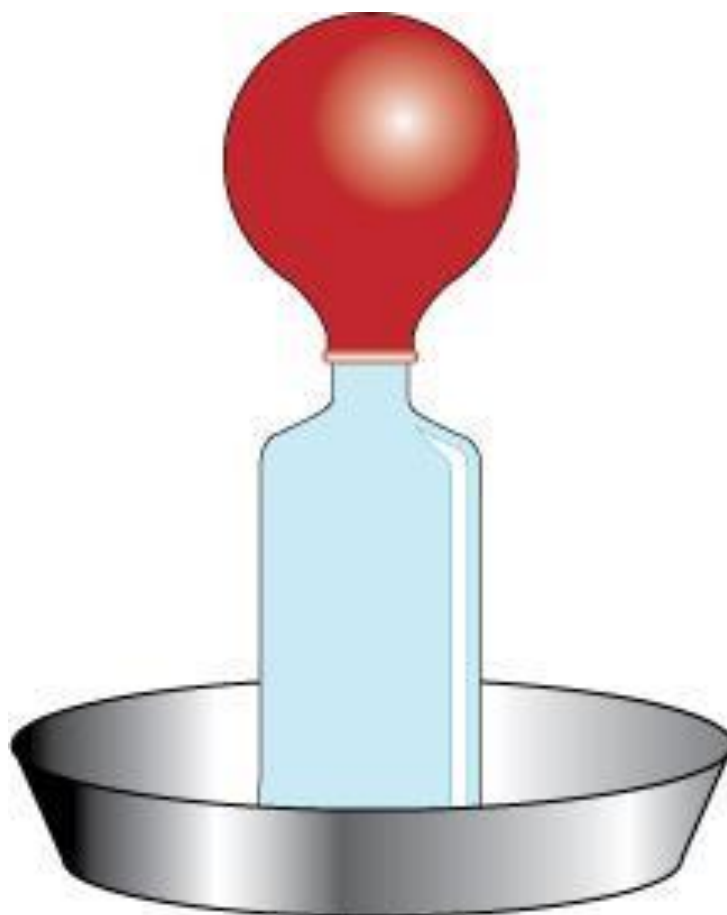WCLN.ca

Inquiry Question
Why do hot air balloons rise?

Name: _____ **Date:** _____

Matter expands when heated and contracts when heat is removed. This is especially obvious when the matter is a gas. When heated, molecules are given more energy, move faster, and thus move further apart from each other. When cooled, molecules have less energy and come closer together. How does this effect the density of matter and why is this important? Recall that less dense objects float in substances that are more dense.

Density depends upon the number of molecules in a given volume. It is a measure of the mass per volume. If a gas expands, it still has the same amount of matter but in a larger space so becomes less dense as it is less crowded. When a gas contracts, it has the same amount of matter but in a smaller volume so it becomes more dense as it gets more crowded.

For this project you will be investigating in your kitchen to see how a gas behaves when heated and cooled.

General Instructions
The goal of this project is to understand how gases behave when heated or cooled.

Materials you'll need:

- balloon
- glass bottle with a narrow neck
- water
- source of heat
- ice
- large tub for the water

Ideas and Hints:

Complete the following procedure:

1. Blow up a balloon about three-quarters full.
2. Place the neck of the partially inflated balloon over the neck of the bottle—try not to lose too much air as you do this.
3. Put the bottle into a tub and pour very hot water into the tub. Do not use boiling water as the glass bottle might break. What happens to the balloon? Why do you think this happens?
4. Let the hot water cool and observe what happens to the size of the balloon.
5. Once the water has cooled to room temperature or close to it, add lots of ice cubes to the basin. What happens to the balloon? Why?

Additional Information:

We can demonstrate that heat makes substances expand. The amount or mass of matter doesn't increase with heat, but the spaces between the particles get bigger as the particles move more quickly. From what we have learned about density, we can see that an increase in volume with no increase in mass results in less crowding and a decrease in density. (density = mass/volume)

These differences in density can be calculated. For example, substance A has a mass of 45.8 grams and a volume of 30.6 mL. After we heat the substance and recheck the measurements, the mass is still 45.8 grams but the volume increases to 36.7 mL. Let's calculate the difference in densities.

Before heating:

density= mass/volume
density = 45.8 g / 30.6 mL
density = 1.5 g/mL

After heating:

density= mass/volume
density = 45.8 g / 36.7 mL
density = 1.2 g/mL

Notice that, after the substance was heated, the volume increased resulting in the density decreasing. In this case, the difference in densities was

1.5 g/mL – 1.2 g/mL = 0.3 g/mL .

By knowing that the density of a substance decreases as heat is added, and that less dense substances will float in substances that are more dense, we can explain why a hot air balloon rises. How does the density of the air in the balloon compare with the density of the air around it? Why would a hot air balloon rise?

Make sure to include all observations and answers in your assignment.

Project Submission:

Upload your completed assignment to the project submission folder at the end of the unit.