KITCHEN CHEMISTRY:
THE CHEF'S CHOICE INVESTIGATION

A Word About Our Special Guest

Mr. Leonard Klein, chemistry teacher at the New Horizons Governor's School, in Hampton, Virginia, will be our guest expert during the March 10 Science Seminar. Mr. Klein will play the role of a visiting cousin to one of the program's student sleuths. Mr. Klein's timely visit and his vast knowledge of chemistry and cooking will be drawn upon as we examine kitchen chemistry in the case called "The Investigation of the Chef's Choice."

Mr. Klein has taught both college and high school students for 10 years. He has taught at the Governor's School in Hampton, Virginia, for 5 years. Besides teaching chemistry, Mr. Klein enjoys experimenting in the kitchen. His chemical reactions from the kitchen are second to none! His favorite concoction is chocolate mousse.

Program Objectives

Students will be introduced to and will conduct experiments on the following chemistry concepts: classification, molecules, ionic and covalent bonding, chemical reaction, and acid-base testing.

Program Activities and Enrichment

Viewers are encouraged to participate in the experiments conducted by the science sleuths during the broadcast. Both the program experiments and suggested additional activities are listed in this print material. The additional experiments may be completed either before or after the broadcast.

Section 1: Activities

Program Activity: Classification

Shelley and her science sleuth team must identify the five white ingredients. They know that the five ingredients are flour, salt, sugar, baking soda, and baking powder. However, they don't know which ingredient is which. Without tasting the ingredients, they must correctly label each container. Using the following flowchart and several chemistry experiments, they will give it their best shot. In this first experiment, Shelley and her science sleuth team will determine whether an ingredient will dissolve in water. Following are the procedures for teachers and students to participate in the on-air experiment. An answer key to flowchart 1 is on page 13.

Materials: 5 clear glasses, flour, salt, sugar, baking soda, baking powder, and water

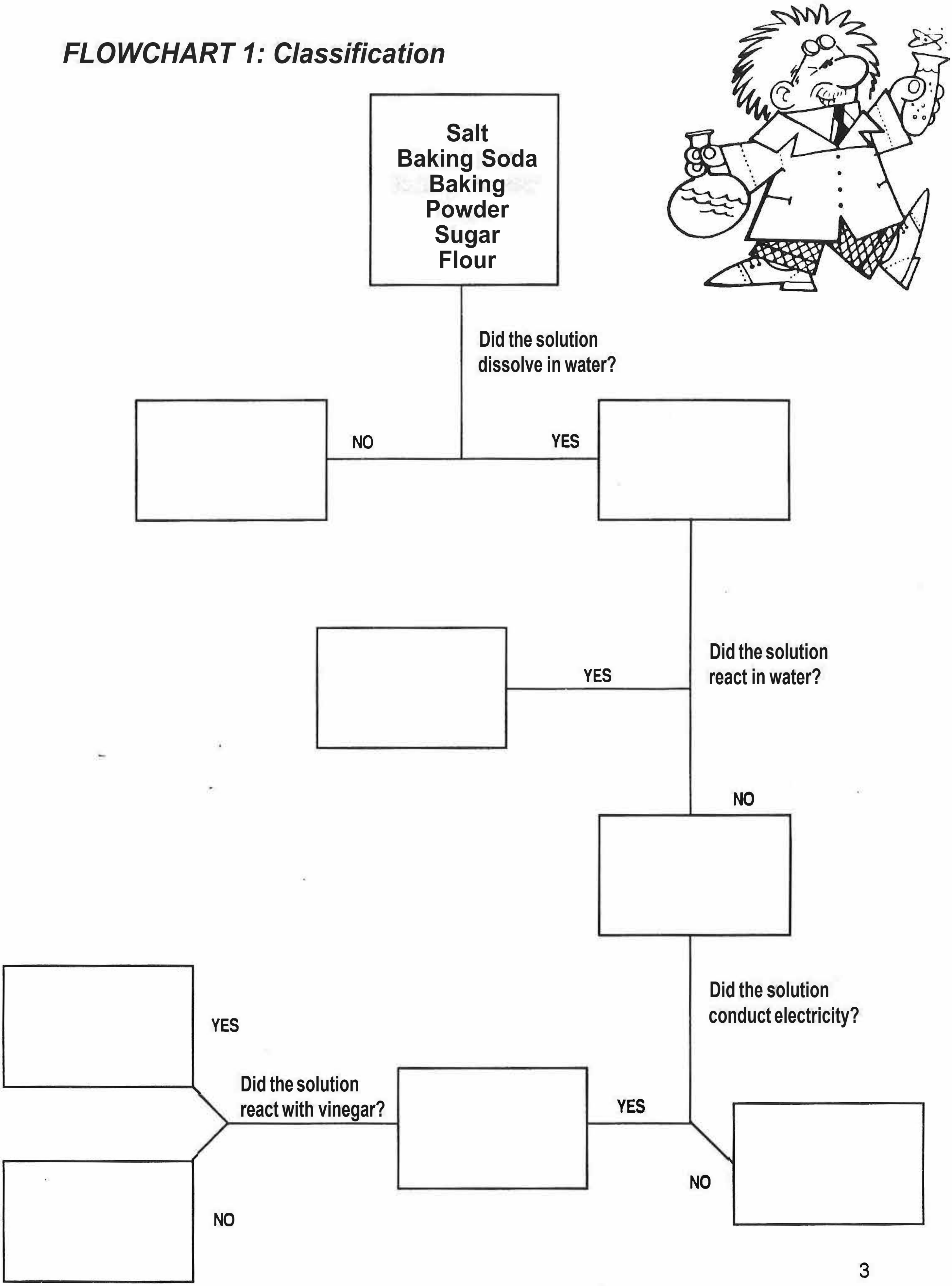
Procedures:

1. Copy and distribute flowchart 1 to each student. Students can record the experiment results along with the program guests.

2. Add water and one of the above ingredients to each glass.

3. Observe each glass. Which ingredient dissolved in water? Record the results on flowchart 1 .

FLOWCHART 1: Classification



Program Extension: Classification

Teachers are encouraged to instruct students to complete the following two classification extension activities. The purpose of these extension activities is to demonstrate to students that there is more than one way to confirm the experimental results obtained on the program.

The first classification extension (A) challenges students to apply an acid test using cabbage juice on three ingredients (baking powder, baking soda, and salt). Record the results of this challenge on flowchart 2.

The second classification extension (8) challenges students to test the melting point (between sugar and salt) and the volume of gas (between baking soda and baking powder). Record the results of these two tests on flowchart 3.

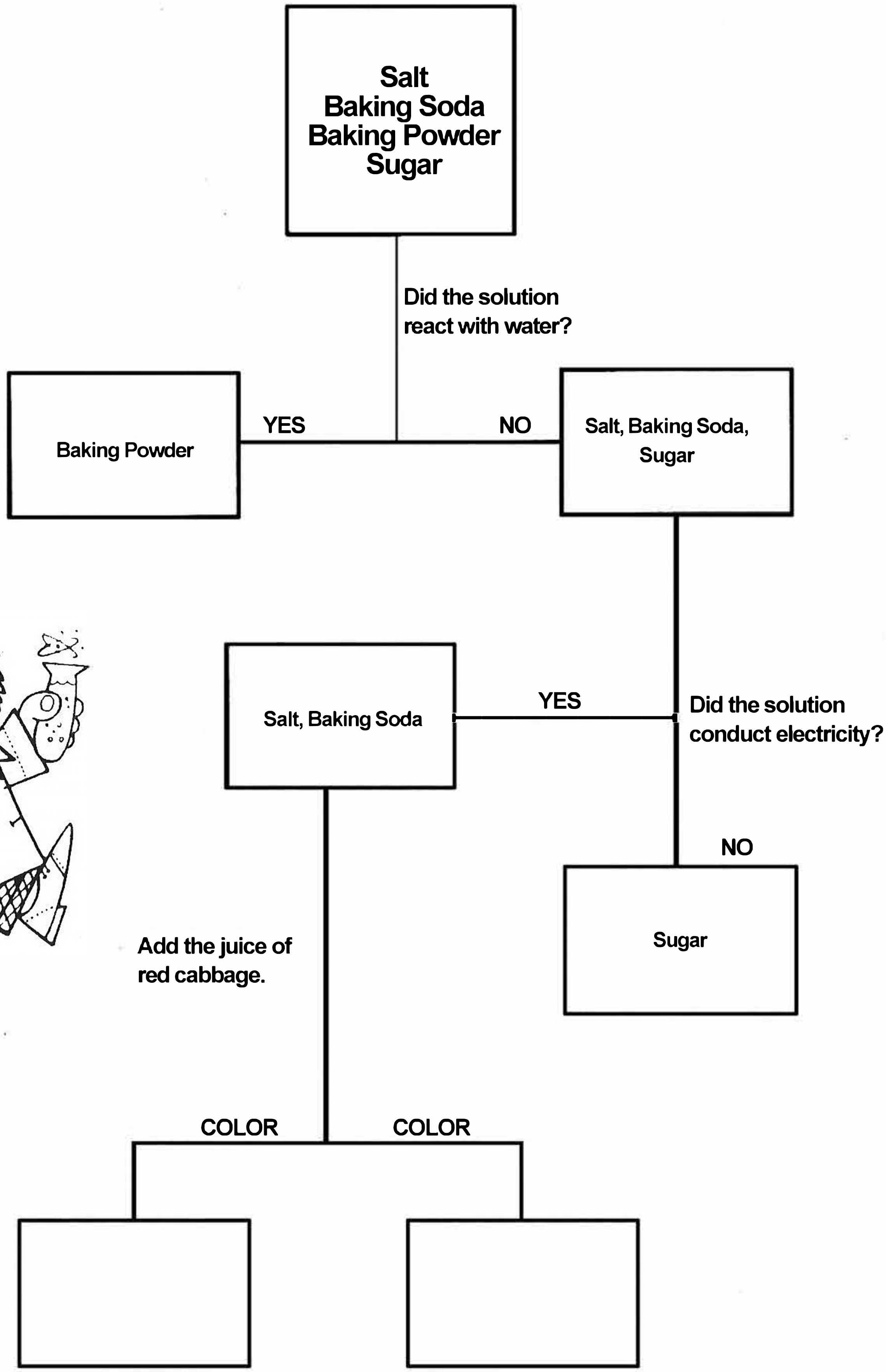
Extension A: Essence of Cabbage

Materials: 1 small red cabbage, grater, saucepan (not aluminum), water, strainer, mixing bowl, measuring cup, large glass jar, teaspoon, salt, flour, baking soda, baking powder, and sugar

Procedures:

1. Grate about two cups of cabbage into the saucepan.
2. Cover cabbage with water.
3. Heat the cabbage and water until the water boils.
4. Collect the red cabbage water by pouring the mixture through the strainer set over the bowl.
5. Put a small amount of the red cabbage water into the jar.
6. Add a teaspoon of one of the five ingredients.
7. Observe for any reaction. Record on your flowchart whether the ingredient fizzed.
8. Clean out the jar and repeat the process of adding a small amount of red cabbage juice to the jar and a teaspoon of a second ingredient.
9. Continue until all five ingredients have been tested and the results have been recorded on flowchart 2.
10. Compare this flowchart to the one completed during the program. Did the same ingredients fizz using cabbage juice that fizzed when tested with vinegar? Explain your results.

