**The Pressure’s Mounting: Gas Law Activities**

**Standards:**

1.1.11E- Establish a reading vocabulary by identifying and correctly using new words acquired

 through the study of their relationships to other words. Use a dictionary or related reference.

1.2.11.A- Read and understand the central content of informational texts and documents in all

 academic areas.
1.6.11 A- Listen to others.

1.6.11 D- Contribute to discussions.

1.6.11 E- Participate in small and large group discussions and presentations.

2.3.11 A- Select and use appropriate units and tools to measure to the degree of accuracy required in

 particular measurement situations.

3.2.10 A- Apply knowledge and understanding about the nature of scientific understanding and

 technological knowledge.

3.4.10 A- Explain concepts about the structure and properties of matter. Know that atoms are

 composed of even smaller sub-atomic structures whose properties are measurable.

**Introduction and background:**

Gases are all around us, all the time. In fact, gas is bouncing off of you right now. When dealing with a gas, the four variables that can be manipulated are temperature, pressure, volume and mass. In this lab, you will be exploring how gases behave when placed in different situations, where one or two of the variables are held constant. Charles’ and Boyle’s Laws will be discussed and analyzed through various hands on activities, teacher led demos and class discussions. Some of the other gas laws will be looked at briefly as well to introduce you to the wonderful world of gases. Hopefully after learning about the ABC’s of gases, you will be able to understand and explain your everyday dealings with gases.

**Guiding questions:**

1. What are the properties of gases?
2. What real-world applications/everyday things deal with gases?

**Materials:**

Part 1: Teacher Led Demos (See Teacher Notes)

Part 2: Rotating Student Stations

1. Beaker, Cold Water, Mirror or Coin, Glass Soda Bottle
2. Glass Tube, Cotton balls, 2 pairs of forceps, gloves, concentrated HCl & aqueous

 NH3, 2 small beakers

1. Potato, plastic straws, sharpie
2. Film canister, Alka-Seltzer, Large Pipette, frogs (optional)
3. Mini bell jar vacuum, syringe, balloon
4. Drinking Bird, Cup of water
5. Water filled pipette, weights (books)
6. Empty Soda Can, Hot Plate, Tongs, Water, Beaker with Ice Cold Water
7. Balloon, Erlenmeyer Flask, water, Hot Plate, Cold Water Bath
8. Marshmallows, Bell Jar, Syringe

Part 3: Explanations & Conclusion

* Calculator
* Ruler
* Full can of soda
* 8 foot straw

**Safety:** Goggles should be worn during the lab.

Gloves are required at Station B.

Do not mix the chemicals at Station B. Follow instructions carefully.

Be careful of hot glassware at Stations H & I.

**Procedure:**

Part 1: Teacher Led Demos

1. Intro to the States of Matter
2. Egg in a Bottle Experiment
3. Balloon in Liquid Nitrogen

Part 2: Rotating Student Stations (Follow the directions for each station below)

