

Experiment 12

Red Cabbage Indicator

OUTCOMES

After completing this lab activity, the student should be able to:

- explain characteristics of acid-base indicators and provide examples of indicators.
- classify several household chemicals as acidic, basic, or neutral.



DISCUSSION

Acid-base indicators are substances that take on different colors depending on the pH of the solution. Some acid-base indicators change colors over a very narrow range. These types of indicators are useful for detecting the endpoint of an acid-base titration, since even one drop of an added acid or base can cause the pH to jump dramatically at the endpoint. They are also useful when the pH of a solution is known to be close to the pH at which the indicator changes color, as it can often enable the estimation of pH within a range of ± 0.1 pH unit.

One common acid-base indicator is litmus, derived from certain varieties of lichens. Since litmus changes color right around a pH of 7, it is often used to tell whether a substance is acidic, basic, or neutral. Litmus turns red in acidic solution, blue in basic solution, and purple in neutral solution. Red litmus paper is made by soaking filter paper in a slightly acidic solution containing litmus and blue litmus paper is made by soaking filter paper in a slightly basic solution containing litmus. Once the filter paper is dried, strips of the paper may be dipped into a solution. If red litmus paper turns blue, the solution is basic. If blue litmus paper turns red, the solution is acidic. Finally, if each of the papers remains the same color or they turn purple, the solution is neutral.

Other indicators change colors over a wide range. These indicators are called universal indicators and usually consist of a mixture of indicators, each of which change color at a different pH. This makes them useful in determining an approximate pH, rather than simply distinguishing between acidic, basic, or neutral. When a universal indicator has soaked and dried onto a piece of filter paper, the result is often referred to as pH paper.

The red cabbage juice that will be prepared in this lab is more of a universal indicator, though it will be used primarily to classify substances as acidic, basic, or neutral. Red cabbage juice contains chemicals called anthocyanins. Anthocyanins are found in many flowers, fruits, and vegetables and are responsible for providing the red, blue, and purple colors. As will be observed in this lab activity, it is these anthocyanins that act as the acid-base indicators and change color depending on the pH. Other fruit and vegetable pigments may also be used as acid-base indicators. These include dyes found in blueberries, cranberries, beets, and many

types of grapes. If desired, experiment with some of these to see what happens. Do you know of other common indicators? Can you find any others?



PROCEDURE

- ⚠ *Eye protection must be worn at all times during this experiment!***
- ⚠ *Keep chemicals used in this experiment away from pets, food, and children!***
- ⚠ *Avoid skin contact with the chemicals in this experiment!***

1. Prepare the red cabbage juice indicator by one of the two methods described below:
 - Place about 1 L (1 qt) of distilled water into a small saucepan that has been thoroughly cleaned and rinsed. Tear up 3-4 leaves of red cabbage and add them to the water. Heat the mixture and to bring it to a boil. Once the water begins to boil, turn down the heat and simmer for about 10 minutes. Add more cabbage if a darker color is desired. Allow the mixture to cool and transfer it to a plastic or glass container.
 - Place 3-4 leaves of red cabbage into a blender that has been thoroughly cleaned and rinsed. Add 1 L (1 qt) of distilled water to cover the leaves. Blend for several seconds. Add more cabbage if a darker color is desired. Filter the liquid into a plastic or glass container.
 - If necessary, dilute with distilled water to yield 1 L of the cabbage juice.

REQUIRED PHOTO 1: Shows the prepared cabbage juice solution. The method of preparation should also be visible, whether done by heating or in a blender. Also visible – Today's date shown on a calendar, newspaper, or phone, or written on a sheet of paper, and Picture I.D. (with name).

Acid, Base, and Neutral Standards

2. Prepare the acid and base standards as follows:
 - Line up eight small cups filled with about 50 mL red cabbage indicator. Mark the fifth cup as the neutral standard for comparison.
 - Add 1 drop of household ammonia to the fourth cup, 2 drops to the third, 3 drops to the second, and 10-20 drops to the first. To the sixth cup, add 1 drop of white vinegar, to the seventh add 2 drops, and to the eighth add 10-20 drops.
 - Stir the contents of each cup to achieve uniform mixing. Avoid cross-contamination of acidic, basic, and neutral solutions by wiping and drying the stirring device.

