THE FIREPROOF BALLOON

Emily McHugh - IDLA-Chemistry Concentration - Elementary

Materials: -Two Balloons
-Matches
-Water

Procedure: Inflate one of the balloons and tie it shut. Take the other balloon and fill it with ¼ cup of water, then inflate the balloon. Take the first balloon and light a match underneath it. The balloon will blow up. Take the second balloon with water in it and light a match under that balloon. This balloon should not explode.

Purpose: This experiment shows how water is a good absorber of heat. When heated, the rubber of the first balloon becomes hot and very soon it can not resist the pressure of the air inside the balloon. The second balloon does not blow up because water absorbs most of the heat away from the plastic of the balloon. Therefore, the balloon does not break.

THE IMPLODING CAN

Emily McHugh - IDLA-Chemistry Concentration - Elementary

Materials: -One soda can
-Shallow, clear dish
-Hot plate
-Water
-Tongs

Procedure: Fill a pop can with a small amount of water, place it can on top of the hot plate and bring water to a boil. Fill the shallow dish with cold water. Once the water comes to a boil, flip the can immediately into the dish of cold water. The can should crush once it hits the cold water.

Purpose: As the water inside the can begins to boil, the water vapor replaces the air inside the can. When the can is inverted into the cold water, the temperature drops suddenly. The temperature decrease changes the evaporation phase to the condensation phase, meaning an abrupt decrease in pressure. As a new equilibrium is trying to be reached, the can will shrink.

GOOD CONDUCTORS

Andrea Lambrecht - IDLA-Chemistry Concentration - Elementary

PURPOSE: Find out which material is the best conductor.
If possible, include spoons made of various materials in your experiment.

MATERIALS: Plastic, metal, and wooden spoons

- Butter
- Bowl of hot water
- Colored Candy

PROCEDURE: Stand the spoons in the hot water with their handles resting on the edge of the bowl.

- Use a pat of butter to stick one piece of candy to the top of each spoon.
- Heat will be conducted up the spoons and melt the butter so that the candy drops off. The best conductor will lose its candy first!

RESULTS: Most of the 80 metals on Earth are good conductors. This means that heat and electricity can pass through them easily. Many of them can be shaped by beating, pulling, or melting. Metals are shiny when cut. Some metals, such as gold, do not react easily with our substances. This means that they do not tarnish and are good for making coins and jewelry.

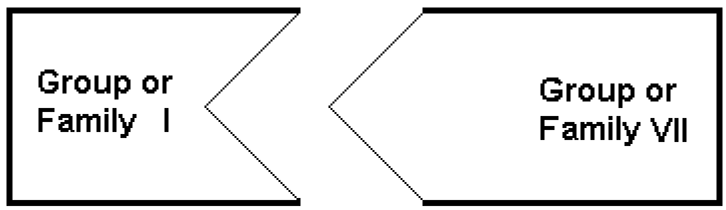
CHEMICAL COMPOUNDS AND THE PERIODIC TABLE

Andrea Lambrecht - IDLA-Chemistry Concentration - Elementary

BACKGROUND INFORMATION: The periodic table is a chart in which elements having similar chemical and physical properties are grouped together. Elements are arranged by atomic number in horizontal rows called periods and in vertical columns known as groups or families, according to similarities in their chemical properties. The elements can be divided into three categories – metals, nonmetals, and metalloids. A metal is a good conductor of heat and electricity, while a nonmetal is usually a poor conductor of heat and electricity. A metalloid has properties that are intermediate between those of metals and nonmetals. A compound is made up of two or more elements. The periodic table correlates the properties of the elements in a systematic way and helps us to make predictions about chemical behaviors.

An atom can lose or gain more than one electron. A positive ion is known as a cation. The formation of a cation is a result of the loss of one or more electrons. On the other hand, an anion is an ion whose net charge is negative due to an increase in the number of electrons.

DIRECTIONS: Cut out the atom examples you have been provided. You should cut the triangles out from inside the blocks for Groups I, II, and III. For Groups V, VI, and VII, the triangles should be left on the outside of the blocks. Therefore, you should end up with a set that has blocks with triangles missing and a set that has blocks with triangles added. The blocks with missing triangles represent metals. While the blocks with added triangles represent nonmetals.



