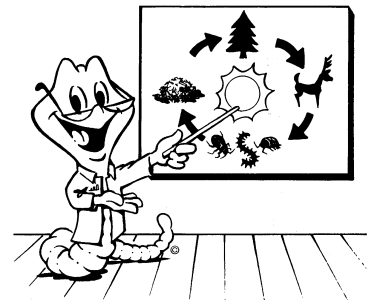


The Breakdown on Decomposition



OBJECTIVES:

Students will:

1. define the characteristics of inorganic and organic matter.
2. set up an experiment using inorganic and organic matter to observe the process of decomposition.
3. identify variables that affect the rate of decomposition.



STANDARDS: Science



SKILLS: Analysis, classification, description, observing, predicting



SETTING: Classroom



TIME: First Day: 50 minutes
Weekly: 15 minutes (4 weeks)
Last Day: 30 minutes



VOCABULARY:

Decay
Decomposition
Inference
Inorganic
Observation
Organic
Prediction
Variable

Introduction

Overview:

In this lesson, students will learn about the process of decomposition by setting up experiments to test the effect of different variables on decomposition of organic and inorganic materials over a month.

Teacher Background:

The word “organic” in science refers to any matter that is or was once living or was produced by living things like plants or animals. Most organic material will decompose over time if exposed to ideal conditions of moisture, temperature, light and air. Trees and leaves fall to the forest floor and “break down” or decay. Grass clippings left on the lawn disappear. Animals die, and in time, little is left of their bodies. “Inorganic” matter tends to decompose more slowly if at all.

Decomposition is a natural process, which means that nature does the work! Normally, billions of living organisms in the soil use organic matter that falls to the ground as a source of food. The end result of this decomposition is a rich, dark brown, earthy-smelling material called “compost” or “humus.” When returned back to the soil, compost improves soil texture and provides nutrients necessary for the next generation of plant life.

Materials:

Students:

- “Decomposition Experiment Design” group worksheet (one per group)
- “Decomposition Weekly Data Collection” worksheet (one per student)
- 2 plastic cups, plastic wrap, rubber bands, label or marker (one set per group)
- Water

Teacher:

- Bag of small organic and inorganic materials for cups
- Overheads of student worksheets
- Varied supplemental material, for example: cut-up apple, small squares of newspaper, bottle caps and cut-up plastic lids
- Sample of compost
- Rubric overhead
- Rubrics (one per student)

Preparation:

Be prepared to divide the students into groups of four.

Assign students to bring in one or two small items from home that may/may not decompose such as glass, metal, plastic, food, wood, paper, etc. The items should be small enough to fit into a plastic cup. You may need to supplement what the students have brought from home.



ACTIVITY

Discussion

1. Ask how many students have heard the word “organic” (write “organic” on the board). Ask what they think it means. Explain that when talking about food, the word “organic” refers to how the food is grown—without added chemicals like pesticides.
2. The word “organic” has another meaning in science. Write the following definition on board: “Organic matter is anything that is or was once living or produced by a living thing.” Ask the students what they think “inorganic” means in science (write definition on board). Inorganic matter comes from nonliving material or minerals in the earth like sodium, calcium, and sand, rather than from plants or animals.
3. Ask students what happens in nature to the organic matter that makes up all things like plants and animals when they die. Show students several leaves in various stages of decomposition. How will these leaves change over time once they fall off the tree? Take the class outside and look for examples of things decomposing or not decomposing on school grounds, gardens, or a compost bin.
4. Once you have returned to the classroom, make a list of what the students found under the categories of decomposing and nondecomposing. Have students suggest other things that might decompose and other things that may not decompose over time and add to the lists.
5. Have the students count how many of the items on the decomposing list are organic. Next, count the number of inorganic items. If necessary, review different things made up of organic matter. Ask students to consider which items would be more likely to decompose: organic or inorganic matter.
6. Based on what students have observed, ask them to guess or hypothesize about the difference in the rate of decomposition of organic versus inorganic material. Once they have formed a hypothesis, such as “dead organic matter begins to decompose or decay over time and inorganic doesn’t decompose as quickly,” write their hypothesis on the board.
7. Ask the students how they might test their hypothesis. Discuss their ideas. If there were different organic and inorganic materials in cups, could they observe how contents decomposed over time?
8. Ask students to describe some of the different factors that might speed up or slow down the decomposition process in their experiment. Ask questions to lead the discussion and write these factors on the board: moisture, light, air, temperature. Since all of these factors might affect or vary the results of an experiment, they are called “variables.” Write a definition on board. If we want to know which of these factors affect decomposition, and how, we’ll have to test each one separately. Stress that it is very important when designing science experiments that you change only one variable at a time in order to draw real conclusions.
9. Tell the students they will have two cups, each with the same set of organic and inorganic materials (draw on board and label #1: control cup and #2: test cup). Ask what they could do to see the effect of moisture on decomposition. Draw a test procedure chart with three columns on board: Variable, #1: control cup procedure, and #2: test cup procedure. Record the final procedure here after each discussion. For example: Variable: moisture, #1: leave alone, #2: add 1 tbs water each week.
10. Ask the students to design other experiments testing the affects of light, air, and temperature.
11. Assign the students to bring organic/inorganic materials from home for their experiment, selecting two pieces of each material that are small enough to fit into a cup.
12. Show an overhead of the lesson rubric, and review the expectations for this lesson.

