Lessons about SEEDS, PLANTS & EVERYTHING A PLANT NEEDS!

Lessons compiled by

The New Jersey Agricultural Society's

LEARNING THROUGH GARDENING

Program

March 2022

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A MAZE FOR PLANTS - DISCOVERING PHOTOTROPISM

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

This experiment will prove to your students that even though plants are stuck in one place in the soil, they can move. Plants will turn and stretch toward the light. This phenomenon is known as phototropism. Students create a maze for a climbing plant, such as beans or peas. Then they check the maze daily to see if their plant can find its way to the light.

This is a great experiment to do when discussing the difference between living and non-living things.

GRADES: PreK-5, Younger grades can do this as a whole-class experiment, with the teacher creating the maze for the students to observe.

OBJECTIVES

The student will be able to:
• explain that plants move toward the light, and why
• explain how they can prove plants move toward the light
• record the day-to-day results of an experiment

MATERIALS NEEDED

- Shoe boxes, enough for each group of three or four students, or one if you are demonstrating the experiment to the whole class
- Small plant containers filled with soil, one for each shoe box, about 3-4 inches high. Half Pint milk cartons from the cafeteria will work fine – just be sure to poke some drainage holes in the bottom.
- Pole bean or pea seeds (Make sure the seed package says ‘pole’ beans and not ‘bush’ beans. Pole beans are the ones that grow on a vine.)
- Scraps of light cardboard (like that used for posters)

- Dark tape such as duct tape or masking tape
- Transparent tape
- Rulers
- Optional: science journals

PREPARATION

Before starting the activity, use a sharp knife to cut a rectangular hole in one small end of each shoe box. To make creating the maze easier for students, it is a good idea to put together a model shoe box maze according to the instructions below, so that students can visualize their instructions.

INTRODUCTION

Begin the discussion by asking students how they know something is alive. Encourage answers such as grow, breathe, reproduce, move, eat or require nourishment. Next ask how we know that plants are alive.

Ask the students what plants need to live. Ask if plants move. Ask if they have ever seen a plant move. Ask why they think a plant would move. Discuss their answers.

Next, tell students that they are going to do an experiment to prove that plants will move toward the light. Ask students if they know what a maze is and if they have ever seen one. (Answers may include a corn maze, a hedge maze, or a puzzle maze drawn on paper.) Now tell students they are going to create a maze that a plant will have to solve to reach the light.

ACTIVITY

Divide students into groups of three or four to make the mazes and give each group a prepared shoe box. Ask the students to hold the boxes up to the light. If there are any spaces where light shines through (except the cut hole on top), have students tape over the spaces with the dark tape.

Making the maze:

Distribute the cardboard, rulers, and transparent tape. Give the students the following instructions or write them on the board:

1. Measure two pieces of cardboard into rectangles so that: Two parallel sides are half the width of the shoe box The other two parallel sides are the same height of the shoe box.
2. Measure the length of the shoe box and divide by three. Make a mark at the points at one-third and two-thirds of the box.
3. Tape one cut cardboard piece on the left side of the box at the one-third mark, lining up the side equal to the height of the box.
4. Tape the other cardboard piece on the right side of the box at the two-thirds mark.

5. Plant two or three pole bean or pea seeds in the small plant container one-inch deep. Water the pot and press the soil down gently.
6. Stand the open shoe box on the small end that does not have the cut whole. Place the small pot gently on its side underneath the first piece of cardboard.
7. Gently place the lid on the box while it is still standing on the uncut small end. The cut end should be facing up.
8. Place the shoe box on a sunny windowsill.

Ask students to check the inside of the box daily and record their observations in their science journals. When checking the box, they should remove the lid very carefully. Remind students that they must water the plant. Check the soil for moisture and stand the pot up and water it whenever the soil is dry. The plant will not grow without water.

Over the next two or three weeks, allow the students to regularly observe the plant as it twists and turns toward the light inside the maze. Students can write their observations in their science journals. When the plants have reached the top of the maze, gather the class, and discuss the results of the experiment.

EVALUATION:

Students write a paragraph or paragraphs (depending on their grade level) explaining what they hoped to prove with the experiment, what they observed during the experiment, and what the conclusion was. Students complete their observations of the experiment in their journals.

EXTENSION:

Have students research other plant tropisms, such as gravitropism or hydrotropism.

NEW JERSEY LEARNING STANDARDS

Science: PreK:5.1.1-5, 5.3.1-4, 5.4.2 K:LS1.C 1:LS1.D 2:LS2.A 3:LS4.C 4:LS1.A 5:PS3.D English Language Arts: K:W.K.2,3 1:W.1.2,7 2:W.2.2,4,8 3:W.3.2.A-D, W.3.4,8 4:W.4.2.A-E, W.4.4,8 5: W.5.2.A-E; W.5.4,8

ALL THE WATER IN THE WORLD

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

This simple activity will give your students a striking picture of how little water on Earth is available for humans, animals, and plants to use. Get your students talking about why it's important to conserve the Earth's water and how they can help.

GRADES: 1-5

OBJECTIVES

The student will be able to:

- Explain why even though almost three-quarters of Earth is covered with water, a very small amount of this water can be used by people, plants, and animals.
- Describe ways people can conserve water on Earth.

MATERIALS NEEDED

- Globe or world map
- 1 gallon water container
- Blue food coloring (optional)
- 1 tablespoon measuring spoon
- 3 clear plastic cups
- Cotton ball
- Eye dropper
- Water labels (included)
- or whiteboard
- Water

PREPARATION

- Fill the gallon container with water and add blue food coloring if desired. The food coloring will make the water more visible.
- Cut out the water labels and fold them into 'tents' so they stand up on the table. You can laminate them for future use. Labels follow the lesson plan.

- Lay out all materials on a table visible to everyone.

ACTIVITY

Show students a globe or world map. Ask them how much of the surface of the earth is covered with water. (The answer is approximately 72%. or almost three-quarters.) Ask students if we can use all the water in the world for drinking, cooking, cleaning, bathing, and all our other needs.

Ask: How much of the water on the earth is available to people, animals, and plants? Hold up the gallon jug filled with water. Explain that the water in the gallon container is a model to represent all the water on Earth. Use the eyedropper to take one drop of water out of the gallon. Put the drop onto the cotton ball, which represents the atmosphere (water in clouds). This is 1/1000 of 1% of the total (a very tiny amount).

Label the cotton ball (atmosphere). Show how much water is potentially available for humans to use by taking 7 tablespoons (3.2 oz.) out of the gallon of water and placing them in a plastic cup. The 7 tablespoons represent all the 2.5% of fresh water on the earth, while the remaining water in the jug (125 oz.) represents the 97.5% of salt water in the oceans.

Label the gallon container Oceans and the plastic cup Fresh Water Take 5 tablespoons out of the cup labeled Fresh Water and place them in a second plastic cup. This is the amount of all freshwater on Earth - 79% - that is frozen in polar ice caps and glaciers. Label the cup Glaciers/Ice Caps. The remaining 2 tablespoons in the Freshwater cup represent groundwater and surface water on the planet.

Use the eyedropper to put 2 drops into the last plastic cup. This is the amount of freshwater found in lakes, rivers, and streams. Label the cup Lakes and Rivers. Show the students the two drops of water in the Lakes and River cup (the surface fresh water). This is all of the freshwater that is readily available to people on Earth.

Cover the label Fresh Water with the label Groundwater. Hold up the cup representing groundwater. Explain to students that this is the amount of groundwater available to people on Earth. Groundwater is water that is trapped underground and must be pumped up using wells. In dry areas of the world where there is little surface water, people must rely exclusively on groundwater. For older students, write the information in the table below on a chalkboard or whiteboard to emphasize the limited fresh water available.

Amount of Water on Earth

- Oceans 97.5%
- Freshwater 2.5%
- Atmosphere 0.001%

Amount of Freshwater on Earth

- Glaciers / Polar Ice Caps
- 79% Groundwater 20%
- Lakes, Rivers, Streams 1%

Divide students into small groups of four or five and ask them to discuss and list ways to preserve the limited amount of freshwater in the ground and on the surface of Earth.

EVALUATION:

Younger students draw a picture showing ways people can conserve water. Students make posters to display around the school on the importance of water conservation. Students write sentences, a paragraph, or essay explaining how little fresh water is available on Earth for people, plants, and animals to use, and include ideas about how to conserve water.

EXTENSION:

Students research ways in which countries around the world are attempting to conserve water. Students write a piece for the school newsletter or website suggesting ways students and staff can conserve water at school and ways families can conserve water at home.

NEW JERSEY LEARNING STANDARDS

Science: 1:LS1A 2:ESS2.C 3:LS2.C, LS4.C 4:ESS2.A 5:ESS2.C, ESS3.C English Language Arts: 1:W.1.2,7 2:W.2.2,4,8 3:W.3.2.A-D, W.3.4,8 4:W.4.2.A-E, W.4.4,8 5: W.5.2.A-E; W.5.4,8

ATMOSPHERE

GLACIERS/
ICE CAPS

GROUND WATER

LAKES/RIVERS/ OCEANS

FRESHWATER

BEAUTIFUL BULBS

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

In this fall planting lesson, students from grade levels PreK-5 learn what bulbs are and how to plant them. Younger students can learn which end of a bulb is up while planting them and older students can dissect a bulb to see its various parts. And everyone can anticipate some beautiful spring flowers by planting bulbs in the fall!

GRADE LEVELS: PreK-5 This lesson can be modified for all grade levels.

OBJECTIVES

The student will be able to:

- Explain that a bulb is a package containing everything needed to grow a new plant – miniature leaves, flower buds, and stem, as well as stored food for the plant to use while it grows.
- Explain the proper way to plant a bulb
- Describe the parts of a bulb. (Older grades)

MATERIALS NEEDED

- Flower bulbs to plant that will bloom the next spring
- Onions to dissect
- Parts of a Bulb worksheet
- Optional: the book From Bulbs to Daffodils, by Ellen Weiss

INTRODUCTION

Tell the students that today you are going to plant bulbs so that they will grow into flowers in the spring. Show the students a bulb and pass it around for them to hold. Explain that a bulb contains everything needed to grow a new plant – miniature leaves, flowers, stem, and the food the plant will need while it grows.

If your students have studied seeds, compare bulbs to seeds. Each contain everything needed to grow a new plant. While most new plants grow from seeds, some plants develop bulbs to make new plants.

Flowers that come from bulbs include: tulips, daffodils, hyacinths, amaryllis and crocuses. Vegetables that come from bulbs include: onions, garlic, scallions, leeks, and fennel.

Explain that flower bulbs must be planted in the fall or early winter so that they will bloom in spring. That is because the bulbs require a long period of cool temperatures to start the biochemical process that causes them to flower.

ACTIVITY

Explain to students that the pointed top of the bulb is where the stem will grow, and the flat, hairy bottom of the bulb is the place from which the roots will grow. Bulbs must be planted pointed side up in order to grow into a plant. Separate older students into small groups and give each group an onion or a tulip bulb.

Have the students cut the bulb in half vertically and use magnifying glasses to see what the bulb contains. Pass out the Parts of a Bulb worksheet.

The parts of a bulb are:

1. Tunic: papery outer covering of the bulb. Not all bulbs have this.
2. Flower bud and immature leaves: the future flower stored in the middle of the bulb for protection
3. Scale leaves: the layers around the future flower that hold the stored food for the plant to use while it grows
4. Basal stem: the thick area at the bottom of the bulb from which the roots grow.

Have your students create a plan showing where they will plant their bulbs. If they are planting large bulbs such as tulips, daffodils, and hyacinths, the bulbs should be planted no more than six inches apart. If they are planting small bulbs such as crocuses, snowdrops, or lilies of the valley, the bulbs should be planted no more than three inches apart. Planting the bulbs: Throw away any bulbs that are soft. The bulb should feel firm.

To plant the bulbs, you can use a bulb planter tool, but it is not necessary. A regular trowel works just as well for planting bulbs. You can dig individual holes for each bulb, or plant several together in a shallow trench. Turn the soil and add organic matter such as compost or peat moss. The directions that come with the bulbs should tell you how deep to plant them. Or you can use this rule: Plant your bulbs twice as deep as the diameter of the bulb (a two-inch diameter bulb would need to go four inches into the ground). Plant the bulb with the pointed end up. Cover the bulbs with soil after planting. Water your new bulb garden when you are finished. Don't forget to visit the flower you have planted the next spring!

EVALUATION:

The student will be able to explain what a bulb is. The student will be able to plant a bulb correctly. The student will be able to identify the different parts of a bulb and explain what each part does (older students).

EXTENSION:

Ask the students to write a paragraph explaining what they have learned about bulbs – what a bulb is and how it should be planted.

~Grow an onion in a jar so that your students can watch the bulb develop into a plant.

- Select a firm onion that has a good root system. The root system is located on the bottom of the onion.
- Fill an empty glass jar three-fourths full of water.

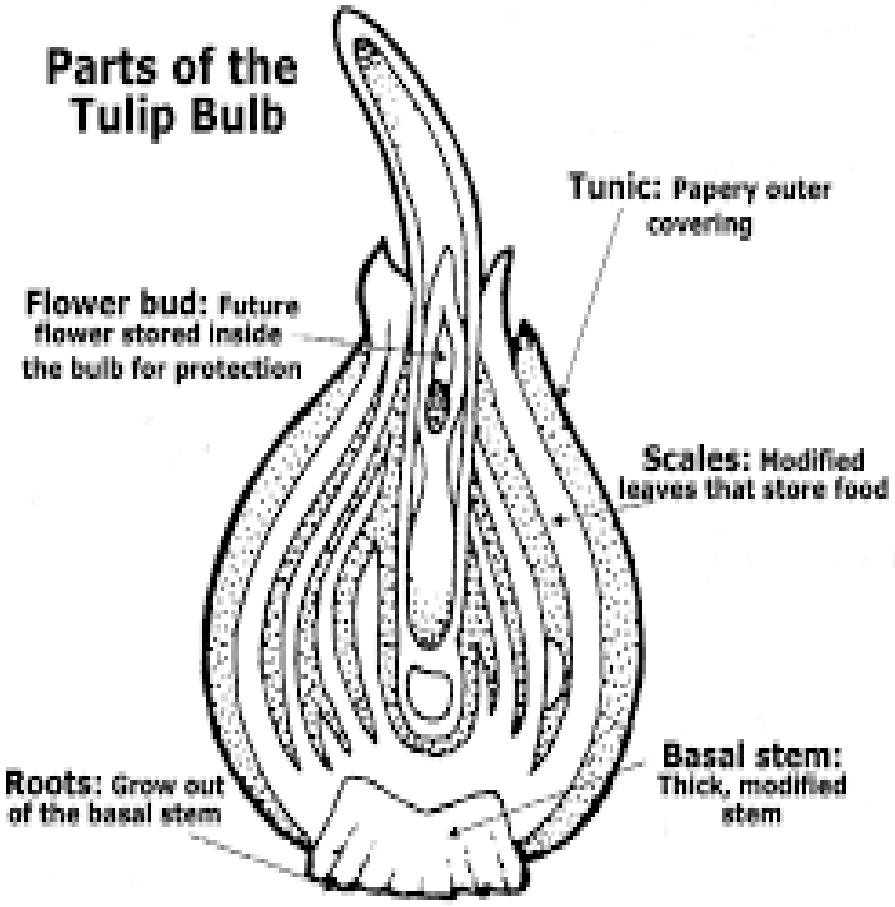
• Stick three toothpicks one inch into the middle of the onion. Space the toothpicks evenly around the bulb. The toothpicks will hold the upper part of the onion out of the water.

• Put the onion bottom into the water with the toothpicks resting on the edge of the jar. Place the jar in a warm location near a window where it receives indirect sunlight. Shoots from the top of the onion will appear in approximately five to seven days.

~Research the history of tulip growing in Holland and how it became a multi-million-dollar industry

NEW JERSEY LEARNING STANDARDS

Science: PreK: 5.1.1-5, 5.3.1-4, 5.4.2 K:LS1.C 1:LS1.A 2:LS2.A 3:LS1.B 4:LS1.A 5:LS1.C


Parts of the Tulip Bulb
Tunic: Papery outer covering
Flower bud: Future flower stored inside the bulb for protection
Scales: Modified leaves that store food
Basal stem: Thick, modified stem
Roots: Grow out of the basal stem

BIRD SEED SURPRISE

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

Students observe an assortment of seeds, then sort them according to different characteristics. Students then plant the seeds to identify conditions seeds need to grow and identify plant parts.

Grade Level: Grades 1-3

OBJECTIVES

Students will:

- Identify seed characteristics
- Sort seeds into categories
- Identify plant parts

MATERIALS NEEDED

- Bag of birdseed
- Potting soil
- Egg carton (one per group)
- Water
- Craft stick

ACTIVITY

Ask students what they know about seeds, what they are, where do they come from, what do we use them for, etc. Give students a scoop of birdseed; have students share their observations. Brainstorm ways that seeds could be sorted: size, shape, color, texture).

Students can sort their seeds using craft sticks as a tool. Use questions to guide discussion including: how are seeds different? Why are they different? What could we do with the seeds?

Divide class into groups. Give each group an egg carton and put them in charge of planting a certain category of seeds. Students should place potting soil, and cover seeds with a thin layer of potting soil. Have students make markers with the craft sticks

to identify the seeds planted in each section of the egg carton. Students should glue an example of the seed planted to the craft stick, then place the craft stick in the appropriate section of the egg carton.

Water egg cartons and place them in a sunny location. Students will observe the plants as they grow. When plants have started to grow, discuss the parts of the plant that have grown. Students should keep learning journals to record observations.

EVALUATION:

Students can pull one plant from the egg carton to observe plant parts. Have students tape their plant to a piece of paper and label the plant parts.

NEW JERSEY LEARNING STANDARDS

Science 5.5.2, 5.5.4, 5.5.9

CAN PLANTS SENSE GRAVITY?

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

Students will conduct an experiment with pumpkin seeds to determine if the direction of root growth remains constant regardless of the position in which the seed is planted.

GRADES: 2-5

OBJECTIVES

The student will be able to:
• explain the effect of gravity on seed germination

MATERIALS NEEDED

- Scientific Investigation worksheet
- Journal
- 8 pumpkin seeds per team
- One clear CD case per team
- Pieces of paper towels
- Plastic quart-size, zipper-seal bag for each CD

INTRODUCTION

Gravity is a strong force that exerts its influence on all things on Earth. Plants contain certain growth-controlling substances that are sensitive to gravity. Plants respond to the pull of gravity by orienting stem growth up and root growth down. This is called gravitropism.

ACTIVITY

Engage student interest by showing them several different seeds and asking if anyone can tell which is the top of the seed and which is the bottom of the seed. When a farmer or gardener plants a seed, how does he or she know which way to plant it? Accept ideas.

Explain to students that they will be planting pumpkin seeds in a variety of directions to determine whether or not the stems always grow upwards and the roots always grow downwards. Students should record their problem and hypothesis on their Scientific Investigation worksheet.

In teams, students set up an experiment to determine if seeds know “up from down.”

1. Place a square paper towel on a diagonal in the CD case with the corners hanging over the edges. (The corner on the left can be slipped between the front and back of the case.)
2. Place a circle of paper towel in the center of the CD case.
3. Students then place eight pumpkin seeds in the case so that two seeds point upward, two point downward, two point to the right, and two point to the left.
4. Mark one side of the case TOP.
5. Place the case in the plastic zipper-seal bag.
6. Pour in about one-half inch of water. Be sure the TOP of the case is toward the top of the bag. Seal the bag.

Ask students to observe and record their seeds’ germination and root growth and direction. (In all cases the stem will grow up and the root will grow down.) Teams can compare their results.

Optional: When both roots and stems are one-half to three-quarters inch long, students can turn their CD cases one-quarter turn to the right. Wait three to four days and have students turn their seed display again. Record observations and drawings on the journal pages. What will happen if the case is turned again?

EVALUATION:

Students complete the materials and procedures sections of their Scientific Investigation worksheet. Students complete their journals during investigation, recording their seed manipulations and resulting observations. Students explain what caused the roots and shoots to change direction during the experiment.

EXTENSION:

The experiment can be conducted with another type of seed to see if the same results occur.

NEW JERSEY LEARNING STANDARDS

Science: 2:LS2.A 3:LS1.B 4:LS1.A 5:LS1.C, PS2.B

Lesson courtesy of Maryland Agriculture in the Classroom

Can Plants Sense Gravity? Scientific Investigation Worksheet

- **Problem** (What question do you want to answer?)

- **Hypothesis** (What do you think will happen and why?)

- **Materials** (What do you need to do your experiment?)

- **Procedures** (What steps must you follow to do the experiment?)

- **Observations** (What do you see happen during the experiment?)

- **Conclusion** (What did you learn/discover from the experiment?

CHLOROPHYLL RUBBINGS

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

Students discover chlorophyll, a key ingredient in photosynthesis, in this simple activity, and learn its role in the process used by plants to make food. Use this lesson together with or after a discussion of photosynthesis.

GRADES: 2-5

OBJECTIVES

The student will be able to:
• Explain what chlorophyll is and its role in photosynthesis.

