



Managing Food Scraps for a Sustainable Food System

A 3-Hour
6-8th Grade
Curriculum





About This Lesson Plan

This lesson plan takes an interdisciplinary approach to teaching general environmental and science concepts, and how they are applied to solid waste management, with specific focus on composting and recycling of food scraps. By teaching students what happens to food scraps, produced by both households and businesses, this three hour lesson plan seeks to teach students how they can use a diverse range of knowledge to identify issues related to geology, mathematics, chemistry and health.

This lesson plan includes both original content and adaptation from other lesson plans, specifically those from:

"Windows on Waste," Ohio Environmental Protection Agency.
<http://epa.ohio.gov/Portals/51/Recycle/WindowsOnWaste.pdf>

"Composting Across the Curriculum," Marin County Office of Waste Management.
<http://www.marincounty.org/depts/pw/divisions/mcstoppp/~media/Files/Departments/PW/mcstoppp/education/nov%202012/Composting%20Curriculum%20out%20of%20print.pdf>

"Waste in Place," Clean Sweep USA. <http://www.wasteinplace.org/>

Rethinking Recycling: An Oregon Waste Reduction Curriculum,
<http://www.deq.state.or.us/lq/education/curriculum.htm>

"Waste Not Project Curriculum," Waste Not Project, Montana.
<http://www.wastenotproject.org/teacher%20curriculum%20packet.pdf>

This lesson plan was developed as a collaborative effort between the Ohio Environmental Protection Agency (Ohio EPA), the Mississippi Department of Environmental Quality, The Constituency for a Sustainable Coast and The Ohio State University. The lesson plan was prepared under the auspices of the U.S. Department of Housing and Urban Development's Regional Sustainability Planning grant program to support regional food systems planning on the Mississippi Gulf Coast.

Standards of Learning

This lesson plan was released for testing in Mississippi in July 2013. The time required to implement the individual activities has not been verified. The curriculum will be evaluated and amended as necessary to meet the Ohio New Learning Standards. A version conforming to Mississippi Education Benchmarks will also be available from the Mississippi Department of Environmental Quality.

This lesson plan may meet the North American Association for Environmental Education (NAAEE) Guidelines for Excellence in Environmental Education. The Guidelines for Learning that may correlate to this curriculum are: Strand 1 A, B, C, D, E, F; Strand 2.3 A, C, E; Strand 3 A, B, C, D; Strand 4, A, B, C, D.
<https://naaee.org/>.

Feedback is requested from teachers implementing this lesson plan. For feedback or questions about the lessons, contact:

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Managing Food Scraps for a Sustainable Food System

Lesson Plan for Grades 6-8

Lesson Overview

In this lesson, students will learn the significance that wasted food has in the environment and in society. Producing the food we need to survive is a resource-intensive endeavor; still much of this food is wasted throughout the production, distribution and consumption chain. While some food scraps are unavoidable, there are many ways to prevent food scraps. Preventing and reducing food scraps allows for better use of food as a resource. Sustainable management of food scraps turns a waste into a resource. Food scraps can be used to feed the animals we consume and to return nutrients to the soils where we grow our food and food for the animals we consume. Healthy soils result in healthy foods, air and water resources. Through class discussion and activities, students will become aware of behavior that results in food scraps, the importance of healthy soils and how they can use composting to manage food scraps and improve soil health.

Objectives

- Understand the composition of the solid waste disposed at landfills and how much of it is food scraps
- Identify other wastes related to food consumption
- Identify the difference between organic and inorganic waste materials
- Understand the difference between biodegradation, oxidation and photodegradation
- Learn the principles of composting
- Understand the food scraps management hierarchy
- Identify opportunities to reduce food scraps

Grade Level: 6-8

Suggested Time: Four class periods

Content

This lesson consists of four activity modules. While the four activities do not need to be implemented at the same time, they should be implemented in the order presented here. Multimedia resources and materials needed for each activity are listed in the respective module.

Activities

1. How much food do we waste? (45 Minutes)
2. What does organic waste look like? (30 Minutes)
3. Composting: Recycling Food Scraps through Nature and Build-Your-Own Mini-Composter (60 Minutes)
4. Food Recovery Hierarchy (30 Minutes)

Activity 1

45 Minutes

How much food do we waste?

Students will gain understanding of how much of the waste they produce every day is food scraps or associated with food.



MATERIALS

- Large trash can or container lined with a plastic bag (large enough to hold the class' lunch waste)
- Weight scale large enough to use with the trash container (a personal weight scale should work)
- Four additional lined containers labeled "plastic and metal," "paper/cardboard," "food scraps," "other"
- Gloves (four pairs minimum)

BEFORE THE ACTIVITY



- It is preferable that all the waste generated by the class during their lunch break is collected for

use in this activity as it will make it more personal.

Arrange for a convenient location for the large-lined trash can in the lunch room area or arrange for students to eat lunch in the classroom that day. If collecting the class' lunch waste is not possible or if it is likely that the students might not generate enough waste for the activity, obtain a full trash container from the school lunchroom after lunch break.

- Make copies of the Waste Sort Worksheet (one per student)
- Print out one copy of the U.S. EPA Municipal solid waste Generation chart



Activity Introduction

Start the activity with a short lecture on municipal solid waste generation and composition in the United States. A script and supporting visuals are provided below. The information in the script was adapted from U.S. EPA's solid waste website. Below are links to additional background information on the topic. Reviewing these links is not necessary for this activity, but doing so might increase your comfort level with the topic.

<http://www.epa.gov/osw/nonhaz/municipal/index.htm>

<http://www.epa.gov/sustainable-management-food>

<http://www.epa.gov/epawaste/consERVE/materials/yardwoodwaste.htm>

Introduction Script:

Today we are going to start our lesson by talking about municipal solid waste (MSW)—more commonly known as trash or garbage. It consists of everyday items we use and throw away, such as product packaging, grass clippings, furniture, clothing, bottles, food scraps, newspapers, appliances, paint and batteries. This comes from our homes, schools, hospitals, businesses, parks, beaches, restaurants and many more places.

In 2013, Americans generated about 254 million tons of trash and recycled and composted more than 87 million tons of this material. On average, we generated 4.40 pounds per person per day, and recycled and composted 1.51 pounds of our individual waste. We will talk more about composting later, so if you are not familiar with composting, you will understand what I mean very soon.

[Show U.S. EPA's waste pie chart] This is a pie chart of all the waste generated by residents and businesses in the U.S. in 2013. It is divided into the most common categories of waste. The pie chart shows that paper and cardboard (paper) is the greatest amount of material generated and food scraps (food) are the second greatest. However, more than half of the paper and paperboard (67%) is recycled, while only 5% of the food scraps is recycled. As a result, more food scraps are sent to the landfill than any other type of waste.

Food scraps consists of uneaten food and scraps from in our homes, grocery stores, restaurants, school cafeterias and kitchens, hospitals and many other places. Yard trimmings are the grass clippings, leaves and branches from our yards and landscaping debris from schools, parks, etc.

Food scraps and yard trimmings are important because it is easier to recycle them together, as we will discuss later. Now I'm going to explain our first activity.