(continued on next page)



ACTIVITY - continued

Procedure

Day One:

1. Divide students into groups of four and ask them share their materials from home and sort the collection into organic and inorganic piles as a group. Ask whether each group of students has at least one example of an organic material and one example of an inorganic material. There should be two pieces for each example. Supplement group materials as necessary from the teacher collection.
2. Provide each group with two clear plastic cups, plastic wrap, a rubber band, and label or marker. Ask them to label their cups with their variable and a #1 or #2.
3. Have each group organize their materials into pairs of the same item. The groups should then place four different types of materials into each of the cups. Each cup should have the same materials and at least one organic and one inorganic material. Remind them that each cup will have a piece of the same material in order to test the rate at which the materials decompose when exposed to different conditions or variables.
4. Assign each group to test one of the four variables during their decomposition experiment: moisture, temperature, light, or air. Review the test procedures developed for each of the variables. Ask each group to follow their assigned procedure and cover the cups with plastic wrap, securing it with a rubber band. Collect the experiments.
5. Model how to complete the "Decomposition Experiment Design" group worksheet and have the groups complete their worksheet. Describe how the experiment will be monitored and pass out the "Decomposition Weekly Data Collection" worksheet to each student. Ask students to write their name, the variable their group is testing, and their own prediction for "Week 1" on their data collection worksheet.

Weekly (once a week for one month):

1. Redistribute the student data collection worksheets to each student and review which boxes on the worksheet will be completed.
2. Have the students examine the contents of their cups and record any changes that have occurred based on their observations.
3. Ask students to write their predictions for the next week in the next set of boxes.

Wrap-Up

Last Day:

1. Have each group present their experiment results by describing the variable they tested, how they tested it, and how the variable affected the rate of decomposition.
2. As a class, compare students' predictions to what they observed.
3. Make a list of the materials that decomposed and what conditions they think increased or decreased the rate of decomposition. Note any differences between what happened to the organic matter and inorganic matter.
4. As a class, discuss the data and ask students whether their results support the original hypothesis that organic materials decompose easier than inorganic materials. What factors increase the rate of decomposition? Is more information needed to draw these conclusions? What other experiments might help collect more data?
5. Have students consider what might happen if things didn't decompose in nature. What would a forest look like if dead organic matter remained intact? Explain that nutrients return back into the soil through the process of decomposition and show a baggie of compost if available. If we recycle inorganic materials (since they don't decompose very fast) and compost organic materials, we conserve natural resources so that they can be used again.

Final Assessment

Ask students to draw a picture of something decomposing over time in nature. Have them describe in writing what causes decomposition and how nutrients are returned back into the soil.



RESOURCES

Extensions:

1. Have students set up a basic compost bin or worm bin and observe how organic waste such as food scraps and plant trimmings decompose over time to make compost. Test the idea that compost returns nutrients to soil by experimenting with adding compost to particular plants or planting areas and comparing to planted areas not amended with compost.
2. Have students conduct research to determine whether the materials we throw away decompose in the landfill.

Teacher Materials:

California State Content Standards

The standards below represent broad academic concepts. This lesson provides connections to these academic concepts through hands-on activities and exploration. This lesson is not designed for a student to master the concepts presented in the standards. Additional lessons in the classroom that build on this lesson or the standard(s) ensure that students will have the opportunity to master these concepts.