MATERIALS NEEDED

- 1 green leaf for each student. You can ask students to bring these from home.
- 1 metal spoon for each student or one for each small group.
- 2 pieces of masking tape for each student
- White paper

BACKGROUND

Plants require light as a form of energy to develop and grow. The way this energy transfer happens is by using chlorophyll. Chlorophyll is the green pigment in plants that is used to trap energy from the sun. Each green part of a plant contains chlorophyll. Chlorophyll helps plants absorb light and convert it into sugar through photosynthesis. It serves a key purpose in the food chain, not only by making food for plants, but by creating food in plants for animal and humans to eat.

ACTIVITY

Fold the white paper in half and crease. Open the sheet and place a leaf on one side of the paper so it is flat and facing down. Fold the other half of the paper over the leaf. Adhere the paper with masking tape to the table to hold it in place while you make the rubbing. Press firmly against the paper using the bottom of the metal spoon. Rub the spoon vigorously over the surface of the paper. The leaf's chlorophyll will be transferred to the paper.

EVALUATION:

The student will explain verbally or in writing what, and what color, chlorophyll is.

NEW JERSEY LEARNING STANDARDS

Science: 2: LS2.A 3:LS1.B 4:LS1.A 5:PS3.D, LS1.C

COMPARING SOIL AND AIR TEMPERATURE

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

Do your students know that the temperature of the soil and the temperature of the air are not the same? Farmers and gardeners need to pay attention to soil temperature to know when to plant the first crops in the spring. Soil holds heat better than air and is usually warmer than the air. In this lesson, students learn the relationship between soil and air temperature, using their math skills to compare and graph the changes in both temperatures during a planting season.

GRADES: 3-5, can be modified for younger grades as a whole class observation

TEACHER'S NOTE: This project is an excellent independent task for students to focus on while the teacher is working with small groups to plant or tend the garden.

OBJECTIVES

The student will be able to

• Measure the air and soil temperature over a period of weeks and chart and graph the results.
• Students calculate the differences between air and soil temperatures and show those differences as fractions, ratios, or percentages.
• Explain the differences between the air and soil temperatures.

MATERIALS NEEDED

- Soil and air thermometers for each small group or one if doing a whole-class observation
- Rulers
- Pencils
- Copy of Soil Temperature Chart for each small group
- Garden Temperature Chart for each student or one large chart for the whole class
- Clipboards or notebooks
- Graph paper

- NOTE: Soil thermometers can be used for measuring air temperature. Just wipe off the soil and hold the thermometer up in the air for a minute or two. An oven thermometer that goes down to 32 degrees can also be used as a soil thermometer.

INTRODUCTION

Begin a class discussion about the temperature of the air and the temperature of the soil. What changes the temperature of the air? What might change the temperature of the soil?

Share these soil temperature facts:

• Soil holds heat better than air does. The heat in soil is protected by the soil above it, vegetation over it, and snow. In fact, the deeper you go, the more insulation and the higher the average temperature, to a point. From about 30 to 200 feet below the surface, the soil temperature is relatively constant at about 55 degrees F. That's how worms and other creatures that live in the soil can survive winter by tunneling down deep in the soil.

• The amount of water in the soil will affect its temperature. Sandy, dry soil heats up very fast, and on hot summer days when the air temperature is in the 90s, the temperature near the surface of sandy, dry soil can spike up to over 100 degrees F. That's why the beach sand is so hot on your feet on a sunny summer day.

• Wetter soil tends to be cooler. That's why in February, when the soil is wet, soil temperatures near the surface can be lower than air temperatures. The soil warms up as the warmer air temperatures evaporate the water in it. From late March through the summer, soil temperatures are usually higher than air temperatures.

• Because the soil temperature is usually different from the air temperature, it is important for gardeners and farmers to know the temperature of the soil before they plant. The green dots on the Soil Temperature Chart tell you when it is okay to plant the seeds of cool-season and summer fruits and vegetables. Notice that the practical temperature for planting for cool-season vegetables such as lettuce, carrots, and spinach is much lower than the practical planting temperature for summer vegetables such as corn, tomatoes, and cucumbers.

ACTIVITY

The best times to start this project are at the beginning of April or mid-September. Explain to the students that once a week for the next seven weeks, you are going to check the temperature of the school garden's soil and compare it to the air temperature. Pass out the Garden Temperature charts.

Each student will complete his own chart. Show students the air thermometer and soil thermometer (or just the soil thermometer if you are using it for air readings.) First, in small groups, the student will measure the temperature of the air around the garden and record it on the chart.

Next, the students will take the temperature of the soil in the garden where vegetables are or will be planted. The soil temperature will be taken at two different depths: two inches and six inches. To measure the soil, first the students should push the ruler into the soil until the two-inch mark is level with the ground. If the soil is hard, the students can use the point of a pencil to loosen the soil for the ruler. Once the two-inch mark is found, the students remove the ruler and put the soil thermometer in the two-inch hole, with the end at the bottom of the hole. The students record this temperature.

Next, the students choose another spot very close by and repeat this entire procedure, making a six-inch hole this time. Both soil temperatures should be recorded on the Garden Temperature Chart.

Next, each small group will take the soil temperature at a second location of their choosing. It can be a shaded spot near a building, under mulch or straw, or a very sunny spot near blacktop. The second location will show them how soil temperature can vary under different conditions. Once the second spot is chosen, the students take the soil temperature as in the garden bed, at a depth of two inches and again at six inches. Each student records the temperatures on the Garden Temperature Chart. Inside the classroom, the small groups will set up and begin a graph showing how the temperatures of the air and soil at different depths vary over the course of the seven weeks.

EVALUATION:

Completed individual Garden Temperature Charts and small group Temperature Comparison Graphs. Once the seven-week project is completed, students can write a paragraph or several paragraphs, describing their observations of soil and air temperatures and explain how the relationship between the two temperatures changed over time.

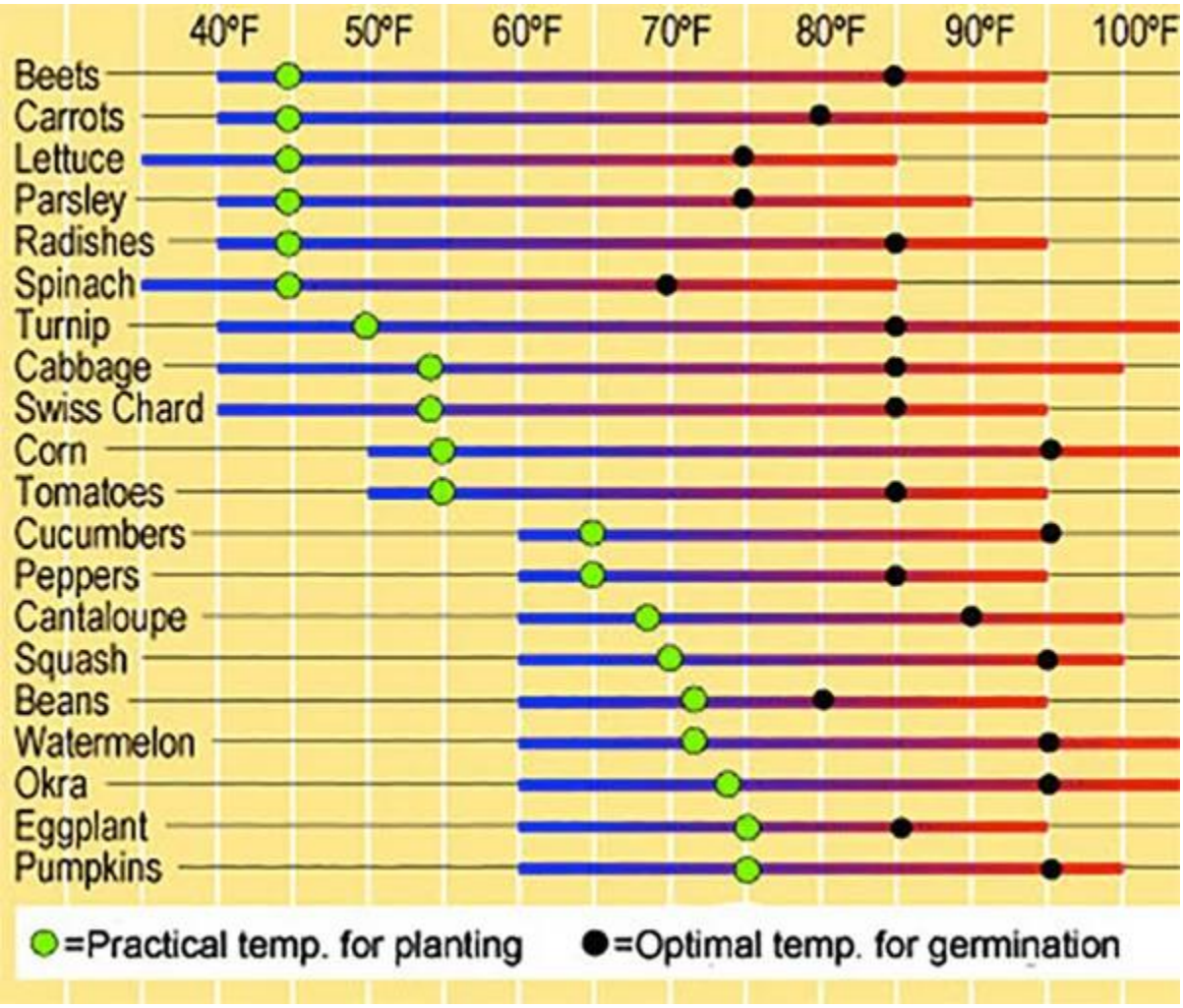
EXTENSION:

Younger students can calculate the difference between the soil and air temperatures and record this difference on a separate class graph. Older students can use fractions, ratios, or percentages to show the difference between the soil and air temperatures. Once they have recorded air and soil temperatures, students can make predictions for the air and soil temperatures before they go outside, based on the weather for the past week.

NEW JERSEY LEARNING STANDARDS

Science: 3: ESS2.D 4: ESS2.A 5: LS2.A, B Math: 3.MD.B 4.MD.A,B 5.MD.B

Soil Temperatures



CREATING THE WATER CYCLE

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

What better way to teach the water cycle than to have your students recreate the process in terrariums they build themselves?

In this lesson, students observe evaporation, condensation, and precipitation while watching seeds germinate and sprout as well. All you need are some plastic salad containers such as the takeout containers from a restaurant, some potting soil, and seeds. Ask a local restaurant for a donation.

GRADES: 2-5

OBJECTIVES

The student will be able to:

- Define evaporation, condensation, and precipitation
- Describe the water cycle with the processes of evaporation, condensation, and precipitation.

MATERIALS NEEDED

- Salad-type takeout containers from a restaurant. You can ask students to supply their own, or you can ask a local restaurant for a donation. (A large ziplock baggie will work if there are not enough salad containers available.)
- Soil
- Spray bottle filled with water
- Fast-germinating seeds such as radishes, beans, marigolds, or grass

DEFINITIONS:

- **Precipitation** occurs when so much water has condensed that the air cannot hold it anymore. The clouds get heavy and water falls back to the earth in the form of rain, hail, sleet, or snow.
- **Condensation** occurs when water vapor in the air gets cold and changes back into liquid, fo**rming clouds.**

- Evaporation occurs when the sun heats up water in rivers, lakes, the ocean, or puddles and turns it into vapor or steam. The water vapor or steam leaves the Earth's surface and goes into the air.

INTRODUCTION

Start a discussion about the different parts of the water cycle: evaporation, precipitation, and condensation. Ask: What are clouds? What are they made of? What is rain? What does the sky look like when it rains? Why does it rain? Where does the rain go after it falls? What happens to puddles after it rains? Use as many questions as possible to determine which concepts the students may understand and where any misconceptions may be.

ACTIVITY

Assemble the terrariums. Have the students build their own terrariums by putting about an inch of soil in the bottom of their plastic containers, planting a few seeds according to the package instructions, and thoroughly watering the soil with the spray bottle. The initial watering should be all that is necessary since the plastic container will create a closed environment that will not allow the water to escape into the atmosphere.

Have students write their names on the containers with permanent marker. Place the terrariums in a sunny window or under a grow light. Observe the terrariums. Have the students make observations about their terrariums each day and record them in their science journals. Try to do the observations at different times each day. Have the students record what they see in writing and with pictures.

Discuss as a class anything the students observe. Continue this throughout the lessons on the water cycle. Possible questions to ask the students include: We only watered the soil in our terrariums once; how did the water get on the lid? Take your lid off the terrarium and feel the soil. Why is the soil still wet? Do you think that any water has evaporated from the soil? Why? If water evaporated, where did the evaporated water go? Did it ever rain in your terrarium? How do you know? Where did the rain come from? Is there anything in your terrarium that reminds you of a cloud?"

The teacher may want to make a connection between the water cycle in the terrarium and in the real world with a discussion using the following: If the terrarium is a model of the real world, what do you see outside the reminds you of the plants in our terrarium? What reminds you of the soil in our terrarium? What reminds you of the small water droplets on the lid? Water collects on the lid of the terrarium, and water also collects in the sky as clouds, so where does the water in the clouds come from?

EVALUATION:

Have the students make a picture model in their science journals that represents their terrariums. Have them draw and label the processes – evaporation, condensation, precipitation – they see happening and their locations in the terrarium.

EXTENSION:

Read and discuss All the Water in the World, by George Ella Lyon.

NEW JERSEY LEARNING STANDARDS

Science: 2:LS2.A, ESS2.D 3:ESS2.D 4:ESS2.A, E 5: LS1.A, ESS2.

DO PLANTS REALLY NEED LIGHT?

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

This lesson teaches students how plants use light to make their own food through a process called photosynthesis.

GRADES: PreK-5

OBJECTIVES

The student will be able to
• Identify sunlight as one of the main things along with soil and water that a plant needs to grow.
• Explain that plants use sunlight to get the energy to produce sugar, their food.
• Define photosynthesis as the process a plant uses to make food.

MATERIALS NEEDED

- 3 similar plants in pots
- Photosynthesis sheets “Do Plants Really Need Sunlight?” worksheet/questions

ACTIVITY

Tell students plants are special because they can do something that nothing else in the world, not even a person, can do. Does anyone know what it is? Plants are the only living things that can make their own food. We know a plant needs light, but why does a plant need light? Plants need light to make their food through a process called photosynthesis.

Tell students that a plant uses sunlight along with carbon dioxide in the air and water from the ground to make a type of sugar, which is its food. During photosynthesis, the plant releases oxygen, which we breathe. So along with being a source of food, plants also help supply the oxygen that we breathe. Explain that people breathe out carbon dioxide, which the plants use during photosynthesis.

Ask students how we can prove that a plant needs light, using three different plants. Allow the students to discuss this question until they decide to place one plant in

a sunlit window, one plant in a shady spot away from the window, and one plant in a closet or under a box where it is totally dark. Give students the plants to put in these places. Ask students what else we must do in order for our experiment to work. (Water the plants frequently so they do not die from lack of water.)

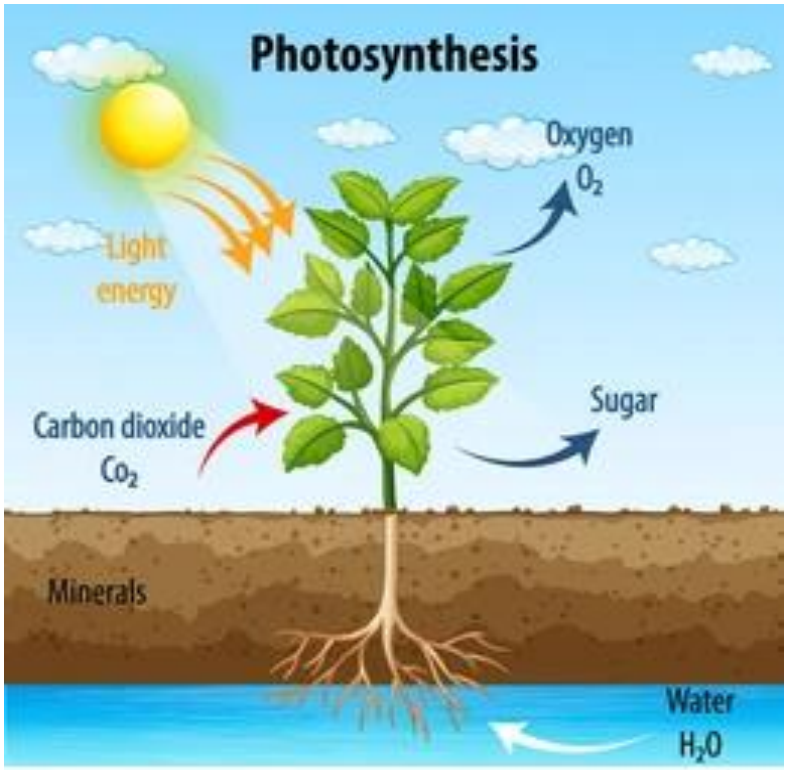
NOTE: In this experiment, all the plants must be watered regularly so that students can observe the effects of the light versus the dark. Students observe the plants over a few weeks and record the changes they see. When the plant that has been placed in the dark has died, discuss with the students why this has happened.

EVALUATION:

Students will be able to explain why a plant needs light and what photosynthesis means. Completed “Do Plants Really Need Sunlight?” worksheet

NEW JERSEY LEARNING STANDARDS

Science: PreK: 5.1.1-5, 5.3.1-4, 5.4.2 K:LS1.C 1:LS1.A 2:LS2.1 3:LS4.C 4:LS1.A 5:PS3.D



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NAME_____

Do Plants Really Need Sunlight?

In this experiment, we want to prove that plants really do need sunlight to live. We will place one plant in a sunny spot, another in a shady spot, and one plant in the dark. We must remember to water both plants frequently. What do you think will happen?

What do the plants look like after one week?

- Plant in the sun?
- Plant in the shade?
- Plant in the dark?

What do the plants look like after two weeks?

- Plant in the sun?
- Plant in the shade?
- Plant in the dark?

What do the plants look like after three weeks?

- Plant in the sun?
- Plant in the shade?
- Plant in the dark?

FIRST PEAS TO THE TABLE (3-5)

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

In Susan Grigsby's book First Peas to the Table, a class stages a contest like the one Thomas Jefferson had with his neighbors every spring to see who could grow the first bowl of peas. The students research Jefferson's experiments in gardening. They research how to grow peas, plant their own pea seeds, and keep a scientific journal of notes and drawings of their plants' progress. In this lesson, your students will compete in a similar contest, planting and growing peas and learning about Thomas Jefferson's gardening passion.

GRADES: 3-5

OBJECTIVES

The student will be able to:
• Explain Thomas Jefferson's spring pea contest, some of his contributions to agriculture, and the method he used to set up his garden.
• Describe the life cycle of a pea.
• Read and explain plant growth information on a seed packet.
• Grow and care for a pea from seed to pod.

MATERIALS NEEDED

- The book First Peas to the Table by Susan Grigsby
- Variety of pea seeds – enough for each student to have 8-10 seeds
- Potting soil Recycled containers (empty and washed half-pint milk containers, yogurt containers, or any small container will drainage holes poked in the bottom.)
- Miscellaneous sticks, string, yarn, twine, etc. to build trellises
- How to Grow Peas worksheet for each student

NOTE: In New Jersey, peas cannot be planted outside until late-March, making it difficult to harvest an abundance of peas before school ends in June. So instead of

growing a bowl of peas, the contest winner could be the student who grows the first peas to maturity. Another way to modify the contest would be to use edible pea pods instead. The winner of the contest could be the first to harvest five pea pods, or could be the student who harvests the most pea pods by a specified date before school ends in June.

PREPARATION

Before starting the activity, use a sharp knife to cut a rectangular hole in one small end of each shoe box. To make creating the maze easier for students, it is a good idea to put together a model shoe box maze according to the instructions below, so that students can visualize their instructions.

INTRODUCTION

Begin the discussion by asking students how they know something is alive. Encourage answers such as grow, breathe, reproduce, move, eat or require nourishment. Next ask how we know that plants are alive.

Ask the students what plants need to live. Ask if plants move. Ask if they have ever seen a plant move. Ask why they think a plant would move. Discuss their answers.

Next, tell students that they are going to do an experiment to prove that plants will move toward the light. Ask students if they know what a maze is and if they have ever seen one. (Answers may include a corn maze, a hedge maze, or a puzzle maze drawn on paper.) Now tell students they are going to create a maze that a plant will have to solve to reach the light.

ACTIVITY

Read aloud First Peas to the Table by Susan Grisby. Discuss the contest. Allow the students time to reread the book together in small groups. Use the accompanying discussion questions to spur conversation about the book.

Pass out pea seed packages to students in small groups. Ask them to read the information on the back and answer the questions on the How to Grow Peas worksheet. In late February or early March, students plant pea seeds indoors in potting soil in the small containers. Students care for their pea seeds on the windowsills until late-March, when they can be transplanted outside. Students keep journals on the progress of their pea plants, including information such as: dates seeds were planted, observations of growth, measurements of weekly growth, drawings, dates, trellises were added, etc.

Students transplant their peas into an allotted space in the outdoor garden. They continue to care for their pea plants over the next few weeks, watering as needed, perhaps adding fertilizer, and fashioning trellises for them to climb.

Determine the winner of the contest depending on the rules set at the beginning: student who grows first peas to maturity, student who first grows five pea pods, student with the most pea pods by harvest date, etc.

EVALUATION:

Students' detailed scientific journals on their experiences growing the peas.

