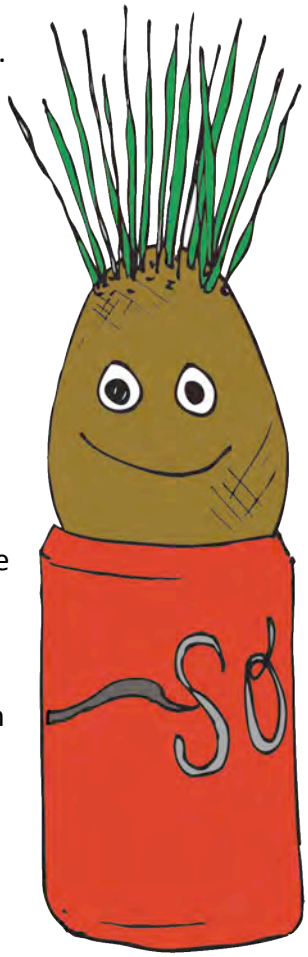
Plant People

From the Junior Master Gardener® Teacher/ Leader Guide, page 12.

Objective: **To show through creative arts an understanding of plant needs**
Time: **30 minutes**
Materials: **Nylon stockings, grass seed, potting soil, soda can, plastic eyes, miscellaneous art supplies.**



Ask the gardeners to recall what plants need. Ask them where plants grow. Point out that plants can grow in many places-in the ground, a pot and even a crack in the sidewalk. Tell them they will make plant people. Explain that plant people are growing, living things that will need to be cared for. Show the group all the materials. Demonstrate how to create one, then help the students make their own.

Pour 1 to 2 tablespoons of grass seed into the stocking toe (Note: If the section of stocking does not have a toe, tie a knot at one end and turn the stocking inside out. Each section of stocking should be about 10 inches long). Pour soil on top of the seeds and tie a knot to hold in the dirt. Add enough soil to form a baseball-sized shape.

The seeds will grow from the end to form the hair of the plant person. Glue eyes to the "head" of the person. Once the glue has dried, submerge the head in water to allow water to penetrate the soil.

Set the head aside. Use various art supplies to decorate an empty soda can to be the plant person's body. It can be wrapped in a strip of construction paper. The gardeners can add paper or pipe cleaner arms and legs to complete the effect. Fill the decorated can with water and set the head on the can top. Push the excess stocking into the can opening to help wick water to the soil of the plant

Within several days, the plant peoples' hair will sprout. Have the gardeners keep the plant people in a well-lit location and make sure they stay moist. Before long, the gardeners will need to clip the grass to give their plant people haircuts.

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Insect Collecting

You may have at some time caught an insect, or watched one closely to see what it did next. Where you were at the time (the environment) and what you used to catch it (the method) influenced the type of insect you observed and/or caught. There are many places to look for insects, and a variety of specialized techniques have been developed for collecting them. Most methods take advantage of insect instincts in one way or another. In this section, you can teach your group a variety of enjoyable ways to collect insects to study. Your JMG'ers can set a trap for insects, make an insect night-light, sweep up insects, or create their own insect farm.

Suck-A-Bug!

Objectives: To make a simple aspirator and use it to collect and observe small insects.

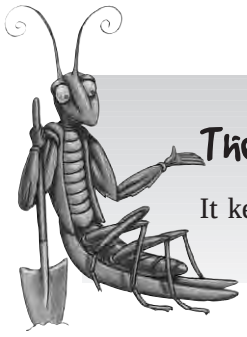
Time: 30 minutes to make the aspirator, plus 30 minutes to 1 hour to collect and observe insects.

Materials: Small plastic containers—clear if possible (film canisters are the perfect size, although usually opaque; you also can use small plastic herb bottles, small butter dishes or plastic test tubes), plastic drinking straws or flexible plastic tubing (tubing works better, but is a little more expensive), modeling clay, netting or gauze, tape, awl, ice pick or drill (for adult use).

There are many insects to see, and many ways to catch them so you can observe them. Nets work well for large insects, but tiny ones often go unnoticed. One way to catch these small ones is with a Bug Sucker, also called a pooter or an aspirator. Bug suckers are easy to make, but you will probably need to practice making and using one ahead of time before doing it with your gardeners.

Clean a small (preferably clear) plastic container and remove the label if it has one. Clear containers are handier because they allow the gardeners to observe the insect inside without opening the container. However, film canisters are the perfect size. (You can create a "window" in one by cutting out a section and replacing it with clear plastic, such as a piece from an overhead transparency. If you do this, make sure to seal the edges of the window with glue to keep air from entering. You will need good suction to be able to suck up a bug.)

Tape a piece of netting or gauze over one end of the drinking straw or tubing.



The netting or gauze is very important—don't forget it.

It keeps you from sucking the insect into your mouth

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Use the awl or ice pick to make two holes in the top of the container. (If possible, use a drill to make holes in the lids ahead of time.) Insert the straw or tubing through one of the holes so that the gauze end is down in the container and the uncovered end is sticking out of the top. Insert the other straw or tubing through the other hole. Finally, seal both holes with a bit of modeling clay, but be careful not to pinch off the tubing.

When you suck on the straw with the gauze on the end of it, you create a vacuum. Use this suction to capture small insects. Gently place the end of the straw without the gauze next to a small ant or other creature, and suck on the other straw. The suction will pull the insect into the container, where you can safely hold and observe it. It takes a little practice to be able to keep the straw next to the insect while sucking on the other end. This is why the flexible tubing is better: It can be longer and is more flexible. However, straws are inexpensive and easy to obtain. Children love practicing their bug-sucking technique, and usually spend quite a while working on it.

Do not use the bug sucker for large insects such as bees and butterflies. They can't fit up the tube, and the suction may damage their wings. (You don't want an angry bee that wouldn't fit up the tube flying around you!) Also, avoid using the bug sucker with "true bugs" (Order Hemiptera), such as stinkbugs; when sucked up a tube, they can spray irritating odors that leave a bad taste in your mouth.

