

ELMER'S GLUE FROM MILK

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Did you ever wonder why Elmer's® white glue has a picture of a cow on the label? This is because cows make glue. Of course, this statement seems strange until you learn that it is the protein in the milk can be used to make glue. The protein in the milk is casein. So, in reality, cows make milk, but you can use milk to make glue.

Casein is actually a micelle consisting of a protein subunit that somehow stabilizes the micelle so that it limits its growth and stays dispersed in the milk colloid. The other components of casein are calcium and phosphate ions. When the protein subunit is removed from the casein micelle, they can clot together to form the curd that can be further treated to make cheese or an adhesive suitable for use in paper, plastics, or glues. When mixed with lime, the curds form a material know as whitewash, which was used in colonial times to paint houses.

Elmer's® glue used to be made from casein, however, it is now made from a polymer, polyvinylacetate (PVA) since that polymer is more stable and has a long shelf storage life. Elmer's® blue gel glue is made from polyvinylalcohol.

PROCEDURE

MATERIALS NEEDED:

- milk, regular, low fat, or skim
- vinegar, 5% acetic acid, $\text{HC}_2\text{H}_3\text{O}_2$
- baking soda, sodium bicarbonate, NaHCO_3
- beakers, 1000-mL and 250 or 400-mL
- strainer
- cheese cloth (available from hardware stores or natural food stores)
- stirrer
- hot plate

SAFETY PRECAUTIONS:

Wear safety goggles or glasses

Vinegar is a dilute solution of acetic acid. It should not cause any injuries to the skin, but it should be washed off with water in case of contact. If vinegar gets in the eyes, rinse well with water.

Other materials used in this experiment do not pose any safety hazards.

DISPOSAL:

Solid materials can be disposed of in the trash.

Liquids can be poured down the drain with running water.

EXPERIMENTAL PROCEDURE:

Measure 500 mL of milk into a 1000-mL beaker. Add 100 mL of vinegar to the milk and stir well. Warm the mixture on a hot plate, stirring occasionally.

When the mixture gets warm, the milk will curdle, forming lumps. Remove from the heat and stir until curdling stops. You have formed the famous curds and whey of *Little Miss Muffet* fame.

Place a piece of cheese cloth in a strainer and strain the mixture to separate the curds from the whey. Gently squeeze excess liquid from the curds.

Place the curds in a beaker and add about 50 mL of water and 5 grams (about one teaspoon) of baking soda (sodium bicarbonate) to neutralize any remaining vinegar and stir well. You now have white glue or casein glue.

Test the glue by pasting together two pieces of paper. Let the glue dry and try to separate the paper.

NOTE: This glue does not contain any preservatives. It will not keep for any long period of time and will probably spoil within 24 hours at room temperature.