EXTENSION:

Learn more about Thomas Jefferson’s work in agriculture from the book Thomas Jefferson Grows a Nation by Peggy Thomas.

NEW JERSEY LEARNING STANDARDS

Social Studies: 3-5: 6.1.5.EconNM.4, 6.1.5.HistoryCC.3 Science: 3:LS1.B 4:LS1.A 5:LS2.A English Language Arts: 3:RL.3.1-7 4:RL.4.1-7 5:RL.5.1,2,4,5

NAME_____

How to Grow Peas

Use the information on the back of a pea package to help you answer these questions:

1. What is the variety (type) of the pea seed?

2. How deep should you plant the pea seeds?

3. How far apart should the pea plants be?

4. How far apart should you plant the rows of peas?

5. How many days will it take until you can harvest your peas?

6. How many weeks is that? How many months?

7. How long does it take seedlings to emerge (germinate)?

8. How much sun do pea plants like?

9. Look for New Jersey on the map of planting zones. When is it recommended to plant pea seeds outdoors?

First Peas to the Table Discussion Questions

In the story, Shakayla wins the contest. Discuss the questions below with the class to hypothesize how she might have won.

1. Maya's first group of successful pea plants was planted on March 1. What is the earliest date on which Shakayla's peas could have been planted. (Hint: On what day did the students receive their seeds?)

2. Can you write a mathematical equation to determine how much older Shakayla's plants could have been compared to Maya's? What is the answer?

3. Why did the first group of seeds that Maya planted fail?

4. Maya kept Jefferson's notes about soaking the pea seeds a “secret.” Do you think that Shakayla may have also read about that idea? Where might she have found the information?

5. Thomas Jefferson would test many different varieties of the same plant to determine information such as which ones grew fastest, tasted best, and yielded the most food. Different varieties of a plant can grow at different rates. How many varieties did Maya plant? How many varieties did Shakayla plant? Do you think that some of the pea varieties could have grown faster than others? Can you look at some seed packets (or Internet seed sites) to investigate this further?

6. What kind of books does Maya see Shakayla carrying home? Why do you think she was reading them?

7. What factors do you think might have helped Shakayla to win the contest? Think beyond the story in the book to come up with additional answers. Make a class list, noting which are supported by clues in the book and which are based on your knowledge of plants' needs.

7. Ask the students to use the list in question #7 to form some hypotheses that they could test in the classroom or school garden. Discuss how to set up the experiments and record the data. Then let students test their ideas.

FIRST PEAS TO THE TABLE (K-2)

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

Thomas Jefferson, our third president, was an avid gardener. In this lesson, students learn about the life cycle of a pea while they learn about the yearly contest Jefferson had with his neighbors to see who could grow the first bowl of peas.

GRADES: K-2

OBJECTIVES

The student will be able to:

- Describe the life cycle of a pea.
- List plant needs.
- Sequence events.
- Write with the purpose of describing, informing, and/or explaining.

MATERIALS NEEDED

- 8 1/2 x 11 piece of green construction paper for each student
- Light green paper
- Circle pattern (preferably 2 inches or less in diameter)
- Glue sticks
- Markers or colored pencils
- Scissors
- First Peas to the Table book by Susan Grigsby

BACKGROUND KNOWLEDGE

Plants undergo a series of changes from the time the seed is planted to the time that the plant is full grown. First the seed must germinate or sprout. To do this, the seed requires moisture, warmth, air, and space. While the seed does not need soil to sprout, it does need the soil's nutrients to grow to maturity. After germination, the seed will grow roots down into the ground and shoots will begin to poke out of the ground. This is the seedling stage. Next, leaves and blossoms will appear on the young plant. After the

blossom is pollinated, the plant will bear fruit. This process is the same whether the plant is growing in the wild, in a backyard, or on a farm.

ACTIVITY

Read and discuss First Peas to the Table by Susan Grigsby. Discuss the contributions of Thomas Jefferson.

Discuss the life cycle of a pea plant as shown in the book. Include how long the plant takes to grow to maturity, the basic needs of the plant, and the planting season. Create a model of Ms. Garcia's class garden on the board or a large piece of paper. What plants might be grown in what sections?

Students draw or trace and then cut out 5-6 circles 2 inches or less in diameter. (Tracing a small bathroom disposable cup works well to create 2-inch circles.) Then they list each step of the life cycle of a pea on a circle. Younger students can draw pictures of each step of the life cycle. (The teacher can model this on the board.)

Then, direct the students to: fold an 8 1/2 x 11 piece of green construction paper vertically in half. Draw a pea pod along the fold of the paper large enough to cover the entire half page. Cut out the pea pod around the fold creating a bi-fold pea pod model. Arrange the steps of the life cycle inside the pea model. Glue the “peas” down to create a bi-fold book illustrating the life cycle.

EVALUATION:

Correctly completed pea pod

EXTENSION:

Write a six-sentence summary of the life cycle of the pea. Create a bulletin board with a trellis, pea vine, and attach the student's pea pods.

PLANT PEAS IN THE CLASSROOM:

School milk cartons work well as containers for seedlings. Open the cartons and wash the inside. Poke a few holes in the bottom so excess water can drain. Fill the cartons about three quarters full of soil. Have students plant 1-3pea seeds in each carton about 1-inch deep.

Place a tray underneath the cartons to catch excess water. Water lightly and place on a sunny windowsill. Water when dry. Record growth observations. Peas can be transplanted into the school garden in late March or early April in New Jersey. They will need a trellis to grow on as they grow larger.

NEW JERSEY LEARNING STANDARDS

Science: K: LS1.C 1: LS1.A 2:LS2.A Social Studies: K-2:6.1.2.EconEM.1, 6.1.2.HistoryCC.3, 6.1.2.HistoryUP.1 English Language Arts: K:RL.K.1-10 1:RL.1.1-4,6 2:RL.2.1-7

FROM WHEAT TO BREAD(3-5)

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

How many of your students really understand that all the things they eat made from flour – bread, pizza dough, cake, cookies, crackers, rolls – actually come from a plant? In this lesson, students will plant wheat seeds to observe how wheat grows, examine the parts of the wheat plant and parts of the wheat seed, and learn the difference between white bread and whole wheat bread.

GRADES: 3-5

OBJECTIVES

The student will be able to:
• Identify wheat as the plant that is the source of much of the flour we eat.
• Identify the parts of the wheat plant.
• Identify the parts of the wheat seed.
• Explain the difference between whole grain and refined grain and the nutritional benefits of each.

MATERIALS NEEDED

- Wheat seeds
- Potting soil
- Container for planting seeds
- Anatomy of a Wheat Plant sheet, one per student
- Parts of a Wheat Seed sheet, one per student
- Wheat: From Field to Mill to Table sheet, one per student
- White Bread Versus Whole Grain: What's Healthier? What's the Difference? YouTube video: https://www.youtube.com/watch?v=418KSrmpMwc

INTRODUCTION

Ask your students to brainstorm a list of food they eat that is made from flour. Ask students if they know where this flour comes from. Explain that today they will plant some wheat seeds to see how wheat grows and learn the difference between white and whole wheat bread.

ACTIVITY

Depending on how many wheat seeds you have, demonstrate the seed planting to the whole class or place students in small groups. Fill any container – milk or yogurt carton, berry container, plant pot, etc. – with potting soil. Make sure the container has drainage holes in the bottom. Sprinkle wheat seeds liberally on top of soil. Cover seeds lightly with soil, about ¼-inch deep. Moisten the soil – a spray bottle is easy to use. Place the container in a sunny area and check the moisture level of the soil frequently so the seeds don't dry out. Water lightly when needed.

The seeds should germinate in two to three days, and sprouts should be visible within a week. Allow your students to observe the growth of the wheat seeds for at least a month. They can record their observations in science journals.

Distribute the Wheat: From Field to Mill to Table sheet. Ask students in small groups to read and discuss this information about wheat. Ask them to list facts that were new to them or that they found particularly interesting. Ask the groups to report their thoughts to the whole class.

Distribute the Anatomy of a Wheat Plant sheet. Ask students to discuss in small groups how the parts of a wheat plant are the same or different from the parts of other edible plants with which they are familiar. Tell students that it is the seeds of the wheat plant that we eat. The seed is ground into flour.

Distribute and discuss the Parts of a Wheat Seed sheet. Ask students if they are familiar with the term whole grain. Ask them if they know what this means. Ask if whole grain bread is different from white bread.

Show the YouTube video White Bread Versus Whole Grain: What's Healthier? What's the Difference? that can be found at this link: https://www.youtube.com/watch?v=418KSrmpMwc After watching the video discuss with students what they have learned about white and whole grain bread.

EVALUATION:

The student can answer the question, "Where does your bread come from?" and describe the parts of a wheat plant and wheat seed. The student can explain the difference between white bread and whole wheat bread.

EXTENSION:

Ask students to research and show on a map the states are the biggest wheat producers. Ask students to research and show on a map the countries are the biggest wheat producers. Ask students to research the history of wheat farming and flour milling. Although many of the bread products we eat are made from flour, there are many other types of flour. Ask students to brainstorm what other plants flour might be made from: oats, corn, rice, potatoes, etc. Arrange a taste test for students to compare wheat flour to other types of flour.

Make Bread in a Bag (recipe following.)

Make wheatgrass smoothies. The young wheatgrass sprouts can be used to make smoothies. Wheatgrass can be bitter, however, so if you want your students to try it, be sure to combine it with something sweet.

Here is a sample recipe: 2 cups of wheatgrass. Plain wheatgrass chops up pretty well in a blender. 1 cup of your favorite fruit; frozen, or if raw fruit is used - include 1 cup of ice 1 carrot 1 Tbs. lemon juice 1 Tbs. agave or other sweetener Add up to 1/2 cup cold water to adjust consistency. Notes: Apples and carrots go great with wheatgrass! If using raw apples, use 2 cups raw apples plus one cup apple or other fruit juice.

NEW JERSEY LEARNING STANDARDS

Science: 3:LS1.B 4:LS1.A 5:LS2.A Social Studies: 3-5: 6.1.5.GeoHE.2, 6.1.5.EconEM.1, 2
English Language Arts: 3:RI.3.1,2,4 4:RI.4.1,2,4 5:RI.5.1,2,4

Bread in a Bag Recipe

Ingredients and Materials for each loaf:

- ½ cup all-purpose flour
- 2 cups whole wheat flour
- cooking oil spray
- warm water
- 2 tablespoons sugar
- 1 package yeast (2 1/4 teaspoons) Quick-rise yeast will speed the process
- 2 teaspoons salt
- 1 tablespoon vegetable oil

Directions:

In a one-gallon heavy-duty ziplock bag, mix: ½ cup all-purpose flour 1 package or 2 ¼ teaspoons yeast ½ cup warm water 2 tablespoons sugar. Close the bag and knead it with fingers until the ingredients are completely blended. Leave the bag closed, with the contents in the corner, and let it rest for 10 minutes. You can eliminate this wait by using instant yeast.

Then add: 2 cups whole wheat flour 3/4 cup warm watering 1 tablespoon vegetable oil 2 teaspoons salt Mix well. Add enough all-purpose flour to make a stiff dough, about 1 or 1 ½ cups. Close the bag and knead it. (You may need to remove some air from the bag.)

Add more flour until the dough no longer sticks to the bag. Spray the students' hands with oil so there will be no sticking. Open the bag and allow the dough to fall out onto clean or gloved hands.

Form the dough into a loaf, and place onto a cookie sheet. Cover the loaves with sprayed plastic wrap and allow to rise 30 (quick-rise yeast) to 45 minutes.

Bake for 30-35 minutes in a 350-degree oven.

Wheat: From Field to Mill to Table

Bread has been an important part of the human diet since early times. Wheat has been discovered in pits where human settlements existed 8,000 years ago. Loaves baked over 5,000 years ago have been found in ancient Egyptian tombs. Bread provided ancient civilizations with a reliable food source.

The wheat plant has four basic parts—roots, stem, leaves, and head. The roots anchor the plant in the soil, absorbing water and nutrients and transporting them to the stem. The stem supports the head and helps transport nutrients and water throughout the plant. The leaves are responsible for photosynthesis. The head of the wheat plant contains the wheat seeds, also referred to as kernels.

Wheat flour is made from the kernels or wheat seed. A wheat kernel contains three parts—the bran, germ, and endosperm. The bran is the hard outer covering of the kernel. The germ is the embryo that will sprout into a new plant. The endosperm is the germ's food supply. It provides essential energy to the young wheat plant, allowing the plant to send roots and send up stems.

During the milling process, the germ and bran are often separated from the flour. The germ is removed because its fat content limits the flour's shelf-life. The bran is removed to give the flour its white color and fluffy texture. This is called refined flour.

Refined flour is not as nutritious as whole-grain flour that contains both germ and bran. The germ contains

healthy fats, and bran contains protein. Both the germ and bran contain B vitamins, minerals, and fiber. Refined wheat contains just the wheat seed's endosperm, which only contains carbohydrates.

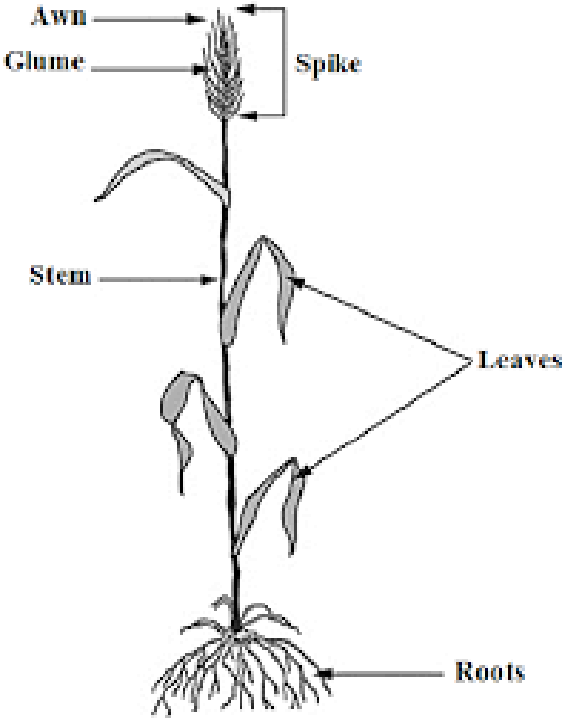
In Neolithic times, stones were used to crush grain into coarse flour. In the Stone Age, hand powered mills with a rotating circular stone on top and a stationary stone on the bottom were used to grind grain. In the 18th century, automated stone wheels powered by wind or water were used to produce flour. These mills still used flat circular stones to crush the grain. The invention of the roller mill in the middle of the 19th century, which used metal cylinders instead of the flat circular stones, to crush grain increased the productivity of flour mills.

Commercial flour mills today still use the roller mill. When wheat arrives at the mill, water is added to the grain in order to toughen the outer part of the wheat and soften the inner part. The wheat then rests for about 12 hours. Steel rollers break open the grain to release and separate the endosperm from the bran and the germ. The starchy endosperm is ground and sifted several times to make white, all-purpose flour.

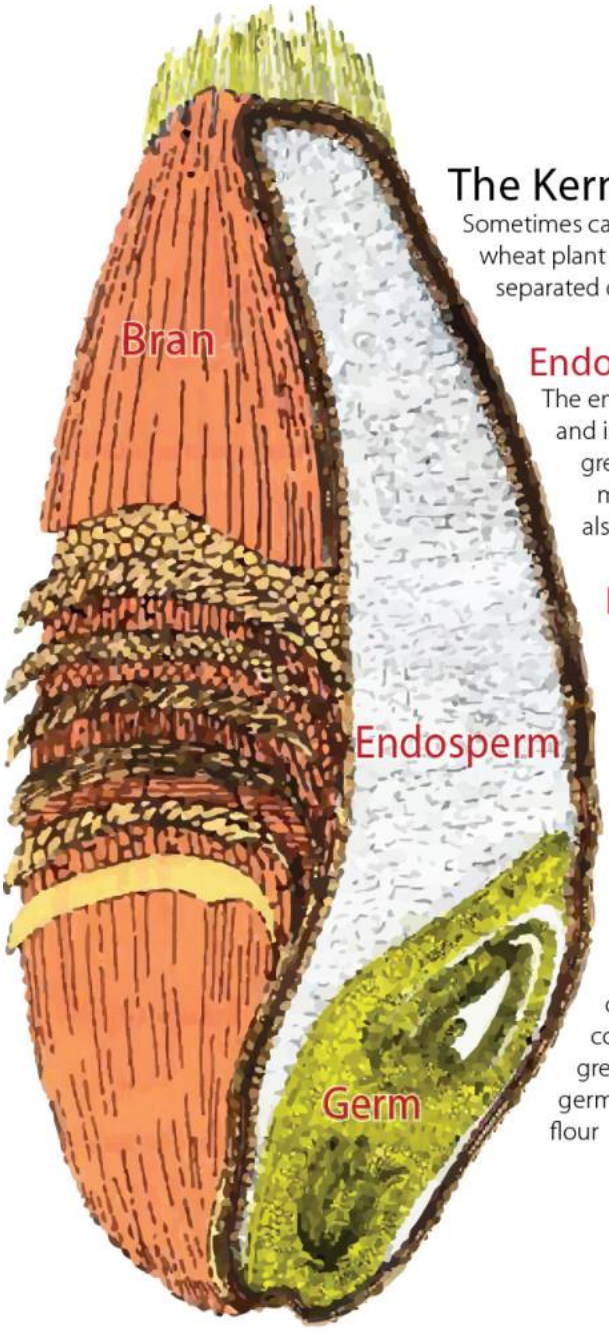
When making whole wheat flour, the bran and germ is put back into the white flour at the end of the milling process. The flour is then packed into bags to be transported to stores, bakeries, and food processing plants.

Anatomy of a Wheat Plant

A wheat plant has four basic parts: the head, stem, leaves and roots. Wheat plants grow to be about 2-4 feet tall. The awn is a slender, bristle-like attachment of a wheat plant, such as those found at the tips of the spikelets in many grasses. The head contains kernels or the wheat seeds. The stem supports the head and helps transport nutrients and water throughout the plant. The leaves are responsible for photosynthesis, the process in which green plants produce simple carbohydrates by using carbon dioxide, hydrogen and a light source, usually the sun. The roots anchor the plant in the soil and absorb water and nutrients from the soil and transport them to the stem.



Parts of a Wheat Seed



The Kernel of Wheat

Sometimes called the wheat berry, the kernel is the seed from which the wheat plant grows. Each tiny seed contains three distinct parts that are separated during the milling process to produce flour.

Endosperm

The endosperm comprises about 83 percent of the kernel weight and is the source of white flour. The endosperm contains the greatest share of protein, carbohydrates and iron, as well as the major B-vitamins such as riboflavin, niacin and thiamine. It is also a source of soluble fiber.

Bran

Bran makes up about fourteen and a half percent of the kernel weight. Bran is included in whole wheat flour and can also be bought separately. The bran contains a small amount of protein, large quantities of the three major B-vitamins, trace minerals and dietary fiber -- primarily insoluble.

Germ

Germ is about two and a half percent of the kernel weight. The germ is the embryo -- or sprouting section -- of the seed, often separated from flour in milling because the fat content (10 percent) limits flour's shelf-life. the germ contains minimal quantities of high quality protein and a greater share of B-complex vitamins and trace minerals. Wheat germ can be purchased separately and is part of whole wheat flour

FROM WHEAT TO BREAD(K-2)

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

How many of your students really understand that all of the things that they eat are made from flour – bread, pizza dough, cake, cookies, crackers, rolls – actually come from a plant? In this lesson students will see wheat grow and learn the process of turning wheat seeds into bread.

GRADES: PreK-2

OBJECTIVES

The student will be able to:
• Identify wheat as the plant that is the source of much of the flour we eat.
• Identify food that is made from wheat flour.
• Describe the process of turning wheat seeds into flour.

MATERIALS NEEDED

- Wheat seeds
- Potting soil
- Containers for planting seeds
- One or more of these books:
  - Bread Comes to Life, A Garden of Wheat and a Loaf to Eat, by George Levenson
  - The Little Red Hen, by Jerry Pinkney or Paul Galdone
  - The Little Red Hen (Makes a Pizza), by Philomen Sturges
  - Pancakes, Pancakes, by Eric Carle
  - Everybody Bakes Bread, by Norah Dooley

INTRODUCTION

Ask your students to brainstorm a list of food they eat that is made from flour. Ask students if they know where this flour comes from. Read one of the books listed in the Materials section on the growing and harvesting of wheat and processing it into

flour. Show students the wheat seeds and tell them that this is what much of the flour – and flour products they eat – is made of.

ACTIVITY

Depending on how many wheat seeds you have, demonstrate the seed planting to the whole class or place students in small groups. Fill any container – milk or yogurt carton, berry container, plant pot, etc. – with potting soil. Make sure the container has drainage holes in the bottom. Sprinkle wheat seeds liberally on top of soil. Cover seeds lightly with soil, about 1/4 inch. Moisten the soil – a spray bottle is easy to use. Place the container in a sunny area and check the moisture level of the soil frequently so the seeds don't dry out. Water lightly when needed. The seeds should germinate in two to three days, and sprouts should be visible within a week. Allow your students to observe the growth of the wheat seeds for at least a month. They can record their observations in science journals.

EVALUATION:

The student can answer the question, “Where does your bread come from?” and describe the process of growing, harvesting, threshing, and grinding wheat to turn it into flour.

