3) Waste Management: The Cycle is Broken

Overview

Introduction

Nature has efficiently recycled since life began. Resources are used by organisms, broken down, and used again. Humans also create cycles, but they sometimes conflict with nature. When the natural cycle of biodegradation and renewal is broken, waste management can become a serious environmental issue.

Learning Objectives

After completing this unit, students will be able to:

- Understand the relative biodegradability of our trash;
- Explain how each of us in our daily lives contributes to pollution in the watershed;
- Take an active role in trash reduction by analyzing trash and learning to pack a trash-free lunch,
- Learn how to compost biodegradable trash; and
- Explain how human use of resources and the management of waste compare to the cycles of nature.

Unit Table of Contents

The table below lists the activities and documents in this unit and gives a brief description of the main ideas and the setting for each activity.

There are multiple activities for many learning phases of the unit. Teachers may choose to use one or more activities from any one phase.

Phase	Activity	Main Topic	Setting	Page
Engage	**STUDENT INTRODUCTION TO WASTE MANAGEMENT**	This is a student page that introduces the topic of waste management.	N/A	3-3
	3.1 TRASH TIMELINE	Biodegradability of Trash	Indoors/Outdoors, Small Groups	3-4
	3.2 WHO POLLUTED THE POTOMAC?	A Model to teach sources of Potomac River pollution	Indoors/Outdoors, Whole Class	*Insert*
Explore	**3.3 TRASH TALLY** (*optional student sheets included*)	Students collect and analyze trash categories (recyclable/non) to encourage personal responsibility.	Outdoors, Small Group/Whole Class	3-9
	3.4 COMPOSTING (*optional student sheets included*)	Students investigate the process of composting.	Outdoors, Whole Class/Small Group	3-17
	3.5 COMPOST IN A BAG	Students create small-scale compost piles.	Indoors/Outdoors, individual/small groups	3-27

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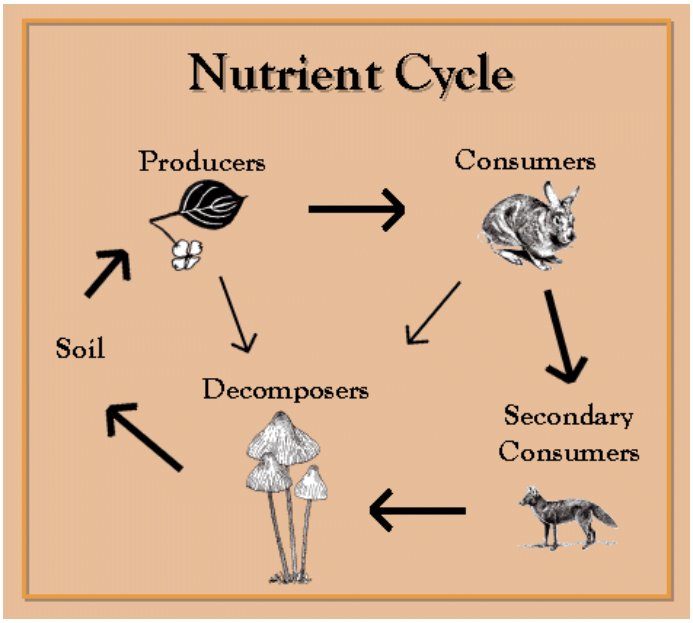
Unit Table of Contents (continued)

Student Introduction to Waste Management

Nature is really good at recycling living things. The picture below shows how energy and nutrients are exchanged between living things. In this unit, you will learn about the cycles of nature. You will also learn how human actions stop this cycle.



Plants (**PRODUCERS**) use energy from sunlight to make food.

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Energy from plants goes to animals (**CONSUMERS**) when they eat them.

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When plants or animals die, their bodies decompose (rot). **DECOMPOSERS,** like bacteria or fungus, break these dead things down into smaller pieces. This returns nutrients to the soil where it helps new plants to grow.

When humans make products like plastics, that aren't natural, they don't decompose (rot). This breaks the cycle.

If we REDUCE, REUSE, and RECYCLE materials, we can keep them from piling up as trash. Trash is a big problem in modern society.

3.1 Trash Timeline

Exploring the Biodegradability of Trash

Overview

Students will use common household objects to create a visual timeline depicting the rate of biodegradation of different materials.

Lesson Characteristics

Use the table below for lesson planning purposes.

Time Required	15-30 minutes
Key Concepts/Terms	Decompose; Biodegrade; Nutrient Cycling; 4 R's: Rethink, Reduce, Reuse, and Recycle
Prerequisites	None
Setting	Indoors or Outside; Small Groups

Learning Objectives

After completing this lesson, students will…

- Understand that some materials biodegrade much more quickly than others; and
- Recognize trash items that can be recycled, reused or composted as alternatives to sending them to the landfill.

Materials Needed

The table below lists the materials needed to conduct this activity.

Items Needed for the Whole Class	**Items Needed for Each Group**
Trash Timeline Display Board (to make a Trash Timeline Display board, attach one of each of the items you choose to put in student kits in the order in which they decompose, from fastest to slowest. Draw a line to connect these items in your "timeline.")	One Trash Timeline Kit composed of up to 10 items from the ***Biodegradation Rate Table*** below in a large, zip closure plastic bag.
Tape/Glue (hot glue works well)	
String/Twine	

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Background Information

Decomposition vs. Biodegradation
We generally use the words decompose and biodegrade interchangeably to mean "rot" in our society. Decomposition can also be used as the following: to break down into smaller pieces (physically). This is VERY different from rotting, and any claims of decomposition times by various industries should be researched carefully to understand how the word is being used.

Where these years came from
Although no one has lived for 450 or 600 years, many scientists believe plastics never entirely go away. These decomposition rates are estimates for the time it takes for these items to become microscopic and no longer be visible. Sources: EPA, Woods Hold Sea Grant – Marine Debris Talking Trash Taking Action

Why Do We Care?
Nature recycles by breaking down organic (once living) material into nutrients to be used again by new plants. Humans interrupt this cycle when they use and discard non-biodegradable materials. This activity helps students make more "environmentally-friendly" choices in their daily lives.

Trash Timeline Kits

For the Trash Timeline Kits, choose 10 items from the list below and put them in a large, zip-closure plastic bag (one for each group of students).

BIODEGRADATION RATES	
Material	**Time Required to Biodegrade**
Paper Towels	2-4 weeks
Newspaper	6 weeks
Apple Core (Add this in at the last minute. Do not store these in the plastic bag.)	2 months
Plain Cardboard (unwaxed)	2 months
Cotton cloth	2-5 months
Waxed Milk Carton	3 months
Cigarette*	5-10 years
Plastic Grocery Bag* (*If using Ziplock™ bag, longer)*	10-20 years
Steel Can	50 years
Styrofoam Cup*	50 years
Aluminum Can	200 years
6-pack Ring*	400 years
Plastic Bottle*	450 years
Disposable Diaper*	450 years
Monofilament Fishing Line*	600 years
Glass Bottle	Thousands to millions of years

**Items are made from a type of plastic.*

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Procedure

Follow the steps in the table below to conduct the activity. *Items in italics are possible student answers to questions.*

Phase	Step	Action
Engage	1	**Prepare** one completed Trash Timeline display, mounting the same materials that the students receive in their kits on the display board. Use the string as your "timeline" to show the order in which materials decompose, from fastest to slowest. Hide this "answer key" until students have completed their own Trash Timelines.
	2	Break a Styrofoam cup into pieces. Then cut an apple into pieces. Ask students to explain what will happen to these items over time. *The Styrofoam can break into small pieces, but will never biodegrade/rot, like the apple.*
	3	Ask students if they have ever heard the terms **BIODEGRADE** or **DECOMPOSE**. Discuss what they think these might mean and lead them to understand that these terms are synonymous with **ROT.**
	4	**Explain** that students will be completing an activity to learn about how different materials BIODEGRADE/DECOMPOSE/ROT.
	5	**Pass out** one Trash Timeline Kit (that you have prepared ahead of time) per group of 4-6 students.

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Procedure (continued)

Phase	Step	Action
Explore	6	Give students 10 minutes to sort the items in their Trash Timeline Kit (including the large, re-sealable plastic bag) into a "timeline," from the item that they think will take the shortest amount of time to biodegrade to the item that they think will take the longest.
Explain	7	Once all groups are ready, have each group present their predictions/hypotheses to the class.
	8	Show your prepared Trash Timeline Display Board. Allow students to compare and rearrange their items to match the real timeline.
	9	Discuss the actual times that each material takes to biodegrade. For each item, discuss what natural resource was used to make it. Have students classify items are renewable/non-renewable.
	10	Ask students if they can think of items that are composites – items made of more than one material. What happens to these? *Examples could include diapers with plastic linings, milk cartons/juice boxes with wax/foil linings, etc.*
	11	Discuss which materials are reusable (plastic bags, rope), recyclable (plastic bottles, aluminum or steel cans, glass), or compostable (orange/apple, cotton, rope, paper). Compost is most likely a new concept for students and may need further explanation before they can identify which items can be composted.
	12	Discuss why we buy and use non-biodegradable products. *Answers include convenience, low cost, etc.* Explain that we all make choices and we need to consider the consequences of our actions.

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Procedure (continued)

Phase	Step	Action
Elaborate	13	Use any of the following suggestions to elaborate on this activity: • Have students research different materials to understand why they decompose at certain rates. • Have students create a "trash time capsule" where they collect different items and bury them. Later, dig up the capsule and examine the decomposition/biodegradation process. • Students can create different experiments to test the rate of decomposition/biodegradation by varying the materials, or the experimental setting (moist vs. dry; exposed to light/dark, etc.). • Visit a local landfill and discuss the rate at which it is filling with the manager. • Visit a local recycling center or start a recycling project at school or home.

Sources:

https://uhs.berkeley.edu/tobaccofacts

https://marinedebris.noaa.gov/sites/default/files/TalkingTrashTakingAction.pdf

3.3 Trash Tally

A Look at What's In Our Trash

Overview

During the Trash Tally, students will collect and analyze trash to understand how much of it could or should have been recycled. This activity will serve two purposes:

1. Students do a public service by collecting trash; and
2. By analyzing that trash, students will become more aware of how they might be contributing to the trash problem.

Lesson Planner

Use the table below for lesson planning purposes.

Time Required	Trash Collection: 10-20 minutes Data Analysis: 5-15 minutes
Key Concepts/Terms	Watershed, 4 R's: Rethink, Reduce, Reuse, & Recycle
Prerequisites	Understanding of the watershed concept
Setting	Outside, Small groups of 3-5 students

Learning Objectives

After completing this activity, students will be able to:

- Understand how trash travels throughout the watershed and ends up in our streams, rivers and bays;
- Realize how much of the trash we find could have and should have been recycled or reused; and
- Explain how personal actions might be contributing to a major environmental problem.

Materials Required

The following materials are required to complete this activity:

- Bags for collecting trash (grocery bags are a manageable size; each group should have separate bags for recyclables and all other trash)
- ***Student Sheets – Trash Tally,*** pg. 14
- Clipboards
- Pencils
- Spring scales (if scales are not available, trash can be analyzed by volume / number of bags)
- Container for sharp objects, such as needles or broken glass* (An empty detergent bottle works well.)

  NOTE: Only adults should handle these objects, not students, and these should be disposed of as per biohazard guidelines.
- Optional: work gloves

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Procedure

Follow the steps in the table below to conduct the activity. **Sentences in bold are suggestions for what teachers might say to students.** *Items in italics are possible student answers to questions.*

Phase	Step	Action
Engage	1	Preparation • Choose a site that will be safe to clean. If along a shore, avoid areas with very deep water or swift current. Also, avoid steep ravines or hillsides, or areas of deep mud. If cleaning up a schoolyard, clearly define areas that are off-limits. • Determine how to dispose of trash. Get permission to use school or other trash facilities. Find out what is recyclable in your area.
	2	**"We are going to collect trash and analyze it to determine how it got there and how much of it could/should have been reused or recycled. One member of each group is going to be the data recorder, and the others will collect the trash and report their findings."**
	3	Divide students into teams of 3-5 people. Assign each team a specific area to clean.
	4	To each group distribute: • One clipboard, with a ***Trash Tally Worksheet*** attached • Two sets of bags: one for collecting trash, the other for collecting recyclables • A pencil • A spring scale • Optional: work gloves (one pair per student collector)
	5	**"When you collect a piece of trash, you need to decide if it is a recyclable item or not. Recyclables should go in separate bags from the non-recyclables. When a bag is full, take it to your data recorder, who will weigh it and record it on the Trash Tally worksheet. The first full bag that is weighed is Bag #1, etc.** As an alternative to having one person record as you go along, all group members can collect trash, and then measure and record data at the end of trash collection.

