

curiosity

EXperiments



MERCK

What does a scientist do?



A background in science can allow a person to pursue a great variety of careers. The possibilities include academic, governmental and industrial career paths.

Scientists can make a career out of sharing their knowledge as a high school teacher or college professor. Many college professors also focus on uncovering new information and making the knowledge of these discoveries available to the rest of the global scientific community by publishing in scientific journals.

Scientists can also pursue careers with governmental agencies such as the Food & Drug Administration or the National Institute of Standards and Technology. Scientists in these areas help to develop new products and materials. They also develop guidelines and regulations to ensure that medications and consumer products are safe for people, animals and the environment.

Scientists in industry, like the ones at Merck for example, develop new materials and manufacture chemicals that may be used for research, testing or as starting materials for other products.

At Merck we develop, manufacture and analyze thousands of chemicals. Merck products are used by millions of scientists to better understand our bodies and the world around us. This understanding leads to improved quality of life for us all.

Bright as a New Penny

Note: This experiment can be done with regular household items, but don't forget to have Mom or Dad supervise, working with glass can be dangerous!

TOPIC

Oxidation/Reduction

PROBLEM

What will happen to an old, dull penny when it is washed in a solution of vinegar & salt?

SUPPLIES

- Dull pennies
- White vinegar
- Salt
- Glass jar
- Measuring spoons
- Water
- Paper towels

WHAT IS YOUR HYPOTHESIS ON WHAT WILL HAPPEN TO THE PENNY?

A hypothesis is a scientist's best guess about what will happen.

WILL THE PENNY...

1. Not change?
2. Make a sizzling sound?
3. Begin to bounce up and down?
4. Become clean and shiny

INSTRUCTIONS

Put some salt on a penny. What happens?

Put some vinegar on a penny. What happens?

Now mix three tablespoons of vinegar and one tablespoon of salt in a jar. Add the dull penny and stir them around for a few minutes. Take out the penny, rinse it with water and dry it with a paper towel. What happened to the penny?

CONCLUSION

The solution of the salt and vinegar

You can also try this with old silver coins to see what happens to them.

WHY YOUR EXPERIMENT WORKS...

Two substances can combine to form a third new substance. Pennies are made of copper. The air all around us that you breathe has oxygen in it. The oxygen joins with the copper on the penny leaving it with a film that looks dull called copper oxide (Cu_2O). Your experiment created a chemical reaction that cleaned the dull film of copper oxide off of the penny. Vinegar is acetic acid ($\text{HC}_2\text{H}_3\text{O}_2$) and salt is sodium chloride (NaCl). When these two are mixed together they form a third substance called hydrochloric acid (HCl). Hydrochloric acid (made from the mixture of salt and vinegar) mixes with the oxygen in copper oxide on the surface of the penny and lifts the dull copper oxide away. Underneath the dull copper oxide is the clean, shiny copper. This is why salt and vinegar made your penny look bright again.

Scientists use chemical formulas to write equations. This is the equation that you performed when you mixed salt and vinegar to make hydrochloric acid.

NaCl (salt) + $\text{HC}_2\text{H}_3\text{O}_2$ (vinegar/acetic acid) = HCl (hydrochloric acid)

Scientists must record all of their data in a notebook. They also must be able to remember exactly what they did, so they often draw a picture.

Draw a picture of your experiment.

Bobbing Raisins

Note: This activity can be done with regular household items, but don't forget to have Mom and Dad supervise. (This experiment is from www.kids-science-experiments.com)

TOPIC

Gas Release

SUPPLIES

- Clear glass jar
- Carbonated drink (clear)
- Handful (4-6) of raisins

INSTRUCTIONS

1. Pour the carbonated drink into the glass jar
2. Drop the raisins into the glass jar

WHAT HAPPENS?

WHAT CAUSES ALL THE ACTION?

The bobbing up and down happens because the bubbles of the carbon dioxide gas in the drink are much less dense than the drink or the raisins.

Once the raisins start bobbing up and down, they continue to rise and fall for about an hour.