EXTENSION:

- Although many of the bread products we eat are made from flour, there are many other types of flour. Ask students to brainstorm what other plants flour might be made from: oats, corn, rice, potatoes, etc. Arrange a taste test for students to compare wheat flour to other types of flour.
- Make Bread in a Bag. (See recipe next page)
- Use the wheatgrass sprouts to make smoothies. Wheatgrass can be bitter, however, so if you want your students to try it, be sure to combine it with something sweet. Here is a sample recipe: 2 cups of wheatgrass. Plain wheatgrass chops up well in a blender. 1 cup of your favorite fruit; frozen, or if raw fruit is used - include 1 cup of ice 1 carrot 1 Tbs. lemon juice 1 Tbs. agave or other sweetener Add up to 1/2 cup cold water to adjust consistency. Notes: Apples and carrots go great with wheatgrass! If using raw apples, use 2 cups raw apples plus one cup apple or other fruit juice.

NEW JERSEY LEARNING STANDARDS

Science: PreK: 5.1.1-5, 5.3.1-4 K.LS1.C 1.LS1.A 2.LS2.A Social Studies: K-2: 6.1.2.Geo.GI.1, 6.1.2.EconEM.1,2; 6.1.2.EconNE.1 English Language Arts: PreK: RL.PK.1-3 K:RL.K.1-10 1:RL.1.1-4,6 2:RL.2.1-7

Bread in a Bag Recipe

Ingredients and Materials for each loaf:

- ½ cup all-purpose flour
- 2 cups whole wheat flour
- cooking oil spray
- warm water
- 2 tablespoons sugar
- 1 package yeast (2 1/4 teaspoons) Quick-rise yeast will speed the process
- 2 teaspoons salt
- 1 tablespoon vegetable oil

Directions:

In a one-gallon heavy-duty ziplock bag, mix: ½ cup all-purpose flour 1 package or 2 ¼ teaspoons yeast ½ cup warm water 2 tablespoons sugar. Close the bag and knead it with fingers until the ingredients are completely blended. Leave the bag closed, with the contents in the corner, and let it rest for 10 minutes. You can eliminate this wait by using instant yeast.

Then add: 2 cups whole wheat flour 3/4 cup warm watering 1 tablespoon vegetable oil 2 teaspoons salt Mix well. Add enough all-purpose flour to make a stiff dough, about 1 or 1 ½ cups. Close the bag and knead it. (You may need to remove some air from the bag.)

Add more flour until the dough no longer sticks to the bag. Spray the students' hands or food handlers' gloves with oil so there will be no sticking. Open the bag and allow the dough to fall out onto clean or gloved hands.

Form the dough into a loaf, and place onto a cookie sheet. Cover the loaves with sprayed plastic wrap and allow to rise 30 (quick-rise yeast) to 45 minutes.

Bake for 30-35 minutes in a 350-degree oven.

FRUIT OR VEGETABLE?

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

Explore the difference between a fruit and a vegetable.
Grades: 2-5

OBJECTIVES

Student will

- differentiate between a fruit and a vegetable.
- Compare and contrast similarities and differences between fruits and other edible parts of plants
- State reasons people should eat fruits and other edible plant parts.

MATERIALS NEEDED

- Fruits and vegetables, or pictures of them.

INTRODUCTION

Botanically, a fruit is the part of a plant that develops from a flower and produces seeds. Many plant parts we eat and called vegetables are really fruits. A true vegetable is the food product that comes from any part of the plant other than the flower. So, roots such as carrots and radishes, and leaves such as cabbage and lettuce are true vegetables. If you cut produce open and it contains seeds inside, such as a tomato, squash, or cucumber, then it is a fruit. If there are no seeds, then it is a vegetable.

ACTIVITY

A few days before the lesson, ask students to bring in produce. A local grocer may be willing to contribute some samples for the lesson. Engage student interest by bringing in a variety of fruits and vegetable or you can use pictures of fruits and vegetables. Pose the question, “what makes a fruit a fruit and a vegetable a vegetable?” Using the definition given in the background, have students work in small groups to classify the samples (or pictures) as fruits and vegetables.

When groups have finished sorting, groups can share their sorts and students can judge each other’s sorts. The class can then play, “Guess My Rule”. The purpose of the game is for students to figure out what unites different kinds of produce into a group. Begin by selecting

three produce items that go together for a reason (all are green, all are peeled to be eaten, all grow underground, etc.) Tell students who think they know the rule to keep it a secret until it is time to reveal. Explain the following procedures:

- After you show the three items, a volunteer student will pick another produce items he or she thinks follows your rule. And therefore, fits into the group.
- The student makes an incorrect choice according to your rule. Set aside that item to start a group of produce items that do not follow the rule. There is information to be gained from this. It does not follow the rule group in making further guesses.
- It seems that many in the class understand the rule select remaining produce items.
- Have the students tell by a shell of thumbs up or down whether or not that particular item follows the rule.
- Solicit from the class what the rule was.
- Clear the table and begin again with a new rule. Invite volunteers to make up the new rule for future rounds.

After a couple of rounds, while interest is still high, play around with the rule. These produce items are all fruits. Once all of the examples of fruits are together in a group, discuss how these items are alike and how the items that are in the does not follow the rule group are different.

EVALUATION:

Have students fold a paper in half and label one side for fruits and one side for vegetables or complete a chart, listing each item as a fruit or vegetable. Students can be asked to identify what plant part is being eaten if it is classified as a vegetable.

Divide the class into groups of three or four students. Each group takes a turn sorting the assembled produce according to fruits and vegetables. As in the “Guess my Rule” game, group several produce items together following a rule’ include what one item that does not belong. Have the students state the rule, identify the misplaced items, and tell why it does not belong. Use the rules: These are fruits; These are vegetables; most often. As long as the student can justify a response to what is the rule, it must be accepted as a correct response. Even if the student's rule is different from what was intended.

Have older students complete a written series of the following statement: _____ is a_____ because _____. People should eat it because _____.

EXTENSION:

- Students may write to describe the difference between a fruit and a vegetable giving three examples of each.
- Have a veggie and fruit tasting party, includes some unusual varieties.

NEW JERSEY LEARNING STANDARDS:

Science: K.ETS1.A,1.LS1.A, 2.ESS1.C, 2.ETS1.B

GARDENERS PLANT IN SOIL NOT DIRT

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

To understand what makes soil, soil.

GRADES: K-4

OBJECTIVES

The student will be able to:

- examine a small scoop of soil from their garden and describe what it contains.
- describe soil as an ecosystem and explain what that means for the plants growing in it.

MATERIALS NEEDED

- Soil Not Dirt worksheet/ questions
- White or light-colored paper
- Newspaper to cover desks, if necessary,
- Small magnifying glasses
- Small bucket to collect soil
- Trowel to collect the soil

PREPARATION

This lesson is ideally done outside, but if it is too cold for students to work in the garden, you can bring a small bucket of garden soil into the classroom

ACTIVITY

Explain the difference between dirt and soil, asking these questions: What happens to all the leaves that fall to the forest floor every fall? Why are they not there in the spring? Where do they go and how do they get there? (The leaves are decomposing and becoming a part of the soil, providing important nutrients for plants.)

Each child sits with Soil Not Dirt worksheet and a piece of white construction paper. Place a small scoop of soil from the school's garden on the construction paper. The students first describe what the soil looks and feels like and then examines the soil with a magnifying

glass to see what is in it. (Among the things students will find are: roots, leaves, seeds, stems, sticks, grasses, stones, insects, and worms.)

EVALUATION:

Completed Soil Not Dirt worksheet

NEW JERSEY LEARNING STANDARDS

Science: K:LS1.C 1:LS1.A 2:LS2.A 3:LS1.B 4:ESS2.A

Gardeners Plant in SOIL, Not Dirt

Dirt is dead – It's mostly minerals like pebbles and finely ground rock.

Soil is an ecosystem – It contains a multitude of life including insects, fungi, and bacteria that live in a nutrient-rich world made up of decaying plants and creatures.

1. What does your soil look like? Describe its color and texture (how it feels.)

2. What do you find in your soil? Make a list.

GREENHOUSE STEM DESIGN CHALLENGE

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

Students work in small groups to design a small greenhouse for a plant and observe the plant's growth in the greenhouse compared to a plant without greenhouse protection. GRADES: K-5 To modify the challenge for younger grades, plant the seeds in a container with a flat bottom, such as cut-down milk cartons, and omit the criteria about stabilizing the plant.

OBJECTIVES

The student will be able to:

- Design a mini greenhouse based on criteria provided.
- Compare multiple greenhouse designs and with a group design a mini greenhouse based on criteria provided.
- Build the greenhouse with a group based on the design.
- Evaluate the group's greenhouse based on the criteria provided.

MATERIALS NEEDED

- Potting soil
- Craft sticks
- Straws
- Ziplock bags
- Plastic wrap
- Paper plates
- Tape
- Glue
- Plastic cups OR milk cartons, for younger students (both with holes in the bottom)
- Seeds (If you are doing this challenge in late winter or early spring, plant seeds of hot weather plants such as tomatoes, sweet peppers, cucumbers, or corn.)
- K-2: A Greenhouse Design Challenge, How Did We Do? sheet for each student
- 3-5: A Greenhouse Challenge Rubric sheet for each student.

BACKGROUND INFORMATION

A greenhouse is a building where plants such as flowers and vegetables are grown. It usually has a glass or see-through plastic roof. Many greenhouses also have glass or plastic walls. The plants stay warm as the sun shines through the roof and walls during the day.

Plants are grown in greenhouses in late winter and early spring when it is too cold to grow plants outside. The plants are moved or transplanted into the soil outside as the weather warms up. In New Jersey, most tomatoes and sweet peppers get their start in a greenhouse and then are moved into fields.

Growing plants in greenhouses is different from growing plants outside. No rain can get inside a greenhouse, so gardeners must water the plants. Greenhouses can also get very hot from the sun's heat, so gardeners must make sure the temperature does not get too hot for the plants. Greenhouses usually have vents that can be opened to let excess heat out.

ACTIVITY

Divide the students into groups of four. For K-2 students, write the criteria on the board or on a large paper. For 3-5 students, distribute the design challenge rubric sheets. Explain and review the criteria with the class and answer questions. Explain and review the challenge rules. Explain and review the time schedule. Tell students that you will be observing their progress and reminding them to stick to the challenge criteria, rules, and time requirements.

CRITERIA: Plant your seeds in a plastic cup and water them lightly. Your mini greenhouse must be big enough to hold the cup your plant is planted in. The greenhouse walls cannot touch the plant. The greenhouse must be opened easily to water the plant and release heat if necessary.

CHALLENGE RULES:

- Listen carefully to ideas from everyone on your team.
- Decide on the best design before you begin to build.
- You may only use the materials provided.
- You do not have to use all the materials provided.
- You must build your greenhouse in the time provided.
- You may use additional tools such as scissors and rulers.

TIME SCHEDULE:

Teacher will set a timer and notify students when to move on to the next step.

- 5 minutes for each student to sketch his/her own design.
- 5 minutes to brainstorm ideas as a group.
- 10 minutes to plan out the design.
- 20 minutes to create the product (the greenhouse).

- 10 minutes to reflect. How can we improve the design? What worked well? What did not work well?

EVALUATION:

Rubric will be used to score.

EXTENSION:

Have each group plant another plastic cup with seeds. Then place both the plant in the greenhouse and the exposed plant outside in a sunny area where they will not be blown by the wind. Visit the plants every other day to water them and to check on their growth. In the same small groups, have the students measure the growth of both the exposed plant and the plant in the greenhouse and keep a record of the growth by date. Choose an end date for your experiment – two weeks or a month – and then ask the students to graph the growth pattern for each plant. Discuss the results. Did the greenhouse protect the plant and allow it to grow faster?

NEW JERSEY LEARNING STANDARDS

Science: K-2: ETS1.A,B,C 3-5: ETS1.A,B,C

NAME_____

GREENHOUSE DESIGN CHALLENGE RUBRIC Grades 3-5

Today your challenge is to design and construct a greenhouse for seeds planted in a plastic cup. You will have only 40 minutes to build your greenhouse. After your greenhouse is completed, we will take it outside and see how your seeds grow in your greenhouse compared to seeds planted without a greenhouse.

BEFORE YOU BEGIN: Plant seeds in two plastic cups and water them lightly.

CRITERIA: Your mini greenhouse must be big enough to hold the plastic cup. The greenhouse walls cannot touch the plant. The plant must be supported so that the plastic cup does not tip over. The greenhouse must be opened easily to water the plant and release heat if necessary.

CHALLENGE RULES:

1. Listen carefully to ideas from everyone on your team.
2. Decide on the best design before you begin to build.
3. You may only use the materials provided.
4. You must build your greenhouse in the time provided.
5. You may use additional tools such as scissors and rulers.

6.

Rubric

To evaluate your greenhouse, circle how you met each specification below.

CRITERIA	3	2	1
Greenhouse big enough to hold plant.	Yes!	Almost	Not really
Greenhouse walls do not touch plant.	Yes!	Barely touch	Not really
Plastic cup does not tip over.	Yes!	A little unsteady	Not really
Greenhouse opens easily for watering.	Yes!	A little tricky	Not really
Original and Creative	Impressive	Unique	Interesting
Use materials on list only	Yes!	Some	Other

NAME_____

GREENHOUSE DESIGN CHALLENGE Grades K-2

How Did We Do?

Our greenhouse is big enough to hold our plant.

YES NO

The walls of our greenhouse do not touch plant.

YES NO

We can easily open our greenhouse to water our plant.

YES NO

We only used the materials on the table.

YES NO

We worked together and listened to each other.

YES NO

We are proud of our greenhouse design.

YES We can do better next time

IT STEMS FROM THIS

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

Background Information:

Stems of plants appear in a variety of shapes and sizes. Stems provide structure to a plant and support the leaves. Some stems, called trunks, are hard and woody. Others such as daffodil stems and corn stalks are hollow. Most, but not all, stems grow above the ground. Potatoes are specialized stems called tubers which grow underground.

The second basic function of stems is to transport nutrients and water throughout the plant. Xylem bundles transport water and nutrients from the roots to all parts of the plant. Phloem bundles transport the food the plant makes for itself in its leaves to the rest of the plant.

Grades: PreK-2

OBJECTIVES

Students will:

- explore the physical structure and function of stems
- Discover that plants have a system of tubes to transport liquids

MATERIALS NEEDED

- Asparagus
- Broccoli
- Celery
- Daffodil, wheat steam or other hollow stemmed flower
- Knife

ACTIVITY

Discuss stems of plants and identify the stem plants—asparagus, broccoli, celery and daffodil. Cut of a slice of each stem. Look closely at the cross section and pass around the samples for students to observe.

Ask students to identify similarities and differences among the stems. Make sure students notice the tubes in the celery. Cut a piece for each child to examine and dissect. Take the celery apart to find the tubes.

EVALUATION:

Student participation in the lesson; reinforce the concept that stems give plants their structure and have tubes to carry water and nutrients throughout the plant.

EXTENSION:

Students can pull weeds from the school garden or be provided with some weeds—interesting ones include dandelions, clover and milkweed.

"The Day the Celery Dyed" experiment

NEW JERSEY LEARNING STANDARDS

Science: K: LS1.C 1: LS1.A 2:LS2.A 3:LS1.B 4:LS1.A 5:LS2.A Language Arts: K:W.K.2 1:W.1.2,8 2:W.2,8 3:W.3, W.3.8 4:W.4.2, W.4.8 5: W.5.2, W.5.8

MAKING MUD SHAKES TO LEARN ABOUT SOIL

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

Grades:K-5

OBJECTIVES

The student will be able to:

- Name the three types of soil: sand, silt, and clay
- Define silt as the best soil for plants because it can hold just enough water for plants and let in air.

MATERIALS NEEDED

- Plastic bottle with screw top for each small group of 3-4students
  For each bottle you will need:
  - one cup of sand (play sand is fine)
  - one cup of soil from the school garden
  - one cup of clay (available in most New Jersey backyards)
- Funnels made from the tops of the bottles (one for each group).
  - To make a funnel, cut the top off a bottle and turn it over. Use duct tape to tape a funnel to the top of plastic bottle for each small group
- Water
- Small watering can or empty gallon milk jug for each group to use to hold water
- “Types of Soil Experiment” worksheet

INTRODUCTION

Ask students if plants can grow in any type of soil. What type of soil is it difficult for plants to grow in? Explain the three types of soil – sand, silt, and clay.
Sand is the biggest and heaviest type of soil with more space in between particles so that water can run through it easily. Clay is the smallest and lightest type of soil that is packed together so tightly it is difficult for water to run through it. Silt is the “just right” medium- sized type of soil that allows water to move slowly through so plants can catch the water with their roots.
The teacher can demonstrate how water runs through each type of soil by drawing circles

on the board – big circles spaced far apart for sand, medium-sized circles spaced closer together for silt, and small circles spaced close together for clay.

ACTIVITY

Play the Types of Soil Game

This fun, active, and fast game shows students how water moves through the three types of soil. The game can be played indoors or outdoors.

Divide the students into three groups by having them count off by three, reminding them to remember their numbers. Ask the students with the number 1 to line up. Tell them to stretch their arms out at shoulder height and move away from each other until they are in a line with only their fingertips touching. Tell the students that they represent sand particles.

Ask the rest of the class to line up about 8-10 feet in front of these students. Tell the students that each of them is a drop of water. They are to move through the sand by moving underneath the arms of the “sand” students and moving back out again. After the students have moved through and back under the “sand” students’ arms, ask them if it was difficult or easy to do. Water moves very easily through the large particles of sand.

Next, ask the sand students to join the other students in line, and ask the students with the number 2 to line up in front. They are the silt particles. Ask them to put their hands on their hips and make a line with the tips of their elbows touching. Then ask the rest of the students - the water droplets - to move through the “silt” students by again moving under their arms. Once all of the students have moved through the silt and back, ask them if it was more difficult to pass through the silt than the sand. Water moves more slowly through the medium-sized silt particles, allowing the roots of plants to catch and soak up water.

Ask the silt students to join the other students in line and ask the students with the number 3 to line up in front. They are the clay particles. Ask them to line up with their arms at their sides with their hands in a fist with only their thumbs sticking out. They should line up with the tips of their thumbs touching. Remind the rest of the students that it is difficult for water to move through the very small clay particles and that they must move slowly and carefully. Ask them what happens to water when it cannot run through soil? It forms puddles on the surface. Tell students that if they find they cannot move through the line of “clay” students, they can flop down and lay in front of the clay line, calling out, “I’m a puddle.”

After everyone has either moved through the clay line or become a puddle, ask students about the differences they experienced moving through sand, silt, and clay.

MAKING MUD SHAKES

Tell the students that the soil in the school garden is made up of silt that is good for plants. Say that today we are going to make mud shakes to compare this silt to the other types of soil – sand and clay.

Divide the students into small groups of three to five. Give each group a plastic bottle with a funnel taped to the top. Ask the students to fill the bottle two-thirds full of water. Using the

funnel, the students add one cup of clay, one cup of sand, and one cup of garden silt to the bottle. The sand and garden silt will be easy to put into the bottle. The students will have to use a pencil to push the clay through the funnel.

Remove the funnel and the tape and seal the bottle cap on tightly. Give each child in the group a chance to shake the bottle vigorously until the water and all the soil is mixed well. (It defuses arguments to ask each child to take a turn shaking by counting to 10 and then giving someone else a turn.) Ask the students to let the bottles stand in their classroom until the water at the top is fairly clear. This may take several days. Do not move the bottles.

The students should see the three different types of soil settle in layers. The sand will be the heaviest and will be at the bottom. The silt will be in the middle. The clay will be the lightest and will be at the top. Look at the surface of the water. Is there some plant material floating there? How does your garden soil compare to the other soil?

EVALUATION:

Students will be able to list the three types of soil. Students will be able to tell which type of soil is most desirable for plants and why.

Completed “Types of Soil Experiment” worksheet

EXTENSION:

Read and discuss Steve Tomecek's book *Dirt.*

NEW JERSEY LEARNING STANDARDS

Science: K:LS1.C 1:LS1.A 2:LS2.A 3:LS3.B, LS4.C 4:ESS2.A 5:LS2.B

Types of Soil Experiment

There are three types of soil. Sand is the largest and heaviest. Silt is medium- sized. Clay is the smallest and lightest.

Describe the contents (what's inside) of one of the soil bottles after it's just been shaken.

_____

_____

Describe the contents of one of the soil bottles the next morning.

_____

_____

Describe the contents of one of the soil bottles after three days. Do you see any layers?

_____

_____

_____

Why do you think the soil settled the way it did?

_____

_____

MINI-GREENHOUSES

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OBJECTIVES

The student will be able to:

•To set up an on-going experiment in order to observe seed sprouting, growth and the parts of plants.

MATERIALS NEEDED

- a pre- soaked lima bean seed for each student
- Ziplock bags
- Cotton balls
- Water

VOCABULARY

seed coat, stem, sprout, greenhouse

ACTIVITY

Students will assemble “mini” greenhouses in class so they can watch seeds sprout and begin to grow. As a class, make predictions…how does a seed sprout? Tell students that they will learn about the parts of a seed during the growth process.

Students can work in groups of two. Each group gets a ziplock bag, 4 presoaked lima bean seeds and 5-6 cotton balls. Wet the cotton balls and squeeze out the excess water and drop them into a sandwich bag with your seeds. Ziplock bags can be sealed and labeled with groups’ name and hung on the window with tape.

