

Student Activity

Name _____
Class _____

Many common household solutions contain acids and bases. Acid-base indicators, such as litmus and red cabbage juice, turn different colors in acidic and basic solutions. They can, therefore, be used to show if a solution is acidic or basic. An acid turns blue litmus paper red, and a base turns red litmus paper blue. The acidity of a solution can be expressed using the pH scale. Acidic solutions have pH values less than 7, basic solutions have pH values greater than 7, and neutral solutions have a pH value equal to 7.

In this experiment, you will use litmus and a pH Probe to determine the pH values of household substances. After adding red cabbage juice to the same substances, you will determine the different red cabbage juice indicator colors over the entire pH range.



Figure 1.

OBJECTIVES

- Use litmus paper and a Vernier Go Direct (GDX) pH Sensor to determine the pH values of household substances.
- Add cabbage juice to the same substances and determine different red cabbage juice indicator colors over the entire pH range.

MATERIALS

- TI-Nspire CX II Handheld
- Go Direct pH Probe
- Calculator Cable (Mini-A to Micro-B USB)
- ring stand
- test tube clamp
- wash bottle
- distilled water
- sensor soaking solution
- household solutions
- test-tube rack
- 7 small test tubes
- red and blue litmus paper
- paper towel
- stirring rod
- red cabbage juice
- 250 mL beaker

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PROCEDURE

1. Obtain and wear goggles. **Caution:** *Do not eat or drink in the laboratory.*

Part I: Litmus Tests

2. Label seven test tubes with the numbers 1–7 and place them in a test tube rack.
3. Measure 3 mL of vinegar into test tube #1. Refer to the data table and fill each of the test tubes 2–7 to about the same level with its respective solution. **DANGER:** *Treat all laboratory chemicals with caution. Prudent laboratory practices should be observed. Avoid inhaling vapors. Avoid contacting your skin and clothing with any of the solutions. Wear goggles at all times. Notify your teacher immediately in the event of an accident.*
4. Use a stirring rod to transfer one drop of vinegar to a small piece of blue litmus paper on a paper towel. Transfer one drop to a piece of red litmus paper on a paper towel. Record the results. Clean and dry the stirring rod each time.
5. Test solutions 2–7 using the same procedure. Be sure to clean and dry the stirring rod each time.

Part II: Red Cabbage Juice Indicator

6. After you have finished the Part I litmus tests, add 3 mL of red cabbage juice indicator to each of the seven test tubes. Record your observations. Dispose of the test-tube contents as directed by your teacher.

Part III: pH Tests

7. Turn on the TI-Nspire CX II.
8. Connect the GDX pH Probe to the TI-Nspire CX II Handheld with the cable provided. The Vernier DataQuest App will automatically open.
9. Remove the pH Sensor from the sensor storage solution bottle by unscrewing the lid. Carefully remove the bottle, leaving the cap on the sensor body.
10. Rinse the tip of the sensor with distilled water and place the sensor tip into a beaker containing sensor soaking solution. Use a test tube clamp and ring stand to hold the pH Probe as shown in Figure 1.
11. Raise the pH Sensor from the sensor soaking solution and set the solution aside. Use a wash bottle filled with distilled water to thoroughly rinse the pH Sensor. Catch the rinse water in a 250 mL beaker.
12. Obtain one of the 7 solutions in the small container supplied by your teacher. Raise the solution to the pH Sensor and swirl the solution about the sensor. When the pH reading stabilizes, record the pH value.
13. Prepare the pH Sensor for reuse.
 - a. Rinse it with distilled water from a wash bottle.
 - b. Place the sensor into the sensor storage solution and swirl the solution about the sensor briefly.
 - c. Rinse with distilled water again.

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14. Determine the pH of the other solutions using the previous procedure. You must clean the pH Sensor between tests using the previous procedure.
15. When you are finished, rinse the Probe with distilled water and return it to the sensor soaking solution.
16. Turn off the pH probe.

DATA TABLE

Test tube	Solution	Blue litmus	Red litmus	Red cabbage juice	pH
1	vinegar				
2	ammonia				
3	lemon juice				
4	soft drink				
5	drain cleaner				
6	detergent				
7	baking soda				

QUESTIONS

1. Which of the household solutions tested are acids? How can you tell?
2. Which of the solutions are bases? How can you tell?
3. What color(s) is red cabbage juice indicator in acids? In bases?
4. Can red cabbage juice indicator be used to determine the strength of acids and bases? Explain.
5. List advantages and disadvantages of litmus and red cabbage juice indicators