IMHOTEP'S LEGACY ACADEMY

9.1 Acids & Bases: Using Purple Cabbage as a pH indicator

Grade 9 Activity Plan

Reviews and Updates

9.1 Acids, Bases & Purple Cabbage

Objectives:

1. To demonstrate the basic physical and chemical properties of acids and bases.
2. To undersatnd what a pH scale is, and be able to interpret pH data.
3. To be able to predict pH values of different substances by testing them with indicators.

Key words/concepts: Solubility, Solvents, Solutes, Concentration, Acids, Bases, pH, Indicators

Curriculum outcomes: 111-6, 208-7, 209-7, 307-13, 307-14.

Take home product: samples of tested substances in small medical vials.

Segment	Details
African Proverb and Cultural Relevance (5 min.)	"A paddle here, a paddle there—the canoe stays still." **Sierra Leone**
Pre-test (10 min.)	Ask probing questions on students' knowledge of atoms.
Background (10 min.)	Brainstorm examples of acids and bases, and discuss their properties. Encourage application of classroom knowledge and educated guessing.
Activity 1 (10 min.)	Explain solubility and demonstrate it by trying to dissolve salt and Tums tablets in water.
Concept (10 min.)	pH: Explain what Acids and Bases are and explain how pH scale is used.
Activity 2 (30 min.)	Engage the students in the Purple Cabbage pH Meter activity.
Post-test (15 min.)	Students will use concepts they learned to fill in the blanks.

Suggested interpretation of proverb: It is good to have balance in life. For example, those who work hard can also play hard. Also, if you only put a little bit of effort into something you won't go anywhere. So try hard in everything you do to maintain balance. In this activity, you will learn that an acid and a base can balance each other out to produce a neutral solution.

Note: mentor should begin by chopping and boiling cabbage juice to ensure that the juice would have cooled to a safe temperature for handling at the time when it is needed.

BACKGROUND INFORMATION

Acidic: A solution that has an excess of H+ ions.
Basic: A solution that has an excess of OH- ions. Another word for base is alkali.
Aqueous: A solution that is mainly water. Think about the word aquarium. AQUA means water.
pH: measure of the concentration of hydrogen ions in a solution
Strong Acid: An acid that has a very low pH (0-4).
Strong Base: A base that has a very high pH (10-14).
Weak Acid: An acid that only partially ionizes in an aqueous solution. That means not every molecule breaks apart. They usually have a pH close to 7 (3-6).
Weak Base: A base that only partially ionizes in an aqueous solution. That means not every molecule breaks apart. They usually have a pH close to 7 (8-10).
Neutral: A solution that has a pH of 7. It is neither acidic nor basic.

The **pH scale** is used to measure how acidic or basic a liquid is. Although there may be many types of ions in a solution, pH focuses on concentrations of hydrogen ions (H+) and hydroxide ions (OH-). The scale goes from 0 through 14. Distilled water is 7 (right in the middle). Acids are found between a number very close to 0 and 7. Bases are from 7 to 14. Most of the liquids you find every day have a pH near 7.

Acids are compounds that break into hydrogen (H+) ions and another compound when placed in an aqueous solution. Bases are compounds that break up into hydroxide (OH-) ions and another compound when placed in an aqueous solution. If you have an ionic compound and you put it in water, it will break apart into two ions. If one of those ions is H+, the solution is acidic. If one of the ions is OH-, the solution is basic.

That pH scale measures the number of H+ ions in a solution. If there are a lot of H+ ions, the pH is very low. If there are a lot of OH- ions that means the number of H+ ions is very low, so the pH is high.

Additional Information
http://www.braukaiser.com/wiki/index.php/An_Overview_of_pH
Purple cabbage pH scale

Activity 1: Solubility Demo

Purpose: To develop a good knowledge of solutions; soluble and insoluble substances

Suggested format: make students form groups of two.

Item	**Quantity (for mentor and 10 students)**
250ml beakers/plastic cups	2 (for mentor)
Water	4L
Salt	1box
Tums	20 tablets
Spoon	10

Procedure:

1. Fill both beakers to the 200ml mark (let each group of students pour about 200ml of water into their plastic cups).
2. Pour half teaspoon of salt into the beaker/plastic cup of water and stir. Record observations.
3. Now pour a bunch of salt into the beaker/plastic cup and stir. Record observations.
4. In the second beaker/plastic cup, **throw** a single tum tablet into the water. Record observations.
5. Now **smash** a different tum tablet into a powder and pour that into the same beaker of water. Record observations.

Activity 2: Making a pH Meter with Purple Cabbage

Resource: http://www.funsci.com/fun3_en/acids/acids.htm

Purpose: To be able to predict pH values of different substances by testing them with indicators.

Part 1: Making the indicator

Suggested format: mentor should execute this activity asking for students help when possible.

