PLAYING WITH PRESSURE

By Doaa George, based on the workshop investigation by Nicolette Wheaton

Introduction

Have you been watching the weather forecast? Have you ever wondered why they keep mentioning areas of high atmospheric pressure and low atmospheric pressure? If you are a good observer, you would have noticed that high pressure is associated with nice sunny weather while low pressure is accompanied with cloudy and rainy weather.

It is well known that temperature affects the movement of particles (the kinetic energy of particles) where high temperature causes particles to move faster. Temperature also may cause changes of

state, changing liquid to gas at high temperatures or changing gas to liquid by cooling. When gas particles get hotter, they move more and exert more pressure on each other and on their surroundings. This is why temperature and pressure are very closely related and together they play a very important role in controlling the weather and in our daily life as you will investigate in this experiment.

Risk analysis

1. This experiment involves the use of a Bunsen burner. Bunsen burners produce an open flame at a high temperature. Make sure you follow the safety rules below:

- The Bunsen burner should be placed away from any overhead shelving and away from any equipment at least 30 cm.
- Place the Bunsen burner on a heat proof mat.
- Keep away from any combustible materials.
- Tie back any long hair, and avoid wearing any dangling jewellery.
- Fit the hose securely on the gas valve and on the burner, check for any cracks or holes in the hose. Replace the hose if there are any defects.
- Have your match or lighter ready before turning on the gas. It is safer to use a flint (also called a striker) if it is available in the laboratory.
- Make sure that the collar near the bottom of the barrel is positioned such that the air ports are nearly closed to ensure that you obtain a safety flame while igniting the burner (safety flame is the coolest flame).
- Turn the gas tap on such that the tap handle is in line with the gas hose similar to figure 2.

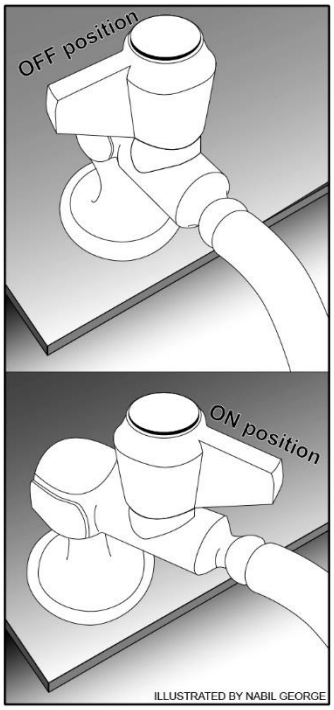


Figure 2: The Bunsen burner tap in the open and closed positions

- After lighting the Bunsen burner, turn the collar until you get a blue flame to use it in heating.
- To turn the Bunsen burner off, first turn the collar until you get the safety flame then turn the gas tap off.

- Bunsen burners get very hot, leave them to cool before carrying them.

2. Always wear safety goggles.

3. Report any glass breakage to your teacher.

Questions

- What is the relationship between increased movement of gas particles (kinetic energy) and the gas pressure?
- How would heating and cooling affect the volume of a substance?
- What is the relationship between pressure, temperature and volume?
- Is there a relationship between the volume of a gas and its pressure at a constant temperature?
- What happens to a gas when it is cooled?
- Can you think of some real world applications that deal with pressure?

Aim

Your aim is to investigate the effect of gas pressure on different systems and to communicate your understanding so that you can explain real life situations which use pressure.

Plan

Form groups of three. There are three experiments to choose from. Your teacher may give you the chance to choose which experiment you will investigate or could assign your team to a specific experiment.

According to the experiment you will study, write your hypothesis after discussing it with your team members.

Materials

Experiment 1 – Station 1

Gas Pressure on a balloon

1. A conical flask
2. A balloon
3. Water
4. Bunsen burner
5. Tripod
6. Net mesh
7. Lighter or flint
8. Silicon hot hands
9. Ice water

Experiment 2 – Station 2

Can Crush

1. An empty soft-drink can
2. Shallow tray
3. Cold water
4. Tongs
5. Bunsen burner
6. Tripod
7. Net mesh

Experiment 3 – Station 3

Fountain Experiment

1. Large beaker
2. Cold water
3. Food colouring
4. Round bottom flask
5. Rubber stopper
6. Retort clamp
7. Bunsen burner
8. Tripod
9. Net mesh

Conduct

Before starting the experiment, discuss with your group and decide the role of each member in the team.

Procedure

Station 1 – Gas Pressure on a balloon

1. Add 50mL (approx.) of water to a conical flask and place a balloon over the opening.
2. Heat the water in the conical flask over a Bunsen burner.
3. Observe what happens to the balloon.
4. Using silicon 'hot hands' remove the flask from the heat.
5. Quickly take the balloon off the top of the flask and immediately re-attach it.
6. Sit the conical flask in ice water.

7. Observe what happens to the balloon.

Figure 2 – Gas pressure on a balloon

Station 2 – Can Crush

1. Add 20-30mL of water to a soft-drink can.
2. Half-fill a shallow tray with cold, tap water.
3. Grip the can with tongs so that the palm of your hand is facing upright.
4. Heat the can over the Bunsen until steam is coming out consistently
5. Flip the can over so that the opening is submerged in the cold-water tray.
6. Observe the results.

