Seed and Soil Detectives

For

NYS Library

Summer Reading Programs
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Includes activities from: Afterschool Agriculture – Acres of Adventures (www.4hmall.org)

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Welcome! The following six science lessons are a brief glimpse into the wonderful world of gardening and plant science. Keeping with the 2013 “Dig Into Reading” Library theme, we have focused on seeds, soils, and roots.

In addition to our materials from Cornell’s Garden-Based Learning program, we have mined from the very best of our 4-H materials nationwide – including the Acres of Adventures Agriculture Afterschool curriculum, and materials developed through Ag in the Classroom. All content has been developed and reviewed by scientists and education specialists, and provide a basis for understanding the plant world around us.

Lesson 1: Sprouting Turtles (approx. 50-60 minutes)

Through the Hot House Detective activity, youth will learn what it is like to design an experiment while learning the basics of germination. They will finish the session by creating their own version of CGBL’s “Turtle Sprout.”

Note: Both activities require a demonstration example (or 2-5) in the library and students will take their own home to observe.

Lesson 2: Sorting Seeds (approx. 50-60 minutes)

Youth will first practice the skills of observing and classifying according to size, shape, texture and more. Then there will be the chance to use these seeds to decorate a planter for their room or backyard.

To keep costs low, ask the youth to bring a terra cotta pot to this first session.
Lesson 3: Fruit Investigations (approx. 50-60 minutes)

These activities get youth to hone in on their observation skills and get up-close and personal with plants including fruits and vegetables. Youth will start off working in pairs, sharpening their observation skills as a “human camera.” Next, they will practice these skills as they collect data on various fruits and vegetables. Two versions of the data collection activity are included.

If your library lacks for green spaces, borrow a couple of interesting house plants for the day.

Lesson 4: Soil Simulations (approx. 50-60 minutes)

After an overview about soil – its importance for supporting life and its varying textures – we’ll play a game where youth will become soil particles and water droplets, acting out the process of percolation through different soil types. Then with “Can I Really Hold You,” youth will spend some time observing through sight and touch how water flows through different types of soil.

Optional Activities – Set up some soil samples as described on pages 3 and 4 ahead of the session. To make it “personal,” use soil samples provided by the families.

Lesson 5: Pieces Parts (approx. 50-60 minutes)

What determines whether a tomato is a vegetable or a fruit? Youth will play the “Guess My Rule” game to discover which is which. We’ll look into what parts of plants we are able to eat and the purpose (and importance!) of the roots of plants. We’ll then have a “Root-Tasting” party and to investigate moisture, sweetness, and crunch of some of our favorites vegetables – or are they fruits? 😊

Lesson 6: A Garden Celebration (approx. 50-60 minutes)

Youth will play CGBL’s well-loved Nutrition Superheroes game to learn all about the vitamins and nutritional benefits of certain vegetables. Then they will get to plant seeds to grow these vegetables in their own a recycled container garden.

Ask the youth to bring a recycled container to this session or collect a mix of containers on your own. Almost anything that is clean, has drainage holes (or holes can be poked into it) and is 2-3 inches deep will work!

For more Cornell’s Garden-Based Learning activities and projects, visit our website: http://www.gardening.cornell.edu/
“Seed and Soil Detectives”
Overview – 6 One-Hour Lessons to Mix and Match

| Lesson 1  | Hot House Detectives  |
|          | Turtle Sprouts        |
| Lesson 2 | Seed Sort             |
|          | Seed Mosaic Planter   |
| Lesson 3 | Human Camera          |
|          | Seed Search           |
| Lesson 4 | Soil Particle Game (Pages 2-3) |
|          | Can I Really Hold You (Page 6) |
| Lesson 5 | Guess My Rule Game (Pages 2-3) |
|          | Root Tasting Party (Page 7) |
| Lesson 6 | Nutrition Superheroes |
|          | Recycled Container Gardens |

**Sample Schedule for 3 Two-Hour Sessions**

- “Seed Day” Lesson 1 + Lesson 2
- “Detective Day” Lesson 3 + Lesson 5
- “Soil Celebration” Lesson 4 + Lesson 6

Other Ideas:

- Invite Garden Enthusiasts to Help (CCE Master Gardeners, Garden Club)
- Ask parents to help shop for activities involving fresh produce
- Provide seed catalogs, gardening magazines, and planting guides as reading materials.
Hot House Detective

What does it take to make a seed grow? Detectives figure things out through careful observation. Each detective becomes a “walking” experiment by choosing a variable and making a seed necklace. Discover what it takes to cause a seed to germinate and grow.

The Activity

1 Brainstorm a list of things it takes to make a seed grow. (Sample answers – water, sunshine, soil, heat, fertilizer)

2 Experiment by making a seed necklace to demonstrate what conditions are needed for germination of a seed.
   a. Place a cotton ball in a small plastic bag.
   b. Add one or two soybeans or navy beans.
   c. Use the pipette/dropper to dampen the cotton ball. (Too much water will cause the seed to rot.)
   d. Seal the bag. Punch a hole in the top.
   e. Cut a piece of yarn long enough to fit around your neck like a necklace.
   f. Put the seed necklace inside your clothes – seeds need warmth to grow. (Alternative – safety pin bag inside clothing.)
   g. Take good care of your seed necklace – it’s fragile!

3 Set up other “experiment necklaces” that only involve one change in variable. Each student becomes a “walking experiment.”
   a. Seeds with dirt.
   b. Seeds with no water.
   c. Seeds with another liquid instead of water (pop, coffee, or lemonade).
   d. Seeds on the outside of clothing (less heat).
   e. Seeds on a sunny windowsill.
   f. Seeds necklaces stored in the refrigerator or freezer.
   g. Other kinds of seeds.

Ag Skills: Creating seed necklaces to examine what makes seeds grow.

Like Skills: Solving Problems – Analyzes possible causes/reasons

Education Standards: NS.K-4.1 Sciences as Inquiry

Success Indicator: Creates an experiment that tests conditions needed to germinate a seed.

Time Involved: 15 minutes to make necklace, 4-8 days to germinate seeds in prime conditions.

Suggested Group Size: Any size.

Materials Needed

- Scissors
- Hole punch
- Water
- Yarn
- Pipette/dropper

Per Student:

- 2 – 3 soybeans or navy beans
- Cotton balls
- 2.5” x 3” plastic sealable jewelry bags
Talk it over

Share
- What did you provide for your seed so that it would germinate?
- Why did your seed necklace grow or not grow?

Process
- What are the prime conditions needed to make a seed germinate?

Generalize
- What problems might farmers or gardeners need to solve to provide the proper conditions for germination of their seeds?

Apply
- What are some other problems than can be solved by experimenting to find solutions?

Ag Facts

Germination
Germination is the sprouting of a seed when exposed to certain conditions – water, oxygen, and warmth. Water is absorbed by the seed, causing it to swell and the seed coat to soften. The young plant is called a seedling when it first sprouts. Monocots, such as corn and grasses, possess one seed leaf (cotyledon). Dicots, such as radishes, soybeans, and peas possess two cotyledons. The food for the growing plant is stored inside the seed until leaves emerge.

Although all plants need water, some will germinate at cooler temperatures than others. Radishes, peas, lettuce, and broccoli can germinate in early spring. Beans, corn, and sunflowers need the warmer soil of late spring. To germinate, seeds need warmth, not sunshine. However, as leaves emerge, the plant needs light in order to survive.

