

Bouncing Polymer Ball Lesson Plan



The Bouncing Polymer Ball Experiment

(Teacher Notes)

Safety Concerns:

1. Make sure the students do not eat any of the materials used to make the ball or the ball itself.
2. Have the students wear PPE (personal protective equipment) such as latex gloves to prevent getting food colorings/materials on their hands.
3. Have the students clean up their work area and hands after completing the activity.

Objectives:

- Understand what polymers are and their distinct characteristics
- Understand how polymers can be made and how polymers can also break down into monomers
- Relate the formation of bouncy ball to polymerization (creation of chain-like molecules) and depolymerization (breaking down polymers into monomers/individual molecules)

Materials:

- Borax ($\frac{1}{2}$ teaspoon for each ball)
- Warm Water (2 tablespoons for each ball)
- Cornstarch (1 tablespoon for each ball)
- Elmer's Glue (1 tablespoon for each ball)
- Measuring Spoons ($\frac{1}{2}$ teaspoon, 2 tablespoons, 1 tablespoon)
- Stirring bars/Wood popsicle sticks (# of students in class + maybe few extra)
- Ziploc Bag (# of students in class + maybe few extra)
- Sharpie (for writing their names on the ziploc bag)
- 2 Plastic Cups (for each ball)
- Food Coloring (optional)

Procedure:

Try to find an optimal ratio of borax, glue, cornstarch, and water before hosting the activity

1. Pour **2 tablespoons of warm water** and **$\frac{1}{2}$ teaspoon of borax powder** into one cup. Stir the mixture until borax (white powder) dissolves. Add food coloring, if desired! Label this cup as "**Borax solution**".
2. In the second cup, pour in **1 tablespoon of glue**. Add **$\frac{1}{2}$ teaspoon of the "Borax Solution"** from step 1 and **1 tablespoon of cornstarch**. **DO NOT STIR.**

3. **Wait** and allow the ingredients to interact on their own for **10-15** seconds and then **stir them together to fully mix**. Once the mixture becomes gummy enough, take it out of the cup and start molding the ball with your hands.
4. The ball will start out sticky and messy, but will **solidify** as **you knead it**.
5. Once the ball is less sticky, you can **bounce** it!

The Science Behind Bouncy Balls!

- Polymer = A chain of monomers.
- Monomer = Single units that make up a polymer.
- Crosslinker = A molecule that allows 2 polymer strands to bind.
- When borax and glue are combined, borax acts as a “**crosslinker**” that helps to connect already-existing polymer molecules of the glue.
 - This helps explain how the combined materials become more slimy as you mix them.
- Cornstarch then helps to further bind the molecules.
 - This helps explain how the bouncy balls are ultimately solidified enough to mold them into a ball.
- The reason behind waiting for the ingredients to interact on their own before stirring is to allow for enough time for chemical reactions to take place (creating chains of polymers).

Troubleshooting Tips

- ★ Add more cornstarch to make the ball more stretchy.
- ★ Add more glue to make the ball more slimy.
- ★ Add more borax to make the ball less sticky.

Take it further!

- Have the students try creating bouncy ball using different ratios of borax, glue, corn starch, and water & observe the different outcomes (viscosity of the ball, stickiness of the ball, bounciness of the ball...etc)
 - Have the students understand the role of each material.
 - Borax = Crosslinker.
 - Glue = Contain polymers that will be further polymerized by borax.
 - Cornstarch = Tightly bind molecules to make the ball more bouncy.
 - Water = To dissolve borax powder & allow
- ❖ Page **4-12** is for [students](#) to use while performing the activity
- ❖ Page **13** includes an [answer for teachers](#) to use while helping students answer questions on page **12** (post-lab)

SCIENTIST
Name:

EXPERIMENT
DATE:

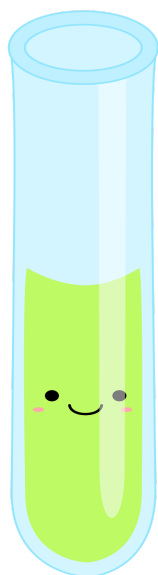
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The Bouncing Polymer Ball Experiment

*Playing with a bouncing ball is fun :)
BUT have you ever thought of making
your own bouncing ball??*



Hi guys! My name is
Owl the Scientist.
Today we are going to
make a bouncing
ball!



Hi! My name is
'Borax Solution.' I
am made of
tablespoons of
warm water and 1/2
teaspoon borax
powder.



For our experiment, we will be mixing Borax and Warm Water in one cup.

Borax

Warm Water



Hi!! My name is
'Ball mixture.' I am
made of 1 tablespoon
of glue and $\frac{1}{2}$ spoon
of 'Borax Solution'
and 1 tablespoon of
cornstarch.

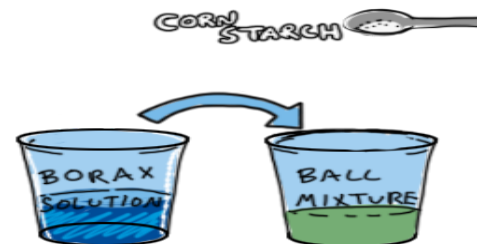
For our experiment,
we will put glue, 'borax solution', and cornstarch in another cup.

