Carmen and Ernie's Classroom Keyhole Garden

Grades 3-5

Vocabulary

weathering
particle size
boulder
cobble
pebbles. gravel
dirt
clay
compost
decomposers
photosynthesis
retain water
mixture
green organic matter
brown organic matter
soil
life cycle
germinate
seed
seedling
sprout
sowing
flower buds
transplant
pollinate
fruit
vegetable
stem
roots
bulbs
leaves
harvest

Overview

In this lesson plan students will:

- Review previous concepts regarding soil color, texture, and particle size.
- Learn that soil is composed of living and nonliving materials.
- Amend soil so that desert soil can host nonnative plants to grow and harvest.
- Use information found on seed packets to understand growing conditions for plants.
- Compare the life cycles of food plants to understand and plan for a growing season.

TEKS Alignment

3.7A The student is expected to explore and record how soils are formed by weathering of rock and the decomposition of plant and animal remains

4.7A The student is expected to examine properties of soils, including color and texture, capacity to retain water, and ability to support the growth of plants

5.9A The student is expected to observe the way organisms live and survive in their ecosystem by interacting with the living and nonliving components

3.10C The student will investigate and compare how animals and plants undergo a series of orderly changes in their diverse life cycles such as tomato plants, frogs, and lady beetles.

4.10C The student will explore, illustrate, and compare life cycles in living organisms such as beetles, crickets, radishes, or lima beans.

THE SCIENCE BEHIND IT:

In 3rd Grade students learned that a mixture is two or more substances that are combined together, but what they may not understand is that the soil under their feet is not only a mixture, but that the key components of our soil mixture is air, water and decomposed organic materials belonging to plants and animals. The combination of living and nonliving materials in soil, (biotic and abiotic factors) create an environment in which plants can survive and thrive.

How to Approach this Lesson Plan

Classroom gardens are a great way for teachers to do a long term, (yearlong) project with their students that will quickly become a springboard for multiple cross-curricular lessons. Many teachers when attempting a garden project, will try to begin the project in early or late spring. Unfortunately, the project may run into issues, especially when growing plants from seed, as the school year often ends before the garden has a chance to get established or bear fruit. The result may be an unattended garden during the summer months, that may become an eyesore.

In the Carmen and Ernie Classroom Keyhole Garden Lesson Plan, teachers will have an opportunity to do a yearlong gardening project that can survive in the Chihuahuan Desert, with a robust lesson plan that gives their students a chance to study soil composition and plant life cycles. This lesson includes a guide for creating a collapsible Keyhole Garden, which means that at the end of the school year, the garden can easily be taken apart, with the composted soil spread to garden plants around the school. However, if a teacher needs to strictly follow a science curriculum through a specific scope and sequence, the activities in this lesson also lend themselves to be done in isolation. (***In other words, the teacher can choose to do the garden project, or they can choose to do the activities of this unit in their own scope and sequence without doing a classroom garden.)***

How to Use the Parts of the Lesson:

This is a quick guide for the different mini lessons within the big yearlong project of Carmen and Ernie's Classroom Keyhole Garden.

Part I: Soil Activities (3.7A, 4.7A):

- Carmen's Soil Investigation (Procedure and Data Collection Sheet)
- Carmen's Perfect Soil Booklet
- Carmen's Composted Soil Guide
- Carmen and Ernie's Classroom Keyhole Garden Guide (optional in conjunction with the composted soil guide)

Part II: Plant Activities (3.10C, 4.10C, 5.9A):

- Ernie's Earth Day Salsa Garden Booklet
- Ernie's Sow Chart and Sample Seed Packets
- Ernie Compares Plant Life Cycles, Plant Diagrams, Venn and Matrix
- Ernie's Recycled mini Greenhouse
- Ernie's Portable Bucket Keyhole Garden
- Carmen and Ernie's Classroom Keyhole Garden Guide

Teachers can choose to do these activities without doing the entire Classroom Keyhole Garden Project. The following is a description of the sequence if you intend to do the entire Classroom Keyhole Salsa Garden Project.

What is a Keyhole Garden?

A Keyhole Garden is a raised garden developed in Africa to promote home gardens in arid and desert regions. They are favored in these regions because they provide a way to amend soil so that the soil retains water and they provide a high yield plant cover so that the garden is more resistant to evaporation, therefore needing less watering. The container is above ground making it harder for pests to get in. It is called a "keyhole" because its shape resembles a keyhole of a door.

At the center of the keyhole garden is a composting basket that contains layers of composting materials that is collected throughout the growing season. This basket is used to provide nutrients to the soil as well as a type of "compost tea" when watered directly into the basket.

Keyhole gardens can be made from any recyclable materials found around the yard, including burlap sacks, sticks, wood planks, stones, or bottles, but our Classroom Keyhole Garden, which is made from landscape plastic and vinyl lattice will be made so that it is collapsible and can be removed at the end of the school year. For more information on how to build the collapsible Keyhole Garden, see: "Carmen and Ernie's Classroom Keyhole Garden Guide."

Community examples of Keyhole Gardens:

TecH2O Center, the El Paso Zoo and Ascarate park have great examples of Keyhole Gardens that have been created for the El Paso community. These locations would make great fieldtrips for students to see a keyhole garden in action. Examples of these locations are provided in the video, "What is a Keyhole Garden?"

Carmen and Ernie's Classroom Keyhole Garden, Part I: The Retention of Water in Soil and Its Ability to Support Plants

The Science of Soil

Soil is an interesting topic in Texas Science because the soils of Texas are diverse. Texas is a large state and hosts soils from areas that were once an inland ocean, to areas that are mountainous or hilly. Most Texas ecoregions have soil that suffer from both wind erosion and moisture content, which means the soil in these regions may have trouble supporting plants without irrigation and some type of soil amendment. Farmers of Texas soils may be confronted with issues concerning high clay or caliche content. Caliche is a soil high in calcium carbonate. Clay and caliche soils are apt to succumb to cementation, a hardening of the soil. If planting in soils that are subject to cementation, plant roots often get trapped inside the cemented soil and cannot move to grow. In areas of high clay and caliche soils, soil amendments become a must. In the interest of soil conservation, Texas has made its soil standard a required and tested item on the STAAR exam for Elementary Science.

Lesson Focus: The primary focus of this lesson will be through the lens of the tested standard 4.7A "*The student is expected to examine properties of soils, including color and texture, capacity to retain water, and ability to support the growth of plants."* Although native plant species in the El Paso area have adapted to soils with low water content, a vegetable garden requires soils with higher water content because fruits and vegetables usually have a need for more water. In this lesson, Ernie wants to grow a Salsa Garden, which will contain plants that are not native to the desert environment.

This does not mean that people who lived in the Chihuahuan Desert did not farm for food. On the contrary, native peoples have been farming in this area for thousands of years, but they did things to create irrigation and amend soils to improve harvest.

In Carmen and Ernie's Keyhole Garden Lesson, students will be learning about soil content and formation through both a booklet about soil "Carmen's Perfect Soil Recipe" and a school yard soil investigation, "Carmen's Soil Investigation". In these two activities students will learn that soil composition can change dramatically within a few feet of the school yard, dependent upon the soils ability to retain water and sustain life.

In this lesson, students will learn about the formation of soil and how to amend it. Students will first look at the different soils present at a typical schoolyard in the El Paso area. It is important to note that soil colors change dramatically depending on the land make up in your area, especially if the soil had been previously amended during landscaping. The key idea for students to understand is that darker soils in the El Paso area typically are darker because of humus content provided by the plants living in the soil. Around a school yard you may find soil taken from a sandbox (playground sand) which is tan, gritty and devoid of living materials. You may find dirt taken from under a bush, which because the soil is kept in the shade, may be darker, less sandy and typically mixed with dead leaves and decomposers such as pill bugs. You may also find soil in grassy areas where the grassroots aid in the ability to retain water and stop erosion. Areas that the students typically trample the grass will leave exposed dirt that is tan and blanched in color and may expose other components to the soil such as gravel and rock. Typically, a campus will be able to find 4-5 distinctly different soil sample types regarding color, texture, and composition.