It's a Small World

Objectives: To make a Berlese (burr-lay-z) funnel and use it to collect and observe insects living in the ground and soil.

Time: 30 minutes plus additional time later that day and the next for observing.

Materials: 2-liter soda bottle (1 per child or group), coarse screening or hardware cloth (different materials may be used, but they should have holes at least ¼ inch wide to allow insects to crawl through it), light with extension cord, place to hang light, bowl, soapy water.

Many insects live in the soil or the leaf litter just above the soil. Although we usually do not see many of these insects because they hide below ground, they can easily be collected using a Berlese funnel.

Show the gardeners how to make a funnel out of a 2-liter soda bottle by cutting the bottle in half. Turn the top part over to make a funnel. If you cut the bottom from the remaining portion of the bottle, you can use the resulting cylinder as a holder for the funnel to keep it from falling over. Have the gardeners place a piece of coarse screening or hardware cloth around the outside of the

Know and Show Sombreros

Purpose
Children create wearable pieces of art by decorating newspaper hats, as a way to their knowledge of a question of interest.

Objective:
The objective of this activity is to make wearable works of art that show children's understanding of a question of interest, such as the benefits of plants to people. This activity is both a creative arts project as well as an effective evaluation tool. If you make the hats as a pre- and post-test, you can note the difference between what the children included before, and after, the program.

Time:
- 1 hour during the program pre-session
- 1 hour during the program post-session

Materials
- 2-inch clear tape
- Newspaper
- Miscellaneous art supplies (markers, yarn, glitter, pipe cleaner, tissue – whatever you can think of!)

Instructions:

This activity needs to be done twice – once during the program pre-session and once during the program post-session. The rationale behind this is that through comparing these activities, you will be able to identify a change in a group of children's knowledge or understanding of your program's subject of interest.

Make the Hat
- Place the middle of two large, square sheets of newspaper on the top of a student's head.
- Lay the rest of the paper flat against the student's head.
- Tape around the newspaper starting right over the ear, and continue wrapping until the tape goes all the way around the student's head.
- Curl up the edges of the newspaper to form the brim of the hat.

Decorate the Hat

- During the pre-session, simply ask, without prompting, a question of interest related to your project goals, such as: what are the benefits that plants provide us? Or, what do plants need to grow? Encourage them to be creative, but do not offer suggestions or prompting.
- Encourage children to decorate their hats, with different art supplies, to show what they know.

Describe the Hat

- When everyone's finished their hats, encourage them to show their creation and talk about what each decoration or item means.
- As they do this, jot down the numbers and range of responses.
- For example, when asked what plants need, children may show water drops, and a sun. Note those as examples of two different needs. Note, too, any misinformation you see presented.

Post-Session:

- Repeat this activity again at the end of your program's session. Again, jot down the numbers and range of responses.
- Is there a difference? At the end of the session, are children able to identify more, or present a broader/deeper understanding of the plant world?
- For example, they may now note that plants need sun, water, nutrition, time to grow, a good location, and care.

You've just completed another evaluation method and most likely had some fun while doing it!

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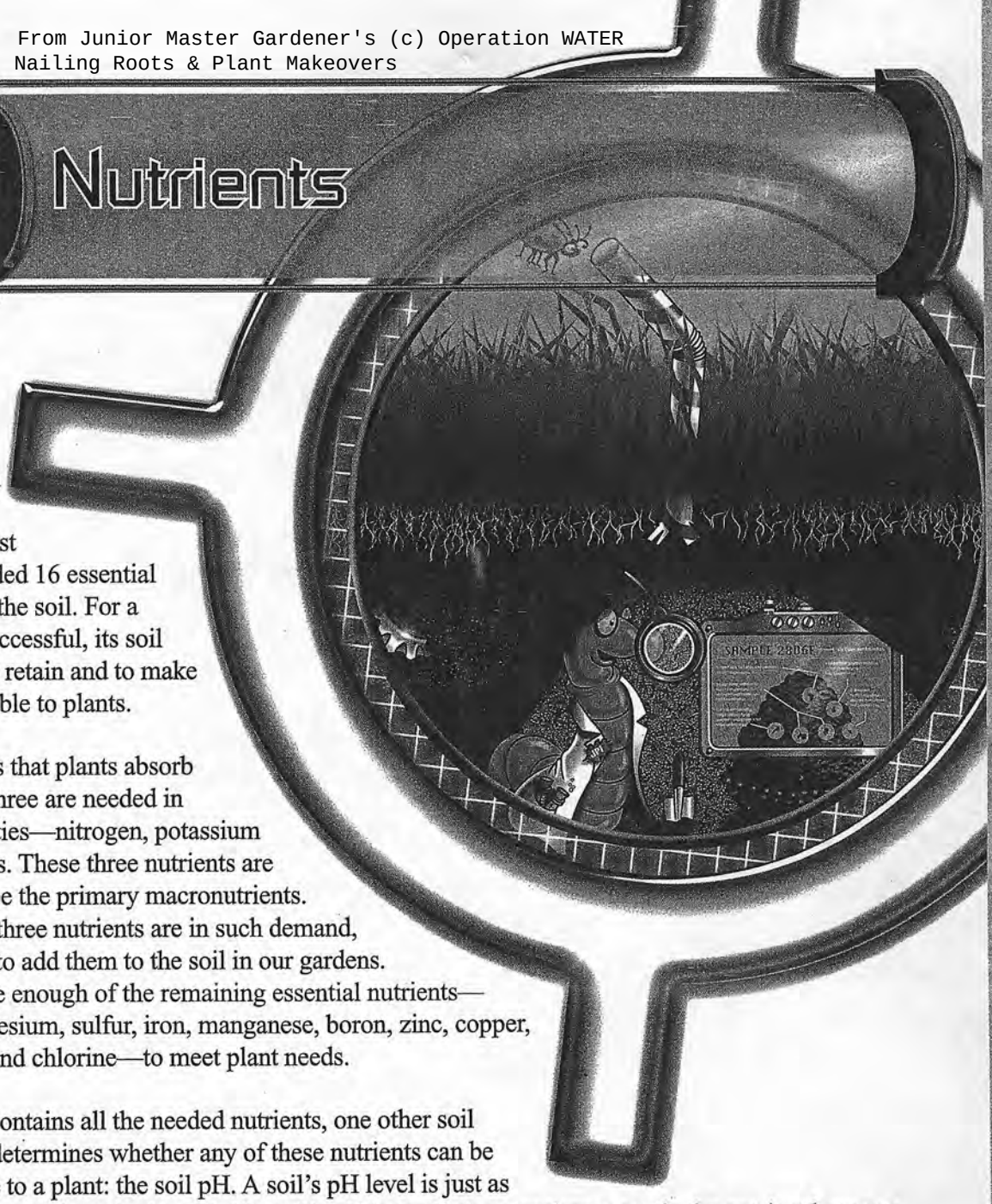
Nutrients



