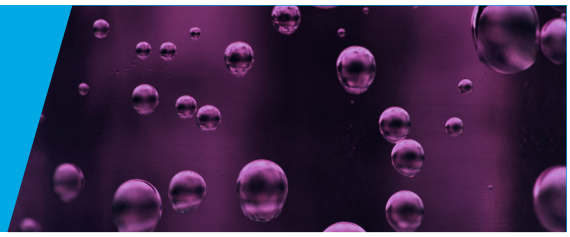
CURIOSITY AT HOME

PURPLE PRODUCE pH INDICATOR

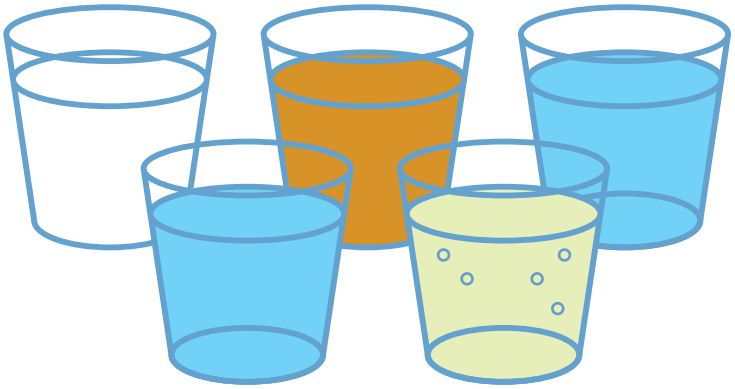


Indicator solutions are used to tell if a liquid is an acid or a base. Let's make our own indicator solution out of red cabbage!

MATERIALS

- 1-2 cups red cabbage leaves
  - Alternatives: Red grapes, radish skin, turnip skin, red onion, plum skin, purple 100% grape juice without adding additional water
- Water
- A way to boil water
- A container that can hold very hot liquid (eg soup bowl, small cooking pot, or large coffee mug)
- At least 4 small clear cups
- Test Liquids
  - White vinegar (substitute apple cider vinegar, rice wine vinegar, or lemon juice)
  - Baking soda dissolved in water (substitute over-the-counter anti-acids dissolved in water)
  - 2 or more of these additional test liquids:
    - Milk
    - Tea
    - Fruit juice
    - Salt water
    - Tap water
    - Lemon/lime soda
    - Cream of tartar dissolved in water
- Paint brush (substitute q-tips, cotton balls)
- Tape (optional)
- Scissors (optional)
- Science notebook or paper
- Something to write with

SAFETY NOTE: While these items are safe to touch, *do not* eat or ingest them as part of the experiment.



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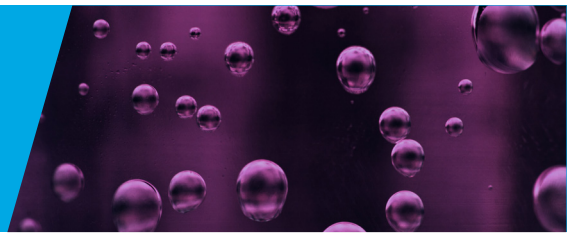


PROCEDURE

Making the indicator solution

- Rip up red cabbage leaves into small shreds.
- With your adult's help, boil some water. Use about equal parts water to shredded cabbage.
- If you're using a different indicator plant, use whichever of these techniques makes sense in your situation: smush, peel, tear, or have your adult slice it.
- With your adult, combine shredded cabbage leaves with boiling water in a heat-safe container.
- Let cool until lukewarm or cooler.
- Strain out the cabbage leaves.

