A Garden-Based Curriculum

WPI

Cuenca Soup Kitchen

A collection of garden-based lessons and activities for elementary students developed by:

Ethan Bae
Michael Laemmle
Alison Lambert
Andrew Ventura Molina

Worcester Polytechnic Institute

Sponsored by:

Desmion Disney
Bill O'Brien

Cuenca Soup Kitchen

Acknowledgements

Thank you so much to our sponsors, Des Dizney and Bill O'Brien. None of this would have been possible without their support. We'd also like to thank our advisors, Professor Melissa Belz and Professor Courtney Kurlanska. Their assistance to our project was invaluable. We'd also like to thank all of the wonderful educators we had the pleasure of meeting, especially directors of CETAP-Lucy and El Arenal.

Table of Contents

Authors **2**

Acknowledgements **3**

Table of Contents **4**

Summary **7**

Lesson Structure **8**

Natural Sciences 8

Culture and Art 10

Language and Literature 10

Mathematics 10

Lesson Plans **11**

Natural Science **12**

Introduction to the Garden 13

Summer Gardening 19

Garden Planning 23

Classroom Hydroponics 25

Installing Plant Markers 31

No-Cost School Garden Drip Irrigation System 34

Soil Composition 37

Soil and Compost 42

Gardeners Plant in Soil, Not Dirt 45

A Classroom Garden from Trash 48

Compost Chaos 51

Wondrous Worms 54

Seed Germination 57

Seed Saving 60

Seeds and How They Grow 62
Sprouting Seeds - A Seed Has a Coat 66
Plant Parts and Functions 70
Dissecting Flowers 73
Flowers and Pollination 76
Growing a Knowing Nose 82
Do Plants Really Need Light? 85
Weeding Our Garden 88
Bugs in the Garden 91
Health and Nutrition 93
Investigating the Nutritional Guide 96
Nutritional Guideline Matching Game 102
Cross Contamination of Food 104
Healthy Eating Habits 106
Cooking a Few of my Favorite Things 108
Culture and Art 113
Interview an Elder 114
Your Ingredients 116
Chlorophyll Prints 118
Blind Contour Drawings 120
Drawing Upside Down 123
Painted Leaf Prints 125
Garden Songs 127
Negative Space 129
Language and Literature 132
Writing in the Garden 133
Mathematics 136

Harvest Math 137
Measurement and Geometry in the Garden 139
Measurement and Graphing in the Garden 142
How to Measure Rain 144
Recommendations **147**
Building a Raised Bed Garden 148
Nutrient Solutions for Hydroponics 149
1. Appoint a garden manager. 150
2. Collaborate with existing garden organizations for long-term support. 150
3. Adapt the content and structure of the curriculum when needed. 151
4. Focus on implementing active learning activities. 152
Bibliography **153**

Summary

The purpose of this document is to provide lesson plans and activities based in and around the garden. We hoped to provide alternative methods for indoor and urban gardening so that all schools, regardless of location, may use the lessons. Our goal in creating this document was to emphasize active learning methods and activities to engage students. It was designed in a way that educators could pick and choose those lessons and activities that would work best in their classroom, and adapt them if needed. Each lesson plan is tied to corresponding objectives and performance criteria as outlined in the Ministry of Education's national curriculum for EGB students.

The lesson plans are structured by subject: Natural Sciences, Language and Literature, Culture and Art, and Mathematics. Within each subject, we determined a logical order for which the lessons may be taught. Each lesson plan lays out its purpose, objectives, materials, and activities, and also includes any required supplemental worksheets or materials.

Also provided in this document is a set of recommendations, as well as a list of garden organizations near you, that we feel may be effective in sustaining a garden-based curriculum at your organization.

Lesson Structure

Natural Sciences

Earth Sciences

1. Understanding the purpose of the garden
    - *Introduction to the Garden Lesson* Lesson Plan
2. Climate, seasons, and topography
    - *Summer Gardening* Lesson Plan
    - *Garden Planning* Lesson Plan
3. Constructing a garden
    - *Classroom Hydroponics* Lesson Plan
    - *Installing Plant Markers* Lesson Plan
    - *No-Cost School Garden Drip Irrigation System* Lesson Plan

Lifecycle of a Crop

1. Soil
    - *Soil Composition* Lesson Plan
    - *Soil and Compost* Lesson Plan
    - *Gardeners Plant in Soil, Not Dirt* Lesson Plan
2. Composting
    - *A Classroom Garden From Trash* Lesson Plan
    - *Compost Chaos* Lesson Plan
    - *Wondrous Worms* Lesson Plan
3. Germination
    - *Seed Germination* Lesson Plan
    - *Seed Saving* Lesson Plan

4. Sprouting of a Plant
    - *Seeds and How They Grow* Lesson Plan
    - *Sprouting Seeds - A Seed Has a Coat* Lesson Plan
5. Plant parts/biology
    - *Plant Parts and Functions* Lesson Plan
    - *Dissecting Flowers* Lesson Plan
    - *Flowers and Pollination* Lesson Plan
    - *Growing a Knowing Nose* Lesson Plan
6. Needs of a Plant
    - *Do Plants Really Need Light?* Lesson Plan
    - *Weeding Our Garden* Lesson Plan
    - *Bugs in the Garden* Lesson Plan

Nutrition

1. Food Groups
    - *Health and Nutrition* Lesson Plan
    - *Investigating the Nutritional Guide* Lesson Plan
    - *Nutritional Guideline Matching Game* Lesson Plan
2. Cooking
    - *Cross Contamination of Food* Lesson Plan
    - *Healthy Eating Habits* Lesson Plan
    - *Cooking a Few of my Favorite Things* Lesson Plan

Culture and Art

Cultural Meals

- *Interview an Elder* Activity
- *Your Ingredients* Activity

Artistic Creation

- *Chlorophyll Prints* Lesson Plan
- *Contour Drawings* Lesson Plan
- *Drawing Upside Down* Lesson Plan
- *Garden Leaf Prints* Lesson Plan
- *Garden Songs* Lesson Plan
- *Negative Space* Lesson Plan

Language and Literature

- *Writing in the Garden* Lesson Plan

Mathematics

Measurement

- *Harvest Math* Lesson Plan
- *Measurement and Geometry in the Garden* Lesson Plan
- *Measurement and Graphing in the Garden* Lesson Plan
- *How to Measure Rain* Lesson Plan

Lesson Plans

Natural Science

Introduction to the Garden

Lesson Plan prepared by Youth Grow Garden Lesson Manual by Growing Gardens

Length of Lesson: Preparation Time (15 minutes), Lesson (45 minutes), Activity (45 minutes)

OVERVIEW & PURPOSE

This lesson plan serves as the jumping-off point, where students will get a basic overview of how crops grow, what they need, how to work in a garden, and learn about why we garden.

OBJECTIVES

Students will be able to:

1. Explain activities, expectations, and routines.
2. Demonstrate basic techniques for planting seeds in the garden.
3. Explore the plant life cycle and discover what plants need to grow.
4. Compare plant food needs to human food needs.

ECUADORIAN STANDARDS

Natural Science: O.CN.2.1.

MATERIALS NEEDED

1. Potting Soil for indoor planting or compost for outdoor planting
2. Seeds appropriate for the season
3. Popsicle sticks for plant labels
4. Seed packets, tape, pens

5. Garden journals and pens or pencils (or supplies to make journals)
6. Garden tools

SUGGESTED ADDITIONAL MATERIALS

1. Grow Light (such as UV lighting) for winter

ACTIVITY

Discussion Questions

What do plants need to grow? (Do humans need the same things that plants need to grow? What are they?), What types of food do you like to eat? What types of foods can we grow in our garden?, What is the first stage in the plant life cycle? (seeds)What plant part makes the seeds?, and Why do you think many plants stop growing in the winter?

Procedure

Planting with the Seasons

The types of plants growing in school gardens vary by the season.

Fall: During the early fall, students may be able to explore plants leftover from the summer, including tomatoes, basil, peppers, & summer squash.

Winter: During the winter, students may explore the wildlife in the garden, watch garlic and cover crops sprout, and if a season-extender such as cloche is used, students may be able to grow colder weather plants such as lettuce, mustard greens, broccoli, and cabbage. These seeds will need to be planted in September or October.

Spring: In the spring, students will be able to watch lettuce, kale, chard, and peas sprout in the garden, as well as many types of vegetables, flowers and weeds.

Linking the garden to Food, Health and Nutrition

Different types of plants require different levels of light for growth and varying temperatures for germination and continued growth. If students have gardens at home, ask the students what they remember planting or growing during the different seasons. Discuss why certain plants may need different amounts of warmth, water, and nutrients

to grow. Talk with students about what similarities there are between what people need to grow. Be sure to ask students what types of fruits and vegetables they like to eat and what types they'd like to grow in the school garden.

Exploring the Garden

On the first day, it is important to set garden rules for safety and follow them throughout the term. As students begin to explore the garden, it is important to remind them to respect the plants and other creatures living in the garden. It is also important for students to understand that they should stay on paths and avoid stepping on garden beds, as this compacts the soil, making it difficult for plant roots to grow, as well as decreases the soil's capacity to hold water.

Planting Seeds

The first day of class is a great opportunity to talk with students about the basics of planting in the garden. The information below provides an overview of how to plant different types of seeds, as well as how to effectively plant starts. Depending on the age of your students you can adapt the background information to include more or less detail.

Some important things to find out about each vegetable before planting:

1. When is it optimal to plant the seeds or start outside? (which month)
2. How deep do the seeds need to be planted?
3. How far apart do you plant the seeds or do you thin them after they germinate?
4. Where to plant this vegetable? (Does it need a trellis? Is full sun needed? etc?)
5. How might they eat this vegetable? Do students' families cook with it at home?
6. When is it ripe and how do you harvest it?

Methods for Planting Seeds

Direct Seeding: This means planting the seeds directly into the garden soil.

Big seeds: are best for younger children with less developed fine motor skills. Big seeds include: cucumbers, squash, beans, peas, chard, beets & nasturtiums:

- Make little holes where you want to plant your seeds. The holes should be no deeper than your first knuckle.
- Put 2 seeds in each hole. About half of the seeds will actually sprout.

- Cover with soil (no clumps) and lightly tap down.
- Gently water the soil after planting. (note: Watering too strongly will wash the seeds or soil away.)
- Keep the top of the soil moist.
- You will probably need to water once or twice a day.

Little seeds: Better for older children with more developed fine motor skills. Little seeds include: carrot, spinach, lettuce:

- Sprinkle the seeds over the soil.
- Cover the seeds with loose soil, 1/4 inch deep.
- Gently water the soil after planting.
- Keep the top soil moist.
- When the plants get their 2nd set of leaves, it's time for thinning!

Thinning

Thinning is the process of removing extra seedlings to ensure each plant has adequate space to develop fully. How much to thin depends on the vegetable and the variety. All seed packets have instructions for how much space is needed between the plants. For fast growing crops such as lettuce or radishes, you can sow thickly, and pull out the small plants as they grow, until you have the recommended distance between plants. You can eat the tender seedlings of crops such as lettuce, beets, chard, spinach, making a delicious early treat for students in the garden. When removing larger plants, use a knife or scissors to cut the stem at ground level. This will thin the plant population effectively and will not damage the root systems of the remaining vegetables, which will occur if the unnecessary plants are pulled-out.

<u>Hands-on Activities</u>

Planting Starts

Plant starts are young plants that are used for transporting

- Water your plants well before transplanting.
- Dig a hole in the soil slightly larger than the container the plant is in.
- Carefully remove the entire plant (including the roots and soil) out of the pot.
- Gently place the clump, roots down, into the hole.
- Fill the remaining space in the hole with soil and gently pat down.

- After transplanting, water the soil around the plant, but avoid getting water on the leaves of the plant.

Grow your own transplants: Using Grow Lights (for winter gardening classes)

There are several options for using grow lights in the classroom. After you build or obtain a grow light find a place in the school that will be easy for you, or another individual at the school, to care for throughout the winter months.

Hang the light 6 to 12 inches above the plants, and adjust the light based on plant growth (we use s-hook chains or twine to make it possible to adjust the light height). You could also raise and lower the plants using bricks, etc, if you have a fixed-height light fixture. When working at a school and using grow lights, it is important to make sure the plants are sufficiently watered, and that a timer is used to make sure the light is on for a sufficient amount of time during the day. Work with teachers incorporating taking care of the plants into regular student chores, or try to find a place for the grow lights in an office of an after- school program manager who can help maintain the plant starts if your hours working in the garden at the school are limited.

Making Garden Journals

There are many different ways you can make garden journals. One easy way is to use sheets of paper and fold them in half. Use as many sheets as you'd like (5 sheets will make 10 pages, etc). Use a three-hole punch to punch holes in the folded paper and use string to tie the pages together.

Plant Personification

Ask students to spread out into a circle. Tell them that during this activity, they will be acting out the lifecycle of a plant. Ask one student in the group about his or her favorite fruit (remind students that tomatoes could be fruit). Tailor the activity to that particular fruit or vegetable.

- Begin by asking students to curl up into tight ball: You're a seed!
- Pretend to be a rain cloud and rain on the little seeds (students) underneath the soil. Tell students to uncurl and kneel. They've sprouted!
- Slowly uncurl feet, staying low to the ground. You've grown roots.
- Stick up arms like a little sprout-you've sprouted.
- Open your hands palms up, and wiggle your fingers-you've grown baby leaves.
- Wiggle your toes. You grow lots of little roots (rootlets).
- Grow a little taller and spread arms and hands out wider. You've grown bigger leaves. Tell students that their leaves are soaking up the sun, and making food for the plant.
- Stand up (feet together) – Your stem has grown taller.

- ‘Slurp, slurp’- Your roots drink up water from the ground.
- Spread your fingers wide and surround your face- Your flowers are blooming.
- Pretend to be a bee or butterfly, and fly around the room pollinating the little flowers (or ask a student to help you).
- Interlock your fingers and make a circle over your head- you’ve produced a juicy ripe fruit – it is a tomato (or other fruit or vegetable).
- Tell the students that for some reason, in this garden, this one little fruit or vegetable was forgotten by the garden. You sway back and forth, and suddenly…
- ‘Splat!’- The tomato (or other vegetable) falls off the stem and breaks on the ground.
- Little bugs and insects help the tomato break down, and suddenly, you are left with a tiny seed.
- Start the activity over, but have the students move through the actions more quickly.

Thinning game (adaptation/extension of Plant Personification)

Play the plant personification game, but have students stand bunched together. As they “grow” they will bump into each other. Lead a discussion about how growing too close together makes it difficult for plants to get the sun and nutrients they need. Play again at arm’s distance apart, and discuss how the additional space affects the plants. Another option is to make “sun” and “nutrient” cards and sprinkle them around the students, and have them try and pick the card up during the game, simulating plants competing for resources. Only use this version if you think your group can handle it without being overly pushy or competitive.

EVALUATION CRITERIA

1. Students can recite all garden rules.
2. Students properly explain the basic life cycle of plants.
3. Students can explain why proper distancing is important for crops.

NEXT STEPS

1. Further discussion of how plants grow.
2. Alternate methods of growing crops (e.g. hydroponics).

Summer Gardening

Lesson Plan prepared by Lane County School Garden Program

Length of Lesson: Preparation Time (45 minutes), Lesson (25 minutes), Activity (1 hour)

OVERVIEW & PURPOSE

In temperate climates weather patterns shift yearly along with sun exposure, temperature, precipitation and humidity. These environmental changes directly affect crops by altering their resources. For instance, in the summer there is an abundance of sun which plants use to photosynthesize (creating food), however in winter, the sun becomes far less available and thus plants must either be adapted to cope with the lack of this resource (by storing food in roots, having thicker leaves or needles or slowing growth down to minimum to preserve food) or otherwise reproduce and perish. As the season and climate changes, so does the diversity of life within the garden. Bees and butterflies get to work again as the sun makes its return, and plants gain more opportunities to create food and grow. This growth helps them to produce flowers, become pollinated and create fruits and go to seed. This seasonal ebb and flow drastically affects the types of crops which can be planted and grown at different times throughout the year.

By observing the seasonality of crops, students can plan and plant gardens with appropriate species. Too much sun is not always the best for tender greens such as spinach and lettuce, however, without the blasting summer heat, corn and tomatoes would not be possible. By gaining an understanding of cool season vs. warm season crops, students can expand their knowledge of plants and their life cycles, taste a greater diversity of foods, and improve soil health and habitat within their garden.

OBJECTIVES

Students will be able to:

1. Understand the seasonality of plants in connection to their climate.
2. Mimic diverse plant life through a game.
3. Plant summer crops.
4. Survey the garden for different plant life cycle changes.

ECUADORIAN STANDARDS

Natural Science: CN.2.1.3., CN.2.4.12.

MATERIALS NEEDED

1. Harvest trading cards for game - Create them using notecards that have a picture of a vegetable or fruit from the garden
2. Seeds and starts for summer crops
3. Pencils/colored pencils for drawing

ACTIVITY

Procedure

Begin the lesson by showing students pictures of different fruits and vegetables one at a time. Students will be using a thumbs up/thumbs down approach to share whether they believe that the food shown can grow locally. Be sure to include tropical foods such as bananas, citrus and coconut. Once students have a peeked interest, ask them to explain why, for instance, a coconut cannot grow in your local climate. The answers are all directly related to plant needs and habitat. Plants need food, water, sunlight, air, soil and nutrients, but not all plant species require the same amount of these resources. Just as different animals such as wolves and lions eat and live very differently, plants too have unique needs, which vary among species, and enable survival. Students recognize that a polar bear could not survive in the jungle so it becomes easy to accept that a mango would not survive in Antarctica.

Tomatoes are a great example of diverse plant lifecycles, especially in more temperate climates. Ask students if they have ever seen a tomato growing locally- many will say yes. Now ask students to describe the season when they have seen tomatoes grow. Tomatoes are an annual plant in temperate climates, meaning that they cannot survive year round (in their native habitat, tomatoes are perennial plants but are grown as tender annuals in temperate climates). If tomatoes can only live for four to five months in a particular climate, how long is their lifecycle? Have students revisit plant lifecycles briefly and describe the steps from seed to seed which a plant takes throughout its life.

Does the changing of season have an effect on what we can grow in our garden? The answer is yes. As days become longer, warmer and less rainy, different plants will grow

well, while others may begin to grow less, or even complete their lifecycle by going to seed. This means that the types of crops we can plant will change along with the season. Explain to students that in the garden, they will be learning more about different crops which can grow locally and when. They will then have the opportunity to use that knowledge to plan and plant a summer garden with plants which cannot normally grow during the colder months of the school year.

SUPPORTING ACTIVITIES

Planting the summer garden

During this activity, students will be working to plant summer specific crops based on what they have learned in the classroom. This is a great time to seed beans and corn, or transplant squash and tomatoes into the garden. Have students compare the difference between the plants they put into the garden during the fall vs what they are planting presently. Some good questions to ask students include: did any fall plants complete their life cycles already? Are any plants still thriving now? What do they notice about these plants? If there is time after planting, have students do any necessary weeding or garden clean up.

Seasonal Plants Game

To set up the activity, cut out a variety of Harvest Trading Cards that correspond to crops grown within your garden. If your garden has a small variety of crops in it, use other common crops grown in your schools region. Clearly label, draw, and color them in. During this activity students will be using the Harvest Trading Cards to act out the varying life cycles of plants. To begin the game, give each student a different food card from the harvest trading cards set. On the front of each card is a picture of a fruit or vegetable which can grow in a temperate climate. The back of the card has a chart which includes the months during which the plant can grow (specifically for Oregon). Not all plants can grow year round, although some can.

To play the game, have all students gather at a cone or marked area. Explain to students that they are currently in the “seed bank” (they may be seeds in the soil which have spread on their own or seeds being stored by humans for use). In the seed bank, students must wait to germinate until the month when they can begin their life cycle. Depending on which plant you are, you may get to begin germinating immediately or wait, sometimes for a long time, before you begin to grow. You will be going through the months of the year, beginning with January. If your plant can germinate in January (the month is colored in) you get to take a hop forward and shout out the name of your food. If you cannot germinate then you have to stay put in the seed bank.

As the adult, go through the different months seasonally (using 3 month increments) being sure to pause and have students share cards after March, June, September and December. Whenever a plant can grow during a month they get to take a hop forward. (For groups who can handle a bit of silliness, you can have crops, such as radishes, with very short life cycles, die dramatically when there is a break or end to their growing season).

At the end of the "year" have students look around at the different crops. Warm season varieties such as corn, squash and tomatoes will be close together while brassicas and many "greens" will be farther away. This distance corresponds with the varying life cycle lengths of the different plant varieties which is affected by the seasons when they can grow. Have your group gather back together at the end of the game to share whether they can grow during the summer or not and whether their lifecycle was long or short.