More Challenges
- Set up other experiments to test germination conditions for a wide variety of vegetable seeds. Share your information with a local garden club.
- Germinate your own seeds and plant a garden. Use a journal to record seed growth from germination to harvest.
- Investigate seeds with unusual germination requirements.
Turtle Sprouts

Creating a Turtle Sprout is an easy, fun, and accessible activity that introduces children to the world of plants. The activity requires little preparation and can be used as springboard for a new living sculpture project like those highlighted in the upcoming Garden Based Learning Program’s Living Sculpture online curriculum.

We are encouraging educators in CCE programs to use this activity as an exciting statewide growing project for Cloverbuds. Turtle Sprouts is a simple activity with all the pieces: it’s a state-wide project aimed at galvanizing youth and adults across NY and can be shown at State Fair; it’s easy to do, a great introduction to plants and may just be a catalyst for a bigger project with lots of room to expand and be creative.

Turtle Sprouts offers many “layers” and can be a launching point for other investigations and activities.

You might consider:
• Sending Turtle Sprouts to the New York State Fair.
• Doing a public presentation on how to make a Turtle Sprout.
• Adapting the activity to other creations, shapes, and forms.
• Working with science inquiry: what is the best method to water? What happens if the soil and water are mixed first versus after? Is there a way to create a “wick” with the stocking end? How does light effect a Turtle Sprout?
• Teaching this activity to older youth mentors that lead the activity with younger children.

Supplies:
4” plastic pot saucer
knee high stocking
craft foam
untreated grass seed
potting soil/promix
scissors
markers
google eyes
tacky glue
cereal bowl
water
Instructions
1. Cut craft foam into the shape of a turtle “skeleton.” Add eyes, claws, scales or other decorations using markers, google eyes, and tacky glue.

2. Place the “skeleton” on top of the 4” pot saucer. The saucer serves as the turtle’s belly.

3. Roll one knee high stocking up your arm until completely stretched. Starting near your elbow, roll the stocking down to your wrist. From here you can remove it from your hand, creating a bowl shape.

4. Scoop 2 to 4 heaping spoonfuls of untreated grass seed into the bottom of your stocking bowl.

5. Fill the stocking with soil, unrolling as you go along so that the stocking can hold more soil. You’ll need about 2 cups of soil per stocking.
* Note: it’s much easier to work with dry soil than moist soil.

6. Holding your stocking, which looks more snake-like than shell-like, at the open end, gently bounce and press against the palm of your other hand to create more of a pancake or shell shape. Once you’ve achieved the shape you desire, tie the stocking off close to the soil, very much like a balloon. You can trim the excess stocking off if you’d like.

7. Looking at your shell you should be able to see the grass seed through the stocking. If the seed is gathered in one spot, gently use your fingers to spread the seed out evenly over the top of the shell. Be careful though, grass seed needs some light to germinate so you don’t want the seed to be buried beneath the soil.

8. Once the seed is evenly spread make sure to water the shell generously. The stocking can often prevent water from reaching the soil if watered from the top. A good alternative is to fill a cereal-sized bowl full of water and place your shell inside. Capillary action will draw the water up through the soil until completely moistened. This can take 1-2 hours depending on how dry the soil is. Feel free to flip your shell around half way through.

9. Once watered place your shell on top of your skeleton to complete your turtle and find a sunny spot for it to sit.

10. Check once a day to see if your shell needs water. Repeat step 8 to water when needed.

The turtle shell should sprout within a week. With enough light and water your shell will continue to grow for months. If the grass gets too tall trim with scissors to shorten or create interesting designs.
Edible Alternative:

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:

- **Alfalfa**  \(\text{Broccoli} \quad \text{Red Lentils}\)
- **Green Lentils**  \(\text{Garbanzo Beans} \quad \text{Mung Beans}\)
- **Peas**  \(\text{Radishes} \quad \text{Soybeans}\)

Adapted from: Literature in the Garden, A Junior Master Gardener Golden Ray Series
Seed Sort

Seeds grow into plants that produce beans that we eat. Detectives observe carefully and use reasoning and logic to answer questions. Using a sorting map to observe all the beans in this kind of soup. Do you eat all these beans and seeds?

The Activity

1. Pour out the ½ cup of beans on the map at the “Start Here” point.

2. Begin to sort all the beans according to the steps in the bean sorting map.

3. Count up the numbers of beans of each kind: green split pea, yellow split pea, garbanzo, lentil, black bean, pink bean, small red bean, cranberry bean, pinto bean, black-eyed pea, kidney bean.

Ag Skills: Making connections between various types of bean seeds.

Like Skills: Reasoning – Applies rule/principles to process/procedures

Education Standards: NM-AIG.3-5.1 Understand Patterns, Relations and Functions

Success Indicator: Sorts bean/seeds using the rules from a sorting map.

Time Involved: 30 – 45 minutes.

Suggested Group Size: Any size.

Materials Needed

Per student (or pair of students)
- ½ cup of 15-bean soup mix (like a Hurst’s HamBeens® Mix)
- 1 copy Seed Sort sorting map (See Appendix)
Seed Sort

START HERE

1. Completely white
   - Less than 16mm long
     - Less than 10mm long
       - Small Northern Bean
     - More than 10mm long
       - Flips over between your fingers, has marks like sun rays on the side.
       - Small Lima Bean
   - More than 19mm long
     - Large Lima Bean

2. Not completely white
   - Large Northern Bean
     - Round shape (sometimes irregular)
       - Two color
         - Stripes and spots
           - Black around the eye
           - One Color
             - Dark Red
             - Brown
               - Black-eyed Pea
                 - Less than 14mm
                   - Black
                     - Pink Bean
                   - More than 14mm
                     - Not black
                       - Red
                         - Kidney Bean
                       - Small Red Bean
                         - Cranberry Bean

3. Elongated shape (bean shaped)
   - Round on one side
     - Big and wrinkled
     - Small and smooth
       - Lentil
         - One Color
           - Yellow Split Pea
             - Flat on one side
               - Green
                 - Green Split Pea
               - Yellow
                 - Yellow Split Pea

- Garbanzo
Overview  
Students will beautify terracotta flowerpots with mosaic patterns using a variety of seeds.

Objectives  
Students will:
- identify different seeds and beans
- design and create a mosaic using seeds as their tesserae (tess-a-ray), or mosaic material

Time  
2 hours

Materials  
- terracotta pots
- water sealant spray (even though these pots are meant for indoor use, the water sealant protects the glue from any moisture that may soak through the porous clay when the plant is watered)
- seeds and beans of all kinds (red lentils, green lentils, chickpeas, black beans, navy beans, mung beans, pinto beans, popping corn, sunflower seeds, etc.)
- ceramic mosaic glue
- popsicle sticks
- bowls

Instructions  
1. Spray all of the terracotta pots with the water sealant spray prior to beginning the activity. Follow the instructions on the container for drying times and safety precautions.

2. Introduce your students to the art of seed mosaics as you show them photos from books and online galleries (see Resources). Crafting seed mosaics is a traditional Mexican art form that is made during harvest festivals and ceremonies.

