Compost Basics

Home Composting Workshop

Today's Workshop Leaders:
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Master Composters

Composting Education Program
COMMUNITY • HOME • CLASSROOM

Santa Clara County - Composting Education Program

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Objectives

- Learn the basic processes for:
  - Backyard Composting
  - Grasscycling
  - Vermicomposting
- Enable you to:
  - Decide which composting method(s) is/are appropriate for you & your home
  - Create a plan to start composting or expand/improve your current composting system
  - Find additional composting resources

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What is Composting?

Composting: Recycling Organic Materials

The bio-oxidative degradation of organic wastes under controlled conditions

Large Scale Composting: Commercial composting facilities, Farms
Small Scale Composting: Homes, Schools, Offices

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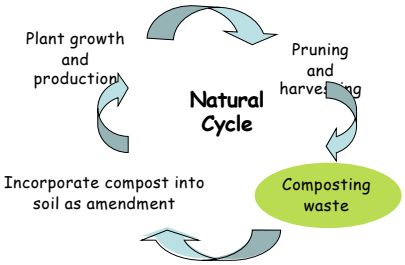
What is Backyard Composting?

One step in ongoing backyard process



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Why Backyard Composting?

Let's Minimize:
- Landfills -- they lock away valuable materials in un-usable forms
- Transportation and handling costs
- Using fossil fuels and increasing CO_2 emissions

Landfill

Commercial Composting is appropriate when on-site composting is not possible (e.g. restaurants).
Home gardens are perfect for small-scale composting and avoids transportation and processing costs and pollution.

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Home Composting Advantages

- Reuse valuable nutrients to feed your plants & trees
- Use less water in your garden
- Grow healthy plants
- Good exercise
  Fun and rewarding
- Get in touch with nature
- Reduces carbon emissions
- Promotes a more sustainable lifestyle

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Compost Pile Ingredients

Greens

Water

Air

Soil

Browns

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Ingredient #1: Greens (~50%)

Nitrogen-rich organic material

- The majority of our kitchen waste
- Green yard waste
- Nitrogen is food for fungi and bacteria

Examples:

- Disease-free green leaves and stems, grass clippings, weeds (before they go to seed), vegetable/fruit peels and scraps, coffee grounds, tea bags, flowers, fleshy roots, leguminous plants
- Herbivore manures: cow, poultry/bird, rabbit, horse droppings and cage cleanings (none from meat-eating animals)

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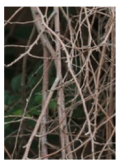
Ingredient #2: Browns (~50%)

Carbon-rich organic material

- Dry, dead yard waste
- Brown, woody plant material
- Carbon is food for fungi and bacteria

Examples:

- Dried leaves, evergreen needles, straw, coir (coconut husk), shredded woody stems/stalks/branches, dried tree/shrub prunings (a few stalks and thin branches provide good air pockets)
- Also, dryer and vacuum lint, wood chips, sawdust (from untreated wood) and shredded paper/cardboard — use sparingly



Did you know whole or crushed egg shells can go into a compost pile? It's a good calcium source!

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Ingredients #3 - #5

Ingredient #3 Air
- Air is necessary for microorganisms to thrive and to breakdown the organic materials into compost.
- A compost pile needs aeration by turning or fluffing.

Ingredient #4 Water
- Moisture allows microorganisms be active and to move around.
- Moisture is easier to regulate in bins that are contained and have lids.
- Your pile should be kept as moist as a wrung-out sponge.

Ingredient #5 Soil
- Not always necessary! Soil contains very helpful microorganisms (bacteria and fungi) but most greens and browns have them also. If dirt is added, only a small quantity is needed. Too much dirt makes the compost pile heavier to turn.

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What to Avoid

- No animal products - meats, bones, fish — Egg shells are OK
- No dairy products: cheese, milk, yogurt
- Be careful with breads (because of molds)
- No pet wastes or litter from carnivores (e.g. cat or dog feces)
- No oils or plastics
- No wood ash or charcoal
- No diseased plants
- No plants treated with herbicides

No toxic materials

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Ingredient Tips

These items may spread undesirable plants or have negative effects when using your compost:

- Bermuda grass
- Bind weed (wild morning glory)
- Oleander or any weed with seed heads or persistent roots (ok if hot composting higher than 140°F)
- Ivy (ok if dried and finely chopped)
- Thorny plants (ok if finely shredded)