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Procedure (continued)

Phase	Step	Action
Engage	6	Go over safety rules: **a) Do not pick up hypodermic needles or waste medical supplies*.** **b) Do not pick up broken glass or bulging cans, which might explode when touched*.** c) **Do not pick up aerosols or propane containers*.** *Inform an adult, who will safely pick up these items.
Explore	7	Give students 10-20 minutes to pick up trash and collect the data, depending on the amount of trash and size of your chosen site.
	8	Dispose of the trash properly. Items that are in recyclable condition (relatively clean and free of dirt/sand) should be bagged separately and recycled.
	9	Compile the class data. Calculate the approximate percent that could have been recycled. This could be done by counting items, by weight, or by number of filled trash bags (if recyclables were bagged separately).
	10	Have students complete the rest of the ***Trash Tally Student Worksheet***, pg. 14.

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Procedure (continued)

Phase	Step	Action
Explain	11	Discuss student answers to the analysis questions on the ***Student Sheet – Trash Tally***, pg. 14. Sample answers are listed below: **What are the most common types of litter?** *Plastic is probably a large portion of the trash in any littered area because it lasts almost forever, and is light enough to be carried by wind or water. Other non-biodegradable trash will also rank high.* **Where did all this litter come from?** *The trash found on a shoreline could have come from anywhere in the watershed, even areas far from any stream. In heavy rainstorms, trash is carried by runoff into storm drains that empty into streams and rivers. Anything that can float could be carried long distances.* *Often, trash may be linked to a particular activity. For example, an oil container comes from someone who changed their oil, fishing line and chicken liver containers (livers are used for bait) from someone who fishes, etc.* **Are any of the collected types of litter hazardous to wildlife or the environment?** *Many types of trash put animals or water supplies in danger. Six-pack plastic rings and fishing line entangle animals, preventing them from moving or feeding. Oil and other automotive fluid containers usually leak small amounts of toxic chemicals into the environment. Bits of Styrofoam may be mistaken for food by animals leading to digestive problems and possible death when eaten.* **What else can we do to help solve the problem?** *The suggestions students have may range from deciding that they will not drop litter, to thinking about recycling at home or school, to thinking about buying products in containers that can be easily reused or recycled.*

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Procedure (continued)

Phase	Step	Action
Elaborate	12	• Assist the class in organizing cleanups on the school grounds involving other classes or grades, on a continuing basis. • Have students identify the trash that is most commonly found caught in the school fence, or along the edge of a parking area, and trace it to its source. Find ways to prevent its recurrence.
Evaluate	13	Use the ***Student Sheet – Trash Tally*** for evaluation.

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Trash Tally Student Worksheet

What You Are Going to Do

With your group, you are going to collect, sort and weigh trash to figure out what portion of it is recyclable, how it got there and how to solve the trash problem.

Objectives

After completing this activity, you should…

- Understand how trash moves through the watershed and ends up in our streams, rivers and bays;
- Explain how much of the trash you find could and should have been recycled or reused; and
- Be able to give two examples of how people's actions are contributing to this major environmental problem.

Materials Needed

Your group will need:

- Trash collection bags – one for recyclables, and one for all other trash
- A clipboard
- This worksheet
- A spring scale (to weigh your trash)

Part A. Collect the Trash

1. One person in your group needs to be the data recorder. This person will use the clipboard and the data table to record the data you collect during this activity.

2. Collect all of the trash in your area. Separate recyclables from non-recyclables in different bags.

3. When you have a full bag, take it to the data recorder. This person will weigh it and record the weight on the data table.

4. After the trash collection time is over, dispose of all the trash as your teacher tells you.

Part B. Collect the Data

Now we need to collect the data from the entire class.

5. Your teacher will put each group's data on the board. Copy down the all of the data on your data table.
6. Calculate the total weight of the following categories and fill in these numbers on your data sheet:
    - all of the bags,
    - just recyclable bags, and
    - just the non-recyclable bags.

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Part C. Analyze the Data

7. Answer the questions below to analyze your data.

What are the most common types of litter?

Explain how the litter got here.

Explain which kinds of litter are dangerous to wildlife or the environment and why.

What else can we do to help solve the problem?

Trash Tally Data Table

Bag #	Recyclable? (Yes or No)	Weight of bag

Total Weight of Recyclables = _____

Total Weight of Non-Recyclables = _____

Total Weight of All Trash = _____

3.4 Composting

Investigating and Learning from Nature's Recycling System

Overview

Students will examine decomposition/biodegradation in nature to identify necessary factors, and will then apply their knowledge to learn how we can imitate nature to reduce trash and benefit other organisms.

Lesson Planner

Use the table below for lesson planning purposes.

Time Required	One hour
Key Concepts/Terms	Energy Cycle, Decomposition, Biodegradation, Compost
Prerequisites	***Trash Timeline,*** Understanding of the Energy Cycle and Habitats (see ***Illustrated Glossary***).
Setting	Outside, Whole Class

Learning Objectives

After completing this activity, students will be able to…

- Explain why decomposition is necessary and beneficial to the ecosystem;
- Explain what conditions are necessary for biodegradation; and
- Explain the necessary components for creating a successful compost pile.

Materials Required

<u>For the Class</u>

- One large demonstration jar with visually distinct layers of organic wastes: grass clippings, dried leaves, coffee grounds, straw, banana peels, etc.
- One large demonstration jar with completed compost
- Enlarged version of the pie chart, ***US Trash Data***, pg. 24 (alternatively, you could have a copy on the clipboard for each group).

<u>Per Group</u>

- Clipboard with data sheet
- Diagram of ***Food Web of the Compost Pile,*** pg. 26
- Zip-closure bags with:
  - Spoon
  - Marker
  - Small container for collecting decomposers

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Background Information

What is Compost?
Compost is a mixture that consists largely of decayed organic matter and is used for fertilizing and conditioning land.

How Do We Compost?
Organic (once living) materials are combined under conditions favorable for decomposition: moisture, heat (room temperature or above), and air. This can be done on various scales from quite small to very large. Many gardeners have compost bins or areas in their yard. These are easy to maintain and produce excellent additions to garden soil.

Why Should We Compost?
Backyard composting is a way to recycle food scraps, such as apple cores and vegetable peels; and yard waste, such as grass clippings, weeds, branches, etc. This reduces the amount of material sent to the landfill, and recycles organic matter for improving our soils.

What SHOULD go in a Compost Pile

The following list explains what is necessary for a successful compost pile.

Component	Amount	Examples
Carbon Source	2 parts	dry leaves, chopped woody stems, straw, sawdust, or other dried plant matter
Nitrogen Source	1 part	moist kitchen scraps, young weeds, grass clippings, manure from plant-eaters
Air	enough air for aerobic organism survival	layering materials and turning the pile from time to time adds oxygen needed for aerobic organisms to survive
Microorganisms	Soil sprinkled throughout your pile will give you all you need.	earthworms, bacteria, fungi, sow bugs, etc.
Water	moist, but not soggy	N/A

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What Should NOT go into a Compost Pile

Below is a list of things to avoid putting in a compost pile:

DO NOT INCLUDE:

- meat or bones
- plywood
- dairy products
- poisonous plants
- grease
- diseased plants
- droppings from meat-eaters
- barbecue ashes
- weeds of invasive plants having seedpods
- sawdust from chemically treated wood

Note: Never put meat scraps (or cooked food if you live in a city) in compost, as this may attract animals. If you live in a more rural area, you may include cooked food (that doesn't contain meat) if you bury it in your pile.

Procedure

Follow the steps in the table below to conduct the activity. **Sentences in bold are suggestions for what teachers might say to students.** *Items in italics are possible student answers to questions.*

Phase	Step	Action
Engage	1	Brainstorm with students all the words that come to mind when you say the word "rot." List them all on the board (If you are conducting the entire activity outside, take along a portable white board).
	2	After the list is complete, discuss the words, and circle any that are beneficial. ***Note:*** It is important for students to move beyond disgust with rotting and see the value of decomposition, which is that old organic matter is broken down to be made into something new.
	3	**"Imagine a world without rotting. What would it look like? How would your life be different?"**

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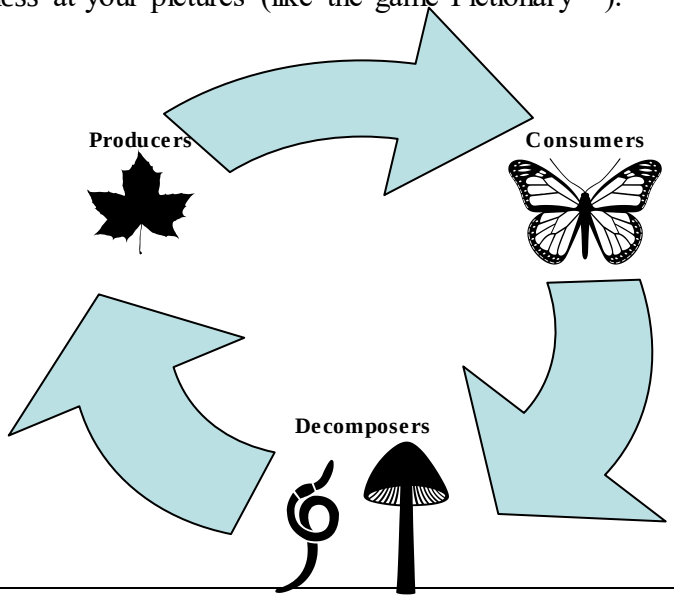
Procedure (continued)

Phase	Step	Action
Engage	4	Discuss why rotting is so important to the ecosystem, and how it fits into the Energy Cycle (see the ***Illustrated Glossary***) Draw a simple Energy Cycle on the board (see sample below) and have students guess at your pictures (like the game Pictionary™). 
	5	Review: • ***Trash Timeline*** – Some things biodegrade quickly (organic materials), others take longer (manmade materials). • Where trash goes (landfill), and reasons why this interrupts the Energy Cycle.
	6	Examine the ***US Trash Data Sheet***, pg.24, with students. Discuss the following points: • **Which types of trash would biodegrade and return to the Energy Cycle?** *Paper, Food, Wood, Yard Waste* • **What is the total percent of biodegradable trash that could have been kept out of the landfill?** *71%* • **Which types of trash could possibly be recycled?** *Paper, Metals, Plastics, Glass* • **What is the total percentage of potentially recyclable trash that could have been kept out of the landfill?** *56%* • **What is the total percentage of material that could have been kept out of the landfill?** *91% -- To get this total, subtract the "other" and "rubber, leather, and textiles" categories from 100%. Paper was counted in both biodegradable and recyclable, so you can't just add the two percentages calculated previously, as this would total 126%.*

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Procedure (continued)

Phase	Step	Action
Engage	7	Discuss that we can learn how nature recycles materials and imitate it for two benefits: • Remove organic waste – reduce trash • Return nutrients to the Energy Cycle for other living things to use
Explore	8	Pass out the data sheet and explain what students are expected to do. Stress the following points: • BE GENTLE when collecting soils and organisms – don't harm them • Set boundaries of the study area • Respect for nature – Return everything where you found it.
	9	Hand out a plastic bag with supplies to each group.
	10	Give students 15-20 minutes to investigate and collect data.
	11	Have students share their data and look at the organisms each group collected.
Explain	12	Have students generate a list of what factors are necessary for things to biodegrade: • Decomposers • Food Sources (Carbon & Nitrogen) • Good Conditions – Air & Moisture

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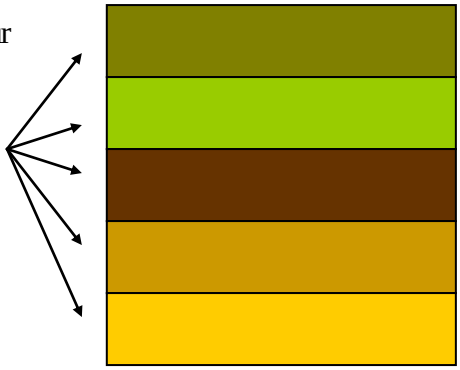
Procedure (continued)

Phase	Step	Action
Explain	13	**"We are going to imitate nature to recycle organic materials and return the nutrients to the Energy Cycle, rather than sending them to the landfill."** **"In order to do this, we need to create a good home for decomposers. What would they need to live?"** *Student answers should include FOOD (yard/farm/kitchen wastes), WATER (It should be moist, but not soggy), and AIR (The soil needs to be mixed from time to time).*
	14	**"When we talk about worm food, it must have been living once."** Spread out a bunch of items and ask students to decide what could/could not go in a composting bin.
	15	Show examples of composting in process: • Show students your jar of organic waste before composting. Walk around and have students identify the layers. Make your jar with visibly different layers of organic waste, as shown in this diagram.  • Show another jar with finished compost. Let students touch the compost and examine its texture. This is the good stuff! • Show students a worm bin. Again, let them examine the materials, look for decomposers, etc.