Except for oxygen, carbon and hydrogen, plants get almost all of their needed 16 essential elements from the soil. For a garden to be successful, its soil must be able to retain and to make nutrients available to plants.

Of the nutrients that plants absorb from the soil, three are needed in greatest quantities—nitrogen, potassium and phosphorus. These three nutrients are considered to be the primary macronutrients. Because these three nutrients are in such demand, we often need to add them to the soil in our gardens. Most soils have enough of the remaining essential nutrients—calcium, magnesium, sulfur, iron, manganese, boron, zinc, copper, molybdenum and chlorine—to meet plant needs.

Even if a soil contains all the needed nutrients, one other soil characteristic determines whether any of these nutrients can be made available to a plant: the soil pH. A soil's pH level is just as important as the nutrients in the soil. If a soil's pH is too high or too low, a particular nutrient becomes insoluble, preventing it from being dissolved in water and absorbed by a plant's roots.

All of these 16 essential elements are constantly being used through nutrient cycling. They have been used again and again since time began. Because of this, natural landscapes throughout the world have supported a diversity of plant life that has flourished without any help from people.

In this section, the students will learn about these nutrients and how plants absorb them. Three group activities will help illuminate these concepts: the students will collect and measure composite soil samples, take an expedition to observe the nutrient cycle in action, and work together to diagnose and "heal" sickly plants suffering from nutrient deficiencies.

In addition to the group work are activities the youths may complete independently. A student may complete an activity on the student page or one in the *Nutrients* option at www.jmgkids.us/thistle. As you distribute the student pages, read the narrative (page 32) to the group.

4. Nailing Roots

Objective: Understand that soil pH affects a plant's ability to absorb nutrients; measure soil pH and amend the soil as needed

Time: Session 1: 25 minutes; Session 2: 40 minutes; Session 3: variable

Materials: Hammer, nail, bottle of multivitamins, several shovels and trowels that can be shared among student groups, bucket, pH test kit; for each student: a copy of the pH Nutrient Availability Chart

***Note:** Before the lesson, you will need to obtain a soil pH test kit. Garden centers sell basic, easy-to-use kits to test soil pH for $4 to $8 each. Instructions on collecting a soil sample for the test are detailed in this lesson.*

Although it may be a bit more expensive, you can have the soil analyzed by your state's soil-testing service. To obtain a soil sample bag and submittal form, contact your local county Extension office. The listing for the Extension office is in the white pages of the phone book under "county government."

The results from a soil-testing laboratory are generally more accurate than those from consumer test kits. The lab will send you a report that includes a measurement of soil pH and key nutrients. The cost for this service may range from $10 to $20 per sample.

Session 1

Escort the students to your garden area. Also take a hammer, nail and a bottle of multivitamins. Tell them that nutritionists and doctors say it is important for people to eat a variety of fruits and vegetables. Ask the students why variety is so important to nutrition.

Help them understand that we need to consume different foods because in order to live and grow, our bodies require a variety of nutrients found in these foods. Different nutrients each serve specific functions in our bodies, such as maintaining a steady heart rhythm (manganese) or helping wounds heal (zinc). Without all of these nutrients, our bodies cannot function normally.

Show the bottle of vitamins to the group and read aloud the nutrients listed on the label. Point out one specific nutrient—calcium. Ask the students: **What is a food source for calcium?** Most of the group will likely recommend milk as an excellent source of calcium.

Ask: **Where do cows get the calcium for their milk?** *A cow's body does not produce calcium, but rather it converts the calcium found in its food source—plants.*

Explain that plants take in calcium when it is dissolved in water and absorbed through the roots. Plants use this *soluble* (dissolved in water) calcium to form cell walls. Once the calcium enters the tissues of the plant material, it can then be absorbed by animals and, in effect, be recycled to help the animals' bones grow strong and healthy.

Point to another vitamin on the label—iron. Explain that iron is a required nutrient for plants and animals. When iron occurs in its soluble form in the soil, plants absorb it and use it to make chlorophyll.

Thanks to plants, our bodies can absorb iron from the foods we eat. Our bodies need iron to transport oxygen between our cells.

Hold up the hammer and nail. Tell the group that the nail contains iron. Explain that you will place it into the roots to provide the nutrient for the tree. Begin driving the nail into the soil at the base of the tree just below the surface. Ask which students think the tree can get iron from that nail.

Ask the students if they have ever tried to grow any type of plant. Were they successful? Tell them that many people cannot grow plants but don't know why. These two facts can help explain:

1. **All living organisms need nutrients, but they must have them in a form that their systems can absorb.**

   Just as we couldn't absorb iron from holding a nail in our mouths, a plant cannot absorb the insoluble form of iron in the nail. Plants must have access to nutrients that are available in a soluble form.

2. **Whether a nutrient is in a soluble form in the soil depends on the soil's pH.**

   The pH level of the soil tells us how acidic or basic the soil is. Most soils have a pH between 5 and 9. Tell the students that the soil in their garden has a pH measurement in that range now.

