Science Lessons

And worksheets for

Food Forests and Edible Gardens

Be a Chemist: Physical and Chemical Changes Experiment for all Grades

Overall objective: To observe a chemical change by adding an acidic liquid.

Standards and Pacing Guide:

Grade 1 - 1st quarter, SC.1.N.1.1: Practicing of Science
3rd quarter, SC1.L.14.2 Identify Plant Parts

Grade 2 – 2nd quarter, SC2.P.9.1: Investigate How Matter Can Change

Third Grade: 1st quarter, Practice of Science SC3.N.1.1. Question Investigate and Explain

Grade 4- 1st quarter, Practice of Science SC.$.N.1.1: Question Investigate and Explain
2nd quarter, SC.4.P.9.1: Changes in Matter

Grade 5 - 2nd quarter, SC.5.P.9.1: Physical and Chemical Changes

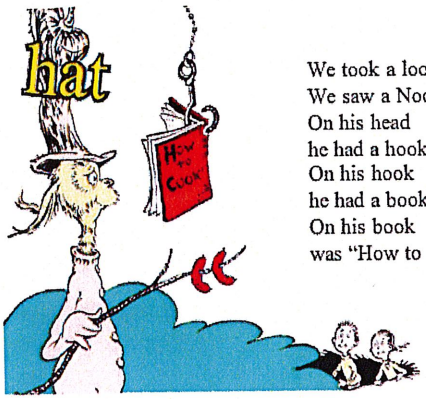
Materials:

- Dried Butterfly Pea flowers which can be found in most school gardens or a bag of dried Butterfly Pea flowers can be ordered from Amazon. See recipe.
- Worksheet for grades 3-5 on chemical changes.

Dr. Seuss Butterfly Juice

—A Chemical Change Science lesson

Serving size: ½ gallon



We took a look.
We saw a Nook.
On his head
he had a hook.
On his hook
he had a book.
On his book
was "How to Cook."

INGREDIENTS:

4 cups boiling hot water
6 tsp butterfly pea flowers (fresh or dried)
fresh lemon juice from 1 medium lemon
honey to taste
ice

DIRECTIONS:

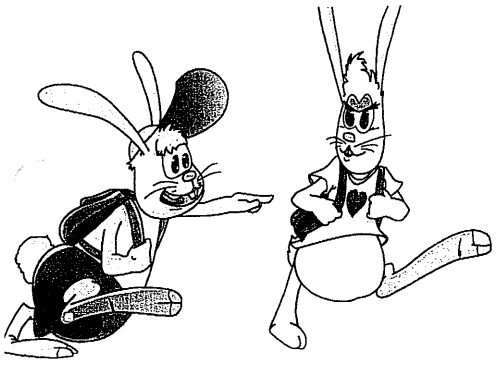
1. Add tea to hot water and cover surface to retain heat. Allow tea to seep a few minutes until water turns a deep shade of blue. You can leave the tea leaves in or remove. Stir in lemon juice and add sugar or honey to taste. Serve over ice.

When an acid is introduced to the brewed flower tea, it has a chemical reaction and turns the liquid from blue to purple!

Butterfly pea flower

The Benefits:

* Strengthens the hair for healthy hair growth
* Detoxifies the whole body
* Provides antioxidants
* Slows aging process
* Enhances immune system
* Treats urinary problems
* Stimulates blood circulation
* Prevents skin bruising
* Improves eyesight & night vision
* Keeps skin glowing & healthy
* Treats eye infections



Name:_ _ _ _ _ _ _ _ _ Class: _ _ _ _ _ _ _ _ _ _ _

Physical & chemical change

Fill in the blank spaces with either '**Physical**' or '**Chemical**'

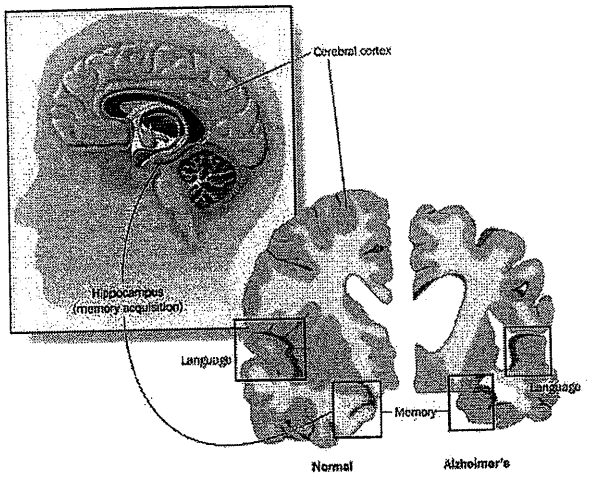
1. Boiling water is a _____ change.
2. Bending a metal pole is a _____ change.
3. Boiling potatoes is a _____ change.
4. Cutting an orange is a _____ change.
5. Cutting a sheet of paper is a _____ change.

   Baking cake is a _____ change.
7. Melting snow is a _____ change.
8. Slicing a banana is a _____ change.
9. Molding shapes with play dough is a _____ change.
10. Melting glass into different shapes is a _____ change.
11. Mixing a cocktail of fruit juice is a _____ change.
12. Rusting of a metal gate is a _____ change.
13. Washing clothes with bleach leads to a _____ change.
14. A _____ change leads to the formation of a new chemical substance.
15. A _____ change does not lead to the change of the chemical composition of a substance.
16. Adding baking powder to scrambled eggs is a _____ change.

