

DESCRIPTION

Students will discuss compost, organic matter, microorganisms, and the soil F.B.I. (fungi, bacteria, and invertebrates). They will discover the L.A.W. (life, air, and water) as the main ingredients for creating an aerobic compost pile, as well as what not to include. They will collect, process, and layer plant materials to create an 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 microorganisms (such as fungi and bacteria) and invertebrates play in creating compost.
- Build and maintain an aerobic compost pile and explain the main ingredients needed as well as what not to include.

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.W.2, Obtaining, Evaluating, and Communicating Information, Analyzing and Interpreting Data, Developing and Using Models, Systems and System Models

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

LESSON OUTLINE

- I. Introduction (20 minutes)
 1. What Is Compost?
 2. Organic Matter
 3. The Soil F.B.I.
 4. Main Compost Ingredients & the L.A.W.
 5. Do Not Include
 6. Group Activities Overview
- II. Group Activities (30 minutes)
 1. Plant Materials Processing (15 minutes)
 2. Compost Pile Creation (15 minutes)
- III. Closing (10 minutes)



KEY TERMS AND CONCEPTS

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

Āina - Land; that which feeds, nourishes, and sustains us (e.g., food, water, air)

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

Compost Pile - A heap of vegetation and other organic matter that is decomposing to become compost

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)

Microorganism - Any organism too small to be seen by the unaided eye, such as bacteria, protozoa, and some fungi and algae

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)

Lesson Supplies:

- Decomposers Sign
- Garden Agreements Sign
- Healthy Life Cycle Sign
- Kōkua Compost Song Sign
- Compost Map Answer Cards: Compost; Air; Water; L.A.W.; Decomposers (F.B.I.); Life/Organic Matter; Aerobic Composting: Browns; Aerobic Composting: Greens; Meat, Bones, and Processed Foods; Dairy; Cooking Oil; Glass; Metal; Plastic; Glossy Paper
- Optional: Compost thermometer
- Student Workbook
- Class Data Workbook



Compost Map
Answer Cards

Teaching Team to Provide:

- Bin materials: Wood pallets and discarded bicycle tubes (see Advance Preparation)
- Plant materials: Greens and browns (see Advance Preparation)
- Sample of finished compost

School to Provide:

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

ACCOMPANYING DOCUMENTS

- ĀINA Pre-Unit Survey
- Take Home Letter: Grade 3 Lessons 1-4
- 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.
- Confirm teachers have administered ĀINA Pre-Unit Surveys prior to the first lesson.
- 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.
- Make copies of the Guided Notes and Take Home Letter, one per student if not using the Student Workbook.
- Download the Kōkua Compost Song at www.kokuahawaiifoundation.org/audio
- Collect bin materials to create 3 compost bins: 7 wooden shipping pallets of approximately equal size (look for the best quality pallets available, made of untreated wood); 8 or more discarded bicycle tubes.
- Assemble the compost bins with students prior to this lesson. Stand pallets vertically so that they form the back and sides of the compost bins (see photo below and directions in the Resource Sheet). Attach the pallets together in several places at each corner by cutting the bicycle tubes and tying them in place securely with a double knot.
- 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.
- Collect samples of finished compost for use during the Introduction.
- Have students ready to take notes in their journals if not using Student Workbooks.

INTRODUCTION

20 MINUTES

“Aloha! We are... (state docents’ names) with the ‘ĀINA In Schools program. The ‘ĀINA In Schools program connects us to our food and land so we can live healthy lives and be great stewards of the environment. ‘ĀINA is an important Hawaiian word that means land and that which feeds, nourishes, and sustains us all, including food, water, and air.”

“When we come to visit you, we will discuss and practice waste reduction through composting.”

Get to know which ‘ĀINA components are being implemented at your school so you can briefly refer to them in this section. For example, “Some other classes are exploring nutrition and food choices, some are planting and caring for gardens, and some are visiting local farms to learn about where our food comes from.”



WHAT IS COMPOST?

“What is COMPOST?” Accept a few student answers. “COMPOST is decayed organic matter that is used to improve soil texture and fertility.”

Show students the sample of finished compost. “This may once have been leaves and banana peels! Now it is broken down so that the nutrients are available to plants again. Gardeners and farmers add finished compost to the soil, adding life and nutrients to improve the health of the soil, plants, and people!”



ORGANIC MATTER

“We begin the composting process by collecting and chopping up plant materials and carefully layering them to create a COMPOST PILE.”

The special name for these materials is ORGANIC MATTER, which is any material that is either living or that originated from life.” Have students think of and share examples of living organic matter (e.g., worms, roots, trees, bacteria) and organic matter that originated from life (e.g., fallen leaves, dead insects, wood chips).



