Part 1

Gases can be classified into three different categories based on their atomic structures.

Look at the three gases in the table below and classify them with one of the following three terms: **Molecular Compound**, **Monatomic**, or **Diatomic Molecule.**

Picture	Name	Classification
	Helium	
	Fluorine	
	Carbon Dioxide	

6. Considering its location in the periodic table, to which family does helium belong?

7. Based on periodic trends, what assumptions can we make about the atomic structure of the elements in the last column of the periodic table?

8. How is the *halogen* family of gases classified?

9. Using your drawings in the table on the next page, rank the balloon, water, and coin from least to most dense.

Part 2

The following activity will help you discover the unique properties of gases.

On your teacher's desk is a beaker of water with a copper coin and a balloon filled with oxygen placed inside. The coin sinks while the balloon floats. Look at the demonstration of each component and sketch as directed.

	Macroscopic Picture	Submicroscopic sketch of substance
Balloon filled with <u>oxygen</u>		
Beaker filled with <u>water</u>		
Penny made of <u>copper</u>		
Key		

Part 3: *Use Simulation 1,* ***Set 1***

Create a submicroscopic sketch from the simulation at time 15 s.
Key

10. Which gases were added to the simulation?

11. What type of mixture was formed by the gases?

12. The gases in the simulation are considered diatomic molecules. Why is carbon dioxide not considered a diatomic molecule?

13. Gases combine easily with one another. What are the potential helpful or harmful consequences?

Activity 3: Physical Properties of Air

Part 1: *Use Simulation 1,* ***Set 2***

The following activity will help you discover the unique properties of gases.

Gases can be compressed. Watch as your teacher uses the simulation. Pay close attention to how volume changes over time as the size of the box is changed. Create a sketch before and after as directed.

Create a submicroscopic sketch before box is compressed		**Create a submicroscopic sketch after box is compressed**	
Moles of gas molecules		Moles of gas molecules	
Volume of container		Volume of container	
Volume of the gas		Volume of the gas	
Actual volume of gas		Actual volume of gas	
Key			

14. How did the moles of gas molecules change over time?

15. How did the volume of the container change over time?

16. How did the volume of the gas change over time?

17. How did the actual volume of the gas change over time?

18. Using your sketches, explain how the submicroscopic characteristics of a gas allow it to be stored in small metal tanks for hospital use or for diving in the ocean.

19. In the CCC simulations, your focus is on the submicroscopic view of the particles. How does the piston in the simulation violate this view?

Part 2: *Continue to use Simulation 1, Set 2*

Your teacher is going to add more gas to the simulation. Create sketches as directed.

Create a submicroscopic sketch at time 0 s.		Create a submicroscopic sketch at time 30 s.		Create a submicroscopic sketch at time 60 s.	
Moles of gas molecules		Moles of gas molecules		Moles of gas molecules	
Volume of container		Volume of container		Volume of container	
Volume of gas		Volume of gas		Volume of gas	
Actual volume of gas		Actual volume of gas		Actual volume of gas	
Key					

20. What happened to the moles of gas over time?

21. How does the number of moles change the volume of the gas?

22. How did the actual volume of the gas change over time?

23. How did the volume of the container change over time?

24. What is the relationship between concentration and the amount of moles present in the container?

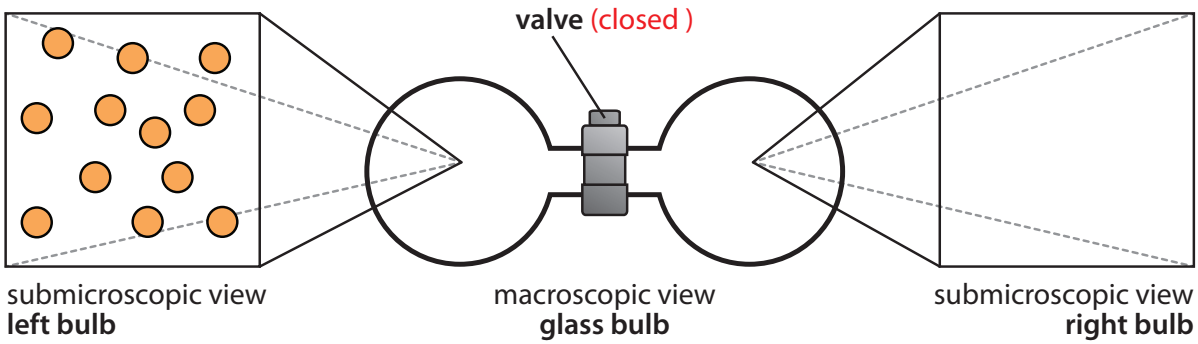
25. When is the concentration of helium greatest? When is it lowest?

26. Explain any difference or similarity between the volume of the container, the volume of the gas, and the actual volume of gas.

27. Using your values, calculate the concentration of helium from your 60 second trial.

Part 3

The glass bulb below contains a monatomic ideal gas, sealed in the bulb on the left. On the right no monatomic gas is present.



Sketch what will happen to the gas after the valve is opened.

28. Explain why you sketched the gas the way that you did.

29. Using your submicroscopic sketches, explain why when someone makes popcorn or walks in a room wearing perfume, other people in the room can smell the popcorn or the perfume.

Lesson Reflection Question

30. Explain what happens to the molarity of the gas in the left bulb after the valve was opened.

Activity 4: Teacher Facilitated Discussion

A group of students debate some information they read on the Internet about gases.

In your small group, decide if the claims these students make are true or false. Circle your response and be prepared to defend your claim with evidence. Consider what you know about solutions, pure substances, and pressure to help guide your decision-making.

Claim 1: Air is a solution.

31. This statement is true or false. *Support your claim with evidence.*

Claim 2: Air is a pure substance.

32. This statement is true or false. *Support your claim with evidence.*

Claim 3: Highly compressed gases inside metal tanks and containers can be dangerous.

33. This statement is true or false. *Support your claim with evidence.*