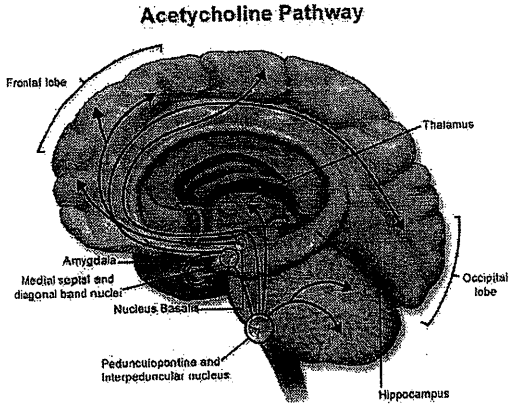
FYI

Why is the butterfly pea healthy?

Butterfly pea is one of the few plants that has *cyclotides* in it. These are peptides that have antitumor properties and cause cancer cell death because they can penetrate the cancer cell membrane.
A recent study in China found butterfly pea to be very effective against certain lung cancer cell lines.1Other studies have shown that a powder made from the ground-up leaves of the butterfly pea can enhance memory and brain power.



A team of researchers in India found that butterfly pea increases the levels of the neurotransmitter *acetylcholine*. Acetylcholine is important for communication in your brain. And it's one of the brain chemicals that decreases the most as you age.



How does the butterfly pea improve your thinking?

The less of it you have, the slower the messages will travel in your brain. They might even break down and stop traveling altogether.

Low acetylcholine levels can cause loss of memory and coordination as you get older. Butterfly pea improves your thinking and balance naturally because it reverses this process.

Effects of butterfly pea

Be a Chemist: Acid to Alkaline

Grades 4-6

From Florida Agriculture in the Classroom, Inc

Overall Objective: Using ph/acid test strips, students will determine the ph levels of the garden soil and various liquids. Students will conduct an experiment to determine influence of acidity on plants.

Special Materials: pH/acid test kits - available from Amazon or in garden supply stores at low cost. Other materials are listed on the lesson plan.

Standards and Pacing Guide:

Grade 4-1st quarter, The Practice of Science SC.4.1.1.: Question, Investigate, Explain
3rd and 4th quarter, SC.4.L.16.2: Plant and animal characteristics are affected by their environment.

Grade 5 - 1st quarter, SC.5.N.1.1: Question, Investigate, Explain,
2nd quarter, SC.4.P.9.1: Changes in Matter
3rd quarter,SC.5.L.14.2 Plant and Animal Organs and Functions

Activity: Acid to Alkaline

Grades 4-8

Overview

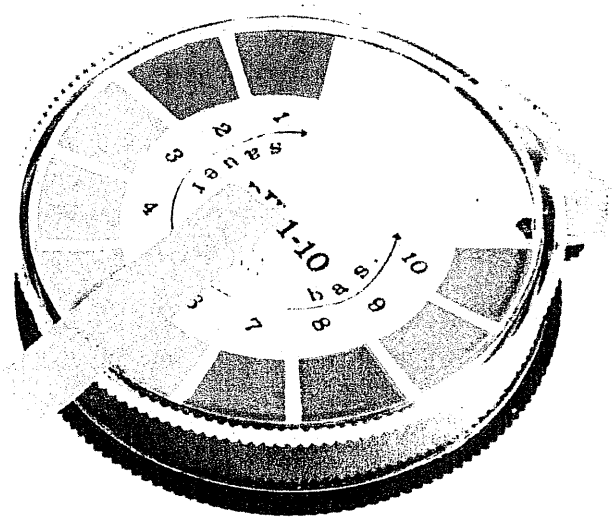
Students explore pH with an emphasis on soil pH. This activity uses soils and vinegar solutions.

Background

of the significant factors in growing successful gardens or crops of any kind is the pH of the soil. A simple explanation of pH is whether a solution is an acid, base or neutral. The pH scale is numbered from 0 to 14. Seven is neutral, and distilled water would have a pH of 7.0. Solutions below 7.0 are acidic, and those above 7 are basic or alkaline. Examples of alkaline solutions are lye soap – pH between13 and 14, bleach – pH 13, a solution of ammonia – pH 11, Milk of Magnesia – pH 10, baking soda – pH 9, sea water – pH 8. Examples of acid solutions are black coffee – pH 5, tomato juice – pH 4, vinegar – pH between 3 and 4, orange juice – pH 3, lemon juice – pH 2, gastric acid – pH 1, battery acid – pH between 0 and 1.0. Human skin has a pH of 5.5, while human blood is 7.3 to 7.4. (Note: Temperature will alter pH.)

How does this relate to soils? Soils are not a solution. This is true, but soils capable of growing plants contain about 25 percent water and 25 percent air. Mineral transport into a plant's roots is accomplished when those minerals are dissolved in the water found in soil and those minerals are absorbed as the water is taken in. That is the solution we are actually evaluating. Since water molecules cling to soil particles, it is very difficult to remove the water solution to test it. So, we test the moist soil. Most soils in the Eastern United States have a pH between 6 and 6.9.

