Healthy Soil Activities
for the
New Earth Project

New Earth Classroom

ACTIVITY 1
INTRODUCTION TO WORMS & VERMICULTURE

LEARNING OBJECTIVES

1. Students will be able to recognize redworms and their anatomical features.
2. Students will be able to explain how redworms' physical characteristics are similar to and different from humans' characteristics.
3. Students will be able to define "decompose," and describe the role of redworms as decomposers, both in their natural habitat and in human-made vermicompost systems.
4. Students will be able to identify the needs of redworms in their classroom worm box, care for the worms, and make observations in their classroom Worm Observation Notebook.

EQUIPMENT

- Worm box with redworms
- Large sheets white paper (5)
- Magnifying glasses (one per student)
- Worm anatomy pictures (4 or 5)
- Spray bottle
- Worm castings
- Large sturdy paper (¼ sheet poster board) for Worm Care Checklist, Sharpie & tape to hang
- Worm Observation Notebook & pen
- "Keeping Your Worms Happy" worm care sheet for teachers
- Worm Blanket (optional)

INTRODUCTION
10 minutes

DIVIDE
students into groups of 4

I. <u>INTRODUCTION</u>: (10 mins)

Tell students: today, you are getting some new classroom pets: WORMS!

A. Who has seen an earthworm before?

B. We have a special kind of earthworm:
redworms or red wigglers (type of earthworm that eats decomposing organic matter)
What does it mean to decompose?
Decompose: to decay, to rot, to break down into smaller particles.

C. Pass out **anatomy** diagrams. Ask students:

1. What features are similar to humans?
2. What features are unique to worms?
3. Why might they need these different features (like segments, 5 hearts, gizzards)?

WORMS!
15-20 minutes

II. WORMS! (15-20 mins)

A. QUESTION: Where do earthworms live? (just under the surface of the soil and organic matter on the ground)
REMINDER: The worms are used to living where it's dark and moist, and they will be uncomfortable in the light. Please treat them gently and with respect.

B. Each group gets a **large paper & magnifying glasses.** Pass out worms.

C. Worm Observations – once every group has their worms, ask them to:

1. Find the **head & tail**. How can you tell?
2. Do worms have backbones? (They are **invertebrates.**)
3. How do earthworms move? (They move using their **setae**, tiny bristles on their bodies.)
4. Find the **clitellum** and **segments** (The clitellum is near the head; segments help them twist and turn.)
5. Do worms have eyes? (They don't have eyes, but they are sensitive to light.)
6. Do worms have mouths? (At the tip of the head is the **prostomium**, a flap of skin that protects the mouth, kind of like our lips protect our mouths.)
7. How does their **skin** feel & look? (It glistens because it's moist.)
8. How do worms **breathe**? (They don't have lungs; they respire through their whole bodies. Oxygen dissolves in the moisture on their skin and passes into their bloodstream. Worms need oxygen like we do, and they need to stay moist to breathe.)
9. Are there males & females? (No, all worms are identical and contain both male and female reproductive parts.)

THE WORM BOX
10-15 minutes

III. THE WORM BOX (10-15 mins)

A. Where do earthworms live? (What is their natural habitat?) Earthworms' **natural habitat** is in the soil. Many kinds of earthworms burrow in the dirt.

1. Redworms live in decomposing matter, like in a pile of dried leaves, a manure pile, or just under the soil surface where plant material is decomposing. They live in areas that are dark and moist. Worms are sensitive to light and dry air.

2. Why are earthworms good for the soil? (They burrow and break up the soil.)

REDWORMS have a special job.**They eat decomposing matter & recycle it back to dirt so more plants can grow.** When worms eat, they make nutrient-dense **castings**, or very rich soil. Because they turn our leaf piles and kitchen scraps into worm castings, we like to use these worms for composting, or recycling our food back into healthy soil.

3. **"Vermicompost" (write on board)**: means to compost, or break down organic matter, with worms
Vermicomposting helps us in two ways:

   a. How many of you have a smelly garbage can? Why does it smell? Because when we throw food away in a plastic bag it breaks down without air and releases smelly gasses. Worms will eat this "garbage," or food waste to keep the extra food from going to the landfill!

   b. Their castings (poop) make a rich soil amendment. Pass around a **castings** sample.

B. We have a **perfect home for your classroom worms**: a cedar box that has everything the worms need: air/ventilation, moisture (wet bedding), darkness. **Show the features** of the box, including the screen on the bottom**.**

C. Circulate with the box and have each group put the worms in the box. Bury them in the bedding. Have the students feel how moist the bedding is so they know how wet it should be.

CARING FOR THE WORMS
10 minutes

IV. CARING FOR THE WORMS:

Make a simple checklist on poster board to remind the worms' guardians what to do. This checklist can be displayed by the classroom worm box. (10 mins)

A. Feed the worms

GO OVER WITH STUDENTS:

1. What redworms eat and don't eat (see "Keeping Your Worms Happy")
2. How much to feed: Begin with two kid-sized handfuls of food each week.
   a. Sources: leftover breakfast at school, snacks, school lunches
   b. Examples: banana peels, apple cores, grapes, carrot sticks, etc.
3. Food preparation: Give worms smaller pieces of food instead of whole pieces of fruit, veggies, or bread.
4. How to feed: Bury the food in the worm box bedding. Begin in one corner and bury food in a slightly different place each time.

B. Moisture: Check and spray the bedding to be sure it is as moist as a wrung-out sponge. Pay special attention to the bedding in the corners and edges of the box, where the bedding may tend to dry out more quickly. Every two weeks, dig down and check the moisture in the bedding near the bottom of the box. If it's dry, you can pour water into the box to moisten it, as long as there is a catch basin for the water under the box. Use the water you catch to water your classroom plants!

C. Bedding: The bedding should fill the box. This way, the worms have enough bedding to move through, and the food can always be buried. **Add bedding as necessary**. Your class can collect scrap paper to shred to make bedding when needed.

D. Observe the worms and **record observations** in the Worm Observation Notebook. Have each student observer include the date and their name. Their observations can be statements or poems, or they can draw an illustration.

PROMPTS:

1. How many worms do you see? Are they different sizes?
2. Are there any new castings? Describe them.
3. Who else lives in the worm box?
4. Do the worms seem to like some food more than others?
5. Do you see any cocoons? How many? What do they look like?
6. Use your senses: smell, touch, look (but don't taste!). Describe.

CONCLUSION
3-5 minutes

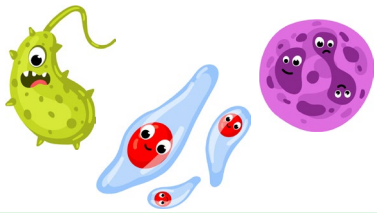
V. CONCLUSION (3-5 mins)

A. Quick review: ask questions that relate to the learning objectives to see what they've learned.

B. Remind students to care for the worms daily and record their observations in the notebook.

New Earth Classroom

ACTIVITY 2
LIVING SOIL



LEARNING OBJECTIVES

1. Students will watch a video called “Soil is Alive,” then recall and review the information they learned.
2. Students will assess the components of soil and discuss how these components support the soil food web, which in turn feeds plants.
3. Students will cite the types of living organisms in the soil (FBI: Fungi, Bacteria, Insects)
4. Students will define microorganisms as living things that can be seen only with a microscope.
5. Students will study a visual diagram depicting the interaction between a photosynthesizing plant and microorganisms in the soil and review the symbiotic relationship between them.
6. Students will analyze methods of caring for soil to keep the soil food web alive.

