

# HOUSEHOLD ITEMS AS pH INDICATORS

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# Tennessee 4-H Youth Development

## ***Food Science***

### *Household Items as pH Indicators*

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#### **Skill Level**

Intermediate

Advanced

#### **Learner Outcomes**

*The learner will be able to:*

Understand the pH scale

Differentiate between acids and bases

Describe what an indicator does

Create your own pH indicator by using different food products

#### **Educational Standard(s) Supported**

CHEM1.PS1

CHEM2.PS1

PSCL.PS1

#### **Success Indicator**

*Learners will be successful if they:*

Identify the pH of at least two household items

#### **Time Needed**

30 minutes to 1 hour

#### **Materials List**

½ head red cabbage

Metal grater or food processor

Kitchen pot filled with enough water to cover cabbage

Strainer

Stove top or heating element

Household items: apple juice, baking soda, corn starch, lemon juice, orange juice, vinegar, and water

*Food Science pH Experiment Guide*

PowerPoint and student handout

#### **Introduction to Content**

Food chemistry explains how food interacts with our bodies and with the nutrients that we require to live. It also explores how food molecules interact with each other.

#### **Introduction to Methodology**

This activity utilizes group discussions to build a picture of food and pH testing. It also aims to have 4-Hers work together or in pairs to test the pH level of household items using red cabbage as an indicator.

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## Terms and Concepts Introduction

anthocyanin – blue, violet, or red pigment found in plants.

indicator – any substance that gives a visual sign, typically by yielding a color change in the presence or absence of a solution.

pH (power of hydrogen) – a scale used to classify acidity or basicity (alkalinity) of a water-based solution.

## Setting the Stage and Opening Questions

Scientists measure the acidity or alkalinity of a solution using a logarithmic scale called the **pH** or power of hydrogen scale. The pH scale is used to classify acidity or basicity (alkalinity) of a water-based solution. The pH scale has 14 units and is centered on 7, which is neutral. pH levels below 7 are considered in the acidic range (0-6) and readings above 7 are in the alkaline (or basic) range (8-14). Substances with low pH are very acidic, while those with high pH are highly basic.

In this activity, we will explore an important phenomenon that occurs in molecular interactions within food. Some substances are classified as either an acid or a base. Scientists can tell if a substance is an acid or a base by means of an indicator. An **indicator** is typically a chemical that changes color if it comes in contact with an acid or a base.

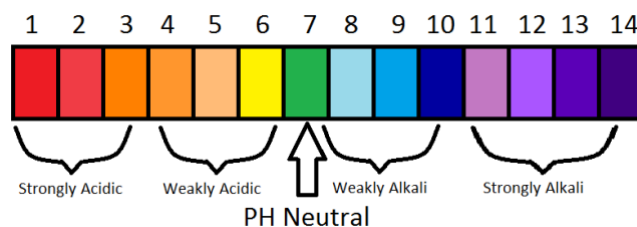
Tell students, “Let’s conduct an experiment to learn more about acids and bases. You will generate a hypothesis about which household chemicals serve as an indicator and what their pH is.”

## Tips for Engagement

Have the group brainstorm their favorite fruits or vegetables and hypothesize pH based upon the indicator chart provided.

See if anyone has had to test the pH of the pool or seen someone test the pH of a pool at the local recreation center or YMCA.

As a group, view the YouTube video from University of Kentucky Extension on measuring the pH of food products by scanning or clicking on the image.



## Experience

Divide students into groups of two or three. Use the *Food Science pH Experiment Guide* to guide students through completing the experiment described below.

1. Cut cabbage into small pieces and place in pot with enough water to cover the cabbage completely.
2. Boil for 20-30 minutes.
3. Strain the cabbage pieces from the purple water. Discard the cabbage pieces and save the water in a bowl.
4. Prepare your solutions for testing and place them in separate bowls. This can be done by removing some of the liquid from the food product and mixing left over cabbage water with household items, such as baking soda, corn starch, lemon juice, orange juice, vinegar and water.
5. Add a few drops of the purple cabbage water and observe the color change using the provided chart 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/Basic	Acid	Acid	Acid/Neutral	Basic	Basic	Basic



## Share

With your club or at home, see if students can guess the pH of various household items, similar to what you did today. Make sure to share your findings from your experiment. Circle your results below.

