WILLETT GARDEN OF LEARNING

Worms, Worms, Worms: Taking a Willett Census

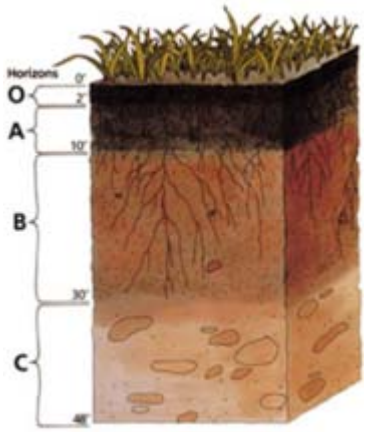
Activity: Count the number of earthworms in a cubic foot of Willett soil and estimate the total Willett earthworm population

Goals: To learn about earthworms and how they help our gardens, to learn how to estimate a total population based on survey data

Supplies: cubic foot container, shovel, garbage bag, ruler, worm worksheet, clip board, pencil in shed

How to proceed:

Dig a cubic foot of soil from any one location on the school grounds. The students may dig the soil or you may do it in advance, but take the class to the location you dug for the activity. Dig to one foot in depth (making sure to avoid any irrigation pipes or sprinkler heads). This will keep you within the O and A soil horizons that earthworms frequent. (Diagram source http://en.wikipedia.org/wiki/Soil.) The soil should fill the cubic foot container without any large air pockets.



Designate one person to be secretary for the group and ask them to record the date and class gardening on the worksheet. Next ask the group to describe the location where the soil was dug (e.g. grassy area next to the tennis courts, Wildlife Garden under the tree, etc.) The secretary records this description.

Empty the container of soil onto the garbage bag and have students search for earthworms. Allow them time to examine the worms as they are found. Ask questions and share background information about the biology of earthworms. Emphasize how worms help our gardens.

As time permits, you may do this activity from Kidsgardening.com: challenge students to guess the length of an earthworm, then try using a ruler to determine the actual size. Ask, *What problems do you encounter? After watching how earthworms move, why do you think it's difficult to measure their true length? What is it about their bodies that might cause them to seem to shrink and grow? How do you think this helps them move through soil?*

Count the number of worms found in the cubic foot of soil and record the number.

Now ask students to describe the soil. Ask, *How does it feel – is it gritty, clay-like or crumbly? Is it dry or moist? What do you see in the soil – roots, stones, grass, other insects?* Record these observations.

The total volume of Willett soil is **239,400 cubic feet** (570 feet in length x 420 feet wide x 1 foot deep). This is the amount of soil you would have it you peeled a one foot layer of soil off the school grounds. This was calculated by pacing the distance from the road to behind the backstop, from the backstop to the southwest corner of the fence, and one foot of soil depth.

How can your earthworm count be used to estimate the total earthworm population at the school? Guide students to extrapolate from their cubic foot to the total volume of soil (their number of earthworms in one cubic foot of soil x 239,400 total cubic feet).

What could be a problem with this method? The answer that you want them to find is that earthworms may not be uniformly located throughout the school. They may prefer shadier, moister soil; undisturbed soil (i.e. that under the blacktop); soil with more organic matter; or garden soil. A better estimate could be arrived at by averaging the findings of all our garden classes and extrapolating the total population based on surveys from different locations around the school grounds taken on different days. This will be done for you so that students can compare their class estimate to the collective estimate.

Return the earthworms and soil to the hole and leave the area as you found it. Return supplies to the shed and leave your class results on the counter. Check next week for school-wide results.

More information can be found on the Lesson Links page of the Garden of Learning website at

http://www2.dcn.org/orgs/willettgarden/spages/SD1143384095

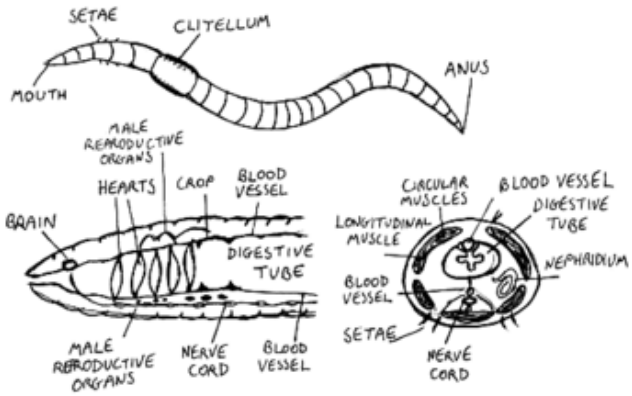
Background Information

Worm Structure

(Source of photos and diagrams http://en.wikipedia.org/wiki/Earthworm)

Worms are intriguing creatures. They are both female and male (hermaphroditic). Worms have no eyes and no teeth but they can sense light and prefer the dark, as sunlight can harm their sensitive skin.