KEY WORDS

soil, organic matter, biodiversity, microorganisms, bacteria, fungi, decomposers, soil food web

EQUIPMENT

- *Nutrient-rich soil (1 cup)*
- *Teaspoon*
- *8x10 sheets paper (1 sheet per 3 students)*
- *Photos of Fungi, Bacteria & Insects*
- *Visual diagram of how plants and microbes interact in soil*

SOIL IS ALIVE!
20-25 minutes

WATCH VIDEO
“Soil Is Alive”

I. SOIL IS ALIVE! (20-25 mins)

A. Watch video: “Soil is Alive” (7 mins) https://youtube/Q-J2FErZHuA
Ask questions about some key points in the video:

- What is **soil** made of? (minerals, organic matter)
- What are some names of very small critters that live in soil? (**bacteria**, **tardigrades**)
- What are some examples of **organic matter**? (dead plant material, fallen leaves)
- What word describes a wide variety of living things? (**biodiversity**)
- What do plants release into the soil? (**sugars**)
  How does this help the microorganisms in the soil? (the sugars **feed the microorganisms**)
- What do we call the group of living things that includes mush rooms, yeasts & molds? (**fungi**)

- How do **fungi** in the soil help plants grow?
  - They can act like extra roots that help the plants pull water and nutrients from the soil.
  - Fungi also break down organic matter and help make nutrients available to plants.
- What do we call living things in the soil that break down organic matter? (**decomposers**)
- What other interesting facts did you learn from this video?

REVIEW & DEEPEN OUR INVESTIGATION

II. REVIEW & DEEPEN OUR INVESTIGATION

A. What is **soil**?

1. Soil is a mixture of **minerals** (bits of rock created by **erosion**), water, air, **organic matter** (decaying remains of plants & animals) & billions of microorganisms.
2. The non-living components of soil (sand, silt, clay) hold nutrients and make up soil structure.
3. Soil is like the skin of the earth and supports all life on this planet.

B. How do plants depend on soil & critters that live in the soil?

1. Soil holds plants' **roots**.
2. Soil provides plants with **water**.
3. Soil contains billions of organisms: **FBI**!
   - Define **microorganisms**: very small living things that can only be seen with a **microscope**
   - Microorganisms in soil include most **bacteria**, some **fungi** & algae, protozoa, nematodes
   - Write "FBI" on the board
   - FBI stands for **Fungi**, **Bacteria**, **Insects** (write "Fungi, Bacteria & Insects" on the board)
   - These organisms **decompose** organic matter & **release nutrients** into the soil for plants.
   - **Predatory microorganisms** (like tardigrades) consume fungi and bacteria in soil, and their waste feeds plants.
   - Define **soil food web**: a complex community of living things in the soil, some of which depend on each other as food sources.
   - Living organisms in the soil are VITAL to plant health

FBI
Fungi, Bacteria, Insects

C. How does life in the soil depend on plants?

1. Decaying **organic matter** is food for microorganisms.
2. During photosynthesis, **plants release sugars** into the soil to feed microorganisms.
3. Plants **shade** the soil, keeping it cool and moist for the critters that live in it.
4. Plants' roots break up and **aerate** the soil, providing oxygen for microorganisms, fungi and insects that live in the soil.

ILLUSTRATE ABUNDANCE OF MICRO-ORGANISMS

D. Illustrate the abundance of microorganisms in healthy soil:

1. Divide the class into clusters of three students per group. Pass out a piece of paper to each group.
2. Put **2 tsp** of soil on each paper.
   Explain that each group is getting 2 tsp soil as you do this.
3. Write on the board: **8,000,000,000**
4. Ask “what number is this?”
   Answer: **8 billion**
   That is how many people live on the Earth.
   That is also how many living things there are in the 2 tsp of soil on your desk.
5. What lives in the soil?
   Answer: **FBI**!!
6. Show pictures of Fungi, Bacteria & Insects
7. Show a visual diagram of how plants and microorganisms interact in soil.

E. How do we keep the organisms in soil alive?

1. Cover with **mulch** to keep the soil moist.
2. **Do not** till or disturb the soil.
3. Do not use **herbicides, pesticides or fungicides**.
4. Do not use chemical fertilizers that can upset the **soil food web balance** and damage the microorganisms.
5. **Grow plants!** Even “weeds” can be beneficial in shading and aerating the soil as well as feeding the microorganisms.

PLEASE NOTE: This activity works well in combination with **Activity 3: The Decomposer Game.**

New Earth Classroom

ACTIVITY 3
DECOMPOSER GAME (20-25 minutes)

PLEASE NOTE: This activity works well in combination with **Activity 2: Living Soil.**

LEARNING OBJECTIVES

1. Students will distinguish between producers, consumers, and decomposers.
2. Students will cite examples of producers (plants), consumers (animals), and decomposers.
3. Students will engage in a running game that demonstrates how the food web depends on decomposers, which break down organic matter to provide soil and nutrients to grow new plants.
4. Students will analyze the results of the Decomposer Game to clarify the importance of the relationship between animals, plants and decomposers.

KEY WORDS

food web, food chain, consumer, decomposer, organic matter, producer, native

EQUIPMENT

- Bell or whistle
- Laminated photos of animals* (with yarn or string loosely attached so photos can be worn around kids' necks)
- ties or scarves
- orange cones, flags, or flagging tape to delineate perimeter of playing field**

* Should be a combination of herbivores, omnivores and carnivores, preferably animals native to your region. In the southwest high desert, examples include swallowtail butterflies, roadrunners, javelina and tarantulas.

** Playing field should be from about 20x50 feet to 30x60 feet, depending on how many kids are playing. The area should be large enough for the kids to be able to run around but not so large that they don't get tagged.

INSTRUCTIONS

DESCRIBE ROLES

ASSIGN ROLES

I. GO OUTSIDE
and have students sit in a circle to go over game instructions.

II. EXPLAIN THE RULES

A. This is a running game, but it's not a competition. It's a demonstration to show how all living things depend on each other to survive and create a balanced food web.

B. Each student will have an assigned role:

1. ***Animals*** (consumers) - eat or consume plants or other animals.
   Ask students for examples of animals from your region.
   (in the Southwest, examples include owl, bobcat, jaguar, javelina, kangaroo rat, Mexican wolf, butterfly)
2. ***Decomposers*** - What do decomposers do?
   Decomposers break down (decay) dead organic matter to create new soil and release nutrients for plants growing in the soil.
   Ask students for examples of decomposers.
   (examples could include bacteria, fungi such as mushrooms, mold & yeast, insects such as worms, beetles & flies)
3. ***Plants*** (producers) - produce energy from the sun.
   Plants are the foundation of our food chain.
   They produce energy from sunlight that is passed on to animals that eat them. Animals (predators) that consume plant-eating animals (prey), get energy from the animals they eat.
   Ask students for examples of plants from your region as well as others that may not be native but provide food.
   (juniper tree, desert willow, sunflower, sage, prickly pear cactus, poppy, apple tree, pumpkin, strawberries, cucumbers)

C. Assign each student a role in the game:

1. ***Animals:***
   a. Hold up a card of a native animal.
      Have the students identify it and ask them what it eats.
      Remind them that this is called a **consumer** because it consumes (or eats) plants and/or animals.
   b. (OPTIONAL) Introduce or review the terms herbivore, omnivore and carnivore when discussing each consumer and what they eat.
   c. Pass out animal cards to 5 kids. They will wear these and identify as animals.
2. ***Decomposers:***
   a. Ask again for examples of decomposers.
   b. Pass out ties or scarves to 5 kids who will wear these and identify as decomposers
   c. Please note that for the first round of the game, there should be an equal number of animals and decomposers with almost double the number of plants. For example, if there are 5 animals and 5 decomposers, there should be about 8-10 plants.

3. ***Plants:***
    a. Ask again for examples of plants.
    b. Kids who are neither animals nor decomposers will be plants.
4. Do a hand count and announce how many animals, decomposers and plants there are. This is an important point for comparison later in the game.

