# Doing the 4Rs

## *A Classroom Activity Guide to Teach Reduce, Reuse, Recycle and Rot*


Fourth and Fifth Grades

i RECYCLE @SCHOOL!

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**About StopWaste.Org**
The irecycle@school program is a program of StopWaste.Org. StopWaste.Org is the Alameda County Waste Management Authority and the Source Reduction and Recycling Board operating as one public agency. StopWaste.Org helps provide environmentally sound waste management programs for the residents and businesses of Alameda County. We develop programs to reduce materials such as leaves, grass and tree trimmings along with food scraps, wood, concrete, and other building materials from ending up in the landfills. We help cities, school districts, and businesses implement waste reduction, reuse, and recycling programs to help them save money, conserve natural resources and operate more efficiently.

We offer grants, low-interest loans, and incentive programs to qualifying Alameda County organizations. We also have the Bay-Friendly Gardening and Landscaping program, the Green Building program, the irecycle@school program and the StopWaste Business Partnership, which help specific groups like homeowners, landscapers, construction companies, large businesses and institutions reduce waste to help meet Alameda County's 75% waste reduction goal by 2010.

**Publishing Information**


The information presented in this guide is provided as a public service by the Alameda County Waste Management Authority and Recycling Board. This information is not a substitute for the exercise of sound judgment in particular circumstances and is not intended as recommendations for particular products or services.

**For Additional Information**
To obtain a copy of this guide through Doing the 4Rs Teacher Workshops for teachers and informal educators in Alameda County, contact:

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# Doing the 4Rs

## *Table of Contents*

# Introduction

Thank you for choosing to use *Doing the 4Rs – A Classroom Activity Guide to Teach Reduce, Reuse, Recycle and Rot.* Everybody creates garbage, but do we need to do so? How does creating garbage impact us at home, at school or at play? This guide will help you explore with your students the integrated waste management hierarchy of reduce, reuse, recycle and rot (compost), which we call the 4Rs.

This guide was developed for educators teaching fourth and fifth grades and was designed to be engaging and academically challenging for students. The curriculum is hands-on and cooperative, which will motivate your students and encourage academic achievement.

## The Importance of Teaching the 4Rs in Alameda County

In 2003, Alameda County deposited 1.4 million tons of garbage into landfills. Schools in Alameda County alone produce approximately 60,000 tons of garbage a year. While recycling keeps materials out of a landfill, understanding the concepts of 4Rs — reducing, reusing, recycling and composting — and practicing them in everyday life addresses how we value and use our natural resources and how we can use them more efficiently. Teaching about waste reduction helps students learn about their built surroundings (local environment) as well as the natural environment (nature).

## Building Skills for Student Achievement

Using the 4Rs concepts requires the application of critical-thinking and problem-solving skills. Many activities in *Doing the 4Rs* involve the basic principles of the scientific method such as forming questions, conducting research and observation, solving problems, and thinking critically. These principles are the most important steps of inquiry and the scientific process.

The lessons provide a fundamental understanding of both living and nonliving systems, along with developing the reasoning skills needed to weigh evidence and make choices. Teaching about the environment has been shown to enhance student achievement. Information from a nationwide study on environment-based education has shown dramatic results. When the environment was used as an integrating context, participating students outperformed traditional students in standardized assessments in reading, writing, math, and social studies. The vast majority of these students also earned higher grades. Students were also more engaged and enthusiastic, which resulted in less discipline problems and days away from school.[1]

## Encouraging Environmental Literacy

This guide is a stepping-stone for students' environmental literacy development. It will help you teach students how we use natural resources and identify ways to conserve those resources, reduce air and water pollution, and protect habitat for wildlife. It will show students ways our society can meet our needs in the present, without compromising our ability to meet our needs in the future. Learning about garbage and waste reduction is a direct way that students can learn about their community and local environment.

1 Lieberman, Gerald & Linda Hoody. *Closing the Achievement Gap: Using the Environment as an Integrating Context for Learning.* 2002. State Education and Environment Roundtable. San Diego, CA.

## Best Practices in Environmental Education

The guide was developed using the best practices in environmental education as defined in "Environmental Education Materials: Guidelines for Excellence," developed by the North American Association for Environmental Education (NAAEE). The Guidelines for Excellence identify six characteristics of quality environmental education: (1) fairness and accuracy, (2) depth, (3) emphasis on skills building, (4) action orientation, (5) instructional soundness, and (6) usability. For more information on NAAEE and the Guidelines for Excellence, go to www.naaee.org.

## About irecycle@school

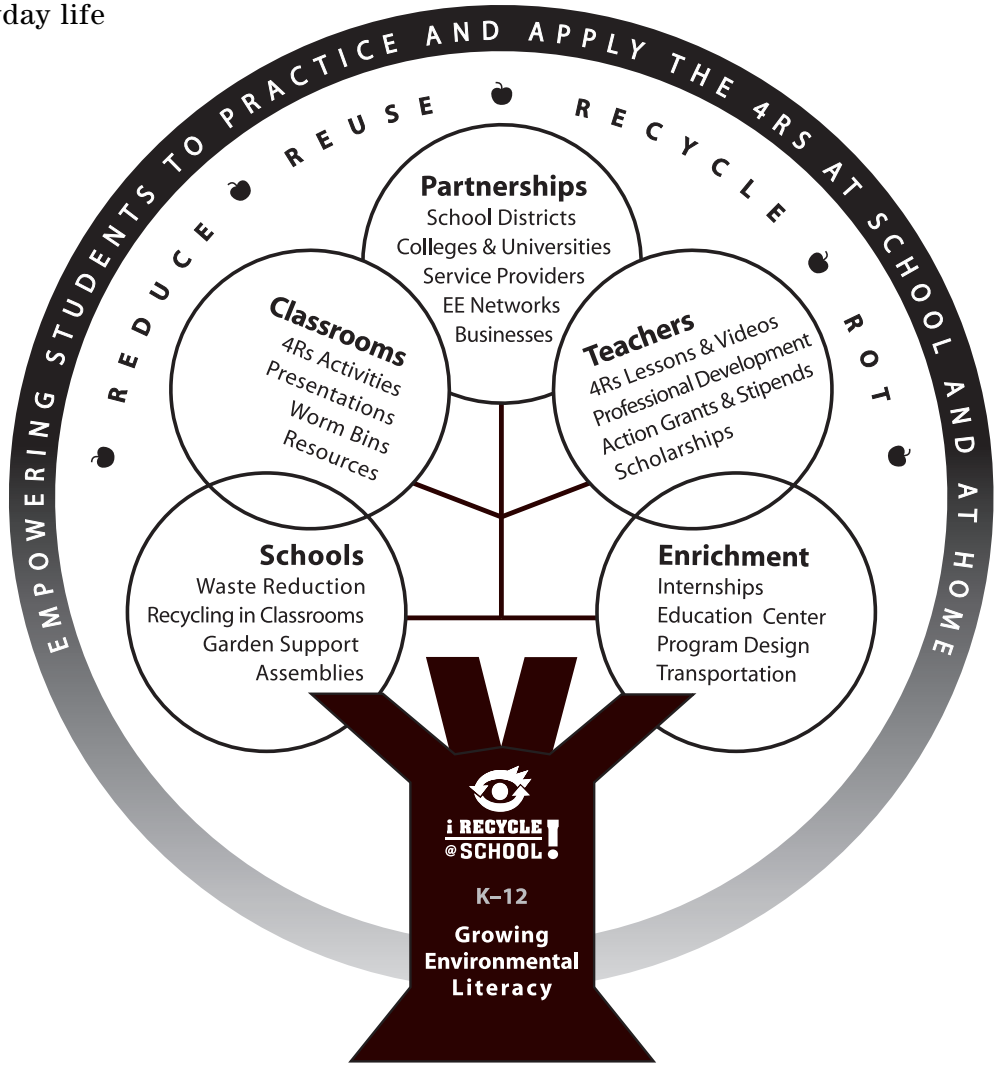
The irecycle@school program was created to assist schools with waste reduction programs and to provide quality waste reduction activities to teach students about the 4Rs.

The irecycle@school objectives are to empower students to:

- engage in 4Rs behaviors
- practice 4Rs behaviors in school
- apply 4Rs behaviors in everyday life

The long-term impact of these objectives are less waste from Alameda County going into landfills, adoption of lifelong waste reduction behaviors, and appreciation of natural resources and increasing environmental literacy.

The irecycle@school program consists of five interconnected branches of programs and services that support the growth of environmental literacy in K-12 schools located in Alameda County.



# How to Use this Guide

## How This Guide Is Organized:

This guide is comprised of twenty-four lessons divided into five thematic units:


**Natural Resources and the Environment Lessons**
Students will become aware of the resources needed to produce products they use every day through hands-on investigation.


**Reduce Lessons**
Students will examine their own consumption habits, both at school and at home, and learn and discuss ways in which they may want to change their consumer behavior.


**Reuse Lessons**
Students will be introduced to the concept of reuse. Students will uncover simple ways they can reuse items in their everyday life and will create reuse projects.

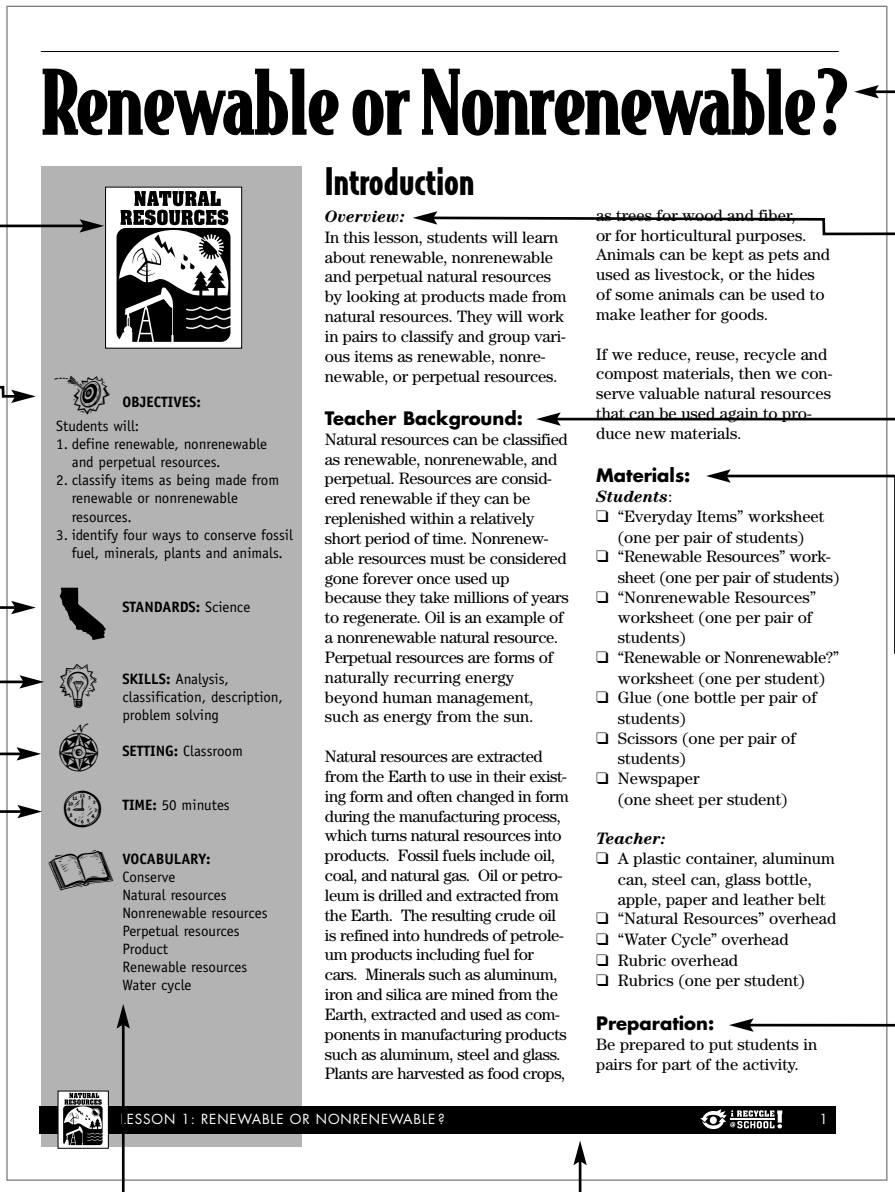

**Recycle Lessons**
Students will discover how to recycle in their own community and how recycling conserves natural resources. They will explore how new product get made using the materials they recycle at school and home.


**Rot/Compost Lessons**
Students will learn through investigation and discovery about the web of life and the decomposition cycle. They will learn what organisms contribute to decomposition, why people compost, and how compost improves soil health.

## Using the Lessons:

Because the 4Rs are organized in a hierarchy, we recommend beginning with the first unit and progressing through the others in order, because the units build on knowledge from the previous section. The lessons from any unit, however, are designed to stand alone and can be taught independently or presented in a series as part of a larger thematic unit.

### Sample First Page of Lesson



# Renewable or Nonrenewable?

NATURAL RESOURCES

**OBJECTIVES:**

Students will:
1. define renewable, nonrenewable and perpetual resources.
2. classify items as being made from renewable or nonrenewable resources.
3. identify four ways to conserve fossil fuel, minerals, plants and animals.

**STANDARDS:** Science

**SKILLS:** Analysis, classification, description, problem solving

**SETTING:** Classroom

**TIME:** 50 minutes

**VOCABULARY:**
Conserve
Natural resources
Nonrenewable resources
Perpetual resources
Product
Renewable resources
Water cycle

## Introduction

***Overview:***
In this lesson, students will learn about renewable, nonrenewable and perpetual natural resources by looking at products made from natural resources. They will work in pairs to classify and group various items as renewable, nonrenewable, or perpetual resources.

**Teacher Background:**
Natural resources can be classified as renewable, nonrenewable, and perpetual. Resources are considered renewable if they can be replenished within a relatively short period of time. Nonrenewable resources must be considered gone forever once used up because they take millions of years to regenerate. Oil is an example of a nonrenewable natural resource. Perpetual resources are forms of naturally recurring energy beyond human management, such as energy from the sun.

Natural resources are extracted from the Earth to use in their existing form and often changed in form during the manufacturing process, which turns natural resources into products. Fossil fuels include oil, coal, and natural gas. Oil or petroleum is drilled and extracted from the Earth. The resulting crude oil is refined into hundreds of petroleum products including fuel for cars. Minerals such as aluminum, iron and silica are mined from the Earth, extracted and used as components in manufacturing products such as aluminum, steel and glass. Plants are harvested as food crops, as trees for wood and fiber, or for horticultural purposes. Animals can be kept as pets and used as livestock, or the hides of some animals can be used to make leather for goods.

If we reduce, reuse, recycle and compost materials, then we conserve valuable natural resources that can be used again to produce new materials.

**Materials:**
***Students***:
- ❑ "Everyday Items" worksheet (one per pair of students)
- ❑ "Renewable Resources" worksheet (one per pair of students)
- ❑ "Nonrenewable Resources" worksheet (one per pair of students)
- ❑ "Renewable or Nonrenewable?" worksheet (one per student)
- ❑ Glue (one bottle per pair of students)
- ❑ Scissors (one per pair of students)
- ❑ Newspaper (one sheet per student)

***Teacher:***
- ❑ A plastic container, aluminum can, steel can, glass bottle, apple, paper and leather belt
- ❑ "Natural Resources" overhead
- ❑ "Water Cycle" overhead
- ❑ Rubric overhead
- ❑ Rubrics (one per student)

**Preparation:**
Be prepared to put students in pairs for part of the activity.

LESSON 1: RENEWABLE OR NONRENEWABLE? i RECYCLE @SCHOOL! 1

**LESSON TITLE:** Large lesson title at the beginning of each new lesson

**OVERVIEW:** Each lesson begins with an ***Overview*** or summary of the lesson

**Teacher Background:** provides information necessary to conduct the lesson

**Materials:** lists both ***student*** and ***teacher*** materials required to teach the lesson

**PREPARATION:** provides tips for preparing to teach the lesson.

**ICON:** shows the thematic unit of each lesson

**OBJECTIVES:** identifies what students will be able to do after participating in the lesson

**STANDARDS:** connections to specific content in the CA State Content Standards

**SKILLS:** lists the thinking processes and skills addressed in the lesson

**SETTING:** indicates where the lesson takes place

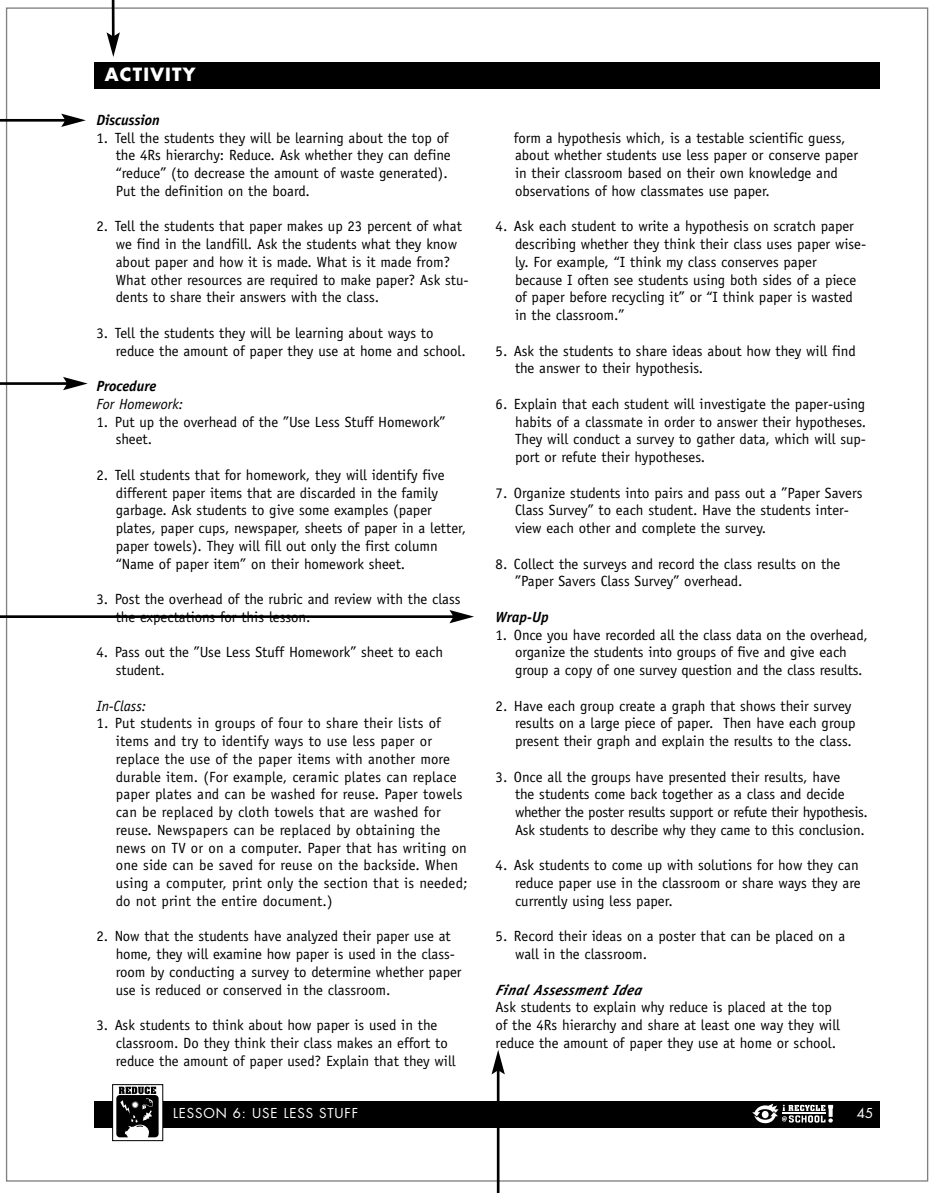
**TIME:** indicates the estimated time necessary to teach the lesson

**VOCABULARY:** lists words used in the lesson to help build students' vocabulary

**FOOTER:** includes the thematic unit, lesson title and page number for quick reference

## Sample Activity Page

The lesson content begins in the **ACTIVITY** section.



**ACTIVITY**

***Discussion***

1. Tell the students they will be learning about the top of the 4Rs hierarchy: Reduce. Ask whether they can define "reduce" (to decrease the amount of waste generated). Put the definition on the board.
2. Tell the students that paper makes up 23 percent of what we find in the landfill. Ask the students what they know about paper and how it is made. What is it made from? What other resources are required to make paper? Ask students to share their answers with the class.
3. Tell the students they will be learning about ways to reduce the amount of paper they use at home and school.

***Procedure***

*For Homework:*

1. Put up the overhead of the "Use Less Stuff Homework" sheet.
2. Tell students that for homework, they will identify five different paper items that are discarded in the family garbage. Ask students to give some examples (paper plates, paper cups, newspaper, sheets of paper in a letter, paper towels). They will fill out only the first column "Name of paper item" on their homework sheet.
3. Post the overhead of the rubric and review with the class the expectations for this lesson.
4. Pass out the "Use Less Stuff Homework" sheet to each student.

*In-Class:*

1. Put students in groups of four to share their lists of items and try to identify ways to use less paper or replace the use of the paper items with another more durable item. (For example, ceramic plates can replace paper plates and can be washed for reuse. Paper towels can be replaced by cloth towels that are washed for reuse. Newspapers can be replaced by obtaining the news on TV or on a computer. Paper that has writing on one side can be saved for reuse on the backside. When using a computer, print only the section that is needed; do not print the entire document.)
2. Now that the students have analyzed their paper use at home, they will examine how paper is used in the classroom by conducting a survey to determine whether paper use is reduced or conserved in the classroom.
3. Ask students to think about how paper is used in the classroom. Do they think their class makes an effort to reduce the amount of paper used? Explain that they will form a hypothesis which, is a testable scientific guess, about whether students use less paper or conserve paper in their classroom based on their own knowledge and observations of how classmates use paper.
4. Ask each student to write a hypothesis on scratch paper describing whether they think their class uses paper wisely. For example, "I think my class conserves paper because I often see students using both sides of a piece of paper before recycling it" or "I think paper is wasted in the classroom."
5. Ask the students to share ideas about how they will find the answer to their hypothesis.
6. Explain that each student will investigate the paper-using habits of a classmate in order to answer their hypotheses. They will conduct a survey to gather data, which will support or refute their hypotheses.
7. Organize students into pairs and pass out a "Paper Savers Class Survey" to each student. Have the students interview each other and complete the survey.
8. Collect the surveys and record the class results on the "Paper Savers Class Survey" overhead.

***Wrap-Up***

1. Once you have recorded all the class data on the overhead, organize the students into groups of five and give each group a copy of one survey question and the class results.
2. Have each group create a graph that shows their survey results on a large piece of paper. Then have each group present their graph and explain the results to the class.
3. Once all the groups have presented their results, have the students come back together as a class and decide whether the poster results support or refute their hypothesis. Ask students to describe why they came to this conclusion.
4. Ask students to come up with solutions for how they can reduce paper use in the classroom or share ways they are currently using less paper.
5. Record their ideas on a poster that can be placed on a wall in the classroom.

***Final Assessment Idea***

Ask students to explain why reduce is placed at the top of the 4Rs hierarchy and share at least one way they will reduce the amount of paper they use at home or school.



LESSON 6: USE LESS STUFF i RECYCLE @ SCHOOL! 45

***Discussion*** engages students in the topic, draws on prior knowledge and models the activity for them

***Procedure*** provides information for teachers to model and conduct the activity step-by-step

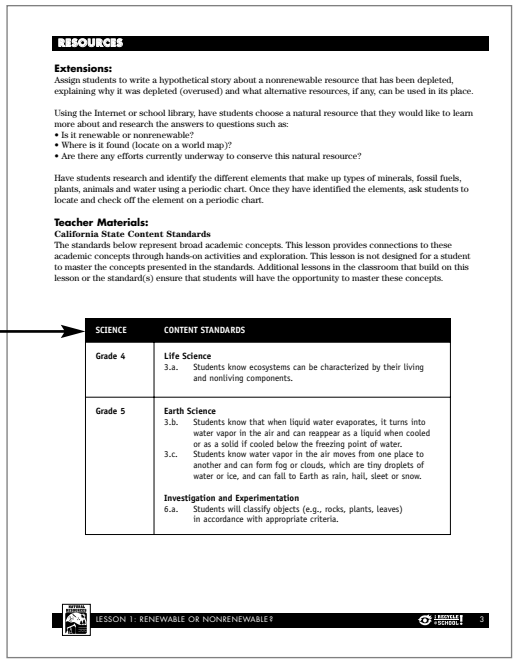
***Wrap-up*** provides an opportunity for student reflection and reinforcement of the concepts covered in the lesson

***Final Assessment Idea*** includes ideas to assess the level at which students' have met the learning objectives

## California Content Standards:

The lessons in this guide make connections to the California State Content Standards, with emphasis on the science and mathematic content standards. Language arts and social science content standards may be addressed through the activity as well. A table showing specific connections to the standards is included at the end of each lesson.

A table at the end of each lesson identifies connections to **California State Content Standards**



RESOURCES

**Extensions:**
Assign students to write a hypothetical story about a nonrenewable resource that has been depleted, explaining why it was depleted (overused) and what alternative resources, if any, can be used in its place.

Using the Internet or school library, have students choose a natural resource that they would like to learn more about and research the answers to questions such as:
- Is it renewable or nonrenewable?
- Where is it found (locate on a world map)?
- Are there any efforts currently underway to conserve this natural resource?

Have students research and identify the different elements that make up types of minerals, fossil fuels, plants, animals and water using a periodic chart. Once they have identified the elements, ask students to locate and check off the element on a periodic chart.

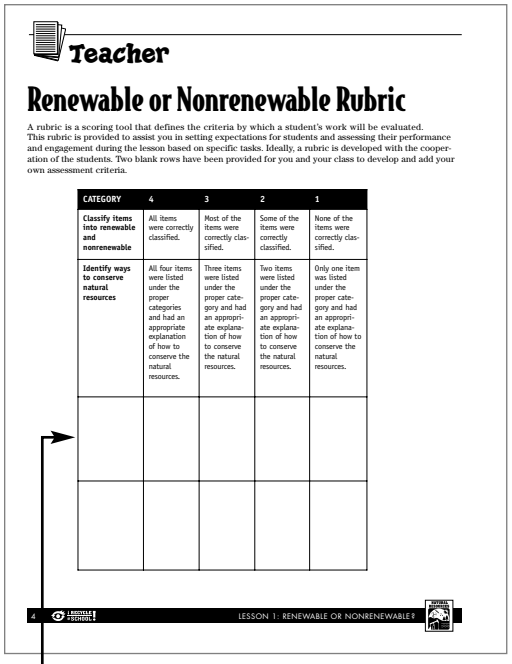
**Teacher Materials:**
**California State Content Standards**
The standards below represent broad academic concepts. This lesson provides connections to these academic concepts through hands-on activities and exploration. This lesson is not designed for a student to master the concepts presented in the 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 | **Life Science**<br>3.a. Students know ecosystems can be characterized by their living and nonliving components. |
| Grade 5 | **Earth Science**<br>3.b. Students know that when liquid water evaporates, it turns into water vapor in the air and can reappear as a liquid when cooled or as a solid if cooled below the freezing point of water.<br>3.c. Students know water vapor in the air moves from one place to another and can form fog or clouds, which are tiny droplets of water or ice, and can fall to Earth as rain, hail, sleet or snow.<br>**Investigation and Experimentation**<br>6.a. Students will classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria. |

LESSON 1: RENEWABLE OR NONRENEWABLE? 3

## Rubrics

A rubric is a scoring tool that defines the criteria by which a student's work will be evaluated. Ideally, a rubric is developed with the cooperation of the students. Although a rubric may help with assessment, its primary goal is to show expectations before the activity begins.



Teacher

### Renewable or Nonrenewable 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 |
|---|---|---|---|---|
| **Classify items into renewable and nonrenewable** | All items were correctly classified. | Most of the items were correctly classified. | Some of the items were correctly classified. | None of the items were correctly classified. |
| **Identify ways to conserve natural resources** | All four items were listed under the proper categories and had an appropriate explanation of how to conserve the natural resources. | Three items were listed under the proper category and had an appropriate explanation of how to conserve the natural resources. | Two items were listed under the proper category and had an appropriate explanation of how to conserve the natural resources. | Only one item was listed under the proper category and had an appropriate explanation of how to conserve the natural resources. |
| | | | | |
| | | | | |

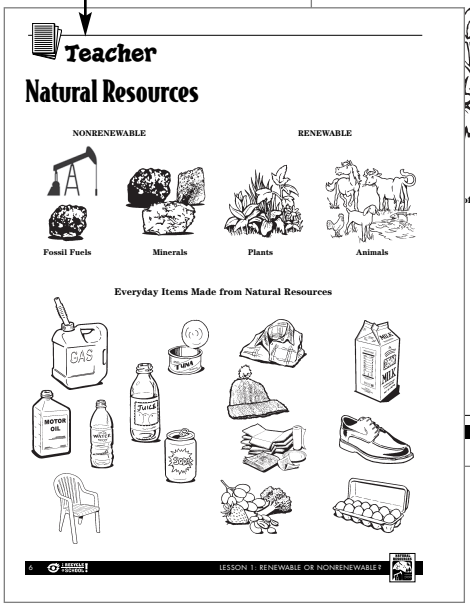
4 LESSON 1: RENEWABLE OR NONRENEWABLE?

Two blank rows have been provided for the teacher and student to add additional assessment criteria based on the lessons' learning objectives

## Teacher and Student Pages

For duplication and use with each activity

Headings at the top of the page identify teacher or student usage



Teacher

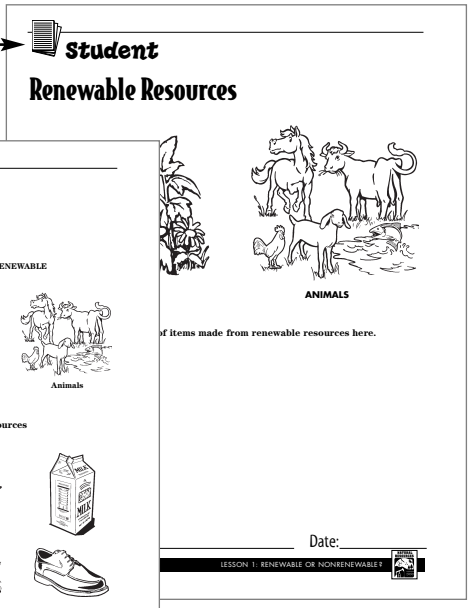
### Natural Resources

NONRENEWABLE RENEWABLE

Fossil Fuels Minerals Plants Animals

Everyday Items Made from Natural Resources

6 LESSON 1: RENEWABLE OR NONRENEWABLE?



Student

### Renewable Resources

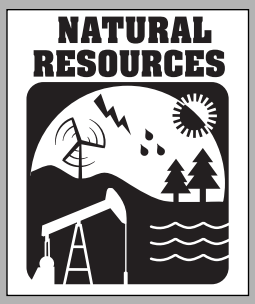
ANIMALS

f items made from renewable resources here.

Date:

LESSON 1: RENEWABLE OR NONRENEWABLE?

# Renewable or Nonrenewable?




**OBJECTIVES:**

Students will:
1. define renewable, nonrenewable and perpetual resources.
2. classify items as being made from renewable or nonrenewable resources.
3. identify four ways to conserve fossil fuel, minerals, plants and animals.

**STANDARDS:** Science

**SKILLS:** Analysis, classification, description, problem solving

**SETTING:** Classroom

**TIME:** 50 minutes

**VOCABULARY:**
Conserve
Natural resources
Nonrenewable resources
Perpetual resources
Product
Renewable resources
Water cycle

## Introduction

***Overview:***
In this lesson, students will learn about renewable, nonrenewable and perpetual natural resources by looking at products made from natural resources. They will work in pairs to classify and group various items as renewable, nonrenewable, or perpetual resources.

### Teacher Background:

Natural resources can be classified as renewable, nonrenewable, and perpetual. Resources are considered renewable if they can be replenished within a relatively short period of time. Nonrenewable resources must be considered gone forever once used up because they take millions of years to regenerate. Oil is an example of a nonrenewable natural resource. Perpetual resources are forms of naturally recurring energy beyond human management, such as energy from the sun.

Natural resources are extracted from the Earth to use in their existing form and often changed in form during the manufacturing process, which turns natural resources into products. Fossil fuels include oil, coal, and natural gas. Oil or petroleum is drilled and extracted from the Earth. The resulting crude oil is refined into hundreds of petroleum products including fuel for cars. Minerals such as aluminum, iron and silica are mined from the Earth, extracted and used as components in manufacturing products such as aluminum, steel and glass. Plants are harvested as food crops, as trees for wood and fiber, or for horticultural purposes. Animals can be kept as pets and used as livestock, or the hides of some animals can be used to make leather for goods.

If we reduce, reuse, recycle and compost materials, then we conserve valuable natural resources that can be used again to produce new materials.

### Materials:

***Students***:
- ❑ "Everyday Items" worksheet (one per pair of students)
- ❑ "Renewable Resources" worksheet (one per pair of students)
- ❑ "Nonrenewable Resources" worksheet (one per pair of students)
- ❑ "Renewable or Nonrenewable?" worksheet (one per student)
- ❑ Glue (one bottle per pair of students)
- ❑ Scissors (one per pair of students)
- ❑ Newspaper (one sheet per student)

***Teacher:***
- ❑ A plastic container, aluminum can, steel can, glass bottle, apple, paper and leather belt
- ❑ "Natural Resources" overhead
- ❑ "Water Cycle" overhead
- ❑ Rubric overhead
- ❑ Rubrics (one per student)

### Preparation:

Be prepared to put students in pairs for part of the activity.

## ACTIVITY

***Discussion***

1. Hold up the plastic container, aluminum can, steel can, glass bottle, apple, paper, and leather belt.

2. Put up the "Natural Resources" overhead, and cover up the bottom half (the pictures of the items). Tell the students that all of these items are made from natural resources and that these resources are either nonrenewable or renewable. Explain that nonrenewable resources exist on Earth in limited amounts, e.g., fossil fuels (coal, oil, natural gas) and many minerals (e.g., iron, gold, and bauxite, the source of aluminum). Fossil fuels are nonrenewable natural resources because they take millions of years to form. Most minerals are also nonrenewable resources. Explain that renewable resources are replaced naturally or through human-assisted actions within a relatively short amount of time, such as a human lifetime. For example, plants, such as trees, can be replanted indefinitely.

3. Hold up the items, one at a time, and ask student volunteers to classify them as made from a nonrenewable or renewable resource. Uncover the rest of the overhead, and review the items that were not discussed (i.e., gasoline, bike helmet, etc.). Briefly explain how natural resources are taken from the Earth and made into products.

4. Let students know that resources can also be classified as perpetual resources. These are forms of naturally recurring energy that are beyond human management, e.g., sun, wind, falling water, tides. Put up the "Water Cycle" overhead, and explain how the water cycle is an example of a perpetual resource.

5. Introduce the concept of conservation. Ask students whether there are ways that they can use fewer resources. Share one way that students can conserve natural resources. For example, by riding a bike to school instead of driving in a car, students can conserve fuel, which comes from a nonrenewable resource.

6. Show an overhead of the lesson rubric, and review the expectations for this lesson.

***Procedure***

1. Divide the class into pairs. Give each pair of students the following worksheets: "Everyday Items," "Renewable Resources," "Nonrenewable Resources." Also give them a pair of scissors, and glue.

2. Instruct each pair to cut out the items and classify them by gluing them into one of the two possible categories: renewable or nonrenewable resources.

3. Review with the whole class which items they classified as renewable or nonrenewable resources.


***Wrap-Up***

1. Ask students what they think will happen to nonrenewable resources if we continue using them. (They will be depleted.)

2. Ask students whether they think renewable resources are always available forever. Pass out one sheet of newspaper to each student, and have them roll it up to represent a tree. Put all of the "trees" together at the front of the class to represent a forest. Ask the students what would happen if they needed to cut down ten trees a year to provide enough paper for their school but only five trees were replanted each year (the natural resource will be depleted).

3. Ask the students to turn to a partner to brainstorm some ways that they can conserve nonrenewable and renewable resources. (Use less. Use renewable resources instead, e.g., a paper bag in place of a plastic bag. Reuse bags and recycle them.)

4. Pass out the "Renewable or Nonrenewable" worksheet, assign students to name one item from each of the four categories (fossil fuels, minerals, plants and animals) and explain how they can conserve the natural resources.

***Final Assessment Idea***

Have students identify ten items in the classroom, writing the natural resource used to produce the item and whether the resource is renewable or nonrenewable.

## Extensions:

Assign students to write a hypothetical story about a nonrenewable resource that has been depleted, explaining why it was depleted (overused) and what alternative resources, if any, can be used in its place.

Using the Internet or school library, have students choose a natural resource that they would like to learn more about and research the answers to questions such as:

- Is it renewable or nonrenewable?
- Where is it found (locate on a world map)?
- Are there any efforts currently underway to conserve this natural resource?

Have students research and identify the different elements that make up types of minerals, fossil fuels, plants, animals and water using a periodic chart. Once they have identified the elements, ask students to locate and check off the element on a periodic chart.

## 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** | **Life Science**<br>3.a. Students know ecosystems can be characterized by their living and nonliving components. |
| **Grade 5** | **Earth Science**<br>3.b. Students know that when liquid water evaporates, it turns into water vapor in the air and can reappear as a liquid when cooled or as a solid if cooled below the freezing point of water.<br>3.c. Students know water vapor in the air moves from one place to another and can form fog or clouds, which are tiny droplets of water or ice, and can fall to Earth as rain, hail, sleet or snow.<br><br>**Investigation and Experimentation**<br>6.a. Students will classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria. |

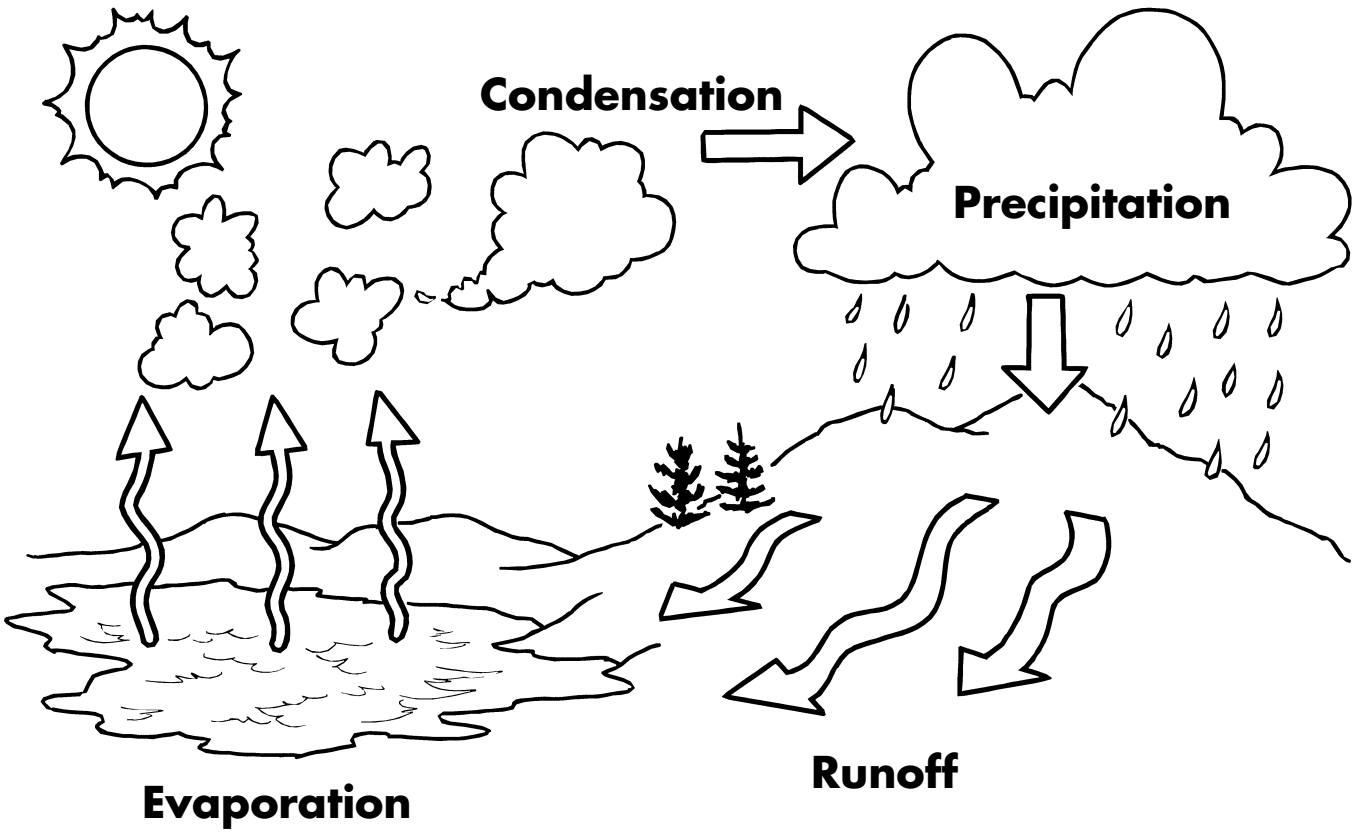
# Teacher

# Renewable or Nonrenewable 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 |
|---|---|---|---|---|
| **Classify items into renewable and nonrenewable** | All items were correctly classified. | Most of the items were correctly classified. | Some of the items were correctly classified. | None of the items were correctly classified. |
| **Identify ways to conserve natural resources** | All four items were listed under the proper categories and had an appropriate explanation of how to conserve the natural resources. | Three items were listed under the proper category and had an appropriate explanation of how to conserve the natural resources. | Two items were listed under the proper category and had an appropriate explanation of how to conserve the natural resources. | Only one item was listed under the proper category and had an appropriate explanation of how to conserve the natural resources. |
| | | | | |
| | | | | |

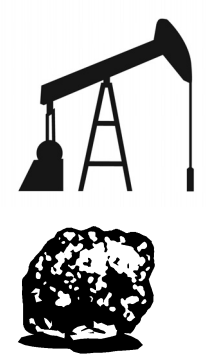
# Water Cycle



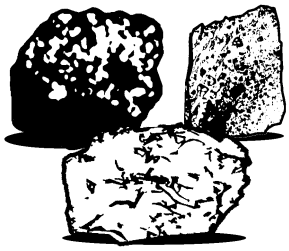
# Teacher

# Natural Resources

**NONRENEWABLE** **RENEWABLE**

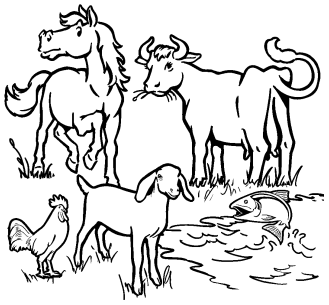


**Fossil Fuels**



**Minerals**

**Plants**

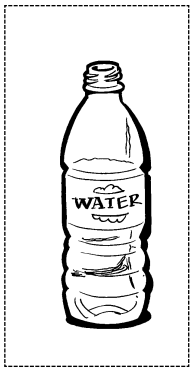


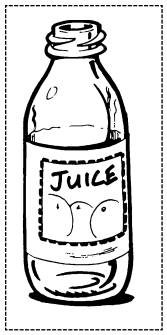
**Animals**

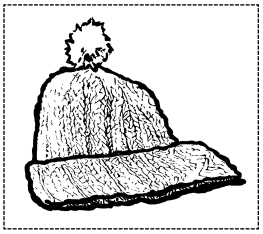
**Everyday Items Made from Natural Resources**

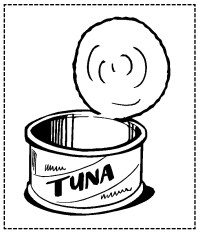
# Everyday Items

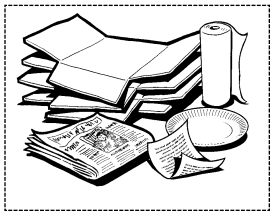
**Directions: Cut out each item and decide whether it is made from a renewable or nonrenewable resource.**

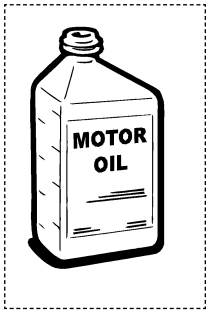


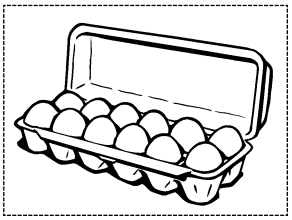



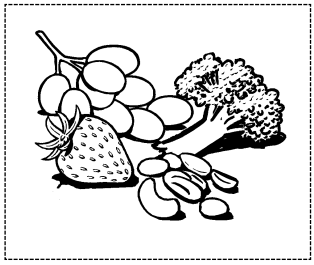


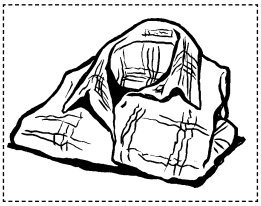



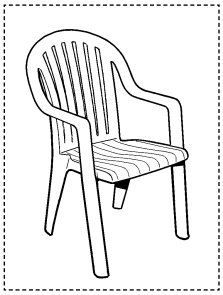


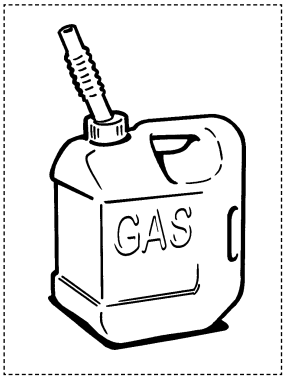











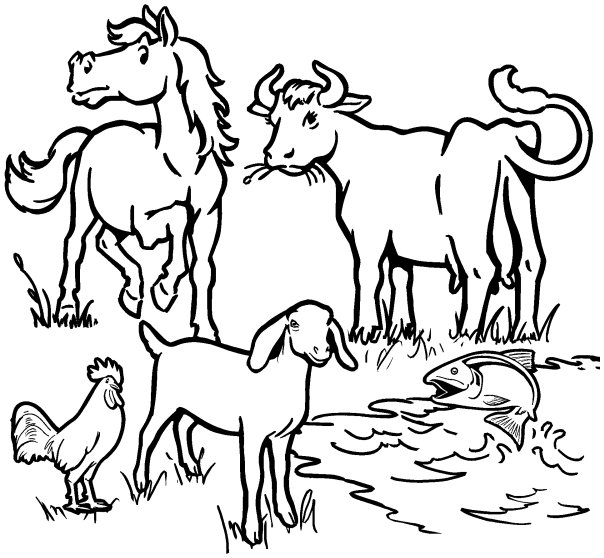



Name:_____ Date:_____

# Student

# Renewable Resources

**PLANTS**

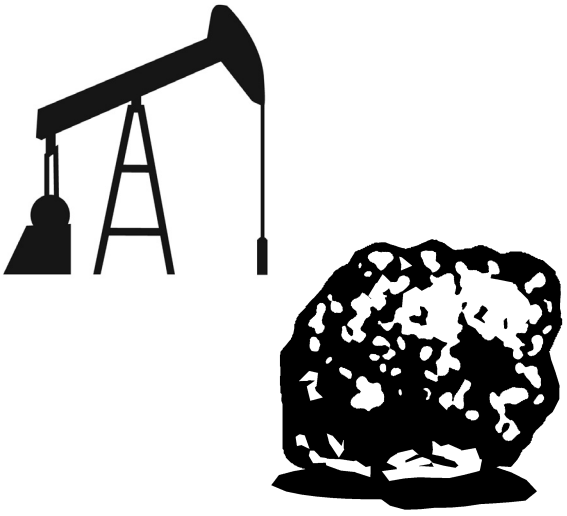


**ANIMALS**

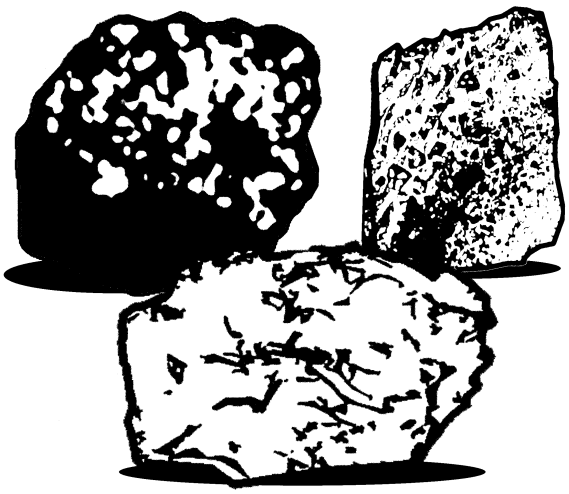
**Directions: Glue examples of items made from renewable resources here.**

Name:_____ Date:_____

# Nonrenewable Resources



**FOSSIL FUELS**



**MINERALS**

**Directions: Glue examples of items made from nonrenewable resources here.**

Name:_____ Date:_____

## Student

# Renewable or Nonrenewable?

**Directions: Write the name of one item from each of the four natural resource categories (fossil fuels, minerals, plants, animals), and explain how to conserve the natural resources needed to produce it.**

1a. Item made from fossil fuels: _____

1b. How can you conserve fossil fuel resources?

