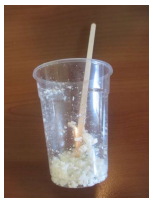
Milk glue

This glue is made from biodegradable food products and is environmentally friendly. Use your glue to make a collage of animal or nature pictures!

Experimental Steps:

1. Add two tablespoons of powdered milk to the plastic cup.
2. Add four tablespoons of hot water to the cup. (The water should not be boiling. Hot water from the tap works just fine.)
3. Mix the water and milk until dissolved.
4. Add 1 tablespoon of vinegar to the cup and mix well.
5. Stir the solution until the milk solids (curd) separates from the liquid (whey). This should take about one minute.
6. Pour the solution into a coffee filter placed over a plastic cup. You will use this to remove the liquids from the solids.

7. Squeeze the liquid into the plastic cup. Dry the curd as much as possible. Discard the liquid in the plastic cup down the drain.

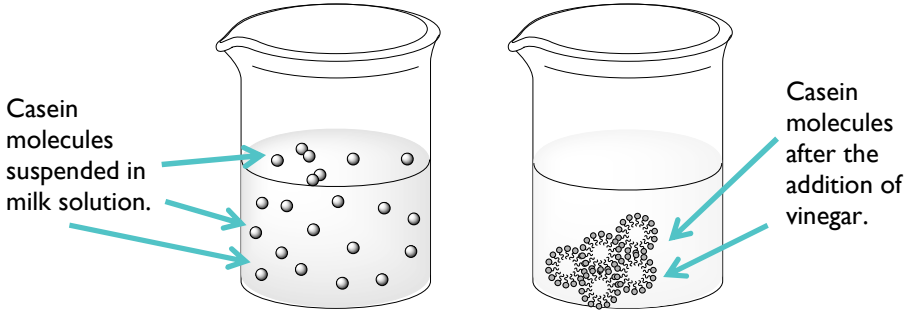


8. Break the curd up into smaller pieces and place it back into the plastic cup.
9. Add one tablespoon of hot water. (The water should not be boiling. Hot water from the tap works just fine.)
10. Add 1 teaspoon of baking soda to the curd and water. Mix everything thoroughly breaking up the clumps of curd. Your glue is not ready to use!

11. Store the glue in an airtight container in the refrigerator. The glue will last approximately two weeks.

Milk glue: Scientific Explanation

Milk is not a uniform liquid. It is a solution made of several types of molecules (proteins, fats, lipids) suspended in water. One of those molecules is the protein casein. There are four different kinds of casein, which make up approximately 80% of the total protein in milk.



Adding vinegar (acetic acid) to milk forces the casein molecules to clump together and form structures called micelles (molecular 'bubbles'). They can now be separated from the liquid whey. The same reaction is used in the first step of many cheese making processes.

The solid curd (acidic casein molecules) can be loosened and returned to a liquid state by reacting the acid with a base (baking soda-Sodium bicarbonate).

$$H_3COOH + NaHCO_3 \rightarrow NaH_3COO + CO_2 + H_2O$$

acetic acid + sodium bicarbonate → sodium acetate + carbon dioxide + water

Mixing this acid and base creates a salt (sodium acetate), carbon dioxide, and water. The carbon dioxide gas is released which is why you see bubbles at the last step. Adding the base neutralizes the acid and causes the clumps to break down into long, sticky polymer chains.