Activity Procedure

1. Introduce the exercise to the students by saying that they will be doing a waste sort of their lunch waste. A waste sort is a process used to examine the trash and find out what is in it in order to help us figure out what can be recycled and how we can recycle it.
2. Explain that the students will sort their lunch waste into the four categories: *plastic and metal*, *paper/cardboard*, *food scraps* and *other*. Have students predict which of the four bags will contain the most material at the end of the activity. You can list predictions on the board and later make a graph of the actual results.
3. Distribute the waste sort worksheets to the students.
4. Students will start by weighing the full trash container and recording the weight; then remove the bag of waste and weigh the empty container. They will subtract the weight of the empty container to calculate the total waste weight.
5. Cover floor with a tarp or plastic covering and empty the bag of waste into it.
6. Wearing gloves, students will sort the waste into the appropriate sorting containers as follows:
 - Plastic and metal: include plastic bottles (such as water and soda bottles), aluminum and steel cans, and other plastics locally allowed in recycling bins
 - Paper/cardboard: paper napkins, cardboard boxes from packaging, cardboard milk and juice containers, any other paper items
 - Food scraps
 - Other: ketchup packets, straws, film plastic wrap, Styrofoam service ware, metallic yogurt lids, etc.
7. Students will weigh each waste category and write it down in the waste sort worksheet. They will use the weights to calculate the percentage of each waste category in the total waste.
8. Using a ruler, students will measure the approximate height of the space occupied by each category in the trash container. This will be used for basic observation of volume occupied by the waste.



Discussion

1. Guide the students in using the weights to calculate the percentages of the waste they

sorted. What is the largest category by weight? Does it match their predictions? Is food scraps the largest or second largest category? Was it the smallest?

Discuss how their waste percentages compare to the U.S. EPA chart. If food scraps was the smallest category, ask the students why they think it was the smallest. A student should explain that it was the smallest because they ate most of the food and wasted little of it. If a student doesn't say it, bring it up and commend the class for eating their food and preventing it from being wasted and sent to a landfill.

2. Guide the students in estimating the volume of each category of waste sorted. This portion of the lesson can be kept basic by comparing only the heights reached inside the container by each waste category and explaining that the higher the space occupied, the larger the volume. Alternatively, the mathematics skill set can be increased by integrating volume calculations. Since the volume calculation will depend on the shape of the container available, this lesson will defer to the teacher to develop this portion of the lesson to suit their needs.

The discussion should be guided to compare volumes and weights. Food scraps is usually the heaviest component for the same volume. Wastes such as polystyrene foam (Styrofoam) cups and plates are lightweight, but occupy a large volume. Larger volume materials occupy more space at a landfill even if they are light.

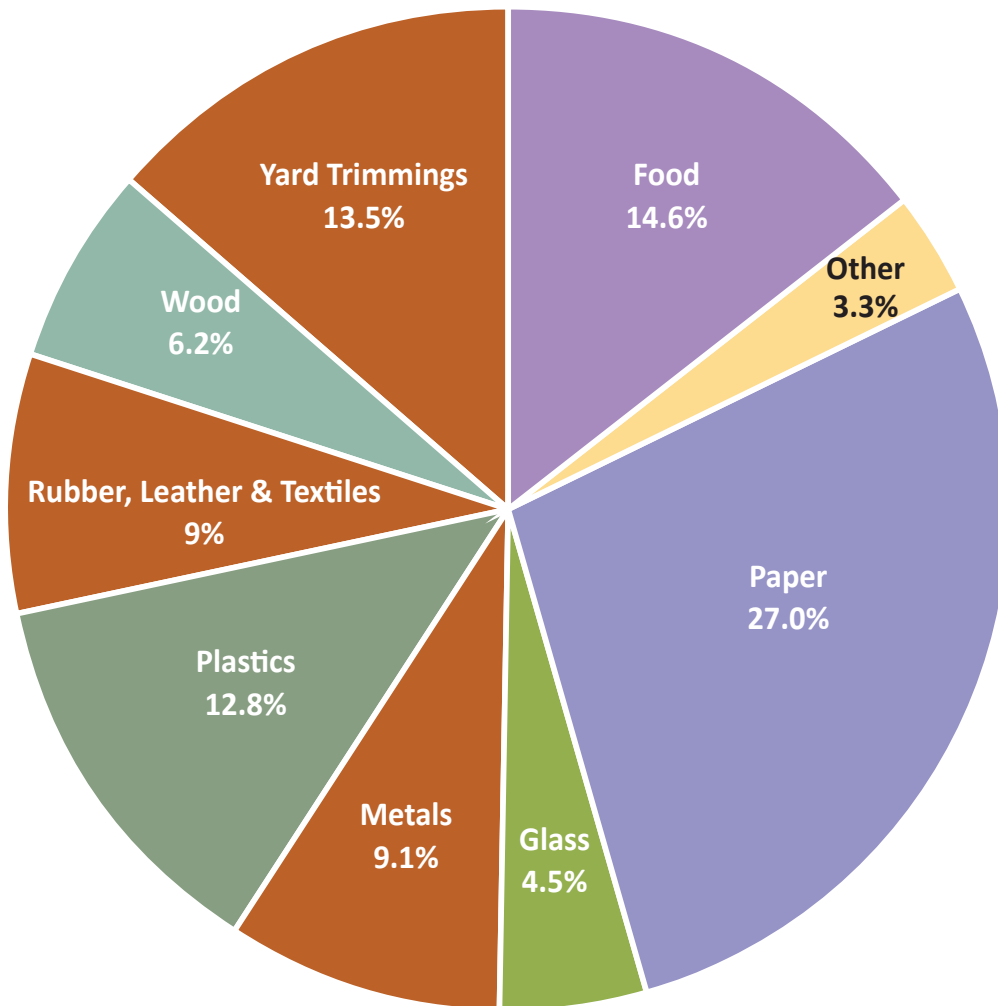
3. Discuss the composition of the food scraps and the difference between food that is not edible, such as a fruit core or peel, and food scraps created when we take more food than we can actually eat or don't like certain foods. Are there any items that should not have been thrown out, such as whole apples, untouched food or items with just a couple bites?

Ask the students what they could have done to prevent wasting the untouched or hardly eaten food, such as saving it for later, offering it to another student, trading lunches, telling their parents that they don't like certain foods for lunch, or requesting not to have it served at the cafeteria, etc. Guide the discussion toward actions they can take at school and at home to prevent food scraps.

4. Take items from the other three waste categories and discuss how they are related to food. For example, plastic bottles and cans are containers that make it possible to transport liquids in a size that's easy to manage and drink. Cardboard packaging helps keep food from being crushed during transport, on store shelves and in our hands. On the other hand, while paper napkins and straws do not keep the food safe and whole, they are related to food because we use them while eating.

Discuss how the choices we make about food also affect the amount of waste we create. What are some of the things in their lunch waste that they could reduce by finding products with little or no packaging? Are there any wastes that could be eliminated by switching to a package that is recyclable?