HOW TO PLAY THE GAME

D. Instructions:

1. **Animals tag plants** to symbolize that they have eaten them. Plants can try to avoid animals, but it is inevitable that many will be tagged (eaten). **Plants sit down** when tagged.
2. **Decomposers look for plants that have been eaten** (and are sitting down) **& tag them** to bring them back to life. <u>This shows that the decomposers are breaking down and recycling the plant material so new plants can be grown.</u> **Plants that are tagged by decomposers stand up** and are back in the game.
3. Point out the playing field boundaries, designated by orange cones, flags or flagging tape. The players should not go out of bounds.
4. Please emphasize that there is no need to be aggressive. This is not a competition but rather a demonstration to show how living things interact as parts of the food web. The students' roles will change in each round, so they will have opportunities to participate as different players in the game.
5. When students hear the bell or whistle, they will freeze.
6. Demonstrate the game procedure with kids representing one animal, one plant and one decomposer for clarity.

E. Play the game:

ROUND 1

1. <u>Ring the bell or blow the whistle to begin ROUND 1.</u> Animals tag plants, who sit down when they are tagged. Decomposers tag the plants that are seated, and those plants are back in the game. After about 2 minutes, ring the bell or blow the whistle. Students freeze.
2. Have kids in each group raise their hands in order to count the numbers of animals, decomposers and plants (only count the plants that are standing).
   Ask students: **Do we have the same number of each as when we started?**
   (Numbers of animals and decomposers will be the same. The number of plants will be close to the original number, even though a few plants may be seated.)

3. **Role change** - this gives kids a chance to try different roles and makes the game less competitive.
   a. Take scarves from 2 decomposers to reduce the number of decomposers in the next round.
   b. Have the other decomposers give their scarves to plants or animals.
   c. Animals give their cards to kids who want to be animals.
   d. Anyone who is not an animal or decomposer is a plant.

ROUND 2

4. Play Round 2. After about 2 minutes, ring the bell or blow the whistle. Students freeze.
5. Have each group raise their hands in order to count the numbers of animals, decomposers and plants (again, only count the plants that are standing).
   Ask students: **How have the numbers changed?**
   (There should be fewer plants.)
   Why are there fewer plants?
   (Because there are fewer decomposers available to break down dead plant material and make soil and nutrients for new plants.)
6. Let's see what happens if we have no decomposers.
   a. Collect scarves from remaining decomposers.
   b. Animals give their cards to someone who hasn't yet been an animal.
   c. Everyone else is a plant.

ROUND 3

7. Play Round 3.
   It won't be necessary to time this round because soon the plants will all be seated, and there are no decomposers to revive them.
8. Once all the plants are seated, tell students to freeze. Count how many there are in each group. There will be zero plants and zero decomposers.
9. Collect the animal cards and have students sit in a circle.

DISCUSSION

F. Discussion
   1. What happened when we had fewer decomposers?
      (There were fewer plants.)
      What happened when we had no decomposers?
      (There were no plants.)
   2. Why were there no plants without decomposers?
      (The dead organic matter was not "recycled" into soil and nutrients to make new plants.)
   3. What happened to the animals?
      (They had nothing to eat.)
   4. Conclusion: Decomposers break down dead plants, creating soil and nutrients so more plants can grow. They recycle organic material. Without them, the life cycle and food chains are broken.

New Earth Classroom

ACTIVITY 4
CORN & COMPANION PLANTING: *Four Friends Skit*

SUMMARY

Following are three activities that focus on corn as a staple food and companion plant. Each activity can stand alone, or students can rotate between them, spending 15-20 minutes at each activity station. We recommend having no more than 10 kids do each activity at one time.

Here is a summary of what each activity entails:

Four Friends Skit

Students participate in a short skit that shows how the Four Friends, also known as Four Sisters (corn, squash, beans and sunflower), have acted as companion plants for centuries. The adult leader narrates a story while students wearing simple costumes to represent the four crops demonstrate their dependency on each other. Students also fill the roles of the sun, earth, and sound effects for wind and rain.

Masa Grinding

Students take turns grinding corn into masa using a replica of a traditional stone metate and mano. If possible, they use corn native to the students' home region that has been soaked in water overnight, which is how corn for masa is customarily prepared. While students are grinding the masa, the adult leader talks about the meanings of "metate" and "mano," where corn comes from, how corn is grown, and how we use corn.

Corn Tortillas

Students flatten prepared masa balls in a tortilla press, or using a rolling pin or jar, and then the adult leader cooks their tortillas on a hot plate. As students prepare and eat their tortillas, the group discusses the translation of "tortilla," how masa harina is prepared, and how tortillas are used in regional cuisine.

FOUR FRIENDS SKIT

LEARNING OBJECTIVES

1. Students will discuss companion plants and ways plants assist and protect other plants when they grow together.
2. Students will examine specific examples of various companion plants.
3. Through role play, students will demonstrate how four companion plants (maize/corn, beans, squash and sunflowers) help each other grow by providing protection from weather, making nutrients available, and attracting pollinators.

KEY WORDS

maize, companion plant, symbiotic relationship, pollinators

EQUIPMENT

- Simple costumes for Maize (corn), Bean, Squash, Sunflower, Sun, Earth
- Popsicle sticks or pieces of paper with each role written on them for students to pick
- Skit script for narrator

COMPANION PLANTS

I. COMPANION PLANTS

A. What is a **companion**?
(someone whose company you enjoy; someone you want to spend time with)

B. Just like people and other animals have companions, so do plants.

C. Some plants prefer to grow near other plants because they improve growing conditions. Plants that help each other grow have a **symbiotic** relationship.

D. Examples of **Companion Planting**: (Do students know any?)

1. ***Tomatoes & basil*** (Basil repels some pests from tomatoes.)
2. ***Tomatoes & marigolds*** (Marigolds attract beneficial insects to help tomatoes pollinate.)
3. ***Carrots & leeks/onions*** (Onions repel the carrot fly.)
4. ***Radishes & cucumbers*** (Radish roots break up compacted soil and improve air flow and water drainage for cucumbers.)
5. ***Squash & dill*** (Dill attracts predatory wasps that feed on a wide range of insects that might eat the squash.)

FOUR FRIENDS

II. FOUR FRIENDS (aka Four Sisters)

A. We are going to focus on four crops cultivated by native people of North America: **maize (corn)**, **squash**, **beans** (that climb) and **sunflowers**.

B. Native Americans planted these **companion crops** together because the plants help each other, resulting in healthier plants and more food.

C. We're going to do a skit to demonstrate how these four plants help each other grow.

FOUR FRIENDS SKIT

III. FOUR FRIENDS SKIT

A. Students draw sticks/papers to determine which students are cast in which roles.
Cast Members: Maize (corn), Bean, Squash, Sunflower, Sun, Earth
Audience members are Rain and Wind.

B. Instructions for the skit:

1. When students hear their characters mentioned in the narration, they act or sound out their parts in the story. For example, when the narrator says: "**Squash** sprouted and grew along the ground around Maize and Bean, spreading big leaves to shade the soil, keeping it moist and cool," the student representing squash will stretch along the ground near Maize and Bean.
2. When **Rain** is mentioned, audience members will make rain and thunder sounds. When **Wind** is mentioned, the audience will make whooshing and blowing sounds.

C. THE SKIT (adult leader narrate):

THE SKIT
adult leader narrate

Once upon a time, a beautiful plant named **Maize** grew in a field.
As the summer **Sun** gave its heat,
and the monsoon **Rains** poured down,
Maize grew taller and taller.

But with the monsoon **Rains** came fierce **Winds** that blew across the field,
And **Maize** swayed in the winds, worried s/he would fall.

Until one day, **Earth** brought a companion and planted **Bean** at Maize's feet.
Bean grew, wrapping vines around Maize's tall body
So when the winds blew across the field, **Bean** held Maize tight,
keeping Maize from falling.

As **Bean** grew up toward the sun, **Maize** said: "wrap your vines and tendrils around me, I will support you." And the companions were happy together.

But the **Sun** was so hot, and the ground around the two crops got dry.