3. As you prepare for this activity, encourage students to procure their own collection of seeds and beans from the garden and other outdoor areas. Supplement their collection with lentils and beans that can be purchased in bulk at your local store or farm.
4. Distribute a pot to each student and divide the students into small work groups at different tables. Ask the students to help you divide the seeds and beans up by color into bowls and then distribute the bowls to each group.

5. Encourage students to sketch out design ideas on paper before beginning their mosaic project. Once they begin, show them how to put a little bit of glue at a time on their pots, using a popsicle stick. They can then either use the sticks to individually place the beans and seeds one at a time, for more refined designs, or for a quicker approach, they can pour a handful of seeds over the glued area.

6. When the mosaics are finished put the pots somewhere out of the way to dry over night.

**Taking it Further**

Once dry, students can choose their favorite seeds or flowers to plant in their newly decorated flowerpot. These decorated pots make a great gift for Mother’s Day or other celebrations. Remind them that these pots should be for indoor-use only and to be gentle in handling them, because the mosaics are delicate and some of the seeds and beans may fall off if handled roughly.

**Resources**

**Books**


**Websites**

Check out these sites for inspirational photos of seed mosaics:


http://www.firstpalette.com/Craft_themes/Food/Seed_Mosaic/Seed_Mosaic.html

http://www.photography.flordemielfilms.com/Seed%20Mural.html

http://www.ultimatejourney.com/MX.Cuernavaca.SeedMuralLg.JPG

http://www.ultimatejourney.com/MX.Cuernavaca.SeedMuralSm.JPG
Overview

This engaging activity offers a chance to observe plants and gardens closely in pairs followed by descriptive and creative writing.

During the course of our lives, we are constantly bombarded with visual information. In fact, so much visual news comes to us that we learn to tune out and “not see” details that would overwhelm us if we were to be continually observing. With this activity, we aim to look closely in an effort to sharpen observation skills — skills that are essential to many disciplines such as science, writing, and the arts.

Students will work in teams, with one as the “photographer,” and the other as the “camera,” and then they will switch roles. After talking about the activity, and what they noticed, they will write short poems, such as haiku, based on what they have observed about the plants they have seen.

Objectives

Students will:
- experience the beauty of plants by looking closely
- sharpen observation skills
- write creatively and descriptively
- work in cooperative learning teams

Time

30-60 minutes

Materials

- writing paper and a pencil for each participant
- flowers or other garden plants

Instructions

1. Begin by preparing the group to go outdoors to the garden or schoolyard. Alternatively, you could move to an indoor space where students can explore flowers and other plants up close.

2. Gather together near the garden and discuss initial observations, including what we tune out or don’t see. Ask the group what the difference is between looking and careful observation. You might begin with an example, such as the way people in the Northeast eagerly await the return of robins. Those first few robins you see are exciting, and are often pointed out – “It’s a robin, it must really be spring!” Within a week or two, robins are everywhere, become a part of the outdoor background, and many people stop noticing them.
Another example is how we tune out familiar information that we simply don't need. You may ask the group to describe details of very familiar settings, such as the school hallway, places in their homes, the after school program, or the community center that they walk through daily. Although they may recall the bigger parts of the scene, they may likely have forgotten details. Subtle patterns on the wall, accumulated dirt or papers in corners, what is written on a chalkboard, and other elements may disappear from our conscious minds.

3. Generate a discussion. What are other examples of ways in which we have a great deal of visual information around us that we miss? Why do we tune it out? In which occupations would keen observation be a critical part of the work?

4. Have students pair up. Ask for two volunteers to demonstrate how one student will be the "photographer" while the other is the "camera." The camera will have his/her eyes closed, while the photographer positions him/her close to a beautiful flowering bulb, for example, at an angle that will offer a unique and perhaps unexpected perspective. Positioning could be from above, from below, up close, or far away. When cued the camera will open his/her eyes for 10 seconds, record a visual memory of what s/he has observed, then close their eyes again. Move the camera to a new location; repeat two more times. Have the camera jot down her/his observations then switch roles.

5. Gather together to discuss the process. What did students notice when they were the camera that they might not have otherwise? Often, young people will describe intricate details of texture, color variation, delicate drops of dew, flower structures, insect visitors, and other details they may never have seen before.

6. From this discussion, generate a list of types of things a good artist or scientist observes: lines, shapes, forms, shadows, shades, tones, perspectives and size in relation to each other, etc.

Seed and Soil Detectives
7. After discussing, students are ready to use their observations to write poetry about the plants they observed. The 5-7-5 syllable structure of a haiku is a good place to begin.

Pale butter petals  
Early morning dew still clings  
Nodding, soft breezes

You might encourage students to take the same subject and play around with different versions of it. Which of their poems do they prefer and why?

Vivid markings steer  
Honey bee heavy laden  
With golden pollen

Vivid markings guide  
Heavy laden gold miner  
Bee exits, stage right

8. Seek student input as to how they want to go further with this flexible activity. It can lead to exploring indoors or outdoors, really anywhere there are plants or a garden.

**Taking it Further**

Host a nature-based poetry slam on Earth Day, Arbor Day, or any other time that seems appropriate. Feature these and other creative writings or artwork from young people.

Write about the experience, and other outdoor experiences, in a garden or nature journal.

Expand the activity to include opportunities to draw, paint, make collages, or other creative expressions.

Repeat the activity with other outdoor elements as a focus – for example, observe trees during the winter months.

An interesting twist is to explicitly notice, and write about, pollution, garbage, trash, and other waste elements of the environment that we may be tuning out. What are the impacts of ignoring the waste we generate?

Try this activity on a micro-scale. Look through a microscope or hand lens and describe in detail the color, textures, and other elements of the subject.

**Resources**  
National Gardening Association’s Human Camera Activity:  
Seed Search

Detectives solve mysteries by searching for answers. Students can be plant detectives and experiment to solve some plant mysteries. Seeds can be planted, eaten, decorated or used in craft projects. Seeds come in all sizes and shapes. Investigate seeds in familiar fruits and vegetables.

The Activity

1. Pair students to act as Plant Detectives.
2. Set up an Experiment Supply Station with a variety of fruits and vegetables.
3. Collect information from each Plant Detective team and post on a poster board or white board for everyone to see.

Sample Data Collection Chart

<table>
<thead>
<tr>
<th>Fruit/Vegetable</th>
<th>Location of Seed</th>
<th>Number of Seeds</th>
<th>Are the seeds Edible? (ask the Teacher if you can taste!) Yes/no</th>
<th>What kind of seed is it? (Take a seed to two other students. Ask them to identify which plant it comes from.)</th>
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</tbody>
</table>

4. Plant Detective teams can continue to collect seeds on a plastic plate.

5. Challenging the Plant Detectives to group seeds by developing three sorting rules, i.e. small vs. medium vs. large, round shape vs. diamond shape, light color vs. dark color, and fruit vs. vegetable. Count and record number of seeds according to sorted groupings.

Sorting Rules and number of seeds in each group.
1. 
2. 
3. 

6. Can the Plant Detectives solve these mysteries?
   - Is it true that all apples have the same number of seeds?
   - Where are the seeds in a strawberry?
   - Do all tomatoes have the same number of seeds?

