BRUCE MUSEUM
www.brucemuseum.org

Bruce Museum at Home

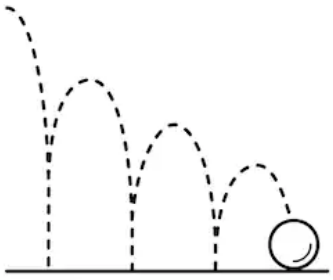
STEAM Activities for Children

Lesson # 13: *Bouncy Balls*

Week of June 22, 2020

This week's STEAM at Home lesson is a continuation of last week's exploration of the properties of polymers. Learners will create a bouncy ball while exploring the physical and chemical interactions of two polymers. The experiments this week do not use materials that are difficult to source; if you've made the projects for the last two weeks, you may already have everything you need!

These experiments are messy and require specific materials. Please plan accordingly before beginning any of these projects with your learners.



Learners will use their science journals to predict, record, and explore their experiments. If your learner hasn't made a science journal, instructions can be found here. If learners have a notebook or other paper they prefer to use, that's fine.

In order of appearance, this lesson contains: a materials list for *Bouncy Balls*, instructions for the experiment, ways to add onto the activity, a simple art activity, and NGSS Performance Expectations. Additionally, a list of chemistry vocabulary words is available as a separate document, and can be found here.

A note for adults: This week's art project calls for boiling water. Both the experiment and the art project can be messy and use borax, which is a detergent. Please make sure your learner is supported in working with hot water and that you watch out for any physical reaction to borax, which can cause skin irritation.

Materials for the Bouncing Balls: borax, corn starch, two cups for mixing, non-metallic stirrers (popsicle sticks, plastic spoons, etc.), three cups of warm/room temperature water, 1 container school glue, measuring cups, and spoons.

Optional experimental materials: glitter or food coloring.

Materials for art project: borax, pipe cleaners, at least 1 large glass jar (we used old pickle jars), string, pencils or chopsticks, 4-8 cups of just boiled water.

Bounce it Out

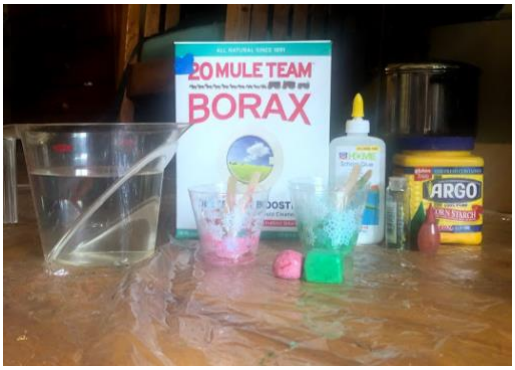
Make sure you have the materials laid out before you start. Ask your learner to use their science journals to speculate about what you might be making today.

- Have they used these materials before? (If you participated in the past few weeks of STEAM at Home activities, these materials will be familiar).
- How have they used these materials?
- What are the physical properties they've noticed or experimented with previously?

As we learned previously, glue, warm water, and borax will mix together and create long interlocking chains of molecules called **polymers**, creating a non-Newtonian fluid commonly referred to as slime**.** The polymer chains in slime compress under hard pressure or fast movement and cause the slime to behave like a solid. When touched gently, or slowly, the slime will behave like a liquid. This experiment tests what happens when the tiny particles of cornstarch are introduced into the borax and glue mixture.

To make 1 bouncy ball, you will need the following supplies (multiply as needed for multiple or larger balls):

- 1 tablespoon white glue
- 1/2 teaspoon borax
- 1 tablespoon cornstarch
- 2 tablespoons warm water
- 2 stirring utensils
- 2 cups for mixing
- Measuring cup and measuring spoons
- Food coloring/glitter, if using



Get Mixing!