_____

_____

2a. Item made from minerals: _____

2b. How can you conserve mineral resources?

_____

_____

3a. Item made from plants: _____

3b. How can you conserve plant resources? _____

_____

_____

4a. Item made from animals: _____

4b. How can you conserve animal resources?

_____

_____

Name: _____ Date: _____

## DEFINITIONS

### Vocabulary:

***Conserve:*** to protect something from harm or destruction.

***Natural resources:*** living and nonliving materials that come from the Earth such as fossil fuels, minerals, plants, animals, water, air, sunlight, and other forms of energy.

***Nonrenewable resources:*** minerals or sources of energy that can be mined or collected from the Earth, such as coal, petroleum, iron ore, copper, etc. The processes of their formation are so slow that these resources may be considered gone forever once they are used up.

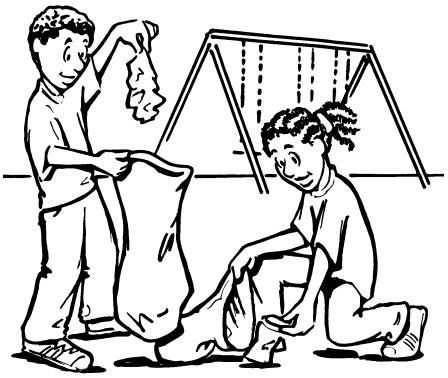
***Perpetual resources:*** forms of naturally recurring energy that are beyond human management, e.g., sun, wind, falling water, tides.

***Product:*** something produced by human or mechanical effort or by a natural process.

***Renewable resources:*** naturally occurring raw materials or form of energy that has the capacity to replenish itself within a relatively short amount of time (e.g., a human lifetime) through ecological cycles and sound management practices, e.g., trees, agricultural crops, grasses.

***Water cycle:*** sunlight evaporates water that condenses to clouds that produce rain that falls on the land, flows to an ocean or lake and evaporates again. The water can flow through other routes such as through sand underground or through an animal. The cycle begins with evaporation and ends with water returning to a place for evaporation to occur again.

# Scavenge for Litter



NATURAL RESOURCES

**OBJECTIVES:**

Students will:
1. collect five items of litter found on school grounds and identify the natural resource it came from.
2. calculate the percentages for different types of litter found on school grounds.
3. compare the percentages of each type of waste produced in Alameda County to litter found on school grounds.

**STANDARDS:** Science and Mathematics

**SKILLS:** Analysis, classification, construction, description, problem solving

**SETTING:** Outdoors and in the Classroom

**TIME:**
Outdoors: 10 minutes
Classroom: 40 minutes

**VOCABULARY:**
Garbage
Inorganic
Litter
Organic

## Introduction

***Overview:***
In this lesson, students will collect litter found on school grounds and link this litter back to natural resources. They will classify the materials into different categories of waste and compare the types and percentages of litter found on school grounds to the amount of waste that's generated in Alameda County.

### Teacher Background:

Litter commonly includes pieces of paper, plastic and glass, packaging, bottle tops, cigarette butts and bottles, but it can also be anything considered out of place. Litter impacts the environment in many ways. It can become hazardous to wildlife and humans, it reduces the aesthetic appeal of public places and it costs money to clean up.

Litter can be a major problem on school campuses. Many items that become litter when discarded could have been reduced, reused, recycled or composted. Teachers can remind students that they can take responsibility for reducing litter by practicing the 4Rs and participating in litter cleanups at school and in their community.

### Materials:

***Students:***
- ❑ Paper or plastic bags (one per group of four students)
- ❑ "School Litter Bar Graph" worksheet (one per student)
- ❑ Latex gloves (one pair per student)

***Teacher:***
- ❑ "School Litter Bar Graph" overhead (model how to complete and record class data)
- ❑ "Litter Disposal at School" overhead (garbage can graphic to record class percentages)
- ❑ "Waste Disposal in Alameda County" overhead
- ❑ One to two items from the following categories: (a) paper (b) other organics, e.g., tires, rubber, scrap wood, diapers, textiles (c) other waste, e.g., wallboard, rock, asphalt, roofing (d) yard/garden (e) food (f) plastic (g) metals (h) glass
- ❑ Rubric overhead
- ❑ Rubrics (one per student)

### Preparation:

Gather bags and waste items. Be prepared to divide the class into groups of four students.

## ACTIVITY

***Discussion***

1. Explain that students will be collecting litter at their school. Invite the students to guess what items of litter they may find at school. For example, the students may expect to find only wrappers and aluminum cans.

2. Record and save their ideas on the board so they can compare their predictions to what they actually collected.

3. Explain to the students that after they collect litter, they will categorize and compare the items collected with different types of waste generated in Alameda County.

4. Describe the different categories that litter can be placed into. Explain that these categories are used in Alameda County to track different types of waste generated in the county. Show an example for each of the following categories: (a) paper (b) other organics, e.g., rubber, scrap wood, diapers, textiles (c) other waste, e.g., wallboard, rock, asphalt, roofing (d) yard/garden (e) food (f) plastic (g) metals (h) glass.

5. Explain that the first five categories (paper, other organics, other waste, food, yard or garden debris) are called "organic" because they came from once-living plants or animals. The last three (plastic, metal, glass) are "inorganic" because they did not come from a living organism.

6. Tell students that they will be doing a scavenger hunt for litter from the school grounds.

7. Ask students to predict what kind of litter they think they'll find and where they might find it. Put these predictions on the board.

8. Let the students know that they will be comparing the type and percentage of litter found on their school grounds to the amount of waste that's generated in Alameda County.

9. Show an overhead of the lesson rubric, and review the expectations for this lesson.

***Procedure***

1. Organize the students into groups of four, and give each group a bag.

2. Tell the students that they have ten minutes to collect at least five items of litter from the school grounds.

3. Explain that litter consists of items that should have been placed in garbage cans or recycle bins or something that is considered out of place.

4. Ask the students to be safe during their search. Pass out latex gloves to students. Discuss items that should not be picked up such as needles, BandAids, etc. Stress that if the students are in doubt, they should ALWAYS ask the teacher.

5. Return to the classroom, and have the students remain in their groups with their bag of litter.

6. Put up the overhead "School Litter Bar Graph." Model for the students how to fill it out.

7. Tell the students that in their group, they should identify and discuss the natural resources used to make the items of litter collected. Next, they will classify their items according to the categories on the graph. They will each individually graph their data.

8. Pass out the student worksheet "School Litter Bar Graph," and give the class about ten minutes to complete it.

9. Have the students put their litter items back into the bag.

10. Put up the overhead "School Litter Bar Graph" to record the class data.

11. Have one person from each group report their data while you fill out the overhead.

12. Guide the class into turning the class graph data into percentages. Model how to convert the graph data into class percentages.

13. Put up the overhead "Litter Disposal at School" to record the class's percentages.

14. Put up the overhead "Waste Disposal in Alameda County." Compare this data with the class percentages of litter at school.

15. Now have the group compare their group findings with the waste disposal in Alameda County.

***Wrap-Up***

1. How did the students' predictions compare to the type of waste they found on the school grounds? Ask why their collection of litter closely resembled or was greatly different from the percentages of garbage disposed in Alameda County.

2. Ask the students what they can do at home and at school to reduce litter and waste.

***Final Assessment Ideas***

Have students work in groups to design a poster that informs other students about litter commonly found at school and the importance of the natural resources used to make each item. Students can draw pictures, cut out pictures from magazines or use the litter they have collected on their posters. They should also include several ways to reduce litter and waste at school.

## Extensions:

Have the students individually create pie charts showing the percentages of litter found on school grounds.

Have students predict where they would find the most as well as what type of litter on school grounds. Then have students create a map of the school grounds showing where they collected the greatest amount of litter and where recycling and garbage bins are located in these areas. In writing, have them hypothesize why they found very little litter in some areas and large amounts in another. For example, some areas may be heavily used by students during lunchtime and there are not enough recycling and garbage bins, so they throw stuff on the ground.

## 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 | **Investigation and Experimentation**<br>6.c. Students will formulate and justify predictions based on cause-and-effect relationships.<br>6.e. Students will construct and interpret graphs from measurements. |
| Grade 5 | **Investigation and Experimentation**<br>6.a. Students will classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria.<br>6.g. Students will record data by using appropriate graphic representations (including charts, graphs and labeled diagrams) and make inferences based on those data. |
| **MATHEMATICS** | **CONTENT STANDARDS** |
| Grade 4 | **Mathematical Reasoning**<br>2.3 Students will use a variety of methods, such as words, numbers, symbols, charts, graphs, tables, diagrams and models to explain mathematical reasoning. |
| Grade 5 | **Statistics, Data Analysis and Probability**<br>1.3 Students will use fractions and percentages to compare data sets of different sizes.<br>**Mathematical Reasoning**<br>2.3 Students will use a variety of methods, such as words, numbers, symbols, charts, graphs, tables, diagrams and models to explain mathematical reasoning. |

# Scavenge for Litter 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 |
|---|---|---|---|---|
| **Collect and identify litter** | Student collects more than five types of litter. | Student collects five items of litter of several types. | Student collects less than five items or all of the same type. | Student fails to do the assignment. |
| **Compare percentages** | Student correctly interprets the amount of litter items collected in a bar graph and correctly compares these to the percentages of waste in Alameda County. | Student correctly interprets the amount of litter items in a bar graph but has difficulty in comparing these to the percentages of waste in Alameda County. | Student does not correctly organize the amount of litter items in a bar graph and is not able to compare with percentages of waste in Alameda County. | Student fails to do the assignment. |
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# Teacher

# School Litter Bar Graph

**Directions: Write the name of each litter item in the appropriate column starting at the bottom of the column. The filled-in spaces will show you a bar graph of each category.**

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| **PAPER** | **OTHER ORGANICS (RUBBER, SCRAP WOOD, DIAPERS, TEXTILES)** | **OTHER WASTE (WALL-BOARD, ROCK, ASPHALT, ROOFING)** | **YARD/ GARDEN** | **FOOD** | **PLASTIC** | **METALS** | **GLASS** |
| **ORGANIC** | | | | | **INORGANIC** | | |

# School Litter Bar Graph

**Directions: Write the name of each litter item in the appropriate column starting at the bottom of the column. The filled-in spaces will show you a bar graph of each category.**

| | | | | | | | |
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| **PAPER** | **OTHER ORGANICS (RUBBER, SCRAP WOOD, DIAPERS, TEXTILES)** | **OTHER WASTE (WALL-BOARD, ROCK, ASPHALT, ROOFING)** | **YARD/ GARDEN** | **FOOD** | **PLASTIC** | **METALS** | **GLASS** |

Name:_____ Date:_____

# Teacher

# Litter Disposal at School

**Paper ___%**

**Other Organics ___%**
(rubber, scrap wood, diapers, textiles)

**Other Waste ___%**
(wallboard, rock, asphalt, roofing)

**Food ___%**

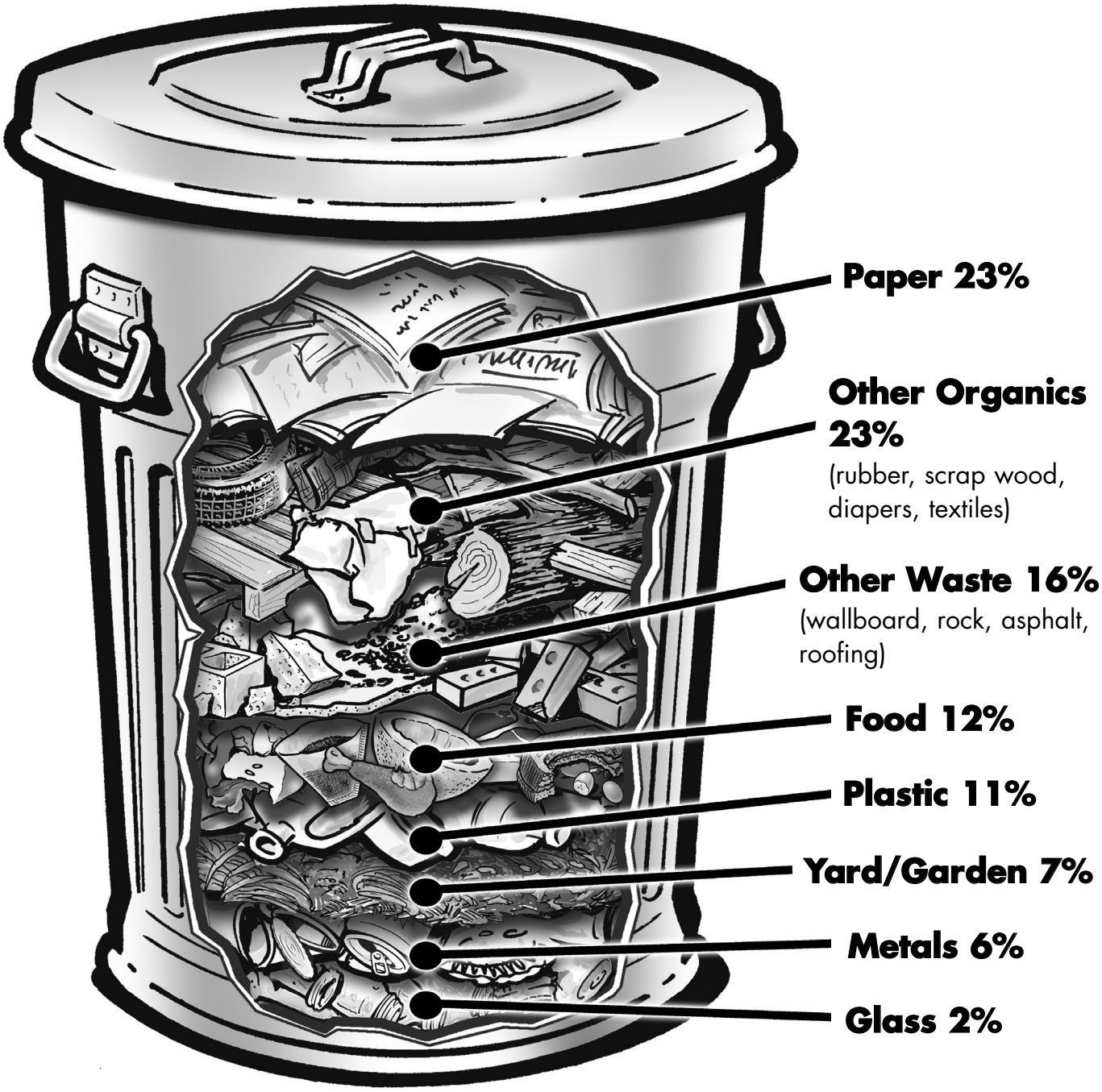
**Plastic ___%**

**Yard/Garden ___%**

**Metals ___%**

**Glass ___%**

# Waste Disposal in Alameda County




Source: Waste Characterization Study prepared for the Alameda County Waste Management Authority and Recycling Board by RW Beck 2001.

## DEFINITIONS

### Vocabulary:

***Garbage:*** things that people throw away.

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

***Litter:*** waste materials that are carelessly discarded or put in the wrong place.

***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.

# Kids Doing the 4Rs

NATURAL RESOURCES

**OBJECTIVES:**

Students will:
1. explain the need for each of the 4Rs.
2. give at least two ways to practice of each of the 4Rs, i.e.: Reduce, Reuse, Recycle and Rot (Compost).

**STANDARDS:** Science

**SKILLS:** Analysis, classification, construction, description, problem solving

**SETTING:** Classroom

**TIME:** 45 minutes

**VOCABULARY:**
Compost
Conserve
Decomposition
Hierarchy
Pictograph
Recycle
Reduce
Reuse
Rot

## Introduction

***Overview:***
In this lesson, students will learn about the 4Rs hierarchy by watching a video of students demonstrating ways to practice the 4Rs. Working in groups, they will use 4Rs pictographs to brainstorm ways to practice the 4Rs.

### Teacher Background:

The 4Rs (Reduce, Reuse, Recycle and Rot/Compost) are organized in a hierarchy, or order of importance. The first goal is to reduce the amount of waste we generate. If we use less stuff, we reduce the amount of waste produced. Some ways to reduce waste include buying products with minimal packaging, using a cloth bag instead of paper or plastic and buying durable products with a longer life span. When waste does occur, the next level in the hierarchy is to reuse items. The reuse of items does not require the expense of energy or new materials because the manufacturing process is not involved. Some ways to reuse items include using both sides of a piece of paper, saving and using plastic or paper grocery bags for future visits and donating unwanted items such as clothing, books or toys to a charity. If waste items cannot be reused, the next level is recycling. For example, paper can be recycled to produce new paper. Glass can be recycled to produce new bottles or kitchen tile. Recycling conserves natural resources, reduces air and water pollution and saves energy. Finally, organic materials (originally living plants or animals) that cannot be reused or recycled can be decomposed (rot) to produce compost, a rich soil amendment that helps plants grow.

### Materials:

***Students:***
- ❑ "4Rs Pictographs" with labels (one set per group of four)
- ❑ "Kids Doing the 4Rs" worksheet (one per student)

***Teacher:***
- ❑ *Doing the 4Rs: Reduce*, *Reuse*, *Recycle*, *Rot* video
- ❑ "4Rs Pictographs" (without labels) overheads
- ❑ Rubric overhead
- ❑ Rubrics (one per student)

### Preparation:

Be prepared to divide the class into groups of four for part of the activity.

## ACTIVITY

***Discussion***

1. Ask students whether they can name the 4Rs. Write them on the board.

2. Explain that the 4Rs are arranged in a hierarchy of importance, and guide them to list in the correct hierarchy (Reduce, Reuse, Recycle, Rot/Compost). Give another example of a hierarchy.

3. Show an overhead of the lesson rubric, and review the expectations for this lesson.

***Procedure***

1. Before showing the video, inform the students that they will be looking for examples of students practicing the 4Rs.

2. Ask them to write down several examples for each of the 4Rs while they watch the video.

3. Show the video *Doing the 4Rs*.

4. Organize the students into groups of four. Pass out one set of the "4Rs Pictographs" to each group.

5. Ask each group to cut out the pictographs.

6. Provide a definition for each of the four pictographs and have the groups identify which pictograph represents each of the 4Rs. Ask them to write the name of each pictograph below the picture.

7. Have them place the 4Rs pictographs in the correct hierarchy.

8. Have them brainstorm examples of 4R practices shown in the video.

***Wrap-Up***

1. Put up the "4Rs Pictographs" overheads one at a time. Have groups name and provide a definition for the pictograph and provide examples of how to practice that particular R.

2. Ask students to address why each of the 4Rs is important.

3. Pass out "Kids Doing the 4Rs" worksheet to each student. Have students write down two examples for each of the 4Rs that they would like to implement at home or school.

***Final Assessment Idea***

Have students draw or create their own pictograph showing one way to practice each of the 4Rs at home or school. In groups, have them present their pictographs, and the group members can choose which of the 4Rs each pictograph represents.

## Extensions:

Have students interview family members about ways they practice the 4Rs at home. Have students record their family's waste reduction behaviors and identify other ways to reduce waste at home.

## 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** | **Life Science**<br>2.a. Students know plants are the primary source of matter and energy entering most food chains.<br>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.<br>2.c. Students know decomposers, including many fungi, insects and micro-organisms, recycle matter from dead plants and animals.<br>3.a. Students know ecosystems can be characterized by their living and nonliving components. |
| **Grade 5** | **Physical Science**<br>1.c. Students know metals have properties in common, such as high electrical and thermal conductivity. Some metals, such as aluminum (Al), iron (Fe), nickel (Ni), copper (Cu), silver (Ag) and gold (Au), are pure elements; others such as steel and brass are composed of a combination of elemental metals.<br>1.h. Students know living organisms and most materials are composed of just a few elements. |

# Teacher

# Kids Doing the 4Rs 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 |
|---|---|---|---|---|
| **Define and explain the need for the 4Rs** | Student is able to define and explain the need for each of the 4Rs. | Student can define but is not able to explain the need for each of the 4Rs. | Student is able to define two of the 4Rs and explain the need. | Student is not able to define any of the 4Rs. |
| **Give examples of each of the 4Rs** | Student is able to provide more than two examples of each of the 4Rs. | Student is able to provide two examples for each of the 4Rs. | Student is not able to provide two examples for each of the 4Rs. | Student is not able to provide any examples of the 4Rs. |
| | | | | |
| | | | | |

# 4Rs Pictographs




# Student

# 4Rs Pictographs

**Directions: Cut out and write the name next to each pictograph.**

Student

# Kids Doing the 4Rs

1. List two examples of how to "Reduce":

a. _____

b. _____

2. List two examples of how to "Reuse":

a. _____

b. _____

3. List two examples of how to "Recycle":

a. _____

b. _____

4. List two examples of how to "Rot (compost)":

a. _____

b. _____

5. Explain why it is important to practice the 4Rs:

_____

_____

6. Explain why "Reduce" is placed at the top of the 4Rs hierarchy:

_____

_____

_____

Name:_____ Date:_____

## DEFINITIONS

### Vocabulary:

***Compost:*** the process or end result of living organisms digesting and reducing organic material into a dark, rich, soil amendment.

***Conserve:*** to protect something from harm or destruction.

***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 such as compost bins.

***Hierarchy:*** a ranking system according to relative importance.

***Pictograph:*** a picture or symbol showing an idea.

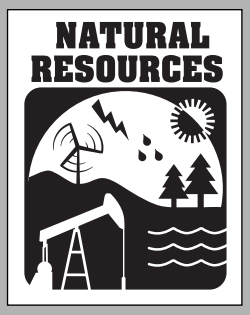
***Recycle:*** the process of producing new products from used material or the process of remanufacturing used materials into new products. Some used materials can be made into new items of the same thing. Others are made into entirely new items.

***Reduce:*** use less "stuff" and produce less waste.

***Reuse:*** extending the life of an item by reusing it again as it is or creating a new use for it.

***Rot:*** to decompose.

# Highest and Best Use of Resources


**OBJECTIVES:**

Students will:

1. explain the 4Rs hierarchy.
2. classify ten items that were destined for the garbage, recycling or compost bin into the 4Rs hierarchy.
3. construct a graph to explain the results of categorizing items that were destined for the garbage, recycling, or compost bin.
4. convert data into fractions and percentages.

**STANDARDS:** Science and Mathematics

**SKILLS:** Analysis, classification, construction, description, problem solving

**SETTING:** Classroom

**TIME:** 50 minutes

**VOCABULARY:**
Garbage
Hierarchy
Litter
Organic
Waste prevention

## Introduction

***Overview:***

In this lesson, students will learn about the 4Rs hierarchy (Reduce, Reuse, Recycle, Rot/Compost) by bringing in waste items from home that they will classify into groups according to the 4Rs hierarchy. They will justify why they placed each item into its category in writing and report their findings to the class.

### Teacher Background:

The 4Rs are placed in a hierarchy: Reduce, Reuse, Recycle and Rot/Compost. The most important practice is to reduce waste by not creating waste in the first place. Reuse is next in the hierarchy because if an item is reused, resources are not required to produce the same item again. Recycle is next in the hierarchy since this extends the life of existing resources by turning old materials into new products. Composting is a human-controlled way of recycling food and yard waste into fertilizer for plants.

See "Teacher Background," Lesson 3, for more on the 4Rs hierarchy.

### Materials:

***Students:***

- ❑ Three to four items from home that were destined for the garbage, recycling, or composting bin
- ❑ "Group Predictions" worksheet (one per student)
- ❑ "Highest and Best Use of Resources" worksheet (one per student)

***Teacher:***

- ❑ Bags (one per group of four)
- ❑ Items to supplement what the students bring to class so that each group will have ten items (and at least two from each of the 4Rs categories)
- ❑ "Group Predictions" worksheet overhead
- ❑ "Waste Characterization of Alameda County" overhead (garbage can with percentages can be found in Lesson 2)
- ❑ 4Rs pictographs (found in Lesson 3)
- ❑ Rubric overhead
- ❑ Rubrics (one per student)

### Preparation:

The in-class activity will need to be done two days after the initial in-class discussion because you will need to see what kind of items to bring into class to supplement what the students bring from home.

## ACTIVITY

***Discussion***

1. Ask the students what the 4Rs are and whether one is more important to practice than another. Guide the students toward putting the 4Rs in the correct hierarchy (order) and explain what a hierarchy is. (You can have student volunteers post the 4Rs pictographs in its hierarchy.)

2. Discuss Reduce choices. (What we need, how much we use, etc.).

3. Discuss with the students that many items of waste need not be discarded in landfills. Some items may be reused for the same or different purpose; other items can be recycled. Gardens can be greatly improved by using compost as a natural fertilizer to amend the soil. Compost is made by decomposing organic materials.

4. Discuss why it's important to practice the 4Rs (conservation of natural resources).

5. Show an overhead of the lesson rubric and review the expectations for this lesson.

***Procedure***

*For Homework:*

1. Have students bring three or four items from home that were destined for the garbage, recycling or compost bin to class. Remind students that the items should be cleaned or rinsed.

*In-Class:*

2. Organize the students into groups of four. Give each group a bag with at least ten waste items (at least two from each category; you may need to supplement the bag with additional items). Hand out the student worksheet "Group Predictions." Have the group quickly estimate what percentage of their items can be reduced, reused, recycled, composted or placed in a landfill and record their predictions on the student worksheet.

3. Explain that the goal is to classify the items according to the 4Rs hierarchy. This means making the best choice for each item even though there may be more than one choice. Review the definitions of reduce, reuse, recycle and rot/compost.

4. Put up the overhead of the student worksheet "Highest and Best Use of Resources," and model how to complete it. Pass out one worksheet per student, and have them fill it out.

5. In groups, ask students to compare their predictions to the data they have collected. Have the groups discuss why their predictions and results were similar or not.

6. On the back of their worksheet, assign each student to justify in a paragraph why each of the items were placed in that category. Model or scaffold how to write this paragraph, if necessary, to the class.

Sample scaffold:

We placed _____ in the **reduce** category because _____.

_____ were in the **reuse** category because _____.

_____ were in the **recycle** category because _____.

_____were in the **rot/compost** category because _____.

_____ were in the **landfill** category because _____.

***Wrap-Up***

1. As a class, call on volunteers from groups to discuss and report their findings. Ask the class to agree or disagree with a few examples by putting their thumbs up if they agree or thumbs down if they disagree with the group's choice. If there is disagreement, discuss the best use of the item (reduce, reuse, recycle, rot/compost).

2. Put up the overhead "Waste Disposal in Alameda County" (from Lesson 2). Lead a class discussion regarding ways to decrease (keep waste out of the landfill) the waste that's currently generated in Alameda County. Ask the students whether they think it's important to try to reduce the amount of waste we make and if so, why. If necessary, lead a class discussion about the importance of conserving natural resources by practicing the 4Rs hierarchy.

***Final Assessment Ideas***

Have the students create a comic strip showing a character demonstrating different ways to practice the 4Rs. For example, a person buying bananas at the grocery store and choosing not to bag the bananas would demonstrate the concept of reduce. The comic strip should include four frames, one for each of the 4Rs, and they should be placed in the correct hierarchy.

## Extensions:

Empty the contents of the classroom garbage can onto the floor, and have students classify the items according to the 4Rs hierarchy. Brainstorm ways to reduce the amount of items by practicing the 4Rs in class. If there is a lot of scrap paper, create a scrap paper bin for the classroom that can be used for art projects, etc.

Have groups discuss any items that could not be reused, recycled or composted. Ask them to share what these items are made out of or what natural resources are needed to produce the item. Discuss the value of these natural resources. Brainstorm ways to save resources by buying differently and making choices that help reduce waste.

## 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** | **Investigation and Experimentation**<br>6.e. Students will construct and interpret graphs from measurements. |
| **Grade 5** | **Investigation and Experimentation**<br>6.a. Students will classify objects (e.g. rocks, plants, leaves) in accordance with appropriate criteria. |
| **MATHEMATICS** | **CONTENT STANDARDS** |
| **Grade 4** | **Mathematical Reasoning**<br>2.3. Students will use a variety of methods, such as words, numbers, symbols, charts, graphs, tables, diagrams and models, to explain mathematical reasoning. |
| **Grade 5** | **Mathematical Reasoning**<br>2.3. Students will use a variety of methods, such as words, numbers, symbols, charts, graphs, tables, diagrams and models, to explain mathematical reasoning. |

# Teacher

# Highest and Best Use of Resources 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 |
|---|---|---|---|---|
| **Graph** | Graph is completely accurate and labeled. | Graph is generally accurate and labeled. | Graph is mostly inaccurate and occasionally labeled. | Graph was not attempted. |
| **Classification and justification** | All items are justifiably in the appropriate 4Rs category. | Most of the items are justifiably in the appropriate 4Rs category. | Some of the items are justifiably in the appropriate 4Rs category. | None of the items are justifiably in the appropriate 4Rs category. |
| **Mathematical reasoning** | All of the data was correctly converted into fractions and percentages. | Most of the data was correctly converted into fractions and percentages. | Some of the data was correctly converted into fractions and percentages. | None of the data was correctly converted into fractions and percentages. |
| | | | | |
| | | | | |

# Group Predictions

**Directions: Look at your bag of items and estimate/predict the percentage of items that will fit into the following categories:**

Percent of items that can be **reduced**_____%

Percent of items that can be **recycled** _____%

Percent of items that can be **reused** _____%

Percent of items that can be **composted** _____%

**List: Group each item into one of the five categories listed below.**
**Write the name of each item in a blank space with a number.**

| REDUCE | REUSE | RECYCLE | ROT/COMPOST | LANDFILL |
|---|---|---|---|---|
| 1. | 1. | 1. | 1. | 1. |
| 2. | 2. | 2. | 2. | 2. |
| 3. | 3. | 3. | 3. | 3. |
| 4. | 4. | 4. | 4. | 4. |

**Bar Graph: Write the name of each item from the table above in one of the blank spaces below. Using your pencil, shade in each used space to see a bar graph.**

| | | | | | |
|---|---|---|---|---|---|
| 4 | | | | | |
| 3 | | | | | |
| 2 | | | | | |
| 1 | | | | | |
| | REDUCE | REUSE | RECYCLE | ROT/COMPOST | LANDFILL |

**Conclusions: As a group, convert the data above into fractions and percentages.**

| | Fraction (# of items in category) ÷ (total # of items) | Percentage |
|---|---|---|
| REDUCE | ÷ | % |
| REUSE | ÷ | % |
| RECYCLE | ÷ | % |
| ROT/COMPOST | ÷ | % |
| LANDFILL | ÷ | % |

Name:_____ Date:_____

Student

# Highest and Best Use of Resources

**Directions: Justify why you placed each item into its category by completing the paragraph below:**

We placed_____ in the **reduce** category because_____

_____.

_____were in the **reuse** category because_____

_____.

_____were in the **recycle** category because_____

_____.

_____were in the **rot/compost** category because_____

_____.

_____were in the **landfill** category because_____

_____.

Name:_____ Date:_____

## DEFINITIONS

### Vocabulary:

***Garbage:*** things that people throw away.

***Hierarchy:*** a ranking system according to relative importance.

***Litter:*** waste materials that are carelessly discarded or put in the wrong place.

***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.

***Waste prevention:*** not making so much waste in the first place.

# Pack It Up


**OBJECTIVES:**

Students will:

1. define "reduce" and describe at least three ways to reduce unnecessary packaging.
2. analyze different types of packaging found at home.

**STANDARDS:** Science

**SKILLS:** Analysis, classification, description, problem solving

**SETTING:** Homework assignment and Classroom

**TIME:** Day One: 45 minutes
Day Two: 60 minutes

**VOCABULARY:**
Packaging
Reduce

## Introduction

***Overview:***

In this lesson, students will learn how to reduce packaging waste by comparing products that have minimal or excessive packaging. Students will bring in examples of packaging from home and work in groups to create a poster depicting ways to reduce waste from packaging.

### Teacher Background:

Packaging serves a number of purposes. It is used to hold or contain a product such as bottles, bags, and molded plastic or paper packaging. Packaging also protects products from damage, prevents theft and makes it easier to display or transport products.

Making packaging consumes a great deal of resources. Paper, steel, glass, aluminum, and plastic are all used to package products. Californians produce 66 million tons of solid waste per year and approximately one-third of it is packaging.[1] Ten cents of every dollar spent on a product goes towards the cost of packaging. Reducing the need for packaging can greatly reduce the amount of paper and plastic waste in Alameda County.
We can reduce waste from packaging by purchasing products that have the least amount of packaging (e.g., not purchasing single-serve packages).


### Materials:

***Students:***

- ❑ "Pack It Up Homework" sheet (one per student)
- ❑ One or two packages from home
- ❑ "Pack It Up" worksheet (one per group of four students)
- ❑ Poster paper and markers or crayons

***Teacher:***

- ❑ Contrasting packaged items (i.e., single-serve juice containers and a large juice jug and an overpackaged item toy)
- ❑ "Pack It Up Homework" sheet overhead
- ❑ "Pack It Up" worksheet overhead
- ❑ Rubric overhead
- ❑ Rubrics (one per student)

### Preparation:

Be prepared to divide the class into groups of four for the in-class activity. Assign students to bring in packaging from home as homework the day before the lesson.

1 California Integrated Waste Management Board's website www.ciwmb.ca.gov/Packaging/

## ACTIVITY

***Discussion***

1. Tell the students that they will be learning about the top of the 4Rs hierarchy. Ask students whether they can define "reduce." Put a definition on the board, e.g., "to decrease the amount of waste generated."

2. Ask the students what they know about packaging. Ask them to share examples of something they buy that comes in packaging.

3. Describe how packaging protects products, conveys important information about the product and prevents theft. For example, a CD case protects the CD from being broken and provides a place to display information and to insert anti-theft devices.

4. Show the students contrasting packaged items, e.g., a single-serve juice container and a large juice jug. Ask the students what is left over from the single-serve juice pack after the juice has been consumed (the juice packaging and the plastic straw and plastic wrapper on the straw).

5. Ask the students what would be left over if they used reusable cups for everyone to get juice from a large juice jug. Disposing of one large juice jug requires fewer resources than discarding dozens of small juice packages and straws. Show other examples of excessive packaging that you brought to class.

***Procedure***

*For Homework:*

1. Ask students to share examples of packaged items they might find at home. For example, in the kitchen they might find cereal, snack food, chips, and ice cream. Other items may include gum wrappers, shoe boxes, containers for toys, etc.

2. Have a few students estimate how many of these items come in bulky or unnecessary packaging.

3. Assign students to bring two items to class from home that they think have minimal or excessive packaging for the next day's in-class work.

4. Distribute the "Pack It Up Homework" sheet, and model how to complete it using an overhead.

5. Show an overhead of the lesson rubric, and review the expectations for this lesson.

*In-Class:*

1. As a whole class, discuss some of the findings from their homework sheet.

2. Ask students how their estimates of minimal or bulky packaging they might find at home compare to their findings on the homework sheet.

3. Place students in groups of four, and give each group a copy of the "Pack It Up" worksheet.

4. Show the overhead of the group worksheet and model how to complete it. Ask the students to place their packaging items from home in one pile. Redistribute packaging as necessary.

5. In groups, have students share the packages they brought in and have them identify ways to reduce the packaging, if it's possible. For example, toys are usually sold in unnecessary packaging. Cereal can often be bought in bulk or large boxes. Soup can be made at home from fresh vegetables, water and seasoning. Lunch food can be placed in reusable plastic containers. Bananas and apples don't need to be put into plastic bags before they are purchased.

6. Have each group share with the entire class one item they chose with ways to reduce its packaging.

7. Have each student make a poster that says and depicts one way of reducing packaging. On the back of the poster, have the students list two more ways of reducing the need for packaging.

***Wrap-Up***

Write the word "reduce" on the board. Ask the students to help write a definition for "reduce." Ask the students why "reduce" is at the top of the hierarchy. (By generating less waste in the first place, we are conserving natural resources, e.g., trees used for paper packages, petroleum used for plastic, etc.).

***Final Assessment Idea***

Provide students with three types of packaging choices for a product, e.g., orange juice in a 58oz. plastic jug, gallon paper carton and six pack of individual containers. Have students write an essay explaining which packaging has the least amount of waste and which choice they would buy, justifying why they would choose to buy it.

## Extensions:

Have students calculate the cost per serving for the products used in the assessment section.

Have students choose a product they like that they think comes in excessive packaging. Have them describe, in writing, how they would redesign the packaging to reduce waste. They must design packaging that protects the product and makes it easy to store and transport the product.

Have students research how a particular product's packaging has changed or been reduced over time using the Internet. For example, the weight of aluminum cans has decreased by 52 percent since 1972; twenty-nine cans can be made from a pound of aluminum, up from twenty-two cans in 1972.[2] The EPA's website has fact sheets for common commodities or materials listed at www.epa.gov/epaoswer/non-hw/muncpl/comm.htm.

## 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** | **Investigation and Experimentation**<br>5.a. Students know some changes in the Earth are due to slow processes.<br>6.a. Students will differentiate observation from inference (interpretation) and know scientist's explanations come partly from what they observe and partly from how they interpret their observations. |
| **Grade 5** | **Investigation and Experimentation**<br>6.a. Students will classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria. |

2 Aluminum Association website www.aluminum.org

# Teacher

# Pack It Up 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 |
|---|---|---|---|---|
| **Homework: Brings in packaging from home and describes it** | Student describes the packaging for five items and brings to class two examples of packaging. | Student describes the packaging for four items and brings to class one example of packaging. | Student describes the packaging for at least two items and brings to class one example of packaging. | Student describes the packaging for at least one item and does not bring to class an example of packaging. |
| **Group work: Writes ways to reduce packaging** | Students write three ways to reduce packaging. | Students write two ways to reduce packaging. | Students write one way to reduce packaging. | Students do not attempt assignment. |
| | | | | |
| | | | | |

# Pack It Up Homework

**Directions: Describe packaging of five different items from home.**

| Name of item | Describe packaging | Is this packaging needed? | Why is this packaging used? |
|---|---|---|---|
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |

Write a definition of Reduce: _____

_____

_____

Name: _____ Date: _____

# Student

# Pack It Up

**Directions: Select five of the items that the group members brought from home, and answer the questions below for each item.**

| Name of item | Does this item come in unnecessary packaging ? Yes or No | If yes, how would you REDUCE this item's packaging? |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |

**Poster Directions: Make a poster that says and shows one way to reduce packaging. On the back of the poster, list two more ways to reduce the need for packaging.**

Name:_____ Date:_____

## DEFINITIONS

### Vocabulary:

***Packaging:*** a container or wrapping such as paper, plastic, metal, etc., used to protect, transport, display or store a product.

