

LESSON 1: The Basics of Vermicomposting

Note: Before implementing this activity, students will need to know what animals need in order to live. You will need to use an existing lesson (most science programs have lessons on this topic) or design one yourself to teach students the needs of animals, which should include food, water, shelter, air, and a place to live (habitat).

LESSON'S CONCEPT

Food scraps can be recycled through vermicomposting.

PURPOSE

Students are introduced to the basics of vermicomposting and learn about the physical requirements of red worms as they set up a worm bin to demonstrate how food waste and paper can be recycled.

OVERVIEW

In this lesson students will:

- Brainstorm what they know and what they would like to know about worms.
- Set up a vermicomposting bin.
- Classify those items that can be fed to red worms and those that cannot be fed to red worms and write a poem about it.
- Design a chart with pictures of what to feed and what not to feed red worms.
- Record the weight and type of worm food and where it was placed in the worm composting bin.
- Select questions about red worms that they can research in books, on the computer, through videos, and through personal observations.

CORRELATIONS TO CALIFORNIA'S CONTENT STANDARDS AND FRAMEWORKS AND TO BENCHMARKS FOR SCIENCE LITERACY

- Students set up a vermicomposting bin in the classroom and keep a class journal of everything that gets put into the bin.
 - "Plants and animals meet their needs in different ways. As a basis for understanding this concept, students know: plants and animals both need water, animals need food, and plants need

light." (*Science Content Standards, Grades K-12; Grade 1; Life Sciences, Standard 2c*)

- "A lot can be learned about plants and animals by observing them closely, but care must be taken to know the needs of living things and how to provide for them in the classroom." (*Benchmarks for Science Literacy, page 15*)
- "Students collect information about objects and events in their environment." (*Mathematics Content Standards for California Public Schools, Kindergarten Through Grade Twelve, page 3*)
- "To participate effectively in society, students need to: Develop personal skills . . . group interaction skills (and) . . . social and political participation skills." (*History-Social Science Framework, page 24*)
- Older students do research on worms in various sources.
 - "Students identify the basic facts and ideas in what they have read, heard, or viewed." (*English-Language Arts Content Standards for California Public Schools, Kindergarten Through Grade Twelve, page 2*)
 - Students "understand the purposes of various reference materials." (*English-Language Arts Content Standards for California Public Schools, Kindergarten Through Grade Twelve, page 13*)

SCIENTIFIC THINKING PROCESSES

observing, communicating, comparing, classifying, relating, applying

TIME

60 minutes or more (especially if you need to buy the worm bin and worms) to prepare for the lesson; 60 minutes or more to implement the lesson (depending on whether you have younger or older students and their involve-

ment in preparing the worm bin)

VOCABULARY

compost, organic, organisms, red worm, vermicomposting

PREPARATION

- ___ 1. Read the “Background Information for the Teacher” at the end of this lesson.
- ___ 2. Obtain a ready-made container measuring approximately 1 foot deep by 2 feet wide by 3 feet long with a lid. Plastic storage containers can be purchased from most large variety stores. If possible, reuse a previously used container or purchase one made from recycled plastic.
 - Drill several 1/4-inch drainage holes through the bottom of the container.
 - Place screen on the bottom of the container. (Red worms will usually not crawl out of the drain holes, because they prefer the dark; however, if your bin becomes too dry or too wet, the worms will leave in search of more favorable conditions.)
- ___ 3. Make a transparency of the “Sample Vermicomposting Data Sheet” (page 117).
- ___ 4. For younger students (in kindergarten and first grade), duplicate “What to Put and Not to Put in a Worm Bin” for each group of students (page 118).

Note: Some people who vermicompost drill 1-inch round holes on each of the four sides of their bins for an additional air supply. These holes are covered with screen, and a glue gun or waterproof tape is used to secure the screens to the container.

