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Roots

ROOT FUNCTIONS:
absorb water and nutrients; anchor the plant; store food

After tasting and comparing root snacks, children observe, dissect, and draw a radish plant, describing external features (such as root hairs) and internal structures. The group shares ideas and evidence about the ways roots help the plant absorb water and nutrients, and anchor it in the soil. Next, students compare and contrast fibrous roots with the radish taproot, noting the food-storing adaptation. Finally, they apply what they have learned as they examine new examples of roots that people eat.

What You Need

Plant Snack Items (at least 4 cut pieces of each item per child)

- carrot and/or jicama pieces
- radish slices

Dissection Materials for Student Pairs

- 2 radishes with leaves and obvious root hairs
- paper plate or cutting board
- dissection knives
- magnifier
- journals
- pencils and crayons
- 30-centimeter ruler
- Root Nutrition Labels (carrot and jicama, p. 70)

For the Group

- uncut example of each plant snack item
- Structures of a Tomato Plant diagram (p. 65)
- 11"x 2" paper sentence strips and tape
- classroom board or chart paper
- marking pens
- 1-2 examples of fibrous roots with leaves attached (wild or lawn grass, wheat grass, or lettuce)
- snack supplies: cutting board, knife, containers, spoons, plates, and napkins
- additional roots: choose taproots with root hairs and leaves attached if possible (see Plant Products Kit, p. 12, and Produce Shopping List by Lesson, p. 13)

Getting Ready

1. Before starting this lesson, familiarize students with nutrition labels and the information they contain (see How to Read a Nutrition Facts Label, p. 69).

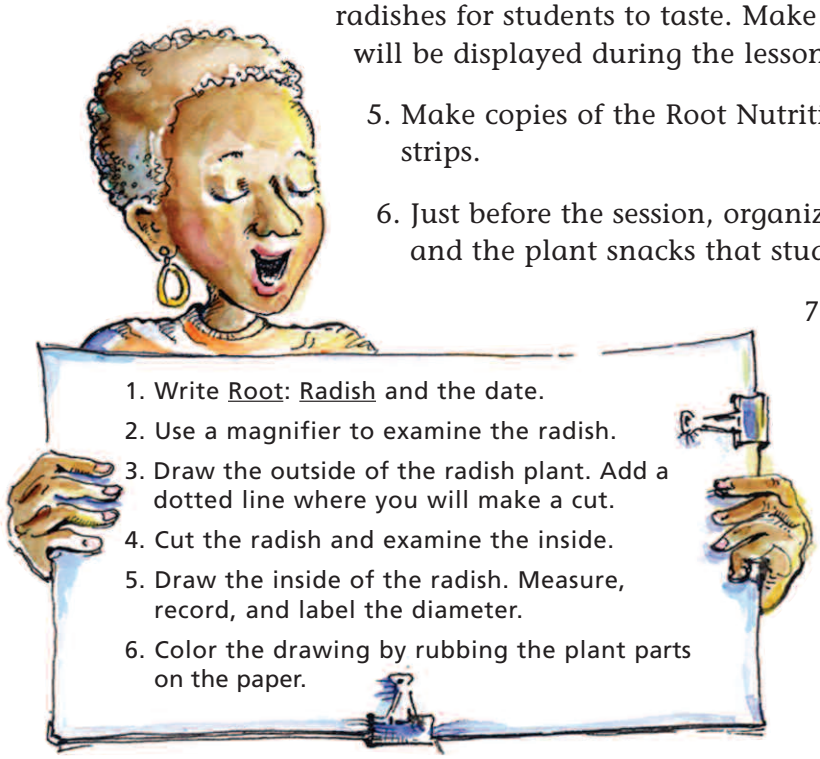
2. Purchase produce that has not been treated with pesticides. Farmers' markets usually have a great selection of organic produce that is less processed than grocery store produce (root crops, for instance, will have more root hairs). Select root examples for the science dissection that have root hairs and leaf tops attached. Wash the produce that students will taste. Bags of processed baby carrots are fine to use for snacks, but not for dissection.