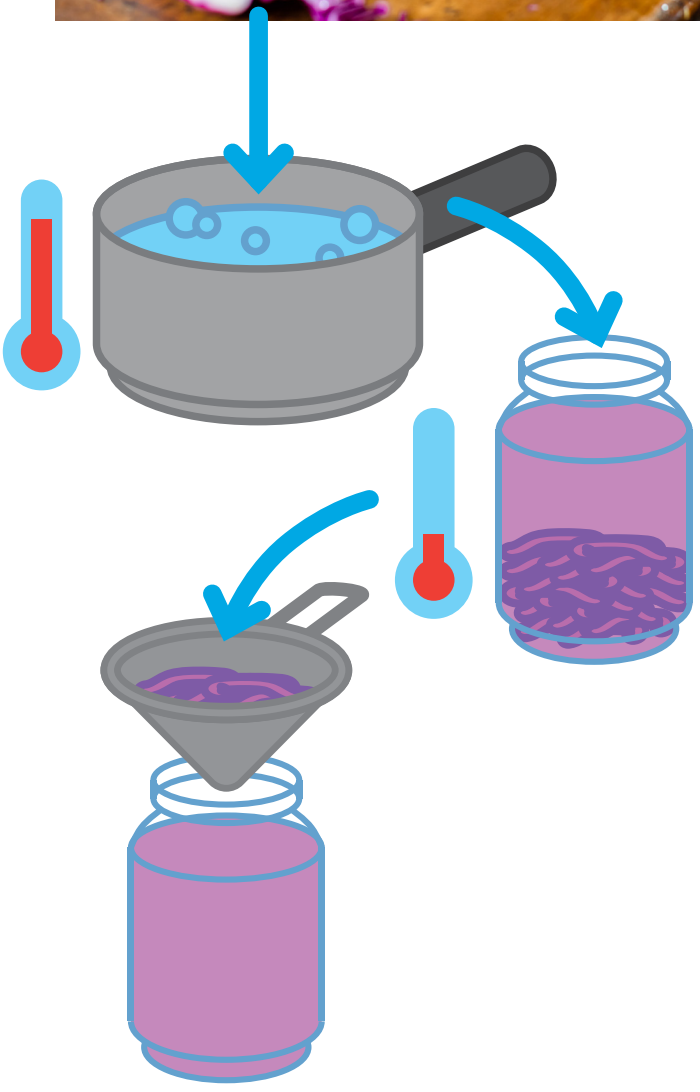
Testing the indicator

Method one:

- Pour one of your test liquids into a small cup, filling no more than halfway.
- Write down the name of the test liquid and tape it to the cup.
- Pour about as much indicator liquid into the first cup and mix. What do you notice?
- Repeat for each test liquid.
- Arrange the cups by the color of the liquid inside, ordering from most red to most blue.
- Write down the order of the cups in your science notebook.

Method two:

- Paint several small patches of the indicator solution in sections spread out on a sheet of paper. Make as many individual patches as you have liquids to test, plus at least one extra.
- Let the patches dry.
- Label the first patch 'control'. Label each of the remaining patches with the names of the liquids you will be testing.
- Leaving the control patch alone, drip or paint a small amount of each test liquid on its designated patch. What do you notice happening?



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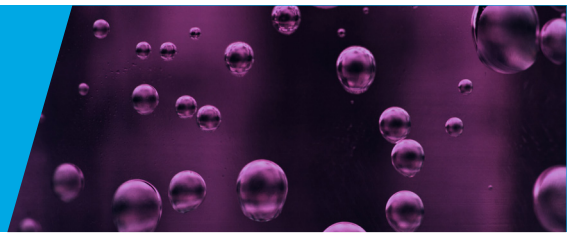
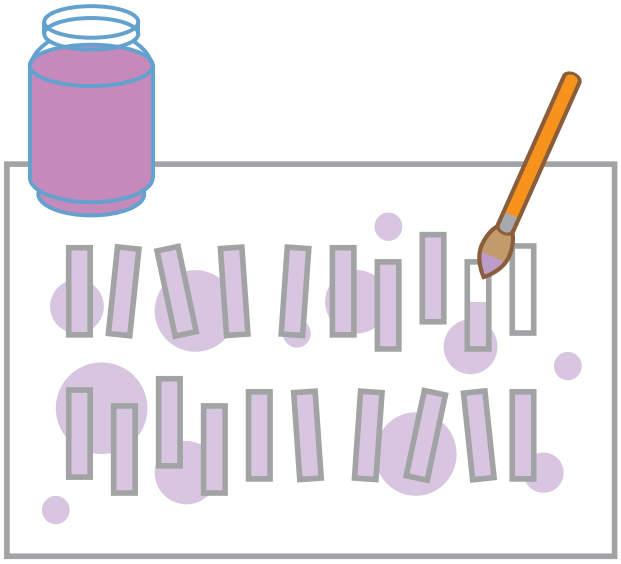


- Thoroughly rinse the paintbrush between each test liquid, then repeat for each test liquid.
- Once dry, cut the individual test strips apart.
- Tape the test strips into your science notebook in order of most red to most blue.
    - Tip: Tape either on the back of the test strips, or around the edges. Some tapes are very mildly acidic and may change the color of the test strips over time if you tape over the colored testing patch.

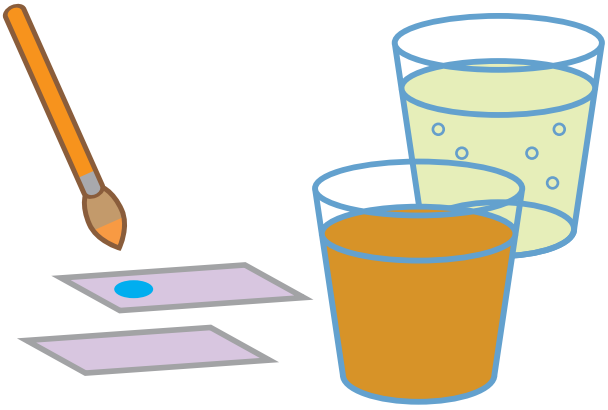


Analyzing the results

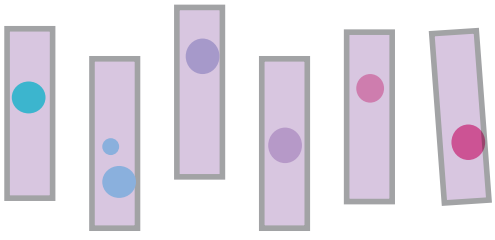
Look at the order you sorted your test liquids into. Knowing that sour liquids are often acidic and slippery liquids are often bases, which color means your indicator liquid mixed with an acid? Which color means that your indicator liquid mixed with a base? Were any of your test liquids somewhere in the middle, or neutral? Write down your predictions in your science notebook.