MATERIALS

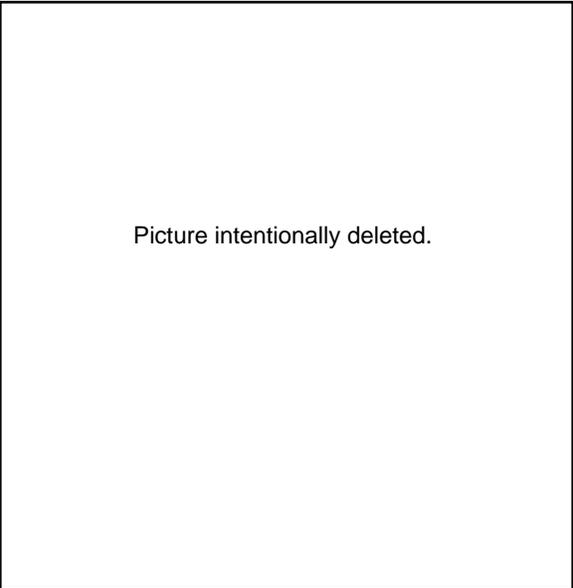
- ___ Butcher paper on which to write students’ responses
- ___ Vermicomposting container with lid
- ___ Newspaper (a stack about 6 inches tall) or classroom paper to be used for bedding (Colored paper and paper with crayon drawings can be used. Do not use glossy advertisements and magazines.)

- ___ A plastic milk jug for measuring water
- ___ Water (in a watering can)
- ___ 1 or 2 pounds of red worms, depending on the size of the bin (Red worms can be purchased from bait shops or from worm suppliers. See the list of worm suppliers in the “Appendix.”)
- ___ 4 to 6 cups of garden soil (Do not use sterilized potting soil.)
- ___ Utility scale (up to 20 pounds) (This scale can be a hanging scale on which students hang a bucket with items to be weighed or a parcel post scale on which students can place a container with items to be weighed.)
- ___ Large clean plastic bucket or other container (or wheelbarrow) for mixing bedding (Bedding can also be mixed in the vermicomposting bin.)
- ___ Two boards, or four bricks, or other comparable items to place under the bin so that the bottom will receive sufficient air
- ___ Sheet of plastic, or large flat garbage bag, or several unfolded newspapers to put under bin in case water leaks through the holes
- ___ A 2-quart plastic container with lid in which to keep food waste to feed to the worms
- ___ A class worm journal to keep by the worm bin
- ___ The book *Squirmy Wormy Composters* by Bobbie Kalman and Janine Schaub
- ___ Nontoxic permanent marker
- ___ Six 3- by 5-inch cards
- ___ The transparency, “Sample Vermicomposting Data Sheet”
- ___ For younger students, a copy of “What to Put and Not to Put in a Worm Bin” for each group of students

PRE-ACTIVITY QUESTIONS

- A. Ask students:
- After you eat lunch, what do you do with your garbage? *Throw some of it away; recycle some of it.*
 - What do you throw away? *Some paper, food, plastic.*

- What do you do with the paper from your lunches? *Throw it in the garbage can; recycle it; reuse it; compost.*
- What do you do with cans? *Throw them in the garbage can; recycle them.*
- What do you do with food waste? *Throw it in the garbage can.*
- What else can you do with food waste? *Feed it to animals; bury it; compost it.*
- If we could have a container in our classroom with special animals that are easy to take care of and that could eat our food waste, would we want this container? *Yes.*
- Can you guess what animal might eat our garbage in a container in our classroom? (As students name some animals, you might give them hints, like “it is much smaller than a mouse,” until a student identifies the animal as a worm.)
- What do we know about worms? (List what students say on a piece of butcher paper.) *They are slimy. I’ve used them for fish bait. I have some in my garden. I’ve seen them after it rains. They don’t have any hair.*
- What do you want to find out about worms? (List what students say.) (See answers from Betsy Weiss’s class.)



Students in Lynda Mooney’s first-grade class at Las Palmas Elementary School compile a list of what they know about worms.

What do you already know about worms?
Worms:

- *Live in the ground, under soil, and compost with centipedes and other bugs*
- *Recycle the dirt*
- *Eat garbage*
- *Dig in soil*
- *Take care of gardens*
- *Wiggle to move*
- *Are long and skinny*

What do you want to find out about worms?

- *What happens if they live in the sun? Will they die?*
- *How do they eat?*
- *Do they have teeth?*
- *What do they eat?*
- *Do they sleep underground?*

Submitted by Betsy Weiss’s kindergarten and first-grade class, Paden Elementary School, Alameda City Unified School District.

Note: Keep the lists your students developed to use at the end of the lesson.