- Raisins are denser than the carbonated drink, so they will sink.
- Gas bubbles attach to the wrinkles on the raisins.
- When the raisins are covered with the bubbles they become less dense than the drink, so they start to rise.
- The gas bubbles start bursting and then the raisins become denser than the drink, so they sink again.



HOMEmade silly putty

Note: This activity can be done with regular household items, but don't forget to have Mom or Dad supervise. It can get messy!

TOPIC

Polymerization

SUPPLIES

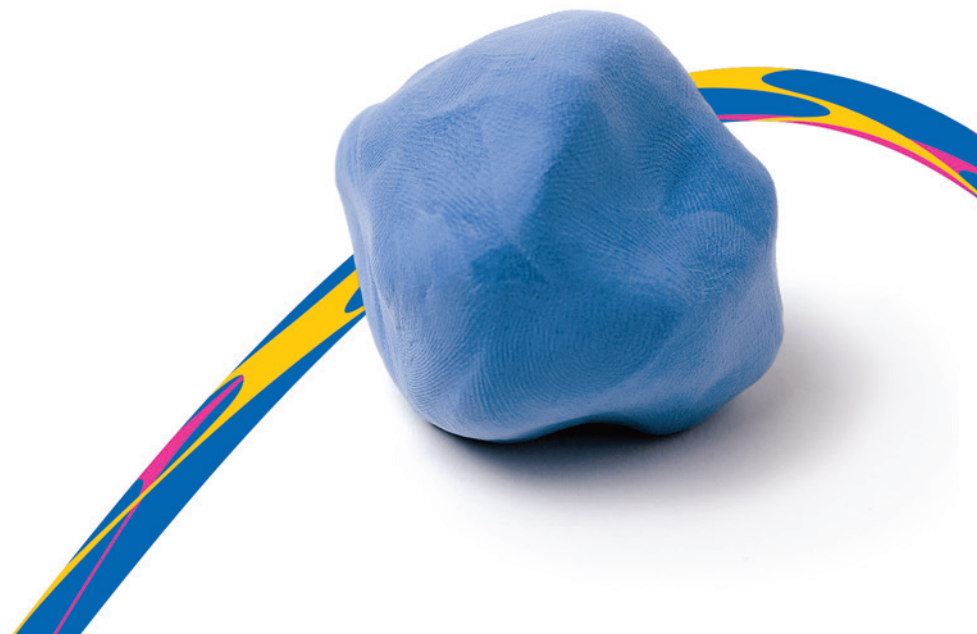
- 1 cup white glue (Elmer's)
- Food coloring (optional)
- 1 cup liquid laundry starch (you can find this near laundry detergents in the grocery store, some common brands are Sta-Flo and Mule Team)
- Plastic container

