

A Sticky Situation

Grade: 3-4

Time: 45min

Activity Overview :

What do you think makes glue so sticky? Today you will explore this as you are the lead chemical engineer in a high-end shoe factory. Your factory decided that they are going to make a change to be entirely environmentally friendly in the next 5 years. You have been given a very important task to come up with a new adhesive (glue) to be used in the manufacturing process of the shoes. You must create this glue with completely eco friendly products, since your old glue was made from petroleum, which is a fossil fuel. You will experiment with different proportions of materials and observe the effects of certain chemical reactions.

Before we begin think about the following questions:

- What gives glue its consistency? Can you change it to make it stickier?
- How can glue be created to be eco friendly?
- What other things can be made to be eco friendly? What materials can be used?

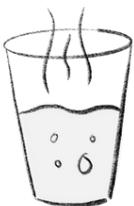
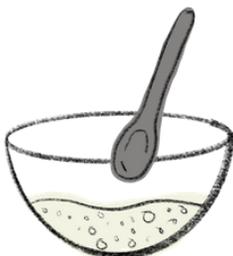
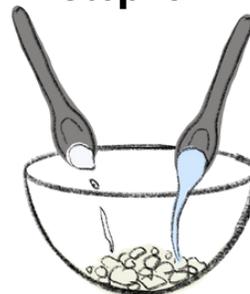
Materials:

- Powdered Milk (or just milk)
- Flour
- Water
- Vinegar
- Baking Soda
- Coffee Filter (or Paper Towel)
- Bowl
- Covered Container
- Sugar (Optional)
- Salt (Optional)
- Corn Syrup (Optional)
- Cornstarch (Optional)



Activity:

- 1 If you're using powdered milk, ask a parent to heat up $\frac{1}{4}$ cup of water. If you're using regular milk, ask a parent to warm $\frac{1}{4}$ cup of milk.
- 2 Dissolve the powdered milk in the hot water. If you're just using warm milk, skip this step.
- 3 Add in 1 tablespoon of vinegar and stir it into the mixture. Observe the chemical reaction occurring. The milk separates into liquid (whey) and solid (curds). Continue stirring until the mixture is completely separated.
- 5 Using a coffee filter or paper towel, filter the mixture through it. Do this over a bowl and discard the liquid. Then, add the solid curds into the bowl.
- 6 Add 1 teaspoon of hot water and 1 teaspoon of baking soda into the bowl with the curds and mix together. The left-over vinegar and the baking soda will create a bubbling chemical reaction here.
- 7 If you notice that your glue is too thick or lumpy, you can adjust it now. If it is too lumpy, add a small amount of baking soda. If it is too thick, add in some water and stir.
- 8 Pour the glue into a covered container so that you can keep it from drying out when you're not using it.
- 9 Make a craft to determine if your glue works well!
- 10 Compare it to normal white glue and observe the consistency difference, as well as what works best.

Step 1**Step 3****Step 5****Step 6****Step 8**

Engineering and Science Connections

Chemical Reactions and Proportions

When you were mixing the ingredients together, hopefully you noticed the chemical reactions occurring. Evidence that a chemical reaction occurred is when the substance shows a colour change, a gas is released (bubbles), a solid forms in a solution (precipitate), or a change in temperature occurs. When the vinegar was first added to the mixture, the milk separated into liquid whey and solid curds. When the baking soda was added to the mixture, the left-over vinegar combined with it to produce bubbles. These bubbles were an indication that a gas was released. You also probably observed how adding more of a certain ingredient was able to make a difference in the glue. Adding more baking soda made it less lumpy and adding more water made it thinner. This shows how important specific amounts are in chemistry and how they can have a big effect on the end product.

Renewable Agricultural Materials

In this activity, you were able to create a new type of glue, that is completely non-toxic and environmentally friendly. Your glue was made from renewable materials that are more abundant on earth. Renewable materials mean that they replenish quickly and do not run out. This is opposite to non-renewable resources such as fossil fuels, since they will eventually be all used up. Many popular examples of renewable materials are cellulose and starch which can be found in foods such as corn. Cellulose and starch are used to make many products such as renewable glues and bioplastic. Since these materials are made from food, they are biodegradable and very earth friendly.

Chemical Engineering

Chemical engineers focus on designing and developing manufacturing processes that involve chemicals. They mainly focus on the production of chemicals, fuel, food, and pharmaceuticals. Today, you used the right materials that were able to make the required glue needed in the factory, but also made it more eco-friendly. When the vinegar separated the milk into solid curds and liquid whey, you kept the curds. These curds are the protein components from the milk, which is called casein. Casein is actually natural glue when in its liquid state. Baking soda is basic and when it was added to the mixture, it neutralized the vinegar, turning the casein into its liquid form. The vinegar in the glue also acts as a natural preservative to help slow down the milk from spoiling.

Extensions

Make Different Types of Glue and Compare

Try making 3 different types of glue using this recipe:

- Make a batch of glue using the exact measurements stated in this procedure.
- Make another batch of glue but add more baking soda.
- Make another batch of glue but add more water.

Now, use the 3 types of glue on different crafts or items. Observe the difference of the glues. Which glue stuck the best? Why do you think that?

Other things you can do:

- Use different ratios of flour and water and mix it in a bowl.
- Observe the difference between the milk and flour mixture.
- Ask a parent to heat the mixture on medium until it boils.
- Use this glue on different crafts and see if it works better/worse than the glue mixture with milk.
- Look into more ingredients such as: sugar, salt, cornstarch, and corn syrup. See what kind of mixtures you can make to turn them into glue. Can you make a really sticky substance?

Share your creations!

Don't forget to share your experiments and creations with us! We would love to see what you've made. You can Email us at: esqinfo@uwaterloo.ca or send us a message/tag us on our social media!

Facebook: @uwengoutreach **Twitter:** @UWEngOutreach **Instagram:** @uwengoutreach

Thanks for exploring, discovering, and learning with us!

3, 2, 1 Done!

3 - Write or draw 3 things you learned from this activity

2 - Write or draw 2 things you found super interesting or cool and want to learn more about

1 - Do you have any questions about the activity? Did something make you wonder...what if? how? or why?