So **Earth** brought forth another companion and planted **Squash** at the feet of Maize and Bean.

Squash sprouted and grew along the ground around Maize and Bean, spreading big leaves to shade the soil, keeping it moist and cool.

Squash also helped keep away bugs that would eat Maize and Bean, and her/his leaves blocked other plants that might grow there and compete for water.

Bean was thriving, and s/he invited special bacteria to live on her/his roots, and they helped feed Maize & Squash with nitrogen and nutrients in the soil.

And **Maize** supported the companions by holding up their vines toward the sun.

But as **Maize** and **Bean** grew, birds became more interested in their delicious fruit and seeds.

So **Earth** brought forth another friend, **Sunflower**, and planted her/him among the other crops.

Sunflower quickly grew tall and helped support **Bean's** vines. S/he also lured the birds away from **Maize** by allowing them to eat her/his own tasty seeds.

Sunflower attracted beneficial insects, called pollinators, for all the plants. These insects helped the Four Friends by visiting their flowers and spreading pollen among them. This helped them make more fruit and seeds.

The people of the land saw how these **companions** helped each other, and to this day, they plant the **Four Friends** together in their fields.

REVIEW

IV. REVIEW how the Four Friends help each other

A. How did Bean help Maize?
(Bean's vines held on to Maize to keep Maize from blowing over in the wind.)

B. How did Maize help Bean?
(Maize supported Bean's growing vines.)

C. How did Squash help Bean and Maize?
(Squash's large leaves shaded the soil around Maize and Bean, keeping it cool and moist. Squash also helped keep bugs away, and Squash's leaves blocked other plants from growing around Maize and Bean and competing with them for water.)

D. How did Bean help Maize and Squash?
(Bean, and other legumes, host bacteria on their roots that make nitrogen and other nutrients in the soil available for surrounding plants.)

E. How did Sunflower help Maize, Bean and Squash?
(Sunflower's seeds helped lure birds away from Maize's seeds. Sunflower's colorful yellow petals also attracted pollinators that help plants grow more fruit and seeds.)

New Earth Classroom

ACTIVITY 4
CORN & COMPANION PLANTING: *Masa Grinding*

SUMMARY

Following are three activities that focus on corn as a staple food and companion plant. Each activity can stand alone, or students can rotate between them, spending 15-20 minutes at each activity station. We recommend having no more than 10 kids do each activity at one time.

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Masa Grinding

Students take turns grinding corn into masa using a replica of a traditional stone metate and mano. If possible, they use corn native to the students' home region that has been soaked in water overnight, which is how corn for masa is customarily prepared. While students are grinding the masa, the adult leader talks about the meanings of "metate" and "mano," where corn comes from, how corn is grown, and how we use corn.

Corn Tortillas

Students flatten prepared masa balls in a tortilla press, or using a rolling pin or jar, and then the adult leader cooks their tortillas on a hot plate. As students prepare and eat their tortillas, the group discusses the translation of "tortilla," how masa harina is prepared, and how tortillas are used in regional cuisine.

MASA GRINDING

LEARNING OBJECTIVES

1. Students will grind corn into masa using a replica of a traditional stone metate and mano.
2. Students will discuss the meaning and history of the metate and mano.
3. Students will examine where corn comes from, how it's grown, and various uses of corn.

KEY WORDS

mano, metate, Mesoamerica, Native American, maize, masa

EQUIPMENT

- Stone mano & metate (replicas)
- Whole corn* (soaked overnight)
- Small bowl of water (for sprinkling on corn while grinding)
- Bowl or tray to collect masa
- Bucket of clean water (for kids to rinse hands, if needed)
- Towel

* preferably corn that is native to students' region

BEGIN GRINDING CORN

I. Begin grinding the soaked corn (maize) using the mano and metate: Scatter a handful of soaked corn on the **metate**. Dip your fingers in the small bowl of water and sprinkle on the corn to moisten. Using the **mano**, pull the soaked corn toward you, and then pulverize the corn as you push the mano down and away from you. Place a bowl or tray at the low end of the metate to catch the masa.
(There are some great videos online about how to grind masa using a mano and metate.)
As you grind the masa, explain & discuss:

A. What is a **metate**?
(A metate is a stone slab tool used to grind maize, seeds, and other grains and foods.)

B. What does **mano** mean in Spanish?
(Mano translates to "hand." A **mano** is also a handheld stone used to crush and grind grains and seeds on a metate.)

C. For thousands of years, **Mesoamericans** (people living in Mexico, Central America and South America) and **Native Americans** living in the southwest US grew maize, sunflowers and chili peppers and used metates and manos to grind these and other foods.

EXPLAIN MASA

II. Explain that you are grinding **masa**.
Masa is corn soaked in water containing ashes from cooking fires (the ashes contain the mineral lime). This soaked corn has been ground to make masa for centuries. Tortillas and tamales are made from masa.

GRIND & DISCUSS

III. Have the kids take turns grinding the soaked corn, putting more on the metate as needed. Sprinkling the corn lightly with water will make it easier to grind.
As they are grinding, ask & discuss:

A. **Who likes to eat corn?**

B. **Where does corn come from?**
(Scientists believe that Mesoamericans developed corn at least 7000 years ago. It comes from a wild grass called teosinte that still grows in Mexico today.)

C. **What does corn need to grow?**
(A lot of water, a long growing season with soil temperatures of at least 60 degrees, and nitrogen-rich soils.)

D. **How do we use corn?**

1. There is ***cornstarch*** in batteries, cosmetics, deodorant, baby powder, matchsticks & vitamins.
2. Corn is fermented to make ***ethanol***, used in gasoline.
3. A byproduct of corn fermentation is lactic acid, which can be used to make plastic.
4. Food!

E. **What foods are made from corn?**

1. Corn on the cob, grilled corn, salsa, corn chowder
2. Corn syrup is in candies and baked goods
3. Ground corn makes porridge, polenta, cornbread, and breading for corn dogs.
4. Hominy (posole) is made from soaked corn
5. Masa, corn that is treated with lime, is used to make tortillas and tamales.
6. Corn tortillas are used in enchiladas, tacos, tostadas, chilaquiles and tortilla chips.

F. **How did Native Americans eat corn?**
(raw on the stalk, roasted in coals, dried and ground into cornmeal and baked in tortillas and tamales)

G. **How did they grind corn?**
(They used a metate and mano!!)

H. **How could Native Americans use the whole corn plant?**

1. Corn husks could be woven into mats or baskets and used to make dolls.
2. Cobs could be burned as fuel or made into ceremonial rattling sticks.
3. Seeds were used in a variety of foods.

New Earth Classroom

ACTIVITY 4
CORN & COMPANION PLANTING: *Tortilla Making*

SUMMARY

Following are three activities that focus on corn as a staple food and companion plant. Each activity can stand alone, or students can rotate between them, spending 15-20 minutes at each activity station. We recommend having no more than 10 kids do each activity at one time.

Here is a summary of what each activity entails:

Four Friends Skit

Students participate in a short skit that shows how the Four Friends, also known as Four Sisters (corn, squash, beans and sunflower), have acted as companion plants for centuries. The adult leader narrates a story while students wearing simple costumes to represent the four crops demonstrate their dependency on each other. Students also fill the roles of the sun, earth, and sound effects for wind and rain.

Masa Grinding

Students take turns grinding corn into masa using a replica of a traditional stone metate and mano. If possible, they use corn native to the students' home region that has been soaked in water overnight, which is how corn for masa is customarily prepared. While students are grinding the masa, the adult leader talks about the meanings of "metate" and "mano," where corn comes from, how corn is grown, and how we use corn.

Corn Tortillas

Students flatten prepared masa balls in a tortilla press, or using a rolling pin or jar, and then the adult leader cooks their tortillas on a hot plate. As students prepare and eat their tortillas, the group discusses the translation of "tortilla," how masa harina is prepared, and how tortillas are used in regional cuisine.

