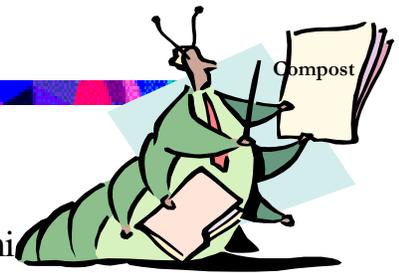


Compost Lesson



Goals

Students will...

- Learn basic facts about composting with worms, called vermi
- Compost at home.
- Increase their awareness of the environmental benefits of composting.
- Reduce food waste.

Objectives

Students will be able to...

- a. Define composting
- b. Explain the two types of composting
- c. Explain the role of worms in composting
- d. Give an example of a “brown” ingredient
- e. Give an example of a “green” ingredient
- f. Construct a worm composting bin
- g. Observe and record composting changes over time
- h. Demonstrate the importance of aeration
- i. Observe and record temperature and moisture of compost bin
- j. Construct a bar graph of the temperature and moisture observations
- k. Problem solve for compost bin problems
- l. Write to persuade parents to compost
- m. Write composting directions

Lesson Activities

- Introduce composting
- Background information on composting
- Lessons from the Farm
- Set up compost bin
- Make salad and dessert recipes
(Form groups of 4 to 6 students)
- Eat
- Wrap-up
- Distribute copies of recipes and challenge sheets to students
- Clean-up

Other Compost Activities

Compost fact sheet, Writing ideas, Worm anatomy sheet

Background Information on Composting

Composting is...

Composting is the decomposition of plant remains and other once-living materials to make an earthy, dark, crumbly substance that is excellent for adding to houseplants or enriching garden soil. The best way to recycle yard and kitchen wastes is to put food and other once-living matter into a compost bin to decompose. It should be possible to recycle up to 30% of garbage that is usually thrown away. When these materials decompose, they break down into an organic matter that is rich in nutrients and nitrogen. The nutrients in the compost are added back to the soil as a means of recycling and replacing the nitrogen that was previously used up by plants' growth. Compost is natural fertilizer that adds nutrients to the soil and loosens the structure of the soil. There are two types of composting – indoor and outdoor. Outdoor composting uses heat, bacteria and microorganisms to break down composted ingredients. Indoor composting, or vermicomposting, can be done in a bin and uses worms, bacteria and microorganisms, and should not generate heat.

Worms help with the composting process by...

Worms help to speed up the decomposition process. They are constantly burrowing and tunneling in the earth. As they go, they gobble up dirt and debris, bits of dead leaves, insects, and other decaying plant and animal matter. They grind this mixture into mush and break down the debris. Their *castings* (a fancy name for manure) are rich with nutrients that are added to the natural decomposition taking place in the compost bin.

A composting bin includes...

A compost bin includes two types of ingredients—brown and green. The “brown” ingredients are good sources of *carbon* and the “green” ingredients are good sources of *nitrogen*. You need a balance of these two elements in order for the compost pile to work and break down the different materials.

“Brown” ingredients include:

coffee filters	cotton/wool/silk scraps
corncobs	sawdust
dried grass clippings	tea bags
hay or straw	wood chips
dead leaves	wood ash
paper	pine needles

Background Information continued



“Green” ingredients include:

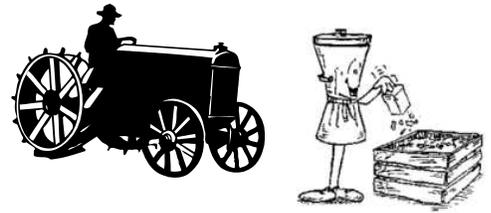
- algae
- bone meal
- coffee grounds
- eggshells
- feathers
- flowers
- fruit and fruit peels
- fresh grass clippings
- hair
- manure
- seaweed
- tea leaves
- vegetable scraps and peelings
- weeds

Materials NOT to put in a compost pile**:

- Meat
- Fish
- Fats
- Dairy products

**These materials should not be in a compost pile because they are more likely to produce strong odors and attract animals.

Lessons from the Farm – Compost



Composting is a process that breaks down organic waste materials like the food scraps that are left over from cooking and makes them into soil and humus, thus completing the growth cycle.

Compost can also be made from parts of the vegetables and other foods that are discarded before eating and from lawn clippings and any weeds that are in your garden. Also, you can use the manure from pet cages or from farm animals.

How do you do this? It is really very simple.