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Procedure (continued)

Phase	Step	Action
Elaborate	16	• Using the activity ***Compost in a Bag***, pg.27, students create their own miniature composting system, which can be the source of many experiments to further understand the process of composting. • Create a class compost pile or vermiculture bin at your school.
Evaluate	17	Use ***Student Sheet – Composting***, pg. 25

Vocabulary

Understanding of the following terms is useful in this activity.

Term	Definition
Biodegrade	To rot/decay; to break up into constituent parts physically, biologically and chemically
Compost	A mixture that consists largely of decayed organic matter and is used for fertilizing and conditioning land
Consumer	An organism that consumes other organisms to gain energy
Decompose	To break down into smaller component parts
Decomposer	An organism that helps to break organic material down physically, chemically and biologically
Energy Cycle	The constant exchange of energy from producers to consumers to decomposers, which return nutrients to the soil for producer use in a food chain/web
Producer	An organism that can make its own food (usually a photosynthetic organism)

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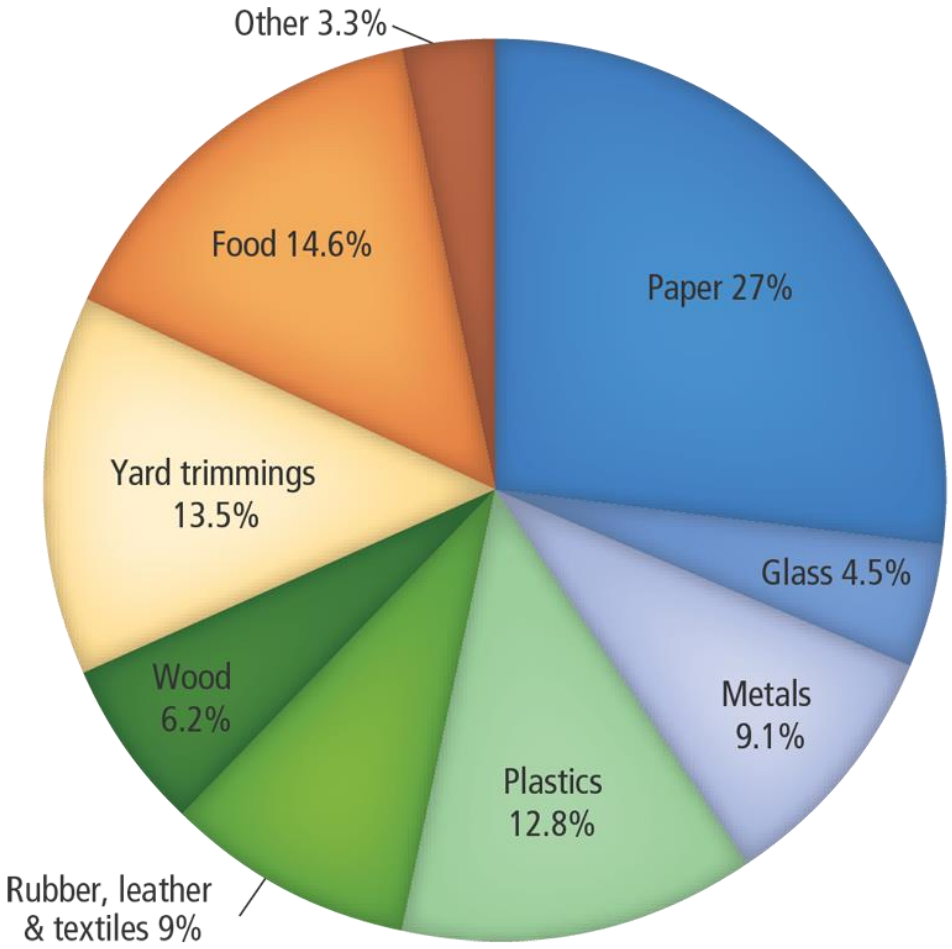
U.S. Trash Data

2013 Trash Data The graph below show the net waste disposal for the United States during 2013

Data source: Characterization of MSW in the US: https://archive.epa.gov/epawaste/nonhaz/municipal/web/html/index.html



Student Sheet -- Composting

Objective

Your job is to find out what is has to be present for things to decompose (rot) in nature.

Materials

- Clipboard with this data sheet
- Sturdy Spoon
- Container for collecting decomposers
- Diagram of Compost Pile Food Web

How Does It Happen?

1. Find a place in the natural world where you can see decomposition (rotting) happening. Check off everything you find on the list below. Write in anything you find that is not on the list.

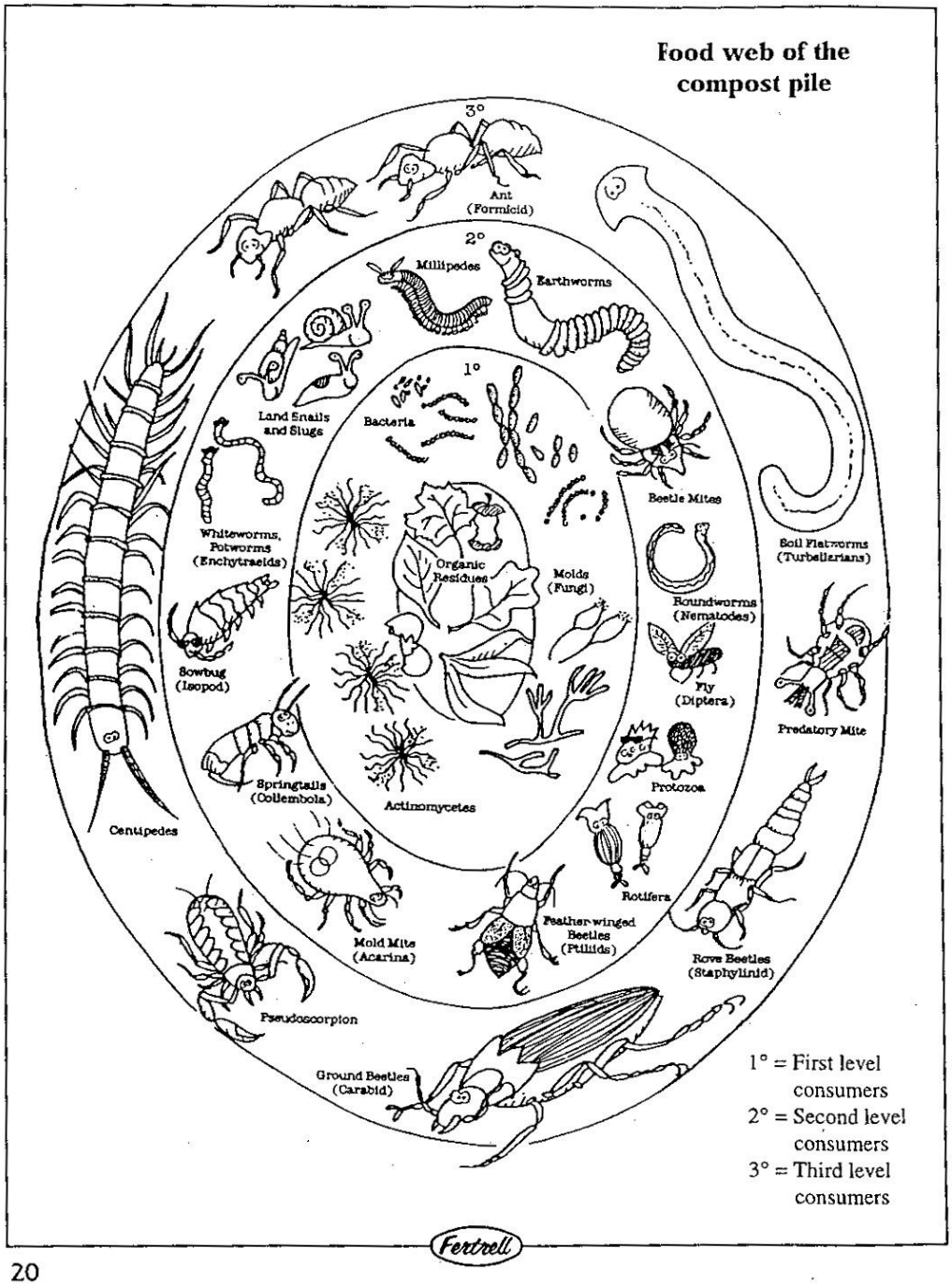
Things Needed for Decomposition		
Soil Organisms	**Food Source (Organic Matter – Nitrogen & Carbon)**	**Conditions**
_____ Earthworms	_____ Leaves	__ Water (moisture)
_____ Sow bug	_____ Wood	_____ Air (spaces, small particles)
_____Millipede	_____ Animal parts	_____ Other:
_____Beetle or Beetle Grub	_____ Animal Droppings	
_____Fly or Fly Larva	_____ Dead Insects	
_____Bacteria (slime)	_____ Other:	
_____Fungus (mushrooms or white threads)		
_____Other:		

What is Missing?

2. Find a place where little or no decomposition is happening. What is missing?

Food Web of the Compost Pile

The diagram below shows the food web of the compost pile. Source: The Fertrell Company Catalog.



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3.5 Compost in a Bag: Moving Beyond Rot

Making Compost in the Classroom

Overview

Students will create their own miniature compost pile to test and observe the decomposition rates of various organic materials.

Lesson Characteristics

Use the table below for lesson planning purposes.

Time Required	Set up: 1 hour Observation & Data Collection: Weeks/Months
Key Concepts/Terms	Decomposition; Biodegradation; Energy Cycle: Food Chains/Food Webs; 4 R's: Rethink, Reduce, Reuse, & Recycle; Composting
Prerequisites	Students should have completed the ***Trash Timeline*** (see pg.4)
Setting	Indoors/Outdoors; Individual/Small Groups

Learning Objectives

After completing this activity, students will be able to…

- Explain the form and function of soil as well as the process of decomposition; and
- Explain how resources are continually recycled in nature.

Materials Required

For each student/pair of students, you will need:

- One large, plastic zip-closure bag
- Compostable materials (see ***What Should Go in a Compost Pile***, pg.36; and ***What Should NOT Go in a Compost Pile***, pg.37)
- Recycled containers for measuring compost pile ingredients

Continued on next page

Background Information

What is Compost?
Compost is a mixture that consists largely of decayed organic matter and is used for fertilizing and conditioning land.

How Do We Compost?
Organic (once living) materials are combined under conditions favorable for decomposition: moisture, heat (room temperature or above), and air. This can be done on various scales from quite small to very large. Many gardeners have compost bins or areas in their yard. These are easy to maintain and produce excellent additions to garden soil.

Why Should We Compost?
Backyard composting is a way to recycle food scraps, such as apple cores and vegetable peels; and yard waste, such as grass clipping, weeds, branches, etc. This reduces the amount of material sent to the landfill, and recycles organic matter for improving our soils.

What SHOULD go in a Compost Pile

The following list explains what is necessary for a successful compost pile

Component	Amount	Examples
Carbon Source	2 parts	dry leaves, chopped woody stems, straw, sawdust, or other dried plant matter
Nitrogen Source	1 part	moist kitchen scraps, young weeds, grass clippings, manure from plant-eaters
Air	enough air for aerobic organism survival	layering materials and turning the pile from time to time adds oxygen needed for aerobic organisms to survive
Microorganisms	Soil sprinkled throughout your pile will give you all you need.	earthworms, bacteria, fungi, sowbugs, etc.
Water	moist, but not soggy	N/A

Continued on next page

What Should NOT go into a Compost Pile

Below is a list of things to avoid putting in a compost pile:

DO NOT INCLUDE:

- meat or bones
- plywood
- dairy products
- poisonous plants
- grease
- diseased plants
- droppings from meat-eaters
- barbecue ashes
- weeds of invasive plants having seedpods
- sawdust from chemically treated wood

Note: Never put meat scraps (or cooked food if you live in a city) in compost, as this may attract animals. If you live in a more rural area, you may include cooked food (that doesn't contain meat) if you bury it in your pile.