**U.S. Environmental Protection Agency
Municipal solid waste Generation in the United States for the year 2013**



	Paper & Paperboard (tons)	Food scraps (tons)
Generated:	68,600,000	37,060,000
Recycled:	43,400,000 (63.3%)	1,840,000 (5%)
Sent to Landfill:	25,200,000	35,220,000

Waste Sort Worksheet

Calculating Total Waste Weight

Weight trash container – Full: _____ lb

Weight trash container – Empty: - _____ lb

Total Waste Weight: _____ lb

Calculating Individual Categories Percentage of Total Waste

<u>Category Weight</u>	<u>Total Waste Weight</u>	
Plastic & Metal: _____ lb	/ _____ lb	x 100 = _____ %
Paper/Cardboard: _____ lb	/ _____ lb	x 100 = _____ %
Food scraps: _____ lb	/ _____ lb	x 100 = _____ %
Other: _____ lb	/ _____ lb	x 100 = _____ %

Estimating Volume of Total Waste in Each Waste Category

Measurement unit used: _____

	<u>Height</u>
Total Waste:	_____
Plastic & Metal:	_____
Paper/Cardboard:	_____
Food scraps:	_____
Other:	_____

Activity 2

30 Minutes

What does organic waste look like?

Students will gain understanding of the difference between organic and inorganic waste and how these wastes degrade in the environment.



MATERIALS

Rubber gloves
Assortment of waste items
as suggested in this list:

aluminum beverage can	egg carton
apple core	music cassette
oyster shells	paper egg carton
cereal box	paper grocery bag
chicken or fish bones	PETE soda bottle
coffee grounds	piece of wood or lumber
doll	plastic container
egg shells	plastic grocery bag
crawfish or shrimp hulls	aluminum foil
glass jar	rubber band
coffee can	shirt button
paper clip	“Solo” cup
baggie of grass clippings	steel can (soup)
orange peel	t-shirt
pencil stub	telephone book
flowers or potted plant	bandage
HDPE milk jug	facial tissue
newspaper	dental floss
notebook paper	old cell phone
cardboard	Styrofoam plate
	candy wrapper



BEFORE THE ACTIVITY

Teacher pre-assembles a box or bag with samples of organic and inorganic wastes for students to sort into organic and inorganic piles. The wastes from Activity 1 can also be used for this activity with the addition of items from the suggested list above.



Activity Introduction

Start the activity with a short lecture on the difference between organic and inorganic materials. A script is provided below.

Introduction Script

Some of the wastes generated during lunch were organic. The cells of plants and animals, including humans, contain great amounts of the element carbon. Chemists refer to anything that has a great amount of carbon as *organic*. Organic is used to describe a material that comes from something that is alive or was once alive. For example, the fruits, vegetables, fish, oysters, breads and other things we eat are organic because they were once alive or are made with ingredients that were alive. Biologists use the word *biotic*, which means *related or caused by living things*. So something that is biotic is also organic. They mean very much the same thing.

Who has gone to the grocery store and seen fruits, vegetables and other foods labeled as organic? The label refers to something a little different. The stores are not telling us that these foods are made of carbon, such as a chemist would say. What this organic label means is that that these foods were grown in soils fed with organic or biotic materials. For example, the farmers use compost instead of synthetic or human-made fertilizer. So the plants get nutrients from something that was alive, just like plants that grow in a forest. Later today we will learn more about compost.

Materials that are not organic are called *inorganic*, these are materials that were not alive, such as rocks, minerals, metals, glass. In general, most inorganic materials are referred to as minerals. Biologists refer to inorganic materials as *abiotic*. Again, both words mean the same thing.

For our next activity, we are going to practice identifying which materials are organic and which are inorganic. Then we are going to discuss what happens to them.



Activity Procedure

Select items from the box or bag and show them to the class, then ask them to tell you whether they are organic or inorganic. Explain why each item is organic or inorganic. For example, napkins, cardboard and newspaper are organic because they are made from plants. Some materials will be tricky. Most plastics are organic because they have carbon since they were made from petroleum. Petroleum is organic because it is made from plants and animals that died millions of years ago, however these plastics behave as inorganic. More recently, scientists were able to use some plant extracts to make plastics that behave like other organic materials. Oyster shells are considered inorganic because they are made of minerals. Shells are made of minerals like those found in rocks and sands, that's why they are used to pave roads throughout the Gulf Coast of the United States. Egg shells are minerals too.



Discussion

This part of the activity will explain why it is important to know the difference between organic and inorganic materials and the three main processes by which these materials decompose in the environment.

1. Ask the students what happens to the food they throw away after a couple days in the trash can. Explain that the trash can starts to smell because the food starts to decompose. The smell is caused by compounds released by decomposer organisms while feeding on the food. Compare this to what happens to all the leaves and branches. In a forest, the leaves and branches will decompose and form part of the soil. They do not smell like our food scraps because leaves and branches have fewer nutrients. This means that fewer decomposers can feed from these materials which takes less time. Also, the compounds do not concentrate for us to smell them. However our food scraps, just like leaves, could become part of the soil.
2. Explain that decomposers are organisms that break down the cells of dead plants or animals into smaller substances by feeding on these cells. These organisms include bacteria, fungi, actinomycetes, insects and worms. Most of the decomposition is done by bacteria that are so small they can only be seen with a microscope. When decomposition is done by living organisms, it is called biological degradation or biodegradation. When we see items labeled as biodegradable, it means that microorganisms can decompose these items by using them as food. Write the word *biodegradable* on the board and summarize by saying that this means that decomposers can biodegrade organic or biotic materials.

3. Inorganic materials are not a good source of food, so they are not biodegraded, instead they decompose by chemical reactions. Two common chemical reactions are *oxidation* and *photodegradation*. Write the two words on the board.

Oxidation is what appears as rust on metals. This rust will spread becoming flaky and brittle causing the metal to eventually disappear. There are some materials, like the aluminum in cans, that can take hundreds of years to rust.

Photodegradation is caused by light. Light causes chemical reactions that break down the molecules that make up inorganic materials.

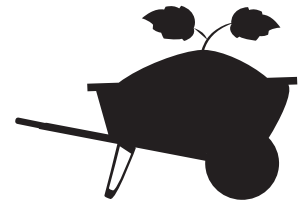
Ask the students if they have ever left a plastic toy outside in the sun for a long time. Ask if they saw any changes. Explain that sometimes light degradation only causes the colors to fade away, but for some materials, light makes them hard and flaky and causes them to eventually break apart. Also explain that because some plastics are first degraded by light into molecules, these plastics can later be biodegraded by decomposers, but this process can take a long time.

4. Review the difference between organic and inorganic materials. Review biodegradation, oxidation and photodegradation.
5. If time allows, select a few items and ask them whether they think it will be biodegraded, oxidized (rusty) or photodegraded.

Activity 3

60 Minutes

Composting: Recycling Food Scraps through Nature and Building Your Own Mini-Composter



Students will learn the importance of soil health for food production and how composting can be valuable for recycling food scraps to improve soils. Students will learn how to assemble a composting pile and make a mini-composter for classroom use.