***Reduce:*** to use less "stuff" and produce less waste.

# Use Less Stuff


**OBJECTIVES:**

Students will:
1. define "reduce" and describe at least three ways to decrease the use of paper items.
2. form a hypothesis and collect data using a survey to support or refute their hypothesis.

**STANDARDS:** Science

**SKILLS:** Analysis, classification, description, problem solving

**SETTING:** Homework assignment and Classroom

**TIME:** 60 minutes over two days

**VOCABULARY:** Reduce

## Introduction

***Overview:***
In this lesson, students will bring in paper waste items from home. They will work in groups to brainstorm ways to reduce the amount of paper they use by describing alternative materials that can be used in place of paper products.

### Teacher Background:

In 2000, paper accounted for 23 percent of waste by weight generated in Alameda County that ends up in the landfill. When paper is thrown away, many resources required to produce the paper including wood, pulp, water and energy are lost. Trees are one of the many natural resources harvested to make paper. In the United States, we produce one-quarter of the world's paper and consume almost 30 percent of forestry products including paper. Americans alone used an average of 718 pounds of paper products in the year 2000.[1]

The process for making paper utilizes other resources besides trees. The manufacturing process requires oil, electricity, coal and water. Many chemicals such as chlorine are often used in the bleaching process. Recycling paper reduces the use of these resources and reduces pollution; however, recycled paper fibers break down over time, so eventually new trees must be harvested and added to the paper production process.

### Materials:

***Students:***
- ❑ "Use Less Stuff Homework" sheet (one per student)
- ❑ "Paper Savers Class Survey" worksheet (one per student)

***Teacher:***
- ❑ "Use Less Stuff Homework" sheet overhead
- ❑ "Paper Savers Class Survey" worksheet overhead
- ❑ Poster paper (one sheet per group of five students)
- ❑ Rubric overhead
- ❑ Rubrics (one per student)

### Preparation:

Assign students to complete the homework activity the day before the lesson. Be prepared to divide the class into groups of five.

1 American Forest and Paper Association's article "Forest Health" at www.afandpa.org/Content/NavigationMenu/Forestry/Forestry_Facts_and_Figures/forest_health.pdf

## ACTIVITY

***Discussion***

1. Tell the students they will be learning about the top of the 4Rs hierarchy: Reduce. Ask whether they can define "reduce" (to decrease the amount of waste generated). Put the definition on the board.

2. Tell the students that paper makes up 23 percent of what we find in the landfill. Ask the students what they know about paper and how it is made. What is it made from? What other resources are required to make paper? Ask students to share their answers with the class.

3. Tell the students they will be learning about ways to reduce the amount of paper they use at home and school.

***Procedure***

*For Homework:*

1. Put up the overhead of the "Use Less Stuff Homework" sheet.

2. Tell students that for homework, they will identify five different paper items that are discarded in the family garbage. Ask students to give some examples (paper plates, paper cups, newspaper, sheets of paper in a letter, paper towels). They will fill out only the first column "Name of paper item" on their homework sheet.

3. Post the overhead of the rubric and review with the class the expectations for this lesson.

4. Pass out the "Use Less Stuff Homework" sheet to each student.

*In-Class:*

1. Put students in groups of four to share their lists of items and try to identify ways to use less paper or replace the use of the paper items with another more durable item. (For example, ceramic plates can replace paper plates and can be washed for reuse. Paper towels can be replaced by cloth towels that are washed for reuse. Newspapers can be replaced by obtaining the news on TV or on a computer. Paper that has writing on one side can be saved for reuse on the backside. When using a computer, print only the section that is needed; do not print the entire document.)

2. Now that the students have analyzed their paper use at home, they will examine how paper is used in the classroom by conducting a survey to determine whether paper use is reduced or conserved in the classroom.

3. Ask students to think about how paper is used in the classroom. Do they think their class makes an effort to reduce the amount of paper used? Explain that they will form a hypothesis which, is a testable scientific guess, about whether students use less paper or conserve paper in their classroom based on their own knowledge and observations of how classmates use paper.

4. Ask each student to write a hypothesis on scratch paper describing whether they think their class uses paper wisely. For example, "I think my class conserves paper because I often see students using both sides of a piece of paper before recycling it" or "I think paper is wasted in the classroom."

5. Ask the students to share ideas about how they will find the answer to their hypothesis.

6. Explain that each student will investigate the paper-using habits of a classmate in order to answer their hypotheses. They will conduct a survey to gather data, which will support or refute their hypotheses.

7. Organize students into pairs and pass out a "Paper Savers Class Survey" to each student. Have the students interview each other and complete the survey.

8. Collect the surveys and record the class results on the "Paper Savers Class Survey" overhead.

***Wrap-Up***

1. Once you have recorded all the class data on the overhead, organize the students into groups of five and give each group a copy of one survey question and the class results.

2. Have each group create a graph that shows their survey results on a large piece of paper. Then have each group present their graph and explain the results to the class.

3. Once all the groups have presented their results, have the students come back together as a class and decide whether the poster results support or refute their hypothesis. Ask students to describe why they came to this conclusion.

4. Ask students to come up with solutions for how they can reduce paper use in the classroom or share ways they are currently using less paper.

5. Record their ideas on a poster that can be placed on a wall in the classroom.

***Final Assessment Idea***

Ask students to explain why reduce is placed at the top of the 4Rs hierarchy and share at least one way they will reduce the amount of paper they use at home or school.

## Extensions:

Assign students to research types of paper that they can recycle in their community using the *Alameda County Recycling Guide*.

## 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** | **Investigation and Experimentation**<br>6.a. Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations. |
| **Grade 5** | **Investigation and Experimentation**<br>6.h. Students will draw conclusions based on scientific evidence and indicate whether further information is needed to support a specific conclusion. |

# Use Less Stuff 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 |
|---|---|---|---|---|
| **Homework** | Student identifies five different paper items. | Student identifies four different paper items. | Student identifies three different paper items. | Student identifies two different paper items. |
| **Group Work** | Students provide five different ideas for reducing the paper items. | Students provide four different ideas for reducing the paper items. | Students provide three different ideas for reducing the paper items. | Students provide two different ideas for reducing the paper items. |
| **Generate Hypothesis** | Student clearly states a hypothesis. | Student attempts to write a hypothesis. | Student has difficulty writing a hypothesis. | Student does not write a hypothesis. |
| | | | | |
| | | | | |

# Teacher

# Paper Savers Class Survey

**Directions: Record the class data below.**

1. I recycle paper after I am done using it.
   How many students answered:

   almost always _____**total** sometimes_____**total** never_____**total**

2. When I take my lunch to school, I use a lunch box that I can reuse instead of using a paper bag.
   How many students answered:

   almost always _____**total** sometimes_____**total** never_____**total**

3. I use both sides of a piece of paper before recycling it.
   How many students answered:

   almost always _____**total** sometimes_____**total** never_____**total**

4. I print lots of stuff from the Internet that I later throw away.
   How many students answered:

   almost always _____**total** sometimes_____**total** never_____**total**

5. I often grab more paper towels than I end up using after washing my hands in the restroom.
   How many students answered:

   almost always _____**total** sometimes_____**total** never_____**total**

# Paper Savers Class Survey

**Directions: Read the statements below to your partner and circle their answers.**

1. I recycle paper after I am done using it.

   almost always _____ sometimes_____ never_____

2. When I take my lunch to school, I use a lunch box that I can reuse instead of using a paper bag. How many students answered:

   almost always _____ sometimes_____ never_____

3. I use both sides of a piece of paper before recycling it.

   almost always _____ sometimes_____ never_____

4. I print lots of stuff from the Internet that I later throw away.

   almost always _____ sometimes_____ never_____

5. I often grab more paper towels than I end up using after washing my hands in the restroom.

   almost always _____ sometimes_____ never_____

Name:_____ Date:_____

# Student

# Use Less Stuff Homework

**Directions:**
**Homework: Identify up to five paper items that are thrown away at home. Describe how each paper item is used.**

**Group Work: Identify ways to use less paper or replace the paper item with something more durable.**

| Name of paper item | Use of paper item | How could you reduce the use of this paper item? |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |

Name:_____ Date:_____

## DEFINITIONS

### Vocabulary:

***Reduce:*** to use less "stuff" and produce less waste.

# The Art of Saving Birds


**OBJECTIVES:**

Students will:
1. reuse discarded items to create a model of a bird.
2. explain how reducing waste conserves natural resources and wildlife habitat.

**STANDARDS:** Science

**SKILLS:** Analysis, classification, construction, description, problem solving

**SETTING:** Classroom or multiuse space

**TIME:** 120 minutes over two days

**VOCABULARY:**
Carnivores
Conserve
Ecosystem
Endangered
Food chain
Food web
Habitat
Herbivores
Omnivores
Reduce
Reuse
Species
Threatened

## Introduction

***Overview:***
In this lesson, students will learn about how their waste can impact habitat for plants and animals. Working in groups, they will create a model of a bird species by reusing materials brought from home. Students will discover how the practice of reducing waste saves natural resources, which can also conserve habitat for wildlife.

### Teacher Background:

The items we use every day originate from natural resources. For example, trees are harvested for wood to make paper, water bottles are made from petroleum or fossil fuels, the food we eat comes from plants, and metal cans are made from minerals. Many of these natural resources, such as trees, water used during the manufacturing process, or the land where oil and minerals are mined, provide habitat for wildlife. The process of extracting natural resources, manufacturing and transporting products, and landfilling waste can reduce or impact habitat for wildlife. For example, displaced garbage or litter can remain in the environment for many years. During the process of making products, pollutants can be released into the environment. In order to manage the disposal of waste materials, landfills have been developed in areas that once provided homes to plants and animals.

To protect wildlife and natural areas, we can take steps to reduce our impact on the environment. The practice of reducing waste helps to conserve natural resources by keeping items out of landfills. By using less stuff, we conserve natural resources. By participating in community clean-up days, providing habitat for wildlife at home or school, reusing when possible, and purchasing products with minimal or recycled packaging, we can do our part to protect wildlife and natural areas.

### Materials:

***Students:***
- ❑ "Creating a Bird Project Directions" (one per student)
- ❑ "Our Created Bird worksheet " (one per student)
- ❑ "Bird Information Pages" (one bird per group)
- ❑ Bird books with pictures (Peterson's Western Field Guide), Internet bird sites, other references
- ❑ Waste materials that are reused, such as paper, cardboard, cotton wads, corks, bottle caps, toothpicks, chopsticks, string, pieces of cloth
- ❑ Classroom art materials such as tape, crayons, paper clips, rubber bands, glue, etc. (one set for for each group)
- ❑ Poster paper and marker pens (one set for each group)

***Teacher:***
- ❑ "Creating a Bird Project Directions" overhead
- ❑ Poster example (and bird example if available)
- ❑ Rubric overhead
- ❑ Rubrics (one per student)

### Preparation:

Be prepared to place students in groups of two or three.

Save materials collected from other lessons in the guide for students to use in making models of birds.

Look in the teacher workroom or art cabinet for colorful scraps of materials such feathers, beads, etc.

## ACTIVITY

***Discussion***

1. Ask the students where they think their classroom garbage goes once it leaves the school? How many people, vehicles or other equipment are required to manage the things we no longer need? (List their ideas on the board.)

2. Have the students consider what they would do with their garbage at home if the garbage company suddenly stopped picking it up? Would you try to reduce the amount of garbage you make? How? What would your neighborhood look like if there was nowhere to send garbage away?

3. Have the students think about the place where their garbage goes. Describe your local landfill in terms of size and location. For example: 2,170 acres of land have been set aside in the hills of Livermore for the Altamont Landfill.
   An acre is about the size of one football field. So far, 470 acres are used for waste disposal, and approximately 1,300 acres are currently being managed to provide habitat for wildlife species. Ask the students what will happen to the numbers above if we continue to produce waste.

4. What natural resource is required to site a landfill for our waste disposal (land)? (Describe the ecosystem your landfill is in. For example: Our landfill is in rolling foothills in a dry grassland ecosystem.) Ask them to close their eyes and imagine what the land might have looked like before a landfill was built. Were there creeks, hills or valleys? Was the land flat? How much rain do you think this ecosystem gets? What kinds of habitat does it have?

5. Explain that there are many species of wildlife and plants that live in the ecosystems where our landfill is located. What kind of plants and animals would you expect to see? Show pictures of different birds and other animals that live in the ecosystem. Possible birds include: Western Burrowing Owl, Golden Eagle, Northern Harrier, White-tailed Kite, Ferruginous Hawk, Prairie Falcon, Loggerhead Shrike. Possible animals include mice, moles, rabbits, fox, and coyote.

6. Which of these animals and birds are herbivores (eating plants)? Which are carnivores (eating meat)? Are there any omnivores that eat both plants and animals in this ecosystem? What do you think a food web for these animals might look like (who eats what)? (List birds and animals in columns and then connect food web with arrows.)

7. Ask students to describe what these plants and animals need in order to survive in their habitat (space, shelter, food, water, etc.). How does the garbage you throw away have an impact on the land? For example, what happens to the grass? Does that affect rabbits? If there are fewer rabbits, does that affect any other animals in our food web? What if a bird nests or hunts in the grasslands? Can these animals survive here if their habitat is altered, for example by the conditions found at a landfill?

8. Explain that habitat is also removed when we make new things. The overharvesting of forests in the United States to address the demand for lumber and paper has reduced the habitat available for all kinds of animals, including the spotted owl. The spotted owl is endangered because it builds its nest only in old-growth forests.

9. Have the students think of ways that we could use less and create less waste to conserve habitat for wildlife? (Write ideas on board. List might include use both sides of paper, don't break pencils, buy things with less packaging, reuse, and recycle.)

10. Explain that the students will be working on a project that will reduce their waste so they can save habitat for wildlife and learn about birds that might live near our landfill at the same time.

*(continued on next page)*

***Procedure***

1. Explain the three steps to the group project. We're going to divide into groups and each group will 1) conduct research on a particular bird, 2) make a model of your bird with reused materials, and 3) present your research and model to the class in a poster session.

2. Tell the students that they will be given handouts, will use the Internet, or bird books to answer the questions on "Our Created Bird" worksheet. Post the overhead of the student worksheet "Creating a Bird Project Directions." Review the instructions, read one of the 11 "Bird Information Pages" and discuss how to use the information to fill in the worksheet. For example, Western Burrowing Owls are commonly found in grassland areas. They rely on burrows dug by burrowing mammals for their nests. This species eats insects, rodents, amphibians or small birds, and they are often seen perching or standing by their burrow. Western Burrowing Owls are threatened primarily by habitat loss, eradication of ground squirrels or other burrowing rodents and agricultural practices. After you've answered the questions about your bird, try to think of three ways that you could reduce waste and conserve habitat for your bird.

3. Describe some of the items students will be reusing to create their birds. This could be a variety of materials including cotton wads, corks, cardboard or toilet paper rolls, etc. Ask students to show any items they have brought from home for reuse. You can use tape, string, paper clips, glue, or rubber bands to hold your model together. When you're done, write down the materials you reused and kept out of the landfill on your worksheet.

4. Describe how the groups will make a poster of their research findings. Show the overhead of poster directions. Use the table on the directions page to guide your poster design. Put information about habitat in one square, information on the food chain in another, information on endangered status, and how the landfill might affect your bird and what you can do about it in another square.

5. Show an example of a poster and a bird model if possible. Put up the overhead for the rubric and review with the class the expectations of this lesson.

6. Place the students in groups of three. Hand out a copy of the instructions and student worksheet to each student and one bird information card for each group. Distribute the materials for the activity to each group. Each group will research and create a model and poster for a different bird species that might be found in habitat near the landfill.

7. Have each group present their bird with its story to the class. After the presentations, the students may keep their artwork or reuse the items for another project.

***Wrap-Up***

1. Allow the groups to ask questions or give feedback to other groups about their bird stories.

2. Have the groups explain how reducing waste conserves natural resources and habitat for wildlife. Summarize: Reducing our use of new materials reduces impacts to ecosystems that provide raw materials and impacts to ecosystems used for landfill sites. Make a list of ideas for reducing waste to conserve habitats including.

***Final Assessment Idea***

Look at learning evident in oral reports and collect individual worksheets. After the lesson, have students write three ways that reducing waste conserves natural resources and habitat for wildlife.

## Extensions:

Have students create a habitat diorama for their bird reusing materials to show where their bird lived.

Create a classroom book about how reducing waste protects wildlife and habitat. In pairs or groups, have students research how a particular waste item affects wildlife or impacts habitat using the school library or the Internet. Students can reuse materials to create their story pages. Compile all of the group stories into a classroom book to share with other classes.

## 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 | **Life Science**<br>2.a. Students know plants are the primary source of matter and energy entering most food chains.<br>2.b. Students know producers and consumers make up food chains and food webs, competing for resources in ecosystems (herbivores, carnivores, omnivores, and decomposers).<br><br>3.a. Students know ecosystems can be characterized by their living and nonliving components.<br>3.b. Students know that in any particular environment, some kinds of plants and animals survive well, some survive less well and some cannot survive at all. |

# Teacher

# The Art of Saving Birds 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 |
|---|---|---|---|---|
| **Group reports** | Every question was answered in the group report. | Most questions were answered in the group report. | Few of the questions were answered in the group report. | None of the questions were answered in the group report. |
| **Group work** | Group composed a creative model of a bird. | Group composed a model of a bird. | Group is unable to compose a complete model of a bird. | Group does not participate in the activity. |
| | | | | |
| | | | | |

# Creating a Bird Project Directions

**Task 1: Research**

1. Read about your bird on the information sheet.

2. Conduct research about your bird using your handout, the Internet, field guides or books from the library, to answer the questions on your worksheet:
   a. What is the common and scientific name?
   b. What type of habitat does it live in?
   c. Where is the habitat located?
   d. What does it eat?
   e. Is it threatened or endangered?
   f. Why it is threatened or endangered?

3. Record three ideas for how you could reduce waste in order to conserve habitat for birds.

**Task 2: Build a Model Bird**

1. Construct a model of the bird by reusing scrap materials.
2. Record the materials you used to construct your bird on your worksheet.

**Task 3: Make a Poster with Your Research Information**

Make a poster using the information on your worksheet to present to class:

| **Yellow-Tailed Pipsqueak**<br>***Elanus Sulfurous*** | |
|---|---|
| **Where It Lives** | **What It Eats** |
| **Status Information** | **Landfill Impacts & Ideas for Reducing** |

Name:_____ Date:_____

# Student

# Our Created Bird

Common name of bird: _____

Scientific name of bird: _____

Habitat and location: _____

What does it eat? _____

_____

Is it threatened or endangered? _____

_____

Why it is threatened or endangered? _____

_____

_____

_____

Three ways to reduce waste and conserve habitat for birds:

1. _____

2. _____

3. _____

What materials were reused to construct it? _____

_____

This bird was created by: _____

_____

_____

_____

Name: _____ Date: _____

# Bird Information Pages

**Common name: Swainson's Hawk**
**Scientific name:** *Buteo swainsoni*

**Habitat:** foothill grasslands or valleys near creeks

**Food:** voles, birds, and insects

**Status-reason:** There has been a 90% decline in the population of Swainson's Hawks in California since the year 1990. The main causes of the population decline are loss of habitat due to commercial development and loss of food sources due to changes in nearby agricultural land and pesticide use.

Swainson's Hawks migrate south in the fall and winter to find warmer weather. Frequently they migrate in large groups, sometimes into the thousands. Some travel to Mexico, and some go as far south to Argentina. They return to California in the spring to build their nests in tall trees near creeks and open fields, which are home to their prey. Swainson's Hawks have amazing eyesight and hunt during the day. While hunting they fly close to the ground and can even be seen chasing after insects. Other times they sit high on their perch waiting to spot small animals like rodents or even frogs and small snakes.

**Common name: Willow Flycatcher**
**Scientific name:** *Empidonax traillii*

**Habitat:** swampy thickets, upland pastures, abandoned orchards

**Food:** insects and berries

**Status-reason:** Endangered and declining. The number of flycatchers is declining due to habitat loss along creeks and because of disturbances in their breeding areas from cattle grazing.

Willow Flycatchers migrate south in the fall and winter and return to California in the spring to build their nests in small bushes or grasses near creeks. Male flycatchers sing to protect their hunting territory during mating season. They catch flying insects by making short quick flights from their perches.

**Common name: Western Burrowing Owl**
**Scientific name:** *Athene cunicularia hypugea*

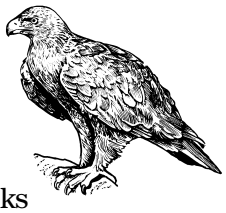
**Habitat:** open grasslands

**Food:** insects, rodents, fish

**Status-reason:** California Species of Special Concern and Federally—due to loss of habitat.

The Western Burrowing Owl is one of the smallest species of owls, being only nine inches long. It lives in underground burrows usually made by other animals that have abandoned their homes. Unlike most owls, which are nocturnal, the Western Burrowing Owl is diurnal meaning that it is active during both the day and night. Dusk and dawn are its most active times of day when it hunts prey using its almost silent flight to sneak up on insects, rodents, reptiles, and amphibians. The burrowing owl is one of the more visible species of owls because it is diurnal and spends much of its time standing or perching near its nest.

**Common name: Golden Eagle**
**Scientific name:** *Aquila chrysaetos*



**Habitat:** open grass lands, oak savanna

**Food:** rodents, rabbits, snakes, skunks

**Status-reason:** California Species of Special Concern and is fully protected—due to loss of habitat and hunting (even though it is against the law to kill these birds).

The Golden Eagle is a great hunter, reaching speeds of 240 to 320 km/h when diving to catch its prey. Though the Golden Eagle is very skilled at hunting, when there is a low food supply, it must migrate to an area with more food. The Golden Eagle begins mating typically at four years of age, and most eagles mate with the same partner for life, which is uncommon for most birds. Though the Golden Eagle can be found across northern areas of the U.S., the densest population of Golden Eagles can be found in Livermore, CA, near the Altamont Landfill.

# Student

# Bird Information Pages

**Common name: Northern Harrier**
**Scientific name:** *Circus cyaneus*

**Habitat:** grasslands and wetlands

**Food:** small mammals, birds, reptiles, insects

**Status-reason:** California Species of Special Concern—due to loss of habitat, prey, and nesting areas

The Northern Harrier flies slow and low to the ground until it hears its prey and plunges down to catch it. It's sense of hearing is better than most hawks due to the disk shape of its face, which is similar to owls and amplifies sounds. The Northern Harrier builds its nest on the ground. Because it is such a good hunter, one male frequently has two to three female mates that he cares for by providing food and protection during mating season.

**Common name: White-tailed Kite**
**Scientific name:** *Elanus leucurus*

**Habitat:** open grasslands and wetlands

**Food:** rodents, small birds

**Status-reason:** They are fully protected due to near extinction in 1930s because of loss of habitat, hunting, and egg poaching. Today their numbers are greater but loss of habitat and changes in farming that affect their prey is a concern.

The White-tailed Kite is not a migratory bird but moves around a lot, leaving areas with a shrinking food supply to find better areas for hunting. The kite got its name due to its unique style of hunting called "kitting" where it flaps its wings in such a way that it remains in the same spot up in the sky as though it is standing in place. It then dives down attacking its prey when it deems ready. Outside of mating season, kites live in groups up to one hundred birds though smaller groups of about five are more common. Frequently kite communities hunt in the same general area together, but do not attack a specific prey item as a team.

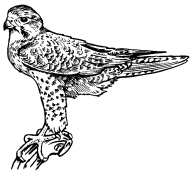
**Common name: Ferruginous Hawk**
**Scientific name:** *Buteo regalis*

**Habitat:** prairies, bushy open country, grasslands

**Food:** ground squirrels and rodents

**Status-reason:** Federal Non-game Migratory Bird Species of Management Concern; California Species of Special Concern—due to loss of habitat

Ferruginous Hawks have a rare adaptation that makes it possible for them to live in colder climates; feathers that go down their legs, which is uncommon in most birds and makes it look as though they are wearing leg warmers. They migrate to the Bay Area in the winter months, whereas many other birds fly much farther south to warmer climates. While here, they are solitary birds, allowing more area for hunting prey. Most commonly they attack prey from the ground or a low perch.



**Common name: Prairie Falcon**
**Scientific name:** *Falco mexicanus*

**Habitat:** barren mountains, dry plains, and prairies

**Food:** ground squirrels, birds, reptiles, insects

**Status-reason:** State and federally protected—due to rodent-poisoning programs

The Prairie Falcon is a skillful flyer. It uses this to its advantage while hunting. It flies high and characteristically swoops down on its mammal prey. It has also been known to catch birds, even some of the fastest fliers, by chasing them through the sky and dive bombing them to the grounds where it kills them.

# Bird Information Pages

**Common name: Loggerhead Shrike**
**Scientific name:** *Lanius ludovicianus*

**Habitat:** grasslands and orchards

**Food:** insects, small birds or mice

**Status-reason:** Population declining—due to loss of habitat and use of pesticides and herbicides among farmers.

The Loggerhead Shrike kills prey whenever it can and keeps excess food by sticking it on thorns, barbed wire, or another spiky object to eat later. The bird was previously named "Butcher Bird" because of this practice. Though it is like a butcher with its prey, the bird is fairly small, 8-10" and has a dark grey head with a black tale and wings.

**Common name: American Robin**
**Scientific name:** *Turdus migratorius*

**Habitat:** towns, gardens, woodlands, agricultural lands

**Food:** earthworms, berries, fruit, insects

**Status-reason:** Protected by U.S. migratory bird act but are in no danger of becoming extinct.

You may have seen the American Robin hunting for its lunch on your school lawn or in your backyard. It stands very still with its head tilted to one side waiting until it sees its prey, which is usually an earthworm, and then catches it. The bird's bright red-orange chest, contrasting with its white underbelly, brown back, and black head makes it easier to recognize. Currently the robin is a protected bird under the U.S. Migratory Bird Protection Act but previously they were hunted in southern states and their meat was considered a delicacy.

**Common name: Anna's Hummingbird**
**Scientific name:** *Calypte anna*

**Habitat:** chaparral, brushy oak woodlands, and gardens

**Food:** nectar and small nectar-feeding insects

**Status-reason:** Expanding habitat range because of increase in suburban gardens and feeders making it possible for them to find food in a wider range of areas.

Hummingbirds have three adaptations that make it possible for them to eat nectar from flowers and sap from trees: their long narrow bills, long tongues, and their ability to hover in front of their food source. All species of hummingbirds aggressively defend their eating territory even if they have had enough to eat, which on some days can equal half the amount of their body weight. Female hummingbirds mark eating territory with the movement of their tail, which signals to the other birds not to eat in that area. Male hummingbirds protect their area with loud buzzing and swooping, flying displays. During the spring, juvenile or newborn hummingbirds are not yet familiar with these displays and intrude on feeding territory, which is why you may see many hummingbirds at your feeder from July to late fall. Hummingbirds are also unique because they are the only bird that has adapted to fly both backwards and forwards.

## DEFINITIONS

### Vocabulary:

***Carnivores:*** animals that eat other animals.

***Conserve:*** to protect something from harm or destruction.

***Ecosystem:*** the interacting system of a biological community and its nonliving environment; also, the place where interactions occur.

***Endangered:*** a species that is in danger of extinction in the foreseeable future.

***Extinct:*** a species or subspecies that no longer exists in living form.

***Food chain:*** the sequence of one organism eating another organism. An example of a food chain is the following: green plants (using sunlight to grow) are eaten by sheep, which are eaten by wolves, which die and are eaten by decomposers that free fertilizing material into the soil that are needed by the plants to grow.

***Food web:*** many food chains that are interconnected.

***Habitat:*** the place where an organism normally lives and thrives.

***Herbivores:*** animals that eat plants.

***Omnivores:*** animals that eat both plants and animals.

***Reduce:*** use less "stuff" and produce less waste.

***Reuse:*** extending the life of an item by reusing it again as it is or creating a new use for it.

***Species:*** a group of plants or animals that have common characteristics.

***Threatened:*** a plant or animal species that is likely to become endangered in the near future.



# Reduce: Where Do You Stand?


**OBJECTIVES:**

Students will:

1. express their values about reducing waste.
2. describe whether their values about reducing waste changed because of discussions with other students.
3. understand and apply the term "evidence."

**STANDARDS:** Science

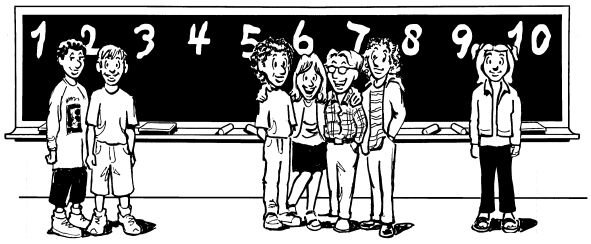
**SKILLS:** Analysis, description, problem solving, critical thinking

**SETTING:** Classroom

**TIME:** 60 minutes

**VOCABULARY:**
Evidence
Opinion
Reduce
Value

## Introduction




***Overview:***

In this lesson, students will practice critical-thinking skills while examining their own values related to reducing waste and the consumption of resources. Students will have the opportunity to express their own values and opinions about different waste reduction statements. Then they will share their opinions about the waste reduction statements with other students in small groups and explore how their values may differ from others.

### Teacher Background:

People express a wide variety of opinions, values and behaviors related to the environment. Values represent how a person rates the usefulness or importance of a principle or ideal. Values provide the foundation for beliefs that drive decision making and behavior. People can also value material objects for their worth. Producing these objects requires the use of natural resources, which can be classified as renewable or non-renewable. Consumption of some of these resources may eventually lead to either the loss or the near loss of these resources within the current century.

Students can develop the ability to think critically and carefully about their values, can develop their own opinions, and can learn to convey and justify their thoughts in order to make decisions based on their values. During the decision-making process, students may attempt to locate additional evidence that may support their opinions on topics such as reducing waste. Through this process students can discuss their values with others and be exposed to values and opinions that differ from their own. By looking at both sides of an issue, students can learn the importance of respecting the values and opinions of others.

### Materials:

***Students:***

- ❑ "Value Statements" & "Fast Facts" (one per student)
- ❑ "Student Reflection" worksheet (one per student)

***Teacher:***

- ❑ "Value Statements" & "Fast Facts" overhead
- ❑ Rubic overhead
- ❑ Rubics (one per student)

### Preparation:

Be prepared to assign the students into five groups.

Each group will be assigned to one of five different value statements.

## ACTIVITY

***Discussion***

1. Ask students to think about different ways that people dispose of waste materials; some may help reduce waste, and others may not. For example, some people are very careful—before they throw something away, they consider whether it can be reused, recycled, or composted. They use recycling and compost bins and produce very little waste. Other people do not recycle much and sometimes even contribute to litter by throwing waste on the ground or out of a car window.

2. Ask students to share some examples of things that people might throw away that could be of value to someone else.

3. Define the word "value": "the quality of an object that makes it desired or wanted." If we value something like a material object, we will sometimes pay or do much to get it. A value may also be defined as "the beliefs of an individual or social group that guide how decisions are made." For example, a school may have a recycling club made up of students who believe that recycling is important. The students participating have the common goal of reducing waste at school through recycling.

4. Ask students to name something that they value. Explain that this can be an object, belief or principle. Share some examples as needed to start the discussion.

5. You may want to specifically discuss examples of principles or beliefs that people value so that students understand the difference between valuing material things and beliefs or principles. For example, Cesar Chavez fought for the rights of migrant farm workers who experienced unsafe working conditions and low wages, and Dr. Martin Luther King Jr. sought equal protection for citizens of all races during the Civil Rights Movement.

6. Explain that people may base their values on factual information or evidence; e.g., some people choose to bring a cloth bag to the store when shopping instead of using a paper bag. They may have read research showing that paper makes up 23% of the waste from Alameda County that ends up in the landfill. The practice of using a cloth bag shows that they value the resources needed to make a paper bag by reducing the amount of paper they use.

7. It is important for students to be able to justify their values and to answer questions about their values based on factual evidence.

***Procedure:***

1. Organize the students into five groups.

2. Pass out a "Value Statements" card to each student in the group. There are five versions of the value statement cards so each group will have different statements. For example, all students in group one will have a card titled "Group One."

3. Post up the overhead for one of the group value statements, and model for the students how to fill it out. For each statement have them circle a number. A "10" signifies that you strongly agree with the statement. A "1" signifies that you strongly disagree with the statement.

4. Next, ask the students to answer the questions below each statement that ask them to cite factual evidence to support their opinions. Factual information is located on the back of their value statement cards.

5. When the students are done filling out the card, ask them to take turns sharing their opinions about the value statements, citing evidence to support their opinions.

6. Ask each group to share one or two value statements they discussed with the entire class, citing examples of how their opinions were similar or different.

7. Have the students return to their seats.

8. Pass out the "Student Reflection" worksheet to each student and have them answer the questions.

***Wrap-Up***

1. Ask students to raise their hands if any of their values changed after talking with a partner who had a different value. Ask for students to share what evidence persuaded or influenced them to change their values.

2. Ask students whether there were any value statements they had difficulty agreeing or disagreeing with. What additional evidence or factual information would have helped them better understand the waste reduction value statement?

***Final Assessment Idea***

Have students write their own value statements about reducing waste. Ask them to cite evidence supporting their beliefs, where they located the information, and whether they have additional questions they would like to research.

## Extensions:

Have the students create several value statements about reducing waste. Then assign students to conduct a survey of other student's opinions of the value statements from another class or their family and report their results as a percentage of students or family members that chose or rated the value statement the same as them.

## 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** | **Investigation and Experimentation**<br>6.c. Students will formulate and justify predictions based on cause-and-effect relationships. |
| **Grade 5** | **Investigation and Experimentation**<br>6.b. Students will develop a testable question.<br>6.h. Students will draw conclusions based on scientific evidence and indicate whether further information is needed to support a specific conclusion. |

# Teacher

# Reduce: Where Do You Stand? 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 |
|---|---|---|---|---|
| **Expresses personal opinions** | Student participates in activity and presents. | Student has difficulty participating in the activity. | Student is unable to present opinions. | Student fails to participate in the activity. |
| **Describes how values changed or why they did not change** | Student writes how their values changed or did not change because of discussions with other students. | Student has difficulty in writing how their values changed or did not change because of discussions with other students. | Student is unable to write how their values changed or did not change because of discussions with other students. | Student fails to do the activity. |
| **Provides evidence that supports a waste reduction value statement** | Student provides specific evidence that supports one of their opinions about reducing waste. | Student has difficulty providing specific evidence that supports one of their opinions about reducing waste. | Student is unable to provide specific evidence that supports one of their opinions about reducing waste. | Student fails to do the assignment |
| | | | | |
| | | | | |

# Value Statements Page 1

**GROUP ONE**

**Directions: Read each statement and the fast facts about the statement on the back of the card and circle the number that reflects your thoughts or opinion about the statement.**

1. It is better to ask for a plastic bag than a paper bag when I'm shopping at the store.

   *strongly disagree* **1 2 3 4 5 6 7 8 9 10** *strongly agree*

   Explain why you agree or disagree with the statement by citing evidence to support your opinion.

2. It is my responsibility to put litter in a garbage can.

   *strongly disagree* **1 2 3 4 5 6 7 8 9 10** *strongly agree*

   Explain why you agree or disagree with the statement by citing evidence to support your opinion.

**GROUP TWO**

**Directions: Read each statement and the fast facts about the statement on the back of the card and circle the number that reflects your thoughts or opinion about the statement.**

1. Using less stuff is important because things are made from natural resources.

   *strongly disagree* **1 2 3 4 5 6 7 8 9 10** *strongly agree*

   Explain why you agree or disagree with the statement by citing evidence to support your opinion.

2. Many things we buy come with too much packaging.

   *strongly disagree* **1 2 3 4 5 6 7 8 9 10** *strongly agree*

   Explain why you agree or disagree with the statement by citing evidence to support your opinion.

# Student

# Value Statement Fast Facts Page 1

**GROUP ONE**

**Directions: Use the fast facts below to cite evidence that supports your opinion about each value statement.**

1. **Fast Facts**
- Plastic bags are mistaken by many marine animals, especially sea turtles, for food.
- Paper bags hold five to six times the amount that plastic bags hold.
- Californians use more than 19 billion plastic bags each year (about 552 bags per person). Discarded plastic bags create 147,000 tons of waste that end up in the state's landfills each year and are enough to circle the Earth more than 250 times.
- Using a reusable canvas bag decreases the amount of bags used, which in turn shrinks the amount of waste going to our landfills.

2. **Fast Facts**
- Almost 80% of marine debris comes from litter left on the ground. Most of the litter gets to the ocean when it is washed down storm drains, into streams, and empties into the ocean.
- Based on research conducted from 2003-2005 at 26 different sites in the Bay Area, an average of 2.93 pieces of trash were found for every square foot of stream.
- California spends more than $300 million every year just on litter cleanup.

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**GROUP TWO**

**Directions: Use the fast facts below to cite evidence that supports your opinion about each value statement.**

1. **Fast Facts**
- It takes over one ton of natural resources to make one ton of glass. This includes 1,300 pounds of sand, 410 pounds of soda ash, 380 pounds of limestone, and 160 pounds of feldspar.
- In the state of California alone we use more than 19 billion plastic bags a year. It takes more than one million barrels of oil, or 4,000 barrels a day, to make these bags. Oil is a nonrenewable resource.
- Every ton of steel that is recycled prevents 2,500 pounds of iron ore, 1,400 pounds of coal, and 120 pounds of limestone from being used.
- For every aluminum can that is recycled instead of being created from bauxite, enough energy is saved to watch three hours of television.

2. **Fast Facts**
- On average 60% to 80% of total marine debris is plastic garbage. Single-use disposable products, packaging, and bags make up a large part of the plastic marine pollution.
- Californians throw away 66 million tons of solid waste and about one third of that comes from packaging.
- Ten percent of the average grocery bill pays for packaging.

# Value Statements Page 2

**GROUP THREE**

**Directions: Read each statement and the fast facts about the statement on the back of the card and circle the number that reflects your thoughts or opinion about the statement.**

1. The commercials I see influence me to buy certain products.

   *strongly disagree* **1 2 3 4 5 6 7 8 9 10** *strongly agree*

   Explain why you agree or disagree with the statement by citing evidence to support your opinion.

   _____

   _____

2. It is okay to throw things away that could be reused, recycled or composted because they will go to a landfill.

   *strongly disagree* **1 2 3 4 5 6 7 8 9 10** *strongly agree*

   Explain why you agree or disagree with the statement by citing evidence to support your opinion.

   _____

   _____

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**GROUP FOUR**

**Directions: Read each statement and the fast facts about the statement on the back of the card and circle the number that reflects your thoughts or opinion about the statement.**

1. It is cool to fix up things like bikes and skateboards instead of always buying new stuff.

   *strongly disagree* **1 2 3 4 5 6 7 8 9 10** *strongly agree*

   Explain why you agree or disagree with the statement by citing evidence to support your opinion.

   _____

   _____

2. I should use the backside of a piece of paper to do my math calculations.

   *strongly disagree* **1 2 3 4 5 6 7 8 9 10** *strongly agree*

   Explain why you agree or disagree with the statement by citing evidence to support your opinion.

   _____

   _____

Student

# Value Statement Fast Facts Page 2

**GROUP THREE**

**Directions: Use the fast facts below to cite evidence that supports your opinion about each value statement.**

1. **Fast Facts**
- The average American receives 41 pounds of junk mail, or advertisements through the mail each year.
- Half of parents believe that the food they buy and the restaurants they go to are strongly influenced by their children's desires.

2. **Fast Facts**
- Over one million pounds of food is thrown away in Alameda County every single day.
- In California, during 2003, food was the number-one thing thrown away by residents, making up 17.3% of waste disposed in landfills.
- When paper is made from used paper instead of timber, it uses half the energy and produces 75% less air pollution.
- Making new aluminum products out of old aluminum cans uses 95% less energy than it takes to make new aluminum out of bauxite.

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**GROUP FOUR**

**Directions: Use the fast facts below to cite evidence that supports your opinion about each value statement.**

1. **Fast Facts**
- Wood is the most common material used to make skateboard decks, the part skaters stand on. Skateboard trucks, which hold the deck to the wheels, are usually made of aluminum or other metals (steel, brass, or another alloy). Skateboard wheels are made of polyurethane (a synthetic rubber polymer). All of the parts come from natural resources.

2. **Fast Facts**
- California school districts create approximately 763,817 tons of waste per year.
- It takes 17 trees to make one ton of paper.
- The average American uses 749 pounds of paper and paper products each year.

Name:_____ Date:_____

# Value Statements Page 3

**GROUP FIVE**

**Directions: Read each statement and the fast facts about the statement on the back of the card and circle the number that reflects your thoughts or opinion about the statement.**

1. Students should buy several sets of school supplies at the beginning of the year, so they always have what they need.

   *strongly disagree* **1 2 3 4 5 6 7 8 9 10** *strongly agree*

   Explain why you agree or disagree with the statement by citing evidence to support your opinion.

   _____

   _____

2. It is okay to buy a new bottle of water each day because the bottles can be recycled.

   *strongly disagree* **1 2 3 4 5 6 7 8 9 10** *strongly agree*

   Explain why you agree or disagree with the statement by citing evidence to support your opinion.

   _____

   _____

Name:_____ Date:_____

Student

# Value Statement Fast Facts Page 3

**GROUP FIVE**

**Directions: Use the fast facts below to cite evidence that supports your opinion about each value statement.**

1. **Fast Facts**

- The main reason students need new pens and pencils is because they lose them, not because the ink has run out or the pencil has been sharpened away. Using a cloth pencil bag helps students keep track of their supplies, causing them to need less.
- Frequently students have leftover school supplies that can be used for the following year, such as binders, notebooks, and folders.

2. **Fast Facts**

- In 2002, 93 billion plastic water bottles went into landfills in the US. That is enough plastic bottles to reach the moon and back 38 times.
- One third of water consumed in the United States comes out of a container. This adds up to 45 million new plastic bottles of water consumed daily, with less than 10% of this total being recycled.
- Fourteen recycled plastic bottles create enough fiber to make an extra-large T-shirt.
- On average, each household in California throws away 34 pounds of plastic water and soda bottles each year.

Name:_____ Date:_____

# Student Reflection

**Directions: Describe which of your values changed after talking to a partner and what made you change the value. If your values remained the same, explain why.**

1. Did any of your values change after talking with a partner who had a different value?

2. Describe how and why your values changed or why they did not change.

3. Write one value statement about reducing waste using facts to support your statement or belief.

Name:_____ Date:_____

## DEFINITIONS

### Vocabulary:

***Evidence:*** facts that indicate whether something is true.

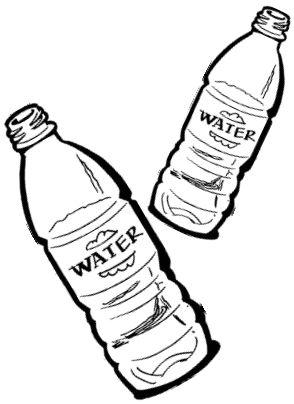
***Opinion:*** a person's thoughts or beliefs about something that may not be based on facts.