TORTILLA MAKING

LEARNING OBJECTIVES

1. Students will shape masa into corn tortillas and eat the tortillas!
2. While making corn tortillas, students will discuss the process of making masa harina and recall the many uses of corn tortillas from their own culinary experiences.

KEY WORDS

Masa, masa harina, tortilla, maize

EQUIPMENT

- Masa dough (pre-made, see recipe below)
- Extra masa harina (dry) for sprinkling on dough to prevent tortillas from sticking & for students to examine
- Hot plate with extension cord
- Brightly colored masking tape to make a boundary around the hot plate which students should not cross
- Tortilla press, rolling pin or large jar
- Plastic sheets, parchment paper, or wax paper
- Spatula
- 2-Tbs. Cookie scoop
- Paper towels
- Mild salsa to put on tortillas (optional)
- Copies of recipe to hand out to students

TORTILLA DISCUSS

I. Tortillas (background to discuss while making tortillas)

A. What is a **tortilla**? (translation: omelet)

B. Who has made tortillas before?

C. What is **masa**?

1. **Masa is a maize dough** that is made from ground nixtamalized corn, or corn that is treated with lime water, which makes it more savory and easier to digest. This “lime” is not the citrus fruit! It is calcium hydroxide, a mineral also called limestone.
2. **Masa harina** is corn flour made from dried maize that has been soaked in water containing lime or wood ash.
3. **Masa** can be made by adding water to masa harina (as we are doing here) or by grinding corn soaked in water with lime using a metate and mano.

II. What can we make with corn tortillas?
(We can make tacos, tostadas, enchiladas, tortilla chips, chilaquiles, nachos, quesadillas, tortilla pizza, flautas, migas, chimichangas, taquitos, wraps, soup, taco salad)

MAKING TORTILLAS

III. Making tortillas

A. On a table, have a pre-heated hot plate set to medium-high temperature, a spatula, prepared masa balls, a small bowl of dry masa, a tortilla press lined with plastic, parchment or wax paper (or a rolling pin or large jar), paper towels, salsa and a spoon.

B. Using the masking tape, delineate a boundary on the table around the hotplate (about 8-12 inches from the hotplate). For their safety, students should not reach across this boundary.

C. The adult leader will demonstrate how each masa ball is coated with masa harina, flattened and cooked. **The students will ONLY do the flattening of the tortillas.** This makes the process more hygienic and safer.

D. ***Demonstrate for students:*** take a masa ball and roll it in the small bowl of dry masa to coat. Set it in the center of the open tortilla press, which should be lined with sheets of plastic, parchment, or wax paper to prevent sticking. Close the press and gently but firmly press the tortilla until you have a tortilla that is 4 or 5 inches in diameter. If the tortilla is too thick, it can be pressed again.

E. If you don't have a press, you can roll out the balls between sheets of plastic, parchment, or wax paper. Flatten the tortillas with a rolling pin or jar on its side. You can also use your hands to press the ball flat.

F. Gently peel the tortilla off the plastic sheet, parchment, or wax paper and place the tortilla on the hot plate. Cook for about two minutes on each side, until the top of the tortilla gets bubbles, and there are small brown flecks on the bottom.

G. While the tortilla is cooking, the adult leader takes another masa ball, rolls it in dry masa to coat and sets it between the sheets of plastic, parchment, or wax paper for pressing. A student does the pressing. The adult removes the tortilla and puts it on the skillet.

H. Once the tortillas are cooked, remove them from the skillet with the spatula and place them on paper towels. After cooling for one to two minutes, offer them to students with optional salsa.

I. Repeat until each student has pressed a masa ball and eaten a tortilla.

IV. After every student has made and eaten a tortilla, pass out copies of the recipe to students who want them so they can make corn tortillas at home.

TORTILLA RECIPE

V. The Recipe:

HOMEMADE CORN TORTILLAS

INGREDIENTS:

2 c. masa harina (translates to corn flour; has corn (maize) & hydrated lime
1.5 - 2 c. hot water
½ - 1 tsp. fine sea salt (to taste)

RECIPE ADAPTED FROM:

gimmesomeoven.com/homemade-corn-tortillas/#tasty-recipes-72274

INSTRUCTIONS:

Mix the dough: In a large mixing bowl, briefly whisk together masa harina and salt. Gradually add 1.5 cups hot water, and stir the mixture with a wooden spoon or silicone spatula until an evenly-mixed dough begins to form. Use your hands to knead the dough for 2-3 minutes in the mixing bowl until it is smooth and forms a cohesive ball. The dough's texture should feel springy and firm, similar to Play-Doh. If the dough feels too wet and is sticking to your hands, add a few extra tablespoons of flour, one at a time. If it feels too dry and crackly, add in an extra tablespoon or two of hot water.

Rest the dough. Cover the bowl with a damp kitchen towel (or paper towel) and let the dough rest for 10 minutes.

Portion the dough. Use a spoon or a medium ice cream scoop to portion the dough into a 2-tablespoon ball (35-40 grams, or about the size of a golf ball), then use your hands to roll the ball until it is nice and round.

Press the dough balls. Place the dough ball between two pieces of plastic, parchment paper, or wax paper in a tortilla press. Then gently press the dough ball until it forms a 4- to 5-inch tortilla.
If you don't have a press, you can roll out the balls between plastic sheets, parchment or wax paper, or using a rolling pin or jar on its side. You can also use your hands to press the ball flat.

Cook the tortilla. Heat a non-stick skillet or comal over medium-high heat. Once the pan is nice and hot, gently peel the tortilla away from the plastic wrap and lay the tortilla flat in the skillet. Cook the tortilla for about one to two minutes on each side, flipping it once speckled brown spots begin to appear on the bottom of the tortilla. The tortillas will likely bubble up while cooking, especially on the second side, which is a good sign! Once it is cooked, transfer the tortilla to a tortilla warmer or a bowl wrapped in a clean kitchen towel, so that the tortillas do not dry out.

Repeat with the remaining tortillas. Once you get the hang of it, you can try keeping the cycle going by cooking one tortilla while pressing the next dough ball at the same time. If you notice that the skillet begins to seem too hot, just turn down the heat a bit.

Serve. The tortillas will continue to soften a bit more as they sit in a stack in your tortilla warmer (or wrapped in a towel). You may want to use the tortillas at the bottom of the stack first — they will be the softest. Serve however you would like and enjoy!

HOMEMADE CORN TORTILLAS

INGREDIENTS:

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New Earth Classroom

ACTIVITY 5
Using the Scientific Method to Analyze WATER RETENTION IN SOIL COMPONENTS

LEARNING OBJECTIVES

1. Students will use the scientific method to analyze which material in soil (sand, compost or clay) absorbs the most water.
2. Students will propose a hypothesis to address the question based on the appearance and feel of each soil component.
3. Students will conduct an experiment using specialized laboratory equipment (ring stands, Buchner funnels, and graduated cylinders) to collect data.
4. Students will measure amounts of water in milliliters in graduated cylinders.
5. Students will calculate how many milliliters of water was retained by each soil material.
6. Students will graph data showing how many milliliters of water was retained (absorbed) by each soil material.
7. Students will analyze and discuss the data to draw a conclusion about which material (or what combination of materials) in soil may make the best growing medium for plants.

KEY WORDS

scientific method, hypothesis, experiment, Buchner funnel, graduated cylinder, milliliter, procedure, sand, compost, clay, data, conclusion

EQUIPMENT

- 3 ring stands with clamps
- 3 Buchner funnels
- 3 coffee filters cut to fit on the inside bottom of the Buchner funnels
- 3 squeeze bottles, pipettes, or droppers
- water
- 3 100 mL graduated cylinders
- 3 50 mL graduated cylinders
- 30 grams each of sand, compost & clay
- 1-2 cups of each material (sand, compost & clay) for students to handle and analyze
- Signs on index cards to label stations: SAND, COMPOST, CLAY
- Bar graph (laminated poster or on the board) with material (sand, compost, clay) on the bottom axis and mLs of water absorbed by each on the vertical axis

SUMMARY

For this lab, the class will divide into three groups. Each group will perform an experiment to analyze one of three components of soil: sand, compost, or clay. Each group will have a lab station with their own set of equipment so the three groups can perform their experiments simultaneously.