At the end of the lesson, gather back together as a whole group. Ask students the question "why do different plants grow in winter compared to summer?" Be sure that students identify varying plant needs and life cycles during this time.

EVALUATION CRITERIA

1. Students should be able to describe the life cycles of various crops.

NEXT STEPS

1. Have students determine why certain crops grow better at certain times and why certain crops last longer than others.

Garden Planning

Lesson Plan Prepared by Greater Richmond Fit4Kids

Length of Lesson: Preparation Time (5 minutes), Lesson (45 minutes), Activity (30 minutes)

OVERVIEW & PURPOSE

Students will prepare a garden plan for each planting season.

OBJECTIVES

Students will be able to:

1. Know how to prepare a plan for a gardening season.
2. Know how long it takes for a plant to produce fruit or vegetables.
3. Understand why some plants grow better in different seasons.

ECUADORIAN STANDARDS

Natural Science: O.CN.2.8., CN.2.1.9., CN.2.1.11., CN.2.4.6.

MATERIALS NEEDED

1. Calendar

ACTIVITY

Show students the garden calendar and explain how it can be used as a reference when deciding which plants should be planted for the upcoming garden season, and then when you'll be able to harvest those plants.

Tell students as a class you're going to be planning the garden for the upcoming year (or season) and they'll need to decide which plants they should plant by using the garden calendar.

Ask students to examine the garden calendar and think of which vegetables/fruits they think should be planted in the garden for each season.

Start with the upcoming season and call on students one at a time and ask what they think should be planted in the garden. Repeat until you've filled up the garden bed for that season, and then go through each of the remaining seasons until you've planned out the whole year.

Review the importance of planning for your garden and how what you plant and when you plant is influenced by the seasons.

Ask students what else they can think of that might be important to consider when planning a garden (the space that each plant needs to grow).

EVALUATION CRITERIA

1. Completing and creating a Garden Calendar.

NEXT STEPS

1. Calculate the space and resources needed to grow the selected plants.
2. Plant the chosen seeds or bulbs.

Classroom Hydroponics

Lesson Plan prepared by KidsGardening

Length of Lesson: Preparation Time (20 minutes), Lesson (1 hour), Lesson Activity (1 hour and 15 minutes)

OVERVIEW & PURPOSE

Students will explore hydroponics and discover how and why plants are able to grow without soil.

OBJECTIVES

Student will be able to:

1. Learn how plants grow and thrive, and that plants need water, nutrients, light, air, and structural support for their roots.
2. Understand that hydroponic growing systems are designed so that that water is used to provide the right balance of nutrients to the plants' roots.
3. Know that a non-soil material, such as rockwool, provides support for the roots.

ECUADORIAN STANDARDS

Natural Science CN.2.4.6., CN.2.4.12.

MATERIALS NEEDED

1. Plastic container (size can vary depending on your growing space and how many plants you want to plant)
2. Styrofoam sheet (1/2 to 1 inch thick and cut to fit your container)
3. Rockwool cubes (sand and gravel also work)
4. Easy-to-grow seeds, such as lettuce or basil

5. Small aquarium pump and tubing
6. Hydroponic nutrient solution (readily available from online retailers, or created in your school (see *Preparation*))

SUGGESTED ADDITIONAL MATERIALS

1. Hand lenses

ACTIVITY

Background

Although hydroponic growing techniques are often viewed as being more technologically advanced than traditional growing methods, records show that plants have been grown without soil for many thousands of years. The hanging gardens of Babylon used hydroponic techniques. Marco Polo observed these systems in China. To escape enemies and compensate for a challenging growing environment, the ancient Aztecs reportedly took to the lakes and maintained large floating rafts woven of rushes and reeds on which they raised food crops.

In 1699, the British scientist John Woodward grew plants in water to which he added varying amounts of soil. He concluded that while there are substances found in soil that promote plant growth, the bulk of the soil is used for support. By the late 1800s, horticultural scientists were successfully raising plants in solutions of water and dissolved minerals. The modern science of hydroponics began in the 1930s when Dr. W. E. Gericke at the University of California raised tomatoes and other crops on floating rafts, applying the earlier principles in a commercially successful way. He coined the term hydroponics (hydro=water).

Plants, like all living things, have certain requirements that need to be met for them to grow and thrive. These include water, nutrients, light, air, and structural support for the roots. In traditional gardening, plants get root support, nutrients, water, and air from the soil. Hydroponic growers don’t use soil and instead provide water and the right balance of nutrients directly to the plants' roots, enabling the plants to concentrate their energy on producing leaves and fruits rather than forming extensive root systems to search for water and nutrients. Hydroponic growers use a variety of systems to provide water and nutrients. The systems must also provide roots with the oxygen they need and offer a way for the roots to anchor the plants in place.

Meeting Water and Air Needs

In the soil there are naturally occurring pockets of air and water, both of which contribute to proper root growth and functioning. It is important for students to understand that even roots must have oxygen for the plant to survive, so hydroponic systems can not merely submerge the roots in a bath of water for a plant to function properly and survive long-term.

There are many different ways for hydroponic systems to deliver this mix of water and oxygen to the roots. In some hydroponic units, water and nutrients reach the roots via a wick made of absorbent material, and part of the roots are continually exposed to air. Others actually grow the plants in a porous medium like rockwool, which acts as a soil substitute due to its capacity to offer similar pockets of air and water for roots. Some hydroponic systems use a pump to infuse oxygen into the water, similar to how a fish tank aquarium works. Another option is for the medium and roots to be periodically splashed or flooded with a nutrient solution, allowing oxygen to bathe the roots in the interim.

A Place to Grow - Root Support

The material that a plant lives in or on is called its medium or substrate. For most plants, the medium is soil. As stated above, soil naturally provides pockets of both water and air and provides plant roots with the structure necessary so the plant can anchor itself securely.

Hydroponic growers find other ways to support growth — and to prevent drowning roots by allowing them to remain sitting in water. Many setups use an inert, sterile medium to serve as a base (like a soil substitute). Some of the more popular choices included gravel, clean sand, perlite (volcanic material that is heated until it expands into a lightweight, Styrofoam-like material), a lightweight pebble-like aggregate, and rockwool (an inorganic, spongy, fibrous substance that holds large amounts of water and air). These materials provide passages among the particles or fibers where air and water can circulate.

Each medium has strengths and weaknesses. Gravel and sand, for instance, provide support and good drainage, but can be heavy when wet and will dry out fast. Perlite is light and holds water well, but its fine dust can irritate lungs. (Sprinkle it lightly with water to avoid this.) Rockwool holds water and air nicely and makes it easy to move plants around, but breaks down fairly quickly.

Some hydroponics systems have no real support media, but rather incorporate more or less elaborate ways of suspending plants in nutrient solutions. In nutrient film technique (NFT) and aeroponic systems, for instance, the roots lie or are suspended in a dark

channel and nutrients are sprayed or trickled along the root zone.

Light

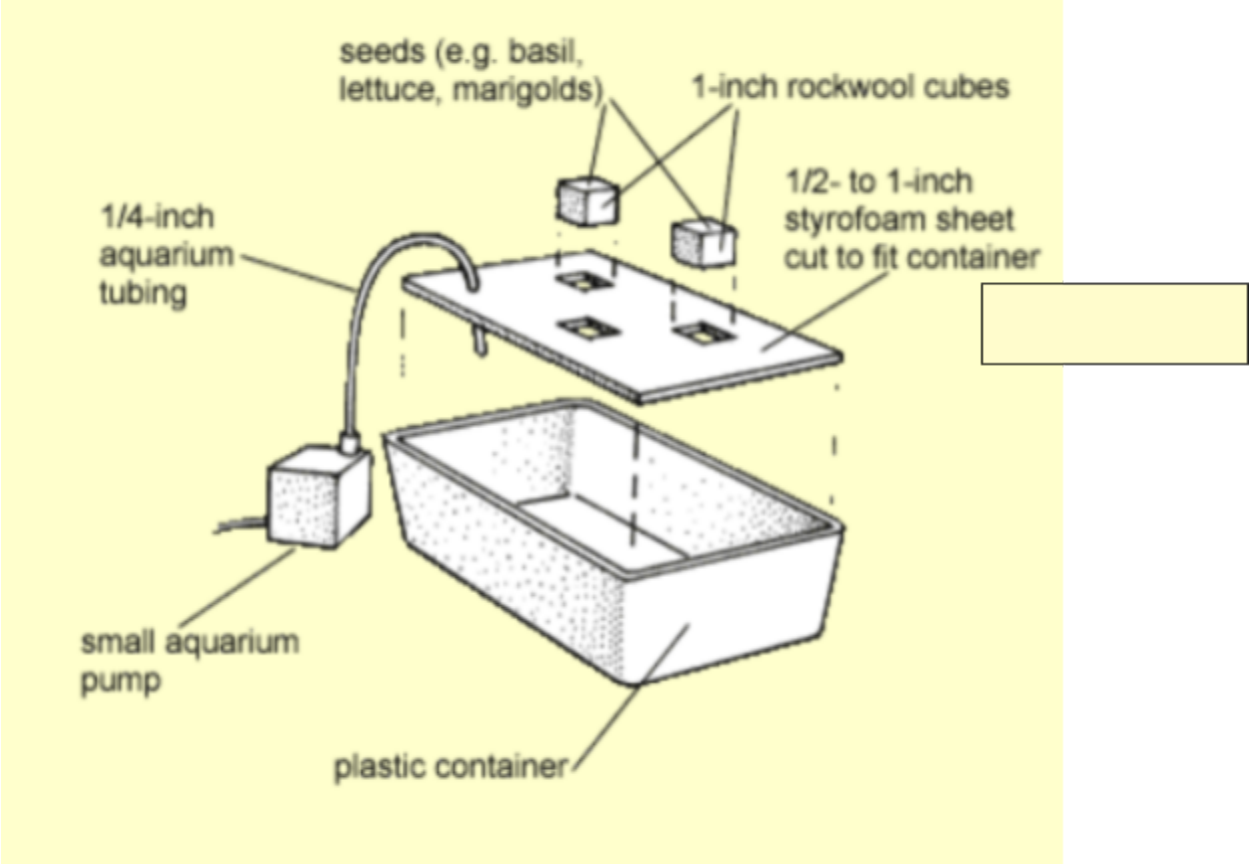
When growing outdoors in soil, plants rely on sunlight to meet their light needs. Many hydroponic systems are set up in indoor environments so that plants meet their light needs through sunny window sills or through artificial light.

Nutrients

In soil, nutrients come from rock and mineral leaching and organic matter decomposition. They are "held" by the soil particles and dissolved in the surrounding water before being absorbed by the roots. In hydroponics, growers add nutrients to the irrigation water being applied to the roots. The easiest way to supply these nutrients is to purchase prepared hydroponic nutrients in dried or liquid form. Most are concentrated and must be mixed with water. Water between 65 and 75 degrees F makes nutrients most available to plants. Tap water may contain significant concentrations of chlorine, which can adversely affect plant growth. If water has a lot of chlorine, gardeners can use distilled water or simply let water stand uncovered for a couple of days before using it.

Laying the Groundwork:

Ask students to list all the different things plants need to grow. Is soil one of those needs? With your students, watch this video and/or this video. Ask students how water can provide for all of the plants needs and what some of the benefits hydroponics could offer.



Designing a hydroponic system

Challenge your class to research, design, and create a simple hydroponic system. Here are instructions for a simple Styrofoam raft system that might serve as a springboard for other ideas:

1. Soak rockwool (or substitution) cubes with a diluted nutrient solution and place a seed in the top of each cube.
2. Cut a Styrofoam raft to fit in the container, then cut holes in the raft, spaced 6 to 9 inches apart, to snugly fit the rockwool cubes. Be sure the cubes extend to the bottom of the raft.
3. Poke the aquarium tubing through the raft into the solution. Keep the aquarium pump outside.
4. Fill the container with room-temperature water around to within 1 inch of the top, then float the raft with planted cubes on the surface.
5. When seedlings appear, add nutrients to the water at half the recommended strength (based on package instructions). Let the aquarium pump run

continuously to oxygenate the water. After a week, raise the nutrient solution to full strength and maintain a constant level. Change the entire solution every 2 weeks.

For best growth the pH between 5.8 and 6.5. As long as you are using a nutrient solution designed for hydroponic systems and changing your solution regularly, this should not be a problem. If you are concerned, you can test your pH with pH test strips and then if needed you can raise the pH with baking soda or lower the pH with vinegar if needed.

Have another video here about how to do a thing

Use your hydroponic growing system to design an experiment comparing traditional and nontraditional growing techniques. Have students catalog how each system provides the chosen plant's needs and collect data and make observations to determine if one growing technique is better than the other.

EVALUATION CRITERIA

1. Students can list the needs of plants

NEXT STEPS

1. Find out if you have any hydroponic growing facilities in your area and invite a representative of the facility to be a guest speaker in your class.

Installing Plant Markers

Lesson Plan prepared by Grow Pittsburgh

Length of Lesson: Preparation Time (5 minutes), Lesson (45 minutes), Lesson Activity (50 minutes)

OVERVIEW & PURPOSE

Students will understand the importance of species diversity in the garden. Students will also understand how smart garden planning and crop rotation can help to deter pests and disease.

OBJECTIVES

Students will be able to:

1. Recognize plants prior to being fully grown.
2. Recognize the realities of disease and pests and can recognize the symptoms of both disease mitigation through species diversity.
3. Categorize crops.

ECUADORIAN STANDARDS

Natural Science CN.2.1.7., O.CN.2.4., O.CN.2.7., OG.CN.2.

Culture and Art: ECA.2.1.4., ECA.2.2.4.

MATERIALS NEEDED

1. Plant markers (To identify where a certain plant is)
2. Popsicle sticks, sticks

3. Clear duct tape any clear tape or tape
4. Garden journals and pencils, paper and writing utensil is good as well
5. Magnifying glasses, not necessary but useful

ACTIVITY

Procedure

Part 1: Identify Crops and Search for Evidence of Pests and Disease

As a class, gather in the garden. “By now, all of our cool-season crops have been planted in the garden and are on their way to reaching maturity. Along the way, these plants will undergo many changes in size and appearance.” Instruct students to get their garden journals and pencils ready for plant observation. Have magnifying glasses on hand. Save plant markers for later.

Lead the group to the first plant station and evenly arrange students around the garden bed. “Do you recognize this plant?” If necessary, give the group a few hints. Once students have correctly identified the plant, have them kneel down for a closer look. “This plant is in its early stages of growth. The mature plant will look different from the one we see now.” Instruct students to draw a rough sketch of the featured plant (and its name) in their garden journals. Encourage students to label any plant parts that they are familiar with.

“If all goes well, these plants will supply us with food to eat. However, a successful harvest is never guaranteed. There is always the risk that our plants might be severely damaged by pests or disease during their life cycle. Do you see any evidence of pests or disease on this plant?” Have students examine the entire plant for evidence of pests or disease. “Do you notice any holes in the leaves? Mold? Weak-looking plants? Yellowing of the leaves?”

If there is evidence or pest of disease, distribute magnifying glass so that students may take a closer look. Have students record any findings in their garden journals. Encourage additional sketches, written observations, etc. Lead the group to the following plant stations and repeat the process outlined above. After the final plant station is complete, return to the first station.

Part 2: Install Plant Markers

“By now, we have identified and examined three different garden crops.” Review the names of each. “Each crop comes from a different plant family. Members of each plant

family are often prone to similar pests and diseases. By planting a variety of crops from different families, we reduce the possibility that a single pest or disease could wipe out our entire harvest. In addition, we rotate our plant families yearly to reduce the risk of pests or diseases over-wintering in the soil and attacking plants during the following growing season."

Introduce the plant marker for the first station and select a student volunteer to insert it into the garden soil. Introduce the featured crop's plant family name and have students record it in their journal. Repeat this process for the following plant stations. When finished, gather in a common area for recap and discussion.

EVALUATION CRITERIA

1. Have the students write in their journals or on a paper about prompts such as:
    a. What are the risks of growing a single crop over a large area of land year after year?
    b. How can we protect our harvest from year to year without using chemicals?

NEXT STEPS

1. Explain more about species diversity in a garden.

No-Cost School Garden Drip Irrigation System

Lesson Plan prepared by the New Jersey Agricultural Society
Learning Through Gardening Program

Length of Lesson: Preparation Time (30 minutes), Lesson (45 minutes), Lesson Activity (50 minutes)

OVERVIEW & PURPOSE

Vacations and weekends when nobody is around to water the plants can be tough on the school garden. It's discouraging for teachers and students to return from a much-needed break only to discover that the garden plants are dry and suffering. The solution is simple – collect some empty gallon milk jugs or other large plastic containers. Poke some holes in the bottom, fill the jugs with water, and place them strategically around your plants. Ta da! A drip irrigation system that doesn't cost a cent.

OBJECTIVES

Students will be able to:

1. Create a no-cost irrigation system for the school garden.
2. Experiment with the number and size of holes made in the milk jugs and the way the jugs are spaced in the garden to determine the optimum watering system for their plants.

ECUADORIAN STANDARDS

Natural Science CN.2.4.8.

Mathematics: O.M.2.6., CE.M 2.1.

MATERIALS NEEDED

1. A collection of empty gallon milk jugs or other plastic juice containers (2-liter soda bottles can be used as well)
2. Large pins, small nails, or pointed scissors to cut holes

ACTIVITY

Rinse the containers out thoroughly with soap and water. Don't discard the caps. You will need them later.

Cut a few pin size holes or slits into the bottom of each jug, or one hole with a small nail. Start with one container, as you may have to experiment with making the holes until you get the right "drip." Test the drip over your sink. Fill your milk jug with water, put the cap on, and watch to see that the water drips slowly, but does not pour out. If it does, the holes may be too big.

Take the jugs out to the garden. Have your students survey the garden area to decide the best placement of the jugs. You want to choose places where the water will reach the root zones of several plants. Space the jugs around the plants. To prevent them from blowing away when the water level gets low, tell your students to bury the bottom of the jugs one-inch deep in the soil. Or you can fill the bottoms of the jugs with about three inches of gravel or small rocks. Fill each jug with water — the opening should be a perfect fit for a hose.

Have your students monitor the drip system for a few days to see how long the jugs take to empty, and to make sure that your plants are not too wet or too dry. Make modifications to the jug placement or to the drainage holes if needed. Refill the jugs when needed.

NOTE: If rain is forecast, have your students remove the caps of each container, so the rain will refill them!

EVALUATION CRITERIA

1. Students should be able to self-evaluate the efficiency of their drip-irrigation system by measuring the amount of water that drips out over time, then compare it to the experimentally determined needs of plants.

NEXT STEP

1. Continued discussion of irrigation.
2. Continue units of measurement - apply to larger time frames.
3. Effects of evaporation.

Soil Composition

Lesson Plan prepared by School Garden Project of Lane County

Length of Lesson: Preparation Time (5 minutes), Lesson (1 hour), Lesson Activity (45 minutes)

OVERVIEW & PURPOSE

During this lesson students will get serious about sediments. Through observation and exploration, game based learning and soil sediment testing, students will get their hands dirty and feet moving to learn more about the earth beneath them.

OBJECTIVES

Students will be able to:

1. Explain what soil is made up of and why it's important.
2. Accurately distinguish between the four soil types and know which type is best for growing gardens.

ECUADORIAN STANDARDS

Natural Science: CN.2.4.10.,CN.2.4.11.

MATERIALS NEEDED

1. Glass jar for WAMO
2. Cups with materials to represent WAMO- water, sticks/leaves, rocks, empty cup
3. Examples of the four types of soil

ACTIVITY

Background

Soil is the backbone of any garden. It's a complex mixture of water, air, minerals and organic matter (WAMO). Good soil for gardening has what's called tilth- loamy, nutrient rich soil. Soil provides the structure and nutrients that plants need to survive. The type of soil you're working with in a garden tells you what plants to grow, how much and how often to water, what types of fertilizers and amendments you'll want to use and even what type of garden beds you should make. But you can't know any of this without first understanding what the different types of soils are and their characteristics.

Soil Types

Sand has the largest particles. It is made from small bits of rock and minerals. It's loose, with lots of room for the easy flow of air and water, but has little nutrients. It also dries out quickly. A garden in sandy soils will need lots of organic material and compost added for water retention and nutrients.

Silt is the next in size. It's made from pieces of soil and rock and has more nutrients than sand. Silt is a productive type of soil for gardening.

Clay is the smallest of the soil types, made of small mineral particles that stick together strongly. So much that plants' roots have a hard time growing through it. Clay is also very difficult for water to get through, causing water to sit on the surface of the soil when the ground is saturated or to only dampen the top layer of soil during dry months. It does, however, have a lot of nutrients that are great for plants.

Loam is a mixture of all three soil types and is the best type of soil for gardening. The sand allows for aeration of the soil, the clay adds important nutrients and the silt gives the soil body and fertility. Add some more organic matter in the form of compost and you have the perfect mix for a great garden.

