# Pre-Lab Information

Purpose Explore acids and bases using 2 different pH indicators.

Time Approximately 45 minutes

Question How can you use a red cabbage solution to determine the pH of a solution?

Hypothesis If you can measure the pH of a range of acids and bases with a universal pH indicator, then you can use those values to calibrate a cabbage pH indicator.

Summary Using pH indicator paper, you will measure the pH of several acids and bases. This data will help you establish a key for a cabbage indicator. Finally, you will rate the pH of three everyday solutions with this new cabbage indicator.

# Safety

* Always wear a lab coat and safety goggles when performing an experiment.
* Behavior in the lab needs to be purposeful. Exercise caution when using the hot plate, as it can   
  cause burns.
* Check glassware, such as beakers and test tubes, for cracks and chips prior to use.
* Wear the right gear, such as chemically resistant gloves and oven mitts, when performing   
  the experiment.
* Report all accidents—no matter how big or small—to your teacher.

# Procedure

1. **Gather Materials:** Gather all items in the list shown below.

|  |  |  |
| --- | --- | --- |
| * Balance * 10 g red cabbage * Thermometer * Distilled water * 250 mL beaker * Hot plate * 10 test tubes | * Test tube rack * pH indicator paper (seven 1-in strips) with chart * 0.00001 M HCl * 0.001 M HCl * 0.1 M HCl * 0.001 M NaOH * 0.1 M NaOH | * Lemon juice * Hand sanitizer * Dishwashing liquid * 14 transfer pipets * Funnel * Filter paper * 250 mL Erlenmeyer flask |

1. **Cook Up a Cabbage pH Indicator**
   1. Weigh out approximately 10 g of red cabbage.
   2. Cut the cabbage into small pieces about the size of a penny.
   3. Put the cabbage into an empty 250 mL beaker.
   4. Measure approximately 60 mL of water into the beaker.
   5. Heat the cabbage and water on a hot plate, stirring occasionally, until the temperature reaches approximately 95°C.
   6. Remove the solution from the hot plate and allow it to cool to room temperature. (While   
      you wait, complete Steps 3–5.)
2. **Prepare Seven Solutions to Establish a pH Scale**
   1. Place 7 test tubes into a test tube rack. The acids and bases shown below cover a range of pH values. Use what you know about acids, bases, and concentration levels to label the test tubes, in order, from most acidic to most basic.

**Acids:** 0.1 M HCl 0.001 M HCl 0.00001 M HCl

**Neutral:** Distilled Water

**Bases:** 0.1 M NaOH 0.001 M NaOH 0.00001 M NaOH

* 1. Using a new transfer pipet each time, transfer 15–20 drops of each solution into its correspondingly labeled test tube.

1. **Compute the pH of the Solutions**

For the acids, use the formula pH = –log[H+]. (Because HCl has 1 H+ ion per formula unit,   
[H+] equals the molarity.) For water, use what you know about the pH of neutral solutions.   
For the bases, examine and extend the pattern.

1. **Test the Solutions with pH Indicator Paper**
   1. Arrange 7 indicator papers on a paper towel, laying 1 strip in front of each of the 7 test tubes.
   2. Transfer 2–3 drops of each solution onto a strip of the indicator paper, using a new transfer pipet each time.
   3. Record the colors in the data table using either words or a colored pen or marker. Then compare your results to the universal indicator’s color key to determine the pH range   
      (e.g., 5–6).
2. **Finish Preparation of the Cabbage pH Indicator Solution**

When the cabbage indicator solution is cool, filter it into a 250 mL Erlenmeyer flask.

* 1. Fold the filter paper in half. Fold again in fourths.
  2. Open in the center so the solid particles can get trapped.
  3. Place in a funnel. Pour all liquid mixture through the filter system into flask.

1. **Calibrate the pH Cabbage Indicator by Retesting the Solutions**
   1. Using a transfer pipet, add 20–25 drops of cabbage indicator to each of the 7 test tubes. Gently swirl the tubes to mix the solutions.
   2. Record the colors of the solutions in the data table to complete the cabbage pH indicator key. Describe the colors in words or use colored pencils or markers.
2. **Test Three Household Solutions with the Cabbage pH Indicator**
   1. Using a new transfer pipet for each solution, add 15–20 drops of lemon juice, hand sanitizer, and soap/dishwashing liquid to 3 clean test tubes.
   2. Using a new transfer pipet, add 20–25 drops of cabbage indicator to each of the test tubes. Gently swirl the tubes to mix the solutions. Record the colors for all 3.
   3. Determine the pH of each with your cabbage pH indicator key. Enter the pH ranges into   
      the data table.
3. Dispose of all materials according to your teacher’s directions.

# Data

Record your data in your lab notebook or in the space below.

**Table A: Control Solutions (in order from most acidic to most basic)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Solution Name** |  |  |  |  |  |  |  |
| **pH using  –log[H+]** |  |  |  |  |  |  |  |
| **Indicator Paper Color** |  |  |  |  |  |  |  |
| **Indicator  pH Range (low–high)** |  |  |  |  |  |  |  |

**Table B: Cabbage pH Indicator Key**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **pH Range (low–high)** | 1–2 | 3–4 | 5–6 | 7 | 8–9 | 10–11 | 12–13 |
| **Cabbage Solution Indicator** |  |  |  |  |  |  |  |

**Table C: Test Solutions**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Lemon Juice** | **Hand Sanitizer** | **Soap/Dishwashing Liquid** |
| **Predicted pH** |  |  |  |
| **Cabbage Indicator Color** |  |  |  |
| **pH Range (low–high)** |  |  |  |
| **Acidic, Basic, or Neutral** |  |  |  |