



## SWENext Engineering Challenge #5

### Plastic Milk

This next challenge will last for two weeks. During this time you will practice being a chemical engineer by making plastic from milk and vinegar.

Once you finish this challenge try pushing yourself even further with the two additional experiments, “Chalk it Up” and “Shrinkers”, to help build your chemical engineering skills even further!

Good luck and have fun!

Source: <http://www.oms.edu/sites/all/FTP/files/chemistry/takehome/TakeHomeIndustrial.pdf>

### #SocialMedia

Share your pictures and videos from this activity on Facebook, Instagram or other social media with us and other SWENexters We can't wait to see what you come up with!

Use the hashtags

#SWEtheFuture #SWENext #BeThatEngineer #OMS #NationalScienceFoundation

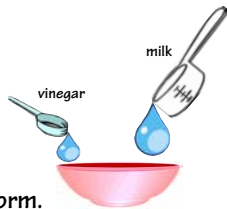
*To have your design featured by SWE please keep a lookout for an email on how to do this!*

# Plastic Milk

*You can make plastic from milk!*

## Materials:

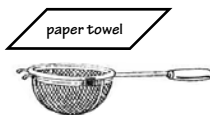
- ½ cup milk
- ¼ cup vinegar
- plastic tub (yogurt or margarine container)
- old spoon or stick
- paper towels
- strainer
- small plate



## To do and notice:

1. Mix ½ cup milk and ¼ cup of vinegar together in the plastic tub. Stir the mixture until no more lumps (curds) form.
  - **What do the curds look like?**

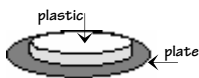
2. Spread a paper towel over the bottom of the strainer, and place the strainer in the sink.



3. Pour the milk mixture through the strainer. Gently blot the curds with more paper towels to squeeze out any excess liquid.

4. Use your hands to squeeze the solid pieces together into a ball.
  - **What does the solid feel like?**

5. Pat the ball of solids into a disk and leave it on the plate to dry for one or two days. When it is completely dry, pick it up.



- **What does it feel like now?**

## A closer look:

You have just made a type of plastic using milk protein. Casein is a protein found in milk. The vinegar (an acid) made the casein molecules in the milk cling together to form curds. By drying out these curds, you obtained a hard material, called a **polymer**, made of many molecules linked together.

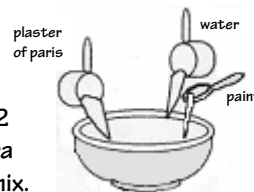
Casein is a common ingredient in food. It is also used in the manufacture of paint, white glue, and paper.

# Chalk it Up

*Make your own sidewalk chalk!*

## Materials:

- 2 tablespoons powdered tempera paint
- 1 cup plaster of paris
- plastic tub (yogurt or margarine container)
- old spoon or stick
- water
- small paper cups
- gloves (optional)



## To do and notice:

1. Mix 1 cup plaster of paris with 2 tablespoons powdered tempera paint in the bowl. Stir well to mix.
2. Add about ½ cup of water, a little at a time, stirring well after each addition. The mixture should be smooth like thick cake batter.

3. Pour the mixture into the paper cups.

4. Let the cups dry for 1 day.
  - **CAUTION: When cleaning up, do not pour extra plaster of paris into the sink. Throw it away into the trash.**



5. When the mixture is completely dry and hard, peel off the paper cups. You have made chalk!
  - **How does your chalk look and feel?**
  - **Can you use your chalk to write on the sidewalk?**

6. Try the procedure again with different colors of paint.

## A closer look:

Plaster of paris is made of calcium sulfate ( $\text{CaSO}_4$ ). When you add water to the dry plaster, the water molecules bind the calcium sulfate molecules together, forming a hard mass. The paint provides the color for your chalk. This colored solid is scraped off as you write with it.

Calcium sulfate is also used in the manufacture of artificial marble, wall plaster, gypsum sheetrock, and concrete.

# Shrinkers

*Cook up some plastic!*

## Materials:

- polystyrene (#6) plastic from cup or take-home box
- scissors
- permanent marker (optional)
- non-stick pan
- stove
- plastic spatula or tongs
- bowl of water

**CAUTION: This project uses a hot stove. Adult supervision is required.**

## To do and notice:

1. Use the scissors to cut your plastic into squares about 2in by 2in.

- **How does the plastic feel?**

2. Write your name on the plastic using a permanent marker.

3. Heat the non-stick pan on the stove until it is very hot.
  - **CAUTION: This project uses a hot stove. Adult supervision is required.**

4. Put your plastic in the pan. After 10 seconds, turn over the plastic using a plastic spatula or tongs. Continue to heat and flip the plastic every 10 seconds until the plastic has finished shrinking.

5. Remove the plastic from the pan and put it in the bowl of water to cool. Take your plastic out of the water.

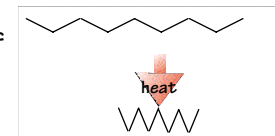
- **How does the plastic feel?**

- **Can you read your writing on the plastic?**

## A closer look:

Polystyrene molecules are made of long zigzag-shaped chains of carbon atoms. During the manufacturing process the plastic is heated, stretched into shape, and cooled. This process freezes the molecules in a stretched-out position.

When you heated the piece of polystyrene, the molecules returned to their original zigzag shape. Thus, the plastic shrank.



Plastic cups are stretched in one direction when they are made, so they will shrink in only one direction. Plastic trays are stretched in two directions, so they will shrink in two directions.