- The result should be a beautiful variation in shades ranging from green to aqua to blue to violet to red.
- Record your observations in the table. Note the color, number of drops, and whether the solution was acidic, basic, or neutral. Use adjectives like **slightly**, **least**, or **most** in identifying the acidic and basic solutions (Example: most basic). **Only one** solution is **neutral** and should be pretty easy to figure out. Which one is it?

Testing the Solutions

3. Obtain **at least 10** different water-soluble substances to test with the cabbage juice indicator. You may test any substances you wish, but here are some suggested substances: salt, sugar, baking soda, rubbing alcohol, 7-Up (or other soda), milk, lemon juice, hydrogen peroxide, aspirin, acetaminophen, antacid tablets, soap, shampoo, household cleaners, fingernail polish remover, or mouthwash. The primary requirement is that the liquids are colorless or white, besides being water-soluble.
4. Test the water soluble substances selected to see whether they are acidic, basic, or neutral by placing 50 mL of cabbage juice indicator into a cup and adding 10-20 drops of the solution to be tested. Solids may be tested by adding an amount equal to a match head. Record your observations.
5. Tell whether each of the substances is acidic or basic by comparing the results to your standards. Adjectives like *least*, *slightly*, *very*, or *most* may be used in classifying the substances. (Example: slightly acidic)

REQUIRED PHOTO 2: A selfie with the required eye protection that shows all of the cups of cabbage juice (after the substances have been added and the color has changed), as well as the chemicals that were tested.

6. **Save** the cups with your acid, base, and neutral **standards**, while pouring the **test solutions** down the drain and flushing with water.

pH of Breath

7. Place 25-30 mL of cabbage juice indicator solution into a clean, dry cup. Using a straw, blow your breath through the cabbage indicator solution. Use slower, deeper breaths that come from your lungs rather than quick, shallow breaths that primarily exhale air that was just inhaled. This step may take 5-10 minutes or more. Take a break if necessary.
8. Observe any change in color to see if the solution is remaining neutral or becoming more acidic or basic. The standards in cups 4, 5, and 6 should be most helpful. Use standard cups 3 and 7 for comparison, if necessary.
9. Pour all of the solutions down the drain and flush with water.

PRELAB QUESTIONS

1. Classify ammonia and vinegar as acidic, basic, or neutral. Consult the product label on the vinegar for verification.

Solution	Classification
ammonia	
vinegar	

2. Which pH values or ranges are expected for these solutions?

Solution	Expected pH
acidic	
basic	
neutral	

3. Which safety precautions, if any, must be observed during this lab activity?

Name _____

Lab Section _____

DATA

Acid and Base Standards

Cup	Substance Added	Drops	Color	Acidic, Basic, or Neutral?
1				
2				
3				
4				
5				
6				
7				
8				

Testing the Solutions *optional

Cup	Substance Tested	Color	Acidic, Basic, or Neutral?
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11*			
12*			
13*			
14*			
15*			

pH of Breath

Report your observations here:

POSTLAB QUESTIONS

1. Comment on the results/observations of the experiment. Were they what you expected? Were there any surprises? Did you have any trouble?

2. What color would be expected if the following were added to red cabbage juice? Tell whether they are acidic, basic, or neutral.

Substance	Color Expected	Acidic, Basic, or Neutral?
Sodium hydroxide		
Hydrochloric acid		
A solution with a pH = 3		
A solution with a pH = 7		
A solution with a pH = 11		

3. Is your breath acidic, basic, or neutral? Explain.

PHOTO 1 - Please compress photos and save your file **before** uploading to the dropbox. Photos should come close to filling the box below and all required items should be **clearly visible**.
[Consult the procedure for the required photo.](#)

Required Photo 1:



PHOTO 2 - Please compress photos and save your file **before** uploading to the dropbox. Photos should come close to filling the box below and all required items should be **clearly visible**. Consult the procedure for the required photo.

Required Photo 2:



