

### What you will need:

- \* Recycled glass jar or bottle
- \* Balloon
- \* 2 Bowls
- \* Boiling Water
- \* Ice Water



# Thermal Expansion

### Instructions:

1. With adult supervision, boil water and place in a bowl. Make another bowl of ice water.
2. While the water is boiling, take a balloon and place it air-tight across the top of your container.
3. (Optional) weigh the balloon+ container before the experiment and write down its mass
4. Once you have your bowls of hot and cold water, place your container with the balloon into the ice cold water for 30 seconds
5. *Carefully*, Move the container to the hot water and observe what happens to the balloon
6. (Optional) Weigh the mass of the container + balloon to see if there was any changes in the mass of the system. Compare the mass difference, if any.



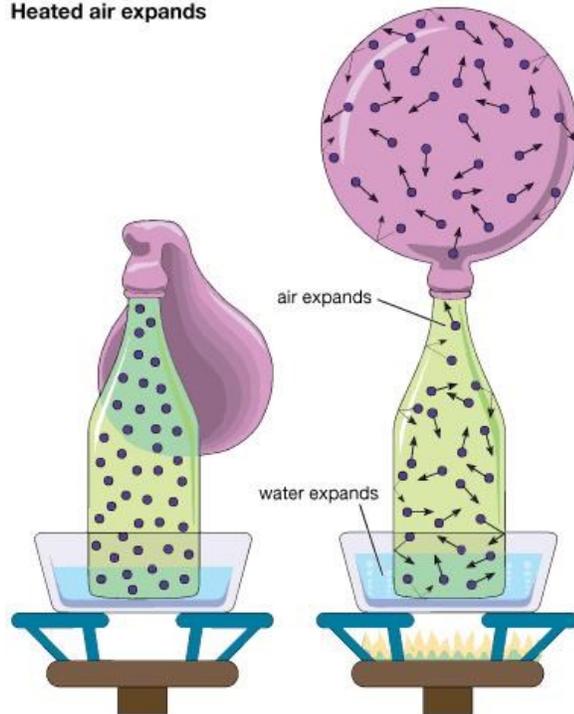
### How it works:

Even though it doesn't look like there is anything inside of the water bottle, the bottle is filled with air! As the air is heated inside of the bottle, it begins to take up more space. This is because of the particle interactions that we cannot see with our eyes. Scientists and Engineers call this process Thermal Expansion.

All matter is made up of tiny particles that are constantly in motion. When these particles react with one another, it can affect the volume an object has. As the air is heated, the air particles begin to move faster. With more speed, these particles can collide with more force and more frequently allowing the particles to have a larger range of motion. Even though we can't see this larger range of motion, we can see the increase of volume in the balloon.

# Thermal Expansion

Heated air expands



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Density is the relationship between mass divided by volume. As air inside the bottle is heated, it takes up more space. However, you have the same amount of mass. If you have the same amount of air particles in the bottle, but now taking up *more* space, the air will be less dense. Same mass divided by a larger volume will make the object *less* dense.

If you weighed the system, before and after the volume increase you should see the same mass both times! Because there is no change in mass, we know particles themselves do not get larger. This is due to the conservation of mass. Even though it looks bigger, it doesn't weigh more because matter itself cannot be created or destroyed.

Not to worry if you didn't get the *exact* mass. Small differences in mass are often due to human error and could possibly be water droplets on the container after the experiment. Any difference in mass within a few grams is negligible.

Summarizing Questions: Answer questions using evidence from the experiment

1. What is all matter made up of?
2. When a solid, liquid or gas is heated what happens to its volume?
3. What is this process called?
4. Explain how *density* of an object is effected by temperature.
5. (optional) During this heating process, do the particles themselves get larger?
6. (optional) During this heating process, describe how the particles interact.