Soil pH is determined by the parent material of the soil. The rocks that weather to produce soil minerals also dissolve elements into solution. Rocks such as limestone will result in soils with higher pH. Plant material, microorganisms, decomposition, amount of rainfall, temperatures and animal waste, all alter soil pH. Acid rain caused by the burning of fossil fuels also affects soil pH more significantly than a more neutral pH and will cause additional weathering of soil and rock minerals that further affect soil pH. An interesting map of the world's soils by pH can be found at *http://en.wikipedia.org/wiki/File:World_Soil_pH.svg* and the impact of rain is easily seen. Soils in Florida have a median pH of 6.1, but can vary widely across the state. Soils growing slash pine can be quite acidic. Soils formed from calcium-rich limestone or seashells will be alkaline. So, in coastal areas and South Florida, pH will be higher – above neutral to alkaline. Florida's common building materials, concrete and stucco, will also create alkaline conditions in soils near buildings, sidewalks, walls or where water draining from those structures flows over or through soils.



Time:

Groundwork: 45 minutes

Exploration – Soil pH: 45 minutes

Exploration – How does pH affect plants?: 45 minutes setup, three-to-four weeks ongoing observations

Making connections: Ongoing

Materials:

- **Red cabbage water**
- **Baking soda**
- **Glasses with water**
- **Wide-range pH paper (0-12)**
- **pH test kits for soil**
- **A variety of common household liquids and beverages (milk, orange juice, cola, pickle juice, dish detergent, vinegar)**
- **Garden soil**
- **Bean plants**
- **White vinegar**
- **Copies of student handout pages**

Standards At-A-Glance

Next Generation Sunshine Standards Met:

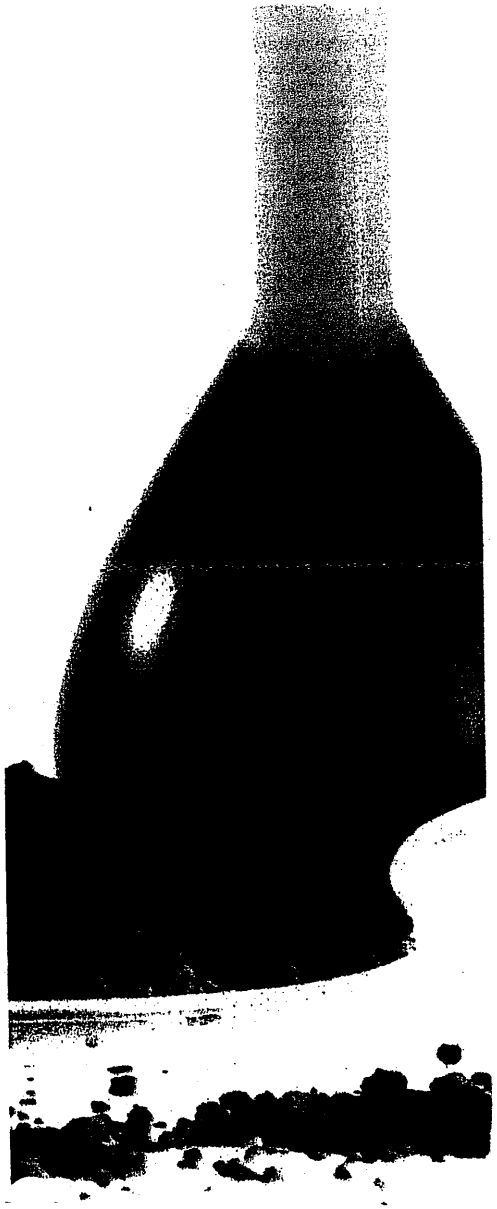
SC.2.E.6.3, SC.2.L.17.2, SC.3.N.1.6, SC.3.N.1.1, SC.3.P.8.3, LA.3.6.1.1, LA 4.6.1.1, LA.4.4.2.2, SC.3.N.1.2, SC.3.N.1.3, SC.4.E.6.3, SC.4.E.6.6, SC.4.P.8.1, LA.5.4.2.2, MA.5.G.5.3, LA.6.4.2.2, LA.7.4.2.2, LA.8.4.2.2, SC.8.P.8.4, SC.8.P.8.8, SC.912.P.8.8, SC.912.P.8.11

Standard Reinforced or Skill Utilized

SC.K.N.1.2, SC.K.N.1.3, SC.1.E.6.1, SC.1.L.14.1, SC.1.L.14.3, SC.1.N.1.3, SC.1.P.8.1, SC.2.E.6.1, SC.2.N.1.1, SC.2.N.1.2, LA.K.1.6.1, LA.1.1.6.1, LA.2.1.6.5, LA.2.4.2.2

The goal of most farmers is to maintain a soil pH between 6.0 and 7.0 for most crops.

"Acid to Alkaline" lesson



The goal of most farmers is to maintain a soil pH between 6.0 and 7.0 for most crops. A neutral soil pH will not interfere with plant growth nor the uptake of minerals needed by corn, wheat, oats, alfalfa and other field crops. Gardeners and vegetable growers work to maintain the pH required for the crops they are growing. Some crops need a higher or lower pH, having evolved in areas of either acidic or alkaline soils. Blueberries are an example of a crop that needs acidic soil (pH 4.0-5.0). Hydrangea blossoms can be colored from pink to blue depending on the pH of the soil (blue pH 4.5-5.0; less acidic for pink blossoms.) Soil pH can affect both plant nutritional deficiencies on one end of the spectrum to plant nutritional toxicity on the other. Some plant diseases are also caused or exacerbated by improper soil pH. Each plant has adapted to grow and thrive in a particular pH range of soils, which determines which minerals and nutrients the plant can absorb.

