

# Bubbles in the Cabbage Juice

## Objective

Students will conduct experiments with cabbage juice as an indicator to identify carbon in a variety of substances.

## Background

Cabbage is a cole crop, related to broccoli, cauliflower, kale and Brussels sprouts. It is a cool weather vegetable that grows well in Oklahoma when planted very early in the spring or in the fall.

The cultivated cabbage is derived from a leafy plant called the wild mustard plant, native to the Mediterranean region. It is an excellent source of Vitamin C and contains large amounts of glutamine, an amino acid that has anti-inflammatory properties.

Red cabbage contains a pigment molecule called flavin (an anthocyanin). This water-soluble pigment is also found in apple skin, plums, and grapes. Very acidic solutions will turn anthocyanin a red color. Neutral solutions result in a purplish color. Basic solutions appear in greenish-yellow. Because of this it is possible to determine the pH of a solution based on the color it turns the anthocyanin pigments in red cabbage juice.

The color of the juice changes in response to changes in its hydrogen ion concentration. Acids will donate hydrogen ions in an aqueous solution and have a low pH. Bases accept hydrogen ions and have a high pH.

## Activities

### ACTIVITY 1

#### Advance Preparation

- Warn teachers in the surrounding classrooms that you will be conducting an experiment that smells bad.
- Bring distilled water to a boil.
- Chop the cabbage and add it to the boiling water.
- Remove the water from the heat and let it stand for about 30 minutes, stirring occasionally.
- Strain the liquid into a pitcher and let it cool.
- Label five clear short fat cups as follows:
  - control
  - yeast/sugar
  - baking soda/vinegar
  - club soda
  - breath
- Pour some of the cooled liquid into each of the cups.
- Set aside the remaining liquid to use in Activity 2.

#### Explain

- Read and discuss background and vocabulary. Explain that cabbage is

## Standards

### GRADE 6

#### P.A.S.S.

Science Process—1.1,2;  
3.1,3,4,5,6; 4.1,3,4,5; 5.3,4  
Physical Science—1.1; 2.1

### GRADE 7

#### P.A.S.S.

Science Process—1.1,2;  
3.1,3,4,5,6; 4.1,3,4,5; 5.3,4  
Physical Science—1.1

### GRADE 8

#### P.A.S.S.

Science Process—1.1,2;  
3.1,3,4,5,6; 4.1,3,4,5; 5.3,4  
Physical Science—1.1,2

## Resources Needed

1 purple cabbage

2 quarts distilled water

pitcher

clear, short, fat cups

funnel

measuring cups and  
spoons

yeast

sugar

1 bottle of club soda

baking soda

2 empty 16-ounce soda  
bottles

vinegar

balloons

soil samples from three  
different places with vary-  
ing amounts of humus  
(organic content)

lab journal

an indicator—a substance which indicates the presence, absence or concentration of a substance or the degree of reaction between two or more substances by means of a characteristic change. In addition, explain that carbon dioxide makes an acid when dissolved in water.

### Procedure

- Remind students of potential hazards when mixing substances together. As always, practice safety procedures in all science activities.
- Divide students into four groups, and provide each group with one of the cards included with this lesson.
- Students will read the cards ahead of time to make sure they understand the procedure.
- Divide the cabbage juice evenly among the five labeled cups.
- Keep the “control” cup separate so all groups will be able to compare their results to it.
- Give each of the groups one of the labeled cups and the appropriate materials.

### Summary

- After all groups have concluded their experiments, line up all four cups.
- Students will compare the four cups with the control cup and with each other.
- Students will summarize the investigation using the “Scientific Method Outline” included with this lesson.
- Students will answer the following questions in their summaries:
  - Did one source of carbon dioxide cause more color change than the other sources?
  - Which method would you use if you needed to make a large amount of carbon dioxide?
  - How is carbon dioxide formed?

### Extension

Since plums and grapes have the same water-soluble pigment as cabbage, students will repeat the above activity, using plums and/or grapes as an indicator.

## ACTIVITY 2

### Explain

- Soils rich in humus (organic matter) tend to be more acidic than others.
- Decomposition and respiration of soil creatures makes carbon dioxide, which forms an acid when dissolved in water.
- Alkaline soils (less acidic) have low organic content. However, some soils will test high for acid even though they do not contain much organic matter.

### Procedure

- Hand out the worksheet to each group of students.
- Students will follow the directions on the worksheet and write their

results in their journal.

—Students will also copy and answer the questions from the worksheet into their journals.