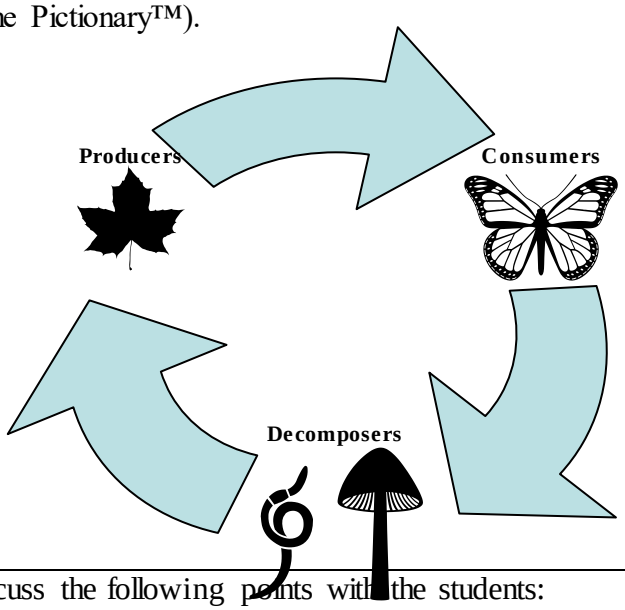
Procedure

Follow the steps in the table below to conduct the activity. **Sentences in bold are suggestions for what teachers might say to students.** *Items in italics are possible student answers to questions.*

Phase	Step	Action
Engage	1	***Note:*** If you completed the *Engagement* as part of ***Composting***, pg. 17, skip this section, and proceed to *Explore*. Brainstorm with students all the words that come to mind when you say the word "rot." List them all on the board.
	2	After the list is complete, discuss the words, and circle any that are beneficial. ***Note:*** It is important for students to move beyond disgust with rotting and see the value of decomposition, which is that old organic matter is broken down to be made into something new.

Continued on next page

Procedure (continued)

Phase	Step	Action
Engage	3	Discuss why rotting is so important to the ecosystem, and how it fits into the Energy Cycle (see the ***Illustrated Glossary).*** Draw a simple Energy Cycle on the board (see sample below) and have students guess at your pictures (like the game Pictionary™). 
	4	Discuss the following points with the students: **Have they ever seen anything rotting in nature**? *Log, dead animal, leaves* **Did they notice if there was anything helping these things to decompose?** *fungi, termites, earthworms, sowbugs, etc.* **What happens to the trash once it goes to the curb?** *Trash collectors take it to the landfill, where it piles up.* **What happens to garbage at the landfill? Does it decompose? Why not?** *It is covered with compacted soil/concrete, which results in a lack of oxygen, so many types of bacteria and fungi cannot break down the organic materials.*
Explore	5	Discuss composting as a process of breaking down organic material to be reused, as in soils for new plants. Explain that students will be making their own compost in a bag.

Continued on next page

Procedure (continued)

Phase	Step	Action
Explore	6	Show a list of materials that can be included in a compost pile (see ***What Should Go In A Compost Pile,*** pg.36).
	7	Give each student a large plastic zip-closure bag. (Try to collect used ones if possible, to further reinforce recycling concepts.)
	8	Have students select materials, from those you have collected, to add to their compost bag, making sure that the bag is no more than ½ full.
	9	Have students record the ingredients and quantities they included in a journal.
	10	Students should observe the bags several times/week and record changes in their journals.
	11	After recording observations, open the bags briefly, reclose and shake to mix the contents. There may be some odor at the beginning of the process, which is from bacteria at work.
Explain	12	After sufficient time has passed for changes to occur, have students draw conclusions, discuss results, and make comparisons.

Continued on next page

Procedure (continued)

<table>
<tr><th>Phase</th><th>Step</th><th>Action</th></tr>
<tr><td>Elaborate</td><td>13</td><td>Students may conduct various experiments in the bags, by selecting an independent variable for their compost bag, choosing a dependent variable to measure, forming hypotheses about what will happen, observing the results and drawing conclusions.

The table below gives some examples that students might choose for their experiments.

<table>
<tr><td>Term</td><td>Examples</td></tr>
<tr><td>Independent Variable</td><td>• Amount of one of the following: sunlight, water, air exchange, etc.
• Size of organic pieces included
• Mixing rate
• Chemical Additives</td></tr>
<tr><td>Dependent Variable</td><td>• Amount of time required for decomposition
• Amount of compost produced in a given time period
• Odor produced</td></tr>
<tr><td>Hypothesis</td><td>• Bottled water will result in faster decomposition than tap water.
• Increasing the temperature will increase the decomposition rate.</td></tr>
</table>
</td></tr>
<tr><td>Evaluate</td><td>14</td><td>Students can write a report or give a presentation on their experiment.</td></tr>
</table>

Continued on next page

Vocabulary

The following terms are useful in this activity.

Term	Definition
Aerobic	Living, active, or occurring in the presence of oxygen
Anaerobic	Living, active, or occurring without any oxygen
Biodegrade	To rot/decay; to break up into constituent parts physically, biologically and chemically
Decompose	To break down, physically, into constituent parts
Energy Cycle	The constant exchange of energy from producers to consumers to decomposers, which return nutrients to the soil for producer use in a food chain/web
Food Chain	The sequence of transfers of food energy from one organism to another (Producer-Consumer-Decomposer: who eats what)
Food Web	The complex association of plants and animals in nature, whereby organisms are interconnected because they are sources of food for one another. At the base of the food web are green plants and bacteria, which supply food for small animals. Larger animals eat smaller animals, as well as plants. In addition, decomposers recycle nutrients by breaking down decaying plants and animals.
Organic Matter	Matter that came from living things
Recycle	The salvage and reprocessing of used materials, such as paper, metals, glass, cloth or organic matter

3.6 Complete the Compost Heap

Recycling in Nature

Overview

This activity is an energetic, fast-paced card game, based on the more traditional card game of SPOONS, which can be used to introduce/review the components of a successful compost pile.

Lesson Planner

Use the table below for lesson planning purposes.

Time Required	30 minutes
Key Concepts/Terms	Composting
Prerequisites	None
Setting	Indoors/Outdoors; Students will work in groups of 5-8.

Learning Objectives

After completing this activity, students will be able to…

- Explain what components are necessary for successful composting; and
- Understand what compost is, and how and why it is used.

The diagram at left shows a sample compost pile.

Continued on next page

Materials Required

The following materials are required for **EACH** group of 5-8 students:

Material	Amount	Things to Note
Complete the Compost Heap Playing Cards (see pg. 42)	10 sets	For durability, copy the templates on heavy cardstock. You may choose to laminate the cards as well, but this is not necessary. If you do not have a color copier, use markers to color around the cards so that each category is a different color.
Objects to represent worms	You will need enough objects per group to equal one less than the number of students in that group. Example: if there are 5 students in a group, you'll need 4 objects.	Pipe cleaners work well, but you could also choose to use pencils, sticks, straws, etc.
Complete the Heap Key Card (see pg. 43)	One	You may choose to have more than one card if you have larger groups of students.
Complete the Heap Player Instructions (see pg 44)	One	You may choose to have more than one instruction sheet if you have larger groups of students.

Background Information

What is Compost?
Compost is a mixture that consists largely of decayed organic matter and is used for fertilizing and conditioning land.

How Do We Compost?
Organic (once living) materials are combined under conditions favorable for decomposition: moisture, heat (room temperature or above), and air. This can be done on various scales, from quite small to very large. Many gardeners have compost bins or areas in their yard. These are easy to maintain and produce excellent additions to garden soil.

Continued on next page

Background Information (continued)

Why Should We Compost?

Backyard composting is a way to recycle food scraps, such as apple cores and vegetable peels; and yard waste, such as grass clipping, weeds, branches, etc. This reduces the amount of material sent to the landfill, and recycles organic matter for improving our soils.

What SHOULD go in a Compost Pile

The following table explains what is necessary for a successful compost pile.

Component	Amount	Examples
Carbon Source	2 parts	Dry leaves, chopped woody stems, straw, sawdust, or other dried plant matter
Nitrogen Source	1 part	moist kitchen scraps, young weeds, grass clippings, manure from plant-eaters
Air	enough air for aerobic organism survival	layering materials and turning the pile from time to time adds oxygen needed for aerobic organisms to survive
Microorganisms	soil sprinkled throughout your pile will give you all you need	Earthworms, bacteria, fungi, sowbugs, etc.
Water	moist but not soggy	N/A

Continued on next page

What Should NOT go in a Compost Pile

Note: Never put meat scraps (or cooked food if you live in a city) in compost, as this may attract animals. If you live in a more rural area, you may include cooked food (that doesn't contain meat) if you bury it in your pile.

Below is a list of things to avoid putting in a compost pile:

• meat or bones	• plywood
• dairy products	• poisonous plants
• grease	• diseased plants
• droppings from meat-eaters	• barbecue ashes
• weeds of invasive plants having seedpods	• sawdust from chemically treated wood

Procedure

Follow the steps in the table below to conduct the activity. **Sentences in bold are suggestions for what teachers might say to students.** *Items in italics are possible student answers to questions.*

Phase	Step	Action
Engage & Explain	1	**Say: "Have you ever played the game SPOONS? We are going to play a card game that is very similar."**
	2	**"We are going to learn what types of things are necessary for a compost pile. Composting is the breaking down of organic material (once living) to be reused, as in soils for new plants."**
	3	**"When we compost, we help rotting things break down faster and this returns the nutrients to the soil so other living things can use them. In order to speed up this process, we need to have certain things in our compost pile, and this game will teach us how to do that."**
	4	Pass out sets of cards to each student group.

Continued on next page

Procedure (continued)

Phase	Step	Action
Engage & Explain	5	There are six different cards in this game. We suggest discussing what each card is, why it is important, and how to get that part in a compost pile. A sample script for CARBON is provided below. "**Everyone find a card that shows CARBON, and hold it up in the air so that I can see.**" After students have found the requested card, hold one up yourself and say, **"CARBON is necessary for composting. Carbon sources are generally brown in color. What kinds of things does the card say we should put in the compost pile to add CARBON?"** *Students should read the card and volunteer shredded paper, sawdust, coffee grounds, dry leaves, wood chips, and straw.*
	6	Repeat this discussion for each of the remaining five cards, changing the specifics as pertain to each component/card.
Explore	7	Pass out the ***Complete the Heap Key Cards*** to each group (see pg. 43). **"Take a look at the key cards I have just passed out. To make a complete hand in this card game, you must have all of the parts necessary to make a complete compost heap. Let's review them. You'll need:** • 2 CARBON SOURCE CARDS (You need approximately 2 times the amount of Carbon as Nitrogen in a real compost pile.) • 1 NITROGEN SOURCE CARD • 1 WATER CARD • 1 AIR CARD • 1 SOIL ORGANISM CARD • NO SPOILER CARDS

Continued on next page

Procedure (continued)

Phase	Step	Action
Explore	8	**"To play the game, we will put these worm-like objects in the center of the play area. Each group should have one less object than there are players. So, if there are five people in your group, you should have 4 worms in the center."** Pass out worms (pipe cleaners) to each group.
	9	**"Mix up all of the cards face down."**
	10	**"The dealer deals each player 6 cards, face down, one at a time. Players may not look at the cards until the dealer says so. The remaining cards are spread out so that there is a small pile between each player."**
	11	**"When the dealer says "GO" play begins. After looking at his/her hand, each player picks up a card from the pile on his/her right."**
	12	**"If the card is needed to complete the compost heap, it is kept and one not needed is discarded to the pile on the player's left. Everyone plays at the same time, picking up cards from the right and discarding the ones not needed to the left."**
	13	**"Play as quickly as possible."** **"Everyone must have 6 cards in his/her hand at all times and can only pick up and discard the cards one at a time."**
	14	**"The first person to get all six cards takes a worm, trying to be sneaky, while continuing to play."**
	15	**"After the first worm is taken, anybody can take a worm EVEN IF THEY DON'T HAVE ALL THE RIGHT CARDS."**

Continued on next page

Procedure (continued)

Phase	Step	Action
Explore	16	**"Players must try to watch the worms while play continues."** **"Play ends when all the worms are taken."** **"Each player shows his/her cards and tells what was still needed to complete the heap."** (This is part of the EXPLAIN portion of the lesson.)
	17	**Scoring:** **"Everyone with a worm gets the letter 'R'. You'll need someone to keep track of the scoring. Keep playing rounds of the game until one or more players get all the letters to spell 'ROT.' If a longer game is desired, play until someone spells 'COMPOST,' instead of 'ROT'."**
	18	Pass out a copy of the ***Player Instructions -- Complete the Compost Heap***, pg.44, to each group so that they can refer to it if they forget the game instructions.
	19	Students play the game for enough rounds to reinforce the concept of which components are necessary for a successful compost heap.
Explain	20	This phase is spread out through both the ENGAGE and EXPLORE phases, and is accomplished by: • Class discussion of the cards/components of a compost pile; and • Individual student explanations of what their hand was missing for a complete compost heap at the end of each round.

Continued on next page

Procedure (continued)

Phase	Step	Action
Elaborate	21	The following options would extend this activity further: • Create an actual compost heap on school grounds or as a home project. • Conduct an experiment to compare plant growth in soil, with and without compost enrichment.
Evaluate	22	Have students play for a few rounds using the ***Complete The Heap Key Cards*** for reference, and then remove the key card and make students complete their hands from memory.