- Does anyone know what compost is? Lead students to conclude that compost is a soil enricher that helps plants to grow. Tell students that a special type of worm, called a red worm, can eat garbage, like food scraps (e.g., apple cores, banana peels, bread crust). The worms’ droppings, called castings, look like rich soil and contain nutrients to help plants grow. These droppings can be collected and placed in the garden or in flower pots.
 - How can red worms help to reduce the waste we throw away? *They can eat our food garbage.*
 - If “vermi” means worms, what do you think vermicomposting means? *Composting with worms.*
- B.** Discuss with students the following:
- If we decide to set up a worm composting bin where worms would live, what will we need to know? *How to do it; what worms need to live; who will take care of them.*
 - What do animals need in order to live? *Food, water, shelter, air, and a place to live.*

- What do you think red worms need in order to live? *Food, water, shelter, air, a place to live.*

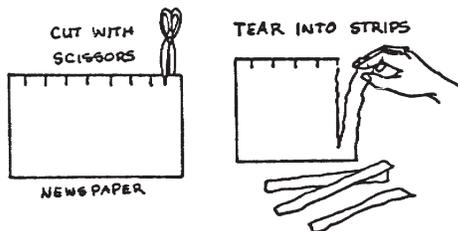
PROCEDURE

Part I, Providing a Habitat for Red Worms

- A. Describe the components in a worm bin: bin, lid, paper strips, soil, water, air, red worms, food scraps.

Note: The following could be done in several short sessions by working with one small group at a time, while other groups work on another assignment.

- B. Tell students that they will first be making the bedding for the red worms. Provide a stack of paper about 6 inches tall. Have students cut and tear strips of paper. You will need several grocery bags full or approximately 10 to 12 pounds of strips. Newspaper can be easily torn into strips by folding sections and using scissors to snip one inch strips along the fold and then tearing strips starting where the scissors snips began. Adult volunteers can make the snips in the folded paper, and students can tear the strips. Then the strips should be separated from each other so that each strip contains only one layer of paper.



- C. Prepare the bedding by completing #1 or #2 below, depending on the grade level of your students (#1 is recommended for students in kindergarten or first grade; and #2, for students in grades two or three).

For younger students

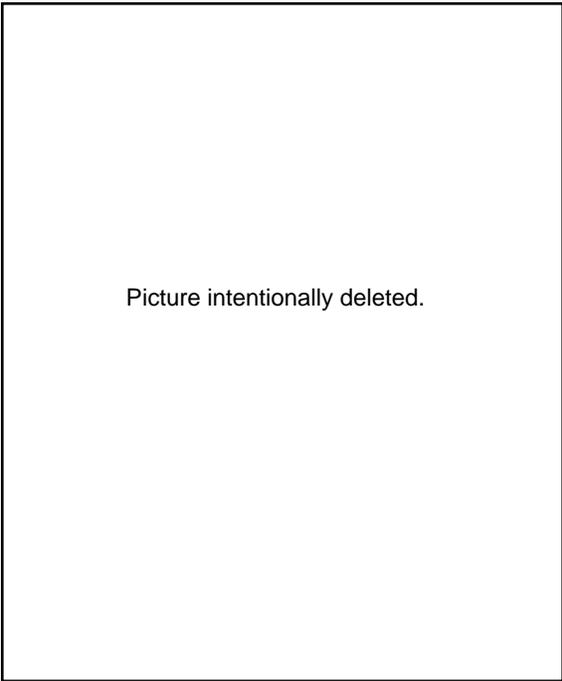
1. The following can be done in the worm bin or in a wheelbarrow or other large waterproof container:
 - Place a couple of grocery bags full of paper strips in the mixing container with enough water to dampen the paper, but not so much as to make the paper strips soggy. A watering can works well. To judge how wet the paper should be, think in terms of a squeezed out sponge.
 - Add several cups of soil and mix well.
 - If mixing is done in a container other than the vermicomposting bin, then place the wet newspaper in the worm bin and distribute the paper evenly.
 - Fluff up the paper to provide air.

For older students

2. Mathematics problems could be added to this lesson by having students calculate the proper amount of bedding, soil, and water. Have students:
 - Weigh 10 to 12 pounds of dry paper strips. They can weigh the paper on a household utility scale.
 - Calculate the amount of water needed by multiplying the weight of the paper by three (see the "Note" below). Tell students that a pint of water weighs a pound; therefore, a gallon (8 pints) of water weighs 8 pounds.

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Students in Ted Schut's first-grade class at Ripona Elementary School prepare bedding for red worms.



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Two students from Sharon Janulaw’s kindergarten class at Marguerite Hahn Elementary School prepare a worm bin.