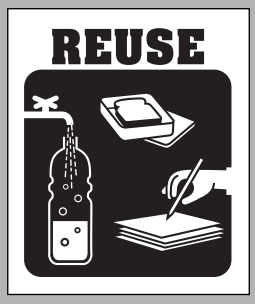
***Reduce:*** use less "stuff" and produce less waste.

***Value:*** the quality of an object that makes it desired or wanted; the beliefs of a person or social group; the fundamental beliefs or guiding principles that guide behavior and decision making.



# Reuse or Recycle: Which Comes First?




**OBJECTIVES:**

Students will:

1. compare the amount of energy and natural resources saved by reusing a plastic bottle before it is recycled.
2. discuss different energy sources and inputs required to manufacture and transport a plastic product.
3. list three benefits of reusing something before it is disposed of.

**STANDARDS:** Science

**SKILLS:** Analysis, classification, description, problem solving

**SETTING:** Classroom

**TIME:** 50 minutes

**VOCABULARY:**
Electricity
Energy
Manufacture
Recycle
Refine
Reuse

## Introduction

***Overview:***

In this lesson, students will explore the 4Rs hierarchy by looking at the benefits of reusing a plastic bottle before recycling it. They will work in pairs to identify the amount of energy required to manufacture a water bottle and compare the amount of energy necessary to manufacture, reuse or recycle a plastic bottle.

### Teacher Background:

Reuse and recycling are quite different, but are often considered the same practice. Recycling involves the process of taking a product, deconstructing it and using the materials in remanufacturing a new product. A product that gets recycled may not always get remanufactured into the same product again. Recycling products conserves the resources and energy used during the early parts of the manufacturing process; however, the process of remanufacturing recycled products still requires energy and resources. Reuse involves the process of taking a product or material in its current form and using it for the same or different purpose without changing its original form. The practice of reuse reduces solid waste, conserves even more nonrenewable resources, and reduces emissions such as carbon dioxide released during the manufacturing process. Reusing items also saves money and landfill space, creates local jobs and keeps resources in our local economy.

### Materials:

***Students:***

- ❑ "Energy of Making Plastic" worksheet

***Teacher:***

- ❑ "Making Plastic" overhead
- ❑ "Energy of Making Plastic" worksheet overhead
- ❑ "Energy of Making Plastic" worksheet answers
- ❑ Plastic soda or water bottle
- ❑ Rubric overhead
- ❑ Rubrics (one per student)

### Preparation:

Be prepared to put students into pairs for part of the activity.

## ACTIVITY

***Discussion***

1. Explain that many of the things we use everyday are made, or "manufactured," in factories using some kind of raw material. Ask the students what paper is manufactured from. Explain that the process of making things for people to use has several steps: Draw T-chart on board as shown below and fill in first column only:

| Manufacturing Steps | Manufacturing a Plastic Bottle |
|---|---|
| Collecting raw materials | *Drilling for oil* |
| Cleaning materials ("refining") | *Cleaning or refining the oil* |
| Making item | *Making oil into plastic, shaping plastic into bottles, filling bottles with a drink* |
| Packing | *Pack bottles into boxes* |
| Transporting to Store | *Transport to stores in trucks, trains, boats* |
| Selling to Customer | *Store sells bottles* |
| Use of Product | *Purchase bottle and use it* |

2. Explain another example of something that is manufactured such as a plastic bottle. Ask the students what the bottle is made from. Show a clear plastic bottle. Explain that plastic bottles are made from black, liquid oil that is pumped out of the ground. The atoms in the oil are rearranged and combined with other things during manufacture to make plastic: solid but a little flexible, fairly clear. Show the overhead: "Making Plastic." Complete the T-chart by writing down the steps to manufacturing a plastic bottle.

3. Ask students what they might do with a plastic bottle when they're finished drinking the contents? Record their answers on the board. Ask the students if they can think of ways to use the bottle again. Explain that there is an important step in the 4Rs hierarchy that comes before recycling: Reuse. When we reuse something, it is used for a new purpose. When we're finally done with it, we can still recycle the bottle. When the bottle gets recycled, it will go back to the manufacturing part of our process to get made into a new thing, instead of having to pump more oil and make more plastic. Refer to T-chart and draw a line labeled recycling connecting back into manufacturing from bottom.

4. Ask students to name items they often recycle but do not reuse. Write the names of these items on the board. Why do people use some things only once before recycling? Examine some of the reasons that people do not reuse items before recycling; i.e., convenience, durability, accessibility to purchasing a new item, cost, it can't be refilled, it's dirty, etc.

5. Ask students to define reuse (to use again) and write their definition on the board. Then ask them to define recycle (making something old into something new, the process of remanufacturing used materials into new products).

6. Tell the students that they will learn why reuse is so important and why it comes before recycling in the 4Rs hierarchy by looking at how much energy is saved by reusing a plastic bottle before it is recycled.

7. Post the overhead of the rubric, and review with the class the expectations for this lesson.

***Procedure***

1. Explain that if a bottle is reused to carry water or something else instead of buying a new one, we save natural resources and energy.

2. Ask the student to consider how much energy might be saved by reusing a bottle. Define energy: the capacity for doing work. Explain that energy is stored in food, batteries, and different fuels like gas. Energy is carried by electricity, waves of water or sound, and moving objects. Have the students discuss different ways that they use energy and identify where it comes from. Make a T-chart on the board with the titles below and ask students to complete the T-chart.

| Where we use energy | Where we get it |
|---|---|
| In our bodies | *Food* |
| Light our rooms | *Electricity* |
| To get around, cars and trucks | *Gas, electricity* |
| Cook food | *Gas, electricity* |
| Make things in factories | *Gas, oil, electricity* |

3. Ask the students to describe where is energy might be used to make a plastic bottle? Show the overhead "Energy of Making Plastic." Discuss and circle the different energy sources and inputs required to manufacture and transport a plastic product.

4. Have the students describe where is energy used if a plastic bottle is reused? Where is energy used if you buy a new bottle made from recycled plastic? Is the energy required to reuse a product different from the type of energy used to remanufacture a new product from recycled material? Discuss the differences.

5. Tell the students that they will work with a partner to compare the amount of energy required to make a new plastic bottle, reuse a bottle and recycle a bottle.

6. Assign the students to work in pairs. Hand out a worksheet "Energy of Making Plastic" to each pair of students. Model how to complete the worksheet.

(*continued on next page)*



## ACTIVITY – *continued*

***Wrap-Up***

1. Come back together as a class and discuss their findings with a series of questions, for example:
   - How many energy units are required to reuse a plastic bottle versus buying a new bottle made from recycled plastic?
   - If you reuse a plastic bottle before recycling it, how many energy units are you saving? (A bottle's worth of energy for each time you reuse it.)
   - Which action conserves more natural resources reusing or recycling?
   - Did anyone think of some other things that are saved when you reuse, besides energy?

   (Go back to the overhead "Making Plastic" to discuss other resource inputs and pollution outputs. An interesting fact to share is that local environmental scientists have figured out that it takes more water to make the bottle than a plastic water bottle actually contains for you to drink. The process of moving the materials and bottles around and manufacturing the bottles produces both air and water pollution. Time, money, and landfill space are other savings associated with reuse.)

2. Ask students to describe other things that people throw away that could be reused?

3. Explain when an item such as a plastic bottle is reused, all of the resources and energy required to make plastic and manufacture and transport a new bottle are conserved. Even if the new bottle was recycled, energy and resources are still required to transform the recycled plastic into a new product—so reuse before you recycle!

***Final Assessment Idea***

Have students write a paragraph describing why reuse is placed before recycling in the 4Rs hierarchy, citing at least three benefits of reusing something before it is recycled or thrown away. Have them describe one specific example of an item from home that can be reused before it is recycled.

## RESOURCES

### Extensions:

Have students contact their local utility company to find out how the electricity they use is generated (gas-fired power plants, wind power, hydroelectric, coal-fired or biomass power plants, geothermal power) and research the availability and impacts of these energy sources.

Research different types of energy used during the manufacturing process of a common product.

Compare the elements found in oil and the elements found in plastic and look at the different molecular structures that make these hydrocarbon molecules have such different properties. See the Reciprocal Net website for pictures of fuels and polymer compounds that can be manipulated on the computer screen to see the structure. http://www.reciprocalnet.org/edumodules/commonmolecules/material/index.html

### 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** | **Physical Science**<br>1.g. Students know electrical energy can be converted to heat, light, and motion. |
| **Grade 5** | **Physical Science**<br>1.a. Students know that during chemical reactions the atoms in the reactants rearrange to form products with different properties. |

# Teacher

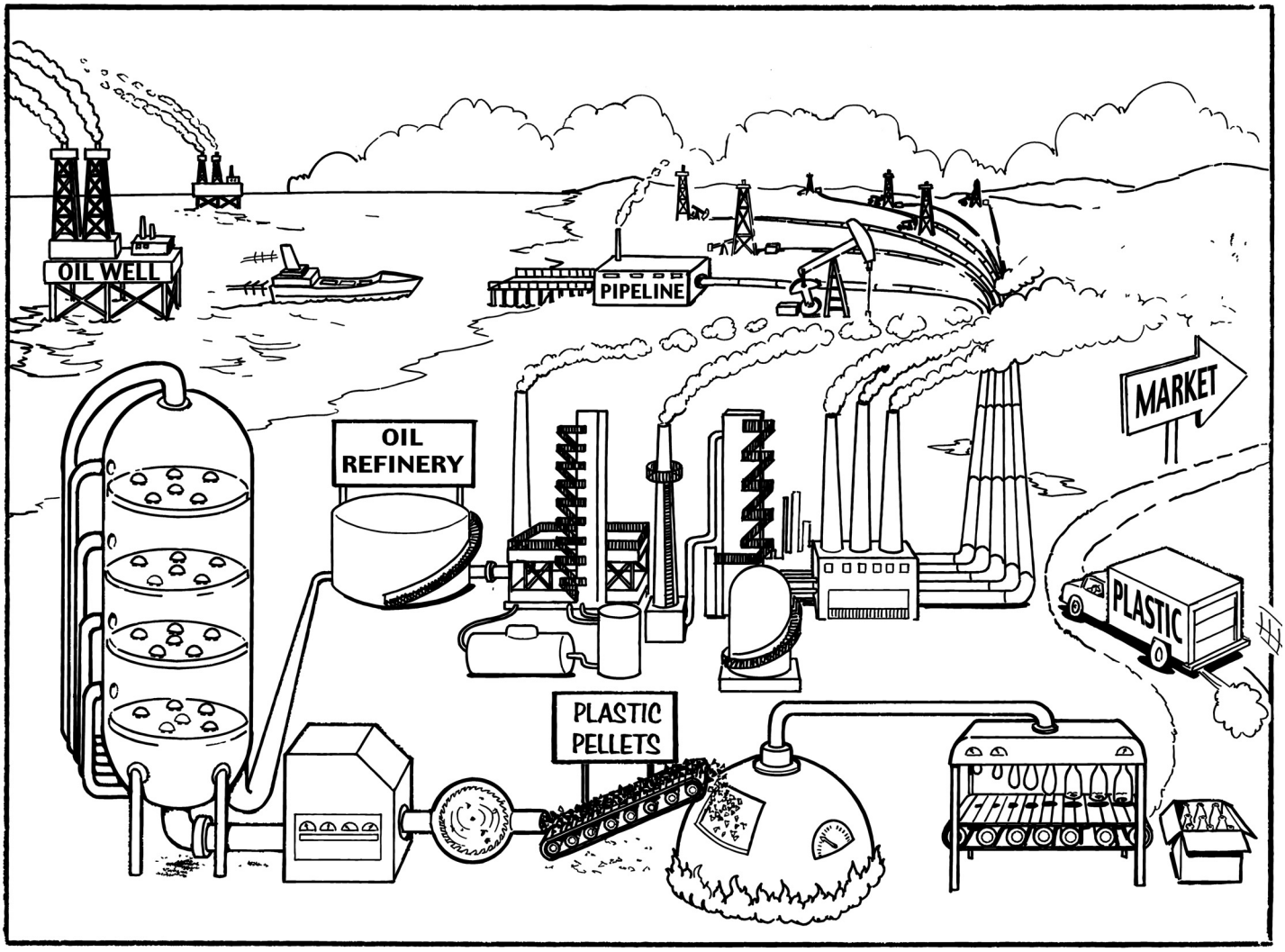
# Energy of Making Plastic Rubric

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 |
|---|---|---|---|---|
| **Identify different energy inputs required to manufacture, reuse or recycle a plastic bottle** | Student correctly identifies all the energy inputs. | Student identifies most of the energy inputs. | Student identifies some of the energy inputs. | Student does not complete the assignment. |
| **List three benefits of reusing a plastic bottle** | Student lists three detailed benefits of reusing a plastic bottle. | Student lists two benefits of reusing a plastic bottle. | Student lists one benefit of reusing a plastic bottle. | Student does not complete the assignment. |
| | | | | |
| | | | | |



# Making Plastic




Wells pump crude oil on land and deep beneath the ocean. Oil is shipped and transported to oil refineries. Oil is refined and turned into plastic pellets. Plastic pellets are melted and formed into plastic products. Plastic products are packaged and shipped or transported to stores that sell the products.

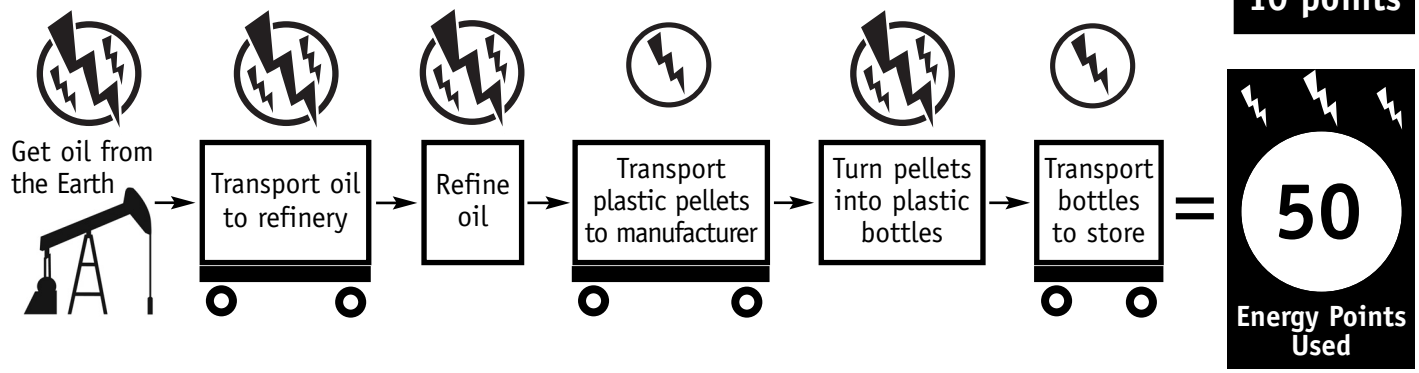
# Teacher

# Energy of Making Plastic



**Directions: Look at the diagrams below showing the difference between the manufacturing, reuse and recycling of a plastic bottle.**

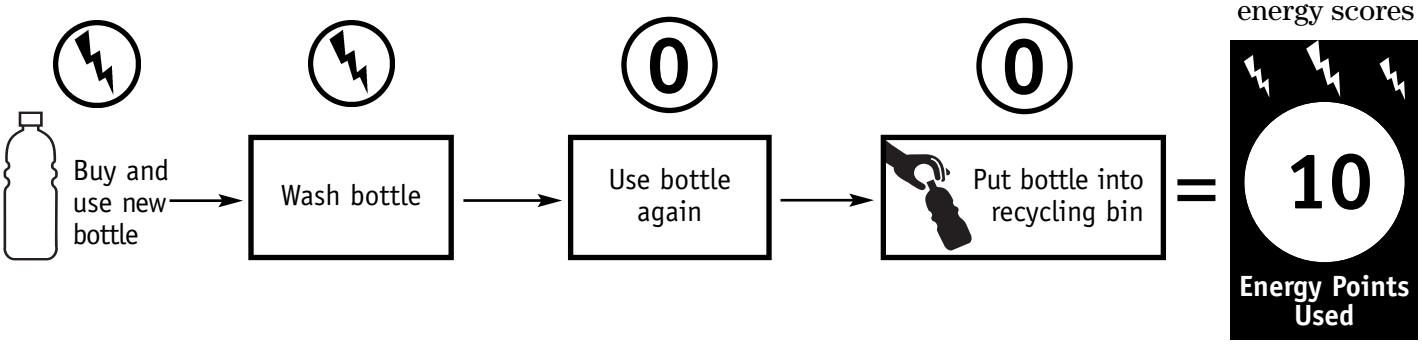
Energy required to **MANUFACTURE** a plastic bottle from natural resources:



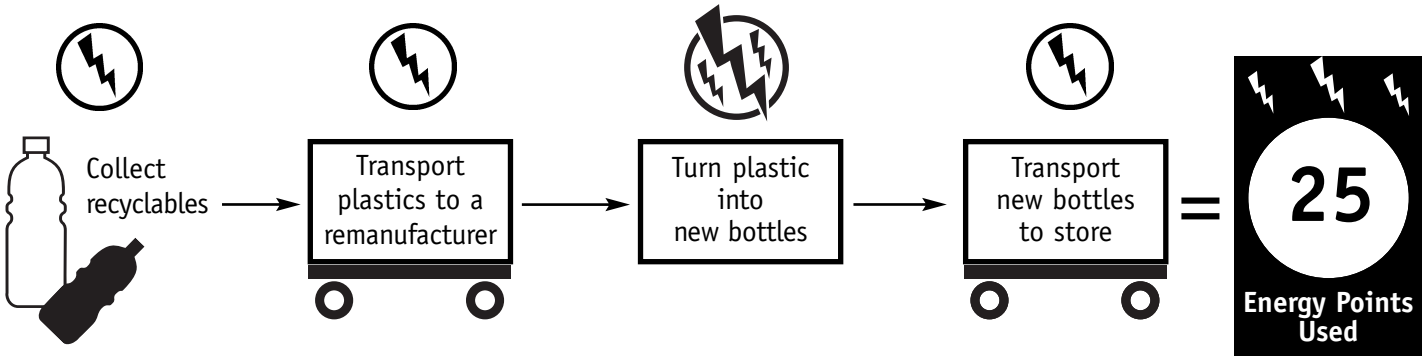

**For each diagram below, draw an energy symbol in the circle to show where energy is used during the reuse or recycling process of a plastic bottle.**

Energy required to **REUSE** a plastic bottle:

Compare your energy scores




Energy required to **RECYCLE** and **REMANUFACTURE** a new plastic bottle:





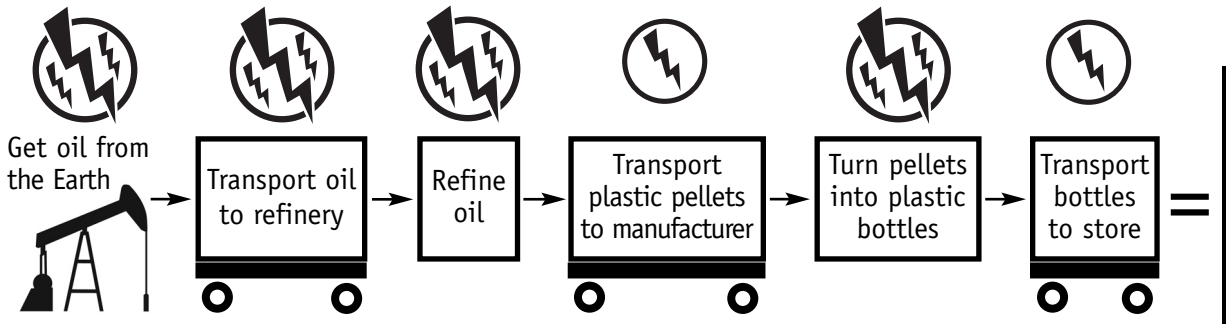

# Energy of Making Plastic

5 points

10 points

**Directions: Look at the diagrams below showing the difference between the manufacturing, reuse and recycling of a plastic bottle.**

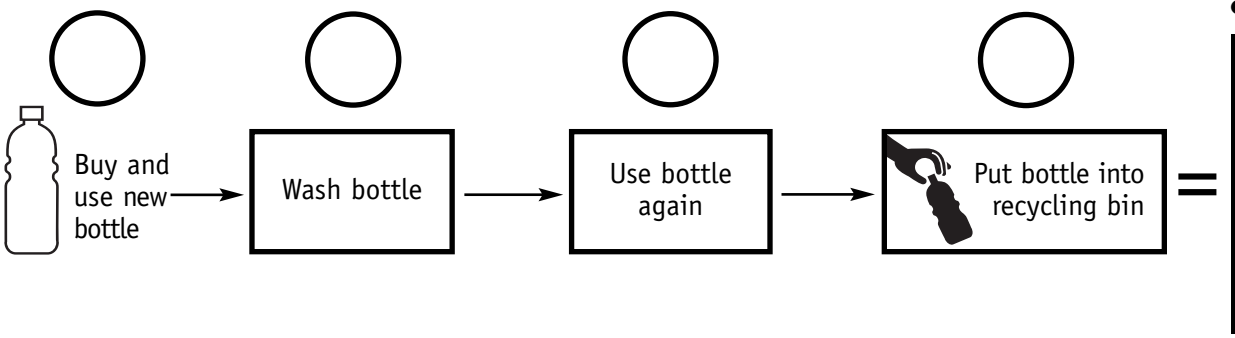
Energy required to **MANUFACTURE** a plastic bottle from natural resources:



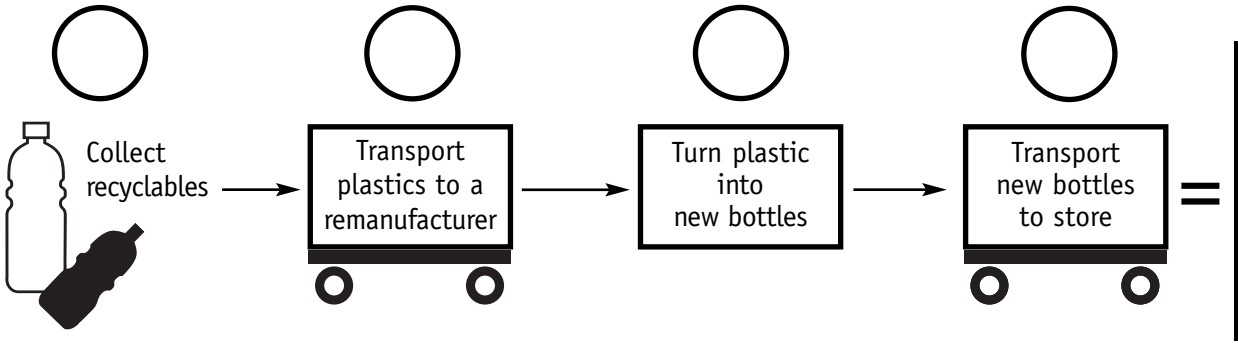

**For each diagram below, draw an energy symbol in the circle to show where energy is used during the reuse or recycling process of a plastic bottle.**

Energy required to **REUSE** a plastic bottle:

**Compare your energy scores**




Energy required to **RECYCLE** and **REMANUFACTURE** a new plastic bottle:




Name:_____ Date:_____

Student

# Energy of Making Plastic

1. Describe at least three ways that energy is used to make a plastic bottle.

2. Which practice conserves more natural resources and saves energy: **reuse** or **recycle**? Why?

3. Describe three benefits of reusing a product before recycling it.

Name:_____ Date:_____



## DEFINITIONS

### Vocabulary:

***Electricity:*** the electric current used or regarded as a source of power.

***Energy:*** the capacity for doing work. Forms of energy include thermal, mechanical, electrical, and chemical. Energy may be transformed from one form into another.

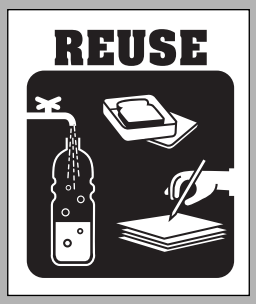
***Manufacture:*** to make or process a raw material into a finished product, usually by a large-scale industrial operation.

***Recycle:*** the process of producing new products from used material or the process of remanufacturing used materials into new products. Some used materials can be made into new items of the same thing. Others are made into entirely new items.

***Refine:*** the process of purification or transformation of a substance. Refining is often used with natural resources that are almost in a usable form but that are more useful in pure form. For example, most types of petroleum will burn straight from the ground but will burn poorly and quickly clog an engine with residues and byproducts.

***Reuse:*** extending the life of an item by reusing it again as it is or creating a new use for it.

# Reuse Choices




**OBJECTIVES:**

Students will:
1. make group decisions about different ways to reuse things.
2. list three ways to reuse at least three items.

**STANDARDS:** Science

**SKILLS:** Analysis, classification, description, problem solving

**SETTING:** Classroom

**TIME:** 40 minutes

**VOCABULARY:**
Recycling bin
Reuse

## Introduction


***Overview:***
In this lesson, students will participate in making group decisions for identifying the best choice among four alternatives for reusing items. The students will bring in items from home and list at least three ways to reuse each item.

### Teacher Background:

The products we use require many resources to produce. Compact disks have many components, including aluminum, gold, crude oil, natural gas, water, silver and nickel, among others. A lot of resources are needed to produce paper, with wood from trees, of course, being the main ingredient. One way to reduce the amount of resources we use is to reuse products.

Reuse is the second choice in the 4Rs hierarchy because the life of an item is extended. By reusing items instead of disposing of them, resources are conserved and landfill space is saved. Energy is also saved because it is not required to make a new product. The practice of reuse eliminates waste handling and disposal costs.

Students can develop the ability to think critically about choices they make that will help reduce waste. They can develop their own opinions and learn to convey and justify their thoughts in order to make decisions based on their values. During the decision-making process, students may attempt to locate additional information or evidence that may support their opinions on topics such as waste reduction.

### Materials:

***Students:***
- ❑ "Reuse Choice Cards" (one card per group of four students)
- ❑ "Reuse Choices" worksheet (one per student)

***Teacher:***
- ❑ Example of a "Reuse Choice Card" overhead
- ❑ "Reuse Choices" worksheet overhead
- ❑ Rubric overhead
- ❑ Rubrics (one per student)

### Preparation:

Be prepared to divide the students into groups of four and assign each student within the group to defend one solution (a, b, c, or d).

Make copies of the reuse choice cards and cut them out so each group has one card.

Blank cards have also been provided for students to create their own reuse choice cards.

## ACTIVITY

***Discussion***

1. Have the students describe choices that they make every day such as selecting food, choosing which games to play, picking who will be their friends, etc. Help them to recognize that there may be long-term consequences to many of their choices.

2. Ask students what they could choose to do with a piece of paper after writing on one side (write/draw on the backside, make a paper airplane, put it in the recycling bin, throw it away, etc.).

3. Ask the students to explain how they arrived at that particular choice. Explain that we often make decisions based on evidence that supports our opinions about different topics.

4. Ask students whether they can define "reuse" (extending the life of items by using them again as they are or creating new uses for them). Help the students recognize that there are long-term consequences to their choice of reusing, recycling or throwing away things like paper. Reusing helps extend the life of items by using them again, and it conserves natural resources.

***Procedure***

1. Tell the students that they will be divided into groups of four and given reuse choice cards.

2. Have four volunteers come up to the front of the class and help you model how to do the activity.

3. Assign each volunteer to represent choices a, b, c, and d.

4. Put up an overhead of a reuse choice card. Read it aloud to the class.

5. Model for the class how to defend their assigned solution, and ask the volunteers to come up with answers or evidence to defend their solutions. For example, the student assigned to choice b might defend it by saying that recycling the box saves natural resources because the cardboard will get used to make something new.

6. After hearing about all four solutions, model how the group should decide on the best solution(s) to their choice that helps conserve natural resources. Students can share their personal opinions and ask questions of other group members to justify their opinions.

7. Explain how solution "d" may be a good choice because reusing the cardboard extends the life of the box until it is recycled.

8. Post the overhead of the rubric, and review with the class the expectations for this lesson.

9. Organize the class into groups of four, and pass out one card to each group. Give the groups five minutes to discuss their reuse choice card.

10. Come back together as a class, and have each group present the best solution from their choice card.

11. Pass out the "Reuse Choices" worksheet to each student, and assign them to write a list of three items that they can reuse at home or at school and how each item can be reused.

***Wrap-Up***

1. Ask some students to share their list of items and reuse ideas with the class.

***Final Assessment Idea***

Have the students create their own reuse choice cards using the blank cards provided on the student worksheet. Then have them answer their own questions and explain in writing how their reuse choice extends the life of a product or natural resource.

## RESOURCES

### Extensions:

Have a classroom "reuse" show-and-tell day. Ask students to bring in an item from home that has been or will be reused. Have each student show their object and tell how it can be reused.

Have students research artists who reuse common objects. Then ask students to collect items from home they would normally throw away such as bottle caps, packaging, etc. Create a class sculpture by reusing the items brought from home to show the importance of practicing the 4Rs.

### 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** | **Investigation and Experimentation**<br>6.a. Students will differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations. |
| **Grade 5** | **Investigation and Experimentation**<br>6.h. Students will draw conclusions from scientific evidence and indicate whether further information is needed to support a specific conclusion. |



# Reuse Choices 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 |
|---|---|---|---|---|
| **Identifying the best reuse choice to conserve natural resources** | Student leads a group in identifying the best choice for reusing items. | Student participates in identifying the best choice for reusing items. | Student has difficulty in participating in group decisions to reuse items. | Student does not participate in the group activity. |
| **Listing ways to reuse three items** | Student clearly identifies three reuse items with many ways to reuse each. | Student identifies three reuse items with some ways to reuse them. | Student identifies items for reuse but does not clearly show ways to reuse them. | Student does not do the assignment. |
| | | | | |
| | | | | |

# Student

# Reuse Choice Cards

**Directions: Each group member will defend one of the four reuse choices below (a, b, c, or d). After each group member has justified why their choice is the best to conserve natural resources, decide on the Best solution as a group.**

| CHOICE CARD | CHOICE CARD |
|---|---|
| You help a neighbor unload her groceries and you notice that, as she unloads the food, she is throwing the paper bags in the garbage can.<br>**SOLUTIONS** You should:<br>**A.** suggest she can reuse the bags next time she shops.<br>**B.** say nothing.<br>**C.** ask her whether you can have the bags to make something.<br>**D.** tell her to buy some cloth bags she can reuse every time she shops. | You are running on the playground, and you fall and rip the knee of your jeans.<br>**SOLUTIONS** You should:<br>**A.** patch the hole in the jeans.<br>**B.** throw away the jeans.<br>**C.** save the jeans to cut off and use for shorts.<br>**D.** cut up the jeans and use the fabric to make a rug. |

# Reuse Choice Cards

**Directions: Each group member will defend one of the four reuse choices below (a, b, c, or d). After each group member has justified why their choice is the best to conserve natural resources, decide on the Best solution as a group.**

| CHOICE CARD | CHOICE CARD |
|---|---|
| Your friend tells you they just bought a CD and listened to it. They say they hate it and are going to throw it away.<br>**SOLUTIONS** You should:<br>**A.** tell them to give the CD to a friend who might like it.<br>**B.** do nothing.<br>**C.** ask them for the CD and use it for an art project.<br>**D.** ask them for the CD because you like it. | You are at the Alameda Flea Market and see a sturdy old chair for a cheap price.<br>**SOLUTIONS** You should:<br>**A.** buy the chair and paint it.<br>**B.** buy the chair and use it as it is.<br>**C.** do nothing.<br>**D.** buy the chair and try to sell it to someone for more money. |

# Reuse Choice Cards

**Directions: Each group member will defend one of the four reuse choices below (a, b, c, or d). After each group member has justified why their choice is the best to conserve natural resources, decide on the Best solution as a group.**

| CHOICE CARD | CHOICE CARD |
|---|---|
| You are helping a friend organize their room and you notice they have a large pile of greeting cards. | A package full of styrofoam pellets, each about the size of popcorn, arrives at your home. |
| **SOLUTIONS** You should:<br>**A.** throw the cards in the garbage.<br>**B.** do nothing.<br>**C.** show your friend how to cut up the cards and turn the cards into gift tags.<br>**D.** tell your friend to put the cards in the recycling bin. | **SOLUTIONS** You should:<br>**A.** place the pellets in a recycling bin.<br>**B.** use them for an art project, like Christmas tree ornaments<br>**C.** save them for packaging your own gifts that you will be mailing later.<br>**D.** throw them away. |

# Reuse Choice Cards

**Directions: Each group member will defend one of the four reuse choices below (a, b, c, or d). After each group member has justified why their choice is the best to conserve natural resources, decide on the Best solution as a group.**

| CHOICE CARD | CHOICE CARD |
|---|---|
| After cleaning out a closet, you have twenty-five extra wire coat hangers. | When you help clean out a refrigerator, you find leftover food scraps in containers that are now spoiled. |
| **SOLUTIONS** You should:<br>**A.** give them to a thrift store for hanging up their donated clothes.<br>**B.** return them to dry cleaner or laundry that uses them as part of their business.<br>**C.** recycle them in a container for metals.<br>**D.** save them at your home for reuse when you buy new clothes. | **SOLUTIONS** You should:<br>**A.** throw the food in the containers away.<br>**B.** put vegetable and fruit scraps in a compost bin, wash and reuse the container.<br>**C.** put the food scraps in an organics recycling bin that accepts food items with yard waste.<br>**D.** get rid of the food scraps by putting them in the sink's garbage disposal and throw away the container. |

# Student

# Reuse Choice Cards

**Directions: Each group member will defend one of the four reuse choices below (a, b, c, or d). After each group member has justified why their choice is the best to conserve natural resources, decide on the Best solution as a group.**

| CHOICE CARD | CHOICE CARD |
|---|---|
| After shopping at a grocery store, you have taken home ten plastic bags.<br>**SOLUTIONS** You should:<br>**A.** return these bags to the grocery store for recycling.<br>**B.** throw them in the garbage because you can't put them in your recycling bin.<br>**C.** reuse the bags during your next trip to the grocery store.<br>**D.** use the bags at home to collect garbage and then throw them away. | After shopping at a clothing store, you have taken home some plastic bags.<br>**SOLUTIONS** You should:<br>**A.** recycle the bags.<br>**B.** throw them in the garbage because you can't put them in your recycling bin.<br>**C.** reuse the bags during your next shopping trip.<br>**D.** use the bags at home to collect garbage and then throw them away. |

# Reuse Choice Cards

**Directions: Use the blank cards below to create your own reuse choice card.**

| CHOICE CARD | CHOICE CARD |
|---|---|
| | |



# Reuse Choices

**Directions: Write or draw three items that you can reuse at home or school. Describe three ways that each item can be reused.**

| NAME OF REUSE ITEM | WAYS IT CAN BE REUSED |
|---|---|
| 1. | 1.<br>2.<br>3. |
| 2. | 1.<br>2.<br>3. |
| 3. | 1.<br>2.<br>3. |

Name:_____ Date:_____

## DEFINITIONS

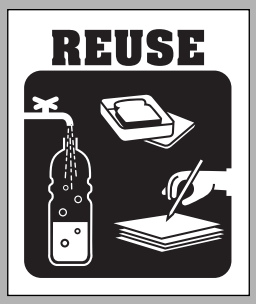
### Vocabulary:

***Recycling bin:*** container for accepting items that will be recycled into new products.

***Reuse:*** extending the life of an item by reusing it again as it is or creating a new use for it.



# Well-Built Quilts




**OBJECTIVES:**

Students will:

1. make a quilt square out of fabric and describe how reusing fabric in quilting saves natural resources.
2. identify the type of triangle used to make a quilt square (equilateral, isosceles, scalene).

**STANDARDS:** Math

**SKILLS:** Analysis, classification, description, problem solving

**SETTING:** Classroom

**TIME:** 50 minutes

**VOCABULARY:**
Equilateral
Isosceles
Quilt
Reuse
Scalene
Triangle

## Introduction

***Overview:***
In this lesson, students will learn about the natural resources used to make fabric and use their math skills to make a quilt square from re- used fabric scraps or old magazines.

### Teacher Background:

There are many traditions of quilt making throughout the world. In the United States, factory-made blankets were not made until the industrial revolution (mid-nineteenth century). Prior to that, fabric was expensive to buy, so scraps of materials were reused and pieced together to make bedding. Historical and modern quilts are made from both new and used fabric. Used fabric from clothing items was meant to remind the viewer of the person who wore the clothes.

There is a strong African American quilting tradition of making each quilt quite different, using bright contrasting colors and repeating patterns or stripes. Alice Walker from Berkeley is well-known as the author of the book *The Color Purple* and for her many beautiful quilts.

Today, both natural and man-made fabrics are made from natural resources such as animals, plants, and fossil fuels. Fabric is cloth made of fibers. Natural fibers come from animals and plants, e.g., cotton, flax, wool, silk. Manmade fabrics can be made from petroleum. Manmade fibers found in fabrics such as acrylic, rayon and polyester are made through a chemical process. When fabric is reused, the natural resources used to make the fabric are conserved.

### Materials:

***Students:***

- ❑ Ruler (one per student)
- ❑ Pen or pencil (one per student)
- ❑ Protractor (one per student)
- ❑ Scissors (one per student)
- ❑ Cardboard or card stock to make 8" by 8" square triangle pattern (one per student)
- ❑ Eight inch square cardboard or card stock for backing (one per student)
- ❑ Scraps of colored paper, greeting cards, old magazines or catalogs
- ❑ "Quilt Math" worksheet (one per student)
- ❑ Glue (one per student)
- ❑ 8 1/2" by 11" piece of paper (one per student)

***Teacher:***

- ❑ A variety of fabric scraps for quilt squares
- ❑ "Quilt Math" worksheet overhead
- ❑ "Quilt Square Example" overhead
- ❑ Rubric overhead
- ❑ Rubrics (one per student)

### Preparation:

Collect various types of fabric scraps in different colors to use as triangle pieces for quilt squares (colored paper can be substituted for fabric).

## ACTIVITY

***Discussion***

1. Ask the students what they know about fabric. What types of fabric can they name? Explain to the students that fabric is sometimes made from natural resources such as plants. For example, jeans are made from cotton.

2. Explain how people have historically reused scraps of fabric by sewing them together to make bedding or clothing.

3. Ask students whether they know anyone who makes quilts today.

4. Discuss how even though blankets are affordable, people still enjoy making their own quilts by reusing scraps of material they have saved.

5. Explain that when people reuse items such as fabric, they are conserving natural resources and creating less waste.

6. Tell the students that they will be making their own quilt squares out of fabric or reused paper.

***Procedure***

1. Post the overhead of the student worksheet, and introduce the activity. Model how to make a cardboard square to use as the quilt square backing.

2. Ask students whether they can name different types of triangles. Write the names of each triangle on the board (e.g., equilateral, isosceles, scalene).

3. Draw an example of each triangle next to its name and ask students to describe the properties of each type.

4. Next, model how to make one triangle of a quilt square by reviewing the directions on the "Quilt Math" worksheet.

5. Post the overhead of the rubric and review with the class the expectations for the lesson.

6. Pass out the "Quilt Math" worksheet and distribute the materials.

7. Have the students complete the "Quilt Math" worksheet.

8. Ask the students to choose the best triangle they made and cut it out of their paper pattern when finished completing the worksheet. This triangle will be used as their triangle pattern.

9. Next have them cut out eight triangles from scraps of fabric or other material using their triangle pattern. Then glue the eight triangles onto the cardboard backing to form one complete quilt square. Explain that triangles of similar colors should touch only at the corners. Show the teacher overhead "Quilt Square Example" to model how the quilt square will look when it is completed.

10. When the students have completed their quilt squares, have them place each square on the classroom floor and tape the squares together to form a complete quilt.

11. Ask the students how much fabric has been saved because the classroom quilt is made from reused materials. Help students calculate the fabric or paper savings by multiplying the size of one quilt square by the total number of students in the class.

***Wrap-Up***

1. Discuss with the students ways that their quilt squares could be used such as making clothing, curtains, etc.

2. Ask the students to share ideas about other projects where they could reuse fabric. Making quilts is one example of reusing materials and conserving resources.

3. Hang the reuse quilt on a wall in the classroom.

***Final Assessment Idea***

Ask students to write different ways they could use their fabric quilt squares at home or school. Have them brainstorm a list of materials they have at home that could be used in place of fabric to make a quilt.



## Extensions:

Have students watch the last segment of the video *Doing the 4Rs*, where students enter a classroom quilt into a creative reuse art contest. Ask students to compare their quilt to the one in the video, discussing differences and similarities. Did the students in the video reuse materials to make their quilt? If so, what materials did they reuse?

## 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.

| MATHEMATICS | CONTENT STANDARDS |
|---|---|
| **Grade 4** | **Measurement and Geometry**<br>3.7. Student will know the definitions of different triangles (e.g., equilateral, isosceles, scalenes) and know their attributes. |
| **Grade 5** | **Measurement and Geometry**<br>2.1. Student will measure, identify and draw angles, perpendicular and parallel lines, rectangles and triangles by using appropriate tools (e.g., straightedge, ruler, compass, protractor, drawing software). |

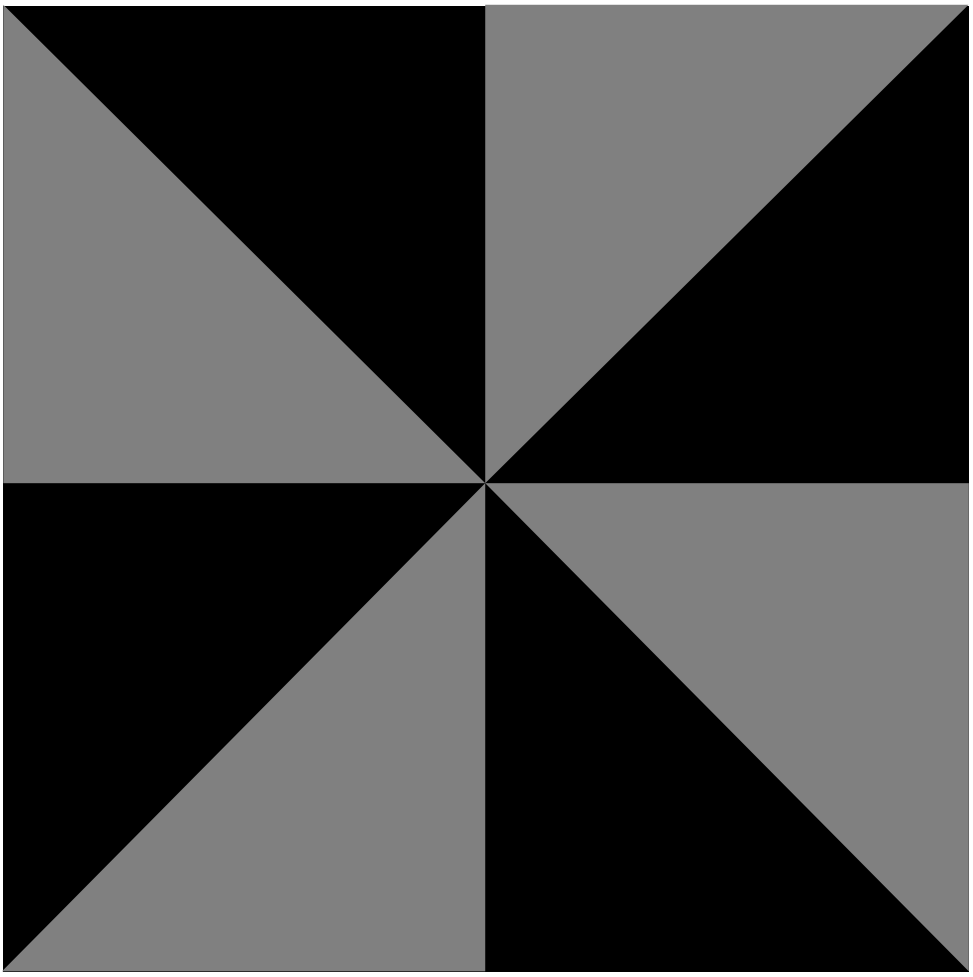
# Teacher

# Well-Built Quilts 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 |
|---|---|---|---|---|
| **Construct a quilt square and identify the triangle used to complete the square** | Student makes a complete quilt square and identifies the correct triangle. | Student makes a quilt square missing one triangle, and identifies the correct triangle. | Student makes a quilt square, missing more than two triangles and cannot identify the correct triangle. | Student makes an incomplete quilt square missing more than four squares and cannot identify the correct triangle. |
| **Explain how reusing materials in quilting saves natural resources** | Student can describe how reusing fabric saves natural resources. | Student has problems describing how reusing fabric saves natural resources. | Student is not able to describe how reusing fabric saves natural resources. | Student does not attempt to describe how reusing fabric saves natural resources. |
| | | | | |
| | | | | |

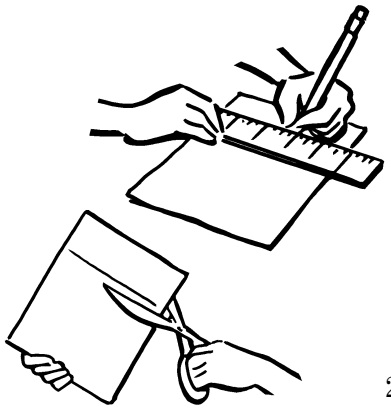
# Quilt Square Example



# Student

# Quilt Math

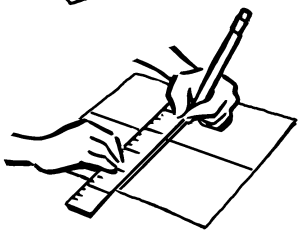
**Directions: Using cardboard and fabric or reused paper, follow the directions and answer the questions to complete a reuse quilt square by using a ruler, protractor, pencil and scissors.**



1. In this lesson, you will make a quilt square.
   First, make an eight-by-eight-inch square out of cardboard for the backing.
   Using your ruler, measure eight inches for the length and width and cut out the square. How wide and long is the square pattern?
   _____inches (It should be the same width and length).

