

EXPERIMENTING WITH ACIDS & BASES

INTRODUCTION:

A common way to classify chemicals is to sort them into acids and bases. Acids tend to have a sour taste and react with metals and carbonate minerals. Bases taste bitter, they are slippery to the touch and they can be corrosive to organic materials. (Obviously, you should never taste dangerous chemicals.) When you put acids into a water solution, they donate hydrogen ions (H^+). And when you put bases into a water solution, they donate hydroxide ions (OH^-).

The pH scale tells us how acidic or basic a solution is. It does that by measuring the concentration of hydrogen ions (H^+) in a solution. (pH stands for "potential Hydrogen".) At room temperature, any pH less than 7 is considered acidic, and any pH greater than 7 is basic.

You can take a quick read of a chemical's pH by adding it to an acid-base indicator. The colour change will tell you whether it's acidic, basic or neutral.

Acid-base indicators are often weakly basic or acidic themselves and will accept hydrogen ions when a stronger acid is added, or will give away hydrogen ions if the added solution is a base. This changes the indicator molecule which causes a change in colour.

Many plants contain natural acid-base indicators. Hydrangea flowers, for instance, have an acid-base indicator known as anthocyanin, and they will change colour based on the acid or base in the soil. Another plant that is rich in anthocyanins is red cabbage, and it is with this humble vegetable that we begin.



ACTIVITY: Making a homemade acid-base indicator

Make a simple acid-base indicator right in your kitchen, then use it to determine the acidity and basicity of chemicals in your home.

TIME: 30 minutes

SAFETY:

- Never leave the stove unattended, including when boiling your cabbage.
- Follow the labels on household chemicals: avoid contact with your eyes and skin, work in a well-ventilated area, and wear gloves and safety goggles if necessary.
- Do not mix household chemicals together. Use a separate cup of indicator solution for each chemical you test.
- Do not ingest any of the solutions.



SCIENCE AT HOME

EXPERIMENTING WITH ACIDS & BASES

GRADE: **10**

SNC2D, SNC2P

SUBJECT: SCIENCE

STRAND: CHEMISTRY

TOPIC: CHEMICAL REACTIONS —
ACIDS AND BASES

EXPECTATIONS: C2.6, C2.5, C2.6, C3.3, C3.5, C3.6, C3.7

VIDEO: youtu.be/xaTRdgelIzo

SAFETY (continued):

- Flammable, poisonous, corrosive and explosive items can't be tossed down Ontario's drains or into its garbage bins. To avoid pollution, please don't use anything considered household hazardous waste — including bleach, ammonia-based cleaners, nail polish remover, paints, or cooking oil.

Check your local municipality's website for instructions on how to dispose of waste properly.

WHAT YOU NEED:

- Red cabbage
- Clear cups
- Pot for boiling water or blender
- Water
- Measuring cup
- Measuring spoon (1 tbsp)
- Heat-resistant container
- Household chemicals to test (vinegar, baking soda, etc.)

WHAT YOU DO:

Make your acid-base indicator by either boiling or blending.

Boiling Method:

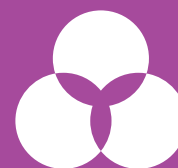
Chop the red cabbage into small pieces. Put the cabbage into a pot, and add just enough water to cover it. Bring to a boil, then turn the heat down and simmer gently for about 10 minutes. After cooking, strain out the cabbage to eat later and keep the liquid — your indicator!

Blending Method:

Chop the red cabbage into small pieces. Put it in a blender, and add just enough water to cover it. Blend until the cabbage is thoroughly minced. Let it steep for 10 minutes. Strain the cabbage out using a fine mesh strainer, to eat later, and keep the liquid — your indicator!

Instructions:

- Measure 100 mL of tap water into three clear containers. Add 1 tbsp/15 mL of red cabbage indicator liquid into each of the three containers. Stir.
- Add 1 tbsp/15 mL of acid (vinegar) into the first container. Stir. Observe.
- Add 1 tbsp/15 mL of base (baking soda) into the second container. Stir. Observe.
- Add nothing to the third container. This is your control. Observe.



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WHAT YOU DO (continued):



Now that you know what acid, base and neutral look like, use your cabbage indicator to test out the following household chemicals:

- Milk
- Body wash
- Dish soap
- Antacid
- Gentle skin cleanser
- Tap water
- Carbonated water
- Lemon juice
- Orange juice

Compare the colours you get with these chemicals to the colours created by the vinegar and the baking soda. Which are the most basic? Which are the most acidic?

Can you figure out which chemical is which in the ice cube tray?



WHY THIS MATTERS:

Water treatment plants use indicators to check the pH of water going into your home, and environmental scientists use them to determine the water quality for animals in the wild. The pH of water is important to the health of living things, because cells work best at a pH of between 6.5 and 8.5.

TAKING IT FURTHER: Test away!

Use the cabbage indicator fluid to test out other common household chemicals — like Windex or hot sauce! Which are acids and which are bases? You might want to use a chart like the one on the following page to keep track of your findings.



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| Colour of indicator with 100 mL of H ₂ O | Household chemical | Hypothesis? (What colour do you predict?) | Actual colour |
|---|--------------------|---|---------------|
| | | | |
| | | | |
| | | | |

INVENT YOUR OWN: Next, use the cabbage process to create your own indicator. The method to extract indicators is the same for lots of other plants and vegetables (check the video for tips on which foods to try). Does the same chemical create the same colour reaction as it did with the cabbage indicator? You might want to use a chart like this one to keep track of your findings:

| Colour of indicator with 100 mL of H ₂ O | Household chemical | Hypothesis? (What colour do you predict?) | Actual colour | Different from red cabbage? |
|---|--------------------|---|---------------|-----------------------------|
| | | | | |
| | | | | |
| | | | | |



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UNPACK WHAT HAPPENED:

Your results using the cabbage indicator may look something like this:



1. Vinegar
2. Lemon juice
3. Orange juice
4. Carbonated water
5. Milk
6. Tap water
7. Gentle skin cleanser
8. Antacid
9. Baking soda
10. Body wash
11. Dish soap

MORE ONLINE:

Advanced information about the chemical reactions that occur with indicators:

https://lecturedemos.chem.umass.edu/chemReactions4_9A.html

Detailed information about the pH scale:

<https://www.sciencebuddies.org/science-fair-projects/references/acids-bases-the-ph-scale>



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