



Toy Creations

Did you know you can turn milk into plastic? Use a chemical reaction to turn milk into a moldable polymer that you can shape into your own toy to enjoy!

TEKS:

SCI 5.5 C: The student is expected to identify changes that can occur in the physical properties of the ingredients of solutions such as dissolving salt in water or adding lemon juice to water.

SCI 6.5 C: The student is expected to identify the formation of a new substance by using the evidence of a possible chemical change such as production of a gas, change in temperature, production of a precipitate, or color change.

SCI 7.6: The student knows that matter has physical and chemical properties and can undergo physical and chemical changes. The student is expected to distinguish between physical and chemical changes in matter.

Materials:

- Cookie cutters
- Decorating materials: glitter, markers, paint, paint brushes, etc. (optional)
- Fine mesh strainer
- Food coloring (optional)
- Measuring cup
- Microwave
- Microwave-safe bowl
- Milk (1 cup)
- Paper towels
- Spoon
- Teaspoon
- Timer or clock
- Vinegar or lemon juice (1/2 cup)

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How To:

1. Pour one cup of milk into a microwave-safe bowl and heat it in the microwave until it just starts steaming. This typically takes 2-2 ½ minutes. Make sure to stir the milk every 15-30 seconds.
2. Remove the bowl of milk from the microwave and add four teaspoons of vinegar or lemon juice to the steaming milk. It should start to “curdle,” or separate into lumps.
3. Gently stir the vinegar and milk for about one minute to allow the two liquids to fully react and all of the curds to form.
4. Pour the milk and vinegar mixture over the strainer to remove excess liquid, leaving only the curds behind.
5. Next, pour these curds out onto a layer of paper towels. Use the paper towels to carefully roll and squish the curds and remove as much of the liquid as possible.
6. Knead the curds together. They may be a bit dry or crumbly but will be easier to shape after another vinegar soak.
7. Place the dried curds back in the bowl and add about ¼ cup of vinegar. Let the curds soak in the vinegar for one hour. (Optional: Add 3-5 drops of food coloring before setting the bowl aside.)
8. After one hour, repeat steps 4 and 5 to dry the curds again.
9. Use your hands to roll out the curds on a dry countertop or table, flattening them into a thin layer. Then, use your cookie cutters to cut out fun shapes.
10. Allow the shapes to completely dry (this may take 1-2 days) into their new hard plastic shapes.
11. Optional: Color, paint, and decorate the new toys you made.
12. Have fun playing with your new toys!

STEM Explanation:

When you mixed hot milk with vinegar/lemon juice, you caused a chemical reaction to occur! Chemical reactions happen when two or more substances mix and create a new product. Milk contains a protein called casein. When an acid, such as vinegar or lemon juice, is added to milk, the chemical reaction causes the casein molecules to reshape into a new polymer, or a chain of repeating molecules. In this case, during the chemical reaction, the casein molecules changed into curds. The curds that formed are called casein plastic, or milk plastic, and are a polymer that can be molded and shaped into all different shapes. Casein plastic has been used for hundreds of years to make buttons, toys, jewelry, and more!

Career Connection:

Chemical engineers design, construct, and operate machines and plants that perform chemical reactions to solve practical problems or make useful products. Chemical engineers use math, physics, and economics to create new laboratory equipment, processes, and products for advancements in science, medicine, and consumer use.

Resources:

<https://www.steampoweredfamily.com/activities/make-plastic-from-milk/>

<https://www.scientificamerican.com/article/bring-science-home-milk-plastic/>

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