You need to have the right balance of green and brown materials. Green materials are such things as discarded plant and food materials. Brown materials can range from dry plant materials like hay, to materials such as sawdust and paper. These are mixed in a pile or bin in your backyard. Occasionally you must turn and mix these materials and make sure they are damp enough. Eventually you will see them beginning to become “soil.” This compost may then be mixed with your garden soil to grow new plants. The same thing happens in worm bins where you feed kitchen food scraps to worms. The worms break down the scraps into rich vermicompost that can be added to your garden soil or to potted plants to help make them grow.

Good luck with your lessons and on learning how to compost!

Materials and Preparation



Food needed for making a fresh layered salad (for 4 groups)

- 4 heads lettuce or other greens
- 4 cups diced celery
- 4 cups diced red onion
- 4 small bags frozen peas –thawed
- 1/2 cup of sugar
- 1 quart light sour cream, light mayonnaise, nonfat, or low-fat plain yogurt
- 4 cups vegetarian or regular bacon bits
- 4 cups grated parmesan or cheddar cheese
- 4 cups crunchy dried chow mein noodles (to represent worms)

Materials needed (for 4 groups)

- 4 large glass bowls
- 4 small bowls
- 4 cutting boards
- 4 knives
- 4 sets measuring cups and spoons
- Cleaning towel, napkins
- Compost bucket
- 4 large spoons
- Copy of recipes for each student
- Copy of compost fact sheet for each student
- Copy of writing ideas sheet for each student
- Copy of challenge sheet for each student

Each station should have the following:

Food

- 1 head lettuce or other greens
- 1 cup diced celery
- 1 cup diced red onion
- 1 small bag frozen peas –thawed
- 2 tablespoons of sugar
- 1 cup light sour cream, light mayonnaise, nonfat, or low-fat plain yogurt
- 1 cup vegetarian or regular bacon bits
- 1 cup grated parmesan or cheddar cheese
- 1 cup crunchy dried chow mein noodles (to represent worms)

Materials

1 large glass bowl

1 small bowl

Cutting board

Knife

Measuring cups and spoons

Cleaning towel, napkins

Compost bucket

1 large spoon

Copy of recipes for each student

Use Maine ingredients when available.

Classroom Recipe for Fresh Layered Salad

Ingredients:

- 1 head lettuce or other greens
- 1 cup diced celery
- 1 cup diced red onion
- 1 small bag frozen peas –thawed
- 2 tablespoons of sugar
- 1 cup light sour cream, light mayonnaise, nonfat, or low-fat plain yogurt
- 1 cup vegetarian or regular bacon bits
- 1 cup grated parmesan or cheddar cheese
- 1 cup crunchy dried chow mein noodles (to represent worms)

Use Maine ingredients whenever possible.

Student Cooking Activities

Note: This recipe needs to be made a couple of hours before serving.

Mix sugar and sour cream (or yogurt or mayonnaise) together. Make a layer of each ingredient in order listed, reminding students how layers are important for composting (although you wouldn't use animal products such as sour cream, cheese or bacon bits in real compost pile). Using a glass bowl will help show various layers. Top with sprinkles of crumbled bacon. Let set in refrigerator 2-3 hours. Do not let sit overnight. Add chow mein noodles just before serving.

Materials and Preparation continued

Food needed for dirt dessert (for 4 groups)

4 pkgs. chocolate sandwich cookies
1/2 gal milk
4 pkg. chocolate flavor instant pudding mix (package for 4 servings)
4 tubs whipped topping, thawed (8oz tub)
64 gummy worms
4 bottles green food coloring
4 7oz bags shredded coconut

Materials needed (for 4 groups)

4 large bowls	4 rolling pins
8 wooden spoons	4 wire whisks
4 sets dry measuring cups	Cleaning towels, napkins
4 trays	4 rubber spatulas
Plastic spoons	4 sets measuring spoons
4 small bowls	32 9oz plastic cups
4 plastic bags	

Each station should have the following:

Food

1 pkg. chocolate sandwich cookies
1 pint milk
1 pkg. chocolate flavor instant pudding mix
1 tub whipped topping, thawed (8 oz)
16 gummy worms
1 bottle green food coloring
1 7oz bag shredded coconut

Materials

1 large bowl	Plastic spoons	1 wire whisk
2 wooden spoons	1 small bowl	Cleaning towel
1 set dry measuring cups	1 plastic bag	1 rubber spatula
1 tray	1 rolling pin	Measuring spoons
Copy of recipe	8 9oz plastic cup	

Use Maine ingredients when possible.