Glue

Cornstarch

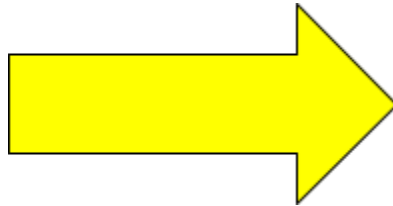
Borax

Solution

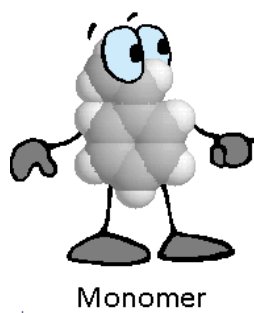
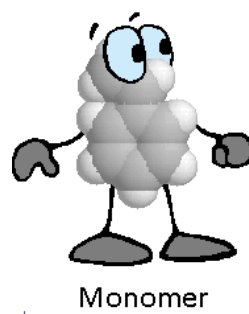
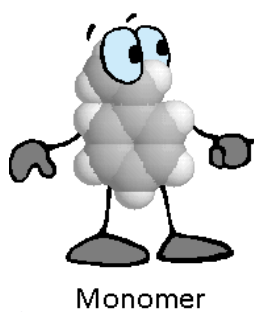
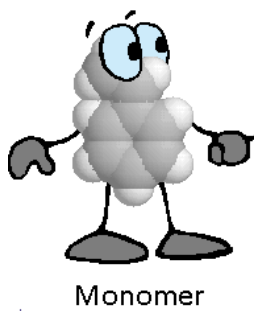
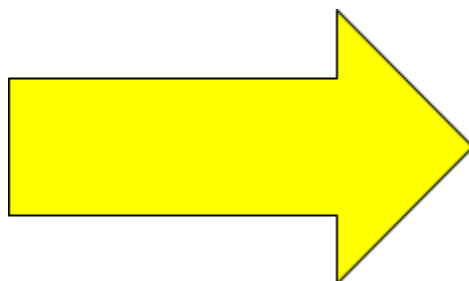




A quick question!! I have the 'ball mixture' in my hand. Do you think that I should stir it?

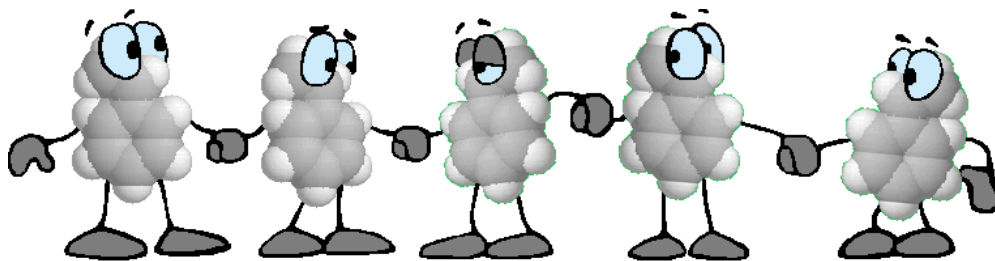
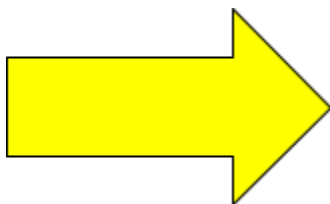


If you **stir** the 'ball mixture' they will become **monomers** meaning the mixture will not be all connected to each other!!





If you **do not** stir the 'ball mixture' they will become **polymers** meaning the mixture will be all connected to each other!!



Polymer



Now it is time for you
to think! Do you want
them to be separated
or not?

Circle **O** (STIR IT!)

or

Circle **X** (DO NOT STIR IT!)





Oh! No!
I became a
blob.



Yay! I
became a
bouncing ball!
Thank you
guys!

The bouncing ball in this activity is made from a polymer. Polymers are molecules made up of repeating blocks. Glue contains the polymer, which entangles when mixed with borax.



Bouncing Polymer Ball Lab

Post Lab Questions:

1. Why did we add glue to the 'ball mixture solution'?

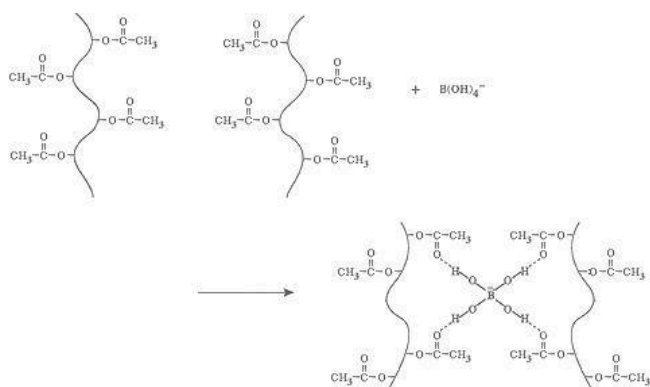
2. Why did we not stir the 'ball mixture solution'?

Bouncing Polymer Ball POST-LAB **ANSWER KEY**

Post Lab Questions:

3. Why did we add glue to the 'ball mixture solution'?

A: The bouncing ball in this activity is made from a polymer. Polymer molecules entangle themselves together like chains and that makes them unique! (Glue contains the polymer polyvinyl acetate, which cross-links to itself when mixed with 'borax solution.')



4. Why did we not stir the 'ball mixture solution'?

A: We do not stir the 'ball mixture solution' because it takes some time for the glue to cross-link itself with the 'borax solution.' If we immediately stir the 'ball mixture solution' after pouring in the 'borax solution' we are preventing them from connecting with each other by physically disrupting their state. **A good analogy would be... if we are all holding hands and there is a strong tornado it would be hard for us to stay altogether, yet if there is no tornado it is easy to stay with each other**

