How to Make a Cabbage pH Indicator

Testing the pH of your aquaponics system is important for keeping your fish, bacteria, and plants healthy. Each living thing prefers a certain range of pH for their specific environment. Below you'll find an easy experiment to complete at home or in your classroom. With this simple homemade testing kit, you can check the pH of your aquaponics system as well as explore the pH in your own environment.

MATERIALS

All you need for this experiment is a cabbage and a few kitchen tools!

- One small red cabbage
- Two large pots
- One grater
- Boiling water (enough to fill one of the pots at least halfway.)
- One strainer
- Various liquids for testing (known as your "test solutions"): You can Test your ECO-Cycle water, vinegar, laundry detergent, lemonade, tap water, milk, ammonia....The options are pretty endless! Ask your students to get creative and decide what they would like to test.

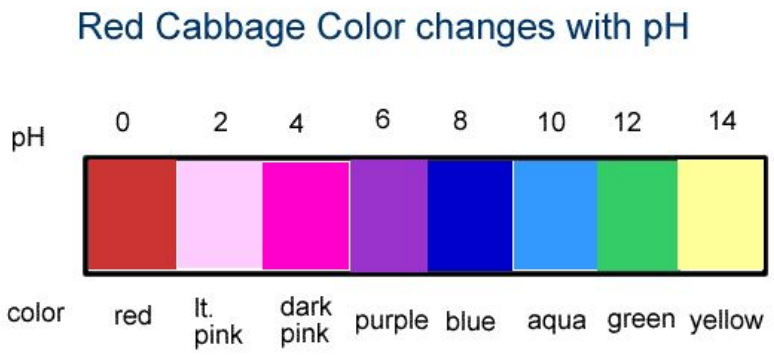
EXPERIMENT

1. Grate the cabbage into one of the large pots.
2. Pour boiling water into the pot until it just covers the top of the cabbage.
3. Let the pot stand until the water is room temperature (approximately 30 minutes).
4. Pour the liquid through a strainer into the second pot, making sure to catch all the cabbage pulp.. Press down on the pulp -while it's still in the strainer- to get any remaining liquid out.
5. You should now have a pot that is full of purple/blue liquid. This is your "cabbage solution".
6. Set out cups for test solutions.
7. Fill each cup halfway with cabbage solution.

8. Slowly add the first test solution to one cup until the color begins to change.
9. Repeat steps 7 and 8 in your remaining cups, using different test solutions for each one.

RESULTS

The color of the resulting solution indicates the pH of what you added to it. Below is a chart to help you identify the pH of your test solution. A healthy aquaponics system should have a pH between 6.5 - 8.0.



HOW IT WORKS

Certain chemicals react differently depending on the solution's pH levels. These chemicals are called indicators. In this case, cabbage contains a water-soluble pigment called *anthocyanin* that acts as our indicator chemical. The anthocyanin in cabbage changes color when it comes in contact with an acid or a base. The pigment will turn red in acidic environments with a pH less than 7. The pigment will turn bluish-green in alkaline (basic) environments with a pH greater than 7. This is an identical process to store bought pH test kits, only with a different indicator chemical.

WIDER APPLICATION

PH levels are very important to our aquatic world. Each water habitat will have particular pH levels that affect the life within it. Our planet currently has an overabundance of carbon dioxide levels, a greenhouse gas with an acidic molecular structure. When this acidic structure enters our oceans from the atmosphere (our biggest carbon sinks of all) it raises the pH levels for everything within them.

Though our oceans are not filled with anthocyanin, we see chemical reactions in many other ways that affect everything living within it. One major issue due to the effects CO_2 has on the ocean's calcium carbonate levels. Calcium carbonate is the main compound that many sea creatures use to build their shells, who are an essential part of an ocean's food web. Higher concentrations of CO_2 effectively dissolve more of this important compound.

Sea creatures have to work twice as hard to make their shells, and the shells they do make will often be more fragile than normal.

For more information on these phenomena, you can visit the following links to the California Coastal Commission Website or the NOAA Ocean Acidification Webpage.

As a further experiment, you can see first hand what is happening to our oceans by adding CO_2 directly to your cabbage solution. All you need is a straw and your own lungs. When we exhale we emit CO_2. By blowing into the solution through the straw you will slowly see it turn more red as the acidity increases.

CONCLUSION

This experiment is a great way to test various pH levels in our everyday environment. From a practical standpoint, it is also a great basis for comparison to show how some of our natural systems are affected by pH levels and the human impact of CO_2 emissions leading to Ocean Acidification and Shellfish Endangerment.

We hope you have fun experimenting!