



Healthy Bodies, Healthy Gardens

Lesson

Goals

Students will learn what nutrition is and why it is important. They will also begin to learn the connection between healthy bodies and healthy gardens.

Objectives

Students will discuss what nutrition is and brainstorm ways to keep bodies and gardens healthy. Students will tour the garden to identify what makes a garden healthy.

Standards

Science: Life Science

GR.5-S.2-GLE.2

Comprehensive Health: Physical & Personal Wellness in Health

GR.1-S.2-GLE.1

GR.2-S.2-GLE.1

GR.3-S.2-GLE.1

GR.4-S.2-GLE.1

GR.5-S.2-GLE.1

GR.6-S.2-GLE.1 & GLE.4

Did you know?

Breakfast eaters consume more calories in a day than those who skip it, but they are less likely to be overweight. Eating breakfast also improves children's concentration, memory, test scores and school attendance.

Total Time – 60 minutes

Materials

- Seasonal fruits & vegetables (or images)
- Healthy snack

Vocabulary

concentration

diversity

improve

memory

nutrition

nutrients

seasonal

Mentor Texts

- *Roots, Shoots, Buckets, & Boots.* Sharon Lovejoy, 1999.

Method

Introduction (15 minutes)

1. Write the words nutrition and nutrient on the board. Ask the class: *What is nutrition?* Nutrition is the study or practice of understanding that what we eat affects our health. *What are nutrients?* Nutrients are the food we eat, including vitamins, minerals, carbohydrates, proteins, fats and water. Nutrients keep our bodies functioning and give us energy to grow, work, play, think and learn.

- a. Discuss with the class: *One way to be healthy is to eat a variety of foods. Nature gives us a wide variety of colors and kinds of food. You can choose to eat fresh, whole foods that are closest to the way they grow. When we learn about nutrition we learn about how to take care of ourselves. A great way of having good nutrition and taking care of ourselves is to eat the food we grow. We can have healthy bodies by having healthy gardens.*
2. Make two columns on an anchor chart. One labeled, “Healthy Bodies” and the other labeled, “Healthy Gardens.” Have the students come up with as many ideas as they can of how to keep a healthy body and how to keep a healthy garden.
 - a. Have the class take five minutes to copy in their journals the lists they created on the anchor chart.
 - b. You could also create a Venn diagram based on the two lists to emphasize that there are overlaps in maintaining a healthy body and garden.

Activity (30 minutes)

1. Bring the class out to the garden to discuss what healthy seasonal vegetables the garden brings us in the fall.
2. Have the class identify as many plants and vegetables as they can.
 - a. If your garden does not have many vegetables, bring samples or images of seasonal foods. See: http://www.coloradofreshmarkets.com/crop_calendar.html for ideas.
3. Ask the class what they observe in the garden that makes the garden healthy. You might discuss: the diversity of crops, healthy soil amended with compost, crops that are harvested before they are over mature, use of herbs and flowers to repel insects, enough space between plants to allow for air circulation, etc.
4. Have the class draw in their journals their favorite fall crops.

Conclusion (10 minutes)

Have the class discuss and then journal: *What is nutrition? How can we have good nutrition? How does gardening connect to being healthy?*

Snack (5 minutes)

Hand out the apples and almond butter. Discuss how apples are a fall fruit, but can easily be stored through the winter to be eaten year round. Discuss with the class: *Apples are rich in dietary fiber, which is good for our digestive systems, and vitamin C. Almond butter with no added sugar is a good source of protein and fiber, keeping us fuller for a longer period of time.*

Assessment Tools

- Journals
- Participation in brainstorming and plant/vegetable identification

Modifications

- Have students draw and label a healthy garden in their journal.

Extensions

- Have students compare and contrast the vocabulary words “nutrition” and “nutrients” in their journal.

Apples and Almond Butter

Try to get organic apples, if possible. Apples are number one for pesticide residue in all fruits and vegetables. Use no sugar added almond butter. You can use other types of nut butter, but be aware of allergies.

- Apples
- Almond butter

Preparation (5 minutes): Cut and core apples. Dip apples in almond butter and enjoy!

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Denver Urban Gardens School Garden and Nutrition Curriculum

Be Healthy!

Lesson

Goals

Students will learn how to interpret MyPlate and will be introduced to the idea of growing and eating healthy foods.

Objectives

Students will compare healthy and non-healthy behaviors and activities through brainstorming. Students will make begin to make connections between eating healthy and growing healthy foods by looking at the food groups outlined in USDA's MyPlate.

Standards

Science: Life Science

GR.5-S.2-GLE.2

Comprehensive Health: Physical & Personal Wellness in Health

GR.K-S.2-GLE.1

GR.1-S.2-GLE.1

GR.2-S.2-GLE.1

GR.3-S.2-GLE.1

GR.4-S.2-GLE.1

GR.5-S.2-GLE.1

GR.6-S.2-GLE.1 & GLE.4

Did you know?

Today, chips and french fries make up half of all of the vegetables children eat. Children who eat fast food tend to weigh more than their peers who do not, even if they are active.

Total Time – 60 minutes

Materials

- MyPlate nutrition poster
- MyPlate Handouts (Available on DUG's curriculum website: <http://dug.org/school-garden-curriculum/resource-sheets/myplate-information.html>)
- Crayons, markers or colored pencils (optional)
- Journals
- Various seed packets

Vocabulary

connections
dairy
fruits

gardening
grains
ingredients

MyPlate
nutrition
protein

recipe
vegetables

Mentor Texts

- *Rookie: Grains*. Carol Alexander, 2005.
- *Rookie: Fruits and Vegetables*. Susan DerKazarian, 2005.
- *Rookie: Dairy*. Susan DerKazarian, 2005.
- *Rookie: Proteins*. Justine and Ron Fontes, 2005.
- *Rookie: Fats, Oils and Sweets*. Carol Parenzan Smalley, 2005.

BE HEALTHY!

DENVER URBAN GARDENS' SCHOOL GARDEN AND NUTRITION CURRICULUM

Background for Teachers

This is a great introductory lesson to get your students to begin thinking about gardening and nutrition and the connection between the two and their own health.

In June 2011, the USDA's nutrition guidance tool changed from MyPyramid to MyPlate. For more information on this new tool, please visit: <http://www.choosemyplate.gov/>. The *My Plate* lesson on our website goes into more detail about this new tool.

http://dug.org/storage/school-garden-curriculum/My_Plate.pdf

Method

Introduction (20 minutes)

1. Begin by explaining that the class will be learning about nutrition and gardening. The focus of the classes will be to learn how to prepare, eat and grow healthy food.
2. Introduce and hand out the garden/nutrition journals to the class. Explain that they will be used for taking notes, writing stories or poetry and collecting recipes. Have each student write on the cover his/her name and Garden Journal (or other appropriately named title).
3. On the board draw two columns labeled "Healthy" and "Not Healthy." Have the class start by brainstorming actions/behaviors that they know are healthy. Then have the students come up with actions/behaviors that they know are unhealthy. Go back and forth between the two sides as students continue brainstorming.
 - a. Encourage them to think real hard by stating a goal: *I challenge you to come up with at least 15 actions/behaviors, can you do it?*
 - b. Let the behaviors and actions they come up with lead to discussion and more creative higher level thinking. Such as asking the class: *What can we do to make watching TV more healthy* (exercise during commercials)? *Should you use an elevator or take the stairs?* Etc.
4. Transition the activity to MyPlate.
5. Display the brightly colored plate for all the students to see. Discuss the different food groups to help the class understand what grains, dairy, fruits, vegetables and protein entail.
6. Hand out the MyPlate worksheet.
 - a. Have students work in groups or on their own to correctly label the food group sections on the MyPlate worksheet. Students can color the plate if time allows.

Activity (15 minutes)

1. Tell the students that you can hold at least 200 carrots in one hand, while holding about 100 lettuces in the other. Have the class problem solve on how this would be possible.
2. After the students guess, pull out your seed packets and hold them in your hands explaining that each seed turns into a whole plant—one little lettuce seed can grow into a head of lettuce.
3. Explain to the class that all of our fruits, vegetables and grains are plants that are grown from seeds. Get them excited about seeds by telling them they will get to plant lots of seeds and grow their own fruits and vegetables later in the year. This is a good way to connect eating

healthy and growing healthy food in the garden.

4. Have the students write in their journals about what they learned and what they hope to plant later.

Snack (10 minutes)

While students are eating, discuss how the snack they are enjoying connects to the discussion on healthy behaviors, MyPlate and growing food in their garden. (*Did they find seeds in the fruit they are eating? What parts of the salad go into which part of MyPlate? Are all of the sections on MyPlate filled up by the snack?*)

Conclusion (15 minutes)

Have students create their own MyPlate in their journal. The students will put the ingredients of the salad in the proper sections. Students will complete their journal activity with a sentence reflecting on why the Glorious Fresh Fruit Salad was chosen for today's snack.

Assessment Tools

- Journal
- MyPlate Worksheets
- Participation

Modifications

- Have students only draw the ingredients of the Glorious Fresh Fruit Salad on their MyPlate worksheet.
- Have students help make the snack by having different teams cut up the various types of fruit (using a butter knife).

Extensions

- Challenge students to add one more ingredient in each of the MyPlate sections to make the today's salad healthier.
- Discuss and demonstrate how to use measuring cups and spoons (this is an easy and great way to incorporate math into the lesson). Discuss how to read recipes and how to double or reduce recipes is another great way to incorporate math. Challenge students to rewrite the recipe for today's snack by either doubling it or reducing it by half.
- Discuss with the class general cooking and cutting techniques. Show the class how to safely use their knives and teach them cutting terms such as cut, slice, julienne, dice, etc. Have them practice their new vocabulary.

Glorious Fresh Fruit Salad

Kids love fruit. Feel free to experiment with other fruits that may be in season.

- 2 apples
- 1 cup seedless grapes
- 1 banana
- 1 can (16 oz) pineapple chunks, drained
- 1 cup cantaloupe
- 1 kiwi
- ¼ cup low fat sour cream
- 1 cup low fat cottage cheese (creamed)
- 1 cup low fat vanilla yogurt
- 1 Tbsp honey
- 2 tsp limejuice

Preparation (10 minutes): To make the dressing, combine sour cream, cottage cheese and yogurt. Mix well. Blend in honey and limejuice. Peel the banana, kiwi and cantaloupe. Cut all fruit into bite-sized pieces. Combine first five fruits with a little dressing. Garnish with slices of kiwi and serve with extra dressing.

Sources

United States Department of Agriculture. *USDA's MyPlate*. Web. 27 June 2011.

<http://www.choosemyplate.gov/tipsresources/printmaterials.html>.

Mott's Fresh Apples. *Salad Recipes*. Web. 27 June 2011. <http://www.mottsfresh.com/salads.asp>.

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BE HEALTHY!

DENVER URBAN GARDENS' SCHOOL GARDEN AND NUTRITION CURRICULUM



Adapt a Seed

Lesson

Goals

Students will learn about various seed dispersal mechanisms.

Objectives

Students will investigate different types of seeds and how they travel. Students will then use their imagination and team building skills to invent their own seeds.

Standards

Science: Life Science

GR.1-S.2-GLE.2

GR.2-S.2-GLE.1 & GLE.2

GR.4-S.2-GLE.1 & GLE.3

GR.5-S.2-GLE.1

Total Time – 60 minutes

Materials

- Assortment of seeds (or pictures) that are dispersed in different ways
- Hand lenses
- Traveling seed cards, cut out (end of lesson)
- Healthy seed-based snack

Did you know?

Some plants distribute their seeds by violently ejecting them so that they fall far away from the parent plant. Examples of this include plants from the pea family. As the two halves of the pod curl back, they suddenly release like a tense spring and flick out the seeds in an explosive manner.

Background for Teachers

This lesson works best as a follow up to the *Seed Collecting* lesson.

Method

Introduction (10-15 minutes)

1. Tell the class that you need help solving a gardening mystery. Plants cannot move, yet some new plants have recently appeared in the garden. Can the students help you discover how the new plant seeds have found their way into your garden? Show a selection of two or three different types of weed seeds. Pass out one seed to every two students. Have them examine these seeds carefully, using hand lenses and looking specifically for features that help the seeds travel. Discuss the students' ideas about how these different seeds might have found their way into your garden.
2. Before moving on to the activity, make the connection between healthy plants and healthy bodies. Remind the students that only healthy plants are able to disperse their seeds so they can spread and continue living. Ask the students about things a plant needs to be healthy (air, water, soil and nutrients in the soil). Ask the students what people need to be healthy.

Activity (30 minutes)

1. Explain that even though plants do not move, seeds do travel. Challenge the students to invent or design their own seeds that travel in different ways. Explain that each group will be choosing a traveling seed card that will describe a particular seed's way of being dispersed. Ask them to use their imagination and the materials provided to create a seed on the go that fits this description.
2. Divide the class into small groups and have a member of each group pick a traveling seed card (see end of lesson). The students will create their seeds and then test them to make sure they meet the dispersal requirements detailed on their cards. Each group should give their seed a name and think about the life history of the plant from which the seed came.

Snack & Conclusion (15-20 minutes)

1. When everyone is finished, gather the students together and have them demonstrate how their invented seed travels. Have them tell their seed's name and parent plant's story. Compare their seeds to the real seeds they examined earlier. Do they see and similarities? Can they think of other seeds that travel?
2. Have seed based snack, such as peas, beans, peanuts, etc.

Assessment Tools

- Group work
- Participation

Possible Modifications and Extensions

- Discuss how plants in the same family have similar looking seeds.
- Have the students write about and draw their invented seed in their journals.

Suggested Products

- Some seed ideas include:
 - Helicopters – maple and ash samaras
 - Air Passengers – cherries, berries and grapes
 - Parachutes – milkweed and dandelions
 - Hitchhikers – burdock and bidens
 - Animal Express – blueberries, raspberries and apples
 - Boats – coconuts and cranberries

Sources

Parrella, Deborah, and Cat Bowman Smith. *Project Seasons: Hands-on Activities for Discovering the Wonders of the World*. Shelburne, VT: Shelburne Farms, 1995.

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ADAPT A SEED

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Traveling Seed Cards

Make a seed like a helicopter, which can spin, twirl or fly through the air when dropped from a height of 8 to 10 feet and land at least one foot away.

Make a seed that is carried by the wind like a parachute for at least 10 seconds.

Make a seed that can hitchhike on a person or animal by sticking to it and going wherever it goes.

Make a seed that looks good enough for a bear to eat.

Make a seed that is thrown through the air like a cannonball and lands at least two feet away.

Make a seed that can float like a boat for at least one minute.

Make a seed that a bird might eat. This seed travels as an air passenger.



Let's Make Compost

Lesson

Goals

Students will experience the process of decomposition and the nutrient cycle.

Objectives

Students will build a compost pile.

Standards

Science: Life Science

GR.1-S.3-GLE.1

GR.2-S.2-GLE.1

GR.3-S.3-GLE.1

GR.6-S.2-GLE.2

Science: Earth Science

GR.6-S.3-GLE.3

Did you know?

In the United States, each person generates about 4.3 pounds of trash every day equaling 195.7 million tons. About two thirds of our trash is biodegradable and could be composted. So reduce your garbage by composting!

Total Time – 60 minutes (plus time for follow-up observations, measurements and care of pile)

Materials

- Compost materials
- Shovels and spading forks
- Wheelbarrow
- Water access
- Meter stick
- Soil thermometer
- Healthy snack

Background for Teachers

Before beginning the lesson, select a permanent area outdoors for your compost pile. The ideal location is close to the garden for easy hauling as well as easy access. You will also need to collect compost materials. See the end of the lesson for what materials work best. This is a great follow up lesson to The Rotten Truth lesson

(http://dug.org/storage/school-garden-curriculum/The_Rotten_Truth.pdf).