Classroom Recipe for Dirt Dessert

Ingredients:*

- 1 package (16 oz.) chocolate sandwich cookies
- 1 pint cold milk
- 1 package (4-serving size) chocolate flavor instant pudding and pie filling
- 1 tub (8 oz.) whipped topping, thawed
- 8 (9 oz.) plastic cups
- 16 gummy worms
- 1 7 oz. bag shredded coconut (3.5 oz. needed)
- 1 bottle green food coloring



*** Choose Maine ingredients when possible.**

Student Activities

Dirt: Place chocolate cookies in plastic bag, seal and crush with rolling pin.

Add 2 cups milk to large bowl. Add pudding mix.

Beat pudding mix for 2 minutes with wire whisk. Let stand 5 minutes.

Fold in the whipped topping.

Grass: Place coconut in bowl and add a few drops of green food coloring. Mix well.

Place 2 Tbs. crushed cookies in the bottom of each cup.

Place 1 gummy worm in each cup.

Add 1/2 cup pudding to each cup.

Repeat steps until cup is full.

Top with coconut grass.

Yield: 6 servings

Date _____ Name _____

Compost Fact Sheet

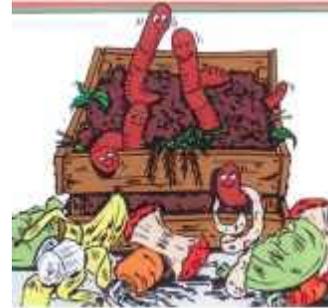
1. What is composting?

2. What are the two types of composting?

3. How do worms help make compost?

4. What are “brown” ingredients good sources of? Give an example of a brown ingredient.

5. What are “green” ingredients good sources of? Give an example of a green ingredient.

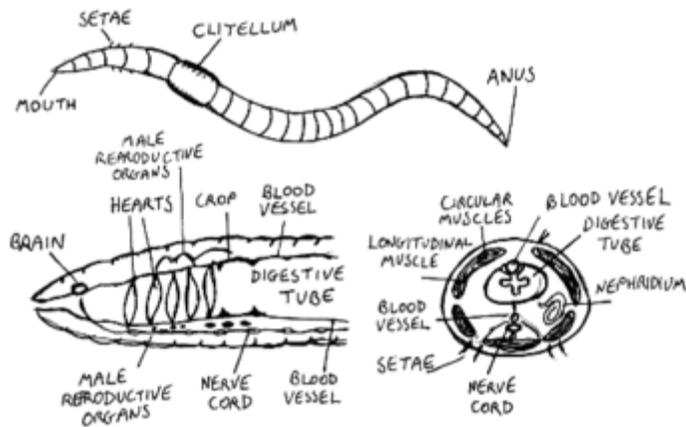


Writing Ideas – Composting and Vermicomposting



1. What did you like or dislike about this lesson?
2. Write a paragraph that describes how to set up an outdoor compost bin.
3. Write a narrative that explains the benefits of composting and encourages people to start composting.
5. Write a story from the worm's point of view telling what it is like living in a compost bin.
4. Prepare the dirt dessert recipe for your family or friends.
What did they think? Did they like it? Were they surprised?

Worm Anatomy



Mouth- where food enters the body

Pharynx- moistens the food and pumps food into the esophagus

Esophagus- a pathway for passing food from the pharynx to the crop

Crop- temporary storage place for food

Gizzard- grinds food into tiny pieces

Intestine- where food is digested and the nutrients are absorbed into blood

Heart(s)- beats and pumps blood into the blood vessels

Blood vessel(s)- carries the blood throughout the body of the worm

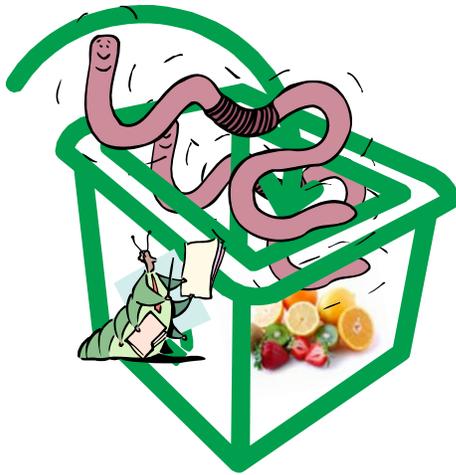
Nerve cord- extends the length of the worm

(Blank worm anatomy worksheet on page 239)

How to Start a Worm Composting Bin

Materials:

Bin:	Plastic tote bin Burlap bag Drill	1/4"-1/2" drill bit Bricks (4) Large plastic tray
Bedding:	Shredded newspaper strips	Topsoil
Worms:	See reference list to order worms	



Set Up:

1. Take the plastic bin and, using the drill, make a few holes in the bottom. This is important for aeration and drainage of the vermicompost.
2. To create the bedding, take shredded newspaper and dampen with water.
3. Fill three quarters of the bin with this bedding (should be the consistency of a well-wrung sponge).
4. Take two or three handfuls of topsoil to mix in with the newspaper combination. This is important because it helps introduce microorganisms.
5. Now introduce the worms to the bin: place them in the bin without the lid so that they become accustomed to their new environment, ideally in the morning to give them plenty of time to establish their new burrows.

