

WormEzine Volume 2, Number 3

News and information from Mary Appelhof
about vermicomposting, worms, and other critters that live in the soil.

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For THE SMALL PRINT, scroll to end.

They laughed when I said worms eat my garbage,
but I showed them how, and now thousands say the same thing

A WORD FROM MARY APPELHOF aka Worm Woman

Dear Worm Workers,

Worm bin outside temperature is 20 degrees F (7 C), worm bin 40 degrees F (18 C). The worms are alive and well, but the bin also has thousands and thousands of enchytraeids in it! I don't know if they like the colder weather, or what. If any of you picked up on that ice worm article, you learned that the annelids that live in the melt water on glaciers in Alaska are enchytraeids. I'd welcome any insight on this situation-I really don't know much about enchytraeids.

We're fast approaching Earth Week April 21-26 with a flurry of events coming up. Make sure you sign up for Worm-Powering Kids if you are willing to read *Compost, By Gosh!* to a group of kids. Even if you aren't into doing that, at least go to the website to take a look at the delightful presentation Ranee and Eric have put together. http://www.wormwoman.com/acatalog/wormpowering/wormpowering_main.html

The feature this month on setting up a worm observation chamber gives teachers a project they can do with their students all year long. It would also make an excellent science fair project for the student who doesn't wait until the last minute to get started. Homeschoolers can also use it to stimulate questions and develop understanding about soils and the roles of different kinds of earthworms. You can visit Lisa McCurdy's site to see how much this activity contributed to their classroom learning.

Until next month ...

Mary Appelhof

“Changing the way the world thinks about garbage ...”

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1=====FEATURE=====

How to Set Up a Soil Profile to Maintain as an Earthworm Observation Chamber By Mary Appelhof

Observing the effects of masses of worms, as you do when you have several thousand *Eisenia fetida* processing organic wastes in a home worm bin, is quite different from seeing a single worm at work in the soil. Because the worm is surrounded by soil, you can't normally watch it carry out its important jobs of aeration, mixing mineral soil with organic material, and converting nutrients into forms usable by plants. You can get a glimpse into the life of a worm by setting up an earthworm observation chamber that can provide a source of fascination for several months. Set up in the manner described here, a worm observation chamber also provides an opportunity to learn about soil profiles. Another possibility is to compare behavior between different kinds of worms.

The Worm Observation Chamber described here is based on that presented more comprehensively in *Worms Eat Our Garbage: Classroom Activities for a Better Environment*. It is constructed from lumber and acrylic plastic and requires the use of a drill and screws to put it together. It is approximately 12 inches tall, 18 inches wide and 3 1/2 inches thick based upon U.S. standard-sized lumber. I will not convert to metric other than to say it is approximately 30 cm tall, 45 cm wide, and 9 cm thick. Since dimensions need not be exact, available materials can be used.

Note: Other "thinner" designs exist to enable direct viewing of earthworms. These allow a single worm to move between the panes with the worm squeezing against each pane. Such a design guarantees that you will be able to see a worm, but it is difficult to load with soil. The thin design also does not allow the use of pebbles and other materials to develop the concept of soil profiles that this thicker design provides.

Materials

- 2 12" x 18" sheets of acrylic plastic (have an 18" x 24" sheet cut in half)
- 2 12" 1 x 4 lumber (actual dimension is 12" x 3/4" x 3 1/2")
- 1 16 -1/2" 1 x 4 lumber
- 1 18" 1 x 6 lumber
- 48 3/4" Phillips round-head machine screws
- 10 1-1/4" wood screws (size 8)
- 1 white candle

Directions

1. Rub the candle on all wood surfaces using pressure to help waterproof and protect the wood.
2. Place the 16 -1/2" base BETWEEN the sides and use 3 1-1/2" screws to fasten each side to the base. Make sure to maintain right angles of the sides to the base.
3. Place one acrylic sheet in position on the frame and drill holes through the acrylic and into the wood to secure the acrylic onto the base. Insert round-head machine screws on the bottom of the frame PRIOR to drilling the sides and placing the screws. (Wood screws with their angled head will cause the acrylic to crack. That is why it is important to use machine screws with their flat surface.) Repeat with side 2.
4. Stabilize the unit by attaching the 6" board to the base with the remaining wood screws. Countersink the holes so the screws do not scratch the tabletop when the chamber is in the upright position.

