

DESCRIPTION

Students will review the key concepts of aerobic composting and the importance of the F.B.I.: Fungi, bacteria, and invertebrates. They will harvest compost from the pile that was created during Lesson 1, observe and record the invertebrates found, and add finished compost to the gardens on campus. They will chop and layer organic matter in order to create a new aerobic compost pile.

TIME: 60 minutes

SUBJECTS: Language Arts, Science

LEARNING OBJECTIVES

After this lesson students will be able to:

- Understand that composting helps reduce waste, recycle nutrients, and nourish the garden soil and plants.
- Recognize the important role that fungi, bacteria, and invertebrates play in creating compost.
- Build, maintain, and harvest an aerobic compost pile and utilize finished compost to improve the health of their garden soil and plants.

ACADEMIC STANDARDS*

CCSS, Language Arts: 3.RF.3, 3.W.1, 3.W.2, 3.W.10, 3.SL.1
NGSS: 3-LS4-3, LS4.C, Influence of Science, Engineering and Technology on Society and the Natural World, Patterns, Systems and System Models
Lesson Extensions: 3.SL.4, Obtaining, Evaluating, and Communicating Information

*A detailed list of the Academic Standards can be found in the Unit Overview document.

LESSON OUTLINE

- I. Introduction (20 minutes)
 1. Aerobic Compost Review
 2. F.B.I. Review
 3. Group Activities Overview
- II. Group Activities (30 minutes)
 1. Aerobic Compost Pile Harvest (10 minutes)
 2. Plant Materials Processing (10 minutes)
 3. Compost Pile Creation (10 minutes)
- III. Closing (10 minutes)



KEY TERMS AND CONCEPTS

Aerobic - Refers to the presence of air (oxygen) in the system

Bacteria - Unicellular organisms; widely distributed in soil, water, air, and on or in the tissues of plants and animals

Compost - Decayed organic matter; used to improve soil texture and fertility

Fungi - Plural of fungus; spore-producing organisms that feed on organic matter; includes molds, yeast, mushrooms, and toadstools

Invertebrate - An animal lacking a backbone, such as an insect (arthropod) or a worm (annelid)

Organic Matter - Material that is either living (e.g., worms, roots, and bacteria), or that originated from life (e.g., fallen leaves, dead roots, and dead insects)

LESSON MATERIALS

Community Supplies:

- Optional: Hanging scale (to weigh compost ingredients and/or finished compost)

Lesson Supplies:

- Decomposers Sign
- Nutrient Cycle Sign
- Garden Agreements Sign
- Compost Map Answer Cards: Compost; Air; Water; Decomposers (F.B.I.); Life/Organic Matter
- Optional: Compost thermometer
- Student Workbook
- Class Data Workbook

Teaching Team to Provide:

- Plant materials: Greens and browns (see Advance Preparation)

School to Provide:

- Compost/Garden/Science Journals (1 per student if not using Student Workbooks)
- Garden gloves (1 pair per student)
- 4 loppers
- 2 wheelbarrows
- 2 shovels
- Compost sifter
- Hand trowels
- Buckets and/or garden hose
- Optional: Cover cloth (burlap or other heavy cloth)



ACCOMPANYING DOCUMENTS

- Resource Sheet: How To Create Aerobic Compost
- Guided Notes
- Class Data Sheet: Weekly Aerobic Compost Log
- Class Data Sheet (Optional): Temperature Log

ADVANCE PREPARATION

- Discuss lesson preparation and presentation plans with your teaching team.
- At least three adults are needed for this lesson to supervise the three outdoor group activities.
- Remind students to wear covered shoes on the day of this lesson.
- Review the Resource Sheet: How To Create Aerobic Compost.
- Make copies of the Weekly Aerobic Compost Log Class Data Sheet, one per class if not using the Class Data Workbook.
- Check to make sure there is finished compost to harvest inside the “resting” pile by carefully digging down into or under the pile.
- Discuss with the school’s garden leader(s) about where in the gardens to apply the finished compost harvested during this lesson.
- Determine a location where the new compost pile will be created during this lesson. If necessary, build a new pallet bin prior to the lesson (for instructions refer to Lesson 1 or the Resource Sheet: How To Create Aerobic Compost).
- Collect and organize plant materials (greens, browns, and bottom layer) in separate piles near the compost area. Green (nitrogen-rich) materials include green plants and fruit and vegetable waste. Brown (carbon-rich) materials include wood chips, leaves, and shredded paper. Bottom layer materials include palm fronds or other bulky yard waste items. See the Resource Sheet for further details on what to add and not to add. Ask the school custodians several weeks in advance to reserve bags of yard waste for the lesson. Have students participate in a scavenger hunt to collect available plant materials around campus.
- Have students ready to take notes in their Compost/Garden/Science Journals if not using Student Workbooks.