EXAMPLE: Sodium (Na^+)is a metal in group I and chlorine (Cl^-) is a nonmetal from group VII. Due to the fact that different electrical charges attract, the positive sodium is attracted to the negative chlorine and the chemical compound sodium chloride is formed. Therefore, the formula NaCl represents the compound because there is one sodium and one chlorine. On the other hand, if chlorine (group VII) were to combine magnesium (group II), the magnesium would lose two electrons while the chlorine would only gain one, as a result there would have to be 2 chlorines for each magnesium. The formula for this compound would be $MgCL_2$. Usually, the positive atom is listed first and the negative atom is listed second.

RISING WATER

Sara Cleaves - Earth Science Concentration - IDLA (Elementary Teacher)

Materials: Clear glass pie pan or other clear container, clay or playdough, candles, matches or lighter, jar, food coloring, and water.

Set-up: Place a piece of clay in the middle of the pan. Put a candle in the middle of the clay. Put a few drops of food coloring into the water and pour the water into the pan so that it touches the very bottom of the candle. Light the candle and then place the jar over the top of the candle and the clay (make sure it is placed around the clay not on it and that the candle does not touch the bottom of the jar). The candle will burn out and the water will quickly rise into the jar.

Science: As the candle burns, the air in the jar is heated, begins to expand, and then starts to escape from the jar. When the candle uses all of the oxygen in the jar, it goes out. The pressure then becomes lower in the jar than on the outside, which causes the water to be pushed into the jar by the higher pressure outside.

NON-BURNING MONEY

Sara Cleaves - Earth Science Concentration - IDLA (Elementary Teacher)

Materials: A dollar bill, lighter or match, 100mL of rubbing alcohol, and 50mL of water.

Set-up: Mix the rubbing alcohol and the water together and soak the dollar bill in it. Light the dollar bill on fire.

Science: As you will see, the bill lights on fire but does not burn. The part that is burning is actually the alcohol on the bill. The bill has enough water on it that it does not burn when the alcohol is burning.

THE FLOUR BOMB

M. Travis O'Hair - Biology

Purpose: The classic high school flour bomb demonstration shows the explosive power of flammable powders under the right circumstances, which is dictated by surface area.

Materials:

- 500g coffee tin with lid (not too stiff a fit).
- Funnel with bottom edge flat to put flour in - can be made from plastic and paper.
- Single hole bung to put funnel through.
- Small candle.
- Bulb-type pipette filler.
- One spatula of dry flour (does not work as well if damp).
- Splint and matches.

Safety:

- Apparatus should be enclosed in safety screens.
- Everybody should wear safety goggles.
- Coffee tin needs to be wrapped in sticky back plastic or sellotape.
- Pupils and staff to stand at least 2 metres back.
- When lighting the candle and placing the lid on the coffee tin keep your head out the way.
- Do not use a glass funnel.

Procedure:

1. First, demonstrate to the students how a pile of flour (on a table) is not flammable by placing a lit match to it.
2. Next, make a hole in the coffee tin the same size as your bung at approximately the same height as the center of the flame of the candle.
3. Push the funnel into narrow end of the bung as far as it will go, then insert this into the hole in your coffee tin (funnel on the inside). Attach the pipette bulb to the narrow end of the funnel. This needs to make a tight seal.
4. Put a spatula of flour (cornflour, custard powder, etc. will do very well) into the funnel, blocking the tube from the pipette bulb.
5. Put the candle inside the coffee tin (approximately in the center).
6. Light the candle carefully using the splint (making sure not to light the funnel).
7. Fit the lid securely, without too much force, and then quickly give the pipette bulb a rapid squeeze.

Principal involved: The large surface area of the carbohydrate (flour) means that it is rapidly oxidised. There is a loud WHOOMP and the lid flies off (normally vertically) about 4 feet up. Given a large enough suspension of combustible flour or grain dust in the air, a significant explosion can occur. For example, the 1998 explosion of the DeBruce grain elevator in Wichita, Kansas which killed 7 people.

THE CELL MEMBRANE AND SURFACE AREA

M. Travis O'Hair - Biology

Purpose: To demonstrate how cell size is dictated by maimum surface area for reactions to occur.