FLOWCHART 2: Essence of Cabbage



Extension B Part 1: Carbon Dioxide Collector

Both baking soda and baking powder will release a gas, carbon dioxide, when mixed with an acid, such as vinegar. Which releases more carbon dioxide, baking soda or baking powder? Below are directions for an apparatus that students can construct to test the amount of carbon dioxide released by the two baking ingredients. Record the results of the test on flowchart 3. Encourage students to conduct additional carbon dioxide tests, such as:

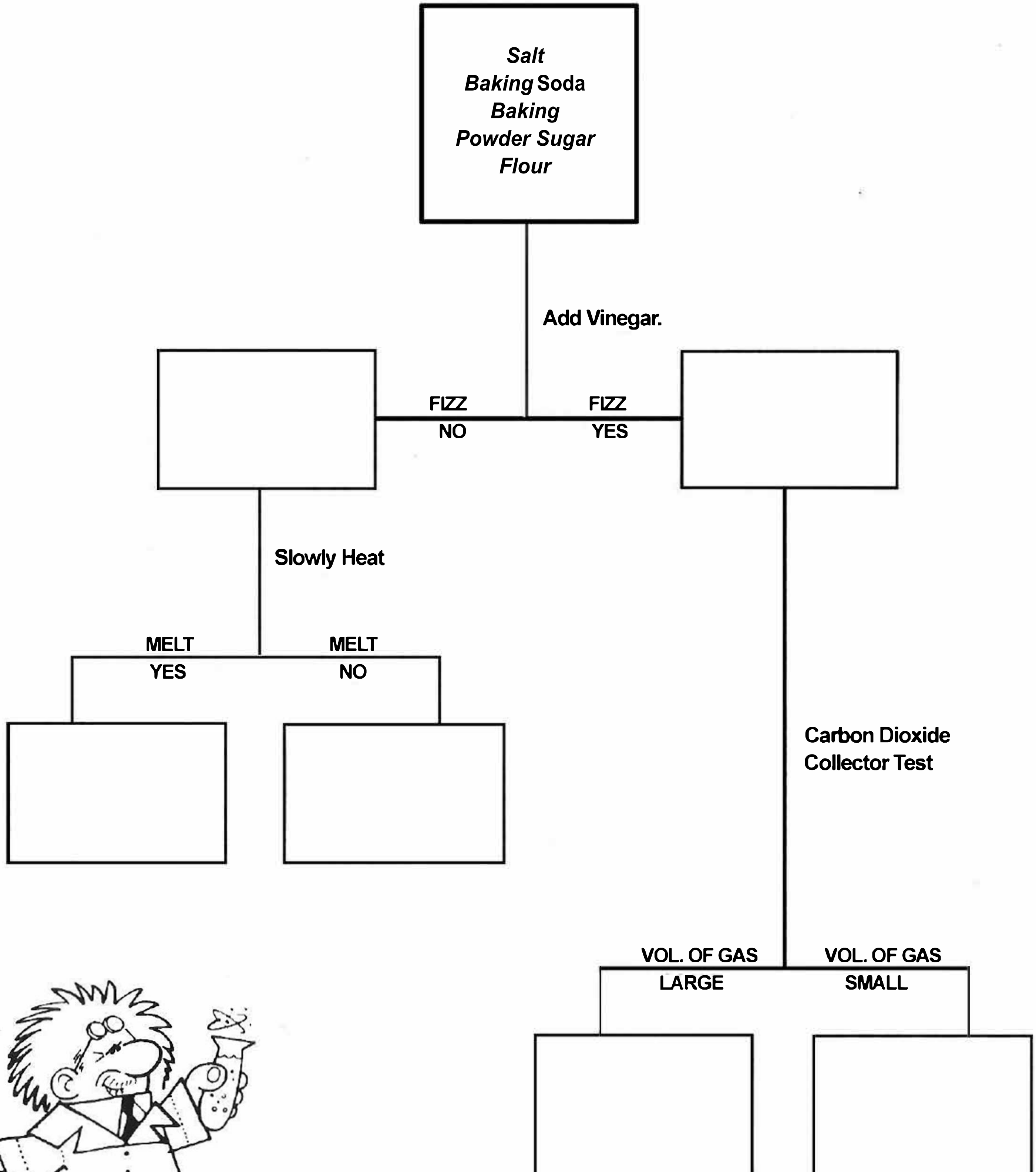
1. Compare the different brands of baking soda. Do they give off the same or different amounts of carbon dioxide?
2. Compare an opened box of baking soda taken from the refrigerator to an opened box of baking soda taken from the shelf.

