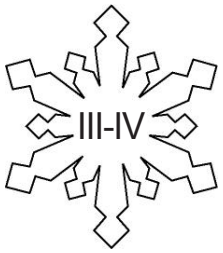
Collecting Compost

Levels



Grades 5-8

Overview:

Soil is composed of tiny rocks, and plant and animal debris. In this lesson, students explore soil formation by starting a composting box.

Objectives:

The student will:

- observe a composting box;
- organize a composting food web;
- collect temperature data; and
- write observations about the appearance of the decomposition in the composting box.

GLEs Addressed:

Science

[5-8] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating.

[7] SA3.1 The student demonstrates an understanding that interactions with the environment provide an opportunity for understanding scientific concepts by designing and conducting a simple investigation about the local environment.

[6] SC3.2 The student demonstrates an understanding that all organisms are linked to each other and their physical environments through the transfer and transformation of matter and energy by organizing a food web using familiar plants and animals.

[7] SC3.2 The student demonstrates an understanding that all organisms are linked to each other and their physical environments through the transfer and transformation of matter and energy by classifying organisms within a food web as producers, consumers, or decomposers.

Materials:

- Ebeling, E. (ed.). (2003). *Basic composting: All the skills and tools you need to get started.* Mechanicsburg, PA: Stackpole Books.
- Plastic bin, 5- to 10-gallon, opaque
- Newspaper
- 1 pound redworms
- Drill with ¼- to ½ –inch drill bit
- Paper shredder, optional
- 1 pound food scraps, cut into small pieces
- STUDENT WORKSHEET: “Composting Food Web”
- STUDENT WORKSHEET: “Composting Data”
- OVERHEAD: “Food Web for Collecting Compost”

NOTE: Redworms require dark conditions as well as bedding, food and water. Be sure to complete this activity soon after acquiring the worms.

Whole Picture:

Soil is composed of very small rock particles formed from weathering and erosion, air, water, and organic material (dead animals and plants). Subsoil is the soil below the topsoil and is usually lighter in color. Subsoil contains less plant and animal material.

Permafrost is frozen ground. When permafrost thaws, the dead plant and animal matter within the soil begins to decompose, releasing methane. Methane is a greenhouse gas that contributes to global warming. Large quantities of methane are currently "locked" within the permafrost. As the permafrost thaws, methane gas is produced and released, contributing to atmospheric warming, which further warms the permafrost, causing a feedback loop. Scientists study thawed permafrost, called thermokarst, to determine how it will affect local ecosystems and global climate.

Decomposition within the soil occurs in three stages at varying temperatures. During the first stage, at 55˚ to 70˚F, microbes called psychrophiles appear and begin to digest the food. The second stage, from 70˚ to 90˚F, involves mesophiles. These bacteria perform most of the work in the decomposition process. The final stage, at 104˚F and above, brings the thermophiles. After the thermophiles are done eating, the temperature will decrease and the mesophiles will return, beginning the cycle again.

Small insects and other invertebrates (earthworms, millipedes, sow bugs, grubs, mites, snails, spiders, etc.) feed on the bacteria and fungi throughout the soil and help with decomposition. As they burrow through the soil, they help to mix the organic materials and create natural tunnels that provide air circulation. The presence of these organisms indicates that decomposition is occurring.

Activity Procedure:

Starting the Composting Bin

1. Explain students will help start a composting box and then observe it over several weeks. Show students the bucket of worms. Explain worms produce something called castings. Castings are rich in nutrients that are good for plants. To produce castings, the worms need food scraps and bedding.
2. Explain soil is produced in a similar way. Worms, and other insects called decomposers, eat dead plant and animal material and turn it into nutrient-rich soil that combines with small rocks and other non-living material to form topsoil (the top few inches of soil).

Teacher's Note: Soil is made of many components. Worm composting produces castings, which are high in nutrients. Traditional composting, without the addition of worms, is a more accurate, but less sanitary, way to model soil production.

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3. Point out the features of the worm composting box (box, air holes, paper). Show students how they should be gentle when handling the worms. Reach down into the bedding and lift up a section. Place a handful of worms in the area. The worms may move into the bedding to avoid direct light. Repeat in different sections of the bin until all the worms have been distributed.
4. Carefully bury the food scraps down in the bedding and cover with fresh paper. Ask students to make observations and discuss. Ask students to predict how long until they will be able to see castings.
5. Distribute the STUDENT WORKSHEET: "Composting." Explain students will collect the temperature of the composting box each week for the life of the box to see how the temperature changes over the length of the investigation. Model how to take the temperature, and ask groups to take turns taking the temperature and recording it on their data sheet.