#### Answers to Worksheet Questions

- If a soil tests acidic, does it have high or low organic content? (Usually high organic content, but not always. Sand may be acidic but contain low amounts of organic materials.)
- Why would the organic content of soil from a forest floor differ from that of a plowed field? (There generally is more organic matter in a forest than in a plowed field. A forest canopy will continually drop leaves, sticks, and other debris, whereas a plowed field has no canopy. However, some agricultural fields can be rich in added material, and some forests, such as those containing cedar trees, can be low in organic material.)
- Would all plants grow well in highly organic soil? (No. Desert plants grow best in low organic conditions.)

#### Extra Reading

Burnie, David. *Plant – Eyewitness Books*, Dorling Kindersley, 2003.

*The Concise Science Encyclopedia*, Concise Encyclopedias, 2001.

Gifford, Clive. *The Kingfisher Geography Encyclopedia*, Kingfisher, 2003.

#### Vocabulary

**acidic**—any compound that reacts with a base to form a salt

**alkaline**—any base, as soda or a mineral salt, which can neutralize an acid

**anthocyanin**—any of various soluble pigments producing blue to red coloring in flowers and plants

**base**—any of various compounds that react with an acid to form a salt, have a bitter taste, and turn red litmus paper blue

**neutral**—neither acid nor basic

**pH**—a number used in expressing acidity or alkalinity on a scale whose values run from 0 to 14 with 7 representing neutrality, numbers less than 7 increasing acidity, and numbers greater than 7 increasing alkalinity; also : the condition represented by such a number

**pigment**—a substance that gives color to other materials; especially : a powder mixed with a liquid to give color

**soluble**—capable of being dissolved in a liquid

**solution**—a liquid in which something has been dissolved

# Bubbles in the Cabbage Juice

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## GROUP 1: YEAST/SUGAR

Materials: jar with cabbage juice  
funnel  
16-ounce soda bottle  
balloon  
1 packet of yeast  
1 teaspoon sugar  
1/2 cup warm water

1. Blow up a balloon and let the air out.
2. Use the funnel to put the yeast, sugar and warm water into the soda bottle, and let it sit for about 10 minutes.
3. Put a balloon over the mouth of the bottle and gently shake the contents.
4. Let the bottle and balloon sit until the balloon is inflated.
5. Twist the balloon closed.
6. Release some of the gas from the balloon into the cabbage juice jar.
7. In a journal, record materials used, steps completed, and results.
8. Compare with the “control” cup to justify your results.

## GROUP 2: BAKING SODA/VINEGAR

Materials: jar with cabbage juice  
funnel  
16-ounce soda bottle  
balloon  
1 tablespoon baking soda  
2 tablespoons vinegar

1. Blow up a balloon and let the air out.
2. Use a funnel to place baking soda in the bottle.
3. Use a funnel to place vinegar in the balloon.
4. Attach the balloon to the mouth of the bottle, and allow the vinegar to flow into the bottle to mix with the baking soda.
5. When the balloon inflates, twist the opening, and remove it from the bottle.
6. Release some of the gas from the balloon into cabbage juice in the cup.
7. In a journal, record materials used, steps completed, and results.
8. Compare with the “control” cup to justify your results.

## GROUP 3: CLUB SODA

Materials: jar with cabbage juice  
bottle of club soda  
balloon

1. Blow up a balloon and let the air out.
2. Open the bottle of club soda, and quickly put the balloon on the bottle mouth.
3. Let the balloon stay on the bottle until it inflates.
4. Twist the balloon closed.
5. Take the balloon off the bottle.
6. Release some of the gas from the balloon into the cup of cabbage juice in the cup.
7. In a journal, record materials used, steps completed, and results.
8. Compare with the “control” cup to justify your results.

## GROUP 4: BREATH

Materials: jar with cabbage juice  
balloon

1. Blow up a balloon, and let the air out.
2. Blow up the balloon again and twist the opening.
3. Release some of the gas from the balloon into the cup of cabbage juice in the cup.
4. In a journal, record materials used, steps completed, and results.
5. Compare with the “control” cup to justify your results.



# Scientific Method Format

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Title of Experiment or Study:

I. Stating the Problem:

What do you want to learn or find out?

II. Forming the Hypothesis:

What is known about the subject or problem, and what is a prediction for what will happen?

III. Experimenting: (Set up procedures)

This should include: materials used; dates of the experimental study; variables, both dependent and independent (constant and experimental); how and what was done to set up the experiment; fair testing procedures.

IV. Observations:

Includes the records, graphs, data collected during the study.

V. Interpreting the Data:

Does the data support/defend the hypothesis?

VI. Drawing Conclusions:

Justify the data collected with concluding statements about what has been learned. Discuss any problems or concerns. Use other studies to support the conclusion. Give alternative ideas for testing the hypothesis.