1. Magic Moving Mirror
	1. Place bottle neck and small mirror in the beaker of cold water for 1-2 minutes.
	2. Remove bottle and mirror from the cold water and turn upright.
	3. Place the mirror on the top of the bottle mouth.
	4. With the bottle on the table, wrap your hands around the bottle and observe. (Be patient!)
2. Dramatic Diffusion
	1. In the fume hood & with gloves on, use forceps to split a cotton ball.
	2. Dip one cotton ball part into the concentrated HCl and the other into the concentrated aqueous NH3. (Do not let the chemicals mix!)
	3. Once the cotton balls are soaked, use the forceps to place into opposite ends of the glass tubing clamped to the stands in the hood.
	4. Watch the reaction and explain.
3. Who Killed Spud?
	1. Place potato on the lab table.
	2. Hold a straw at the top, without covering the hole.
	3. Try to stab into potato, record what happened & draw a line around straw at potato to mark how far the straw went into the potato.
	4. Now try to stab the potato by placing your thumb over the straw’s opening. Draw a line where the straw now is in the potato. What happened?
4. Bouncing Bullfrogs
	1. Obtain a film canister with a lid.
	2. Fill one large pipette with warm water and squirt it into the canister.
	3. Put a frog onto the lid of the canister.
	4. Take an Alka-Seltzer tablet and place in the canister and immediately place your frog lid on top.
	5. Step back and keep your face away from the canister.
5. Just Keep Pulling…Just Keep Pulling…Just Keep Pulling!
	1. Place a small semi-filled balloon in the bell jar.
	2. Set up Bell Jar apparatus like the provided diagram.
	3. Begin to pull back the syringe and watch the balloon.
	4. Keep pulling back until you absolutely cannot pull anymore.
	5. Then unscrew the bell jar from the tubing and watch the balloon.
6. Thirsty Tweety
	1. Make bird’s felt head wet.
	2. Place cup of water in front of the beak and observe.
7. Piping Pressure
	1. Observe a liquid filled, sealed pipette, focus on the air bubble, then lay it on the table.
	2. Add a book to the bulb of the pipette and observe the air bubble.
	3. Keep adding books and measuring the distance from the liquid to the end of the pipet. Quickly record length of air bubble in data table for 1, 2, 3 & 4 books under observations.
8. Shy Soda
	1. Fill a soda can 1/8-1/4 with tap water.
	2. Place can on a hot plate until steam is seen coming from the top of can.
	3. Using tongs, flip the can over into a beaker of ice cold water.
9. Innie or Outie?
	1. Fill approximately 1/3 of an Erlenmeyer flask with water.
	2. Place a large balloon over the mouth of the flask.
	3. Place flask onto a hot plate and heat.
	4. Once it has boiled, remove flask from hot plate with tongs and place gently (upright) into the cold water.
10. Mini & Mega Marshmallows
	1. Place a small marshmallow in the bell jar.
	2. Set up Bell Jar apparatus like the provided diagram.
	3. Begin to pull back the syringe and watch the marshmallow.
	4. Keep pulling back until you absolutely cannot pull anymore.
	5. Then unscrew the bell jar from the tubing and watch the marshmallow.

Part 3: Explanation of the Gas Laws Activities & Conclusion

Review the activities from the rotating student stations and review Charles’ and Boyle’s Laws. Then ask for a volunteer from the class. This student will use an 8 foot straw to try to drink a can of soda. Other students will need to time the drinker to see how long it takes to get the soda to their lips. Then students should explain how straws work and as a class try to calculate the volume of displaced air in the 8 foot straw.

**Data table:** Record observations & explanations for each of the stations. Then try to determine which gas law the activity represents.

Station A: Magic Moving Mirror (Boyle, Charles, Other)

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| --- |
| Observations: |
| Explanation: |

Station B: Dramatic Diffusion (Boyle, Charles, Other)

|  |
| --- |
| Observations: |
| Explanation: |

Station C: Who Killed Spud? (Boyle, Charles, Other)

|  |
| --- |
| Observations: |
| Explanation: |

Station D: Bouncing Bullfrogs (Boyle, Charles, Other)

|  |
| --- |
| Observations: |
| Explanation: |

Station E: Just Keep Pulling…Just Keep Pulling…Just Keep Pulling! (Boyle, Charles, Other)

|  |
| --- |
| Observations: |
| Explanation: |

Station F: Thirsty Tweety (Boyle, Charles, Other)

|  |
| --- |
| Observations: |
| Explanation: |

Station G: Piping Pressure (Boyle, Charles, Other)

|  |
| --- |
| Observations: |
| Explanation: |

Station H: Shy Soda (Boyle, Charles, Other)

|  |
| --- |
| Observations: |
| Explanation: |

Station I: Innie or Outie? (Boyle, Charles, Other)

|  |
| --- |
| Observations: |
| Explanation: |

Station J: Mini & Mega Marshmallows (Boyle, Charles, Other)

|  |
| --- |
| Observations: |
| Explanation: |

**r**

**Calculations:**

Calculate the volume of air displaced in the 8 foot straw: SHOW YOUR

 WORK!!!

**h**

 V = πr2h

 **Answer: \_\_\_\_\_\_\_\_\_\_\_\_\_**

**Questions:**

1. How does changing the temperature of a gas impact its pressure?
2. What is the relationship between volume and pressure? Explain how you know.
3. What is the relationship between volume and pressure? Explain how you know.
4. From your data, what would happen to the air bubble in the sealed pipette, if we added 8 textbooks?

**References:**

[**http://www.kids-science-experiments.com**](http://www.kids-science-experiments.com)