Once the students are familiar with the components of El Paso soil, they can begin learning about soil amendments used to create high water retention. Part of this year long lesson plan will be creating a compost pile. In "Carmen's Perfect Soil Procedure" students will learn to start a compost pile in the fall which can be made larger throughout the winter months, later becoming the soil used for the Classroom Keyhole Garden. By layering green matter, brown matter and local dirt, the students will be able to witness the decomposition of organic materials that will later become healthy soil for vegetables and fruits to grow and thrive. This composted soil will look dramatically different than the soil samples that were collected around the school yard.

Carmen's Soil Investigation

Guiding Questions:

- Is all soil at my school (or neighborhood) the same?
- Can I recognize the components of soil by observing and describing a soil sample?

Materials:

- Carmen's soil booklet
- small spade or garden shovel for each group
- Quart size or sandwich bags (4 per group)
- masking tape for each group
- "Sharpie" marker for each group
- Spoon for each group
- Small paper cups "Dixie" type (4 per group)
- Water
- scissors for each student
- clear packing tape for each group
- index cards 4 per student
- cardboard roll from paper towels or toilet paper (I per student)
- white glue for each group
- Carmen's Soil Journal pages 1 set for each student
- Hand lens or brock microscope 1 for each student
- various locations to collect soil, including but not limited to:
    - from under a bush
    - from an area without plants and exposed to the sun
    - from a houseplant
    - from an arroyo or area where water pools when it rains
    - Near or next to a water source such as a water spicket, faucet or fountain

Engage:

The teacher will pose the question to the class, "How would you describe soil in El Paso?" The teacher will then scribe on chart paper descriptions of what the students feel describes El Paso soil by the following categories:

Color Texture Particle Size Moisture

After scribing descriptions into these categories, the students will then follow the procedures of "Carmen's Soil Investigation.

Explore: Carmen's Soil Investigation Procedure

1. Each group will collect 4 different soil samples. Once the students are done with this investigation, return the soil from where you took it. Using a small shovel or spade and a quart size or sandwich size baggie, the students should collect one shovel full of soil carefully noting the place where it was collected and if there were any insects or bugs in the area.

   Choose four of the following areas at your school or neighborhood:
   - A sandbox
   - Under a bush
   - In an area with no plants in the direct sun
   - In an area under a faucet, spicket or water fountain
   - From a house plant
   - Under a tree
   - In the shade
   - From a garden area
   - From an arroyo or place that water collects when it rains
   - In a desert lot or desert area

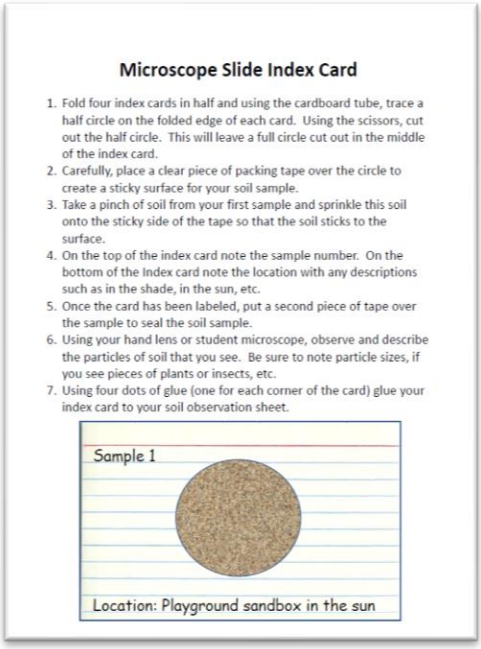
2. Once the samples have been collected, the students should label each bag with masking tape and sharpie, numbering the samples 1-4, noting where they were taken. Once this is completed have the student bring their soil samples back to class.
3. The students will brainstorm with their groups or class for description words for soil that would describe how the soil looks, sounds, and feels. Write these words in the word bank on your soil investigation sheet.
4. The students will pass around their four samples to each other as they note the following about each soil sample on the soil investigation sheet.
   - Describe the color of the soil (*red soil may indicate iron in the soil, tan soils show a lack of living materials in the soil, dark soils in the El Paso area most likely indicate the presence of humus in the soil., however the color of the rocks in the area may also indicate soil color)*
   - Note if there are rocks, sand, or powdery dirt in the sample *(most soil in El Paso will have a combination of sand, dirt, clay, gravel and rocks, humus will most likely be found near planted areas)*
   - Is there humus in the sample? (*Look for the presence of small sticks, broken dead leaves, root materials, insect parts, etc.)*
   - Are there decomposers or other insects in the sample or were those insects around the sample when collecting it? *(Depending on the shaded area, decomposers such as pill bugs may come along for the ride, pill bugs can only survive if they have a water source, humus will provide that for them)*

5. Have the students touch the soil, feel it between their fingers, grind the particles together and listen to the sound *(sound indicates sandy soil)*
   - Are the particles large, small or a mixture? *(Most samples will contain a mixture of particles unless it is from the sandbox or potting soil from a houseplant. Playground sand particles are usually consistently sized, and house plant soil is mostly made of humus.*)
   - Does the soil feel gritty, sandy or powdery? *(grittiness indicates gravel and sandy soil, powder indicates clays and silts)*
   - Does the soil feel moist? *(cool feeling soil may indicate a water or humus presence)*

6. Put a couple of spoonsful of the soil into the small paper cup and add water enough to form a dough like mud and put the soil in your hand. Can you form a ball with the soil? If yes, can you flatten the mud ball into a ribbon without it breaking apart?
   -If you can form a ball, this indicates that there may be clay in the soil that help the particles stick together. If you can take this ball and form a ribbon with the soil, this means that there is a lot of clay present in the soil sample.

Next: Looking at your soil up close!

In this next activity students will create a giant microscope slide so that they can look at their sample at a microscopic level. To do this they will create a soil slide using clear packing tape and an index card for each sample. (Directions on how to make the slide are found on the second page of the procedure. It is recommended that the students use a hand lens or brock microscope to look at their soil. Brock microscopes are a heavy-duty elementary school microscope that uses a fiber optic for its light source. The magnification of brock microscope is about 20X the size in magnification. If your school does not have brock microscopes, you may use a hand lens (usually 10x magnification). You can stack two hand lenses to get double the magnification.