3. Dig up a grass plant or small lettuce and shake most, but not all, of the soil from the roots. Store it in a clear plastic bag so that children can observe the roots clinging to soil.

4. Cut the jicama vertically and save a portion to display the outside covering and root hairs. Peel and dice the rest for students to taste during their snack time. Slice several radishes for students to taste. Make a name card for each kind of root that will be displayed during the lesson.

5. Make copies of the Root Nutrition Labels, and cut the paper sentence strips.

6. Just before the session, organize the dissecting materials, the produce, and the plant snacks that students will taste.



7. Copy the Structures of a Tomato Plant diagram large enough for children to see it clearly and color the drawing accurately. Sketch a radish plant on the board or a piece of paper, being as detailed as possible, including tiny root hairs at the "tail" of the radish. This will encourage your students to make detailed drawings in their journals. Write the dissection steps shown in the illustration (left) on the board or a piece of chart paper.

Tastings and Journals

1. Have children take out their journals and get ready for the snack.

2. Referring to the colored-in Structures of a Tomato Plant diagram, ask students:
   - *What kind of a plant does this look like? How do you know?* [the fruit looks like a tomato]
   - *What other way might you be able to tell what kind of a plant this is if it did not have fruits yet?* [shape of leaves; color of flower]

3. Show that there are six main parts of a plant, pointing to them on the diagram as you go: roots, stems, leaves, flowers, fruits, and seeds. Explain that students will investigate each major plant part. Today they will start with the roots.

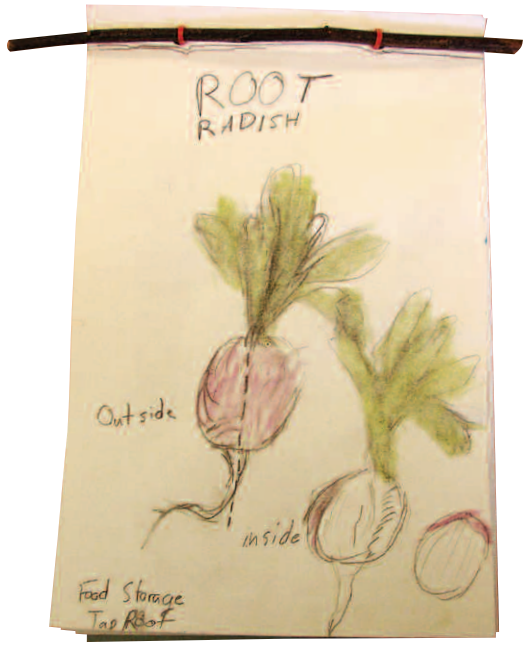
4. Display a whole carrot with its leafy top and a jicama root, and announce that students will taste and observe the part of these plants that is hidden underground. Write on the board and have students title their journal page "Root" and record the date.

5. Have students get their root snacks. Tell the children to taste and observe the plant part using all of their senses.

6. Distribute the Root Nutrition Labels and ask:
   - *What are some important nutrients that our body gets from plant snacks?* [vitamins, minerals, fiber, carbohydrates, water, protein, fats, and oils]
   - *Looking at the nutrition labels, which nutrients are our snacks high in?*

7. Encourage students to share and write as many adjectives as they can to describe the smell, taste, appearance, and texture of the snacks. During the discussion, record their adjectives on paper strips that you post on a word wall for children to use later in the unit.

Dissecting Roots to Explore Structure



1. Hold up a radish plant and ask who recognizes it. Have children add the word "Radish" to their journal entry and tell them that they will use all of their senses to examine both the outside and inside of the radish root. Display your sketch of the plant and demonstrate how to use the natural pigments in the radish to color the drawing. (Rub the radish on the paper for red; rub the leaves for green.)