Materials: 2 film cannisters, 1 tablet of Alka Seltzer, stop watch, water

Procedure:

1. Place enough water into the 2 film canisters so that they are about half full.
2. Take 1 Alka Seltzer tablet and cut it in half.
3. Leave one half of the tablet solid (not crushed) and crush the other half into small pieces.
4. Ask the students to make a prediction as to what they believe will happen when the two examples are placed into the cannisters. Why?
5. Have one student be in charge of timing this experiment with the stop watch.
6. Place both halves of the tablet into separate cannisters and replace the lids.
7. Time how long it takes for each half to blow the top off of the film cannisters.
8. Were the students correct? Discuss why or why not.

Principal involved: This demonstration highlights how cell size is dictated by a maximum suface area for reactions to occur. When done correctly, the cannister with the crushed Alka Seltzer should blow first because of a greater surface area.

FLOATING PAPER CLIP

Erica Engels – Earth Sciences

(Found on nerds.unl.edu)

Objective: To show surface tension.

Materials: 1 paper clip, container of water, and bottle of dish soap.

Procedure: Take a clear container and fill it with water. Carefully take the paper clip and place it in the water so that it floats. It may take a few tries to get the paper clip level enough that it will float. Discuss why the paper clip is floating with the class. Then add a drop of dish soap and watch the paper clip fall to the bottom of the container.

Explanation: This experiment is an example of the surface tension of water. The attraction of the water molecules creates almost a skin like surface. Adding the soap then disrupts the attraction of the water molecules and makes the paper clip fall.

TRICK COFFEE CAN RAMP

Joshua Cooper - Physics

This demonstration is easy to perform, but requires a bit of set up to begin with. Materials required are 2 coffee cans, a board to serve as an inclined plane, a large lump of modeling clay, and enough sand, sugar, or some other grainy substance to fill one quarter of the volume of a coffee can. Affix the modeling clay to one side of a coffee can, so that when laid on its side the can rocks back and forth. Put the sand, sugar, etc into the other coffee can, and replace the lids on both. Set up the board into a small angle inclined plane, making certain that the cans will not slide down the plane due to gravity. While throwing in as much theatrics as you wish, set up both cans close to the top of the ramp. Make sure the can with the clay has the heavy end facing off the back of the ramp. When released, the clay-can will rock backward and fall off the back of the ramp, while the sand-can stays firmly in place. For added effect, a third coffee can, empty, can be allowed to roll down the ramp freely. The clay-can rolls backward because the center-of-mass of the can is housed within the mass of clay, which will cause the can to rotate backward until the clay is at the bottom of the can. The sand-can stays put because the center of mass is housed within the sand. Because the location of the center of mass relative to the can is comparatively more fluid, the can will not roll down the ramp of its own volition. The center of mass will always be near the bottom of the can, with will not allow for any rotational motion.

FARADAY CAGE

Joshua Cooper - Physics

This demo requires a small handheld radio, a metal container large enough to contain the radio, a glass beaker large enough to contain the radio, and a wire mesh barrel capable of completely surrounding the radio. Using the radio, find the signal from a nearby radio station. When the radio is placed in the metal container, the signal drops out. The reason for this is that when an electric field, like that of radio waves, is incident on a metal container, the electrons in the metal arrange themselves in such as way so that there is no electric field inside the closed space. To prove that this is phenomenon is due to the metal of the container; put the radio into the glass beaker. The radio will continue to pick up its signal. Next, put the radio into the wire mesh. You will find the same phenomenon you observed with the metal container. This wire mesh is called a “Faraday Cage”, after Michael Faraday, who created the first one in 1836. Faraday found that an electric field incident on a metal surface causes that surface to have the same electric potential on all parts. Therefore, because the electric potential is the same, Gauss’ law states that the electric field within such an enclosed space would be zero. Faraday showed that the same effect can be produced with a wire mesh cage as with a solid metal one. This electric field cancellation effect is the reason why cell phone and radios tend to have trouble working in large building made of concrete reinforced by a mesh of re-bar. The whole building works as a Faraday cage. Yet, the same effect does not occur within houses since most houses are made of wood timber, not reinforced concrete

LIQUID NITROGEN EXPERIMENTS

Travis Stinar - Physics

Materials: Liquid Nitrogen, a bowl or cooler for liquid nitrogen, tongs, red and blue balloons, aluminum can, a lighter and a splint of wood.

Procedure: Experiment 1 – Fill the aluminum can half way with liquid nitrogen, set aside. Light splint of wood. When the can starts “sweating” place splint against liquid on outside of aluminum can. Careful splint will start on fire.