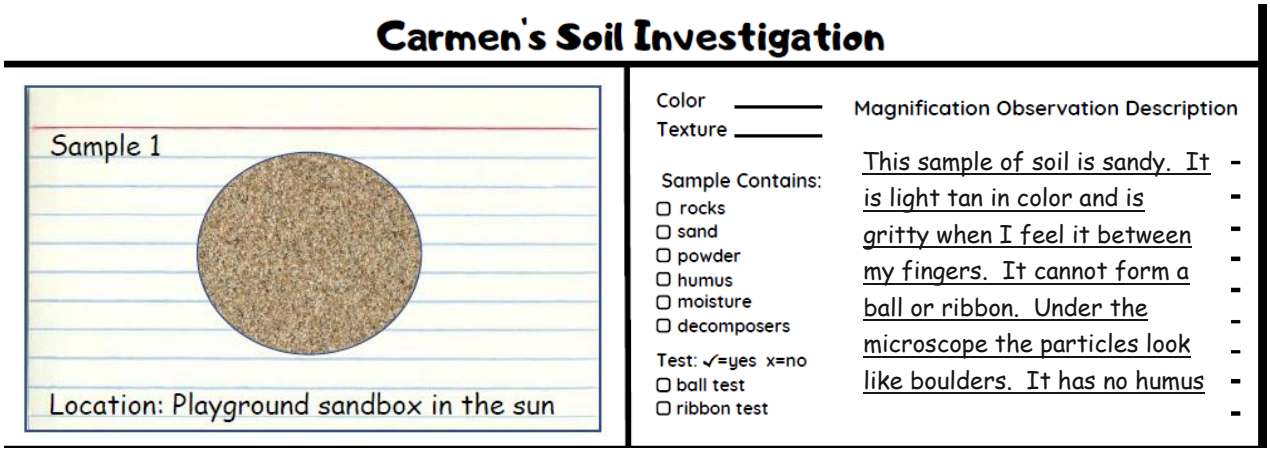

Microscope Slide Index Card

1. Fold four index cards in half and using the cardboard tube, trace a half circle on the folded edge of each card. Using the scissors, cut out the half circle. This will leave a full circle cut out in the middle of the index card.
2. Carefully, place a clear piece of packing tape over the circle to create a sticky surface for your soil sample.
3. Take a pinch of soil from your first sample and sprinkle this soil onto the sticky side of the tape so that the soil sticks to the surface.
4. On the top of the index card note the sample number. On the bottom of the index card note the location with any descriptions such as in the shade, in the sun, etc.
5. Once the card has been labeled, put a second piece of tape over the sample to seal the soil sample.
6. Using your hand lens or student microscope, observe and describe the particles of soil that you see. Be sure to note particle sizes, if you see pieces of plants or insects, etc.
7. Using four dots of glue (one for each corner of the card) glue your index card to your soil observation sheet.

Things that you may see in your sample will be

- Pieces of organic matter such as leaves, stems, roots
- Different sized particles of dirt, sand and clay
- Pieces of dead insects that were decomposing in the soil
- Different colored rocks
- Small fossils such as shell

Once the students have looked at their samples up close, they will be able to write a summary about each sample using Carmen's Soil Investigation Data Worksheet. They will glue or tape their index card microscope slide for samples 1-4 and using their word bank, they will describe their soil and its composition. Here is an example:



After the soil investigation is completed and all four samples have been analyzed, the teacher can go back to the original chart and repose the question, "How would you describe soil in El Paso?" Students should make the connection that soil in El Paso can be vastly different depending on the location of where you collect the sample.

Explain: Carmen's Perfect Soil Booklet

Guiding questions:

- **What are the ingredients of soil?**
- **Do all plants like the same type of soil? Why or why not?**
- **What would be the best soil for a vegetable garden?**

Materials

- **Carmen's Perfect Soil Booklet (slideshow, or print)**
- **Completed Soil Sample Investigation Worksheets**
- **"What is a Keyhole Garden?" Video**

Procedure

This booklet is to be used to explain the components of soil and the importance of water retention in soil so that it benefits the growth of plants. As the class is reading this booklet, the teacher should have the class refer to their soil samples to see if any of the descriptions that they found in their investigation matched those described in the booklet.

1. Have the students get out their soil investigation data collections sheets and distribute the booklets to each student, or the teacher can share the slide show version on a projector or to each student's device.
2. As the class reads about each ingredient of soil, try to see if any of the groups have a sample that may define that ingredient, for example, **Ingredient 1: Rock** describes the different forms of rock

that is present in soil due to weathering. **Ingredient 2**, **Humus**, will likely be found in samples taken from underneath bushes, potting soil from house plants, or anywhere on the school grounds where soil seems to be amended in some way. **Ingredient 3, Air**, will be noticeable if the students found that they could easily scoop their soil when taking the sample. If the soil was compacted and hard to dig, there probably wasn't much air between particles of soil. This is a great time to discuss the presence of **Ingredient 4, decomposers** in the soil, especially any signs of insects or crustaceans such as pill bugs. It is not unusual to find exoskeletons of insects in soil samples that contain humus. The last **ingredient, 5**, discusses **water**. This is one of the most important features of soil because without this ingredient, the soil will not be able to support the growth of plants.

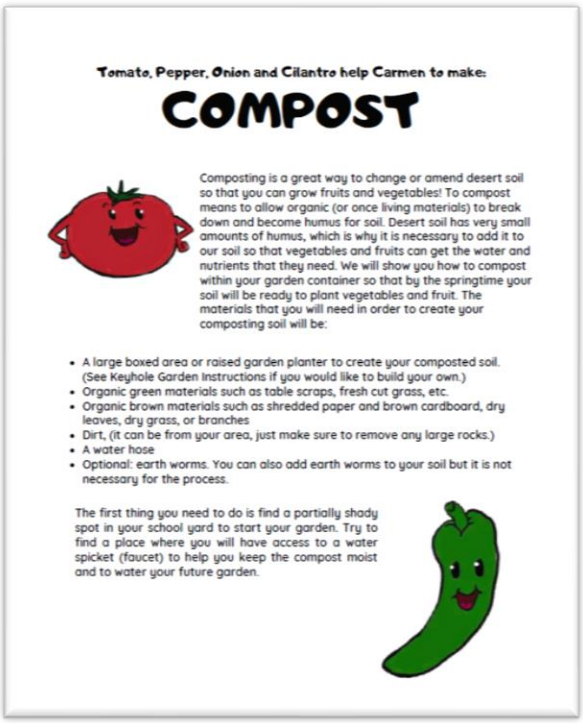
3. **Photosynthesis and why water is so important to the growth of plants.** As this lesson plan is aligned to grades 3-5, there is a mention of photosynthesis as the process of how plants make their own food. Texas students at the elementary level need to know that sunlight, water, and carbon dioxide are needed by producers to make their own food, but there is no formal mention of the term photosynthesis in the elementary standards. This process is represented in a small diagram about photosynthesis with a short description shown on page 5 of the booklet. Please note that elementary students are not expected to understand photosynthesis at a more complex level than this diagram. Soil's retention of water and its ability to support plants is a tested topic on STAAR. Most Texas ecoregions have soils that need to be amended because they lack moisture content and suffer from wind erosion. However, there are plants that have made adaptations so that they can survive the harsh conditions of the Chihuahuan desert. Which leads us to Carmen's dream sequence:
4. **In the booklet, Carmen is looking for the "Perfect Soil" that will help Ernie to grow a salsa garden…** In this dream sequence Carmen learns that the term "perfect soil, is relative to the plant species that has adapted to it. She is visited by native plants such as ocotillo, yucca, and prickly pear cactus and they try to convince her that the soil that they live in is perfect for them. This is a chance to revisit the soil samples once again to see if any groups have the perfect soil for desert plants, plants near the Rio Grande River, house plants and then finally, salsa plants.
5. **On page 12 of the booklet, Carmen has managed to create the perfect soil to grow Ernie's Garden plants**. The end of this booklet leads into a class project where the student can create a compost pile during the fall and winter months that will eventually become the amended soil that you will need to plant the salsa garden.

If your class is doing the Salsa Garden project, it is at this time that you would build the container for the salsa garden with "Carmen and Ernie's Keyhole Garden Guide". If your school already has a garden area established, then you can skip the classroom keyhole garden container section and move onto the compost pile using "Carmen's Guide to Composted Soil"

Elaborate

Carmen's Composted Soil Procedure (Class Project)

As described in the story, the salsa garden plants will be giving directions to Carmen on how to build a composted soil pile within the keyhole garden raised bed.