Note: Red worms need an environment that has approximately the same moisture content as their bodies, 75 percent. The environment in the bin can be set up by weighing the shredded paper and adding approximately three times as much water (by weight). Once the bin is established, the food waste usually provides enough moisture, and you will probably not need to add water to the bin.

- Place about half of the paper in the mixing container, add about half of the required amount of water to dampen the paper, and mix.
- Add 4 to 6 cups of garden soil and the rest of the paper and water.
- Mix well, and if a separate mixing container was used, empty the contents into the worm bin and distribute the paper evenly.
- Fluff up the paper to provide air.

Part II, Composing a Poem About Vermicomposting

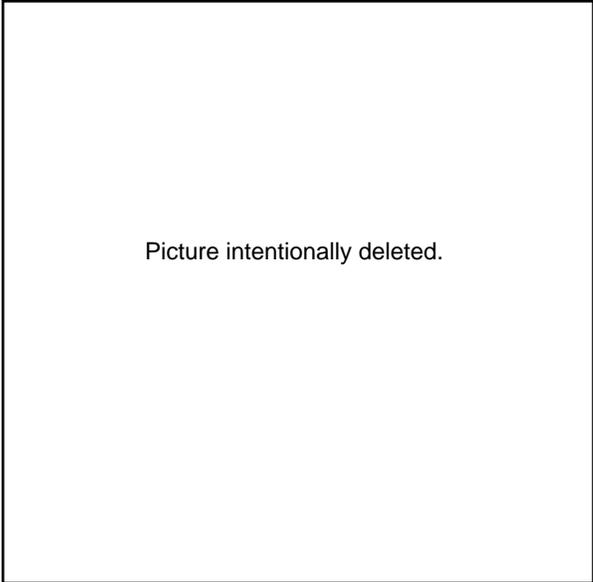
- A. In this activity, students will write a poem about what should and should not be placed in the vermicomposting bin.
- Tell students that just about any food waste left over from school lunches can be

fed to the worms, including bread, fruit, vegetables, and pasta. Note that these food wastes come from plants.

- Materials not to feed worms are meat, bones, and nonfoods, such as plastic wrap or rubber bands.

Note: Although meat and bones can be composted, these materials take a long time to decompose, and their presence in a worm bin may attract rodents (mice and rats) and flies.

- B. Ask students to make a chart with pictures and words of what to feed and what not to feed red worms. One way to do this is described below:
- Brainstorm and list items that are common in students’ lunches.
 - Write the name of each item on a separate scrap of paper, place these scraps in a container, and let students take one.
 - Ask students to draw and write the name of the item under each drawing.
 - Write the following headings on chart paper: okay to feed to worms/not okay to feed to worms.
 - Ask students to glue their drawings under the appropriate category. The placement of the drawings should be agreed upon by a majority of the students.
 - Hang the chart paper by the worm bin.



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Students in Lynda Mooney’s first-grade class at Las Palmas Elementary School develop a chart illustrating “Good Food for Worms” and “Bad Food for Worms.”

Note: A chart, “What to Put and Not to Put in a Worm Bin,” on page 118 is included in this lesson to use with younger students.

- C. Ask students to meet in groups and write a poem about what should and should not be placed in a worm bin.

Note: For younger students, consider writing a poem as a class.

- D. If poems were written by groups, have students read the poems to the class.

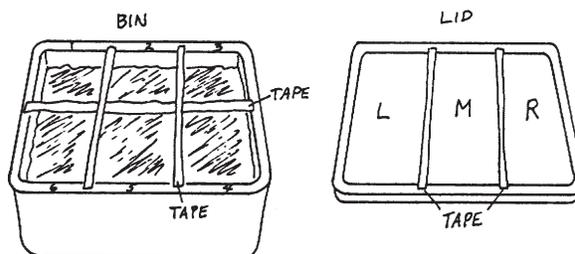
Part III, Adding Worms and Food

Note: Do this before lunch.

- A. Show students how to weigh something (e.g., a book). Have students weigh the worms before they place them in the bin, and record the worms’ weight on the transparency “Sample Vermicomposting Data Sheet.” (There are approximately 1,000 worms in a pound.) Ask a couple of students to gently place the worms on top of the bedding, spreading them out evenly. Keep the bin uncovered; within a few minutes, the worms will move down into the bedding to avoid light.
- B. Have students write numbers 1 to 6 on 3- by 5-inch cards. Tape these to the top of the lid. You can also use tape to separate the sections on top of the bin and write the numbers with a marker on the top edges of the bin (see illustration). Students should use this diagram for placing food waste in

different sections of the bin. This will enable students to keep track of where and when the food waste was placed. These sections can also be drawn on the back of the class worm journal for reference.