   The reason pH is so important is that at certain pH levels, even soluble nutrients can quickly become insoluble, which makes them unavailable to plants. If the pH of a soil is too high or too low, plants can't get the nutrients they need.

Ask the students how to determine the soil pH. If the pH is too high or low, how they can fix it? These concepts will be covered in the next session.

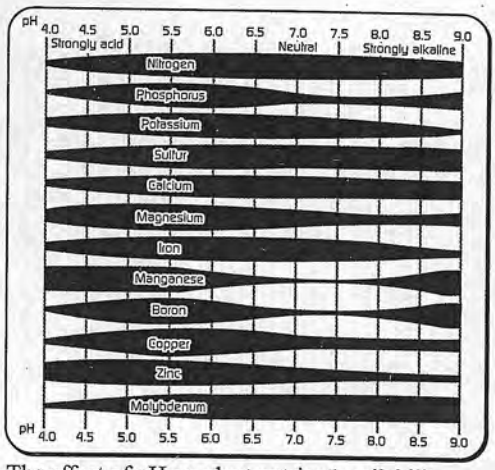
Session 2

Return to the classroom and ask a student to make a rough sketch of the garden area to be tested. The student should draw the outline of the garden from a bird's-eye perspective on a chalkboard or poster.

Give a copy of the pH Nutrient Availability Chart to each student. Ask the class to examine and then discuss the information in the chart. Explain that the nutrients listed are the essential elements for the plants. Along the top of the chart is a scale of possible pH readings of the students' garden soil.

Remind the students that the soil might contain nutrients that are soluble—and able to be absorbed by plants—only at certain pH levels. The bars along each nutrient listed show the pH levels at which the nutrient becomes soluble. The wider the bar, the greater the nutrient availability at that pH level.

Ask the students to examine the chart. Point out that there is a wide range of soil pH levels at which elements are available for use by plants. Have the students draw a box on the chart to outline a range of 5.5 to 6.5. Explain that when the soil pH is within this optimum range, all of these essential elements can be readily absorbed by plants.



The effect of pH on plant nutrient availability. Although nutrients are available at lower pH levels as the chart indicates, when the soil pH falls below 5.5, other variables related to soil chemistry impede most plants' ability to absorb some nutrients.

Refer to the garden sketch created earlier. Explain that the way to accurately measure the soil pH of their garden is to take several soil samples, mix them to create a *composite sample,* and test the pH of that composite. Have the students help mark Xs on 10 to 12 spots on the garden map where your group could take samples.

Divide the students into groups corresponding with the number of Xs on the garden map and return outdoors, taking shovels, trowels and a bucket with you. Explain the steps of the correct method to collect a soil sample, and have the students help demonstrate the steps.

Taking a soil sample

1. Select 10 to 12 spots throughout the garden from which to collect small samples.
2. Using a shovel, scrape away the surface layer of grass or leaf litter.
3. Collect one trowel full of soil (about ½ cup) at each site from the 0 to 6 inches deep level.
4. Mix all the samples in a bucket to create a composite sample.

After taking the sample, allow the soil to dry completely before testing it.

Next assign each group a location in the garden from which to collect soil.

Session 3: Nails in the Garden?

Have the students guess what their soil pH will be. Follow the instructions on the label of your test kit to demonstrate how to test a soil sample. Soil test kits vary in how they measure pH.

With the pH measurement, ask the students to use a highlighter to mark the pH reading and nutrient availability in their garden. Use the following questions to guide them in planning to use the information:

Is the pH in a range that will allow needed nutrients to be available for their plants? *Different plants thrive at different pH levels. In typical garden areas, most vegetables, herbs, fruit and ornamental plants do well if the soil pH falls in a range of 5.5 to 6.5.*

Some plants require a lower (acidic) pH; others grow best at much higher (alkaline) pH levels. The ideal pH conditions for a wide range of plants are available at resource links through www.jmgkids.us/thistle.

Examples of specific crops that grow best in very acidic soils are listed below.

Plants needing lower pH/acidic soils

Vegetables	Fruit	Ornamentals
Radishes (4.5-5.5)	Blueberries (4.0-5.0)	Azaleas (4.5-5.5)
Sweet potatoes (4.5-5.5)	Cranberries (4.2-5.0)	
Potatoes (4.8-5.5)	Raspberries (4.5-5.5)	

What if the soil pH is too low? How can it be raised? *To help raise soil pH, add powdered limestone, or lime. Wood ash can also make the soil less acidic.*

The amount of material needed and how to apply it vary according the crops or plants to be grown and the garden's size, soil type and pH. For specific details for using these materials, consult a county Extension agent or nursery professional.

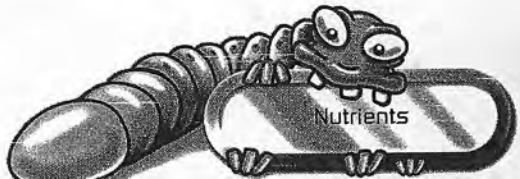
What if the pH of the soil is too high? How can it be made lower? *Sulfur can be added to the soil to lower pH. However, if the pH is very high, it may be difficult to lower it enough for many garden plants.*

Powdered and granular sulfur products are sold at local garden centers. A county Extension agent or nursery professional can provide specific instructions on using these materials.