Food Item	pH		
Corn Starch	Acidic	Neutral	Basic
Baking Soda	Acidic	Neutral	Basic
Lemon Juice	Acidic	Neutral	Basic
Orange Juice	Acidic	Neutral	Basic
Vinegar	Acidic	Neutral	Basic
Water	Acidic	Neutral	Basic

## Process

Lead students through a discussion to help them understand that everything is made of chemicals. Chemicals can be sorted into various categories, such as acids, bases and neutrals. Red cabbage juice is called an indicator because it shows us something about the chemical composition of other substances. Cabbage juice is naturally neutral (pH 7.0). When it is neutral, it is a purplish color. If an acid (0-6.0) is poured into it, it will turn a reddish color. If a base (8.0-14.0) is added, it turns blue or greenish.

Remind students that vinegar made your solution turn red, so vinegar is categorized as an acid. Baking soda made your solution turn blue or greenish, so baking soda is a base.

## Generalize

Share the following information with students:

Red cabbage contains pigments called **anthocyanins** which gives it the purple/red color. Most pH indicators gain a proton at low pH and lose a proton at high pH. This proton change changes the wavelengths of light reflected back to our eyes. This lets us see a different color than originally seen. Anthocyanins in the cabbage behave in the opposite way from how a normal reaction would go. Therefore, anthocyanins gain a proton at basic pH and lose a proton at acidic pH. Acids contain excessive amounts of protons while basic solutions contain less protons than they need to be stable.

## Apply

Now that you all have learned about pH and indicators, identify foods and ingredients in your pantry or refrigerator as an acid, base or neutral. Scan the QR code below or click on the image to open a table of common food and ingredients' pH levels.



## Life Skill(s)

6<sup>th</sup> Grade Head, Thinking  
*Wisely use resources to achieve a purpose.*

Identify the parts, steps and necessary sequence or order to achieve a goal.

7<sup>th</sup> Grade Head, Thinking  
*Learn to form ideas, make decisions and think critically.*  
Consider priorities, resources, needs and interests for a given problem or situation. (Head, Thinking)

8<sup>th</sup> Grade Head, Managing  
*Wisely use resources to achieve a purpose.*

Determine the purpose of a specific type of record when recordkeeping for a project.

## ***Supplemental Information***

### ***Educational Standards Met***

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CHEM1.PS1: Matter and Its Interactions

8. Identify acids and bases as a special class of compounds with a specific set of properties.

CHEM2.PS1: Matter and Its Interactions

15. Explain common chemical reactions, including those found in biological systems, using qualitative and quantitative information.

PSCI.PS1: Matter and Its Interactions

12. Classify a substance as acidic, basic or neutral by using pH tools and appropriate indicators.



## Purple Cabbage Experiment Data Sheet

Name: \_\_\_\_\_

Experiment Hypothesis: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Materials: (List all supplies used, so the lab can be repeated successfully)

\_\_\_\_\_

\_\_\_\_\_

Procedure: (List steps in order, so the lab can be repeated successfully)

\_\_\_\_\_

\_\_\_\_\_

# Purple Cabbage Experiment Data Sheet

Household Test Chemical	Hypothesized pH (1-14)	Initial Color	Indicator (Yes or No)	Final Color	Estimated pH (1-14) using Indicator Guide
apple juice					
baking soda					
corn starch					
lemon juice					
orange juice					
vinegar					
water					

Data Collection:



## Purple Cabbage Experiment Data Sheet

Results: (Write at least five complete sentences explaining your results.)

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Conclusions: (Write at least five complete sentences explaining how your results can be applied to everyday life. Don't forget to write about your hypothesis.)