Items	**Quantity (for mentor only)**
Purple cabbage	1
Knife	1
Cutting board	1
Water	1L
Pot/sauce pan	1small
Stove top or hot plate	1

Procedure:

1. Chop some purple cabbage using a knife and cutting board. **For every litre of indicator intended to be made, chop about 125g (1 ¼ cups) of cabbage.**
2. Boil the matching amount of water in a pot.
3. Once water is boiled, turn off heat and carefully add the cabbage to the hot water. Let it sit for about half an hour to cool off.
4. **To measure/compare the pH of solutions, it is important one measures the same amount of solution for every substance you measure.**

Part 2: Testing pH

Suggested format: make students for groups of two.

Items	**Quantity (for 10 students)**
Test tubes	12
Tums	5 tablets
Acetone	1L
Lemon Juice	1L
Pop	1L
Vinegar	1L
Hydrogen Peroxide	1L
Medical vials	30
pH testing strips	20

Procedure:

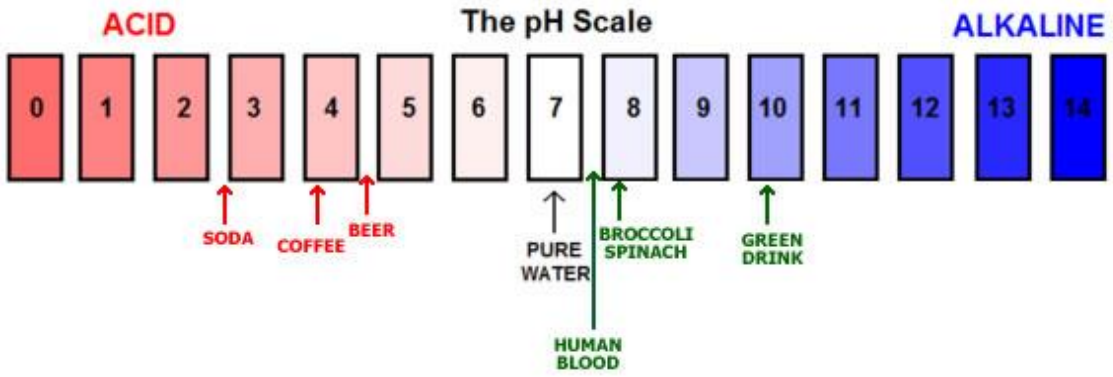
1. Use the cabbage juice solution to test the pH of various solutions provided by your mentor such as lemon juice, cola, vinegar, ammonia, Tums, etc. Allow student to record results in their charts.

2. Test the same solutions from step 1, **except this time use litmus paper**. Compare your results. Were they the same?

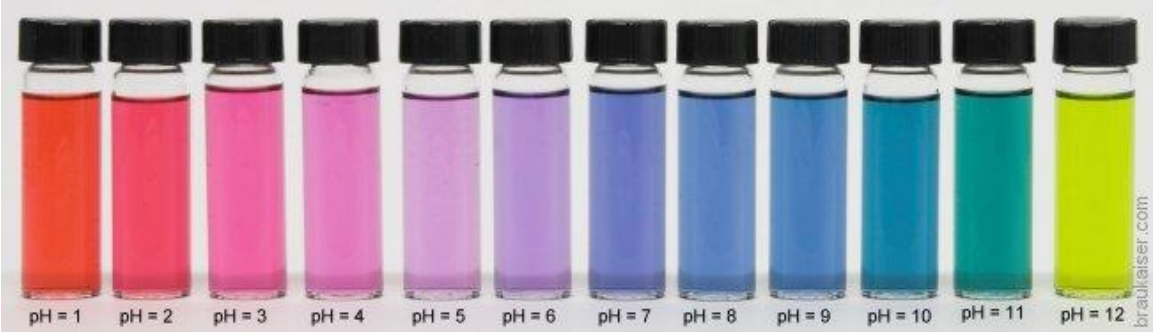
By boiling the purple cabbage leaves, one extracts a class of pigment molecules called anthocyanins into solution. Anthocyanin molecules will change their colour depending upon the pH of their environment and can indicate the pH of a solution.

Results table to record the outcome of testing purple cabbage juice with various substances.

Substance	Test tube	Predicted pH	Colour/Observations
Tums			
Lemon Juice			
7-up			
Vinegar			
Hydrogen Peroxide			



Colour scale for red cabbage



Post-Test: Knowledge is Power

_ _ _ _ _ make up all matter in the universe.

_____

A _ _ _ _ _ _ _ _ is _ _ _ _ _ linked together.

_____

_ _ _ _ _ _ _ are located in the nucleus, and carry a _ _ _ _ _ _ _ _ charge.

_____

_ _ _ _ _ _ _ _ are also located in the nucleus and carry _ _ charge.

_____

_ _ _ _ _ _ _ _ _ orbit around the nucleus and are _ _ _ _ _ _ _ _ _ _ charged.

_____

An _ _ _ is an _ _ _ _ with an electric charge.

_____

An _ _ _ with a positive charge is missing an _ _ _ _ _ _ _ _.

_____

When substance which has dissolved is _ _ _ _ _ _ _.

_____

A substance which will not dissolve is _ _ _ _ _ _ _ _ _.

_____

_ _ _ _ _ _ _ is the substance which is doing the dissolving.

_____

HCL is an _ _ _ _ and NaOH is a _ _ _ _.

_____

H+ and OH- are highly _ _ _ _ _ _ _ _.

_____