Procedure

Classroom Introduction

Begin by asking the class why soil is important. Write WAMO somewhere for the students to see. After a minute explain that you need four things in order to have soil. Bring out your "magic" soil making jar. Give each table group a cup with one part of

WAMO in it: an empty cup (representing air), water, rocks/minerals, leaves/sticks (organic matter). Give them a minute to look at what is in their cup, decide what they have and how it relates to soil. One at a time go over each part of WAMO. Go to the table group with that part and have them dump it in the jar (even the air) and share why they think that part is important for soil. When everything has been added shake up the jar dramatically and then show the students the jar. Ask them if you now have soil. Explain that you don't. There's one last step before these things will become soil- they need to break down or decompose. Explain that it can take a long time (around 500 years) to make new soil, which is why we need to take care of the soil we have.

Activities

Soil Sediments Inquiry Station

Pass around examples of each type of soil for the students to examine (sand, silt, clay, loam). Ask them to be thinking about which type of soil they believe is going to be best for growing gardens. Have a show of hands for each of the four types of soil to see which one they think will be best. Then explain that you are going to do a demonstration to see which is right.

Water and Sediments Game

Begin by having students line up shoulder to shoulder in one or two groups (depending on group size). Explain that they are all going to be the different types of soil. First they will be grains of sand. Have them spread apart so that their fingers are touching. Ask for a volunteer. This volunteer is going to represent water. Water will weave his or her way between all the grains of "sand" under the arms. Time how long it takes water to get through all the grains by having the group count out loud. Once they're done ask how difficult it was for water to get through the sand. Explain why it wasn't very hard and how this might affect garden plants. Next, go through each of the other soil types, using the information below. Pick someone new to be water each time and keep timing them. If all goes well, it should take the longest for them to get through clay than silt or loam with sand being the quickest. (This depends on the kids picked to be water and how fast they are moving). To offset any weird timing results discuss the difficulty level of getting through each type of soil.

Soil Type	Formation	Soil Characteristics

Sand	Students stand in a line facing you with fingers touching.	- largest of the four types of soil - particles visible by the naked eye - a lot of space between particles - doesn't stick together, water goes between particles easily - dries out too much on hot days for plants to survive well - low in nutrients
Silt	Students link arms and stand with little space between (remind them that they can't push in their legs to keep water out).	- smallest of the soil types - sticks together very strongly - really hard for water to get between the particles - Areas like wetlands with standing water often have clay soils. - high in nutrients - hard for plants to access them (roots can't penetrate clay easily)
Clay	Students stand with their hands on their hips, elbows touching.	- in between clay and sand in size - more nutrients than sand, but less than clay - holds some water, not too much
Loam	A mixture of the first three. Some students linking arms, some elbow to elbow, some with fingertips touching.	- Best type of soil to grow garden plants - a mix of the three other soil types - Sand keeps the soil aerated - Clay in it adds nutrients - Silt gives it body. - Last ingredient is organic matter in the form of compost. This makes the soil alive and healthy- perfect for growing plants.

WAMO Game

During this game students will learn 4 hand and body signals one to represent each part of WAMO: water, air, minerals, and organic matter. This game is played with one person (you to begin with) as the leader. The leader will turn their back to the students who will each pick one of the 4 signs and act out its motion. When you yell "WAMO" you will turn around doing one of the 4 signs. Any student with a matching sign comes to join you. The last person in the line is the winner and can now be the WAMO caller if there is time. You can continue this game until the end of the rotation.

EVALUATION CRITERIA

1. Students participate in games and activities related to soil composition.

NEXT STEPS

1. Talk about natural resources, and why soil is one of them.

Soil and Compost

Lesson Plan prepared by Growing Gardens Non-Profit

Length of Lesson: Preparation Time (30 minutes), Lesson (1 hour), Lesson Activity (1 hour)

OVERVIEW & PURPOSE

Highlights the composition of soil and the role soil plays in the garden to grow healthy food. Through activities and games, students investigate what soil is made of, learn different methods of composting and the importance of waste reduction, and learn about the microorganisms in the soil that play a valuable role in food production. Students taste a root vegetable, grown directly in the soil.

OBJECTIVES

Students will be able to:

1. Describe the role that soil plays in a healthy ecosystem.
2. Explain how compost is produced and how it benefits plants.
3. Identify producers, consumers and decomposers and their roles in the soil food web.

ECUADORIAN STANDARDS

Natural Science CN.2.4.8., CN.2.4.11., CN.2.4.12.

MATERIALS NEEDED

1. Jars for soil tests
2. Compost materials

ACTIVITY

Preparation

Soil is the foundation of the food and other materials that help sustain us. The food we eat, the clothes we wear, and the homes we live in, could not have been produced without the help of soil. Soil is formed from weathered rock, minerals, and different living and dead plants, animals, bacteria, and fungi. Soil is found on the top layer of the earth and develops over millions of years as bedrock is broken down by wind, water, and microorganisms. Throughout this lesson, students learn about soil composition, and why soil is essential to plant growth. Students will also learn about all of the creatures living in the soil and how they are all connected by the soil food web.

Soil is important for sustaining life for numerous reasons, including: Producing and absorbing gases, serving as a medium for plant growth, filtering water and waste, and providing a home to organisms (plants, fungi, bacteria).

Soil is made up of different sized particles. Particles are the smaller pieces that make up soil. Clay is made of tiny particles that make it difficult for water to flow through the soil. In contrast, sand is made up of larger particles, and allows water to drain easily. Silt has particles that are larger than clay, but smaller than silt. These three materials make up soil texture, and impact the soils' ability to retain water, which impacts how well certain types of plants can grow in the soil.

The soil food web and the web of life, are important concepts for students to understand. The web of life is the connection between different life forms (plants, animals, microorganisms and decomposers, fungi, etc). The food web describes the transfer of energy between life forms in the ecosystem. A producer produces energy from the sun using photosynthesis (plants, algae, etc). A consumer consumes plants, or other consumers, to get energy (herbivores, carnivores, and omnivores). A decomposer consumes dead, organic material to produce energy, is vital to soil production and reduces organic waste in the ecosystem (such as worms).

Pre-lesson discussion questions:

- Why is soil important?
- What materials are found in soil?
- What animals live in soil?
- Can you describe the soil food web?

- What is a producer, consumer, and decomposer?
- What role does soil play in producing food?

Soil Sampling

Have students take soil samples from several different parts of the garden (in jars). Add water and shake. Tell students they will examine the jars next week to see the different parts of the soil (clay, silt, sand). (See attached instructions).

Compost Exploration: If your garden has a compost pile, work with students to turn the compost pile, add green and brown materials, and explore what is living in the pile. Check on plants planted in previous weeks and observe growth. Plant more seeds relevant to season if garden space allows.

Soil Food Web Activity

Lead students in a discussion about the soil food web and the roles of producers, consumers, and decomposers (see background information above). Have students make a food web collage using pictures from magazines or their own drawings. Make sure to have examples of producers, consumers, and decomposers available for students. Have the students draw lines showing how the different plants and animals are connected (i.e. connect cows to grass, because cows consume grass).

Clean up. Have students split into pairs, and share what a decomposer is, and why decomposers are important for soil and plant health.

EVALUATION CRITERIA

1. Students should be able to describe the process of compost.
2. Students should be able to differentiate and categorize producers, consumers, and decomposers.

NEXT STEPS

1. Compost Chaos Lesson plan.

Gardeners Plant in Soil, Not Dirt

Lesson Plan prepared by the New Jersey Agricultural Society Learning Through Gardening Program

Length of Lesson: Preparation Time (5 minutes), Lesson (45 minutes), Lesson Activity (30 minutes)

OVERVIEW & PURPOSE

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. Students can learn about soil and its importance for plant growth.

OBJECTIVES

Students will be able to:

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

ECUADORIAN STANDARDS

Natural Science CN.2.4.10., CN.2.4.11.

MATERIALS NEEDED

1. Soil, Not Dirt Worksheet
2. Paper
3. Bucket to Collect Soil
4. Newspaper to cover desk (if needed)

SUGGESTED ADDITIONAL MATERIALS

1. Hand lenses

ACTIVITY

Each child sits with a “Soil, Not Dirt” worksheet and a piece of 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, if available, 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 CRITERIA

1. Students are able to successfully complete the “Soil Not Dirt” worksheet.

NEXT STEPS

1. Teachers can discuss soil composition in further detail with students.
    a. Talk about different types of soil and how one can create fertile soil.

SUPPORTING MATERIAL

“Soil, Not Dirt” Worksheet (Attached)

Soil, Not Dirt Worksheet

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.

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

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

A Classroom Garden from Trash

Lesson Plan prepared by Teacher.org

Length of Lesson: Preparation Time (1 hour), Lesson (2 weeks based on plant growth), Lesson Activity (2 weeks based on plant growth)

OVERVIEW & PURPOSE

Learners will understand that some foods are sustainable and can be regrown from scraps, then used in a meal.

OBJECTIVES

Students will be able to:

1. Create and grow several plants from parts of plants that are normally thrown away.
2. Learn what makes a food sustainable and how it can be regrown from its scraps.
3. Use grown food to create a healthy meal.

ECUADORIAN STANDARDS

Natural Science CN.2.1.3., O.CN.2.4., CN.2.4.8., O.CN.2.7.

Culture and Art: ECA.2.1.4.

MATERIALS NEEDED

1. Lettuce leaves
2. Potato peelings with eyes

3. Several small planters or containers
4. Several bowls with water
5. Mister or any type of water spray

SUGGESTED ADDITIONAL MATERIALS

1. Other re-growable vegetable plants as desired (Celery, Cabbage, Carrot, Leeks, etc.)

ACTIVITY

Pre-Lesson

Ask students where vegetables come from. Ask students if they know how to grow a plant like lettuce or potatoes. Discuss how each of these plants grow over time. Explain .

to students that some plants can be grown from other pieces of the same type of plant that we typically throw away, such as the bottom of a celery stalk or the peeling on a potato.

Procedure

Show students the pieces that will be planted and a whole plant if available. Ask students if they think new plants will grow from the clippings. Have students guess how long it will take to grow each new plant.

Allow students to plant each new plant as described below. Also allow students to care for and monitor the plants daily.

- For Lettuce: Place a lettuce leaf in a bowl with just a bit of water. Mist lightly each day. Within 3 to 5 days roots should start to develop and the plant can be transferred to soil.
- Celery: Place the bottom (cutting) of a celery bunch in warm water(keep water levels consistent daily, should not cover cutting) and place in direct sunlight for as long as possible for about a week. Leaves should begin to grow within the week and the plant can be transferred to soil.
- Potatoes: Place dry potato peelings about 4 inches deep in soil with the eyes (growing points on skin) facing up, growth should be seen within a couple weeks.

EVALUATION CRITERIA

1. Evaluation will be based on participation and discussion of how the plants are growing over time.

NEXT STEPS

1. As plants reach maturity, prepare a snack using what was grown for students to try.
2. Talk about the benefits of eating healthy foods such as the food from the garden.

Compost Chaos

Lesson Plan prepared by the Growing Gardens Non-Profit

Length of Lesson: Preparation Time (5 minutes), Lesson Activity (30 minutes)

OVERVIEW & PURPOSE

This garden-based education game is a fun way to familiarize students with some basic composting concepts.

Composting is an important facet of organic gardening and a tremendous waste-reduction practice. Teaching students about composting helps them become more aware of where their food waste goes and what they can do about it. It is also a useful skill to teach students if they ever want to practice gardening at home or in the future.

OBJECTIVES

Students will be able to:

1. Understand that compost piles should be alternately layered with “green” and “brown” materials.
2. Understand that compost piles should be turned and watered to speed up the decomposition process.
3. Understand that worm bins are an option for composting food scraps.
4. Use a tumbler as a method for composting.
5. Creating your own compost can be a fun and exciting endeavor.

ECUADORIAN STANDARDS

Natural Science CN.2.4.8., CN.2.4.11., CN.2.4.12.

ACTIVITY

Procedure

Begin with an open-ended question that asks about different ways that we build soil or different ways that we compost.

As students supply answers, pull out a little more detail. For example, a student might say, “We make compost in the bins outside.” Educator: “Yes. That’s right. What kinds of things do we put in the bins?” After the students have supplied some answers, the educator might say, “Yeah. Great. So straw, leaves, and twigs are all carbon-rich materials and generally brown so we call them the ‘browns.’ The vegetable trimmings and such are often leafy and green so we call them the ‘greens.’

Ideally, we add browns and greens to the compost in layers. What else do we need to do to the compost? Does it just sit there?” etc.

Ideally, the students already have seen some or all of this in action so it need not be so talky. The main points can be communicated during the explanation of the gesture combinations in the game.

To play the game, have the students form a circle. While explaining the rules, it is probably best for the educator to be part of the circle but be sure to explain that someone will be standing in the middle of the circle. The person standing in the middle of the circle is the Composter.

The Composter stands in the center of the circle, spins around, points at one of the participants, and calls out one of the catch phrases.

When the Composter directs his/her finger towards someone in the circle and calls out a catch phrase, there are corresponding actions that the pointed-at participant and the participants to the immediate right and left of that person must take.

The participant who is slowest to react (if that is clear) takes the Composter’s place in the middle and the game continues. If all of the participants are reacting quickly and/or simultaneously, then the Composter stays in the middle and finds someone else to point at. This game can continue indefinitely. The possible catch phrases that the Composter can utter: Worm Bin, Tumbler, Layer Brown, Layer Green, Compost -Water, Compost -Turn, and Compost –Done!

The corresponding gesture combinations do not all need to be used and, if they are, they should be introduced incrementally instead of all at once. Please see the next page for illustrations of the gesture combinations:

Worm Bin: Pointed-at wiggles side to side like a worm, sides turn in and stretch out their arms with thumbs up – touching right fingertips to the other's left fingertips and vice versa.

Tumbler: Pointed-at wiggles front to back – rounding and arching their back, sides mime the action of turning the handle on a compost tumbler.

Layer Brown: Pointed-at squats, sides turn towards each other and try to beat the other person to say the word "Green" (opposite for Layer Green.)

Compost – Water: Pointed-at grabs nose with thumb and index finger of one hand and mimes submerging into water, sides hold their hands over the pointed-at's head and mime the action of flicking water off of their fingertips

Compost – Turn: Pointed-at spins around in a circle, sides mime the action of turning a compost pile with a pitchfork.

Compost - Done: Pointed at squats, makes a fist with one hand and thrusts that same elbow in towards their stomach; sides turn towards each other and do a high five, all three exclaim, "Yes!" (or perhaps "Black Gold, Baby!")

Debrief

When the students are starting to show signs of tiring of this game or it is time for the next rotation, try to do a quick debriefing before moving on. You can ask some of the same questions as you asked before the game started and you should get some quicker and more solid responses. "Did you have fun?" or "Did you like that game?" are fair questions to ask as well. Reinforcing composting concepts is the educational objective but more importantly, this game should be fun. Hopefully, the students are associating these composting concepts with good times in the garden – having fun wiggling like a worm and sharing a few laughs as they watch their classmates spin around in circles, etc.

EVALUATION CRITERIA

1. Students should be able to distinguish between brown and green layers of compost, and explain which is green and which is brown.

NEXT STEPS

1. Applying compost within the garden.

Wondrous Worms

Lesson Plan prepared by Growing Gardens Non-Profit

Length of Lesson: Preparation Time (30 minutes), Lesson (1 hr 30 minutes), Lesson Activity (25 minutes)

OVERVIEW & PURPOSE

Learn all about worms and their roles in the garden. Teach students about decomposers and the roles they play in the garden.

OBJECTIVES

Student will be able to:

1. Describe basics of how worm bin composting works.
2. Explain why worms are important for soil & plant health.
3. List the main anatomical parts of a worm.

ECUADORIAN STANDARDS

Natural Science: CN.2.1.11., CN.2.4.10, CN.2.4.11.

MATERIALS NEEDED

1. Worm Bin (Optional)
2. Object to place worm on (1 per student)
3. Popsicle sticks (1 per student)
4. Picture of the anatomy of a worm

Optional activities: Supplies to make a school worm bin (See Worm Bin Instructions) or mini- Worm Bin

ACTIVITY

Procedure

Show worm anatomy poster and explain the different parts of the worm

Worm Observation:

Give each student a worm placemat and encourage them to gently examine and observe the worm. Make sure to consider students who are less comfortable touching worms and offer popsicle sticks to use for gently moving the worms around.

Worm Bin Exploration and Investigation:

Look inside a working worm bin with the students, discuss their observations. If there is not a worm bin available, see attached instructions for making a worm bin with the students.

If time allows, make miniature worm bins using old yogurt containers and worms from an existing bin. Send kids home with a few worms and some scraps.

Explore the garden for evidence of decomposers (earthworms, red wigglers, as well as mushrooms). Ask students to compare and contrast the decomposers they find in the garden with those in the worm bin. Plant seeds with students, and add worm castings and discuss how castings help provide nutrients for the plants

EVALUATION CRITERIA

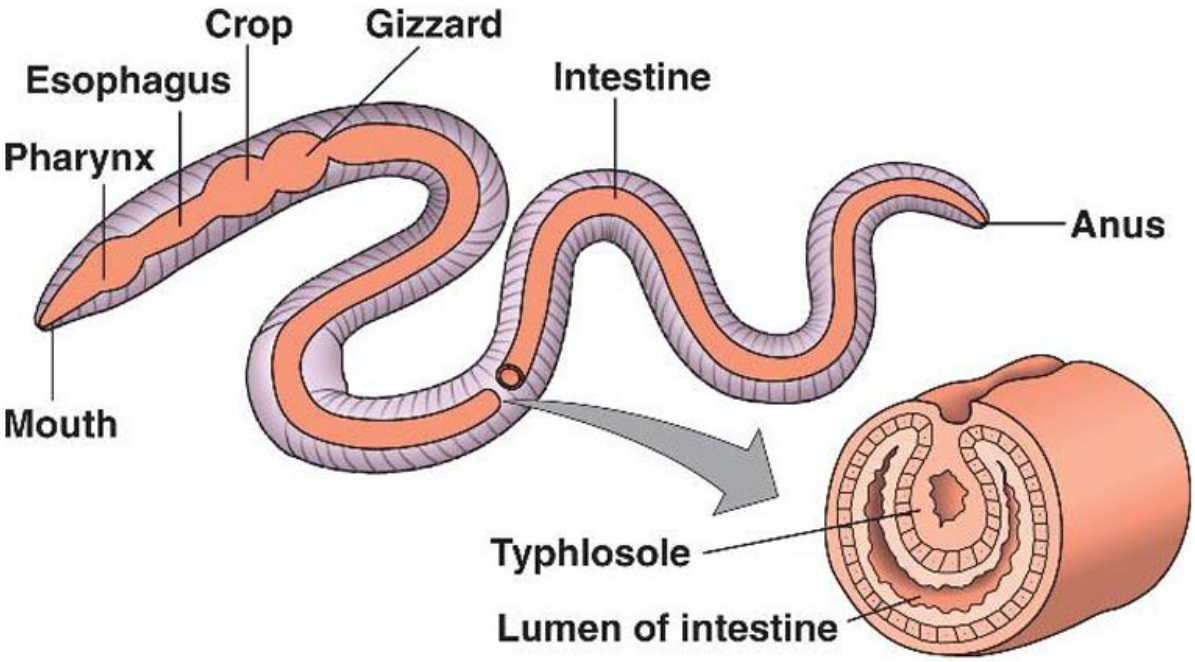
1. Students are able to recognize decomposers in the garden.
2. Students are able to understand why worms are important.
3. Students are able to describe what a worm does in the garden .

NEXT STEPS

1. Talk about more decomposers and their roles in the garden.

SUPPORTING MATERIALS

1. Anatomy of a worm diagram



Digestive System of Earthworm | Zoology | The Biology Notes

Seed Germination

Lesson Plan prepared by Greater Richmond Fit4Kids, North Carolina State University

Length of Lesson: Preparation Time (45 minutes), Lesson (1 hour), Lesson Activity (1.5 hours, 7 day grow period)

OVERVIEW & PURPOSE

Students will examine the process of seed germination and its role within the plant life cycle.

ECUADORIAN STANDARDS

Natural Natural Science O.CN.2.1., CN.2.1.3., CN.2.1.7.

OBJECTIVES

Students will be able to:

1. Understand seed germination.
2. Learn what conditions are necessary for seeds to properly germinate (water/moisture, heat, growing medium, time).
3. Learn what are the first plant parts that develop after the seed has begun to grow (roots, stem, 1st leaves).
4. Discuss the benefits of a greenhouse (controlled climate) for seed germination.
5. Discuss how long it takes seeds to germinate and how different plants grow at different rates.

