

# Vermi-Fun

**Grade:** 4

**State Standards:**

Grade: 4; Science 2: a-c All organisms need energy and matter to live and grow. As a basis for understanding this concept: Students know plants are the primary source of matter and energy entering most food chains. 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. Students know decomposers, including many fungi, insects, and microorganisms, recycle matter from dead plants and animals.

**Preparation Time:** 25 minutes

**Activity Time:** 2 hours

**Key Words:** consumers, decomposers, habitat, vermicompost,

## OBJECTIVE

Students will demonstrate concepts of habitat and community and identify factors that may affect these. Students will investigate dependency of animals on habitat and interrelationships of plants and animals in a specific habitat. They will describe ways in which humans can change habitats and affect those changes on the plant and animals within these habitats.

## MATERIALS

A bin either handmade or a plastic tub (drill for air holes), starter soil, bedding such as newspaper and a small bag of potting soil for initial set-up. Writing materials for graphing results and a magnifying glass.

## BACKGROUND

- The mission of the Department of Resources Recycling and Recovery (CalRecycle) is to reduce the generation and improve the management of solid waste in California in order to conserve resources. Vermicomposting deals with one recovered material in particular: food waste.
- At the very heart of waste management is the integrated waste management hierarchy; reduce, reuse, and recycle. Many people have added a fourth component to the hierarchy; rot in order to further eliminate waste from entering the landfill.
- Rot refers to recycling food waste and other organic materials through composting or vermicomposting. In vermicomposting, worms do the “dirty work.” The organic materials decompose and are transformed into nutrient-rich material that can be used or in this case “reused” as soil amendments and fertilizer. Keeping food waste out of our landfills!

The Worms:

The worms used in vermicomposting are called redworms (*Eisenia foetida*), also known as red wigglers, manure worms, red hybrid or tiger worms. You can order them through lawn and garden catalogs. You may also be able to find them in a bait store.

**Vocabulary:**

- **Soil structure:** Determined by how individual soil granules clump or bind together
- **Species:** A class of individuals having some common characteristics or qualities; distinct sort or kind
- **Epigeic:** An earthworm that lives primarily in leaf litter on the soil's surface and feeds on surrounding plant debris
- **Endogeic:** An earthworm that primarily feeds on soil and plant roots
- **Anecic:** An earthworm known for burying leaf litter in the soil and pulling it into underground burrows for consumption

**What About Nightcrawlers?** Do not try to use nightcrawlers to stock your worm bin. These worms depend on cooler temperatures and an extensive tunneling system to survive. They will die in your worm bin

**Why Redworms?** (Red wigglers) Redworms prefer temperatures between 55 and 77 degrees Fahrenheit and are suited to living in a worm bin. The temperature of the bedding should not be allowed to get below freezing or above 84 degrees.

**How Many Worms Do I Need?** The amount of worms needed will depend on the amount of kitchen or classroom waste generated per day. One pound of redworms will easily take care of a half-pound of garbage per day. To add worms to the bin, simply scatter them over the top. The skin on the worm reacts to light and they will immediately work their way down into the bedding to get away from the light.

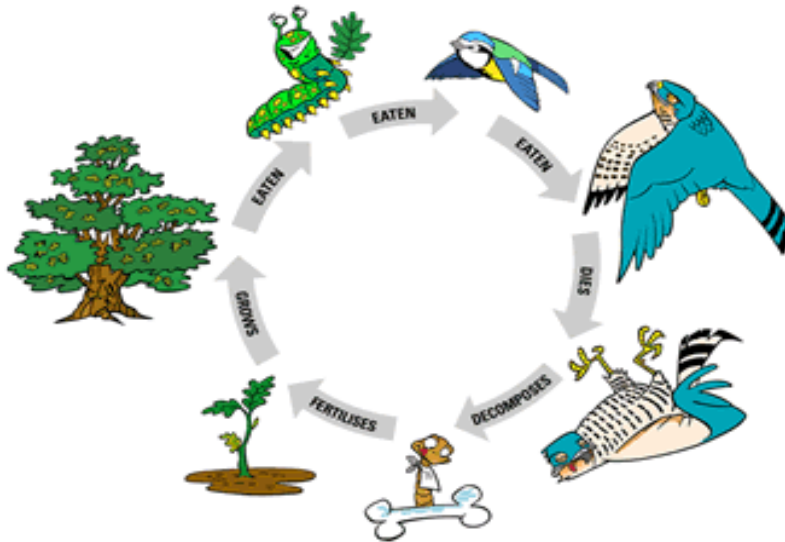
Kitchen Waste:

The kitchen waste fed to worms can come from a variety of sources, including all vegetable and fruit waste (don't be surprised that some seeds may germinate and potato peels with eyes sprout), pasta leftovers, coffee grounds (with filter) and tea bags. Worms may have a problem with garlic and onion skins. Worms have a gizzard like chickens so fine grit should be added to help the worms digest food. This gritty material includes corn meal, coffee grounds and/or finely crushed egg shells (dry the shells and then crush). Avoid fat, meat scraps or bone.

