LESSON 16

Using the Known Solids to Identify Unknown Liquids

Overview and Objectives

In this final lesson, students encounter an interesting reversal: instead of using the test liquids—water, iodine, vinegar, and red cabbage juice—to identify the solids, they are challenged to use the properties of the solids to identify unlabeled test liquids. To solve this new problem, students must apply the problem-solving and chemical-testing skills they have developed throughout the unit. Through class discussion of their results, students will recognize that more than one strategy can be used to solve a problem and that some strategies require applying more tests than others. In addition, this culminating lesson enables you and your students to assess growth in two areas: the application of skills and the understanding of the concepts included in this unit.

- Students decide which chemical tests they will perform and in what order they will perform them to solve a new problem.
- Students analyze their recorded data, draw conclusions, and support these conclusions with their test results.
- Students record their thoughts about the significance of negative results and about chemical properties as indicators.

Background

This activity reverses the testing procedure used in previous lessons. The chemical properties of the five unknowns now serve as indicators for three liquids in "disguise":

- Liquid A is white vinegar.
- Liquid B is water.
- Liquid C is iodine.

To keep the class from identifying the liquids by their color, you will dye them with food coloring.

Students may discover that

- Cornstarch is the indicator for iodine.
- Baking soda is the indicator for vinegar.
- All five chemicals are indicators for water.

Once again, remember that negative results are as valuable as positive ones. For example, if the mixture of baking soda and the unknown liquid does not bubble, you will know that the liquid is not vinegar.

Materials

For each student

- 1 science notebook
- 1 **Record Sheet 16-A: Unknown Liquids Test Results Table**

For every two students

- 1 science pail
- 1 tray
- 1 test mat
- 5 toothpicks
- 1 dropper bottle of unknown solution, 7 ml (¼ oz), labeled A, B, or C
- 1 dry-erase marker
- 1 sheet of wax paper, 16 x 22 cm (6 x 8½")

For the class

- 1 stock bottle of white vinegar, 250 ml (½ pt)
- 1 stock bottle of 0.1% iodine solution, 250 ml (½ pt)
- 1 package of food coloring
- 1 plastic funnel
- 3 plastic cups, 207 ml (7 oz), for disguising unknowns
- 3 dropper bottles, 7 ml (¼ oz)
- 3 blank labels
- Cleanup supplies

Preparation

1. Have student helpers trim the 15 wax paper sheets and add them to the materials center.
2. To make the iodine, vinegar, and water look similar, add food coloring to 50 ml of each liquid. Since the iodine is already colored, you can try to match its shade by adding combinations of red and yellow food coloring to equal amounts of water and vinegar. Or, you can make each liquid a different color. The goal is to mask the property of color so that students cannot easily identify the liquids by their colors.
3. Fill five dropper bottles with each unknown liquid:
   - Unknown Liquid A: White vinegar
   - Unknown Liquid B: Water
   - Unknown Liquid C: Iodine solution

   Write the corresponding letters on each blank label and put the labels on the dropper bottles. Have the unknown liquids ready to distribute.
4. Copy **Record Sheet 16-A: Unknown Liquids Test Results Table** for each student.
5. Pair the students.
6. In the **Final Activities** you can choose whether to reveal the identities of the three unknown liquids or to do Extensions 1 or 2 on pg. 167. Read through the extensions now to decide.

Procedure

1. Ask the class to recall what liquids they used in their chemical tests (water, vinegar, iodine, and red cabbage juice). Hold up bottles A, B, and C, and explain that each contains one of the liquids the students used to test the five unknowns. Explain that the liquids have been dyed so that they cannot be identified by their property of color.
2. Ask students to suggest some ways they could identify the unknown liquids. Remind them that they can use their notebooks, Chemical Information Sheets, and test summary tables to help solve this new mystery.
3. Hand out **Record Sheet 16-A.** As you review it with the class, point out where to record the letter of the unknown liquid being tested. Explain that they will choose their own testing methods.
4. By now, students know the testing procedures well. Explain that students should use one of the six circles as a compare circle in which to put a few drops of the unknown liquid.
5. Have the students pick up their materials.