MATERIALS NEEDED

1. Paper towels
2. Ziploc bags
3. Buckets of water
4. Seeds or beans
5. Markers
6. School glue
7. Seeds for planting

ACTIVITY

Seed Germination

Procedure

Give each student a paper towel and demonstrate dipping the paper towel into the water bucket, squeezing the paper towel between their hands to make sure the paper towels aren't soaking wet. It is important to be gentle so the paper towel doesn't rip. Don't wring it out.

Once students have moistened their paper towels, have them lay the paper towel flat in front of them.

Give each student one seed to place in the middle of the paper towel and then have them fold the paper towel in half so that the seed is in the middle. Give each student a plastic Ziploc bag to place their paper towel in.

Have students write their names on the bags with a sharpie.

Students will take the bags back to their classroom to tape on a window and observe the seed's growth over the next 7 days.

Square Foot Seeds Activity

Procedure

Students can work as individuals, pairs, or groups for this activity.

Each student/group will need a paper towel.

At this point you may want to do one or more of the following depending on your grade

level and goals.

Fold the paper towel in half, fourths, ninths, or sixteenths, depending on the seed requirements. They may want to trace the squares to make them more visible.

Measure with standard or non-standard units and mark the needed grid.

Once the grid has been made, students will put a drop of glue in the center of each square and attach one seed to the drop of glue.

To explore why plants need space, place some of the seeds according to the planting guide and seed others very heavily to see what happens when plants do not have the space they need to grow. (Radishes work well because they can be harvested in 25-30 days.) Students can compare the size of the vegetables harvested.

Students should put their names on the paper towel and set them aside to dry. The seeds will not germinate until they are placed in the soil and watered and may be stored in a dry location until you are ready to use them.

When you are ready to plant in the garden, simply lay the mat down on an available square foot and cover with a thin layer of soil so that the paper towel is no longer visible. Water gently; the water will initiate germination. Consult seed packets to see how long the seeds will take to germinate. This is a great time to talk about what will happen to the paper towel.

EVALUATION CRITERIA

1. Have students continue to observe their seeds in the plastic bags, and journal (writing and/or drawing) about the changes they observe.

NEXT STEPS

1. Talk more about seed germination and its role in the growth of a plant.
2. Start to transition into examining the plant as a whole and how the seed plays into this process.

Seed Saving

Lesson Plan prepared by Greater Richmond Fit4kids

Length of Lesson: Preparation Time (30 minutes), Lesson (1 hour), Lesson Activity (45 minutes)

OVERVIEW & PURPOSE

Students will use plant material from the garden to harvest and preserve seeds for next season. They will learn how to recycle and reuse parts of plants, people normally throw away.

OBJECTIVES

Students will be able to:

1. Know what the life cycle of a plant is.
2. Understand why seeds are so important.
3. Understand how seeds germinate.
4. Recognize the importance of knowing how to harvest and prepare seeds.

ECUADORIAN STANDARDS

Natural Science CN.2.4.8.

MATERIALS NEEDED

1. Dried Basil Flowers, Lettuce Flowers for activity or any type of seed
2. Tomato / Pepper/ Swiss Chard Seeds and Beans as example seeds (optional)
3. Small Containers or Jars

4. Markers

ACTIVITY

Procedure

Explain the life cycle of a plant and tree from 1st seed to final seed to the students. Note that some plants end their life cycle with seeds - this is called an annual, and some plants make seeds year after year-this is called a perennial.

Discuss the benefit of saving seeds (saving money - no need to buy seeds at the store, conserving resources, recycling, reusing, seeds remember their environment from last year)

If you are able to go outside, ask students to look around and locate where the seeds can be found in the garden.

Demonstrate how to use your hands to rub plant flowers until you can see tiny basil or lettuce seeds, then place them in the jar for saving.

Using the example seeds (tomato, pepper, beans), ask students to compare several types of seeds for texture, size, shape and type of plant it produces. Bring several types of seeds for students to see, feel, compare and contrast.

Students will harvest seeds for storing and label the jar with type of plant, date of harvest and any notes from this season that may help in the future.

Ask students to talk about how the plant changed during the life cycle before it produced its seed.

Ask students what types of seeds we eat (rice, flour, corn, beans, etc)

EVALUATION CRITERIA

1. Have students draw a diagram that includes the plant structures covered in this lesson.

NEXT STEPS

1. Talk about different seeds and plants that can be easily recycled like in the lesson.

Seeds and How They Grow

Lesson Plan prepared by Tower Garden Plant Lesson

Length of Lesson: Preparation Time (30 minutes), Lesson (3 days), Activity (30 minutes per session)

OVERVIEW & PURPOSE

The key questions that will be answered in this lesson plan are questions such as “What is inside a seed?”, “How does soaking a seed in water change its appearance?”, “How is the soaking of seeds mirrored in nature?”, “Why do seeds need to get wet to germinate?”, “What is the connection between what is inside the seed and how it grows?”, “What do seeds need to grow?”, “Can seeds germinate without soil?”, and “Do seeds need light to germinate?”. The purpose of this lesson is to provide students with knowledge of the process of seed growth with more detail.

OBJECTIVES

Students will be able to:

1. Learn different parts of a seed.
2. Learn about the process of germination.
3. Understand the overall concept of how a seed becomes a plant.

ECUADORIAN STANDARDS

Natural Science CN.2.4.12., CN.2.1.3.

MATERIALS NEEDED

Each student will receive:

1. A small plate with several large beans that HAVE been soaked

2. One of each bean type that is NOT soaked
3. Toothpick
4. Hand Lenses
5. Paper
6. Pencil
7. Seeds and How they Grow Worksheet

ACTIVITY

Preparation

Soak enough beans so each student receives 2-3 of each type under investigation. *Each student will also need a toothpick and something to view the objects closer.

Procedure

What is inside a seed? Students predict, then discuss their ideas in their groups and have a spokesperson share the group's ideas.

Upon receiving the materials, have students make observations, without too much manipulation, of the soaked seeds vs. the dry seeds. Have them share their observations. They should note that the soaked seeds are larger and softer. This is an important observation that will be revisited when germination is discussed.

EVALUATION CRITERIA

1. Students will demonstrate their understanding by completing the following on the attached assessment handout.

NEXT STEPS

1. Have students plant and grow their own seeds in class in another lesson.

Seeds and How They Grow Worksheet

1. Draw and label the exterior and interior of one of your seeds (seed coat, food source, embryo shoot, embryo root).

2. Write the term next to its definition:

food source _____
embryo shoot _____
embryo root _____
seed coat _____

a. protects seed from insects, disease, damage
b. will grow down into the ground
c. will provide baby plant with energy
d. will grow up towards the sun

3. What would happen to the germinating plant if an insect munched on the shoot part of the embryo?

4. What will your seed need to grow other than warmth? Explain.

Sprouting Seeds - A Seed Has a Coat

Lesson Plan prepared by the Whole Kids Foundation and American Hearts Foundation

Length of Lesson: Preparation Time (30 minutes), Lesson (2 lessons, 1 hour each), Lesson Activity (24 days)

OVERVIEW & PURPOSE

Students will plant seeds that are quick starters in a variety of containers – plastic cups, 2 liter bottles on its side, peat cups, etc. Then, they will study the growth of their seed through the plant development process.

OBJECTIVES

Student will be able to:

1. Identify what we need to give seeds so that they would grow into healthy plants.
2. Explain what will happen if plant needs aren't met.

ECUADORIAN STANDARDS

Natural Science: O.CN.2.1, CN.2.1.3, CN.2.4.6,

Culture and Art: ECA.2.3.10

MATERIALS NEEDED

1. Various planting containers (plastic cups, 2 liter bottles with a slit cut out of its side, etc.)
2. Soil
3. Quick start seeds (lettuces, beans, etc.)

4. Inside a Seed Worksheet

ACTIVITY

Procedure

Ask students what they know about seeds. Ask the students if they know how to plant a seed and what a seed needs to grow (soil, water, sunlight, nutrients). Make a chart about:

- *What the students know*
- *What the students want to now*
- *What the students have learned*

Using the "Inside a Seed" Worksheet, explain that seeds have different characteristics (shapes, sizes, hard, soft), but all have the same things inside them to turn into a plant. The process of growing from a seed to a plant is called germination. Inside every seed is an embryo (a tiny plant) and endosperm (small leaves that supply the embryo food). The outside of the seed has a seed coat, which protects the embryo. All seeds need moisture, oxygen and the right temperature to grow. Until they have these conditions, the seed remains dormant and does nothing. Once the seeds have the right conditions, the plant inside the seed starts to grow and pushes open the seed coat. Tiny leaves appear and push out of the soil.

Allow students to observe the different types of seeds and share some of the information on the seed packets. Younger students who are non-readers can compare the pictures that are on the seed packets and the teacher can point out and read some of the content that's included on seed packets.

Demonstrate how to plant a seed. Seeds shouldn't be buried deeply. The planting depth should be based on the size of the seed. For example, carrot seeds are planted shallow because they're small and lima beans are planted a little deeper because they're bigger. Information about the planting depth can be found on the seed packets.

Allow students to select their seed type and container and plant the seeds. After the seeds have been properly planted, have students water their seeds and put them in a sunny spot. Then have students make predictions using a garden journal so that the students can refer back to it as time goes by.

Over the next 24 days, have the students write about or draw a picture of their seed/plant each day and continue to fill out their garden journal. On the last day, have students review their predictions and discuss the outcomes.

Plants can be sent home or planted in the garden or a pot outdoors.

EVALUATION CRITERIA

1. Successful completion of garden journal entries for every day of the experiment.

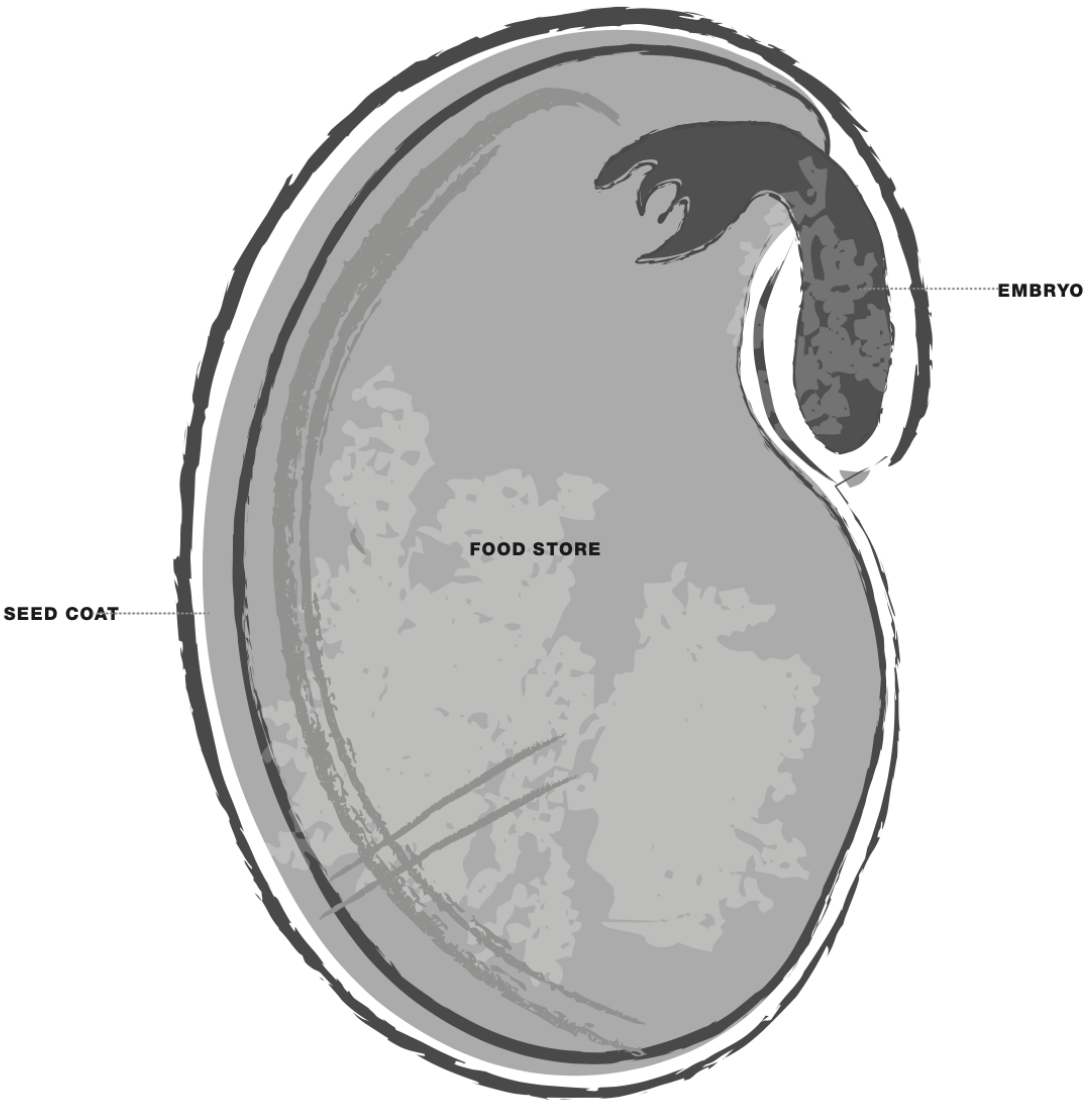
NEXT STEPS

1. As the plants grow, students can sketch and label the parts of the plant at different stages of development (leaves, stem, roots, etc.).
2. Compare different plants, containers and seed parts.
3. Experiment with different amounts of light and water to make observations.

SUPPORTING MATERIAL

1. “Inside a Seed” Worksheet

Inside a Seed



Plant Parts and Functions

Lesson Plan prepared by School Garden Project of Lane County.

Length of Lesson: Preparation Time (25 minutes), Lesson (50 minutes), Lesson Activity (1 hour)

OVERVIEW & PURPOSE

During this lesson students will learn the six basic plant parts, gain an understanding of how they function to support plant survival and create a vegetable wrap using all plant parts. A game will help students to begin thinking of the food they eat in terms of botany. Students will learn the 6 major plant parts, be able to identify them on a plant and explain their simple functions which aid in plant survival

OBJECTIVES

Student will be able to:

1. Learn about the 6 major parts of a plant.
2. Identify the 6 parts and each part's job.

ECUADORIAN STANDARDS

Natural Science CN.2.1.3., CN.2.1.7., OG.CN.2.

MATERIALS NEEDED

1. White board
2. Cutting board and knife (optional)

ACTIVITY

Preparation

Begin the day by drawing a picture of a leaf on the board. Ask students to name your drawing (write leaf next to the drawing). Next, tell the students that, like humans, plants have many different parts to their body which all contribute to their survival. To begin getting students thinking about plant parts, ask them to tell you where plants come from (seeds), you now have two of the six plant parts named. Continue having students brainstorm other plant parts until all six of them are drawn on the board. As students name each part, have them share how it supports plant survival. Next, explain that today students will be doing multiple activities to learn more about plant parts and how they work together as a complete system to support plant life.

Procedure

In order to better learn the plant parts, students will be playing a game similar to "evolution: egg, chicken, dinosaur." In this game students will be growing from a seed to a fruit one plant part at a time. Each plant part has a body motion to let the other students know in which plant phase you are at:

- Seed: Crouched down like a rock with hands around knees,
- Roots: Crouched down with fingers spread out like tree rootsStem: Hands straight up above the head palms together
- Leaf: Hands to the side with elbows in and hands pointed out
- Flower: Hands around head with fingers making pedals
- Fruit: Hands in circle at stomach making a big belly gesture

To begin the game, explain to students that they will be growing through all of the plant parts with the goal of being the first plant to become a seed again. Each student will begin the game as a seed; they will then find another seed and play rock paper scissors with that seed, whoever wins will get to become the next plant part, a stem. Students will need to play others of their same plant part, (flowers can only play flowers), in order to evolve. It is a good idea as the adult, to play students who may be stuck on a plant part for a while (if someone has been a seed for a bit, go be a seed and play them). This game can continue on indefinitely as fruits become seeds again or you can end the game once the first person becomes a seed again.

EVALUATION CRITERIA

1. Students should be able to identify the major parts of the plant, describe their basic purposes, and describe where they come from on the plant.

NEXT STEPS

1. Continue learning about the various plant parts, especially the leaves.

Dissecting Flowers

Lesson Plan prepared by Edible Schoolyard Pittsburgh

Length of Lesson: Preparation Time (10 minutes), Lesson (45 minutes), Lesson Activity (30 minutes)

OVERVIEW & PURPOSE

Flowers are some of the most common and beautiful forms of life in the world. Understanding how flowers grow and they function can be very empowering for children. This lesson plan aims to teach students about the main parts of the flower and how flowers interact with their surroundings.

OBJECTIVES

Students will be able to:

1. Define the important parts of the flower.
2. Describe how each part of the flower is essential to the flower's reproduction and growth cycle.

ECUADORIAN STANDARDS

Natural Science: CN. 2.1.3., CN. 2.1.7.

MATERIALS NEEDED

1. A perfect flower for each student
2. White construction paper - folded in half lengthwise
3. Glue or tape
4. Pencil

5. Colored Pencils

SUGGESTED ADDITIONAL MATERIALS

1. Hand lenses

ACTIVITY

Preparation

Important parts of the flower (ideal flower has all these)

Sepals - Just below the flower on the stem. Very small, petal-looking. Function: enclose and protect the developing flower.

Petals - function: protect the other parts inside the flower. The color, shape, and arrangement of the petals is usually designed to attract pollinators (you may gently remove it).

Stamens - located inside petals, usually yellow or orange. Function: Male reproduction - split into two parts. The filament (long, thin strands) holds up the anther, a small pod which holds the pollen. (Have students rub their fingers on top of the anther to gather pollen just like a bee or bird might. If there is no pollen, then it is not ripe yet). (Pull off the stamens being careful to leave the thicker tube in the middle).

Pistil - Thicker, singular tube in the middle of the stamens. Function: the female reproductive parts. The sticky tip is called the stigma. When it's pollinated the pollen goes down the style (Pistil tube) into the ovary. The ovary is located at the bottom of the flower where it meets the stem. This is where the seeds form. Each individual section of the ovary is called an ovule.

Procedure

Begin by having students describe the function of each part of the human body on a pre-made list (with 3 or 4 parts). Just as each part of our bodies has a purpose, each part of a flower is unique and important, too. What is pollination? The flower on a plant is usually colorful to attract bees, butterflies, and birds, which help pollinate the plant.

Explain to students that to "dissect" is to take apart. The purpose of dissecting a flower is to explore each individual part to see what it looks like and how it helps the flower.

Pass out folded booklet paper to each student. Have students write their name on the

back. Give students 5 minutes to use the hand lens to investigate their flower. (No dissecting yet!) Draw the full flower on the front cover. Include the name of the flower.

Dissection

As a class, “dissect” the flower part by part, listing names and functions (see Background definitions) that help with pollination as you go. Be careful to place “dissected” parts down carefully on the desk for later use and examination. (See opposite second page for procedure).

After dissection, accept questions. Then, have students glue/tape and label each part name inside the booklet. Write the function if desired.

At the end of class, ask students which parts of the flower help with pollination. Trace the pollen from part to part to reiterate the process. Ask students why some flowers have brightly colored and interesting shaped petals. Ask why pollination is important. Name other pollinators if time allows.

EVALUATION CRITERIA

1. Students should be able to identify the major parts of the flower, describe their basic purposes, and describe where they come from on the flower.

NEXT STEPS

1. Class discussion about roots and answering any questions students may have.

Flowers and Pollination

Lesson Plan prepared by School Garden Project of Lane County

Length of Lesson: Preparation Time (10 minutes), Lesson (45-60 minutes), Lesson Activity (30 minutes)

OVERVIEW & PURPOSE

During this lesson students will learn about the important role flowers play in plant reproduction and survival. Through flower dissection, pollination games and related garden work, students learn that flowers create fruit and seeds through pollination.

OBJECTIVES

Students will be able to:

1. Point out the different parts of flowers and the function of each.
2. List at least two common garden pollinators.
3. Describe how the anatomy of pollinators and flowers are made to match each other.

ECUADORIAN STANDARDS

Science: CN.2.1.3., CN.2.1.7.

MATERIALS NEEDED

1. Variety of Flowers (one per students)

ACTIVITIES

Have students recall the parts of the flower from the *Dissecting Flowers* Lesson Plan. What can they say about the four major parts?

- The Outermost Whorl- these are the SEPALS. They are the modified leaves that cover the bud. The sepals all together are called the calyx.
- The Next Outer Whorl- the PETALS. These are the showy parts of the flower that attract the pollinators. The petals together are called the corolla.
- The Male Whorl- is called the STAMEN (has the word “men” in it). The stalk of the stamen is the filament and the top is the anther, which creates and holds the pollen.
- The Inner Female Whorl- is called the PISTIL, made up of the ovary (where the eggs are), the styles (the pollen tube that the pollen travels down to reach the eggs) and the stigma (where the pollen lands).

