

## Measuring pH with Cabbage Extract

pH can be measured in several ways. Probes can be used to measure pH very exactly. pH paper can also be used but is less exact. pH paper is paper that is saturated with a pH indicator. When the paper is dampened with the test solution it will change color. The color is compared to a standard color chart which indicates the solution's pH. Other indicators, both organic and inorganic can be added to samples to measure pH of a solution. Again the indicator changes to a specific color to reflect the solution's pH.

Red cabbage contains a pigment called anthocyanin, a flavin that can be used as a pH indicator. The color ranges from green-yellow to deep red depending on the solution's pH. Cabbage extract is a deep red color at pH 2, purple at pH 4, violet at pH 6, blue at pH 8, blue-green at pH 10 and green-yellow at pH 12.

### Materials

Red cabbage leaves	Spot plate or 8 small beakers (25 mL)
3-500 mL beaker	Pipette
Water	Hydrochloric acid (stomach acid)
Strainer or fine colander	Lemon juice
Hot plate	Ammonium hydroxide (household ammonia)
Hot gloves or tongs	Sodium bicarbonate (baking soda)
Spoon	Ammonium nitrate (fertilizer)
Knife	Milk
Cutting board	Vinegar

### Preparing Red Cabbage Indicator

1. Remove 3 or 4 leaves from the cabbage head. Slice the leaves into thin strips. The smaller the pieces the better.
2. Place the chopped cabbage into one of the 500 mL beakers.
3. Fill the other beaker with ~300 mL of water. Place the beaker on the hot plate and bring the water to a boil.
4. While waiting for the water to boil assemble the rest of the materials (see below).
5. Use the tongs or gloves to handle the hot beaker. Pour the boiling water over the cabbage leaves. Add enough boiling water to just cover the chopped cabbage leaves.
6. Use the spoon to push the cabbage leaves into the water. Allow to extract and cool for 20 minutes.
7. After 30 minutes the beaker should be cool enough to handle. Place the strainer over the third 500 mL beaker.
8. Pour the boiled cabbage extract into the strainer. Your extract is in the beaker.

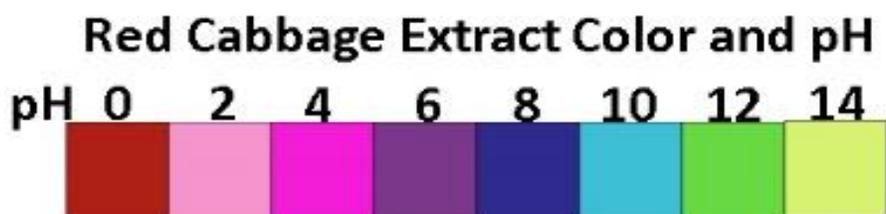
You will be using cabbage extract to determine the pH of several solutions (see materials list). Write a hypothesis for this activity. Which solutions do you think will have an acidic, basic or neutral pH?

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### Measuring pH

1. Pick up a spot plate from the supply table. If spot plates are not available pick up 8 small beakers. For the spot plates you will only need 2 or 3 mL of liquid. If you are using small beakers you will need to add more liquid.
2. Add water to the first depression on the spot plate (or to a small beaker). Add each of the following, hydrochloric acid, lemon juice, ammonium hydroxide, sodium bicarbonate, ammonium nitrate, milk and vinegar to a depression on the spot plate. Keep track of where you put each test reagent.
3. If the reagent added to a depression on the spot plate is a solid (powder), use a pipette to add several drops of water to suspend the solid. pH can only be determined in solution.
4. Add 6 drops of cabbage juice to each spot plate (30 drops to the small beakers).
5. Compare your results to the color chart below. Record your results in the table provided.



Tested Compound	Color	Estimate of pH	Acid or Base	Ion in highest concentration? H <sup>+</sup> or OH <sup>-</sup>
Water				
Hydrochloric acid				
Lemon juice				
Ammonium hydroxide				
Sodium Bicarbonate				
Ammonium nitrate				
Milk				
Vinegar				

Was your hypothesis supported? Explain.

Which solution was the most basic?

Which solution was the most acidic?