Tomato, Pepper, Onion and Cilantro help Carmen to make:

COMPOST

Composting is a great way to change or amend desert soil so that you can grow fruits and vegetables! To compost means to allow organic (or once living materials) to break down and become humus for soil. Desert soil has very small amounts of humus, which is why it is necessary to add it to our soil so that vegetables and fruits can get the water and nutrients that they need. We will show you how to compost within your garden container so that by the springtime your soil will be ready to plant vegetables and fruit. The materials that you will need in order to create your composting soil will be:

- A large boxed area or raised garden planter to create your composted soil. (See Keyhole Garden Instructions if you would like to build your own.)
- Organic green materials such as table scraps, fresh cut grass, etc.
- Organic brown materials such as shredded paper and brown cardboard, dry leaves, dry grass, or branches
- Dirt, (it can be from your area, just make sure to remove any large rocks.)
- A water hose
- Optional: earth worms. You can also add earth worms to your soil but it is not necessary for the process.

The first thing you need to do is find a partially shady spot in your school yard to start your garden. Try to find a place where you will have access to a water spicket (faucet) to help you keep the compost moist and to water your future garden.

Materials:

- Carmen's Composted Soil Procedure
- A large, boxed area or raised garden planter to create your composted soil.
  (See Keyhole Garden Instructions if you would like to build your own.)
- Organic green materials such as table scraps, fresh cut grass, etc.
- Organic brown materials such as shredded paper and brown cardboard, dry
- leaves, dry grass, or branches
- Dirt, (it can be from your area, just make sure to remove any large rocks.)
- Water hose and water spigot
- Optional: You can also add earth worms to your soil, but it is not
  necessary for the process.

This activity is a great way for students to work on a long-term project that shows how decomposition happens in soil. The "Carmen's Composted Soil Guide" provides a chart listing which materials make great green matter and brown matter. **The chart also provides a list of stuff to avoid**, such as the poop of animals that are not herbivores (dog poop, cat poop, etc.) Compost materials can be dumped directly into the compost pile, but please follow the directions. This soil recipe is very similar to lasagna gardening, in which you layer brown matter, green matter and soil, being careful not to leave a layer of green (or fresh) rotting materials on the top of the pile as this attracts pests. Be careful not to collect and dump the green matter unless you have a layer of brown or soil to help cover up the green layer. Students will be amazed at how quickly this composting process can turn what seems to be waste into healthy soil. Schools have an abundance of brown materials in the form of cardboard and paper waste. It is important to note that most ink, especially those found at a school, are now biodegradable. However, any paper that has sheen, (plastic coating) should not be used to compost in the pile, ex: shiny advertisement paper, shiny labels, etc.

Teachers can ask the students to collect table scraps from their home or even collect them from the school cafeteria after lunch. The cafeteria staff can also be asked to collect their food scraps during preparation if it is too difficult to monitor the students as they collect green matter materials during lunchtime. As the parents of students and the rest of the school learn about the garden project, people may be willing to help add to layers by providing fall leaves, branches, cut grass clippings, etc. In this soil project we are amending desert soil, so it is not necessary to use commercial garden soil in the layers for this pile. The soil can be any desert soil either from the school yard or lot. Large rocks and cobble should be removed from the soil before mixing into the compost pile. Once this soil is amended it will provide nutrient rich soil for not only the garden plants that you wish to grow, but at the end of the school year this nutrient rich soil can be spread out to the school yard plants and trees as fertilizer. This compost pile will be added to and turned throughout the fall and winter months becoming the soil for the class garden in the spring. While the class is creating composted soil outside, inside the classroom they will be cultivating the plants for the spring garden.

Carmen and Ernie's Classroom Keyhole Garden, Part II: The Life Cycles of Plants

Plant Life Cycles

This unit of instruction has a secondary focus on plant life cycles. In the tested standard 3.10C "*The student will investigate and compare how animals and plants undergo a series of orderly changes in their diverse life cycles such as tomato plants, frogs, and lady beetles.*" Students will learn about timing a garden for harvest by understanding the life cycle of the plant that they wish to grow.

Just like different animal and insect species have specific changes that happen as they grow, for example, complete or incomplete metamorphosis, plants also go through a series of changes before the plant goes to seed.

In this unit Ernie will be investigating the life cycles of plants used to make salsa, i.e., onion, tomato, cilantro, and chili peppers. The big ideas that are addressed in this activity are the changes that take place in the life cycle of a plant and how long it takes for a plant to go through its life cycle.

When comparing the life cycles of plants, the teacher and students need to be aware that plant species are as diverse in their cycles as animals and insects. Most plants, however, have some sort of seed dispersal to propagate the plant once it has gone through its life cycle. Some plants die after their plant has gone to seed (annuals), other plants such as trees and shrubs may flower and disperse seeds but do not die after this cycle (perennials.) The vegetables and fruits grown for this lesson plan are mostly annual, although some onions have a two-year cycle (biennial.) Some biennial onion plants can be harvested after the first year of growth.

Fruits and Vegetables

In the booklet, "Ernie's Earth Day Salsa Garden", Ernie learns about the life cycles of onions, tomatoes, cilantro, and peppers. It is mentioned in the booklet that both peppers and tomatoes are a type of fruit. This is because in nature (biology) the term for the ovary of a flower is "fruit." Many plants produce an enlarged ovary so that their seed can be dispersed when the fruit is eaten. Seeds are hard for animals to digest and usually will be passed through the animal's system in their poop, therefore dispersing and

depositing seeds of a plant into another location. Fruit can also be dropped from the plant and while rotting, can also provide a medium for the seed to grow. Botanically, plants can disperse seeds in several ways, for tomatoes and peppers it is by producing a fruit. Both cilantro and onions however do not produce fruit. Their seed dispersal is done through wind. In these two plants the flowers expel seeds as the flower dies.

NOTE: Since the focus of this lesson is on the life cycle of plants, we are following the scientific, or botanical categorization of fruits and vegetables, which is that a fruit is the ovary of a flower which contains a seed, and vegetables are the parts of the plant that are not flowers such as stems, roots, bulbs and leaves. However, according to the USDA, the US does not recognize or categorize peppers or tomatoes as "fruits". A little history: this categorization has nothing to do with science and everything to do with commerce. In the late 1800's, vegetables shipped to the US were charged a 10% tariff. Fruits were not charged this tariff. In 1893, the U.S. Supreme Court ruled that tomatoes can be considered vegetables rather than fruit based on their taste and not on their biology. Any savory fruit such as tomatoes, cucumbers and squash could be considered vegetables because they are not sweet, thus being subject to tariff. (The categorization of fruits and vegetables in the US is based on culinary application and not on science.)

Growing Plants Indoors

In the plant life cycle part of this lesson, Ernie learns about the time it takes for plants to typically produce a harvest by looking at the information given on the back of the seed packet. In some cases, such as the harvest period for the onion, it will take at least 100 days or more before the onion will be ready for harvest. This will mean that if the onion plant is to be harvested by Earth Day, (April 22nd) he must start the seeds early in the year such as the first two weeks of January. The onion seed packet, however, may suggest planting indoors no more than 8 weeks before transplanting outdoors. Please note that the seed packet information is based on data for the area (Zone) that you are in, and whether you are planting into the ground rather than containers. Since this is a container garden, it is okay to try planting in early January. Try researching indoor vegetable gardens online to get tips and tricks on how to help your plants survive indoors. There is a large movement of people who promote indoor vegetable gardening, and you can find various videos and web pages on this topic.