Now, ask students what they think pollination is. Pollination is the transfer of pollen grains from the stamen of one flower to the stigma of the same or another flower. Anything that transfers pollen from one flower to another is called a pollinator. There are more than 100,000 pollinator species, including bees (20,000 species), moths, butterflies, bats, birds, beetles and flies. Even wind can be a pollinator- the oldest method- but it is less efficient than living pollinators since the grain of pollen must hit an exact spot on the flower for reproduction.

Most plants are pollinated by organisms. Flowers and pollinators have co-evolved - plants exhibit certain traits to attract a certain pollinator and pollinators have adapted certain physical characteristics that allow them to gather and transport pollen as they seek out food (nectar and pollen). (Examples: Daisies are not picky- many pollinators can distribute its pollen, however certain flowers are dependent on only one pollinator)

Plants may attract pollinators in a number of ways: color, unique designs (bull’s-eye, spiral), nectar, sweet smells, shapes, and/or construction (a landing pad for bees). While plants receive the benefit of transferred pollen, pollinators receive food for themselves and their offspring. Nectar is a sugar-based substance that contains vitamins, amino acids, and other nutrients. Pollen is a source of protein. Some plants also produce fatty oils, resin, or wax for their helpers.

Identifying method of seed dispersal

To germinate, there are a few variables that affect how plants evolved to germinate.

- Height - how far a seed takes before it hits the ground. Also affects how hard the seed hits the ground. Coconut trees, for instance, grow large, sturdy coconuts so as not to damage the seed.
- Wind strength - a plant in a place with strong winds could germinate more easily through the wind. A dandelion or poppy plant might be more likely to use the wind to its favor
- Plant size - this determines how large the seeds can be. A tree that is 100 meters tall can rely on large, strong seeds, such as pine cones. However, a flower certainly cannot use pinecones to germinate.
- Pollinators - which insects or animals are likely to naturally assist in the germination process, such as butterflies, bees, etc. If they are present, plants may form a more spore like germination process
- Predators - which animals or bugs are likely to try to eat the plant. Some plants adapt by hurting the predator to suggest that they shouldn't be eaten, such as pepper plants, coffee beans, and poisonous berries. Other plants adapting by growing tall, out of the reach of most predators, such as banana trees, or shrinking down, such as many forms of undergrowth.

Discuss with students how there are many forms of seed dispersal, and not all seeds spread the same way. Have students discuss why that is - why don't acorns spread the same way pollen does? How did trees evolve so distinctly from flowers? How might the shape of a flower change the germination needs of the flower?

Procedure

The main introduction aims at getting students to begin differentiating between fruits and vegetables to better understand the function of flowers, fruits and seeds. Inform students that they will be playing a game in the classroom about fruits and vegetables. Draw two columns on the board, one labeled Fruit, one labeled Vegetable. Explain to students that they will be pulling produce from a bag and discussing, then voting, as a class as to whether the item is a fruit or a vegetable (you can either bring in plastic food representations, or for added engagement, bring in a collection which may include more tricky items such as a cactus leaf or tomato). Call up a student volunteer to choose one item from your bag, let them pull it out and see if they can identify it by name. Let students share whether they think it is a fruit or a vegetable with one another by pair sharing. Now, tell students that they will be voting by a raise of hands. Tally votes on the board. Repeat 3-5 more times with new students and food items. Once you have made it through enough of the food samples, ask students to share "How do you know if it is a

fruit or a vegetable?" Most students will be able to identify that fruits have seeds in them. Next, ask students to share a method of testing whether something is a fruit or a vegetable "you can cut it open and look for seeds!" If you used real food samples, cut them open one at a time to test and see if students hypotheses were correct or not. If you used plastic foods, move onto the question of "Why do fruits have seeds? What is the fruit's function?"

The main function of a fruit is to protect seeds until they have completed maturation. Fruits can also help seeds to germinate at certain times or to be dispersed by moving through different animal's digestive systems. But where do fruits come from, how are they made? Fruits are created through the process of pollination. Show students a diagram of a cross section of a flower (see picture above) and review the different flower parts. Now tell students that they will be spending the day in the garden focusing on pollinators, improving pollinator habitat and playing games to learn more about how flowers become pollinated to create fruits and seeds.

Improving Pollinator Habitat

During the garden group, you can begin by having students taste any edible flowers which may be growing in the garden (this may include pansies, borage, calendula or any brassica flowers). Recall the habitat lesson with students, what do flowers provide for pollinators? Food. By planting more flowers within our garden, we can provide a better food source for the important pollinators who help our fruits to grow in our garden. Have students seed or transplant pollinator flowers such as sunflowers, calendula, borage, cosmos and bachelor button. You can also have students search the garden for examples of flowers where the ovary is already enlarged from pollination.

Insect Pollination Game

Divide the group into teams and arrange them in lines at one end of the playing field. At the other end of the space two tubs are placed on the ground, one with powdered cinnamon and one with flour (any colors/spices may be used).

The first member of both teams will run to one first tub carrying a cotton ball and collecting some pollen (demonstrate to students that pollinators do not "scoop" pollen, but that it gets stuck to them- have students "poke" the powder). This team member returns to their team and deposits the pollen in a collecting dish. Now, the same student repeats this but runs to the second tub of different colored pollen and brings it back to the "hive." They then pass the cotton ball off and the remaining team members take

turns until they have all completed the activity.

Students will try to “win” by collecting the most pollen. You can discuss certain adaptive techniques to collecting lots of pollen. You can also show the cross- pollination takes place (the mixing of the brown and white pollen).

Once students have finished playing the game, give each of them a Q-tip to become pollinators within the garden; going from plant to plant moving pollen between flowers.

Build a Seed

Next, challenge students to design their own seeds with specialized dispersal mechanisms. Students can use a dried bean as the base of their design, along with “junk” materials (such as popsicle sticks, toothpicks, cardboard, egg cartons, cotton balls, string and rubber bands), to design a seed.

Pass out a bag of materials to each group and either assign the group a way their seed needs to move around or let each student decide individually how their seed will move.

Give them 10-15 min to make their seed, then test the seeds to see if they work. Here are some challenges to inspire creativity if the students are having a hard time starting:

- Float in water for at least five minutes
- Attract an animal to carry them away
- Float in air for at least 5 feet
- Stick to an animal and can be carried at least 10 feet
- Are thrown at least 2 feet away from the parent plant

Finish the lesson by bringing the group back together. Ask students to share in pairs the importance of flowers. They provide a food source for important pollinators, become fruit and seeds and ensure species survival through reproduction.

EVALUATION CRITERIA

1. Students can demonstrate they know the difference between different germination methods.
2. Students can guess at the process of germination for an unknown plant.

NEXT STEPS

1. Explore specific methods of germination in more detail.

Growing a Knowing Nose

Lesson Plan prepared by Kids Gardening Non-Profit

Length of Lesson: Preparation Time (30 minutes), Lesson (1 hour), Lesson Activity (45 minutes)

OVERVIEW & PURPOSE

Students explore a variety of plant-derived aromatic substances, reflect on the memories and feelings they evoke, and describe them. Next, as they try to taste without using their sense of smell, they begin to grasp the importance of this remarkable adaptation. They also learn that scents provide plants with a way to communicate, aid in reproduction and seed dispersal, and protect themselves.

OBJECTIVES

Students will be able to:

1. Understand that plants give off many different distinctive scents.
2. Recognize that people's sense of smell and sense of taste are connected.
3. Understand that many plant scents aid the plant in its survival.

ECUADORIAN STANDARDS

Natural Science: O.CN.2.4., O.CN.2.7.

Culture and Art: ECA.2.1.4., ECA.2.2.4.

MATERIALS NEEDED

1. Small bottles or plastic containers with lids. If clear, cover the containers with paper to hide what they contain.

2. Cotton balls
3. Different plant-derived aromatic substances for each container. Try vanilla; herbs (basil, cilantro, dill, etc.); rose water or other flower inspired perfumes; cinnamon; cocoa powder; lemon juice or peel; garlic; etc.

ACTIVITY

Preparation

If your small bottles or plastic containers are clear, cover the containers with paper to hide what they contain. Poke a hole in the lid of each jar and mark the jar with a letter.

Gather different plant-derived aromatic substances for each container. Examples include vanilla; herbs (basil, cilantro, dill, etc); rose water or other flower-inspired perfumes; cinnamon; cocoa powder; lemon juice or peel; garlic; etc.

For liquid scents, put drops of the liquid on cotton wads and insert into your bottles. For solids, place under cotton balls.

Procedure

Ask students to brainstorm different plant-derived scents in their environment. If possible, go out to your garden or schoolyard and conduct a Nose Scavenger Hunt. Write down as many different scents as the students can find.

Line up the aromatic containers on a table or counter. As students go from bottle to bottle with a notebook in hand, and direct them to carefully smell each one and then write these things in their notebooks for each one: 1) any memory, feeling, or activity the aroma brings to mind, words that describe what they smell, 3) guesses about what they are actually smelling. Non Writers can discuss their responses with you.

Discuss students' experiences and notebook entries. Ask, Which smells did you like most, and why? How do you think the substances taste? Which did you like least? Which were easier (harder) to describe, and why? What conclusions can you draw about our sense of smell?

Finally, ask, Which do you think is more important when we eat our sense of smell or our sense of taste? Consider having students explore this question by sampling slices of two mystery foods: apples and pears.

Have partners work together on the challenge. One student should be blindfolded and hold his or her nose. The other should give the taster the slices, one at a time. Ask, Are

the samples the same or different? How can you tell? (Students may notice texture differences.) What does each taste like? Next, students should unplug their noses, taste again, and try to identify the flavors. Ask, What did you notice about the taste test? What do you think made the difference? What new questions do you have? Revisit and discuss the initial question. Switch roles if possible

EVALUATION CRITERIA

1. Now that students have had a chance to observe different plant-derived scents, help them understand the benefits plants get from producing these odors. Ask students:
    a. Why do plants need to attract pollinators?
    b. Why is it important for plant leaves to be protected?
    c. How does fruit help a plant with seed dispersal?
2. Use the background information above to share with them how plant-produced scents can help with pollination, seed dispersal and plant survival.

NEXT STEPS

1. Challenge students to keep logs of everything they do for a day that involves a plant-derived aroma. They should write down what they did along with an adjective to describe the smell (e.g., I woke up and smelled strong coffee. I brushed my teeth and smelled something minty).
2. Explore plants using other senses (Taste, touch, Sight, etc.).

Do Plants Really Need Light?

Lesson Plan prepared by the New Jersey Agricultural Society Learning Through Gardening Program

Length of Lesson: Preparation Time (10 minutes), Lesson (1 hour), Lesson Activity (30 minutes)

OVERVIEW & PURPOSE

The purpose of this lesson is to help students understand and make a connection between the sun and the growth of plants.

OBJECTIVES

Students will be able to:

1. Identify sunlight as one of the main things along with soil and water that a plant needs to grow
2. Explain that plants use sunlight to get the energy to produce sugar, their food.
3. Define photosynthesis as the process a plant uses to make food.

ECUADORIAN STANDARDS

Natural Science: CN.2.4.6., O.CN.2.4.12., OG.CN.2., CN.2.1.3.

MATERIALS NEEDED

1. Three similar plants in pots
2. “Do Plants Really Need Sunlight?” worksheet

ACTIVITY

Procedure

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.

Pass out photosynthesis sheets. 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 breath. So along with being a source of food, plants also help supply the oxygen that we breath. Explain that people breath 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 CRITERIA

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

NEXT STEPS

1. Ask students to think of some examples of where to plant so that it can grow best.
2. Explain more about the sun and how it plays into helping the Earth.

Do Plants Really Need Light? Worksheet

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?

Plants in the Sun:

Plants in the Shade:

Plants in the Dark:

What do the plants look like after two weeks?

Plants in the Sun:

Plants in the Shade:

Plants in the Dark:

What do the plants look like after three weeks?

Plants in the Sun:

Plants in the Shade:

Plants in the Dark:

Weeding Our Garden

*Lesson Plan prepared by Grow Pittsburg*h

Length of Lesson: Preparation Time (5 minutes), Lesson (30 minutes), Lesson Activity (45 minutes)

OVERVIEW & PURPOSE

Students will understand what weeds are and how they compete with garden crops for vital resources such as sun, water, and air. Students will also be able to identify common garden weeds and demonstrate how to carefully and completely remove them from the soil.

OBJECTIVES

Students will be able to:

1. Identify weeds and weeding tools.
2. Understand the importance of removing weeds at the root.
3. Understand the concept of resource competition.
4. Understand that weeds aren't always the enemy - they are just growing in the wrong place at the wrong time.
5. Understand that weeds spread differently than plants.

ECUADORIAN STANDARDS

Natural Science CN.2.1.3., CN.2.1.7., O.CN.2.7., OG.CN.2.

Culture and Art: ECA.2.1.4., ECA.2.2.4.

MATERIALS NEEDED

1. Garden gloves (1 pair per student)
2. 10 –20 hand trowels (for garden beds) or any tool to dig
3. Additional garden tools: hula hoes, rakes, and, shovels (for garden pathways)
4. (3) 5-gallon plastic buckets or any bucket for weed debris or any large bucket

ACTIVITY

Preparation

Identify garden beds and pathways to be weeded. Place one plastic bucket by each garden bed for weed debris. Mark weeding stations if necessary.

Arrange large and small tools in a spacious area of the garden for Part 1.

Identify a variety of common weeds in the garden and collect a few to serve as examples during Part 1. Review weed names.

Procedure

Part 1: Identify Weeds and Introduce Tools

As a class, gather in a spacious area of the garden. “Regular upkeep is an important part of gardening. Without regular care and attention, garden beds can easily be taken over by weeds.” Introduce pre-collected garden weeds to the group. Pass them around for students to examine.

Introduce common weed names to the group. Explain how weeds can negatively affect garden plants by competing for vital resources. “It is our job as gardeners to protect our edible crops from outside competition.”

Demonstrate how to remove small weeds by hand. Using one of the example weeds, show students how to grasp the weed at the base and pull it out of the soil with its root system still intact. Explain the importance of removing the root system along with the upper part of the plant.

“We can use hand trowels to remove larger weeds. This method enables us to remove as much of the plant’s root as possible.” Demonstrate how to use the hand trowel to remove a weed at its base.

"The larger tools are not the best choice for weeding newly planted garden beds. These tools can disturb developing plants' root systems. Therefore, we should only use these tools to remove weeds along the garden pathways." Introduce each tool and demonstrate how to safely and properly use it.

Part 2: Weed Gardens Beds and Pathways

Divide students into 3 groups. Each group is in charge of weeding one of the following garden beds: sugar snap peas, lettuce, or turnips. Distribute garden gloves. Set aside larger tools for students that finish early; they can work on weeding garden pathways. This is also an ideal job for any students who prefer individual work.

Lead the entire class to the first weeding station. Point out the food crops in the bed – these are to be left undisturbed. Explain the procedure for weeding the bed. Repeat for following beds, then have groups begin.

Snap peas and Lettuce – Carefully remove weeds along rows. Hunt for weeds between plants and gently remove them by hand. Use hand trowels to remove larger weeds along the sides.

Turnips – Point out turnip plants to the group. Carefully remove weeds between plants by hand.

Point out any weeds that have gone to seed and explain why these must be placed in the trash. All other weeds can be placed in 5-gallon plastic buckets and added to the compost pile. When groups have finished, gather buckets and return to the gathering area. As a class, examine the assortment of weeds from each group. "Which weeds were the most common?" Finally, discard the weeds in the compost pile. Collect tools and gloves.

EVALUATION

1. Ask students to write on a piece of paper or in a journal on topics such as:
    a. Why is it important to keep garden beds free of weeds?

NEXT STEPS

1. Talk more about weeds and the art of weeding.
2. Ways to keep a weed free garden.
3. Ways to use collected weeds in a useful manner.

Bugs in the Garden

Lesson Plan prepared by Growing Gardens Non-Profit

Length of Lesson: Preparation Time (15 minutes), Lesson (45 minutes), Activity (45 minutes)

OVERVIEW & PURPOSE

This lesson will teach students about arthropods that have six main features: two antennae, compound eyes, six legs, and two pairs of wings, a thorax and an abdomen. Not all insects have wings; it depends on the species.

OBJECTIVES

Student will be able to:

1. Describe the basic anatomy of an insect.
2. Identify some beneficial and pest insects in the garden.

ECUADORIAN STANDARDS

Natural Science O.CN.2.1., O.CN.2.7., OG.CN.2.

MATERIALS NEEDED

1. Bug collecting jars or something to capture bugs

ACTIVITY

Procedure

Ask students to describe insects they have seen at school or in their gardens at home - What did they look or sound like? What color are they? Where did they find (on a leaf,

etc), How did they move (fly, crawl, etc).

Search for different bugs and insects in the garden. Do they have three body sections? Antennae and wings? What kinds of mouthparts do they have? What do they eat? How do they move? Have students share their discoveries with other students in the class. Teachers can help students collect the insects for observation and release them after.

EVALUATION CRITERIA

1. Students can share their discoveries about insects with the class.

NEXT STEPS

1. Talk more about bugs and their role in the ecosystem.
2. Talk about beneficial, harmful, and neutral bugs/insects native to the area.

Health and Nutrition

Lesson Plan prepared by the Global Pulse Confederation

Length of Lesson: Preparation Time (15 minutes), Lesson (30 minutes), Activity (30 minutes)

OVERVIEW & PURPOSE

Introduce and understand the importance of maintaining a balanced diet.

OBJECTIVES

Student will be able to:

1. Recognise the role different foods play in a balanced diet, and the effects on health of an unbalanced diet.
2. Explore ways in which we can design balanced meals from different food types.
3. Evaluate the benefits of including pulses in a balanced diet.

ECUADORIAN STANDARDS

Natural Science: CN.2.2.4., CN.2.2.5., CN.2.2.6.

MATERIALS NEEDED

1. Diagram of an empty plate

ACTIVITY

Procedure

Discuss with pupils what is meant by the term ‘a healthy, balanced diet’. What are the types of food that we need to consume to live healthily? Can you name the types of food we ought to eat?

Definition: A balanced diet is when you eat a wide variety of foods in the right proportions. Eating the right amount of food helps us to have a healthy body weight.

A balanced diet includes…

- Grains (e.g. bread, pasta, rice) 30%
- Vegetables (e.g. broccoli, carrots, potatoes) 30%
- Fruit (e.g. apples, grapes, bananas) 20%
- Protein (e.g. lean / not fatty meat, fish, eggs, pulses) 20% It can also include a small portion of…
- Dairy (e.g. milk, cheese, yogurt) and healthy oils (e.g. olive or sunflower oil)

And as an occasional treat…

- Food and drinks that are high in fat or sugar (e.g. burgers & sausages and cakes & biscuits/cookies)

What happens if we eat too much, or too little of these food groups? This is called an unbalanced diet. For example, eating a diet too heavy in grains, such as rice, bread and pasta, with little protein is unbalanced. Or if we don't eat enough vegetables or fruit then our diet is also considered out of balance.

Eating too much or too little of certain food groups can cause many serious problems to the human body including heart disease, high blood pressure, type 2 diabetes, tooth decay and even some cancers.

How can we be sure that we are eating enough of any of these food groups? What combinations of foods would make a balanced diet? What would be the consequences to health of an unbalanced diet? Pupils are given three pictures of an empty plate. In groups, they must draw a picture of a breakfast, lunch and supper that together represents the definition of a balanced diet.