Materials: vinegar, baking soda, baking powder, balloons, spoon, narrow-necked bottle, funnel, and plastic tape measure

Procedures:

1. Carefully pour the vinegar into the bottle until the bottle is about one-quarter full. (Warming the vinegar will speed up the reaction.)
2. Fill the balloon with baking soda using a funnel. (Tap the funnel occasionally if it clogs.) Be sure to measure the amount of baking soda used, because you will use the same amount of baking powder in the next test.
3. Keeping the balloon hanging down, stretch the neck of the balloon over the bottle neck.
4. Lift the balloon quickly so that the baking soda falls into the bottle--shake if necessary. As soon as the baking soda meets the vinegar, it begins to fizz as carbon dioxide gas is released, slowly inflating the balloon.
5. When the balloon stops expanding, pinch the neck of the balloon to prevent the gas from escaping. Remove the balloon from the bottle.
6. Measure and record the distance around the balloon using the tape measure.
7. Rinse out the bottle completely arid dry the inside.
8. Repeat the experiment (steps 1 through 6) using a new balloon and baking powder instead of baking soda. (Be certain that the baking powder measures the same amount as the baking soda that was placed in the first balloon.)
9. Compare the balloon measurements. Which ingredient, baking soda or baking powder, released more carbon dioxide and took up more volume in the balloon?
10. Record the answers on flowchart 3.

FLOWCHART 3: Melting Poing & Volume of Gas



Extension B Part II: Melting Point

An ionic solid has a high melting point. A covalent solid has a low melting point. Conduct the following experiment and determine which substance (salt or sugar) is ionic and which one is a covalent solid.

Materials: sugar, salt, saucepan, and wooden spoon

Procedures:

1. Put one-fourth cup sugar in a saucepan. On low heat, slowly heat the sugar. Stir with a wooden spoon to prevent the sugar from sticking to the bottom. Notice what happens to the sugar whdn it is placed over heat. Does it melt? Record the results on flowchart 3.

2. Repeat step 1 using salt instead of sugar. What happens to the salt? Does it melt? If the salt does not melt, what does it do? Record the results on flowchart 3.

Program Activity: Charge It!

In this experiment, students will use the water samples from the first program activity, "Classification," and a battery devise to determine which ingredients do and do not conduct electricity.

Students can build their own battery devise to use either during or after the program. Following are directions for building a galvanometer and for testing solutions. A picture of a galvanometer is on page 10.

Make a Galvanometer

Materials: cardboard, inexpensive compass, 15 feet of bell wire (from a hardware store), string (optional), scissors, and 6-volt battery

Procedures:

1. Cut the cardboard into a rectangle that will form a cradle for the compass. Make the rectangle large enough so that you can bend the ends up as shown in the picture.

2. Set the compass in the cradle so that the north-south poles on the dial face the folded ends of the cradle. Hold the compass in place by winding bell wire around the cardboard to form a coil of wire. Make your coil as compact as possible along the north-south axis. You may wish to tie the wires together with string to hold them in place. Don't use twist ties, or any other conducting material, however It will take about 25 turns. (NOTE: Every turn of the wire multiplies the strength of the electric field)

3. Flatten the bottom of your coil so that the compass will rest horizontally and the needle can rotate freely. Leave about six inches of wire free at each end.

4. Strip the insulation off each wire lead. To do this, gently cut around the plastic insulation with scissors about 1 /2 inch from the end, being careful not to cut through the wire. When the cut is complete, the insulation will pull off easily.

5. Test your galvanometer. Set it on the table so that it is perfectly horizontal. Turn it so that the needle is aligned with the north-south axis, parallel to the coil. Touch one bare wire lead to one electrode of the battery. Touch the other lead to the other electrode. The instant swing of the needle indicates current is passing through the coil.

To Test for Electric Current

Materials: safety pin, styrofoam square, mechanical pencil lead (graphite sticks), electrical tape, scissors, bell wire, solutions (ingredients mixed in water: flour, salt, sugar, baking soda, and baking powder), custard cup, and distilled water (optional)

Procedures:

1. With the safety pin, make two holes in a 1½-inch square piece of styrofoam ¼ inch apart.

2. Insert a 2½-inch piece of pencil lead (graphite) in each hole, leaving about ½ inch sticking out of one side.

3. With electrical tape, attach one of the wire leads from your galvanometer to one of the short sides of pencil lead. Make sure the wire and the graphite are in close contact.