After greenhouses are assembled, the class can gather back together and discuss what they discovered about their seeds. Did they see the seed coat splitting or roots emerging from their presoaked seeds? How long do they think it will take for the plants to grow?

Students should understand that not all seeds sprout and not to be disappointed or feel like they failed. Some seeds will grow quickly, others will take longer, and some won't grow at all. This is an opportunity to think like a scientist and think about why and how seeds grow.

Over the next few weeks, students should be encouraged to observe their seeds sprouting every day and to take the lid off for a short period of time to let their plants breathe and to remoisten the paper towel. This is a great opportunity to encourage scientific thinking. A class chart can be made documenting seed sprouting and growth.

EVALUATION:

Students complete their observations of the experiment in their journals.

NEW JERSEY LEARNING STANDARDS

Science: K:LS1.C 1:LS1.A 2:LS2.A 3:LS1.B 4:LS1.A 5:LS1.C

More Books About Seeds

From the New Jersey Agricultural Society Learning Through Gardening program

The Bad Seed by Jory John
This is a book about a *bad seed*. *A baaaaaaaaaad seed. How bad? Do you **really** want to know?* He has a bad temper, bad manners, and a bad attitude. He's been bad since he can remember! This seed cuts in line every time, stares at everybody and never listens. But what happens when one mischievous little seed changes his mind about himself, and decides that he wants to be—happy?

The Carrot Seed by Ruth Kraus and Crockett Johnson
When a little boy plants a carrot seed, everyone tells him it won't grow. But when you are very young, there are some things that you just know, and the little boy *knows* that one day a carrot will come up. So he waters his seed, and pulls the weeds, and he waits...

The Empty Pot by Demi
A long time ago in China there was a boy named Ping who loved flowers. Anything he planted burst into bloom. The emperor loved flowers too. When it was time to choose an heir, he gave a flower seed to each child in the kingdom. "Whoever can show me their best in a year's time," he proclaimed, "shall succeed me to the throne!" Ping plants his seed and tends it every day. But month after month passes, and nothing grows. When spring comes, Ping must go to the Emperor with nothing but an empty pot.

Flip, Fly, Float, Seeds on the Move by JoAnn Early Macken
Spinning like a shiny green helicopter, a maple seed floats on the wind. Where will it land? Seeds splash away in raindrops, slide across the snow, and hitch rides on birds and animals—and even people's clothing.

Miss Rumphius by Barbara Clooney
The story of Alice Rumphius, who longed to travel the world, live in a house by the sea, and do something to make the world more beautiful. The countless lupines that bloom along the coast of Maine are the legacy of the real Miss Rumphius, the Lupine Lady, who scattered lupine seeds everywhere she went.

Seeds by Ken Robbins
In this fascinating chronicle, young readers will learn how seeds grow, and how they vary in shape, size, and dispersal patterns. From cherry pits to exploding pods, to sticktight seeds that cling to your shoes.

A Place to Grow by Stephanie Bloom
No matter where it lands or how desperately it hopes, the tiny seed can't find a place to grow. Will the tiny seed ever find a home, or will it keep searching and floating forever?

A Seed in Need by Sam Godwin

An inquisitive ladybug and snail follow the growth of a plant from seed to full flowering.

One Little Seed by Elaine Greenstein

Simple language and endearing illustrations follow a seed from the time it is planted until it grows into a beautiful flower.

Seeds: A Book About How Living Things Grow by Joanna Cole

Ms. Frizzle's class is growing a beautiful garden, but Phoebe's plot is empty. Her flowers are at her old school! So, the kids climb aboard the Magic School Bus. They go to Phoebe's old school to get some of her old flowers, but they end up actually going inside the flowers. Follow the kids' colorful adventure as they learn how living things grow.

PARTS OF A FLOWER

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

Students create a flower with craft materials in order to learn the parts of flowers and their functions.

GRADES: 3-5

OBJECTIVES

The student will be able to:

• Identify the parts of a flower and their functions
• Explain the process of pollination and the role of pollinators

MATERIALS NEEDED

- Parts of a Flower worksheet
- Flower Anatomy worksheet
- Q-Tips
- Tissue paper in flower petal colors– four rectangular pieces per child, 5x7 or larger
- Green pipe cleaners
- Glue sticks or glue Glitter

BACKGROUND INFORMATION:

Parts of a Flower

Each part of the flower contributes to the flower's role of making seeds.

- Pistil: the female part of the flower shaped like a bowling pin that is made up of the stigma, style, ovary, and ovule
- Stigma: the sticky bulb at the center of the flower at the top of the pistil. Pollen grains attach to the stigma.
- Style: a long stalk that holds up the stigma. Pollen travels down the style to the ovary.

- Ovary: the enlarged base of the pistil where seeds develop. A mature ovary becomes the fruit of the plant.
- Ovule: small parts inside the ovary that when fertilized with pollen become seeds. Stamen: the male parts of the flower that surround the pistil
- Anthers: the top of the stamen stalk that is filled with pollen. When the pollen is ready to be spread, the anthers open to release pollen.
- Filament: the long thin stalk that supports the anther.
- Petals: the soft parts surrounding the pistil and stamen that are often brightly colored to attract pollinators.
- Sepal: the small leaves directly under a flower
- Nectar: a sweet sticky substance produced by flowers to attract pollinators and used by bees to make honey

*Some flowers, such as those on pumpkin plants, have only stamens (the male part) or pistils (the female part). They are called imperfect flowers. Other plants, such as tomatoes, have both stamens and pistils and are called perfect plants.

Pollination

Pollination happens when the pollen from the male parts of one flower connects with the female parts of another flower. How does the pollen from one flower get to the ovules of another flower?

Plants make flowers to attract pollinators to do this for them. Pollinators can be bees, flies, beetles, moths, hummingbirds, bats, and other creatures that visit flowers. They travel from flower to flower to gather the nectar and pollen to feed themselves and their young. When a pollinator goes into a flower to collect the nectar or pollen, tiny grains of pollen from the anthers of the flower (the male parts) stick to their bodies. When the pollinator visits another flower of the same species, some of this pollen brushes onto the sticky stigma at the top of the pistil. The pollen travels from the stigma down the style to the ovary. When an ovule is fertilized, a seed is made. Some flowers are pollinated by the wind.

INTRODUCTION

Discover what students already know about flowers and pollination. Ask what pollinators are? What is pollination? How do flowers grow seeds and fruit? Explain that students will learn that pollination enables a plant to grow seeds and that most plants need the help of pollinators – bees and other insects – for this to happen.

ACTIVITY

Pass out a diagram of the parts of a flower and discuss the different parts and their functions with the students.

MAKING THE FLOWER:

Start with three to six pieces of tissue paper (5 x 7 or larger). Fold each piece into an accordion (about 2 inches for each fold). Place all accordion strips in one pile. Tie the center of the pile with a green pipe cleaner, which will serve as the stem. Pull each layer of tissue paper out around the stem, creating petals. To create the stamens: Glue four Q-Tips to the tissue paper in a circle in the center of the flower. (The soft tips act as the anthers, while the stem acts as the filament.) For smaller (5 x 7) tissue pieces, you can cut the Q-tips in half. To create a pistil: Students trace precut samples in the shape of a bowling pin about the height of the Q-tips. Put glue on the top of this bowling pin piece and dip it in glitter for the pollen. Glue the pistil in the center of the Q-Tips. Ask students in small groups to explain the parts of their flowers to one another.

EVALUATION:

Students complete they Flower Anatomy Worksheet. Students can verbally explain parts of the paper flower they have made.

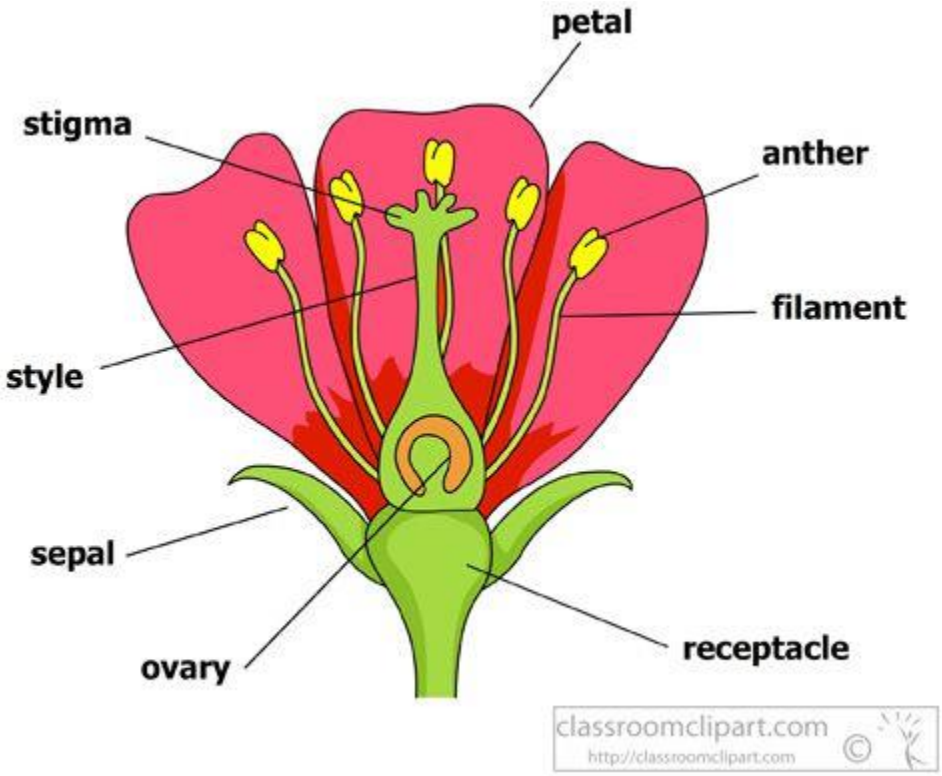
EXTENSION:

Students dissect real flowers to observe the various parts. Distribute a flower to each student or group of students. Lilies and tulips are preferable because they have large petals, stamens, and pistils that are easy to identify. Ask your local florist or grocery store to donate leftover flowers. Ask students to identify the flower parts and observe them under a microscope.

NEW JERSEY LEARNING STANDARDS

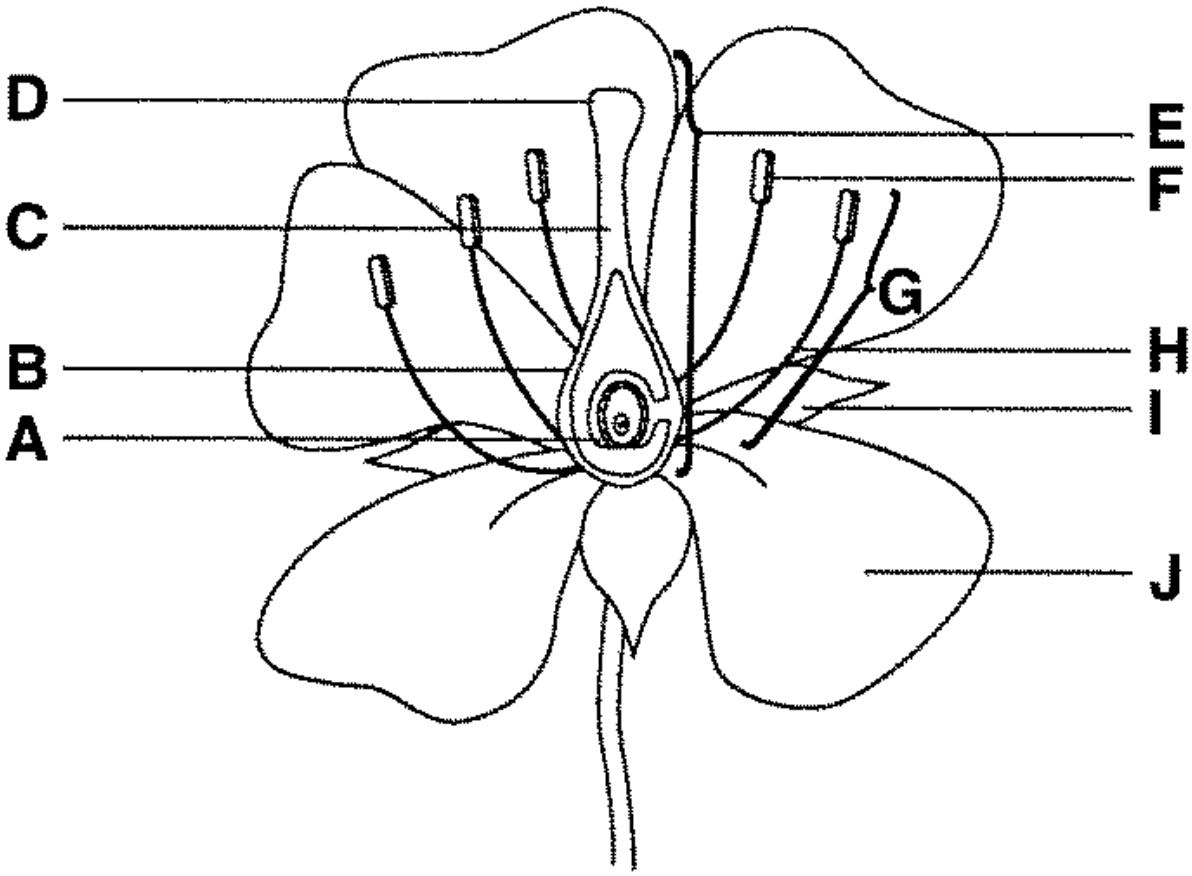
Science: 3:LS1.B 4:LS1.A 5:LS1.C

Parts of a Flower



Parts of a Flower

Label the parts of a flower.



PARTS OF A PLANT GAME

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

What parts of plants do we eat? All of them! In this fun card game, students learn whether their favorite fruits and vegetables are roots, stems, leaves, flowers, fruits or seeds. The game can be played by individuals in a small group or by teams of students. Do your students know that broccoli is a flower? Here's how they can learn!

GRADES: K-5 (The degree of difficulty can be modified for all grade levels.)

OBJECTIVES

The student will be able to:
Look at pictures of fruits and vegetables and tell what parts of the plant they are.
• Describe the function of six plant parts: roots, stems, leaves, flowers, fruits, and seeds.

MATERIALS NEEDED

- Learning Through Gardening fruit and vegetable cards, printed and cut out. It is recommended that the pictures be glued onto cardboard or laminated before the game.
- Signs for each of the six plant parts: roots, stems, leaves, flowers, fruit, seeds.
- Optional for grades 2-5: Parts of a Plant I Eat worksheet for each student.
- Optional: A large picture of a plant such as a tomato or cranberry that shows all of the six plant parts. This can be drawn on a large piece of plastic, vinyl tablecloth, or with chalk on pavement if the game is played outside.

NOTE: Teachers should separate cards for teams of students in advance, so that each team receives a variety of different plant parts.

ACTIVITY

Spread the six plant part signs in the middle of the room where each team can reach them easily. Divide students into teams of three or four. Distribute the fruit and vegetable cards equally to each team, making sure each team receives a variety of plant parts.

Explain to the students that their team should work together to identify what plant part each fruit and vegetable is. When they have decided upon the plant part, they should discuss what that part does for the plant. Then one team member should place the card by the correct

plant part sign in the middle of the room. If you are using a large drawing of a plant, the students should place the cards around the appropriate part of the plant.

When all the cards have been placed, all students should gather in a circle around the plant part signs. They should look carefully at where the cards have been placed. The teacher should point to each plant part one by one and ask students if they agree if all the cards have been placed there correctly. Before moving on to the next plant part, ask the students what the plant part does for the plant. At the end of the game, ask students which plant part had the most cards. Which had the least?

NOTE: For younger students, the teacher may want to use fewer cards or select only cards of the most familiar fruits and vegetables.

EVALUATION:

Each student lists the six plant parts, describes what it does for the plant, and names his/her favorite fruit or vegetable that is that plant part.

EXTENSION:

Older students can teach the Parts of a Plant game to younger students. Ask each team to name a fruit or vegetable that was not included in the plant part cards. What part of the plant is it?

NEW JERSEY LEARNING STANDARDS

Science: K: LS1.C 1: LS1.A 2:LS2.A 3:LS1.B 4:LS1.A 5:LS2.A Language Arts: K:W.K.2 1:W.1.2,8 2:W.2,8 3:W.3, W.3.8 4:W.4.2, W.4.8 5: W.5.2, W.5.8

NAME_____

Parts of a Plant I Eat

Beside each plant part, describe what that part does for the plant. Then write the name of your favorite fruit or vegetable that is that plant part. Explain why you like it.

ROOT:

STEM:

LEAVES:

FLOWER:

FRUIT:

SEED:

My favorite:

Parts of a Plant Game

Answer Key:1) apple - fruit 2) artichoke - flower 3) asparagus - stem 4) avocado - fruit 5) banana - fruit 6) beans - seeds 7) beet - root 8) blueberries - fruit 9) celery - stem 10) cherry - fruit 11) corn -seeds 12) grapes - fruit 13) bok choy - stem and leaves 14) cauliflower - flower 15) carrots - root 16) broccoli - stem and flower 17) cucumber - fruit 18) eggplant - fruit 19) kale - leaves 20) tomato - fruit 21) lettuce - leaves 22) orange - fruit 23) peach - fruit 24) pear - fruit 25) peas - seeds 26) pepper - fruit 27) pineapple - fruit 28) pumpkin - fruit and seeds 29) radish - root 30) kiwi - fruit 31) spinach - leaves 32) strawberry - fruit 33) cabbage - leaves 34) Swiss chard - leaves 35) watermelon - fruit 36) zucchini - fruit

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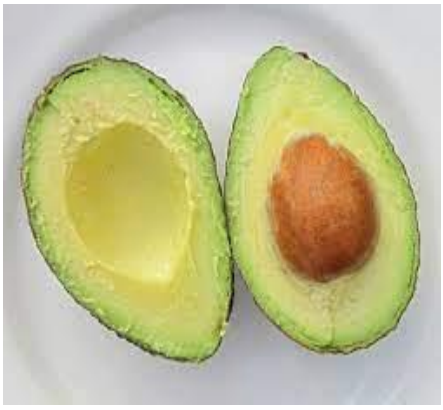
3. 	4. 

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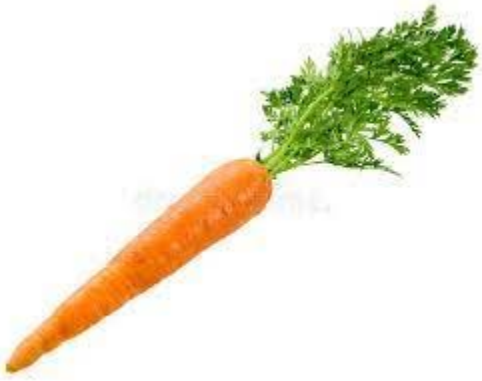
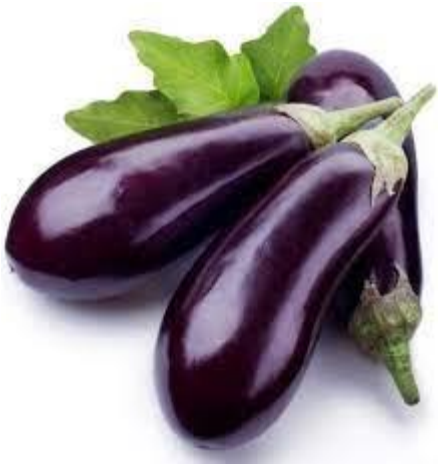
15. 	16. 

17. 	18. 
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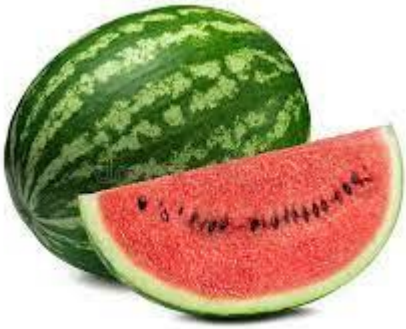
35. 	36. 

Parts of a Plant Song

(sing to the tune of the theme song of the Addam's Family)

Parts of a plant (Snap fingers or clap hands twice)
Parts of a plant (Snap fingers or clap hands twice)
Parts of a plant, parts of a plant, parts of a plant (Snap fingers or clap hands twice)
There's roots (touch toes)
And stems (put hands on waist)
And leaves (wave arms out to the side)
Flowers (Circle arms overhead)
Fruit (Circle arms out to the front)
And Seeds (Wiggle fingers in front)
You roll them all together (Roll hands)
And you've got the parts of a plant (Snap fingers or clap hands twice)
Parts of a plant (Snap fingers of clap hands twice)
Parts of a plant, parts of a plant, parts of a plant (Snap fingers or clap hands twice)

PARTS OF A PLANT WE EAT

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

Edible parts vary from plant to plant. Teach or reinforce parts of a plant by focusing on the different parts that we eat – root, stem, leaf, flower, fruit, and seed. In the book Tops and Bottoms by Janet Stevens, Bear learns his edible parts of a plant the hard way from a clever hare who tricks him three times into giving up the edible crops while he gets the useless leftovers.