Ag Skills: Investigating the variety of seeds in fruits and vegetables.
Like Skills: Reasoning – Examines data for relevance and accuracy.
Education Standards: NS.K-4.3 Life Science
Success Indicator: Collects experimental data to learn about seeds in fruits and vegetables.
Time Involved: 30 minutes.
Suggested Group Size: Any size, pairs of students.

Materials Needed

Per pair of students
- Cutting board
- Plastic plate
- Paring knife (or teach can cut fruit ahead of time)
- Paper towel
- Pencil
- Data Collection chart
- 3 different varieties/sizes of apples, strawberries, grape, orange, or cucumber
- 2 tomatoes (regular and cherry)
- Kiwi or other selection of fruit
- Some unusual fruits such as pomegranate, start fruit and red peppers.
Talk it over

Share
- What new information did you learn about seeds?
- What is one new fruit or vegetable that you tasted for the first time?

Process
- Which seeds are edible?

Generalize
- What other examples of seeds can you find in plants that you eat?

Apply
- Why do scientists try to develop some fruits and vegetables without seeds?

AgFacts

How Seeds Travel
Seeds such as burrs can travel from place to place by hooking onto clothing or animal fur. Other seeds have sticky coats that stick to animals. Seeds also travel by the wind. Seeds from maple, elm, and ash trees have curved wings to help them stay in the air longer. The wind also carries seeds that have fine hairs that fluff out and catch the wind. Dandelions, golden rods, and milkweeds are like this. Some plants even catapult the seeds through the air. Animals like squirrels bury seeds like acorns, hickory nuts, and peanuts. When they don’t find them, the seeds grow into plants. Other animals eat fruits. The seeds in the fruits pass through the animal’s body and come out in their droppings. Another way seeds travel is through water. Seeds float on rivers, streams and oceans. Heavy rain can wash seeds away too. Coconuts have a hard, hairy shell that protects the coconut seed and the milk inside helps it float. When a coconut falls, it gets carried away by the ocean. Coconuts can drift for thousands of miles before reaching another shore, germinating and starting a coconut tree.

More Challenges
- Plant some of these seeds and see if you can produce a plant.
- Collect recipes for seeds. Test them on your friends. Create a Seed Cookbook.
- Plan and grow a fruit/vegetable garden. Start your Plants from seed. Give away the produce or flowers To neighbors and friends.
**MATERIALS**
Magnifying glasses or hand lenses; one (or more) empty, clear, plastic 1-liter soda bottle with lid; several different soil samples; water; 60 feet of string; photocopies of the attached Soil Settling and The Feel of Soil sheets.

**VOCABULARY**
absorption, clay, groundwater, particle, percolation, pore space, porosity, sand, saturated, silt

**RELATED LESSONS**
From Apple Cores to Healthy Soil
Root, Root for Life
Till We or Won’t We?
In Harmony

**SUPPORTING INFORMATION**
Soil is important to support life. We need it for building homes, planting vegetation, raising animals, and growing our food and fiber. Soil is made up of mineral particles, organic matter (once living plant and animal matter), and pore spaces (potential living spaces filled with air, water, or living organisms). Mineral particles, classified according to size, include:

- Sand: soil particle between .05 and 2.0 mm in diameter
- Silt: soil particle between .002 and .05 mm in diameter
- Clay: soil particle less than .002 mm in diameter

Sand is the largest mineral particle and it has more pore space between its particles than silt or clay. Silt particles are smaller than sand, but larger than clay particles. Likewise, there is less pore space between silt particles than between sand particles, but more than between clay particles. Clay, the smallest particle, has the least amount of pore space.

Since these particle sizes are difficult to visualize, an analogy helps clarify. If a sand particle is the size of a basketball, a silt particle would be the size of a golf ball, and a clay particle the size of a dot made by chalk. Rarely made up of only one type of particle, soils consist of varying combinations of the three. The percentage of sand, silt, and clay in a particular soil determines its texture.

**THE RELATIVE SIZE OF SAND, SILT, AND CLAY**

![Diagram of relative sizes of sand, silt, and clay]

All soil particles have the ability to attract and hold water. Water moves quickly through a sandy soil because of the large pores, or empty spaces between the particles. A clay-type soil, however, will actually attract water and absorb it like a sponge. Clay particles, as a clump, swell as they get wet and shrink as they dry. These particles have the ability to pull and hold onto water with 2,500 pounds of force.

Water passes down or percolates through the soil at various rates. Over the years, some of this water may end up in the groundwater supply. The rate of water
percolation, however, is reduced when all the pores are full of water, causing the soil to be saturated. Unfortunately, this can cause water to collect on top of the soil, increasing the possibility of soil erosion and flooding.

The porosity of the soil - the available pore space of a soil type - determines how quickly water will move through the soil. Some of the water is held by the soil particles. Gravity pulls the rest of the water, called free water, downward. The water held by soil particles is removed by plant roots for plant use.

Along with farmers, city and town planners are concerned with soil texture and porosity. A heavy clay soil can crack a building foundation because it shrinks and swells. Soil type is an important consideration in the location and size of septic systems and landfills.

Percolation and other soil tests help city and town planners and builders understand the soil types. From these tests, they can learn if there is too much clay in the soil, for example. If negative soil conditions exist, the builders will have to adjust their plans.

GETTING STARTED
Have students bring in soil samples from home or a nearby area: gather one (or more) empty, clear, plastic 1-liter soda bottle with lid, water, string, and magnifying glasses or hand lenses. Make photocopies of the Soil Settling sheet for individual or pairs of students and The Feel of Soil sheet for pairs or small groups of students.

PROCEDURE
SESSION ONE
1. Ask the students what they know about soil and why it is important. List their comments in a visible place. Explain that they are going to learn about the different sizes of particles in soil.

2. Explain that students are going to pretend to become soil particles. They will simulate different soil particle sizes and pore spaces between the particles. Designate three or four students as “water droplets.” The rest of the students will all simulate the “particles”: sand, silt and clay. Explain that they will use arm actions to represent each soil particle. Draw these three stick people figures in a visible place.

3. Have all the “particle” students represent “sand” particle size by getting in an imaginary flower pot with their arms outstretched. They should stand in a random arrangement and be able to rotate 360 degrees without hitting another student. (You may need to arrange some of the students.) Tell students their outstretched arms represent the largeness of a sand particle. The empty space between sand particles represents pore space. These “living” spaces in nature are filled with air, water or living organisms. Place the string on the floor around all the sand particles. Explain that this string defines our flower pot filled with sand. (Leave the string in the same position on the floor during the whole simulation.) Have students note the amount of space between particles.

4. Add the “water droplet” students. Have them pass through the “sand” particles in the flower pot and out of the pot (circle). Throughout the simulations, the “water droplets” aren’t allowed to go around the “particles,” but they must pass through them in the easiest way possible by walking upright. (Students representing “sand” particles must allow “water droplets” to push their arms slightly to pass through the “sand” particles.)

5. Discuss briefly the relative ease with which the “water droplets” passed through the large pore spaces between the “sand” particles.

6. Next have all the “particle” students represent “silt” particles by placing hands on their hips with arms bent at the elbow. Have the students move next to each other with elbows just touching each other. They must stay within the flower pot. Add the “water droplet” students. Again, “water droplets” must pass through the particles in the easiest fashion and out of the pot. They may swing the arms of the particles.