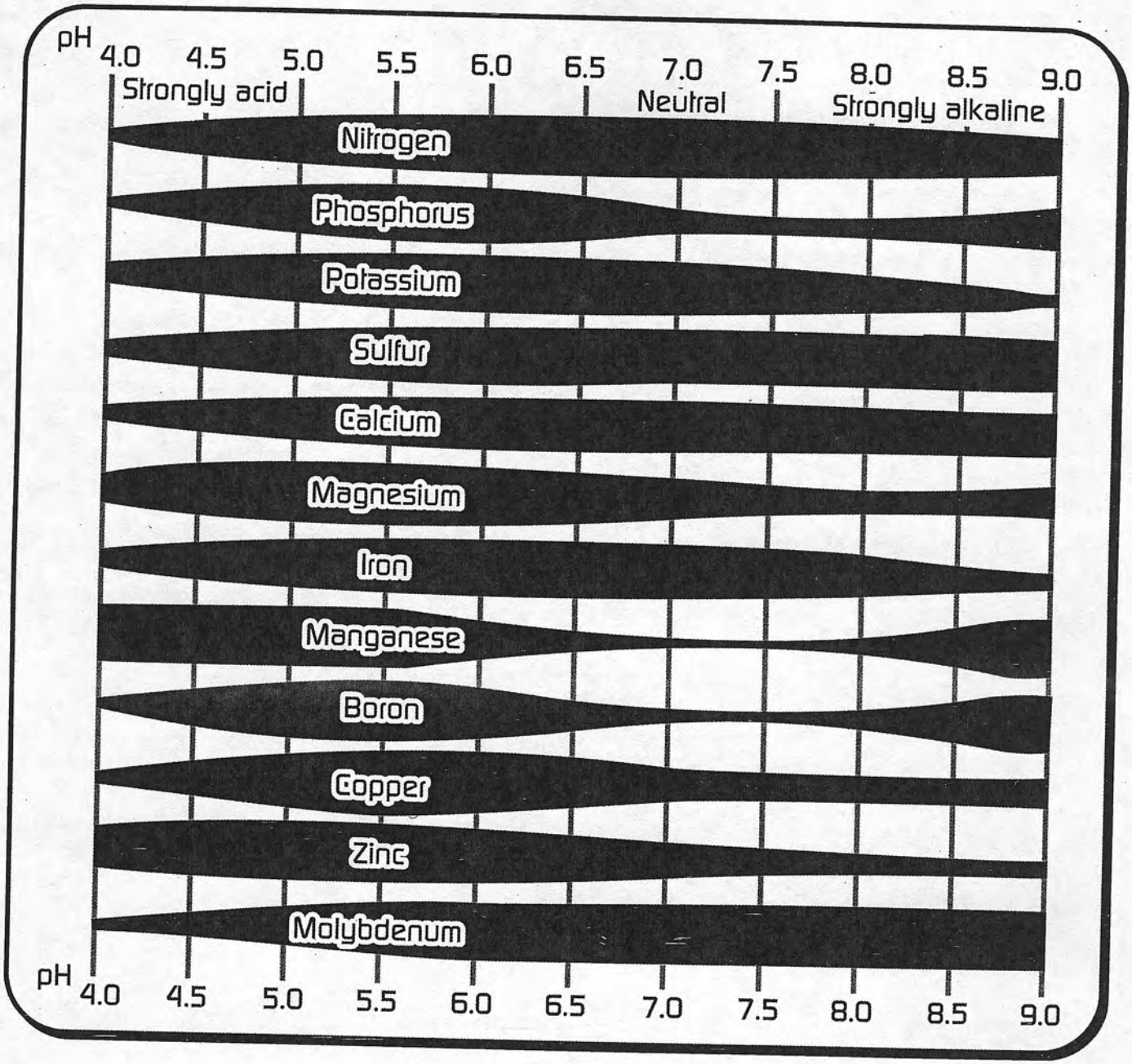
Close the discussion by reiterating that soil pH that is too high or too low can make soil nutrients insoluble, and roots cannot absorb insoluble nutrients. It helps to know the pH of the soil, especially if the plants are showing some type of nutrient deficiency. If the pH is too high or too low, adding more nutrients may be no more useful than sticking nails in the soil.

Extension

Science: Have the children experiment with soil pH by using hydrangea shrubs in containers. If the soil is acidic, the shrub will produce blue flowers; an alkaline soil will produce pink flowers. Adjust the soil pH by adding sulfur or lime to regular potting or garden soil.



pH Nutrient Availability Chart



6. Plant Makeovers

Objective: Demonstrate the symptoms of nutrient deficiencies in plants
Time: 45 minutes for construction of plants, 15 to 30 minutes for discussion
Materials: For each group of two to four students: Plant Makeover Card, construction paper, other miscellaneous craft supplies (tape, markers, scissors)

Ask the students if they have ever seen makeovers in magazines or on television in which a person is given a new haircut or new clothes, for example. Have them describe some of the dramatic changes shown in some of the "before" and "after" photos.

Tell the students that today they will be the ones doing the makeovers. The subject of the makeovers will be plants needing help. Explain that the class will "make over" sickly looking plants that have health problems, such as dead spots on the leaves and rotting of the ends of the fruit.

Clarify that a plant's health problems can be caused by many different factors, including insects, diseases and environmental conditions. But the plants in today's class are all lacking needed nutrients.

Divide the class into groups of two to four students each and give each group Plant Makeover Cards. Have the students read the cards to learn the symptoms that a plant would demonstrate if it lacked that specific soil nutrient. They could also use the resource links at www.jmgkids.us/thistle or other references to find examples of various symptoms.

The groups will use construction paper and other craft supplies to create two models of the plant displaying the symptoms on their cards. The models could be paper sculptures, or the group could dress up students as the healthy and unhealthy plants.

Stress that the students should illustrate the symptoms listed on their cards. The groups should first create a "before" model of an unhealthy plant, then create an "after" plant with no deficiency and its health restored.

As an option, the groups could also act as announcers in a fashion show, detailing what the plant lacked, explaining the functions that the needed element serves, and describing the physical symptoms of the deficiency.