MATERIALS

- Computer with MS PowerPoint or Adobe Acrobat Reader installed
- Projector compatible with computer
- Two-liter bottle (at least one)
- Black or dark color paint
- Knife
- A nail to punch holes
- Spray bottle filled with water
- Brown compostable materials (leaves, shredded office paper)
- Green compostable materials (fruits and vegetable scraps, grass, coffee grounds, egg shells)
- Plastic cup or any container that can be used to scoop compostables
- Duct tape



BEFORE THE ACTIVITY

- Collect enough brown and green compostables. For each bottle collect about one gallon of brown and two cups of green materials.
- Prepare the bottle following the instructions in the next page. More bottles can be prepared to allow students to build the mini-composter in teams. You may make all of the bottle preparations beforehand, then tell the students how you did it; or you can leave some steps for students to complete.



Multimedia Resources

The Story of Soil: *Where our food comes from?* Quick Time Video

Composting: Recycling Food Scraps through Nature PowerPoint Presentation and presenter's notes (Appendix A)



Activity Introduction

Explain that in this activity they will learn about compost and how to assemble a composting bin in their backyard or any similar location. They will practice by building a mini composter.

Activity Procedure

1. Show the *Composting: Recycling Food Scraps through Nature* PowerPoint presentation.
2. Ask students if they have questions about composting and clarify as needed.
3. Tell students that the class will now practice setting up a composting bin by setting up a mini-composter bin.
4. Provide instructions for building the mini-bin or explain how it was prepared, as applicable.
5. Explain how to load the mini-bin with the compostables. Roughly measure five scoops of brown material for one scoop of green. Add enough materials until bin is one-half to two-thirds full. Spray the material with water until it is damp, but not soggy. Secure the closed door with duct tape. Roll the mini-bin on a table until the material is well mixed. Open and check to see if more water is

Preparing the Bottle:

- Remove the label from the two-liter bottle by soaking the bottle in warm soapy water for a few minutes. Rinse and dry.
- Lay the bottle on its side and cut three sides of a rectangle 5"x3" in the side of the bottle. Leave one five-inch side attached to provide a *hinge*. This door is for adding material to your compost bin and removing compost.
- A piece of duct tape will secure the *door* once you have filled the bottle with compost materials.
- Paint the outside of the bottle with any flat black or dark paint and let dry.
- With a nail, punch holes in the bottle about four inches apart in all directions. These holes provide aeration for your compost.

needed. Place the compost bin on a sunny windowsill. Check the compost every day for the first few days to make sure you have the correct amount of moisture. If the contents get too dry, simply add water. If they are too wet, add dry material and remove the cap from the bottle. If the contents become soggy, leave the door open until dry.

6. Encourage students to add any fruit or vegetable scraps from lunch to the mixture. Be careful to add enough brown ingredients to maintain a balance of wet and dry material. However, at some point they will need to stop adding fresh materials in so that all materials finish composting at about the same time. Stop adding materials when the bottle is two-thirds full or when you see that compost is starting to form.
7. Periodically allow students to view the contents and record any changes they see. This is a great opportunity to engage students in recording their findings and observances in a science journal. Challenge them to observe carefully and note even subtle changes in appearance, temperature, smell and texture.
8. Once the compost is done, it can be used for a classroom plant or spread around outdoor plants. Compost is done when all of the material looks and smells like soil.

Activity 4

30 Minutes

Food Recovery Hierarchy

To teach students the different options available for managing food scraps and how the options rank in terms of environmental sustainability according to the U.S. EPA's Food Recovery Hierarchy



MATERIALS

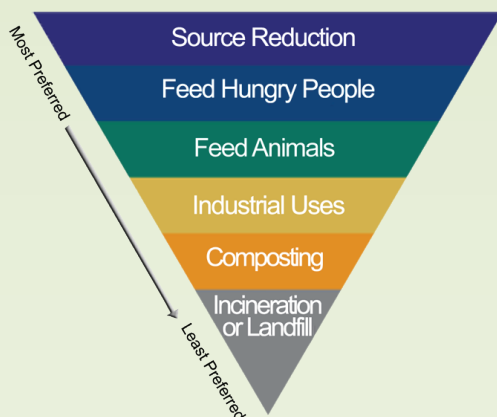
- Six pieces of poster board or paper for making signs large enough to be seen by all students.
- Color markers
- Scotch tape



PRIOR TO ACTIVITY

- Prepare six signs that read "Source Reduction," "Feed Hungry People," "Feed Animals," "Industrial Uses," "Composting," or "Incineration/Landfill."
- Become familiar with U.S. EPA's Food Recovery Hierarchy (shown below) by reviewing U.S. EPA's document, "Putting Surplus Food to Good Use". The document is included in this packet and can also be accessed at: <http://www.epa.gov/sustainable-management-food/food-recovery-hierarchy>

Food Recovery Hierarchy



For additional detailed information, visit U.S. EPA's website on food scraps:
<http://www.epa.gov/sustainable-management-food>



Activity Introduction

Explain that in the previous activity we learned about composting and how it is a good option for managing food scraps. However, there are things other than composting that we can do, not only to manage food scraps, but to prevent the creation of food scraps.

Discuss with the class the six options for managing food scraps and what they entail. Discuss them out of order and do not mention that some options are preferred over others.