7. Discuss the differences in water movement through the silt and the sand. Ask, “Did the sand or the silt particles take up the most space in the flower pot?”
8. Finally, have all the “particle” students represent “clay” particles by standing with their arms at their sides and touching the shoulder of another “clay” particle. The particles will be bunched in together. Add the “water droplet” students. The droplets pass through the particles by moving two particles “slightly apart” and moving through them. Have the “slightly apart” particles stay apart to represent the swelling action of clay. Water droplets cling to and surround clay particles. Excess water is pulled down into soil by gravity. Water that adheres to the clay particles is either removed by plant roots or evaporation.

9. Explain to students that when water percolates through a soil in nature each dry soil particle actually holds some water. Only the extra or “free” water that the soil particles cannot hold can be pulled further down by gravity. This water held by the soil particles is the water plants “drink” (suck up) with their roots.

10. Ask students to discuss the differences in:
- particle size
- pore space
- total space occupied in the flower pot by the same number of different particles
- ease of “water droplets” passing through the “sand” and “silt” versus the “clay” particles

Make sure students understand that the same number of soil particles were in the flower pot each time. Ask:

- Why do the same number of “clay” particles take up less room in the flower pot than the “silt” particles? (The “clay” particle size and pore space between particles are smaller.)

- Why do the same number of “silt” particles take less room in the flower pot than the “sand” particles? (The “silt” particle size and pore space between particles are smaller.)

11. Have the “particle” students, still in the flower pot, demonstrate “clay,” “silt,” and then “sand” particles by adjusting their arm actions and the space between particles. Have the particles go from “sand” to “clay” to demonstrate the differences.

Have individual students be the particle of their choice so that the flower pot contains a combination of particles. (Be sure that the different particles are scattered in the pot.) Let students decide, based on the arm positions of the particles, if the flower pot’s soil has a sandy, silt, or clayey texture. Is there an equal combination of particles, or is there more of one than the others? Have students repeat this process several times to help them draw the conclusion that the size of the pore space is directly related to the proportion of particle sizes in the soil. (More clay particles means smaller total pore space while more sand means larger total pore space. You can add the “water droplet” students to the mixtures to aid in the understanding of pore space.) Ask:

- Was it easier or harder for the “water droplets” to pass through the pore spaces in the pure samples of sand, silt and clay or in the mixtures you created?

- Which soil type does water move through the fastest? (sand) The slowest? (clay) Why?

- What are the three soil particles called? (Sand, silt, and clay.)

- Soils in nature are usually a mixture of the three soil particles. What might be the advantage of having a very sandy soil? A heavy clay soil? The disadvantages to one or the other? (Sandy soil holds less water for plants and dries out more rapidly. Water moves through clay soils very slowly and may cause plants to suffocate by drowning the roots. Play areas in sandy soils would drain quickly and not be muddy. Play areas on clay soils would be wet a long time after a rain and be muddy. Clay soils shrink and swell and may break up things built on them.)

- What kind of soil texture do you have at home or at school? How would you manage it to grow healthy plants? Why?

SESSION TWO
1. Distribute the Soil Settling sheet for individual or pairs of students to complete during the demonstration.

2. Add several handfuls of one soil sample to the 1-liter soda bottle and fill it with water. (Break up any clumps of soil before adding the water. Adding a few drops of detergent may help to break the clay aggregates [clumps] so they perform like individual clay particles.) Cap and shake the bottle well. Set it on a table where students can observe the soil.
particles settling. Ask:

- What do you think will happen? What is happening?

- Why are some of the soil particles settling and some floating?

- Which soil particles weigh more? The ones settling or floating?

- How long will it take for all the soil particles to settle?

The sand will settle in less than one minute. The silt will settle on top of the sand, followed by the clay. This process can take all day or even as long as a week. Have students observe the differences in soil particles’ sizes, colors, and amounts. Have students record and draw their findings on the sheet.

3. Discuss with students the fact that a typical soil sample contains all three soil particles in varying amounts. Water allowed us to separate the particles. Use the diagram showing the relative size of the particles (see Supporting Information).

4. Optional: Repeat Step 2 using soils from different locations. Compare the differences. Ask:

- Is the amount of sand, silt and clay the same in each sample?

- How would you describe the colors of sand, silt and clay in each sample? Are they the same color in each sample?

- Is there anything still floating after the bottles have been sitting for 24 hours? What is it? (Organic matter, e.g., plant and animal material, will generally float.)

5. Students can identify a soil’s texture by experiencing the “feel” of different soil samples. Distribute The Feel of Soil sheet. Have several students place a small amount of soil from different soil samples in their hand, add water droplets slowly, and knead the soil to break up any clumps. Tell students the proper consistency for identification exists when the soil stays together. Have students identify its general texture using the information on The Feel of Soil sheet.

Pass the soil samples around so all the students can feel the differences and similarities among the various samples. (The samples will dry quickly after several students have handled them. Add a little water to the samples after they have been handled by four to six students.) Ask if students agree with the assigned texture of each sample. Encourage the use of hand lenses or magnifying glasses to observe soil particle sizes.

There are several commercially available types of clay-like substances used in schools, such as Plastcine® and Permo plast Molding Clay®, that are more like plastic than soil. If your school has any available, have students investigate its texture and its particle size with a hand lens. Have them add water to it. Ask, “What are some similarities and differences between these samples and real clay?”

6. To increase students’ understanding of soil particle sizes, have them repeat the soil particle simulation from Session One.

EVALUATION OPTIONS

1. Evaluate students’ Soil Settling and The Feel of Soil sheets for understanding and completeness.

2. Have students fold a piece of paper into thirds and draw lines between the sections. In the first section, have students label “sand” particles, in the middle section, “silt” particles, and in the last section, “clay” particles. In all three sections, have students label the particle types and indicate the amount of pore space between the particles.

3. Give students a handful of soil. Have them identify the sample’s general texture of sand, silt or clay, using the technique and characteristics described in the procedure on The Feel of Soil sheet.

4. Have students imagine they had three flower pots, one full of sand, one full of silt, and one full of clay. Which pot has the smallest pore space, the largest? Which soil type will hold more water?

EXTENSIONS AND VARIATIONS

1. Have students demonstrate porosity. Porosity, the available pore space in a soil, and water-holding capacity vary from one soil type to another. Porosity determines how fast water will move through the soil. It’s important for water to move through soil, but not so quickly that plants don’t get enough for their needs. Have students:
A. Assemble four clear plastic cups. Punch several drainage holes in the bottom of two cups. Line the bottom of the cup with a piece of thin cloth or paper towel so the soil is not washed out of the cup.

B. Put an equal amount of two different types of soil in the two cups with the holes in them. (Preferably a 'heavy' soil with clay content in one cup and a sandy soil in the other.) Which cup will have more soil particles in it?

C. Pour equal amounts of water onto the soil in each cup. Hold or place the cups over the other two cups, without holes, to catch the water draining out.

Ask:
- Which soil type drains more quickly?
- Did equal amounts of water drain out of both soil types?
- Which soil type is holding more water for plants to use? Why?

2. Have a student contact the office of the county commissioner and inquire about soil “perc tests” required before any new construction can be initiated.