Preparation

- Obtain several pH test kits from your county Cooperative Extension office or local gardening shops. Have enough for all groups when the whole class is divided into groups of five students.

- A day before conducting this lesson, chop a red cabbage into small pieces. (If a red cabbage is not available, blackberries, red onions or hibiscus flowers can be substituted.) Cover the cabbage with water and simmer the mixture until the water turns a deep shade of purple. Allow the water to cool; drain and refrigerate the solution.

- Fill three glasses with 1 cup of water and line them up in front of the class. Leave the first just water. To the second, add two tablespoons of vinegar, and to the third add 2 teaspoons of baking soda.

Groundwork

Objective: To distinguish between acidity and alkalinity.

1. Find out what your students already know about acids by asking such questions as: What is an acid? Can you name any? What is a base? Can you name any? Do you think acids or bases are helpful or harmful? What have you heard that leads you to believe this? Generate a list in a visible place.
2. Explain that there are acids and bases, giving examples from the background information provided above, omitting the pH of each. List the examples in a visible place under the headings acids and bases.
3. Explain that there is a pH scale that ranges from zero to 14, with the midpoint of 7 being neutral, and numbers below it representing acids and those above it representing bases. Next to the acids and bases on your list, add the pH of each from the information provided above.
4. Explain that this pH scale is actually representative of the concentration of hydrogen ions. Using the animation found at *www.purdue.com/chemistry/ph.htm* provide a pictorial demonstration of the hydrogen ion concentration changes as you move up or down the pH scale and the acids or bases that are identified.
5. Using the three glasses set up in advance, explain to students that the first glass contains water, the second is a mild acid, and the third is a mild base. Explain that you have a pitcher of water made by cooking red cabbage. Show students its purple color. Ask them to predict what will happen if you pour the cabbage water into the glass with water.
   a. Pour the cabbage water into the first glass — it will turn purple. Discuss with the students that this is as expected since the glass just contained water with a pH near or at neutral.
   b. Pour the cabbage water into the second glass. It will turn red. Explain that the cabbage water acts as an indicator. The water turning red indicates that it is an acid.

c. Pour the cabbage water into the third glass. It will turn green and this indicates that it is a base.
d. Explain that making red cabbage water is time consuming and messy, and while you refrigerated it for use with this class, it would eventually spoil. So, other solutions or pH paper are used to reveal the same information. Display litmus paper and one of the soil test kits.

6. Divide the class into groups of five students, and have the students measure the pH of common household substances such as milk, water, lemon juice, cola, etc. Measure the pH and record results on pH of Common Liquids handout.
7. Explain that acids and bases are all around us, and that they have specific uses. As food scientists and chefs are creating new foods, they consider pH and pH is important in food preservation. As chemists develop dish detergents, laundry soap, bar soap, hand creams, lotions, fertilizers and other products you use every day, pH is monitored and altered to meet the needs of the product user. Imagine putting lotion on your skin only to have it be too acidic. What would happen? (It would burn.)

Exploration - Soil pH

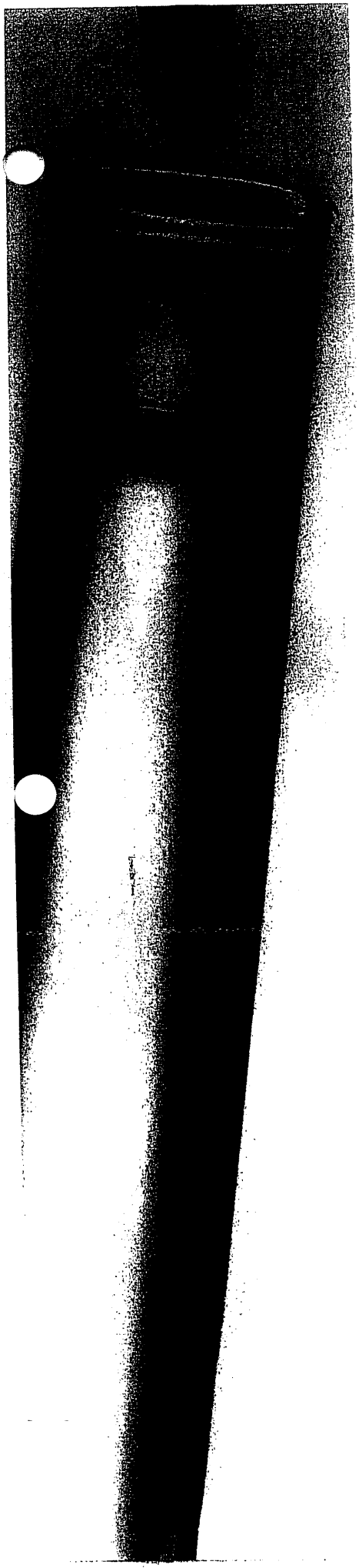
Objective: Determine the pH of the soils in the school garden and how pH influences plant crops.