Soil Profile

The profile of a soil is specific to a particular site and consists of a vertical section from the surface down to either a specified depth, to bedrock, or to the so-called parent material from which that particular soil is derived. Soil profiles consist of horizontal layers that give a striped appearance. Each layer is known as a horizon. Named from the surface down, horizons are called O, A, B, and C, with O, or the Organic Horizon being the top layer and the C Horizon the deepest layer. NASA has a website with images of soil profiles from around the world at <http://ftpwww.gsfc.nasa.gov/globe/soilgall/images/images.htm>

My soil horizon in Michigan will differ from a soil horizon in Georgia, which will differ from soil horizons in the desert, or mountains, or floodplains. I have based the loading of the Earthworm Observation Chamber here on a typical soil profile in Kalamazoo because this illustrates the various horizons and these are the materials I have available when I dig in my garden or in a field. Our subsoil is most likely to be beige-colored sand and is most easily seen on construction sites.

Use this activity to teach about soil profiles in your own environment. I was amazed to see how red the subsoil was from the Georgia red clay in the Worm Observation Chamber that Lisa McCurdy's class put together. She has posted photographs and comments from her class on her website at <http://www.ncsu.edu/kenan/fellows/2001/lmccurdy/ObsTank/index.html>

Setting up the Soil Profile for your Worm Observation Chamber

The basic idea is to load the chamber from the bottom first, placing parent material first (C Horizon), followed by subsoil (B Horizon), topsoil (A Horizon), and then the O or organic horizon. You can use an optional marker layer between the organic and topsoil horizons to enable you to see more dramatically the extent to which worms mix the soil layers. I used a 1/2" layer of beach sand for this marker layer. This is a model, not an exact replica, of a soil profile, so the horizons will not be proportional to the actual depth in your region. Parent material will be much thicker than the 1/12 proportion given, subsoil will be much deeper than the 4/12 proportion. The model enables students to become familiar with the different characteristics of the various horizons and observe the degree to which worms exert their influence by mixing the layers.

The recipe given here was used to set up the Worm Observation Chamber illustrated in the photographs on the website at <http://www.wormwoman.com/acatalog/wormezine.html>

Soil materials needed

Leaves
2 quarts compost
1-pint fine white sand (marker layer)
3 quarts topsoil
4 quarts subsoil
1 quart small rocks or pebbles; 1-2" in diameter

Procedure

1. Place about 1 qt of small rocks in the soil profile chamber. These represent the lowest layer, known as the C Horizon, or sometimes called the parent material. The C Horizon has little living matter. It may show some weathering, but less than the layers on top of it.
2. Next place about 4 qt of subsoil. Subsoil, the B Horizon, may be brown, red, yellow, or gray. It may be quite sandy. If made up of clay, it will be hard when dry, and stickier when wet than surrounding soil layers. This middle soil layer contains few organisms, but plant roots may penetrate into it.
3. Place about 3 qt of topsoil on top of the subsoil. Known as the A Horizon, healthy topsoil teems with life. Plant roots, bacteria, fungi, and small animals make topsoil a living system. Because it has more organic matter, topsoil is darker than subsoil.
4. Place the marker layer (if you choose to have one) on top of the topsoil. This is an artificial layer not found in a natural soil profile. It serves as a marker to help with your observations.
5. Add 2 qt of compost for the O, or Organic Horizon. Compost is partially decomposed organic matter such as leaves, garden residue and food waste. In its active state, compost contains millions of microorganisms and other soil-dwelling organisms, which consume the ever-changing organic matter and each other. Finally, add a layer of leaves to the surface.

Converting the Soil Profile Chamber to a Worm Observation Chamber

Earthworms need moist soil to live in, so you will need to add water to your soil. It may take several quarts. Excess water may run out the bottom, so place the entire chamber in a tray initially. It may be good to place a narrow plastic sheet or waxed carton on the surface to reduce evaporation of water from the chamber.

Earthworms also prefer to work in the dark, so you need to make a dark cover to place over the Worm Observation Chamber. This can be a fabric cover, or perhaps cardboard flaps. You want something that will permit the worms to work in the dark most of the time, but which can be lifted up or removed occasionally to make observations. Remember to feed the worms some fresh organic matter every now and then. Perhaps leaves, an apple core or two, banana peel, some coffee grounds, potato peels, or lettuce leaves. Lay them on top of the litter layer and make sure they are moistened.

Decide what kinds of things you want to observe, and what kinds of worms you will use. Nightcrawlers (*Lumbricus terrestris*) are deep burrowing worms and large-size, so you should be able to see a definite burrow after one or more days. They may not live in this environment for long, or they may live all year. One or two nightcrawlers would be enough to get started.