Note: For younger students, separate the worm bin into three parts: a left side (L), a middle section (M), and a right side (R). Students can alternate feeding sides.



- C. Before lunch or snack time, separate the class into four teams. Ask each team to bring back to class one piece of food waste approximately the size of an apple core. These food items will be fed to the worms. Examples of food waste that students can bring are: apple core, banana peel, pieces of bread crust. Also see “What to Put or Not to Put in a Worm Bin” or the chart that students developed in “Part II,” section “B.”
- D. Collect the lunch or snack food waste from students and place it in a plastic container with a lid.
- Have students weigh lunch leftovers and record the weight.

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Students in Ted Schut’s first-grade class at Ripona Elementary School add food scraps to the worm bin.

A student in Mario Chang’s second-grade class at Mission Education Center places food into the first corner of the vermicomposting bin.

- Ask one student to add approximately one-half pound of the food waste to the vermicomposting bin. The first pile of food should be placed in the corner for week one (based on the food waste pattern diagram) or on the left side (for younger students).

Note: Students should realize that it is important not to overfeed the worms; otherwise, the bin will have too much food for the worms to process, which will cause the bin to become too moist and acidic for the worms. Students should feed the worms a half-pound of food waste only once a week for the first three weeks until the red worms become established. Also, the worms will eat the paper, so keeping the food waste to a minimum will not hurt the worms. Once the worms are acclimated, they will be able to consume half their weight a day. Food scraps can be kept in a sealed container until it is time to feed the worms.

Note: With the small bin, you will not be able to compost a lot of food. If your class is interested in participating in large scale vermicomposting, see the “Resources” section in this lesson.

- E. Project the transparency “Sample Vermicomposting Data Sheet” and have students help you fill in the information.
- F. Do #1 or #2 below. (It is recommended that #1 be used with younger students and #2 with older students.)

For younger students

1. Use the transparency to record information when additional food is added to the bin. The information can be transferred from the transparency to a copy of the sheet and kept by the worm bin.

For older students

2. Keep a class worm journal next to the bin. Students can copy the data in their own journals.
 - In the class’s worm journal, students could record how much food by weight the worms are getting, what type of food was fed, and into what area of the bin the food was placed. The weight of paper added to the bin could also be recorded.
 - Practice writing in the class’s worm journal as a class and in groups until all students know how to do it.
 - Charts can be developed to be included

in the class’s worm journal, or the “Monthly Vermicomposting Data Sheet” can be used on which to record data.

Note: Directions for harvesting compost from the worm bin are described in Lesson 5 in this unit.

DISCUSSION/QUESTIONS

- A. Why is vermicomposting a good idea? *Through vermicomposting, paper and food waste are recycled; therefore, less garbage ends up in our landfills. The compost helps to improve the soil.*

For younger students

- B. What are the main ingredients of a vermicomposting system? *A vermicomposting system’s components include the following:*
 1. *A place where the worms live – the box*
 2. *Living things—red worms and bacteria and fungi*
 3. *Food*
 4. *Moisture*
 5. *Air*
 6. *Preparing, maintaining, and harvesting the bin: preparing the bedding, adding worms, burying garbage, separating worms and castings, using castings*

APPLICATION

- A. Have students look at the questions they listed in “Pre-Activity Questions” about what they wanted to find out about worms. Are there any questions that they now can answer and place on the list, “What do we know about worms?” List students’ responses.
- B. Do #1 below with younger students and #2 with older students.

For younger students

1. Have groups of students make a collage of “worm food” cut out of magazines and newspapers.

For older students

2. Ask students to add to the list of questions they began in the “Pre-Activity Questions” about red worms and about vermicomposting. Have each student or group of students select a question that they would be willing to research in

books, on the computer, through videos, and through personal observations. (A question can also be selected to be researched by the whole class, and answers can be compiled and compared.)