1. Explain that the pH of soil is very important to gardeners and farmers as they try to raise food and feed crops. Share that soils that have a high pH are not known as basic soils but alkaline soils.
2. Hand out the Soil pH Requirements Chart (page 31) for students. Have students read the chart and identify three crops that need acidic soils and three that require neutral to alkaline soils.
3. Divide the class into groups of five students, and have each group take a soil sample from a different part of the school garden. At least two should be near either the building or sidewalk to see the impact of structures.
4. Provide each group with a soil pH test kit and, following the directions, test the soil for pH.
5. Compare results and make a map of the pH in the garden.
6. Using the Soil pH Requirements Handout (page 32), have each group identify which crops could thrive in soil with the same pH as their group found in the garden.
7. Begin the process to determine what plants might be grown in the school garden.

Exploration - Does pH affect plants?

Objective: Conduct an experiment to determine influence of acidity on plants.

1. Ask: "How can we find out if and how plants are sensitive to different levels of acidity?" Encourage students, in small groups or as a class, to design experiments to examine this question.
2. A sample setup could be:
   a. Plant three bean seeds per four-inch pot, keep in full sun, and thin to one plant per pot when plants are approximately two inches tall.
   b. Prepare solutions with a pH of 3 (1 quart vinegar), 4 (1 quart tap water to ½ cup vinegar), 5 (1 quart tap water to 2 teaspoon vinegar), and 6 (1 quart tap water and no vinegar).
   c. When plants have grown three-to-four inches tall, begin watering with acid solution. Spray on leaves and then water with the rest of the quart.
3. Have students conduct their experiments as designed, record their observations and measurements and develop conclusions. Each group should prepare a report of their experiment and conclusions.



Enrichment

1. What can you infer about the effects of pH on a plant in the garden?
2. How could acid rain affect you? How could it affect a farmer anywhere in the world?

Extensions for Middle and High School students

1. Collect rainwater and determine the pH.
2. Research methods to lower or raise pH.
3. Lower or raise pH in the school garden following the results of the exploration in #2.
4. Select an industry and research how pH plays a role in their product development, research, environmental stewardship, and product manufacturing or processing. Create a poster project, oral report or PowerPoint presentation to give to the class.

Additional Information

The Master Gardener program of Cooperative Extension with the University of Florida has additional information on soil pH and other resources. They can be found through your county Cooperative Extension office or at: *http://gardeningsolutions.ifas.ufl.edu/mastergardener/newsletter/2009/more/soil_ph.shtml*

Soil pH Requirements Chart

Crop	Grows in soil pH	Crop	Grows in soil pH
African Violet	6.0-7.0	Geranium	6.0-8.0
Alfalfa	6.2-7.8	Lettuce	6.0-7.0
Almond	6.0-7.0	Magnolia	5.0-6.0
Alyssum	6.0-7.5	Oats	5.0-7.5
Apple	5.0-6.5	Onion	5.8-7.0
Apricot	6.0-7.0	Peach	6.0-7.5
Asparagus	6.0-8.0	Peanuts	5.6-6.6
Beans	6.0-7.5	Peas	6.0-7.5
Beets	6.0-7.5	Pineapple	5.0-6.0
Begonia	5.5-7.0	Poinsettia	6.0-7.0
Blueberry	4.0-5.0	Potato	4.8-6.5
Broccoli	6.0-7.0	Red Raspberry	5.5-7.0
Cabbage	6.0-7.5	Rice	5.0-6.5
Carnation	6.0-7.5	Rhubarb	5.5-7.0
Carrot	5.5-7.0	Rose	5.5-7.0
Cantaloupe	6.0-7.0	Snapdragon	6.0-7.5
Cauliflower	5.5-7.5	Spinach	6.0-7.5
Celery	5.8-7.0	Strawberry	5.0-6.5
Chrysanthemum	6.0-7.5	Sugar Cane	6.0-8.0
Corn	5.5-7.5	Sweet Cherry	6.0-7.0
Cranberry	4.2-5.0	Sweet William	6.0-7.5
Cucumber	5.5-7.0	Tomato	5.5-7.5
Easter Lily	6.0-7.0	Zinnia	5.5-7.5
Gardenia	5.0-6.0		

Name _____

Soil pH Requirements Handout

Which plants can grow at the soil pH found?

Soil pH found in school garden soil sample: _____

Possible Plants	Acceptable pH Range

pH of Common Liquids Chart

Name _____

Liquid	pH	Acid or Base?

Acid to Alkaline

Sample Pre-and Post Assessment

1. What is pH?

2. Give an example of an acid.

3. Give an example of a base.

4. List one reason why it is important to test soil pH before planting a plant:

5. Why does the pH of soil vary?

Learning about the Compost Pile

Though this unit is originally for Third Grade, it can easily be modified for grades 2-5.

Grade 2- The Practice of Science: SC.2.N.1.1, SC.2.N.1.2, SC.2.N.1.3, SC.2.N.1.5.
2nd quarter, Investigate how matter can change – SC.2.P.9.1

Grade 3- The Practice of Science: SC.3.N.1.1, SC.3.N.1.2, SC.3.N.1.3, SC.3.N.1.6.
2nd quarter, Energy's ability to cause motion and create changeSC.3.P.10.2

Grade 4 - The Practice of Science: SC.4.N.1.1, SC.4.N.1.2, SC.4.N.1.3, SC.4.N.1.4.
2nd quarter, Forms of Energy: SC.4.P.10.1

Grade 5 - The Practice of Science: SC.5.N.1.1, SC.5.N.1.2,
2nd quarter, Forms of Energy: SC.5.P.10.1

Overview: Students will learn that composting is a way to recycle materials from plants.