WHAT'S HAPPENING?

Many liquids can be categorized as an acid or a base. Whether a substance is an acid or a base is one of its chemical properties, or a characteristic of that substance that can be observed in a chemical reaction. Substances can be measured for how acidic or basic they are using a tool called the pH scale. The pH scale goes from 0 to 14, with low numbers meaning more acidic, 7 meaning neutral, and high numbers meaning more basic. Lemon juice, vinegar and soda are examples of acids, while dish detergent and baking soda are examples of bases. Pure water is neutral.



Cabbages, along with many other purple fruits and vegetables, contain a colorful molecule called anthocyanin. When anthocyanin is mixed with certain substances, a chemical reaction takes place and the color changes, becoming more of a red or blue depending on if it is mixed with an acid or base.



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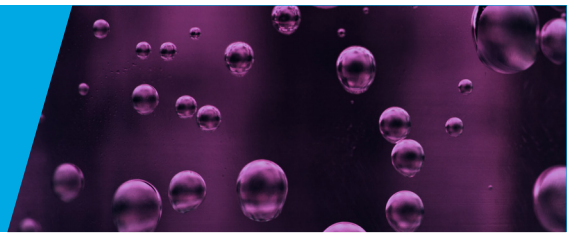

EXPLORE MORE:

Your indicator solution can be used to make art! Cover a piece of paper by painting on your indicator solution and let it dry. Then paint designs on the purple paper with mild acids and bases, and watch the color change to red and blue!

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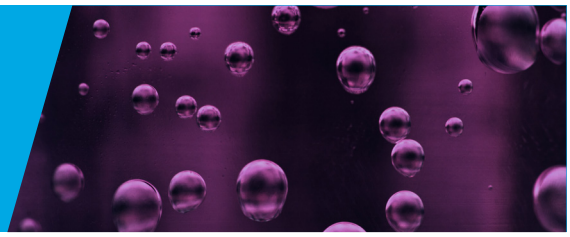

K–2 GRADE EXPLORATION

- Acids and bases are opposites. Make a mixture of your cabbage juice indicator and a base like baking soda. What color is it? What do you think will happen if you mix in an equal amount of an acid, like lemon juice? What color will the cabbage juice be then? Make a prediction then test it out!
- Make a thick paste of baking soda and water. Use it to draw a picture or write a secret message. Let it dry. Which materials from this experiment could you use to reveal the secret message?
- Choose 3 more liquids to test. Now that you know a little more about acids and bases, predict if each additional liquid is an acid, a base, or neutral. Then test your liquids to find out.

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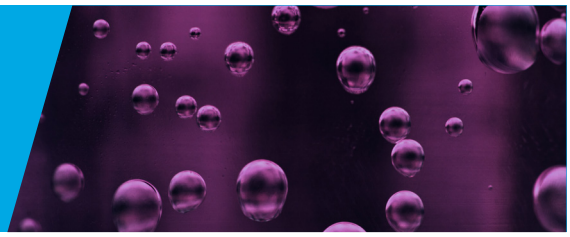

3–5 GRADE EXPLORATION

- Choose 3 more liquids to test. Now that you know a little more about acids and bases, predict if each additional liquid is an acid, a base, or neutral. Then test your liquids to find out and record your findings in your science notebook.
- What is the smallest amount of indicator liquid you need to add in order to get color change? Try adding just one spoonful of indicator liquid at a time to your test liquids. How many spoonfuls did it take to see color change? If you add more spoonfuls, does the color become stronger? Is the perfect amount of spoonfuls different for each test liquid?·

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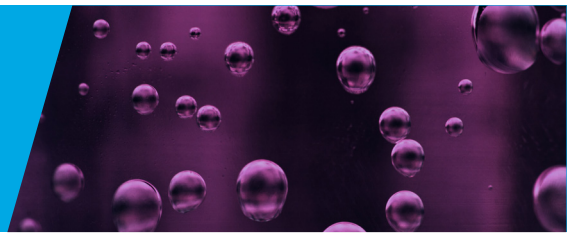

6–8 GRADE EXPLORATION

- Pick 3 additional test liquids that you haven't tested yet. Using what you learned in the experiment, make a prediction about whether these test liquids will be a strong acid, a weak acid, neutral, a weak base, or a strong base. Record your predictions in your science notebook, then test the 3 new liquids. What did you find? Did any part of your results surprise you?
- Acids and bases are measured using a scale called the pH scale, which goes from 0 (most acidic) to 14 (most basic). 7 is in the middle, which makes it neutral. By sorting your liquids by the color that they turned the indicator, you have sorted them by pH. Look up the pH of the liquids you tested and label them with their pH numbers in your science notebook.
- Every time a liquid goes down by one whole number on the pH scale, it becomes 10 times more acidic. And each time the pH goes up by one whole number, it becomes 10 times more basic.
    - Imagine you have two liquids, labelled A and B. Liquid A has a pH of 3, while liquid B has a pH of 5. Which one is more acidic? By how many times?