INSTRUCTIONS

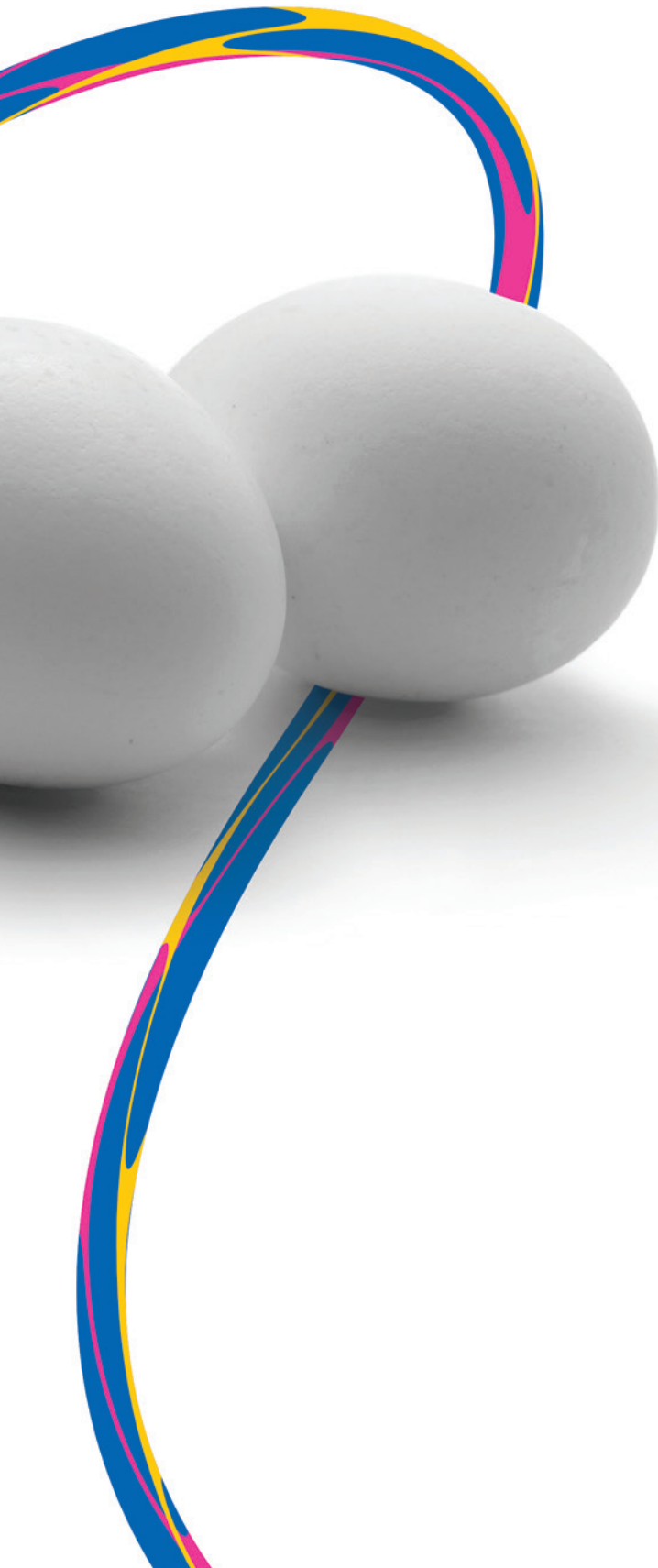
1. Put glue and coloring in a plastic container.
2. Add starch a little at a time, stirring constantly. Keep stirring until mixture holds together like a putty.
3. Test mixture with your fingers, if too sticky add more starch until the mass is smooth and rubbery.
4. Your final product will bounce and stretch easily, have fun!
5. Store it in a plastic bag or airtight container.

WHAT HAPPENED?

How did ordinary items like glue and laundry starch turn into such an extraordinary material? Basically, glue and laundry starch are made of millions of tiny particles called molecules. Molecules can join together in long chains to form materials called polymers. A chemical reaction occurs when you mix the glue and the starch. This reaction causes the polymer chains of glue and starch to join together into even larger chains. The resulting putty can be stretched and bounced.



specific density: Floating Eggs



Note: This activity can be done with regular household items, but don't forget to have Mom and Dad supervise. (This experiment is from www.kids-science-experiments.com.)

TOPIC

Specific Density

SUPPLIES

- 2 Clear glass containers
- Water
- Salt
- 2 Hard boiled eggs

INSTRUCTIONS

1. Fill both containers with water
2. To one container add salt while stirring until the salt no longer dissolves in the water (saturated solution)
3. Slowly place one egg in each of the containers

WHAT HAPPENS?

The salt in the water makes the liquid dense enough to support the egg (causing the egg to float).

Can you name a place on earth where you could float on water like eggs?

WIND YOUR WAY AROUND YOUR OWN DNA!

DNA contains the instructions for making an organism, including YOU! Your DNA determines how you look, what blood type you have, even your tendency to get some diseases. Almost every cell in your body contains the same DNA and same genes (some cells such as gametes have half as much DNA, and mature red blood cells don't have any DNA). Each chromosome is made of a single, long strand of DNA. If the DNA from the 46 chromosomes in one cell of your body could be laid out end-to-end, it would measure 6 feet! In this activity, you will isolate your very own DNA from your cheek cells. First, you will break away the membranes surrounding the cells and nuclei, and then you will precipitate the DNA so you can see your DNA!

MATERIALS NEEDED

- Clear Gatorade or another other sports drink
- 3 oz paper cup
- 30-50 ml conical tube or other small container
- 25% soap solution
- Safety glasses and gloves; lab coat optional
- Cold 91% isopropanol or 95% ethyl alcohol (for instructor use only)

PROCEDURE

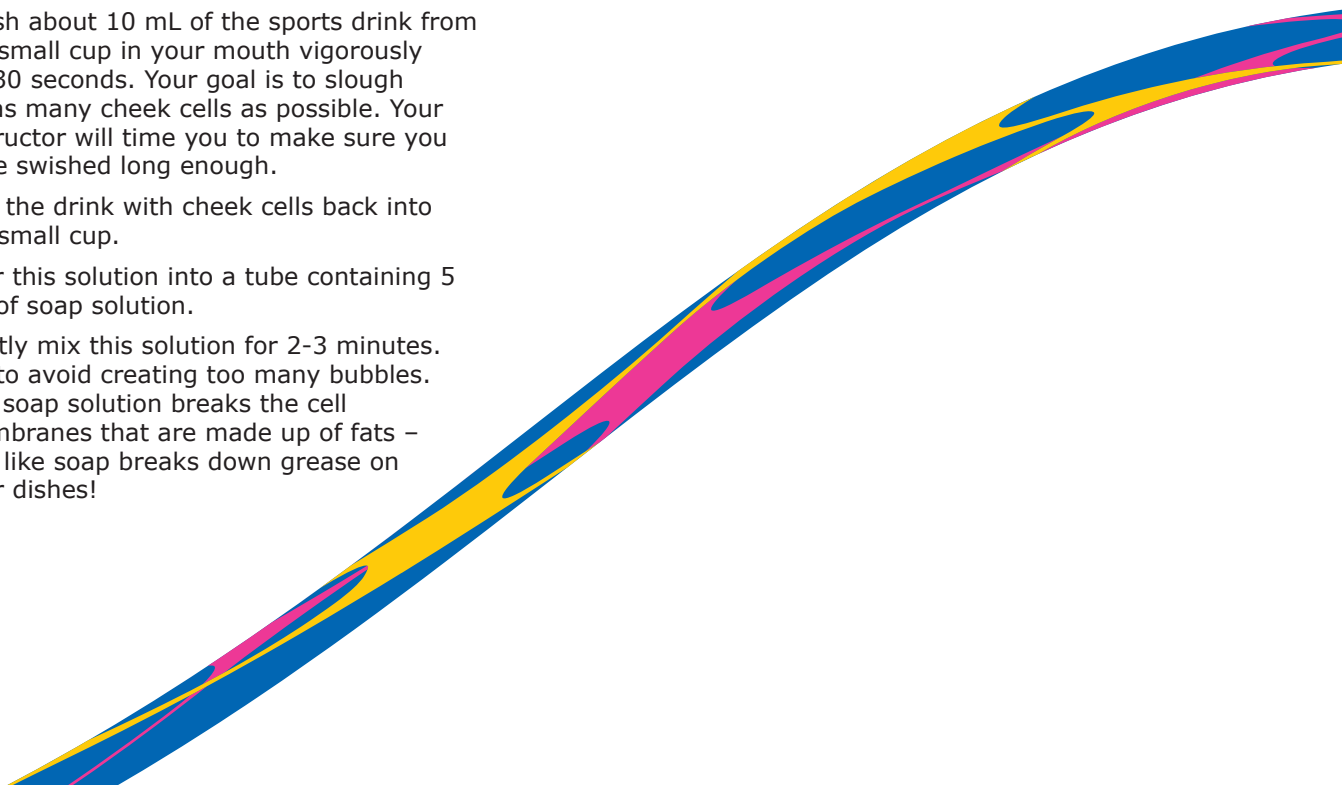
1. Swish about 10 mL of the sports drink from the small cup in your mouth vigorously for 30 seconds. Your goal is to slough off as many cheek cells as possible. Your instructor will time you to make sure you have swished long enough.
2. Spit the drink with cheek cells back into the small cup.
3. Pour this solution into a tube containing 5 mL of soap solution.
4. Gently mix this solution for 2-3 minutes. Try to avoid creating too many bubbles. The soap solution breaks the cell membranes that are made up of fats – just like soap breaks down grease on your dishes!