Objectives:

Lesson #1: Students will sort and identify items to be composted

Lesson#3: Students will utilize a card game to recognize the ingredients necessary to successfully make compost.

Upper grade modifications: Add vocabulary. Students should also understand the value of nitrogen and carbon, and why energy is released.

Lesson #6: Students will build a mini compost and landfill then compare and contrast the ingredients and the success of each.

Teacher Resources:

- Background and Vocabulary,
- What is a Compost
- Sources of Carbon/Nitrogen Ratio.

Resources:

Wake County Environmental Services, Solid Waste Management Division, Raleigh, NC
Sydney Park Brown, Extension Agent, Environmental Horticulture Seffner, FL

Background Information and Vocabulary

Vocabulary:

Aerobic-a biochemical process or condition occurring in the presence of oxygen.

C/N ratio – Carbon-to-Nitrogen Ratio. The proportion of carbon to nitrogen affects how quickly microorganisms work. The optimum ratio is 30-1. See reference sheet.)

Compost – organic matter that is undergoing or has resulted from decomposition.

Decomposition – the process by which organic materials are broken down into component chemicals.

Microorganisms – small living organism that digest organic material

Organic – Material that is or was living. Contains carbon

Process:

Given the proper environmental conditions-moisture, available oxygen, and a favorable nitrogen/carbon ratio, bacteria will begin to regenerate. They reproduce by cell division. Soon two become four, then eight, sixteen and so on.

Nitrogen provides bacteria with elements of protein to build their bodies.

Carbon is the energy source for the bacteria.

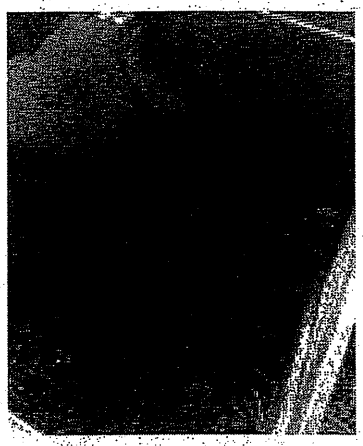
A moisture content of 40%-60% is ideal. If it is less than 40%, the bacteria are forced to slow down and grow dormant. With moisture content over 60%, the pile loses too much air and will begin to smell like rotten eggs.

As the bacteria eat the organic material, chemical changes occur and heat energy is released.

The bacteria will also become a food source for many other insects.

Does your school have a compost pile? If you have a banana circle, the compost pile is in the center. Building or purchasing a compost bin will be of great benefit to your school garden.

What is Compost?



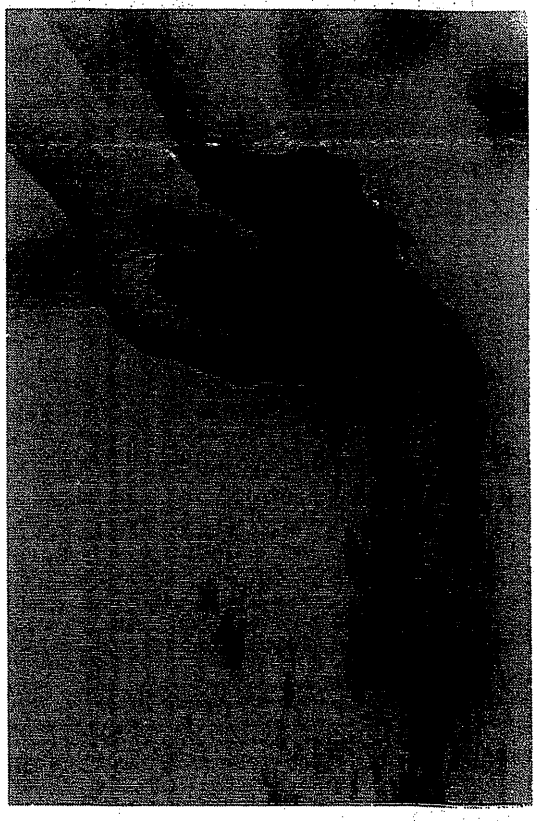
Improving soil by using compost is a keystone of organic gardening. Well-made compost is an incredibly useful material. It is a wonderful soil improver, aiding water retention in light sandy soils and breaking up heavy clay soil. As a growing medium it provides nutrients to plants, allowing for vigorous growth and higher yields. When used as mulch it feeds the plant and improves soil. The composting process has many learning opportunities that are accessible to pupils of all ages.

Compost is a mixture of organic matter that has broken down naturally over time. Good quality finished compost has a dark brown almost black colour. It has a rich, almost sweet, earthy smell. Once passed through a sieve there should be no trace of the component parts, e.g. vegetable peelings, egg boxes etc.

As the organic matter breaks down, a myriad of bacteria, other micro-organisms and mini beasts come together creating a complex ecosystem. It is the management and maintenance of this ecosystem that is vital in creating good quality compost.

Why is compost seen as a keystone in organic gardening?

Successful growing relies upon many factors and arguably the most important factors are the quality of soil and availability of nutrients. If soil is of poor quality with little nutrients, plant growth will be stunted and sickly, yields will be poor and diseases may be an issue. Regular use of compost solves many of these problems.