6. Once they have established themselves (they all should have burrowed throughout the bin—if they have crawled up on the sides of the bin then they may be disoriented), (check activity chart on page 37) you can add the food.
7. Feed green material, especially green vegetables and other table scraps, excluding fruit, dairy, fatty foods, meat and poultry.
8. When you add the food (see background information in the compost lesson), make sure it is buried in the newspaper mix and not placed on top.
9. Ideally, the bedding should be changed every two months or so and the same steps must be taken to provide a new, healthy environment for the worms.

Please note that this is only one method for constructing a bin. It is strongly recommended that you use the references listed on the following page to supplement these instructions or to purchase a pre-assembled bin.

Composting Bin - Student Activity Sheet

Name _____



Over the next 6 weeks, you will be making observations of what is happening in the compost bin. In the table below, describe what you observe each week – how the compost looks, feels and smells, as well as worm activity.

Week	Observation
1	
	Worm Activity:
2	
	Worm Activity:
3	
	Worm Activity:
4	
	Worm Activity:
5	
	Worm Activity:
6	
	Worm Activity:

Composting Bin - Student Activity Sheet (continued)

Name _____

Over the next 6 weeks, you will be making observations of what is happening in the compost bin. In the table below, record the temperature and the moisture (dry, moist, very moist, wet) of the compost bin.



Week	Temperature	Moisture
1		
2		
3		
4		
5		
6		

At the end of week 6, construct a bar graph showing the results of your temperature and moisture observations.

A detailed description on how to establish your own worm composting bin can be obtained from the following websites:

Flowerfield Enterprises www.wormwoman.com
10332 Shaver Road
Kalamazoo, MI 49002

The original “Worm Woman,” the late Mary Appelhof, created Flowerfield Enterprises. Her website contains a wealth of information regarding worms, bins, and the how to’s of composting, as well as the books and videos listed below.

Resources for Worms and Composting

Worms Eat My Garbage: How to Set Up and Maintain a Worm Composting Bin
By Mary Appelhof
\$12.95

The Worm Book: The Complete Guide to Worms in Your Garden
By Loren Nancarrow and Janet Logan Taylor
\$9.56

The Worm Café, Mid-Scale Vermicomposting of Lunchroom Wastes
By Binet Payne
\$25.95

Worms Eat Our Garbage: Classroom Activities for a Better Environment
By Mary Appelhof, Mary Frances Fenton, Barbara Loss Harris, and Daniel L. Dindal
\$22.95

The World of Worms
By Dorothy Hinshaw Patent

Healthy Foods From Healthy Soils
By Elizabeth Patten and Kathy Lyons.
One of your Maine-ly Nutrition recommendations, this “teacher’s guide ... allows children to experience the cycle of gardening, eating food, and composting.”
www.tilburyhouse.com/Children%27s%20Frames/child_health_fr.html

How to Use the Mini-Lessons with the Program



The topic of composting is a very important subject to introduce to young people. The issue of environmental conservation is becoming more prevalent in our society as concern for our planet escalates. Composting is a simple way to cut down on waste and return key ingredients to the earth to improve soil quality.

The compost lesson is thorough and informative and allows for tremendous interaction between the students and nature. This unit is recommended as the primary unit in order to establish a foundation that can be continued and applied through the rest of the program.

To complement the compost lesson, we have designed twelve hands-on “mini-lessons” on composting and vermicomposting, one for each of the twelve food lessons. Composting is a methodical process that requires time before the final result is seen. Once the compost lesson is presented, note that each food lesson has a segment expanding on one of the various concepts of composting. The mini-lessons follow a recommended order based on building the fundamentals of the composting process. They are arranged so that you may select the food lessons and use the sequential interactive mini-lessons to develop students' knowledge of composting.

Compost Mini-Lessons: 1 Formation of Soil



The natural process of composting has been going on since the beginning of time. As plants die, worms and bacteria help break down plants into decomposed matter called *compost*. This once-living plant material mixes with inorganic (non-living) matter such as minerals from rocks. Over time rocks are changed into smaller particles by wind, water, ice, and the roots of plants as they move in the earth. All this breaking down of material results in the gradual formation of soil. Good soil is very rich in nutrients and nitrogen needed for plants to be healthy.