3. Invite a soil scientist from your local conservation district or the U.S. Department of Agriculture's Natural Resources Conservation Service to discuss local soil types with the class or obtain a soil survey report for your area. Discuss or investigate the implications local soil types have for agriculture, construction, home owners, and others. Ask the soil scientist to bring soil profiles or pictures of them, if possible. Upon what type of soil is your school built?

4. Place different-size metal balls (or plastic beads) in glass jars filled with an equal amount of water. Explain that the various balls (or beads) are similar to the different types of soil. The space between the balls is similar to pore space.

Have students compare the water height. What does this show about the different types of soil?

5. See the FLP lesson “Till We or Won’t We?” to learn about soil formation, soil erosion, and soil conservation. See the FLP lesson “Root, Root for Life” to learn about the importance of roots to soil. See the FLP lesson “From Apple Cores to Healthy Soil” to learn about soil nutrients and composting.

CREDIT
Relative size of particles drawing from U.S. Department of Agriculture, Natural Resources Conservation Service.

ADDITIONAL RESOURCES


Station 3: Can I really hold you?

Materials: 1 mature potted plant (with holes in bottom of pot)
1 pot (with holes in the bottom) of soil with no plants (Soil may need to be refilled after each group.)
2 bowls
2 cups of water (one cup for each pot)
1 paper towel

Procedure: Set the pots in the bowls. Write a guess or prediction of what will happen to the water as it is poured into each pot. Then pour the cup of water into each pot. Let the water drain into the bowls for two minutes.

Describe and compare the amount and color of the water and the contents in the water in each bowl. When finished, drain the water in each bowl through a paper towel. Describe what and how much is left on each paper towel. Clean the bowl for the next group.

Questions
1. How do the results for both pots compare with your guess or prediction?

2. What conclusion can you make about roots holding soil in place?

3. Why is this important?

4. Erosion is the wearing away and loss of soil by wind or water. How do plant roots help prevent soil erosion?
MATERIALS
Samples or pictures of many different fruits (e.g., apple, avocado, banana, cucumber, grape, melon, nectarine, orange, peach, pear, various colored peppers, pumpkin, tomato) and vegetables (e.g., artichoke, beet, broccoli, brussel sprout, cabbage, carrot, cauliflower, celery, collard greens, jicama, lettuce, potato, radish, spinach); cutting board, knife; transparency of Parts of a Plant sheet located in the Appendices and photocopies of the attached Fruits and Vegetables sheets.

VOCABULARY
flower, fruit, leaf, root, seed, stem, vegetable

SUPPORTING INFORMATION
Plants provide people and other animals with food. Furthermore, people depend on plants for clothing, shelter, oxygen, transportation, and even recreation. This lesson looks at fruits and vegetables as two important food sources for people.

The word “fruit” is a botanical term, but the word “vegetable” is a popular term, not a botanical one. In common usage, vegetables are plants or plant parts that are eaten with the main course of a meal and salads, while fruits are eaten for breakfast, dessert or snacks. This definition does not always agree with the botanical definition of a fruit. (Note: This lesson focuses on the botanical definition.)

By botanical definition, a fruit is the edible fleshy part of the plant that surrounds the seeds - a seed package. The fruit is the result of fertilized flowers, and all or part of it formed from a ripened ovary. Apples and watermelons are excellent examples of seed packages. Many foods we call vegetables are actually fruits. For example, cucumbers, peppers, tomatoes, and squash are botanical fruits. Corn, green beans, and peapods are also botanical fruit, not vegetables. Other fruits include figs, pineapples, strawberries, and nuts (the whole nut with its shell), such as almonds, pecans, walnuts, and more.

People can often identify those plant parts which are actually vegetables. What we consider vegetables are vegetative parts of plants. For example, lettuce is leaves, carrots and beets are roots, and broccoli and cauliflower are immature flowers. Other plant parts are more difficult to identify. Potatoes are not roots; rather, they are swollen underground stems (tubers). Onions are not roots but are composed of modified stems and leaves.

GETTING STARTED
A few days before the lesson, ask students to bring in produce. A local grocer may be willing to contribute samples for the lesson. Encourage students to include some unusual items. Be sure the produce includes fruits as well as vegetables. Include

FRUIT? ? VEGGIE?

BRIEF DESCRIPTION
Students identify and compare fruits and other edible plant parts through a fast-paced game.

OBJECTIVES
The student will:
- identify two to three fruits and other plant parts used as vegetables;
- compare and contrast similarities and differences between fruits and other edible plant parts; and
- state reasons people should eat fruits and other edible plant parts.

ESTIMATED TEACHING TIME
One and a half to two hours. (Can be taught in two sessions.)

Seed and Soil Detectives
some “student stumpers” such as peas, beans and corn. Make a transparency of Parts of a Plant and photocopy the Fruits and Vegetables sheets. Students could color and sort the fruit and vegetable pictures instead of using real items. Also, the pictures could be incorporated into an activity center. Gather the produce, cutting board and knife. In a visible place write flower, fruit, leaf, root, seed, stem.

(Note: To avoid wasting food or adding extra expense, you could bring in one or two produce items a day to exhibit over a period of several days. Then play the game using colored pictures of the items.)

Optional: Clip pictures from food ads and horticulture catalogs. Glue them to cards instead of using actual items or use pictures from the Fruits and Vegetables sheets. Write a letter to parents explaining the project and asking them to help students gather pictures or actual items. The school cafeteria may be able to lend produce.

PROCEDURE
1. Have students name all the produce. Using the Parts of a Plant transparency, briefly review the parts of a plant. Have a volunteer point out roots, stems, leaves, and the blossom. Ask:

   - Which parts of a plant do people eat? (If students get stumped, draw attention to the words on the board. In various forms, we eat all these parts.)

   - Which parts of the plant do each of the foods in our collection come from? (See Supporting Information for examples.)

2. Explain that a fruit develops from a flower that has been fertilized and usually contains seeds. Stems attach a fruit to the plant. On the transparency, write the names of some fruits. Add the name of some vegetables that come from different parts of a plant. (See Supporting Information.) Discuss similarities and differences among the produce items.

3. Explain that the class will be playing “Guess My Rule.” The purpose of the game is for students to figure out what unites different kinds of produce into a group. Begin by selecting three produce items that go together for a reason (all are green, all are peeled to be eaten, all are leaves, all grow underground). Tell students who think they know the rule to keep it a secret until it is time to reveal it. Explain the following procedures.

A. After you show the three items, a volunteer student will pick another produce item he or she thinks follows your rule (the reason the items belong together) and therefore fits into the group.

B. If a student makes an incorrect choice according to your rule, set aside that item to start a group of produce items that do not follow the rule. (There is information to be gained from this “does not follow the rule” group in making further guesses.)

C. Once it seems that many in the class understand the “rule,” select remaining produce items.

D. Have the students tell, by a show of thumbs up or down, whether or not that particular item follows the rule.

E. Solicit from the class what the rule was.

F. Clear the table and begin again with a new rule. Invite volunteers to make up the new rule for future rounds.

4. After a couple of rounds while interest is still high, play a round with the rule “These produce items are all fruits.” Once all the examples of fruits are together in a group, discuss how these items are alike and how the items that are in the “does not follow the rule” group are different. If you need to prompt, ask:

   - In which group do all of the items have seeds? (fruits)

   - In which group do all of the items have “seed packages” (fleshy, pulpy, or pod coverings for seeds)? (fruits)

   - Which group comes from many different parts of plants? (vegetables)

   - How can you tell the difference between a fruit and a vegetable? (Fruits have seeds and seed packages. They start out as fertilized flowers.)
Many vegetables may not have seeds in the parts we eat.)