2. Explain that pairs of children will dissect radishes. Dissection is a method scientists use to carefully cut open and look at the structures inside of something. Note that because these plants are being used scientifically, there will be no eating of plants during the dissection. Children may taste washed plant parts again at the end of the lesson.

3. On your sketch, draw dotted lines that bisect the radish root horizontally and vertically. Explain that one student per pair will make either a vertical or horizontal cut to their radish. Students should draw one of these lines on their journal sketch to show which way they will make their cut.

4. If students will be making their own cuts, provide safety directions as you demonstrate how to use a knife to make a horizontal cut. (See Using Dissecting Tools, p. 25.)

5. Review the dissection steps listed on the board. Distribute the radishes and equipment and have the children begin their observations. Encourage them to make detailed measurements and drawings and record their observations.

6. As you circulate among the students, draw the children's attention to the tiny root hairs coming off the bottom of the radish. Ask, *How long are the root hairs?* [1 to 3 millimeters] Remind students to use their magnifier to see small details, patterns, and irregularities and to add these to their drawings.

Root Function Ideas Based on Observations

1. Allow a few minutes for each pair to share observations with another pair and to write at least two characteristics in their journals. Depending on the children's literacy level, have them include complete sentences describing the radish and dissection procedure.

2. Make two columns on the board for observations titled "Outside" and "Inside." Ask each pair in turn to share an observation. List all observations on the board, continuing the reporting as long as pairs still have new characteristics to share.

3. Guide students in sharing their knowledge and ideas about the functions of roots based on what they have observed. Pose questions such as:
   - *Why do you think the radish was moist inside?* [the root pulls in water from the soil]
   - *How did water get inside the radish root?* [absorbed by root hairs at the bottom]

4. Draw attention to the observation of little threads or "hairs" coming out of the bottom of the radish root.
   - *How do hairs coming off the root help the radish plant?* [extend its reach for water; anchor the plant in the ground]

5. Explain that root hairs are the tiny structures that go between individual pieces of soil. Each of these root hairs is surrounded by many more microscopic root hairs that absorb water and nutrients. Having root hairs is a way we can decide if an underground plant part is actually a root. (This characteristic will be a helpful distinction for the Stem lesson.)

6. From the list of "inside" radish observations, note the dotted pattern (like tops of straws) from the horizontal cut and the tube-like structures from the vertical cut.
   - *How might water get from the roots to the rest of the plant?* [goes up tubes]

Two Different Types of Roots

1. Display the grass plant and carrot plant side by side, and ask students:
   - *How are these roots different?* [grass roots are thin with many strands; the carrot root is singular and fat]

2. Explain that botanists use the terms fibrous root to describe the stringy roots of the grass

plant, and taproot to describe the fat, solid root of the carrot plant. In comparing the roots, ask:

- ❀ *Which kind of root might be specially adapted to store food? What evidence supports your idea?* [taproot; it is large, moist, colored, sweet]
- ❀ *Which would you rather eat? Which would hold more energy and be more nutritious?*
- ❀ *Which kind of root is the radish?* [taproot]

Reflecting on the Investigation

1. Solicit from the group the main functions of roots for the plant, and write these on the Structures of a Tomato Plant diagram on the line for roots. [absorb water and nutrients; anchor the plant; store food]

2. Present the additional examples of edible roots and rotate them through teams of students to observe and compare to the radish. If you have a sweet potato among your examples,

Using Dissecting Tools

We encourage you to teach children safe procedures for using small paring knives to dissect produce. If the ages and numbers of your students prevent their direct use of science tools, you and classroom aides may rotate among the pairs with a dissecting knife to assist with the cuts. Second grade teachers have reported success using the following approach with their children.

1. We will use knives as scientific tools to dissect the plant parts. *How many of you have used knives at home?*

2. Let's make a list of safety steps we will follow:
   - ✻ Hold the point away from yourself and others.
   - ✻ Only make cuts while using a cutting board or stable surface.
   - ✻ Keep your fingers away from the area to be cut.
   - ✻ Make a steady cut straight down and not at a slant or toward you.
   - ✻ Hold the handle and steady the knife with your index finger along the blunt, top edge of the knife.
   - ✻ Set the knife aside in a safe place.

