Natural pH Indicator Lab

Background:

Red cabbage contains pigments call **anthocyanins.** The pigments give it the red/purplish color. Anthocyanins belong to group of chemical compounds called **flavonoids**. Other plants that contain anthocyanins include beets, cranberries and blueberries. Red cabbage juice changes from deep red at pH 1 to purple at pH 7 to to green at pH 12. At higher pH (13-14) it turns yellow.

Anthocyanins are the pigments responsible for reds and blues in flowers and fruits. Anthocyanins are also responsible for the red color of cranberry juice, and many juice blends. They are also naturally occurring pH indicators. A typical anthocyanin is red in acid, violet in neutral solutions, and blue in basic solutions. A single type of anthocyanin can be responsible for different colors; for example a red zinnia, purple pansy, and blue morning glory may all contain the same anthocyanin in a different pH environment. Because of their indicator nature, anthocyanins can be used to demonstrate principles of acids and bases and light absorption.

For most pH indicators, the compound acquires a proton at low pH (lots of H+) but looses it at higher pH. This seemingly minor alteration is sufficient to alter the wavelengths of light reflected by the compound, thus creating the color change with respect to pH.

Beets change from red to purplish in very basic solution.

Blackberries, black currants, and black raspberries change from red in acids to dark blue or violet in basic solution.

Blue and red grapes contain several different pH-sensitive anthocyanins. For example, blue grapes are colored by a monoglucoside of malvinidin that changes from deep red in acidic solutions to violet in basic solution.

Red wines naturally contain these same pigments.

Blueberries change from blue (around pH 2.8-3.2) to red in a strongly acidic solution.

Cherries and cherry juice is bright red in acidic solution but purple to blue in basic solution.

Curry powder and tumeric are spices that contain a bright yellow pigment called curcumin (which is *not* an anthocyanin). It turns from yellow at pH 7.4 to red at pH 8.6.

Delphinium petals contain an anthocyanin called delphinin, which changes from bluish red in acid to blue to violet in basic solution.

Geranium petals contain pelargonin, an anthocyanin which changes from orange-red in acid solution to bluish in basic solution.

Horsechestnut leaves can be ground with alcohol to extract esculin, a fluorescent dye. Esculin changes from colorless at pH 1.5 to fluorescent blue at pH 2. Shine a black (ultraviolet) light on the indicator to get the full effect.

Morning glories contain an anthocyanin called "heavenly blue anthocyanin" which changes from purplish red at pH 6.6 to blue at pH 7.7.

Natural pH Indicator Lab

Onion is an olfactory indicator. The onion odor isn't detectable in strongly basic solutions. Red onion can act as a visual indicator at the same time. It changes from pale red in acid solution to green in basic solution.

Petunia petals contain petunin, an anthocyanin that changes from reddish purple in acid to violet in basic solution.

Purple peonies contain peonin, which changes from reddish purple or magenta in acid solution to deep purple in basic solution.

Red cabbage contains a mixture of anthocyanins and other pigments that indicate a wide range of pH. The photograph at right shows how red cabbage juice changes from deep red at pH 1 to purple at pH 7 to to green at pH 12. At higher pH (13-14) it turns yellow.

Rose petals contain the oxonium salt of cyanin, and they turn blue in basic solution. (The potassium or calcium salt of the same pigment makes cornflowers blue!)

Vanilla extract, like onion, is an olfactory indicator. The vanilla odor isn't detectable in strongly basic solution because vanillin exists in ionic form at high pH.

Natural pH Indicator Lab

Purpose:

To use the juice of red cabbage, a natural acid/base indicator, to test the pH of different fluids.

Materials:

petri dishes
droppers
- water
- white vinegar
- fresh pop/flat pop (Sprite)

pre-made cabbage indicator
- diluted lemon juice
- diluted sodium bicarbonate solution

various acid/base solutions:
- other solutions as provided by your instructor

Procedure:

1. Place approximately 25 to 50mL of each of the solution each into its own petri dish. One solution per petri dish. Label each dish.
2. Add a few drops of the cabbage juice indicator to your solutions, and note any color changes. The juice should turn pink in acidic solutions, and green in basic solutions.
3. Order the samples from pink to green.
4. Record the samples in order of pH.
5. Research the pH of each solution and record it in the chart. The internet is a great tool for this task.

Solutions	Color of Solution mixed with Indicator	Approximate pH number

Natural pH Indicator Lab

Questions:

1. The human body uses many types of fluids in order to maintain health. What is the pH level of urine, stomach acid and saliva?

2. Discuss why stomach acid needs to have a very low pH level and how that level affects digestion.

3. Some visits to the doctor's office might require a urine sample. What are some possible explanations for urine with a high pH level?

4. What is the pH range for blood in humans? Discuss why the pH for blood should be in this range.

5. What is the pH level of ammonia? Discuss why ammonia is an effective disinfectant.

6. What is the pH level of the water in a properly maintained swimming pool? Discuss why must the pH be kept at this level.

7. What is the pH tolerance level for microscopic organisms that may otherwise live in swimming pools?

8. How might one correct the pH of a lake with a reading of 3?

9. Discuss how plants like morning glory or hydrangea act as indicators of the soil's pH level.

10. Why is compost pH worth measuring?