5. Tilt the tube of soap solution/cells. Your facilitator will pipette 10-15 mL of ice cold alcohol down the side of the tube so that it forms a layer on top of your soapy solution. DO NOT MIX THIS!
6. Put the cap back on the tube. Hold the tube still for 1 or 2 minutes. The white clump that you see is YOUR DNA!
7. You may take the tube with your DNA home with you, but do not remove the cap.

Research laboratories use a similar procedure to isolate and study DNA from different organisms.

QUESTION

How would you describe the appearance of DNA to someone who has never seen it?



Chromatography Done at Home

Note: This activity can be done with regular household items, but don't forget to have Mom or Dad supervise. It can get messy!

TOPIC

Separating Mixtures

SUPPLIES

- Coffee filter
- Black marker (not permanent)
- Water
- Eye dropper (or straw)

INSTRUCTIONS

1. Use a clean, dry coffee filter.
2. Use your marker to draw a black spot in the center.
3. Put the filter on a saucer and put a few drops of water on the spot.

What happens to the black spot?

WHAT CAUSES THE INK TO SEPARATE?

Most nonpermanent markers use inks that are made of colored pigments and water. When you drop water on the filter the colored pigments, from the ink, dissolve. As the water travels from the center of the filter, it carries the pigments along with it. Different-colored pigments are carried along at different rates: some travel farther and faster than others do. How fast each pigment travels depends on the size of the pigment molecule. Since water carries the different pigments at different rates, the black ink separates to reveal the colors that were mixed to make the black ink.

In this experiment you are using a technique called "chromatography". The name comes from the Greek words, "chroma" meaning color and "graphein" meaning "writing".

WHY IS CHROMATOGRAPHY IMPORTANT?

Chromatography is a very valuable technique scientists use for separating mixtures. There are many different types of chromatography. In all of them, a gas or liquid (like the water in this experiment) flows through a stationary substance (like the coffee filter in this experiment). Because the different ingredients in a mixture are carried along at different rates, they end up in different places. By examining where each ingredient ends up scientists can figure out what was combined to make the mixture.



The Basics and Acid of pH

Note: This activity can be done using regular food and household items, but make sure to have an adult supervise.

(This experiment is from <http://chemistry.about.com/od/acidsbase1/a/red-cabbage-ph-indicator.htm>)

TOPIC

Acidity/Basicity

SUPPLIES

- red cabbage
- blender or knife
- boiling water
- filter paper (coffee filters work well)
- one large glass beaker or other glass container
- six 50 mL beakers or other small glass containers
- baking soda (sodium bicarbonate, NaHCO_3)
- washing soda (sodium carbonate, Na_2CO_3)
- lemon juice (citric acid, $\text{C}_6\text{H}_8\text{O}_7$)
- vinegar (acetic acid, CH_3COOH)
- cream of tartar (Potassium bitartrate, $\text{KHC}_4\text{H}_4\text{O}_6$)
- antacids (calcium carbonate, calcium hydroxide, magnesium hydroxide)
- seltzer water (carbonic acid, H_2CO_3)

INSTRUCTIONS

1. Chop the cabbage into small pieces until you have about 2 cups of chopped cabbage. Place the cabbage in a large beaker or other glass container and add boiling water to cover the cabbage. Allow at least ten minutes for the color to leach out of the cabbage. (Alternatively, you can place about 2 cups of cabbage in a blender, cover it with boiling water, and blend it.)
2. Filter out the plant material to obtain a red-purple-bluish colored liquid. This liquid is at about pH 7. (The exact color you get depends on the pH of the water.)
3. Pour about 25-30 mL of your red cabbage indicator into each 250 mL beaker.