Method

Introduction (5 minutes)

1. Ask the class: *What types of materials decompose* (materials that have been alive)? *Why is it important for these materials to decompose* (they become nutrients for other plants)? *Is this a cycle? What are the parts of this cycle* (living plant or animal grows, dies, decomposes, provides nutrients for another living plant or animal to grow)? *What is this cycle called* (nutrient cycle)? *Do you think we can create a nutrient cycle in our garden?*

Activity (45 minutes)

1. Demonstrate building a miniature compost pile with samples of carbon, nitrogen and soil prior to building the actual pile. Discuss the different ingredients that can be used in the pile. Stress the importance of the size, ingredients and moisture level.
2. Divide the students into groups for carbon, nitrogen and soil. Assign one student to water. Equip the students with shovels, spading forks and a wheelbarrow.
3. Using the spading forks, have students loosen the ground where the pile will be. The area should be a minimum of 4' x 4'.
4. To build the compost pile, have students gather materials that are higher in carbon (tougher, less water, garden plants that have woody stalks, fall leaves, etc) and those that are higher in nitrogen (softer in texture, weeds without mature seed heads, over-ripe vegetables, thinned plants, etc). Chop all materials (with a shovel) into 1-2" pieces.
5. On the top of the ground with loosened soil, spread 4-6" of mixed, chopped carbon material, followed by 2-3" of mixed, chopped nitrogen material. Sprinkle a handful of soil on top and mix all layers with a spading fork.
6. Water the layers until the moisture feels like a wrung-out kitchen sponge. The layers should appear to glisten but the pile should not be saturated.
7. Rotate groups after one round of layering carbon, nitrogen and soil or let each group build their own pile.
8. Continue the process of layering 4-6" of chopped carbon, 2-3" of chopped nitrogen and a handful of soil; mixing and watering until the pile reaches a maximum of 4-5' tall. Have the students measure and record the dimensions of the compost pile. If you do not have enough material to make it that tall, you can continue to add materials at the appropriate ratios until it is large enough.
9. Have the students make a hole toward the center of the pile and take the temperature. Cover the top of the pile with black plastic (to assure that moisture is retained), making sure not to completely cover the whole pile (this would not allow air to enter). Use rocks to keep the cover in place.
10. Make sure to mix your pile once a week. Check to make sure it is wet enough and add water if necessary. Your pile will take about 2-3 months to decompose. Then you will need to let it cure for 3-4 months. If using in the fall, you can add the compost to the garden and let it cure there over the winter.

Snack & Conclusion (10 minutes)

1. Have a healthy snack for the kids. While eating, have the students answer the following questions: *What are the ingredients for a compost pile? What will happen to the organic matter? What will the pile look like in a few months? How will the compost be useful after it is decomposed? What materials could you use at home to make compost?*
2. Draw connections to how our old kitchen scraps will be broken down and turned into nutrient rich compost for our soil so we can grow healthy plants, which are sources of healthy food for our bodies. It is important that the students understand that healthy soils lead to healthy plants, which leads to healthy bodies.
3. This is a great time to introduce the nutrient life cycle. Hand out or display the nutrient cycle (end of lesson) and discuss how the cycle works in the garden.
 - a. *Compost added to the soil provides nutrients for the plants. Seeds are planted; they germinate, grow, flower and produce an edible crop. Food is harvested from the plant. As seeds are produced, the plant's life cycle is completed and it begins to die. Gardeners dig the plants out of the ground, chop them up and add them to the compost pile so they can decompose and become compost. This compost is then added back into the garden.*

Assessment Tools

- Team work and participation

Possible Modifications and Extensions

- Record the temperature of the compost pile every couple of days for the next week and create a graph with the readings. The pile should heat up to approximately 140° F and then start to cool down. Let the students feel the heat from the pile. Discuss how the heat is being produced through the biological activity of the microorganisms.
- In a month, measure the dimensions of the pile again. How has it changed, what layers can you identify?
- Have students observe chunks of the compost at various stages of decomposition through a microscope. Record any changes.

Suggested Products

- Carbon (dried matter): dried leaves, straw, dried grass, branches, corn and sunflower stalks
- Nitrogen (fresh matter): green leaves, over-ripe vegetables, weeds without seeds or flowers, grass clippings without pesticides

Vocabulary Words

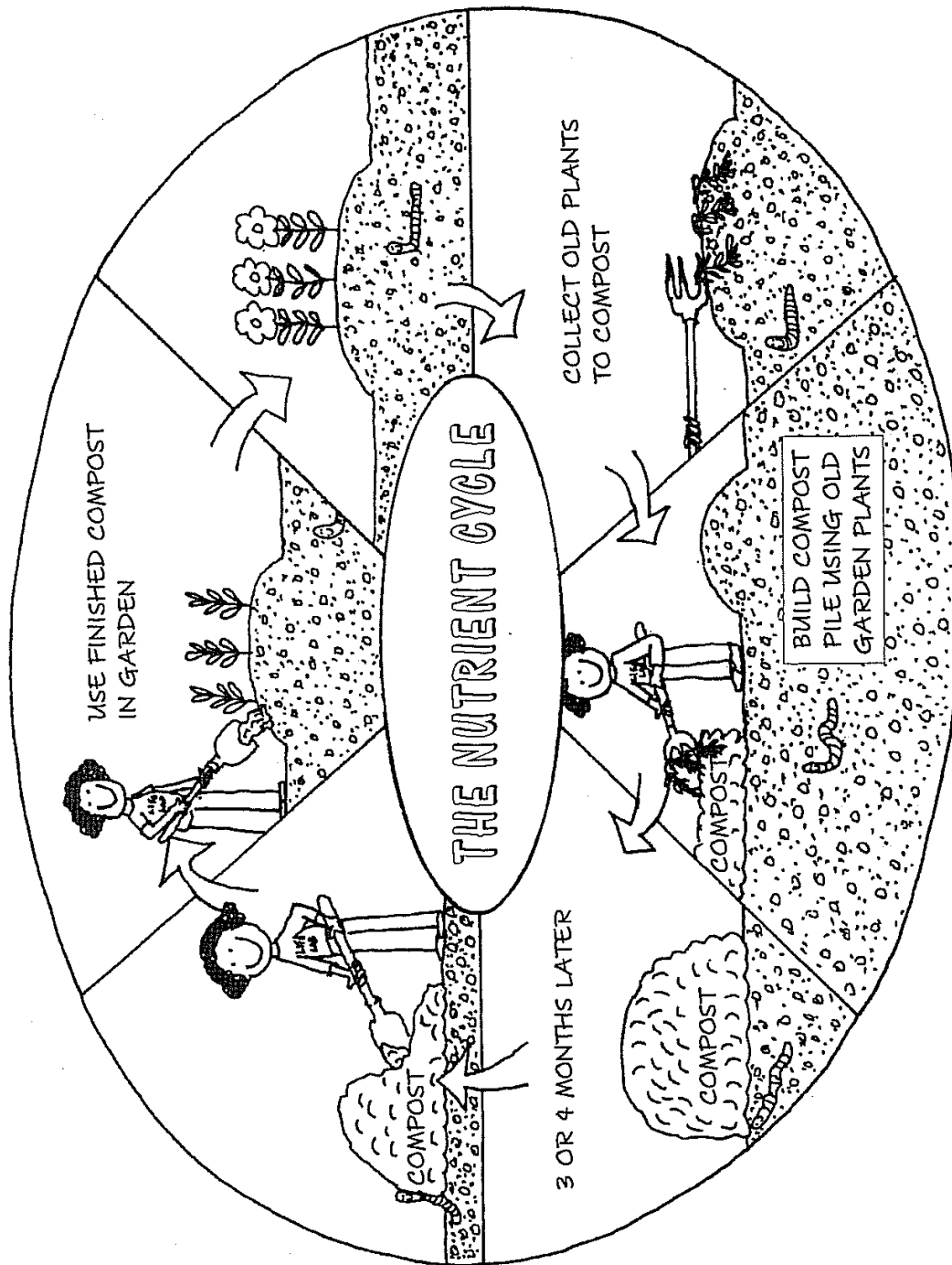
- **Biodegradable** – capable of being broken down by living microorganisms into simpler compounds
- **Compost** – well rotten plant and animal waste prepared by people to be used as a soil conditioner or fertilizer in gardens
- **Decomposer** – an organism that digests organic waste and dead organisms by breaking them down into simpler compounds and absorbing soluble nutrients
- **Decomposition** – the process of breaking down dead plants, animals and animal waste into simpler nutrients
- **Humus** – dark organic matter found in topsoil that consists of decayed vegetable matter; humus increases water retention of soil and provides nutrients important for plant growth
- **Non-degradable** – material that cannot be broken down by natural processes
- **Nutrient** – any element an organism needs to live, grow and reproduce
- **Photodegradable** – material capable of being broken down by exposure to sunlight
- **Recycling** – the process of collecting matter from garbage or the waste stream so that it can be made into new products
- **Reusable** – a produce that can be used over and over again in the same form

Sources

Jaffe, Roberta, and Gary Appel. *The Growing Classroom: Garden-based Science*. South Burlington, VT: National Gardening Association, 2007.

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Nutrient Cycle





Seed Collecting

Lesson

Goals

Students' understanding of the connection between healthy bodies and healthy gardens will be reinforced through a fall activity of seed collecting in the garden.

Objectives

Students will discuss how a healthy plant will make seeds and that seeds help plants continue the life cycle. Students will then collect seeds, describe seeds and identify seeds to package up for spring planting.

Colorado Academic Standards

Science: Life Science

- GR.2-S.2-GLE.1
- GR.2-S.2-GLE.2
- GR.3-S.2-GLE.1
- GR.4-S.2-GLE.1
- GR.4-S.2-GLE.3
- GR.5-S.2-GLE.1

Did you know?

If you grew 100 apple trees from the seeds of one tree, they would all be different.

Total Time: 60 – 80 minutes

Materials

- Egg cartons (one for each pair of students)
- Small paper and plastic bags
- Mailing labels
- Crayons or markers
- Healthy snack
- Journals

Method

Introduction (10 minutes)

1. Ask the class how healthy bodies and healthy gardens are connected (as we care for the garden, it produces healthy plants that provide healthy food for our bodies).
2. Draw a new connection for the students to see that we can live long lives by staying healthy. Ask the class how plants and a garden can stay alive after the winter. Discuss how most garden plants are annuals and only live one season, and if they are healthy, they create seeds. They then spread their seeds in order for new plants to continue the life cycle.

Activity (20-40 minutes)

1. Tell the students that they are about to embark on a search for one of nature's wonders—seeds.
2. Divide the class into pairs and give each pair an egg carton, where they can put their collected

seeds. Explain that their mission is to fill each of the 12 compartments with a different type of seed.

3. Head to the garden or a field in search of seeds. Give the class enough time to find a variety of seeds.
4. When you get back to the class have the students share their biggest, smallest and favorite seeds. Ask the students to also try to identify the seeds they collected.
5. If any of the seeds are the ones the students want to plant in the spring, have them place the seeds in paper bags if they are moist, or in plastic bags if they are dry.
6. Label the bags. For paper bags use crayons or markers. For plastic bags use mailing sticker labels. If there is enough time, have the students decorate the labels.
7. Store the seeds in a cool (room temperature) dark place (a drawer). Properly stored seeds can then be planted in the proper growing season to extend the concept of seed to seed.

Snack & Conclusion (15 minutes)

1. Have the students write in their journals about the seeds they found and how they found them. You may want to have the students draw their favorite seed and write why it is their favorite.
2. Have a healthy snack. Discuss the seeds of the snack and talk about how these seeds are sometimes planted to produce new trees or vegetables.

Assessment Tools

- Journals
- Seed collection

Suggested Products

- For the snack consider having fruit such as apples, pears, peaches, etc, where the seeds are noticeable. Or you may want to have a seed-based snack, such as peas, sunflower seeds, pumpkin seeds, corn, beans, etc.

Source

Parrella, Deborah, and Cat Bowman Smith. *Project Seasons: Hands-on Activities for Discovering the Wonders of the World*. Shelburne, VT: Shelburne Farms, 1995.

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The Rotten Truth

Lesson

Goals

Students will learn about the decomposition process and the importance of composting and recycling.

Objectives

Students will investigate the process of decomposition by conducting hands-on experiments with various food items. They will learn what happens to various items when they are thrown away.

Standards

Science: Life Science

GR.6-S.2-GLE.2

Science: Earth Science

GR.1-S.3-GLE.1

GR.3-S.3-GLE.1

GR.6-S.3-GLE.2

Did you know?

We would all be knee-deep in garbage without decomposition. In one spoonful of soil there are more bacteria and fungi than all the people on Earth.

The typical American throws away about five pounds of trash every day.

Total Time – Day one: 60 minutes, Day two: 60 minutes

Materials

- Various decomposable and non-decomposable items (suggestions at end of lesson)
- Plastic Ziploc bags
- Soil or compost
- Spray bottle
- Journals

Vocabulary

bacteria

decomposition

nature

resources

biodegradable

fungi

organisms

decay

microscopic

recyclers

Mentor Text

- *Compost Happens*. Mike Peters, 2000.

Background for Teachers

Have enough decomposable and non-decomposable items for each student to have one each. To save time have the items cut into one-inch or smaller pieces before the lesson.

Two great follow up lessons are Let's Make Compost

(http://dug.org/storage/school-garden-curriculum/Lets_Make_Compost.pdf) and Worms Are Our Friends (http://dug.org/storage/school-garden-curriculum/Worms_Are_Our_Friends.pdf).

Method – Day One

Introduction (10 minutes)

1. Ask the class to name some of the things they have thrown away over the past two days. *What happens to these things? Do they disappear? Or remain in the soil forever?*
2. Review the terms “biodegradable,” “non-biodegradable,” “decompose” and “compose.”
3. Create two headings on the board “Biodegradable” and “Non-Biodegradable” and have the class come up with items that fit under each term.
4. Explain to the class that they will conduct an experiment to learn the fate of some commonly thrown away items.

Activity (40 minutes)

1. Give each student a plastic Ziploc bag. Students should put one of each item into their bag, so that each student has the same contents. Have the students write their name and today’s date on the bag.
2. Have only a few students add a sprinkling of soil or compost and a light misting of water to their bag. Every student should lightly breath into their bags before carefully sealing them.
3. In their journals, have students record exactly what they are putting into their bags. They should also note their predictions of what will happen to each item over time (Rot? Smell? Stay the same?). If the students put soil/compost or water in their bags, make sure they include their predictions of what effect these variables may have.
4. Explain that they will leave their bags for 2-8 weeks. You may decide to keep all of the bags together, or place them in various locations with differing conditions (hanging in a sunny window, hidden inside a dark closet, in a cool entry way, etc). In their journals, have the students record their predictions related to the various locations.

Snack (5 minutes)

Enjoy the Asian Slaw.

Conclusion (5 minutes)

Discuss the various parts of the slaw and whether or not the students think they could be recycled or composted. Also review what section on MyPlate the salad ingredients belong.

Method – Day Two (2-8 weeks later)

Introduction (10 minutes)

1. Ask a few of the students to share some of their predictions for their bags. Have them explain why they made those predictions.

Activity (30 minutes)

1. Bring the class outdoors with their bags. Have the students sort through their bags and record any items still identifiable in their present state. Are any of the items missing? Provide spray bottles so items can be cleaned off for closer observation and identification.