Objectives

Students will be able to:

- a. Explain the difference between organic and inorganic substances
- b. Predict what the worms will eat
- c. Observe decomposing items at established intervals
- d. Draw conclusions from the decomposing observations

Activity:

- Fill a lunch bag with pieces of waste, demonstrating lunch leftovers (bread crumbs, apple cores, a plastic spoon and napkin).
- Show the students the items in the bag, asking which ones are organic (i.e., once-living, not to be confused with foods which were raised naturally without synthetic chemicals/pesticides) and which are not.
- Ask the students which items they think the worms will eat.
- Pick two of the items and bury them in the worm bed to see if they will decompose.
- Write the name of each food item on a label and attach the label to a dowel or straw.
- Mark each spot with the dowel or straw where the items are buried.
- Check each item after 2 weeks to see if it has decomposed.
- Check again at 3 weeks, and again at 1 month.

Compost Mini-Lesson: 1 – Student Activity Sheet

Name _____



Record your observations in the chart below.

Decomposed Items

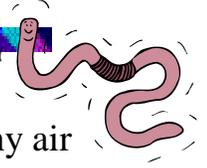
	Item #1	Item #2
2 weeks		
3 weeks		
1 month		

1. Based on the information in your chart, did one item decompose faster than the other? If so, which one?

2. Why do you think this happened?

3. What conclusions can you make about worm activity?

Compost Mini-Lesson: 2 Importance of Aeration



Aeration is just a big word that means “air in the soil.” Does anyone know why air is so important in the worm compost bin?

Air is very important for the microorganisms and the worms in the soil to survive. The worms take water in through their skin and that is how they breathe.

Air allows passage of water, which is necessary for the worms to live.

A microorganism is an organism that can be viewed only with a microscope. An example of a microorganism is bacteria. When the microorganisms are working in the soil, they need a certain amount of air to break down the different parts of the compost. If there isn't enough air for the microorganisms to work, the compost bin will have a very bad smell, sort of like rotten eggs.

Air is also important to make the soil “porous,” which means having many holes. The holes are important for water to move and keep the worms moist. To make the soil more porous, it is important to turn or stir the compost every so often. For a large compost bin, such as an outdoor compost pile or bin, a pitchfork can be used. For a smaller bin, like our worm bin, a small three-pronged garden tool will work best. Gloved hands will also work in the smaller bins.

Objectives:

Students will be able to:

- a. Define *aeration*
- b. Explain why aeration is important
- c. Define micro-organism
- d. Explain the role of micro-organisms in producing compost
- e. Demonstrate how to turn the compost
- f. Predict what will happen if compost is not aerated.
- g. Construct a table and record observations
- h. Write a paragraph based on observations

Activity:

- Have students demonstrate how to turn the compost in the worm bin by taking turns with the garden tool. Gently turn the compost so that the bottom material is brought to the top, being careful not to harm the worms.
- Have students show and explain what would happen if the compost is not aerated.
- Prepare two mini-compost jars and show over time how the compost is affected when the contents of only one jar are aerated while the other is not. This can also be demonstrated by aerating only one side of the compost bin.

Compost Mini-Lesson: 3 - The Importance of Carbon, Nitrogen and Oxygen in Composting (To be done when finished compost is available)

When the organic material (the food) is breaking down in the compost, this is called decomposition and carbon is released. **Carbon** is the most common component in organic matter. The bacteria and the fungi in the compost digest or “oxidize” carbon for energy. (Remind students that the word “organic” also refers to foods grown without the use of chemical fertilizers, pesticides, or drugs.)



There are five factors that encourage the process of decomposition:

1. Warm temperatures (up to a maximum of 85°F-90°F)
2. Adequate moisture – when squeezed, the bedding(or finished vermicompost) should feel like a well-wrung sponge
3. Adequate aeration
4. Microorganisms
5. Decomposers (such as worms)

Nitrogen

In the compost bin, bacteria and fungi will ingest nitrogen for protein synthesis. When organic matter is removed from the compost bin and mixed with the soil around houseplants or around plants in the garden, the plants get nitrogen from the organic matter. The plant material that decomposes is very rich in nitrogen. A perfect balance of nitrogen is important because too little will cause the leaves of plants to turn brown rather than green, and too much will kill the plant. A small amount of vermicompost, however, is much milder than a synthetic fertilizer product.

Oxygen

Oxygen is incorporated into the compost bin through aeration, which is done by stirring or turning the material in the bin. Oxygen is needed for the aerobic bacteria to survive and work in a compost bin to break down the food material.