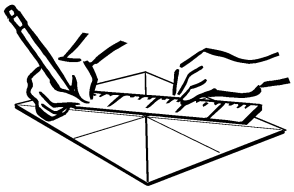
2. Repeat this process to make a square out of a piece of paper.
   This will be used to make your quilt pattern.

3. Divide the length or width of the paper square by two and show your result. _____ inches



4. Now measure this distance on the length of the square and draw a straight line through the square.
   Measure this distance on the width and draw a line through the square.
   Your original square should now be divided into four identical squares.

5. Make the four squares into eight triangles.
   These triangles will have two equal sides and one longer side.

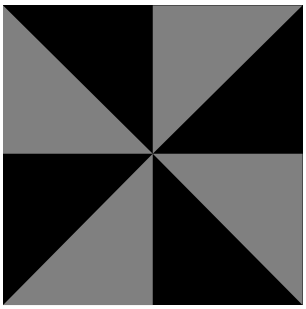


6. To make the triangles, choose a square to start with.
   Measure forty-five degrees on your protractor and make a mark.
   Now go to opposite corner of the square, and measure forty-five degrees with your protractor.
   Make a mark. Now connect your two marks by drawing a line.
   Repeat on each square.

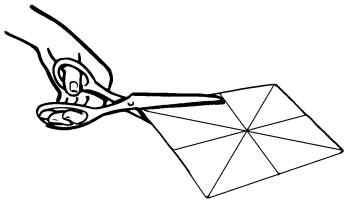
*(continued on next page)*

Name:_____ Date:_____

Your pattern should now have eight triangles and look like this:



7. Review the definitions for the three different kinds of triangles below and identify which type you have just made.
   - **Scalene:** a triangle having three sides of unequal length.
   - **Equilateral:** a triangle having all sides or faces that are equal.
   - **Isosceles:** a triangle having two equal sides.



8. Now cut out one triangle and use this to measure eight fabric triangles that will become a quilt square.

9. Glue the fabric triangles on the cardboard backing.

Is this type of triangle an equilateral, scalene or isosceles triangle?

_____

10. Describe how reusing fabric to make a quilt can help save natural resources.

_____

_____

_____

Name:_____ Date:_____

## DEFINITIONS

### Vocabulary:

***Equilalateral:*** a triangle having all sides or faces that are equal.

***Isosceles:*** a triangle having two equal sides.

***Quilt:*** a bed coverlet of three layers: a top, middle, and bottom. The middle layer is a filling of wool, cotton, down, etc.

***Reuse:*** extending the life of an item by reusing it again as it is or creating a new use for it.

***Scalene:*** a triangle having all sides of unequal length.

***Triangle:*** a plain figure that has three sides and three angles.



# From Oil to Plastic


**OBJECTIVES:**

Students will:
1. identify the natural resources used to make plastic products.
2. compare and contrast different types of life cycles (both natural and human-made).
3. sequence and describe the steps of a plastic product life cycle.

**STANDARDS:** Science

**SKILLS:** Analysis, description, critical thinking

**SETTING:** Classroom

**TIME:** 50 minutes

**VOCABULARY:**
Landfill
Life cycle
Natural resources
Nonrenewable resources
Oil
Petroleum
Plastic
Raw material
Recycle

## Introduction

***Overview:***
In this lesson, students will learn about the life cycle of a plastic product and the nonrenewable resource used to make it, by watching a video showing how plastic is produced from raw material to final product. They will create posters showing the chronological steps to making a plastic product and discuss how recycling completes a product life cycle.

### Teacher Background:

All of the products we use are made from natural resources. Some of these are made from renewable resources like wood and others from nonrenewable resources such as oil. Renewable resources can be replaced over a human's lifetime whereas nonrenewable resources are finite and cannot be replaced once they are used up.

All products have a life cycle, meaning there are a series of stages that a product goes through from extraction of raw materials to production and final product. A life cycle becomes incomplete when any stage of the cycle is disrupted or removed. If a product is not recycled after use, it will most likely end up in the landfill, which ends the life of the product and the natural resources used to make it. If the product is recycled, the natural resources and energy used to make the product will continue to be used in making a new product from the recycled material.

Plastic is made from fossil fuels (oil and natural gas), which are nonrenewable resources. Recycling saves these resources, which cannot be replaced over a short period of time.

### Materials:

***Students:***
- ❑ Markers
- ❑ Glue (one bottle per group)
- ❑ Scissors (one per student)
- ❑ Poster paper (one piece per group)
- ❑ "Plastic Life Cycle Cards" (one set per group)
- ❑ "Plastic Life Cycle" worksheet

***Teacher:***
- ❑ "Life Cycle of a Tree" overhead
- ❑ "Life Cycle of a Plastic Product" overhead
- ❑ *From Oil to Plastic* DVD
- ❑ Rubric overhead
- ❑ Rubrics (one per student)

### Preparation:

Be prepared to organize the students into groups of four.

## ACTIVITY

***Discussion***

1 . Ask students what natural resource is used to make plastic and whether this is a nonrenewable or renewable resource.

2. Explain that both nonrenewable and renewable resources are used to make products. The products we use have a life cycle, meaning that all products originate from somewhere and often, after use, have an end of life. Recycling extends the life of a product by keeping recycled materials available to make a new product.

3. Tell the students that they will be learning about the plastic life cycle.

4. Ask students to describe a cycle and share some examples.

5. Show the overhead "Life Cycle of a Tree" and discuss the stages. Ask the students to vote whether this is an example of a renewable or nonrenewable resource cycle (renewable).

6. Explain that the products we use also have a life cycle. Put up the overhead "Life Cycle of a Plastic Product" and ask whether this is an example of a renewable or nonrenewable resource cycle (nonrenewable).

7. Explain that a cycle can be disrupted if any step in the process is disturbed or removed.

8. Cover the left side of the overhead and show the students how the plastic cycle can be incomplete or disrupted when a plastic product ends up in the landfill. Ask the students if there are any other choices besides putting it in the garbage that will help to continue the cycle.

9. Uncover the left side of the overhead and point out that recycling completes the cycle because a new plastic product can be made from the recycled material.

10. Tell the students that they will be learning about the life cycle of a plastic product by watching a video of how a plastic is made.

11. Show an overhead of the lesson rubric and review the expectations for this lesson.

***Procedure***

1. Before showing the video, ask the students to suggest some ideas for how plastic is made. While watching the video, students should write down the steps required to make a plastic product.

2. Show the DVD *From Oil to Plastic*.

3. Put the students into groups of four.

4. Tell the students that each group will receive a set of "Plastic Life Cycle Cards." Their job is to put the cards in chronological order on a poster representing how a plastic product is made. Each step should be numbered. They should also write a brief description of what happens at each stage of the life cycle based on what they saw in the video.

5. Pass out one set of "Plastic Life Cycle Cards," a piece of poster paper, markers, glue and scissors to each group.

6. As groups finish their posters, hand out the student worksheet "Plastic Life Cycle Cards" to each student and have them answer the questions.

7. Ask each group to present their plastic life cycle poster to the rest of the class.

***Wrap-Up***

1. Ask the class how the cycle would change if someone chose to throw away a plastic product instead of recycling it.

2. Ask the students whether they think that product life cycles using nonrenewable resources like oil can continue forever. Why or why not?

***Final Assessment Idea***

Have students write a narrative (as if they were a plastic bottle) of a plastic product's life from production to final product. They should write it as an autobiography so the reader can imagine what it is like to be a plastic product.

## Extensions:

Assign groups of students to research other product life cycles stating what natural resources are lost if the products end up in the landfill. Have them present their findings.

## 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** | **Physical Science**<br>6.g. Students know electrical energy can be converted to heat, light and motion.<br>**Investigation and Experimentation**<br>6.c. Students will formulate and justify predictions based on cause-and-effect relationships. |
| **Grade 5** | **Physical Science**<br>1.f. Students know differences in chemical and physical properties of substances are used to separate mixtures and identify compounds.<br>1.h. Students know living organisms and most materials are composed of just a few elements. |
| **Language Arts** | **Content Standards** |
| **Grade 4** | **Reading Comprehension**<br>2.1. Students identify structural pattern found in informational text (e.g., compare and contrast, cause and effect, sequential or chronological order, proposition and support) to strengthe comprehension. |
| **Grade 5** | **Reading Comprehension**<br>2.1. Students understand how text features (e.g., format, graphics, sequence, diagrams, illustrations, charts, maps) make information accessible and usable. |

# Teacher

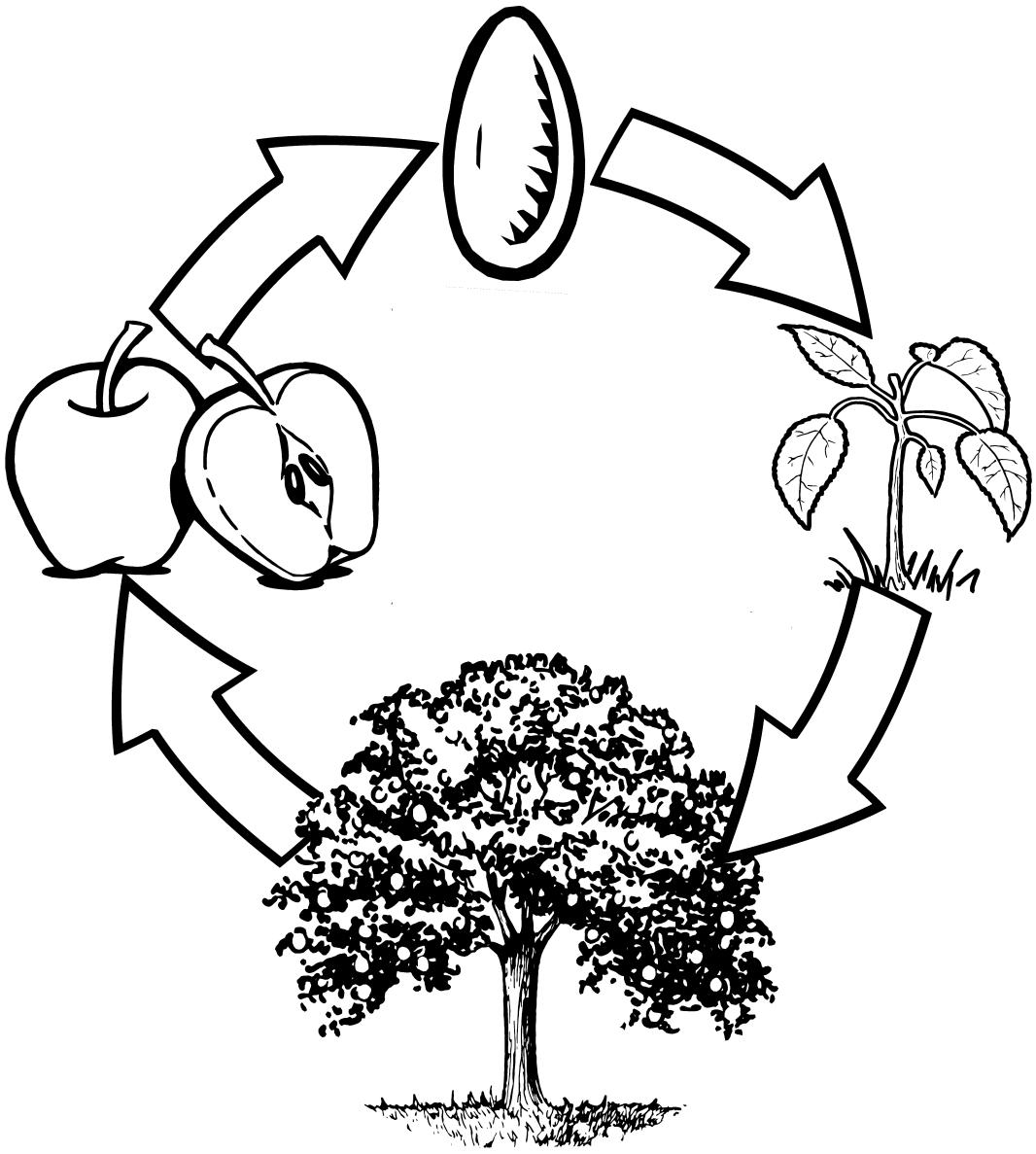
# From Oil to Plastic Rubric

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 |
|---|---|---|---|---|
| **Plastic Life Cycle poster** | The group's poster includes all the steps for making plastic in order with a description of each step. | The group's poster includes all of the steps for making plastic although some are not in order or missing descriptions. | The group's poster includes all of the steps for making plastic although a few are not in order or missing descriptions. | The group's poster includes all the steps for making plastic but they are out of order and missing descriptions. |
| **Listing non-renewable resources and products made from these resources** | The group clearly identifies three nonrenewable resources and three products made from these resources. | The group identifies three nonrenewable resources and two products made from these resources. | The group identifies three nonrenewable resources but does not list products made from these resources. | The group does not attempt the assignment. |
| | | | | |
| | | | | |

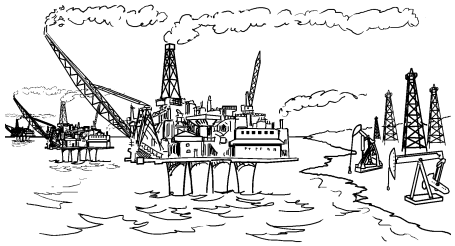
Name:_____ Date:_____

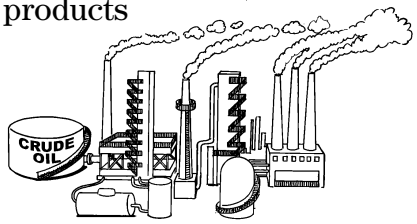
# Life Cycle of a Tree

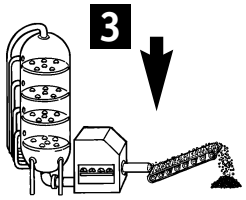


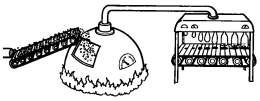
# Teacher

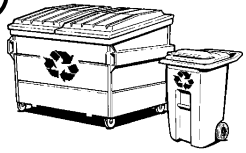
# Life Cycle of a Plastic Product

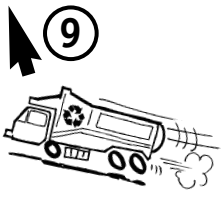


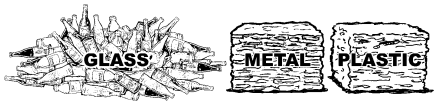


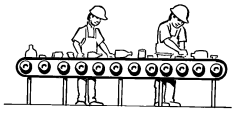



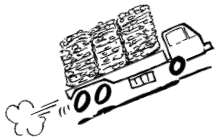


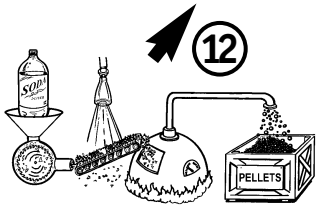


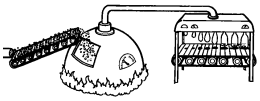








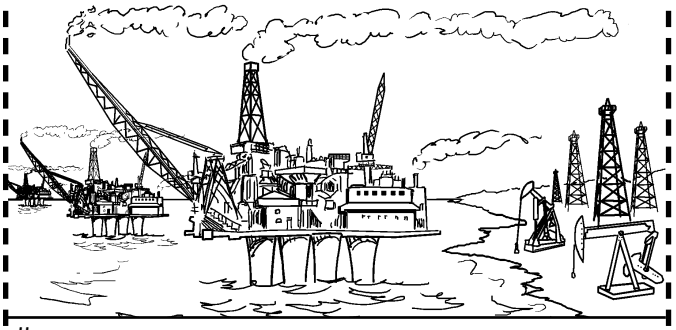
1. Wells pump crude oil
2. Oil is shipped and transported to refineries
3. Oil is refined
4. Plastic pellets are made
5. The pellets are melted to make plastic products
6. Plastic products are used
7. There is a choice; if plastic is thrown away, it ends up in a landfill

**Or**

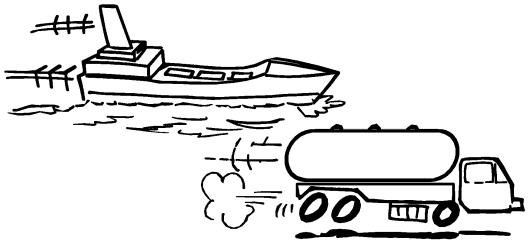
8. If plastic is recycled, the resources can be used again
9. Recyclables get picked up by a recycling truck
10. Recyclables are sorted by type at a recycling facility
11. Bales of plastic are sold and transported to a remanufacturer
12. Bales of plastic are shredded; plastic flakes are washed and melted to form recycled plastic pellets
13. Recycled plastic pellets are melted to make plastic products
14. Plastic products are used

# Plastic Life Cycle Cards

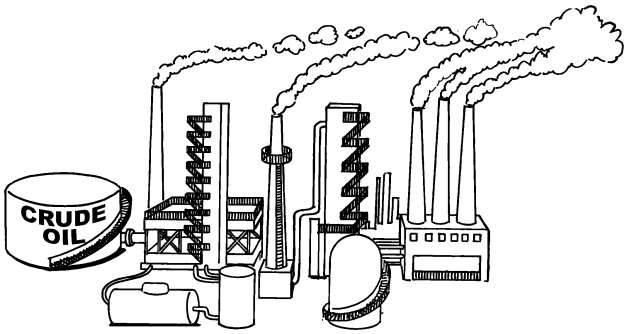
**Directions: Cut out each card and glue the cards in chronological order to show how a plastic bottle is made and how it can be used again to make a new product.**
**Arrange the cards on your poster to show a cycle (in a circle).**



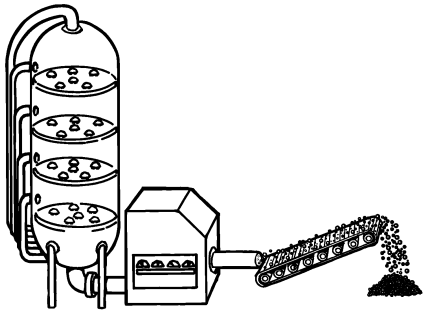
# ____ Wells pump crude oil.



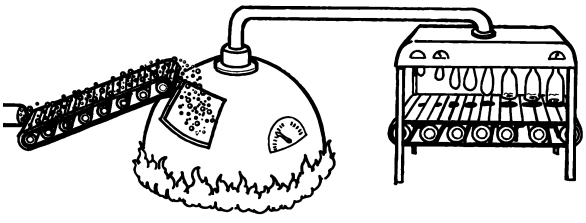
# ____ Oil is shipped and transported to refineries.




# ____ Oil is refined.



# ____ Plastic pellets are made.



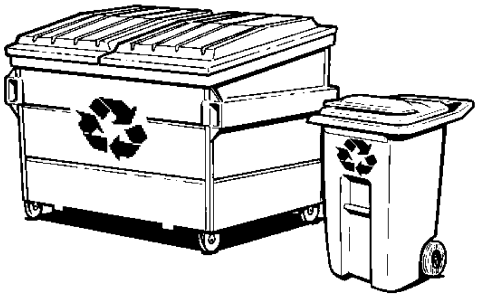
# ____ The pellets are melted to make plastic products.


# ____ Plastic products are used.

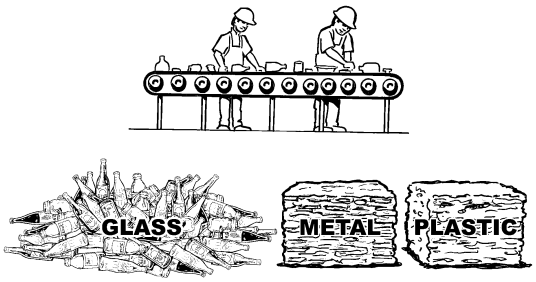
# Student

# Plastic Life Cycle Cards

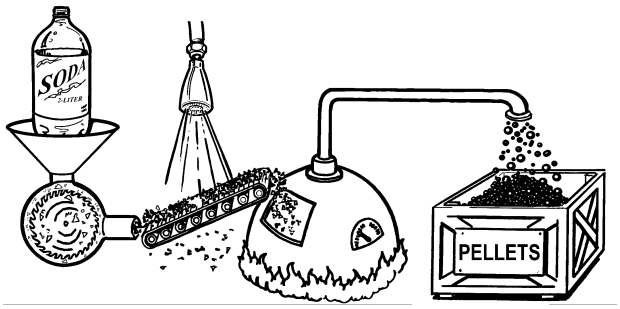
**Directions: Cut out each card and glue the cards in chronological order to show how a plastic bottle is made and how it can be used again to make a new product. Arrange the cards on your poster to show a cycle (in a circle).**



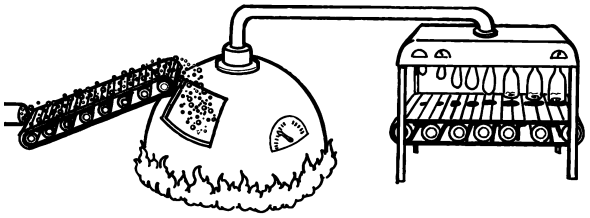
# _____ If plastic is recycled, the resources can be used again.




# _____ Recyclables are sorted by type at a recycling facility.



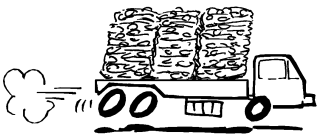

# _____ Plastic is shredded, washed and melted into recycled plastic pellets.



# _____ Recycled plastic pellets are melted to make plastic products.


# _____ Plastic products are used.

# _____ Recyclables get picked up by a recycling truck.



# ___ Bales of plastic are transported to a remanufacturer.

Student

# Plastic Life Cycle

**Directions: List three nonrenewable natural resources and one product made from this resource.**

| Nonrenewable Natural Resources | Product Made: |
|---|---|
| 1. | |
| 2. | |
| 3. | |

What natural resources are lost when a plastic product ends up in a landfill instead of being recycled?

Name:_____ Date:_____

## DEFINITIONS

### Vocabulary:

***Landfill:*** an area of land designed to handle the disposal of solid waste. The garbage is usually spread out, compacted and covered with dirt or other material in order to protect the environment in and around the landfill.

***Life cycle:*** a series of changes that an organism undergoes throughout its life. For example, a frog life cycle usually includes the following stages: egg, tadpole, immature frog and adult frog. A life cycle can also describe the steps to producing a product, which usually includes the following stages: extraction of raw materials, production, distribution and use of a product, and final disposal or recycling of remaining materials.

***Natural resources:*** living or nonliving materials that come from the Earth such as fossil fuels, minerals, plants, animals, water, air, sunlight, and other forms of energy.

***Nonrenewable resources:*** minerals or sources of energy that can be mined or collected from the Earth, such as coal, petroleum, iron ore, copper, etc. The processes of their formation are so slow that these resources may be considered gone forever once they are used up.

***Oil:*** a liquid substance, usually black and sticky that is used to produce fuel and products such as plastic.

***Petroleum:*** a substance occurring naturally in the Earth in solid, liquid or gaseous state that is composed of a complex mixture of hydrocarbons used to make products such as oil, natural gas, plastic and fuel.

***Plastic:*** a material made from petroleum. It can be molded, extruded or cast into a desired shape.

***Raw material:*** a material or natural resource that is mined or harvested for use in producing a product such as bauxite (aluminum), iron ore, silica, or trees.

***Recycle:*** the process of producing new products from used material or the process of remanufacturing used materials into new products. Some used materials can be made into new items of the same thing. Others are made into entirely new items.

# Recycling Plastics


**OBJECTIVES:**

Students will:

1. identify and sort a variety of plastic products and distinguish which types can be recycled in their community.
2. observe and describe the properties of different types of plastic.
3. list ways to reduce or reuse plastics that cannot be recycled.

**STANDARDS:** Science

**SKILLS:** Analysis, classification, description, problem solving

**SETTING:** Homework assignment and Classroom

**TIME:**
Classroom: 50 minutes
Homework: 10 minutes

**VOCABULARY:**
Petroleum
Plastic

## Introduction

***Overview:***

In this lesson, students will learn about different types of plastic by collecting and examining examples of plastic from home. They will identify the seven different types of plastic, observe and record the properties of each plastic type, and research which types they can recycle in their community.

### Teacher Background:

Today, most plastic is made from natural gas and crude oil; both are classified as nonrenewable resources. Plastics are made by linking tiny molecules together in long, repeating chains, which form polymers. Plastic makes up a growing portion of the products we use every day ranging from food packaging and beverage bottles to the outer shells of TVs, boats, and automobiles.

Different polymers make up different types of plastic. Each type can be categorized based on observable properties unique to that type of plastic. The plastic industry has developed an identification system to label and divide plastic into seven groups with different properties using a number code on the bottom of the container. Some plastic types are flexible; others are rigid. Some plastics are translucent, transparent, or opaque, and many have different densities. Each type melts at a different temperature. These properties determine various uses for different types of plastic.

Most plastic is recyclable in theory, but many types of plastic are not economical to collect for recycling. In addition, the properties that make plastic useful also make it a difficult waste item if it is not recycled. Reducing the need for and purchasing of plastic products conserves nonrenewable natural resources as well as other resources used during the extraction of fossil fuels (crude oil and natural gas). It also helps prevent a common source of litter and pollution in the environment.

### Materials:

***Students:***

- ❑ At home: bring examples of different types of plastic, e.g., bottles, wrappers, packaging pellets, cups, etc.
- ❑ "Types of Plastic" handout (one per student)
- ❑ StopWaste.Org *Recycling Guide* (one guide per pair of students)
- ❑ "Plastics at Home" worksheet

***Teacher:***

- ❑ Examples of different types of plastics (water bottle, detergent bottle, yogurt container, plastic bag, etc.)
- ❑ "Types of Plastic" handout overhead
- ❑ Rubric overhead
- ❑ Rubrics (one per student)

*(continued on next page)*

## Preparation:

Call to request a set of StopWaste.Org *Recycling Guide*s at the Recycling Hotline at 1-877-786-7927 or at **www.StopWaste.Org**. Begin collecting examples of different plastic types several days before lesson.

Assign students to bring in a variety of plastic items from home the day before the lesson.

Be prepared to put students in pairs for part of the activity.

You may need to collect and redistribute plastic items to each pair of students.

## ACTIVITY

***Discussion***

1. Ask the students to describe how they use plastic at home or school.

2. Have students state why they think some plastic items can be used many times, while others must be disposed of after one use. For example, plastic baggies are not as rigid as a reusable plastic container.

3. Describe how different types of plastic have different characteristics or properties such as being rigid or flexible.

4. Show an overhead of "Types of Plastic." Explain to the students the different types of plastic. Show students examples of each type of plastic and where to look for the numbered code on the bottom of the container.

5. Explain that plastic is made from crude oil, which is a nonrenewable natural resource. These resources need to be conserved because they are limited in availability. Explain that nonrenewable resources such as oil take millions of years to form; so once they are used up, they cannot be replaced.

6. Ask students to share what they do with plastics at home or school after use. Are they recycled or thrown away?

7. Tell the students that they will be learning about the properties of different plastic types while researching which types can be recycled in their community.

8. Show an overhead of the lesson rubric and review the expectations for this lesson.

***Procedure***

1. Homework (day before activity): Assign students to bring in different types of plastic. Have them collect a variety of items, e.g., one plastic water bottle, one food wrapper, one beverage container, one film canister, etc. Encourage students to collect different colors, shapes, and forms.

2. Put students into pairs and pass out the handout "Types of Plastic" to each student and give each pair an *Alameda County Recycling Guide*.

3. Ask the students to share their plastic items from home with their partner (walk around the room and distribute plastic items to pairs of students that do not have an adequate variety).

4. Using their handout, ask students to locate the code and identify the type of plastic for each item brought from home. Then sort the samples into those that can be recycled in their community and those that cannot. Have them refer to their *Recycling Guide* for a list of plastics commonly accepted for recycling by cities in Alameda County. Have students observe the different characteristics of each type of plastic, e.g., stiffness, transparency, color, etc.

5. Ask some students to present their findings to the class such as what type of plastic they identified, specific properties or characteristics, and whether it can be recycled in their community.

6. Pass out the student worksheet "Plastics at Home." Model how to complete the worksheet for one plastic item. Each student will complete their own worksheet and brainstorm ways to reduce or reuse plastics that can't be recycled in their community.

***Wrap-Up***

1. As a class, have students share ways to reduce or reuse plastic, especially those that cannot be recycled in their community. Make a list of their ideas on the board, and have the students vote on two or three ideas to implement in the classroom, e.g., reuse plastic bags, collect plastic bottle tops for classroom art projects, etc.

***Final Assessment Idea***

Have students create a template for a plastics recycling refrigerator magnet for their family that states which plastic types can be recycled in their community, some common examples of each type of plastic, and a drawing or picture of each plastic type and number.

## Extensions:

Have students discuss and record the properties of different types of plastic on a chart such as whether it is opaque, colored, textured, flexible, rigid, etc. Next, have the students predict how different types of plastic can be sorted in a recycling facility based on the properties that are unique to each type.

## 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** | **Life Science**<br>6.a. Students will differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations. |
| **Grade 5** | **Investigation and Experimentation**<br>6.a. Students will classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria. |

# Teacher

# Recycling Plastics 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 |
|---|---|---|---|---|
| **Identify plastic types and whether they can be recycled** | All items were correctly identified. | Most of items were correctly identified. | Some of the items were correctly identified. | None of the items were correctly identified. |
| **List at least one creative way to reduce or reuse three plastic items from home** | Ideas were exceptional and original. | Some ideas showed originality and creativity. | A few ideas showed originality or creativity. | Ideas lacked variety and creativity. |
| | | | | |
| | | | | |

# Types of Plastic

There are many types of plastic in common use. Plastics must be sorted by type for recycling since each type has different properties, such as different melting temperatures. The plastic industry has developed an identification system to label the different types of plastic containers. The system divides plastic into seven groups and uses a number code generally found on the bottom of a container.


**Plastic #1: Polyethylene Terephthalate (PET or PETE)**
Common uses: two-liter soda bottles, water bottles, cooking oil bottles, peanut butter jars. All residential recycling programs accept narrow-neck PET containers.


**Plastic #2: High Density Polyethylene (HDPE)**
Common uses: detergent bottles, milk and water jugs, grocery bags, yogurt cups. All residential recycling programs accept narrow-neck HDPE containers; #2 bags can be recycled at large grocery stores.


**Plastic #3: Polyvinyl Chloride (PVC or V)**
Common uses: plastic pipes, outdoor furniture, shrink-wrap, water bottles, liquid detergent containers. Recycling centers rarely take #3 PVC plastic. Look for alternatives whenever possible.


**Plastic #4: Low Density Polyethylene (LDPE)**
Common uses: dry cleaning bags, produce bags, trash can liners, food storage containers. Many residential recycling programs accept narrow-neck LDPE containers; #4 produce bags can be recycled at large grocery stores.


**Plastic #5: Polypropylene (PP)**
Common uses: ketchup bottles, aerosol caps, drinking straws, yogurt containers. Recycling centers rarely take #5 PP plastic. Look for alternatives whenever possible.


**Plastic #6: Polystyrene (PS)**
Common uses: packaging pellets or Styrofoam peanuts, cups, plastic tableware, meat trays, to-go clamshell containers, egg cartons, shipping blocks. Many shipping/packaging stores will accept polystyrene peanuts and other packaging materials for reuse. Cups, meat trays and other containers that have come in contact with food are rarely accepted for recycling. Look for alternatives whenever possible.


**Plastic #7: Other**
Common uses: three- and five-gallon reusable water bottles, ketchup bottles. This plastic category, as its name "other" implies, is any plastic other than the named #1–#6 plastic types. These containers can be several different types of plastic polymers. Most recycling centers do not take plastic #7. Look for alternatives whenever possible.

Name:_____ Date:_____

Student

# Plastics at Home

| Describe plastic product | Identify type of plastic (code on bottom) | Can it be recycled where you live? Yes/No | Describe some of the properties of this plastic type (e.g., flexible, rigid, transparent, etc.) |
|---|---|---|---|
| | | | |
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| | | | |
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| | | | |
| | | | |
| | | | |

List one or two ideas for how to reduce or reuse three of the containers that cannot be recycled where you live.

1. _____

2. _____

3. _____

Name: _____ Date: _____

## DEFINITIONS

### Vocabulary:

***Petroleum:*** a substance occurring naturally in the Earth in solid, liquid, or gaseous state that is composed of a complex mixture of hydrocarbons used to make products such as oil, natural gas, plastic, and fuel.

***Plastic:*** a material made from petroleum. It can be molded, extruded, or cast into a desired shape.

# From Tree to Paper


**OBJECTIVES:**

Students will:
1. learn how paper is made from trees.
2. make recycled paper and learn ways to conserve resources by recycling paper.

**STANDARDS:** Science

**SKILLS:** Analysis, classification, description, problem solving

**SETTING:** Classroom

**TIME:** Day One *(prepare paper pulp)*: 30 minutes
Day Two *(make paper)*: 40 minutes

**VOCABULARY:**
Paper
Recycle

## Introduction

***Overview:***
In this lesson, students will learn about how trees are harvested to make paper. They will participate in an experiment and make a recycled piece of paper from newspaper.

### Teacher Background:

Trees provide numerous benefits to humans and the environment. They provide habitat for wildlife species and absorb carbon dioxide, giving off oxygen we breathe. Trees also enhance the environment in which we live by providing wind breaks and altering climate, temperature and air quality. Trees provide economic benefits as timber for building materials, furniture, paper products, fuel, and food.

The word "paper" comes from the Egyptian word "papyrus," a plant whose leaves were used as sheets for writing. Today, most paper is made from wood harvested from trees. Most of the trees harvested for the papermaking process are planted for this purpose. Another source of material for making paper is wood scraps from saw mills where lumber is made.

Wood is made up of strong fibers or strands of cellulose that are stuck together by lignin. The papermaking process separates and reorganizes these fibers to produce a flat sheet of paper. It takes approximately seventeen trees to make one ton of paper in addition to many other resources including energy and water, to name a few.

When paper is recycled, the recovered paper can be used to make recycled paper, saving trees, water, and energy required to make a new sheet of paper from raw materials.

### Materials:

***Students*** *(for six groups of five students)*
- ❑ Bucket, tub, or tray (one per group)
- ❑ Material to cover tables or floor
- ❑ Newspaper (twelve sheets per group)
- ❑ "From Tree to Paper" worksheet (one per student)
- ❑ Pencils to flatten wet paper

***Teachers:***
- ❑ "From Tree to Paper" overhead
- ❑ Water to fill buckets
- ❑ Two bags of used newspaper
- ❑ Rolling pins or dowels to flatten paper
- ❑ Rubic overhead
- ❑ Rubrics (one per student)

### Preparation:

Be prepared to organize students into groups of six.

Ask other adults to assist on day two if possible.

Have extra towels on hand for cleanup.

## ACTIVITY

***Discussion***

*Day One:*

1. Ask the students where they think paper comes from. Tell them paper is made from trees that are harvested for wood. Trees are considered a natural resource.

2. The practice of recycling paper not only saves trees, but it also conserves other resources such as energy and water while reducing pollutants that are released in the environment during the manufacturing process.

3. Post the overhead "From Tree to Paper" and explain how paper is made by describing the steps listed on the overhead.

4. Have students raise their hands if they recycle paper at home or school. Ask students to predict what happens to paper when it gets recycled. Write their predictions on the board.

5. Have students look at the overhead and describe which steps of the papermaking process are not needed when paper that gets recycled is used to make new paper.

6. Tell the students they will learn about how recycled paper is made and participate in an activity that will test whether newspaper can be recycled to make new paper in the classroom.

7. Show an overhead of the lesson rubric, and review the expectations for this lesson.

***Procedure***

*Day One (Preparation to Make Paper Pulp)*

1. Show students the tools they will be using to make recycled paper out of newspaper. Ask the students to describe how they might use these tools to make a new piece of paper from newspaper.

2. Pass out the "From Tree to Paper" worksheet to each student.

3. Have students predict what will happen to the newspaper if it is placed in a bucket of water and left to soak overnight. Ask them to record their prediction on the worksheet and justify it using a cause-and-effect relationship. For example, "I predict that the paper will begin to fall apart because the wet paper will not be as strong as dry paper."

4. Now have the students write a testable question based on their prediction statement about what will happen to newspaper when it is placed in water. For example, "Will newspaper lose its strength when soaked in water overnight?"

5. Organize the students into six groups.

6. Pass out at least six sheets of newspaper to each group and a bucket (or small tubs or trays) filled with water.

7. Have the groups tear or cut the newspaper into small pieces (approximately two inches by two inches) and soak the paper pieces in warm water for at least one day.

8. Ask the groups to write their group number on a piece of tape and place it on the bucket.

*Day Two (Making Paper Pulp)*

1. Organize students into their groups from the day before.

2. Introduce students to the materials that each group will collect. Describe or model how the materials will be used.

3. Assign two students from each group to collect their group's bucket and sheets of newspaper. Each student in the group will share one set of supplies so they will have to take turns making paper.

4. Have the students observe what happened to the newspaper in the bucket, tubs or trays from the day before and record their observations on their worksheet.

5. Ask students to describe whether or not their predictions were correct. Have them answer the question they wrote on their worksheet based on their observations.

6. Using their hands, have the students squeeze water from lumps of soaked paper (wood fibers) in the bucket.

7. Have students spread out the paper pulp onto a tray lined with sheets of dry newspaper and flatten out the pulp using their hands, rolling pin or pencil.

8. After a day or two, or when the pulp is dry, have the students describe whether or not they were able to make new paper out of newspaper. Then have them write instructions for a friend that describes how to make recycled paper from newspaper using the same steps they followed in the classroom.

***Wrap-Up***

1. Discuss different uses for recycled paper and share examples of products made from recycled paper, e.g., paper towels, cereal boxes, writing paper.

2. Ask students what natural resources are saved by recycling paper.

3. Brainstorm ways to conserve trees as a natural resource, e.g., reuse paper bags, use both sides of a piece of paper, use durable napkins and plates, etc., instead of disposables.

***Final Assessment Idea***

Have students describe how the practice of recycling paper saves natural resources.

## RESOURCES

### Extensions:

Have students participate in a papermaking activity in the classroom. Resource Area For Teaching (RAFT) offers a papermaking lesson (www.raft.net/ideas/Paper%20Recycling.pdf) and classroom kit as well as other low-cost reuse kits available for teachers. Visit their website for more information: www.raft.net.

When making paper, add seeds to the pulp and plant the seed cards in a garden or planter using compost or potting soil.

Have students research the history of paper and describe how the process of making paper has changed throughout time. A historical timeline can be created to illustrate their findings.