EVALUATION CRITERIA

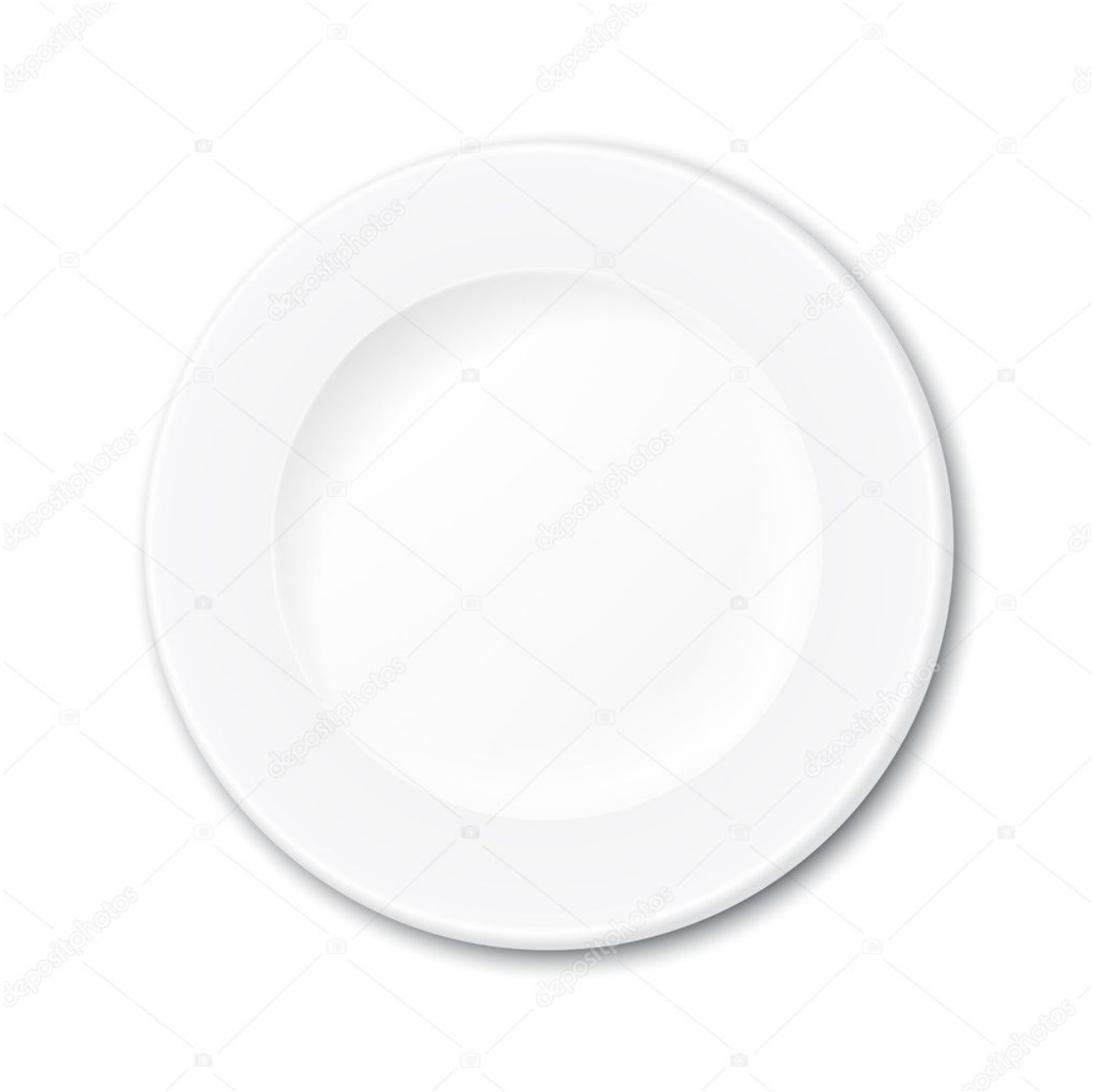
1. Students can describe what a healthy diet and meal consists of.
2. Students can imagine a food plate of their favorite foods that could make a healthy plate.

NEXT STEPS

1. Talk about exercise and how that plays a role in making a healthy lifestyle.

SUPPORTING MATERIAL

Diagram of an empty plate.



Investigating the Nutritional Guide

Lesson Plan prepared by Cathy Burgess, Beacon Lesson Plan Library

Length of Lesson: Preparation Time (15 minutes), Lesson (15 minutes), Lesson Activity (1 hour)

OVERVIEW & PURPOSE

Students learn that the Ecuadorian Nutritional Guide is an important nutritional tool. They classify foods and compare the number of servings per group that are necessary for maintaining good health by placing empty food containers in grocery bags.

OBJECTIVES

Students will be able to:

1. Understand positive, healthy behaviors that enhance wellness.
2. Classify healthy foods and identify food combinations according to the Ecuadorian Nutritional Guide.
3. Use simple graphs, pictures, written statements, and numbers to observe, describe, record, and compare data.

ECUADORIAN STANDARDS

Natural Science O.CN.2.4.

Mathematics: O.M.2.2.

MATERIALS NEEDED

1. Empty food containers with labels (several from each food group)
2. Pencils

3. Crayons
4. Construction paper
5. Cutout of the Ecuadorian Nutritional Guide
6. A food magazine

SUGGESTED ADDITIONAL MATERIALS

1. Four bags labeled for the four major food groups
2. Science Journals

ACTIVITY

Preparation

Collect many different empty food containers like cereal boxes, rice, pasta, tuna, ravioli, green beans, Kraft Macaroni and Cheese, broccoli, soup, bread bag, actual fresh fruit and vegetables, frozen vegetable bags, canned vegetables, etc.

Cut out pictures of a healthy meal from magazines and tape loosely onto a plate. (An example would be, chicken, black-eyed peas, squash, potato salad, tea, cornbread, and coconut pie.)

Create a pile of pictures of each major food group into groups. If you have labeled bags, use those instead, placing the pictures on the bags.

Make sure the Ecuadorian Nutritional Guide is posted where students can see and refer to it.

If possible, make copies of the Ecuadorian Nutritional Guide for students to keep in their portfolios. (See attached file.)

Make Happy Healthy Me science journals out of 11x13 construction paper folded in half like a book with 10 sheets of primary writing paper stapled inside.

Happy Healthy Me portfolios - A Message from Your Heart.

Send home the Sleep Data Collection sheet today. The students have a full week to complete it. It must be returned to school by lesson eight on day ten in order to complete the activity for that day.

Procedure

1. Ask what nutrient means. Tell students: Nutrients are ingredients in the food we eat. Your heart needs different kinds of foods to keep it healthy. In fact, there is something called the Ecuadorian Nutritional Guide. Introduce students to the Ecuadorian Nutritional Guide poster. Point out that the Ecuadorian Nutritional Guide shows four food groups. It also gives the number of helpings of food adults should eat everyday. Point out children need fewer servings than adults do. The Nutritional Food Guideline was published by Ecuador as a guideline to help Ecuadorians choose a healthy diet

2. Ask students to name their favorite meals. Have them name different foods that make up that meal. (As an example, I always tell them my favorite meal.) Pictures of my meal are loosely taped to a plate. There are smoked chicken, black-eyed peas, squash, potato salad, corn bread, ice tea, and coconut pie for dessert.

3. Discuss each food group and talk about how students can identify the food group it belongs to in the Ecuadorian Nutritional Guide poster. Relate the foods from the book to the pyramid. Putting foods into the correct place on the Ecuadorian Nutritional Guide is called classifying. Tell students they need to know how to classify foods to see if they are eating a healthy diet. There are certain amounts from each group that they should eat every day. Show the brown grocery bags that are labeled with each food group. Pick up the plate from step 2 (your favorite meal) and classify each of the foods onto the correct bag. Tape the pictures to the outside of the bag under the label so students have a visual aid to help in classifying.

4. Now display the empty food containers and ask what food each held. Decide which group it belongs to and place the container into the correct bag. (Example: Beans go into the fruits and vegetables section) Make sure they know that some containers show food combinations and belong to more than one group. It is ok for students to put food combinations in more than one bag. Continue classifying until all the containers are gone.

   An example of positive feedback might be: “Good answer! Yes, that does belong in the _____ group. Wow, I can tell you have been listening to the lesson by the way you classify the food containers.” Corrective feedback may be “Where else could you put that? Think hard about where you are placing that. Is meat loaf really a fruit? Look up at the Ecuadorian Nutritional Guide and find the place where that belongs.”

5. After the students have classified all the containers into the correct locations/bags, directly relate it back to the poster of the Ecuadorian Nutritional Guide. This is a good time to orally practice classifying.

6. Say something like, “I had black beans and rice for dinner last night. How would I classify my black beans?” Call on different students to give you a name of a food and decide as a group where it belongs on the Ecuadorian Nutritional Guide (bread, meat, vegetables).

7. Hand out the Happy, Healthy Me science journals.

    a. Have students write their names on the front of the journals.

    b. Then have students title the first page The Ecuadorian Nutritional Guide.

    c. Next have students draw the Ecuadorian Nutritional Guide in their journals (do this together).

    d. Then students draw a picture of a food they placed in each group from the grocery bag activity.

    e. Also on the bottom of the page, have them make an entry that answers this question: Why is it important to learn about the Ecuadorian Nutritional Guide and the food groups?

    Depending on the time of year and the writing ability of your students, you may want to put a sentence starter up on the board:

    “It is important to know about the different food groups because:_____.”

    Students can share and compare their journal entries with the person sitting next to them. Keep science journals in the portfolio.

EVALUATION CRITERIA

1. A students’ ability to correctly classify food and food combinations according to the Food Guide Pyramid through observation on activities # 4 and #5 in the procedure section.

2. A students' ability to use pictures to observe, describe, record data in their science journals. Criteria is that the Ecuadorian Nutritional Guide is drawn and correctly labeled, one picture is drawn correctly in each of the groups, and one sentence

about why it is important to learn about the Ecuadorian Nutritional Guide is included. See attached checklist for criteria.

NEXT STEPS

1. Have students create a Class Cookbook

SUPPORTING MATERIAL

Ecuadorian Nutritional Guideline

Nutritional Guideline Matching Game

Lesson Plan prepared by Teachnology

Length of Lesson: Preparation Time (5 minutes), Lesson Activity (20 minutes)

OVERVIEW & PURPOSE

In this lesson, students will have to match the correct food to its place on the nutritional guideline.

OBJECTIVES

Student will be able to:

1. Match food to the correct category on the Ecuadorian Nutritional Guidelines.

ECUADORIAN STANDARDS

Natural Science O.CN.2.4.

MATERIALS NEEDED

1. Pictures of different foods from all the food groups (cards with drawings also work)

ACTIVITY

Procedure

Hang the food guide on the wall of the classroom. Pass out a picture of a food from one of the food groups to each student. Have them come up one at a time and put their picture where it belongs on the guide. Have students draw their own food pyramids using pictures of food that they like for each group.

This activity can be kept in a center for students to practice with. Write the correct food group on the back of each food so students can check their work.

EVALUATION CRITERIA

1. Students show improvement in their ability to guess the nutritional makeup of foods should the game be played again.

NEXT STEPS

1. Cooking a Few of my Favorite Things lesson.

Cross Contamination of Food

Lesson Plan prepared by Teachnology

Length of Lesson: Preparation Time (5 minutes), Lesson Activity (15 minutes)

OVERVIEW & PURPOSE

It is important for students to know how to be safe when they are cooking. In this lesson students will review what they know about cross contamination and ways they can help prevent it.

OBJECTIVES

Student will be able to:

1. Observe and recognize cross contamination.

ECUADORIAN STANDARDS

Natural Science O.CN.2.4.

Language and Literature: LL.2.2.1., LL.2.4.3.

MATERIALS NEEDED

1. Cutting board
2. Watered down paint

ACTIVITY

Procedure

Discuss food contamination with students. Use paint to demonstrate how bacteria can be

passed from one item to another in the kitchen. Place an item in the paint and then place it on the cutting board. When you take the item off the board, wipe the board down with a paper towel. There will still be paint left on the board. Discuss with your students how they would clean the board fully.

Have students work in groups to brainstorm other ways that cross contamination can happen. Have them talk about what they would do to stop it. Discuss their answers as a class.

For homework, have students watch someone prepare food at home. They should write down as many ways cross contamination could occur as they can. Discuss what they saw the next day.

EVALUATION CRITERIA

1. The student will be able to name three ways that food becomes cross contaminated.

NEXT STEPS

1. Talk about where different kinds of germs can come from in cross contamination, which cross contaminations are distinct, etc.

Healthy Eating Habits

Lesson Plan prepared by Greater Richmond Fit4Kids

Length of Lesson: Preparation Time (15 minutes), Lesson (45 minutes), Lesson Activity (45 minutes)

OVERVIEW & PURPOSE

Students will discuss healthy eating options and students will harvest food for preparation and consumption in the garden.

OBJECTIVES

Students will be able to:

1. Identify and answer questions about healthy eating options.
2. Make a meal using ingredients from the garden.
3. Discuss why healthy eating is important for growing strong and healthy.
4. Identify what kind of nutrients are in fruits and vegetables and whether these same nutrients are provided in fast food.
5. Identify what proteins, sugars, fats and fibers are and why we need them.

ECUADORIAN STANDARDS

Culture and Art: ECA.2.1.4.

Natural Science O.CN.2.4.

MATERIALS NEEDED

1. Materials to eat food (Utensils, Napkins, Plates, etc.)

2. Cleaning and hand-washing station
3. Vegetables from garden and supplemental produce if needed

ACTIVITY

Procedure

Working with the students, generate a list of foods that students like to eat. Record this on chart paper in the garden or inside the classroom. Make sure that the list includes healthy, moderately healthy, and unhealthy foods. Using a red, yellow and green marker, label each food choice. Red represents rarely to be eaten; yellow represents a sometimes food; and green represents an “any time” food. Have students help label foods that they eat throughout the day.

Have students pick vegetables from the garden. Depending on the size of your garden you may have to supplement with outside produce. Wash and chop the vegetables.

Using a large bowl, mix-toss the vegetables and a small amount of vinaigrette together. Serve each student a 3-4 bite serving. Encourage all students to take the 2 bite test. If they don’t like it after two bites they are free to dispose of their serving.

EVALUATION CRITERIA

1. Students are able to identify proper nutrition and healthy diet habits.
2. Students can successfully give an example of what a healthy habit may look like.

NEXT STEPS

1. Talk about more recipes that can be made with vegetables out in the garden.
2. Ask students what their favorite kinds of vegetables are.
3. Have the students draw their ideal salad with an array of vegetables.
4. Talk about how fruits and vegetables lose nutrients the longer they sit after harvesting before eating.

Cooking a Few of my Favorite Things

Lesson Plan prepared by Joyce Sewell, Beacon Lesson Plan Library

Length of Lesson: Preparation Time (15 minutes), Lesson (15 minutes), Lesson Activity (1 hour)

OVERVIEW & PURPOSE

In this activity, students learn about the nutritional value of foods, calculate the measurements, and prepare a healthy recipe for the class. Then students publish a class cookbook with their recipes.

OBJECTIVES

Students will be able to:

1. Produce final documents that have been edited for correct spelling, punctuation and grammar.
2. Solve problems by generating, collecting, organizing, displaying, and analyzing data using various graphing techniques.
3. Understand the nutritional values of different foods.

ECUADORIAN STANDARDS

Natural Science O.CN.2.4.

Mathematics: O.M.2.6.

Language and Literature: LL.2.4.4.

MATERIALS NEEDED

1. Children informational books and literature about food and nutrition, including children's cookbooks-Measurement chart that shows common conversions

2. Measuring cups and spoons
3. Measurement chart handout, one per group (see Associated File)

SUGGESTED ADDITIONAL MATERIALS

1. Word processing software, such as notepad or Microsoft Word
2. Spreadsheet software, such as excel or Data Wonder by Addison-Wesley

ACTIVITY

Preparation

Collect books related to food, cooking, and nutrition.

Collect charts relating to the Ecuadorian Nutritional Guide.

Find a measurement conversion chart in a recipe book and enlarge it to chart size.

Arrange for adult supervision during the cooking, perhaps a room mother or other school volunteers.

Make copies of the Measurement Chart (see Associated File).

Procedure

If possible, Prior to this lesson, invite a nutritionist, perhaps a nurse or lunchroom manager, to talk with the students about the nutritional value of foods and the National Nutrition Guide.

1. Divide the class into groups, one for each of the food groups as represented on the National Nutrition Guide. Each group researches to find the foods that belong to their food group. Use books or food boxes that display the National Nutrition Guide for research materials. Access the Internet site listed in the Resource section of this lesson. Students prepare a chart and a mini report that shows the foods in their group to share with the class.
2. Each group shares what they have learned about the foods in their category in an

oral presentation. Each group then conducts a survey to answer the question -Which foods are the most popular in our food group with the students in the class?-

   a. Optional: Students graph this information using a spreadsheet program. (This requires a lesson on how to use the particular spreadsheet program you choose to use.)

3. Groups then search for recipes that include foods from their group based upon the survey. They select one recipe to prepare for the class.

4. Next, model using problem-solving skills to plan how much food it will take to prepare their recipe for the entire class. Do this using the Measuring Chart (see Associated File) and a recipe of your choice that is consistent with the survey results. Model how to take each ingredient, find its nutritional value, and multiply the ingredient by the number of servings you will need for your class. This will give the total quantity of each ingredient needed to prepare the recipe.

5. Students are now ready to make a list of the ingredients necessary to prepare their recipe for the entire class. Groups also prepare a chart of their favorite recipe that is later shared with the class. (The chart needs to be in large print so students can read it as they cook. It should also contain information about the nutritional value of foods in the recipe.)

6. Students measure each ingredient as calculated and prepare their recipe for the class under adult supervision.

7. Students share their illustrations or charts showing the foods found in their recipe and the nutritional value. They present their graphs to show the results of the survey about the most popular foods in their group. After the reports, have a tasting party to try out their cooking.

8. Compile the recipes into a class cookbook.

EVALUATION CRITERIA

1. Students explain clearly what their nutritional topic (i.e. protein) is.

2. Individual recipes and (optional) charts, graphs, and posters relate to the food group.

3. Students present well.

4. Food is cooked well.

NEXT STEPS

1. Have students learn how macronutrients (proteins, fats, etc.) cook differently from one another

SUPPORTING MATERIAL

Measurement chart

Name _____ Recipe _____
Group _____ Source of Recipe _____

Measurement Chart

Ingredient	Nutritional Value	Amount of one serving size	X _____ students	Total quantity of ingredient

Culture and Art

Interview an Elder

Lesson Plan prepared by Rachel Mewes of Edible Schoolyard

Length of Lesson: Activity (30 minutes)

OVERVIEW & PURPOSE

In this activity, students will interview an elder who they know about a favorite recipe of theirs and why that recipe is meaningful to them.

OBJECTIVES

Students will be able to:

1. Understand how food can relate to heritage.

ECUADORIAN STANDARDS

Culture and Art: ECA.2.3.16., ECA.2.3.18.

MATERIALS NEEDED

1. Pencil
2. Paper

ACTIVITY

Preparation

Explain to students that food can be a pathway to our past, our heritage, and our history. One way for us to understand how food can link us to our past is to speak to people who have been around a little longer than we have. Ask them to think of an elder in their life—they could be a family member, community member, or friend—and ask them to interview them about their favorite childhood recipe.

Tell students to take some time to think about the question, What are the flavors, smells and ingredients that remind them of home and/or family?

Procedure

Interview an elder. Prepare your questions ahead of time. Sit down with your interviewee or call them up. Then ask them your questions. Here are some questions you might include, but feel free to add your own.

- What is one of your favorite recipes from your childhood?
- What makes the dish special?
- How did you learn about the recipe?
- Would you walk me through the recipe?
- How would you describe the flavors of the dish? What spices does it require?
- What memories do you have about eating or making the dish?
- What are the flavors, smells and ingredients that remind you of home and/or family?

Write a paragraph capturing the responses to your questions and your reflections from your interview.

Your written should include the following:

- At least three things that you learned from your conversation.
- At least two things you are still curious about.
- A question that you still have.

EVALUATION CRITERIA

1. Students will share their paragraph on the sharing platform indicated by their teacher or share it with another family member.

NEXT STEPS

1. Discuss regional foods that are common in your community.
2. Talk about the native plants that make up these dishes.

Your Ingredients

Lesson Plan prepared by Rachel Mewes of Edible Schoolyard

Length of Lesson: Activity (30 minutes)

OVERVIEW & PURPOSE

The ingredients we put into our cooking can sometimes have deep personal meaning behind them. Chances are students already have some ingredients with a special place in your heart. This lesson gives students a chance to reflect on those ingredients. They will find ingredients that are meaningful to them, their family, and their heritage.

OBJECTIVES

Students will be able to:

1. Discover their self-identity and heritage through food.

ECUADORIAN STANDARDS

Culture and Art: ECA.2.3.16., ECA.2.2.11.

MATERIALS NEEDED

1. Pencil
2. Paper

ACTIVITY

Procedure

Have the students brainstorm: Tell them to think of as many foods as possible that remind them of home and family. Then list the ingredients in those foods. Have them write down any other ingredients that come to mind.

Here are some questions that could help them brainstorm:

- What are foods or ingredients that remind you of your heritage?
- What are foods or ingredients that you could eat every day?
- Is there a food or ingredient that makes you think of a special memory?
- What fruits, vegetables, or spices often show up in your family's cooking? See if your family members have any ideas!

EVALUATION CRITERIA

1. Completed list of five ingredients that have personal value.

NEXT STEPS

1. Discuss how native recipes impact communities.

Chlorophyll Prints

Lesson Plan prepared by Cornell Garden-Based Learning

Length of Lesson: Lesson (30 minutes), Activity (1-1.5 hours)

OVERVIEW & PURPOSE

Students will extract chlorophyll from a plant part and create a beautiful chlorophyll print.

OBJECTIVES

Students will be able to:

1. Engage in the science concepts behind photosynthesis and chlorophyll.
2. Extract the chlorophyll from a plant and create a print with it.

ECUADORIAN STANDARDS

Natural Science: CN.2.1.3.,CN.2.1.7.