2. How did the results compare to the predictions? Have the students record the results on the same page in the journal as where they wrote their predictions.
3. Define and discuss the process of decomposition or decay. Explain how certain materials are broken down by microorganisms, mainly bacteria and fungi, into basic nutrients and recycled back into the soil. Talk about composting as an alternative to the garbage dump or garbage disposal for certain items. Review the vocabulary terms: biodegradable, non-biodegradable, recyclable and reusable. Have the students sort the items in their bags into these categories.

Conclusion (10 minutes)

Have students share their findings. Discuss with the class how decomposition relates to the garden and healthy eating.

Snack (10 minutes)

Have a healthy snack.

Assessment Tools

- Participation
- Predictions and observations in journals

Modifications

- You can try having students put different items in their bags.
- Have students bring scraps from their lunches to put into their bags.
- Have students write a list of all the items they have thrown away in the past day in their journals. Then have the students predict which items are biodegradable and non-biodegradable.

Extensions

- Have students create a product list for a subsequent experiment to ensure understanding of which objects are biodegradable and which ones are not.
- Kitchen waste composes the most significant amount of a landfill. Have students brainstorm ways to reduce the amount of kitchen waste.

Suggested Products

- Suggested items to put in bags: paper bags, celery sticks, leaves, newspaper, plastic bags, cabbage, carrots, twist ties, etc.

Asian Slaw

This is a great alternative to the traditional cole slaw and kids love it!

- 1 Tbsp vegetable oil
- 1 tsp sesame oil
- 3 Tbsp rice vinegar
- 3 Tbsp honey
- 3 tsp soy sauce
- 3 cups shredded cabbage
- 2 carrots, shredded
- ¼ cup sunflower seeds

Preparation (15 minutes): Combine first 5 ingredients in medium sized mixing bowl and mix well to make dressing. Add the rest of the ingredients and mix together well. Cover and refrigerate until ready to serve, up to 24 hours.

Sources

Parrella, Deborah, and Cat Bowman Smith. *Project Season: Hands-On Activities for Discovering the Wonders of the World*. Shelburne Farms, 1995.

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Worms Are Our Friends

Lesson

Goals

Students will learn about Red Wiggler worms, composting and decomposition.

Objectives

Students will begin to explore garden friends and garden foes by starting a worm-composting bin.

Standards

Science: Life Science

GR.6-S.2-GLE.2

Science: Earth Science

GR.1-S.3-GLE.1

GR.3-S.3-GLE.1

GR.6-S.3-GLE.3

Did you know?

Red Wiggler worms:

- Consume their weight each day in raw organic matter.
- Live about one year.
- Do NOT turn into two worms when cut in half.
- Take only six weeks to grow from hatchling to adult.

Total Time – 60 minutes (plus weekly care)

Materials

- Container (wood or plastic)
 - Drill about 30 holes along the long sides and bottom (1/4" holes)
- Newspaper (black and white only)
- Red Wiggler worms
- Fall leaves
- Food scraps (Old bread, eggs shells, fruit and vegetable peels, coffee grounds, etc. Do not use meat, fat, dairy, junk food or citrus.)
- Magnifying glasses
- Journals
- Healthy snack

Vocabulary

cocoon

cold-blooded

compost

erosion

fertilizer

hatch

improvement

invertebrates

moisture

oxygen

recycle

vermicomposting

Mentor Text

- *Compost Happens*, Mike Peters, 2000.
- *The Worm Café*, Binet Payne, 1999.
- *Wormology*, Michael Elsohn Ross, 1996.
- *Composting with Willie the Worm*:
<http://www.michigan.gov/kids/0,4600,7-247-49067-62499--,00.html>

Background for Teachers

This lesson covers:

1. How garden friends can help decompose material and turn it into compost.
2. Why compost is good for garden soil.
3. How to recycle for the garden and why recycling is good.
4. How to care for worms.

See the Worm Composting 101 resource sheet for more detailed information on how to care for your worm bin (http://dug.org/storage/school-garden-curriculum/Worm_Composting_101.pdf).

This is a great follow up lesson to *The Rotten Truth*

(http://dug.org/storage/school-garden-curriculum/The_Rotten_Truth.pdf).

Method

Introduction (10 minutes)

1. Explain the benefits of worm composting (vermicomposting) to the class. Emphasize how worm composting recycles materials.
 - a. Review the basic definition of composting. (Compost is well-rotted plant and animal waste prepared by people to be used as a soil amendment in the garden.)
 - b. About 25% of all trash is yard waste or food scraps—both of which could be composted.
 - c. Compost has the ability to increase water retention in gardens and decrease overall usage.
 - d. Compost reduces erosion.
 - e. Compost reduces or eliminates pesticide and chemical fertilizer usage.
2. Ask the class what they know about worms. Have them make a list or go around the room and give each student a chance to add to the list. Teach them what they do not already know. (See “Did you know?” above.)
 - a. Worms are invertebrates, lacking bones and cartilage.
 - b. Worms are blind.
 - c. Worms breathe by absorbing oxygen through their moist skin.
 - d. Worms have no teeth.
 - e. Worms possess both male and female reproductive organs (hermaphrodites) but require a partner in order to reproduce.
 - f. Worms are sensitive to light and possess organs along their upper side that sense ultra-violet light. After prolonged exposure, breathing becomes depressed and the worm may die.
 - g. If worms are managed properly, it only takes two to three months to produce worm compost (castings).

Activity (35 minutes)

1. Have students tear single pages of black and white newspaper into strips and then into small squares. If time is limited, pre-tear the newspapers.
2. Have students fill the container with the torn newspapers and dry leaves, adding equal amounts of each by volume. Mix them together. Slowly, add lukewarm water to make the bedding moist but not soaking. It should feel like a wrung out sponge. Have a few students

break up all the newspaper to avoid big clumps and to create air space, which will help control odors and provide ideal living conditions for the worms. Thoroughly mix the newspaper and leaves together.

3. Spend some time looking at the worms with the magnifying glass. Have the students try and identify the longitudinal and circular muscles, the clitellum (band or ring) that indicates sexual maturity and explain that the head of the worm is closer to the clitellum.
4. Explain what worms like to eat (decaying organic material).
5. Make a worm sandwich. Using old bread and other appropriate items, make a sandwich. Explain to the class what to put and what not to put into the worm bin and why.
 - a. You can compost non-meat food scraps, such as fruit and vegetable peels, tea bags and coffee grounds. Pulverized eggshells help the worms “chew” their food since they do not have any teeth. This is similar to the way birds use small rocks.
 - b. It is advisable not to compost meats, bones, dairy products and oily foods because of problems with smells, flies and rodents. Do not add junk food, hot peppers or too many onion skins or citrus peels. Only add small amounts of citrus items and grains because too many can promote an acidity problem, leading to an overabundance of pests such as decomposition mites. Be moderate with the amount of fruit added (over-ripe fruit such as bananas left on the kitchen counter are a perfect breeding ground for fruit flies). It goes without saying that worms decompose organic materials only. Therefore, do not add plastic bags, rubber bands, aluminum cans, glass, etc.
 - c. Any food that is to be added to the box is best kept in sealed containers in the refrigerator.
6. Always bury the food waste by pulling aside some of the bedding, dumping the waste and then covering it up with the bedding again to avoid fly and odor problems. Bury successive loads in different locations in the bin.

Conclusion (10 minutes)

Have students brainstorm in their journals what they learned about worms and any new vocabulary words during today’s lesson.

Snack (5 minutes)

Hand out a healthy snack. While students are enjoying their snack, discuss as a whole group the proper ways to care for the worms.

Assessment Tools

- Journals

Modifications

- Have students draw a detailed picture of a worm in their journal and label the parts. You may want to have them look at the worms under a microscope or have a diagram of a worm available.

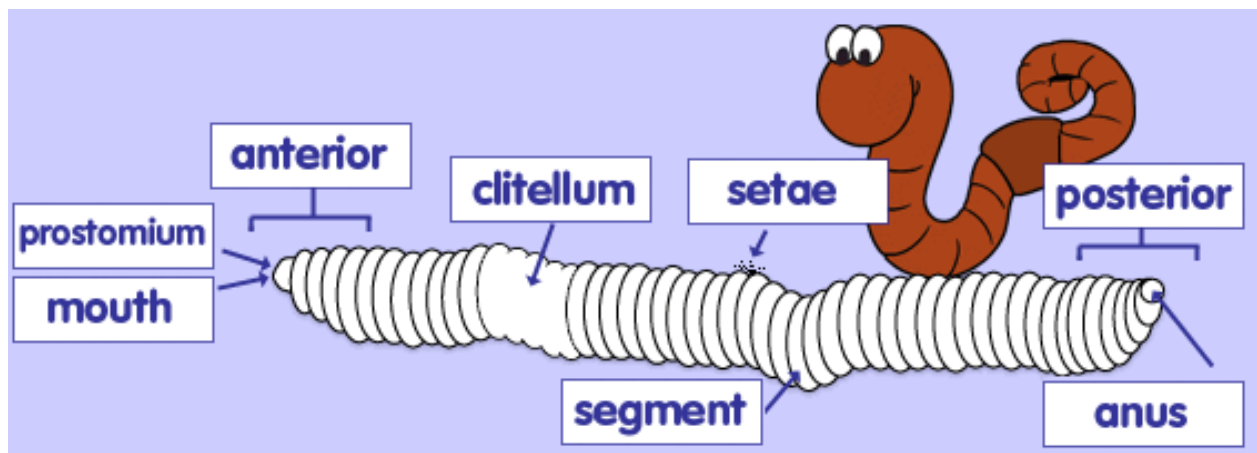
Extensions

- *Wormology* by Michael Elsohn Ross is a student friendly worm book with many experiments and lesson extension ideas.
- Hand out the worm related resource sheets and review their material (<http://dug.org/school-garden-curriculum/resource-sheets/gardening-tips.html>).
- Weigh the amount of food scraps going into the bin each week. Do various math or graphing projects with the numbers.

Suggested Products

- Roughneck storage containers, 10 gallon size are perfect for classroom worm bins.
- Worms can be purchased by the pound at <http://www.wilsonsworms.com>
- *The Worm Café* by Binet Payne has a lot of great information about worm composting at the school level.

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Easy Ways to 5-A-Day

Lesson

Goals

Students will find new ways to add fruits and vegetables to their everyday diets.

Objectives

Students will discuss easy ways to add 5-A-Day to commonly eaten meals and prepare a rainbow fruit salad.

Standards

Science: Life Science

GR.5-S.2-GLE.2

Comprehensive Health: Physical & Personal Wellness

GR.K-S.2-GLE.1

GR.1-S.2-GLE.1

GR.2-S.2-GLE.1

GR.3-S.2-GLE.1

GR.4-S.2-GLE.1

GR.5-S.2-GLE.2

GR.6-S.2-GLE.4

Total Time – 60 minutes

Materials

- Copies of meal images (end of lesson)
- Crayons, markers or colored pencils
- Seed catalogues (optional)
- Glue and scissors
- Cooking kits
- Journals

Did you know?

Bananas are the most popular fruit in the US. Americans eat an average of 28 pounds of bananas per person per year. That equals about 112 bananas per person per year.

Today Americans are consuming 900% more broccoli than 20 years ago.

Method

Introduction (10 minutes)

1. Introduce the activity by talking about the USDA Food Guide Pyramid. Explain to students that they should eat at least five servings of fruit and vegetables each day. Ask if anyone knows what a serving is.
2. One serving is (it is helpful to show what these look like with measuring cups):
 - a. 1 medium-sized fruit
 - b. $\frac{3}{4}$ cup 100% fruit or vegetable juice
 - c. $\frac{1}{2}$ cup fresh, frozen or canned fruit (in 100% juice) or vegetables
 - d. 1 cup raw leafy vegetables

3. Explain that eating a low-fat diet that includes **five to nine daily servings** of fruits and vegetables is key to developing a healthy lifestyle. Colorful fruits and vegetables provide a wide range of vitamins, minerals, fiber and phytochemicals (phytochemicals are chemical compounds that occur naturally in plants that give fruits and veggies their color, such as beta-carotene), which our bodies use to stay healthy and energetic. They also help us maintain a healthy weight, protect us against the effects of aging and reduce the risk of cancer, heart disease, high blood pressure and other chronic diseases.

Activity (25 minutes)

1. Ask the class to name fruits and vegetables that they like and eat often. Write their ideas on the board. Have them think about common meals they have and what fruits and vegetables are in those meals.
2. Tell the class: *Today we are going to find out how easy it is to add 5-A-Day to common meals that you and I like to eat.*
3. Hand out the meal images to the students. Have each student (or group of students) draw (or cut and paste images from the seed catalogues) fruits and/or vegetables they would like to add to their food to make a healthy meal. Some ideas are below:
 - a. Pizza: green or red bell peppers, pineapple, broccoli, jalapeños, mushrooms, fresh tomatoes, onions
 - b. Burrito: beans, spinach, red or green bell peppers, mushrooms, zucchini, avocado, tomatoes, cilantro, jalapeños
 - c. Oatmeal: dried fruit, raisins, blueberries, strawberries, bananas
 - d. Sandwich: lettuce, spinach, tomatoes, sprouts, avocado, cucumber
 - e. Spaghetti: green or red bell peppers, zucchini, eggplant, tomatoes, peas, green beans
4. Discuss other ways to make these common foods even healthier: limit the amounts of meat and cheese and choose products made with whole grains.
5. Ask the students: *What were the main points of the exercise?* (Learning to think about eating healthier; learning that fruits and vegetables don't have to be eaten separately but it's easy to add them to things; learning that there are already veggies in many things we are already eating; etc.)

Snack & Conclusion (25 minutes)

1. Prepare a snack with a variety of colorful fruits (or vegetables) and whole grains. Crunchy Burrito Banditos is attached as a recipe.
2. Discuss with the class or have the students write in their journals: *What are a few easy ways to eat a rainbow every day?*

Assessment Tools

- Participation
- Journals

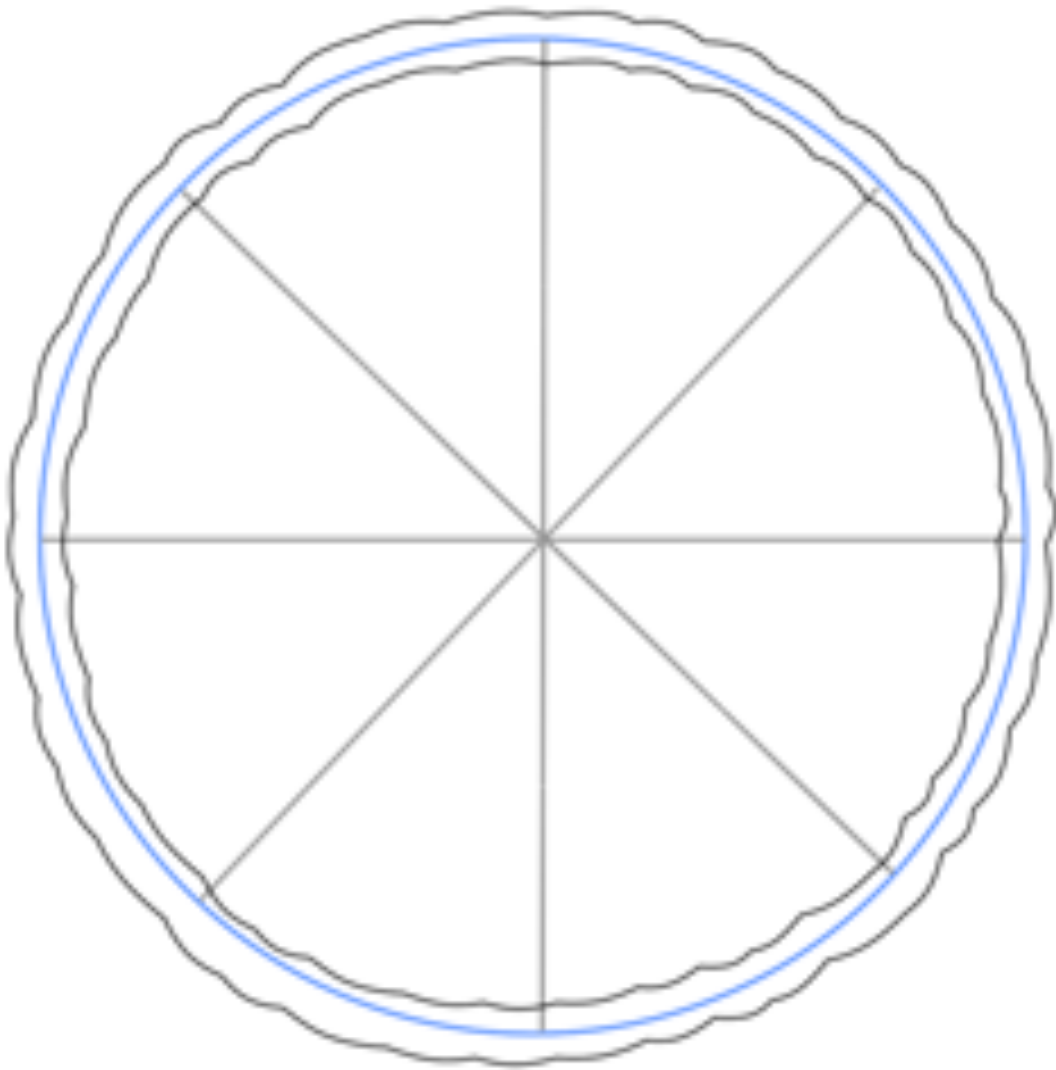
Crunchy Burrito Banditos

- ½ cup shredded carrots
- ½ cup chopped broccoli
- ½ cup chopped cauliflower
- 2 green onions, thinly sliced (optional)
- 4 ounces shredded low fat cheddar cheese
- 4 small whole-wheat tortillas
- 1 cup torn Greenleaf lettuce, bite-size pieces
- ½ cup of your favorite salsa

Preparation (10-15 minutes): In a mixing bowl, combine carrots, broccoli, cauliflower, and onions with cheese. Add the salsa and toss lightly. Place mixture and ¼ cup lettuce down the center of the tortilla. Wrap each tortilla around the vegetable mixture. Cut in half. Provide extra salsa to use as a dip.