**Life Cycle**

Mold and bacteria and higher level organisms like beetles, centipedes and, of course, worms are all busy recyclers. By breaking down organic matter for example, dead plants, feces, and decaying animals, they create valuable nutrients necessary for rich and fertile soil. Trees, leaves, fruit, nuts, dead animals, and food waste would not have a way to decompose and renew the balance of life without decomposers. Every organism needs to obtain energy in order to live. For example, plants get energy from the sun, some animals eat plants, and some animals eat other animals. A food chain is the sequence of who eats

whom in a biological community (an ecosystem) to obtain nutrition. When any organism dies, it is eventually eaten by detritivores (like vultures, worms and crabs) and broken down by decomposers (bacteria, fungi, and worms), and the exchange of energy continues.



## PROCEDURE

Steps to successful classroom vermicomposting include Set Up, Worm Adoption, and Maintenance.

1. **SET-UP:** Like all living creatures, worms need food, water, air and shelter. Set up is simply creation of the worm ecosystem which includes: **Bin, Bedding and Food.**

**Bin:** You can purchase commercially made bins or construct a bin from wood or plastic. A bin needs to be 12"-18" deep, have a snug fitting lid and small holes in the bottom or sides for ventilation. The ideal bin for classroom use and first time vermicomposters is an eighteen-gallon plastic tote, with a tight fitting lid (12" to 18" tall, 12" x 24" base). Drill air holes (no bigger than 1/4 inch) about halfway up on the sides of the bin.

**OPTIONAL:** To improve drainage, you can drill some holes in the bottom, but the bin will need to be placed on a tray to catch the vermicompost "tea". This requires a bit more maintenance and if neglected could cause a nuisance in your classroom. If you don't wish to drain the tea\* onto a tray, skip the bottom holes and collect any excess liquid from the bottom of your bin with a household turkey baster.

\*"Tea" is the term composters use for liquids that seep through compost picking up nutrients. Add this liquid to the water you use on your plants. In addition to nutrients, compost tea has shown to help plants be more resistant to disease.

**Location:** Worms prefer temperatures of 65-84 degrees F. Keep your worm bin indoors, out of the sun, in a quiet place, but not so isolated you or your class forget about them!

**Bedding:** Worms love to live under moist paper or leaves. Bedding keeps the worms damp and also provides a high carbon material that the worms will break down.

Tear black and white newspapers into one-inch strips, fluff them up, and then moisten them so they are as damp as a wrung-out sponge. Fill your bin 3/4" full with this moist "bedding." Sprinkle bedding with a few handfuls of soil. Shredded leaves, paper, cardboard or straw are also good bedding materials.

**Food:** Worms eat about half their body weight a day! Feed 1 pound of worms about a cup of good scraps per day.

Food scraps include:

Fruit and vegetable peelings, cores, seeds

Breads, cereals, macaroni

Coffee grounds, paper napkins

NO Meats, Fat, or Dairy (worms will consume these foods, but you run the risk of a very smelly bin!)

Always bury food at least 4" down under the bedding. If the bin starts to smell or food isn't breaking down quickly, give your worms a break and feed them less food. Worms reproduce quickly, so they should be able to eat all your food if there's enough space and you increase the amount of food gradually. Hint: wrap food scraps in moistened newspaper. It reduces chances of developing fruit fly problems and adds fresh bedding at each feeding. Feed in a pattern, choosing a spot and rotate around the bin. Rotation provides excellent observation activities. How many days until the worms find the new food? How long did it take them to completely eat all the food in one location? As you feed the worms, take a look at the bin. Is the bedding drying out? Is the bedding too wet? Where are most of the worms hanging out? Do you see worm cocoons?

## 2. WORM ADOPTION

For vermicomposting, the red wiggler or *Eisenia fetida* is the preferred species. These worms are "composter" worms, capable of processing large amounts of organic material. They thrive in the fluffy layer of leaves on the forest floor and in manure piles.

Soil dwellers, earthworms or night crawlers, thrive in earth tunnels and won't be happy in the confined space of a vermicompost bin with the constant interruption of waste additions and observation by students.

Red wigglers or red worms can be purchased at local bait shops or via the Internet. The bait shop owner may call red wigglers manure worms or red hybrid. Start your bin with about a pound of worms (1,000-2,000 worms). When the worms arrive, just place them on top of the bedding. Leave the bin exposed to light as the worms work their way down in to the bedding. Once all the worms have left the surface, bury their first meal, cover with the lid and leave them alone for a week or so to allow them to get used to their new home. Then begin their regular feeding schedule.