3. You and your partner will each make one cut today, so it is very important to plan your cut carefully.

explain that this kind of root is called a root tuber. The sweet potato plant stores food in the form of starch in these fleshy roots.

3. Circulate among the teams and provide prompts as needed:
   - ❀ *How is this root the same as or different from the radish?*
   - ❀ *What do botanists call this kind of a root?* [taproot or fibrous root]
   - ❀ *What is something interesting you have learned about roots?*
   - ❀ *What do you still wonder about roots?*

Going Further

Root Math: Measuring

❀ Volume: How much space do root crops like carrots and rutabagas take up in the ground? Use a container big enough for your food items, a substance like lentils or barley to fill the container, and a measuring scoop. First, count how many scoops of your filler it takes to fill the empty container, and then, how many scoops with a root inside the container. *Why did it take fewer scoops? How many "scoops" does the root occupy?* Subtract the first count from the second count and you have your root's volume in "scoops." Make volume predictions and measurements for roots with various shapes.

❀ Length and Weight: Have students harvest root vegetables from the garden, and use string and rulers to find the length and circumference of each item picked. Then use balance scales to find their weights. Students can compare their measurements and discuss how the practice of measuring and weighing root crops is helpful to farmers.

Root Nutrition: How to Read a Nutrition Facts Label

❀ Use the Carrot and Jicama Nutrition Labels as examples for learning how to read the information on a nutrition facts label. How to Read a Nutrition Facts Label (p. 69) offers a guide to this information. Children can apply their knowledge to packaged foods.

Root Cooking and Social Science: Botany In Your Soup

❀ Tell students that soup was invented about 5,000 years ago and that the science of making soup profoundly improved the survival of the people who invented it. Heating water to its boiling point (212°F) killed waterborne parasites, made grains and roots more easily digestible, and provided warmth. Early cultures learned to make soup in clay pots, finely woven baskets, and skin bags to which were added small rocks heated in a fire.

As a class project, use the edible roots from this lesson to make a soup. Rinse any dissected plant parts, and add them to a pot of water that has been seasoned with salt and herbs. Simmer the ingredients for about an hour to kill all microorganisms and allow the flavors of the roots to blend into a delicious soup. Some good candidates for root soup include carrots, sweet potatoes, celeriac, and parsnips.

Root Language Arts: Reading Stories

❀ Many wonderful children's stories feature root crops. Some examples are *Tops and Bottoms, The Gigantic Turnip, Stone Soup,* and *The Tale of Peter Rabbit*. Choose a few to read aloud or add to your library in conjunction with this lesson.

Root Science: Hydroponics

❀ Show students a variety of roots and ask what they think might happen if roots are suspended in water. Following the directions, set up the Sweet Potato Root Hydroponics experiment (below).

Give students time to draw the sweet potato root, and talk and write about their ideas. Guide them to develop a hypothesis for the experiment, as well as a schedule for observing and documenting any changes in the root over a period of weeks.

Do not tell students that in about a week, a stem will begin to grow out of the top, and root hairs will grow from the lower end.

Sweet Potato Root Hydroponics

A sweet potato plant stores food in thick, tarchy roots called root tubers. Use one of these roots for the following experiment.

What You Need

- sweet potato root
- clear glass or jar
- 3 toothpicks
- water

Grow a Plant in Water

1. Fill a glass about 1/2 full with water.
2. Stick toothpicks into the root like spokes of a wheel so they encircle the lower portion of the sweet potato.
3. Position the sweet potato in the glass so the toothpicks rest on the rim and the bottom 1/3 of the root is immersed in water; the stem end (it usually looks cut) should be above the water.
4. Place the glass in a bright area, but not in direct sunlight.
5. Add water as needed so the bottom of the sweet potato remains covered.
6. Have students keep a record of the changes they observe.