You may be able to see a worm pressing its body against the transparent pane. How fast does it move away from the light? Which direction does it go? Can you tell the anterior end from the posterior end? Do you see definite signs of a burrow?

Garden worms (several species, depending on where you live and what species are there) may behave differently and work in different areas of the chamber. Make notes as to which horizons they seem to prefer, and whether you can identify them or their burrows. Try 3 or 4 of the garden worms.

Which horizon would redworms (*Eisenia fetida*) prefer? Do they stay there, or do you see any evidence of their making burrows and lining the burrows with their castings? Can you believe everything you've read about them after observing them in your worm observation chamber? Try 20 or so redworms to begin.

Record keeping

It is important to keep a record of your Worm Observation Chamber. One method would be to draw a diagram of the chamber and record the different layers and how deep they are when you begin. You could make several copies of this diagram. Note the changes on your diagram every month or so as you make observations. You can also photograph the chamber. Write the beginning date and current date in large numbers on a card leaning against the chamber so that each photograph will indicate how long the worms have been working.

Conclusion

I have found living with a Worm Observation Chamber in my home for nearly two years one of the most fascinating experiences in my life. It's not as mesmerizing as an aquarium because there is little movement. The changes are more subtle over time. But I watched a nightcrawler die, something I will never forget. It didn't take long before thousands of tiny white worms were consuming the juices. I thought they were enchytraeids, but perhaps they were nematodes. I was able to put a magnifying loupe right up to the glass, so at that scale I think they could have been nematodes. Did the population explode shortly after there was an abundance of food for them, or were they there all the time? When we finally dismantled the chamber by removing the screws and the acrylic pane so that we could carefully go through the various horizons, counting worms as we progressed. We could not believe that there were over 1400 *Eisenia fetida* of all sizes and ages! We found no worms of any other species that we could identify, even though we had introduced other species into the system. I wish that I had kept better track of inputs and dates and changes. But it remains a powerful memory. Do a better job than I did. But don't deprive yourself of the experience!

2. =====RESOURCES=====

A. Appelhof, Fenton, and Harris: *Worms Eat Our Garbage: Classroom Activities for a Better Environment*. Flower Press, 1993
[http://www.wormwoman.com/acatalog/Wormwoman catalog Worms Eat Our Garbage 17.html](http://www.wormwoman.com/acatalog/Wormwoman_catalog_Worms_Eat_Our_Garbage_17.html)

B. NASA maintains a website on Soil Science Education at <http://ltpwww.gsfc.nasa.gov/globe/index.htm>. It includes such topics as soil science basics, soil and society, soil and the environment, working with soil, soil and students, and soil and agriculture. It features a soil profile of the month and encourages people from all over the world to submit photographs of soil profiles. A collection of soil profiles is at <http://ltpwww.gsfc.nasa.gov/globe/soilgall/images/images.htm>

C. Lisa McCurdy teaches fifth grade Hillsborough, North Carolina. She is a Kenan Fellow, which gives her resources to develop programs that other teachers may not have. She is also obligated to share the process that she and her students have gone through with others who can benefit. She and her students share their

experiences with the Worm Observation Chamber on her website at:
<http://www.ncsu.edu/kenan/fellows/2001/lmccurdy/ObsTank/index.html>

3=====NOTABLE BITS=====

- A. California Department of Education has just published a document entitled *A Child's Garden of Standards*. This 88-page document correlates the specific ways that school gardens meet California's academic standards for grades 2-6. According to the Delaine Eastin, the State Superintendent of Public Instruction, some people were concerned that "time in the garden would not be valued because classroom time was at a premium." She recognized that teaching to the standards could easily become rote lessons and felt that gardens in every school were even more essential to make the standards come alive. She said, "Gardens should not compete with our standards; gardens should be an avenue to high standards."

The authors reviewed nine sets of instructional materials that covered content in gardening, nutrition, cooking, waste management, and agricultural systems. These materials had to be widely used, readily available, affordable, and current. Most of the documents reviewed were developed by agencies such as the California Department of Education, Junior Master Gardener Program, California Integrated Solid Waste Management Board, CA Foundation for Agriculture in the Classroom and others. We are pleased to announce that *Worms Eat Our Garbage: Classroom Activities for a Better Environment* was one of the nine selected for this review and activities selected were found to meet standards in each of the 5 grades evaluated.

