Concepts

Objects that people use are made of chemicals. Many industries rely on chemistry to produce items.

Words to know

atom - a very very small particle that makes up all matter

molecule - a small particle made of two or more atoms

electron - a tiny, negatively charged particle found in atoms

chemical reaction - an interaction of atoms or compounds to form new atoms or compounds

solution — a completely uniform mixture

soluble — the ability of a substance to dissolve in another substance

acid — a compound that increases the hydrogen ions (H^+) in a solution

base — a compound that increases the hydroxide ions (OH^-) in a solution

pH — a scale measuring relative acidity and basicity

indicator — a chemical that changes color with changes in pH

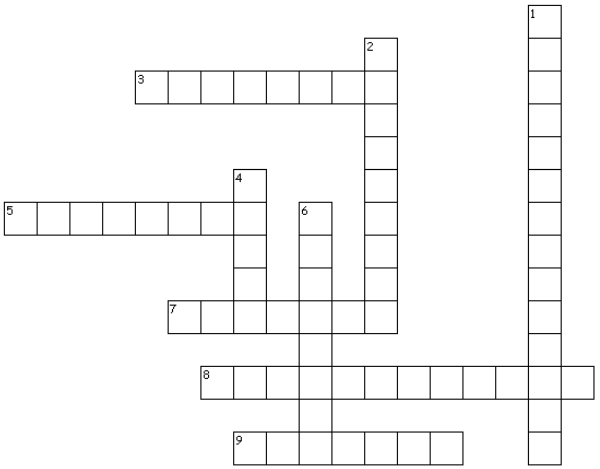
metal — a substance that is often shiny, is able to be shaped, and conducts heat and electricity well

electrolysis — a process in which electricity is used to separate atoms in a molecule

electroplating — a process in which electricity is used to coat one metal onto the surface of another metal

polymer — a large molecule that is made of many smaller molecules linked together

Use the clues and the Words to Know to complete the crossword puzzle.



Across

3. An _____ is a tiny, negatively charged particle found in atoms.
5. The _____ SiO_2, found in glass, is made from atoms of silicon and oxygen.
7. A _____ is a large molecule made from many similar small molecules.
8. _____ is used in industry to break molecules apart.
9. Sugar is _____ in water; it is able to dissolve completely.

Down

1. Zinc can be coated with copper by using _____.
2. An _____ changes color in acids and bases.
4. Aluminum is a _____ because it is shiny and conducts electricity.
6. _____ reactions can produce enough energy to power rockets.

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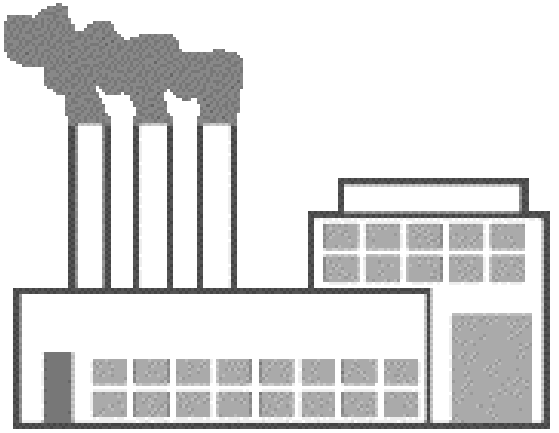
Take-Home Activities



Industrial Chemistry

This project funded by

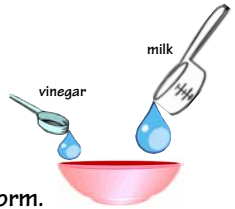
National Science Foundation
WHERE DISCOVERIES BEGIN

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:

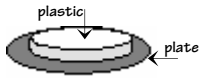
1. Mix ½ cup milk and ¼ cup of vinegar together in the plastic tub. Stir the mixture until no more lumps (curds) form.
   - **What do the curds look like?**

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.

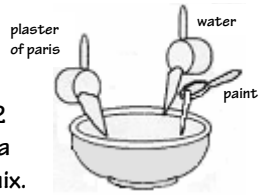
Casein is a common ingredient in food. It is also used in the manufacture of paint, white glue, and paper.

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 ($CaSO_4$). 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.

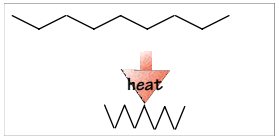
3. Heat the non-stick pan on the stove until it is very hot.
   CAUTION: This project uses a hot stove. Adult supervision is required.

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.