What is pH and how is it tested? Acids and bases, Sour vs. Bitter
8th Grade Garden Science Lesson

SUMMARY
The health and success of the garden depends on the soil. Plants have preferences. Most garden vegetables prefer a slightly acidic /neutral soil. A pH between 6.0 and 7 will support just about any commonly grown vegetable. This includes beans, tomatoes, carrots, peppers, squash, onions and lettuce.

Some crops, such as potatoes, sweet potatoes and rhubarb, will also tolerate a pH as low as 4.5, but even these crops will thrive with a pH between 6.0 and 6.8.

Blueberries thrive in a more acidic soil with a pH of 4 to 5. Preparing and testing the soil for pH (and nutrients) are the first steps to take when planning a garden. We can add amendments to the soil like compost or mulch to change the pH.

In this lesson we will test the pH of various household substances and two samples of garden soil. Using red cabbage liquid as a pH indicator.

Students will be able to manipulate the taste of a basic ingredient using ingredients that represent salty, sweet and sour. Students will describe their preferences and the role of flavor in their preferences.

How do you turn something sour more sweet, sweet more salty and vice versa when cooking a soup or sauce and the flavor is not what you want?

OBJECTIVES
- Students will learn what pH is and how to read a pH chart. Students will learn how to identify if a household substance is an acid or a base using red cabbage liquid as a pH indicator solution.
- Students will be able to determine the pH of sample garden soil and conclude which vegetables will grow best in the soil they tested.
- Students will sample the five basic tastes: sweet, salty, sour, bitter and umami and determine which are acids or bases.
- Students will experiment mixing the different tastes together to balance the flavor. How do flavors change when we mix them with other ingredients?

MATERIALS

Red cabbage liquid (boil a red cabbage, strain and collect the purple liquid)
Plastic cups
Soil sample – acidic
Soil sample from garden
Household items to test for pH

- Lemon juice
- Vinegar
- Sprite
- Baking soda
- Liquid detergent
- Water

Ingredients for 5 tastes

- White sugar
- Salt
- Cocoa powder
- Lemon juice
- Furekaki

Ingredients for tasting

- Cut lemon wedges
- Salt
- Sugar
- Olive oil
- Lettuce

PART ONE

How do you tell if something is an acid or a base? You use a chemical called an **indicator,*** which changes in color depending on whether a solution is acidic or basic. You can make your own pH indicator with a red cabbage and use it to test the pH of various household solutions. Using the liquid from a boiled red cabbage, students will test the pH of various household substances as well as some sample garden soil.
The pH scale measures how acidic or basic a substance is. The pH scale ranges from 0 to 14. A pH of 7 is neutral. A pH less than 7 is acidic. A pH greater than 7 is basic. pH stands for power of Hydrogen.

*An indicator works by responding to the levels of *hydrogen ions* in a solution.) Red cabbage contains an indicator **pigment** molecule. Very acidic solutions will turn a red color. Neutral solutions result in a purplish color. Basic solutions make a greenish-yellow or yellow color.

Students test 6 household substances and predict whether they are acids, bases or neutral.

Liquids all around us have either acidic or basic (alkaline) properties. For example, acids taste sour; while, bases taste bitter and feel slippery.

PART TWO

A central skill in learning how to cook and enjoy healthy foods is to know how to manipulate the flavor of any dish. Learners will add flavors to plain lettuce to discover how different tastes go together, balance each other, and work together. They will also learn how to change a food they may not like into one they may prefer.

For each station:

Wedge of lemon for each student
Small bowl with 2 tablespoons salt
Small bowl with 2 tablespoons sugar
One plate per student
Bowl with bite size pieces of lettuce
Journals
Pencils

Prepare enough stations so that there are 6-8 students in each group.
Each table should have lemon wedges, a bowl of salt, a bowl of sugar, and the bowl of cut up lettuce.

Make sure everyone has washed his/her hands.

Plain: Each student tries a piece of plain lettuce, describes the flavor and records it in their journal.
Acid: Each student takes another piece of lettuce with a lemon wedge. Ask them to squeeze a few drops on the food. Have them taste it and see if they like it more or less. How does the flavor change? Record the results in a journal.
Salt: Repeat the process with the salt.
Sweet: Repeat the process with the sugar.
Combination: Now have them add a combination of the three ingredients. They should add a little of each until it reaches a flavor combination that they like. They should record the results of their inquiry in their journals.

Substance	Predicted Color Change	Actual Color Change pH number
Vinegar		
Liquid Soap		
Baking Soda		
Sprite		
Lemon Juice		
Tap water		

Discuss results:

Color:	Pink	Dark Red	Violet	Blue	Blue- Green	Green- Yellow
Approx. pH	1-2	3-4	5-7	8	9-10	11-12
Acid/ Base	Acid	Acid	Acid/Neutral	Base	Base	Base

Tasting	Describe the taste	Did you like it? Scale of 0-5
Plain lettuce		
With salt		
With sugar		
With lemon juice		
With a combination of added flavors		

Discuss results:

- Which individual flavor was your favorite?
- Which combinations of flavors did you like the best?
- How did the food change when you added different elements of taste?
- What is the most surprising thing you learned about flavors today?

Vegetables	Ideal Soil pH	Is Soil Sampled Appropriate?	
Arugula	6.0 - 6.8	yes	no
Asparagus	6.0 - 8.0	yes	no
Beans	6.0 - 7.5	yes	no
Beets	6.0 - 7.5	yes	no
Broccoli	6.0 - 7.0	yes	no
Brussels Sprouts	6.0 - 7.5	yes	no
Cabbage	6.0 - 7.5	yes	no
Carrot	5.5 - 7.0	yes	no
Cauliflower	5.5 - 7.5	yes	no
Celery	6.0 - 7.0	yes	no
Corn	5.5 - 7.0	yes	no
Cucumber	5.5 - 7.5	yes	no
Eggplant	6.0 - 7.0	yes	no
Garlic	5.5 - 7.5	yes	no
Horseradish	6.0 - 7.0	yes	no
Kale	6.0 - 7.5	yes	no
Lettuce	6.0 - 7.0	yes	no
Leek	6.0 - 8.0	yes	no
Mustard	6.0 - 7.5	yes	no
Onion	6.0 - 7.0	yes	no
Parsley	6.0 - 7.0	yes	no
Peas	6.0 - 7.5	yes	no
Pepper	5.5 - 7.0	yes	no
Potato	4.5 - 6.0	yes	no
Pumpkin	5.5 - 7.5	yes	no
Radish	6.0 - 7.0	yes	no
Rhubarb	5.5 - 7.0	yes	no
Shallot	5.5 - 7.0	yes	no
Soybean	5.5 - 6.5	yes	no
Spinach	6.0 - 7.5	yes	no
Tomato	5.5 - 7.5	yes	no
Turnip	5.5 - 7.0	yes	no
Watermelon	5.5 – 6.5	yes	no