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Pizza



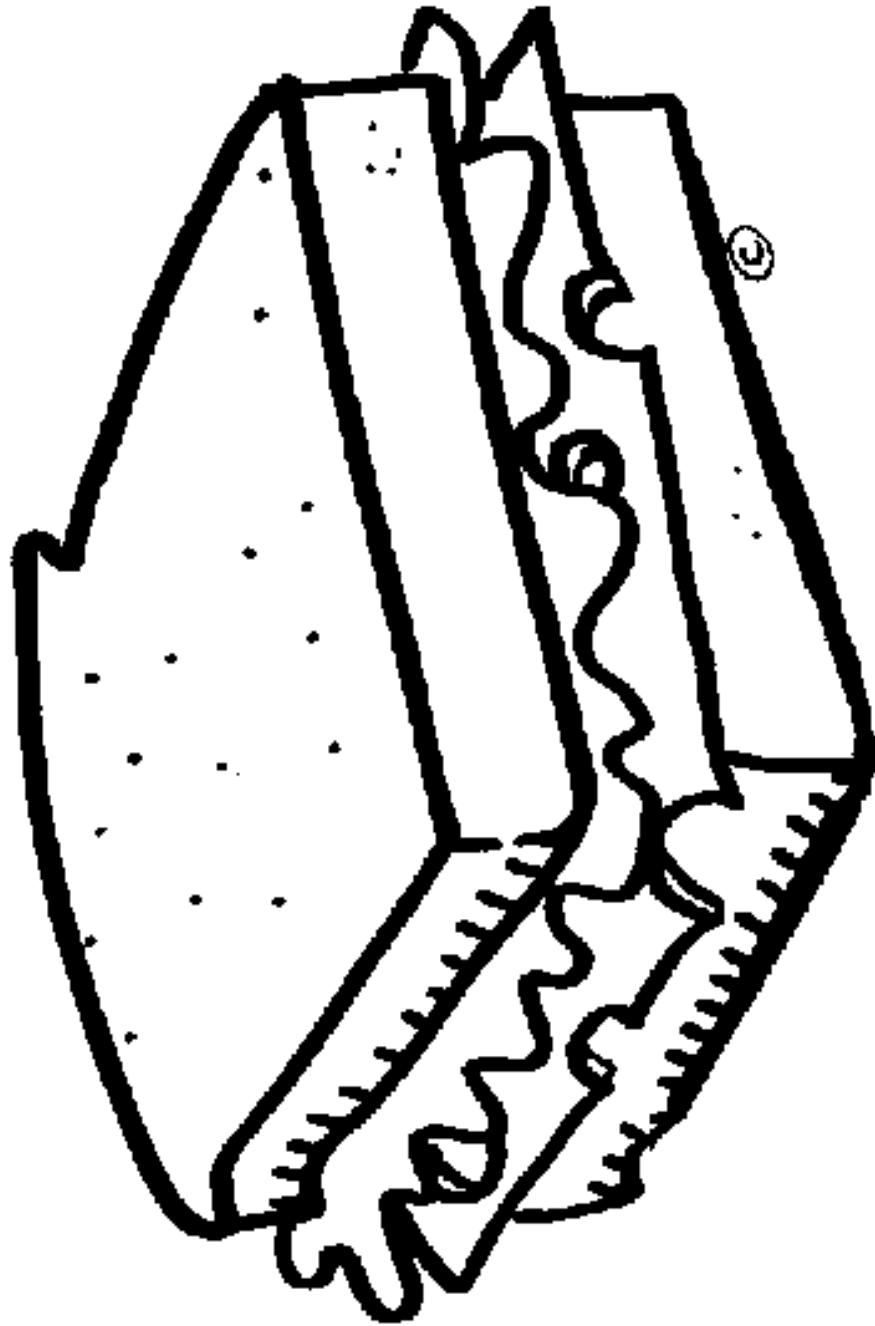


Burrito

Oatmeal



Sandwich



Spaghetti





Fun with Fiber

Lesson

Goals

Students will learn about fiber and why they need it.

Objectives

Students will discuss and read about fiber, analyze nutrition labels looking for fiber content, and calculate how much fiber they need in a day. Student will also evaluate which type of cereal with high fiber they like the best.

Colorado Academic Standards

Science: Life Science

GR.5-S.2-GLE.2

Comprehensive Health: Physical & Personal Wellness in Health

GR.2-S.2-GLE.1

GR.3-S.2-GLE.1

GR.5-S.2-GLE.1

GR.6-S.2-GLE.4

Did you know?

Food changes when processed and the fiber content may change too. A whole apple with peel has 3.7 g of fiber, an apple without peel has 2.4 g, applesauce has 1.5 g and apple juice has 0 g.

Total Time – 60 minutes

Materials

- Copies of handouts and recipe (end of lesson)
- Four different types of cereal (or use the attached nutrition labels and skip the taste test)
- Plates
- Calculators
- Journals

Vocabulary

body waste

fiber

intestines

calories

healthy weight

whole grains

Method

Introduction (10 minutes)

1. Ask the class: *Who knows what fiber is?* Fiber is a nutrient found in many foods such as whole grain breads, dried beans, fruits and vegetables. Our body does not digest fiber; therefore it helps our stomach to feel full without providing any calories. *Why is fiber good for us?* Fiber helps keep our intestines healthy by promoting movement of waste out of our body. Fiber also helps us to maintain a healthy weight by providing a feeling of fullness without calories.
2. If you have covered whole grains, review with them with the class. If not, have a brief discussion about the importance of whole grains and what are whole grains.
3. Go over tips for increasing fiber.

- a. Eat whole fruits and vegetables, with the peel.
- b. Read nutrition labels. Look for good sources of fiber (3g) and excellent sources (5g).
- c. Look for whole grain or whole wheat in ingredient lists.

Activity (25 minutes)

1. Have the class complete the attached sheet to determine how much fiber they need a day. You may need to help the younger students with their math.
2. Put a little of each cereal on a plate for each student or group of students. Have the students sample four or more types of cereal and fill out the charts at the end of the lesson. It is helpful to put the name of the cereal and the grams of fiber on the board for the class to write down, but you may also want to photocopy the nutrition labels from your cereal boxes and have the class find the grams of fiber themselves.
3. Make sure students understand how to find fiber on a nutrition label. It is labeled dietary fiber and can be difficult for students to find. Have a few students show the class where fiber is on different nutrition labels. Also, make sure they know to look at the grams in the serving not just the Percent of Daily Value.
4. Have students cut and paste the handouts into their journals.

Conclusion (15 minutes)

Discuss or have the students write in their journals: *What is fiber? Why do we need fiber? How can we increase our fiber? Are any of the foods we grow in the garden high in fiber? How are fiber and whole grains related?*

Snack (10 minutes)

Have the Fruit Pizza or Banana Split Cereal snack. While eating the snack, discuss the fiber value of the snack ingredients.

Assessment Tools

- Participation
- Fiber charts and math
- Journals

Modifications

- Provide students with calculators to help calculate daily fiber intake on Fiber Worksheet. May need to scaffold skill needed to accurately use the calculators.
- Combine with the "What Are Whole Grains?" lesson by cutting the snack preparation from both of them for a full one-hour lesson.

Extensions

- Give the students a recipe (such as Fruit Pizza) with ingredient analysis. Have the students calculate the amount of fiber per serving.
- Have the students write in their journals: *Are any of the foods we grow in the garden high in fiber? How are fiber and whole grains related?*

Suggested Products

- Cheerios
- Kix
- Special K
- Quaker Oatmeal Squares
- Raisin Bran
- Shredded Wheat (without frosting)
- Kashi Autumn Wheat

Fruit Pizza

- Whole wheat pita bread or English muffins
- 8 oz. light cream cheese (or Neufchatel cheese)
- 1 banana, peeled and sliced
- 4 cups of assorted fruit (pineapples, blueberries, strawberries, honeydew, cantaloupe, pitted cherries, peaches, etc)

Preparation (15 minutes): Spread cream cheese over pita or a half of English muffin. Arrange the fruit on the pizza in a design you desire. Be creative! If using pita bread, cut into wedges.

Banana Split Cereal

Who said banana splits were only for desert? Yogurt, cereal and fruit combine to make a powerhouse breakfast!

- 1 small ripe banana
- ½ cup fresh blueberries or other fresh fruit
- ½ cup nonfat or low-fat vanilla yogurt
- ½ cup low sugar cereal (Cheerios, Wheaties, Grape Nuts, Kashi Autumn Wheat)

Preparation (10 minutes): Peel the banana and slice it lengthwise (from tip to tip). Wash the blueberries or other fresh fruit. If using other fruit beside blueberries, cut them into small pieces. Spoon the yogurt in a mound in the center of a cereal bowl. Sprinkle the cereal on top of the yogurt. Arrange the banana halves on either side of the yogurt. Sprinkle the top with the blueberries or other fruit. Or yogurt and fruit can be layered in a cup with cereal sprinkled on top.

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How much fiber do you need daily?

Consuming fiber helps to keep our stomach full making it helpful in achieving and maintaining a healthy weight. The recommended amount of fiber for children is 5 grams of fiber plus the your age.

For example, if Billy is 8 years old, he needs to eat $8 + 5$ grams of fiber every day, or 13 grams of fiber.

Your age in years: _____

+ 5 grams of fiber

= _____ grams of fiber per day

Taste Test

Name of Cereal	Grams of Fiber	Did you Like it:
		Yes or No
		Yes or No
		Yes or No
		Yes or No

High Fiber Foods

- Fresh fruit with their peels (apples, pears, peaches, berries, etc)
- Vegetables (broccoli, carrots, cauliflower, cabbage, avocados, peas, spinach, etc)
- Nuts and nut butters (almonds, cashews, pistachios, sunflower seeds, peanuts, etc)
- Bananas
- Oranges
- Raisins
- Beans
- Oatmeal
- Popcorn
- Multi grain cereals
- Whole-grain bread
- Wheat crackers

Ways to Increase Your Fiber

- **Eat Breakfast:** Enjoy a high-fiber cereal, whole-wheat toast, oatmeal and fresh fruit to start your day out right.
- **Eat Fruit:** An easy, delicious snack can be fresh or dried fruit. Keep the peel on to get the most fiber out of your snack.
- **Become a Topper:** Don't forget the fiber-filled toppers like: bananas, blackberries, or hummus while enjoying cereal, oatmeal, or whole-wheat toast.
- **Keep the Veggies:** Carrots, celery, snap peas are easy high-fiber snacks. It is easy to add vegetables to your sandwiches or burritos.

Cheerios



Nutrition Facts

Serving Size 1 cup (30g)

Amount Per Serving

Calories 110 **Calories from Fat** 20

%Daily Value*

Total Fat 2g **3%**

Saturated Fat 0g **0%**

Trans Fat 0g

Cholesterol 0mg **0%**

Sodium 210mg **9%**

Total Carbohydrate 22g **7%**

Dietary Fiber 4g **16%**

Sugars 2g

Protein 4g

Vitamin A 10% • Vitamin C 10%

Calcium 10% • Iron 60%

* Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs:

		Calories:	2,000	2,500
Total Fat	Less than	65g	80g	
Sat Fat	Less than	20g	25g	
Cholesterol	Less than	300mg	300mg	
Sodium	Less than	2,400mg	2,400mg	
Total Carb		300g	375g	
Dietary Fiber		25g	30g	

Nutrition Facts

Serving Size 1/2 cup dry (100g)

Amount Per Serving

Calories 370 **Calories from Fat** 60

%Daily Value*

Total Fat 7g **11%**

Saturated Fat 1g **5%**

Trans Fat 0g

Cholesterol 0mg **0%**

Sodium 0mg **0%**

Total Carbohydrate 68g **23%**

Dietary Fiber 9g **36%**

Sugars 1g

Protein 14g

Vitamin A 0% • Vitamin C 0%

Calcium 6% • Iron 25%

* Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs:

		Calories:	2,000	2,500
Total Fat	Less than	65g	80g	
Sat Fat	Less than	20g	25g	
Cholesterol	Less than	300mg	300mg	
Sodium	Less than	2,400mg	2,400mg	
Total Carb		300g	375g	
Dietary Fiber		25g	30g	



Nutrition Facts			
Serving Size 3/4 cup (30g)			
Amount Per Serving			
Calories 120		Calories from Fat 10	
%Daily Value*			
Total Fat 1g		2%	
Saturated Fat 2g		10%	
Trans Fat 0g			
Cholesterol 0mg		0%	
Sodium 150mg		6%	
Total Carbohydrate 26g		9%	
Dietary Fiber 1g		4%	
Sugars 12g			
Protein 2g			
Vitamin A 10%		•	Vitamin C 25%
Calcium 0%		•	Iron 35%
* Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs:			
	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carb		300g	375g
Dietary Fiber		25g	30g



Nutrition Facts			
Serving Size 1 cup (28g)			
Amount Per Serving			
Calories 100		Calories from Fat 0	
%Daily Value*			
Total Fat 0.5g		1%	
Saturated Fat 0g		0%	
Trans Fat 0g			
Cholesterol 0mg		0%	
Sodium 130mg		5%	
Total Carbohydrate 25g		8%	
Dietary Fiber 3g		12%	
Sugars 12g			
Protein 1g			
Vitamin A 10%		•	Vitamin C 25%
Calcium 0%		•	Iron 25%
* Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs:			
	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carb		300g	375g
Dietary Fiber		25g	30g



Shredded Wheat

Nutrition Facts

Serving Size 2 biscuits (47g)
Servings Per Container 9

Amount Per Serving	2 Biscuit	1 Biscuit
Calories	160	80
Calories from Fat	10	5
% Daily Value**		
Total Fat 1g*	2%	1%
Saturated Fat 0g	0%	0%
Trans Fat 0g		
Polyunsaturated Fat 0.5g		
Monounsaturated Fat 0g		
Cholesterol 0mg	0%	0%
Sodium 0mg	0%	0%
Potassium 180mg	5%	3%
Total Carbohydrate 37g	12%	6%
Dietary Fiber 6g	24%	12%
Soluble Fiber <1g		
Insoluble Fiber 5g		
Sugars 0g		
Other Carbohydrate 31g		
Protein 5g		



Nutrition Facts

Serving Size 59 g

Amount Per Serving

Calories 187 **Calories from Fat** 13

% Daily Value*

Total Fat 1g	2%
Saturated Fat 0g	1%
Trans Fat	
Cholesterol 0mg	0%
Sodium 289mg	12%
Total Carbohydrate 45g	15%
Dietary Fiber 7g	29%
Sugars 17g	
Protein 6g	
Vitamin A 15% • Vitamin C 8%	
Calcium 3% • Iron 79%	

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.