“Today is our first lesson on composting and we are going to get started with a song, the Kōkua Compost Song by Jack Johnson.” Play the Kōkua Compost Song and have students sing along!

THE SOIL F.B.I.

“What causes the organic matter to break down inside a compost pile?”

Accept a few student answers. “In fact, the real work of creating finished compost is performed by the soil F.B.I.: FUNGI, BACTERIA, and INVERTEBRATES!

They are the main characters in the composting process! Fungi and bacteria are called MICROORGANISMS because they are too small to be seen by the unaided eye.” Show the Decomposers Sign and point out the electron microscope images of bacteria and fungi and the examples of different types of invertebrates that may be found in the garden and aerobic compost piles.



Kōkua Compost Song Sign

In Kindergarten and Grade 1 you grew healthy plants during ‘ĀINA Garden Lessons, in

Grade 2 you learned about eating healthy foods during ‘ĀINA Nutrition Lessons, and in Grade 3 you are going to learn about healthy soil during ‘ĀINA Compost Lessons.” Show students the ‘ĀINA In Schools Healthy Life Cycle Sign.

Workbook Question #1: Have students fill in healthy plants, food, and soil. Continue to use the Guided Notes and Compost Map Answer Cards to help lead discussion.



Healthy Life Cycle Sign



Decomposers Sign

INTRODUCTION

CONTINUED

Workbook Question #2: Have students write in and draw FUNGI, BACTERIA, and INVERTEBRATES.

Workbook Question #3 Have students draw a star next to the MICROORGANISMS (fungi and bacteria).



MAIN COMPOST INGREDIENTS & THE L.A.W.

“Let’s discover how to create compost by discussing the main ingredients in a compost pile.” Write the main compost ingredients on the board and use the Compost Map Answer Cards. **Workbook Question #4:** During the discussion, have students fill in the blanks.

1. Life/Organic Matter:

- **Carbon:** “Brown/dry materials, such as wood chips, leaves, and shredded paper.”
- **Nitrogen:** “Green/wet materials, such as fruit and vegetable waste and green plants.”
- **Decomposers (F.B.I.):** “Fungi, bacteria, and invertebrates may be added to the compost pile by adding small amounts of garden soil, vermicast tea, or un-decomposed materials sifted from a previous compost pile. Fungi and bacteria are also naturally present on organic plant matter and will thrive and multiply given the correct conditions.”



2. **Air:** “By alternating the carbon (brown) and nitrogen (green) materials while building the compost pile, and by preventing the materials from being compacted (e.g., avoid leaning on or pressing down on the pile), we ensure that our compost pile remains AEROBIC (air is present in the system). The balanced environment in our aerobic compost pile allows the F.B.I. to thrive!”



3. **Water:** “Water is essential for life! The F.B.I. need water in order to survive and thrive and carry out their important role in the composting process. The compost pile must be watered thoroughly as it is being built, and each week after that.”



The L.A.W.: “We can remember these main ingredients by asking, what LAW must an aerobic compost pile follow to decompose? The L.A.W. acronym stands for the 3 basic components of a compost pile.

Life, Air, and Water. Components of the Life/Organic Matter category are the the Browns = Carbon (dead organic matter), Greens = Nitrogen (living organic matter) and, the Decomposers = F.B.I.. The F.B.I. works for the L.A.W. because they are the life of the L.A.W..”



Processing the Ingredients: “By chopping up the carbon and nitrogen materials into smaller pieces, the compost process speeds up because the F.B.I. have access to more surface area on which to work.”

Putting It All Together: “When we add the main ingredients together in layers, something amazing happens: Our compost pile begins to heat up! This is thanks to the hard work of the microorganisms (mostly due to the bacteria) working to break down the organic matter into finished compost. Aerobic composting is also known as ‘hot composting’ because of the heat that is generated as the materials are broken down.”

Optional, if the compost thermometer will be used: Explain that students will use the compost thermometer and Temperature Log to measure and record the temperature at the center of the compost pile every day. 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.

INTRODUCTION

CONTINUED

DO NOT INCLUDE

“Certain things should not be added to the compost pile, including meats, fish, processed foods, and dairy products. Although they do decompose, they can go rancid, attract rodents and other pests, and make your pile smell bad if not composted properly. You also would not want to add materials that will not break down such as glass, metal, plastic, nor materials that might leach chemicals into your compost such as glossy paper from magazines. Small amounts of paper, cardboard, and compostable trays may be added if they have been torn into small pieces first.”

Workbook Question #7: Have students cross out the ingredients that stay out of the compost pile.