Culture and Art: ECA.2.2.5., ECA.2.2.6.,ECA.2.2.7., ECA.2.1.7., ECA.2.1.8.

MATERIALS NEEDED

1. Green leaves (vegetables like kale and spinach, herbs like basil and mint, green
2. leaves from trees and shrubs)
3. Pieces of white fabric or watercolor paper
4. Metal spoons
5. Masking tape

ACTIVITY

Procedure

Review concepts of photosynthesis and chlorophyll with your students: Light is a form of energy. Plants need energy to develop and grow. Humans and animals get their energy from plants. Plants get their energy from the sun, which works to combine water and carbon dioxide to produce sugar. Plants contain chlorophyll, a green pigment that traps the sun's energy. Plants use the sun's energy to combine water and carbon dioxide together to make sugar. Every green part of a plant has chlorophyll and makes sugar.

Fold a piece of paper or fabric in half and open it up again. Place a leaf facedown on half of the paper/fabric, and fold the other half over it. Tape the paper/fabric to the table so that it stays in one place. Use the bottom of a spoon to press firmly and rub it across the paper/fabric.

Rub the spoon over the entire leaf area so that all of the leaf's chlorophyll will be transferred to paper or fabric. The chlorophyll print will be more prominent on the paper because it is thinner and will absorb the chlorophyll more easily than fabric.

Repeat this process as many times as you like, trying different leaves and paper or fabric materials.

EVALUATION CRITERIA

1. Each student should finish their own chlorophyll print. You can bind the finished prints together in a garden journal or class book, laminate and frame, or hang them as special flags around the classroom.

NEXT STEPS

1. Discuss how nature can inspire art.
2. If performing activity first, learn about photosynthesis and chlorophyll.

Blind Contour Drawings

Lesson Plan prepared by Cornell Garden-Based Learning

Length of Lesson: Activity (30-45 minutes)

OVERVIEW & PURPOSE

This activity provides students with the opportunity to draw in a mode of complete concentration, so much so that they won't even look at their paper - the drawing is removed from the students' view as they create it. This is often troubling for students when they initially try it and they often react in protest saying things like "my drawing is going to be awful!" However, the point of this exercise is not what drawing students produce, rather it is to show them the concentration and focus necessary to draw plants from the garden, by "training" their eyes to fully take in the subject and connect directly to their drawing hand.

OBJECTIVES

Students will be able to:

1. Practice contour drawings without looking at their paper.

ECUADORIAN STANDARDS

Culture and Art: ECA.2.2.5., ECA.2.2.6., ECA.2.2.7.

MATERIALS NEEDED

1. Desks or some other comfortable place to draw
2. Plant subject for each student (a flower, veined leaf, piece of driftwood, collection of nuts or seeds, potted plant, etc.)
3. Drawing paper
4. Pencils

ACTIVITY

Procedure

Students will begin by taping a piece of paper to their drawing surface so it can't shift while they work.

Next, students will place their chosen plant subject on a stool or table next to their drawing surface, or hold it in their non-drawing hand.

Turning their chair so that they are completely facing the plant object, students will arrange their workspace so that their sketchbook and drawing hand are completely out of their peripheral vision. Remind them that they will never look at their drawing throughout this exercise.

As they begin to draw, guide students by telling them to allow their eyes to move slowly along the surface of their subject, only a few centimeters at a time.

As their eyes move, so should their pencil (out of sight), drawing the line in coordination with their eye movement. If the edge of the object moves slightly upward, so should the direction of their line. Ask them to imagine that the pencil point is their eye, following it as their eyes move slowly.

Tell them they should allow themselves to get lost in the subject matter and forget what their drawing looks like.

Encourage students to continue drawing until every element of their subject has been drawn. At that time, they can turn back to their drawing. Maybe it will resemble the subject, but it likely will not, or the lines will have a different flavor.

Remind students that the idea with this exercise is to abandon thoughts of how the object should look in a drawing and focus on how the object actually looks from life.

Encourage students to try this again and again. It will sharpen observation skills and likely create a sense of calm as students become engrossed in the shapes of their subject.

EVALUATION CRITERIA

1. Completion of a blind contour drawing.

NEXT STEPS

1. Discuss other ways in which nature can be used in art.

Drawing Upside Down

Lesson Plan prepared by Cornell Garden-Based Learning

Length of Lesson: Activity (30 minutes)

OVERVIEW & PURPOSE

This activity guides students in further sharpening their observation skills. By drawing a familiar object upside down, students will begin to forget the image they're trying to draw, and instead focus on the lines and shapes that make up the object.

OBJECTIVES

Students will be able to:

1. Draw an object upside down.

ECUADORIAN STANDARDS

Culture and Art: ECA.2.2.5., ECA.2.2.7.

MATERIALS NEEDED

1. Paper
2. Pencil
3. Plant subject for each student (a flower, veined leaf, piece of driftwood, collection of nuts or seeds, potted plant, etc.)

ACTIVITY

Procedure

Students will place the plant that they will draw upside down in front of them before beginning to copy the lines exactly as they see them on their own drawing paper.

Encourage students to follow the path of lines and preserve intersections, shapes, and negative space. Students should allow themselves to become lost in these components of the drawing by forgetting that this piece depicts anything.

When finished, invite students to turn the subject right-side up and look closely at what they've drawn. They may even want to draw the plant right-side up, and compare their two images. Do they see any differ- ences? Is their upside down drawing closer to the real thing? Encourage them to keep practicing with different images they find.

EVALUATION CRITERIA

1. Completed upside down drawing.

NEXT STEPS

1. Discuss how items of the environment can be used in art.
2. Talk about the abstract ways in which art can be created.

Painted Leaf Prints

Lesson Plan prepared by Cornell Garden-Based Learning

Length of Lesson: Preparation Time (30 minutes), Activity (1.5-2 hours)

OVERVIEW & PURPOSE

Students will create beautiful painted prints of leaves, flowers, and other objects found in the garden.

OBJECTIVES

Students will be able to:

1. Explore printmaking methods using leaves and other materials gathered from the garden.

ECUADORIAN STANDARDS

Culture and Art: ECA.2.1.7., ECA.2.1.8., ECA.2.2.7.

MATERIALS NEEDED

1. Paint
2. Palettes (small plates or bowls to mix paint in)
3. Paint brushes
4. Small containers with water
5. Newspaper
6. Masking tape to secure newspaper covering to work space
7. Tweezers
8. Paper

9. Flat leaves
10. Other materials gathered from the garden that may make interesting prints (twigs, mosses, rocks, etc.)

ACTIVITY

Procedure

Prepare a workspace by covering tables with newspaper, setting out tools, etc.

With students, gather a diversity of leaves and other appropriate printing materials from the garden.

Students will then begin by choosing a color of paint or printing ink that they would like to work with and putting a dab of it on their palette. A foam brush works well to paint the underside of the leaf (the one with the prominent veins).

Next, students will choose a leaf to print and roll the paint-covered foam brush, evenly but thoroughly coating it with a thin layer of ink or paint.

Using tweezers to pick up the painted leaf, place it face down on a piece of paper. Cover the leaf with a second piece of paper. Using a firm fist, press down on the leaf so that it makes a thorough, consistent print.

Follow these same steps again, with a few more leaves. Once students have the hang of it, encourage them to continue the printing process on their own, using different paint colors on the leaves and arrangements of the leaves on their paper. Sturdy leaves can make up to ten or twenty prints, so no more than a few leaves will be needed per person.

EVALUATION CRITERIA

1. Students will complete one or more painted leaf prints. These painted leaf prints make great journal decorations, and can be used in making harvest season garden calendars and thank you cards.

NEXT STEPS

1. Try this activity with fruits and vegetables.

Garden Songs

Lesson Plan prepared by Cornell Garden-Based Learning

Length of Lesson: Lesson (15 minutes), Activity (1-1.5 hours)

OVERVIEW & PURPOSE

Students craft songs that express, and reflect upon, their experiences learning in the garden.

OBJECTIVES

Students will be able to:

1. Write a poem or song about a gardening experience or related topic.
2. Explore creative expression and performance as part of a group.

ECUADORIAN STANDARDS

Natural Science: CN.2.1.3., CN.2.1.7., CN.2.1.8., CN.2.1.9.

Culture and Art: ECA.2.1.8., ECA.2.2.5., ECA.2.2.6., ECA.2.2.7.

MATERIALS NEEDED

1. Paper
2. Pencils

ACTIVITY

Procedure

Challenge students to create a song about a gardening experience or special topic, such as plant development, composting, or the water cycle.

As a group, brainstorm all of the concepts we consider important to our understanding of the garden. Your list may yield results such as soil preparation, seed germination, plant propagation, photosynthesis, the sun, water cycles, harvesting, nutrition, biodiversity, insects, and more.

Weather permitting, have students go in small groups and sit in the garden quietly to observe and gather inspiration. Ask each group to weave their understanding of the garden concepts they came up with into a song, which they will then present to the rest of the class.

Give students the opportunity to read songs created by other students and songwriters, in order to get them thinking creatively and 'outside the box'. This activity is widely adaptable and can use familiar tunes set to your own lyrics.

Based on the success of this activity and the enthusiasm of the students, consider creating regular opportunities for musical performances and creative reflection in the garden.

EVALUATION CRITERIA

1. Students will work in groups to create and perform their own garden-based song.

NEXT STEPS

1. Create more opportunities for creative expression.
2. Discuss garden concepts that the students seemed to have misunderstood (if there are any).

Negative Space

Lesson Plan prepared by Cornell Garden-Based Learning

Length of Lesson: Activity (30 minutes)

OVERVIEW & PURPOSE

This activity focuses on drawing using negative space—a term used for the spaces that surround an object.

OBJECTIVES

Students will be able to:

1. Practice botanical illustration skills by drawing using visual concepts of negative space.

ECUADORIAN STANDARDS

Culture and Art: ECA.2.2.4., ECA.2.2.7.

MATERIALS NEEDED

1. A plant, potted or from outdoors, and preferably leafy, with large and loosely arranged leaves. If students absolutely cannot find one, a photograph of a houseplant could work, but note that learning to draw from 3-dimensional objects will take students much further in their ability to illustrate and they should always do so if possible.
2. Paper viewfinder (a note card or piece of paper with a hole cut out of the center)
3. Drawing paper
4. Pencil

ACTIVITY

Procedure

Students will first find a comfortable seated position. Moving during this exercise will change their spatial perception and may become confusing.

Demonstrate how to hold a viewfinder between yourself and the plant so that the outer edges of the plant are cut off by the edges of the viewfinder. This will give students fully-enclosed negative spaces to draw.

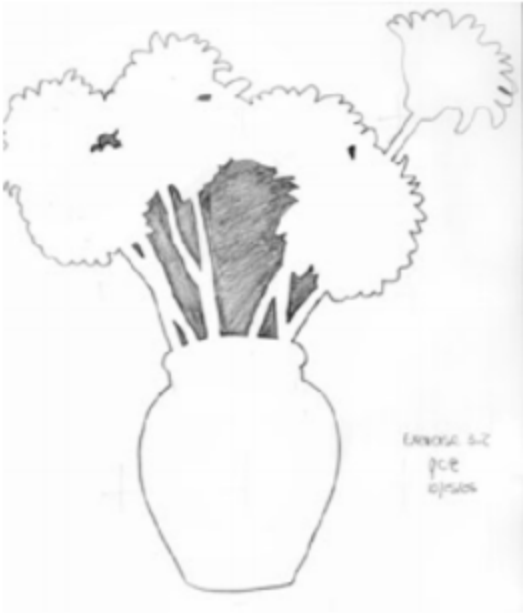
Ask students to let their focus blur slightly until they no longer see a plant in front of them, and they are instead concentrating on the negative - empty or “in between” - spaces between the leaves, stems or petals.

This may take a bit of time because our brains are trained to neglect this information and pay attention only to the shapes of objects in front of us. Try to imagine that the shapes of the negative spaces are just as real or physical as the shapes of the leaves.

Next, guide students to move their eyes slowly along the edges of the negative space as their pencil moves correspondingly on the page.

Remind students that they are not drawing the leaves or stems in this exercise, but instead drawing the spaces between them and fitting these spaces together on their page exactly as they fit together on their plant.

As they move along, students may notice that their drawing will contain references to the plant, and yet will look a bit different, too. Encourage students to stay focused on the negative spaces.



When all of the negative shapes that exist in their plant have been drawn, students can fill the spaces in. Does an image of their plant pop out? It should. If not, encourage them to keep practicing this exercise.

If your students are still having trouble with this exercise, encourage them to try copying only the negative shapes of the picture (shown left) as an example. Remind them that details of these spaces are just as important as the details of the object shown.

Students occasionally find this exercise

frustrating. This is because they are learning to see in a way that opposes how they have seen things their whole life, and they are using information they typically tune out. The more they practice trying to see both the positive shapes and negative spaces that surround objects and the more they practice depicting objects this way, the better they'll become at drawing. The more they engage as they're drawing, the more naturally it will come and the more the practice of capturing negative space will become an intuitive, useful tool.

EVALUATION CRITERIA

1. Completed negative space drawing.

NEXT STEPS

1. Learn about different ways of creating art.
2. Discuss different artistic techniques.

Language and Literature

Writing in the Garden

Lesson Plan prepared by the New Jersey Agricultural Society

Length of Lesson: Preparation Time (5 minutes), Lesson activity (45 minutes, recurring weekly)

OVERVIEW & PURPOSE

It is easy to link writing with the school garden. Your students will be learning something new every time they visit the garden. Give them the opportunity to share their knowledge through writing.

OBJECTIVES

Students will be able to:

1. Learn to write about experiments and observations.
2. Learn to write stories and poetry.
3. Learn to use descriptions through the garden.

ECUADORIAN STANDARDS

Language and Literature: LL.2.1.1., LL.2.2.1., LL.2.2.5., LL.2.4.3., LL.2.4.4., LL.2.4.6.

MATERIALS NEEDED

1. Notebook
2. Pencils

ACTIVITY

Procedure

Journals are an essential tool when teaching in the garden. It is impossible to plant seeds or teach any other hands-on lesson with 20+ students at once. Our recommendation is to teach in the garden using the approach teachers use when teaching small reading groups. While the teacher focuses on a small group, all the other students in the class have a task to work on, and if they have a question or don't understand something, they can quietly ask another student.

Journals can be used the same way when visiting the garden. Children can write in their journals when the teacher is working with a small group. The journals can be used in a variety of ways:

Garden observations
What has changed in the garden since the last visit? Are there leaves that are yellow or have holes? Are some plants thriving while others are struggling? Students record their observations and hypothesize the reasons for the changes.

Science experiments
Students record data for science experiments such as recording the growth of different plants or the amount of rainfall.

Poetry
Teach different types of poetry and ask students to try them in the garden.

Stories
Take notes for or write rough drafts of stories about the garden.

Pictures
Younger students can draw pictures and practice writing words or sentences about the garden.

Free writing
Record any feelings, questions, or ideas about the garden.

EVALUATION CRITERIA

1. Students should be able to describe the natural world.
2. Students should be able to express their thoughts and feelings in a variety of ways.

NEXT STEPS

1. Possible Pen pal program where students communicate with students outside of the Sierra region of Ecuador.

Mathematics

Harvest Math

Lesson Plan prepared by North Carolina State University

Length of Lesson: Preparation Time (30 minutes), Activity (1 hour)

OVERVIEW & PURPOSE

Students will explore math concepts using harvested vegetables.

OBJECTIVES

Students will be able to:

1. Explore math concepts using harvested crops.
2. Teach students how to measure plants, etc.
3. Integration of math concepts to better help understand math in the real world.

ECUADORIAN STANDARDS

Mathematics: CE.M.2.1, M.2.2.2, M.2.2.10, M.2.2.11, M.2.2.12.

MATERIALS NEEDED

1. Buckets for harvesting
2. Rulers
3. Crops ready to harvest (carrots and radishes work well for this lesson)

ACTIVITY

Procedure

Count the number of each type of crop harvested, identify whether one crop is “more

than, less than, or equal to" another crop.

Order the crops by length, measure the length using rulers or another non-standard unit.

Organize the crops into categories and count each category (can be organized by crop, color, or plant part; example: roots, leaves, etc.); add the different number of crops.

Determine if each crop harvested has an even or odd number of vegetables.

Measure the lengths of the vegetables using inches and centimeters. How much longer is the longest than the shortest?

Graph numbers/colors of each crop harvested.

Solve addition, subtraction, multiplication, and division problems: add up all the red crops, divide the harvest into groups of 2, 3, 4, etc.

Have students research the crop and find out where it originated and how it is used today. What state/country grows the most? How do other cultures use this crop?

EVALUATION CRITERIA

1. Students will be able to answer math questions based around the number of crops that were harvested.

NEXT STEPS

1. Have students solve more problems using math and integrating the garden into those programs.

Measurement and Geometry in the Garden

Lesson Plan prepared by Greater Richmond Fit4Kids

Length of Lesson: Preparation Time (10 minutes), Lesson (1 hr), Lesson Activity (30 minutes)

OVERVIEW & PURPOSE

Students will use the garden to apply concepts of measurement and geometry in a real world setting. Students will also explore how these concepts can be used to plan a garden.

OBJECTIVES

Students will be able to:

1. Utilize the garden to apply concepts of measurement and geometry.
2. See a real world example of mathematics being used.
3. Learn how to apply concepts in planning of a garden.

ECUADORIAN STANDARDS

Mathematics: CE.M.2.1, M.2.2.2, M.2.2.10, M.2.2.11, M.2.2.12.

Culture and Art: ECA.2.3.10.

MATERIALS NEEDED

1. Measuring tape
2. Pads of paper and pencils
3. “Produce” tiles representing how much space each plant needs to grow (i.e. tomato tiles picturing one tomato and carrot tiles picturing 16 carrots, since tomatoes require more space than carrots)

ACTIVITY

Preparation

Gather the students around the raised beds and discuss the characteristics of the raised beds. What shape are they? What clues did you use to decide on the shape?

How many ways can you cut the beds to create two symmetrical pieces? What shape are these pieces? Have students use the measuring tape to “cut” the beds to visually demonstrate their ideas (vertically or horizontally, two smaller rectangles or maybe squares, diagonally, two right triangles)

Show the class the produce representation tiles and ask them to identify the fruit or vegetable pictured, and if they’ve ever eaten it. Explain how the number of times that the plant is pictured on the tile corresponds to how many of that plant is “planted” when they place the tile in the bed.

Divide the class equally among the beds in your garden and number off each student, restarting numbering at each bed (4 raised beds and 20 students= 5 students per bed numbered 1-5).

Hand out produce representation tiles to each student and explain that one by one (as you call out their number) they will place one tile in the raised bed so that no two tiles are overlapping. Cycle through all of the students until there is no more space in the bed.

Have students count how many individual plants for each type of plant they were able to fit in the bed (for example each carrot tile has 16 individual carrots so if the students were able to place 3 carrot tiles in the bed they will have “planted” 48 individual carrots).

Discuss with students how some tiles (carrot) “planted” more of a type of plant while others (tomato) “planted” less and how this corresponds to how much space the different types of plants need to grow.

Ask students what they think would happen if you tried to grow too many plants in a contained area, such as a raised bed garden?

EVALUATION CRITERIA

Students will participate in a roundtable on garden planning, shapes, and garden measurements.

NEXT STEPS

1. Why do you think it's important to plan for our garden?

2. What sorts of things are useful to know when planning our garden?

Measurement and Graphing in the Garden

Lesson Plan prepared by North Carolina State University

Length of Lesson: Preparation Time (30 minutes), Lesson (1 hour), Activity (45 minutes)

OVERVIEW & PURPOSE

Students will collect data in the garden and create various graphs to represent the data. Students will solve real world and mathematical problems using the graphs.

OBJECTIVES

Students will be able to:

1. Collect data from the garden and use the data to create various graphs to represent it.
2. Solve real-world problems using the graphs.

ECUADORIAN STANDARDS

Mathematics: O.M.2.2, M.2.2.1., M.2.3.1.

MATERIALS NEEDED

1. Rulers
2. Paper
3. Writing utensil

ACTIVITY

Procedure

Break the students into small groups. Determine what is to be measured and have them begin collecting data. Stagger the order of the questions so that each group is trying to find each measurement at different times. Have the students write their results on their sheet of paper or garden journal, and share with the class.

Display the data using various graphs. What and how data is collected and displayed will vary according to grade level, below you will find some suggestions.

- Count and display any or all of the following using a bar or pictograph.
    - The number of each type of plant
    - The number of leaves on different plants of the same type or different types
    - The number of each color you find in the garden
- Measure the height of different plants in centimeters or non-unit measures.
- Measure the temperature in different locations (air, soil, and water) in the morning and afternoon. How does the temperature change? Why does the temperature change? Is the temperature different on cloudy days compared to sunny days?

EVALUATION CRITERIA

1. Students are able to correctly measure objects in the garden.
2. Students can measure different objects not from the garden.