Figure 16-1

Testing unknown liquids

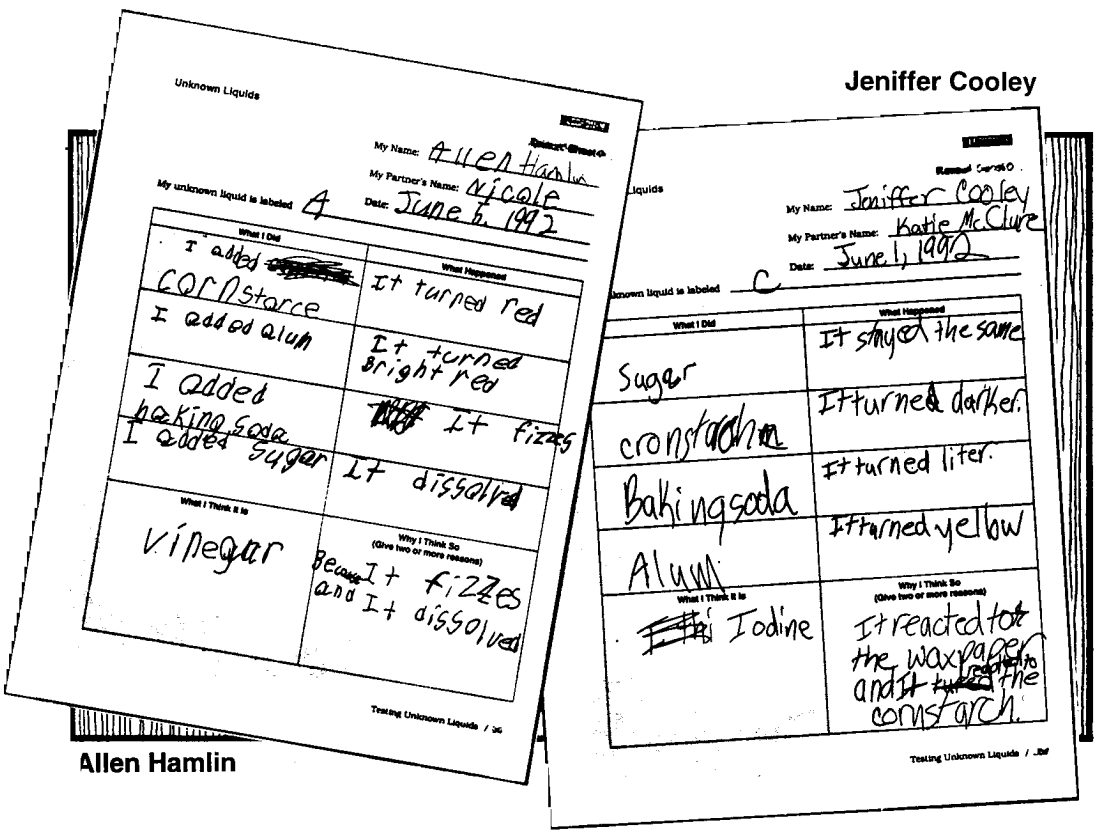
6. Give one bottle of unknown liquid to each team. Make sure teams near one another receive different liquids.
7. Circulate as the teams work, checking for skills such as those listed in the **Assessment** section on pg. 167. As teams finish, ask them to clean up.

Final Activities

1. Ask students to record in their notebooks answers to the following questions:
   - Which tests gave you the most information?
   - Which properties helped you identify the unknown liquid? Why do you think these properties were so helpful?
   - How did you use negative results to support your conclusions?
2. Have teams share information on their testing procedures, results, conclusions, and supporting data.
3. Collect the record sheets.
4. Reveal the identities of liquids A, B, and C (unless you are going to do Extensions 1 or 2).

Figure 16-2

Samples of Record Sheet 16-A



Samples of Record Sheet 16-A

Extensions

1. Have students test the other unknown liquids, including the red cabbage juice. Then reveal their identities.
2. Switch the labels on the unknown liquids. Add a drop of perfume to each to remove odor, which is another identifying property. Let the students test these unknown liquids.

3. Have the class create a "Chemical Information Sheet" (like the one used to identify the five unknowns in Lesson 12) for the unknown liquids. Ask groups of students to write "What Am I?" descriptions using the properties of each liquid. You can also include the red cabbage juice.

Assessment

This lesson offers you several opportunities to assess students' current ability to apply tests, interpret information, and relate that information to aspects of chemistry. Because this is the end of the unit, you also will want to examine the post-unit assessment on pg. 171. In addition, final assessment activities are offered in **Appendix A.**

In this lesson, students' testing strategies, discussions, notebook entries, and record sheets will help you assess growth in the following areas:

- Students' ability to record observations and experiences that are informative and are not based on inference or unobservable properties.
- Students' ability and willingness to verbalize what they are doing, what they have discovered, and what they can conclude.
- Students' ability to devise testing strategies and solve problems through the application of new knowledge and skills.
- Students' ability to perform the physical and chemical tests in this unit.
- Students' skill and confidence in handling materials.
- Students' ability to analyze test results and draw conclusions based on them.
- Students' ability to support their conclusions with reasons based on experiences.
- Students' ability to work cooperatively.
- Students' ability to use new vocabulary appropriately.

Note: You may now want to return the record sheets you have collected. Students can take them home (along with the rest of their notebooks) when the unit ends.

Post-Unit Assessment

The post-unit assessment is a matched follow-up to the pre-unit assessment in Lesson 1. By comparing students' pre- and post-unit responses, you will be able to document their growth in knowledge about the properties of chemicals.

Final Assessments

The final assessments in **Appendix A** include a self-assessment for students and an activity in which students analyze the composition of unknown mixtures.

Management Tip: Students will need their science pails for the post-unit assessment and final assessments. After that, have the class empty and clean their five unknown jars. Also have students clean the measuring spoons and goggles before putting them away.