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# Household Items as pH Indicators

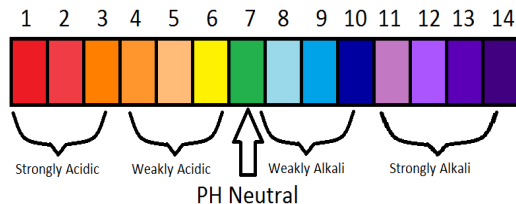
Food Science

# pH Experiment

- Scientists can tell if a substance is an acid or a base by means of an indicator.
- An **indicator** is typically a chemical that changes color if it comes in contact with an acid or a base.

# Curious about pH

- Brainstorm your favorite fruits and vegetables and hypothesize the pH of each based upon the following indicator chart.
- Check out researchers at the University of Kentucky test the pH levels of food products.



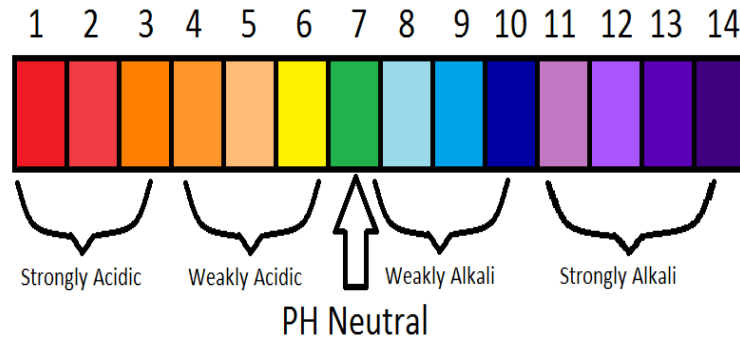
Video is also available at  
<https://youtu.be/H1m54TZ-7lc>

# Materials

- ½ head red cabbage, chopped
- metal grater or food processor
- kitchen pot filled with water
- strainer
- stove top
- household items: baking soda, corn starch, lemon juice, orange juice, vinegar and water

# Hypothesis

- In your opinion, which household items serve as an indicator? Using the image below, what would be their pH level?



# Methodology

1. Cut cabbage into small pieces and place in pot with enough water to cover the cabbage completely.
2. Using an electric kettle or stovetop, boil for 20-30 minutes.





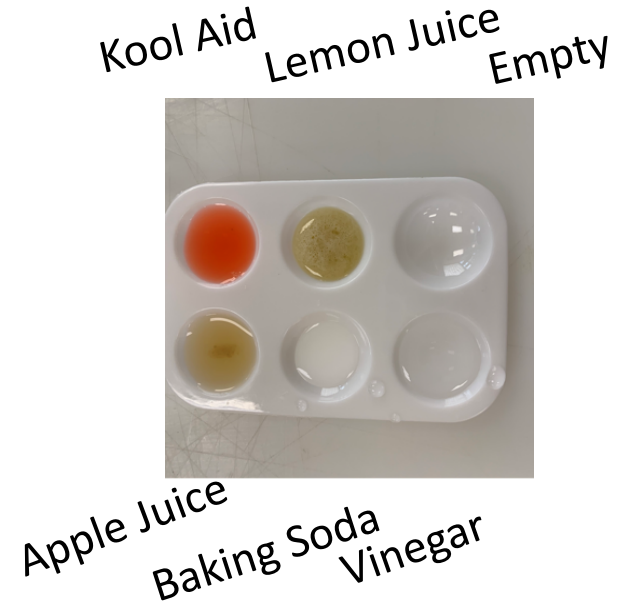
# Methodology

3. Strain the cabbage pieces from the purple water. Discard the cabbage pieces and save the water in a bowl.



# Methodology

4. To prepare your solutions for testing you will place each solution into a separate bowl. To do this, remove some of the remaining cabbage water and mix with household items, such as baking soda, corn starch, lemon juice, orange juice, vinegar and water.



# Methodology

5. Observe the color change using the chart 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/Basic	Acid	Acid	Acid/Neutral	Basic	Basic	Basic

# Results



# Results

- Did your results match your hypothesis? If so, how? If not, how could you improve the experiment?

# Discussion