

Activity 5.2

Using chemical change to identify an unknown

How can you identify an unknown powder?

In this activity, students will develop a method to test five similar-looking powders with four test liquids. They will use the characteristic set of reactions for each powder to identify an unknown powder, which is one of the five powders they have tested.

Note: This activity will probably take more than one class period. On the first day, students can plan how to test baking soda, test it, record observations, discuss results, and consider how to test the other powders. On the second day, students can test the remaining powders, record observations, plan how to test the unknown, and then test and identify the unknown powder.

Materials needed for each group

Baking soda	Vinegar
Baking powder	Iodine solution
Cream of tartar	Red cabbage indicator
Detergent	5 Popsicle sticks
Cornstarch	4 Droppers
Water	10 Small cups

Notes about the materials

- Be sure you and the students wear properly fitting goggles.
- When using iodine, read and follow all warnings on the label.
- Use fresh red cabbage leaves; pre-shredded red cabbage will not work.

Preparing materials

- Label 6 small cups **baking soda, baking powder, cream of tartar, detergent, cornstarch,** and **unknown** for each group.
- Place about $\frac{1}{2}$ teaspoon of each powder into its labeled cup. Baking powder works well as the unknown.
- Prepare the iodine solution for the class by adding 1 teaspoon of tincture of iodine to $\frac{1}{4}$ cup water.
- Prepare the red cabbage indicator according to the directions on p. 254.
- Label 4 small cups **water, vinegar, iodine,** and **red cabbage indicator** for each group.
- Place about 2 teaspoons of each solution into its labeled cup.



Testing sheet

Make one copy of *Testing sheet 5.2—Using chemical change to identify an unknown*, pp. 266–267, for each group. You may choose to copy the testing strips onto colored paper to give some contrast to the white powders. Be sure the paper you select is light enough that the labels can be easily read. Once laminated, these testing strips can be reused.

- Use a paper cutter to cut one blank piece of paper into strips so that each group can write the names of the test liquids on the strip.
- Cut 6 different testing strips for each group.
- Laminate the labeled strips and trim the edges.
- Sort out the testing strips for baking soda and the blank strips of paper. These will be distributed at the start of the activity.
- Compile sets of testing strips including baking powder, cream of tartar, detergent, cornstarch, and the unknown. These will be distributed after students have tested baking soda and decided how they will organize and test the remaining powders.

Activity sheet



Copy *Activity sheet 5.2—Using chemical change to identify an unknown*, p. 268, and distribute one per student when specified in the activity. This activity sheet is a chart for students to record their observations. First students will transfer their recorded observations from the four tests on baking soda onto the chart. Then they will record their observations for each of the other powders immediately after conducting each test. Once complete, students will use this chart to help them identify the unknown powder. They will refer to it again in *Activity 5.3*.

Assessment

An assessment rubric for evaluating student progress during this activity is on pp. 305–307. For this formative assessment, check a box beside each aspect of the activity to indicate the level of student progress. Evaluate overall progress for the activity by circling either “Good”, “Satisfactory”, or “Needs Improvement”.

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Question to investigate

How can you identify an unknown powder?

1. Discuss with students how they might test the baking soda with four different test liquids.

Tell students that in this activity they will test five different powders with water, vinegar, iodine solution, and red cabbage indicator. Explain that the set of reactions the liquids have with each powder will be different. Let students know that at the end of the activity, they will be given an unknown powder that is the same as one of the known powders they have been testing. Their job is to identify this unknown powder.

2. Discuss with students how they might test baking soda with four different test liquids.

Ask students questions like the following to help them plan how they will organize and conduct their tests with baking soda.

- **Do we need more than one pile of baking soda?**
Students should test each liquid on a separate pile of baking soda.
- **How many piles of baking soda should we make?**
Since there are four liquids, students should make four piles of baking soda.
- **Do the piles have to be about the same size?**
The size of the piles is not particularly important as long as enough powder is used to see a reaction, if there is one. However, it may be easier for students to compare the results of the unknown to the results from each of the powders if the piles are of similar size.
- **Should the number of drops placed on each pile be the same?**
The precise number of drops is not particularly important, although enough liquid should be added to see the reaction if there is one. However, it will be easier for students to compare the results of the unknown to the results from each of the powders if they use the same number of drops on each pile.
- **How will you remember which pile was tested with which liquid?**
Students should write the names of the test liquids in four separate areas on a strip of paper. The name of each test liquid should be next to each pile of baking soda.
- **How will we remember our observations for each reaction?**
Students should agree to record their results. They can design a chart or table to organize their observations for baking soda.

3. Test baking soda with water, vinegar, iodine, and red cabbage indicator.

Distribute the testing strip for baking soda, one blank strip of paper, the cup with baking soda, the four droppers, and the four test liquids to each group. Have your students follow their class plan for setting up, labeling, and testing the baking soda. The procedure provided below is one example of a possible plan.