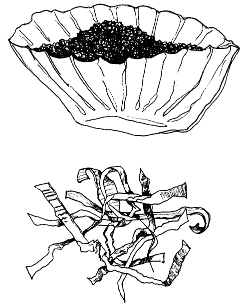
Vocabulary

Understanding of the following terms is useful in this activity.

Term	Definition
Biodegrade	To rot/decay; to break up into constituent parts physically, biologically and chemically
Compost	A mixture that consists largely of decayed organic matter and is used for fertilizing and conditioning land
Decompose	An organism that helps to break organic material down physically, chemically and biologically
Organic	Once living

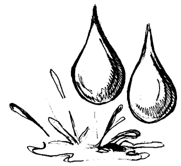
Complete the Compost Heap Playing Cards

CARBON SOURCE
brown, dry



Shredded paper, sawdust, coffee

WATER

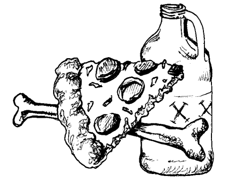


Moist but not soggy

SOIL ORGANISMS
(add soil)

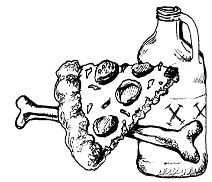
Bacteria, fungi, insects, earthwoms,

SPOILERS
DO NOT ADD



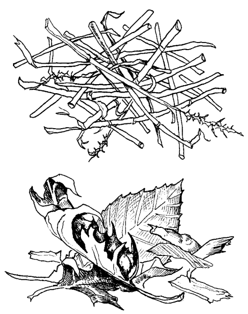
Meat, dairy products, grease, toxic chemicals, droppings from carnivores, BBQ ashes, weeds in seed, poison ivy

SPOILERS
DO NOT ADD



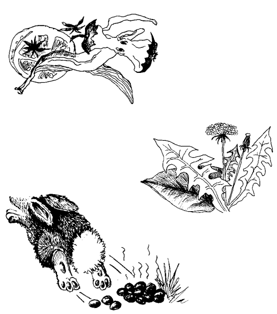
Meat, dairy products, grease, toxic chemicals, droppings from carnivores, BBQ ashes, weeds in seed, poison ivy

CARBON SOURCE
brown, dry



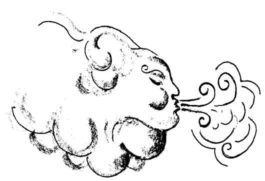
Dry leaves, wood chips, straw

NITROGEN
SOURCE-green,



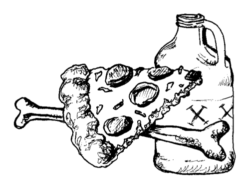
Grass clippings, young weeds, fruit & vegetable scraps, manure from herbivores

AIR



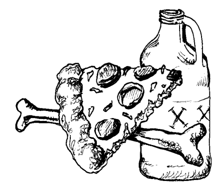
Turn pile, include some coarsely chopped material

SPOILERS
DO NOT ADD



Meat, dairy products, grease, toxic chemicals, droppings from carnivores, BBQ ashes, weeds in seed, poison ivy

SPOILERS
DO NOT ADD



Meat, dairy products, grease, toxic chemicals, droppings from carnivores, BBQ ashes, weeds in seed, poison ivy

Complete the Heap Key Cards

COMPLETE THE HEAP KEY

2 –CARBON CARDS

1 NITROGEN CARD

1 WATER CARD

1 AIR CARD

1 ORGANISMS CARD

COMPLETE THE HEAP KEY

2 –CARBON CARDS

1 NITROGEN CARD

1 WATER CARD

1 AIR CARD

1 ORGANISMS CARD

COMPLETE THE HEAP KEY

2 –CARBON CARDS

1 NITROGEN CARD

1 WATER CARD

1 AIR CARD

1 ORGANISMS CARD

COMPLETE THE HEAP KEY

2 –CARBON CARDS

1 NITROGEN CARD

1 WATER CARD

1 AIR CARD

1 ORGANISMS CARD

Player Instructions -- Complete the Compost Heap

A NEW version of the old game of SPOONS

SET-UP

- Put worm-like objects in the center of play area (table or floor). Have one less object than there are players. Pencils, straws, or pipe cleaners may be used. (If 5 students play, use 4 objects).
- Mix cards face down.
- Each player is dealt 6 cards face down one at a time, which are held until all players have their cards.
- Remaining cards are divided into roughly equal piles, passed out face down around the circle and placed between each player. Each player will have 6 cards in his/her hand and a pile face down to his/her left and right.

COLLECT

- When the dealer says, "GO," play begins. Each player looks at his/her hand, and then picks up a card from the pile on his/her right.
- If the player needs the card to complete the compost heap, he/she keeps it. If the player doesn't need it, he/she discards it onto the pile to the left.
- Collect 2 brown, 1 green, 1 purple, 1 blue, and 1 yellow card. Do not save red spoiler cards.
- Everyone plays at the same time, picking up cards from the right and discarding any they don't need to the left. Play as quickly as possible.
- Everyone must always have 6 cards in his/her hand. You can only pick up and discard one card at a time.

TAKE a worm

- The first person to get all six cards takes a worm, trying to be sneaky, while continuing to play.
- Players must try to watch the worms while they play.
- After the first worm is taken, anybody can take a worm **EVEN IF HE/SHE DOESN'T HAVE ALL THE RIGHT CARDS.**
- The round is over when all the worms are gone. Players show cards and tell what was needed to complete the heap.

SPELL ROT

- Everyone with a worm gets the letter "R."
- Play more times until one or more players get all the letters to spell "ROT". If a longer game is desired, play until someone spells "COMPOST" instead of rot.

3.7 Take Out the Trash

Teacher Lesson Plan

Overview

Students will complete a series of Web-based activities to learn how their choices when packing lunch affect trash production. Students will "pack" a lunch online, learn how to make less trash, and work with real data regarding previous students' trash.

Lesson Characteristics

Use the table below for lesson planning purposes.

Grade Level(s)	3rd-6th
Time Required	**Pre-Field Study**: 1 class period, best if completed 1 week before field study **Post- Field Study**: 1 class period
Key Concepts/Terms	The Four Rs, Compost, Data Analysis
Prerequisites	Understanding of how to use the Internet, Internet Access
Setting	Classroom with Internet Access or Computer Lab; Individual Students or Student Pairs

Learning Objectives

After completing this activity, students will be able to…

- Discuss why trash production is an environmental problem;
- Use the Four Rs (rethink, reduce, reuse, and recycle) in order to be better environmental stewards by making good choices that result in less trash;
- Describe how following the Four Rs helps conserve renewable and nonrenewable resources; and
- Explain how their actions affect the environment.

Materials Required

For each pair of students, you will need:

- Pencil
- ***Student Sheet-Take Out the Trash: Trash Free Lunch Worksheet*** (pg. 3-50)
- ***Trash Data*** (tables available at www.fergusonfoundation.org)
- ***How to Plan a Trash Free Visit*** Guide, pg. 3-52
- ***Student Sheet-Take Out the Trash: Trash Data Analysis Worksheet,*** pg. 3-55
- ***Student Sheet-Take Out the Trash: Trash Reduction Home Challenge***, pg. 3-57
- Internet Access (for **online activities**)

Continued on next page

Background Information

Why Trash is a Problem?

We live in a throwaway society and trash seems to magically disappear after we put it out for the garbage trucks. Those trucks take our trash to the landfill, where it is collecting at an alarming rate. This trash does not decompose, because it is removed from sunlight, water and oxygen, which are necessary for decomposition. In addition, many of the items sent to the landfill could have been recycled or used for something else, saving renewable and nonrenewable resources for the future.

What Can We Do About It?

We all make choices about which products to buy and how we handle our trash. Two decisions that students make are what items they purchase and how they pack their lunch. By learning to choose items with less packaging material, and reuse or recycle whatever possible, students can make a difference every day by sending less trash to the landfill.

Procedure

Follow the steps listed in the table below to complete the activity.

Phase	Step	Action
Engage	1	**Pre-Field Study** Instruct students to think about packing a lunch. Why did they choose certain items? (Note: If your class includes children who receive school lunches, phrase the question to include them. Example: If you had the opportunity to pack your lunch, why would you choose certain items? If appropriate, suggest that students who do not already pack their own lunches take on that responsibility.)
	2	Hand out ***Trash Free Lunch Worksheet,*** pg. 3-50, to each student.
	3	Have students complete the first section.
	4	Discuss the answers as a group. All answers are acceptable. *Typical responses might include: food I like, stuff that is easy to make, healthy food, things that are on sale, etc.* Make sure to include the following questions in your discussion: • **Did anyone consider trash or packaging?** • **Were student estimates of the weight of trash their class would produce in one day realistic? Are they curious?**

Continued on next page

Phase	Step	Action
Explore	5	Explain to the students that they will use a computer activity to learn more about trash and lunches. They are expected to read all the information from the computer screen and follow the instructions given to complete the activities. ***Note:*** Determine the level of computer/Internet experience among students. Consider pairing inexperienced students with those who have more experience.
	6	Write the website address on the board in the computer lab - www.fergusonfoundation.org. Instruct students to access the website using the school's Internet browser.
	7	When the Alice Ferguson Foundation Webpage appears on the screen, have students go to: 1. **Hard Bargain Farm Kids' Zone** tab, then 2. **Take Out the Trash**
	8	Have students read the **Introduction** and then complete the **Four Rs** section and **Trash Sorting Activity**. Students should read all information on the screen.
	9	Students complete the **Trash Free Lunch Activity** online and record scores as indicated on the ***Trash Free Lunch Worksheet***, pg. 3-50.
	10	Students complete the **Lunch Ranking Activity** and record which lunch was best.
	11	Students complete the rest of the activity back in the classroom or as a homework assignment and then discuss as a class.
	12	Hand out the ***How to Plan a Trash Free Visit*** guide, pg. 3-52, to each student. Read the guide with the students and answer any questions. Explain that this guide: • is for students to share with their parents. • will help students and adults pack trash free for their trip.
	13	**Field Study** at Hard Bargain Farm Environmental Center, or other outdoor educational facility: Students and adults pack trash free for their visit. Staff aids in weighing trash and recording data. Trash weight data is available in the **Trash Data** section at www.fergusonfoundation.org.

Continued on next page

Phase	Step	Action
Explain	14	**Post – Field Study** ***Note*: It is highly recommended to complete the *Trash Data Analysis Worksheet* as a computer lab assignment.** Provide students with **Trash Data** tables (available online at www.fergusonfoundation.org) and the ***Trash Data Analysis Worksheet***, pg. 3-55. Review how the data was collected and answer any questions about terminology.
	15	Have students complete the ***Trash Data Analysis Worksheet*** using the ***Trash Data*** tables (available at www.fergusonfoundation.org). ***Note*:** If students have trouble getting started, write the average trash weight per person for the class on their visit. This number goes in the first blank space in the ***Word Problems*** section of the ***Trash Data Analysis Worksheet***.
Elaborate	16	• Have the students find some things that weigh the same as the amount of trash calculated on the ***Trash Data Analysis Worksheet***. For example, would the amount of trash the whole class would produce in 12 years of school weigh as much as the average elephant? • If your school does not have a recycling program, could your students be instrumental in starting one? Ask the students to brainstorm about this and present ideas to the administration or parents group. • Visit a recycling center or the nearest landfill operation. The sights, sounds, and smells are unforgettable. • Explore whether bulk buying really does make a difference in the amount of trash produced. Is bulk buying really more economical? Purchase the largest bag of chips available and a similar quantity of individually packaged chips of the same type. Weigh the packaging and perform the mathematical operations for a fair comparison. (Don't forget to let the kids eat the chips!) • Examine the trash produced in your classroom and then discuss how your class can produce less trash. Make it a fun challenge for the students by weighing their trash periodically and rewarding improvements. Classroom lesson plans are available at the Resourceful Schools Project website: www.resourcefulschools.org/teachers/lesson-plans. Activities include a "Classroom Waste Audit" and "What's In Your Trash Bag."

Continued on next page

Evaluate	17	• Distribute ***Trash Reduction Home Challenge***, pg. 3-57, to students as a weeklong homework project. Alternatively, select one challenge on the sheet for the whole class to complete at home together. • Use scores from online activities and the ***Trash Data Analysis Worksheet***.

Continued on next page

Name_____
Date_____

Trash Free Lunch Worksheet

In The Classroom

1. List three things (factors) you normally consider or think about when you pack a lunch.

_____

_____

_____

2. Rank these factors from the most to the least important by writing a 1, 2, or 3 next to your factors on the lines in question 1.

3. Estimate the weight of trash your class might produce from packed lunches for one day.

_____

In The Computer Lab

4. Read the ***Introduction*** and ***Four Rs*** sections.

5. Do the ***Trash Free Lunch*** activity. Choose items you might use to pack your own lunch. (Be honest!)

Record your score here._____

6. Do the activity again, but this time try to get the best score you can by packing a lunch with the least amount of trash.

