Activity 5.8
Neutralizing acids and bases

How can you return the color of a red cabbage indicator solution back to blue?

In *Activity 5.7*, students saw that acids turn red cabbage indicator pink and bases turn it greenish-blue. In this activity, students will use their knowledge of color changes with red cabbage indicator to neutralize an acidic solution with a base and then neutralize a basic solution with an acid.

Materials needed for each group

Red cabbage leaves
Cream of tartar
Powdered laundry detergent
Water
Zip-closing plastic bag (quart-size, storage-grade)
4 Clear plastic cups
2 Small cups
4 Toothpicks
1 Tablespoon
Permanent marker
White piece of paper

Notes about the materials

- **Be sure you and the students wear properly fitting goggles.**
- Use fresh red cabbage; pre-shredded red cabbage will not work.
- Students should make fresh cabbage indicator solution or, if conducting this activity immediately after *Activity 5.7*, use the left over indicator solution.

Preparing materials

- Either reuse the labeled cups and substances from *Activity 5.7* or label 2 small cups **detergent** and **cream of tartar**.
- Place about ¼ teaspoon of laundry detergent and ¼ teaspoon of cream of tartar in their labeled cups.

Activity sheet

Copy *Activity sheet 5.8—Neutralizing acids and bases*, p. 293, and distribute one per student when specified in the activity.

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".

Activity 5.8
Neutralizing acids and bases

Question to investigate

How can you return the color of a red cabbage indicator solution back to blue?

1. Introduce the concept of *neutralization*.

Ask students if they can think of a way to return the pink indicator solution from *Activity 5.7* back to blue. Give students a hint by telling them that acids and bases are like chemical opposites. Tell students that adding just the right amount of laundry detergent to the indicator + cream of tartar can bring the indicator solution back to its neutral color—blue. This process is called *neutralizing* an acid.

Ask students what they might do to return the green indicator solution from *Activity 5.7* back to blue. Tell students that they will use the color changes of red cabbage indicator to help them neutralize both an acid and a base.

Distribute *Activity sheet 5.8—Neutralizing acids and bases.*

2. Have students prepare for the experiment.

If students conduct this activity immediately after *Activity 5.7*, they can reuse the solutions and skip the procedure on the activity sheet.

Procedure

1. Make indicator solution as described on p. 286. This indicator solution will be used in this activity and in *Activity 5.9*.
2. Label 3 empty clear plastic cups **indicator + detergent**, **indicator + cream of tartar**, and **control**.
3. Carefully pour 2 tablespoons of indicator solution into each cup and place the cups on a white piece of paper.
4. Use the flat end of a toothpick to scoop up a small amount of cream of tartar. Add the cream of tartar to the *indicator + cream of tartar* cup. Gently swirl to mix.
5. Use the flat end of a different toothpick to scoop up a small amount of laundry detergent. Add the detergent to the *indicator + detergent* cup. Gently swirl to mix.

***Expected results*: Cream of tartar turns the indicator a pinkish color. This means that vinegar and cream of tartar are both acids. Laundry detergent turns the indicator a greenish-blue color. This means that laundry detergent is a base.**

3. Discuss with students how they might neutralize each solution.

Ask questions such as the following to help students plan how they will neutralize each solution.

- What should you add to the pink *indicator + cream of tartar* solution to change the color back to blue like the control?
- What should you add to the green *indicator + laundry detergent* solution to change the color back to blue like the control?
- Should you add a little bit of laundry detergent or cream of tartar, or a lot at once?
- What will you do if the color does not quite change back to blue after mixing the powder into the indicator solution?
- How will you know when the solution has been neutralized?

Students should suggest adding a little bit of laundry detergent to the pink *indicator + cream of tartar* and adding a little bit of cream of tartar to the green *indicator + laundry detergent* solution. They should realize that they will need to add a little bit of powder at a time, mix the contents of the cup, compare the color to the color of the control, and repeat if necessary. This process is described in the procedure below.

4. Have students neutralize the *indicator + cream of tartar* solution and the *indicator + laundry detergent* solution.

Procedure

1. Use a clean toothpick to add a small amount of laundry deterent to the *indicator + cream of tartar* and swirl. Observe the color. If needed, continue this process until the solution returns to blue.
2. Use a different clean toothpick to add a small amount of cream of tartar to the *indicator + laundry detergent* and swirl. Observe the color. If needed, continue this process until the solution returns to blue.

Expected results: **The pink *indicator + cream of tartar* solution will return to blue after adding small amounts of laundry detergent. The greenish *indicator + laundry detergent* solution will return to blue after adding small amounts of cream of tartar. The color of the indicator may not return to the exact color of the control.**

5. Discuss student experiences.

Ask students questions like the following to find out what they could do if they accidentally added too much detergent to the *indicator + cream of tartar* or too much cream of tartar to the *indicator + detergent*:

- Were you able to return the pink and greenish-blue indicator solutions back to blue?
- What could you have done if the pink indicator turned greenish-blue instead of blue?
- What could you have done if the greenish-blue indicator turned pink or purplish-pink instead of blue?
- Do you think you could have neutralized the greenish-blue indicator + laundry detergent solution with vinegar?
- How would you neutralize an indicator + vinegar solution?
- Can a base neutralize an acid?
- Can an acid neutralize a base?

Students should realize that adding a small amount of cream of tartar to the greenish-blue indicator solution could bring it back to blue and adding a small amount of detergent to the pink solution could bring it back to blue. Also, vinegar is an acid like cream of tartar. It can be used to neutralize an *indicator + detergent* solution. A base, like detergent, can be used to neutralize the *indicator + vinegar* solution. Students should conclude that a base can neutralize an acid and an acid can neutralize a base.

6. Conclude the activity by giving students real-life examples of the process of neutralizing.

Suggest some examples where neutralizing acids and bases is useful.

- Sometimes soil needs to be made a little more acidic or basic so that certain plants will grow better.
- Excess stomach acid can be neutralized with an antacid, which is a base.
- The amount of acid or base in a swimming pool or aquarium is adjusted by adding either an acid or base to help neutralize the water.
- The amount of acid or base in drinking water is adjusted at water purification plants. The water is made acidic to clean it and then neutralized before sending it out to homes and businesses. If the water were too acidic, it could react with the pipes and cause leaks.