4. Cut two 8-inch lengths of bell wire and strip ½ inch off all the ends.

5. Attach one lead to an electrode of the 6-volt battery and the other end of that wire to the other pencil lead. Attach one end of the other wire to the other electrode of the battery.

6. Put the sugar-water solution, your first test solution, in the custard cup. Insert both pencil leads in the solution. Touch the free wire of the galvanometer to the free wire coming from the battery to complete your circuit. Watch the galvanometer needle. If it moves, you know that the circuit is being completed by the solution conducting current between the pencil leads. Record your results on flowchart 1.

7. Empty the solution and rinse out the cup well with tap water (or distilled water). Rinse the graphite electrodes, also. Give a final rinse with distilled water, if you have it. Put distilled water in the cup and test to see if it carries a current. The needles should not move.

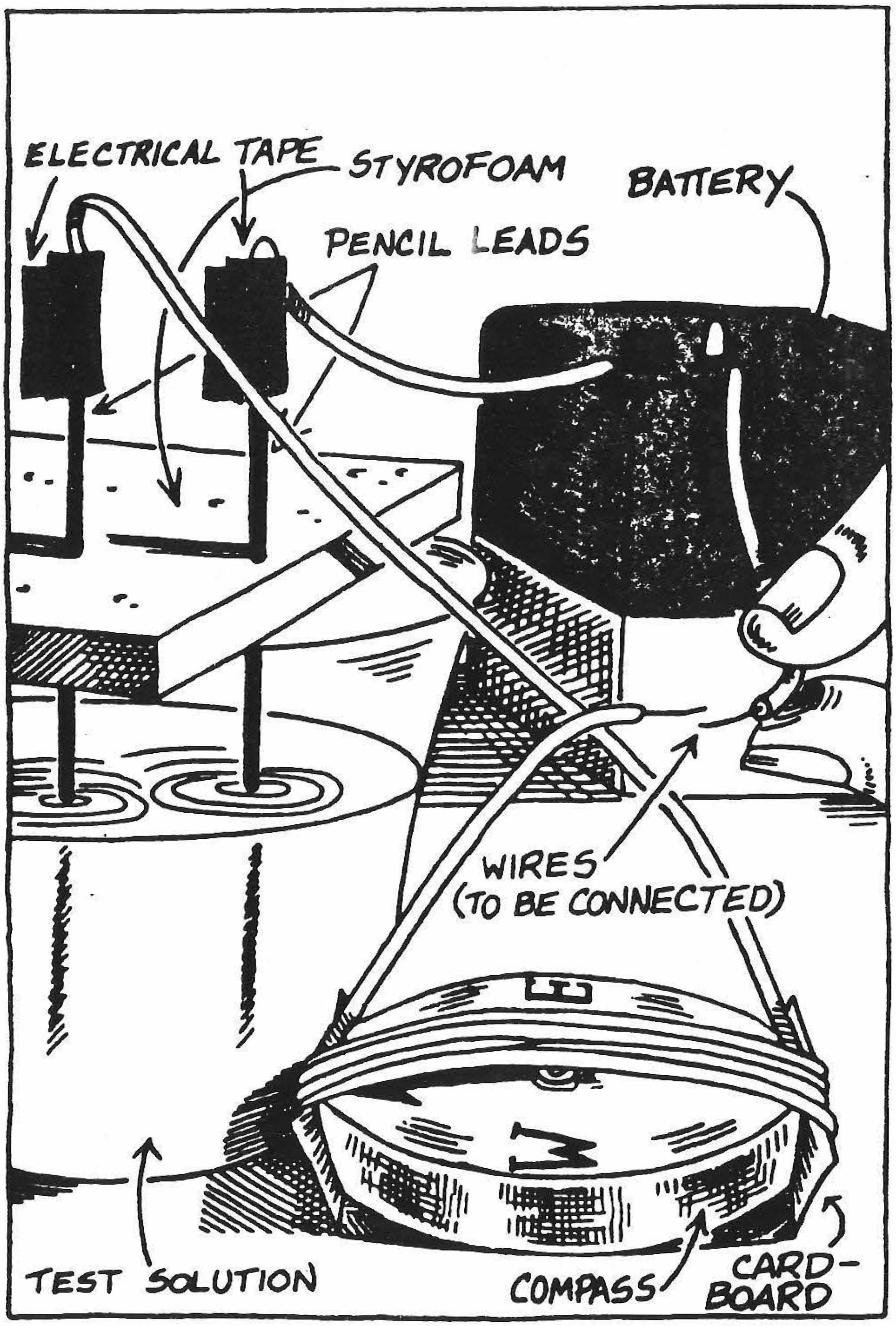
8. Test each of the other solutions following the above steps. (Note: Rinse the cup and graphite electrodes after each test.)