Each lab station consists of: a sturdy table, a ring stand with a clamp holding a Buchner funnel, a coffee filter cut to fit perfectly on the inside bottom of the funnel, a squeeze bottle, pipette, or dropper, a water source, a 100 mL graduated cylinder, a 50 mL graduated cylinder (put beneath the Buchner funnel, to catch the water that drains), 30 grams of material (sand, compost, or clay), and a sign to indicate the type of material being analyzed at that station (sand, compost, or clay).

BACKGROUND INFORMATION

I. I. BACKGROUND INFORMATION:

A. What is soil?
Soil is a mixture of minerals (bits of rock), living things (microorganisms), organic matter, water and air

B. Living components of soil

1. Healthy soil contains fungi, bacteria, insects, nematodes, protozoa
2. Healthy soil also contains water, oxygen, and organic matter (living or once-living plant or animal material) to feed and support life in the soil

C. Non-living components of soil

1. Sand, silt and clay (bits of broken-down rocks) make up soil structure
2. Soil structure is important because soil holds water and nutrients, allows air flow, and is habitat for microorganisms that help feed plants.

D. Why is it important for soil to hold water?

1. Water supports life in the soil (fungi, bacteria, insects and plants)
2. What happens if there is not enough water in the soil?
(living things in the soil won't be able to survive)
3. What happens if there is too much water in the soil?
(there is less room for oxygen in the soil and therefore fewer living things)

E. Today, we will do an experiment to compare how much water is retained (absorbed) by different components of soil (sand, compost, and clay).

SCIENTIFIC METHOD

II. Explain or review the **scientific method** and how we will be applying that to our experiment today.

A. We begin with a question:
Which material holds the most water: sand, compost, or clay?
Which holds the least?

B. We will make a **hypothesis** (an educated guess). Scientists do research before they try to answer questions. We will also do a short investigation to try to answer this question before we perform the actual experiment.

C. We will then do an **experiment** to test our hypothesis and answer our question.

D. We will use special laboratory equipment so our measurements can be as accurate as possible

LABORATORY EQUIPMENT

1. **Buchner funnel:**
Each soil component (sand, compost, clay) will be in a Buchner funnel, and we will pour water into the funnel and see how much water the sand, compost, or clay absorbs by measuring how much water comes out the bottom. The Buchner funnel is special due to its wide width, so it allows us to pour a lot of water in at once, and then we can wait for it to drain. The Buchner funnel is held by a clamp on a special ring stand, and Buchner funnels are usually made of porcelain so they can be used in many different types of experiments.

2. **Graduated cylinders:**
These are used to measure the volume of liquids. Because they are tall and slender, they measure small amounts of liquids very accurately. We will be measuring water in **milliliters**, which is one thousandth of a liter. Soda often comes in 2-liter bottles. We're measuring in units of one thousandth of half of one of those bottles!

EXPLAIN THE PROCEDURE

E. Explain the **procedure**

1. The class will be divided into three equal groups. One group will conduct the experiment for sand, one for compost, and one for clay.
2. There are several procedural steps, so be sure to take turns doing them so all students get to participate.
3. The first steps require specific instructions, so listen carefully:
   a. Fill your 100 mL graduated cylinder with 50 mLs of water. To make the measurement exact, add water to the cylinder but do not exceed 50 mLs. Use your squeeze bottle, pipette, or dropper to make exactly 50 mLs.
   b. Put the coffee filter in the bottom of the Buchner funnel. Using the squeeze bottle, pipette or dropper, wet the coffee filter (one drop or small squeeze at a time) to form a vacuum seal between the filter and the funnel. This ensures that no material (only water) can get through the funnel.

4. Add the (pre-measured) 30 grams of material to the Buchner funnel. Tamp lightly with your fingers to make sure it's level, but don't pack it in.
5. Make sure the 50 mL graduated cylinder is positioned directly under the Buchner funnel so it will collect the water that drains from the funnel.
6. <u>Have all three groups do this step at the same time:</u> Slowly pour the water from the 100 mL graduated cylinder into the funnel.
7. Once all groups have poured their water, wait as a class for about 10 minutes, when drips from the funnel become less frequent.
8. At the same time, each group will measure the amount of water that drained into the 50 mL graduated cylinder and subtract that number from 50. That will be the amount of water absorbed by your material.

F. Graphing the data:
Data is information collected during an experiment or research. It used to analyze a problem or question to draw a conclusion. One at a time, a representative from each group will come to the board and put their results on a bar graph by shading the number of mLs of water that were absorbed by the material they studied.

G. **Conclusion:** we will analyze the data and discuss the results of the experiment to conclude (decide) what might be the best type(s) of soil for growing plants.

DO THE EXPERIMENT

III. Do the experiment

A. Question: Which material holds the most water: sand, compost or clay? Which holds the least?

HYPOTHESIS

B. Hypothesis:

1. Each group gets a container of 1-2 cups of either sand, compost, or clay. Use your senses (sight, smell, touch) to study the material. Discuss its properties and how these characteristics may or may not enable it to hold water. Do this for about 1 minute, then pass the components to another group for analysis. Continue until all three groups have analyzed each material.
2. Ask each group to rate the materials in terms of which they think will hold the most water, second most, and the least amount of water. Write their hypotheses on the board. If they feel unsure, explain that a hypothesis is a guess, and if we already knew the answer for certain, we wouldn't have to do the experiment!

EXPERIMENT

C. Experiment

1. Measure 50 mLs of water in the 100 mL graduated cylinder. (see instructions above under “II. E. 3. a.”)
2. Put the coffee filter in the Buchner funnel and wet lightly (instructions above under “II. E. 3. b.”).
3. Add 30 grams of material to the funnel and level with fingers, but do not pack.
4. At the same time, each group will slowly add the 50 mLs of water to the funnel.
   The whole class will wait about 10 minutes. During this time, students can walk around and look at what is happening at the three lab stations.
5. Measure the amount of water in the 50 mL graduated cylinder below the funnel. Subtract that number from 50 to figure out how many mLs of water were retained (absorbed) by the soil component.