Objectives:

Students will be able to:

- a. Explain the role of carbon, nitrogen, and oxygen in composting
- b. Make a prediction as to which seeds will grow better
- c. Observe growth and record observation
- d. Draw conclusions based on experiment results and explain in a paragraph

Activity:

Materials: 2 flower pots or jars
6-8 beans (for example, dried pea or kidney beans)
Potting soil
Finished compost

Procedure:

- Soak six to eight beans overnight in water.
- Fill one flowerpot or jar with ordinary potting soil from your lawn or garden.
- Fill the second flowerpot or jar with a half-and-half mix of the same type of soil and some finished compost or vermicompost.
- Plant a few beans in each pot.
- Place them in a warm, sunny place.
- Water the pots as needed and see what happens.

This is a good way to demonstrate how recycling food waste can be turned into natural compost, as opposed to purchasing potting soils that contain chemical fertilizers.

Compost Mini-Lesson: 3 - Student Activity Sheet

Name _____



Complete the table below:

1. Predict what you think will happen with the bean seeds in each container during the next 3 weeks.

2. Record observations.

Time	Jar with Potting Soil	Jar with Half & Half Mix
Week 1		
Week 2		
Week 3		

3. Write a paragraph telling what you observed and what you can conclude about how the beans grew.

Mini-Lesson 4: The importance of water in a compost bin



Compost bins of any type need moisture. Worms and microorganisms need water to survive just like we do. They need it to move around and break down organic matter. The bedding and compost should be as moist as a well-wrung sponge. It cannot be too wet or too dry because the microorganisms and worms would not survive. The worms need water to breathe.

Objectives

Students will be able to...

- a. Explain why compost bins need to be moist
- b. Test for correct moisture

Activity:

- Have students soak a medium-sized sponge in water and wring it out until no water comes from the sponge.
- Test the moisture content of the worm bin by taking a handful of the bedding/compost and comparing with the wetness to the sponge. It should be about the same. If water runs through your fingers when you squeeze the compost/bedding, then there is too much water in the bin and you should add more “brown” ingredients (newspaper, pine needles, etc.). If it crumbles in your hand, it is too dry and you should spray water into the bin to moisten the contents.
- Test the moisture content of the compost bin with a hydrometer (can be purchased at any hardware or garden store).

Why do worms need moisture?

Why do we need moisture?

Worms need moisture in order to take in oxygen to breathe. We need moisture to maintain all the cells in our bodies.

- Have students hold their noses and cover their mouths [briefly] so that they can't breathe. This is how the worms feel if they don't have water or moisture in the compost – they can't breathe!

Mini-Lesson 5: The importance of darkness in a worm bin



Light is not needed in a compost bin; in fact, worms do not like light. Worms can tell the difference between light and dark because they have cells in the front part of their bodies that are sensitive to light. Since they are so sensitive to light, they will burrow deeper into the bin bedding to avoid it. They are more sensitive to some kinds of light than others. Worms much prefer to be in the dark.

Objective

Students will be able to:

- a. Explain how worms can tell the difference between light and dark
- b. Predict worm behavior when placed in light
- c. Record observations in a table
- d. Draw conclusions from light experiment
- e. Explain the details of the experiment in a paragraph

Activity:

- Cover the bottom of a container with paper towels.
- Using a water mister, dampen the paper towels evenly, being careful not to soak them.
- Put some worms in the center of the container. Remember to mist them occasionally as you continue.
- Cover half of the container with a cardboard sheet.
- Shine a flashlight on the open side of the container and note what the worms do.
- Return the worms to their compost bin.
- Cover the flashlight lens with blue colored cellophane, secured with a rubber band.
- Repeat the experiment using a new group of worms and note how they react.
- Repeat again using red colored cellophane.

Worms shy away from white light, while their sensors do not pick up red light, so there should be no reaction. Worms are extra sensitive to blue light, and should shy away immediately.

Compost Mini-Lesson: 5 - Student Activity Sheet

Name _____

Predict what you think will happen when worms are exposed to the three kinds of light in this chart.

Light	Prediction
White	
Blue	
Red	

Follow the directions for the light experiment and record your observation in the chart.

Light	Observation
White	
Blue	
Red	

Share the details of this experiment in a paragraph. Be sure to include what this might mean for worms and how they live.

Mini-Lesson 6: The importance of earthworms in a compost bin



Worms have many different and important roles in the composting process. About one pound of worms is needed for every pound of waste per week that you put into the bin. Worms speed up the process that naturally occurs as organic matter is broken down in your compost bin. As the worms tunnel, they make burrows that allow air to get down into the bedding and help improve the water flow. The major function of the worm is to eat the material put into the bin. They also eat the decaying debris in the compost bin that might otherwise smell like rotten eggs. The worm has a body part called a gizzard, which can grind up big particles of food. After the food is ground up, the worms cast out new organic matter that is packed with nutrients that are very good for your plants and gardens. These digested vermicastings make up vermicompost.