Record your score here. _____

7. Is there a difference in the two scores? What is the difference between your original lunch and the one that has the best score?

8. Do the ***Lunch Ranking*** activity. Which lunch had the least amount of trash? Why?

Continued on next page

Back in the Classroom

9. How did choices for your lunch change after thinking about trash free lunches? How will choices for your real lunch change?

10. How can making earth friendly choices can have a positive impact?

11. What would be your greatest challenge in packing a trash free lunch every day?

12. Give an example of how you will use the Four Rs to have less trash.

13. In the chart below, list the foods you had in your lunch today and the type of container or wrapping they came in. For each container check if you reused, recycled, or threw it away as trash. For trash items, list an alternative you can use next time that would not be trash.

Food	Container Type	Re-Use	Recycle	Trash	Idea For Next Time

How to Plan a Trash Free Visit

At Hard Bargain Farm Environmental Center (HBF), we are working to become a trash free facility. You may already be planning to bring a trash free lunch, so we are challenging you to plan a trash free stay. When deciding what to bring for lunch and snacks during your trip it is important to consider the packaging your food comes in. Please use the following as a general guideline when planning for your trip:

- Think ahead to have the least amount of trash. Use the Four Rs (rethink, reduce, reuse, recycle) before you buy an item. *Visit our website for more information on the Four Rs.*
- Bring items you can reuse during and/or after your trip, such as a reusable water bottle and reusable containers.
- Buy items packaged in recyclable materials (see list of items recycled at HBF).
- Buy items in bulk. At HBF our biggest source of trash is food packaging from individually wrapped items, please buy items in bulk when possible.
- We have plates, bowls, cups, and silverware available for you to use.
- Please bring only what you can consume during your stay, our pigs have enough to eat!
- We do not allow any Styrofoam at our facility.

Here are some of the most common trash items brought to the farm and their less trashy alternative:

Bring This

Reusable Water Bottle

Not That

Bottled Water

Save your money! Our water at HBF tastes great and is safe to drink.
Bringing a reusable water bottle also saves resources.

One Big Bag of Snacks
Wrapped Snacks

Many Individually

For s'mores and snacks, buy in bulk and skip the individually wrapped packages.
It is cheaper, easy to share, and less to throw away!

Bring This 

Recyclable Container

Not That 

Non-recyclable Container

Buy items in recyclable containers that do not have to be thrown away and end up in the landfill.

Lunch box

Grocery bag

Bring a reusable lunchbox that can be used over and over again.

HBF's Most Unwanted:

Styrofoam cannot be reused and is not recyclable. P*lease do not bring it.*

Plastic Flatware is not recyclable. *Instead, use the flatware we have provided for you at HBF!*

Items Recycled at Hard Bargain Farm:
Glass, metal cans and aluminum foil, plastic, cardboard, paper, milk cartons, and juice boxes

Visit ***Take Out the Trash*** on our website for more help, to learn about the Four Rs, and test your trash free packing skills in our ***Trash Free Lunch Game***.

Thank you for helping to make Hard Bargain Farm Environmental Center a trash free facility. We look forward to seeing you at the Farm.

Teacher Page – Trash Facts

Here are some interesting facts to help your class relate to their trash. Did you know…?

- We throw away more than 160 million tons of solid waste each year in the U.S.
- It takes more than 500,000 trees to make the newspapers Americans read on one Sunday.
- Aluminum is America's most recycled product (we recycle 50% of our aluminum cans).
- Producing an aluminum can from recycled material takes only 5% of the energy required to make a new one.
- Product packaging accounts for 30% of the weight and 50% of the volume in our household waste.
- $1 out of every $10 we spend on food pays for packaging.
- When you recycle 1 aluminum can, you save enough energy to run a 100 watt light bulb for about 3 ½ hours.
- Recycled plastic can be used to make things like trash cans, park benches, playground equipment, decks, and kayaks.
- Special fleece-like fabrics are made out of recycled plastic bottles.

Name_____

Trash Data Analysis Worksheet

Trash Data is available in the ***Take Out the Trash*** activity online at www.fergusonfoundation.org.

1. What was the average weight of trash per person (in ounces) that your class produced from your visit to Hard Bargain Farm Environmental Center? _____

2. Look at the ***Trash Data*** to view data from other classes. Write a statement about the amount of trash your class had in comparison to other classes. Explain your statement. Include numbers (data figures) from the ***Trash Data*** tables.

3. The data can be organized in other ways to learn more. Certain patterns or trends can be observed. Rearrange the data from the ***Trash Data*** by filling in the chart below.

CLASSES WITH THE LEAST AND MOST TRASH PER PERSON ON THE OVERNIGHT FIELD TRIP TO HARD BARGAIN FARM

Least Lunch Trash		
School Year	Class	Average Trash Weight (oz. / Person)

Most Lunch Trash		
School Year	Class	Average Trash Weight (oz. / Person)

Look for patterns in your charts. What did you observe?

4. Some classes received instructions on how to pack trash free before coming to Hard Bargain Farm Environmental Center and some schools did not. With this in mind, can you draw any conclusions from the data about the importance of learning how to pack trash free? Support your answer.

Word Problems

Use your class' information, along with information from other fifth grade classes, to answer the following questions.

5. Use the information from the ***Trash Data*** table to figure out how much trash you would produce, by packing the same way you did for your trip, for the entire school year (186 days).

_____ oz.		186 days		_____ oz.
Average trash weight (oz. /person)	**X**	(days/school yr.)	=	Average trash weight/person/school yr.

6. Convert your answer for #1 into pounds (lbs.).

_____ oz.		16 oz.		_____ lbs.
Average trash weight/person/school yr.	÷	per lb.	=	Average trash weight/person/school yr.

7. If you packed the same every day of school, 186 days of school per year, for 12 years (the entire time you attend school) how much trash would you have accumulated in pounds?

_____ lbs.		12 years		_____lbs.
Average trash weight/person/school yr.	**X**	of school	=	Average trash weight/person/12 yrs.

8. How much trash would your whole class produce in 12 years of school?

_____lbs.		_____		_____lbs.
Average trash weight/person/12 yrs.	**X**	# students/class	=	Average trash weight/class/12 yrs.

Student Sheet – Take Out the Trash

Name: _____ Date:_____

Trash Reduction Home Challenge
Rethink, Reduce, Reuse, Recycle

Do any TWO of the tasks listed below. Choose ONE from "rethink/reduce/reuse" and ONE from "recycle." DISCUSS YOUR OPTIONS WITH AN ADULT BEFORE PROCEEDING. You must choose TWO activities that you do not already do. *Each activity you choose beyond the minimum of two will earn +5 points of extra credit.*

Rethink/Reduce/Reuse

1. Use cloth shopping bags the next time you go out to the mall or supermarket (find some around your house or purchase them).
2. Go to the "no junk mail" website and register your name and the adults in your home to stop receiving junk mail. (www.directmail.com/directory/mail_preference/)
3. Do not eat any fast food for the entire week (go to a sit down restaurant or eat at home).
4. Spend half-an-hour looking through items in your home that you have not used for over one year. Bring them to Goodwill or another thrift store (clothes, tools, electronics, books, furniture). While at Goodwill, look around at the furniture, clothes, and other items they have available.
5. For three school days, do not use any disposable goods in the cafeteria (ask for a metal fork, do not take fruits, salads, veggies, or milk offered in disposable containers).
6. For one week, keep a table of items that you considered purchasing. List whether the items were "wants" or "needs" and whether you decided to "purchase" or "not purchase." Do not purchase "wants."
7. Do not use any paper towels for five days. Just dry your hands by waving or wiping on cloth towels.

Recycle

8. The next time you go to the grocery store, buy two products that are more environmentally friendly (for instance post-consumer and/or recyclable packaging) and recycle them when done.
9. Circle ONE item below. Inform your family that you will collect ALL of this item in your home for five days. After five days, count how many you collected, record this number below, and recycle all items.
    a. aluminum/tin cans
    b. glass bottles and jars # Collected _____
    c. office paper
    d. magazines
    e. newspaper
    f. plastic bottles
    g. paperboard/cardboard (cereal boxes, soda boxes, corrugated, etc.)
10. Start a compost pile by setting a large bowl on your kitchen counter (labeled compost), telling your family that it is for all fruit and vegetable matter, and then dumping it regularly in a special spot in your yard. Continue for one week.
11. Discuss an additional option with your teacher for approval.

Adapted from Home Challenges *written by Thomas Kozikowski of Mountain Ridge High School, Maryland*

Have an *adult write 2-3 sentences* below explaining:

- which tasks (from the front of this sheet) you completed
- that you were not doing these tasks before this week
  - that you discussed the tasks in advance
  - how you were successful in the attempt

Include a signature at the end. *If any parents have any major objections to your participation in this task, this is also the place for them to voice their concerns.*

_____ _____

GUARDIAN SIGNATURE **GUARDIAN PHONE NUMBER**

Student Evaluation

1. Explain your successes or struggles in completing the tasks.

2. What did you learn?

3. Explain the benefits and disadvantages of your efforts.

4. What resources did you preserve in this short trial? How much would you save if you continued for a year?

5. Would you recommend that students like yourself continue such habits for waste reduction? Why or why not?

6. What other opinions do you have on the "Trash Reduction Home Challenge"?

Adapted from Home Challenges *written by Thomas Kozikowski of Mountain Ridge High School, Maryland*

3.8 Vermicomposting: Worms in Your Classroom

How to Vermicompost

Overview

Students will create a worm-composting bin, and monitor the decomposition of their lunch scraps over time. This activity teaches that nature truly recycles, turning food matter into rich organic soil. Additionally, there are many experimental design and mathematic extensions with this activity.

Lesson Planner

Use the table below for lesson planning purposes.

Grade Level(s)	1st – 8th
Time Required	Set Up: 1 class period On-going Monitoring: 6 months
Key Concepts/Terms	Biodegradation; Decomposition; The 4 R's – Rethink, Reduce, Reuse, Recycle; Nutrient Cycle; Energy Cycle; "Trash;" Composting; Vermiculture
Prerequisites	None
Setting	Indoors; Whole class/small group

Learning Objectives

After completing this activity, students will be able to…

- Explain how worms and other soil microorganisms break down organic matter to create rich organic soil; and
- Explain what components are necessary for a successful vermiculture bin, as well how to maintain it over time.

Continued on next page

Background Information

Decomposition

Imagine what the world would look like without the decomposition process, where microbes, insects, and fungi break down dead organic matter. Through decomposition and the interactions in food chains and food webs, nutrients and energy are constantly recycled.

What is Vermicomposting?

Vermicomposting is using worms to assist in breaking down food scraps into organic compost you can use to enrich the soil.

Why Vermicomposting is the IDEAL Science/Environmental Project

A fully functioning, properly equipped vermicomposting bin makes an excellent classroom project. You can teach your students about animal needs, nutrient cycles, trash reduction and you will produce SUPER SOIL and concentrated liquid plant food at the same time.

Procedure

Follow the steps in the table below to conduct the activity. **Sentences in bold are suggestions for what teachers might say to students.** *Items in italics are possible student answers to questions.*

Note: This activity has an optional Student Worksheet, pg 64. Directions have been written to include it, but the activity can be conducted with oral directions/discussion instead, if preferred.

Phase	Step	Action
Engage	1	Start this activity in a mysterious way by saying, **"I have some animals that I'd like you to meet today. These animals can live in my house, but I don't have to walk them, or clean up after them, and I can go away for weeks at a time and they are still fine. These animals also take my food scraps and turn them into great soil for plants. Any guesses what they are?"**
	2	**"WORMS are the animals I'd like you to meet today. Did you know that worms benefit us? Do any of you have worms in your house?"**

Continued on next page

Procedure (continued)

Phase	Step	Action
Engage	3	*** You can skip this step if your class has already completed the ***Compost in a Bag,*** pg.27. **** **"Worms help things decompose or rot. When I say the word ROT what do you think of?"** Write down all words that students list. After the list is complete, discuss the words, and circle any that are beneficial. ***Note:*** It is important for students to move beyond disgust with rotting and see the value of decomposition, which is that old organic matter is broken down to be made into something new.
Explore	4	Hand out a paper plate/napkin to each student/pair of students. Then, give each student about ½ cup of soil from your worm bin. While you are doing this, have students distribute the Student Worksheets and magnifying glasses.
	5	**"Find your biggest worm, and separate it from the pile of dirt so you can study it."**
	6	Pass out magnifying glasses while students are locating their worm.
	7	Show a diagram of worm anatomy (You can make a transparency or poster of Worm Anatomy (see the ***Illustrated Glossary***).)
	8	**"There should be a section of your worm that is slightly fatter than the rest of it. This section is closer to one end of the worm than the other."** Walk around and make sure students have correctly located this section. Give out more soil so students can locate another worm if they don't have a large enough worm, or the clitellum is not easily seen.