How Much?

Lesson

Goals

To introduce students to the importance of portion control by reading nutrition labels and measuring portions.

Objectives

Students investigate serving sizes on nutrition labels, measure amounts of food based on serving sizes and calculate nutrition information based on serving sizes. Students will also determine how much exercise is needed to burn off a set amount of calories consumed.

Standards

Science: Life Science

GR.5-S.2-GLE.2

Comprehensive Health: Physical & Personal Wellness

GR.2-S.2-GLE.1

GR.3-S.2-GLE.1

GR.4-S.2-GLE.1

GR.5-S.2-GLE.1

GR.6-S.2-GLE.4

Total Time – 60 minutes

Materials

- Box of cereal
- Variety of sizes of bowls
- Measuring cup
- Handouts (end of lesson)
- Journals

Did you know?

Obesity is among the most serious threats to Americans' health, with rates of obese and overweight children tripling since the 1960s. The main cause is too many calories consumed and not enough burned off. The solution: eating less and exercising more.

Method

Introduction (5 minutes)

1. Begin the class with a review of the nutrition label or other nutrition topics you may have covered. Reiterate how important it is to look at the ingredient list and focus on eating whole grains and limiting sugars and fats. Point out the serving size section of the nutrition label and discuss that in addition to WHAT you eat, you have to also be aware of HOW MUCH you eat.
2. Remind the class that calories are like fuel, but if we consume too many we begin to gain weight. To prevent this from happening we need to burn off the calories with exercise.

Activity (25 minutes)

1. Set up a table in the front of the room with a box of cereal and a variety of different sizes of bowls.

2. Describe a situation: "You just rode your bike home from school and you go into the kitchen to get a snack. You see a box of cereal and grab a bowl and pour yourself some cereal."
3. Have a volunteer from the class come up and pick a bowl and pour how cereal he/she would realistically eat. Have two more volunteers come up and do the same.
4. Now measure out each student's cereal. Compare to the serving size on the cereal box. Have the class calculate how many calories, sugar, fat, etc. based on how much cereal was poured by each student.
5. Write the amount of calories that were consumed by the largest serving on the board.
6. Have the class do jumping jacks for one minute. Tell them that they burned about 3 calories. Have them jump for another minute. How many calories have they consumed now? Have the class calculate how long they would have to jump to burn off all of the calories consumed by the largest serving of cereal.
7. Write the Order Size Guide (end of lesson) on the board with blanks for actual categories. Have students work in groups to estimate how many calories each item contains for a small and large serving.
8. Then display the actual calories. Discuss with the class what their estimates were and why the actual calories may differ from their estimates. Remind the class that they should be consuming between 1800 and 2000 calories per day.
9. Have the students calculate how many minutes you would need to do jumping jacks to burn off a small meal versus a large meal.
10. Handout the Portion Size Guide and review with the class.

Snack & Conclusion (20 minutes)

1. Have the class journal or discuss why it is important to look at serving sizes. Ask the class to brainstorm some strategies to help them with portion control (use smaller plates and cups, read nutrition labels, order small, avoid supersize, share large entrees, avoid eating directly out of the bag or container, avoid eating while watching TV, etc).
2. Have the students prepare their California Wraps or another healthy snack. Discuss the benefits of the various ingredients.

Assessment Tools

- Participation
- Math
- Journals

Possible Modifications and Extensions

- Feel free to do this activity with other types of food (e.g. chips, Cheetos, juice).
- Do the math of how many minutes of jumping jacks you need for other items, such as their lunch or breakfast that day.

Order Size Guide

The difference between a small meal and large (supersized) meal could easily double the amount of calories.

	LARGE	SMALL
French Fries	570	250
Burger	730	260
Soda	310	150
Cookie	470	110
Ice Cream	560	230
Totals	2640	1000

California Wrap

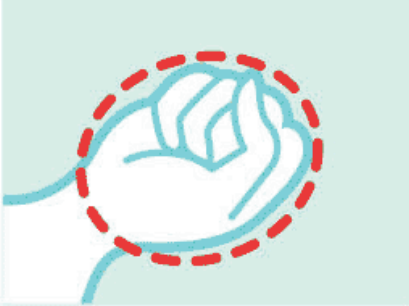
- Cheddar cheese, grated
- Whole wheat flour tortillas
- Carrots, shredded
- Red or yellow bell peppers, sliced thinly
- Avocados, peeled and sliced
- Baby spinach leaves
- Salsa

Preparation (10 minutes): Spread the avocado over the tortilla within ½” of the edges. Arrange all the filling ingredients in a row along the center of the tortilla. Roll the tortilla up as tightly as possible to enclose the filling without tearing the tortilla.

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How Much?

DENVER URBAN GARDENS' SCHOOL GARDEN AND NUTRITION CURRICULUM

Hand Symbol	Equivalent	Foods	Calories
	Fist 1 cup	Rice, pasta Fruit Veggies	200 75 40
	Palm 3 ounces	Meat Fish Poultry	160 160 160
	Handful 1 ounce	Nuts Raisins	170 85
	2 Handfuls 1 ounce	Chips Popcorn Pretzels	150 120 100
	Thumb 1 ounce	Peanut butter Hard cheese	170 100
	Thumb tip 1 teaspoon	Cooking oil Mayonnaise, butter Sugar	40 35 15



What Are Whole Grains?

Lesson

Goals

Students will understand what whole grains are, why they should eat them and how to prepare a healthy snack with whole grains.

Objectives

Students will discuss what whole grains are using MyPlate and pictures of whole grains. Students will prepare a healthy snack using whole grain rolls.

Colorado Academic Standards

Science: Life Science

- GR.2-S.2-GLE.2
- GR.5-S.2-GLE.1
- GR.5-S.2-GLE.2

Comprehensive Health: Physical & Personal Wellness in Health

- GR.2-S.2-GLE.1
- GR.5-S.2-GLE.1
- GR.6-S.2-GLE.4

Total Time – 60 minutes

Materials

- MyPlate
- Examples of whole grains (dried corn, oats, wheat berries, brown rice, quinoa, etc.)
- Wheat bran
- Paper towels
- Plastic bags
- Pictures of whole grains and the plants they come from

Did you know?

A food's color is not helpful in identifying whether it contains whole grain ingredients. Dark or brown bread is often a whole grain food, but it may just have molasses or caramel food coloring added. Alternatively, whole grain foods may be light in color, such as those made from oats. Only 1 in 10 Americans eat the recommended amount of whole grains (3 servings).

Background for Teachers

Whole grains are higher in fiber and about a dozen vitamins and minerals than enriched white flour. Fiber is found only in plants, in the non-digestible outer coating of grains (the bran layer), fruits and vegetables. Examples of whole grains are wheat, oats, corn, barley and rice. Grains are members of the grass family and germinate with one cotyledon (they are monocots). Processed grains (white, wheat or enriched bread) began life as whole grains but had their bran layer removed (which also removes many of the vitamins and minerals) in the manufacturing process. They then need to be enriched with added nutrients before they can be sold.

Follow up this lesson with the Fun with Fiber lesson:

http://dug.org/storage/school-garden-curriculum/Fun_with_Fiber.pdf.

Method

Introduction (15 minutes)

1. Display MyPlate to the class and review the food groups. Remind the class that half of their grains should be whole grains. Ask the class if they know what whole grains are.
2. Discuss the information in the background section. Start with discussing what whole grains are and why they are beneficial to eat. Make sure to emphasize the importance of eating fiber and the vitamins and minerals found in the bran layer.

Activity (25 minutes)

1. Display or hand out the image of the wheat kernel. Talk about each part of the kernel (the bran layer, the endosperm and the germ) and the different components of each (bran-fiber, endosperm-carbohydrates and germ-vitamins and fats).
2. Pass around examples of whole grains so the class has a chance to touch and smell them. Bringing in examples of the actual grains is great because it gives the students a chance to see them in their raw form. While talking about each grain, display images of that grain growing, so students have an understanding of what each plant looks like.
3. Explain that grains are examples of monocotyledons, which means they have one seed leaf. Compare this to a dicotyledon (beans), which have two seed leaves. Explain to the class that they will learn the difference between the two through a germination experiment.
4. Put a few wheat seeds in a moist paper towel. Make sure this is flat and put inside a sealable plastic bag. Do the same with a couple of beans. Each day have a student open the bag and gently blow on the seeds. The wheat and beans should sprout within one week. Make sure all the students see the difference between the two types of sprouts.

Conclusion (5 minutes)

Have students write a list of whole grains in their journals.

Snack (15 minutes)

Have students assemble their Boo-Wiches or Fruit Rice Cakes. Emphasize the difference in whole grains versus refined grains.

Assessment Tools

- Journals
- Presentation of Boo-Wiches or Fruit Rice Cakes

Modifications

- Make this a two-day lesson with the extensions below and use both recipes.

Extensions

- Discuss the origins of the various grains and point it out on the map.

- Discuss the process of growing and processing of different grains. Consider showing pictures of grain mills, mortar and pestle or other grinding mechanisms.

Supplemental Materials

- Wheat images: http://en.wikipedia.org/wiki/File:Wheat_close-up.JPG
- Corn images: <http://en.wikipedia.org/wiki/File:ZeaMays.jpg>
- Oats images: http://en.wikipedia.org/wiki/File:Avena_sativa_L.jpg
- Rice images: http://en.wikipedia.org/wiki/File:US_long_grain_rice.jpg
- Quinoa images: http://en.wikipedia.org/wiki/File:Chenopodium_quinoa_in_flower.jpg

Boo-Wiches

These sandwiches give students a chance to get creative with their food, while eating a healthy low-fat, high-fiber snack.

- Whole grain rolls
- Low-fat cream cheese or hummus
- Condiments of choice (salsa, ketchup, etc.)
- Various vegetables (lettuce, olives, celery, cucumbers, carrots, tomatoes, cabbage, etc.)
- Herbs for decoration (dill, parsley, cilantro, etc.)

Preparation (10 minutes): Cut each roll in half and spread the cream cheese on one side. Now get creative! Give it a ghoulish touch by using the garnishes to make faces. What do you have to make eyes? Olives work great, especially pimento-filled green olives sliced in half. Carrots cut in rounds about 1/4 inch thick will do the trick. What about hair? Many herbs will fit the bill and add a touch of flavor, too.

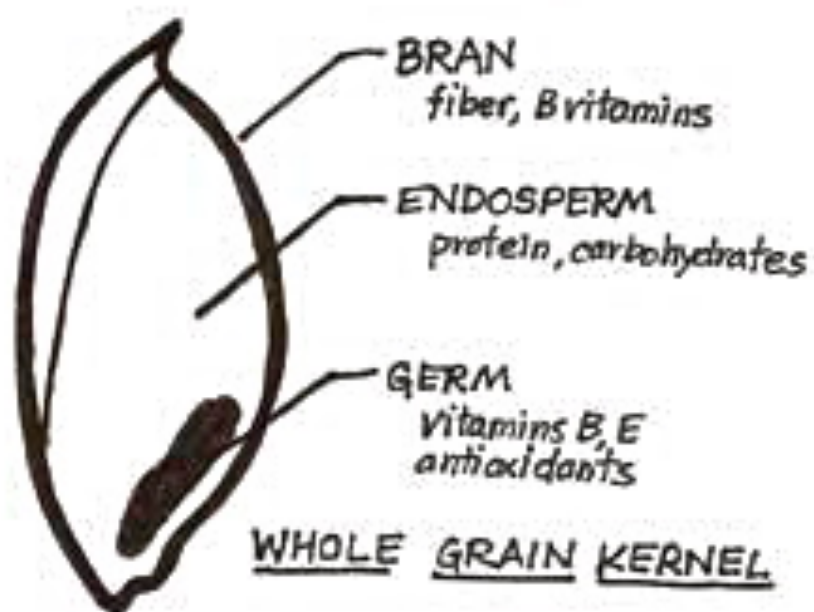
Fruit Rice Cakes

This snack is a good source of B vitamins, fiber and protein with added antioxidants from the berries.

- Whole grain rice cakes
- Natural almond butter (no added sugar)
- Preserves, such as strawberry or raspberry (use a variety that is sweetened with plain fruit juice)
- Fruit, such as raspberries, banana slices or blueberries

Preparation (10 minutes): Spread each rice cake with almond butter and fruit preserves of your choice. Decorate with a few pieces of fruit.

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Grocery Bag Botany

Lesson

Goals

Students will learn to identify foods by their plant part.

Objectives

Students will classify various foods we eat into which part of the plant they come from.

Colorado Academic Standards

Science: Life Science

GR.2-S.2-GLE.2

Total Time – 60 minutes

Materials

- 15-30 fruits and/or vegetables
- Enlarged photo of a plant
- Journals
- Snack (see recipe at end of lesson)

Did you know?

Even though potatoes grow underground, they are not roots. They are specialized stems.

Vocabulary

roots
flowers

stems
fruits

leaves
seeds

Background for Teachers

This lesson is great to use as a precursor for individual lessons on each plant part. The follow-up lessons include: Leaves Make Food, What is a Stem, Introducing the Seed and Rooting for Roots.

Method

Introduction (10 minutes)

1. Begin the class by asking students if they ate any plants for breakfast. List the foods they mention on the board. Brainstorm with the class the six different parts of a plant that people eat: roots, stems, leaves, flowers, fruits and seeds. Tell the class that you had a delicious breakfast of plant parts, explaining that people rarely eat a whole plant. Tell the students you ate a bowl of oval, flattened seeds and dried, brown shriveled fruit with fragrant, crushed bark sprinkled on top. You drank a cup of dried leaves soaked in water with a spoonful of granulated stems and a slice of yellow fruit. Can they guess what you ate? (A bowl of oatmeal with raisins and cinnamon, and a cup of tea with a spoonful of sugar and slice of lemon.) Review the class' list and classify the foods by the part of the plant from which they came.
2. Explain to the class that they will be doing a sorting activity based on the different plant parts that people eat. As a whole group label the plant parts on the enlarged picture of a plant.

Activity (40 minutes)

1. Break the class into groups of four or five students. Hand out 5-10 items to each group.
2. As a group, have the students decide which part of the plant they are eating when they eat each item. Some items may be harder to determine than others. Make sure to have all the plant parts written up on the board (fruit, flower, stem, leaf, root and seed) to remind the class of the possible choices.
3. After the groups have made their decisions, have each group elect a spokesperson to present their findings to the larger class why they chose the plant part that they did.
4. Have each student write up a breakfast, lunch or dinner menu based on the plant parts he or she would eat, similar to the breakfast menu presented at the beginning of the activity. Students will then read their menu to their small groups and the groups will try to guess what foods the menu describes.