9. Record expected results and observations onto the worksheet, "Liquid Conductors."

10. Record results onto flowchart 1.

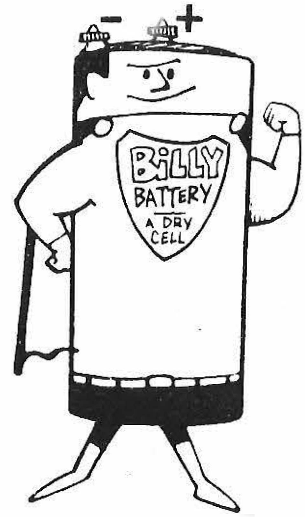
Activity taken from pp. 80-88, "How to Make a Galvanometer," *Chemically Active/by* Vicki Cobb.

A GALVANOMETER



If the test solution is an electrolyte the needle moves when the wires touch.

LIQUID CONDUCTORS



LIQUID	EXPECTED RESULTS	OBSERVATIONS
salt and water		
sugar and water		
baking soda and water		
vinegar and water		
baking powder and water		

Program Activity: Measuring a Molecule

This experiment shows how to make a rough estimate of the size of a molecule of cooking oil.

Materials: scissors, thin wire, cardboard, cooking oil, talcum powder (or flour), tape, small dish, shallow dish or wide glass, calculator, ruler, and magnifying glass

Procedures:

1. Cut off a short length of wire, and tape it in a loop to a small piece of cardboard. Squeeze the end of the loop until it encloses a space roughly 0.5 mm across.
2. Fill the glass with water, and sprinkle on a thin layer of talcum powder. Once it is entirely covered, gently blow away the excess.
3. Use the loop to pick up an oil drop 0.5 mm across. Practice until you get a drop the right size, checking through the magnifying glass.
4. Lower the 0.5 mm drop carefully onto the water. Open the loop to let the oil spread over the water, then measure how far it spreads.
5. Calculate the size: Halve the size of the oil patch, multiply by itself, then by 3.14. Divide this into 0.4 for the molecule size in mm.

Program Activity: It's (NOT) All Mixed Up!

Liquids that dissolve in each other are called "miscible"; those that do not are "immiscible." In this experiment, students will examine oil and vinegar and determine whether the liquids are miscible or immiscible to each other. The students will continue the investigation by introducing a drop of food coloring first into oil and then water. Students will see that this experiment is not all that it is mixed up to be!

Materials: cooking oil, food coloring, vinegar (or water), clear container, dropper, and spoon

Procedures:

1. Pour a little vinegar (or water) into the container.
2. Then pour in the cooking oil on top. Observe what happens.
3. Stir the mixture with a spoon. Observe what happens. Are the vinegar and oil miscible or immiscible?
4. Using a separate dropper or the dropper from the food coloring bottle, carefully lower one or two drops of food coloring into the oil. What do you notice about the color drop? Is the drop miscible or immiscible with oil?
5. Now, using the end of the spoon, push the balls of food coloring down through the oil into the vinegar (water). Record what happened. Is the food coloring miscible or immiscible in water?

FLOWCHART 1: Classification