Milk Plastic

Category: Chemistry

Type: Class Experiment (30 minutes)

Materials:

	Whole milk
	White vinegar
1	Measuring cup
1	Saucepan
1	Hot plate
1	Spoon
1	Bottle of food coloring
1	Tray
	Wax paper

BE CAREFUL WITH THE HOT MILK!! AN ADULT SHOULD HELP WITH THIS PROJECT.

How To:

Measure one cup of milk and pour it into the saucepan.

Heat the milk but do not let it boil.

While waiting for the milk to heat, put one tablespoon of vinegar into a bowl.

When the milk is hot, pour it into the bowl with the vinegar.

Stir the milk and vinegar mixture
and watch what happens.

Place a sieve over a saucepan or another bowl.
Pour the milk/vinegar mixture into the sieve
and let the liquid drip out.

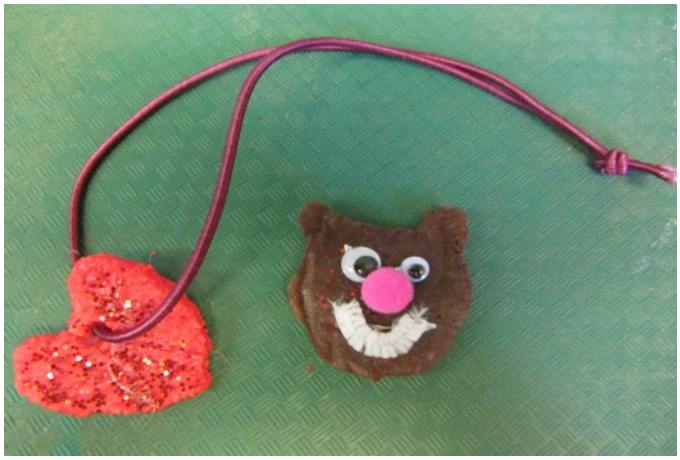
Rinse the remaining “milk plastic” with water.
Drain as much liquid as possible.

Add some food coloring to the
“milk plastic” and mix gently.

Cover a tray with wax paper. Place the mix onto
the tray and shape it using your fingers.

If you want to hang the model,
use a dowel to make a hole in it.

Let the models dry for a few days until they are hard.



Decorate them however you want.

Fine Points:

→ One cup of milk produces enough plastic for one model.
→ Kitchen towels can also be used to absorb excess liquid. This will help speed up the drying process.
→ If you want to paint your models, skip the food coloring step to have a blank canvas.

Objectives:

During this activity students will:

1. Make an interesting material from milk fat.
2. Make and decorate milk plastic models
3. Learn about monomers and polymers.

Concepts Involved:

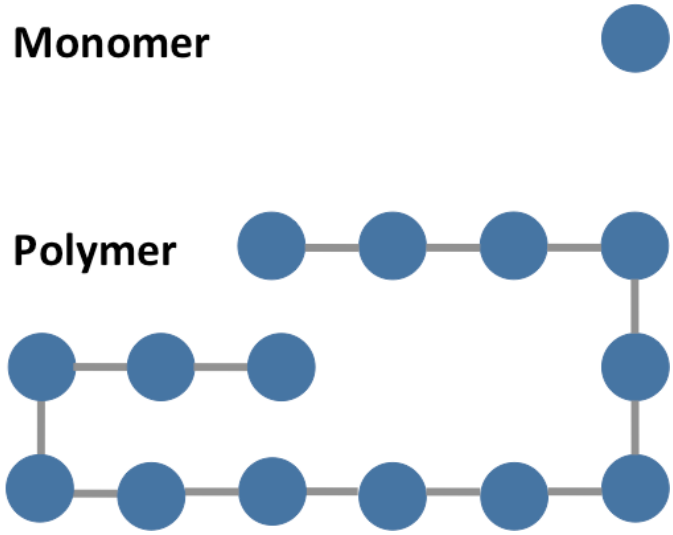
- A monomer is a molecule that can combine with other molecules to form a polymer.
- A polymer is a large molecule made up of chains or rings of linked monomers.
- Coagulation is the transformation of a fluid into a solid mass.

Focus Questions:

1. What do you think will happen when hot milk is mixed with vinegar?
2. Would the same happen with different types of milk such as low fat, almond or soy milk? Try it!
3. What would happen if different amounts of vinegar were used? Try it!
4. Vinegar is an acid. Do you think this experiment would work with other acids at home, for example lemon juice?
5. Do you think it would it work with cold milk?