Conclusion (5 minutes)

Have the class discuss or write in their journals two different foods for each plant part (roots, stems, leaves, seeds, fruits and flowers).

Snack (5 minutes)

Provide a healthy snack that includes various plant parts, such as ants on a log (celery-stem, peanut butter-seeds, raisins-fruit) or Asian Broccoli Salad (end of lesson). While eating the snack reinforce the different parts of the plants that they are eating.

Assessment Tools

- Participation
- Presentation
- Journal

Modifications

- Give each group the same items and make it a contest to see which group can correctly name the plant part of each item.
- Instead of giving each group food items, have the class decide as a whole. This would mean the teacher would be in front of the class with a grocery bag and pulling out one item at a time. Make sure all students understand why each item was put into its category before moving on. Write the items on the board under each plant part as you go.

Extensions

- Have students examine packaged items and have students discuss which plant part(s) that particular packaged food item came from (i.e. catsup is made from tomatoes, a fruit).
- Give students a recipe of a familiar food item. Have students collaborate on what ingredient comes from what plant. Students will then record their thinking in their journals.

Suggested Products

- Asparagus (stem)
- Broccoli (flower, stem)
- Cabbage (leaf)
- Beans (seed)
- Corn (seed)
- Squash (fruit)
- Potatoes (underground stem)
- Onions (leaves)
- Garlic (stem)
- Raisins or grapes (fruit)
- Nuts (seed)
- Herbs (leaf, stem, seed)
- Parsnip (root)
- Carrots (root)
- Peas (seed)
- Celery (leaf-petioles)
- Ginger (underground stem)
- Cucumber (fruit)

Asian Broccoli Salad

- 4 broccoli heads (flower)
- 1 carrot (root)
- 2 oz. sunflower seeds (seed)
- 4 oz bok choy or savoy cabbage (leaf)
- 1 can mandarin oranges (fruit)
- 1 tsp sesame oil (seed)
- 2 tsp olive oil
- 1 Tbsp honey
- 1 Tbsp rice wine vinegar
- 1 Tbsp low sodium soy sauce
- 1 garlic clove (stem)
- 1 Tbsp grated ginger (stem)

Preparation (20 minutes): Cut broccoli into bite sized pieces and blanch in salted hot water and then shock in cold water. Grate carrot and julienne bok choy (or cabbage). Combine with the broccoli. Drain the liquid from oranges and then mix with the vegetables and sunflower seeds. Mince garlic clove and grate ginger. In a bowl mix sesame oil, rice wine vinegar, soy sauce, garlic and ginger. Whisk together. Combine dressing with the other ingredients, mix well and serve.

Source

Recipe courtesy of Corey Ferguson

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Introducing the Seed

Lesson

Goals

This lesson lays the foundation for understand the connection between the seeds that we plant and the plant that grows from the seed.

Objectives

Students will to identify different parts of a plant inside of a bean seed and determine if their onion seeds are viable.

Standards

Science: Life Science

- GR.2-S.2-GLE.1
- GR.2-S.2-GLE.2
- GR.3-S.2-GLE.1
- GR.4-S.2-GLE.3
- GR.5-S.2-GLE.1

Total Time – 60 minutes (plus 10 minutes a day for the following week)

Did you know?

Even if a seed is planted upside down, the seedling always grows right-way up. Plants can sense gravity.

The largest seed in the world is the double coconut (Coco de Mer). It can measure up to 50cm (1.6ft) around the middle.

Materials

- Large bean seeds soaked overnight (limas work great)
- Magnifying glasses
- Copies of “A trip inside a bean seed” (end of lesson)
- Onion seeds (enough for each student or group to have 10 seeds each)
- Paper towels
- Ziploc bags

Background for Teachers

The seed is made up of three main parts: embryo, endosperm and seed coat. The embryo is basically a miniature plant. The endosperm is the built-in food supply, which is made up of proteins, carbohydrates or fats. The testa (seed coat) is the hard out covering, which protects the seed from disease and insects. It also prevents water from entering the seed, which would initiate the germination process before the proper time.

Germination is the resumption of active embryo growth. Prior to any visual signs of growth the seed must absorb water through the testa. When the seed is ready to germinate, water is taken in through the micropyle, which is a tiny hole in the testa. In addition, the seed must be in the proper environmental conditions; that is, exposed to oxygen, favorable temperatures, and for some correct light. The radicle (embryonic root) is the first part of the seedling to emerge from the micropyle. It will develop into the primary root from which root like hairs and lateral roots will develop. The next part to emerge is the embryonic shoot (plumule), from which the first seed leaves called cotyledons develop. The embryonic stem above the point of attachment of the cotyledon(s) is the epicotyl. The embryonic stem below the point of attachment of the cotyledon(s)

is the hypocotyl. The seed leaves (cotyledons) encase the embryo and are usually different in shape from the leaves that the mature plant will produce. After cotyledons have exhausted their supply of food, the first true leaves appear and the cotyledons wither and die. Plants producing one cotyledon fall into the group of monocotyledons or monocots, which includes grasses and corn. Plants producing two seed leaves are called dicotyledons or dicots, which includes beans and squash.

Method

Introduction (10 minutes)

1. Tell the class that you can hold 250 onions in your hand. How is this possible? After letting them problem solve, show the class the onion seeds.
2. Have a discussion with the class about seeds (what are they, what do they need to grow, where do you find them, etc).
3. Review the term *germination* (when the seed begins to grow) and what is needed for germination.

Activity (35 minutes)

1. Pass out the copies of "A trip inside a bean seed" and review the various parts and their purposes.
 - a. Seed Coat – Provides protection for the seeds.
 - b. Embryonic Root – First part of the seed to grow and will turn into the root.
 - c. Cotyledon – First set of "leaves" to emerge and provides nutrients for the tiny plant. They look unlike the rest of the leaves that will emerge.
 - d. First Leaves – These are the first true leaves and emerge after the cotyledons.
2. Once the class understands the different parts of the seed, demonstrate how to dissect the bean seed. A document reader can be helpful here so the class can easily see how to dissect and the parts they are looking for.
3. To dissect the bean, carefully remove the seed coat with your fingernails. Then separate the two halves (cotyledons). Inside you should find the tiny first leaves and the embryonic root.
4. Pass out a bean seed and magnifying glass to each student or pair. Have them carefully dissect the bean and find the various parts.
5. Walk around and make sure all of the students understand the various parts of the bean seed before moving on to the second half of the activity.
6. Explain that the class will now get to germinate seeds to figure out if they are viable.
7. Pass out a moist paper towel folded into quarters and 10 onion seeds to each group. Have the students place the seeds evenly on one edge of the towel. Roll up the towel and place in a plastic bag. Label with the date and seed variety.
8. Once a day for the next week, have the class gently remove and unroll their towel. Blow on the seeds to give them some carbon dioxide. While the towel is unrolled, have the students record

the number of seeds that are germinated and note any changes in appearance.

9. Seeds are viable if 60% or more germinate within 5-7 days. Below 50% germination, seeds are considered non-viable. Have students do the math to figure out if their seeds are viable.

Snack & Conclusion (15 minutes)

1. Review with the class the different parts of the seed. Have the class choose one part and write in their journal its name and purpose.
2. Have a seed-based snack such as the Black Bean Dip below. Make sure to clearly discuss which parts of the snack are seeds (black beans, cumin, coriander and pumpkin seeds).

Assessment Tools

- Participation
- Germination observation chart
- Math calculations on germination rate

Possible Modifications and Extensions

- Consider doing only the dissection of the seed or germination test and use the other half of the class to plant seeds for the classroom grow lab.
- Make connections to what types of foods are seeds and why they are so healthy for us (high in protein, healthy fats and many nutrients).
- Compare germination rates between seeds from different years or different varieties.

Black Bean Dip and Pumpkin Seed Garnish

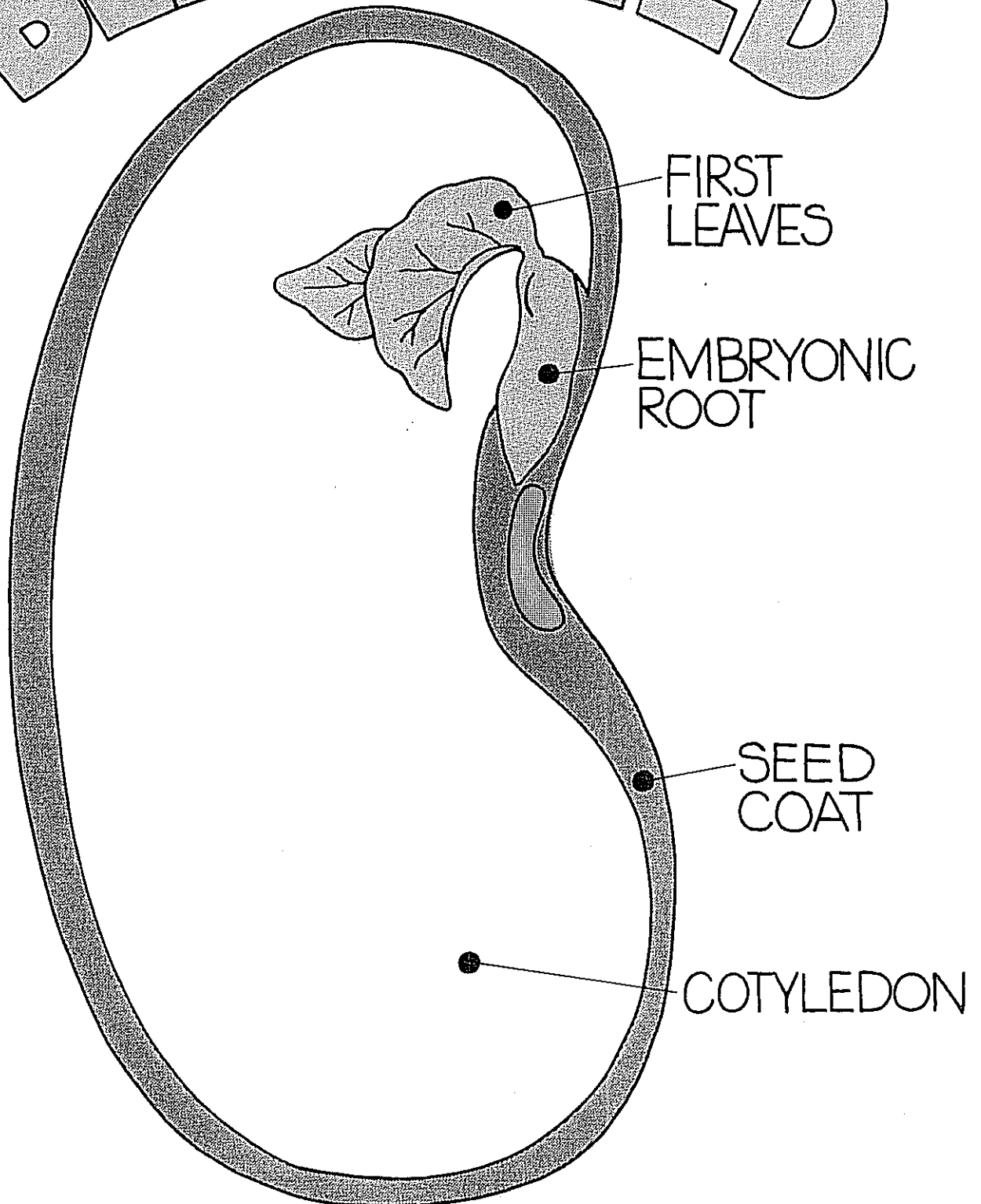
- | | |
|-----------------------------|------------------------------|
| • 2 cans cooked black beans | • salt and pepper to taste |
| • 1 bunch cilantro | • 1 cup pumpkin seeds |
| • 1/2 red onion | • 1 Tbsp honey |
| • 1 jalapeno | • 1 oz lime juice |
| • 1 Tbsp cumin | • cayenne to taste |
| • 1/2 Tbsp ground coriander | • tortilla chips or crackers |
| • 1/2 lime, juiced | |

Preparation (10 minutes): Put cilantro (without the stems), red onion and jalapeno into a food processor. Pulse until roughly chopped. Remove and set aside. Pulse the black beans in food processor until semi-smooth. Add the cumin, coriander, lime juice and jalapeno mixture. Pulse and season to taste with salt and pepper. For the pumpkin seed garnish, whisk honey and lime juice until combined. Sprinkle with cayenne to taste and toss with the pumpkin seeds. Sprinkle the pumpkin seeds on top of the bean dip and serve with crackers or tortilla chips.

Source

Recipe courtesy of Corey Ferguson

A TRIP INSIDE A BEAN SEED





Leaves Make Food

Lesson

Goals

Students are introduced to the concept of plants being food producers, how leaves make food for the plant using photosynthesis and the connection to healthy eating.

Objectives

Students will begin to understand how leaves make food for the plant and why some leaves are really healthy for you. Students will investigate different varieties of leaves by touching and drawing them and then prepare a recipe using leaves we eat.

Standards

Science: Life Science

GR.2-S.2-GLE.2

GR.5-S.2-GLE.1

Did you know?

Spinach is best eaten straight from the garden. Half of the major nutrients are lost by the eighth day after harvest.

Total Time – 60 minutes

Materials

- Variety of leaf and plant samples (real are much more effective)—use cuttings from houseplants, ask a nursery for a few leaf samples and/or collect any from outside
- Magnifying glasses
- Journals

Method

Introduction (20 minutes)

1. Review with the class the different parts of a plant (roots, stems, seeds, flowers, fruit and leaves). Go over any part that you have discussed in previous lessons. Remind the class that different parts of the plant all work together to make the plant grow and be healthy, just like in a community—all the different people in a community work together to make a community healthy and happy.
2. Acting like a plant, ask the class: *How would you eat if your feet were stuck to the ground? Would you stretch your tongue and catch a passing snack? Could you capture the sun's energy and turn it into food? While we get our energy from food we eat, plants have the ability to make their own food and use it for energy. All living things run on energy they obtain from food. Green plants are food producers. Humans and other animals are food consumers.*
3. Have the class list the different functions of leaves.
 - a. Manufacture food through photosynthesis
 - b. Gas/air exchange (CO₂ to Oxygen)
 - c. Protect vegetative and floral buds
 - d. Transport water
 - e. Store food during germination (cotyledons)
 - f. Collect water for roots (funnel shaped)

- g. Provide shade for roots and stem
 - h. Flat to provide a lot of surface area for photosynthesis, gas exchange and water transportation
4. Explain to the class: *Plants make their own food and leaves are the food-making machines (autotrophs) during the process of photosynthesis. They are able to turn water, carbon dioxide and sunlight into a nutritious substance called glucose, which in turn provides sustenance for plants and trees. This sugar, glucose, is the source of food used by most plants and then by all other consumers (heterotrophs) like us when we eat the plants.*

Chlorophyll is the green pigment in plants that traps the light's energy when light strikes the plant. Water molecules are taken up by the roots and transported to the leaves, split into hydrogen and oxygen, using the captured light energy.

With photosynthesis, plants take in carbon dioxide and release oxygen. How do you think this affects humans? (Without plants there would not be enough oxygen replaced in the environment to support life. Make a connection to global warming and the importance of not cutting down all the forests.)

5. Once the class understands the basics of photosynthesis, make the connection to healthy eating. Have the class think of different leaves we eat (lettuce, spinach, kale, herbs, cabbage, etc).
6. Emphasize why leaves are healthy (they contain high levels of minerals, vitamins and phytochemicals) and how this relates to photosynthesis (leaves are nutrient rich because this is where the food is being produced). If you have covered vitamins and phytochemicals, here is a great time to make a connection. Remind the class that the healthiest leaves are the darkest ones (spinach, kale, red leaf lettuce, etc).