Although Ernie's teacher wants to have the plants ready by Earth Day (April 22nd), the date could be set to any spring date in El Paso that avoids a freeze in the weather. Ernie's teacher was influenced by end of school year activities and state testing. As with any long-term project the act of trying to grow plants during a part of the year when plants cannot survive outside, is a scientific experiment. Much like greenhouses across the United States, plants can be grown successfully indoors if the basic needs of the plants are met. Seedlings will need a warm place to grow, water, and sunlight. Depending on the classroom conditions at the school, considerations will have to be made regarding the plant's survival. Will the classroom have heat cut off in the evenings or weekends? Can growth lights be used to help the plant get the required hours of sunlight needed during the short days of winter? If the heaters dry out the air, will it cause us to have to water more often? As with any experiment, some plants will live, and some will die depending on the amount of care given to the plants. For this reason, we have provided two container activities regarding plant growth. The first is a mini-Greenhouse made from a recycled plastic container that will help start the seedlings in the windowsills of the classroom. The other is a

larger bucket keyhole container that will allow students to compost while caring for young plants indoors during spring break. These two portable plant containers can be taken with kids to try indoor plant care with their families at home, or with you inside the classroom. The lesson suggests plant journaling ideas for students to track the growth of their plants.

Explain:

Ernie's Earth Day Salsa Garden

Guiding questions:

- **How are plants species the same and how do they differ within their life cycles?**
- **What are the basic needs of plants?**
- **How do you meet the basic needs of plants if they are started and grown indoors?**

Materials

- **Ernie's Earth Day Salsa Garden Booklet (online or print)**
- **Carmen's Perfect Soil Booklet (online, or print)**
- **Seed packets for students to investigate**
- **"What is a Keyhole Garden" Video**

Procedure:

This story booklet is to be used so that students can understand the basic needs of plants and their life cycles in order to grow and care for them as a classroom project, however, the booklet can also be used as a springboard for teachers to do as independent activities the mini-Greenhouse planter or to investigate and compare the life cycles of different plants.

1. **Have the students watch the video, "What is a Keyhole Garden?"** after watching the video, pose the question, "why do you think that people in El Paso might want to use a keyhole garden to plant food like they do in arid areas of Africa?"

2. **Distribute the booklets or share on student device the slideshow version of the booklet "Ernie's Earth Day Salsa Garden.** Before reading pose the following questions. As you ask these questions, scribe the class responses on chart paper or on the whiteboard:

   - What might be the types of plants that Ernie will be planting in his garden?
   - After reading Carmen's Perfect Soil, what do you think will be the basic needs of those plants that he will be growing? (Have the students look back on the soil booklet if they have trouble identifying what the plants may need to grow.)
   - How long do you think it will take to grow the plants that he plans to grow?

3. **Begin reading the booklet together in class. On page 3, the tomato mentions that he will be ready for harvest between 72-82 days.** Pose the question to the class, "What date do you think

Ernie will have to plant the tomato seeds for them to be ready by Earth Day? Have the class count back from the date of April 22nd (Earth Day) to 82 days back using an electronic calendar found on the internet. Have the student groups share their answers with the class. What would 72 days be? What date would be the middle of those two date ranges?

4. **On page 5, tomato describes the information that might be found on the back of a seed packet.** Distribute the seed packets to the students to compare the information that they find on the back of their packets to the information found in the booklet. Discuss the information found on their packets. What other information can be found on the back of the packet? (Answers will vary, but may include planting zones, variety, description of plant, etc.)
5. **Continue reading the booklet. On Page 8 basic needs of plants are described.** Pose the question to the class: Do these basic needs of plants match what was mentioned in Carmen's Perfect soil? Justify your answer.
6. **On pages 9-11 the life cycles of the different salsa plants are described.** How are these plants alike and how are they different?
7. **Based on the information on the last page of the booklet**: Which book happened first, Carmen's Perfect Soil or Ernie's Earth Day Salsa Garden? What is your evidence?

Science Tools: T-Charts, Venn and Matrix

An important science skill for students to learn is to be able to create their own charts to collect data on science topics and phenomena. Since this lesson plan is designed for grades 3-5, there are data collection activities that will introduce 3rd grade students to charts that help us to compare characteristics of a group of things. In the activity "Ernie's Sowing Chart" students will use a table to collect information about the time it will take for plants to harvest by a certain date. A table is a collection chart that can be used to collect data. The ideas regarding data collection will grow more complex as students will be asked to compare two plants and their life cycle. The first chart students will use is a T-chart to list attributes of each plant. They will transfer this data to a more complex comparison chart (a Venn Diagram) to easily show how the plants are different and what they have in common. The last activity will be the comparison of four plants using a matrix. A matrix is different than a table in that both the rows and the columns can be used to group things by characteristics. As these three activities are very guided (for 3rd graders), 5th graders may be asked to create their own Venn Diagrams and Matrices in their Science notebook or they can do the extension activities which involve independent research on additional plants.

Explore:

Ernie's Sowing Chart

Guiding Questions

- How do plant growers plan the harvest of their plants?
- Do all plants develop at the same rate?

- How do harvests differ between plants?

Materials:

- Ernie's Earth Day Salsa Garden Booklet (online or print)
- Ernie's Salsa Garden Sow Chart
- Ernie's Seed Packet Information or
- Salsa Garden Seed Packets (Tomato, Cilantro, Onion and Pepper) If you do not have enough for the entire class, you can make copies of the back of the packets to share with the groups so that they have the information from the seed packets.
- A calendar for the current year (either printed or online)

Procedure:

In this activity, students will calculate the estimated planting date of the plant using an electronic calendar (or a printed yearly calendar). After the students fill in the "Ernie's Sow Chart", have the students share out their estimates with the class. Questions to pose to promote discussion may be:

- If the plant had a span of days like tomato, (72-82 days) would it be better to plant early at 82 days or later at 72 days? Justify your answer
- Which plant must be planted first? Which type of plant is planted last?
- If you were to plant these plants in the classroom, what type of needs would the plants have to help them survive?
- What are some of the considerations that we should make to help the plant live indoors? Where do we find that information in our story? (See pages 7 and 8)
- If using real seed packets rather than the illustration, how are the real seed packets different than the ones in the seed illustrations? Are the growth cycles the same?
- People and animals have life cycles. How are the life cycles of people or animals similar to that of plants? How are they different? (Answers may vary but may include: "People have a longer life span than these plants." "Some plants such as trees, may have longer life spans than humans." People do not bare fruit or create seeds.
- Why do you think it would be important for farmers to know the life span of the plants that they grow? How could a farmer ensure that his plants gave a harvest throughout the spring or summer? (Answers may vary but may include: The farmer may be able to grow more and different crops based on knowing the life cycle of the plant.)
- What do you think it means for a fruit or vegetable to be "in season"?

Ernie Compares Life Cycles of Plants

Guiding questions:

- **What tools do scientists use to compare and contrast scientific phenomena?**
- **How are plant species the same and how do they differ within their life cycles?**

Materials:

- Ernie's Earth Day Salsa Garden Booklet
- Salsa Plant Diagrams
- Comparing Plant Life Cycles Venn
- Comparing Plant Life Cycles Matrix
- Different types of diagram examples that can be found on the internet or in their science book.
- T-Chart examples

Procedure:

Salsa Plant Life Cycle Diagrams

In this activity, the students will investigate the different life cycles of onion, tomato, pepper and cilantro. Using the booklet and the Salsa Plant Diagrams, students will label the diagrams using the vocabulary specified at the top of the diagram page.