Experiment 2 – Place liquid nitrogen in bottom of bowl, enough to cover bottom. Before the demo, place blue balloon filled with air in bowl, let shrink. At demo show audience red balloon place in bowl and remove blue balloon. Ask why and then tell them the joke.

Explanations: The first experiment is neat, and can be useful explaining changes in states of matter, and can help show that liquid nitrogen is extremely cold. The liquid that collects on the outside of the can is not water, but actually liquid oxygen. The audience will suspect that the splint will not catch on fire, because they think it is water on the side of the can. However, it catches on fire because liquid oxygen is flammable. The other experiments are great examples of changes in states of matter, and shows that molecules slow down at cooler temperatures. Both the balloons will appear to contract, however, as we all know the size of the molecule doesn’t change. The molecules just don’t move as far, lowering the pressure in the balloon. If you shake the balloons you can hear them rattle, this is the water vapor that was present in the balloon and has frozen. You can do this with various other objects, to show changes in states of matter.

FALLING PAPER

Erica Engels – Earth Sciences

(Found on nerds.unl.edu)

Objective: To show air resistance and how that effects how things fall.

Materials: Notebook (or computer paper) and a book that is about the same size as the paper.

Procedure: Take one sheet of paper and crumple into a ball. Take the paper and crumpled paper, hold them side by side and drop them. Discuss why the paper didn't fall the same. Then put the paper on top of the book and drop them again. Discuss why they then both fall the same.

Explanation: Air resistance is the reason the paper floated to the ground. When you add the book underneath the paper, the book blocks the air resistance.

ENZYME-SUBSTRATE ACTIVITY

Anna Beckman - Biology

Purpose: to demonstrate the effects of only one substrate for every enzyme

Materials: water, hydrogen peroxide, 2 clear jars or beakers, raw liver, knife to cut liver

Procedure: Fill one jar/beaker with an inch of water and the other container with about 3 inches of hydrogen peroxide. Cut a 1 inch cube of liver and place it in the water. Make observations. Cut a 1 inch cube of liver again and place it in the hydrogen peroxide. Make observations.

Science behind the demo: The liver in the water should not have any reactions. The liver in the hydrogen peroxide should have caused an off white foam to appear. This reaction demonstrates the break down of hydrogen peroxide. The enzyme catalase in liver will break down the substrate hydrogen peroxide.

CAPILLARY ACTION

Anna Beckman - Biology

Purpose: to show how capillary action allows plants to "drink"

Materials: celery stalks (fresh with leaves), food color, 2 clear jars or beakers, water

Procedure: Fill both containers half full of water. Place one celery stalk in one container and another celery stalk in the other container. Place about 10 drops of one food color in one of the containers and 10 drops of another color in the other container. Allow the stalks to sit overnight. Make observations.

Science behind the demo: Plants obtain water from their roots. In order for the water to reach the top of the plant, a force known as capillary action takes place to allow the water to travel upwards. After sitting overnight, each stalk should be changed to a different color as the water travels up the stalks.

FALLING OBJECT

Brian Unrein - Physics

Procedure: I will rest one quarter on my hand and pull my hand away quickly and then catch the quarter, asking the audience to help me decide the distance the quarter falls. I will then rest two quarters on my hand ask the audience, if I catch one quarter like before and then catch the other quarter in approximately the same amount of time how far will the second free-falling quarter fall. (Most students will think twice as far, but you know better).

Explanation: For every second a free falling object falls, it can be squared to find the difference in distance. The second quarter will fall four times as far as the second quarter since it has averaged twice the speed for twice the time.

BERNOULLI'S PRINCIPLE

Brian Unrein - Physics

Procedure: Using a hair dryer and a ping-pong ball I will demonstrate Bernoulli's Principle. The ping-pong ball will float a distance above the hair dryer's air current. The ball will not fall to the ground. It will stay suspended as long as the angle from the hair blower and the ball is not too drastic.

Explanation: The air that is pushed from the hair blower will create a low pressure and the ball will stay in the middle of the air stream.

UPSIDE-DOWN GLASS OF WATER/ATMOSPHERIC PRESSURE DEMONSTRATION

Scott Brungardt - Biology

I will do a demonstration that is great for showing that although the air all around us is colorless, odorless, and tasteless, it does have properties that can be tested and proven to exist. The atmosphere exerts a force on every object that exists within it. At sea level, the air exerts a pressure of about 14.7 lb/in^2 on all objects including the human body. Rationale for this demonstration includes two concepts. When the cup is completely filled with water, there is no air left in the cup and thus no air pressure. The inverted cup can therefore hold the water up, because the atmospheric pressure is working against the under-side of the cup. An application of these concepts is apparent while drinking a full can of pop; without allowing air to enter the container, you cannot drink it.