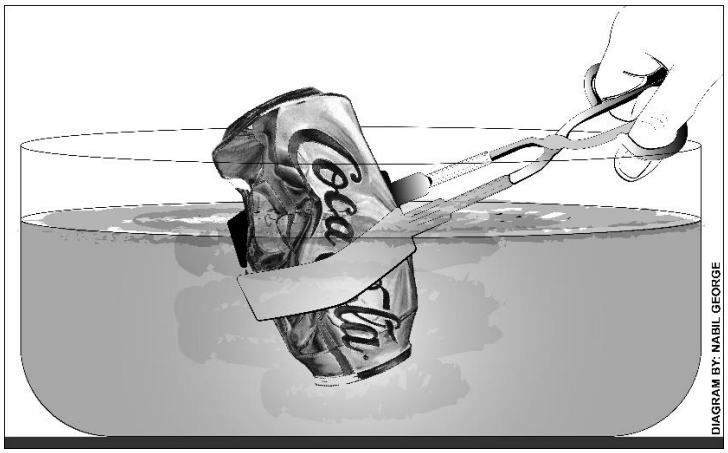
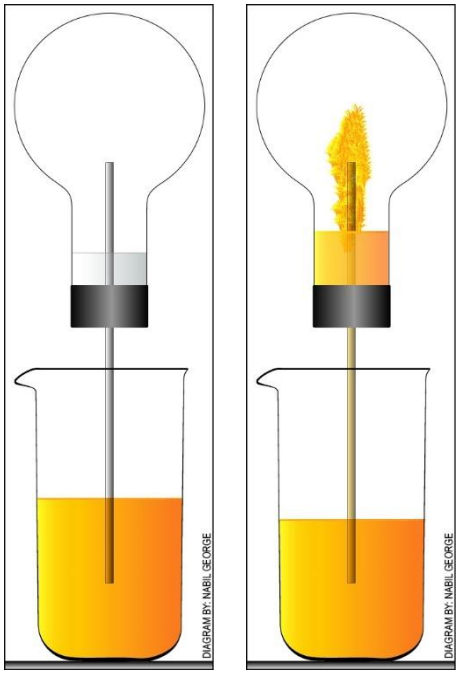


Figure 3 – Can crush experiment

Station 3 – Fountain Experiment

1. Half fill a large beaker with cold water.
2. Add a few drops of food colouring.
3. Add 30mLs of water to the round-bottom flask.
4. Place the rubber stopper with the glass tubing through it in the opening of the round bottom flask (see picture).

5. Holding the round-bottomed flask with the tube at the top, with a retort clamp, heat the contents until steam is pouring out the glass tube.
6. Invert (flip) the flask so that the end of the glass tube is submerged in the coloured water.
7. Observe over the next 30 seconds.



(a) (b)

Figure 4 – Fountain experiment

(a) before heating (b) after heating

Analysis

1. ***Station 1 – Gas Pressure on a balloon***

Tabulate your observations as follows.

	Balloon when flask is heated:	**Balloon when flask is cooled:**
Observations:		

Sketch of results:		

2. Station 2 – Can Crush

Write your observations below.

3. Station 3 – Fountain experiment

Write your observations over a period of 30 seconds.

Problem Solves

Discussion

1. Station 1 – Gas Pressure on a balloon

Write your explanation to what you observed below.

	Balloon when flask is heated:	**Balloon when flask is cooled:**
Explanation: (try to use terms like: kinetic energy, pressure, volume, evaporate, condense, temperature…)		

2. Station 2 – Can Crush

Write your explanation to what you observed below.

3. Station 3 – Fountain experiment

Complete the explanation

The water from the beaker was pushed up the glass tubing and into the round-bottom flask. This happened because the hot water vapour in the flask began to cool and re-condense resulting in the pressure inside……

Conclusion

Do your results support your hypothesis for your chosen experiment?

What have you learnt about pressure after doing your investigation?

Figure 1 link https://www.flickr.com/photos/leedsmuseumsandgalleries/5084070864/in/photolist-8Kgc9d-5ZnaNN-SfVzxx-q69o7i-chxnX5-bXhp4z-dE1Ff2-SRQqgr-9AjRDg-5Yo9Gk-BR6H7v-77Kefu-fyoAAy-g9XZjg-e3dQAA-4zaxCh-Ed39pq-4woCX3-EyoH6t-5t5Je1-pGtkzX-6mUbsN-7Rm1Yp-UB1ymN-bqipBg-22kRg-76f8Gz-2s6K39-8Kfys3-YnahoL-feiCXR-nwMrcg-bngskB-b8igai-nN7mhk-9wLuQS-6yZwtH-YnaQxL-YoKjfo-XpZyTM-S6YTG1-RYBbNM-YnaiDG-8Db3Qj-qTcwCH-YoKi6E-dSVogW-SPmvEw-RPdNZX-RzWm3v Author Leeds Museums and Galleries Licence https://creativecommons.org/licenses/by-nc/2.0/

Figure 2 Author Nabil George for ASELL.

Figure 3 Author Nabil George for ASELL.

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