1. Show students different samples of diagrams before working with the Salsa Plant Life Cycle diagrams
2. Explain to the students that a diagram is a special tool that scientists use in order to understand the parts of something. Write on the board or chart paper the criteria of a good diagram:

Good Diagrams have the following:

   a. A title to explain what the diagram is about
   b. Detailed pictures of what is being studied
   c. Labels that are appropriately placed in the diagram that name the parts of what you are studying

3. Explain to the students that they will be receiving an incomplete diagram of the life cycles of each salsa plant. Their job is to complete the diagram so that it has:
   a. A title for each cycle to identify which plant that it is
   b. Labels in the diagram that appropriately label: germinate, sprout, seedling, young plant and adult plant.

Once these plant cycles have been identified and labeled, discuss similarities between the plants. Pose the following questions:

- Do all four plants have similar life cycles? How are they alike? Possible answers may be: They all start off as seeds, they all produce seedlings, they all have leaves, they all produce flowers, and they all produce seeds from their flowers.
- What stands out as differences between the plant life cycles? Possible answers may be: they all have different time to grow to harvest, some have fruits, one produces bulbs, some disperse their seeds from the flower.

The students will move on to science tools that help scientists to compare attributes of things: Venn Diagrams and Matrices

Comparison Charts

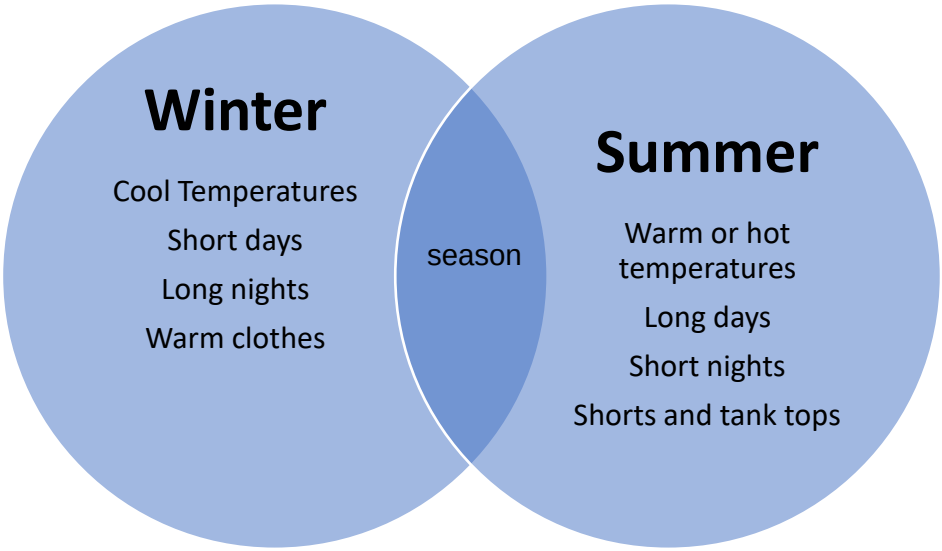
In this activity students will use comparison charts to compare the attributes of the different salsa plants.

Review: By third grade most students have used T-charts to make comparisons. Show the students examples of T-charts and explain that scientists can use T-charts to help compare two things, such as winter and summer. On a chart paper or white board draw a diagram and title them winter and summer. Have the students brainstorm attributes of winter in one column and attributes of summer on the other column. The chart may look something like this:

Winter	Summer
Cool temperatures	Warm or hot temperatures
Season	Season
Short days	Long days
Long nights	Short nights
Warm clothes	Shorts and tank tops

Once the attributes have been recorded, have the students look for attributes that are the same between the two things. In the case of this example the thing that it has in common is that they are both seasons

Explain to the class that although a T-chart helps us to list attributes in columns, there are other charts that can help scientists see at a glance, things that are the same and things that are different. A term that means looking for things that are the same is called “comparing” and looking for things that are different is called “contrasting. A great chart to use to help us compare and contrast is called a Venn Diagram. A Venn Diagram is two overlapping circles where you list within the circles the attributes of each topic, as in the columns of the t-chart. Where the circles overlap is what can be compared between the two things. This T-chart transferred into a Venn Diagram might look like this:



1. Using their science notebooks and their salsa plant diagrams, have the students write down attributes of two salsa plants into a t-chart. Their t-charts must have a title and each column labeled. The attributes listed in the chart must be related to the life cycle of the plant. For example, the tomato plant attributes could be: grown from a seed, creates a flower, harvest a fruit, seeds are in the fruit, takes 72-82 days to harvest, etc.
2. Once they have created their T-Chart, have the students circle any comparisons that they had between the two plants.
3. Next transfer this information using the "Comparing Life Cycles of Plants Venn Diagram"

Matrix Tables

Next pose this question to the students, "What if a scientist wants to compare and contrast more than two or three different things that they are studying?" Another type of chart that the scientist can use is called a matrix. A matrix lists attributes that the scientist is looking for horizontally along the top of the chart. A list of what is being compared runs vertically along the chart. Check marks can be used to check to see if the item being compared has the attributes. This allows the scientist to see at a glance which things have attributes and which do not. A matrix is different than a table in that it allows for the reader to easily group along columns instead of just reading for information by rows. By using a matrix a scientist can quickly compare among many things which hold the same attributes.

In this activity, students will use the Salsa Plant Matrix to label the life cycle attributes of plants horizontally on the top row of the matrix. Then they will provide check marks to compare and contrast all four salsa plants at one time.

Debriefing questions:

Looking at all three charts, the t-chart, Venn-Diagram and Matrix, which chart is easiest to read at a glance? Justify your answer.

Describe a time when it would be appropriate for a scientist to use a T-chart, a Venn Diagram and a Matrix.

Research Extension:

Have the students research 2 more vegetables or fruits to grow in a garden. Using a T-Chart have them research plant life cycles and provide attributes for each plant. Pair students together to collect more information on other plants so that they have 4 or more plants to compare. Have them draw a matrix in their science journal that compares the four plants, or they can use "Ernie's Plant Life Cycles Matrix" to record the comparison of four new plants.

Elaborate

Ernie's mini- Recycled Greenhouse and Portable Bucket Keyhole Garden

Guiding Questions

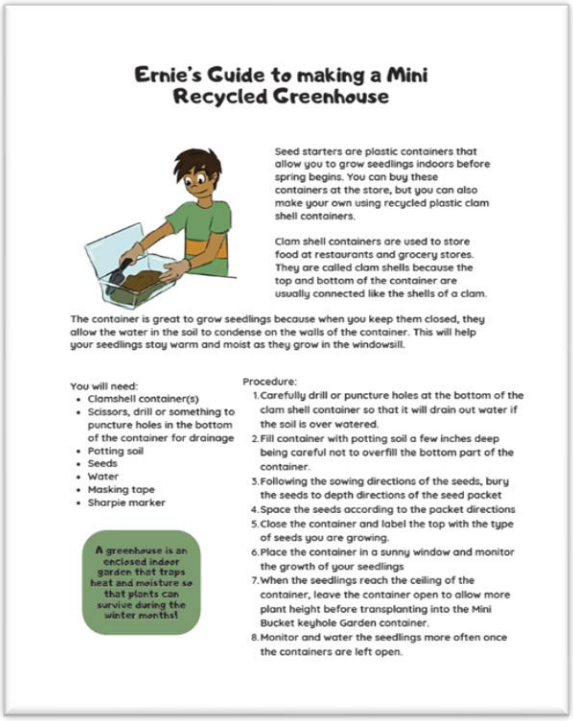
- **What are the basic needs of plants as they go through their life cycle?**
- **How can we provide basic needs for a plant indoors in the classroom?**

Activity 1: Ernie's mini-Recycled Greenhouse

Much like in Ernie's story, the salsa garden plants will be needing a place to start indoors before the weather and temperatures are ready to host plants outdoors. In this activity students will bring in a recycled plastic clam shell container so that they can start seedlings indoors. Clam shell containers are used to store food at restaurants and grocery stores. They are called clam shells because the top and bottom of the container are connected like the shells of a clam. Since these containers are clear and can let in sunlight, the container is great to grow seedlings because when closed, they can simulate greenhouse conditions by retaining moisture and trapping heat. As the plant becomes more resilient the lid to the clamshell container can be opened to allow the plant room to grow past the roof of the container.