The procedure for this demonstration is not complex; the steps are as follows: 1. fill a glass container (use a container that is transparent and has a smooth and uniform lip) completely to the top with water, 2. place an index card or stiff piece of paper on top of the container and press down along the edges to form a tight seal, 3. carefully turn the water-filled contain upside-down over a basin while holding the index card securely in place, 4. gently remove your hand from the index card, 5. observe results. Again, the air pressure acting upwards against the index card will support the weight of the water and prevent it from spilling out.

THE GLOWING PICKLE/CONDUCTIVITY & ENERGY STATES

Scott Brungardt - Biology

I will do a demonstration that shows the conductibility of an ionic solution and the color of visible light given off by NaCl when the its electrons are excited. The pickle will get hot and glow when an electrode is placed in each end of the pickle because the salt (NaCl) and vinegar (acetic acid) in the pickle's juice allows the electrons to flow; thus, the pickle is a conductor. Energy is also being added to the electrons in the pickle as the sodium ions attach electrons from the flowing current. These ions are neutralized electrically, which forms excited sodium atoms. Since each atom of all elements is different, any given atom will emit a different color of visible when excited. The Na in the pickle's salty juice emits yellow-orange visible light at a wavelength of 589 nm when it is glowing; this is the same color that is observed with Na in a flame test.

After attaching an electrode (ford, copper wire, etc.) to each wire os a two-conductor extension cord (cut off the female end), the demonstration can be completed with the following steps: 1. set up ring stands with clamps about one foot apart, 2. put the electrodes onto the stand with the clamps, 3. put the pickle in position by inserting (3-4cm) an electrode into each end of the pickle (make sure the probes are not touching each other inside the pickle), 4. plug in the extension cord attached to the probes. It will take a while before anything happens. The pickle will begin dripping, then it will hiss and smoke, and finally it should begin to glow.

APPLE DEMO

Ashley Parker - Biology

Materials

- Plastic or wood apple
- Real apple
- Picture of an apple
- Paper with the word apple written in red letters

The objective is to have the students learn and practice skills of observation.

Procedure

1. Take wood or plastic apple out of the bag and have the students write down everything they see.
2. Take the real apple out of a bag and have them write down what they see compared to the first apple.
3. Take the picture of the apple out and have them compare that apple to the previous two.
4. Next present the paper with the word apple written on it, and have them compare this to the previous three.
5. Discuss observations

The idea is that students will be able to tell differences between the apples. The reason a fake apple is used is to show students that what might look like one thing, under close examination, is actually something different. The page with the word apple written in red is more abstract in nature. It might be useful to discuss people who don't read English and ask if it would still be an apple.

This demo not only gives the students practice at observation, but also with comparing and contrasting. This would be great activity to do before going on a field trip where observations would be taken.

BOOK DEMO

Ashley Parker - Biology

Materials

- Book with pages cut (approx. in half) and randomly distributed

Procedure

1. Randomly distribute the pages to the students and have them read over the page they recieve.
2. Have the students tell you characters, places, thoughts and ideas that are on their page.
3. Write them down for the whole class to see.
4. After the majority has shared what is on their page, try to put a story line to it.

In science we never get to see the whole story. We merely have bits and pieces in random order. We are then required to try to put together the whole picture from what we know, and what we feel will happen.

Egg in Milk Bottle

Greg Dunn - Biology

Materials: One glass milk jar, matches/lighter, a strip of paper 3cm x 10cm and one peeled hard boiled egg.

Procedure: Demonstrate that the hard boiled egg does not fit through the opening in the bottle. Next take the piece of paper and light it on fire. Drop the paper into the bottle and allow it to burn out. Place the egg on the opening and watch for the egg to fall into the bottle.

Science: The principle of the experiment has to do with hot air increasing pressure, thereby forcing gases out of the bottle, and then, once the burning paper is out, a quick change in temperature resulting in a lower pressure inside the bottle pulls the egg into the bottle.