Millipedes
help to create
finished compost

INTRODUCTION

20 MINUTES

“Aloha! Today is our fifth ‘ĀINA In Schools lesson on composting and our second lesson about aerobic compost piles.” During the discussion, write key terms on the board and have students take notes in their journals or Student Workbooks. **Use the Compost Map Answer Cards during the discussion.**

AEROBIC COMPOST REVIEW

Review the following key concepts with students. Students may refer to their notes from previous lessons.

Workbook Question #1: Have students fill in COMPOST in their guided notes. “What is COMPOST and why is composting important?” Desired answers: Compost is decayed organic matter that is used to improve soil texture and fertility. Composting reduces waste and recycles nutrients, using free, locally available “waste” materials and working with nature to nourish our garden soil and plants. **Workbook Question #2:** Have students list two reasons.



“What does AEROBIC mean?” Desired answer: Aerobic means that air is present in the system. Air is an important ingredient in our aerobic compost pile.



“What are the main ingredients in an aerobic compost pile?” Desired answers: ORGANIC MATTER (carbon, nitrogen, and life), air, and water. Draw a simple diagram of an aerobic compost pile on the board, where carbon (brown) and nitrogen (green) materials are layered alternately and water is added.



F.B.I. AND L.A.W. REVIEW

“What is the special name for the group of living organisms that is responsible for creating finished compost?” Desired answer: The F.B.I.! FUNGI, BACTERIA, and INVERTEBRATES. Show the Decomposers Sign and briefly discuss examples with the students. “The F.B.I. work for the L.A.W., what does the L.A.W. stand for?” Desired answer: Life, Air, and Water. **Workbook Question #3:** Have students fill in Life, Air, and Water in their guided notes.



Decomposers Sign

“Can you imagine what the world might look like without the F.B.I.? Thanks to their work there is no such thing as ‘waste’ in nature!” Show the Nutrient Cycle Sign to remind students of the important role these organisms play in recycling nutrients for use by plants, and people!



Nutrient Cycle Sign

GROUP ACTIVITIES OVERVIEW

“Today we will harvest finished compost from our ‘resting’ aerobic compost pile. As we do so, we will observe and record the different types of invertebrates that have worked with fungi and bacteria to break down the organic matter in our compost pile!”

“In order to harvest our finished compost we will use a compost sifter to separate out the materials that need more time to decompose. These pieces will be put into the new compost pile that we will build today so that they will continue to break down and also inoculate our new pile with beneficial microorganisms! The finished compost that falls through the wire mesh of the compost sifter will be collected in the wheelbarrow below, then added to our garden soil, in order for the nutrients to be used again.”

INTRODUCTION

CONTINUED

“One group will harvest finished compost, observe invertebrates, and add the finished compost to the gardens. Another group will chop up green and brown plant materials, and a third group will create a new compost pile to keep the process going! We will rotate groups twice after 10 minutes each.”

Garden Agreements

Have students take a deep breath, then repeat and discuss the Garden Agreements as listed on the Garden Agreements Sign.

- I will be SAFE
- I will be KIND
- I will have an OPEN MIND
- I will use my TIME WELL



Divide the students into 3 groups before going outside. Designate one volunteer per group as record keepers that will bring journals and pencils to the compost area to record the types (and number) of invertebrates found in the finished compost. Bring the Decomposers Sign and Nutrient Cycle Sign to the compost area to help students with identification of invertebrates and remind them of their own place in the important process of nutrient cycling.

Have students wear garden gloves during the group activities. Rotate groups after 10 minutes. Regroup for closing.