GROUP ACTIVITIES OVERVIEW

“Today we will create an aerobic compost pile and work with nature to reduce waste, recycle nutrients, and nourish the garden soil and plants. Does nature create any waste? No! Everything in nature is recycled over and over again!”

“One group will collect and process (chop) plant materials and the other will begin creating the compost pile, then we will switch.”

Garden Agreements

Have students take a deep breath, then repeat and discuss the Garden Agreements as listed on the Garden Agreements Sign. Spend some time during this first lesson to review with students the examples on page 2 of the 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 two groups before going outside.



GROUP ACTIVITIES

30 MINUTES

Have students wear garden gloves during the group activities. Rotate groups after 15 minutes. Regroup for closing.

Note: The purpose of the 3 compost bins are to contain:

1. “Resting” Compost Pile (once a compost pile reaches at least 3 feet in height it should be allowed to sit and rest for about 3 to 6 months as the materials break down into finished compost; continue watering thoroughly each week)
2. “Active” Compost Pile (one that is actively being added to)
3. “Storage” Bin (where unprocessed plant materials may be kept)



GROUP ACTIVITIES

30 MINUTES

PLANT MATERIALS PROCESSING

(15 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

(15 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. Have students refer to their Guided Notes and ask them to share about their experience.

Discuss with students.

- Why is composting important?
- Who are the soil F.B.I. and why are they important?
- Who is the L.A.W.?
- Describe the main ingredients in an aerobic compost pile, and also what not to include.

Explain the list of weekly tasks to students, 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 we will harvest in about 3 to 6 months. This will become the ‘resting’ pile. As soon as you put the pile to rest you can begin building your next compost pile in the second bin. It is important that you continue to water the ‘resting’ pile, even after you stop adding materials. Water is essential for life!”

If time permits, close with the Kōkua Compost Song, have the students sing along!

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.
- 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.



Aerobic Compost Resource Sheet



Weekly Aerobic Compost Log



Temperature Log

FOLLOW UP ACTIVITIES

Follow Up Activities are the responsibility of the classroom teacher.

- Have students complete #5 and #6 of the Guided Notes, draw and label the main ingredients in the compost pile. Review together as a class.
- Have students keep a journal about the composting experience including notes, opinions, drawings, poems, stories, etc.

- Have students make signs for the compost bins: Resting Pile, Active Pile, and Storage Bin.



LESSON EXTENSIONS

The Kōkua Compost Song

1. Review the lesson key terms and concepts.
2. Play the Kōkua Compost Song by Jack Johnson and have students raise their hand or make a tally each time they hear a compost key term.
3. Link for digital track download:
www.kokuahawaiiifoundation.org/audio

Soil, Compost, Mulch

(Analyzing and Interpreting Data)

1. Collect soil, compost, and mulch samples (about 1 to 2 handfuls each).
2. Have students examine the samples and record and analyze data about them in order to discover their similarities, differences, formation, composition, and how each is used in the garden:
 - Soil is a substrate for plant growth containing minerals, organic matter, air, and water.
 - Compost is decomposed organic matter and is used to improve soil texture and fertility.
 - Mulch is a material used to cover soil. It may be organic (e.g., wood chips, leaves) or inorganic (e.g., plastic) and is used to discourage weeds and preserve moisture.
3. Discuss the term ORGANIC:
 - Organic refers to life and living material.
 - Organic matter in the soil is composed of living organisms (e.g., worms, bacteria, insects) and formerly-living things (e.g., fallen leaves, dead insects).

Soil Investigation

(3.W.2, Obtaining, Evaluating, and Communicating Information, Analyzing and Interpreting Data, Developing and Using Models, Systems and System Models)

1. Discuss with students the fact that soil is composed of minerals (45%), organic matter (5%), air (25%), and water (25%) (percentages represent average proportions).
2. The different types of minerals in soil are sand (large particles, 2.0 to .05mm), silt (medium sized particles, .05 to .002mm), and clay (microscopic particles, <.002mm). Different combinations and amounts of these minerals give soil different characteristics (for example, how well it retains or drains water and nutrients).
3. Divide students into groups and have each group collect a scoop of garden soil (about 1/2 cup) from different areas or types of soil around campus and place each sample in a jar with water (about 2 cups). Label jars with group names.
4. Ask students to formulate a hypothesis about what they predict will happen after the jar is shaken and settled, based on what they have learned about the size of the different soil particles.
5. Close the lid tightly and shake the jar vigorously, then let it sit undisturbed for 24 to 48 hours.
6. The contents of the jar will separate into layers of different sized soil particles, from bottom to top: Pebbles, sand, silt, clay, and organic matter (floating on top).
7. Have students observe, record, and analyze the results by drawing and labeling a picture of their soil sample and writing informative/explanatory text to describe the results of their investigation.