

## Teacher Instructions:

### California State Standard's Covered:

#### Acids and Bases:

- Students know the observable properties of acids and bases.
- Students know acids are hydrogen ion donating and bases are hydrogen ion-accepting substances.
- Students know how to use the pH scale to characterize acid and base solutions.

#### Materials:

¼ of a cabbage  
Blender  
Strainer  
Large Container  
~500 ml---1L Beaker  
7 plastic cups  
7 plastic spoons

#### Liquids to Test:

- Hand Sanitizer
- Lemon Soda
- White Vinegar
- Apple Juice
- Baking Soda
- Shampoo (preferably clear)
- Conditioner (preferably clear)

In this lab, students will use the juice from red cabbage as a pH indicator to test common household liquids and determine their pH levels. Students will mix the cabbage juice with different household liquids and see a color change produced by a pigment called flavin (an anthocyanin) in red cabbage. Through this color change, students will be able to successfully identify the approximate pH of common household liquids and classify each liquid as alkaline (basic), acidic, or neutral using the table below:

Color:	Pink	Dark Red	Violet	Blue	Blue-Green	Green-Yellow
Approx. pH	1-2	3-4	5-7	8	9-10	11-12
Acid/ Base	Acid	Acid	Acid/Neutral	Base	Base	Base

#### Cutting the Cabbage:

- Cut ¼ of a cabbage into thin strips like shown below:



- Place the cut cabbage into a Ziploc bag

Note: Keep the red cabbage refrigerated.

## Answers to Questions:

### Pre- Laboratory Predictions:

Hand Sanitizer= Neutral

Lemon Soda= Acidic

Apple Juice= Acidic

White Vinegar= Acidic

Shampoo= Acidic

Conditioner= Basic

Baking Soda= Basic

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Liquid:	Color Change/ pH	Actual pH
Hand Sanitizer	Purple	~7
Lemon Soda	Pink	2
Apple Juice	Pink/Red	3
White Vinegar	Red	4
Baking Soda	Blue	8
Shampoo	Magenta	5.5
Conditioner	Blue	~7 or 8

\*STUDENT ANSWER FOR QUESTION #7b

8.

Strong Acids	Weak Acids	Neutral	Weak Bases	Strong Bases
Lemon Soda	White Vinegar	Hand Sanitizer	Baking Soda	
Apple Juice	Shampoo		Conditioner	

Adding more baking soda to the water changes the intensity of the color blue. In this case, the liquid becomes a dimmer blue. This is because the pH scale is logarithmic meaning that a difference in 1 unit of pH is a 10X difference in concentration. A 2-unit difference is a 100X difference in concentration and a 3-unit difference is a 1000X difference in concentration.

## Concept Questions:

1. The addition of water does not have a large impact on the pH of strong acids/bases, but it does have a large impact on weak acids/bases. This is because the hydrogen ions in water add the concentration of hydrogen ions in acids/bases. Because weak acids/bases have low concentration of hydrogen ions, the addition of water has a large impact on the pH.
2. A difference in 1 unit is a 10X difference in concentration. For example; a liquid with pH of 3 is 10X more acidic than a liquid with a pH of 4. Therefore, a liquid with a pH of 3 is stronger.
3. Lemon Soda=citric acid  
White Vinegar=acetic acid  
Apple Juice=ascorbic acid  
Shampoo=citric acid  
Conditioner=sodium carbonate  
Baking Soda=sodium bicarbonate

## Real Life Applications:

1. The excess stomach acid is neutralized with a base (Alka-Seltzer). A neutralization reaction always produces salt and water.
2. Acid rain is rain that is slightly acidic due to pollution in the air. Acid rain greatly affects the ecosystems of oceans, rivers, and lakes because once the water becomes too acidic certain fish start to die. Not only is acid rain, fog, or snow dangerous to sea life but also to human's respiratory system as well.