The Same but Different Part II
3rd Grade
Meghan Knapp/Dr. Stephen Hancock

References:


Benchmarks:

SLC 3: Identify the mass, volume and dimensions of familiar objects in standard and nonstandard units.
SLC 8: Distinguish verbally and in writing between observations and inferences
SLC 9: Demonstrate an understanding safe use of materials and instruments in a scientific phenomena
SLC 11: Identify characteristics of a simple physical change.
Benchmark: Students will identify a physical change as a change in size shape or state of matter. Students will demonstrate an understanding that the water cycle includes when matter evaporates and condenses

Objectives:

Students will characterize a physical change as something with a different size, shape, or form, but still the same substance. Students will measure volumes using milliliters. Students will understand that gasses expand when they are hot and contract when they are cool.

Materials:

- small balloons (water balloon types are good)
- hot plate or thermos with hot water
- ice water in 600mL beaker or 4 cup measuring cup
- hot water in 600mL beaker or 4 cup measuring cup
- Room temperature water in 600mL beaker
- 400mL beaker or cup that will nest with measuring cup
- safety goggles (class and teacher)

*Students should not plug in equipment or touch sources of heat (hot plates, etc.)

Preparation: Have a large beaker for each group with water in it on the hot plate. Bring the water nearly to a boil before the lesson, and then turn the heat off. This will help minimize the risk of burns.
**Initial Demonstration:**

Show the students a balloon. Have someone measure the volume of the balloon by difference:

Put about 150mL of water in a 600 mL beaker. Submerge the balloon and read the new volume. The 400 mL beaker can be used to hold the balloon down. Subtract 150 mL from the new volume to get the volume of the balloon. To help the students understand this, ask them if there is anything in the beaker besides the balloon. Ask them why we can’t just put the balloon in the beaker to measure the volume.

Ask, how can we make this balloon smaller? (They may suggest squeezing it or making it colder). How can we make this balloon bigger? (They may suggest heating it up).

**Target Observations:**

- The balloon has a certain volume
- Most of this volume is taken up by air

**Target Model:**

- If we change the size of the balloon, it is still a balloon. This is called a physical change.

**Procedure:**

The teacher should do anything involving hot water and/or liquid nitrogen. Everyone should wear safety goggles around a hot plate.

(They will need to do volume by difference). About 150 mL of water should be sufficient for a 200mL balloon. Put the balloon in the ice water and let it cool for a couple of minutes. Ask, “Is this still a balloon?” It has undergone a physical change; it is the same but smaller. Then measure the volume by difference. Finally, let the volume rest in the beaker with the hot water. Ask the students what they observe. The volume change should be apparent. After a minute or two, use the 400 mL beaker to submerge the balloon and find the new volume. “Is it the same size it was before? (no) Is it still a balloon?” (A dramatic alternative is to use liquid nitrogen to cool the balloon and allow the warm air in the room to let it expand).

Ask the students to describe a physical change they observed. Ask them what caused this physical change. Is this an observation or an inference? What is inside the balloon? What happens to gasses when we heat them up? What happens to gasses when we cool them down? Can you think of a physical change that happens to water in the weather? Can you think of a way that the air can be warmed up? What would happen to it when it warms up?
Ask the students to examine the balloon after it has been dried off. There should be droplets of water inside. This is condensation from the air in the balloon. (If you blew it up by mouth, it should be quite moist in there!). Ask the students to make verbal observations. (These are true things they can see, hear, measure, etc.) If a student says something like “The water from the beaker leaked inside.” Ask the students if this is an observation or an inference. It is an inference because they are making a guess to explain their observations. Inferences may or may not be true. Ask the students if water is in the air all the time. Ask them how it gets there (evaporation). Ask them how it gets out of the air (rain—which is a form of condensation).

**Target Revised Model:**

- When air heats up, it gets bigger.
- When air cools down, it gets smaller.

**Procedure:**

If time permits, try putting the balloon in the 400 mL beaker. Then pour the hot water over it. It will expand, but the pressure from the beaker will prevent it from getting as large as before. Measure the volume now and discuss the effects of pressure on the volume of a gas.

When a gas is under high pressure, does it get bigger or smaller? If we release the pressure, by taking the balloon out of the beaker, what will happen? So when we reduce the pressure, what happens to the volume of a gas? When we changed the pressure from high to low, did we change the temperature? (If you put the balloon back in the large beaker with hot water they will see that you did not). Connection to weather: High pressure areas have calm, sunny weather. Low pressure areas have cloudy, windy or stormy weather. The pressure of the air is not related directly to the temperature of the air. You can have High pressure zones in the middle of the winter or low pressure zones on hot stormy summer days.

**Target Revised Model:**

- When a gas is under high pressure, it gets smaller
- When a gas is under low pressure, it gets bigger
- Pressure and temperature are not directly related

**Summary:**

Gas has size (volume). This size gets bigger when the temperature is hot, and smaller when it cools down. Under high pressure, a gas shrinks, while under low pressure it expands (gets big). Changes in volume like these are examples of physical changes.