### 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** | **Investigation and Experimentation**<br>6.c. Students will formulate and justify predictions based on cause-and-effect relationships. |
| **Grade 5** | **Investigation and Experimentation**<br>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 a procedure. |

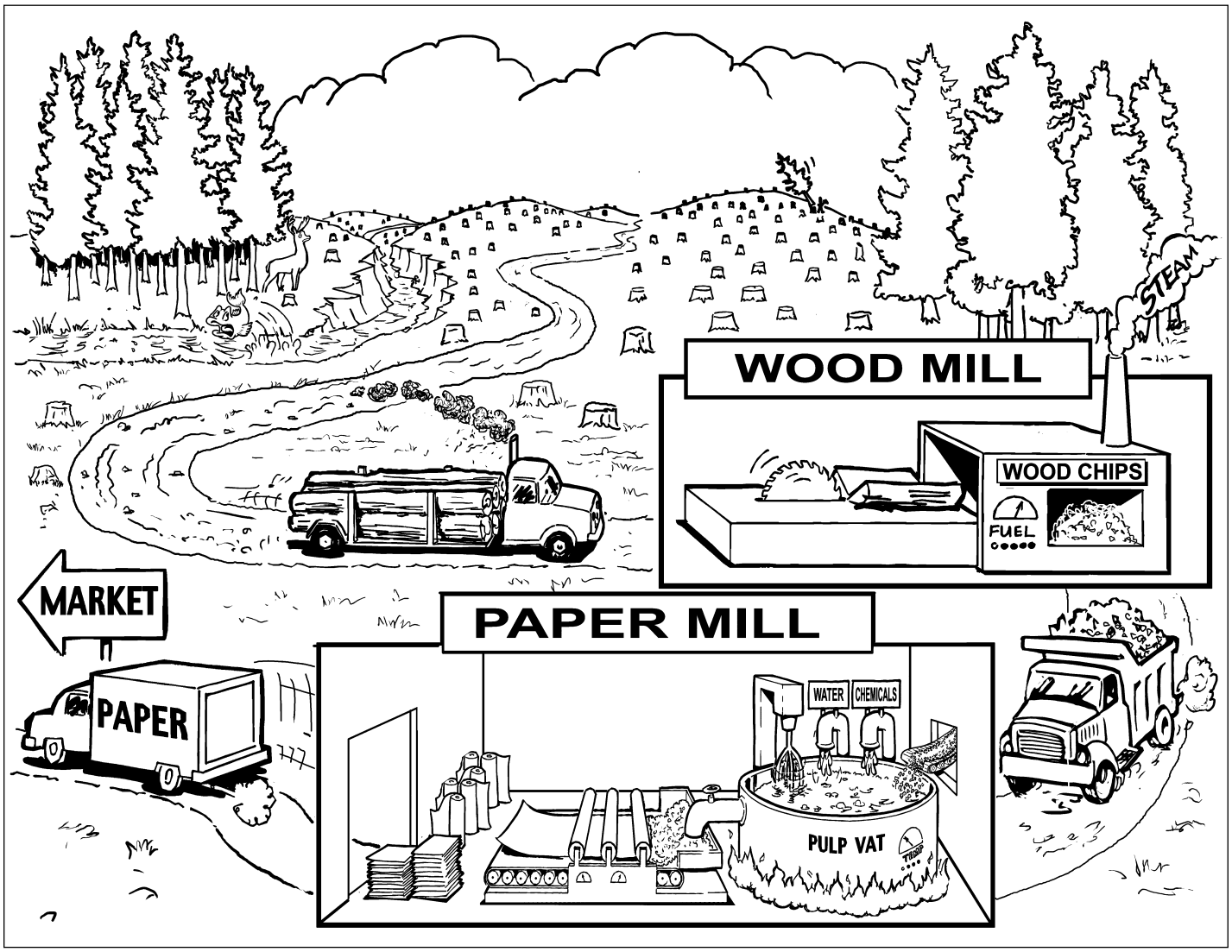
# From Tree to Paper Rubric

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 |
|---|---|---|---|---|
| **Participates in papermaking experiment** | Student follows directions well and produces recycled paper. | Student has difficulty in making recycled paper. | Student attempts to participate but fails to make recycled paper. | Student does not participate in the activity. |
| **Understands how recycled paper is made** | Student organizes all of the papermaking steps in the correct order. | Student organizes and lists some papermaking steps in the correct order. | Student organizes and lists a few papermaking steps, but a few are out of order. | Student does not attempt the assignment. |
| | | | | |
| | | | | |

# Teacher

# From Tree to Paper




Paper is made by processing wood from trees by first chipping the log into small pieces and then placing the pieces in a large pressure-heated digester where the chips are mixed with water and chemicals. When the wood is broken down into cellulose fibers, the fibers are then rinsed and a mushy mixture of water and wood remain. This is called “pulp.” The pulp is sprayed onto large screens where the water begins to drain from the pulp fibers. As the pulp fibers begin to dry, they bond together in a mat that will soon become a sheet of paper.

Student

# From Tree to Paper

**Day One:**

1. Write your **prediction** of what will happen to newspaper that is torn up and placed in a bucket of water overnight.

2. Write a **testable** question based on your prediction above about what will happen to newspaper when it is place in water.

Question: _____

**Day Two:**

3. Observe and record what happened to the newspaper in the bucket.

4. Was your prediction correct? Based on your observations, answer your testable question above.

5. Write instructions for a friend describing how to make recycled paper from newspaper using the same steps you followed in the classroom.

Name: _____ Date: _____

## DEFINITIONS

### Vocabulary:

***Paper:*** a thin material made of pulp from wood, rags or other fiberous material often used for writing, printing or packaging.

***Recycle:*** the process of producing new products from used material or the process of remanufacturing used materials into new products. Some used materials can be made into new items of the same thing. Others are made into entirely new items.

# Where in the World Do I Recycle It?



**OBJECTIVES:**

Students will:

1. learn about resources they can use to research reuse and recycling options for common household materials.
2. use reference materials to identify three items that are recyclable in their community and locate where they can be recycled.

**STANDARDS:**
Language Arts

**SKILLS:** Analysis, classification, description, problem solving

**SETTING:** Classroom/ Computer laboratory and Homework

**TIME:**
Classroom: 50 minutes
Homework: 10 minutes

**VOCABULARY:**
Recyclable
Recycle

## Introduction

***Overview:***
In this activity, students will use multiple sources of information to research reuse and recycling options for a variety of household goods.

### Teacher Background:

StopWaste.Org's *Recycling Guide* is a resource guide filled with references to locations in Alameda County that accept materials for reuse and recycling. The "Recycling A–Z" directory lists reuse and recycling businesses and facilities that accept different categories of materials, from aerosol cans to wood and yard trimmings. The guide also provides a table of recycling information for residents that lists recycling service providers and what they collect by city in Alameda County. In addition, the guide includes articles and resources for residents of Alameda County, such as how to order compost bins.

Note that different communities accept different materials for recycling.

### Materials:

***Students:***

- ❑ From home: three items that can be recycled
- ❑ "Where in the World Do I Recycle It?" worksheet (one per student)
- ❑ "Website Directions" handout (one per student)
- ❑ StopWaste.Org *Recycling Guide*: the "Reuse and Recycling Services Directory" pages (one per student)

***Teacher:***

- ❑ Various discarded items to supplement student supplies
- ❑ Rubric overhead
- ❑ Rubrics (one per student)

### Preparation:

Collect a wide variety of discarded items, and bring to class for students to research, e.g., eyeglasses, batteries, motor oil, etc.

Assign students to bring three items from home to research prior to the lesson.

Review the *Recycling Guide* contents before the lesson.

Call to request a set of *Recycling Guide*s at the Recycling Hotline at 1-877-786-7927 or at **www.StopWaste.Org**.

## ACTIVITY

***Discussion***

1. Ask the students whether anyone in their family has ever thrown something away because they weren't sure whether it could be recycled. Have them share some examples. Look around the classroom, and point out objects such as aluminum cans, batteries, books, eyeglasses, paint, light bulbs and paper notebooks. Tell them that these items often get discarded after use because people do not know how or where to reuse or recycle them.

2. Remind students that all these items were made from natural resources. Recycling keeps these valuable resources out of the landfill. When the items get recycled, they are remanufactured into new products. Recycling is the process of turning something old into something new.

3. Explain that many cities in Alameda County have different practices for accepting materials for recycling. Ask students to describe what their recycling bins look like and share examples of what they put in their bins. Point out the similarities and differences in what students can recycle at home depending on where they live.

4. Tell the class that not all cities recycle things the same way. Students must first identify their community or city where they live before discovering whether a certain material can be recycled. The goal of this activity is to become knowledgeable in using reference materials to find out what is recyclable in their community.

5. Show an overhead of the lesson rubric, and review the expectations for this lesson.

***Procedure***

*Homework (day before activity):*

1. Assign students to bring in three items from home that may or may not be collected for recycling in their community.

*Day of Activity:*

1. Inform the students that they will determine whether the items brought in from home can be recycled in their community by conducting research on a website or using a *Recycling Guide*.

2. Each student should have at least three items to research (pass out items as needed).

3. Tell the students they will be using the StopWaste.Org *Recycling Guide* or online version to conduct their research. Explain that this is a comprehensive guide to reuse and recycling resources in Alameda County.

4. Model how to use the printed guide by looking up an item such as aluminum cans to determine whether it can be recycled in the city where their school is located.

5. Pass out the StopWaste.Org *Recycling Guide* to each student or if using a computer, ask students to go to **www.StopWaste.Org**, and pass out the directions for using the website.

6. Pass out "Where in the World Do I Recycle It?" worksheet to each student.

7. Using various resources, have students answer the questions on the worksheet.

8. When they are finished, call on students to report something new they learned through their research.

***Wrap-Up***

1. Discuss and emphasize the wide variety of materials that can be recycled based on the students' findings.

2. Ask students to share their findings and explain the importance of recycling materials with friends and family.

***Final Assessment Idea***

Have students create a poster for the classroom or their home that shows family members what they can recycle in the city where they live.

## RESOURCES

### Extensions:

Have students develop plans for their families to reuse or recycle materials they are not currently reusing or recycling at home.

### 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.

| LANGUAGE ARTS | CONTENT STANDARDS |
|---|---|
| Grade 4 | **Writing Strategies**<br>*Research and Technology*<br>1.5. Students quote or paraphrase informational sources, citing them appropriately.<br>1.6. Students locate information in reference texts by using organizational features (e.g., prefaces, appendixes).<br>1.7. Use various reference materials (e.g., dictionary, thesaurus, card catalog, encyclopedia, online information) as an aid to writing. |
| Grade 5 | **Writing Strategies**<br>*Research and Technology*<br>1.3. Students use organizational features of printed text (e.g., citations, end notes, bibliographic references) to locate information. |

# Teacher

# Where in the World Do I Recycle It? 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 |
|---|---|---|---|---|
| **Identifies three places for reuse or recycling** | Student identifies three local places for reuse or recycling the items listed on their worksheet. | Student identifies two local places for reuse or recycling the items listed on their worksheet. | Student has difficulty identifying any local place for reuse or recycling the items listed on their worksheet. | Student does not attempt the assignment. |
| | | | | |
| | | | | |

Student

# Where in the World Do I Recycle It?

**Directions: Using the StopWaste.Org *Recycling Guide*, the phone book, and/or the www.StopWaste.Org website, research where you can reuse or recycle three items from home.**

**Name of Item:** _____

Where can you take this item for reuse or recycling? Write the name, address and phone number of two places.

1. _____
2. _____

**Name of Item:** _____

Where can you take this item for reuse or recycling? Write the name, address and phone number of two places.

1. _____
2. _____

**Name of Item:** _____

Where can you take this item for reuse or recycling? Write the name, address and phone number of two places.

1. _____
2. _____

Your neighbor has an item and they don't know what to do with it. You are going to help them!
Where can they get the information they need to reuse, recycle or compost that item?
Name at least two sources.

1. _____
2. _____

Pick one of the sources above. In three or more steps, explain how they can look up the information they need.

_____

_____

_____

_____

_____

_____

Name: _____ Date: _____

Student

# Where in the World Do I Recycle It? Website Directions

**To search on the Web, use the directions below:**

1. Go to the website **www.StopWaste.Org**.

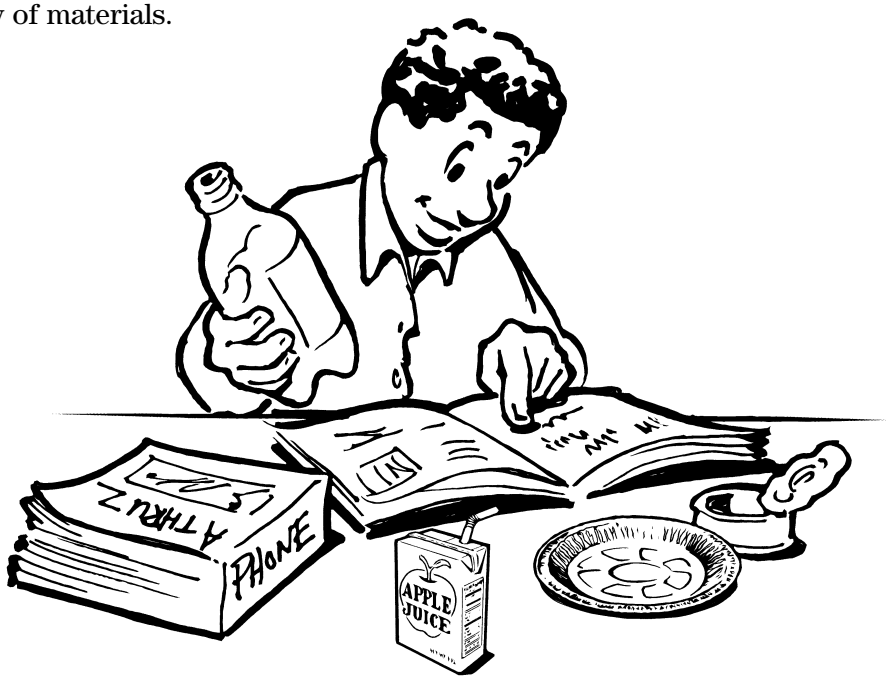
2. Scroll down to the bottom right of the page, and you will find the *Recycling Wizard.*

3. Under the question "Where Can I Recycle?" click on the arrow next to "Select a Material."

4. Select "All Materials" for a full listing of materials.
   or
   Select a category of materials such as Construction and Demolition, Electronic Devices, Glass, Hazardous Materials, Metal, Organic Materials, Paper, Plastic, Materials to be Reused, or Special Materials.

5. Once you find your material, click on it, and the link will tell you where you can reuse, recycle, or dispose of the material.

To research another material, go to the top of the page under "Where Can I Recycle?" to select another material or category of materials.




Name:_____ Date:_____

## DEFINITIONS

### Vocabulary:

***Recyclable:*** discarded materials such as paper, aluminum, tin, plastic, cardboard and glass that in most cases can be recycled and remanufactured into new products.

***Recycle:*** the process of producing new products from used material or the process of remanufacturing used materials into new products. Some used materials can be made into new items of the same thing. Others are made into entirely new items.

# What Is Biodegradable?



**OBJECTIVES:**

Students will:

1. define the differences between things that are biodegradable and nonbiodegradable.
2. identify five materials that are biodegradable and five that are nonbiodegradable.

**STANDARDS:** Science

**SKILLS:** Analysis, classification, description, problem solving

**SETTING:** Classroom and Outdoors

**TIME:** 45 minutes

**VOCABULARY:**
Biodegradable
Compost
Decomposition
Nonbiodegradable

## Introduction

***Overview:***
Students will watch a video that introduces the process of decomposition in a compost bin or pile. They will classify found objects collected on school grounds as biodegradable or nonbiodegradable.

### Teacher Background:

Items that we use every day are made from materials that can be classified as biodegradable or nonbiodegradable. Some of these materials such as plastics and metals are considered non-biodegradable. These materials will not decompose or biodegrade over a short period of time and will often remain intact in the environment for many years. In contrast, biodegradable materials such as food, plant trimmings and paper will decompose under ideal conditions over a relatively short period of time.

Composting is a great way to turn biodegradable materials into compost, a rich soil amendment for plants. Air, moisture, and microbial activity in a compost bin are essential to the process of decomposition. When biodegradable materials end up in a landfill, they will remain there for many years because of a lack of air, moisture and microbial activity. One easy way to reduce waste is to compost biodegradable materials at home or school. Some cities are even collecting food scraps and other organic materials in curbside bins usually with plant debris or wood. These materials will get composted on a much larger municipal scale.

### Materials:

***Students:***

- ❑ Plastic or paper bags (one per group)
- ❑ "Biodegradable vs. Nonbiodegradable" worksheet

***Teacher:***

- ❑ *Do the Rot Thing* video
- ❑ Examples of biodegradable and nonbiodegradable materials
- ❑ Rubric overhead
- ❑ Rubrics (one per student)

### Preparation:

Collect plastic or paper bags from home or grocery stores.

Request the *Do The Rot Thing* video from **www.StopWaste.Org**, or call the Recycling Hotline at 1-877-786-7927.

Organize students into groups of three to four (you will need an even number of groups).

## ACTIVITY

***Discussion***

1. Ask students to name items that get thrown away at school and at home. Record their suggestions on the board. Explain that some of the items listed on the board are biodegradable (circle these items) such as notebook paper, leaves and food scraps, which means they can easily decay.

2. Pass around some examples of biodegradable items. Ask students whether they can share some examples of items that may not decompose or decay over time. Have students point out nonbiodegradable items on the board and underline them. Pass around some examples of nonbiodegradable items.

3 Ask students whether they use more biodegradable or more nonbiodegradable materials.

4. Have students share their ideas on how to recycle biodegradable materials. Explain that these materials can be recycled through composting.

5. Tell the students that they will learn about biodegradable materials by watching a video of things decomposing over time in a compost bin and collecting examples of biodegradable and nonbiodegradable materials outside.

6. Show an overhead of the lesson rubric, and review the expectations for this lesson.

***Procedure***

1. Show the video *Do the Rot Thing*. Prepare the students to watch the video by assigning them to look for the differences between biodegradable and nonbiodegradable materials.

2. Lead students in a discussion about the video that will provide examples of the differences between biodegradable and nonbiodegradable. Review and define the concepts presented in the video.

3. Organize students into small groups. Assign half of the groups to take bags outdoors and collect items that they think are biodegradable, e.g., leaves, twigs, food scraps, etc. The other half will collect items that they think are nonbiodegradable, e.g., metals, plastics, rocks.

4. Pair up small groups (one biodegradable and one nonbiodegradable), and ask the groups to switch bags and examine the examples collected by the other group. For example, students in a group that collected nonbiodegradable items will examine biodegradable items collected by another group.

5. In groups, students will classify the items as biodegradable (organic materials from once living organisms) and nonbiodegradable (usually from nonliving origins, such as metal, rock, etc.). Some items may be moved from one collection into another if there is a group consensus.

6. As a class, discuss examples in each group that were difficult to classify.

7. Ask students how they could test objects to find out whether they are biodegradable. What evidence would they expect to observe that would indicate that the object is biodegradable? For example, what conditions are necessary for things to decompose (air, water, heat, etc.)?

8. Assign students to write a list of at least five items that are biodegradable and five items that are nonbiodegradable.

***Wrap-Up***

1. Have students compare and contrast the materials shown in the video to the materials collected outside. Discuss similarities and differences.

2. Ask the students whether they think they can find materials that are biodegradable at home. Discuss ways to recycle these materials such as starting a compost bin.

***Final Assessment Idea***

Have students write a description of the differences between items that are biodegradable versus those that are nonbiodegradable in their own words.



## Extensions:

Using the Internet, have students research how long it takes biodegradable waste items to decompose if placed in a 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** | **Life Science**<br>2.a. Students know plants are the primary source of matter and energy entering most food chains.<br>2.c. Students know decomposers, including many fungi, insects, and micro-organisms, recycle matter from dead plants and animals.<br>3.a. Students know ecosystems can be characterized by their living and nonliving components. |
| **Grade 5** | **Investigation and Experimentation**<br>6.a. Students will classify objects (e.g., rocks, plants, leaves) in accordance with the appropriate criteria. |

# Teacher

# What is biodegradable? 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 |
|---|---|---|---|---|
| **Identifies biodegradable items** | Student identifies five or more biodegradable items. | Student identifies four biodegradable items. | Student identifies two to three biodegradable items. | Student fails to do the assignment. |
| **Identifies nonbiodegradable items** | Student identifies five or more nonbiodegradable items. | Student identifies four nonbiodegradable items. | Student identifies two to three nonbiodegradable items. | Student fails to do the assignment. |
| **Describes the differences between biodegradable and nonbiodegradable items** | Student clearly describes the differences between biodegradable and nonbiodegradable items. | Student describes some differences between biodegradable and nonbiodegradable items. | Student has difficulty describing differences between biodegradable and nonbiodegradable items. | Student fails to do the assignment. |
| | | | | |
| | | | | |



Student

# Biodegradable vs. Nonbiodegradable

**Directions: List the items that are biodegradable and nonbiodegradable.**

| BIODEGRADABLE | NONBIODEGRADABLE |
|---|---|
| 1. | 1. |
| 2. | 2. |
| 3. | 3. |
| 4. | 4. |
| 5. | 5. |

1. Describe the differences between things that are biodegradable and nonbiodegradable.

2. Describe what would happen to a biodegradable item from your list if it began to decompose.

Name: _____ Date: _____

## DEFINITIONS

### Vocabulary:

***Biodegradable:*** organic materials that can decompose or decay, such as wood, food scraps, paper and grass clippings.

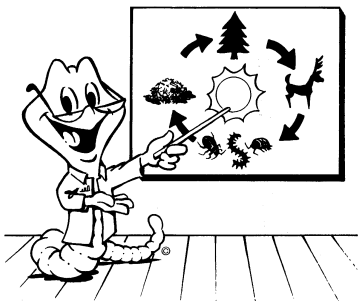
***Compost:*** the process or the end result of living organisms digesting and reducing organic material into a dark, rich, soil amendment.

***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 such as compost bins.

***Nonbiodegradable:*** inorganic materials that do not decompose, for example, glass, metal and plastic.



# 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 tbsp 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*)

***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 | **Life Sciences**<br>2.a. Students know plants are the primary source of matter and energy entering most food chains.<br>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.<br>2.c. Students know decomposers, including many fungi, insects, and microorganisms, recycle matter from dead plants and animals.<br>3.a. Students know ecosystems can be characterized by their living and nonliving components.<br><br>**Investigation and Experimentation**<br>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.<br>6.c. Students will formulate and justify predictions based on cause-and-effect relationships.<br>6.f. Students will follow a set of written instructions for a scientific investigation. |
| Grade 5 | **Investigation and Experimentation**<br>6.a. Students will classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria.<br>6.b. Students will develop a testable question.<br>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.<br>6.d. Students will identify the dependent and controlled variables in an investigation.<br>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.<br>6.g. Students will record data by using appropriate graphic representations (including charts, graphs, and labeled diagrams) and make inferences based on those data.<br>6.h. Students will draw conclusions from scientific evidence and indicate whether further information is needed to support a specific conclusion. |



# 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.

# Web of Life


**OBJECTIVES:**

Students will:

1. illustrate the food chain and the role of decomposers in a food web by playing a game of decomposition tag.

**STANDARDS:** Science

**SKILLS:** Analysis, classification, description, problem solving

**SETTING:** Classroom and Outdoors

**TIME:**
Classroom: 40 minutes
Outdoors: 10 minutes

**VOCABULARY:**
Carnivores
Consumers
Decomposers
Food chain
Food web
Herbivores
Omnivores
Producers

## Introduction

***Overview:***
In this lesson, students will learn about the food chain of a compost bin by playing a tag game that illustrates the role of decomposers in a food web.


### Teacher Background:

Decomposers play an essential role in all food chains. A food chain shows the relationship and sequence of one organism eating another.

Plants produce the food that will be eaten by animals called "herbivores." These plant-eaters are eaten by other animals called "carnivores." Dead plants and animals are decomposed by small organisms, including insects and fungi, called "decomposers." Decomposition frees small molecules of fertilizers that can dissolve in the soil to be taken up by the roots of plants and are essential for the growth and health of plants. The complete food cycle includes decomposers that are very important but often overlooked. Decomposers play an essential role in completing the food cycle. Without decomposers, the world would be covered in stuff. Decomposers are essential to any food chain because they recycle nutrients to be used again by producers and consumers.

### Materials:

***Students:***

- ❑ Two red paper armbands
- ❑ Four blue paper armbands
- ❑ Four white paper armbands (armbands can also be made from any reused material)

***Teacher:***

- ❑ "Food Chain in a Worm Bin" overhead
- ❑ Rubric overhead
- ❑ Rubrics (one per student)

### Preparation:

Make two red, four blue and four white armbands out of cloth or paper.

## ACTIVITY

***Discussion***

1. Define and explain the concept of a food chain. For example, a simple food chain usually starts with green plants that provide food for animals that eat plants, which provide food for animals like carnivores that eat other animals. A food chain demonstrates the transfer of energy between plants and animals. Usually a food chain does not show the actual food web that includes the decomposers.

2. Decomposers play an important role in the food chain because they recycle materials back into living systems by breaking down biodegradable materials into rich compost. Without decomposers the cycle of life could not continue.

3. Introduce the concept of a food web. For example, a food chain consists of four or five links, and each link provides food for the next (draw this on the board or overhead). A food web is made up of interconnected food chains. Many animals are part of more than one food chain because they eat more than one type of food. Ask students to share some examples of animals or insects that eat more than one kind of food.

4. Show the overhead "Food Chain in a Worm Bin" and discuss the role of decomposers in a worm bin (refer to "Compost Critter Information Pages" in Lesson 20).

5. Model for the students how to make a food chain using examples of decomposers shown on the "Food Chain in a Worm Bin" overhead. For example, dead organic matter is eaten by worms that are eaten by centipedes.

6. Explain that students will learn more about the role of decomposers in a food web by playing a walking game of decomposition tag.

7. Show an overhead of the lesson rubric, and review the expectations for this lesson.

***Procedure***

*Decomposition tag:*

1. Clearly explain the directions and rules of the game, assign students to roles and define the boundaries for the area used for the game.

*Tag game directions and rules:*

1. Assign two students to play the role of third-level consumers, which are highest on the food chain. For example, third-level consumers in a worm bin may include centipedes, spiders, or ants. Give these students red armbands to wear.

2. Assign four students to play the role of second-level consumers which are eaten by third-level consumers. Second-level consumers may include springtails and mold mites. Give these students blue armbands to wear.

3. Assign four students to play the role of first-level consumers, which are eaten by second-level consumers. First-level consumers may include slugs, millipedes, sow bugs, worms, etc. Give these students white armbands to wear.

4. Assign the remaining students to be producers, which are eaten by first- and second-level consumers. Producers may include plants or food scraps commonly placed in a worm compost bin.

5. When the game begins, the students assigned to be consumers should try to tag other students who represent food they would eat. For example, a student assigned to be a spider would tag a worm or millipede. A student assigned to be a worm might tag a food scrap. Use the overhead to demonstrate the different levels of consumers.

6. When a student is tagged, they must freeze in place. This signifies that they have been consumed.

7. Start and stop the game as necessary. There is no natural end. Let the participants play long enough to experience the concept that without decomposers, to recycle dead organic matter the food web would not be complete. Stop the game well before students get exhausted or lose interest.

***Wrap-Up***

1. Ask the students to explain what happened in the game and describe the important role of decomposers in a worm bin food chain.

2. Ask the students to predict what would happen if the world did not have decomposers.

***Final Assessment Idea***

Have students create their own food chain using examples of producers and consumers from the teacher overhead "Food Chain in a Worm Bin." This should include a producer and first-, second-, and third-level consumers.

## RESOURCES

### Extensions:

Ask students to create a diagram showing a food chain in a worm bin using drawings or pictures to represent each organism. Have them also state how energy is passed from one organism to the next.

### 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** | **Life Science**<br>2.a. Students know plants are the primary source of matter and energy entering most food chains.<br>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.<br>2.c. Students know decomposers, including many fungi, insects, and micro-organisms, recycle matter from dead plants and animals. |
| **Grade 5** | **Life Science**<br>2.a. Students know many multicellular organisms have specialized structures to support the transport of materials. |

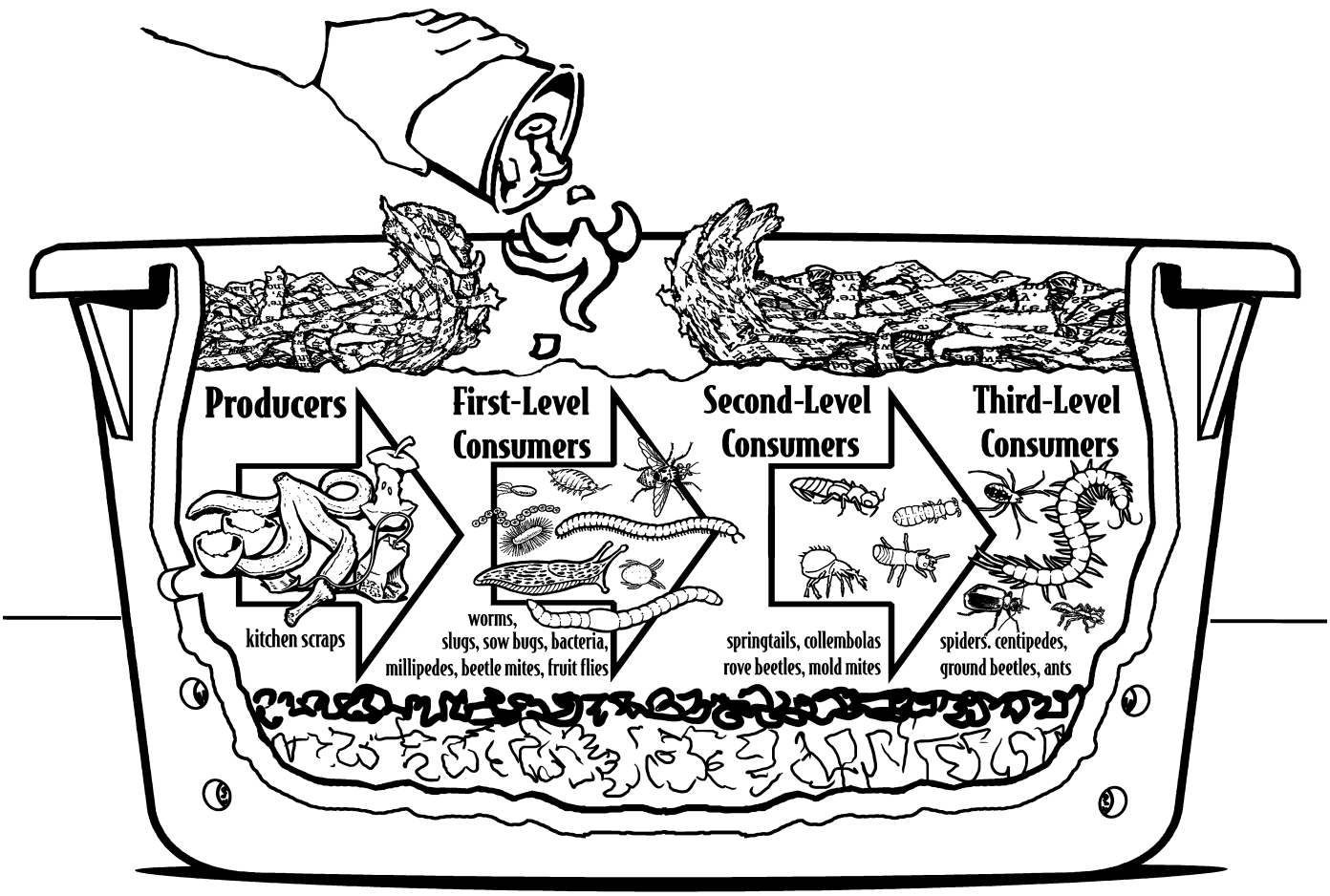
# Web of Life Rubric

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 |
|---|---|---|---|---|
| **Participates in the game** | Student performs well in assigned role. | Student performs assigned role with some difficulty. | Student is not able to perform assigned role without help. | Student fails to participate in the game. |
| **Describes a food chain** | Student writes out a food chain correctly showing various components including producers, first-, second-, and third-level consumers. | Student misses one level of the food chain. | Student misses several levels of the food chain. | Student does not do the assignment. |
| | | | | |
| | | | | |

# Teacher

# Food Chain in a Worm Bin



## DEFINITIONS

### Vocabulary:

***Carnivores:*** animals that eat other animals.

***Consumers:*** animals that get their food from other living things, plants or animals.

***Decomposers:*** an organism, including fungi, bacteria and invertebrates, that breaks down organic waste.

***Food chain:*** the sequence of one organism eating another organism. An example of a food chain is the following: green plants (using sunlight to grow) are eaten by sheep, which are eaten by wolves, which die and are eaten by decomposers, which free fertilizing material into the soil, which is needed by the plants to grow.

***Food web:*** many food chains that are interconnected.

***Herbivores:*** animals that eat plants.

***Omnivores:*** animals that eat both plants and animals.

***Producers:*** plants that make their own food using energy from the sun.

# Compost: How Do You Know?


**OBJECTIVES:**

Students will:
1. conduct a scientific experiment by forming a hypothesis, collecting data, analyzing data and drawing conclusions.
2. describe how compost benefits plant growth and soil health.

**STANDARDS:** Science

**SKILLS:** Analysis, classification, description, problem solving

**SETTING:** Classroom and/or School garden

**TIME:** First Day: 40 minutes
Bi-weekly: 10 minutes (2-3 weeks)
Last Day: 30 minutes

**VOCABULARY:**
Compost
Data
Experiment
Hypothesis
Soil amendment
Variable

## Introduction

***Overview:***
In this activity, students will learn about the benefits of adding compost to soil as an amendment. They will design and conduct their own experiment to test how compost affects plant growth.

### Teacher Background:

Compost is a rich soil amendment produced as a byproduct of decomposition. Decomposers, such as earthworms, bacteria, insects and fungi, eat food, plant waste and each other to produce compost. Compost is often added as a soil amendment in the garden. It helps increase soil nutrients, airflow, and the ability to hold moisture and improves soil texture. Compost can be made at home or school in a compost bin or purchased from a garden center.

The steps of the scientific method used in a complete experiment are the following:
1. Start with a testable scientific question.
2. Form a hypothesis or scientific guess about how to answer the question.
3. Develop a procedure that explains how you will test your hypothesis.
4. Collect data. What did you find out?
5. Form and report your conclusion based on the data collected. Was your hypothesis correct?

In this experiment, the challenge is to identify possible advantages or disadvantages of growing seeds with or without compost. One hypothesis could be that compost will help the plants grow bigger. The data may show that plants with compost grow taller faster. The conclusion would be that compost benefits plant growth and should be used as a soil amendment to fertilize plants.

### Materials:

***Students:***
- ❑ "Scientific Method" handout (copy of teacher overhead)
- ❑ "Plants in Compost" worksheet (one per student)
- ❑ "Group Experiment" worksheet (one per group)

*Planting supplies:(one set per group)*
- ❑ Compost (from compost bin or bag from garden center)
- ❑ Empty six-pack planter containers or six individual containers
- ❑ Tray for planters
- ❑ Potting soil (or soil from the yard)
- ❑ One pack of fast growing seeds, such as beans or sunflowers
- ❑ Measuring cup
- ❑ Masking tape (or craft sticks)
- ❑ Marker
- ❑ Ruler

***Teacher:***
- ❑ "Scientific Method" overhead
- ❑ Rubric overhead
- ❑ Rubrics (one per student)

### Preparation:

Be prepared to organize students into groups of three or four.

If you have a classroom worm compost bin, harvest the castings to use in the seed-planting experiment. See Lesson 24 for instructions on harvesting a worm bin.

## RESOURCES

***Discussion***

*Day One:*

1. Ask the students what they know about compost and why people add it to their gardens. Discuss what compost is, what soil is, and how compost benefits plants.

2. Explain to the students that in this activity they will conduct an experiment to determine how compost affects the growth of plants, but first as a class they must choose a question to answer about compost.

3. Show the overhead "Scientific Method," and explain the steps. Demonstrate how the students will be using the scientific method in their experiment by coming up with a hypothesis and procedure. For example, plants will grow bigger in compost than potting soil. This will be tested by planting seeds in compost and potting soil, making observations, and collecting the results.

4. Show an overhead of the lesson rubric, and review the expectations for this lesson.

***Procedure***

*Day One:*

1. Divide students into small groups.

2. Pass out "Plants in Compost" and "Group Experiment" worksheets, a copy of the "Scientific Method" overhead and the planting supplies (one set for each group).

3. Have the students use masking tape (or craft sticks) to mark two sections/containers with each of the following headings: #1 Compost, #2 Compost and Soil, #3 Soil.

4. Fill the #1 sections of the six-pack planter (or two containers) with compost.

5. Measure equal parts of compost and soil. Mix the compost and soil together, and fill the #2 sections.

6. Fill the #3 sections with potting soil.

7. Place three seeds in each of the sections. Set the containers aside in a warm, sunny area. Water according to the directions on the seed packet.

8. Have students complete the top section and the first columns titled "Plant" on their "Plants in Compost" worksheets. Then, ask students to make predictions about what will happen to their seeds over the next few weeks. Which soil mix will sprout the most seeds? Which will grow the fastest? Why?

9. As a group, have them write a hypothesis on their "Group Experiment" group worksheet describing what will happen to their seeds over the next few weeks.

*Weekly (two times a week for two to three weeks):*

1. In groups, ask students to observe and note the seeds' progress. They should record the date, record the number of seeds that have sprouted, measure the height of each plant, and record their observations on the worksheet.

***Wrap-Up***

*Last Day:*

1. After two to three weeks, ask the students to examine their data and draw conclusions from it. Which section grew the tallest plant? Which one looked the healthiest? Why? If they were going to plant other seeds, what mixture would they use?

***Final Assessment Idea***

Ask the students to explain how compost affects plant growth. Have them write instructions for a friend to conduct the "procedure" section of their experiment.

## RESOURCES

### Extensions:
Have students germinate seeds in the classroom to plant in a vegetable garden at home or school.

### 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** | **Investigation and Experimentation**<br>6.c. Students will formulate and justify predictions based on cause-and-effect relationships.<br>6.d. Students will conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.<br>6.f. Students will follow a set of written instructions for a scientific investigation. |
| **Grade 5** | **Investigation and Experimentation**<br>6.b. Students will develop a testable question.<br>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.<br>6.d. Students will identify the dependent and controlled variables in an investigation.<br>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.<br>6.f. Students will select appropriate tools (e.g., thermometers, meter sticks, balances and graduated cylinders), and make quantitative observations.<br>6.g. Students will record data by using appropriate graphic representations (including charts, graphs and labeled diagrams), and make inferences based on those data.<br>6.h. Students will draw conclusions from scientific evidence, and indicate whether further information is needed to support a specific conclusion. |

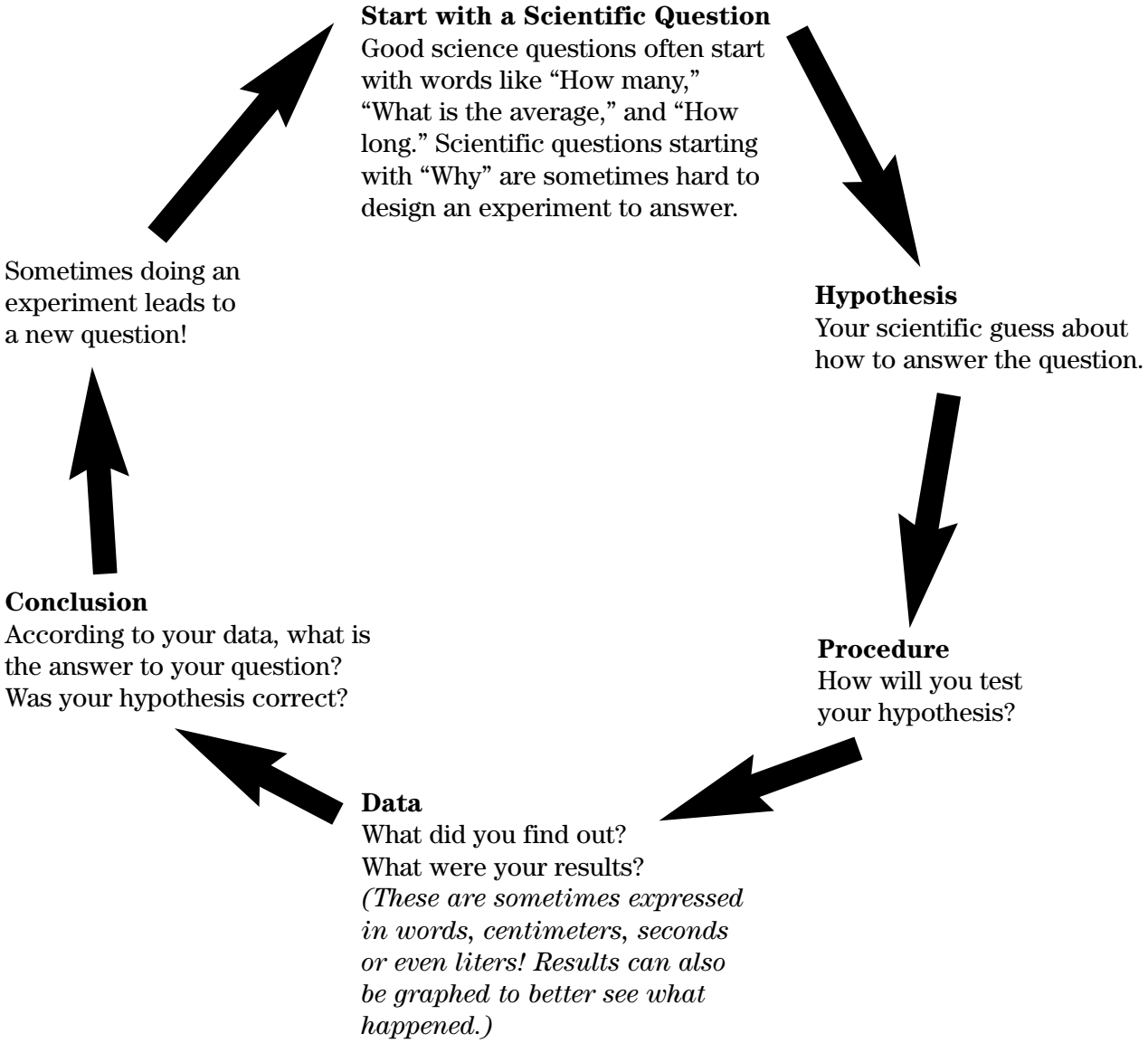

# Compost: How Do You Know? Rubric

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 |
|---|---|---|---|---|
| **Conduct scientific experiment that contains a scientific question, hypothesis, procedure, data collecting and conclusion** | Steps to the scientific method are complete and group provides exceptional detail and organization. | Steps to the scientific method are complete. | Steps to the scientific method are incomplete or do not include sufficient details. | Steps to the scientific method are incorrect or completely missing. |
| **Describe how compost benefits plant growth** | The group accurately describes how compost benefits plant growth. | The group provides some description of how compost benefits plant growth. | The group has trouble describing how compost benefits plant growth. | The group does not do the assignment. |
| | | | | |
| | | | | |

# Teacher

# Scientific Method



Student

# Plants in Compost

Plant species: _____ Date planted: _____

Potting mixtures: _____

#1 _____

#2 _____

#3 _____

| SPROUTING | PLANT | DATE | # OF SEEDS SPROUTED |
|---|---|---|---|
| **Section #1** | | | |
| **Section #2** | | | |
| **Section #3** | | | |

| GROWTH | PLANT | DATE | HEIGHT |
|---|---|---|---|
| **Section #1** | | Week 1 _____<br>Week 2 _____<br>Week 3 _____ | Week 1 _____<br>Week 2 _____<br>Week 3 _____ |
| **Section #2** | | Week 1 _____<br>Week 2 _____<br>Week 3 _____ | Week 1 _____<br>Week 2 _____<br>Week 3 _____ |
| **Section #3** | | Week 1 _____<br>Week 2 _____<br>Week 3 _____ | Week 1 _____<br>Week 2 _____<br>Week 3 _____ |

Name: _____ Date: _____

# Student

# Group Experiment

Our ***scientific question*** about compost is:

Our ***hypothesis*** is:

To ***test*** or answer our question (procedure) we will:

***Data:*** What we found out is: *(Data can be expressed in words, measurements or drawings.)*

***Conclusion:*** According to our data, our hypothesis…

Describe how compost benefits plant growth.

Name:_____ Date:_____



## DEFINITIONS

### Vocabulary:

***Compost:*** the process or the end result of living organisms digesting and reducing organic material into a dark, rich, soil amendment.

***Data:*** information gathered to find the answer to a scientific question.

***Experiment:*** the collection of data to discover whether a variable makes a difference.

***Hypothesis:*** a scientific guess based on observations.

***Soil amendment:*** something added to soil to increase nutrients, improve soil texture or improve how well the soil can hold onto or drain water.

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

# Compost Critters


**OBJECTIVES:**
Students will:
1. identify and describe some common compost critters.

**STANDARDS:** Science

**SKILLS:** Analysis, classification, description, problem solving

**SETTING:** Classroom

**TIME:** 40 minutes

**VOCABULARY:**
Compost
Consumers
Decomposers
Invertebrates
Organic waste
Producers

## Introduction

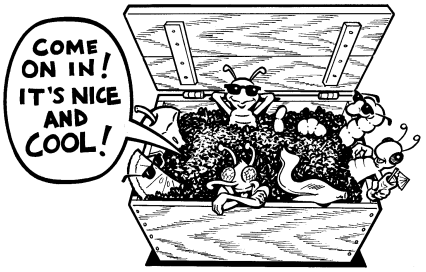
***Overview:***
In this lesson, students will sort through compost in groups. They will identify different types of compost critters that they observe and share what they have found with the class.

