

Making Homemade Glue

A Sticky Experiment



Introduction

Make your own glue from common household items. Discover how easy it is—all you need is milk, vinegar and baking soda!

Concepts

- Chemical changes
- Coagulation
- Neutralization
- Precipitation

Materials

Milk (skim, 1% or 2%), 50 mL	Graduated cylinder, 50-mL
Sodium bicarbonate (baking soda), NaHCO ₃ , 1 g	Heat-resistant pad
Vinegar (0.8 M acetic acid), CH ₃ COOH, 10 mL	Hot plate or Bunsen burner setup
Water, tap, 10 mL	Paper scraps (for glue testing)
Beaker, 250-mL	Scoop
Beaker tongs or hot pad	Stirring rod
Erlenmeyer flask, 250-mL	Support stand and ring (for funnel)
Filter paper	Commercial white glue for comparison (optional)
Funnel	

Safety Precautions

Exercise caution when using a hot plate or Bunsen burner. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Please consult current Material Safety Data Sheets for additional safety, handling and disposal information.

Procedure

1. Measure 50 mL of skim, 1% or 2% milk and pour it into a 250-mL beaker.
2. Measure 10 mL of vinegar. Add the vinegar to the milk in the beaker.
3. Using a hot plate set on medium or a Bunsen burner setup, gently heat the milk/vinegar mixture, stirring constantly until small lumps begin to form.
4. Remove the beaker from the hot plate using beaker tongs or a hot pad and place on a heat-resistant pad. Turn off the hot plate. Allow the lumps (*curds*) to settle for approximately 5 minutes.
5. Prepare a filtration setup using a carefully folded piece of filter paper, a clean funnel, and a support stand with a ring. Moisten the filter paper with water so that it fits snugly in the funnel. Place a 250-mL or larger Erlenmeyer flask below the funnel.
6. Filter the curds from the *whey* (liquid). This step may take some time, as the curds in the funnel slow down the filtering process. Rinse the whey down the drain with water.
7. Gently press the filter paper around the curds to squeeze out the excess liquid and return the solid material from the filter paper to the empty beaker.
8. Add 5–10 mL of tap water to the solid. Stir to break up the large lumps. *Note:* Adjust the amount of water as needed to alter the glue's thickness and consistency.
9. Add a small scoop (about 1 g) of sodium bicarbonate to the beaker to neutralize any remaining acid from the vinegar. Watch for bubbles of gas to appear—this indicates that neutralization is occurring. Stir. The bubbles will subside within 15–20 minutes.

10. The substance in the beaker is glue! Test the adhesive properties of the product using scraps of paper. *Optional:* Conduct experiments comparing your glue to commercial white glue. How can you test the strength of different types of glue?

Disposal

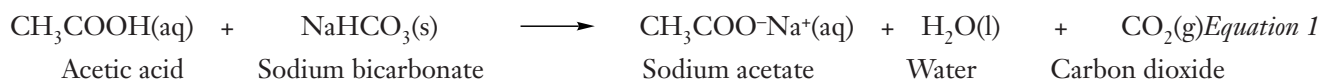
Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures, and review all federal, state and local regulations that may apply, before proceeding. Leftover glue may be rinsed down the drain with plenty of water according to Flinn Suggested Disposal Method #26b. The glued paper scraps may be placed in the trash according to Flinn Suggested Disposal Method #26a.

Tips

- 50 mL of milk is approximately $\frac{1}{4}$ cup. One quart of milk is sufficient for 16 students or groups.
- The glue is very wet when first applied to the paper test scraps. When allowed to dry, the glue has strong adhesive properties. If the glue is allowed to sit overnight, it will become clear and very watery. It will still maintain its adhesive properties.
- Demonstrate to your students the proper techniques for folding a piece of filter paper and assembling a filtration setup. If the curds in the funnel cause the filtration time to be unacceptably long, have students remove the liquid whey in small portions using a Beral-type pipet.

Discussion

White glue is commonly made from a protein in milk called *casein*. Cow's milk contains about 3% casein. Proteins are sensitive to changes in acidity and heat. Casein is easily extracted from milk by adding an acid, such as vinegar, and by adding gentle heat. Milk is a *colloid*, which is a mixture of liquids and very tiny solid undissolved particles of casein that are evenly spread throughout the liquid. The acid (vinegar) breaks down the protein (casein). This causes the casein to *precipitate* (or come out of solution) and *coagulate* (or clump together) into solid lumps called the *curd*. The leftover liquid is referred to as *whey*. When filtered, the curds remain in the filter paper and are used to make the glue. The whey, which contains mostly water and sugar, passes through the filter paper. When the acetic acid in the clumped casein is neutralized with baking soda (see Equation 1), the casein becomes soluble again and can be made into a white glue that dries transparent. The product sodium acetate does not seem to interfere with the glue's adhesive properties.



The glue-making process is very similar to the process of making cottage cheese, except that cheese-making involves using enzymes rather than vinegar to coagulate the casein. Nonfat (skim), 1% or 2% milk is best to use because the fat molecules in whole milk precipitate with the casein. These fat molecules interfere with the glue structure and weaken the glue's adhesive properties. The casein used in industry is manufactured from skim milk and is dried and ground up before it is made into glue. Casein is also used in paints and plastics.

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12

Evidence, models, and explanation
Constancy, change, and measurement

Content Standards: Grades 5–8

Content Standard B: Physical Science, properties and changes of properties in matter

Content Standards: Grades 9–12

Content Standard B: Physical Science, structure and properties of matter, chemical reactions

Reference

Baker, B.; Berger, S.; Bryce, H.; Gettman, N.; O'Brian, D.; Squires, L. *Chem-Pacs: Practical Activities with Common Substances*; Flinn Scientific: Batavia, IL, 1989; pp. 72–73.

Materials for *Making Homemade Glue* are available from Flinn Scientific, Inc.

Catalog No.	Description
V0005	White vinegar, 4 L
S0043	Sodium bicarbonate, 500 g

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.