Using the book Tops and Bottoms is an engrossing way to get students talking about the parts of plants we eat, and what those parts do for the plant. The lesson can be modified for younger and older students

GRADES: K-3

OBJECTIVES

Language Arts: The student will be able to:

- properly sequence and retell a story
- demonstrate comprehension by answering questions about the story

Science: The student will be able to:

- recognize different plant parts as roots, stems, leaves, flowers, fruit, and seeds, tell where each part grows on the plant
- identify what part of a plant vegetables and fruits are that we eat

MATERIALS NEEDED

- The book Tops and Bottoms by Janet Stevens or YouTube read-aloud video of Tops and Bottoms by TMO Learning Journey: https://www.youtube.com/watch?v=zIjh4hYkhrI
- optional: parts of a plant worksheet
- optional: Parts of a Plant Game

ACTIVITY

Begin the lesson by asking the students “Did anyone eat roots for dinner last night?” If no one responds, ask “Did anyone eat carrots?” Explain roots are only one part of plants that we eat regularly. Ask students for others.

Read aloud and discuss the book Tops and Bottoms. Possible comprehension questions: 1) Do you think the hare tricked the bear? Why or why not? 2) In order to get the garden to grow, what were the hares' responsibilities? 3) Why wasn't the bear happy with his

share of the garden? 4) What would you have done differently if you were the bear? 5) What were the vegetables grown in the story?

Younger students can review the sequence of events from the story. What was hare's problem? What did he do first? etc.

Review with the students what each plant part does. Optional: use the parts of a plant worksheet for illustration.

- Roots soak up water and nutrients from the soil for the plant.
- Stems support the leaves and carry water and nutrients to the rest of the plant.
- Leaves make the plant's food by photosynthesis.
- Flowers attract pollinators to the plant.
- Fruit protects the seeds.
- Seeds produce a new plant. Youngest students can discuss just the three plant parts mentioned in the book – the tops (leaves), the bottoms (roots) and the middles (seeds)

EVALUATION:

Older students: Students can correctly identify parts of a plant and explain their function. Students can correctly answer comprehension questions about the book Tops and Bottoms.
Younger students: Students can properly sequence events from the book Tops and Bottoms. Students can name parts of a plant and explain their function.

EXTENSION:

For younger students: Have students fold a piece of paper in half lengthwise, and color the bottom brown and the top blue. Ask the students to color and cut out the vegetables on the worksheet following this lesson. Ask the students to glue the vegetables on the colored paper, placing the roots in the brown area (the ground) and the leaves in the blue area (above ground). Sing the Parts of a Plant Song. Play the Parts of a Plant Game. Small groups of students receive cards with pictures of fruits and vegetables. Each group must identify the fruit or vegetable on each card and say what part of the plant it is. Plant radishes (bottoms), lettuce (tops), and peas (middles) in containers in the classroom, so students can observe how each plant grows. When it is warm enough, transplant the seedlings into your outdoor garden. Ask students to write a persuasive paragraph from the point of view of the bear or the hare explaining why you think the deal was fair or unfair.

NEW JERSEY LEARNING STANDARDS

Science: K: LS1.C 1:LS1.A 2:LS2.A 3:LS1.B English Language Arts: K:RL.K.1-10 1:RL.1.1-4,6 2:RL.2.1-7 3:RL.3.1-8

PARTS OF A SEED: DISSECTION

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

GRADES: PreK-5

OBJECTIVES

The student will be able to:

- describe and locate the different parts of a seed

MATERIALS NEEDED

- Small ziplock bags
- 1 lima bean seeds soaked in water overnight for each student
- Magnifying glass
- Paper towels
- Spray bottle with water
- Optional: Parts of a Seed worksheet

PREPARATION

Soak lima beans in water overnight. You can use a bag of lima beans purchased from the grocery store; you do not need to purchase packages of lima bean seeds.

ACTIVITY

Tell students that they are going to examine some seeds. Give each student one soaked bean seed and a magnifying glass. Instruct students to carefully examine their seeds. What do they observe?

Draw a large bean on the board and ask students to help you make it accurate with their observations. Students can make their own drawings for their learning journals. Identify the

seed coat (it should be loose due to the overnight soaking). Be sure students understand the purpose of the seed coat; this can be compared to the coats we wear. Have students carefully remove the seed coat.
Identify the food storage within the seed. This is the largest part of the seed in which the embryo plant grows. The scientific word for this is endosperm.
Carefully open the seed and locate the embryo plant.
Label each of these structures(seed coat, endosperm(stored food), embryo, cotyledon) on a diagram. Students can either draw their own or the teacher can provide one for students to label.

EVALUATION:

Students labeled pictures or diagrams

EXTENSION:

Compare a dry bean with a soaked bean. Now look at a dry bean. This bean will have the same structures, but they may be visibly different. Record your comparisons in your journal. What are the similarities? What are the differences?

Read one of these books:

A Seed is Sleepy, by Dianna Hutts Aston

A Fruit is a Suitcase for Seeds, by Jean Richards

Flip, Float, Fly, Seeds on the Move, by JoAnn Early Macken

From Seed to Plant, by Allan Fowler

From Seed to Plant, by Gail Gibbons

The Tiny Seed, by Eric Carle

One Little Seed, by Elaine Greenstein

NEW JERSEY LEARNING STANDARDS

Science: K:LS1.C 1:LS1.A 2:LS2.A 3:LS1.B 4:LS1.A 5:LS1.C

PEA TRELLIS STEM DESIGN CHALLENGE(3-5)

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

In this STEM design challenge, students will work in small groups to design and build a trellis to support pea vines in an outdoor garden. This lesson can be paired with the book First Peas to the Table, by Susan Grigsby. In this story, a class of students copy the annual contest Thomas Jefferson had with his neighbors to see who could grow the first bowl of peas.

OBJECTIVES

The student will be able to:

- Design a trellis for pea plants based on criteria provided.
- Compare multiple trellis designs and with a group design a trellis based on criteria provided.
- Build the trellis with a group based on the design selected.
- Evaluate the group's trellis based on the criteria provided.

MATERIALS NEEDED

- Pea seeds
- Tree branches
- Dowel sticks
- Thin pieces of wood
- Yarn
- String
- Before the challenge, you might ask students to brainstorm and search at home for other materials that could be used to make a trellis such as: rulers, yardsticks, broomsticks, etc.

BACKGROUND

Plants grow in many ways. Some plants can grow a sturdy stem that will hold them upright. Some plants are what we call vines. These plants have a very thin stem and need support from something strong and tall. In nature, vines often grow up trees. In a field, farmers will use a man-made structure called a trellis to support the growing vine. The vine will grow up the trellis, often twisting around the trellis as it grows.

INTRODUCTION

Instead of spending money on store-bought trellises for your pea plants, give your students this STEM challenge and have them build their own. You can plant pea seeds under the completed trellises or transplant pea plants started indoors.

ACTIVITY

Divide the students into groups of four. Distribute the design challenge rubric sheets. Explain and review the criteria with the class and answer questions. Explain and review the challenge rules. Explain and review the time schedule. Tell students that you will be observing their progress and reminding them to stick to the challenge criteria, rules, and time requirements.

CRITERIA:

- Your trellis must be at least 24 inches tall.
- Your trellis must be at least 12 inches wide.
- Your trellis must stand upright to support the pea vine and not fall over.
- Your trellis must include string or yarn for the pea vine to cling to.

CHALLENGE RULES:

1. Listen carefully to ideas from everyone on your team.
2. Decide on the best design before you begin to build.
3. You may only use the materials provided.
4. You do not have to use all the materials provided.
5. You must build your trellis in the time provided.
6. You may use additional tools such as scissors and rulers.

TIME SCHEDULE: Teacher will set a timer and notify students when to move on to the next step.

- 5 minutes for each student to sketch his/her own design.
- 5 minutes to brainstorm ideas as a group.
- 10 minutes to plan out the design.
- 20 minutes to create the product (the trellis).
- 10 minutes to reflect. How can we improve the design? What worked well? What did not work well?

EVALUATION:

Rubric

EXTENSION:

Show students pictures of trellises used in farms and gardens today. If you are pairing the lesson with the book First Peas to the Table, show the students pictures of trellises from Thomas Jefferson's Garden. What other vegetables grow on vines and need trellises? Discuss with the class or have them research how their favorite vegetables and fruits grow.

NEW JERSEY LEARNING STANDARDS

Science: 3-5:ETS1.A,B,C

NAME_____

PEA TRELLIS DESIGN CHALLENGE RUBRIC

Today your challenge is to design and build a trellis for the pea vines in our garden to grow on. You will have only 40 minutes to do this project.

CRITERIA:

- Your trellis must be at least 24 inches tall.
- Your trellis must be at least 12 inches wide.
- Your trellis must stand upright to support the pea vine, and not fall over.
- Your trellis must include string or yarn for the pea vine to cling to.

CHALLENGE RULES:

- Listen carefully to ideas from everyone on your team.
- Decide on the best design before you begin to build.
- You may only use the materials provided
- You must build your trellis in the time provided
- You may use additional tools such as scissors and rulers

Name_____

RUBRIC

To evaluate your trellis, circle how you met each specification below.

Criteria	1	2	3
Trellis is at least 24” tall	Yes!	almost	
Trellis is at least 12” wide	Yes!	almost	Not really
Trellis stands upright	Yes!	unsteady	Not really
Trellis includes string or yarn	Yes!	A little	Not really
Original and creative design	Impressive	unique	interesting
Used material on list only	Yes!	some	other

PEA TRELLIS STEM DESIGN CHALLENGE (K-2)

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

Students will work in small groups to design a trellis to support a pea vine that is beginning to grow indoors in a plant pot. This lesson can be paired with the book First Peas to the Table, by Susan Grigsby. In this story, a class of students copy the annual contest Thomas Jefferson had with his neighbors to see who could grow the first bowl of peas.

GRADES: K-2

OBJECTIVES

The student will be able to:

- Design a trellis for pea plants based on criteria provided.
- Compare multiple trellis designs and with a group design a trellis based on criteria provided.
- Build the trellis with a group based on the design selected.
- Evaluate the group's trellis based on the criteria provided.

MATERIALS NEEDED

- Straws
- Tape
- Glue
- Craft sticks
- Yarn
- String
- Paper plates
- Cardboard
- Crayons
- Markers
- Potting soil
- Seeds

- Plant pots or recycled containers such as milk cartons with holes poked in the bottom.

BACKGROUND

Plants grow in many ways. Some plants can grow a sturdy stem that will hold them upright. Some plants are what we call vines. These plants have a very thin stem and need support from something strong and tall. In nature, vines often grow up trees. In a field, farmers will use a man-made structure called a trellis to support the growing vine. The vine will grow up the trellis, often twisting around the trellis as it grows.

ACTIVITY

Divide the students into small groups of four. Place materials on a table for each group. Write the criteria for the trellis on the board and explain the rules. At the end of the challenge, give each student a How Did We Do? challenge sheet. Read the sentences to younger students and ask them to circle the answers “yes” or “no.”

CRITERIA:

- Your trellis must be at least 6 inches tall.
- Your trellis must stand upright to support the pea vine, and not fall over.
- You must decorate your trellis.

CHALLENGE RULES: Listen carefully to ideas from everyone on your team. Decide on the best design before you begin to build. You may only use the materials provided. You do not have to use all the materials provided. You must build your trellis in the time provided. You may use additional tools such as scissors and rulers.

TIME SCHEDULE:
Teacher will set a timer and notify students when to move on to the next step:

- 5 minutes for each student to sketch his/her own design.
- 5 minutes to brainstorm ideas as a group.
- 10 minutes to plan out the design.
- 20 minutes to create the product (the trellis).
- 10 minutes to reflect. How can we improve the design? What worked well? What did not work well?

EVALUATION:

Rubric

EXTENSION:

Show students pictures of trellises used in farms and gardens today. If you are pairing the lesson with the book First Peas to the Table, show the students pictures of trellises from Thomas Jefferson's Garden. What other vegetables grow on vines and need trellises? Discuss with the class or have them research how their favorite vegetables and fruits grow.

NEW JERSEY LEARNING STANDARDS

Science: K-2: ETS1.A,B,C

Lesson created by Christine Doucette Barclay Brook Elementary School, Monroe Township

NAME_____

PEA TRELLIS DESIGN CHALLENGE

How Did We Do?
Our trellis is at least 6 inches tall.
YES NO

Our trellis stands upright to support the pea vine. It does not fall over.
YES NO

We decorated our trellis.
YES NO

We only used the materials on the table.
YES NO

We worked together and listened to each other.
YES NO

We are proud of our trellis design.
YES We can do better next time

PLANT DETECTIVE

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

Students will plant and observe the growth of seeds, as illustrated in Oh Say Can You Seed? All About Flowering Plants by Bonnie Worth.

OBJECTIVES

Objectives: Students will:

- Follow directions to plant seeds
- Observe and record the growth of their seeds

MATERIALS NEEDED

- Cups or pots
- Soil
- Seeds
- Water
- warm/sunny location
- Journal
- Book, Oh Say Can You Seed? All About Flowering Plants by Bonnie Worth.

ACTIVITY

Each student will plant and then observe and record the growth of a seed. Try to use at least three different types of seeds.

Students plant their seeds under the direction of the teacher. After planting, students should water seeds, and be careful not to overwater. Place the pots in a warm location. Students should observe and record their observations in their journals. The first day journal entry should include the type of seed planted, number of seeds and the date.

Observations can be made daily or at significant intervals, such as sprouting, first leaves, flowering, etc.

EVALUATION:

Construct a flowchart that outlines the steps of seed growth from seed to flower.

NEW JERSEY LEARNING STANDARDS:

4LS1-1;4 LS1-2; LA: W.4.2

POLLINATION~A STICKY SITUATION

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

Pollination is a sticky situation. In this active lesson, students learn how pollination works by using colored chalk to simulate pollen and cotton balls to simulate bees. Students color the centers of paper flowers with different colored chalk. Then each student takes a cotton ball to simulate a bee. The students land their cotton balls gently on the different colored chalk-covered centers of the paper flowers, to observe how the "bee" accumulates "pollen."

GRADES: PreK-3

OBJECTIVES

The student will be able to:

- Explain what pollen is and the reason for pollination.
- Describe the process of pollination by bees.
- Explain why bees participate in the pollination process.

MATERIALS NEEDED

- Copy of flower picture for each student
- Sticks of chalk in five different colors (Divide the class into groups of five. You will need one of each of the five colors for each group.)
- One cotton ball for each student

BACKGROUND INFORMATION

Plants are the only living things that can make their own food. They do this through a process called photosynthesis. In photosynthesis, the plant uses the energy of the sun to change water and a gas called carbon dioxide into a sugar called glucose, which is food for plants. The green chemical chlorophyll captures the sunlight that plants need to make their food.

Chlorophyll serves a key purpose in the food chain, not only by making food for plants, but by creating food in plants for animal and humans to eat. The leaves of plants are actually several colors, but during the long, sunny days of spring and summer,

plants produce so much chlorophyll that its green color hides all of the other colors. The plant is busy making food both to grow and to store for the winter.

In the fall, plants begin to prepare for the winter when they will become dormant. During this time, the plant is alive but it is not actively growing. As the days become shorter and there is less sunlight, the plant makes less and less chlorophyll until it stops making it all together. With no chlorophyll, the leaves lose their green color, and the other colors underneath are revealed.

ACTIVITY

Start a class discussion about flowers and bees. Ask students what they know about bees. Ask students why they think bees visit flowers. Show the very amusing Stop Motion Science Animation for Kids YouTube video Pollination Lesson: (59) Pollination lesson with stop motion science animation for kids - YouTube

Read and discuss a book about bees such as:

- Are You A Bee? Judy Allen and Tudor Humphries
- Honey in a Hive, Anne Rockwell
- The Honey Makers, Gail Gibbons
- Flight of the Honey Bee, Raymond Huber
- Gives Bees a Chance, By Bethany Barton

Review pollination for the class: Flowers need to exchange pollen in order to be able to make seeds. Since flowers can't move, they need help from pollinators. Deep in their petals, flowers produce a sweet sugary nectar that pollinators like bees, birds, butterflies, and other insects love to eat. When pollinators visit the flowers, they brush up against the pollen, which is very sticky.

Important teachers' note: Most pollinators that visit flowers eat the nectar the flowers produce in their petals. The nectar is the lure to encourage pollinators to visit the flowers. A few pollinators, like beetles or mites, will eat pollen, but most don't. Honeybees collect both nectar and pollen, but pollen is only used as food for their young. Nectar is what is used to make honey.

Think about stepping in wet, sticky mud. Your mother doesn't want you to walk in the house in those muddy shoes, because with each step, some of that mud will fall off. That's the way pollination works. Pollinators visit a flower and get covered with sticky pollen. Then when they visit the next flower, some of that sticky pollen falls off. This is pollination, which allows the flower to make new seeds.

Tell students that today they are going to act out pollination to see how it works. Divide students into groups of five and give each student a picture of a flower. Distribute five different colors of chalk to each group of students. Tell each of the five students in a group to select one color of chalk. Tell students to color the circle in the middle of the flower with their piece of chalk. Distribute a cotton ball to each student. Demonstrate

how the cotton ball will act as a bee that lands in the middle of a paper flower. Tell students that one at a time, they will take their bee and land gently on the middle of each of the five flowers in their group. Each student should gently place their bee to the side until everyone has a turn landing on the flowers. Students then should examine their cotton balls to see what pollen they have picked up. Ask students to discuss in their groups what happened in their groups. Bring the whole class together and ask students to describe what happens when pollinators like bees visit flowers.

EVALUATION:

Students draw a sequence of pictures or write a sequence of sentences that explain how bees pollinate flowers.

EXTENSION:

Share the background sheet The Buzz About Bees to teach students more about honeybees. Investigate the life cycle of bees in the hive – from larva, to pupa, to adult bee. Compare honeybees to other pollinators such as butterflies or hummingbirds.

NEW JERSEY LEARNING STANDARDS

Science: PreK: 5.2.1, 5.3.1 K: LS1.C 1:LS1.A 2:LS2.A 3:LS1.B

The Buzz About Bees

Fun facts about honeybees!

Honeybees live in hives. There are three types of bees in the hive:

1) Queen: One queen runs the whole hive. Her only job is to lay the eggs that will become the hive's next generation of bees. A queen can lay up to 1,500 eggs every day.

2) Drones: These are the male bees. They mate with queen. 3) Workers: Workers are all female bees. Their job is to find food (pollen and nectar from flowers) for the hive. They also clean the hive, make the honey, take care of the offspring, and groom and feed the queen. Workers are the only bees most people ever see flying outside the hive.

Bees collect two things from flowers:

1) Nectar is food for honeybees and other pollinators such as flies, wasps, butterflies, hummingbirds, and bats. Honeybees take nectar back to their hives and use it to make honey. Nectar is a very sweet, sugary liquid that is made by the flowers to attract pollinators. The nectar is deep inside the flower petals, so that pollinators will have to brush up against the flower parts that hold the pollen. Flowers need pollinators to move the pollen from the male part to the female part before they can make seeds.

2) Honeybees also collect pollen. They mix it with nectar to form beebread, which they feed to their larva (baby bees).

Collecting food is a big job. The worker bees must gather enough food to feed the hive in warm weather and to store food for cold weather when there are no flowers. A

honeybee hive uses 50 to 75 pounds of pollen each year. Worker bees must visit two million flowers to make one pound of honey.

Bees are such great workers that they produce two or three times more honey than the hive needs. That's why people can harvest honey and eat it too. To share information about the best food sources, when a worker returns to the hive it performs dances to show others how to find flowers.

POLLINATION~A STICKY SITUATION

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

Pollination is a sticky situation. In this active lesson, students learn how pollination works by using Cheetos to simulate pollen. Students make bee finger puppets and insert two fingers for the feet. Then they eat Cheetos, trying very hard not to lick or wipe off the powder! Next, they take their bee puppets to visit one another's flower, leaving a sticky trail of pollen (Cheetos) behind.

GRADES: PreK-2

OBJECTIVES

The student will be able to:

- Explain what pollen is and the reason for pollination.
- Describe the process of pollination by bees.
- Explain why bees participate in the pollination process.

MATERIALS NEEDED

- Bee finger puppet for each student
- Flower and hive pictures for each student
- 3/4-inch circle punch **Or** materials to make finger puppets: yellow and white cardstock, googly eyes, white string or yarn, red and black markers, glue
- Cupcake papers
- Cheetos or similar cheese snacks

PREPARATION

There are two ways to make the bee finger puppets for this lesson:

1. Copy a bee figure for each student. Punch two holes for fingers at the bottom of the bee figure. Let the students cut out and color the bee. (Some teachers laminate the black and white bees to use again.)

2. Have the students make the bee finger puppets using pre-cut shapes. (Older students could trace and cut their own shapes.)

The shapes you will need are: a 2 1/2-inch circle and a 3-inch circle from yellow cardstock, and two wing shapes from white cardstock.

Ask the students to draw black stripes on the larger circle. Then use the 3/4-inch circle punch to cut out two holes at the bottom of it. Glue the smaller yellow circle onto the black-striped, yellow circle, making sure the finger holes are at the bottom of the large circle. Then glue the white wings on the sides of the bee body. Glue the googly eyes onto the face and use the red marker to draw a smile. Fold the string in half to make a V and glue it onto the back of the bee head for antennae. You might want to add a piece of tape to help secure the antennae in place until the glue dries.