## 3. MAINTENANCE

A healthy worm bin is a productive worm bin! Adding fresh bedding every 2-3 weeks, keeping a 4" to 6" layer of fresh bedding over the worms and food in your bin will contribute to a healthy home for worms. Keep bedding moist, like a wrung-out sponge. Add dry bedding to absorb excess moisture. Harvest worm castings periodically every 3 - 6 months.

Worms, like all creatures, prefer not to live in their own waste. After about 6 weeks, there will be noticeable changes in the bedding. It will be darker, and you will see more castings than bedding. It is time to harvest the vermicompost.

#### Harvest:

The simplest way to harvest the worm castings is to move the contents of your bin to one side. Fill the empty side with fresh damp bedding and a small handful of soil. Feed only on the new side and the worms will eventually migrate to the fresh side.

The second way to harvest your vermicompost is to empty the contents of your worm bin onto a plastic sheet or used shower curtain where there is strong sunlight or artificial light. Wait 20-30 minutes, then scrape off the top layer of vermicompost. The worms will keep moving away from the light, so you can scrape more compost off every 20 minutes or so. After several scrapings, you will find worms in clusters; just pick up the worms and gently return them to the bin in fresh bedding.

### Classroom Activities

#### Brainstorming

A. Student groups brainstorm "What is vermicomposting?" Record ideas from each group for sharing. After sharing, provide definition so students can compare with their ideas. (Vermicomposting is a system that uses redworms to process/eat kitchen waste, resulting in worm castings that are rich in nutrients and can be used as fertilizer for plants).

B. Student groups brainstorm questions they have about vermicomposting. Have the groups share and list the most common questions. Assign each group to research assigned questions from the list and share with the class.

#### Preparation

A. Assign roles to students such as planners, bedding collectors, bedding preparers, feeders, worm keepers, etc.

B. Students draw a diagram of the worm bin from an overhead view. Students divide bin into sections and number the sections. Students 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 is placed. Worm bins will be fed vegetables, paper, rabbit droppings, try various food groups.

C. Provide an overview of tasks to be completed in building and maintaining the worm bin.

#### Research

A. Give pairs of student's composted soil and a magnifying lens. Have the students identify worm castings.

B. Assign teams to think about and then draw an illustration of the vermicomposting cycle (building a bin, preparing the bedding, adding the worms, adding the food waste, harvesting the castings, fertilizing the garden, growing vegetables, eating the vegetables, feeding vegetable waste to the worms). Assign students to think about the cycle and identify additional possibilities for expanding the cycle (e.g. rabbits in cages near the worm bins being fed lettuce grown from castings. Lettuce waste return to the worm bin).

#### Recordkeeping Assessment

A. Discuss with students how to use a thermometer. Have students practice recording temperatures. Assign students to record temperatures in the worm bin, maintain a log of temperatures. Have students graph temperatures over a period of time.

B. Have students measure and record amount and types of food given to the worms. Have students graph amounts of food over a period of time. Ask students to identify foods that are easy/hard to vermicompost based on their observations.

C. Have students measure and record two sections of their bin with little to excessive amounts of water. Have the students record the temperatures of each, monitor for food consumption and compare to a control section of the bin for a constant variable. Record any unusual changes (i.e. mold, no worms present, fast or no decomposition).

#### Observation

A. Assign pairs of students to observe the activity of the worms when food waste is buried. Students record their observations in their journals and share with other students in their group.

B. Pairs of students collect a small sample of composted material from the worm bin to observe under a magnifying lens. Students record their observations in their journals and share with other students.

#### Conclusion

A. Have students discuss these questions with a partner and then share their ideas with the class. "What does "closing the loop" mean to you?" "How do worms close the loop?" "Why are worms important?"

## **ASSESSMENT**

Students will identify the concepts of vermicomposting with positive way of keeping food waste out of landfills. Students can list several advantages of vermicomposting to recycle food waste and how it can promote a healthy natural environment.

## Set Up Record Sheet

Date set up \_\_\_\_\_

Initial weight of worms \_\_\_\_\_

Type of bedding \_\_\_\_\_

Size of bin \_\_\_\_\_

Classroom size \_\_\_\_\_

### Garbage burying locations:

Label the worm bin so you can keep track of where and when you are feeding the worms.

Example:

1	2	3
6	5	4

### Harvest Results

Date harvested \_\_\_\_\_ No. of days total \_\_\_\_\_

Worm weight \_\_\_\_\_

### Calculate the following from the Feeding Record Sheet:

Total weight of buried food waste \_\_\_\_\_

Average oz. buried per day \_\_\_\_\_

Average temp. \_\_\_\_\_ Temp. range \_\_\_\_\_