

Activity: Colorful Chemistry



INTRODUCE THIS:

It's important for scientists and engineers to test for and identify chemicals according to their properties.

One of the most basic tests is determining if something is an acid or a base. Acids and bases are all around us, in the food we eat, the water we drink or swim in, and the chemicals we use around the house.

Acids typically taste sour when dissolved in water. There are many kinds of acids found in foods including citric acid in fruits, and acetic acid in vinegar. Your stomach contains a hydrochloric acid. There are also strong acids that are dangerous to taste or touch such as battery acid.

In a liquid form, bases often feel soapy and taste bitter. Some common bases include baking soda, ammonia, and bleach.

Acids and bases are measured on the pH scale, which goes from 1 - 14. Acids have a pH below 7, while bases have a pH above 7. A strong acid has a pH near 1, while a strong base has a pH near 14. Acids and bases at the ends of the pH scale need to be handled with care!

Pure water has a pH of 7 which is considered neutral—neither an acid nor a base. Water from natural sources such as rivers and streams can have a pH from 6.5 to 8.5 because of other chemicals dissolved in the water.

Why is this important to engineers? Environmental engineers at water treatment plants need to make certain that the water we drink is safe and the water collected from homes, businesses, and factories is cleaned and returned to a healthy pH before being released back into rivers and streams. Engineers also test water in nature to make certain that illegal dumping isn't taking place.



MATERIALS:

- 1-2 Red cabbage leaves
- Glass or plastic bowl
- Water
- Microwave or stove top
- Small cups, preferably white or clear. Bathroom size cups are perfect, but use what you have.
- A variety of items to test such as: liquid soap, baking soda, detergent, clear soda, milk, Kool Aid crystals (choose a light-colored variety), sugar, flour—whatever is available. Adult supervision should determine what items are approved to test.



DO THIS:

- Chop or tear the cabbage leaves and cover with water in a microwave safe bowl. Microwave for 2-3 minutes. You can also cook the cabbage on a stovetop!
- Let the leaves sit in the water until cool, then strain them out. The liquid remaining should be violet to blue in color.
 - Does your water look more blue than violet? This means that the water used already has minerals in it that make it slightly basic. You can continue to use it, or make a fresh batch using distilled water which has a pH of 7.
- Pour a little of the cabbage juice into a cup.
- Add a few drops/pinches of one material such as baking soda to the cup.
- Watch the cabbage juice change colors which means the pH is changing.



Everyday Engineering: STEM@Home

GRADE LEVEL:
4TH GRADE
THROUGH HIGH
SCHOOL

ADULT SUPERVISION
REQUIRED

- Use the chart below to determine the pH of the solution in each cup.
- Repeat the experiment with different materials. Remember to use a different cup for each experiment!

| PH | COLOR |
|----|-----------------|
| 2 | Red |
| 4 | Purple |
| 6 | Violet |
| 8 | Blue |
| 10 | Blue-green |
| 12 | Greenish-yellow |



TALK ABOUT THIS:

What items were acids? Which were bases? Did you find anything that didn't react? We would say that this was neutral, neither an acid nor a base.



WANT MORE CHALLENGE?

Make your own pH test paper by dipping white paper strips into the cabbage solution and allowing them to dry. You may need to dip/dry a couple times to concentrate the solution in the paper.

Test water in puddles and streams in your neighborhood.



WANT TO GO FURTHER?

Dream Big: Engineering Our World, a 42-minute documentary on engineering, is available on Netflix and Vimeo.

Over 65 activities were developed in support of the award-winning documentary *Dream Big: Engineering Our World*.

The free library of over 65 activities and webisodes can be found at discovere.org/dreambig.