Activity Procedure

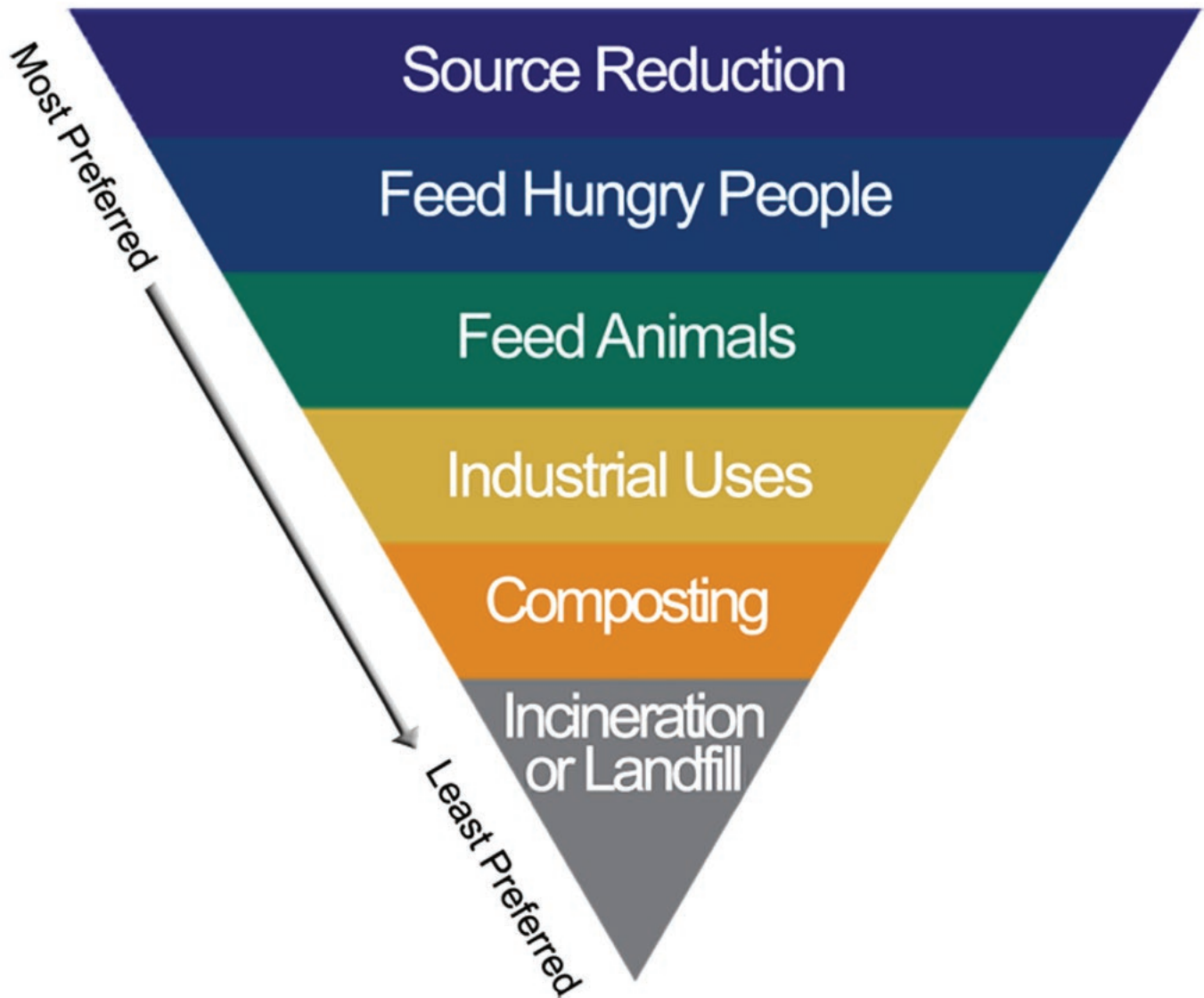
1. Have on hand the six signs that read "Source Reduction," "Feed Hungry People," "Feed Animals," "Industrial Uses," "Composting," and "Incineration/Landfill."
2. Divide the students into six groups and assign a management method to each group. Ask each group to make a list of the positive and negative things about their method.
3. Have each group share their lists with the class. Clarify any misconceptions the students may have about what each method involves.
4. Have students rank the six methods from most to least preferable. Ask one group to tape their sign to the board, then let the other groups take turns taping their signs above or below it, depending on their rank. If the students do not rank the methods correctly, please explain what the ranking should be.



Discussion

Ask the students for ideas about what they can do at home and school to reduce food scraps. If time allows, write the ideas on the board, then ask the students to copy them for future reference.

Food Recovery Hierarchy



Appendix A

Presenters notes for Composting:
Recycling Food Scraps through Nature
and Building Your Own Mini-Composter

Composting

Recycling Food Scraps through
Nature

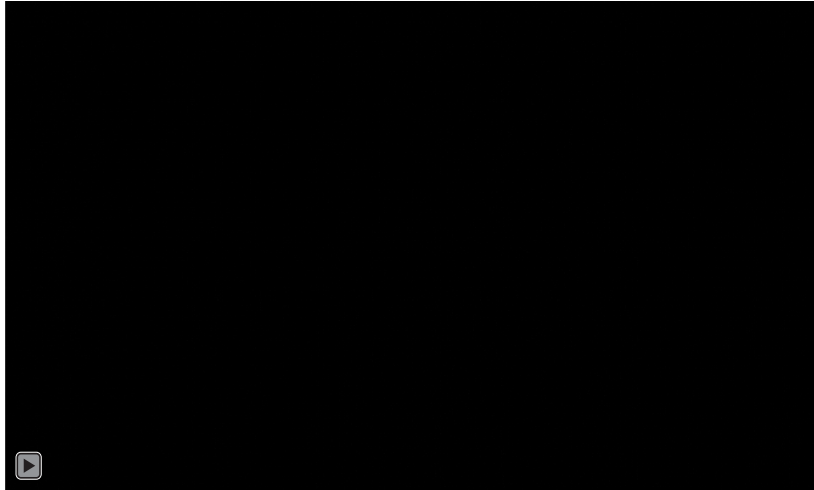


Slide 1: Composting, Recycling Food Scraps Through Nature

In this presentation, we are going to learn what compost **is** and how we can use composting to recycle food scraps in order to grow more food.

Ask the students to raise their hands, if they compost at home. Tell the students who raise their hands “That is great! I will count on you to help me with the presentation a little later by sharing your experience.”

Soul Food or Soil Food?



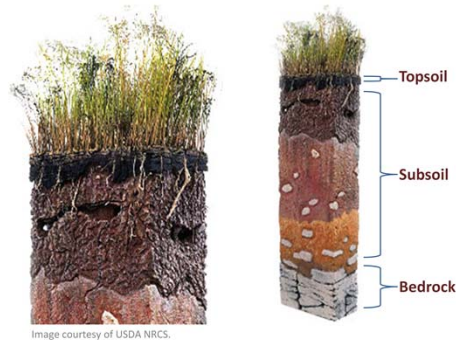
Slide 2: Soil Food

This presentation is about using composting to recycle food scraps to grow more food. Soil has something to do with our food. Who agrees with this? Raise your hand if you agree. This short video explains the importance of soils. Let's watch.

After the video: It seems all food is "soil food". Do you agree? Now let's talk a little more about soil.

What on Earth is Soil?

- 45% Minerals
 - Sand, silt, clay
- 25% Water
- 25% Air
- 5% Organic matter
 - Dead, decaying plants, animals and other organisms



Slide 3: What on Earth is soil?

Soil is a complex mixture of minerals, water, air and organic matter from dead, decaying plants and animals. Soils vary from one location to another depending on the kinds of rocks and how much these rocks have broken down; how much organic matter is in the mixture; and how much water and air the soils contain.

Soil composition:

About 45% of the soil is composed of minerals, mostly rocks that have broken down over time into solid particles of sand, silt and clay. Sand particles are the largest and clay particles the smallest. Although a soil could be all sand, all clay or all silt, that's rare. Instead most soils are a combination of the three. Sand is the largest particle and feels gritty when rubbed between the fingers. In coastal areas, beach sand also contains broken down pieces of shells, coral and other tiny marine species. Silt is the medium-sized particle. It feels smooth like flour. Individual silt particles are barely visible. Clay is the smallest particle and cannot be seen by the unaided eye. Clay feels sticky when wet.

Most soils have 25% water and 25% air. There is not exactly 25% of each as these amounts can change due to rain, drought and other conditions. However, the soil composition is about 25% for each most of the time for most soils. In coastal areas, it is a little different as soils in marshlands, swamps, bayous and wetlands have more water because they get flooded frequently with changes in the tides.

The smallest fraction of soils is organic matter, which is about 5%. Organic matter consists of dead plant and animal tissue and the micro-organisms that live in the soil. While organic

matter accounts for only about 5% of the volume of the soil, it is a very important part of the soil. Organic matter has many functions, including providing food for organisms, helping hold the water in the soil, providing nutrients for plants and more. Soils in marshlands, swamps, bayous and wetlands typically have higher organic matter content than most soils, which means more food for organisms. That is why these areas are considered nurseries for baby shrimp, fish and other aquatic species.