ACTIVITY

Start a class discussion about flowers and bees. Ask students what they know about bees. Ask students why they think bees visit flowers. Show Stop Motion Science Animation for Kids YouTube video Pollination Lesson: www.youtube.com/watch?v=zy3r1zlC_IU.

Read and discuss a book about bees such as:

- Are You A Bee? Judy Allen and Tudor Humphries
- Honey in a Hive, Anne Rockwell
- The Honey Makers, Gail Gibbons
- TheFlight of the Honeybee, Raymond Huber

Review pollination for the class: Flowers need to exchange pollen to be able to make seeds. Since flowers can't move, they need help from pollinators. Deep in their petals, flowers produce a sweet sugary nectar that pollinators like bees, birds, butterflies, and other insects love to eat. When pollinators visit the flowers, they brush up against the pollen, which is very sticky.

Important teachers' note: Most pollinators that visit flowers eat the nectar the flowers produce in their petals. The nectar is the lure to encourage pollinators to visit the flowers. A few pollinators, like beetles or mites, will eat pollen, but most don't. Honeybees collect both nectar and pollen, but pollen is only used as food for their young. Nectar is what is used to make honey.

Think about stepping in wet, sticky mud. Your mother doesn't want you to walk in the house in those muddy shoes, because with each step, some of that mud will fall off. That's the way pollination works. Pollinators visit a flower and get covered with sticky pollen. Then when they visit the next flower, some of that sticky pollen falls off. This is pollination, which allows the flower to make a new seed. Some insects do eat pollen. Honeybees take pollen back to their hives and mix it with nectar to feed to their young (larva).

Tell students that today they are going to act out pollination. Give each student a picture of a flower and a hive. Set a cupcake paper in the middle of the flower and fill it with Cheetos. Tell students to put on their bee puppets and then eat the Cheetos. Tell the students to be sure NOT to brush or lick the Cheetos crumbs from their hands! When they are finished eating, the students' hands – the bee's feet – should be sticky with Cheetos crumbs. Tell the students that their bees need to gather pollen from the flowers near their hive. They should fly around the classroom, landing on other students' flowers with their sticky bee legs and then return to their hive.

When the students land on the flowers, they should be leaving a trail of pollen behind. Tell students to make four or five trips to different flowers and back to their hive. Tell students that after their last trip from flower to hive, they can wash their hands.

Then ask them to complete the Bees Really Get Around worksheet. When everyone has made their last trip from flower to hive, discuss with the students what they observed.

EVALUATION:

Students draw a sequence of pictures or write a sequence of sentences that explain how bees pollinate flowers.

EXTENSION:

Share the background sheet The Buzz About Bees to teach students more about honeybees. Investigate the life cycle of bees in the hive – from larva, to pupa, to adult bee. Compare honeybees to other pollinators such as butterflies or hummingbirds.
PowerPoint Honeybees https://youtu.be/YXAJo2pqtRI

NEW JERSEY LEARNING STANDARDS

Science: PreK: 5.2.1, 5.3.1 K: LS1.C 1:LS1.A 2:LS2.A

The Buzz About Bees

Fun facts about honeybees!

Honeybees live in hives. There are three types of bees in the hive:

1) Queen: One queen runs the whole hive. Her only job is to lay the eggs that will become the hive's next generation of bees. A queen can lay up to 1,500 eggs every day.

2) Drones: These are the male bees. They mate with queen. 3) Workers: Workers are all female bees. Their job is to find food (pollen and nectar from flowers) for the hive. They also clean the hive, make the honey, take care of the offspring, and groom and feed the queen. Workers are the only bees most people ever see flying outside the hive.

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Bees are such great workers that they produce two or three times more honey than the hive needs. That's why people can harvest honey and eat it too. To share information about the best food sources, when a worker returns to the hive it performs dances to show others how to find flowers.

RAIN GAUGE DESIGN CHALLENGE!

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

Students will work in small groups to design and build a rain gauge they can use to measure how much rain falls on their garden.
GRADES: 3-5

OBJECTIVES

The student will be able to:
• Design a rain gauge based on criteria provided.
• Compare multiple rain gauge designs and with a group design a rain gauge based on criteria provided.
• Build the rain gauge with a group based on the design selected.
• Evaluate the group's rain gauge based on the criteria provided.

MATERIALS NEEDED

- a variety of recycled containers with varied shapes: 1-liter and 2-liter plastic bottles, plastic juice bottles, translucent ½-gallon and 1- gallon milk containers or jugs.
- Sturdy, waterproof tape such as duct tape
- Rulers
- Scissors
- Permanent markers
- A Rain Gauge Design Challenge Rubric sheet for each student

INTRODUCTION

Rain is crucial for every garden: rain eliminates the work and cost of watering a garden. Rain gauges help students visualize how much water is necessary for garden plants or how accurate the weather forecasts are. Instead of spending money on commercial rain gauges, give your students this STEM design challenge and have them make their own.

ACTIVITY

Divide the students into groups of four. Distribute the design challenge rubric sheets. Explain and review the criteria with the class and answer questions. Explain and review the challenge rules and the time schedule. Tell students that you will be observing their progress and reminding them to stick to the challenge criteria, rules, and time requirements.

CRITERIA:

- Your rain gauge must be at least 6 inches tall.
- The top of your rain gauge must be at least 3 inches wide.
- Your rain gauge must have measuring marks on the side to measure the water.
- You must be able to empty water from your rain gauge. (In this challenge, students must discover that for the rain gauge to be three inches wide, they must cut the top off their chosen container, turn it over, and insert it into the container like a funnel.
- As plastic can be difficult to cut, the teacher should have a small knife on hand. When the groups realize they must cut the container, the teacher can poke a hole in the container, and then the students can continue to cut carefully with scissors.)

CHALLENGE RULES:

- Listen carefully to ideas from everyone on your team.
- Decide on the best design before you begin to build.
- You may only use the materials provided.
- You do not have to use all the materials provided.
- You must build your rain gauge in the time provided.
- You may use additional tools such as scissors and rulers.

TIME SCHEDULE: Teacher will set a timer and notify students when to move on to the next step.

- 5 minutes for each student to sketch his/her own design.
- 5 minutes to brainstorm ideas as a group.
- 10 minutes to plan out the design.
- 20 minutes to create the product (the rain gauge).
- 10 minutes to reflect. How can we improve the design? What worked well? What did not work well?

EVALUATION:

See Rubric

EXTENSION:

Ask students to research the typical rain trends for New Jersey: What is the usual annual rainfall for New Jersey? Which are the rainiest months? How much rain typically falls during one rainfall? How much rain falls in extreme storms, such as hurricanes or nor'easters? Have students compare the amount of rain that falls in their garden to the amount that is forecast. Are the forecasts mostly accurate?

NEW JERSEY LEARNING STANDARDS

Science: 3-5:ETS1.A,B,C

NAME_____

RAIN GAUGE DESIGN CHALLENGE RUBRIC

Today your challenge is to design and build a rain gauge that can measure the rain that falls on our garden. You will have 40 minutes to complete this project.

CRITERIA:

- Your rain gauge must be at least 6 inches tall.
- Your rain gauge must be at least 3 inches wide.
- Your rain gauge must have measuring marks on the side to measure the water.
- You must be able to empty water from your rain gauge.

CHALLENGE RULES:

- Listen carefully to ideas from everyone on your team.
- Decide on the best design before you begin to build.
- You may only use the materials provided.
- You must build your rain gauge in the time provided.
- You may use additional tools such as scissors and rulers.

RUBRIC

To evaluate your rain gauge, circle how you met each specification below.

Criteria

	3	2	1
My rain gauge is at least 6 inches tall.	Yes!	Almost	not really
My rain gauge is at least 3 inches wide.	Yes!	Almost	not really
My rain gauge has measuring marks on the side.	Yes!	Some	not really
I can easily empty water from my rain gauge.	Yes!	It's difficult	not really
Original and creative	Impressive	Unique	interesting
Used materials on list only	Yes!	Some	Other

SECRET SORTING SHOOTS AND ROOTS

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

Edible parts of plants vary from plant to plant. In the book, Tops and Bottoms, the lazy Bear learns this lesson the hard way from a cunning and crafty Hare. After hearing this story, students will sort the vegetables named in the book by a set of secret instructions provided by the teacher.

Grades: K-4

OBJECTIVES

The student will be able to:

- recognize different plant parts as roots, stems, leaves, flowers, fruit, and seeds, tell where each part grows on the plant
- identify what part of a plant vegetables and fruits are that we eat

MATERIALS NEEDED

- Vegetable Picture worksheet
- Crayons
- Construction paper
- Scissors
- Glue
- Masking tape

BACKGROUND INFORMATION

Carrots, radishes, and beets are all bottoms, or roots, of their plants. Roots are responsible for absorbing nutrients and water from the soil. Although broccoli, celery, and lettuce are all tops, they are each a different part of the plant: broccoli is the flower, celery, the stem, and lettuce is the leaf. Corn is a middle crop. We eat the seeds of a corn plant.

ACTIVITY

Ask students did anyone eat roots for dinner last night? Most students will likely respond no. Ask if any of the students have eaten carrots. Carrots are the root part of the plant. Tell students

they're going to listen to a story about a lazy bear, a smart hair and plant parts. Read the book tops and bottoms.

Possible comprehension questions for discussion during or after the book:

- Do you think Hare tricked Bear? Why or why not?
- To get the garden to grow. What were Hare's responsibilities?
- Why wasn't Bear happy with his share of the garden?
- What would you have done differently if you were Bear?
- What were the vegetables grown in this story? List each and label the parts you eat as top, bottom, or middle.

Ask the students how the hair sorted the vegetables. Tell students they are now going to sort the. Vegetables into two groups. Divide the students into the two groups by hair color, shoes, sneakers, or color of shirts. Then have students determine why they were sorted into each group.

Ask students to brainstorm a list of ways to sort vegetables. For example, by color; tops and bottoms, middle; by the part of the plant: root, stem, leaf, fruit, seed, flower; by shape: long and thin, or short and round.

Give each student vegetable picture worksheets and have students color them and cut them out. Write four different sets of sorting instructions on index cards, such as the part of the plant we eat, the color of the plant we eat, shape of part we eat, if it grows above or below the ground, etc.

Divide the students into four groups. Discuss how Hare kept his sorting method secret from Bear. Have each group sort vegetables by a different set of sorting instructions. Each group must keep their sorting instructions secret from the other groups. Each student will glue their pictures to a construction paper based on his or her group's sorting scheme. on the back of the paper, students may write or glue their sorting method.

Students can then try to guess the method that appears used to sort their vegetables. At the bottom of each page, have each student named their favorite vegetable and identify it as a top, middle, or bottom. Older students can identify it by the plant part.

EVALUATION:

Students will display their sorted groups and the class will guess what the group's secret sorting instructions were.

EXTENSION:

Write a persuasive paragraph from the point of view of the Bear or Hare describing why you think the deal was fair or unfair.

NEW JERSEY LEARNING STANDARDS

Science: K: LS1.C 1:LS1.A 2:LS2.A 3:LS1.B English Language Arts: K:RL.K.1-10 1:RL.1.1-4,6 2:RL.2.1-7 3:RL.3.1-8

SEED INVESTIGATORS

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

GRADES: PreK-2

OBJECTIVES

The student will be able to

- Sort seeds by size, color, and shape.
- Count seeds by ones, twos, fives, and tens.
- Determine which group of seeds is greater than or less than another.
- Depending on grade level, graph the seeds by size or assist in a whole-class graphing.

MATERIALS NEEDED

- A bag or envelope of seeds for each child that contains seeds in a variety of shapes, colors, and sizes. Bird seed works for this activity or a 15-bean soup mix. You can also use packages of expired seeds for this activity. (You can put the seeds in small baggies or envelopes ahead of time to be ready for the lesson.)

ACTIVITY

Give each child a small pile of seeds in assorted shapes, colors, and sizes. First, ask them to count all the seeds. Then, depending on the grade level, ask the students to count them by twos, fives, and tens. Next ask the students to sort the seeds by color and note the number of groups. Then ask the students to sort the seed by shape. Lastly, ask the students to sort the seeds by size. After each grouping, ask the students to determine which group of seeds is greater than and which is less than another. Depending on the grade level, either ask the students to graph their seeds by size or lead the class in making one graph by size of the seeds.

EVALUATION:

Teacher observation. The students can sort their groups of seeds by size, color, and shape, and count the seeds by ones, twos, fives, or tens. Completed graphs of seeds or participation in whole class graphing of seeds

NEW JERSEY LEARNING STANDARDS:

Science: KETS1.A. 1ETS1.A, 2ETS1.A

SEED PACKET BOOKS

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

Students create books reviewing and illustrating important plant concepts.
Grade Level: K-4

OBJECTIVES

Student will:

- Read for content and supporting details
- Review uses of plants, plant parts/function, flower parts, seed parts, seed shapes

MATERIALS NEEDED

- A seed packet cut open on three sides and laminated (one for each student)
- White paper to make pages for the book
- Stapler
- Book, Oh Say Can You Seed? All About Flowering Plants by Bonnie Worth

ACTIVITY

Read and discuss, book, Oh Say Can You Seed? All About Flowering Plants by Bonnie Worth.

Review the book using any or all of the following topics:

- Uses of plants (pages 8-11)
    - Paper for books
    - Cotton for clothes
    - Grains
    - Fruits
    - Vegetables
- Seed Parts (pages 14-15)
    - Embryo
    - Cotyledon
    - Seed coat

- What do seeds need to germinate? (pages 16-17)
    - Moisture
    - Warmth
    - Soil or growing medium
- Plant parts and functions (pages 18-23)
- Types of leaves (pgs. 24-25)
- Photosynthesis (pgs 26-29)
- Parts of a Flower (pgs. 30-33)
- Seed Shapes and Traveling (pgs. 36-37)

Students will now make their own Seed Packet Book, that reviews and illustrates important plant concepts from, Book, Oh Say Can You Seed? All About Flowering Plants by Bonnie Worth. For younger students, omit the more difficult concepts including seed parts and photosynthesis. For older students, omit the less challenging concepts, including types of leaves. Students illustrate and write about the topic selected for each page. Students staple their pages into the laminated seed packets to complete the books.

EVALUATION:

Completed books

EXTENSION:

Share books with peers or other classes.

NEW JERSEY LEARNING STANDARDS

Science 5.5.2, 5.5.4, 5.5.9; LA 3.1.3,2, 3.7

SEED PACKET MATH

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

Planting seeds begins with understanding the instructions on the seed packet. In this lesson, students will map a cool-season vegetable garden plot using the instructions on the back of at least three seed packets. Cool-season plants don't grow in the summer heat. They are planted in the spring and fall, between late March and mid-April and again between late August and mid-September. This lesson can be used as an exercise in the classroom or to map out an actual cool-season garden. Younger students may work in small groups and older students may work individually or in groups.

GRADES: 3-5

OBJECTIVES

The student will be able to:

- Read instructions on the back of seed packets and follow the instructions to plan a vegetable garden plot.
- Use the instructions on the back of seed packets to create a map of a garden plot on graph paper.
- Estimate the distance between seeds in one-foot-square spaces in the garden.
- Calculate and plot the distance between rows of seeds in a garden plot.
- Calculate germination and harvest dates using seed packet instructions.
- Describe the ideal planting conditions for different cool-season vegetables.

MATERIALS NEEDED

- Seed packets for cool-season vegetables such as: lettuce, spinach, Swiss chard, broccoli, onions, radishes, beets, turnips, kale, and peas. (Students can pass around and share seed packets.)
- Graph paper with one-inch squares
- Planning Your Garden Worksheet, three per student or per small group

ACTIVITY

Divide students into groups of three if you want them to work in small groups. Tell students that they are going to draw a garden plot on graph paper using the instructions found on the packets of three different cool-season vegetable seeds.

Explain the difference between cool-season and summer vegetables. Cool-season vegetables cannot grow in the hot summer sun. Decide how big the garden plot should be. Students can go outside and measure actual garden plots, or you can assign an area they should map, such as an 8 x 4-foot garden. Distribute seed packets. Explain that students will be creating a map of a garden using at least three cool-season vegetables. All the information needed to plant the garden is printed on the back of the seed packets.

Review the vocabulary from the seed packets:

- Sow: plant
- Thin: Removing some smaller plants after the seeds have sprouted if the plants are too close together. Explain to students that thinning happens after plants start growing and they do not need to use the thinning instructions today.
- Germination rate: the time it takes the seeds to sprout above ground Tell students that when the instructions give a range for planting, such as 1 ½ to 2 inches apart, the students will have to choose one number within that range.
- Review the symbols for inch (“) and foot (').

Show students the Planning Your Garden Worksheet. Ask them to complete the worksheet for each vegetable before they start drawing their garden plot. Ask students to draw the size of their garden plot in the middle of the graph paper. Tell them that each square inside the garden plot will equal a square foot, and that they must remember to calculate the space between plants in one row as well as the space between the rows of plants. Tell students to draw a small circle in the squares to indicate where the seeds will be planted. Students will have to estimate the space between vegetables. (For instance, if a vegetable's seeds are to be planted eight inches apart, one seed can be planted in the first square, and two seeds in the second square.)

For very tiny seeds, like lettuce and spinach, the instructions will just say “sow thinly” and students will not have to calculate the space between plants, only the space between rows of plants. Be sure to remind students to label the type of vegetable they are planting in a section of squares.

Use at least three different vegetables in the garden plot. Remind students they must complete the Planning Your Garden Worksheet for each vegetable they choose before they begin mapping their garden. Students use the information written on the worksheet to map their garden on graph paper.

EVALUATION:

Student successfully completes a drawing of the garden plot on graph paper using the instructions on the seed packets.

EXTENSION:

Individual students or small groups can swap garden plans and review them to make sure all the planting instructions were followed. Students in small groups can map their actual cool-season vegetable garden plots, based on the varieties of vegetables they plan to plant. The whole class can then compare the maps and choose the garden plan they think will work best. Students can divide their actual garden plot into one-foot-squares with string. (The string can be taped to the sides of the raised bed with duct tape or painter's tape.) Students can plant their seeds in the one-foot squares according to their garden plan.

NEW JERSEY LEARNING STANDARDS

Math: 3.MD, 3.NF 4.NF, 4.MD.A,B 5.NF, 5.MD.A Science: 3:LS1.B 4:LS1.A 5:LS2.A Language Arts: 3:RI.3.1,2,4 4:RI.4.1,2,4 5:RI.5.1,2,4

Name_____

Planning Your Garden Worksheet

Vegetable name_____

- When should you plant?
- Days to germination?
- If you plant your seeds on September 15, between what two dates would you expect to see your vegetables sprout?
- How much space between seeds?
- How much space between rows?
- How deep should you plant?
- How tall will your plant grow?
- How many days to harvest?
- How tall will your plant grow?
- If you plant on September 15, on what date could you harvest?
- What are the thinning instructions?
- Write any additional instructions or information from the seed packet on the back of this paper

SEED SAMPLING

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

Students will sort and then graph an undetermined variety of seeds. Students will then analyze questions about the graphs.

Grade level: K-4

OBJECTIVES

Students will:

- Sort a variety of seeds
- Used data to construct a graph
- Interpret information on a graph

MATERIALS NEEDED

- Seeds
- Paper for graphing
- Rulers or straight edges
- Pencils
- Glue

ACTIVITY

Give each student a handful of seeds. Sort the seeds into groups by type. Have students design and label a bar graph to display seed data.

EVALUATION:

- Which seed did you have the most of?
- Which was the largest? Smallest?
- How many different types of seeds did you have?
- Exchange graphs with a classmate and answer the same questions.

EXTENSION:

- Compile data for the entire class and come up with conclusions as to the most and least frequently occurring seed in the sample.

NEW JERSEY LEARNING STANDARDS

Science 5.5.2, 5.5.4, 5.5.9; Math 4.1, 4.2, 4.3, 4.4, 4.5

SEED STATISTICS

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

Don't throw away those packages of expired seeds! Have your students do a test to see if they are still viable and practice math skills at all levels.

OBJECTIVES

Grades 1-2 The student will be able to

- write and solve number sentences showing the number of seeds that germinated compared to the number of duds that did not sprout .
  (This activity can also be used as a learning center.)

Grades 3-5 The student will be able to

- Use fractions and decimals to show the number of germinated seeds versus duds that did not sprout.

MATERIALS NEEDED

- Empty egg cartons for each pair or small group of students – ask your students' families to collect them for you at the beginning of the school year
- Potting soil
- Plastic spoons
- Any type of seeds

ACTIVITY

Explain that a seed "germinates" when it begins to push shoots up from the ground. Tell the students that some seeds, for unknown reasons, are duds and simply do not grow. Tell students that today they are going to do an experiment to see how many seeds germinate and how many seeds grow out of 12 seeds. (Older students can use a larger number or groups can vary the number they plant.)

Explain that the time it takes for a seed to germinate can be found on the back of the seed packet. In pairs or small groups, students use plastic spoons to scoop potting soil into each cup of an egg carton. Students plant just one seed in each cup and water the seeds lightly. Students observe the growth of their seeds daily and water as needed. After a little more time has passed than the germination time noted on the seed packet,

ask the students to take the egg cartons back to their desks and answer these questions:

Grades 1-2 How many seeds germinated? How many seeds were duds? How can we show in a number sentence how many seeds germinated? How can we show in a number sentence how many were duds?

