# Colour Changing Cabbage Water

In this package you'll find an engaging activity that you can do at home using materials found around your house! This activity focuses on two concepts: the interactions of different liquids and density. We hope you enjoy the activity and are awed, inspired and enlightened. This activity will require adult supervision.

## PROGRAM BASICS

### 1. pH TESTS

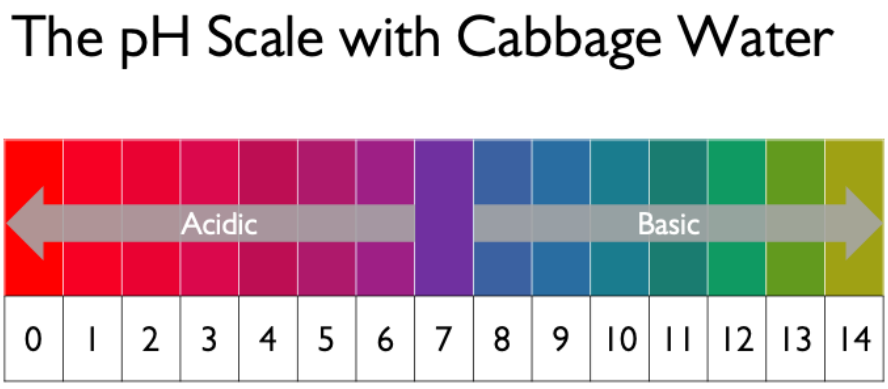
(Time: 30 minutes)

Children will test the ways that red cabbage water changes colour in response to pH (acids and bases) and will experiment with different safe-to-use household liquids.

### 2. NEUTRALIZATION

(Time: 20 minutes)

Children will attempt a neutralization reaction between different acids and bases.




## CURRICULUM CONNECTIONS – SCIENCE AND TECHNOLOGY

### Grade 2

Students will investigate through experimentation the interactions of liquids and liquids (cabbage water and acids or bases) and liquids and solids (cabbage water or vinegar and antacid tablet).

**Grade 5**

Students will observe the commonly found states of matter (solids, liquids and gasses) and the characteristics of each. They will observe the difference between physical change (reversible) and chemical change (irreversible).

## pH TESTS

(Time: 30 minutes)

Children will test the ways that red cabbage water changes colour in response to pH (acids and bases) and will experiment with different safe-to-use household liquids.

### Materials

- Red cabbage
- Knife (optional)
- Boiling water
- Pitcher
- Tap water
- Large Clear Cups (9-12)
- Various acids and bases to test
    - Tap water (same as what was used to make the cabbage water)
    - Tea
    - Fruit Juice
    - Clear Soda
    - Dairy milk (Optional) or Non-Dairy Milk (optional)
    - lemon juice
    - vinegar
    - baking soda solution
    - soapy water/bubble mix
- Paper towels

### Pre Activity Set Up

Shred a 5-6 leaves of red cabbage into small bits. You can cut the leaves or tear with your bare hands (but the red cabbage pigment gets on your fingers). Place the torn red cabbage into a pitcher and ask an adult to pour boiling water over the cabbage. Let it sit for 30 -40 minutes until it's cooled. The liquid should be a dark purple colour. Before the activity, pour out small samples of each of the acids and bases to be tested (mix the baking soda with water so that it fully dissolves). Pour 1 inch of cabbage water into each clear cup for the children to mix.

### Instructions

#### *Introduction*

Red cabbage water is special called an "indicator" and it can tell us important things about other liquids. Ask the children to describe the water, vinegar and baking soda solution. What colour are they? Are they clear or cloudy? The three solutions should look similar but they're very different.

***Development***

Ask the children to mix water into one of the cabbage water cups. Nothing should happen. Now add vinegar to another cup. The cabbage water will change to a pink colour. Finally add the baking solution to another cup. The cabbage water will change to a blue/green colour.

Explain that liquid chemicals are can be different from each other. One of the ways they can be different is if they are an acid (like vinegar), a base (like the baking soda) or neutral (like the water). The cabbage water helps us to learn about which things are acids and which things are bases by changing colour when it is exposed to each.

Invite the children to test the other liquids to see if they are acids and bases. (Acids will turn pink, bases will turn blue or green).

