



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.

Worksheet

Materials (provided by CSM):

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

Discussion:

Have the students get out a piece of paper and a pencil. 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.**
- They should know the states of matter, but transitions and chemical and physical changes may need extra help.
- Then have them write down as many answers as they can to the following questions. Give them about 1-2 minutes for each question. Go through some of their answers and see which group had the most!
- What are the three basic states of matter? Examples.
 - Solid
 - Liquid
 - Gas
- What are the transitions between each state? Examples.

- Solid → liquid= melting
- Liquid → gas= evaporation
- Gas → liquid= condensation
- Solid → gas = sublimation (they will probably not know this so only explain it if a student brings it up)
- What is the difference between a chemical and a physical change? Examples.
 - Chemical change- 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- The reaction only partially changes the subject.
 - Tearing a piece of a paper into 1.000 pieces. It would be really hard, 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!
- What is a polymer?
 - A polymer is a long chain of molecules that have been bound together
 - To better understand, think about cooked spaghetti noodles -- The noodle is long and slides easily without sticking. Once they start to dry the noodles stick and clump together and become kind of rubber like
 - The long chains of molecules are similar to the wet noodles when they stick together
 - What is an example of a polymer?
 - Plastics (like a bouncy ball!) & resins
 - The long chains of molecules can "Stick" in different ways which is why some plastics are hard and some are elastic/bouncy

Activity Description:

For this activity, the students will create a bouncy ball. This reaction is called a polymerization reaction.

Polymerization- a process in which relatively small molecules combine chemically to produce a large network molecule. Think of individuals beads strung together to make a necklace.

Things to remember:

- 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

Set up: 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 because the Borax dissolves. 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 here!
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.
 - Continue this process until all the bubbles are gone. This is a chemical reaction because the glue turns from a solid to a liquid.
7. Start rolling the glue into a ball - continue to shape/roll until a ball has formed (it will dry quickly)
 - It is important to get the polymer into a ball before it starts to dry -- make sure the kids know to do this part fast or else their experiment won't work out
8. Put the bouncy balls in plastic bags and write their names on them to take home.