The Influence of Climate Change

6. Show OVERHEAD: "Food Web" and distribute page 47 from *Basic Composting*. Explain decomposers are organized into three categories: first-level, second-level, and third-level. Initially, microorganisms (first-level decomposers) go to work. Next, second-level decomposers, such as beetles and mites, consume materials, followed by larger invertebrates known as third-level decomposers. Additionally, small insects and other invertebrates, such as redworms, millipedes, grubs, and mites, feed on the bacteria and fungi throughout the soil and help with decomposition.

7. Distribute page 46 from *Basic Composting*. Explain that if you were to measure the temperature of a composting pile, you would see a cyclical pattern; the pile would get warmer, then cool off, and then get warmer again. The process of decomposition itself causes this. During the first stage, at 55˚ to 70˚F, microbes called psychrophiles appear and begin to digest the food. The second stage, from 70˚ to 90˚F, involves mesophiles. These bacteria perform most of the work in the process of decomposition. The final stage, at 104˚F and above, brings the thermophiles. After the thermophiles are done eating, the temperature will decrease and the mesophiles will return, beginning the cycle again.
8. Psychropiles, mesophiles, and thermophiles exist at these temperatures. If the temperature gets too warm or too cold for these organisms they will not be able to survive and the process of decomposition will slow down or stop. In the winter in Alaska, for example, much of the ground remains frozen, and decomposition at the surface of the ground does not occur or is very slow.
9. Distribute the STUDENT WORKSHEET: "Composting Food Web," and assist students in completing the worksheet.

Critical Thinking Question: Think-Pair-Share Method. Ask students to pair up and talk about the following question: How does temperature affect decomposition? What would happen if the surface of the soil was warmed by global climate change? Once they have explored the question, ask students to share their ideas with the class. As a class, discuss how global warming might affect the environment by changing decomposition.

Maintaining the Composting Bin

10. Each week, add another pound of food scraps covered with fresh paper. Alternate locations of food placement in the bin. Check the moisture content of the bedding each time food scraps are added. If it is too dry, add water with a watering can or spray bottle. Involve students as much as possible in the collection of food scraps and maintenance of the bin. Conduct regular (weekly) observations of the bin. Discuss how the worms' environment compares/contrasts to the environment outdoors.
11. Approximately every three months, castings can be removed and bedding replaced. Use pages 85 of *Basic Composting* as a guide to harvesting the castings.

Extension Ideas:

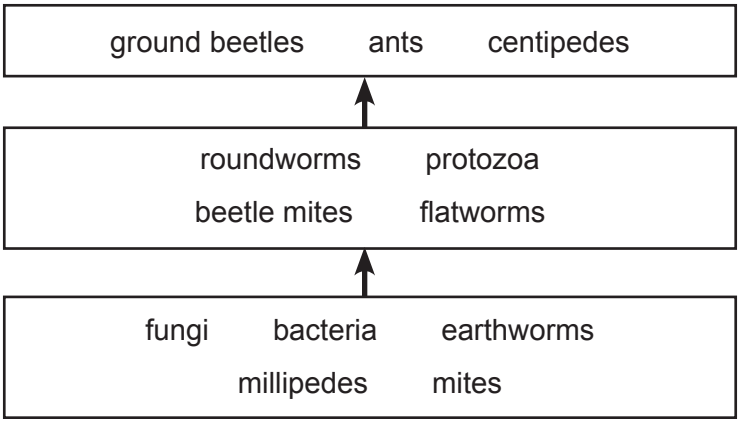
In spring, dig up a soil sample and examine it as a class. A sample near water, if possible, will have a wider variety of things to be examined. What types of decomposers can be seen? What living and non-living items can be seen?

Students can explore the microbial communities in their compost over the course of several weeks by examining the compost under a compound microscope.

Explore other examples of food webs, such as a tundra food web, dessert food web, and marine food web. As a class, develop a food web of local plants and animals.

Composed soil can be used as fertilizer for student gardens.