### Teacher Background:

There are many different animals that help break down organic materials into compost. These animals are networked together through a complex food web. Microscopic bacteria and fungi are the primary consumers in the compost pile. Bacteria are responsible for the majority of decomposition that occurs in compost. Other primary consumers are worms, mites, snails, slugs, springtails, collembolas and pill bugs. Eating these primary consumers are the secondary consumers, which can include other animals such as beetles, flatworms and ants. At the top of the compost food chain can be larger beetles, ants, spiders and centipedes.

Without decomposers, all life would stop because new plants would not have the nutrients needed to grow. Decomposers in a compost pile turn waste and plant debris into a rich soil amendment.

Organic material in a basic compost pile can be categorized as green or brown materials. Green materials include food waste such as vegetables, egg shells and old fruit. Fresh plant debris is also a green material. Brown materials include dry leaves and paper, which can be an important food source in a compost bin.




Other organic waste such as dryer lint, cotton fabrics and even hair can be added to a compost pile.

### Materials:

***Students:***
- ❑ "Compost Critters" worksheet (one per group)
- ❑ "Compost Critters Information Page" (one per student)
- ❑ Compost (at two stages of decomposition, e.g., new and aged)
- ❑ Popsicle sticks
- ❑ Newspaper
- ❑ Magnifying glasses, if available (one per group)

***Teacher:***
- ❑ "Web of Life in Nature" overhead
- ❑ "Food Chain in a Worm Bin" overhead
- ❑ Rubric overhead
- ❑ Rubrics (one per student)

### Preparation:

Be prepared to arrange students in groups of four.

Classrooom compost bins may not contain all the compost critters listed on the information pages. Obtain compost from an active compost pile or bin (not bagged compost). If you have problems obtaining active compost, go to **www.StopWaste.Org** or call 1-877-786-7927.

Review the "Compost Critter Information Pages" prior to the lesson to learn more about the role of decomposers in a compost bin or pile.

## ACTIVITY

***Discussion***

1. Discuss with the students the importance of decomposers. Without them, all life would stop because new plants would not have the nutrients needed to grow. Decomposers turn organic waste and plant debris into a rich soil amendment.

2. Ask students to describe different kinds of animals or invertebrates they have seen in or around soil.

3. Tell students that in nature and in the worm bin, there are producers, consumers, and decomposers that make up the web of life. Put up the overhead "Web of Life in Nature." Show them that producers (plants) get energy from the sun and produce food such as plants and trees for other animals. They are the primary source of food and energy entering a food chain. Consumers eat plants and each other. Decomposers such as worms break down nonliving organisms or organic material and turn it into rich soil for plants and trees to grow.

4. Review the role of producers and consumers in a compost bin using the overhead "Food Chain in a Worm Bin."

5. Ask the students what they think the producers are in a worm bin (the food waste we put in) and point out that just like in nature, plants are the primary source of food and energy in a food chain in the compost bin.

6. Tell the students that they will examine compost at two stages of decomposition and identify the animals/invertebrates they see. They will also classify the organisms as producers and consumers.

7. Have the class discuss how the compost critters should be handled (e.g., respect, be careful, etc.). Write the rules for handling on the board.

8. Show an overhead of the lesson rubric, and review the expectations for this lesson.

***Procedure***

1. Arrange students in groups of four.

2. Pass out the "Compost Critters" worksheet to each group.

3. Pass out "Compost Critters Information Page" to each group.

4. Explain that the students will be learning about different kinds of decomposers by using their worksheet and handout to identify organisms commonly found in compost.

5. Place a pile of compost at the front of the classroom and ask a representative from each group to collect some compost on a piece of newspaper along with a popsicle stick for each person in the group.

6. The students should identify the animals they observe in the compost by circling the ones they see on their "Compost Critter Information Page."

7. Once they identify a compost critter, they should read about it.

8. Next, have the groups look at the critters circled on the information page and have them classify each type as a producer or first-, second-, or third-level consumer on their worksheet.

9. Ask the students to share a few examples of compost critters they observed in their compost.

10. Ask each student to hand in their completed worksheet.

***Wrap-Up***

1. Lead a discussion about which compost critters are first-, second-, or third-level consumers and producers. Which group found the largest amount of different types of compost critters? Ask students to share examples of items they found.

2. Ask the students to explain how each of the compost critters is important and what its role is in a compost bin.

***Final Assessment Idea***

Have students select two or three critters they identified and using their own words write a description and the role of each critter.



## RESOURCES

### 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** | **Life Science**<br>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.<br>2.c. Students know decomposers, including many fungi, insects and micro-organisms, recycle matter from dead plants and animals.<br>3.a. Students know ecosystems can be characterized by their living and nonliving components. |
| **Grade 5** | **Physical Science**<br>1.h. Students know living organisms and most materials are composed of just a few elements.<br>**Investigation and Experimentation**<br>6.a. Students will classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria. |

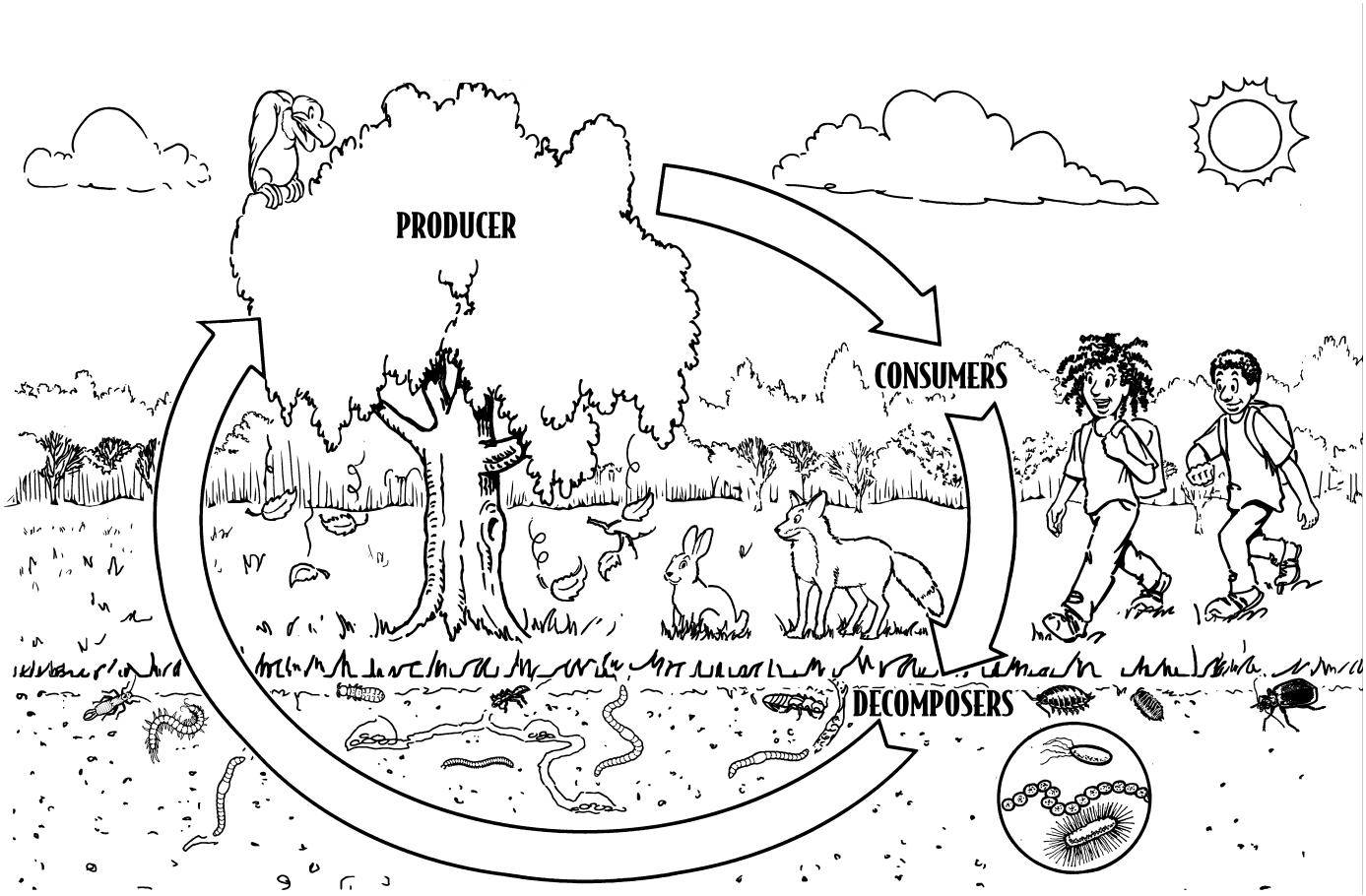
# Teacher

# Compost Critters 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.

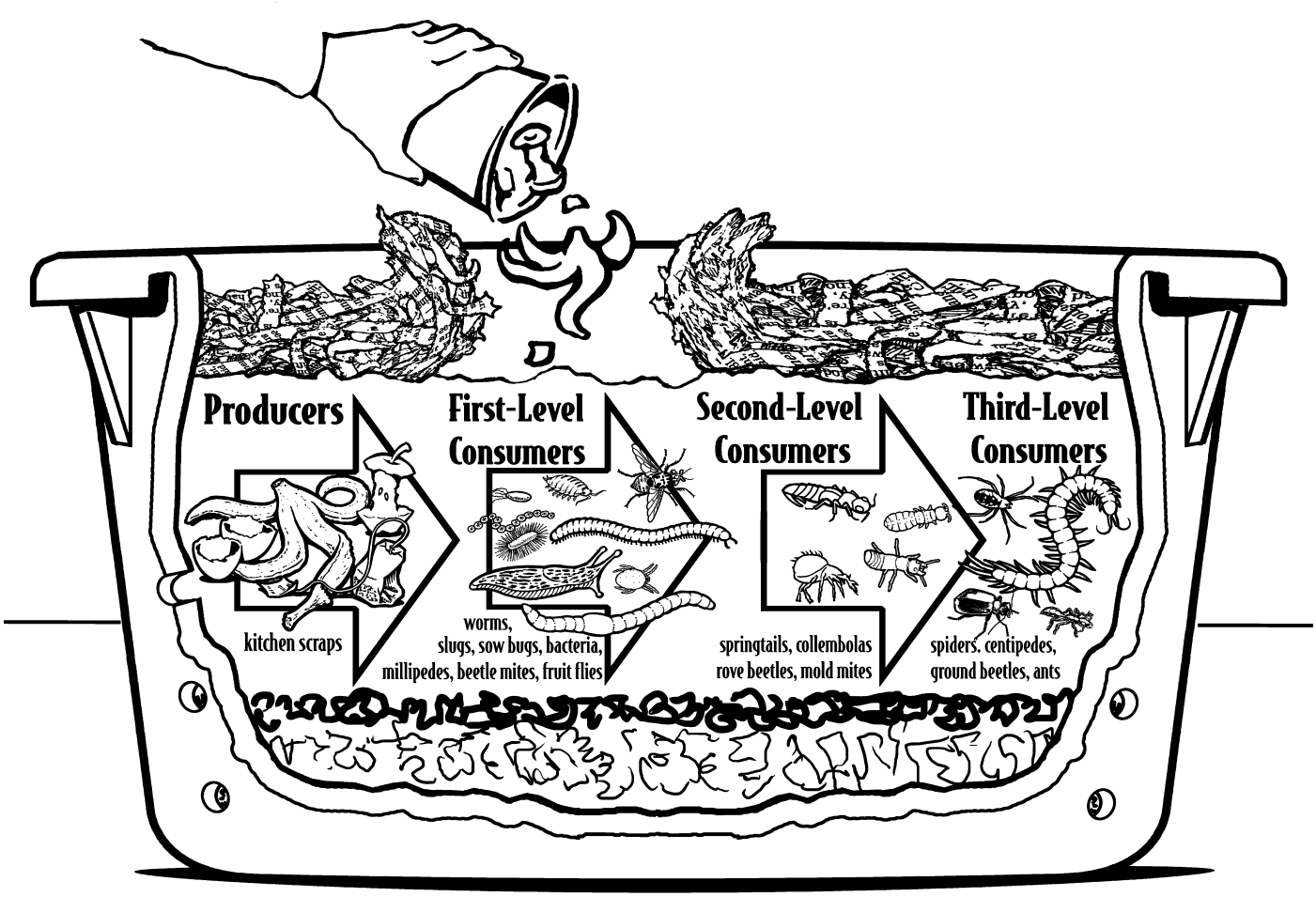
| CATEGORY | 4 | 3 | 2 | 1 |
|---|---|---|---|---|
| **Identify compost critters** | Group identifies most of the compost critters. | Group identifies some of the compost critters. | Group identifies a few compost critters. | Group fails to identify any compost critters. |
| **Classify and describe the role of each compost critter** | Student is able to classify and describe each identified compost critter. | Student has difficulty classifying and describing compost critters. | Student can describe very little about any compost critter. | Student does not describe any compost critters. |
| | | | | |
| | | | | |

# Web of Life in Nature

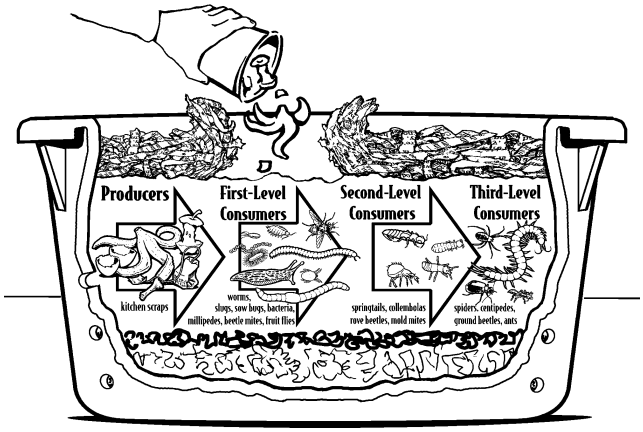


# Teacher

# Food Chain in a Worm Bin



# Compost Critters




**Directions: Write the names of producers and consumers you found in the compost and describe their role in a compost bin using the diagram above.**

Producers:

1. _____

2. _____

3. _____

Role of producers in a compost bin:

_____

_____

_____

First-level consumers:

1. _____

2. _____

Role of first-level consumers in a compost bin:

_____

_____

Second-level consumers:

1. _____

2. _____

Role of second-level consumers in a compost bin:

_____

_____

Third-level consumers:

1. _____

2. _____

Role of third-level consumers in a compost bin:

_____

_____

Name:_____ Date:_____

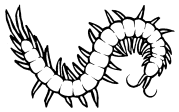
# Student

# Compost Critters Information Page

**Pill Bug or Roly Poly**

I am an isopod, which means I have ten pairs of legs that look very similar to each other. I eat old leaves and veggie scraps. I am about 1⁄2 inch long, and I roll up in a ball if I am disturbed. Some people think that I look like a little armadillo. I am a grayish, dark color.

**Centipede**



I move quickly on my many legs. I have fifteen to 137 segments with a pair of legs on each. I am a fierce hunter. I love to eat earthworms. I use my pair of poison claws to help keep my prey from getting away. I am about one to two inches long. I am usually reddish brown.

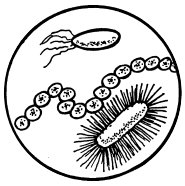
**Ant**

I am an insect with six legs. I help to decompose by breaking materials into smaller particles. I create tunnels and move soil into clumps. Some people would rather not have me around their homes. I am black, brown, or red.

**White Worm**

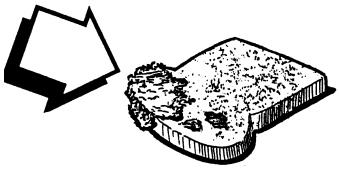
I look like a frayed piece of thread. I am a skinny, white worm. I am 1⁄2 to one inch long. I am related to an earthworm. I like to eat rotting food after the other bugs get to it. You might think of me as one who likes to finish off the job.

**Bacteria**



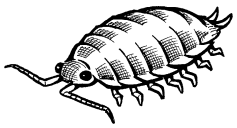
We are so tiny that you can't even see us; we are everywhere. We are colorless and can eat almost anything. Some of us live together in groups and others don't.

**Mold**



I am a fungus. I am related to mushrooms. Most of us live on old food. You might see me on old food in your home or your worm bin.

**Sow Bug**



I have ten pairs of legs. That makes me an isopod like my cousin the roly poly. I eat vegetation and old leaves. My 1⁄2 inch body is oval and flat with flattened plates, but I can't roll into a ball like roly poly. I am related to crayfish and lobsters. I breathe with gills, so I must live in a damp, moist place. I am a dark grayish color.

**Earthworm**

I am a long, thin soft-bodied animal. My body is made up of little segments. I do not have legs or eyes. I sense light, and I breathe though my skin. I eat bacteria, fungi, and other decaying materials. I like dark, moist places.

**Fruit Fly**

I am a very small fly. People don't like me, but I don't bite, sting, or make buzzing sounds. I don't harm earthworms either. Sometimes you will see me around a worm bin if a person forgot to bury their food. I like to lay my eggs where it's moist and warm.

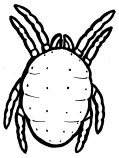
Name:_____ Date:_____

# Compost Critters Information Page

**Slug**

I have muscular disks on my undersides that are adapted for creeping and crawling. I lay egg masses that look like Jello. I eat living plant material but will make an appearance from time to time in your compost pile to eat fresh food scraps and garden trimmings.

**Mite**



I am tiny. It would take twenty-five of us to cover an inch-long line. My body is round and fat so it's hard to see my eight legs. I eat mold and plant materials such as soft tissues of leaves. Some of us eat manure of other organisms. I am usually white or brown.

**Millipede**

I have so many legs you would have a hard time counting them. My name means "thousand legs," but I don't have that many. I am very shy, and I roll up in a ball to avoid danger. I am a vegetarian and eat soft, moist, decaying plants. I am dark red in color and am 1/2 inch to one inch long.

**Springtail**

I am a tiny insect less than 1/16 inch long. I eat molds and decaying materials. I have a little spring that helps me jump high into the air. I am white in color.

**Collembola**

I am a close relative of the springtail, but I can't jump. I am tiny, less than 1/16 of an inch long. I eat molds and decaying matter. I am white in color.

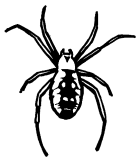
**Beetle**

I am an insect with shiny black, tough wings and am about 1⁄2 inch long. I am a predator and eat slugs, snails and soft insects such as caterpillars. I live beneath stones, boards and other moist places.

**Snail**

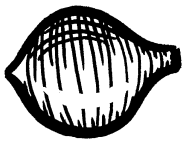
Like my friend, the slug, I am a mollusk and creep around on my muscular belly. I carry on my back a spirally curved shell. I also have a broad retractable foot and a distinct head. Like slugs, I prefer to eat living material, but I will also show up in your compost pile or worm box from time to time for lunch.

**Spider**



I am related to mites and have eight nifty legs. I am one of the least appreciated animals in the garden and compost bin or pile. I feed on other insects and work hard to help control pests that can damage a garden.

**Worm Cocoon**



You can find me in a worm bin or compost pile. Before I have hatched, I am clear and yellowish, the shape of a lemon, and 1/8 inch long. After I have hatched I turn pea green. Two or more baby worms are hatched at once.

Name:_____ Date:_____

## DEFINITIONS

### Vocabulary:

***Compost:*** the process or end result of living organisms digesting and reducing organic material into a dark, rich, soil amendment.

***Consumers:*** animals that get their food or energy from other living things, plants or animals.

***Decomposers:*** an organism, including fungi, bacteria and invertebrates, that breaks down organic waste.

***Invertebrates:*** animals that do not have a back bone. They are cold-blooded so they depend on the temperature of their environment to regulate their own body temperature.

***Organic waste:*** wastes made of natural products such as food, leaves, hair, clothing fibers and yard trimmings.

***Producers:*** plants that make their own food using energy from the sun.



# Wonderful Worms!


**OBJECTIVES:**
Students will:
1. observe a worm, identify and describe different parts of a worm's anatomy.

**STANDARDS:** Science

**SKILLS:** Analysis, classification, description, problem solving

**SETTING:** Classroom

**TIME:** 60 minutes

**VOCABULARY:**
Blood
Crop
Digestion
Esophagus
Gizzard
Heart
Intestine
Pharynx

## Introduction

***Overview:***
In this lesson, students will learn about worms by observing live red worms in groups and answering questions about worms based on their observations.

### Teacher Background:

Worms are incredible decomposers. The worms used for composting are surface feeders called "Eisenia fetida" pronounced (eye-SEN-ee-uh FE-ti-duh). They are also called "manure worms," "red wigglers," or "red worms." More than 7,000 species of worms inhabit the world, and they have always been important to ecosystems.

There are a lot of interesting facts to know about a worm's biology. Their body is designed primarily for digestion and reproduction. They prefer dark, damp environments underground, they breathe through their skin, and their bodies are made up of 90 percent water.

A worm tunnels through the soil by using a complex system of muscles that move its body segments. Each segment has bristles, called "setae," which are attached to the skin and help with movement. Worms do not have eyes or teeth. They use gritty soil particles, held in their gizzard, to grind the food they take in through a muscular mouth opening.

Worms have five hearts and iron-rich hemoglobin-based blood. They are hermaphroditic, so each worm has both male and female sexual organs. Worms drop a cocoon and have offspring; each cocoon may produce two to four worms. Eight adult red worms can produce 1,500 offspring within six months, if conditions are favorable.

### Materials:

***Students:***
- ❑ "Warming Up to Worms" worksheet (one per student)
- ❑ "Worms Inside and Out" handout (one per student)
- ❑ Magnifying boxes or glasses (one per group)
- ❑ Worms (one to two per group)
- ❑ Damp paper towel (one per group)

***Teacher:***
- ❑ "Worm Anatomy" overhead Rubric overhead
- ❑ Rubrics (one per student)

### Preparation:

Be prepared to organize students into groups of four and assign group roles.

Purchase red worms at a gardening store or fish and tackle store; or contact **www.StopWaste.Org**, or call 1-877-786-7927 for more sources.

## ACTIVITY

***Discussion***

1. Using a KWL chart, ask students to brainstorm questions they have about red worms and record what students "Know and Want to Know" about red worms.

2. Discuss how red worms are recyclers (because they eat organic waste like food scraps and turn it into valuable compost).

3. Tell the students that they are going to investigate the answers to their questions about red worms by observing red worms.

4. Show an overhead of the lesson rubric, and review the expectations for this lesson.

***Procedure***

1. Organize the students into groups of four or more.

2. Distribute the "Warming up to Worms" worksheet to each group member.

3. Explain and discuss the anatomy of worms by using the overhead of "Worm Anatomy."

4. Explain that all group members will participate in completing their worksheet by using their handout to help answer the questions.

5. Assign one student in each group to serve as the materials manager with the responsibility of getting and returning materials. Assign a second student in each group to serve as the reporter who will later describe the group's findings to the class. A third student will specialize in using the page "Worms Inside and Out" to help others. A fourth student is assigned the role of recorder.

6. Discuss the appropriate way to handle worms. For example, students should wash their hands before and after handling the worms, treat them with respect, be careful, etc. Write the class rules for handling on the board.

7. Ask the materials manager from each group to collect a worm on a damp paper towel and a magnifying lens.

8. Ask the groups to observe their worm using a magnifying lens and draw or sketch their worm on the worksheet.

9. Distribute "Worms Inside and Out" handout to each student.

10. Ask the group to complete the remaining questions on their worksheet.

***Wrap-Up***

1. Ask the reporters from each group to share one or two answers from their worksheets. If there are any questions that remain unanswered from the KWL chart, brainstorm ways to research the answers to those questions.

2. Once you have completed reviewing their answers, use the KWL chart to address what the student learned about red worms.

3. Ask the students to explain the importance of worms as decomposers.

***Final Assessment Idea***

Have students create a three-dimensitonal model of a red worm by reusing materials to show different parts of a worm's anatomy.



## RESOURCES

### Extensions:

Have students review the KWL chart and identify questions they have about worm behavior. Next, ask them to set up an experiment to test one of their questions about worm behavior using the scientific method.

### 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** | **Life Science**<br>3.b. Students know that in any particular environment, some kinds of plants and animals survive well, some survive less well and some cannot survive at all. |
| **Grade 5** | **Life Science**<br>2.a. Students know many multicellular organisms have specialized structures to support the transport of materials.<br>2.b. Students know how blood circulates through the heart chambers, lungs and body and how carbon dioxide ($CO_2$) and oxygen ($O_2$) are exchanged in the lungs and tissues.<br>2.c. Students know the sequential steps of digestion and the roles of teeth and the mouth, esophagus, stomach, small intestine, large intestine and colon in the function of the digestive system.<br>2.d. Students know the role of the kidney in removing cellular waste from blood and converting it into urine, which is stored in the bladder.<br>2.g. Students know plant and animal cells break down sugar to obtain energy, a process resulting in carbon dioxide ($CO_2$) and water (respiration). |

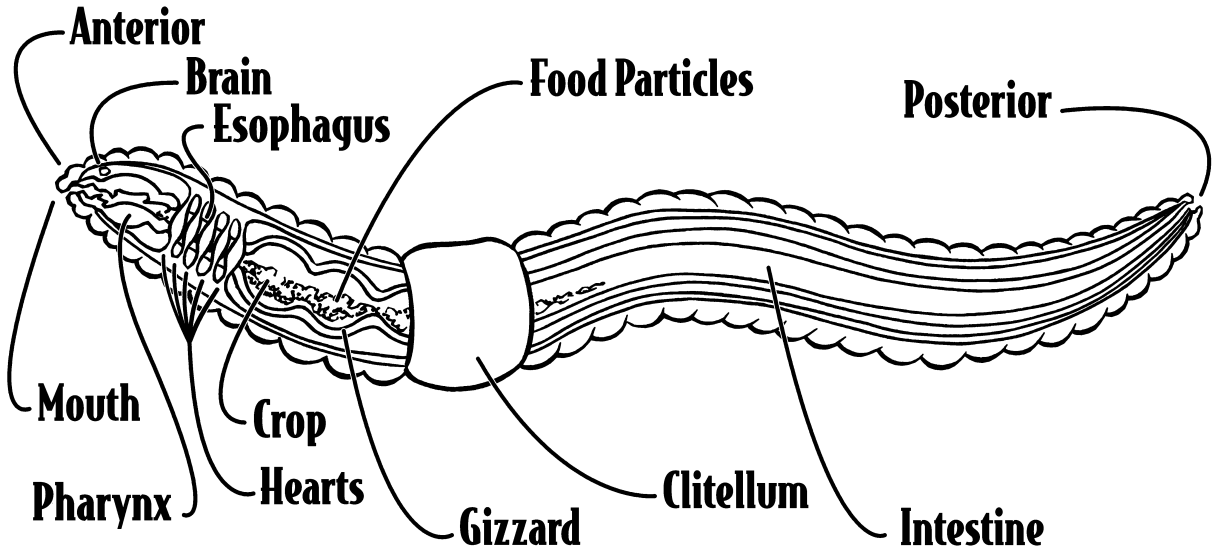
# Teacher

# Wonderful Worms! 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 |
|---|---|---|---|---|
| **Identifies and describes different parts of a worm's anatomy** | Student correctly identifies and describes all parts of a worm's anatomy. | Student correctly identifies and describes some parts of a worm's anatomy. | Student identifies and describes a few parts of a worm's anatomy. | Student does not complete the assignment. |
| **Executing group role** | Student does well executing their group role. | Student has difficulty in executing their group role. | Student does little to execute their group role. | Student does not attempt to execute their group role. |
| | | | | |
| | | | | |

# Worm Anatomy




***Anterior:*** The head is located at the anterior end of the worm's body. The anterior end is closer to the clitellum and usually more pointed than the posterior end. Red worms have no eyes and cannot see. They use light-sensitive skin cells at the anterior end of their body to sense light and move away from it.

***Brain:*** Red worms have simple brains that help direct body movement when exposed to light.

***Clitellum:*** Adult red worms have a distinct swelling called a "clitellum" located closer to the anterior end of the body. Each worm has a set of both male and female sexual organs. Two worms must join up to mix the sperm and egg. During this process, the clitellum releases a sticky secretion that holds the sperm and egg together. This secretion will eventually harden. As the worm wriggles backwards out of the hardened shell, the egg and sperm are deposited, and the secretion seals together to form a cocoon shaped like a lemon.

***Crop:*** Red worms have a crop or storage compartment for food before it moves to the gizzard.

***Esophagus:*** Once food is taken in through the pharynx the food particles go through the esophagus and on to the crop.

***Food particles:*** Soil or organic material passes through a red worm's tube-like digestive system before it is broken down and excreted as castings or vermicompost.

***Gizzard:*** A red worm has a tube-like digestive system. As food particles are ingested, they enter the esophagus and may be stored in the crop before going to the gizzard. Red worms often store small rocks in the gizzard to help grind up food particles before they pass them on to the intestine.

***Hearts:*** Red worms have five pairs of hearts.

***Intestines:*** As food passes through the intestine, nutrients are taken in and the food is digested.

***Mouth:*** Red worms do not have teeth. They use their highly muscular mouth, pharynx and gizzard to break up food particles. A sensitive tongue-like lobe located above the mouth called a "prostomium" is used as a sensory device.

***Pharynx:*** Red worms push their pharynx or throat out of their mouth to grab food particles.

***Posterior:*** The tail end of the worm.

# Student

# Warming Up to Worms

1. Draw or sketch your worm:

2. What color is the worm? _____

3. What shape is the worm? Describe it. _____

_____

4. How does the worm's skin feel? _____

_____

5. Is there a difference between the top side and bottom side of a worm? Describe what both sides are like.

_____

_____

6. Can you tell where the front end of the worm is and where the tail is? How do you know?

_____

7. Does a worm have the following:

a. Ears? ❑ Yes ❑ No

b. Eyes? ❑ Yes ❑ No

c. Legs? ❑ Yes ❑ No

d. A nose? ❑ Yes ❑ No

e. A mouth? ❑ Yes ❑ No

8. Describe the similarities of a worm's anatomy to a human's anatomy.

_____

_____

Describe the differences.

_____

_____

9. How does your worm move? Describe it. _____

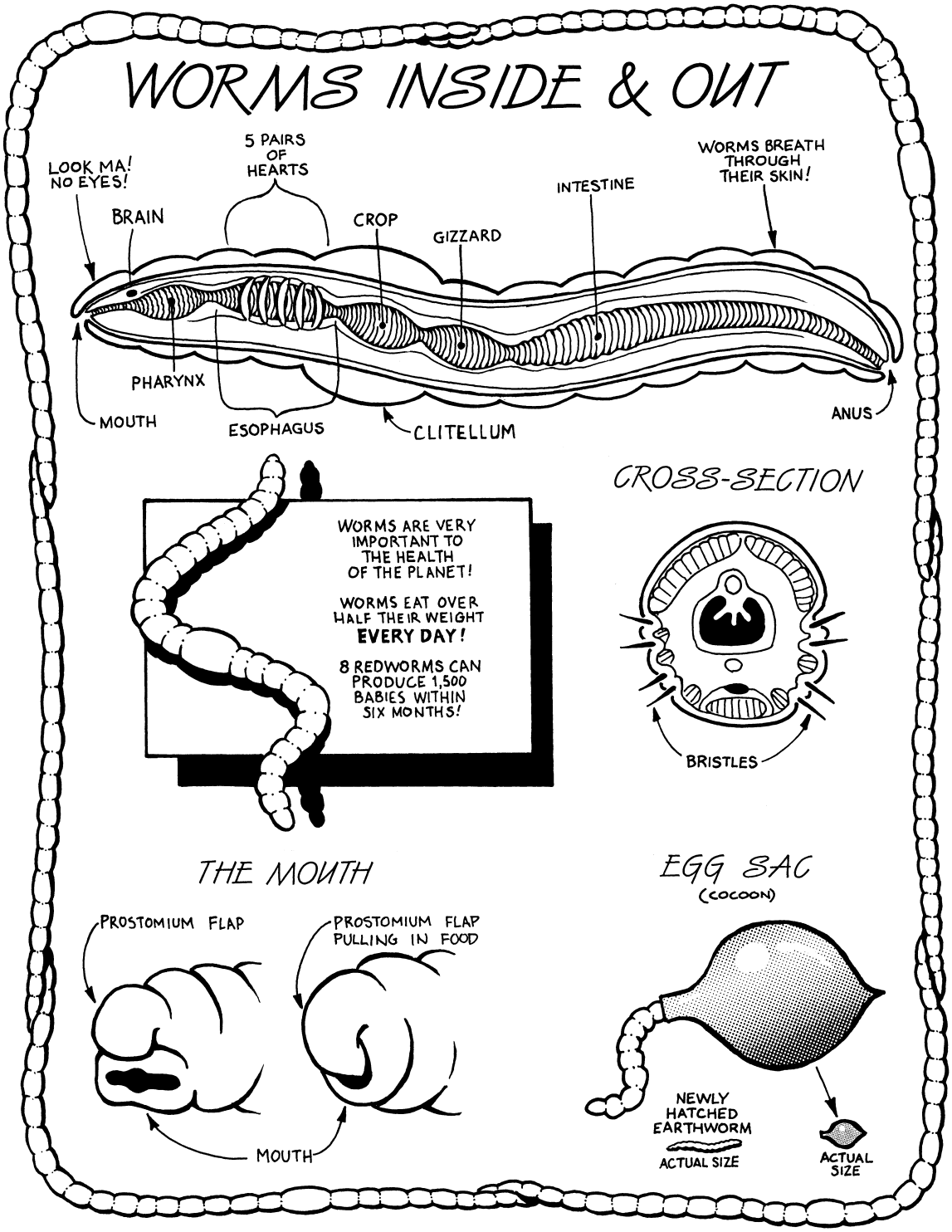
_____

10. Do you have an adult or immature worm? Describe the difference. _____

_____

Name: _____ Date: _____

# Worms Inside and Out




Name:_____ Date:_____

# Student

# Worms Inside and Out

**Skin**
Red worms do not have lungs. They breathe through their moist skin. If their skin dries out, they will die. They have tiny hairs called "setae" between their body segments that help them move. Red worms do not have eyes; they use light-sensitive skin cells to sense light.

**Mouth**
Red worms do not have teeth. They use their pharynx to grab food.

**Brain**
Red worms have a simple brain.

**Pharynx**
Red worms push their pharynx or throat out of their mouth to grab food particles.

**Hearts**
Red worms have five pairs of hearts.

**Esophagus**
Once food is taken in through the pharynx the food particles go through the esophagus and on to the crop.

**Crop**
The crop is storage compartment for food before it moves to the gizzard.

**Gizzard**
Red worms sometimes swallow small stones that are stored in the gizzard, which grinds up food particles before they pass on to the intestine.

**Clitellum**
Adult red worms have a swelling on their body or band called the "clitellum." They are hermaphrodites, meaning they have both male and female organs. Worms mate by joining their clitellum together exchanging sperm. Then each worm forms an egg sac or cocoon inside the clitellum.

**Intestine**
Food passes through the intestine where nutrients are dissolved and absorbed into the bloodstream.

Name:_____ Date:_____



## DEFINITIONS

### Vocabulary:

***Blood:*** the fluid in an animal's blood vessels that carries food and oxygen to the cells throughout the body.

***Crop:*** a pouch-like compartment to store food, before it is ground up, that is found in many birds and insects.

***Digestion:*** the process of breaking down food into small molecules that can be absorbed by the intestine and used by the body.

***Esophagus:*** the muscular tube that leads from the pharynx to the stomach (or in some animals to the crop) and pushes food through this part of the canal.

***Gizzard:*** a second stomach with a thick muscular lining found in birds and other animals where food is ground up. Worms sometimes store small stones in their gizzard to help grind up their food.

***Heart:*** the muscle in animals that pumps blood through the body.

***Intestine:*** the long tube in animals where food is digested and absorbed into the body.

***Pharynx:*** the part of the canal between the cavity of the mouth and the esophagus.

# Building a Compost Pile


**OBJECTIVES:**

Students will:
1. build an outdoor compost pile in a compost bin.
2. describe what compost is, how it is used and why it is important.
3. sort organic materials into greens (nitrogen) and browns (carbon).

**STANDARDS:** Science

**SKILLS:** Analysis, classification, description, problem solving

**SETTING:** Classroom and outdoors

**TIME:** 45 minutes
Ongoing: 5–10 minutes, once a week

**VOCABULARY:**
Big Four
Biodegradable materials
Compost

## Introduction

***Overview:***
In this lesson, students will learn about the process of decomposition by setting up a compost bin at school. They will collect biodegradable materials to place in the bin, learn about how compost is made and why it is important.

### Teacher Background:

Compost returns valuable nutrients to the soil. Composting is an excellent way to demonstrate the cycle of life, which includes life, death, decomposition and rebirth.

The essential ingredients of a compost pile include the BIG FOUR: browns (carbon), greens (nitrogen), air, and water. Browns are dry and woody plant trimmings, such as wood chips, dried leaves, and straw. Browns are rich in carbon. Greens are moist vegetable and fruit scraps, green leaves and fresh herbivore manure. Greens are rich in nitrogen. A good compost pile will have approximately half brown materials and half green materials by volume. Decomposer organisms need air and water to break down organic matter. Turning and watering the compost pile provides it with the air and moisture necessary for the microorganisms to thrive. The pile should be as moist as a wrung-out sponge.

The compost bin needs to be located close to a source of water and resistant to rodents. A rodent-resistant bin has a top and a bottom, and all openings are smaller than a quarter-inch.


The pile should be located outdoors and preferably on top of soil.

### Materials:

***Students:***
- ❑ Pitchfork or spading fork
- ❑ Green and brown plant trimmings such as woody or dry plant trimmings and green leaves, etc.
- ❑ Yard clippers
- ❑ Water
- ❑ Compost bin
- ❑ Flat-edged shovel
- ❑ "Brown and Greens" homework
- ❑ "Building a Compost Pile" worksheet

***Teacher:***
- ❑ Brown and green materials for the compost bin
- ❑ Rubric overhead
- ❑ Rubrics (one per student)

### Preparation:

For information on how to obtain a school compost bin or composting advice for teachers in Alameda County call 1-877-786-7927 or 510-444-SOIL. You can also visit **www.StopWaste.Org**.

Optional: Assign students to bring in organic materials collected from home to help build the compost pile.

Assemble compost bin before the lesson.

## ACTIVITY

***Discussion***

1. Explain the cycle and concept of decomposition. A compost pile is a home for decomposers. Bacteria, earthworms and other creatures actually eat organic materials placed in the compost bin, breaking them down into food that plants can use. The end product is a rich, dark-brown, earthy-smelling material called "compost."

2. Ask students to describe materials from home or school that might decompose in a compost bin. Explain that composting is nature's way of recycling these materials through the decomposition process.

3. Show an overhead of the lesson rubric, and review the expectations for this lesson.

***Procedure***

1. For homework: Ask students to bring in organic materials collected from home or school to help build the compost pile. Explain that organic materials are biodegradable and include things like banana peels, dried leaves, etc.

2. Pass out the "Browns and Greens" homework sheet to each student.

3. Have students list the items they brought from home on the top half of their homework sheet.

4. Explain the basics of composting and that it is essential to have the proper mixture of the BIG FOUR: browns, greens, air and water.

5. Explain the three main steps to building a compost pile:
   a. Chop materials to six inches or less.
   b. Mix browns and greens (half of each by volume).
   c. Maintain moisture by keeping the pile as wet as a wrung-out sponge.

6. Review the steps and write on the board.

7. Show some examples of organic materials that are classified as "Greens" and "Browns" (see teacher background for examples). Ask students to group and categorize their organic materials as "Greens" or "Browns" and record their findings on their homework sheet.

8. Assign students to the following tasks:
   a. Chop materials
   b. Layer greens and browns
   c. Mix layers
   d. Water layers

9. Follow the steps below to build a compost pile and describe ongoing maintenance and how to harvest the finished compost.

   *Starting a Compost Pile:*
   a. Chop greens and browns down to six inches or less in size to speed up the decomposition process.
   b. Start with a layer of browns at the bottom of the pile. Next add an equal layer of greens. Note: Fruit and vegetable trimmings should be buried and mixed into the center of the pile so it's best to add them after mixing the layers.
   c. Keep adding equal layers of browns and greens.
   d. Add water. The pile should be about as wet as a wrung-out sponge.
   e. Stir the layers together to increase air flow in the pile.
   f. Add food scraps in the center of the pile and bury.
   g. Add a final layer of browns.

   *Ongoing:*
   1. Add equal amounts of greens and browns at least once a week.
   2. Keep the pile as wet as a wrung-out sponge.
   3. Turn or mix the pile about once a week, adding a final layer of browns to the top of the pile each time.

   *Harvest Compost:*
   1. After about three to eight months, harvest the finished compost by sifting out course, unfinished materials (these materials can be added to the new pile).
   2. Apply finished compost to amend soil prior to planting as a mulch or top dressing on planted areas or as an amendment to potting soil (make sure the compost is completely decomposed before using it).

10. Pass out a "Building a Compost Pile" worksheet to each students and have the students complete their worksheets.

***Wrap-Up***

1. Review the basics of composting and why it is important.

2. Create a plan for the ongoing maintenance and eventual harvesting of the compost bin.

3. Have the class design a maintenance schedule that describes how often the pile will be turned, watered, etc. Assign students to these roles.

4. Ask students to hypothesize what will happen to materials added to the compost bin over time.

***Final Assessment Idea***

Ask students to create a book that illustrates and describes the steps to starting a compost bin. They should discuss why they think it is important to compost materials and how composting helps reduce waste.

## Extensions:

Have students harvest the compost bin and use the compost to amend the soil in a school garden or take the finished compost home to use.

