The Same but Different
4th Grade
Jeremy White, Brent Greene, & Kathleen Waugaman

1. References:
   - www.crocodile-clips.com/gpv70/LP/chemistry/LP0008/LA0008.htm
   - Modified from a lesson prepared by Meghan Knapp

2. Benchmarks:
   PS-1, PS-3 & PS-4 (Benchmark A & B): Identify characteristics of a simple physical change. Describe objects by the properties of the materials from which they are made and that these properties can be used to separate or sort a group of objects. Explain that matter has different states and that each state has distinct physical properties.

3. Objectives:
   Students will recognize the phase change between solid and liquid and identify this as a physical change. They 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 and mass using grams.

4. Materials:
   - Container with frozen water (alternatively, a plastic container, or graduated plastic bag, as those used in disposable bottles).
   - balance for each group
   - 2 hot plates or thermos of hot water
   - 400 or 600 mL beaker (one per frozen container)
   - Tongs
   - safety goggles (class and teacher)
   - paper towels

   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.

5. Initial Demonstration:
   Show the students the frozen container filled with ice. Ask the students what will happen if we let the ice sit out in the room. Ask the students if there will be more, less or the same amount of water when it melts. The students should explain why they made the guess they did. What is meant by “more” or “less”? (Do we mean smaller or bigger, or heavier or lighter). Use this as a springboard to discuss mass and volume. Ask them when the ice melts will the stuff in the beaker be the same stuff? It is still water, but it
has a different form. Remind students that they learned about phase changes last year. This is a physical change, because it is the same (water) but a different state of matter.

6. Target Observations:

- The water as a solid has a certain size and shape.
- When it melts, it will still be water, and have a certain size, but it will take the shape of its container.

7. Target Model:

- Physical changes cause things that are the same to have a different form.

8. Procedure:

Have students practice measuring the mass and the volume of the ice.

Hints:
- Measure the volume first to see the most dramatic change
- To reinforce the idea of “controls”, dry off the frozen container each time before you weigh it. When it is cold, it will have condensed water, when it has melted it will have water from the warm water bath.
- It may be convenient to have multiple frozen containers and balances so each student will have a chance to try.
- Perhaps some students can make the “before” measurements and some students can make the “after” measurements.

Once the measurements have been made, use the tongs to place the frozen container in a warm water bath to allow the ice to melt. This should take about 10 minutes, depending on the temperature of the water. Was there more or less when the ice melted? When there was less water, was it still water? So when there is the same stuff, but a different size, it is a physical change. Did it weigh more or less? What are two ways we can measure “more or less”? What is the third state of matter? If we turned this water into a gas, would it still be water (yes, just in a different form). Would it weigh the same? (yes) Would it have the same volume? (no)

9. Target Observations:

- A change in phase/state often means a change in size (volume) too
- The mass remains the same (neither created or destroyed)

10. Summary:

The mass and volume of water were measured. The difference between observation and inferences was pointed out- inferences explain observations, and
observations are just things we notice about our world, things we measure, see, heat, etc. Physical changes include changes in shape or size.
The Same but Different (Part II)
4th Grade
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3. 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.

4. Materials:
   - 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)

5. 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).
6. Target Observations:

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

7. Target Model:

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

8. 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?

9. Target Observations:

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

11. 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.