- Show them the book *Squirmy Wormy Composters* by Bobbie Kalman and Janine Schaub. Encourage students to look through the book and to come up with additional questions about red worms and vermicomposting.
- Keep the list of questions posted in the classroom, and encourage students to post and report facts to the class when they learn new information. Consider having students print the fact they learned on a strip of paper (e.g., 4 inches wide by 6 inches long), and have them tape it under the question they think it relates to.
- Examples of questions that students can research are listed below:
 - How much food did our worms eat in one week or one month? (Students weigh the food as it is added and observe its decomposition.)
 - What foods decomposed faster than others? (Students keep track of the amount of a specific food and compare it to another type of food.)
 - How often should water be added? (Students keep track of how much water they added when they first set up the bin. They record how much water they needed to add

through a specific period of time.) Note that with some bins no additional water will be needed, whereas with other bins (especially in dry climates), adding water will be necessary.

- Where do worms tend to congregate? Do they seem to prefer certain foods to others? (Students survey the bin.)
- Do smaller pieces of food waste tend to break down faster than larger ones? (Students set up experiments to find out the answer.)
- Ask students whether there are any ideas stated in the “What Do We Know About Worms” (listed on butcher paper at the beginning of this lesson) which need to be changed or deleted because of what they have discovered.

Homework Assignment: Ask students to do a waste audit at home and measure how much food waste the family produces in one day:

Option 1: Students list the type of food that is being thrown away.

Option 2: Students gather food waste in a plastic bag and weigh it on a bathroom scale.

Note: For younger students, ask students to share with their parents what they have learned about vermicomposting. Then they can talk about what their family does with food wastes. Parents could record this or sign a form that indicates that the student did the assignment.

(Use school’s letterhead.)

Dear Parent or Guardian,

Please read the following information with your child:

We are studying how red worms can be used to turn food waste into compost. We are calculating how much food waste the students in our class could compost using worms. Would you please help your child do one of the following:

- Option 1: Help your child record the type of food scraps being thrown away and have your child bring this list to school.
- Option 2: Place the food scraps in a plastic bag and use a bathroom scale to weigh them. Please write the weight of the food on a piece of paper and have your child bring the information to school.

Thank you,

- C. On the chalkboard write the types of food and the weights that students discovered concerning home food waste. Conduct a discussion on how much trash can be kept from going to a landfill if everyone had a vermicomposting bin at home. A graph could be designed for the data collected.

EXTENSIONS

- A. Obtain a copy of the poem “Sarah Cynthia Sylvia Stout” by Shel Silverstein. (See “Resources” in this lesson.)
- Have students identify which garbage items described in the poem are acceptable to put in worm composting bins and which items are not.
 - Discuss with students what Sarah should have done with her garbage at the very beginning. *She should have had a vermicomposting bin for garbage that can be fed to red worms and throw the rest of the garbage into a garbage can to be taken to a landfill.*
- B. Have students compare a red worm to a night crawler.
- C. Have students participate in a science fair by conducting humane projects on red worms.

RESOURCES

Video

Wormania! Available from The Let’s Get Growing! Company, 1900 Commercial Way, Santa Cruz, CA 95065; 1-800-408-1868; FAX (408) 476-1427 (26 minutes).

Stars Mary Appelhof and songs by Billie B. Explains the natural history of the red worm. Shows a baby worm hatching; explains how worms move and describes how they reproduce. Although designed for students in upper-elementary grades, some parts would be very interesting to younger students.

Audiotapes

Dirt Made My Lunch. Recorded by the Banana Slug Band; includes the song “Decomposition” by Steve Van Zandt. Music for Little People, 1989.

A tape and booklet with the words to this and other songs.

Nature Nuts. Recorded by Mary Miche, 2600 Hillegass Ave., Berkeley, CA 94704; (510) 845-8417.

Includes a song “Recycle Blues” that includes lyrics on composting.

Books

Appelhof, Mary. Illustrated by Mary Frances Fenton. *Worms Eat My Garbage.* Kalamazoo, Mich.: Flower Press, 1997.

Describes how to set up and maintain a composting system in which worms recycle food waste and produce fertilizer that can be used for house plants and garden areas.

Kalman, Bobbie, and Janine Schaub. *Squirmy Wormy Composters.* New York: Crabtree Publishing Company, 1992.

Describes red worms and how to set up a vermicomposting bin. Contains ideas for activities for students to learn more about red worms.

Ross, Michael Elsohn. *Wormology.* Photographs by Brian Grogan and illustrations by Darren Erickson. Minneapolis: Carolrhoda Books, Inc., 1996.

Contains information, colored photographs, and diagrams of earthworms. Describes activities that can be done with worms.