## 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** | **Life Science**<br>2.a. Students know plants are the primary source of matter and energy entering most food chains.<br>2.c. Students know decomposers, including many fungi, insects and micro-organisms, recycle matter from dead plants and animals.<br>3.a. Students know ecosystems can be characterized by their living and nonliving components. |
| **Grade 5** | **Life Science**<br>2.g. Students know plant and animals cells break down sugar to obtain energy, a process resulting in carbon dioxide ($CO_2$) and water (respiration). |



# Building a Compost Pile 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 |
|---|---|---|---|---|
| **Builds a compost pile** | Student participates in their assigned role to build the compost pile. | Student has difficulty participating in their assigned role to build the compost pile. | Student participates outside of their assigned role to build the compost pile. | Student does not participate in building the compost pile. |
| **Describes how to use compost and why it's valuable** | Student clearly describes why compost is valuable and how to use it. | Student describes how to use compost, but not how it is valuable. | Student has difficulty describing how to use compost and why it is valuable. | Student does not attempt assignment. |
| | | | | |
| | | | | |

# Student

# Browns and Greens

**Directions: Write the names of organic materials you collected from home.**

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

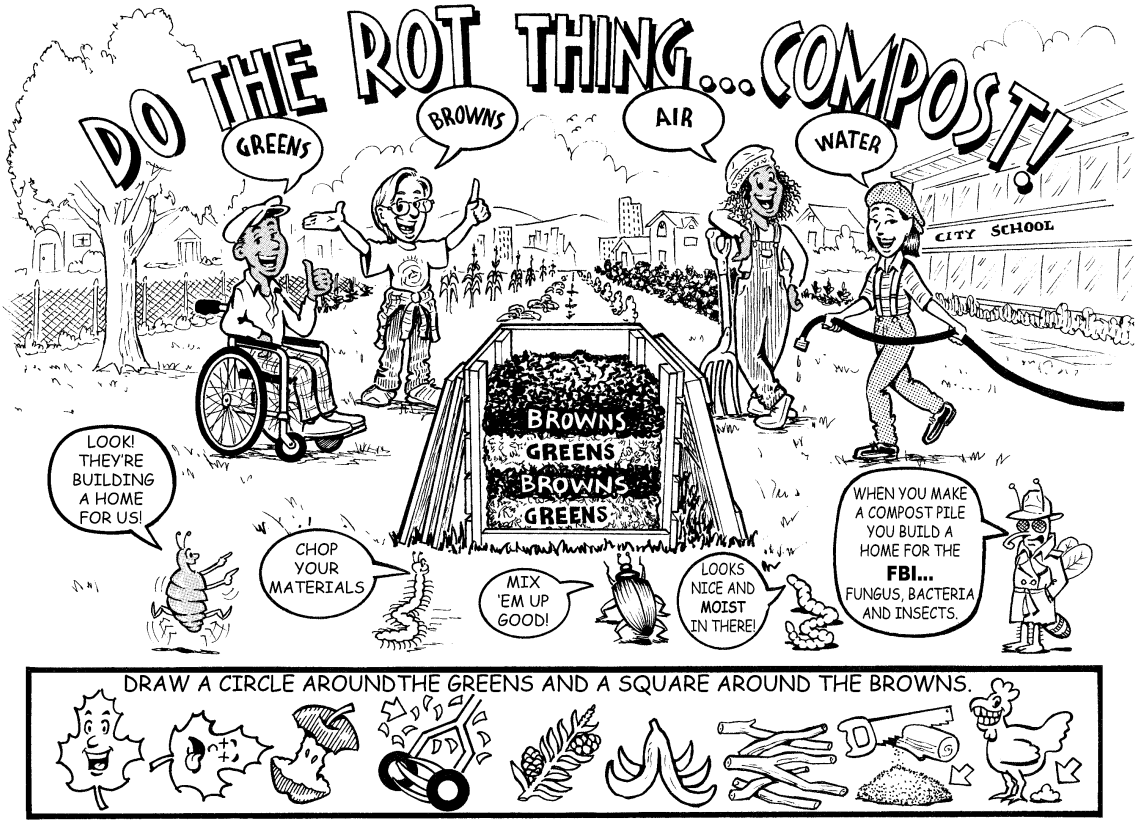
**Directions: Write the names or draw a picture of green and brown materials from the list above.**

| **Greens**: | **Browns:** |
| --- | --- |
| | |

Name: _____ Date: _____



# Building a Compost Pile




1. What is compost?

2. Describe how compost is used.

3. Why is compost important?

Name: _____ Date: _____

## DEFINITIONS

### Vocabulary:

***Big Four:*** the four main ingredients necessary in a composting system – air, water, greens (nitrogen) and browns (carbon).

***Biodegradable:*** organic materials that can decompose or decay, such as wood, food scraps, paper and grass clippings.

***Compost:*** the process or the end result of living organisms digesting and reducing organic materials into a dark, rich, soil amendment.



# Setting Up a Worm Bin


**OBJECTIVES:**

Students will:
1. set up and maintain a worm compost bin in the classroom.
2. learn about the importance of worms as decomposers and identify other compost critters in the bin.

**STANDARDS:** Science

**SKILLS:** Analysis, classification, description, problem solving

**SETTING:** Classroom

**TIME:** Setting up bin: 30 minutes
Ongoing: 5 minutes daily to once a week, maintaining bin by adding food
Worm bin observation: 30 minutes (2–3 weeks after setup)

**VOCABULARY:**
Bedding
Compost
Decomposition
Food scraps
Organic
Red worms
Worm bin
Worm castings
Vermicompost

## Introduction

***Overview:***
In this lesson, students will set up a worm compost bin in the classroom, maintain the bin and observe how the contents change over time.

### Teacher Background:

Worm composting is a fun, low-maintenance way of recycling food scraps and other organic material. Red worms or composting worms eat vegetative food scraps and turn them into a high-quality fertilizer known as "worm castings." Worms can thrive in a composting bin as long as they have moisture, air, bedding, and food. Worm composting can be done inside or outside, requires no turning, is odorless if done correctly and can be done in small spaces. Worm composting is most appropriate for food scraps (no meat or dairy).

Worms like to eat decomposable matter that we throw away such as apple cores, melon rinds, and soggy bread, breaking organics materials down into a rich, dark brown, earthy-smelling material called "worm castings." Castings are a nitrogen-rich fertilizer that is good for lawns, gardens and houseplants.

### Materials:

***Student:***
- ❑ Newspaper
- ❑ Handful of soil
- ❑ Popsicle sticks or cotton swabs
- ❑ Water
- ❑ Food scraps
- ❑ "Worms at School" worksheet

***Teacher:***
- ❑ One pound of red worms
- ❑ Worm bin
- ❑ Rubric overhead
- ❑ Rubrics (one per student)

### Preparation:

For infomation on obtaining a school worm compost bin for teachers in Alameda County call 1-877-786-7927. Get worm composting advice by calling 510-444-SOIL. You can also visit **www.StopWaste.Org**.

Assemble compost bin before the lesson. See information in the "Teachers Resources" on building a worm bin.

Optional: Assign students to bring in vegetable or fruit scraps collected from home.

## ACTIVITY

***Discussion***

1. Introduce worm composting by discussing the importance of worms as a waste reduction strategy. Worms help reduce waste by turning food scraps and other organic materials into a rich soil amendment.

2. Describe how worms turn vegetable and fruit scraps into compost. For example, red worms eat vegetable food scraps, digest the scraps and produce rich vermicompost that can be used as soil ammendment.

3. Ask the students what conditions worms need in order to live in a worm bin (darkness, moisture, moderate temperatures, bedding and food).

4. Tell the students that they will be setting up a worm bin in the classroom that will help reduce organic waste. The students should try to save fruit and vegetable scraps from their lunches to feed the worms instead of throwing them away.

5. Show an overhead of the lesson rubic, and review the expectations for this lesson.

***Procedure***

1. Give each student the "Worms at School" worksheet.

2. Explain how to prepare the worm bin bedding by modeling how to tear newspaper into 1/2" to 1" wide strips. Tear about ten sheets of newspaper lengthwise with the grain. Dunk the newspaper strips in water (the paper should be wet as a wrung-out sponge), and add to the bin. Add a handful of soil, and fluff the "bedding" like a big salad.

3. Add worms and food: purchase or obtain about one pound of red worms (about 500 to 1,000 worms). See the "Teachers Resources" section for worm sources. Gently place the worms on top of the moist bedding near the bottom of the bin. Put about a handful of food waste near the worms and cover the worms and food well with the moist newspaper bedding. Add more dry, shredded newspaper to fill the bin to the top. This will keep fruit flies out of the worm bin.

4. Let the worm bin rest by not adding any additional food for one to two weeks. This allows the worms a chance to get used to their new environment and for the food to begin to decompose.

5. For ongoing maintenance, feed the worms from one to several days a week, always burying the food under paper. Do not overfeed. Bad odors or large amounts of uneaten food indicate overfeeding. Add more paper as needed to cover food. Make sure to never include meat or dairy.

6. After several weeks, the students may do an exploration of the worm bin. Hand out piles of material from the worm bin on newspaper and provide the students with popsicle sticks or cotton swabs. Organize the students into groups of four or six. Have them list all of the things they see in the compost and answer these questions: Can you see pieces of food? What kinds? What kind of compost critters are present? Are the worms active? Describe.

7. Worm castings will be ready to harvest from the worm bin after three to six months. Refer to Lesson 24, "Harvesting a Worm Bin," for information on how to harvest worm castings.

***Wrap-Up***

1. Ask students to share some reasons for using worms to compost food scraps. You may share some of the following reasons:
   a. We will reduce the amount of garbage we create.
   b. Compost improves the soil and makes it hold water better.
   c. When we use compost, we use fewer chemical fertilizers and avoid creating pollution.
   d. Composting is fun!

2. Have them explain how worms turn food scraps into compost.

3. Explain to the students that after three months, they will harvest the worm bin.

***Final Assessment Idea***

Have students write an expository paragraph that describes the sequence of setting up a worm bin and how the contents of the bin has changed over time based on their own observations.

## RESOURCES

### Extensions:

Have students measure the weight of food scraps that are added to the worm bin for one week. Have them calculate how much food they have diverted from the waste stream for one month by composting it instead of throwing it away.

### 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** | **Life Science**<br>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.<br>2.c. Students know decomposers, including many fungi, insects and micro-organisms, recycle matter from dead plants and animals.<br>3.a. Students know ecosystems can be characterized by their living and nonliving components. |
| **Grade 5** | **Life Science**<br>2.g. Students know plant and animals cells break down sugar to obtain energy, a process resulting in carbon dioxide ($CO_2$) and water (respiration). |

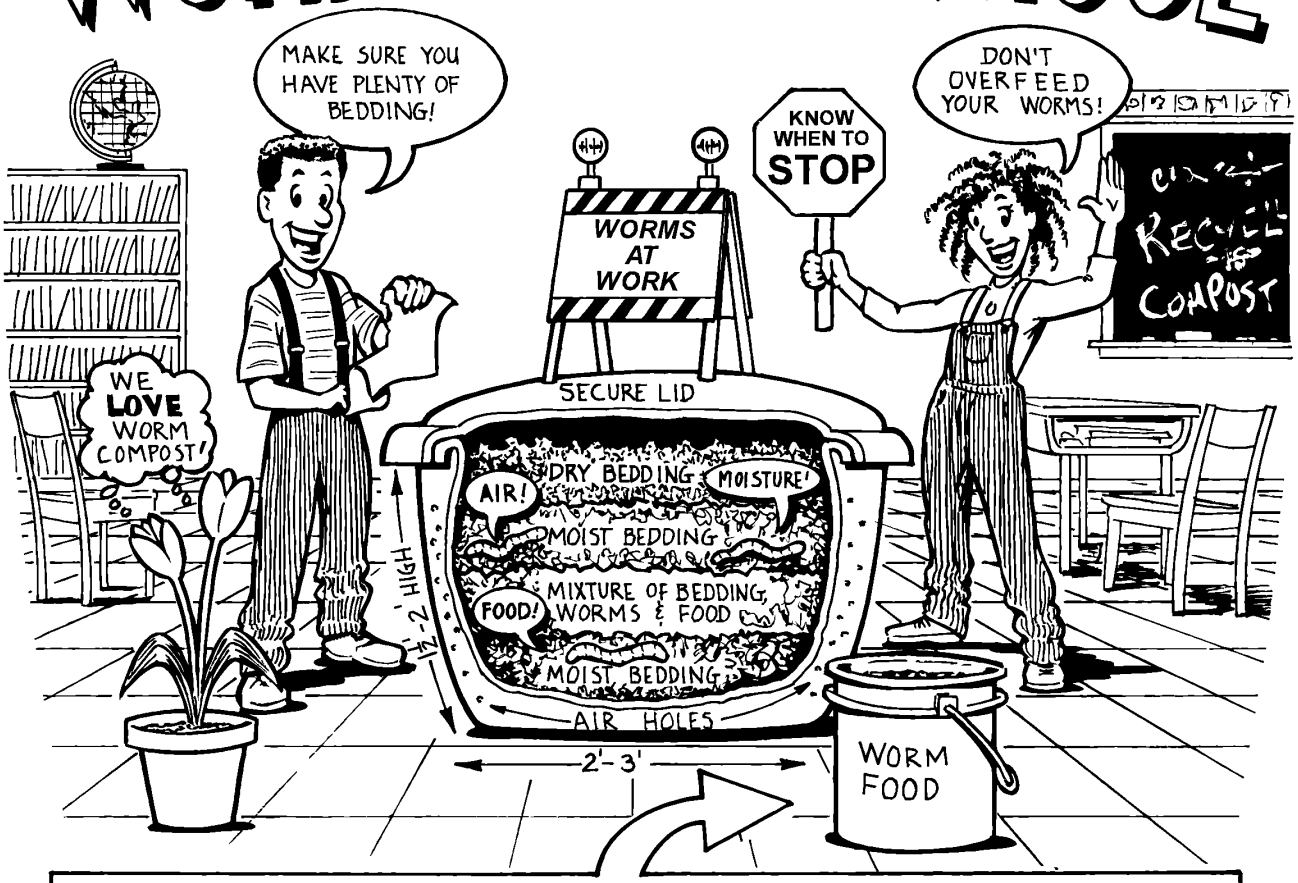
# Teacher

# Setting Up a Worm Bin 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 |
|---|---|---|---|---|
| **Setting up the worm bin** | Student helps with setting up the bin. | Student tries to help with setting up the bin. | Student does little to help with setting up the bin. | Student does not help with setting up the bin. |
| **Maintaining the worm bin** | Student helps maintain the bin. | Student sometimes helps maintain the bin. | Student does little to help maintain the bin. | Student does not help maintain the bin. |
| **Exploring the worm bin** | Student examines and identifies the contents in the bin. | Student examines and identifies some content in the bin. | Student examines very little content in the bin. | Student does not examine the content in the bin. |
| | | | | |
| | | | | |

# WORMS AT SCHOOL




HERE ARE JUST A FEW "KITCHEN SCRAP" TYPE THINGS WORMS LOVE TO EAT!

APPLE CORES | ORANGE PEELS | EGG SHELLS | SHREDDED PAPER | TORTILLA CHIPS | COFFEE GRINDS | MELON | LETTUCE | BREAD CRUST

- LIKE HUMANS, WORMS NEED _____ , _____ & _____ TO LIVE.
- SHREDDED PAPER PROVIDES THE _____ FOR WORMS TO LIVE IN.
- WORMS MAKE _____ THAT CAN BE USED ON PLANTS.

Name: _____ Date: _____

## DEFINITIONS

### Vocabulary

***Bedding:*** material such as dried leaves or shredded paper used to retain moisture, create air space and cover food scraps in a worm composting system.

***Compost:*** the process or end result of living organisms digesting and reducing organic material into a dark, rich, soil amendment.

***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 such as compost piles.

***Food scraps:*** food that can be put into a compost bin, typically fruit and vegetable scraps. Meat, dairy and oils are excluded because they can attract pests.

***Organic:*** any materials that were once living or materials 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.

***Red worms:*** the type of worm typically used in worm composting systems. Red worms can be found in leaf mold and manure piles and can be purchased in bait shops and some gardening stores. Their Latin (scientific) name is *Eisenia fetida*.

***Worm bin:*** a container used to hold worms, food scraps and bedding for composting.

***Worm castings:*** worm manure or the final product of worm composting. It is a high-quality, rich soil amendment that is used to fertilize plants.

***Vermicompost:*** compost produced in a worm composting system. It is a mixture of partially decomposed organic waste, bedding and worm castings. When finished, it is a balanced, nutrient-rich compost for the garden.

# Harvesting a Worm Bin


**OBJECTIVES:**

Students will:

1. harvest a worm bin and learn about the application and benefits of worm castings.
2. describe how red worms make worm castings from food scraps in a worm bin.

**STANDARDS:** Science

**SKILLS:** Analysis, classification, description, problem solving

**SETTING:** Classroom and/or outdoors

**TIME:** 45 minutes

**VOCABULARY:**
Compost
Compost tea
Vermicompost
Worm bin
Worm castings
Worm leachate

## Introduction

***Overview:***
In this lesson, students will learn about three different methods used to harvest an active worm bin. They will test these methods by working at different stations and brainstorm ways to use worm castings.

### Teacher Background:

Harvesting a worm bin allows students to observe different stages of the decomposition cycle. The students will recall the type of food scraps and other materials they placed in the worm bin during the months leading up to harvesting. They will have an opportunity to observe the compost or castings that the worms have made. Worm castings are a high-quality organic fertilizer for plants.

There are several methods for harvesting a worm compost bin. After about six months, there may be an inch to several inches of vermicompost at the bottom of the worm bin. This can be harvested using one of the following methods:

***Bucket method:*** all of the bin contents are placed into a bucket, filled with water, and the contents are strained so worms and any remaining food can be returned to the worm bin.

***Light method:*** the compost is placed into small piles on a tarp which may be placed in indirect sun or under a source of light in the classroom. The worms will move to the center or bottom of the piles to avoid the light. The castings on top of the piles can be removed and placed into a bucket.

***Migration method:*** all of the bedding, worms, castings and food is pushed over to one side of the bin. Stop adding food to that side. Set up the empty side like a new worm bin with moist bedding, food and dry bedding. The worms will migrate to the new side and the vermicompost can be harvested from the old side.

### Materials:

***Student:***

- ❑ Reused plastic bags, bottles or cups to fill with worm castings or compost liquid (one per student)

***Teacher:***

- ❑ Active worm bin

*Station supplies:*

- ❑ Two tarps
- ❑ Two five-gallon buckets
- ❑ Strainer
- ❑ Water
- ❑ Three to six handheld garden forks or trowels
- ❑ "Harvesting a Worm Bin" overhead
- ❑ Rubic overhead
- ❑ Rubics (one per student)

### Preparation:

You must have an "active" worm bin or have access to a bin that has been fed for at least three months in order to teach this lesson.

You can prepare your students for harvesting by teaching Lessons 21, "Wonderful Worms," and 23, "Setting Up a Worm Bin," prior to this lesson.

Be prepared to organize the students into groups of four to six.

## ACTIVITY

***Discussion***

1. Ask students to reflect on having a worm bin in the classroom, describing some of the changes that have occurred in the bin over the last few months and how the students have maintained the bin.

2. Tell the students that they will be harvesting the contents of the worm bin and will use the castings as food for plants.

3. Describe the three methods of harvesting worm castings from a bin by using the overhead "Harvesting a Worm Bin":
   a. **Bucket method:** Place all contents of the worm bin in a bucket. Gently pour cool water into the bucket (one part compost to ten parts water). Within a minute or two, pour the contents of the bucket into a second bucket through the strainer. Retrieve the worms and any uneaten food or bedding from the strainer. Return these to the bin. The remaining light brown liquid can be used to water and fertilize plants (if liquid is not light in color, it may be too concentrated to add to plants).
   b. **Light method:** Place the compost in small piles on a tarp in indirect sunlight or under a light in the classroom for a few minutes. The worms will move to the center of the pile to avoid the light. The outer part of the pile, now without worms, can be removed and put in the five-gallon bucket. As the castings are removed, the newly exposed worms will move to the middle, out of the light. Repeat the process until only a ball of worms remain. The worms and any uneaten food scraps can be returned to the worm bin.
   c. **Migration method:** Push all of the bedding, worms, castings, and food over to one side of the bin. Stop adding new food to that side. Make sure that one half of the worm bin is empty. Set up the empty side like a new worm bin with moist bedding and dry bedding. Put some food in the empty side, and keep feeding that side (about half the amount you usually give the entire bin). After the worms have eaten the food on the old side, they will begin to migrate. The process may require several months. The old side will then be without worms and ready to harvest.

4. Show an overhead of the lesson rubric, and review the expectations for this lesson.

***Procedure***

1. Set up three harvesting stations, or select only one of the following methods: (a) bucket method (requiring a tarp, bucket, water, and strainer); (b) light method (requiring a tarp, two buckets, and sunlight or bright light); (c) migration method (requiring a tarp).

2. Review the steps of worm composting with students. Note that red worms eat food that people would otherwise throw away. Worm castings that are left behind can be used as fertilizer.

3. Divide the students into groups of four to six, and assign them to a harvesting station (more than one group can participate at the light station).

4. Rotate the groups after five minutes.

***Wrap-Up***

1. Ask the students to compare the different methods for harvesting castings. Have them vote on the method they prefer by raising their hands. Ask them to give reasons for their vote.

2. Brainstorm different ways that the harvested castings can be used (putting it on plants in the school garden, around trees or on house plants).

3. Divide the harvested worm castings and give each student a bag or cup full to use at home. The castings will need to sit for two to three days before they are ready to apply.

***Final Assessment Idea***

Based on the three stations, have students describe their favorite method of harvesting a worm bin. Have them write an action plan for how they will use the harvested worm castings at home or school.

## Extensions:

Have students observe and record worms' reactions to light.

## 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** | **Life Science**<br>2.a. Students know plants are the primary source of matter and energy entering most food chains.<br>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.<br>2.c. Students know decomposers, including many fungi, insects and micro-organisms, recycle matter from dead plants and animals.<br>3.a. Students know ecosystems can be characterized by their living and nonliving components. |
| **Grade 5** | **Life Science**<br>2.g. Students know plant and animals cells break down sugar to obtain energy, a process resulting in carbon dioxide ($CO_2$) and water (respiration). |

# Teacher

# Harvesting a Worm Bin 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 |
|---|---|---|---|---|
| **Harvests the bin** | Student helps with harvesting the bin. | Student tries to help with harvesting bin. | Student does little to help with harvesting the bin. | Student does not help with harvesting bin. |
| **Understands the uses and benefits of worm castings** | Student can explain the use and benefits of worm castings. | Student tries to explain the use and benefits of worm castings. | Student poorly explains the use and benefits of worm castings. | Student does not understand the use and benefits of worm castings. |
| | | | | |
| | | | | |

# Harvesting a Worm Bin

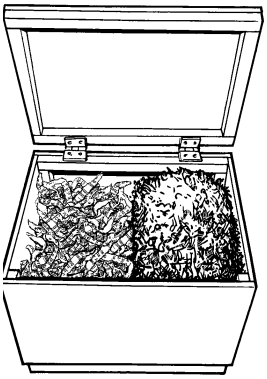
**Bucket method:**

1. Place all contents of the worm bin in a bucket.
2. Gently pour cool water into the bucket (one part compost to ten parts water).
3. Within a minute or two, pour the contents of the bucket into a second bucket through the strainer.
4. Retrieve the worms and any uneaten food or bedding from the strainer.
5. Return any worms and uneaten food to the bin.
   *The remaining light brown liquid can be used to water and fertilize plants (if liquid is not light in color, it may be too concentrated to add to plants).

**Light method:**

1. Place the compost in small piles on a tarp in indirect sunlight or under a light in the classroom for a few minutes. The worms will move to the center of the pile to avoid the light.
2. The outer part of the pile, now without worms, can be removed and put in the five-gallon bucket. As the castings are removed, the newly exposed worms will move to the middle, out of the light.
3. Repeat the process until only a ball of worms remains.
4. The worms and any uneaten food scraps can be returned to the worm bin.

**Migration method:**



1. Push all the bedding, worms, castings, and food over to one side of the bin.
2. Stop adding new food to that side.
3. Make sure that one half of the worm bin is empty.
4. Set up the empty side like a new worm bin with moist bedding and dry bedding.
5. Put some food in the empty side, and keep feeding that side (about half the amount you usually give the entire bin).
6. After the worms have eaten the food on the old side, they will begin to migrate. The process may require several months.
7. The old side will then be without worms and ready to harvest.

## DEFINITIONS

### Vocabulary:

***Compost:*** the process or the end result of living organisms digesting and reducing organic matter into a dark, rich, soil amendment.

***Compost tea:*** an aerated liquid solution made from compost for use on plants.

***Vermicompost:*** compost produced in a worm composting system. It is a mixture of partially decomposed organic waste, bedding and worm castings. When finished, it is a balanced, nutrient-rich compost for the garden.

***Worm bin:*** a container used to hold worms, food scraps and bedding for composting.

***Worm castings:*** worm manure or the final product of worm composting. It is a high-quality rich, soil amendment that is used to fertilize plants.

***Worm leachate:*** liquid waste excreted by worms or excess moisture that leaches to the bottom of the worm bin. This can be applied to plants directly once diluted. Worm leachate can also be made by placing worm castings in water and straining any worms or remaining food scraps from the liquid.



## VOCABULARY

***Bedding:*** material such as dried leaves or shredded paper used to retain moisture, create air space and cover food scraps in a worm composting system.

***Big Four:*** the four main ingredients necessary in a composting system: air, water, greens (nitrogen) and browns (carbon).

***Biodegradable:*** organic materials that can decompose or decay, such as wood, food scraps, paper and grass clippings.

***Blood:*** the fluid in an animal's blood vessels that carries food and oxygen to the cells throughout the body.

***Carnivores:*** animals that eat other animals.

***Compost:*** the process or end result of living organisms digesting and reducing organic material into a dark, rich, soil amendment.

***Compost tea:*** an aerated liquid solution made from compost for use on plants.

***Conserve:*** to protect something from harm or destruction.

***Consumers:*** animals that get their food or energy from other living things, plants or animals.

***Crop:*** a pouch-like compartment to store food, before it is ground up, that is found in many birds and insects.

***Data:*** information gathered to find the answer to a scientific question.

***Decay:*** the gradual breakdown of dead organic material.

***Decomposers:*** an organism, including fungi, bacteria and invertebrates, that breaks down organic waste.

***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 such as compost bins.

***Digestion:*** the process of breaking down food into small molecules that can be absorbed by the intestine and used by the body.

***Ecosystem:*** the interacting system of a biological community and its nonliving environment; also, the place where interactions occur.

***Electricity:*** the electric current used or regarded as a source of power.

***Endangered:*** a species that is in danger of extinction in the foreseeable future.

***Energy:*** the capacity for doing work. Forms of energy include thermal, mechanical, electrical, and chemical. Energy may be transformed from one form into another.

***Equilateral:*** a triangle having all sides or faces that are equal.

***Esophagus:*** the muscular tube that leads from the pharynx to the stomach (or in some animals to the crop) and pushes food through this part of the canal.

***Evidence:*** facts that indicate whether something is true.

***Experiment:*** the collection of data to discover whether a variable makes a difference.

***Extinct:*** a species or subspecies that no longer exists in living form.

***Food chain:*** the sequence of one organism eating another organism. An example of a food chain is the following: green plants (using sunlight to grow) are eaten by sheep, which are eaten by wolves, which die and are eaten by decomposers, which free fertilizing material into the soil, which is needed by the plants to grow.

***Food scraps:*** food that can be put into a compost bin, typically fruit and vegetable scraps. Meat, dairy and oils are excluded because they can attract pests.

***Food web:*** many food chains that are interconnected.

***Garbage:*** things that people throw away.

***Gizzard:*** a second stomach with a thick muscular lining found in birds and other animals where food is ground up. Worms sometimes store small stones in their gizzard to help grind up their food.

***Habitat:*** the place where an organism normally lives and thrives.

***Heart:*** the muscle in animals that pumps blood through the body.

***Herbivores:*** animals that eat plants.

***Hierarchy:*** a ranking system according to relative importance.

***Hypothesis:*** a scientific guess based on observations.

***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.

***Intestine:*** the long tube in animals where food is digested and absorbed into the body.

***Invertebrates:*** animals that do not have a back bone. They are cold-blooded so they depend on the temperature of their environment to regulate their own body temperature.

***Isosceles:*** a triangle having two equal sides.

***Landfill:*** an area of land designed to handle the disposal of solid waste. The garbage is usually spread out, compacted and covered with dirt or other material in order to protect the environment in and around the landfill.

***Life cycle:*** a series of changes that an organism undergoes throughout its life. For example, a frog life cycle usually includes the following stages: egg, tadpole, immature frog and adult frog. A life cycle can also describe the steps to producing a product, which usually includes the following stages: extraction of raw materials, production, distribution and use of a product and final disposal or recycling of remaining materials.

***Litter:*** waste materials that are carelessly discarded or put in the wrong place.

***Manufacture:*** to make or process a raw material into a finished product, usually by a large-scale industrial operation.

***Natural resources:*** living or non-living materials that come from the Earth such as fossil fuels, minerals, plants, animals, water, air, sunlight, and other forms of energy.

***Nonbiodegradable:*** inorganic materials that do not decompose, for example, glass, metal and plastic.

***Nonrenewable resources:*** minerals or sources of energy that can be mined or collected from the Earth, such as coal, petroleum, iron ore, copper, etc. The processes of their formation are so slow that these resources may be considered gone forever once they are used up.

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

***Oil:*** a liquid substance, usually black and sticky, that is used to produce fuel and products such as plastic.

***Omnivores:*** animals that eat both plants and animals.

***Opinion:*** a person's thoughts or beliefs about something that may not be based on facts.

***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.

***Organic waste:*** wastes made of natural products such as food, leaves, hair, clothing fibers and yard trimmings.

***Packaging:*** a container or wrapping such as paper, plastic, metals, etc., used to protect, transport, display or store a product.

***Paper:*** a thin material made of pulp from wood, rags or other fibrous material often used for writing, printing or packaging.

***Perpetual resources:*** forms of naturally recurring energy that are beyond human management, e.g., sun, wind, falling water, tides.

***Petroleum:*** a substance occurring naturally in the Earth in solid, liquid, or gaseous state that is composed of a complex mixture of hydrocarbons used to make products such as oil, natural gas, plastic, and fuel.

***Pharynx:*** the part of the canal between the cavity of the mouth and the esophagus.

***Pictograph:*** a picture or symbol showing an idea.

***Plastic:*** a material made from petroleum. It can be molded, extruded, or cast into a desired shape.

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

***Producers:*** plants that make their own food using energy from the sun.

## VOCABULARY

***Product:*** something produced by human or mechanical effort or by a natural process.

***Quilt:*** a bed coverlet of three layers: a top, middle, and bottom. The middle layer is a filling of wool, cotton, down, etc.

***Raw material:*** a material or natural resource that is mined or harvested for use in producing a product such as bauxite (aluminum), iron ore, silica, or trees.

***Recyclable:*** discarded materials, such as paper, aluminum, tin, plastic, cardboard and glass, that in most cases can be recycled and remanufactured into new products.

***Recycle:*** the process of producing new products from used material or the process of remanufacturing used materials into new products. Some used materials can be made into new items of the same thing. Others are made into entirely new items.

***Recycling bin:*** container for accepting items that will be recycled into new products.

***Red worms:*** the type of worm typically used in worm composting systems. Red worms can be found in leaf mold and manure piles and can be purchased in bait shops and some gardening stores. Their Latin (scientific) name is *Eisenia fetida*.

***Reduce:*** use less "stuff" and produce less waste.

***Refine:*** the process of purification or transformation of a substance. Refining is often used with natural resources that are almost in a usable form but that are more useful in pure form. For example, most types of petroleum will burn straight from the ground but will burn poorly and quickly clog an engine with residues and byproducts.

***Renewable resource:*** naturally occurring raw materials or form of energy that has the capacity to replenish itself within a relatively short amount of time (e.g., a human lifetime) through ecological cycles and sound management practices, e.g., trees, agricultural crops, grasses.

***Reuse:*** extending the life of an item by reusing it again as it is or creating a new use for it.

***Rot:*** to decompose.

***Scalene:*** a triangle having all three sides of unequal length.

***Soil amendment:*** something added to soil to increase nutrients, improve soil texture or improve how well the soil can hold onto or drain water.

***Species:*** a group of plants or animals that have common characteristics.

***Threatened:*** a plant or animal species that is likely to become endangered in the near future.

***Triangle:*** a plain figure that has three sides and three angles.

***Value:*** the quality of an object that makes it desired or wanted; the beliefs of a person or social group; the fundamental beliefs or guiding principles that guide behavior and decision making.

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

***Vermicompost:*** compost produced in a worm composting system. It is a mixture of partially decomposed organic waste, bedding and worm castings. when finished, it is a balanced, nutrient-rich compost for the garden.

***Waste prevention:*** not making so much waste in the first place.

***Water cycle:*** sunlight evaporates water that condenses to clouds that produce rain that falls on the land, flows to an ocean or lake and evaporates again. The water can flow through other routes such as through sand underground or through an animal. But the cycle begins with evaporation and ends with the water returning to a place for evaporation to occur again.

***Worm bin:*** a container used to hold worms, food scraps and bedding for composting.

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## Children's Fiction and Nonfiction Books

The following children's books include content related to the 4Rs (Reduce, Reuse, Recycle and Rot/Compost). The books below are available through the lending library at the StopWaste.Org office, bookstores and most public libraries. These books may be used in conjunction with the lessons in this guide as an extended language arts activity to reinforce the 4R concepts presented in each lesson.

### Reduce

***Aani and the Tree Huggers*** by Jeannine Atkins. (1995). ISBN: 1- 880000-24-5. Published by Leed & Low.
Aani gets the women from the village to save their forest from men sent to cut down the trees.

***Cloudy with a Chance of Meatballs*** by Judi Barrett. (1978). ISBN: 0-590-30384-8. Published by Scholastic.
A town receives its food falling from the sky. When the weather changes, the people there must come up with creative solutions.

***Common Ground: The Water, Earth and Air We Share*** by Molly Garrett Bang. (1997). ISBN: 0-590-10056-4. Published by Scholastic Trade.
A story about sheep and the common ground they graze that reveals how a community must work together conserve the common resources they use.

***Crosby*** by Dennis Haseley. (1996). ISBN: 0-15-200929-2. Published by Harcourt Brace and Company.
Crosby is creative in using or repairing broken items.

***Earth to Matthew*** by Paula Danziner. (1991). ISBN: 0-385-30453-6. Published by Delacorte Press.
Matthew and Jill are assigned to the Recycling committee that does a project. They learn about reducing waste and helping our environment.

***Gift of the Sun*** by Dianne Stewart. (1996). ISBN: 0-374- 32425-5. Published by Farrar, Straus, and Giroux.
A South African folktale shows how simplifying life with fewer possessions can result in great benefits.

***How Come the Best Clues Are Always in the Garbage?*** by Linda Bailey. (1992). ISBN: 0-8075-3410-2. Published by Albert Whitman & Co.
Garbage Busters has collected $1,000 to save the environment, and now the money has been stolen. Investigations lead to the dumpster that must be explored.

***Just a Dream*** by Chris Van Allsburg. (1990). ISBN: 0-395-53308-2. Published by Houghton Mifflin Co.
Walter is careless with litter and garbage. He has a dream of the future that is not at all what he expected.

***The Lorax*** by Dr. Seuss. (1971). ISBN: 0-394-82337-0. Published by Random House.
This Dr. Seuss rhymed story has Lorax trying to save trees from being cut down.

***Pee Wee Scouts Trash Bash*** by Judy Delon. (1992). ISBN: 0-440-40592-0. Published by Bantam.
The Pee Wee Scouts are earning their Save the Earth badge by having a community recycling drive. Their scout leader has offered a prize to the scout who does the most creative thing with the trash.

***The People Who Hugged the Trees*** by Deborah Lee Rose. (1990). ISBN: 0-91197-80-7. Published by Roberts Rinehart, Inc.
Amrita and the people who live in her village try to save valuable trees surrounding the village from being cut down by the Maharaja who want to build a new fortress.

***Sweet Clara and the Freedom Quilt*** by Deborah Hopkinson. (1993). ISBN: 0-679-92311-X. Published by Alfred A. Knopf.
Before age 12, Clara is taken away from her mother and sold to a neighboring plantation to work as a field hand. She learns from others how to gather scraps of fabric, sew them together into a quilt and help her people to find their way to freedom.

***Why the Sky Is Far Away*** by Mary-Joan Gerson. (1992). ISBN: 0-316-30874-9. Published by Little, Brown and Co.
In this Nigerian folktale, villagers get all of their resources from the sky. When they take more than they need, the sky begins to get angry and the villagers are forced to find their own resources.

***Windows*** by Jeannie Baker. (1991). ISBN: 0-688-08917-8. Published by Greenwillow Books.
This wordless picture book describes a view of a landscape that changes over many years from wilderness to a city.

***The Wump World*** by Bill Peet. (1970). ISBN: 0-395-19841-0. Published by Houghton Mifflin Co.
The Wumps lived happily on a planet where they had plenty to eat and drink, shelter, and no natural enemies. One day some new monsters arrived to their planet and began destroying it.

## Reuse

***Angel's Kite / La Estrella de Angel*** by Alberto Blanco. (1994). ISBN: 0-89239-121-9. Published by Children's Book Press.
In a Mexican small town, Angel makes kites from waste materials.

***A Chair for My Mother*** by Vera B. Williams. (1982). ISBN: 0-688-04074-8. Published by Greenwood Books.
After a fire, neighbors come together and give many items to a family in need.

***Cloudy with a Chance of Meatballs*** by Judi Barrett. (1978). ISBN: 0-590-30384-8. Published by Scholastic.
A town receives its food falling from the sky. When the weather changes, the people there must come up with creative solutions.

***Common Ground: The Water, Earth and Air We Share*** by Molly Garrett Bang. (1997). ISBN: 0-590-10056-4. Published by Scholastic Trade.
A story about sheep and the common ground they graze that reveals how a community must work together to conserve the common resources they use.

***Crosby*** by Dennis Haseley. (1996). ISBN: 0-15-200929-2. Published by Harcourt Brace and Company.
Crosby is creative in using or repairing broken items.

***Earth to Matthew*** by Paula Danziner. (1991). ISBN: 0-385-30453-6. Published by Delacorte Press.
Matthew and Jill are assigned to the Recycling committee that does a project. They learn about reducing waste and helping our environment.

***The Electric Kid*** by Garry Kilworth. (1994). ISBN: 0-380-72-847-8. Published by Avon Books.
Hotwire and Blindboy are orphans who survive on what they salvage from the garbage dump. Blindboy can locate discarded electronic devices buried under the garbage. Hotwire is a girl who can repair anything electronic.

***Galimoto*** by Karen Lynn Williams. (1996). ISBN: 0-688-10991-8. Published by Mulberry Books.
A boy in West Africa makes a wire toy.

***How Come the Best Clues Are Always in the Garbage?*** by Linda Bailey. (1992). ISBN: 0-8075-3410-2. Published by Albert Whitman & Co.
Garbage Busters has collected $1,000 to save the environment, and now the money has been stolen. Investigations lead to the dumpster that must be explored.

***Junk Pile*** by Lady Bolton. (1997). ISBN: 0-399-22728-8. Published by Philomel Books.
Jamie and her family live in a trailer in her father's junkyard. She arranges hubcaps like flowers around the trailer.

***The Mushroom Center Disaster*** by N.M. Bodecker. (1978). ISBN 0-689-30424-2. Published by Atheneum.
The Mushroom Center is a little bug town located just beyond the Mole Hills. One day disaster strikes as some careless picnickers carelessly throw away their garbage.

***Pee Wee Scouts Trash Bash*** by Judy Delon. (1992). ISBN: 0-440-40592-0. Published by Bantam.
The Pee Wee Scouts are earning their Save the Earth badge by having a community recycling drive. Their scout leader has offered a prize to the scout who does the most creative thing with the trash.

***Roberto the Insect Architect*** by Nina Laden. (2000). ISBN: 0-8118-24655-9. Published by Chronicle Books. Roberto the termite wanted to be an architect. He begins to build his dream in a vacant lot filled with rubble and rubbish.

***Sam Johnson and the Blue Ribbon Quilt*** by Lisa Campbell Ernst. (1993). ISBN: 0-688-01516-6. Published by Lothrop, Lee & Shepard. Sam Johnson can repair a torn awning, discovers he is a fine quilter and joins his wife's quilting bee that had only women.

***Stay Away from the Junkyard*** by Tricia Tusa. (1988). ISBN: 0-02-789541-6. Published by Alfred A. Knopf A girl discovers the amazing creative potential of junk. A young girl befriends the town outcast and discovers the amazing creative potential of junk.

***Sweet Clara and the Freedom Quilt*** by Deborah Hopkinson. (1993). ISBN: 0-679-92311-X. Published by Alfred A. Knopf. Before age 12, Clara is taken away from her mother and sold to a neighboring plantation to work as a field hand. She learns from others how to gather scraps of fabric, sew them together into a quilt and help her people to find their way to freedom.

***Tar Beach*** by Faith Ringgold. (1991). ISBN: 0-517-58030-6. Published by Crown Publishers. Lying on a quilt blanket on Tar Beach (the roof of her Harlem apartment building), Cassie has the ability to fly and explore her area.

***Windows*** by Jeannie Baker. (1991). ISBN: 0-688-08917-8. Published by Greenwillow Books. This wordless picture book describes a view of a landscape that changes over many years from wilderness to a city.

## Recycle

***Common Ground: The Water, Earth and Air We Share*** by Molly Garrett Bang. (1997). ISBN: 0-590-10056-4. Published by Scholastic Trade. A story about sheep and the common ground they graze that reveals how a community must work together to conserve the common resources they use.

***Earth to Matthew*** by Paula Danziner. (1991). ISBN: 0-385-30453-6. Published by Delacorte Press. Matthew and Jill are assigned to the Recycling committee that does a project. They learn about reducing waste and helping our environment.

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***Just a Dream*** by Chris Van Allsburg. (1990). ISBN: 0-395-53308-2. Published by Houghton Mifflin Co. Walter is careless with litter and garbage. He has a dream of the future that is not at all what he expected.

***Mr. Garbage*** by William Hooks. (1996). ISBN: 0-553-37579-2. Published by Bantam. Eli is a precocious boy who is always getting carried away. Eli begins to fill a room with garbage in his recycling plan.

***Pee Wee Scouts Trash Bash***
by Judy Delon. (1992).
ISBN: 0-440-40592-0.
Published by Bantam.
The Pee Wee Scouts are earning their Save the Earth badge by having a community recycling drive. Their scout leader has offered a prize to the scout who does the most creative thing with the trash.

***Recycle! A Handbook for Kids***
by Gail Gibbons. (1992).
ISBN: 0-316-30943-5. Published by Little, Brown and Company.
A simple book that talks about recycling and waste reduction.

***Recycling for Math*** by Joan Cohn and David Elliot. (1992).
ISBN: 0-9634806-0-x.
Published by Berkeley Educational Materials Assistance.
Provides hands-on, interactive ways to reuse and recycle materials while teaching complex math ideas.

## Rot

***Cloudy with a Chance of Meatballs*** by Judi Barrett. (1978). ISBN: 0-590-30384-8.
Published by Scholastic.
A town receives its food falling from the sky. When the weather changes, the people there must come up with creative solutions.

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by Dianne Stewart. (1996).
ISBN: 0-374-32425-5. Published by Farrar, Straus, and Giroux.
A South African folktale shows how simplifying life with fewer possessions can result in great benefits.

***A Handful of Dirt*** by Raymond Bial. (2000). ISBN: 0-8027-8699-5.
Published by Walker Publishing Company, Inc.
Dirt is on of the essential building blocks of life on Earth. This book provides a down-in-the-dirt tour of one of Earth's most common resources.

***How Come the Best Clues Are Always in the Garbage?***
by Linda Bailey. (1992).
ISBN: 0-8075-3410-2.
Published by Albert Whitman & Co.
Garbage Busters has collected $1,000 to save the environment, and now the money has been stolen. Investigations lead to the dumpster that must be explored.

***The Magic School Bus Meets the Rot Squad; a book about decomposition*** by Joanne Cole. (1995). ISBN: 0-590-62236-6.
Published by Scholastic.
Students climb on the Magic School Bus and head out to a vacant lot where they find an old rotting log, and there they learn that what appears to be dead is actually very alive.

***Mr. Garbage*** by William Hooks. (1996). ISBN: 0-553-37579-2.
Published by Bantam.
Eli is a precocious boy who is always getting carried away. Eli begins to fill a room with garbage in his recycling plan.

***Pee Wee and the Magical Compost Heap***
by Lorraine Roulston. (1992).
ISBN 0-9697883-04.
Published by the Recycling Council of Ontario, Toronto, Ontario, Canada.
Pee Wee, a red wiggler worm, and all the insects in the compost heap go on an adventure to introduce children to backyard composting. The adventure begins when four neighborhood children are magically transported on the back of a butterfly to visit Castle Compost.

***Pee Wee Scouts Trash Bash***
by Judy Delon. (1992).
ISBN: 0-440-40592-0.
Published by Bantam.
The Pee Wee Scouts are earning their Save the Earth badge by having a community recycling drive. Their scout leader has offered a prize to the scout who does the most creative thing with the trash.