Worms have a small, muscular mouth that contains a small, sensitive pad of flesh that stretches out to draw in food. Because worms have no teeth, they are not able to chew their food. They are limited to food that is small enough to be drawn into the mouth. Usually moisture or bacteria soften the food.



Worms, like birds, have gizzards that grind their food. Small grains of sand and mineral particles from the soil lodge in the gizzard. The muscular contractions of the gizzard wall compress these hard materials against each other. Fluid is added to the food and then mixed with the grains of sand, which grind the food into small particles. Once the food particles pass through the gizzard, they enter the intestines where the worm's body absorbs needed nutrients. Undigested material, including soil, bacteria, and plant residues, passes out of the worm through its anus as worm castings.

Make note of a couple of fun facts about worms: most worms probably live and die within the same year, but in a cultured environment, they may live up to four years. If cut in half, worms can regenerate lost or injured parts, but only to a limited extent. The worm can grow a new tail, but not a new head.

How the Earthworm Moves

From Kids' Garden Club http://netdancer.com/web-templates/kidsgardening/earthwormmoves.html

The earthworm has no lungs and takes in oxygen through its moist skin — it is a skin breather. If the worm's skin dries out the worm will suffocate. Mucus secreting cells cover its skin. The mucus, not only serves in respiratory exchange, but it also lubricates the worm's body and eases passage through the burrow. The mucus covered skin helps bind soil particles together and prevents the walls of the burrow from collapsing.

If you watch an earthworm move, you will most likely see it move forward, with its pointy end in the front. The worm's body is divided into 100 or more body segments. As the worm works its way forward, successive peristaltic or contracting waves of thickening and thinning (7–10 per minute) pass down the body. At each place where the body bulges out at a given moment, the bristles, or "setae", are extended and grip the burrow walls. Setae, which are not true legs but pairs of bristles attached to each segment, push against the ground with each contraction and help the animal move.

Your Garden's Best Friend

From Kids' Garden Club http://netdancer.com/web-templates/kidsgardening/earthworms.html

Gardeners, farmers, foresters and soil scientists love the earthworm because of the good they do for flowers, crops, and plants and other animals of the forest. Although they are the most numerous in the top 6 inches, they also work in the subsoil, bringing mineral rich soil from below to the surface. This adds to the supply of nutrients available to the plants.

Earthworms are active animals and feed by eating their way through the soil and bringing organic debris into their burrows from the surface. Research shows that in every 100 square feet of garden soil, earthworms may bring from 4–8 pounds of dirt to the soil surface each year. As earthworms tunnel through the soil, the soil is ingested and any organic matter is digested. Digested leaf litter (dead leaves and animals) contains nutrients made by plants during photosynthesis and includes calcium, nitrogen, potassium and phosphorus, and other organic minerals and nutrients.

Besides incorporating organic matter into your soil, earthworms are good manufacturers of fertilizer. Worm excrement, called castings, is deposited on the surface and is also rich in nutrients. Other animals and microorganisms utilize these castings as food. Castings have a nutrient level and organic matter level much higher than that of the surrounding soil. The micro-organisms in the soil then break down this organic material. Each day they produce nitrogen, phosphorous, potassium and many micronutrients in a form that all plants can absorb. In this way, earthworms have helped produce the fertile humus that covers the land.

A well managed, rich in humus soil can easily support 25 worms per cubic foot. This translates into at least 175 pounds of fertilizer per year for the same 200 square foot garden. For example, a 200 square foot garden with a low worm population of only 5 worms per cubic foot will be provided with over 35 pounds (about 1/3 pounds per worm) of top grade fertilizer by the worms, each garden year. Not only do they produce this fertilizer but spread it thoroughly within the top 12 inches of soil, and incorporate it as far down as 6 feet. This means that your garden or lawn can be supplied with far more superior quality fertilizer than 10–20 pounds of dry or granular fast acting chemical fertilizer. In fact, as the chemical fertilizer becomes soluble, it leaches into the soil and forces the earthworms to seek refuge elsewhere, thereby repelling those earthworms that are already present.

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Date:

Class Gardening:

Describe where your soil was dug:

Describe your soil:

The total volume of Willett soil is **239,400 cubic feet**.

We found _____ earthworms in one cubic foot of soil.

We estimate the total Willett earthworm population is _____ .

Please leave this worksheet on the garden shed counter after your class.