GROUP ACTIVITIES

30 MINUTES

AEROBIC COMPOST PILE HARVEST*(10 minutes)*

Students within each group may rotate jobs at this station: Shoveling, sifting, taking large materials to the new compost pile, observing invertebrates, and adding finished compost to the gardens.

1. Place the compost sifter over a wheelbarrow.
2. Have 2 students use the shovels to move material from the “resting” compost pile (created during Lesson 1) onto the compost sifter.
3. Have 2 students sift the compost by holding the handles and moving the sifter back and forth, or using their hands (with gloves) to gently push the material across the screen of the sifter. The fine, finished compost will sift through the screen and the larger pieces will stay on top.
4. Have a 5-gallon bucket and hand trowel available to safely gather any centipedes found.
5. After the screen is full of large un-decomposed

pieces, dump the material into 5-gallon buckets. Add this material to the new “active” aerobic compost pile so it will continue to break down and inoculate the new pile with microorganisms.



GROUP ACTIVITIES

CONTINUED

6. Have students observe and record the different types of invertebrates found in the finished compost. Remind them that microorganisms (fungi and bacteria) are also present and that thanks to their work, the nutrient cycle is alive and well!
7. Optional: Weigh and record the amount of finished compost harvested.
8. Put the sifted compost into 5-gallon buckets and add handfuls of compost to the garden soil around the base of plants. Mix into the top 1 to 2 inches of soil, and shake any compost off of the leaves.
9. Save enough for all three groups and all participating classes to experience harvesting.

PLANT MATERIALS PROCESSING
(10 minutes)

Have students place large plant materials into the wheelbarrows, then use the loppers to chop the material into smaller pieces (about 3 to 6 inches long). It is important to process (chop) plant materials before adding them to the compost pile because smaller materials will decompose faster.

Safety First: “Loppers in, hands out!” Remind students that hands are not allowed in the wheelbarrow and that the cutting end of the loppers are not allowed outside of the wheelbarrow. Cutting ends should always face downward when being carried, and always at a walking pace.

Other students may tear up leaf material with their hands and help with the movement of materials. Have students take turns using the loppers. Optional: Use the hanging scale to weigh the compost ingredients that go into the pile in order to keep a record of how much waste is being diverted from the landfill.



COMPOST PILE CREATION *(10 minutes)*

1. Begin by creating the bottom layer by placing the large plant materials (palm fronds and small branches) directly on the ground inside the “active” compost bin. This will promote air flow (aerobic conditions) into the compost pile.
2. Have students gather large handfuls of materials and take turns layering them inside the bin. Be sure to keep each layer flat and level, utilizing the entire space inside the bin (avoid only adding materials to the center, which would cause the pile to look more like a volcano than a cube).
3. Have students take turns watering the compost pile as it is built.
4. Continue to layer all the materials (alternating greens and browns as much as possible) until all of the materials are used. Be sure that the top layer is composed of carbon/brown materials. Never leave food waste exposed on the top (or out of the sides) of the pile; it should always be covered with carbon/brown materials such as wood chips.
5. Be sure the compost pile is adequately soaked with water.
6. Optional: Finish by covering the pile with burlap or other material, to preserve moisture.
7. Excess plant materials may be stored in the “storage” bin.



All students must wash their hands thoroughly with soap and water after working with the compost.

CLOSING

10 MINUTES

Gather all the students in the garden/compost area. Ask them to share about their experience.

Discuss with students:

- What does the F.B.I. stand for and why are they important?
- What types of INVERTEBRATES did you observe today?
- Do you remember what types of ORGANIC MATTER were originally used to create the pile we harvested today, and were you able to recognize any of them?
- How does it feel to work with nature through composting?

Remind students of their weekly tasks, including watering, processing, and adding carbon and

nitrogen materials to the “active” compost pile (see Follow Up Compost Care), and completing the Weekly Aerobic Compost Log. Remind them to keep the compost area tidy. Measuring and recording the compost temperature on the Temperature Log is an optional activity for the class.

“When the compost pile is at least 3 feet high, we will stop adding materials and allow them to break down into finished compost, which can be harvested in about 3 to 6 months. It is important that you continue to water the ‘resting’ pile, even after you stop adding materials. Water is essential for life!”