Soil horizons image: The layer called “topsoil” is where most of the organic matter is located. The upper part of the top soil has a thin layer of fresher organic matter that is decomposing or breaking down. This picture shows three different layers of subsoil. The upper subsoil will have more organic matter. As we go deeper, the subsoil contains more minerals because it is closer to the bedrock from which it is formed.

Soil is like the Earth’s skin. Just as we can’t live without our skin, we can’t live without soil. Why? Because soil performs many functions that are fundamental for life.

Before moving to the next slide, ask the students “What are some of the functions of soil that make it so important for life on Earth?” and wait for their answers.

The above discussion is based on information from the following resources:

SoilScienceInfo.Net <http://soilscience.info/index.php>

Soil Science Society of America <https://www.soils.org/>

USDA Natural Resources Conservation Service:

http://www.soils.usda.gov/sqi/concepts/soil_biology/biology.html

We ♥ Soils!

- Provide nutrients and a place for plants & animals to grow (our food!)
- Habitat for soil organisms
- Recycle organic matter into nutrients
- Filter and purify the water we drink and use
- Help maintain clean air
- Where we build our houses and cities



Slide 4: We heart soils!

What are some of the functions of soil that make it so important for life on Earth?

- 1) Soils provide nutrients and a place for plants to grow and most of our food comes directly or indirectly from plants
- 2) Soils provide the habitat for soil organisms--mostly microscopic creatures that account for most of the life on Earth. Soils are so full of life that the soil itself seems to be alive.
- 3) The microorganisms in soils help process and recycle nutrients, including carbon, so that living things can use them over and over again. The dead plants and animals are recycled into nutrients.
- 4) Soils can filter and purify the water we drink and use every day. Microorganisms can use some of the chemicals present in our waters as food by breaking them down (biodegradation).
- 5) Soils modify the atmosphere by emitting and absorbing dust and many gases, including carbon dioxide, methane and water vapor.
- 6) Our houses, buildings, cities are built on top of soil and made of materials that came directly or indirectly from soil.

The discussion above is based on information from the following resources:

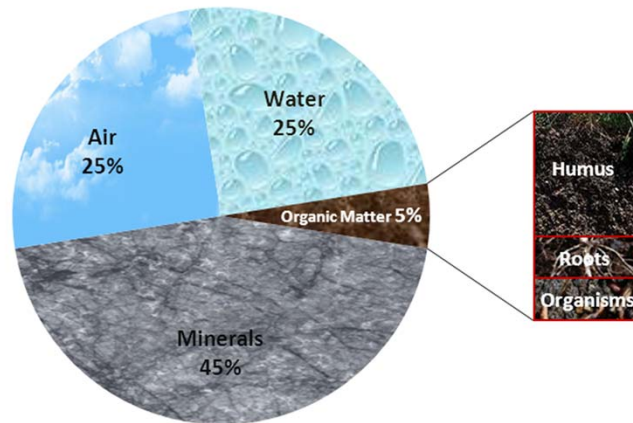
SoilScience.Info <http://soilscience.info/>

Soil Science Society of America <https://www.soils.org/>

USDA Natural Resources Conservation Service:

http://www.soils.usda.gov/sqi/concepts/soil_biology/biology.html

Humus to Hummus



Slide 5: Humus to Hummus

Who likes to eat hummus? The hummus that we eat is spelled with two m's. Humus with one "m" is what soil scientists call the portion of the organic matter in the soil that is already decomposed. Humus is formed when the organic matter decomposes. When you go to a forest or your yard and lift a layer of leaves that have been there for a while, sometimes you will find a layer of dark, spongy material that looks like soil and smells earthy. This is humus.

What is Compost?

- The product from the biological degradation of organic waste materials
- In other words: humus!



Image courtesy of USDA NRCS.



Slide 6: What is Compost?

Compost is the product of biological degradation of organic waste materials. It is the same as humus, but made by us through the composting process. By composting our organic wastes, we can help nature make the humus it needs for soils. We can manage composting so the biodegradation happens faster than it would happen in nature.

The Composting Not-so-Secret Recipe

- The right food for decomposers
- Decomposers
- Water
- Air



Slide 7: The Composting Not-so-Secret Recipe

There are four basic things we need for composting. The first is organic wastes, which are the food for the decomposers. Then we need decomposer organisms. We also need water and air. We will discuss this in more detail in the next few slides. The great thing about composting is that we can control the process.

A Balanced Diet

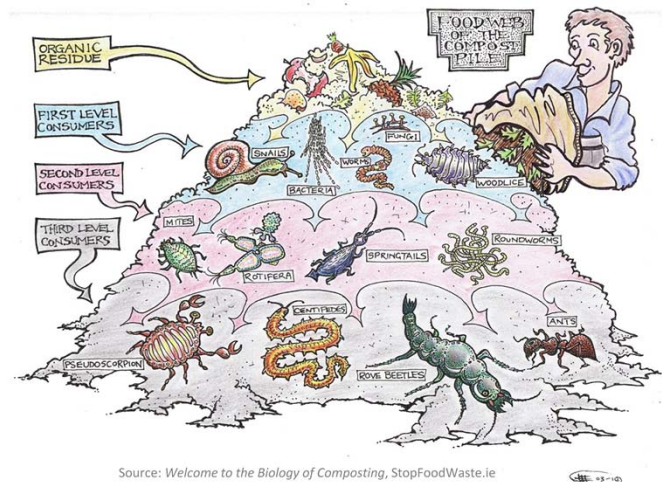
- Carbon (C) rich materials provide energy for microbes and other decomposers
 - Leaves, wood, paper, cardboard, etc.
 - Also called “browns”
- Nitrogen (N) rich materials provide the Nitrogen needed for cell function
 - Food waste, manure, grass, etc.
 - Also called “greens”
- C:N ratio
 - Optimum is between 25:1 to 30:1
 - Or, 5 parts of browns to 1 part of greens



Slide 8: A Balanced Diet

Organic matter, such as leaves, grass clippings, garden plants, kitchen scraps and shredded paper make excellent compost materials. Leaves, woody branches and paper have a high carbon content, which microorganisms need for energy. Grass clippings and vegetables are higher in nitrogen, needed to make the enzymes used in decomposition and other processes. In other words, carbon rich materials are the food and nitrogen rich materials are the vitamins. Achieving an optimum balance of carbon to nitrogen (C:N ratio) is important for effective composting. The optimum ratio is between 25 and 30 carbon atoms for each nitrogen atom. This is clearly not a practical form of measurement outside a very specialized laboratory. Therefore, we use a conversion of about five parts carbon to one part nitrogen or five buckets of browns to one bucket of greens.

Decomposers



Slide 10: Decomposers

There are many decomposers in a composting pile. Soil organisms, such as bacteria, fungi and others, are largely responsible for starting the composting process. Since these organisms naturally occur in soil and vegetable matter, their presence is guaranteed. But you can always add a couple shovelfuls of compost or soil to provide “starter” decomposers for your pile.