- Have you seen apple, plum, peach, cherry, tomato, or watermelon blossoms? What happens to the blossoms? (They can develop into fruits.)

Reinforce that some items we call vegetables are really the “fruit” of plants and contain seeds. Some good examples are avocados, cucumbers, peppers, and tomatoes. Ask:

- Are the seeds of fruits all alike? (no)

- How are they different? (Size, placement, some we eat, and more.)

Cut open some produce items so students can see the seeds.

5. Now play “Guess My Rule” with the rule “These produce items are not fruits.” Reinforce the fact that these foods come from other parts of the plant and are not the result of a fertilized flower.

6. Summarize the “Guess My Rule” game by asking:

- What feature do fruits have that vegetables do not? (seeds)

- Name three fruits that are usually called vegetables, thus breaking the seed rule. (See Supporting Information for possible answers.)

- What did you like best about the game? The least? Why?

- What clues helped you discover the rule? Which clues didn’t help?

- What did you learn by playing this game?

7. Place the various produce items in random order on a table. Ask students to pick an item that is botanically a fruit. Identify what the other produce items are. Ask students to explain why they made their selections. Have students identify the produce by explaining whether each botanical fruit would be used as a fruit or as a vegetable.

8. Have students write about their favorite fruit and vegetable and ways of eating them. Share some of these with the class.

9. Have students give examples and discuss how they depend upon and enjoy fruits and vegetables.

10. Later in the day, challenge students to revisit the display and sort the items by fruits and vegetables.

11. Eat the produce, send it home with students, compost it, or dispose of it.

EVALUATION OPTIONS

1. Divide the class into groups of three or four students. Each group takes a turn sorting the assembled produce according to fruits and vegetables.

2. As in the “Guess My Rule” game, group several produce items together following a rule. Include one item that does not belong. Have students state the rule, identify the misplaced item, and tell why it does not belong. Use the rules “These are fruits” and “These are vegetables” most often. As long as a student can justify a response to “What is the rule?,” it must be accepted as a correct response even if the student’s rule is different from what was intended.

3. Have older students complete a written series of the following statement:

   (produce item) is a (fruit or vegetable) because ___________, and people should eat it because ________________.

4. Have each student fold a sheet of paper in half and label one side “fruits” and one side “vegetables.” Have them list or draw each fruit and vegetable from the produce selection in the correct category. Have them describe or write how fruits and vegetables are the same and different.

EXTENSIONS AND VARIATIONS

1. Make a bulletin board with a simple plant prominently featured. You could use a blown-up picture of Parts of a Plant. Incorporate student drawings of produce items to show which parts of the plant we are eating when we consume different fruits and vegetables.

2. Have a veggie- and fruit-tasting party. Include some unusual varieties. Thoroughly wash produce and have students tell which produce they like. Have students describe the sight, taste and textures of the produce (sweet, crunchy, soft, smooth, juicy).
FRUITS

Cucumbers

Green Peppers

Oranges

Avocados

Lemons

Almonds

Peas

Chili Peppers

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Root Tasting Party

What keeps a plant from falling over? Discover two types of roots that anchor a plant – strong, thick anchor roots known as taproots and fibrous roots which send many branches spreading out through the soil. Investigate some of the taproots that we eat.

The Activity

1. Set up a Root Tasting Party by explaining that people eat roots.

2. Draw a placemat with circles labeled A, B, C, D, E, F, a, b, c, d, e, f, etc.

3. Provide thin slices of small pieces of a variety of edible roots, such as carrots, radishes, beets, parsnips, sweet potatoes, and turnips. Label each plate of samples a, b, c, etc. Do not identify the root. Save one whole root to show as an example following the tasting.

4. Place a sample of each root at the appropriate spot on each placemat.

5. Provide each student with a score sheet and discuss the criteria and the function of the roots:
   a. Moisture (roots transport water for the plant)
   b. Sweetness (roots store sugar for plant food)
   c. Crunchy (taproots are strong to anchor the plant in the ground and keep it from blowing over)

6. Tally the scores and share the identity of the roots. Review the concept of the taproot and the functions it serves for the plant.

7. Optional: Supply oyster crackers as nibbles in between each root sample to clear the palate.

Sample - Root tasting score sheet

| Taster’s Name: ____________________________ |

<table>
<thead>
<tr>
<th>ROOT TASTING RATINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate a Root</td>
</tr>
<tr>
<td>Score</td>
</tr>
<tr>
<td>-------</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Moisture</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweetness</td>
<td></td>
</tr>
<tr>
<td>Crunch</td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
</tr>
</tbody>
</table>

**Easy Rating System**

- **Yum** = 3 points: Moisture - Good root are juicy and full of moisture. Roots transport moisture to the plant.
- **OK** = 2 points: Sweetness - Good roots store sugar and taste rather than sweet. Roots store food for the plant.
- **Yuk** = 1 point: Crunch - Good roots need to be strong to anchor a plant in place. Sturdiness plus moisture makes a good loud crunch.

Ag Skills: Investigating different types of root crops.

Like Skills: Making decisions – Gathers information

Education Standards: NS.K-4.3 Life Science

Success Indicator: Tastes and rates taproots to experience roots as a plant part in food.

Time Involved: 30 minutes.

Suggested Group Size: Any size.

Materials Needed

- Carrots
- Radishes
- Beets
- Parsnips
- Sweet Potatoes
- Turnips
- Papers for placemats
- Scoring sheets
Talk it over

Share
- What roots were the juiciest? The sweetest? The crunchiest?

Process
- How does the purpose or job of a root explain the ratings you gave it?

Generalize
- Besides tasting, what other ways could you test a root for moisture, sweetness, and crunch?

Apply
- How is gathering this information important to cooks when they make Decisions about which ingredients to choose?

Ag Facts

Roots
Different types of plants have different kinds of roots. Some plants have roots that are long and thick and grow straight down into the soil. These roots, known as taproots, are like tent stakes. They grip by burrowing into the soil. Dandelions have roots like this. Some plants have roots that look hairy. Grasses and any garden flowers like marigolds have roots that spread out and almost look like hair. These roots are known and fibrous roots.

Roots grow their way into the soil, gripping the soil to firmly anchor themselves against wind and erosion.

As roots develop, they come in contact with water, air and nutrients. Plants need these three things in the soil to sustain life.

More Challenges
- Using a Popsicle® stick, carefully dig up some plants outside, such as grass blades, dandelions, or other plants. Observe and describe the root systems. Compare fibrous root systems to taproot systems.

- Make a root-viewing box by cutting off one side of a milk carton. Line with overhead acetate, fill with soil and plant seeds close to the sides. Cover the acetate with black paper and take off to view

- Explain these root sayings:
  — Money is the root of all evil.
  — The pigs rooted in the mud.
  — My ideas are finally taking root.
  — I want to learn about my family’s roots.
  — The local people feel rooted in the land.
  — Getting to the root of things.