***Conclusion***

Once they have tested all of the liquid place them in order from:

Red/Pink → Purple-Pink → Purple → Blue → Blue Green

You have now arranged the chemicals in order of pH. Neutral (pH 7) is in the middle (Purple = Cabbage water + tap water). The most acid liquids are the most pink colours (<pH 7). The most basic liquids are the most green colours (>pH 7)

***Explanation***

Red cabbage contains a water-soluble pigment called anthocyanin that changes color when it is mixed with an acid or a base. The pigment reversibly turns red in acidic environments with a pH less than 7 and the pigment turns bluish-green in alkaline (basic) environments with a pH greater than 7. This change can go back and forth making it a useful pH indicator.

Below are the acids or bases found in the chemicals you tested:

- **Tap water**: Neutral. However in areas with hard water, the water may be slightly basic because of the Calcium Carbonate or Magnesium Marbonate
- **Tea**: several acids depending on the type of tea, the main types found are Oxalic Acid, Malic Acid, Citric Acid
- **Fruit Juice**: depends on the fruit, apple juice contains more Malic Acid, and orange juice contains more Citric Acid
- **Clear Soda**: Citric acids, Phosphoric Acid, Carbonic Acid
- **Dairy milk**: Lactic Acid
- **Lemon juice:** mostly Citric acid
- **Vinegar:** Acetic Acid
- **Baking soda**: Sodium Bicarbonate
- **Soapy water/Bubble mix:** it varies, but a common base used in soap is Sodium Stearate

## NEUTRALIZATION

(Time: 20 minutes)

Children will attempt a neutralization reaction between different acids and bases.

### Materials

- Red cabbage
- Knife (optional)
- Boiling water
- Pitcher
- Tap water
- Large Clear Cups (6-5)
- Various acids and bases to test
    - Vinegar
    - Baking Soda
    - Antacids (e.g. Tums, Alka-Seltzer, etc.)
    - Tap water (same as what was used to make the cabbage water)

### Pre Activity Set Up

Shred a 5-6 leaves of red cabbage into small bits. You can cut the leaves or tear with your bare hands (but the red cabbage pigment gets on your fingers). Place the torn red cabbage into a pitcher and ask an adult to pour boiling water over the cabbage. Let it sit for 30 -40 minutes until it's cooled. The liquid should be a dark purple colour.

### Instructions

#### *Introduction*

Review what the children observed in the last activity using cabbage water as a pH indicator.

Acids and bases are a bit like opposites. When they get mixed together they react and can cancel each other's pH. In fact, if you're careful you can add acids and bases together in the correct amount so that the pH is Neutral (7)

#### *Development*

Mix tap water with the red cabbage indicator and use this as your comparison of what colour "Neutral" looks like.

Add vinegar to one container of indicator (it will turn pink) and baking soda to another (it will turn blue green). Observe the colours. Now carefully add the baking soda solution to the mixture of cabbage water and vinegar. Go slowly, the neutralization reaction can create bubbles. The goal is to make the container of vinegar and cabbage water match the colour of Neutral pH (the cabbage water and tap water mix). If you overshoot and turn the mixture blue, try adding some more vinegar.

Try neutralizing other acids and bases e.g. lemon juice, bubble mix etc.

A second activity is to add antacid tablets to the pH indicator. Set out three containers of cabbage water. Add water to two of the containers and to the third container add enough vinegar to change the colour to pink. Now, add an antacid to one container of cabbage water and tap water and to the vinegar and cabbage water container. Ask the child to describe what they observe.

#### *Conclusion*

Acids and bases react with other to "Neutralize", that means they can cancel each other's' pH. However, it doesn't turn the mixture into water. All of the other things that make the acid and acid and the base a base are still in the solution.

Our stomachs contain acids. This helps us break down our food. But sometimes that acid can make our stomachs hurt and we can take an antacid to neutralize the acid in our stomachs and make it feel better. When you added the antacid to the vinegar it should have lowered the pH it may not have gone straight to neutral, but it should have been closer. How did the antacid and vinegar mixture compare with the antacid and water mixture?

***Explanation***

Almost all liquids are either acidic or basic to some degree except for pure water ($H_2O$)which is neutral. Whether a liquid is an acid or base depends on whether it has more Hydrogen Ions ($H^+$) or Hydroxide Ions ($OH^-$). If a liquid has a lot of Hydrogen Ions, then it is an acid. If it has a lot of Hydroxide Ions, then it is a base. pH stands for the power of Hydrogen. Scientists use a pH scale to find out how acidic or basic a liquid is. When acids and bases combine their Hydrogen Ions ($H^+$) and Hydroxide Ions ($OH^-$) react to form water $H_2O$.