Worms have no lungs. They take their oxygen directly through the skin, either from air or water. The oxygen they take in goes directly into their bloodstream, but their skin must stay moist in order for oxygen to pass through.

Objectives:

Students will be able to

- a. Label the worm diagram
- b. Explain the role of worms in composting in a paragraph

Worm Anatomy

Prostomium: Snout or mouth where food enters the body

Pharynx: Moistens the food and pumps food into the esophagus

Esophagus: A pathway for passing food from the pharynx to the crop

Crop: Temporary storage place for food

Gizzard: Grinds food into tiny pieces

Intestine: Where food is digested and the nutrients are absorbed into blood

Heart: Beats and pumps blood into the blood vessels

Blood vessel(s): Carries the blood throughout the body of the worm

Nerve cord: Extends the length of the worm

Setae: Stiff bristle-like extensions that help the worm to move forward

Clitellum: Also called the saddle. When the worms reproduce, this slides up over the worm's body and enclosed the sperm and eggs, forming a cocoon from which the baby worms will hatch.

Activity:

- Label the worm diagram with the appropriate labels.
- Ask questions such as:
 - How do they move without legs? How do they breathe without any lungs? How do they sense light and dark without any eyes? How are they similar to us and how are they different?

Compost Mini-Lessons: 6 - Student Activity Sheet

Write a paragraph that explains why worms are important in composting.

Mini-lesson 7: Other bugs in a compost bin

There are other important animals in a compost bin besides worms and bacteria. These animals are called invertebrates: organisms without a backbone or spine. These invertebrates are also called consumers because they eat different materials in the bin or outdoor pile to help break down the matter put into it. Some animals serve as food for other animals. A food web (or cycle) is made up of many food chains, and shows how a community of organisms is interrelated. One food chain example is when an insect is eaten by a small bird, which is in turn eaten by a larger bird. This important cycle is repeated everywhere in nature.

Objectives:

Students will be able to...

- a. Explain what an invertebrate is
- b. Explain what a food web is
- c. Demonstrate an example of a food web

Activity:

- Demonstrate the food web by assigning students a particular animal (or using the Student Activity Sheet) and determining who will eat it and so on up the chain.

Compost Mini-Lesson: 7 - Student Activity Sheet

Name _____

Select one of the animals listed below and draw a food web for that animal in the space below.

Mosquito

Field Mouse

Japanese Beetle

Snake

Compost Mini-Lesson 8: Proper pH of the soil in the compost bin



An important part of keeping the compost healthy is to keep it at the proper pH, which means having the right balance of acid and base in the soil. For example, lemon is a very acidic food. Baking soda is a very basic food. The two different components of the compost bin (the green and the brown ingredients) help to balance the pH. It is important for the compost to be in a certain range of pH so that the plants can absorb the nutrients from the composted material. The pH of a bin should be between 5.5 – 8.5.

Objectives:

Students will be able to...

- a. Explain why pH is important for composting
- b. Determine pH of a variety of foods and record information in a table
- c. Draw conclusions about the materials that go into a compost bin

Activity:

To test the pH of the compost bin:

- Take one cup of compost and mix it with 2 cups water in a container or jar.
- Let the soil settle for about 5 minutes.
- Gently strain the water out of the container or jar.
- Take one pH hydrion strip (litmus paper) and dip it in the water (for only a second).
- Match the color of the hydrion strip to the key on the side of the bottle to determine the pH of the soil.
- Test different food items to determine if they are acidic or basic.

Compost Mini-Lesson 8: Student Activity Sheet

Name _____

Explain why pH is important in composting.

Write the food items in the table and then, using strips of litmus paper, test the compost and other food items and record the pH in the table below.

Compost/Food Item	pH
Compost	

If the compost had a pH of 4.2, what types of ingredients should you add to the compost bin to get it to a pH of 6.5?

Mini-lesson 9: Temperature of the compost

In a worm bin that is working properly with enough water and oxygen, the temperature should be between 40°F and 90°F. Worms are most active at room temperature and survive well in this temperature range. A higher temperature shows that more organic matter is decomposing. In an outdoor bin, the temperature might be much higher or lower, but because it doesn't depend on worms, this is acceptable. Microorganisms can still function at a range of temperatures to break down the matter in the pile or outdoor bin. During Maine winters, the outdoor pile or bin may be “resting” until warmer weather arrives.