Dozens of the 150 activities in *Worms Eat Our Garbage (WEOG)* were identified as meeting standards in Science, Math, English-language arts, and Social Studies. Here is an example:

Standard 2.0 Reading Comprehension in activities that support English-language arts standards for grade 5. Expository Critique 2.5. Distinguish facts, supported inferences, and opinions in text.

WEOG had two activities, "Fact or Opinion," p. 111. After reading notes from a fictitious science report, students determine whether statements are fact or opinion.

"The Worm Gazette," p. 95. Students pick out the humor, quotes, opinion, and facts from a fictitious news article.

Barbara Harris, Mary Frances Fenton, and I spent two years working on *WEOG*. We wrote it in response to the dozens of parents and teachers who called me after reading *Worms Eat My Garbage* and saying, "This would be such a great thing to do in the classroom. Can you give me some specific suggestions on what I could do in my classroom? With over 35,000 copies in print, I estimate that over 4 million children have been exposed to worms in the classroom through this book. It thrills me no end to receive the kind of recognition for our efforts the California *Child's Garden of Standards* represents.

A Child's Garden of Standards: Linking School Gardens to California Educational Standards can be ordered by sending a check for \$25.45 to California Department of Education, CDE Press, Sales Office, PO Box 271, Sacramento, CA 95812-0271. Phone number is 800-995-4009 or 916-445-1260.

Hello.

I have a question about worms and am hoping you can answer this question before we get too carried away. I've been doing vermicomposting presentations in schools for a few years now. I have read in several books that the 'fact' that worms can be cut in half and they won't die, is actually incorrect. I mentioned this today and had a lengthy discussion with one student, who fishes, and claims that his worms survive for days after he cuts them in half for bait. I can't think of a better person to help us clear up this. I am very hopeful that you will be able to help us out. If you can't, would you know of anyone who might? Thank you very much. Andrea

Dear Andrea

Do you have my book, *Worms Eat My Garbage*? On page 93 there is a presentation responding to the question, "If a worm is cut in half, will both parts grow back?"

My response to this was:

"Worms do have a remarkable capacity to regenerate lost or injured parts, but this capacity is limited.

Depending upon where the worm was cut, the anterior can grow a new tail. The tail, however, cannot generate a new head. The capacity to regenerate new tissue is a form of reproduction among some animal forms, but not among earthworms. On rare occasions you may find a worm with two tails, both at the same end. This condition can be caused by injury to the worm in the posterior end, which results in growth of a new tail adjacent to the original tail."

When you say, "I have read in several books that the 'fact' that worms can be cut in half and they won't die, is actually incorrect," do you interpret this to mean that a worm that is cut in half WILL die? As I said above, worms do have some ability to regenerate lost parts; so cutting a worm in half will not necessarily cause the entire worm to die. You are not likely to get two worms because the cells in the tail end of the worm do not have sufficient "information" in them to create new "controlling" tissue. In other words, cells with brain-like functions are not found in the tail end, so it can't re-create this important function.

Your student could be right. Surviving and growing into two new worms are entirely different things. The worms cut in half could live for some time. Given the proper conditions, the anterior end could regenerate a new tail ... it'll be small and take a long time, but it could happen. I doubt that the tail ends would live as long. And I very much doubt that they would regenerate a new head and become a whole worm. Studies done using very precise cuts at definite segments have shown some capacity to regenerate cells anterior of the cut, but these were carefully controlled studies in a laboratory where conditions for the injured worm to survive were maintained. I doubt that sitting in a bait cup with a bunch of other worms would meet those criteria.

Perhaps you could use this as an opportunity to get the student to find the kinds of statements you said you had read, compile them and analyze them with respect to just how we can be misled by the way things are said. Or ... do a science project on worm regeneration. But with today's climate on injuring animals and dissection, I'm not sure it's appropriate.

Thanks for your email. I hope this helps clarify things. And I commend you for continuing to do "worm work" by teaching about vermicomposting in schools.

Mary Appelhof

Thanks very much for such a quick and detailed reply. I don't have *Worms Eat My Garbage*, just the Our [*Worms Eat Our Garbage*] version. But I do know where I can borrow a copy. I am looking forward to chatting with classes tomorrow about the regeneration. It will be a good lesson about research and facts.

I will look into purchasing the book you mentioned. My favourite is the *Compost Heap* by Rockwell. [It is] Wonderful for preschool and primary levels. Unfortunately it is out of print but our library still has a copy.