Allow time for each group to present the "before" and "after" illustrations. Then guide the group in the following discussion:

What caused the health problems for the plants they worked with today? *The plants could not get the nutrients they needed.*

Why wouldn't a plant be able to get the nutrients it needs? *The nutrients may not be available in the soil. Or, the pH of the soil (how acidic or alkaline the soil is—see the* Nailing Roots *lesson) may be making the nutrients insoluble so they can't be absorbed by the roots.*

How can we find out what would be causing the problem? *The soil can be tested (see the* Nailing Roots *lesson) to determine the soil pH or the nutrients that are lacking.*

How can the problem be solved? *If the pH level is good, the missing nutrients may simply be added to the soil. If the pH is too high or too low, the soil can be amended to adjust the pH.*

The materials, the amount and the method of application will vary depending on the garden's size, location, soil type and the crops or plants to be grown. For specific details on using these materials, contact your county Extension office or nursery professional.

Explain that only 16 elements are essential for plant growth. Three of these—carbon, hydrogen and oxygen—are readily available in the air and water for plants to absorb. The remaining 13 elements are absorbed through the soil.

Ask the students who demonstrated deficiencies in nitrogen, phosphorus and potassium to stand. Point out that these nutrients are unique because they are required in the largest amounts by the plants. They are called the *primary macronutrients.*

Primary macronutrients can easily be added through fertilizer. Every container of fertilizer lists a ratio of numbers such as 25-10-15. These numbers provide the percentages of those macronutrients in the container.

Ask the students demonstrating primary macronutrients to sit down and the students representing plants lacking calcium, magnesium and sulfur to stand. These are the *secondary macronutrients.* Usually, soils have enough of these nutrients for plants to stay healthy.

The students demonstrating secondary macronutrients should sit down. Ask the rest of the class to call out the names of the remaining nutrients: boron, chlorine, copper, manganese, molybdenum, iron and zinc. These are *micronutrients* and are needed only in very small amounts.

Although plants require different amounts of these nutrients, these elements are all essential for the health of a plant.

Close the lesson by applauding the students' makeover efforts. Reiterate that a plant's health can be affected by a deficiency of a needed nutrient. Macronutrients and micronutrients play vital roles in the health of a plant. Gardeners will be more successful if they understand the soil from which the plants are absorbing those essential elements.

Extension

Science: Ask the students to find and discuss the macronutrients and micronutrients on the periodic table of the elements. What do these elements have in common? How are they different?

Plant Makeover Cards
Macronutrients / Micronutrients

Nitrogen (N)

Symptoms of deficiency:
- Reduced growth
- Yellowing of leaves
- Symptoms on oldest leaves first

N is important for foliage (leaf) growth in a plant.

Phosphorus (P)

Symptoms of deficiency:
- Reduced growth
- Thin stems
- Loss of lower leaves
- Reduced flowering

P is important for root growth, especially for young plants and seedlings.

Potassium (K)

Symptoms of deficiency:
- Reduced growth
- Burnt/brown leaf edges
- Dead spots on leaves
- Wilts easily

K is important for flower and fruit development and resistance to frost, drought and certain diseases in a plant.

Magnesium (Mg)

Symptoms of deficiency:
- Reduced growth
- Yellowing of leaf edges
- Reduced seed production
- Cupped leaves

Mg occurs in chlorophyll; therefore, it is important to photosynthesis.

Calcium (Ca)

Symptoms of deficiency:
- Lack of bud growth
- Dead root tips
- Cupping of older leaves
- Rot on ends of fruits
- Pits on root vegetables

Ca is required for plant growth, cell division and enlargement.

Sulfur (S)

Symptom of deficiency:
- General yellowing of leaves or entire plant

S is important in the formation of protein within a plant.

Iron (Fe)

Symptoms of deficiency:

- Yellowing of leaves in newest growth
- Leaves are yellow with dark green veins (called intervenal chlorosis).

Fe is used in the formation of chlorophyll.

Copper (Cu)

Symptoms of deficiency:

- Wilting even with sufficient moisture
- Small, misshapen, wilted new growth
- Leaves can become light green, with tips dying.

Cu contributes to photosynthesis, respiration and reproduction.

Zinc (Zn)

Symptoms of deficiency:

- Smaller leaves
- Puckered leaf edges
- Leaves are yellow with dark green veins (called intervenal chlorosis).
- Yellowing of newer, upper leaves and browning of lower, older leaves
- Some plants show white stripes along the center, or midrib, of leaves.

Zn is an essential component of many plant enzymes.

Manganese (Mn)

Symptoms of deficiency:

- Leaves are yellow with dark green veins (called intervenal chlorosis).
- This begins at edges of leaves and progresses inward.
- Yellowing between leaf veins is followed by brown spotting.

Mn is essential for chloroplast production.

Molybdenum (Mo)

Symptoms of deficiency:

- Whitish tan between leaf veins on older leaves (called intervenal chlorosis)
- Occurs first on older leaves
- Plant stunted

Mo aids in nitrogen absorption.

Boron (B)

Symptoms of deficiency:

- Cracked stems
- Newest buds of the plant die.
- Leaf tips are white and rolled.

B aids in sugar transport, cell division and production of amino acids.

Chlorine (Cl)

Symptoms of deficiency:

- Wilted leaves that turn bronze, then die
- Club roots (stunted)

Cl is essential for photosynthesis and disease prevention.

Plant Parts Rap

From Chapter 1, Plant Growth and Development, page 8

Objective: To lean the main parts of a plant and their roles.
Time: 15 minutes

Say the rap to the gardeners so they can learn its rhythm. As you do, build a plant by attaching parts to the poster as you rap about them. Have the gardeners use their rhythm sheets and the plant parts rap as a group.

Plants are our friends, we give them special care.
They feed, they shelter, they give us fresh air.

Without plants in our world, we simply could not live,
Because of all of the awesome gifts that they give.

The tiny plant begins as a seed that germinates.
And from this moment on, here's the journey that it takes.

The roots are in the dirt to help the plant grow
And hold it in place when the winds blow.

Just like a soda straw, they suck up H_2O.
And when the plant gets water, stand back and watch it grow.

Stems hold the plant up, they carry water to
The leaves, flowers, fruit and seeds. . .that's what the stems do.

Leaves grow from the stem. They soak up lots of sun.
When they change it into food, then their job is done.