Acknowledgements: Horton, Warkentien and Gogolski
Seed to Salad: Nutrition Super Heroes

Overview
Nutrition Super Heroes is a game that gets young people on their feet and moving to learn about nutrition in the garden. Each participant assumes a Nutrient Super Hero "secret identity" such as calcium or vitamin C and must complete the obstacle course if a vegetable their nutrient (secret identity) is found in is called.

Materials
- 12-15 wooden stakes (outside) or a roll of masking tape (inside)
- hula hoops, 5 gallon buckets, dish pans, garden gloves, jump ropes, etc: anything you can find to create reasonable obstacles
- vegetable cards & nutrient tags
- hat or basket for vegetable cards
- super hero capes (optional)

Preparation
Create Nutrient Tags and Veggie Cards
Use the templates provided or develop your own. You'll need a nutrient tag for each participant (if you have a big group, feel free to have 2 of each nutrient). Choose vegetable cards that reflect the vegetables you grow in your garden or vegetables that participants have mentioned as their favorites.

Set Up the Obstacle Course
If you're working outside, use wooden stakes to create an outline of the human body in a level open area. Lay a garden glove at the end of each arm. Alternatively, you can use athletic field paint. Chalk the outline if the only open space is paved. If you're working inside, use masking tape on the floor of a hallway or gym.

Add any obstacles you can think of such as buckets, hula hoops, create squiggly lines with jump ropes. Use obstacles to create major parts of the body: muscles in arms and legs can be buckets. The heart and stomach can be hula hoops. Use jump ropes to create arteries or intestines. Smaller dishpans can be other major organs.

Rules of the game
The group leader will choose a vegetable out of a hat, read the name of the veggie and the nutrients (i.e. secret identities/super powers) that vegetable has. If your secret nutrient identity is among those listed for that vegetable you enter the obstacle course through the head, making sure to hit all the obstacles (i.e. all the parts of the body) before exiting through a foot.

Super heroes must keep their identities secret. Ask youth to keep track of how many times they run through the body. Also encourage them to pay attention to when the body is most full of super heroes. In a discussion at the end of the game you can ask questions that reveal what nutrients are the most readily available in foods and which are harder to get. By noticing when the body is very full versus very empty you can judge how nutrient rich a vegetable is.

Playing the game

1. Hand out secret identity nutrient tags, and capes if desired, to each participant.

2. Explain the rules of the game and demonstrate running through the course to reach each obstacle.

3. Pull veggie cards out of a hat or basket one at a time.

4. Read the name of the veggie and the list of nutrients.

5. Wait until all super heroes are back at the head before reading the next vegetable card.

After the game

6. After all the veggie cards are read, have the group gather. It’s time to reveal secret identities. Have each participant read the description of their nutrient “fights infections; heals bones/wounds,” and see if other participants can guess what nutrient they were.

7. Ask who ran through the course a lot, who only once or twice. What does that mean about your nutrient? Are you easy to find in foods?

8. What about how full the body was? What veggies had the most super heroes in the body? Which the least? What does that mean about how nutritious certain veggies are compared to others?

9. You can follow the activity with sampling veggies from the garden or from those used in the game.

Adapting the game

When working with younger youth (pre-K, K, 1st and even 2nd grade) consider making the super hero identities the vegetables rather than the nutrients. Each youth assumes the role of “Captain Carrot” or “Powerful Peas.” When the leader draws out of the hat, they call the nutrient (Calcium), defines it (helps build strong bones) and then lists all the veggies (super heroes) that contain these nutrients.
Root for Recycling

Background:

Many families with limited access to green spaces have discovered the benefits of container gardening. Some grow flowers to enhance the beauty of a balcony or patio. Others get pleasure from growing fresh vegetables to enhance their family meals.

This activity combines this “small scale” approach to gardening with a lesson in recycling.

Part 1 – Rate This Container

1. Gather up several items from recycling bins. You want to have containers that will make good plant containers, and others that would not. Be sure to include a wide array – dishes from microwave meals, diaper wipe containers, ketchup “squirt-type” bottles, discarded metal baking pans, etc.

2. Show the group pictures of patio gardens that feature container-grown vegetables. Tell them that today they will have an opportunity to design their own, using recycled materials. Show them their selection of seeds for this project – carrots, beets, and radishes.

3. Have the group work in pairs. Give time for the pairs to examine all the container choices, then go over the rating sheet. Challenge each pair to go through and rate the containers, looking for the best container for each type of seed. Be sure to encourage them to give bonus points for unique features (i.e. this container is transparent, so we will be able to see what is happening in the soil).

4. If time allows, give the groups time to brainstorm other container ideas. Encourage them to think of items that they have thrown in the trash recently that were broken – would any of them make a practical planter? Would any of them be beautiful to look at as well?
Part 2 – Ravishing Radishes

1. Ask the parents to contribute 2-liter soda bottles to make planters. Have adults use heavy duty scissors to cut the bottles in half like pictured below. Use a drill to make a drainage hole in the cap (no need for the wicking system shown in the diagram).

2. You may want to have the adults use duct tape to cover the cut edge at the top – you can even find bright colored or animal patterned duct tape!

3. For a more decorative option, provide the youth with different colors of aquarium gravel or floral arrangement gems to make layers in the bottom part of the planter.

4. Now it’s time to plant – make an assembly line with stations.

   Station 1 – rocks and gravel to line the inside of the “planter half” of the bottle.

   Station 2 – Soil – have the youth fill their planters to about two inches from the top.
Station 3 – Planting – have a volunteer demonstrate how to use a finger to make a slight indentation “row” for planting. Plant seeds in pairs, following the package guidelines for spacing distance.

Station 4 – Watering – help the youth use a spray bottle to moisten the soil.

5. If time and supplies allow, give youth the option of planting some of the other types of seeds in the recycled containers.

Adapted from: Literature in the Garden, A Junior Master Gardener Golden Ray Series.

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**Take Home Instructions**

Keep in a cool, shady place until you see some growth poking through the soil. After a couple of weeks, you’ll see the first shoots appear. Allow them to grow for a full week before you thin them. Thinning to about a seedling per inch will ensure that you get full sized radishes. Once you have thinned the radishes, you can move them to a spot with more sun (not full sun). Do not allow to dry out too much before watering, since too-dry conditions can cause cracking. Harvest as soon as they are ready – sometime around 5 weeks, give or take, after sowing seeds.
**Container Rating Sheet**

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
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<tbody>
<tr>
<td><strong>Drainage</strong></td>
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<tr>
<td>• Does the container already have good drainage?</td>
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<td>• Could you easily make drainage holes in the container?</td>
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<tr>
<td><strong>Root Capacity</strong></td>
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<tr>
<td>• Is the container deep enough to grow your root vegetable?</td>
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<td><strong>Stability</strong></td>
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<td>• Is the container sturdy? Will it be strong enough to withstand wind and rain?</td>
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<tr>
<td><strong>Beauty</strong></td>
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<tr>
<td>• Will this container add to the beauty of a container garden?</td>
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<tr>
<td>• Could it be decorated to increase its beauty?</td>
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<tr>
<td><strong>Special Features:</strong></td>
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</table>
PARTS OF A PLANT
PARTES de una PLANTA
(English/Spanish words are provided.)

- Blossom/Flor
- Fruit/Fruta
- Leaf/Hoja
- Roots/Raíces
- Stem (Stalk)/Tallo