Activity (25 minutes)

1. Have your leaf cutting examples in a non-see through bag. Pull each sample out individually so each leaf you pull out surprises the students.
2. Identify the plants the leaves belong to. It is helpful to show and discuss why different plants have different leaves.
3. Give each student or group a leaf sample. Have them examine the leaf—looking at the veins under a magnifying glass. Have them draw the leaf and write a few sentences about why the leaf is neat or special.

Snack & Conclusion (15 minutes)

1. Have a snack that includes leaves, such as Lettuce Wraps. Discuss the different parts of the snack and which part of the plant each item is. See if the class is able to identify all the plant parts.
2. Have the class write in their journals two new facts they learned about leaves. Have a few students share their insights.

Assessment Tools

- Participation
- Journals

Possible Modifications and Extensions

- You could easily do this lesson in the fall and connect it to the changing of the leaves.
- Consider extending the lesson and discussing how leaves can be used for propagation.
- Have a leaf taste test with different edible leaves. You may want to try some cooked and some raw or try them both ways. Ideas include: spinach, lettuces, swiss chard, cabbages, arugula, endive, watercress, kale, mizuna and radicchio.

Vocabulary Words

- *photosynthesis* – the process that occurs inside plants, which converts light energy (sunlight), carbon dioxide, chlorophyll and water into sugar and oxygen
- *chlorophyll* – green pigment in plants that traps the light's energy
- *autotroph* – a food producer (plants)
- *heterotroph* – a food consumer (animals)

Lettuce Wraps

This is a great recipe to follow up the leaf lesson and can help reinforce other plant parts we eat. Below are two different options for fillings.

- Large lettuce leaves, washed and dried
- Toothpicks

Southwest Filling

- Black beans
- Corn, fresh or frozen kernels
- Tomatoes, chopped
- Cilantro, chopped
- Cheese, grated
- Salsa

Asian Filling

- Veggies of choice (carrots, cabbage, snow peas, etc)
- Cilantro, chopped
- Peanut sauce (store bought or mix peanut butter soy sauce, sugar and chili sauce)

Preparation (10 minutes): Mix all ingredients together in a bowl. Spoon a couple of tablespoons into each lettuce leaf. Wrap and secure with a toothpick.

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Rooting for Roots

Lesson

Goals

Students will learn about different types of roots and the functions of roots.

Objectives

Students will be able to identify different roots that we eat and why we include them in our diet. They will also be able to identify different types of roots and explain their various functions.

Colorado Academic Standards

Science: Life Science

GR.2-S.2-GLE.2

GR.5-S.2-GLE.1

Did you know?

Aspen trees that grow near each other often share the same roots. This makes Pando, an Aspen tree grove in Utah, the world's largest organism. It includes 47,000 stems and covers 107 acres. It is thought to be 80,000 years old.

Total Time – 60 minutes and follow-up one week later

Materials

- Examples of roots (carrots, beets, radishes, daikon radishes, scallions, living lettuce, celery root, etc)
- 1 or 2 large carrots
- 5 or more clear plastic cups
- Radish and lettuce seeds
- Germination mix
- Rocks
- Water
- Journal
- Snack (see end of lesson)

Vocabulary

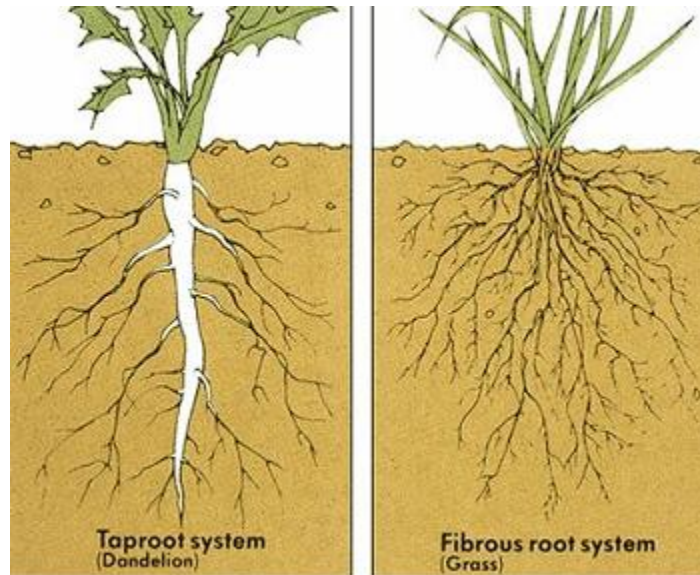
roots	functions	taproot
edible	fibrous	function
eroding	germination mix	hypothesis

Method

Introduction (15 minutes)

1. Review with the class the different parts of a plant (roots, stems, seeds, flowers, fruit and leaves). Go over any part that you have discussed in previous lessons. Remind the class that different parts of the plant all work together to make the plant grow and be healthy, just like in a community—all the different people in a community work together to make a community healthy and happy.
2. Have the class list all that they know about roots. Then have them list roots that are commonly eaten (carrots, radishes, beets, etc).

3. Discuss with the class the different types of roots, while showing examples (these can be brought in or you can pull them up online from the websites listed at the end of the lesson).
 - a. Taproots grow somewhat straight and vertically down. Plants with taproots are difficult to transplant. Edible examples include: carrots, beets and radishes. A non-edible example is a dandelion.
 - b. Fibrous roots are more of a mass of small, entangled roots that grow directly from the stem. Examples include: onions, lettuce, tomatoes, grasses and corn. They often remind the class of hair.



4. Once the class understands the difference between a taproot and a fibrous root, it is time to move on to the functions of the roots.
 - a. Roots anchor and provide support for the plant.
 - b. Roots absorb the water and nutrients necessary for plant growth.
 - c. Roots prevent soil from eroding.
 - d. Roots increase organic material and help with moisture retention as they decompose (acting like a blanket).
 - e. Roots store sugars and carbohydrates.

Activity (35 minutes)

1. Cut off 2" from the top of each carrot. Remove any old leaves. Place the carrot top cut side down in a plastic cup. Add water until the carrot is halfway covered. Place rocks around the carrot to hold it in place. Put the bowl in a bright place, but not too sunny or too hot. Make sure there is always water in the container.
2. Have the class predict what will happen to the carrot. Have the students write their predictions in their journals. Why do they predict that? (Soon feathery green leaves will emerge. Since the carrot is only 2", the plant will eventually die because it does not have enough food.)
3. Break the class up into four groups. Have each group fill a plastic cup with germination mix.

4. Give group one ten radish seeds to place on top of the germination mix in their plastics cups. Have group two do the same with only three radish seeds. Group three will get ten lettuce seeds and group four will get three lettuce seeds. Have each group try to place some of the seeds near the edges of the container so they can watch the roots grow.
5. Lightly sprinkle germination mix over the seeds. Label each cup.
6. Water the seeds and place in a warm sunny location.
7. Have the class write in their journals what they will predict will happen in each cup and why. (Within a week the seeds will germinate and begin to grow. Initially the cups with ten seeds will look wonderful, but over time these cups will fail because they do not have enough room for the roots to develop. The radishes will develop taproots and the lettuce will develop fibrous roots.)
8. Follow-up: Continue to fill carrot container with water and keep seeds moist. Check on them regularly. A week or so later, have the class check their predictions and see if they were right.

Conclusion (5 minutes)

Have the class write in their journals one cool new fact they learned about roots today and their favorite root and why.

Snack (5 minutes)

Hand out the Root Vegetable Salad with Parsnip Puree and discuss the different roots the class is eating.

Assessment Tools

- Journals
- Participation

Modifications

- Check out the following websites and share the images with the class.

- Information about Pando, the world's largest organism:

<http://watchingtheworldwakeup.blogspot.com/2008/08/unbearable-lightness-of-aspen-part-1.html>

- Images of the largest and heaviest carrots:

<http://www.carrotmuseum.co.uk/record.html>

- Have the students illustrate in their journal one example of a tap root plant and one example of a fibrous root plant

Extensions

- Have the students hypothesize why certain plants have taproots while others have fibrous roots in journal.

Root Vegetable Salad with Parsnip Puree

- 2 carrots
- 2 parsnips
- 2 turnips
- 1 bunch of radishes
- 1 jicama
- 6 oz arugula
- 1 oz lemon juice
- 3 oz olive oil
- 2 garlic cloves
- 1 or 2 oz milk or water
- salt and pepper to taste

Preparation (1 hour): Chop parsnips. Rub parsnips and garlic cloves with a little olive oil. Wrap in aluminum foil. Place in 400 degree oven for 45 minutes or until cooked through. Place parsnips and garlic in blender and puree with milk (or water) until smooth. Season with salt and pepper and set aside. Make a simple vinaigrette by whisking the olive oil and lemon juice together. Season with salt and pepper. Grate the carrots and thinly slice the radishes and turnips. Peel and julienne the jicama. Combine carrots, radishes, turnips and jicama with arugula. Toss the ingredients with vinaigrette. Serve on top of a the parsnip puree.

Source

Recipe courtesy of Corey Ferguson

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Spring Planting

Lesson

Goals

Students learn about early spring crops and how to transplant seedlings.

Objectives

Students will plant spring crops and transplant seedlings from flats to the garden.

Standards

Science: Life Science

GR.2-S.2-GLE.1

GR.4-S.2-GLE.3

Total Time – 60 minutes

Materials

- Soil preparation tools (e.g. spading forks, rakes)
- Measurement tools (rulers, yardsticks or tape measures)
- Sticks (to mark mound locations)
- Trowels
- Spring seeds (peas, spinach, lettuce, beets, radishes, Swiss chard)
- Seedlings ready to be transplanted
- Garden snack
- Journals

Did you know?

A study done by the Centers for Disease Control and Prevention found that increased amounts of physical fitness translated into higher academic achievement. And working in the garden increases physical activity. So gardening makes you smarter!

Vocabulary

cool season crops/plants

seedling

Background for Teachers

The purpose of transplanting is to give the plants more space so they can become productive. It is important to handle the roots as little as possible when transplanting seedlings. Teach students to hold plants at the base of the stem. For younger students, you may want to dig the holes where the plant is to be planted. Use the “Vegetable Planting Guide” (end of lesson) to determine spacing needs. The “Companion Planting Guide” (end of lesson) will assist you in intercropping plants that are beneficial to each other. Seedlings need to be transplanted when they are overcrowded in the flat, have their first true leaves or both. Note: The first leaves to emerge are called cotyledons and are not true leaves. Plants that can handle light frost can be planted as early as April and up to the end of May. Earlier is better for longer living cool season crops.

This lesson is a great follow up to the “Dig In!” lesson:

http://dug.org/storage/school-garden-curriculum/Dig_In.pdf.

Method

Introduction (15 minutes)

1. Discuss with the class: *Now that our garden soil is turned and has been fed with our compost it is ready to start growing cool season plants. Does anyone know what cool season crops are?* (Plants that can handle light frost and cooler soil temperatures, such as peas, lettuce, spinach, root crops, etc.) *We are also ready to give our seedlings a new home. The seedling is like a baby. How do we handle it carefully?* (Squeeze it gently out of the flat; don't touch the roots.) *Visualize the plants when they will be big. What kind of space will our plants need? When the plants are put back in the ground, how will we get the soil to stick to the roots?* (Press the plant firmly into the soil and water it well.)

Activity (35 minutes)

1. Mark the spaces in the bed where transplants and seeds will be planted.

FOR TRANSPLANTS:

2. Have students dig a hole two times the size of the root ball for each plant.
3. Demonstrate how to remove the seedling from the flat, shading the roots from the sun to prevent the roots drying out and handling from the base of the stem gently.
4. Demonstrate how to separate the plants carefully. Think them apart, trying not to break too many roots and keeping as much soil around them as possible.
5. Hand each student a seedling, making sure to hold it by the base of the stem.
6. Help students plant each seedling gently by holding it at the stem, having the roots fall straight down, gently covering the roots with dirt up to the first set of leaves, and pressing the soil firmly around the plant.
7. Water the plants and label them.

FOR SEEDS:

8. Have students dig a row as deep as the seeds need to be planted (see seed packet for instructions).
9. Pour a small handful of seeds into the students' hands, helping them space them appropriately (see seed package), explaining to them the need to place one seed gently in the hole at a time and not to hurry.
10. Have the students gently push the removed soil from the row back onto the seeds, like sealing an envelope. Do not pack the soil down, but simply cover the seeds.
11. Water the seeds and label the row.

TRANSPLANTING SEEDLINGS INTO POTS:

12. Seedlings may be transplanted into slightly larger single pots (4") for a plant sale or for students to take home. To transplant into pots, place potting soil in the bottom of pot just enough for

seedling top to be slightly lower than pot top. Add potting soil on top of seedling and lightly packing it in.

Conclusion (10 minutes)

Discuss or write in journals: *Why is it necessary to transplant seedlings? How did you determine how much space to leave between plants? How will you care for your transplants and seeds?*

Assessment Tools

- Participation
- Journals

Modifications

- Have students write in their journals or discuss why we transplant our seedlings.

Extensions

- Have the class come up with a plan for a plant sale, including which plants to sell, prices and an advertising plan.

Source

Jaffe, Roberta, and Gary Appel. *The Growing Classroom: Garden-based Science*. South Burlington, VT: National Gardening Association, 2007.

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Vegetable Planting Guide

Vegetable	Warm Weather	Cool Weather	Sow Indoors	Sow Direct	Spring Planting		Fall Planting**
					Start Seeds*	Set Out *	
Bush Beans	•			•	3-4 before	1-2 after	12 before
Pole Beans	•			•	3-4 before	1-2 after	12 before
Beets	•			•		2-4 before	8-10 before
Broccoli		•	•		5-8 before	5-8 before	14-17 before
Brussel Sprouts		•	•		5-8 before	4-6 before	17 before
Cabbage		•	•		4-6 before	5 before	13-14 before
Carrots	•	•		•		2-4 before	13 before
Cauliflower		•	•		5-8 before	1-2 before	14 before
Celery	•		•		8-10 before	2-3 before	19 before
Chard	•	•		•		2-4 before	6 before
Corn	•			•	3-4 before	1-2 after	6 before
Cucumber	•			•	2-3 before	1-2 after	11 ½ before
Eggplant	•		•		6-8 before	2-3 after	14 before
Garlic		•		•		6 before	Sept. w/mulch
Kale		•	•			5 bef, 2 aft	6-8 before
Kohlrabi		•	•			5 bef, 2 aft	10 before
Leeks		•	•		8-10 before	5 before	
Lettuce	•	•	•			2-4 b, 2 aft	6-8 before
Onion		•	•			3 bef, 2 aft	8 after spring
Parsley	•	•	•	•	4-6 before	1-2 after	
Peas		•		•		4-6 b, 2-3 a	12 before
Peppers	•		•			1-3 after	
Potatoes	•			•		4-6 before	
Pumpkin	•			•		after frost	
Radish	•	•		•		4-6 before	7 before
Spinach	•	•		•		3-6 before	6-8 before
Squash, Summer	•			•		1-4 after	10 before
Squash, Winter	•		•			2 after	13 before
Tomatoes	•		•			2-4 after	

* Weeks before or after last frost ** Weeks before first frost

Vegetable	Days to Emerge	Days to Harvest	Spacing of Plants (inches)	Depth to Plant Seeds (inches)	Soil Temp. for Germination	Best Air Temp. for Growing
Bush Beans	4-10	50-60	6	1	60-85	60-80
Pole Beans	4-10	60-70	6-8	1	60-85	60-80
Beets	7-10	50-80	2-4	½	60-75	50-75
Broccoli	5-10	80-100	15-18	¼	50-65	60-75
Brussel Sprouts	8-10	100-110	18	¼	65-75	55-70
Cabbage	4-10	80-100	18	¼	50-75	50-75
Carrots	10-17	50-75	2	¼	55-75	45-75
Cauliflower	5-10	60-80	15-18	¼	50-75	60-72
Celery	7-12	90-120	6	¼	50-75	60-75
Chard	7-14	45-55	8	1	40-70	45-70
Corn	3-10	90-110	12-15	1	55-85	50-95
Cucumber	3-8	60	12-24	1	65-85	60-80
Eggplant	5-13	90	18	½	65-85	65-85
Garlic		180-200	4-6	½		
Kale		100-120	15	½	40-70	40-70
Kohlrabi	5-10	50-70	6-9	¼	50-75	40-75
Leeks	7-14	130-160	4-6	½	below 70	60
Lettuce	2-10	60-80	10-12	¼	45-70	55-70
Onion	4-12	85-200	4	¼	50-80	60-85
Parsley	11-27	70-90	4	¼		
Peas	6-15	60-80	4	1	40-75	55-75
Peppers	8-20	80-100	10-12	12	65-85	65-85
Potatoes	10-15	140-160	10-12	6	60-65	60-80
Pumpkin	7-10	110-130	36	1	65-85	50-90
Radish	3-10	25-40	1	¼	40-85	45-75
Spinach	6-14	50-55	4-8	¼	60-70	40-75
Squash, Summer	3-12	50-60	15-24	1	65-85	60-85
Squash, Winter	4-10	80-120	24-36	½ - 1	65-85	60-85
Tomatoes	6-14	80-100	18-24	¼ - ½	65-85	65-85

Vegetable Planting Guide

Additional Comments

Bush Beans: Sensitive to transplanting; pinch extra plants, don't pull them. Pick every 3-7 days.