The food is for the plant—it gives it strength and power.
It helps it to grow and make a nice flower.

Wind, birds, and bees. . .these are a flower's friend.
They help the life cycle to start once again.
The flower makes a fruit with a seed deep inside.
Some are eaten, some are blown, or some just hitch a ride.

Once a fruit is dried and a little seed comes out,
The seed will find the dirt and a new plant will sprout.

Secret Smells Game

Objective: To discover how insects use pheromones to communicate.
Time: 30 to 45 minutes.
Materials: Black plastic film canisters (one per student), or other opaque jars, cotton balls, a variety of scents (possibilities listed below).

Obviously, insects cannot talk. However, like other species, they have developed specialized forms of communication. Many use special scents and hormones called pheromones. Many insects identify another as a potential mate (or a potential enemy) by scent recognition.

People are so accustomed to talking that it may be difficult for your gardeners to imagine using scents instead of language to identify and recognize each other. One fun way to illustrate the concept is by playing the Secret Smells Game. Ahead of time, prepare the film canisters by placing in each one a cotton ball that has been dipped into a scent of some sort. Make two film canisters using each scent, and then mix them up.

Tell the gardeners they are going to be insects. Their mission is to search out their partner insect using only their sense of smell. They absolutely positively cannot talk! Ask each student to take one film canister, and lift the lid just long enough to smell the scent. Then ask them to go from person to person, sniffing containers, to try to identify the student who has the scent that matches their own. See how long it takes all the gardeners to locate their Secret Smell Partners.

Some possible scents to use:

- ✓ Peanut Butter
- ✓ Orange Juice
- ✓ Scented soap or lotion
- ✓ Chocolate
- ✓ Mint-flavored mouthwash
- ✓ Perfume
- ✓ Vanilla, peppermint or other types of extract or flavorings

Although there are many possible scents, be kind to your gardeners' noses. Avoid harsh-smelling cleansers or ammonia-based products.

Activity 8:

Sproutzilla

Objective: Cultivate and harvest a crop of sprouts in a mini-hydroponics system

Time: 5 days. First day: 35 minutes; each day for the next 4 days: 5 minutes each

Materials: Seeds for sprouting (see below), clean 4-ounce or 6-ounce baby food jars (one for each child), brown paper lunch bags, cheesecloth (one 4 inch x 6 inch sheet for each child), rubber bands, scissors, one sheet of paper per student, permanent markers, colorful beads and ribbons (optional)

NOTE: This fun, easy, edible and soil-less indoor garden project will give the students hands-on experiences growing and harvesting a crop of sprouting seeds.

If your group meets daily, consider having the children begin sprouting seeds on a Monday, and the sprouts will be ready to eat by the end of the week.

How to find seeds and cheesecloth

You can find a 1-pound bag of sprouting seeds at a local health food store or supermarket. These seeds are readily available for less than $5. A 16-ounce bag of seeds yields 64 teaspoons, which is more than enough for 32 children to perform this activity.

Look for a label specifically stating that the seeds are for sprouting. These seeds have not been treated with any type of fungicide or insecticide. Here are some examples of the type of seed you can use:

Adzuki beans	*Alfalfa*	*Broccoli*	*Red lentils*
Green lentils	*Garbanzo beans*	*Mung beans*	
Peas	*Radishes*	*Soybeans*	

Cheesecloth is readily available at fabric and craft stores. One yard of cheesecloth costs about 99 cents and will yield enough material for more than 24 children. (Each child will need a sheet of cheesecloth that is about 4 inches by 6 inches.)

Begin this lesson by posing the question: How did Mortimer care for Plantzilla? Some example answers: Mortimer gave Plantzilla water, food, love, attention and protection. He also played with and talked to Plantzilla every day. Mortimer even kept notes about his plant's measurements and weight.

Now tell the JMGers that they will have a real live "Plantzilla" of their own. Their new pets will be named Sproutzilla. For the next week, the students will water, care for and protect their plants. They will also need to take notes about and draw pictures of their plants.

Next, tell your students, "There is one little additional thing you will need to do at the end of your experiment—one thing Mortimer would have *never* done! Can anyone guess what you might do?"

Answer: At the end of the week, you will eat your plants!

Day 1

1. Allow the students to use permanent markers to create a "face" for their Sproutzilla on the side of the baby food jar. (Permanent marker may need to be reapplied during the week. Glass paint is another option; it is also easy to find at a craft store and costs about the same as most common acrylic paints.)
2. Have the children measure 2 teaspoons of seeds and rinse them thoroughly. Allow them to handle and examine their seeds.
3. Distribute a sheet of paper to each child. Ask the students to fold the paper into fourths, then unfold them. Next have them number each square 1 to 4 on the front and 5 to 8 on the back.

   In the first square, have them write the words *My Sproutzilla.* In Square 2, they should write *Dormant Seeds.* Explain to the students that dry seeds are dormant. Relate this to the concept of sleeping—seeds are waiting for water to wake them up! Ask the children to draw a few dormant seeds onto the same square or use clear tape

to attach the dormant seed samples onto their paper.

4. When children are finished drawing, have them pour the seeds into their painted jars.

5. Next, give each child a sheet of cheesecloth (about 4 inches by 6 inches). Instruct the children to cover the mouth of their jar with the cheesecloth and secure it tightly with a rubber band. They can use scissors to cut the "extra" cheesecloth (the part that hangs beyond the rubber band) into strips. Tell the group this is Sproutzilla's hair—encourage the children to use their imagination and style it! They can cut bangs, tie small knots, make ponytails and add beads and ribbons to the cheesecloth to decorate their pets.

6. Add about 4 tablespoons of water to the jar. (You can pour the water right through the cheesecloth.) Be sure the seeds are covered with water. In Square 3, they should make a detailed sketch of their Sproutzillas, complete with the face, hair, seeds and water. Ask the students to guess what might happen next. Ask them what they think Sproutzilla will look like the next day.