4. Add various household solutions to your indicator until a color change is obtained. Use separate containers for each household solution - you don't want to mix chemicals that don't go well together!

WHAT IS HAPPENING?

Red cabbage contains a pigment molecule called flavin (an anthocyanin). This water-soluble pigment is also found in apple skin, plums, poppies, cornflowers, and grapes. Very acidic solutions will turn anthocyanin a red color. Neutral solutions result in a purplish color. Basic solutions appear in greenish-yellow. Therefore, it is possible to determine the pH of a solution based on the color it turns the anthocyanin pigments in red cabbage juice.

The color of the juice changes in response to changes in its hydrogen ion concentration. pH is the $-\log[\text{H}^+]$. Acids will donate hydrogen ions in an aqueous solution and have a low pH ($\text{pH} < 7$). Bases accept hydrogen ions and have a high pH ($\text{pH} > 7$).



HOMEmade Lava Lamp

Note: This experiment can be done with regular household items, but don't forget to have Mom or Dad supervise. Working with glass can be dangerous!

TOPIC

Density

SUPPLIES

- Glass jar or clear drinking glass
- Vegetable oil
- Salt
- Water
- Food coloring

INSTRUCTIONS

1. Pour about 3 inches of water into the jar.
2. Pour about 1/3 cup of oil into the jar. Does the oil end up on top of the water or below it?
3. Add one or two drop drops of food coloring. Does it color the oil or the water?
4. Shake salt on top of the oil. What happens to the food coloring? What happens to the salt?
5. Add more salt to keep the action going.

Why does the oil float on top of the water?

What happens when the salt is poured in?

How does this relate to what happens in a lava lamp?

WHAT CAUSES ALL OF THE ACTION?

The oil floats on top of the water because a drop of oil is lighter than a drop of water of the same size. The scientific way of saying this is that water is denser than oil. Density is a measurement of how much a given volume of something weighs. In addition to having different densities, oil and water are also known as immiscible liquids. Immiscible means they don't mix. Pouring salt on the oil and water mixture causes lots of movement. Salt is denser than water and oil so it sinks to the bottom. As the salt passes through the oil layer a blob of oil sticks to it and travels with it to the bottom. As the grain of salt dissolves it releases the oil, which floats back up to the top.

HOW DOES THIS RELATE TO A LAVA LAMP?

The lava in a lava lamp is a special kind of wax. The wax does not mix with the liquid that surrounds it. When the wax is cool it is denser than the liquid so it stays on the bottom. The light in the lamp is located at the base where it gives off heat. The light warms the wax that is resting on the bottom. As it warms up the wax expands. The weight of the wax remains the same but it takes up more space. In other words, it becomes less dense. The warmed up wax is less dense than the liquid so it rises to the top. At the top of the lamp it cools off, becomes denser and then sinks to the bottom where the process repeats itself.

The Making of a rainbow

Note: This activity can be done with regular household items, but don't forget to have Mom and Dad supervise.
(This experiment is from www.kids-science-experiments.com)

TOPIC

Light Spectrum

SUPPLIES

- Tape
- Water
- Mirror
- Scissors
- White Card
- Dark Room
- Clear Plastic Box
- Flashlight
- Black Construction Paper

INSTRUCTIONS

1. Using the black paper cut out the shape of your flashlight face (area that the light come out).
2. Cut a small slit in the middle of the black paper cover which you just cut out.
3. Place the black paper cover over your flashlight and secure it with tape.
4. Fill the plastic box half way with water.
5. Stand the mirror in the water so it leans against the end of the box at an angle.
6. Point your flashlight so the light beam shines on the mirror through the water (the flashlight should be on the outside of the container and not submerged in the water).
7. Hold up the white card so the reflected light coming from the mirror can shine on it.

WHAT HAPPENS?

You can see a rainbow on the white paper. When light travels through water, the light beam slows down and bends. The seven different colors that make up the rainbow all travel at different speeds and therefore each color bends at a slightly different angle. The mirror reflects the different colors so that you see a rainbow or spectrum of the seven separate colors.