Silverstein, Shel. *Where the Sidewalk Ends.* New York: Harper and Row, 1974.

Contains a selection of poems, including “Sarah Cynthia Sylvia Stout.”

Activity Guides

Appelhof, Mary, and others. *Worms Eat Our Garbage: Classroom Activities for a Better Environment.* Illustrated by Mary Frances Fenton and Nancy Kostecke. Kalamazoo, Mich.: Flower Press, 1993.

Contains activities for students to learn about red worms.

Composting Across the Curriculum. A Teacher’s Guide to Composting. San Rafael, Calif.: Marin County Office of Waste Management, 1993.

Contains activities about composting and vermicomposting.

Do the Rot Thing. A Teacher’s Guide to Compost Activities. San Leandro, Calif.: Alameda County Waste Management Authority and Source Reduction and Recycling Board, 1997.

Contains activities about composting and vermicomposting.

Eulo, Anthony. *Worms, Worms, and More Worms: A Guide to Vermicomposting.* Sacramento: California Integrated Waste Management Board, 1996.

Contains background information on how to set up a vermicomposting system and provides ideas for many activities that students could do concerning worms.

Grossman, Shelley C. and Melissa Weitzel. *Recycle with Earthworms: The Red Wiggler Connection*. Illustrated by Lisa Marie Donnabella. Eagle River, Wis.: Shields Publications, 1997.

Describes various types of worms, the anatomy of worms, and methods for composting with red worms.

Newsletter

Worm Digest. Edible City Resource Center, Box 544, Eugene, OR 97440.

A newsletter containing information about teachers using worms in the classroom, activities to learn about worms, workshops, and resources. Back issues are available.

Web sites

www.globalclassroom.org/worms.html

Information regarding a first-grade class that is vermicomposting. Included in this site are comments from the students regarding the activities.

www.interware.net/~levine/worms/

Primarily for classroom work with worm bins. Provides classroom instruction and materials.

www.wormdigest.org/

Worm Digest is a quarterly newsletter that reports about worms and worm composting (vermicomposting) on all levels worldwide. Its aim is to network people, information, and resources concerning the use of worms for organic waste conversion and soil enrichment.

www.wormwoman.com/frameindex.html

The "Worm Woman's" Web page provides an introduction to the methods of vermicomposting, covering materials and the process.

www.ciwmb.ca.gov

The Web site for the California Integrated Waste Management Board and includes the most current list of worm suppliers.

Additional Web sites are listed in "Appendix F-VI."

Other Resources

Environmental Education Compendium for Integrated Waste Management and Used Oil. Sacramento: California Department of Education and California Integrated Waste Management Board, June, 1999. Copies are available through the California Integrated Waste Management Board.

Contains information about and evaluations of many curricula on waste management (including composting) and used oil.



A small plastic vermicomposting bin suitable to use indoors sits on top of the large wooden outdoor vermicomposting bin at Laytonville Elementary School.

SAMPLE VERMICOMPOSTING DATA SHEET

Date bin was set up:

Number of worms (in pounds or actual number of worms):

Kind of bedding used and weight (or amount):

Harvest date(s):

Draw a picture of the worm bin and assign numbered plots to its surface so that you can track the decomposition of food placed in each numbered area.

Month _____

Date	Weight of food	Type of food	Buried in site #	Notes

WHAT TO PUT AND NOT PUT IN A WORM BIN

Put the following in a worm bin:

- Shredded paper products
- Fruit and vegetable trimmings
- Grains, beans, or breads (without butter, margarine, or mayonnaise)
- Egg shells
- Fallen leaves
- Tea bags
- Coffee grounds and filters
- Lawn clippings and young weeds



Do not place the following in a worm bin:

- Meat products
- Dairy products
- Rocks
- Plastics
- Glass
- Metal products (e.g., aluminum cans)



BACKGROUND INFORMATION FOR THE TEACHER

Vermicomposting is the process of using red worms and microorganisms (like bacteria and fungi) to change organic waste (e.g., food scraps and paper) into useful rich compost, full of nutrients that plants can use for growth. Vermicomposting can help to reduce household and school food waste that goes to a landfill. In 1995 food waste made up about 9 percent and paper made up about 31 percent, by weight, of the household garbage sent to landfills in California.¹

In order to vermicompost in the classroom, students will need to prepare a bin to hold the red worms and provide bedding and appropriate organic materials to feed the worms. In addition students will need to monitor and control the environment in the worm bin so that it is conducive to worms and composting. This effective composting system can also be set up outdoors. For information on how to set up large-scale outdoor vermicomposting, see “Resources” at the end of the lesson.