DATA

D. Data: Each group records their data on a class bar graph

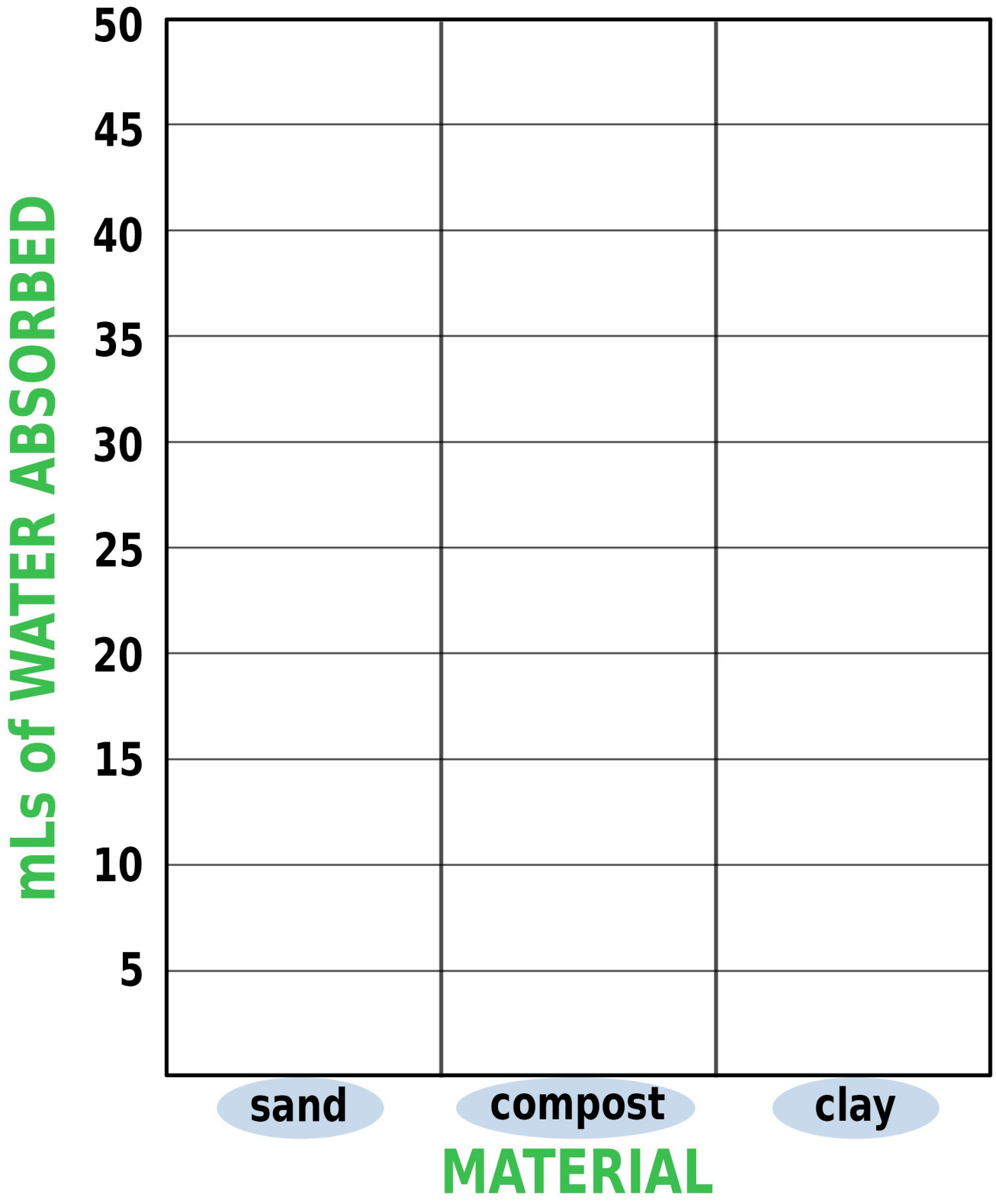
CONCLUSION

E. Conclusion: Discuss as a class

1. Which material absorbed the most water? The least?
2. Were your hypotheses correct?
3. Describe the material that absorbed the most water. What makes it able to do so? What are its properties?
4. In which materials might plants grow best?
5. Sand, compost, and clay can all be beneficial in soil. Sand provides good drainage, clay holds moisture, and compost provides organic material.

   After doing this experiment and learning about which soil component holds moisture best, in what proportions do you think we could combine the components to make soil in which plants could grow well?

Water Retention in Soil Components



New Earth Classroom

ACTIVITY 6
ZERO WASTE (30-40 minutes)

LEARNING OBJECTIVES

1. Students will examine how landfills have evolved over time, why our dependency on them has increased, and how they are harmful to the environment.
2. Students will investigate the greenhouse gas methane and how human activities increase amounts of methane in the atmosphere.
3. Students will identify items that are thrown in the garbage and end up in the landfill.
4. Students will discuss and analyze possible paths of the waste stream: composting, reusing, recycling and disposing in a landfill.
5. Students will consider ways that "garbage" is a resource that could be reused or recycled.
6. Students will discuss the concept of "zero waste" and how some communities have been able to achieve this.

KEY WORDS

landfill, throw-away society, anaerobic decomposition, methane, climate change, reuse, recycle, compost, resource, zero waste

EQUIPMENT

- Cardstock strips (1 sheet of 8½" x 11" cardstock cut into 4 8½" x 2¾" strips; 1 strip per student, plus some extras)
- Markers or crayons
- Masking tape, tacks or magnets (something to affix signs to a wall, board or bulletin board)
- Waste Stream Signs (on quarter-sheets of posterboard): Compost, Reuse, Recycle, Landfill
- Photo of a landfill

SUMMARY & PREPARATION

To prepare the classroom for this activity, display signs (Compost, Reuse, Recycle & Landfill) on the board or wall. Hang the signs just above students' eye level with plenty of room underneath so students can tape or tack their cardboard strips under each heading.

Students brainstorm what items are in their garbage cans at home and write these items down on cardstock strips. They can be asked to notice what items are being thrown away at home in advance, or the kids can just brainstorm during the activity.

Once students write down items, the class discusses each waste stream category displayed on the wall: Landfill, Reuse, Recycle, Compost. Then each student hangs his/her item under the appropriate heading. This encourages the students to think about their waste as a potential resource. Once all items are placed, the class confers about whether each item is placed appropriately.

WHAT IS IN YOUR GARBAGE?

I. WHAT IS IN YOUR GARBAGE?

A. Give each student one blank cardstock strip, and pass out the markers or crayons.

B. Have students write down an item on the cardstock strip that is in their garbage cans at home. Remind them to write large and clearly so words can be seen from a distance.

C. Have extra cardstock strips on hand in case students need another.

D. Once all students have finished, discuss the four possible waste stream paths (see following sections).

LANDFILL

II. LANDFILL

A. What is a landfill? (show photo of a landfill)
A landfill is a site where garbage is buried or dumped, compacted, and covered with soil. Garbage is layered in this manner until the landfill is "full."

B. Why do we use landfills?

1. Humans have always produced waste, but over time, we have needed more and more landfill space because of:

   a. An increase in human population
   b. Increased possessions & consumerism
   c. The rise of the **throw-away society**.
   (Since the 1950s, many products have not been designed to last for lifetime use. Consumers are encouraged to replace and upgrade rather than repair and reuse products.)
   d. An increase in the manufacturing, packaging and disposal of electronic devices (video games, computers, cell phones, dvd players, appliances)
   e. Single use packaging (plastic, Styrofoam, aluminum cans), which takes up about ⅓ of landfill space.
   EXAMPLES:
   - Plastic water, soda & juice bottles
   - Pre-packaged food
   (For example, people used to buy just the amount of meat they needed from butchers, who would wrap the meat in paper. Now meat is sold in pre-weighed amounts on a Styrofoam tray and wrapped in plastic.)
   - Prepared meals that come in plastic trays
   - To-go Styrofoam & plastic packaging from restaurants

C. Problems with landfills

1. **Methane** gas is released as a result of **anaerobic** decomposition (decomposition without oxygen) of organic waste (food scraps, wood, paper). Landfills are one of the nation's largest sources of methane, which is a far more potent greenhouse gas than carbon dioxide and a major contributor to **climate change**
Methane is harmful because:

   a. Methane (CH_4) traps more heat in the atmosphere per molecule than carbon dioxide (CO_2), making it many times more harmful than carbon dioxide for 12 years after it is released

b. After about 12 years in the atmosphere methane oxidizes to become carbon dioxide.
When methane burns, it gives off carbon dioxide.

c. Methane is invisible, odorless and flammable. It is the main component of natural gas. Fewer than 1 in 5 landfills capture methane gas for energy production, but even at these sites, a lot of methane still leaks into the atmosphere.

2. Chemicals (used in cleaners, insecticides, paints and solvents that people throw away) cause leaching in landfills, contaminating surrounding soil and groundwater. Municipalities now line the bottoms of landfills with plastic to try to prevent leaching. Water running off the tops of landfills needs to be collected, tested, and disposed of safely.
3. These problems (methane emission and leaching) also occur at landfills that are already closed and covered up. Closed landfills can continue to emit toxins for more than 50 years.
4. Decomposition occurs very slowly in landfills. Plastic bags and water bottles may take up to 1000 years to decompose and can lead to microplastics entering the ocean.
5. Landfills are getting full, and we are running out of landfill space.
6. Landfills smell bad (from emissions of gasses like ammonia and hydrogen sulfide), they are unsightly, and garbage spreading into surrounding areas can harm wildlife.