H₂O

- Aim for 40-60% moisture
- As wet as a wrung out sponge



Source: Angel Arroyo-Rodriguez



Slide 10: Water

Water is essential for composting. Just like us, microorganisms need water to survive and be active. A moisture level of 40 to 60 percent is best. Your compost pile should be about as wet as a wrung-out sponge. If it is too soggy, the bacteria and other beneficial organisms will not get enough air. On the other hand, a lack of moisture will cause microorganisms to go dormant and delay the composting process.

Air

- Organisms need oxygen (aerobic process)
- Turn pile to increase porosity and air can flow through the pile



Source: Angel Arroyo-Rodriguez



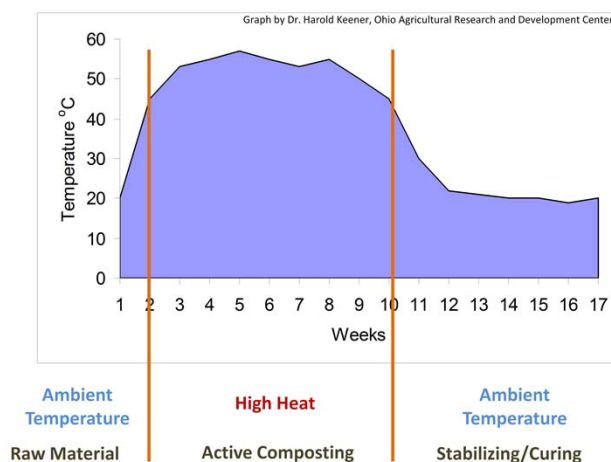
Source: Angel Arroyo-Rodriguez



Slide 11: Air

Oxygen is vital because composting is essentially an aerobic process. Aerobic means that the bacteria need oxygen to live and perform specific functions. If the air supply is cut off, anaerobic bacteria will take over, resulting in unpleasant odors. To ensure that enough oxygen is available, turn your compost pile. Turning also brings the outer, less decomposed portions of the pile into the center where the soil organisms do their work.

How Does It Work?



Slide 12: How Does It Work?

When bacteria and other microorganisms start feeding on organic material, they generate heat. This process is similar to us getting hot when we exercise. At the beginning of the process the raw materials are at a normal ambient temperature. As organisms start feeding on these materials, they generate heat. Eventually it gets hot enough that only organisms that can live at these high temperatures become active (the others go dormant or die). Once the high heat organisms use up all the food, they start to go dormant and the heat goes down again.

The maximum decomposition occurs when compost temperatures range from 110-150 degrees F. Therefore, temperature is a good indicator of effective composting. At these temperatures weed seeds and most disease causing microbes and parasites die. It takes three days at 131 degrees F (55 degrees C) to kill parasites and plant pathogens. It is important that piles are turned frequently to ensure that all parts are exposed to these high temperatures. You may see steam when you turn the pile. A larger pile size helps retain heat. As the temperature exceeds 150 degrees F, the composting rate drops rapidly and becomes negligible at temperatures higher than 160 degrees F.

The discussion above is based on information from: The Composting Process. The Ohio State University Extension, Bulletin 792 http://ohioline.osu.edu/b792/b792_2.html

Get Ready to Compost!



Good to Go

Browns

- Leaves, twigs, woody plant parts
- Straw, hay
- Sawdust, wood chips (clean wood)
- Shredded paper, newspaper, cardboard
- Non-recyclable paper goods
 - Paper towels, napkins
 - Paper plates & cups not coated with plastic
 - Soiled cardboard (pizza boxes, ice cream cardboard tubs)
- Old mulch & potting soil
- 100% cotton, linen & wool fabrics (cut in small pieces)

Greens

- Grass clippings, garden plants
- Indoor plants, cut flowers
- Weeds (without seeds)
- Food Scraps
 - Fruit & vegetable trimmings & peels
 - Coffee grounds & filters, tea bags
 - Breads & other bakery goods
 - Rice & other grains
 - Pasta & cereals
 - Egg shells
- Farm animal manure
- Vegetarian pet cage waste (hamster, guinea pig, rabbit)



Slide 14: Good to Go

Here is a list of common organic wastes that we find at home and school. They are listed as either browns or greens. Remember, green materials have more nitrogen than brown materials.

Browns:

Dried leaves, twigs, hedge clippings, tree branches and any other woody parts of a plant are high in carbon. Green leaves are considered to have a higher amount of nitrogen; however, you can consider a tree branch with green leaves as mostly brown.

Dry straw and hay are considered browns

Sawdust, wood chips (clean wood). Clean wood means that it has not been painted, glued, covered in plastic, etc.

Shredded paper, newspaper, cardboard

Non-recyclable paper goods refers to paper or cardboard that cannot be put in the regular recycling bin. These include paper towels, napkins, and disposable paper plates and cups that are not coated with plastic. All of these materials can be composted even if lightly soiled with food and should be cut or torn into smaller pieces so they will compost quickly. Similarly, cardboard soiled with food, such as pizza boxes and ice cream cardboard tubs, can be composted. Cardboard ice cream tubs are usually covered in wax. While that makes them hard to recycle, microbes can eat the wax so they can be composted. All wax covered cardboard can be composted.

Old mulch and potting soil, and even compost can be added to the pile. The potting soil will not decompose much, but it will add decomposers.

Also, fabrics made of 100% cotton, linen or wool can be composted. They must be cut into small pieces otherwise they will not compost at the same speed as the other materials.

Greens

Material with higher nitrogen content is considered as greens. All the plant parts that are green are high in nitrogen, so that helps us remember. Grass clippings, garden plants, indoor plants, cut flowers and even weeds are considered green. We have to be careful to not include weed seeds, as they might not be destroyed in a backyard composting system.

All food scraps are compostable, if we can eat it, so can the microbes. However, for a backyard setting, these are the food scraps recommended: fruit and vegetable trimmings and peels, coffee grounds & filters, tea bags, breads, donuts and other bakery goods, rice and other grains, pasta and cereals, and egg shells. Eggshells are not really that high in Nitrogen, but they were listed with the food wastes so it is easier for us to remember.

Cow, pig, horse, llama, alpaca, bison and chicken manure are also ok. All manure is rich in nitrogen, but it is only recommended that you use manure from farm animals as they rarely carry diseases that affect us. For the same reason, only pet waste from pets that eat only plants is recommended.

Not So Fast!

Best not to compost at home:

- Diseased plants or plants infested with insects
- Weeds that spread by root or runner or weeds with seeds
- Painted or treated wood
- Dairy products (cheese, yogurt, etc.)
- Meats
- Bones and shells
- Cooking oils, fat or grease
- Dog and cat pet waste
- Compostable plastics
- Vacuum cleaner bags



Slide 15: Not So Fast!

There are some organic and compostable wastes that are not recommended for backyard or other types of small-scale composting, such as school or community garden projects. These materials should only be composted by people with lots of experience and large piles or facilities.

We will go through each of these waste materials and give the reasons why they may cause trouble:

Diseased plants or leaves - Piles often do not get hot enough to destroy all plant diseases.

Insect-infested plants - Piles often do not get hot enough to destroy all eggs, larvae and adult insects.

Weeds that spread by root or runner - Some weeds will not decay during the composting process. Therefore, they could survive and spread.