- Compost is rich in nitrogen (N), phosphorus (P) and potassium (K). Using compost as a mulch or digging it into soil adds these vital nutrients that are needed for vigorous growth and improving crop yields.
- Compost is a first class soil improver, so much so that it is the default solution for many soil problems. Adding organic matter to soil improves drainage in heavy clay soil, aids water retention in light soils and improves aeration, thus reducing soil compaction. Adding compost also encourages creatures such as earthworms which further improve soil quality.
- Compost makes fantastic mulch, locking moisture in the soil, adding valuable nutrients to the soil and improving soil structure as earthworms incorporate it into the soil.

Lesson 1: What Can We Compost?

Grade Level:
3rd Grade

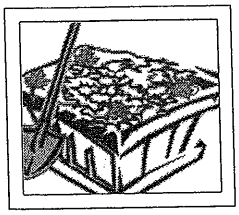
Concepts Taught:
Sorting, identification

Essential Questions:
- What is compost made of?
- What types of items can go into a compost pile?

NC CORE/Essential Standards:
ELA: Text Types and Purposes:
2a,2b,2c,2d
Math 3.NBT.1

Materials:
Copies of the worksheet "What Can We Compost" for each student or use one transparency

Objectives:
- Students will sort and identify items that can be composted.



Procedure:
1. Review the teacher background section on compost.
2. Have each student name one thing they throw away each day and write each item on half of the board.
3. Explain to students that not all the items must go into the trashcan. Some can be recycled, reused, or composted.
4. Explain to students that composting is a way to **recycle organic** (plant or animal) material. Items that can be composted include food waste such as orange peels, banana peels, potato peelings, bread crusts, eggshells, coffee grounds, and other non-food items such as shredded newspaper, teabags, leaves, grass, and sticks.
4. On the other half of the board, make four column headings: recycle, reuse, compost, and trash. Go back through the list of brainstormed trash items and have the students name where each item should go.

Recycle	Reuse	Compost	Trash

Key:
Can be Composted: Leaves, branches, banana peel, vegetables, grass, hay, sticks, apple core
Cannot be composted:
Oil, can, boots, books, cheese, bones, turkey, paint

NOTE: animal products such as cheese, bones, and turkey should only be composted in large-scale or commercial-type composting processes, not in classroom or residential compost bins

Extensions/Modifications:
1. Using the worksheet below, have students identify which items can be composted and which cannot.

2. Using old magazines or catalogs have students create a collage showing items that can be composted.

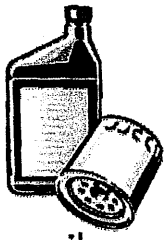
Lesson 1

NAME_____

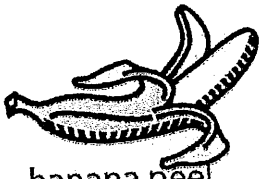
What can we compost?

Make an X on things that do not go in a compost pile.
Circle the things that can go in a compost pile.


leaves


oil


branches

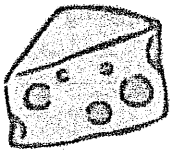

banana peel


can


vegetables

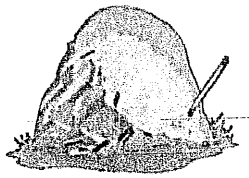

boots


books

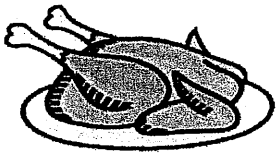

cheese


bones


grass


hay


sticks


turkey


apple core


paint

Lesson 3: Compost Card Game

Grade Level:
3rd Grade

Concepts Taught:
Composting

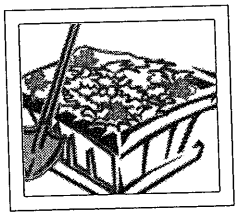
Activity Time: 10-15 minutes

Essential Questions:
- What are the 3 "ingredients" in compost?
- If one of the "ingredients" is missing will the compost pile rot?

NC CORE/Essential Standards:
Math: 3.NBT.1
Healthy Living: 3.ICR.1.1, 3.ICR.1.2, 3.ICR.1.4, 3.ICR.1.5

Materials:
Compost cards (below), 1 of each type for each student

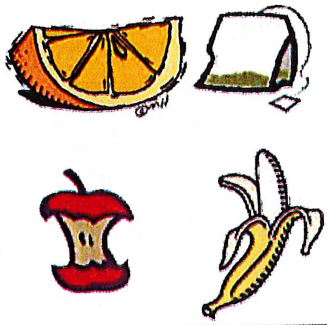
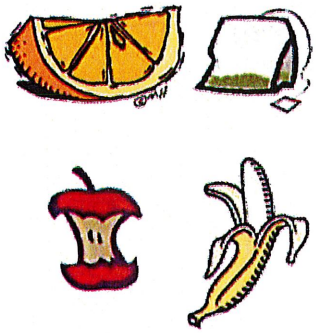
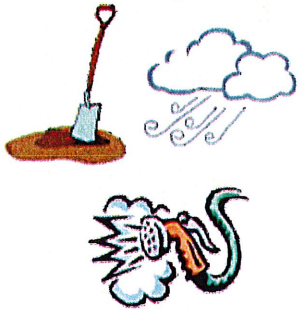
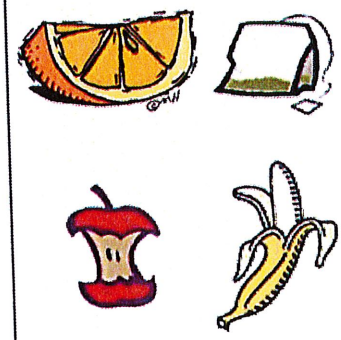
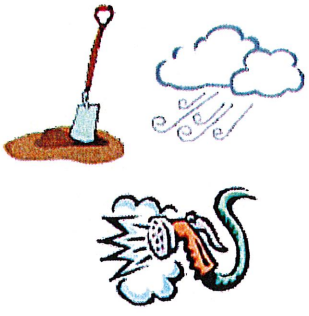
Objectives:
- Students will utilize a card game to recognize the ingredients necessary to successfully make compost



