



STEM @ HOME GUIDE: Plastic Milk

- **Aim: To create plastic from the casein protein in milk**
- **Materials required:**
 - ✓ Milk
 - ✓ Vinegar
 - ✓ Stove or microwave
 - ✓ Mug or heat resistant cup
 - ✓ Paper towels
 - ✓ Measuring cup and spoons
 - ✓ Optional: food coloring and glitter
- **Questions to think about before you start:**
 - ✓ What do you think plastic is made of?
 - ✓ What are some types of plastic you have used or seen before? Shapes, sizes, texture, etc.
- **Instructions:**

Make sure to perform the experiment as a team (parent and student).

 - **Parent:** Heat one cup of milk in a pan on the stove or in the microwave for 3-5 minutes, until just steaming. **DO NOT BOIL**
 - **Student:** Add 4 teaspoons (tsps.) of vinegar to a heat resistant cup or mug
 - **Parent:** Add the hot milk into the mug. You should see white clumps start to form
 - **Student:** Slowly mix the milk and vinegar for a few seconds
 - **Student:** Once the milk and vinegar have cooled use a spoon to scoop out the milk curds and place the curds on a paper towel stack
 - **Parent:** Fold the edges of the paper towel stack over the milk curds and press down to release as much liquid as possible.
 - **Student:** Knead all the curds together into a ball (just like playdough).
 - **Optional:** If you want to add food coloring or glitter to your plastic do it within an hour or making the dough. You can also use a cookie cutter or your hands to turn it into a shape. Let the plastic sit for 48 hours and it will turn hard.
- **Extensions Activities:**
 - ✓ Try changing the amount of vinegar. Repeat the activity using more or less vinegar and see how it change how much casein plastic you get.
 - ✓ What happens if you use another acid instead of vinegar, like lemon juice.
 - ✓ What happens if you use another type of milk (1%, 2%, nonfat, whole, or chocolate)
 - ✓ What happens if you change the temperature of the milk when you heat it up?

HELPFUL TIPS

The milk should be hot but not boiling.

When scooping out the milk curds, try tilting the spoon along the inside of the mug to drain as much water as possible.

Once you have colored or shaped your casein plastic leave it to dry for 48 hours and it will turn hard.

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- **Vocabulary:**

Polymer: long chain of molecules connected together

Protein: A long polymer chain made up of amino acids

- **The science behind the fun:**

When the milk was heated and mixed with vinegar (acetic acid) it caused a chemical reaction and the milk curdled. Milk can also curdle naturally when it 'goes bad'. The milk separates in solids called curds and liquid called whey. The milk curds contain the fat and casein proteins. Proteins like casein are made of long chains of amino acids called polymers. When we removed the excess liquid, the polymers stick together and form a moldable solid.

- **Real world application:**

All plastic come from some natural substance; the word plastic just means moldable. What we think of today as plastic comes from petroleum, crude oil, that is refined. Plastic can be made from animal milk, insects, and certain plants and trees like the rubber tree. Engineers and scientists in many different fields work with plastics and polymers to make all sorts of items like plastic bags, contact lenses, automobile parts and is even used in medicine.

Did you know?

- Casein plastic was used in the 1900s to make buttons, jewelry, buckles and other items and casein plastic is biodegradable!
- Plastic takes a very long time to decompose or break down, many plastic items can take over 400 years to break down.
- A lot of plastic waste ends up in the oceans, more than 8 million tons of plastic ends up in the ocean annually.

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Plastic Milk Step by Step Photos



Supplies: Milk, white vinegar, pan, bowl, measuring cup and spoons, paper towels and stove or microwave.



Heat up the milk on the stove (DONT BOIL IT)



Add 3-4 tbsp vinegar to a bowl



Pour milk into bowl with vinegar, stir and see chunks (curds) start to form

Drain the liquid (whey) from the solids (curds).

Place the curds on a paper towel stack and squeeze out any remaining liquid

Roll the curds into a ball and then mold into desired shape. Let the shape sit and harden for 48 hours