Answers:


ground beetles ants centipedes
roundworms protozoa
beetle mites flatworms
fungi bacteria earthworms
millipedes mites

Name:_____

Levels

III-IV

Composting Food Web

Student Worksheet (page 1 of 2)

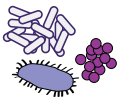
Directions:

Arrange the first, second, and third-level decomposers listed below into a food web.

First-Level Decomposers

fungi

bacteria



earthworms

milipedes

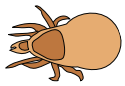
mites

Second-Level Decomposers

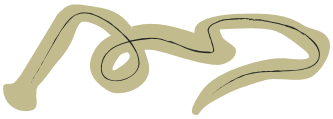
roundworms

protozoa

beetle mites

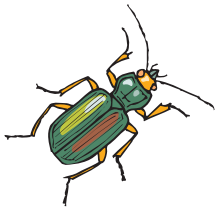


flatworms



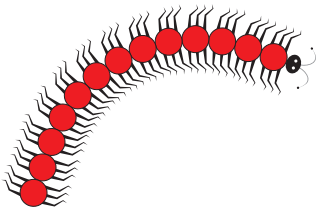
Third-Level Decomposers

ground beetles



ants

centipedes

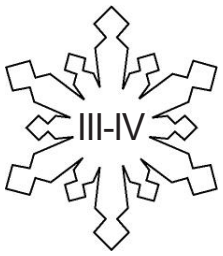


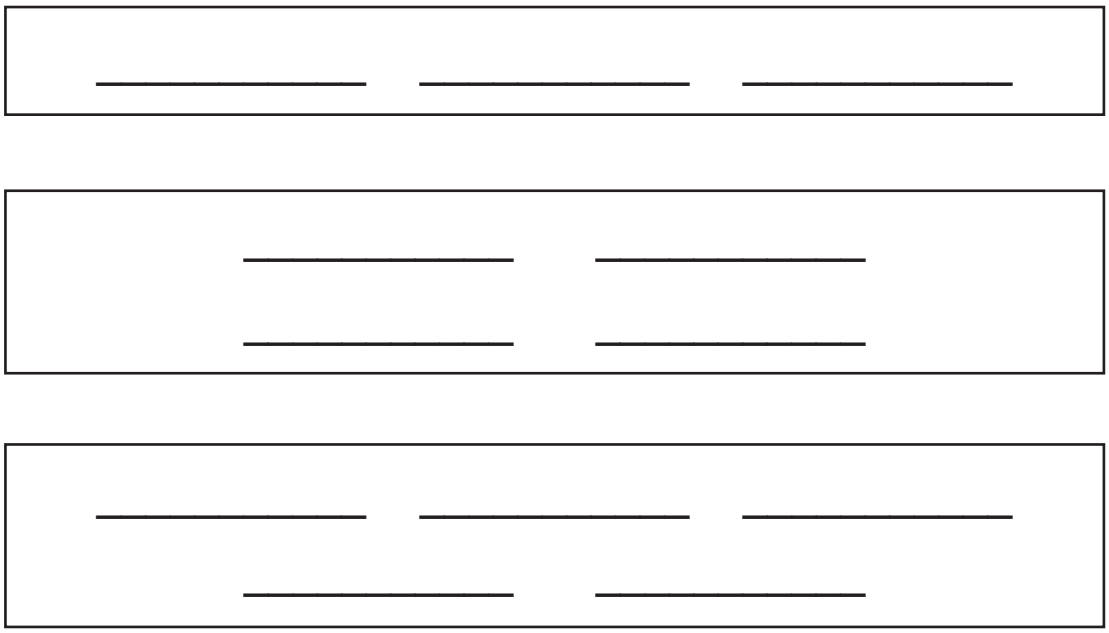
Name:_____

Composting Food Web

Student Worksheet (page 2 of 2)

Levels





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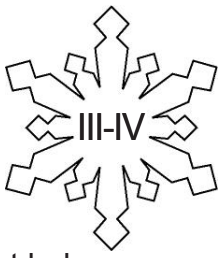
Levels



Composting Data

Student Worksheet

Directions:

Take the temperature of the composting box weekly. Record your data in the chart below.

Date	Temperature (°F)

Food Web of the Compost Pile

From "Basic Composting" by Eric Ebelinger, editor

1° = First level decomposer
2° = Second level decomposer
3° = Third level decomposer