Materials:

- Ernie's Guide to making a Mini Recycled Greenhouse
- How to Make a Mini Recycled Greenhouse Video
- Clamshell container(s)
- Scissors, drill or something to puncture holes in the bottom of the container for drainage
- Potting soil
- Seeds
- Water
- Masking tape
- Permanent marker
- Science Journal
- Rulers
- Digital camera (phone or device)



Ernie's Guide to making a Mini Recycled Greenhouse

Seed starters are plastic containers that allow you to grow seedlings indoors before spring begins. You can buy these containers at the store, but you can also make your own using recycled plastic clam shell containers.

Clam shell containers are used to store food at restaurants and grocery stores. They are called clam shells because the top and bottom of the container are usually connected like the shells of a clam.

The container is great to grow seedlings because when you keep them closed, they allow the water in the soil to condense on the walls of the container. This will help your seedlings stay warm and moist as they grow in the windowsill.

You will need:
- Clamshell container(s)
- Scissors, drill or something to puncture holes in the bottom of the container for drainage
- Potting soil
- Seeds
- Water
- Masking tape
- Sharpie marker

A greenhouse is an enclosed indoor garden that traps heat and moisture so that plants can survive during the winter months!

Procedure:
1. Carefully drill or puncture holes at the bottom of the clam shell container so that it will drain out water if the soil is over watered.
2. Fill container with potting soil a few inches deep being careful not to overfill the bottom part of the container.
3. Following the sowing directions of the seeds, bury the seeds to depth directions of the seed packet
4. Space the seeds according to the packet directions
5. Close the container and label the top with the type of seeds you are growing.
6. Place the container in a sunny window and monitor the growth of your seedlings
7. When the seedlings reach the ceiling of the container, leave the container open to allow more plant height before transplanting into the Mini Bucket keyhole Garden container.
8. Monitor and water the seedlings more often once the containers are left open.

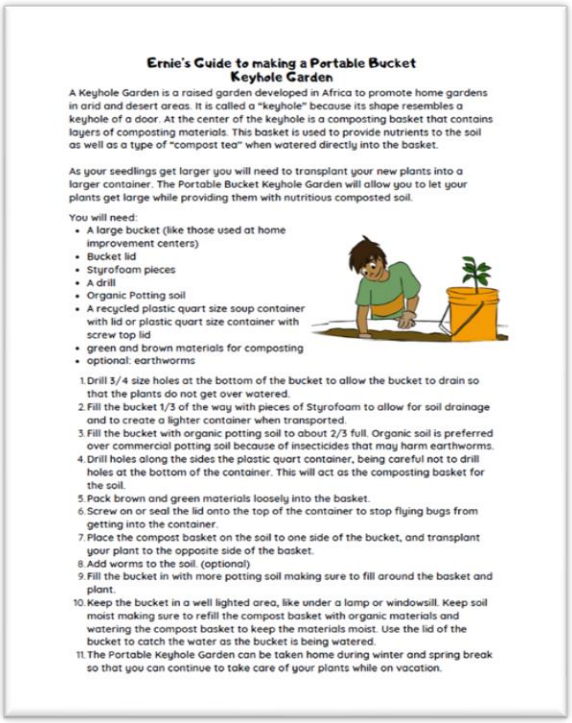
Procedure

1. At least two weeks before doing this project, collect materials from the students such as the clamshell containers, seeds that you would like to plant in the garden and perhaps donations of potting soil for the containers
2. Follow the instructions to the construction of the Mini Greenhouse, **NOTE:** *the teacher or an adult should be the one to puncture or drill holes into the bottoms of the containers for drainage.*
3. Have the students keep a journal to track the growth of their seedlings. Have them note from their seed packets the estimated time for germination so that they understand that germination will take some time to happen.
4. Once the seeds germinate, have students check on their plants daily for plant height, number of leaves, moisture of the soil, etc. using science tools such as rulers, cameras, and drawings. Have the students label the drawings or pictures that they collect.
5. Have the students use the information from sources such as the back of the seed packets, internet research on the plant type and Ernie's Earth Day Salsa Garden Booklet to determine when the plants will be ready to transplant into a larger container such as **Ernie's Bucket Keyhole Garden.**

Activity 2: Ernie's Guide to making a Portable Bucket Keyhole Garden

On page 8 of the booklet, "Ernie's Earth Day Salsa Garden", the tomato describes the needs of plants to have the correct amount of space so that the roots can spread out over time. Plants that live in containers too small for their root systems will soon become root bound. To avoid this from happening to your student's young plants in their mini greenhouse, they will need to be transplanted into a larger

container when they become young plants. The Portable Bucket Keyhole Garden container is actually a smaller model of the large Classroom Keyhole Garden described in the last activity in this lesson plan. At the center of the keyhole is a composting basket that contains layers of composting materials. This basket is used to provide nutrients to the soil as well as a type of "compost tea" when watered directly into the basket. As your seedlings get larger you will need to transplant your new plants into a larger container. The Portable Bucket Keyhole Garden will allow you to let your plants grow large while providing them with nutritious composted soil.



Ernie's Guide to making a Portable Bucket Keyhole Garden

A Keyhole Garden is a raised garden developed in Africa to promote home gardens in arid and desert areas. It is called a "keyhole" because its shape resembles a keyhole of a door. At the center of the keyhole is a composting basket that contains layers of composting materials. This basket is used to provide nutrients to the soil as well as a type of "compost tea" when watered directly into the basket.

As your seedlings get larger you will need to transplant your new plants into a larger container. The Portable Bucket Keyhole Garden will allow you to let your plants get large while providing them with nutritious composted soil.

You will need:

- A large bucket (like those used at home improvement centers)
- Bucket lid
- Styrofoam pieces
- A drill
- Organic Potting soil
- A recycled plastic quart size soup container with lid or plastic quart size container with screw top lid
- green and brown materials for composting
- optional: earthworms

1. Drill 3/4 size holes at the bottom of the bucket to allow the bucket to drain so that the plants do not get over watered.
2. Fill the bucket 1/3 of the way with pieces of Styrofoam to allow for soil drainage and to create a lighter container when transported.
3. Fill the bucket with organic potting soil to about 2/3 full. Organic soil is preferred over commercial potting soil because of insecticides that may harm earthworms.
4. Drill holes along the sides the plastic quart container, being careful not to drill holes at the bottom of the container. This will act as the composting basket for the soil.
5. Pack brown and green materials loosely into the basket.
6. Screw on or seal the lid onto the top of the container to stop flying bugs from getting into the container.
7. Place the compost basket on the soil to one side of the bucket, and transplant your plant to the opposite side of the basket.
8. Add worms to the soil. (optional)
9. Fill the bucket in with more potting soil making sure to fill around the basket and plant.
10. Keep the bucket in a well lighted area, like under a lamp or windowsill. Keep soil moist making sure to refill the compost basket with organic materials and watering the compost basket to keep the materials moist. Use the lid of the bucket to catch the water as the bucket is being watered.
11. The Portable Keyhole Garden can be taken home during winter and spring break so that you can continue to take care of your plants while on vacation.