Workbook Question #4: If time permits have students draw and label

FOLLOW UP COMPOST CARE

Follow Up Compost Care is the responsibility of the classroom teacher and students.

- Assign four **Compost Monitors** per week to process and add materials to the compost pile and water the pile thoroughly. It is very important that the materials be processed (chopped) before being added to the pile, and that the pile contains adequate moisture and a balance of carbon and nitrogen materials. Have Compost Monitors complete the Weekly Aerobic Compost Log Class Data Sheet.
- Optional: Use the hanging scale to weigh and record the amount of organic matter added.
- Optional: Use a compost thermometer to measure the temperature inside the aerobic compost pile every day, and record the data in the Temperature Log Class Data Sheet. After several days at 150°F (or 65°C; where weed seeds and pathogens are inactivated), it is best to keep the pile between 104° and 131°F (40° to 55°C) until the compost is mature (contents are unrecognizable). If necessary,

add carbon materials to cool the pile or nitrogen materials to heat it up, plus water as needed to keep it moist.

- Turning the compost pile is optional and helps the organic matter break down faster. If desired, use a pitchfork to turn the pile into an empty bin. If the compost materials appear dry, water them as they are turned.



Aerobic Compost Resource Sheet



Weekly Aerobic Compost Log



Temperature Log

FOLLOW UP ACTIVITIES

- Refer to the How To Create Aerobic Compost Resource Sheet for additional tips and troubleshooting.

Students must wash their hands thoroughly with soap and water after working with the compost.

HEALTHY SOIL IS ALIVE

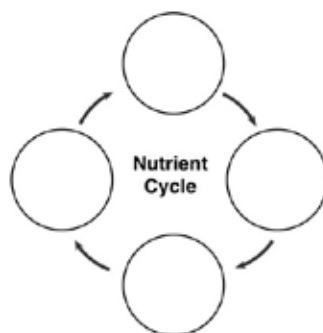
Healthy soil is teeming with life! One teaspoon of healthy garden soil may contain a billion bacteria, several yards of fungal hyphae, several thousand protozoa, and a few dozen nematodes. An equal sized sample of healthy compost can contain even more of these beneficial microorganisms, all contributing to the cycling of nutrients and the health of garden plants. Source: *Teaming With Microbes* by J. Lowenfels & W. Lewis

LESSON EXTENSIONS

Nutrient Cycle Game

(Obtaining, Evaluating, and Communicating Information)

- Create 2 simple game boards according to the diagram at right.
- Create 2 sets of these 4 simple vocabulary game pieces (drawings optional): Plants, Organic Matter, Decomposers, Soil, and Compost (pieces will be correctly arranged in this order).
- Divide students into 2 groups. Provide each group with a game board.
- Explain that the game pieces will need to be earned in order to make the entire nutrient cycle. The first group to complete the cycle (in the correct order) wins.
- Explain the rules of the game:
 - You must raise your hand to answer a question; answers shouted out will disqualify that team for that round.
 - Each team will have a chance to answer a question.
 - If a team answers correctly, they will choose a game piece.
 - If a team answers incorrectly, the other group will have an opportunity to answer it. If they get the correct answer they will then choose a game piece.



6. Examples of questions:

- Name four things that plants need to grow. Answer: Water, sunlight, air/carbon dioxide, nutrients/compost/soil.
 - Name the two categories of decomposers discussed. Answer: Microorganisms (bacteria, fungi, etc.) and invertebrates (worms, insects, etc.).
 - Describe the job of decomposers. Answer: Decomposers break down organic matter, making nutrients available to plants.
 - Name the five ingredients in an aerobic compost pile. Answer: Carbon (browns), nitrogen (greens), air, water, and life (decomposers including microorganisms and invertebrates).
 - Name three types of material that can be added to a compost pile. Answer: Green waste, fruit and vegetable waste, brown waste, cardboard, shredded paper.
 - Name three types of material that should not be added to a compost pile. Answer: Shiny magazines, meat products, processed foods, fish, plastic, just about anything man-made, etc.
7. Congratulate both teams as both are winners in knowing so much about nutrient cycles, decomposition, and creating compost!

