



States of Matter – Grades 3-5

Nebraska Science Standards

5.2.1.a Identify mixtures and pure substances

5.2.1.b Identify physical properties of matter (color, odor, elasticity, weight, volume)

5.2.1.c Use appropriate metric measurements to describe physical properties

5.2.1.d Identify state changes caused by heating and cooling solids, liquids, and gases

Objective: The objective of this lesson is to provide students a hands-on activity that allows them to observe the states of matter and create a chemical change by producing a polymer.

Materials (provided by CSM):

- Activity worksheet
- Colored glue bottles
- Plastic cups
- Paper towels
- Stir sticks
- Measuring cups
- Borax
- Plastic bags
- Permanent marker

Materials (provided by the classroom):

- Water

Discussion: (Questions to ask the students)

- Ask the students if they know the three states of matter?
 - Solid, liquid, and gas
- What are the transitions between each state?
 - Solids to a liquid result in melting.
 - Liquids to a gas result in evaporation.
 - Gases to a liquid result in condensation.
 - Solids to a gas result in sublimation (this is observed with dry ice or fog machines).
- What is the difference between a chemical and a physical change?

- Chemical change is when the reaction completely changes the object. In other words, the reaction is irreversible.
 - Burning a piece of paper. You cannot take the paper ashes and put them back together to recreate the piece of paper.
 - Baking a cake. You cannot take out the ingredients after you bake a cake!
- Physical change is when the reaction only partially changes the subject.
 - Tearing a piece of a paper into 1,000 pieces. It would be difficult, but you could put all the pieces back together.
 - Making a salad. If you do not like a certain vegetable, you can take it out and it's still a salad!

States of Matter Worksheet

Setup:

- Handout the worksheet to all the students.
- They can work in groups or pairs, depending on how the class is set up.
- Go through each question and make sure they understand what you are asking.
- Have them write down as many answers as they can to the worksheet questions. Give them about 1-2 minutes for each question. Go through some of their answers and see which group had the most!

Discussion Questions Continued

- What is a polymer?
 - A polymer is a long chain of molecules that have been bound together.
 - To better understand this, think about cooked spaghetti noodles. The noodle is long and slides easily without sticking when it was first cooked. Once they start to dry, the noodles stick and clump together and become like rubber.
 - The long chains of molecules are similar to the wet noodles when they stick together
- What is an example of a polymer?
 - Plastics and resins are polymers. A bouncy ball is a type of polymer.
 - The long chains of molecules can “stick together” in different ways which is why some plastics are hard and some are elastic or bouncy.

Polymer Activity Description:

For this activity, the students will create a bouncy ball. This reaction is called a polymerization reaction. Polymerization is a process in which relatively small molecules combine chemically to produce a large network molecule.

Setup:

- When passing out materials, remind students to not touch anything on their desk until they are instructed to do so.
- Try to use warm water, if possible, the borax will dissolve better this way.
- Give each student a paper towel, a cup, and a stir stick.

Procedure:

1. Add ~1/2 tablespoon (or less) of Borax to each cup.
2. Add 4 tablespoons of warm water to each cup
3. Mix with the stir stick, dissolving as much Borax as possible
4. Ask the students what kind of reaction is happening in their cups. The answer is a physical reaction. We are not changing the state of matter of either the Borax or the water. They may think it is chemical reaction because the Borax dissolves but have them think about making lemonade or Kool-Aid with sugar packets. When you mix the water and sugar, it is just sugar water. No chemical change is present!
5. Add 1 tablespoon of glue to the mixture and have the students begin mixing immediately. Because glue is hard to clean, just eyeball a tablespoon of glue. Do not use the tablespoon. The students can choose which color they like.
6. After stirring for a few seconds, take out the glue and pop the “glue bubbles” with your hands. The chemical reaction only takes place on the outside of the glue blob. Popping the bubbles exposes the liquid glue on the inside. Put the glue back in the mixture and stir again so the liquid glue can solidify.
7. Continue this process until all the bubbles are gone.
8. Start rolling the glue into a ball and continue to shape/roll the glue until a ball has formed. It is important to get the polymer into a ball before it starts to dry, as it will dry quickly. Make sure the kids know to do this part fast or else their experiment won't work out
9. Put the bouncy balls in plastic bags and write their names on them to take home.