Any animal products or parts (meat, fish, poultry) – Piles are not large enough to heat up quickly and filter potential odors. Animal products can also attract pests.

Bones and shells - Slow to compost, especially in smaller piles. Can cause odors and attract pests as do animal products.

Dairy products - Piles are not large enough to heat up quickly and filter potential odors.

Dairy products can also attract pests. However, limited amounts of milk and melted ice cream can be used to add moisture to piles. The microbes in the pile like the sugars in these liquids and will use them up quickly. Piles should be on the drier side before adding liquids.

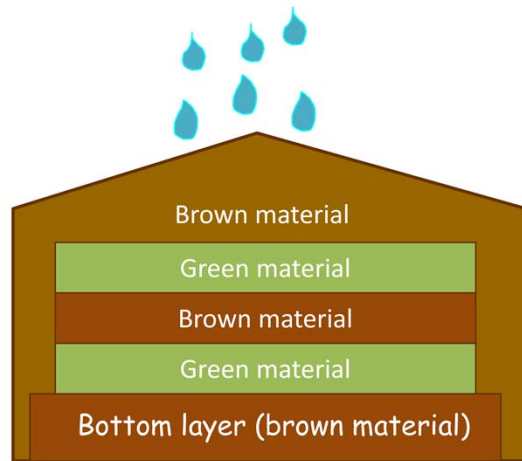
Cooking oils, fat or grease – Too heavy, can clump the materials in the pile and reduce air flow, thus causing odors and attracting pests

Dog and cat pet wastes - May contain pathogens that could spread disease, cause odors and attract pests (flies).

Compostable plastics – These products are disposable forks, spoons, straws and containers made of special plastics derived from plants. They look like regular plastic, but they will compost. However, they must be exposed to the composting heat and moisture levels in order to break down quickly. Therefore, it is not recommended to put them inside a backyard or small composting bin. In an enclosed bin, compostable plastics can take more than a year to compost.

Content of vacuum cleaner bags - Not all bags and/or contents are biodegradable. This is especially true with bags from vacuum cleaners used in homes with installed synthetic carpet.

Assembling a Composting Pile



- Start with bottom layer of brown material
- Alternate green and brown materials
- Finish with cover layer of brown material
- Add water until pile is as wet as a wrung out sponge

Slide 16: Assembling a Composting Pile

This is the basic way to assemble a composting pile. First, create a bottom layer, three to six inches thick, of brown materials. This will help absorb excess moisture from your green materials. Then, place your green materials on top and alternate with layers of brown. By alternating layers, you will ensure that you have enough brown material to absorb excess moisture and help you achieve an optimum carbon to nitrogen ratio. (This is a good opportunity to ask the students to tell you the optimum C:N ratio).

When starting a pile, layer it this way, wait about a week then mix it well by turning it.

If you don't have a lot of green materials, you can start with just one layer and keep building it up as you collect more materials.

You can assemble a pile like this in the open (with no side walls).

Bins



Source: Angel Arroyo-Rodriguez



Source: Angel Arroyo-Rodriguez



Source: Angel Arroyo-Rodriguez



Source: Lucille Beachdeli



Source: James Murray-White, GreenProphet.com



Slide 17: Bins

Here we see some examples of backyard and small-scale composting bins. You can buy bins in different sizes and shapes, or you can construct your own. As we discussed earlier, a bin is not really needed, but many people prefer one. Using a bin that closes is ideal if you want to compost food scraps and you have a curious pet or live near fields with wildlife. Using a bin with a lid also helps you keep your pile tidy.

The bins at the bottom left are commonly referred to as three-sided bins.

Tips for Success

- Turn (mix) the compost pile every couple of weeks or each time you add new material
- Maintain an ideal pile size of 3'x3'x3' to help retain heat and preserve good air flow
- Don't had thick layers of any one kind of waste
 - 6" to 8" for brown material
 - 3" to 5" for green material
- Smaller pieces will compost quicker than larger pieces. Shred brown material if possible



Slide 18: Tips for Success

I want to share some general tips to help you make composting more successful. Turn (mix) the compost pile every couple of weeks or each time you add new material. Turning aerates the pile and will expose the outer portions of the piles to the high heat in the center of the pile.

Maintain an ideal pile size of 3'x3'x3' to help retain heat and preserve good airflow. This is not as important if you are using one of the enclosed bins as the pile is the size of the bin.

Don't add thick layers of any one kind of waste:

6" to 8" for brown material

3" to 5" for green material

Smaller pieces will compost quicker than larger pieces. Shred waste materials if possible.

Is It Done Yet?

Compost is done when it is dark, crumbly and has an “earthy” smell

How long does it take?

Short period (3 weeks to 2 months)

Long period (2 months or more)



Slide 18: Is It Done Yet?

Compost is done when it is dark, crumbly and has an “earthy” smell. How long the material takes to compost will depend on how we started the pile and how much we cared for it.

A short period is considered between three weeks and two months. For the materials in a pile to compost this quickly, the pile should be assembled using mostly smaller pieces of material. The pile should be big enough to retain heat. The appropriate amount of moisture should be added to the pile when needed and the pile should be turned frequently. A long period is considered to be between two months and a year. Composting will take longer if the pile is made up of primarily larger pieces of material, is allowed to dry up often, is small or is not turned frequently.

Also, the kind of materials play a big factor in how long composting takes. For example, wood chips can take as long as a year or more to compost! Therefore, a pile with lots of wood chips will take longer to become crumbly compost. On the other hand, green materials compost more quickly.

What's That Smell?

- Foul odors indicate anaerobic decomposition.
- Solutions:
 - Aerate the pile by turning
 - Increase porosity by adding wood chips or wastes of larger size
 - Add absorbent browns
 - Hold the water until needed again



Slide 19: What's that Smell?

If the pile starts to smell like rotten eggs, this indicates that the material is decomposing anaerobically (without oxygen). When this happens, hydrogen disulfide, the chemical that causes the rotten eggs odor, is released. This usually happens because the pile is too wet and air can't go through it, which allows anaerobic microorganisms to take over the pile.

This is easy to fix, although it might take a couple days for it to be completely fixed. The first thing to do is turn the pile to make sure that air gets through it. Another thing we can do is add woodchips or materials of a larger size to increase porosity or air space. We can also add absorbent browns such as shredded paper or cardboard to soak up the moisture. And last, stop adding water until the pile dries enough.



Slide 20: Composting is as much of an art, as it is a science

This concludes the presentation. You have probably noticed that there is a fair amount of trial and error in composting. We know how some things should work, but sometimes they don't work the way we expect due to factors out of our control. For example, maybe it rains a lot for many days and the pile is allowed to get too wet. Even in these unpredictable situations, by observing and troubleshooting, in time we can learn the art of composting.

Disclaimer

This presentation is a component of the lesson plan *Managing Food Scraps for a Sustainable Food System*, prepared under the auspices of the U.S. Department of Housing and Urban Development Regional Sustainability Planning grant program supporting regional food systems planning on the Mississippi Gulf Coast. The lesson plan was developed as a collaborative effort between the Ohio Environmental Protection Agency, the Mississippi Department of Environmental Quality, The Constituency for a Sustainable Coast and The Ohio State University.