7. Have the children carefully place their Sproutzillas into brown paper lunch bags. (Be sure to label the bags!) Allow the seeds to soak overnight.

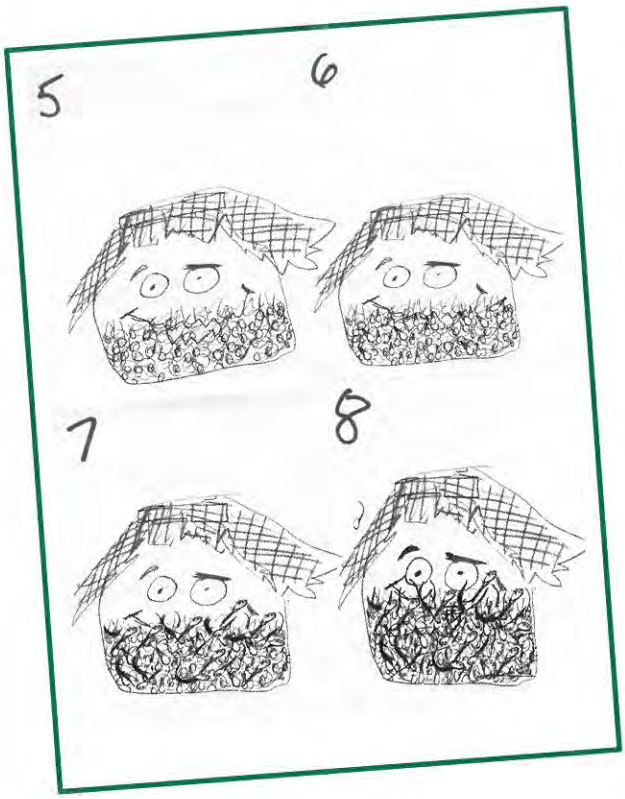
Day 2: Morning

1. In the morning, ask the students to label Square 4 with the word "Germination" and remind the group that water is signaling the seed to "wake up." Explain that *germination* means the seeds are sprouting and have begun to awaken.

2. Allow the children to take their Sproutzillas out of their bags. They will be very surprised at what they find! Like a sponge, the seeds will have absorbed most of the water and will have doubled (or even tripled) in size overnight!

3. Ask the children to gently remove the rubber bands and Sproutzilla's "hair." Have them take out two or three seeds to examine.

4. Also in Square 4, have them draw the shape of their seeds today. Be sure to note any changes in size, shape and



color of the seeds. (A few seeds may already be sprouting.) They can even take a taste if they want! Tell the children that the taste of the sprouts will change over the next few days—the sprouts will taste sweeter as they grow.

5. When the children are finished taking notes, have them put the "hair" back on their pet. In Square 5, have the students make a detailed sketch of their day-old Sproutzillas.
6. Next, the children will take turns at a sink and gently rinse and drain off excess water from their Sproutzillas. Be sure the children understand that they can drain right through the cheesecloth. Next, they should add fresh, cold water from the faucet, very gently swirl their seeds, and then drain. Repeat twice. Be sure the children drain off as much water as possible.
7. After everyone is done rinsing, have the children set their jars on their sides, gently shaking them so the seeds are distributed evenly along the side of the jars. This step gives the sprouts better air circulation.
8. The jars can now be placed back into the brown paper lunch bags.

Day 2: Afternoon

Have the students rinse the seeds again at the end of the day. Rinsing the seeds twice daily will keep them fresh and prevent them from drying out.

Remind the students of the importance of allowing the jars to thoroughly drain. If the sprouts remain in too much water, they could mold!

Sprouts grown in the light will turn green (photosynthesis) and will likely be less sweet. One way to keep your seeds dark and to help kids find their Sproutzilla is to carefully place each jar into a brown paper lunch bag with the student's name on it. Keep the bag open for proper air circulation, and remember to keep the jars on their side.

Days 3, 4 and 5

1. To grow a healthy crop of sprouts, the students will need to rinse, drain and turn their jars in the morning and afternoon of each day.
2. Have the students sketch the growing, changing Sproutzillas each day in the next empty square. They should continue to keep up their journal entries and record the growth and changes of their seeds beside the sketch of the current day's Sproutzilla.
3. They can also taste a few of the seeds at any time during the week—most sprouts taste sweet and spicy! The average sprouting time for most seeds is 4 or 5 days.
4. Once the sprouts are about ½ inch to 1 inch long, they are finished! Now it is time to enjoy a nutritious snack. There are many ways to eat sprouts. Children can eat them right from the jar, sprinkle them onto a salad or add them into their sandwich at lunchtime. You can also have a class picnic. Try spreading ranch dip onto crackers and then sprinkling sprouts right on top!
5. Conclude the week by congratulating the group on being able to grow and harvest a healthy crop of sprouts in just a week!

In the Classroom

Allow the students to explore variables controlled in their Sproutzilla growth. Divide the students into groups of two or three and have them repeat the steps of growing the sprouts.

Each group can be assigned one of the following variables to see how the results of Sproutzilla's growth might change:

- Grow Sproutzilla in open light outside the paper bag.
- Do not rinse Sproutzilla after the initial soaking.
- Do not drain Sproutzilla after the initial soaking.
- Rinse Sproutzilla only *once* a day.
- Grow Sproutzilla without turning the jar after each rinse.
- Keep Sproutzilla covered with a lid.

By experimenting with the different variables, the students can determine these and other interesting concepts:

Sprouts growing in darker areas will be less green than those grown in areas with more light. This is because light causes plants to produce chlorophyll, which allows the plant to change the light to energy for the plant in a process called photosynthesis.

Rinsing and draining the seeds keeps them moist but also keeps them fresh by washing away bacteria and fungus. If left unchecked, the bacteria and fungi can cause the seeds to rot.

Leaving the mouth of the jar open and turning the seeds allows air to move around the seeds. This also helps prevent the bacteria and fungi from growing.