Note: This lesson is adapted from an activity originally developed by Brooke Smitherman

Procedure:
1. Print out enough copies of the compost cards below so that each student has one of each card (Browns, Greens, and Soil, Water, and Air). Cards should be printed on colored or thick paper so that students cannot see through the back of the card.
2. Discuss with students how materials are recycled in nature through a variety of means: decomposers, detritivores, and composting. Decomposers, such as mushrooms, get their nourishment from leaf litter or decaying matter. Detritivores are animals that eat decaying organic matter (leaves, bark, trees, etc.) such as earthworms or beetles.
3. Remind students of the three basic things that are necessary to make compost:
a. **Greens**: Nitrogen-rich materials such as grass clippings and food scraps (items such as peelings, bread, rinds; but no cheese, meat, or bones)
b. **Browns**: Carbon-rich materials such as dried leaves, straw, and newspaper
c. **Soil, Air, and Water**: Compost piles often need "starter" soil rich in microorganisms, frequent turning of the pile to allow air in, and watering to encourage decomposition
d. Arrange students in groups of three and give each student one of each card: Browns, Greens, and Soil, Water, & Air.
4. This game will be played similarly to "Rock, Paper, Scissors." The object of the game is for the group of three students to make compost with their cards. In order to make compost, each player will have to show a different card. For example, two "Greens" cards and a "Soil, Water, Air" card will not make compost.
5. Most groups like to count "One, two, three, go!" and then all players show a card without looking at which card they are choosing. When a group has one of each card played, they can say "Compost!"

Extensions/Modifications:
Groups can count how many times they get compost and compare with other groups' results. Probability and statistics can be calculated as well.

Browns 	**Greens** 	**Soil, Water, Air** 
Browns 	**Greens** 	**Soil, Water, Air** 
Browns 	**Greens** 	**Soil, Water, Air** 

Lesson 6: Building a Mini Composter

(5)

Grade Level:
3rd Grade

Concepts Taught:
Composting, time lapse

Essential Questions:
- How long does it take for compost to decompose, or rot?
- What items decomposed the fastest? The slowest?

NC Core/Essential Standards:
Science Objective 3.L.2.2

Materials:
Two emptied and cleaned water bottles (one for mini composter, one for mini landfill)
soil (can be dug from school grounds or potting soil)
a handful of food scraps such as orange peels or lettuce leaves chopped into small pieces, ruler
scissor
masking tape

Objective: Students will conclude that composting is a way to recycle plant and animal material

Procedure:
1. Explain to students that they will be able to view composting in the classroom on a small scale. Show students the materials collected.
2. Using scissors and following the diagram, cut off the top two inches (below the mouth) of the bottle. Save this portion for later. It will be used in step 6.

3. In the bottom of the bottle, place 1" of soil. Do not compact the soil.
4. Place the food scraps on top of the soil and cover with another 1" of soil. *
5. Using scissors carefully poke 5-7 air holes in the top (cut off) portion of the bottle.
6. Use the masking tape to secure the two sections of the bottle, being careful not to cover the air holes with the tape.
7. Place the bottle in a sunny place that is not too hot or too cold.
8. Over the next 1-2 weeks, shake the bottle once daily to mix the soil and food scraps, being careful not to spill the contents. This represents the turning that would ordinarily occur in a backyard compost pile and allows air and moisture to circulate through the soil and scraps.

9. Discuss with students what they observe each week. Is the food decomposing? Why or why not?
a. What would happen if the bottle were not shaken?
b. What would happen if there were no air holes in the bottle?
Why was the soil added?

* Add a carbon source, like shredded paper or a ball of cotton.

Extensions/Modifications:

Build a mini-landfill with students. Follow steps 1 and 2 above.

1. In the bottom of the bottle, place 2" of soil. Compact the soil by pressing it down into the bottom of the bottle.
2. Place the same amount and type of food as in the mini-composter and repeat step 2.Do not make air holes in the top portion.
3. Tape the top back onto the bottle. Place the bottle in a dark place in the room or cover the sides with a dark material such as construction paper or black plastic.
4. After a few weeks, ask students what they expect to happen. Remind them that the mini-landfill was not shaken, had no light, and had no air holes.
5. Remove the tape from the bottle and examine contents. Did the material decompose as much as the material in the mini-composter? (It should not.) This is what happens when food scraps are thrown away instead of composted. Rather than breaking down as compost will do, food scraps in the landfill decompose very slowly and will not be used again.