REUSE

III. REUSE

A. We can reuse things by finding new uses for them instead of throwing them away.

B. For example, if you outgrow a sweatshirt, you could give it to a friend or the thrift store instead of throwing it away. When old clothes get holes in them, you could use them as cleaning rags or in pet beds.

RECYCLE

IV. RECYCLE

A. Recycling means to convert waste materials into new materials that can be used.

B. We can recycle items like plastic bottles, aluminum cans and corrugated cardboard.

C. The EPA (Environmental Protection Agency) estimates that about 75% of all waste is recyclable.

COMPOST

V. COMPOST

A. Composting is the aerobic decomposition of organic materials (food scraps, leaves, grass clippings and tree branches) into a nutrient-rich soil.

B. We can compost things like apple cores, banana peels, leftover pasta, autumn leaves and grass clippings, right in our own backyards. In a backyard compost, we would avoid adding meat or dairy because they might attract animals to our compost bin or pile.

C. Food is the single largest component taking up space inside US landfills. The US discards more food than any other country in the world, about 120 billion pounds every year. That is estimated to be almost 40% of the entire US food supply and is equal to about 325 pounds of waste per person. The amount of food wasted in America each year is about equal to 130 billion meals.

VI. Invite students to come up to the wall or board and tape or tack their items written on cardstock strips under the appropriate heading (Landfill, Reuse, Recycle, Compost).

VII. Once all items have been placed, discuss each category and the items placed in it as a class.
Begin with Reuse, then Recycle, Compost and Landfill. By saving "Landfill" for last, students may find that something that they thought was garbage could be reused, recycled or composted.
Possible discussion points:

A. What is something new that you learned from this activity?

B. A **resource** is something that can be used to benefit someone or something. How can we think of garbage as a resource?

C. Garbage isn't waste until it's wasted, and it's not garbage until it's thrown away. Instead of burying things we no longer want in the ground, we can save energy and money by composting, reusing & recycling.

ZERO WASTE

VIII. Some communities are adopting the practice of "zero waste."
Zero waste means to conserve resources by engaging in responsible production, consumption, reuse and recovery of products, packaging and materials. Zero waste practices do not include burning "garbage" or putting "waste" in the land, water or air.

A. Why adopt zero waste?

1. It reduces emisisons of greenhouse gasses that would be produced during the manufacturing of new materials. It takes twenty times less energy to make an aluminum can from recycled materials than raw materials.
2. It reduces emissions of methane from landfills, caused by the anaerobic decomposition of organic materials.
3. It saves resources by reusing "waste" materials.
4. It saves food and turns unwanted food back into soil (to grow more food!).
5. It saves landfill space.

6. It is good for the economy. Reducing, reusing and recycling creates ten times more jobs than the disposal of garbage.
7. It helps build community. Clothing, furniture and other items people would have thrown away can be given to community members who need them. Unwanted food can be redistributed to shelters and food banks. Compost can be used in school and community gardens to grow more food. People work together to create and implement solutions,

B. Concepts of zero waste: “The 5 Rs:”
   1. Refuse
   2. Reduce
   3. Reuse
   4. Recycle
   5. Rot

C. Communities that have adopted Zero Waste Policies
   1. Kamikatsu, Japan
      - This remote village recycles, composts or reuses more than 80% of its waste.
      - Residents sort their garbage into 45 different types and separate and wash everything before sending it to recycling centers.
      - The village reduces waste through initiatives like giving new parents cloth diapers and housing a “swap-shop” where residents can leave items for others to take and use for free.
   2. Taiwan
   3. Vancouver, Canada
   4. San Francisco, CA
   5. Cappanori, Italy
   6. Thiruvananthapuram, India
   7. Flanders, Belgium

H. Suggested follow-up activity: have students research a zero waste community and the actions that community is taking to minimize their waste. How has the community benefited? What are some of the challenges? How might a zero waste project be undertaken in the students’ own community?

Keeping Your Worms Happy

- Worms like to live in a warm, dark place—70-degree temperature is ideal. If it's too cold or hot for you, it's too cold or hot for them!
- Worms need moisture in their environment. Their bedding should be slightly moist but not drippy; like a wrung-out sponge. Check the bedding moisture when you add food. If the bedding feels too dry, you can mist it with a spray bottle.
- Every couple of weeks, feel the bedding at the bottom of the box. You may need to pour extra water into the box to add moisture to the bedding in the bottom. Make sure there is a basin under the box to catch the excess water!

- Worms need air—they breathe through their skin! Avoid putting heavy material directly on top of the worms.
- Feed worms no more than three days' worth of food. Very small pieces are best when they are young since they have small mouths. Bury the food in the bedding to keep odors down.
- Bedding should be shredded and kept loose for air circulation. Shredded paper (not glossy and not too much colored paper) is an ideal bedding. Shred office paper, newspaper, and/or light brown bags and mist with water to prepare the bedding. The food you add to the box to feed the worms will add moisture to the bedding as well. As long as you are adding food to the box, keep adding bedding so that the box is full. Just like us, the worms need space, and the bedding allows them to move around.

Best Foods for Your Worms

- Leafy Greens—lettuce, kale, chard, spinach
- Melons, squash, pumpkin, cucumbers
- Broccoli & cauliflower
- Apples, bananas, berries
- Pasta (no sauce), rice, bread, cornmeal
- Coffee grounds, used tea bags and leaves
- Egg shells & avocado skins - worms love to lay their eggs in these protected areas!
- Shredded cardboard
- Shredded paper—no colored ink please
- When adding denser veggies like carrots or potatoes, the worms would appreciate it if you cut them into small pieces, but you don't have to. Whole fruit and veggies will take longer to break down. Carrot tops and potato peelings are the perfect size!
- You can add onion & garlic skins in small quantities

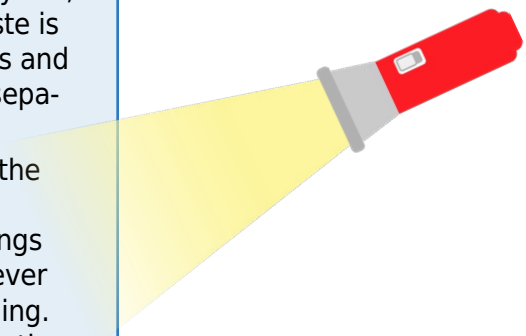
Foods to Avoid

- Citrus
- Meats
- Fats or grease
- Spicy foods
- Onions
- Dairy
- Sugar
- Anything with preservatives

How to Harvest Worm Castings

When your worm box is about ⅔ filled with moist, dark, rich, earthy soil, you will want to begin harvesting the castings. The redworms' waste is toxic to them, so they will need to be separated from their castings and supplied with fresh bedding in their box. Here are some ideas for separating the worms from their castings:

- Because worms are sensitive to light, you can shine a light on the pile of castings and bedding, and the worms will burrow to the bottom of the pile. Keep scooping and scraping away the castings until you are left with mostly worms at the bottom. (You can never separate the worms completely from all the castings and bedding. It's okay to put a small amount of castings back in the box with the worms and fresh bedding.)
- Be sure to keep the worms moist when they are out of the box. They can dry up quickly when touched by human hands and left out of the box for an extended time.



Signs to Watch

- There should not be any smell! Bad odors indicate you are feeding the worms more than they can eat and the food is going bad. If this happens, take out uneaten food and add shredded paper.
- Helpful online site: tumbleweed.com.au/pages/worm-farming-faqs
- We purchase worms and worm blankets from unclejimswormfarm.com
  The blanket helps to keep worms warm during cold weekends in the school.