NEXT STEPS

1. Talk more about real world measurement scenarios.
2. Discuss how climate and weather impact the garden.

How to Measure Rain

Lesson Plan prepared by the New Jersey Agricultural Society
Learning Through the Garden Program

Length of Lesson: Preparation Time (15 minutes), Lesson (15 minutes), Lesson Activity (1 hour)

OVERVIEW & PURPOSE

The purpose of this lesson plan is to help students learn how to correctly collect and measure rain. They will also learn about the importance of rain in the growth of a plant. By the end of the lesson the students should be able to explain the concept of rain and how it is nature's way of keeping plants alive and healthy. They will also learn how to accurately collect and interpret data through this lesson.

OBJECTIVES

Students will be able to:

1. Explain that plants need water to grow and that in nature, this water comes from rain.
2. Explain how to measure how much water falls on their garden or neighborhood.

ECUADORIAN STANDARDS

Natural Science CN.2.4.12.

Mathematics: M.2.3.1.

MATERIALS NEEDED

1. 2 Liter sized plastic bottles with the tops cut off, one for each group

2. Rulers
3. Permanent marker or any marker that will mark the bottles
4. Duct tape or any tape that can seal well

ACTIVITY

Preparation

Cut the tops off two-liter soda bottles about one-third of the way down from the top. Turn these tops upside down so they look like funnels. Insert these “funnels” inside the cut bottles to catch the rain. So that the funnels do not slip down into the bottles, tape the tops securely in two places with duct tape. Before this lesson, the teacher, or the teacher and students, should dig small holes somewhere in the garden away from foot traffic that are big enough to bury just the bottoms of the rain gauges. (See detailed rain gauge-making instructions below.)

Procedure

Ask students what three things plants need to grow. Ask how our garden would get water if we didn't water it with a hose or watering cans. Ask what would happen to the plants if there wasn't enough rain.

Tell students that they are going to make a tool called a rain gauge that will let them measure the amount of rain that falls on our garden. In small groups of three or four, students measure inches and mark them on the side of the bottles. This is easier for younger students if the ruler is taped to the side of the bottle with the 0 end of the ruler flush against the bottom of the bottle. Students use permanent markers to mark measurements one inch apart on the side of the bottle, marking 0 at the bottom of the bottle. Students should mark up to at least three inches. Then add numbers to the marks. (Older students can add measurements of one-half inches.)

Place bottles in the holes in the garden and tamp soil down around them so the wind does not blow them over. Students check each week to see how much rain has fallen and record their observations.

EVALUATION CRITERIA

1. The student will be able to describe the three things plants need to grow and how to make a tool to measure the amount of rain.

NEXT STEPS

1. Discuss the water cycle, and how rain is a part of the cycle.
2. Students can graph the amount of rain that falls over several weeks and compare the actual amount of rain in a week to the amount of rain forecasted.

Recommendations

Recommendations for Constructing the Garden

Building a Raised Bed Garden

How to Build a Raised Garden Bed

To build a raised garden, first pick a spot where you would like your bed to be. Different crops require different amounts of sunlight, you wouldn't want students tripping over the water pump, etc. You can create as large or small garden bed as you'd like, however, we recommend it be at least 15 centimeters high off the ground for ease of access. These instructions will describe building a 1.25-meter by 2-meter by .25-meter bed with .5 meter by 1.25 untreated wood.

1. Measure and mark length of the walls and cut the boards. Measure and cut wood for corner posts to support the walls. They should be the height of the garden bed wall. For additional strength, cut posts to install along the walls.
2. Clamp together the boards for each wall. Set corner posts on top of the boards, flush with the ends of the 2-meter walls and set back ~2.5-4 centimeters from the ends of the shorter walls. Drill pilot holes and attach the posts with screws. Hammering also works. If you have cut additional posts. Attach them as well.
3. Drill pilot holes and connect all the sides with screws to form a box - alternatively, use nails and a hammer. The posts should be on the inside of the bed.

If you have outdoor space,

4. Place the frame of the raised bed in position and outline it with a shovel. Setting up the bed on the ground rather than concrete or another hard surface allows proper root growth and drainage.
5. Set the frame aside to remove the grass. Loosen the dirt to help your new plants roots grow deeply into the ground.
6. If you can, staple a wire frame mesh to the bottom of the frame to keep out weeds while still allowing worms access to the soil.
7. If the wood isn't rot resistant, staple strong plastics along the interior walls before adding soil.

If you are planning on making it indoors,

8. Instead of creating a simple box with four sides, add a fifth wall to the bottom of the raised bed.
9. To create drainage, put a material at the bottom of the bed to promote drainage, such as pea rocks, crushed granite, or stone. On top of this material is where the soil will be placed.
10. Drain several small holes in the bottom of your raised bed to allow drainage to occur.

Nutrient Solutions for Hydroponics

To prepare your own nutrient solution, you will need measuring cups, a good set of weighing scales, and rubber gloves for crystalline chemicals in some of the formulas.

Solution 1: Easy chemical solution

> This formula is sufficient for a 20-liter container full of water. This formula is for *non-circulating systems,* as they are no longer diluted before adding. Ideal for small systems where roots are sitting in the solution (for instance, raft systems). Combine 10g Masterblend Tomato 4-18-38, 10g Calcium Nitrate 15.5-0-0, and 5g epsom salt

Solution 2: Compost solution

> Make a compost heap with (ideally) half-green waste (leaves, grass cuttings, food waste) and half-brown waste (dead leaves, old papers, straw, or wood chippings). Turn the compost heap once every few weeks to stir the waste. Add two large shovel-full to a large 20-liter bucket. Add water, let steep for three days. After this, pour out the liquid and strain it to remove all traces of compost sediment. Add sediment back to the compost heap. Use ½ liter for every 50 liters of water in your tank.

Solution 3: Easy sea-based solution

> This formula is a good base recipe. If this formula isn't as effective as desired, add a growth enhancer or liquid fertilizer. This recipe requires 170 oz seaweed/kelp and 5 teaspoons Epsom Salts. Take seaweed, wrap in cheesecloth (or another cotton fabric) and tie with twine. Next, add 20 liters of water
>
> To make a liquid fertilizer, place four liters of organic compost, manure, or a pound of worm castings into a large bucket with a lid. Stir in water and agitate the contents well. Then, aerate the mixture with an air pump, and set aside the bucket for three days, stirring every day. Once ready, strain the fertilizer. This is very

similar to Solution 2.

In addition to our lesson plans, we have a few suggestions for any educators looking to implement our curriculum. Although these are not necessary, having all of these structures and philosophies in place may greatly aid in the success in the garden.

1. Appoint a garden manager.

Garden managers are the central leadership of the garden, and oversee the upkeep of the garden infrastructure and perform administrative duties. They allocate green space for projects, facilitate care of the garden's infrastructure when school is not in session, manage inventory, and create and enforce rules for conduct and behavior while in the garden. They also do not take care of the plants, provide educational support, or micromanage projects. The appointed manager will need to provide direction and organization within the garden, ensure that green space is being used to its fullest extent, and ensure the garden is operationally efficient.

2. Collaborate with existing garden organizations for long-term support.

In addition to the garden manager, who focuses on more administrative duties, it is also important for educators to be able to reach out for gardening support when needed. Educators aren't experts in every field of science, so it is important for educators to be able to reach out to those who may be able to help them when needed. With this in mind, we have created a small list of possible organizations to reach out to to help with gardening needs.

Potential Resources	Contact information	Description
University of Cuenca community outreach	Vinculación | Universidad de Cuenca (ucuenca.edu.ec)	The University of Cuenca requires students to complete 160 hours of community service. It may be a good idea to reach out to UC to see if they would be interested in working with school gardens to complete their requirements.
Banco de Alimentos Diakonia	Banco de Alimentos Diakonía | Facebook	Banco de Alimentos Diakonia is a Food bank and charitable organization that does a large variety of community projects. They've worked with distributing clothes, food, etc. in the past.
Rocio Warmi	+593 99 125 8873	Rocio Warmi works with a gardening Minga in Cuenca. However, this Minga is not very mobile, and is unlikely to be able to provide support to cities outside the city limits of Cuenca.
Des Dizney	info@cuencasoupkitchen.org	Des Dizney works with various charitable organizations in Cuenca and runs the Cuenca Soup Kitchen. Although she is unable to provide direct garden support, she is well connected to others in Cuenca, and may be able to provide indirect support.

3. Adapt the content and structure of the curriculum when needed.

We have designed our curriculum to be as adaptable and adjustable as possible. Thus, we suggest making full use of the robustness of the curriculum. It was never designed to be a one size fits all, so if you don't think that a lesson plan will address your students needs, we often provide multiple options for teaching the same subject.

4. Focus on implementing active learning activities.

We believe that it is important to focus on the active learning methods that are afforded by this curriculum. To only focus on the lecture portion of the lessons and not follow through with the hands-on elements may not be the most effective use of the lesson plans. Furthermore, for many subject areas, we have implemented numerous lesson plans that address the same subject in a different way. In these areas, using multiple lesson plans with only the lecture/theory based information used from one of the lesson plans, and use the hands-on activities from all of those lesson plans.

Bibliography

A Classroom Garden From Trash. [Lesson Plan]. (n.d.). Teacher.org. Retrieved from https://www.teacher.org/wp-content/themes/teacher/scripts/lesson-plans/generate_lesson_plan.php?id=classroom-garden-from-trash

Bugs in the Garden. [Lesson Plan]. (n.d.). Greater Richmond Fit4Kids. Retrieved from http://grfit4kids.org/wp-content/themes/eddiemachado-bones-bf651d3/library/lessons/garden/Bugs%20in%20the%20Garden.pdf

Burgess, C. *Investigating the Food Pyramid.* [Lesson Plan]. (n.d.). Beacon Lesson Plan Library. Retrieved from http://www.beaconlearningcenter.com/lessons/lesson.asp?ID=1708

Classroom Hydroponics. [Lesson Plan]. (n.d.). KidsGardening. Retrieved from https://kidsgardening.org/wp-content/uploads/2018/12/Classroom-Hydroponics.pdf

Compost Chaos. [Lesson Plan]. (n.d.). Growing Gardens Non-Profit. Retrieved from https://www.growing-gardens.org/wp-content/uploads/2013/03/Growing-Gardens-Youth-Grow-Lesson-Plan-Manual-Jan-2016.pdf

Cross Contamination of Food. [Lesson Plan]. (n.d.). Teachnology. Retrieved from https://www.teach-nology.com/teachers/lesson_plans/health/foodcontamination68.html

Dissecting Tulips. [Lesson Plan]. (n.d.). Grow Pittsburgh. Retrieved from https://drive.google.com/file/d/1Px-rKlXCBRoLV0qDyBvEBzDt3GvEtUet/view

Do Plants Really Need Light?. [Lesson Plan]. (n.d.). New Jersey Agricultural Society - Learning Through Gardening Program. Retrieved from http://www.njagsociety.org/uploads/1/7/0/5/17057112/do_plants_really_need_light__lesson_plan_ls_wb.pdf

Eyerly Family. (n.d.). *Raised Garden Bed Drainage: Is It Needed?* Farm & Garden DIY. https://farmandgardendiy.com/do-raised-garden-beds-need-drainage/#:~:text=Drainage%20%E2%80%93%20Using%20a%20liner%20in,lose%20soil%20to%20the%20dirt.

Flowers and Pollination. [Lesson Plan]. (n.d.). School Garden Project of Lane County. Retrieved from https://www.schoolgardenproject.org/download/flowers-pollination/

Gardeners Plant in Soil, Not Dirt. [Lesson Plan]. (n.d.). New Jersey Agricultural Society - Learning Through Gardening Program. Retrieved from http://www.njagsociety.org/uploads/1/7/0/5/17057112/gardeners_plant_in_soil_not_dirt_lesson_plan_ls_wb.pdf

Growing a Knowing Nose. [Lesson Plan]. (n.d.). KidsGardening. Retrieved from https://kidsgardening.org/wp-content/uploads/2019/04/Growing-a-Knowing-Nose.pdf

Harvest Math. [Lesson Plan]. (n.d.). North Carolina State University. Retrieved from https://stem.plantsforhumanhealth.ncsu.edu/wp-content/uploads/sites/4/2018/05/Lesson-Plans-Harvest-Math.pdf

Healthy Eating Habits. [Lesson Plan]. (n.d.). Greater Richmond Fit4Kids. Retrieved from http://grfit4kids.org/wp-content/themes/eddiemachado-bones-bf651d3/library/lessons/garden/Healthy%20Eating%20Habits.pdf

Health and Nutrition. [Lesson Plan]. (n.d.). Global Pulse Confederation. Retrieved from https://iyp2016.org/resources/lesson-plans/44-lesson-plan-2-health-and-nutrition/file

How to Measure Rain. [Lesson Plan]. (n.d.). New Jersey Agricultural Society - Learning Through Gardening Program. Retrieved from http://www.njagsociety.org/uploads/1/7/0/5/17057112/how_to_measure_rain_lesson_plan_ls_wb.pdf

Lesson 1: Introduction to the Garden. [Lesson Plan]. (n.d.). Youth Grow Garden Lesson Manual. Retrieved from https://www.growing-gardens.org/wp-content/uploads/2013/03/Growing-Gardens-Youth-Grow-Lesson-Plan-Manual-Jan-2016.pdf

Measurement and Geometry in the Garden K, 1st. 2nd. [Lesson Plan]. (n.d.). Greater Richmond Fit4Kids. Retrieved from http://grfit4kids.org/wp-content/uploads/2014/04/Measurement-and-Geometry-K-1-2.pdf

Measurement and Graphing in the Garden. [Lesson Plan]. (n.d.). North Carolina State University. Retrieved from https://stem.plantsforhumanhealth.ncsu.edu/wp-content/uploads/sites/4/2018/07/Measurement-and-Graphing-in-the-Garden.pdf

No-Cost School Garden Drip Irrigation System. [Lesson Plan]. (n.d.). New Jersey Agricultural Society - Learning Through Gardening Program. Retrieved from www.njagsociety.org/uploads/1/7/0/5/17057112/no-cost_irrigation_system_lesson_plan_ls_wb.pdf

Planting the Summer Garden. [Lesson Plan]. (n.d.). School Garden Project of Lane County. Retrieved from https://www.schoolgardenproject.org/download/planning-summer-garden/

Plant Parts and Functions. [Lesson Plan]. (n.d.). School Garden Project of Lane County. . Retrieved from https://www.schoolgardenproject.org/download/plant-parts-function/

Printmaking: Chlorophyll Prints. [Lesson Plan]. (n.d.). Cornell Garden-Based Learning. Retrieved from https://cpb-us-e1.wpmucdn.com/blogs.cornell.edu/dist/f/575/files/2016/03/newlogoDigArt-Chlorophyll-Prints-spp6q9-28d6ayz-223js7e-zgfuz6-1fd3pce.pdf

Printmaking: Painted Leaf Prints. [Lesson Plan]. (n.d.). Cornell Garden-Based Learning. Retrieved from https://cpb-us-e1.wpmucdn.com/blogs.cornell.edu/dist/f/575/files/2016/03/newlogoDigArt-Painted-Leaf-Prints-1rx5mfo-tioxk6-2eh11le-1-2e172vd-1x4lwmk-1b5k5uy.pdf

Pyramid Matching Game. [Lesson Plan]. (n.d.). Teachnology. Retrieved from https://www.teach-nology.com/teachers/lesson_plans/health/pyramidk2.html

Rachel Mewes. *Interview an Elder* [Lesson Plan]. (n.d.). Edible Schoolyard. Retrieved from https://edibleschoolyard.org/sites/default/files/Interview%20an%20elder_fillable.pdf

Rachel Mewes. *Your Ingredients* [Lesson Plan]. (n.d.). Edible Schoolyard. Retrieved from https://edibleschoolyard.org/sites/default/files/Your_Ingredients_fillable.pdf

Scavenger Hunt Spring. [Lesson Plan]. (n.d.). Grow Pittsburgh. Retrieved from https://drive.google.com/file/d/1lUjd8nMF-YdT_nL_lYgv-f5aktlUrSLh/view

Seed Dispersal. [Lesson Plan]. (n.d.). Growing Gardens Non-Profit. Retrieved from https://www.growing-gardens.org/wp-content/uploads/2013/03/Growing-Gardens-Youth-Grow-Lesson-Plan-Manual-Jan-2016.pdf

Seed Germination. [Lesson Plan]. Greater Richmond Fit4Kids, North Carolina State University. (n.d.). Retrieved from http://grfit4kids.org/wp-content/themes/eddiemachado-bones-bf651d3/library/lessons/garden/Seed%20Germination.pdf

Seed Saving. [Lesson Plan]. (n.d.). Greater Richmond Fit4Kids. Retrieved from http://grfit4kids.org/wp-content/themes/eddiemachado-bones-bf651d3/library/lessons/garden/Seed%20Saving.pdf

Seeds and How They Grow. [Lesson Plan]. (n.d.). Tower-Garden Plant Lesson. *https://www.towergarden.com/content/dam/towergarden/resources/lesson-plans/all-grade-2-and-up-lesson-plans-PPTS.pdf*

Sewell, J. *Cooking a Few of my Favorite Things,* [Lesson Plan]. (n.d.). Beacon Lesson Plan Library. Retrieved from http://www.beaconlearningcenter.com/lessons/lesson.asp?ID=70

Soil Composition. [Lesson Plan]. (n.d.). School Garden Project of Lane County. https://www.schoolgardenproject.org/download/soil-composition/

Soil and Compost. [Lesson Plan]. (n.d.). Growing Gardens Non-Profit. Retrieved from https://www.growing-gardens.org/wp-content/uploads/2013/03/Growing-Gardens-Youth-Grow-Lesson-Plan-Manual-Jan-2016.pdf

Sprouting Seeds - A Seed Has a Coat. [Lesson Plan]. (n.d.). Whole Kids Foundation and American Heart Association. Retrieved from https://www.wholekidsfoundation.org/assets/documents/school-garden-lesson-plans.pdf

Square Foot Seeds. [Lesson Plan] (n.d.). North Carolina State University. Retrieved from https://stem.plantsforhumanhealth.ncsu.edu/wp-content/uploads/sites/4/2018/01/Lesson-Plans-Square-Foot-Seeds.pdf

Stephens, O. (2020, April 3). *DIY Hydroponic Nutrients: 6 Cheaper Homemade Recipes*. TheHydroponicsPlanet. https://thehydroponicsplanet.com/diy-hydroponic-nutrients-6-cheaper-homemade-recipes/.

Stephens, O. (2019, April 27). *How to Make Liquid Fertilizer for Hydroponics*. TheHydroponicsPlanet. https://thehydroponicsplanet.com/how-to-make-liquid-fertilizer-for-hydroponics/.

Visual Art: Blind Contour, Drawing in the Garden Part 2. [Lesson Plan]. (n.d.). Retrieved from https://cpb-us-e1.wpmucdn.com/blogs.cornell.edu/dist/f/575/files/2016/03/newlogoDigArt-2-Blind-Contour-2fatonf-189fvh2-1w27bof-1f7atmt.pdf

Visual Art: Drawing Upside Down, Drawing in the Garden Part 3. [Lesson Plan]. (n.d.). Retrieved from https://cpb-us-e1.wpmucdn.com/blogs.cornell.edu/dist/f/575/files/2016/03/newlogoDigArt-3-Drawing-Upside-Down-1e6ari5-15qhwaa.pdf

Visual Art: Negative Space, Drawing in the Garden Part 4. [Lesson Plan]. (n.d.). Cornell Garden-Based Learning. Retrieved from https://cpb-us-e1.wpmucdn.com/blogs.cornell.edu/dist/f/575/files/2016/03/newlogoDigArt-4-Negative-Space-t3r30x-14gcjyt.pdf

Visual Art and Performance: Garden Songs. [Lesson Plan]. (n.d.). Cornell Garden-Based Learning. Retrieved from https://cpb-us-e1.wpmucdn.com/blogs.cornell.edu/dist/f/575/files/2016/03/newlogoDigArt-Garden-Songs-1bxrr7z-omvulz.pdf

Weeding Our Garden. [Lesson Plan]. (n.d.). Grow Pittsburgh. Retrieved from https://drive.google.com/file/d/1zQmrsCNOJVo6O4y5DAbiiaEedWFpKTCV/view

Wondrous Worms. [Lesson Plan]. Growing Gardens Non-Profit. (n.d.). Retrieved from https://www.growing-gardens.org/wp-content/uploads/2013/03/Growing-Gardens-Youth-Grow-Lesson-Plan-Manual-Jan-2016.pdf

Writing in the Garden. [Lesson Plan]. (n.d.). New Jersey Agricultural Society - Learning Through Gardening Program. Retrieved from http://www.njagsociety.org/uploads/1/7/0/5/17057112/writing_in_the_garden_ls_wb.pdf