Continued on next page

Procedure (continued)

Phase	Step	Action
Explore	9	**"This section of the worm is called the CLITELLUM, and it is used for reproduction. Worms are both male and female, and when they mate, both become pregnant and reproduce. What would be the advantage of this for worm species?"** *Worms reproduce at a very fast rate and this is a great adaptation for the species, as both worms reproduce, rather than just one.*
	10	**"The end of the worm that is closest to the clitellum is the head of the worm, called the ANTERIOR end. This is where the mouth of the worm is located."**
	11	**"The opposite end of the worm is the rear and is called the POSTERIOR. This is where the waste is removed. The waste is the good stuff that we want for improving our soil."**
	12	**"Using the magnifying glass, examine the body of your worm carefully. It is made of many different SEGMENTS. Each of these segments has small hairs on it. These are called SETAE, and they are to help the worm move."**
	13	**"You should be able to almost see through your worm, along the whole digestive tract. Use the magnifying glass to see if you can find this."**
	14	**"On your Student Worksheet, draw your worm and label the parts we have talked about."**
	15	**"So, what would worms need to live successfully in a bin? If we were to design our own new bin, what would they need?** *Worms need:* • *water (enough to keep the pile damp),* • *air (they get enough from the space between the lid and the bin),* • *warmth (they can't last through freezing),* • *dark (they don't like light), and* • *food.*

Continued on next page

Procedure (continued)

Phase	Step	Action
Explore	16	Pass out the bags of trash items for students to sort in to 2 piles: one of items that CAN go into the bin, and the other pile of items that CAN'T go in. Give student groups a few minutes to sort their trash into piles. After they have finished, have them list what they thought could go into the vermicomposting bin and why. Correct any misconceptions, and explain why some of the items can't go into the bin. **"On Part B of your worksheet, circle all of the items on that list that CAN go in a vermicomposting bin."**
Explain	17	Have students complete the analysis questions on the ***Student Sheet -- Vermicomposting***, or use those questions to guide your class discussion if you are not using the Student Worksheet.
Elaborate	18	• Complete a more in-depth anatomy study by dissecting larger worms and compare various worm species' adaptations with their habitats. • Have students design experiments using the vermiculture bin. These could focus on the types of food fed to the worms, the reproductive rate, etc. • Have students plan/create their own vermicomposting bin.
Evaluate	19	Use the ***Student Sheets*** for evaluation.

Vocabulary

Understanding of the following terms is useful in this activity.

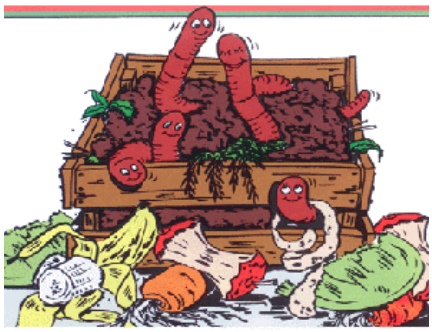
Term	Definition
Biodegrade/ Decompose	To break down physically, chemically and biologically
Organic Matter	Matter that came from living things
Recycle	The salvage and reprocessing of used materials, such as paper, metals, glass, cloth or organic matter.

Continued on next page

Objectives

After completing this activity, you should be able to…

- Explain how worms and other soil microorganisms break down organic matter to create rich organic soil; and
- Explain what components are necessary for a successful vermiculture bin, as well how to maintain it over time.



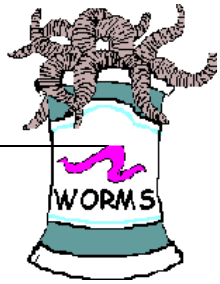
Part A. Worm Diagram

In the box below, draw a picture of your worm and label the CLITELLUM, ANTERIOR END, POSTERIOR END, SEGMENTS, and SETAE.

In the circle to the right, draw a picture of what the worm looks like through the magnifying glass.

Continued on next page

Student Sheet -- Vermicomposting: Worms in Your Lunchroom



Part B. What Can Go in a Worm Bin?

On the list below, circle the items that **CAN** go in the worm bin:

Apple Core	Tea Bag	Plastic Bag
Steak	Pepperoni Pizza	Coffee Grounds
Eggshells	Leaves	Orange Peels
Sandwich Crust	Rotten Banana	Paper Napkins
Newspaper	Paper Bags	Rice

Part C. Questions for Analysis

1. Explain why worms are important to the health of an ecosystem.

2. Imagine that worms didn't reproduce as quickly as they do. What if it took 10 years before worms were old enough to reproduce? How would the world be different?

3. Imagine the world without worms. What would change? How would it affect the ecosystem?

Creating a Vermiculture Bin

Overview

The key ingredients for a vermicomposting bin are:

- suitable container (plastic/wooden box),
- moist bedding material,
- a handful of garden soil,
- redworms, and
- food scraps.

Container Size

The size of your bin depends on the amount of food scraps you want to compost. Worms can only eat so much garbage. The relationship between the weight of worms required to process a given amount of garbage is called the worm to garbage ratio. Have your students collect their food scraps for one week, weigh them, and use the ratio below to calculate the number of worms and bin size needed.

A correct worm to garbage ratio is about 2:1,

(This means that it takes 2 pounds of redworms to process 1 pound of garbage per day.)

Bedding

What is Bedding?

Bedding can be hand-shredded newspaper (colored pages are fine, as well as black & white) or corrugated cardboard torn into thin strips. Bedding provides redworms with the cool, moist environment they need to survive. The worms tunnel through and digest the bedding, along with food scraps to produce vermicompost (worm castings – manure). Adding a handful of natural soil (preferably without any chemicals added) provides other small microbes and insects that help in the decomposition process.

Continued on next page

Bedding (continued)

How Much Bedding Will I Need?

To figure out how much bedding is needed for your bin, complete the following steps:

1. Measure the **length, width, and height** of your worm bin in inches.
2. Multiply these dimensions to get the number of **cubic inches** (a measure of volume).
3. Divide the number of cubic inches by 1,728 (the number of inches in one cubic foot) to get the number of **cubic feet** in your worm bin.
4. You will need 2.5 pounds of shredded newspaper for every cubic foot in your worm bin.

Water Amount

To figure out how much water you must add to the shredded newspaper to make the worm bin 75% moist, multiply the pounds of newspaper needed by 3. This number is how many **pints** of water you will need (one pint of water = one pound).

Redworms

What Kind of Worms Do I Use?

The two most commonly used redworm species are *Eisenia foetida* and *Lumbricus rubellus*. You can purchase them for about $12-$20/pound (see *Sources*). Your worms will reproduce, so your initial investment will pay for itself, as you are able to share worms with your students and colleagues so that they can create home composting bins.

There is a difference between redworms and common garden worms and night crawlers. Common garden worms/nightcrawlers quickly die off in a worm bin, while redworms do poorly in average garden soil and cannot survive cold winters.

Redworm Biology

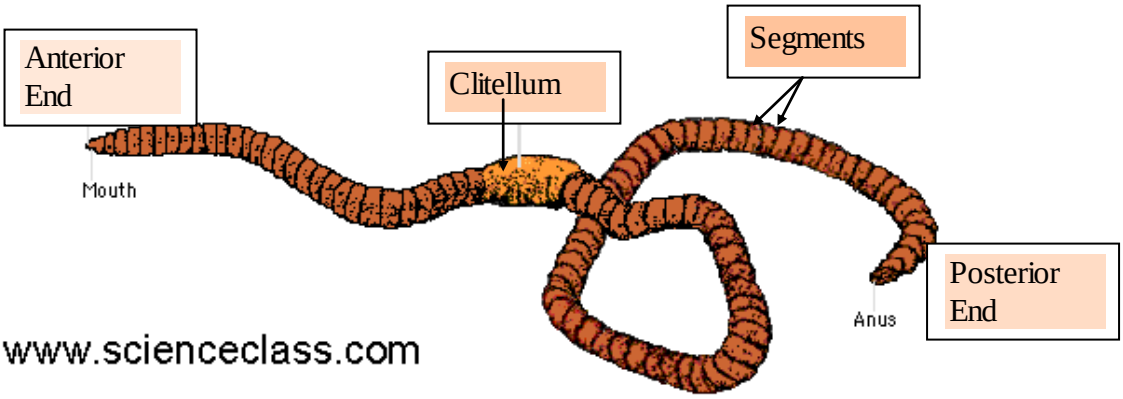
Redworms can consume their own weight each day in organic matter. They live for about 1 year, and reproduce quickly. Light colored cocoons (what we call worm egg cases) are produced continuously. Each one yields 2-3 young worms in about 3 weeks time. Redworms breathe through their skin and must be kept moist at all times.

Continued on next page

Redworms (continued)

Redworm Anatomy

Refer to the diagram and table below for the anatomy of a redworm.



Part	What It Is
Anterior End	Front end of the worm; the mouth is located here
Posterior End	Back end of the worm; the anus is located here
Clitellum	The enlarged area about 1/3 of the way from the anterior end; used for sexual reproduction.
Setae	Small bristly hairs on the exterior of the worm; help in moving the worm; 4 pair per segment (use a magnifying glass)
Segments	Individual sections of the worm's body; the first is the anterior end, the last is the posterior end

Providing Air for Your Vermicomposting Bin

Contrary to many bin instructions, you DO NOT need to drill holes in your bin – enough air will pass through the tiny gap in the lid and bin for your worms to get air. Holes will cause your bin to leak (reducing the amount of moisture) and worms and any other critters (from your handful of soil) will escape and cause a nuisance. Your worms will not crawl out of the bin unless the bin becomes too dry/wet.

Continued on next page

Ideal Temperature & Location of Your Bin

Redworms must be kept moist and well ventilated in a temperature range of 55º-75ºF for maximum consumption of organic matter and reproduction. The bin should also be kept covered and out of direct sunlight, as redworms are light sensitive. Basements, cool garages and closets are all good locations. Again, redworms will die at freezing temperatures.

Feeding & Maintenance

Moisture

Maintain a moist environment for your worms. Periodically, spray or mist the bedding to maintain even moisture. Add shredded newspaper as needed (see *Harvesting Vermicompost,* below).

Feeding

Redworms require a steady supply of food scraps to grow and multiply. However, feeding once a week is fine if you've accurately calculated the amount of food needed to maintain your worms. The smaller the food scraps, the quicker they will be digested. You will want to bury your food scraps into the bedding in different locations (or you can experiment, observe worm migration, collect data, etc.).

Refer to the table below for what to put in/what not to put in your bin.

YES – Good for your bin	NO – Bad for your bin
Fruits/Vegetables	Meat/Fat/Bones
Eggshells (crushed)	Grease/Oils
Cereal/Bread	Pet waste/Litter
Tea bags/Leaves	Plastic wrap/Foil
Coffee filters/Grounds	Chemicals, Glass, Metal
Citrus Peels (these take a long time)	Dairy Products
Onion, Banana, and Potato Peels (etc.)	

Harvesting Vermicompost

It will take about 6-8 weeks to produce a noticeable amount of vermicompost. The castings appear as small, dark clumps that easily break apart. There are several methods for removing the finished compost, as describe below:

- Every 3-4 months, stop feeding for a few weeks, and rake the compost to one side of the bin. Add fresh bedding to the other side; add food scraps to the new bedding only. Within a few days, your worms will move into the new bedding, and you can harvest the finished compost. Refill the empty end of the bin with fresh bedding and food scraps after harvesting.

Continued on next page

Harvesting Vermicompost (continued)

- Every 3-4 months, dump the entire bin contents into several piles on a sheet of plastic in a brightly lit room. The worms will dive to the bottom of the pile, and you can remove the finished compost from the tops and sides of the pile.
- Every 3-4 months, remove 2/3 of the bin contents for use in the garden. Add new bedding and slowly allow the worm population to rebuild.
- Stop feeding after 4-6 months and allow the worms to completely digest all of the bedding and food scraps. The result is a fine, homogeneous compost (pure worm castings), with very few redworms.

Using Vermicompost

You can add vermicompost to seedbeds/planting boxes/holes or use it as a top dressing during the growing season. You can also try adding vermicompost to your potting mix for houseplants (1/4 by volume). Vermicompost will not burn your tender seedlings. However, pure worm castings may have a high soluble salt content; use them sparingly and avoid direct contact with plant roots.

FAQ's

How do I create and care for my vermicomposting bin?

Bury your organic kitchen waste in the worm bin. Bacteria and other organisms break it down and worms eat the food waste, bedding, and bacteria. They turn it all into humus—nutrient-rich food for growing healthy plants

Doesn't it smell?