Grades 3-5, depending on grade level How many seeds germinated? How many were duds? What is the fraction that shows how many seeds germinated? What is the fraction that shows how many seeds were duds? Add the germinated fraction plus the dud fraction. What does the result show you? Show the number of germinated seeds as a decimal. Show the number of duds as a decimal. Add the decimal representing seeds germinated to the decimal representing duds. What does the result show you?

EVALUATION:

Students will be able to answer the math questions about the seeds.

EXTENSION:

Compare the germination rate of some new packages of seeds compared to some that have expired according to the date on the package. Do the “expired” seeds germinate? Is the germination rate the same as the new seeds? Students can let the seedlings continue to grow in the egg cartons and plant them in the school garden, or students can split the egg cartons so that each partner or group member can take some seeds home.

NEW JERSEY LEARNING STANDARDS

Math: 1.OA 2.OA.B 3.NF.A 4.NF.B,C 5.NF.A

SEED SURVIVAL WITH THE TINY SEED

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OBJECTIVES

The student will be able to:

• To understand how soil, air, water, and sunlight play a role in the growth and cultivation from seed to plant.

MATERIALS NEEDED

- Book, The Tiny Seed by Eric Carle or here is a link: The Tiny Seed | A Read Aloud - Bing video

ACTIVITY

During the last lesson, students planted seeds in their mini greenhouses. How will they keep those seeds growing and flourishing? What should students do to help the seeds survive? What do seeds grown indoors or outdoors in a garden need to thrive?

Students can create hypotheses about seeds and ideas can be recorded on the board or on a chart if desired. Why are soil, water, wind and sun so important to seeds and plants? What do they offer for the plant's survival? What environments do different seeds prefer?

Read the book, The Tiny Seed by Eric Carle. As you read, point out how many seeds there are and what happens to them. What events in the book could happen to a seed in the school garden? What was the right environment for the seed to grow? Why did the other seeds not survive?

Discuss with students what seeds need to grow (**water and air**)and what plants need to grow (**the correct amount of water, soil and sunlight).** Students should understand that too much sun and water can be harmful, but the right amount is necessary for them to live.

EVALUATION:

Students write a paragraph or paragraphs (depending on their grade level) explaining what seeds need to grow.

NEW JERSEY LEARNING STANDARDS

Science: PreK: 5.1.1-5, 5.3.1,4 K:LS1.C 1:LS1.A 2:LS2.A 3:LS1.B 4:LS1.A 5:LS1.C

SOMETHING SMELLS FISHY - How much fertilizer does a plant need?

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

Students will discover that plants are affected by the excess or lack of nutrients. Students will observe this effect by experimenting with too much, too little, and just the right amount of fertilizer.
Grades: PreK-2

OBJECTIVES

Students will learn that plants must get the appropriate amount of nutrients.

MATERIALS NEEDED

- 4 of the same type of plant
- Dried fertilizer such as Miracle Grow
- 4 Labels: none, a little, medium, a lot
- Measuring spoons/cups

INTRODUCTION

It is easy to think of soil as a “grocery store” for plants. The plants go “shopping” in the soil and take what they need. Just like it is with humans, if plants do not get all of the nutrients they need, they do not stay healthy. Conversely, if plants get too many nutrients (vitamins), the plant can wilt, burn, or die. A “perfect” soil contains all of the nutrients a plant needs in the appropriate amounts and has the appropriate texture (particle configuration). Most soils must be amended in some way to improve their quality.

Plants remove nutrients from the soil as they grow. Since many soils are often used for growing plants before nutrients are replenished and since plants are being grown in areas that do not have fertile soil, humans have had to find ways to enhance soil quality and fertility. Fertilizers of many types are used to enhance soil quality so food can be grown. A fertilizer is any type of substance added to the soil or water to increase the nutrients available to plants. The amount of fertilizer added to a particular soil should be calculated.

ACTIVITY

Discuss fertilizers as “plant vitamins”. Have students predict what they think will happen if a plant gets no, a little, a medium, or a lot of fertilizer. Explain to the students that they will be doing an experiment to test how much fertilizer plants need.

Add fertilizer to plants by sprinkling the appropriate amount on top of the soil. Water from the top of the soil. Do not pre-mix the fertilizer with the soil. Label the plants appropriately. Put plants on an exploration table and repeat the procedure weekly for four weeks. Students can record observations of the plants.

EVALUATION:

Recorded observations.

EXTENSION:

Discuss the different types of fertilizers. Organic fertilizers such as animal manure and seaweed originate from living things. Commercial inorganic fertilizers are prepared in factories using substances that come from the ground or air.

NEW JERSEY LEARNING STANDARDS:

Science: KLS1.C, 1LS1.A, 2LS2.A, 3.LS2.C, 3.LS4.B, .LS 1.C, 5.LS2.A; LA: W.4.2

THE DAY THE CELERY DYED

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

Students will predict and observe how colored water moves through the stem of a plant.

Grades: PreK-2

OBJECTIVES

The student will be able to:

• explain how water travels through the stem of a plant

MATERIALS NEEDED

- White carnations
- Fresh carrot with leaves
- Celery stalk with leaves
- Red or blue food coloring
- 3 clear plastic cups
- Water

BACKGROUND INFORMATION:

Plants absorb water through their roots. As water evaporates from the leaves a vacuum is created that pulls water up toward the leaves. This helps the plant circulate the necessary nutrients and water. Water is also needed to keep a plant rigid.

ACTIVITY

In front of class, cut a little bit off the root ends of the celery, carnation and carrot. Discuss what students have previously learned about stems and their functions. Put three inches of water in each cup. Stir in food coloring, making sure the water is dark. Place the celery in one cup, the carrot in another and the carnation in the third, root side down.

Have students make predictions of what will happen. Record their predictions. Check plants daily and record observations. Once the color has reached the leaves, slice the stems lengthwise to observe the traveling color. Discuss what happened and why.

EVALUATION:

Have students recreate the experiment at home and explain it to their family members.

NEW JERSEY LEARNING STANDARDS

Science: K: LS1.C 1:LS1.A 2:LS2.A 3:LS1.B English Language Arts: K:RL.K.1-10 1:RL.1.1-4,6 2:RL.2.1-7 3:RL.3.1-8

The Little Red Hen and Making Bread

Lesson ideas from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW:

Do your students know that bread comes from a plant? As do all the things they eat made from flour – pizza dough, cake, cookies, crackers, rolls? Pair these books with Learning Through Gardening's lesson From Wheat to Bread and grow some wheat in the classroom!

GRADES: Pre-K-2, can be modified for older students

The Little Red Hen, by Paul Galdone

The little red hen gets no help to turn her wheat into bread, so she does the work herself. Read and compare different versions of this favorite tale. Let students choose their favorite version and act it out in small groups.

The Little Red Hen Makes a Pizza by Philomen Sturges A modern twist on the classic tale. Compare this version to the original. Make pizza dough in your classroom or make pizza using English muffins.

Bread Comes to Life by George Levenson Photographer George Levenson illustrates the life cycle of the wheat plant and the process of turning wheat into flour with spectacular pictures. Younger students can compare the milling process illustrated in the book to that of the little red hen. Older students can research other grains grown around the world such as rice, corn, barley, and oats.

New Jersey Learning Standards

Science: PreK: 5.1.1-5, 5.3.1-4 K.LS1.C 1.LS1.A 2.LS2.A Social Studies: K-2: 6.1.2.Geo.GI.1, 6.1.2.EconEM.1,2 6.1.2.EconNE.1 English Language Arts: PreK: RL.PK.1, 2, 4, 7 K:RL.K.1-10 1:RL.1.1-4,6 2:RL.2.1-7

The Photosynthesis Play

A lesson idea from the New Jersey Agricultural Society Learning Through Gardening program

Students are introduced to the process of photosynthesis as they act out these different steps in the photosynthesis process. The more you ham it up for the Step 5, the more students will enjoy and remember the steps.

Materials needed.

- Plant.
- A list of steps to share with students

Show students to plant. Ask students, what does a plant need in order to live? Lead students to the fact that plants need soil,(nutrients), water, sunlight and air, (carbon dioxide).

Explain to students that plants use all of these to make their food. Illustrate the photosynthesis process for students.

1. Roots take in water and minerals from the soil.
2. Water and minerals travel up the stem.
3. The leaves of the plant take in carbon dioxide from the air through the pores on the leaves.
4. The leaves capture the sun's energy in the chlorophyll in the leaves.
5. The plant mixes all the ingredients up and makes sugars for its food.
6. Some of the sugars are used, some are stored in seeds, fruits or other plant parts.
7. The leaves give off oxygen into the air.

Have students become a plant. Their legs are their roots; body is this stem; arms are leaves. Now students can add actions to each of the steps in the photosynthesis process.

The actions are listed below:

1. Students bend over and make a sucking noise while acting like they're pulling in water with their hands.
2. Students move hands up their body until they are in upright position.
3. Students extend arms and pull them into their shoulders while exaggerating the inhaling process.
4. Students use arms and quickly grasp at the air, taking in the sun's energy.
5. Students use arms to make a mixing motion.
6. Students pretend to lick a lollipop, which represents sugars and show storing for some later by tapping their hips.
7. Students use air kiss motion to show plants giving off oxygen.

THE TRAVELING SEED

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OBJECTIVES

The student will be able to:

• To identify different ways that seeds travel.

MATERIALS NEEDED

- The Seed is Sleepy by Dianna Aston or here is a link : A Seed Is Sleepy by Dianna Hutts Aston (Read Aloud) Storytime - Bing video
- seed samples

ACTIVITY

Read the book, The Seed is Sleepy and discuss the lessons of the story, paying attention to the different traveling patterns of seeds. The book has excellent examples of how seeds travel and how their parent plant develops mechanisms to help them fly, float or explode from a seed pod. As these travel styles are identified, they can be added to learning journals as a resource for future activities.

The class can explore seed samples and can make predictions on how it travels…hairs for flying, hooks for sticking, etc.

EVALUATION:

EXIT SLIP:
What are different ways seeds can travel? Why do seeds travel?

NEW JERSEY LEARNING STANDARDS

Science: PreK: 5.1.1-5, 5.3.1,4 K:LS1.C 1:LS1.A 2:LS2.A 3:LS1.B 4:LS1.A 5:LS1.

Tomatosphere!

Experiment Description

RESEARCH OVERVIEW

- Tomatosphere-US provides teachers and students with a blind study involving two sets of seeds: a control group that has been Earth-based, and a treated (or "tortured") group of seeds that has been in space or has been subjected to simulated space conditions.
- When teachers have germinated their seeds with students, their results are submitted and recorded.
- Teachers are then informed of the "source" of each of the two sets of seeds and their germination results compared to others who have submitted their results.
- In order to fulfill the research objectives of the Tomatosphere program, seed transportation to the International Space Station (ISS) and return (1,200,000 seeds) is requested.
- Seeds should remain on-orbit for a minimum of 10 days to support the intended science.

DESCRIPTION

Tomatosphere-US, a curriculum-based program for schools, involves students in a germination experiment with two sets of tomato seeds – a control group and a group

that has been to the International Space Station (ISS). Teachers register for the project and receive approximately 30 seeds for each class registered. They are sent out in the spring (or, soon after registration if this takes place after the spring mailing). When the project is completed, teachers submit results to the website, http://tomatosphere.org, and receive notification of the source of the two sets of tomato seeds, and a certificate of participation for students.

Here is the website: Tomatosphere-US (nasa.gov)

WATER CYCLE BAG

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

This experiment will illustrate the water cycle.

GRADES: PreK-5, Younger grades can do this as a whole-class experiment, with the teacher creating the bag for the students to observe.

OBJECTIVES

The student will:
• explain the water cycle

MATERIALS NEEDED

- Sandwich sized zipper seal bags
- Permanent markers
- Aquarium rock
- Tablespoon
- ¼ c measuring cup
- Water
- Packing tape
- Water cycle illustration

ACTIVITY

1. Place the copy of the water cycle illustration inside the bag and close the bag.
2. Using the permanent markers, trace over all the black lines including the numbers.
3. After completely tracing everything, remove the copy from the bag.
4. Add two tablespoons of aquarium rock to the bottom of the bag.
5. Add ¼ cup water to the bag
6. Using wide, clear packing tape, affix the bag to a window in direct sunlight and watch the water cycle work.

EVALUATION:

Students record observations in science journals.

EXTENSION:

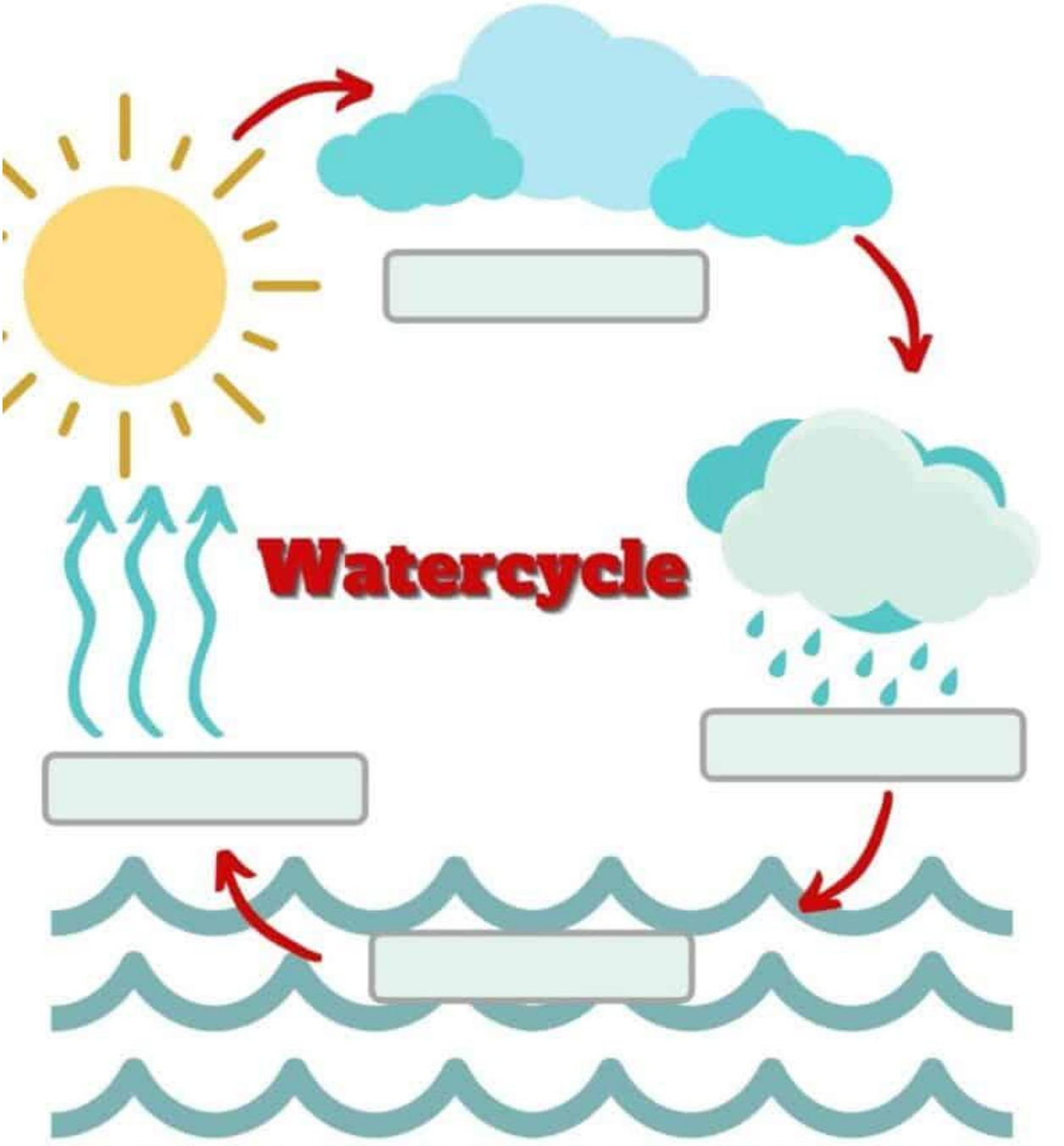
Water Cycle Song:
To the tune of “Oh My Darlin’ Clementine”

- Evaporation, (push both palms up, palms parallel to floor)
- Condensation, (push with arms straight out to the side)
- Precipitation on my head. (Pretend to rain on head)
- Accumulation, (make arms swing back and forth and in front)
- Water Cycle, (arms rotate in circle in front)
- And we start all over again. (Turnaround in place)

NEW JERSEY LEARNING STANDARDS:

Science: KLS1.C, 1LS1.A, 2LS2.A, 3.LS2.C’ 3.LS4.B, .LS 1.C, 5.LS2.A LA: W.4.2

Lesson courtesy 2009 National Agriculture in Classroom conference



EVAPORATION

CONDENSATION

COLLECTION

PRECIPITATION

WATER WE GONNA DO? HOW MUCH WATER DOES A PLANT NEED?

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

Students will learn that plants need water in appropriate amounts. Students will observe this effect by experimenting with too much, too little, and just the right amount of water.
Grades: PreK-2

OBJECTIVES

Students will learn that plants must get the appropriate amount of water.

MATERIALS NEEDED

- 4 of the same type of potted plant
- 4 Labels: none, a little, medium, a lot

INTRODUCTION

A plant, like all living organisms, needs water to live and grow. Water carries nutrients from the soil to all parts of the plant and carries food from the leaves back to the roots. Water is also needed to create the pressure that holds up a plant. Without water, the plant will wilt and eventually die.

Overwatering can cause a plant to die. Roots and seeds need air to grow. Wet roots are more susceptible to plant disease. When seeds and roots are completely submerged in water, they may die since they still need air to breathe–just like people.

ACTIVITY:

Discuss why plants need water. Have students make predictions on what they think will happen if a plant gets too much or too little water.

Explain to the students that they will be doing an experiment to test how much water plants need. Do not water one of the plants. Water one plant with only a few drops (not enough). Water one plant with the right amount (medium) and the last plant with a lot of water

(too much). Make sure you label each plant and re-water the plants every few days with their allotted amounts. Place plants on an observation table so that students can record any observations they make.

EVALUATION:

Have students keep a journal of predictions and observations.

NEW JERSEY LEARNING STANDARDS:

Science: KLS1.C, 1LS1.A, 2LS2.A

WHY DO LEAVES CHANGE COLOR?

A lesson from the New Jersey Agricultural Society Learning Through Gardening program

OVERVIEW & PURPOSE

In the fall, your students may wonder why the leaves around them are changing from green to yellow, orange, or red. In this lesson, they learn that leaves don't really "change" color, they lose their green coloring, revealing the colors underneath. This experiment enables students to separate the colors in leaves to see what is underneath the green. And while they're waiting for the experiment to work, you can talk about chlorophyll, the green substance that all life depends upon.

GRADES: 2-5

OBJECTIVES

The student will be able to:
• Explain why leaves seem to change color in autumn
• Explain what chlorophyll is and its role in photosynthesis.

MATERIALS NEEDED

- Green leaves
- Bowl for water
- Glass jar
- Paper towel
- Rubbing alcohol
- Pencil
- Plastic wrap
- Tape
- Rubber band

BACKGROUND INFORMATION

Plants are the only living things that can make their own food. They do this through a process called photosynthesis. In photosynthesis, the plant uses the energy

of the sun to change water and a gas called carbon dioxide into a sugar called glucose, which is food for plants. The green chemical chlorophyll captures the sunlight that plants need to make their food.

Chlorophyll serves a key purpose in the food chain, not only by making food for plants, but by creating food in plants for animal and humans to eat. The leaves of plants are several colors, but during the long, sunny days of spring and summer, plants produce so much chlorophyll that its green color hides all of the other colors. The plant is busy making food both to grow and to store for the winter.

In the fall, plants begin to prepare for the winter when they will become dormant. During this time, the plant is alive, but it is not actively growing. As the days become shorter and there is less sunlight, the plant makes less and less chlorophyll until it stops making it all together. With no chlorophyll, the leaves lose their green color, and the other colors underneath are revealed.

ACTIVITY

Collect a handful of green leaves. Cut them into small pieces. Put the pieces in the glass jar and pour in rubbing alcohol, just enough to cover the leaves. Cover the top of the jar with plastic wrap and a rubber band.

Stand the jar in a bowl of hot water for at least 30 minutes. (Hot water from the tap will work.) Remove the plastic wrap.

Take a 3- or 4-inch piece of paper towel and fold it over in 1-inch strips. Tape the strip of paper towel onto a pencil so that the end of the pencil sits on the bottom of the jar, and about 1/2-inch of the bottom of the paper towel touches the leaf and alcohol mixture. Wait and observe for a few hours. The colors in the leaves will separate, leaving different colored stripes on the paper towel.

EVALUATION:

Students write an explanation of the experiment explaining what happened and explaining what they know about photosynthesis and chlorophyll.

EXTENSION:

Students research the function of the chemicals that create the other colors in leaves: yellow = xanthophyll orange = carotene red = anthocyanin.

NEW JERSEY LEARNING STANDARDS

Science: 2: LS2.A 3:LS1.B 4:LS1.A 5:PS3.D, LS1.C English Language Arts: 2:W.2.2,4,8 3:W.3.2.A-D, W.3.4,8 4:W.4.2.A-E, W.4.4,8 5: W.5.2.A-E; W.5.4,8