Red worms (*eisenia foetida*), also called manure worms or red wigglers, are the type of worm used in worm composting systems. Red worms naturally live in decaying leaf litter, compost piles, or manure just above the ground’s surface. Animals and plants that die and begin decomposing provide food for the worms. In a worm bin, red worms readily consume food scraps and paper, and each red worm can eat half of its body weight every day.

Red worms are ideal for use in vermicomposting, because they can live within whatever space is available, tolerate a wide range of temperatures (especially the warm temperatures found within the average classroom and home), reproduce quickly, and mate throughout the year. (For information about reproduction of worms, see the “Background Information for the Teacher” in “Lesson 3, Cycles in Nature and Red Worm Development.”) The population of red worms is limited in the worm bin by the amount of food available and by the amount of free bedding that has not been converted into castings (worm excrement).

Red worms can be purchased from worm
¹“Estimated Average 1995 Residential Disposed Waste Stream Composition.” California Integrated Waste Management Board.

suppliers. For the most current listing of worm suppliers, visit the California Integrated Waste Management Board’s Web site at www.ciwmb.ca.gov or see “Appendix D.”

Worms found in an outdoor compost pile would probably be suitable for indoor vermicomposting, but there are definitely some worms found in the ground which are not suitable. For example, night crawlers, or *lumbricus terrestris*, are not recommended for the worm bin, because they need large amounts of soil and cannot survive in soil with temperatures above 50° F.

Other organisms (living things) in the vermicomposting bin include bacteria, which break down most organic matter, and fungi, which break down the tougher materials, such as cellulose (found in materials like paper), that bacteria cannot break down.

Red worms have no eyes, but they do have sensory cells on their skin which detect light. They prefer darkness; therefore, keeping worms in a dark container (with a lid) is important.

The bin for red worms should be shallow (8 to 12 inches deep) because red worms tend to be surface feeders. Therefore, a shallow plastic storage container, with drainage holes works best as a worm bin.

The least expensive and easiest bedding to get for red worms is shredded newspaper. The white paper found in schools and offices can also be used for bedding. Avoid glossy advertisements and magazines.

Worms breathe by absorbing oxygen through the wet surfaces of their bodies. Their bodies must be moist in order for the exchange of air to take place. Therefore, the newspaper (or other paper) must be moistened to keep the red worms’ habitat in the bin damp. The bedding should be at least six inches deep after moistening. Since paper can be fluffed up, oxygen is provided for the worms. Oxygen is necessary not only for the worms but also for the microorganisms that are breaking down the food waste.

Make certain that the contents of the bin do not get soggy. If their environment is too wet, the red worms become uncomfortable because of the rise in acidity levels. Holes on the bottom of the bin will allow excess water to drain out. This

water, called “compost tea,” can be collected and used as a natural concentrated fertilizer for plants.

Worms have gizzards and need a small amount of gritty material to help grind up the food waste. Therefore, several cups of soil should be added to the bin. Before adding the soil, check to make sure that the area that the soil came from was not recently treated with pesticides. An even better source of grit is rock dust, which is ground up rocks. Many nurseries and garden stores sell bags of rock dust. It is rich in minerals and will help balance the acidity of the bin.

Two thousand worms weighing approximately 2.2 pounds (one kilogram) can be fed about 1.1 pounds of food waste each day. Any plant food waste can be put into the bin. Avoid placing animal products in the bin. Meat and cheese attract mice, rats, and other pests and may create an unpleasant odor as they decompose.

It is possible to overload the system by adding too much food waste. Plan to have students keep track of the weight and placement of food buried and check how rapidly the worms are processing the food scraps and paper.

Note: For additional information about maintaining the bin, see “Maintaining a Vermicom-

posting System” in “Appendix D-II.”

Safety Note: If vermicomposting is used at a student’s home and cats are present, make certain that students and parents know that cats should not be allowed to use the vermicomposting bin as a litter box. Cat feces can contain a disease-causing organism called *toxoplasma gondii*, which is harmful to humans, especially pregnant women. Damage to the brain of the fetus can result from contact with this organism.



This sign is posted above each outdoor vermicomposting bin at Cesar Chavez Elementary School, San Francisco Unified School District.