Thank you again.
Andrea

5=====COMING EVENTS=====

A. Worm-Powering Kids is going on now through Earth Day 2003, which is April 22nd. What is Worm-Powering? Worm-Powering kids is program where eco-minded adults all across the nation are planning to read *Compost, By Gosh!* to groups of children to celebrate Earth Day 2003. To empower, educate and love children is to read to them. Click here to learn more:

http://www.wormwoman.com/acatalog/wormpowering/wormpowering_main.html

B. March 11 @ 2:00 pm Mary Appelhof will present the video Wormania! and read *Compost, By Gosh! An Adventure in Vermicomposting* by Michelle Portman at Friendship Village in Kalamazoo. You can order your own video Wormania! At

http://www.wormwoman.com/acatalog/Wormwoman_catalog_Videos_7.html and *Compost, By Gosh!*
http://www.wormwoman.com/acatalog/Compost_By_Gosh_.html

C. March 12 @ 7:00 pm Elkhart Environmental Education Center

<http://business.michiana.org/elkhart/eechome.htm> will learn to distinguish between composting and vermicomposting during a free public program facilitated by Worm Woman her self in Elkhart, Indiana. Call 547-293-5070 for more information.

D. April 13 @ 1:15 Mary Appelhof will read *Compost, By Gosh!* And talk about worms following brunch at the Pierce Cedar Creek Institute in Hastings, Michigan. Call 269-721-4474 for more information.

E. April 22 Earth Day We are still evaluating where we will be Worm-Powering. Where will you be? How about Worm-Powering; click here and we will help you get started!

http://www.wormwoman.com/acatalog/wormpowering/wormpowering_main.html

F. April 23 Earth Day Eco Expo at Allegan County Math and Science Center. Raneer Terrill and Mary Appelhof will give presentations to kids during this all day event. Sorry this is limited to Allegan County classes only; however it is an incredible experience and we wish we could invite all of you!

G. May 17 Tillers International will host all day Worm Composting workshop with Mary Appelhof in Kalamazoo. There is a fee for this workshop; more details to come.

H. May 20 Mary Appelhof to present *Compost Teas: The New Kid on the Block* at Michigan Recycling Conference at the Radisson in Kalamazoo. More info to come!

I. June 2002. A third, three-module USA ZERI Training is scheduled for mid-year in Santa Fe, New Mexico. Contact Lynda Taylor for more info: lyndataylor@cybermesa.com

6. =====PRODUCT HIGHLIGHTS=====

- A. ***Worms Eat Our Garbage: Classroom Activities for a Better Environment*** by Mary Appelhof, Mary Frances Fenton and Barbara Loss Harris. We've already drawn on this book heavily for this newsletter, so further elaboration is not necessary. It's not just for teachers; it's a great guide for homeschoolers and adults who never grew up. My dentist spent an entire Memorial Day weekend going through the activities. He said, "I thought I knew a lot about worms, 'cause I've had a bin for several years, but I had to keep looking up the answers in the back of the book." If you don't have your own copy, now is the time to get it at:

http://www.wormwoman.com/acatalog/Wormwoman_catalog_Worms_Eat_Our_Garbage_17.html

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- B. ***Wormania! (VHS)*** Worm Woman visits the Brennan kids who (as all kids are) are busily involved in their daily lives. They learn about worms--how they move, their role in soil ecology, how worms breed, and how to set up a worm bin for composting organic waste. Video incorporates unique footage of worms in their natural habitat, and shows amazing microscopic images of the beating of a worm's five pairs of hearts and a baby worm hatching from its cocoon. **WORMBITE!** *Wormania!* has a retail price of \$34.90 and comes with teaching guide, which is chock full of information, activities and resources.

http://www.wormwoman.com/acatalog/Wormwoman_catalog_Wormania_33.html

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- C. Shirts for humans, bins for worms, chains for keys, stickers for bumpers, CDs for listening ... OH MY! Visit Worm Woman's web site for fun wormy things and great information!

http://www.wormwoman.com/acatalog/Wormwoman_catalog_Fun_Stuff_8.html

7. =====ABOUT THE AUTHOR=====

Mary Appelhof is founder and president of Flowerfield Enterprises, which develops and markets educational materials on vermicomposting. Its publishing imprint is Flower Press, publisher of the how-to book *Worms Eat My Garbage*; the classroom activity book and curriculum guide, *Worms Eat Our Garbage: Classroom Activities for a Better Environment*; *The Worm Cafe: Mid-scale vermicomposting of lunchroom wastes*; and *Diabetes at 14: Choosing tighter control for an active life*, which is not about vermicomposting, but is an invaluable resource for anyone affected by diabetes.

8. ===== THE SMALL PRINT =====

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