Objectives:

Students will be able to...

- a. Monitor temperature in a compost bin and record measurements in a table
- b. Use results to make adjustments to keep the bin within acceptable ranges

Activity:

- Insert a candy thermometer into the center of the compost bin and determine the temperature.
- Take weekly readings and compare temperatures.
- Make adjustments if needed to keep the bin within acceptable ranges.

Week	Temperature
Week 1	
Week 2	
Week 3	
Week 4	
Week 5	
Week 6	
Week 7	
Week 8	
Week 9	
Week 10	
Week 11	
Week 12	

Mini-Lesson 10: Uses of composted material



Compost can be used in many ways to improve the soil and overall health of your house and garden plants. It can also be used to fertilize the lawn as well as shrubs, bushes, and flowerbeds. Compost tea can be sprayed onto your plants or used to water them. Composted material can be placed around plants in the garden or in the pots with your houseplants.

Objectives:

Students will be able to...

- a. Explain the benefits to plants of using compost
- b. Make and use compost tea

Activity:

Making compost tea:

- Place some composted material into an old pillowcase and soak the pillowcase in a bucket of water until the water becomes tea-colored.
- Put the tea into a watering can to water plants in the house and in the garden. (Your plants will thank you for this.)

Mini-Lesson 11: Harvesting Worms



After the worms have lived in their bedding for 2-3 months, you will notice that the bedding material has changed to a healthy looking “soil” or humus, and even though the worms have been fed a considerable amount, the level of the bedding will have visibly dropped. To encourage the healthy reproduction of the worms, now is the time to harvest the bin’s contents.

Harvest the finished vermicompost when the first bin is full and there are no recognizable food scraps.

Objectives:

Students will be able to...

- a. Observe bedding material changes in compost bin
- b. Harvest the finished vermicompost
- c. Give step-by-step directions for harvesting the vermicompost

Activity:

- Place new bedding material in a second bin and place the bin directly on the compost surface of the first bin.
- Bury your food scraps in the bedding of the second bin.
- In one to two months, most of the worms will have moved to the second bin through the holes in the bottom of the top bin, in search of food.
- The first bin will contain (virtually) worm-free vermicompost. Use this around plants in your garden or your houseplants.
- Describe step-by-step directions for harvesting the vermicompost

Mini-Lesson 12: Troubleshooting

Occasionally you may encounter some problems with your worm bin. It is important to check the worm bin every time you feed the worms. By doing this, you will be able to recognize any problems and correct them before they get out of hand.

Objective

Students will be able to trouble-shoot problems using an information chart.

Activity:

Correct any problems using this chart.

Problem	Probable Cause	Solution
Worms are dying or crawling up the side of the bin to escape	<ul style="list-style-type: none">• Too wet• Too dry• Bedding is used up	<ul style="list-style-type: none">• Add more bedding• Moisten the bedding• Harvest the bin
Bin smells bad	<ul style="list-style-type: none">• Not enough air• Too much food• Too wet	<ul style="list-style-type: none">• Leave lid off or drill more ventilation holes• Do not feed for 1-2 weeks• Add more bedding
Fruit flies	<ul style="list-style-type: none">• Exposed food, especially fruit waste	<ul style="list-style-type: none">• Bury food in bedding• Put open bin outdoors for several hours to kill the fruit fly larvae

Compost Quiz

- 1) T F A nutrient helps a plant grow strong.
 - 2) T F Both brown and green material is needed to make compost.
 - 3) T F Composting has happened since the beginning of time.
 - 4) T F Inorganic matter is living material.
 - 5) T F Nitrogen is the most common component in organic matter.
 - 6) T F Carbon helps keep the leaves of plants a nice, bright green.
 - 7) T F Oxygen is added into the compost bin through aeration.
 - 8) T F Aeration helps to make the soil very porous.
 - 9) T F Earthworms can be very important in the composting process.
 - 10) T F Worms do not help to improve water flow into the compost.
 - 11) T F Anaerobic bacteria need air to work in the compost.
 - 12) T F Bacteria need food and water just like we do to live.
 - 13) T F Invertebrates are animals with a backbone.
 - 14) T F The only animals in a compost pile are worms.
 - 15) T F “Brown” and “green” ingredients help keep proper pH of soil.
 - 16) T F The compost moisture should feel like a well-wrung sponge.
 - 17) T F The lower the temperature of the compost, the more organic matter is decomposing in the compost pile.
 - 18) Write an example of a “green” ingredient _____
 - 19) Write an example of a “brown” ingredient _____
- (Answer Key on page 229-230)**