Exothermic Almonds

Greg Dunn - Biology

Materials: One test tube with 50 mL of water in it, a thermometer, a ring stand or tin cup with a hole for the test tube, one almond rolled in ash and matches/lighter.

Procedure: Tell the audience that the water is room temperature and that only by introducing some outside source of heat can it change temperature. Our fuel will be one single almond and if we know that 1 mL of water is warmed by 1˚ C then we can infer that the almond has released 1 calorie. (our dietary calorie is equal to 1,000 calories).

Science: The energy that we consume is burned off in our cells just as it is seen in the demonstration, organisms require slower more controlled burning than what is observed but the bond energy is still the source of the energy in both.

THE CAN RIPPER

James De Pue - Biology

Demonstration at a glance:

An empty soda can be easily ripped clean in two. This can be used to impress possibly hostile students on the first day of class??

Set-up:

Remove the tab off an empty clean soda can. With a screwdriver or other sharp object "scratch" a circle around the inside middle of the soda can. Pour in a solution of copper (II) chloride to a depth up to the scratch and let sit for a few minutes. Pour out the copper (II) chloride solution and rinse the can. It is now ready for ripping.

Theory:

The need for the scratch around the inside of the can is due to the fact that soda cans contain a plastic lining which protects the can from the acidic soda. The copper chloride solution is involved in a single replacement reaction with the aluminum in the can as follows:

$3CuCl_2 (aq) + 2Al (s) > 3AlCl_3 (aq) + 3Cu (s)$

After the reaction, the can is basically being held together by the outside paint and a thin film of copper.

Extension:

The presence of a plastic lining has impressed my students for years. To see it more effectively, place a soda can full of water in a strong solution of HCl and the aluminum will be dissolved leaving the plastic lining and what's left of the can. This should be done under a fume hood or in a well ventilated area away from students as a lot of vapor is given off and a lot of heat produced (thus the need for water to prevent the lining from melting.)

ELEPHANT TOOTHPASTE

James De Pue - Biology

Procedure

1) Put on the safety goggles and gloves.
2) Use the scissors to cut one of the garbage bags down one side and across the bottom. Open the bag and spread it over the demonstration area. Save the remaining bag for cleanup.
3) Place the graduated cylinder on the open bag.
4) Fill the cylinder to about ¼ full with 30% hydrogen peroxide.
5) Add from 5 mL to 10 mL liquid soap or dishwashing liquid.
6) Sprinkle some food coloring on the inside wall of the cylinder.
7) Add 10 mL saturated potassium iodide solution.
8) STAND BACK! In a few seconds a column of foam will rise out of the cylinder and overflow onto the open bag.
9) Use the recommended safety equipment and observe safe handling practices when working with 30% hydrogen peroxide. It is a strong oxidizer.
10) Note: To prepare the saturated solution of potassium iodide, dissolve 100 g of potassium iodide in 70 mL of water. You can prepare this solution ahead of time and store it for future use.

Explanation

This activity demonstrates the decomposition of hydrogen peroxide catalyzed by potassium iodide. The rapid production of oxygen causes the mixture to foam, rise, and overflow the cylinder. The 2-step decomposition reaction is written as follows:

a. $H_2O_{2(aq)} + I^-_{(aq)} \rightarrow H_2O_l + OI^-_{(aq)}$ (rate determining step)

b. $H_2O_{2(aq)} + OI^-_{(aq)} \rightarrow H_2O_l + O_{2(g)} + I^-_{(aq)}$

You can reveal the presence of oxygen in the foam by performing a glowing splint test. Place a glowing splint in the foam and it will relight, indicating that oxygen is present. Do not drop the splint into the cylinder. The brown color of the foam indicates that iodine is present. Iodine can stain clothing and skin, so avoid contact with the foam. This demonstration is a fun, attention-getting way to introduce topics such as kinetics, rate laws, decomposition, oxidation/reduction, and gas production or limiting reagents.

Cleanup

Rinse the cylinder with water and set it aside to dry. Place the foam and open bag inside the remaining bag and discard.

Materials

- 50 mL to 100 mL 30% hydrogen peroxide
- 10 mL saturated potassium iodide solution
- 10 mL liquid soap or dishwashing liquid
- food coloring
- 2 plastic garbage bags (large size)
- a graduated cylinder (500 mL or larger, glass is preferable to plastic)
- a pair of scissors
- a pair of safety goggles
- a pair of rubber gloves