Procedure

1. Use a popsicle stick to place 4 equal piles of baking soda on the labeled laminated strip.
2. Place a blank strip of paper next to the laminated strip, and write the name of each test liquid next to each pile.
3. Test each pile of baking soda with 5 drops of each liquid and record your observations.



4. Have students share their results and how they recorded their observations.

As you discuss each group's observations, also discuss how students recorded their observations. Students should explain how they described their observations, whether with words, drawings, or both. They should also explain whether they used a chart or other method to organize their observations.

Expected results: Refer to the results for baking soda in the chart on p. 264.

5. Discuss a possible testing strategy that would make it easy to compare the reaction each powder has with each test liquid.

Let students know that they will be testing four other powders with the same test liquids and will need to compare the set of reactions for each powder. Ask students what they could do so that it would be easy to see and compare the way each powder reacts with a certain test liquid. Students should realize that powders in the same position on separate labeled strips should be tested with the same liquid. Ask students how they should record their observations for all the reactions in an organized way.



Distribute *Activity sheet 5.2—Using chemical change to identify an unknown*, p. 268.

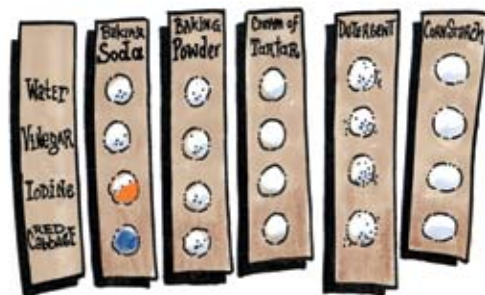
Students should transfer their results for baking soda and place the names of the test liquids in the proper order.

6. Conduct the tests on the remaining powders and record the results.

Distribute the testing strips and the labeled cups of baking powder, cream of tartar, detergent, and cornstarch.

Procedure

1. Set up the baking powder, cream of tartar, laundry detergent, and cornstarch on laminated strips of paper the way you did with the baking soda.
2. Test each of the powders with the test liquids the way you tested baking soda.
3. Record your observations for each reaction in its corresponding area on your observation chart.



<i>Expected results:</i>	Baking soda	Baking powder	Cream of tartar	Detergent	Cornstarch
Water	No change	Bubbling foamy	No change	No change	No change
Vinegar	Lots of bubbling, ends quickly	Bubbling foamy	No change	A little sudsy-looking	No change
Iodine	Stays orange	Black/purple in color foamy	Stays orange	Yellowish	Turns black
Cabbage	Stays blue	Pinkish-purple, then fades to blue, bubbles	Turns pink	Turns green	Stays blue

7. Test the unknown powder and try to identify it.

Explain that you will give each group a powder that is the same as one of the powders students have tested, but you won't tell them which one it is. Students will need to find a way to identify the unknown powder. Ask students:

- Is it possible to correctly identify the unknown powder?
- How could you test the unknown powder so that you could identify it?
- How will you use the results from all of your tests to help identify the unknown?

Students should realize that they will need to test the unknown powder the same way they tested all of the other known powders and compare the results. If the unknown powder reacts with each test liquid the same way one of the known powders does, then these two powders must be the same.

Distribute the unknown powder (baking powder) to each group.

Procedure

1. Place four samples of your group's unknown powder on a separate strip of laminated paper.
2. Test the unknown with each test liquid in the same way you tested the other powders.
3. Compare the set of reactions for the unknown with the other test strips and with your written observations.

8. Have students report the identity of the unknown and discuss what evidence led them to their conclusion.

Ask each group to state what it thinks is the identity of the unknown. Then ask them which observations led them to their conclusion. Remind students that color changes and bubbling are evidence of chemical change. Explain that they were able to use their observations to identify the unknown because each powder had its own set of characteristic chemical reactions with each of the test liquids.

Expected results:

		Powder being tested					
		Baking soda	Baking powder	Cream of tartar	Detergent	Cornstarch	Unknown
Test liquid	Water	No change	Bubbling foamy	No change	No change	No change	Bubbling foamy
	Vinegar	Lots of bubbling, ends quickly	Bubbling foamy	No change	A little sudsy-looking	No change	Bubbling foamy
	Iodine	Stays orange	Black/purple in color foamy	Stays orange	Yellowish	Turns black	Black/purple in color foamy
	Cabbage	Stays blue	Pinkish-purple, then fades to blue, bubbles	Turns pink	Turns green	Stays blue	Purple, then fades to blue, bubbles

Testing sheet 5.2

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Baking soda

Baking powder

Cream of tartar

Testing sheet 5.2

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Unknown

Detergent

Cornstarch