Pole Beans: Sensitive to transplanting; pinch extra plants, don't pull them. Pick every 3-7 days.

Beets: Thin when young and cook tops as greens.

Broccoli: Keep cool to get stocky plants, but don't go below 40° F. Transplant into beds up to first true leaves. Harvest main head when buds begin to loosen. Side heads will form after first head is cut.

Brussel Sprouts: Keep cool to get stocky plants, but don't get below 40° F. Harvest sprouts when they are 1 ½" wide. Pick lower ones first.

Cabbage: Harvest when head is formed. Keep cool to get stocky but don't go below 40° F.

Carrots: Thin early; harvest any size.

Cauliflower: Tie outer leaves around head to protect from sun. Likes between 57°- 68° F.

Celery: Must go below 60° F at night for seeds to germinate. Requires a lot of nutrients and water.

Chard: Cut leaves close to ground when 8-10" high. Harvest outer leaves first.

Corn: Sensitive to transplanting, pinch extra plants. Plant in blocks, harvest when kernels are milky.

Cucumber: Somewhat sensitive to transplanting; pinch extra plants. Mound soil into hills; plant 3 seeds per hill.

Eggplant: Grows well in hot weather.

Garlic: Harvest when tops start to die.

Kale: Keep cool to get stocky plants, but not below 40° F. Cut outer leaves closer to stem when 10" or longer.

Kohlrabi: Keep cool to get stocky plants, but not below 40° F. Harvest when bulb is 3" in diameter.

Leeks: Keep cool to get stocky plants, but not below 40° F. Plant out when 4" high.

Lettuce: Keep cool to get stocky plants, but not below 40° F. Hard lettuce likes repotting. Plant successively every two weeks. Will go to seed in high temperatures. Harvest outer leaves of leaf lettuce vs. head.

Onion: Harvest when tips start to die back.

Parsley: Soak seeds overnight to speed germination. Cut outer leaves near stem.

Peas: Sensitive to transplanting, pinch extra plants, don't pull them. Harvest frequently.

Peppers: Sensitive to cold, harden off gradually. Green peppers turn red when ripe.

Potatoes: Very tender; cannot tolerate frost. Dig up with digging fork after tops have flowered.

Pumpkin: Sensitive to transplanting; pinch, don't pull plants. Plant in hills, 3-4 plants per hill, 6-8 ft. apart.

Radish: Plant every 10 days. Will get woody when over mature.

Spinach: Keep cool for stocky plants. Plant every 2 weeks. Will go to seed in hot weather.

Squash, Summer: Sensitive to transplanting; pinch extra plants, don't pull them. Harvest frequently.

Squash, Winter: Sensitive to transplanting; pinch extra plants, don't pull. Can store through the winter.

Tomatoes: Prefers warm days and cool nights.

Sources

Adapted from *Organic Gardening and Farming*, February 1972, pp. 32-33, 54, and *The Encyclopedia of Organic Gardening*, Rodale Press, Inc., 1978, pp. 233-235.

Companion Planting Guide

Vegetable	Plant with	Do not plant with
Beans	Potatoes, carrots, cucumbers, cauliflower, cabbage, summer savory, most other vegetables and herbs	Onions, garlic, gladiolus
Beans, Bush	Potatoes, cucumbers, corn, celery, summer savory, sunflowers, strawberries	Onions
Beans, Pole	Corn, summer savory	Onions, beets, kohlrabi, sunflower
Beets	Onions, kohlrabi	Pole beans
Cabbage Family (cabbage, cauliflower, kale, kohlrabi, broccoli)	Aromatic plants, potatoes, celery, dill, chamomile, sage, peppermint, rosemary, beets, onions, thyme, lavender	Strawberries, tomatoes, pole beans
Carrots	Peas, leaf lettuce, chives, onions, leek, rosemary, sage, tomatoes	Dill
Celery	Leek, tomatoes, bush beans, cucumbers, pumpkin, squash	
Corn	Potatoes, peas, beans, cucumbers, squash, pumpkin	
Cucumbers	Beans, corn, peas, radishes, sunflowers	Potatoes, aromatic herbs
Eggplant	Beans	
Leek	Onions, celery, carrots	
Lettuce	Carrots and radishes (lettuce, carrots, and radishes make strong team grown together), strawberries, cucumbers	
Onion/Garlic	Beets, strawberries, tomato, lettuce, summer savory, chamomile, beans (protects against ants)	Peas
Parsley	Tomatoes, asparagus	
Peas	Carrots, turnips, radishes, cucumbers, corn, beans, most vegetables, herbs (adds Nitrogen to soil)	Onions, garlic, gladiolus, potatoes
Potato	Beans, corn, cabbage, horseradish (should be planted at corners of patch), marigold, eggplant (as a lure for Colorado potato beetle)	Pumpkins, squash, cucumber, sunflower, tomato, raspberries
Pumpkin	Corn	Potatoes
Radish	Peas, nasturtium, lettuce, cucumbers	
Soybeans	Grows with anything; helps everything	
Spinach	Strawberries	
Squash	Nasturtium, corn	
Sunflower	Cucumbers	Potatoes
Strawberry	Bush Beans	
Tomatoes	Chives, onion, parsley, asparagus, marigold, nasturtiums, carrots, limas	Kohlrabi, potatoes, fennel, cabbage
Turnip	Peas	

Herbs	Companions and Effects
Basil	Companion to tomatoes; improves growth and flavor; repels mosquitoes and flies; dislikes rue intensely.
Beebalm	Companion to tomatoes; improves growth and flavor.
Borage	Companion to tomatoes, squash, and strawberries; deters tomato worm; improves flavor and growth.
Caraway	Plant here and there; loosens soil.
Catnip	Plant in borders; deters flea beetle.
Chamomile	Companion to cabbages and onions; improves growth and flavor.
Chervil	Radishes; improves growth and flavor.
Chives	Companion to carrots; improves growth and flavor; plant around base of fruit trees to discourage insects climbing trunks.
Dill	Dislikes carrots; improves growth and health of cabbage.
Fennel	Plant away from garden; most plants dislike it.
Garlic	Plant near roses and raspberries; deters Japanese beetle; improves growth and health; plant liberally throughout garden to deter pests.
Horseradish	Plant at corners of potato patch to deter potato bugs.
Hyssop	Companion to cabbage and grapes; deters cabbage moth; keep away from radishes.
Lamb's Quarters	This edible weed should be allowed to grow in moderate amounts in the garden, especially in the corn.
Lemon Balm	Sprinkle throughout garden.
Marigolds	The workhorse of the pest deterrents; plant throughout garden especially with tomatoes; discourages Mexican bean beetles, nematodes, and other insects.
Mint	Companion to cabbage and tomatoes; improves health and flavor; deters white cabbage moth.
Marjoram	Plant here and there in garden; improves flavor.
Nasturtium	Companion to tomatoes and cucumbers.
Petunia	Protects beans; beneficial throughout garden.
Purslane	This edible weed makes good ground cover in the corn.
Pigweed	One of the best weeds for pumping nutrients from the subsoil, it is especially beneficial to potatoes, onions, and corn; keep weeds thinned.
Rosemary	Companion to cabbage, bean, carrots, and sage; deters cabbage moth, bean beetles, and carrot fly.
Rue	Keep it far away from sweet basil; plant near roses and raspberries; deters Japanese beetle.
Sage	Plant with rosemary, cabbage, carrots, beans, and peas; keep away from cucumbers; deters cabbage moth and carrot fly.
Summer Savory	Plant with beans and onions, improves growth and flavor; deters bean beetles.
Tansy	Plant under fruit trees; companion to roses and raspberries; deters flying insects, Japanese beetles, stipend cucumber beetles, squash bugs, and ants.
Tarragon	Good throughout the garden.
Thyme	Plant here and there in the garden; it deters cabbage worm.
Yarrow	Plant along borders and near aromatic herbs; enhances essential oil production.

Sources

Adapted from *Organic Gardening and Farming*, February 1972, pp. 32-33, 54, and *The Encyclopedia of Organic Gardening*, Rodale Press, Inc., 1978, pp. 233-235.



What a Stem

Lesson

Goals

Students learn how materials are transported through plants by examining how stems and other objects conduct water.

Objectives

Students will consider and explore the forms and functions of stems by observing and comparing the transport action of plant stems and other objects.

Standards

Science: Life Science

GR.2-S.2-GLE.2

GR.5-S.2-GLE.1

Did you know?

Potatoes and gingerroot are actually stems and not roots.

Total Time – 45 minutes (15 minutes day one, 30 minutes day two)

Materials

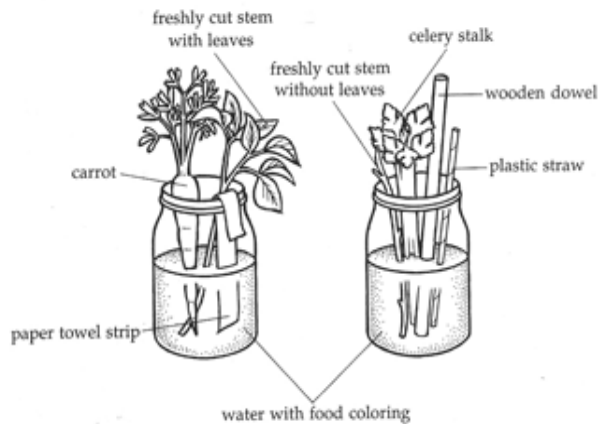
- Pictures of plants and trees
- Assorted materials that might transport water (e.g. celery, carnations, wooden dowel, plastic straws, carrots, paper towel strips)
- Glass jars
- Food coloring
- Hand lenses

Method

Introduction (Day one, 15 minutes)

1. Show your students different plants or pictures of plants, including trees, and then point out the stem in each image. Explain to your students that just as each of their body parts have particular jobs to do, each part of the plant has special jobs to do too.
2. Have the students generate a list of the possible jobs of stems. List them on the board.
 - a. Transports water, nutrients and the produces of photosynthesis
 - b. Supports leaves, flowers and fruit
 - c. Stores water (such as for a cactus)
 - d. Can be used as a method of asexual reproduction in many plants
3. If students' ideas did not include the job that stems transport water, ask: *If you water the roots of a wilting plant, what happens to the plant? How do you think the water starts in the roots and ends up in the leaves?* Tell the students: *Although plant stems have several different jobs, during this activity we are going to focus mainly on the water-carrying job.*
4. Have the class answer the following question: *What will happen if we leave a plant stem and other objects in colored water overnight?* Have the class record their predictions.

- Set up the following and let sit undisturbed for 24 hours.



Activity (Day two, 15 minutes)

- Pull the items out of the colored water. Wash or blot off excess colored water from the objects.
- Give each student (or group) an object and a hand lens to observe how the colored water traveled through the object. Have the students compare the heights the colored water reached.
- Have the class answer: *How does what happened compare with your predictions?*
- Have the students record their results by using colored pencils or crayons to illustrate the height the colored water traveled in each object. Ask: *What direction does the water seem to travel in the stems?*

Snack & Conclusion (Day two, 10-15 minutes)

- Prepare a stem-based snack, which may include: celery, asparagus, broccoli or rhubarb. An easy stem recipe is included at the end of the lesson.
- Journal or discuss one or more of the following questions:
 - Why do you think the wooden dowel carried the colored water as it did? (Hint: Where does wood come from?)
 - Why do you think the colored water did not rise in the plastic straw? What do you have to do to get your drink to rise in a plastic straw?
 - In plants, where do you think the materials inside the stem are going? From where do you think the materials in the stem are coming?
 - What do you think would happen to a plant if its stem were broken? How could you set up a test to find out?
 - How does the water you drink reach the rest of your body?
 - Do you eat stems? If so, which ones? How else do people use stems?

Assessment Tools

- Participation
- Critical thinking
- Journals

Possible Modifications and Extensions

- Turn this into a one-day lesson by presoaking all of the objects. Make sure to have samples of the objects before they were soaked.
- Compare the rate the colored water travels up the stems in light and dark conditions.
- Make tie-dyed flowers. Take a white carnation or rose and carefully slice the bottom of the stem lengthwise into multiple sections (2-4). Leave 3-5" of stem attached near the flower head. Put each section in a jar with different colored water. Let sit for two days. Have students predict what the flower will look like.
- Have a stem scavenger hung outside. Search for stems with different characteristics such as rough, thorny, flexible, green, large, etc.
- Grow some underground stems such as tubers (white potatoes), corms (crocus), bulbs (tulips, daffodils) or rhizomes (iris, ginger).
 - Plant some gingerroot in a 4" pot. Place a 1" piece of ginger $\frac{3}{4}$ " below the surface of the potting mix. Keep moist and wait patiently for the grass like shoots to develop. Rub the leaves to find out if they have the same aroma as ginger.
 - Three different ways to plant a potato:
 - Fill a container halfway with soil. Lay the potatoes on the soil and cover them with 1" of soil. Water until slightly damp and place in a sunny warm place. In a week or so you should see leaves. After several weeks you may see some purple flowers too. If your container is large enough, you may also get little potatoes underground. When you dig up little potatoes make sure to show how they are extensions of the stems.
 - Put a potato in a clean jar so only the bottom stays wet. You may need to use toothpicks to hold it up. Eventually roots will sprout out of the bottom and stems and leaves will grow out of the top. Change the water once a week. If the plant does not start growing in two weeks the potato may have been treated so it will not sprout. Start over.
 - Use potatoes that have little white sprouts on them. Cut them into pieces so that there are three sprouts on each piece. Let them dry overnight. Fill an empty clean $\frac{1}{2}$ gallon milk container with soil. Place this container in an old pie pan so the water does not leak all over. Plant the potato pieces under about 3" of soil. Put the cut side down and the sprouts up. Water until damp. This is how farmers plant their potatoes.

Sources

Lesson adapted from: *Plants Alive! Transport and Support & Gardening Wizardry for Kids*

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