Odor is minimal if you don't overload the system. Worms in a 16"x19"x12" bin can process 2-3 pounds of garbage per week. Capacity of a 20" x 24" x 12" bin is up to 5 pounds of garbage per week.

How long before I have worm castings to feed my plants?

Plan on about six months from the time you set up your bin. You will bury garbage every week. As the worms process the garbage and bedding, the contents of the bin will turn dark brown. You can then harvest the vermicompost (compost produced through the action of worms) in a variety of ways to use on your plants and in your garden.

Continued on next page

FAQ's (continued)

Do I have to keep buying new worms?

If you treat them right, they will reproduce. You will find cocoons in your bin from which baby worms will hatch. After several months, you may have twice as many worms. You can use them to go fishing, or help a neighbor set up a bin, or just leave them in your bin. Overpopulation will not be a problem.

Do people really DO this?

Worm composting is becoming more and more popular. It is the only way to recycle on-site, in your own home. You place food waste in your worm bin. The worms turn it into plant food. You use the plant food to grow vegetables in your garden, or attractive flowers to delight your senses. If you compost your garbage with worms, you help the environment.

Redworm Sources

Flowerfield Enterprises: 10332 Shaver Rd Portage, MI; (269) 327-0108 (also sell worm bin kits).

Gardeners Supply Co.: 128 Intervale Rd., Burlington, VT 05401; (802) 863-4535 http://www.gardeners.com/Red-Wiggler-Worms/Composting_WormBins,02-232,default,cp.html

Uncle Jim's Worm Farm, including FAQ's: www.unclejimswormfarm.com/

3.9 Cup of Compost

A Fun, Edible Model of Composting/Vermiculture

Overview

Students will create and eat their own edible "worm bin." This activity is a fun and delicious way to reinforce how to make and maintain a small worm composting (vermicomposting) bin for your classroom or for home.

Lesson Characteristics

Use the table below for lesson planning purposes.

Grade Level(s)	K-8
Time Required	Set up: 30 minutes Activity: 30 minutes
Key Concepts/Terms	Composting, Vermiculture, Stewardship
Prerequisites	Students should have knowledge of vermiculture/composting (if this is used as a summative activity).
Setting	Indoor; Individual Students

Learning Objectives

After completing this activity, students will be able to…

- Use a model to demonstrate vermiculture/composting;
- Explain the necessary components to a vermiculture/compost bin; and
- Understand ways that organisms cause beneficial changes to the environment, such as worms enriching the soil.

How to Use This Activity

This is a fun activity to introduce, or reinforce the concepts of composting and/or vermiculture.

Continued on next page

Materials Required

The following list is based on a class of 30 students:

- Individual Clear Plastic Cups or Bowls
- Spoons
- Wire Whisk
- Mixing Bowl
- Divided Serving Tray (Muffin Pan)
- Ladle or Large Serving Spoon
- 8 Boxes of Instant Chocolate Pudding
- 1 Gallon Milk (16 Cups)
- Packages of Gummy Worms (allow at least 2 worms/student)
- 1 Box of Mud & Bugs™ or Cocoa Pebbles™ Cereal
- 1 Pkg. Shredded Coconut, dyed green with food coloring

***Note:* Check for food allergies among students and change ingredients accordingly.**

Background Information

See *Vermicomposting: Worms in Your Lunchroom*, pg. 59

Procedure

Follow the steps in the table below to conduct the activity. **Sentences in bold are suggestions for what teachers might say to students.** *Items in italics are possible student answers to questions.*

Phase	Step	Action
Engage	1	Prepare pudding as directions on the box indicate. Chill.
	2	Tell students that since they now know how to create a worm bin, they will learn how students can eat garbage, too!
	3	Distribute cups and spoons to student groups.

Continued on next page

Procedure (continued)

<table>
<tr><th>Phase</th><th>Step</th><th>Action</th></tr>
<tr><td rowspan="3">Explore</td><td>4</td><td>Go through the ingredients individually and discuss how they represent items found in a worm bin, as described in the table below:

<table><tr><th>Item</th><th>What It Represents</th></tr><tr><td>Pudding</td><td>Soil</td></tr><tr><td>Gummy Worms</td><td>Red Wigglers</td></tr><tr><td>Coconut</td><td>Nitrogen source such as fresh plant material, like leaves, apple cores, etc.</td></tr><tr><td>Cocoa Pebbles</td><td>Carbon source such as dried plant matter, etc.</td></tr><tr><td>Mini-marshmallows</td><td>Worm Eggs</td></tr></table></td></tr>
<tr><td>5</td><td>Students go through an “assembly line” to create their edible “cup of compost.”</td></tr>
<tr><td>6</td><td>ENJOY!</td></tr>
<tr><td>Elaborate</td><td>7</td><td>This entire activity is a way to elaborate on previous vermiculture and composting activities.</td></tr>
</table>

3.10 Rethink, Reduce, Reuse, & Recycle

Waste Management Unit Summative Activity

Overview

This is the summative activity for the Waste Management Unit, and is intended to be used to evaluate student performance and mastery of material learned throughout the activities of this unit.

Lesson Planner

Use the table below for lesson planning purposes.

Time Required	45 minutes
Key Concepts/Terms	Waste; 4 R's: Rethink, Reduce, Reuse & Recycle; Composting; Vermiculture
Prerequisites	Understanding of Recycling Practices, Nutrient Cycles, and Composting
Setting	Indoors, Individual

Learning Objectives

After completing this activity, students will be able to…

- Analyze trash sources and current trash disposal patterns; and
- Suggest plausible alternative solutions to trash disposal for trash reduction.

Materials Required

The following materials are necessary to complete this activity:

- Pen/Pencil
- Paper
- *Optional: Collected trash from various parts of the school*

Continued on next page

Procedure

Follow the steps in the table below to conduct the activity.

Phase	Step	Action
Engage	1	Create a list with students of what is discarded on a daily basis at the school. It may be helpful to collect trash for a day of so from the classroom, to sort with the students.
	2	Discuss what may be in trash from other areas of the school, such as the cafeteria or playground.
	3	List bigger or more long-term items that may need to be discarded someday, such as furniture, computers, and books.
Explore	4	Ask students to create a plan for your school that will reduce trash by at least 50%. Use *Student Sheet – Rethink, Reduce, Reuse & Recycle*, pg.77, for guidelines.
Evaluate	5	Assessment can be based on: a. Completeness of list of items that may at some point be trash. b. Alternative to landfill for each item: a plan to rethink, reduce, reuse or recycle each item. c. Plausible explanation of how and by whom each part of the plan could be accomplished. d. Use of concepts learned in this unit, such as: composting, vermiculture, recycling, and wise consumer decisions.

Student Sheet – Rethink, Reduce, Reuse, & Recycle

Objectives

Your assignment is to create a plan for your school that reduces trash by at least 50%

Your Plan

1. Think of all of the things that are used at your school. It is important to think of items used and discarded everyday, such as paper, and to think of the big items, such as furniture and computers.

2. For each category of trash, fill in the table below, explaining:
   - What is done with the trash in that category now;
   - Why it is discarded;
   - What your new plan is for the discarded trash; and
   - How would this get done? Who would do it?

Type of Trash	Why It Is Discarded	What Happens to It Now	Your new plan for it is…	How will this happen? Who will do it?

Teacher Resources

Overview

This section provides teachers with suggested Websites, books, videos and organization contact information regarding recycling, waste management, composting and vermiculture.

Web Resources

General Waste Management

National Oceanic & Atmospheric Association: *Information and education resources about our trash's end destination after travel through our watersheds.*
https://marinedebris.noaa.gov/educational-materials

US Environmental Protection Agency: *information about composting and how you can help reduce the volume of waste gathering in our landfills*
www.epa.gov/compost

Earth 911: *offering localized information for recycling and other environmental issues*
www.earth911.com

Action for Nature: *Encouraging young people to take personal action to nurture and protect a healthy environment on which all life depends.* www.actionfornature.org

Trash Free Schools Project: *The Trash Free Schools Project works to educate and empower students, faculty, and staff to reduce their school's waste footprint by providing education and resources, including a comprehensive Guidebook, to aid in rethinking, reducing, reusing, and recycling. As part of the project, students and staff at K-12 schools will have the resources needed to investigate an environmental issue while implementing a strong waste reduction and litter prevention strategy. A Resource Center with activities, lesson plans and how-to guides is also available.* fergusonfoundation.org/trash-free-potomac-watershed-initiative/education/trash-free-schools/

Games, crafts and activities about recycling:
www.calrecycle.ca.gov/RecycleRex/Activities/default.htm

Sort Your Waste Sorting Game: *kids sort trash into recyclable and reusable categories* https://kidsgoflash.com/homepage-featured/sort-your-waste/

Web Resources (continued)

Composting/Vermiculture

Compost Guide: *a complete guide to composting, information for the beginner or expert*
www.compostguide.com

Happy D Ranch: *worm supplies and information*
www.happydranch.com

Worms.com: *worm supplies and information*
www.worms.com

Recommended Books

Applehof, Mary. 1997 **Worms Eat My Garbage: How to Set Up & Maintain a Worm Composting System** Flower Press.
DESCRIPTION: *A simple, effective, "how-to" guide covering everything you need to know, including how to: set up a worm bin, choose garbage that is best for worm composting, take care of the worms, and effectively save money while reaping the benefits of the process.* (Upper reading level) ISBN: 0942256107

Campbell, Stu. 1998. **Let it Rot!: The Gardener's Guide to Composting**. Storey Publishing, LLC
DESCRIPTION: *A readable, quietly humorous introduction to composting, this covers reasons to compost; differing approaches; how decomposition works; various methods, ingredients, and containers; how to speed decomposition; and how to use the end result.* (Upper reading level) ISBN: 1580170234

Christopher, Tom & Marty Asher. 1994. **Compost This Book**. Random House, Inc.
DESCRIPTION: *Inspirational, funny, and practical, this book provides a somewhat unconventional look at the world of composting, from the large problems of solid waste disposal to the how-tos of turning potato peels and dryer lint into food for your garden.* (Upper reading level) ISBN: 087156596X

Continued on next page

Recommended Books (continued)

Create from Waste! 1998. Resource Conservation Program for Santa Cruz County Schools. Life Lab Science Program. (831) 459-2001.

Cronin, Doreen. 2003. **Diary of a Worm**. Scholastic Inc. NY, New York.
DESCRIPTION: *Hysterical journal about the daily doings and underground world of a worm and the important role worms play in Nature.* (Elementary reading level.) ISBN: 006000150X

Earthworks Group. 1994. **50 Simple Things Kids Can Do to Recycle**. Earthworks Press
DESCRIPTION: *This book provides projects, activities, and simple practices children can use to implement recycling at home, in their community, and at school.* (Elementary reading level) ISBN: 1879682001

Foster, Joanna. 1993. **Cartons, Cans, and Orange Peels: Where Does Your Garbage Go?** Clarion Books
DESCRIPTION: *Emphasizes solid waste problems and reinforces the reduce-reuse-recycle concept. An excellent bibliography is provided for further research.* (Elementary reading level) ISBN: 0395665043

Gershuny, Grace & Deborah L. Martin. 1992. **The Rodale Book of Composting : Easy Methods for Every Gardener**. Rodale Books
DESCRIPTION: *Covering all aspects of composting, from the basics of how to create compost, build compost bins, the chemistry of composting to the history of composting itself.* (Upper reading level) ISBN: 0878579915

Continued on next page

Recommended Books (continued)

Larson, Gary. 1998. **There's a Hair in My Dirt: A Worm's Story**. HarperCollins Publishers. NY, New York.
DESCRIPTION: *Humorous book that incorporates much biology in this rather twisted take on the differences between our idealized view of Nature and the sometimes cold, hard reality of life for the birds and bees and the worms - not to mention our own species.*
(Upper reading level.) ISBN: 0060932740

Madden, Don. 1993. **The Wartville Wizard.** Alladin Press
DESCRIPTION: *Mother Nature gives a tidy old man the power over trash when he grows tired of cleaning up behind his neighbors. The neighbors finally do something about their trashy ways when the trash "sticks to them", promising to never litter again.*(Elementary reading level) ISBN: 0689716672

Martin, D.L. and G. Gershuny, ed. 1992. **The Rodale Book of Composting**. Rodale Press.

Weil, R. and N. Brady. 1998. **The Nature and Properties of Soil**. Prentice Hall, Inc.

Organizations/ Agencies

Air & Waste Management Association: *improves environmental knowledge and decisions by providing a neutral forum for exchanging information*
www.awma.org

Bureau of International Recycling: *international trade federation representing the world's recycling industry*
www.bir.org

US Composting Council: *trade and professional organization promoting compost and providing a unified voice for the growing composting industry*
www.compostingcouncil.org

Waste Management: *the leading provider of comprehensive waste and environmental services in North America*
www.wm.com