Name: _____
Hour: ____ Date: _____

Chemistry: *Casein Glue*

Purpose: In this activity, you will separate a mixture and synthesize glue.

Background:

Homogenized cow's milk contains 4.4% fat, 3.8% protein, and 4.9% sugar. It has been well-mixed to prevent it from separating. At the normal pH of milk (about 6.3 – 6.6), the protein, called casein, remains evenly dispersed in the solution. When an acid is added to the mixture, the pH drops and the casein can no longer stay dissolved; it coagulates into an insoluble mass. This coagulation of casein occurs at a pH of about 4.6.

HOMOGENIZED MILK = FAT + PROTEIN (casein) + SUGAR (lactose)

We will use skim milk in this activity, since it is easier to work with.

Pre-lab:

1. "Milk is a mixture, not a compound." Explain this statement.

2. Is milk an acid or a base? How do you know?

3. In this activity, you will add vinegar (also called acetic acid) to the milk. What is the reason for this?

4. Could other acids (hydrochloric, sulfuric, or nitric, for example) be used to separate the casein from the solution instead of acetic acid?

5. Think of one reason why we are using acetic acid in this activity and not some other type of acid.

Procedure:

1. Pour about 100 mL of skim milk into a 400 mL beaker. Add 15 mL of white vinegar (5% acetic acid).

2. Place the mixture on a hot plate and heat, stirring gently with a glass stirring rod. Observe the mixture carefully and stop when you see turbidity (solid curds floating in the beaker). Do not overheat the mixture; the protein will denature and your glue won't work.

3. Filter the mixture, using a folded piece of paper towel, into an Erlenmeyer flask. The curds should remain in the paper towel, while the filtrate (i.e., the liquid) will filter through into the flask. Discard the liquid filtrate; this contains the whey.

4. Scrape the curds from the paper towel into a small plastic cup.

5. Add ½ teaspoon of baking soda ($NaHCO_3$) to the cup and stir with a wooden splint. Slowly add drops of water, stirring periodically, until the consistency of white glue is obtained.

6. Use your glue to make a collage. Put your name on your collage and set it aside to dry overnight.

As the lab progresses you must write down observations. To prove or disprove the Conservation of Mass Law, you must mass all equipment and chemicals. Make a data table to record the mass and pH.

PROCEDURE

**The procedures do not say when to mass your samples or take pH readings, you will need to decide when it is appropriate to do so.

1. Pour about 100 mL of nonfat milk into a 400 mL beaker. Add 15 mL of white vinegar (5% acetic acid).

2. Place the mixture on a hot plate and heat - while gently stirring with a thermometer. Observe the mixture carefully and record the temperature of the solution when you begin to see turbidity (chunks floating in the beaker). Stop heating if the temperature of the solution becomes warmer than 60 ^{o}C.

3. Filter the mixture through a folded pieces of paper towel into an Erlenmeyer flask, as shown.

4. Discard the filtrate which contains the whey. Scrape the curds from the filter paper back into the 400 mL beaker.

5. Add about 1 g of $NaHCO_3$ (baking soda) to the beaker and stir. Slowly add drops of water, stirring intermittently, until the consistency of white glue is obtained.

6. Use your glue to fasten together two pieces of paper. Also fasten together two sets of wooden splints. Allow the splints to dry overnight, and then test the joint for *strength and water resistance.

* If you test the strength of the glue with a spring scale...must be sure to use equal amounts of glue on each joint.

WRITE-UP

1. Show that mass was conserved in this lab
2. What are the physical and chemical properties used/tested in this lab? List at least one for each step.
3. What data could you take that would allow you to calculate the % protein recovered in the milk?
4. Look up how fat is removed from milk to produce skim and non-fat milk and describe the process.