1. Pour the glue into one of the plastic cups. If you are using food coloring or glitter, add a few drops/shakes to the glue and mix well.
2. In the second cup, combine the water and borax together and stir until dissolved.
3. Add the cornstarch, 1/2 teaspoon of the borax, and water solution to the glue and let stand for about three breaths.
4. After three breaths, stir until fully mixed together; the mixture will become sticky and difficult to stir.
5. When the mixture is fully stirred and sticking to the stirring utensil, remove from the cup and mold into a ball with your hands. The ball will be sticky at first, but it will become more solid as you roll it in your hands.
    a. Our balls stayed somewhat sticky, but still behaved like bouncy balls.
6. You should now have a bouncing ball!
7. Just as with the homemade slime from last week, store your ball in an airtight container or Ziploc bag so it doesn't dry out and crumble.

Now that you have made a bouncy ball:

- Try bouncing the ball in an area with few breakable objects and observe how the ball bounces.
    - How high does it go?
    - Is there a pattern to the way the ball moves?
    - If you have a store-bought bouncy ball, compare its bounce to your homemade bouncy ball. Are they the same or different?
- Learners should note the texture, behavior, and any changes they observe in their bouncy ball.
- How is your homemade bouncy ball the same or different from a bouncy ball that you buy?

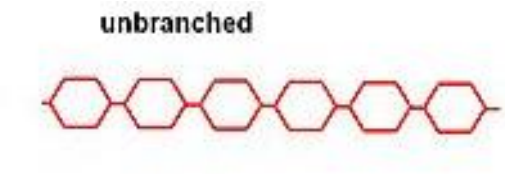
Ways to add on to the experiment:

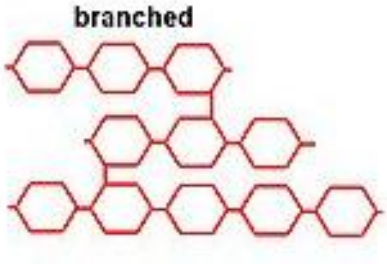
- Try experimenting with different ratios of borax to cornstarch to glue. How does the ball change?
    - Only change one element at a time, for a more accurate experiment.
- What happens if your learners make a bigger ball by doubling the recipe?
- What happens if you use cool water, or hot water, in the mixture?

Learners should write their ideas and experiments down in their science journals.

Why does this work?

School glue contains **polyvinyl acetate**, a strong and flexible polymer that gives slime its changing physical properties and gives the bouncy ball strength. The cornstarch contains **amylopectin**, a polymer that is shaped like the branches of a tree.





The amylopectin gives the homemade bouncy ball the property of elasticity. Elasticity allows the bouncy ball to return to its original shape after being compressed or stretched by hitting the floor. Because the ball is elastic, instead of splattering or shattering when thrown at the floor, the ball bounces back up.

The borax is needed to help the glue and the starch stick together, connecting the two polymers into a net-like formation, keeping the ball from crumbling or becoming slime when it is bounced.

Art Project: Borax Crystals

While we have been experimenting with borax in solution, or in mixtures, this art project exploits borax's natural crystalline properties.

Prepare the materials in advance of the experiment. Before getting started, set your water to boil; you will need at least 4 cups.

Have your learner shape their pipe cleaners into the shape they would like covered in crystals. Show your learner your jars and explain that the shapes will be suspended from the top and should be free of the sides and bottom of the jar. The borax crystals will take on the color of the pipe cleaners, as the crystals will be completely clear

Fill your jars with the water once it has boiled and then stir in borax powder until it no longer dissolves. Make sure you use oven mitts to protect you and your learner from the hot water. Use a stirring stick that won't melt!

The amount of borax you will need will vary based on the size of the jar that is being filled. Roughly 3-4 tablespoons of borax will be needed for each cup of water.

Using a pencil or a chopstick and some string or thread, hang the pipe cleaner shape in the borax solution so that it is submerged and not touching the sides or bottom. Now all you and your learner have to do is wait 12-24 hours and your crystals will form. You might even see crystals within 6 hours.

When your crystals are done forming, remove them from the jar and dry it off, you can hang your shapes in your window as a suncatcher, collect them in a box together, or make more!

NGSS Performance Expectations

2-PS1-2 Matter and Its Interactions: Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

5-PS1-4 Matter and Its Interactions: Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

5-PS1-3 Matter and Its Interactions: Make observations and measurements to identify materials based on their properties.