Materials

- Ernie's Guide to making a Portable Bucket Keyhole Garden
- How to Make a Portable Bucket Keyhole Garden Video
- A large bucket (like those used at home
- improvement centers)
- Bucket lid
- Styrofoam pieces
- A drill
- Organic Potting soil
- A recycled plastic quart size soup container
- with lid or plastic quart size container with
- screw top lid
- green and brown materials for composting
- optional: earthworms

Procedure

1. At least two weeks before doing this project, collect materials from the students such as the large buckets, Styrofoam, and plastic quart containers. If you will be using earthworms as part of your system you will need to use organic potting soil. (Many commercial potting soils carry either chemical fertilizers or insecticides that may harm the earthworms.)
2. Follow the instructions to the construction of the Portable Bucket Keyhole Garden, **NOTE:** *the teacher or an adult should be the one to puncture or drill holes into the bottoms of the containers for drainage.*
3. Continue to have the students keep a journal to track the growth of their plants.
4. Have students research in Almanacs or by planting zones what the best date would be to take their buckets outside to have the plants acclimate to the outdoors and their future home in an outdoor garden, such as **Carmen and Ernie's Classroom Keyhole Garden.**

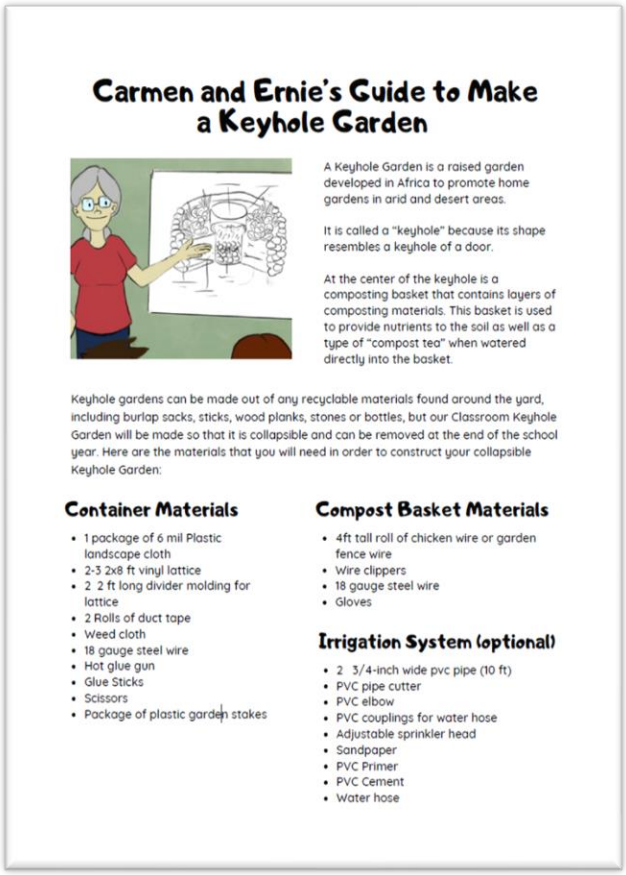
Carmen and Ernie's Guide to creating a Classroom Keyhole Garden

As soon as the plants are in no danger of a freeze, the plants can begin to be acclimated to the outdoors, and be transplanted into the larger classroom garden. They can begin acclimating 1-2 hours a day, gradually increasing the hours every two days until your plants are use to the sun and wind of the area. Students should be sure to check the moisture of the soil as plants that are in containers lose moisture quickly, especially if there is wind or lots of sun. It may good idea to keep your containers in a partially shady area while they acclimate.

The full size collapsible Classroom Keyhole Garden should be constructed if the school does not have a garden area to transfer these plants. If doing this entire lesson plan, Carmen and Ernie's Guide to creating a Classroom Keyhole Garden will have been constructed in the fall and will contain the composted soil suggested in the instructions "Carmen's Composted Soil"

Container Materials

- Carmen and Ernie's Guide to Make a Keyhole Garden
- How to Make a Collapsible Keyhole Garden Video
- Irrigation System (optional)
- 1 package of 6 mil Plastic
- landscape cloth
- 2-3 2x8 ft vinyl lattice
- 2 2 ft long divider molding for
- lattice
- 2 Rolls of duct tape
- Weed cloth
- 18 gauge steel wire
- Hot glue gun
- Glue Sticks
- Scissors
- Package of plastic garden stakes



Carmen and Ernie's Guide to Make a Keyhole Garden

A Keyhole Garden is a raised garden developed in Africa to promote home gardens in arid and desert areas.

It is called a "keyhole" because its shape resembles a keyhole of a door.

At the center of the keyhole is a composting basket that contains layers of composting materials. This basket is used to provide nutrients to the soil as well as a type of "compost tea" when watered directly into the basket.

Keyhole gardens can be made out of any recyclable materials found around the yard, including burlap sacks, sticks, wood planks, stones or bottles, but our Classroom Keyhole Garden will be made so that it is collapsible and can be removed at the end of the school year. Here are the materials that you will need in order to construct your collapsible Keyhole Garden:

Container Materials

- 1 package of 6 mil Plastic landscape cloth
- 2-3 2x8 ft vinyl lattice
- 2 2 ft long divider molding for lattice
- 2 Rolls of duct tape
- Weed cloth
- 18 gauge steel wire
- Hot glue gun
- Glue Sticks
- Scissors
- Package of plastic garden stakes

Compost Basket Materials

- 4ft tall roll of chicken wire or garden fence wire
- Wire clippers
- 18 gauge steel wire
- Gloves

Irrigation System (optional)

- 2 3/4-inch wide pvc pipe (10 ft)
- PVC pipe cutter
- PVC elbow
- PVC couplings for water hose
- Adjustable sprinkler head
- Sandpaper
- PVC Primer
- PVC Cement
- Water hose

Compost Basket Materials

- 4ft tall roll of chicken wire or garden
- fence wire
- Wire clippers
- 18 gauge steel wire
- Gloves

Irrigation System (Optional)

- 2 3/4-inch wide pvc pipe (10 ft)
- PVC pipe cutter
- PVC elbow
- PVC couplings for water hose
- Adjustable sprinkler head
- Sandpaper
- PVC Primer
- PVC Cement

Procedure

A classroom garden is a large project, it is necessary to get clearance from the campus principal and school grounds keeper before starting the project. You will need an area that has easy access to water and ideally a partially shaded area may give your plants a greater chance of survival. Although the cost of materials to create this garden are low, the teacher should not have to finance this project as there are many ways to collect the materials. Letting your parents, school and community know that you are creating a garden is the first step to getting donations for materials. Many home improvement centers have grants and discounts for school garden projects. There are also organizations such as "Donors Choose" (donorschoose.org) that can provide teachers with the materials to build the garden. Enlisting the help of adult volunteers (such as parents, friends, and family) will also help you to build the structure as it will take some physical work to build and fill the garden with soil. This garden is collapsible, which means that the walls of this container garden are designed to be taken apart at the end of the school year when students and teacher will no longer be on campus.

1. Gather the materials for the Container, Compost Basket and Irrigation System and have them collected and ready to use before starting the project.
2. Follow the instructions of the guide carefully. Use the video to get visuals of what the construction looks like. Provide the instructions and the video to all of the volunteers helping to construct the garden.
3. The lattice walls can be constructed indoors if you need access to electricity for the glue gun.
4. The walls of the garden are not connected to the flooring (weed cloth) and once the shape is filled the soil should not leak out at the bottom.
5. If composting soil in the container during fall and winter, you may need to invest in a plastic cover to ward out cats on weekends and during vacations. This can easily be made with the leftover landscape plastic.

Once the school year has ended, the keyhole garden can be taken down. To take down the keyhole garden, simply detach the lattices where they are joined by cutting the wire. The composted soil can be added to gardens around the school. The lattices and irrigation system can be stored for the next school year.