Elaboration:

Milk is made from fat, proteins, carbohydrates, water and minerals and is used to make lots of different things. Some of these you know, like butter, cheese and ice cream but some you might not know about, like plastic. Plastics are *polymers*, and the prefix "poly" means many. Plastics are made up of many repeating units, known as *monomers*. One unit by itself is called a monomer, and monomers joined together are polymers.



Casein is one of the major proteins found in milk. A protein is a chain of amino acid molecules, so it can act like a polymer, though this chain is often tightly bunched up. When milk is heated it *coagulates*. Coagulation is the transformation of a liquid into a soft, semisolid, or solid mass. When the heated milk is added to the vinegar we can see the formation of small white chunks in the mixture. The white chunks are called *curds* and we say the vinegar caused the milk to *curdle*. The curds are formed because the acid in vinegar breaks some bonds in the casein molecules so that they unfold and reorganize into a long chain, like a proper polymer. This is what we pack together to make the models!

Links to k-12 CA Content Standards:

Grades k-8 Standard Set Investigation and Experimentation:
Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other strands, students should develop their own questions and perform investigations.

Grades k-12 Mathematical Reasoning:
1.0 Students make decisions about how to approach problems:
1.1 Analyze problems by identifying relationships, distinguishing relevant from irrelevant information, sequencing and prioritizing information, and observing patterns.
1.2 Determine when and how to break a problem into simpler parts.

2.0 Students use strategies, skills, and concepts in finding solutions:
1.1 Use estimation to verify the reasonableness of calculated results.
1.2 2.2 Apply strategies and results from simpler problems to more complex problems.
1.3 Use a variety of methods, such as words, numbers, symbols, charts, graphs, tables, diagrams, and models, to explain mathematical reasoning.
2.5 Indicate the relative advantages of exact and approximate solutions to problems and give answers to a specified degree of accuracy.

3.0 Students move beyond a particular problem by generalizing to other situations:
3.1 Evaluate the reasonableness of the solution in the context of the original situation.
3.2 Note the method of deriving the solution and demonstrate a conceptual understanding of the derivation by solving similar problems.
3.3 Develop generalizations of the results obtained and apply them in other circumstances.

Grade 1 Standard Set 1. Physical Sciences

Materials come in different forms (states), including solids, liquids, and gases. As a basis for understanding this concept:

1.a. Students know solids, liquids, and gases have different properties.

1.b. Students know the properties of substances can change when the substances are mixed, cooled, or heated.

Grade 3 Standard Set 1. Physical Sciences

Energy and matter have multiple forms and can be changed from one form to another. As a basis for understanding this concept:

1.e. Students know matter has three forms: solid, liquid, and gas.

1.f. Students know evaporation and melting are changes that occur when the objects are heated.

1.g. Students know that when two or more substances are combined, a new substance may be formed with properties that are different from those of the original materials.

1.h. Students know all matter is made of small particles called atoms, too small to see with the naked eye.

Grade 5 Standards Set 5. Physical Science

Elements and their combinations account for all the varied types of matter in the world. As a basis for understanding this concept:

5.a. Students know that during chemical reactions the atoms in the reactants rearrange to form products with different properties.

5.b. Students know all matter is made of atoms, which may combine to form molecules.

Grade 8 Science Standard Set 3. Structure of Matter

Each of the more than 100 elements of matter has distinct properties and a distinct atomic structure. All forms of matter are composed of one or more of the elements. As a basis for understanding this concept:

3.c. Students know atoms and molecules form solids by building up repeating patterns, such as the crystal structure of NaCl or long-chain polymers.

3.d. Students know the states of matter (solid, liquid, gas) depend on molecular motion.

3.e. Students know that in solids the atoms are closely locked in position and can only vibrate; in liquids the atoms and molecules are more loosely connected and can collide with and move past one another; and in gases the atoms and molecules are free to move independently, colliding frequently.

Grade 9-12 Science Standard Set 10. Organic Chemistry and Biochemistry

The bonding characteristics of carbon allow the formation of many different organic molecules of varied sizes, shapes, and chemical properties and provide the biochemical basis of life. As a basis for understanding this concept:

10.a. Students know large molecules (polymers), such as proteins, nucleic acids, and starch, are formed by repetitive combinations of simple subunits.

10.b. Students know the bonding characteristics of carbon that result in the formation of a large variety of structures ranging from simple hydrocarbons to complex polymers and biological molecules.