SCIENCE	CONTENT STANDARDS
Grade 4	<p>Life Sciences</p> <p>2.a. Students know plants are the primary source of matter and energy entering most food chains.</p> <p>2.b. Students know producers and consumers (herbivores, carnivores, omnivores, and decomposers) are related in food chains and food webs and may compete with each other for resources in an ecosystem.</p> <p>2.c. Students know decomposers, including many fungi, insects, and microorganisms, recycle matter from dead plants and animals.</p> <p>3.a. Students know ecosystems can be characterized by their living and nonliving components.</p> <p>Investigation and Experimentation</p> <p>6.a. Student will differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.</p> <p>6.c. Students will formulate and justify predictions based on cause-and-effect relationships.</p> <p>6.f. Students will follow a set of written instructions for a scientific investigation.</p>
Grade 5	<p>Investigation and Experimentation</p> <p>6.a. Students will classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria.</p> <p>6.b. Students will develop a testable question.</p> <p>6.c. Students will plan and conduct a simple investigation based on a student-developed question and write instructions others can follow to carry out the procedure.</p> <p>6.d. Students will identify the dependent and controlled variables in an investigation.</p> <p>6.e. Students will identify a single independent variable in a scientific investigation and explain how this variable can be used to collect information to answer a question about the results of the experiment.</p> <p>6.g. Students will record data by using appropriate graphic representations (including charts, graphs, and labeled diagrams) and make inferences based on those data.</p> <p>6.h. Students will draw conclusions from scientific evidence and indicate whether further information is needed to support a specific conclusion.</p>





The Breakdown on Decomposition Rubric

A rubric is a scoring tool that defines the criteria by which a student's work will be evaluated. This rubric is provided to assist you in setting expectations for students and assessing their performance and engagement during the lesson based on specific tasks. Ideally, a rubric is developed with the cooperation of the students. Two blank rows have been provided for you and your class to develop and add your own assessment criteria.

CATEGORY	4	3	2	1
Set up and conduct an experiment to observe the process of decomposition	The group completed the steps to set up the experiment and recorded detailed observations.	The group completed the steps to set up the experiment and recorded some observations.	The group completed the steps to set up the experiment but did not record observations.	The group did not complete the experiment or record observations.
Identify and describe how a variable affects the rate of decomposition	The group identified and provided an in-depth description of how their variable affected the rate of decomposition.	The group identified and provided some description of how their variable affected the rate of decomposition.	The group identified their variable but did not describe how it affected the rate of decomposition.	The group did not identify their variable or describe its effects on the rate of decomposition.



Student

Decomposition Experiment Design

Directions: List materials that were placed into Cup #1 and Cup #2.

Cup #1	Cup #2
1.	1.
2.	2.
3.	3.
4.	4.

1. Circle the variable your group will test.

Moisture

Temperature

Light

Air

2. Describe how you will test this variable:

3. Draw a picture of the contents of Cup #1:

Draw a picture of the contents of Cup #2:

4. Predict what will happen to the contents of Cup #1 and #2 during the month-long experiment.

Name: _____

Date: _____





Decomposition Weekly Data Collection

Directions:

- Predict:** What do you expect to observe in the cups when you check next week?
Write a prediction of what you think the materials will be like after one more week.
- Observation:** After observing the contents of Cups #1 and #2 with your eyes and nose, write a description of what you observe about the materials on this day.
How has it changed from last time?

Week 1	Cup #1	Cup #2
Date:		
Prediction @ Day 1		
Observation @ Day 8		

Week 2	Cup #1	Cup #2
Date:		
Prediction @ Day 8		
Observation @ Day 15		

Name: _____ Date: _____





Student

Week 3			Cup #1	Cup #2
Date:				
Prediction @ Day 15				
Observation @ Day 22				

Week 4			Cup #1	Cup #2
Date:				
Prediction @ Day 22				
Observation @ Day 29				

Name: _____ Date: _____



DEFINITIONS

Vocabulary:

Decay: the gradual breakdown of dead organic material.

Decomposition: the process of materials being digested and broken down into simpler substances, making nutrients more available to plants. Decomposition happens all the time in nature and in human-managed systems.

Inference: how we interpret what we observe or what we think our observations mean. Scientists draw conclusions from both direct observation and inference.

Inorganic: any material that is not composed of matter that was once living or produced by a living organism.

Observation: using our senses and sometimes equipment that extends our senses to notice characteristics and observe change.

Organic: materials that were once living or material produced by a living organism such as food, leaves, plant trimmings, hair clothing fibers, paper, etc. Organic may also be used to describe food grown using sustainable agricultural methods.

Prediction: a broad statement based on an observation, experience, or scientific reason of what will happen in a given circumstance or situation.

Variable: a factor that might affect the results of an experiment. To draw conclusions from an experiment, it's important to change only one variable at a time.