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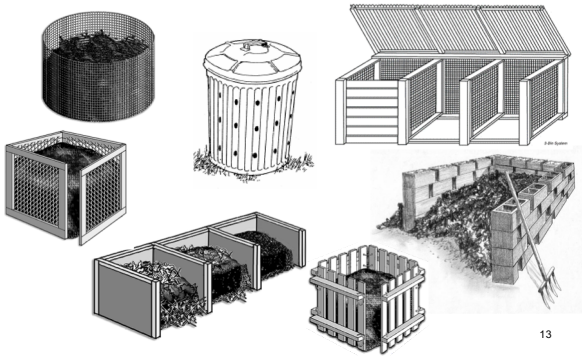
Compost Bins – Build Your Own



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Compost Bins – Many Designs

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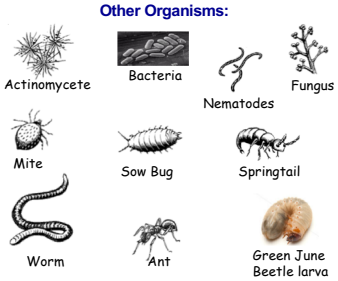
Inside a Compost Bin

Good example of mixed greens and browns
What's missing? Not enough air?
Does it look as damp as a wrung-out sponge?

Other Organisms:



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Two Basic Backyard Pile Types

Hot Pile

- Super-active microbes generate heat in proper conditions
- All materials must be available at the same time, chopped (½" - 1½") & mixed
- Minimum volume: 3'x 3'x 3' (1 cubic yd. = 27 cubic ft.)
  - Requires frequent turning
- Finished compost in one to three months

Cold Pile

- Slow decomposition of materials. Little heat produced
- Minimal chopping of materials
- Minimal concern with proper mixture of materials
- Add materials over time
- Occasional turning
- No minimal volume
- Finished compost in six months to two years

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Tradeoffs

Hot Pile

- Temperatures over 140° F kill most seeds and plant disease pathogens
- Compost is made quickly requiring minimal space
- Little concern with pests due to the heat
- Requires effort in chopping materials
- Requires pile to be built over a few days
- Frequent turning required!

Cold Pile

- Seeds and many plant diseases are not killed
- Requires more space than a hot pile for an equivalent volume of input material
- Must use rodent-resistant compost bins if food scraps are added to pile
- Minimal chopping
- Piles can be built over months
- Minimal turning

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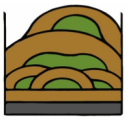
Building a Cold Compost Pile

- Materials can be added as they become available
  - Little or no chopping required
  - Stir new material into pile, mixing greens and browns
  - Add water as needed, keep it damp, not wet
  - Mix food scraps with dry browns, add mixture to center of pile and cover with non-food ingredients
  - Use a rodent-proof compost bin if adding food scraps to the compost pile
- Turn once per month, or when pile smells, or has zones that are too wet/too dry
- Perhaps add a little soil to the pile
- Produces compost in six months to two years
- Harvest compost from the bottom of the pile



"The more effort you put in, the more compost you'll get out"

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Troubleshooting

Symptom	Problem	Solution
Smells like eggs	Too much moisture	Add dry ingredients
	Too compact not enough air	Mix more often, turn or aerate
Smells like ammonia	Too much nitrogen (green)	Add more browns (carbon) and mix, turn or aerate
Process is slow	Not enough surface area	Shred or break organics into smaller pieces
Large critters are interested in my compost pile	Wrong material has been added	Don't add any grains, meat or bones
	Vegetable scraps are exposed	Make sure food is covered with soil or 6" of material
Winter is coming – process has slowed	This is normal for cooler temperatures	Continue adding to your compost bin. Process will speed up again in the spring.

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Building a Hot Composting Pile

Reminder: **Hot Composting**
A monitored compost pile that is turned frequently, reaches high temperatures and is ready for harvest in shorter time than cold composting.

Preparation:
Accumulate enough organic material to fill the compost bin with shredded/chopped pieces (50% greens, 50% browns)

Day 1: Build the Compost Pile

- Chop or shred the organic material into pieces 1" – 3", or smaller.
- Layer 50% greens & 50% browns, 3" deep layers.
- Add water as pile grows. Make it "as wet as a wrung out sponge" -- not dripping wet, not dry.
- Leave air pockets to provide oxygen.
- Completely fill the bin. Hot composting needs a minimum size of 1 cubic yard (3' x 3' x 3' = 27 cubic feet).

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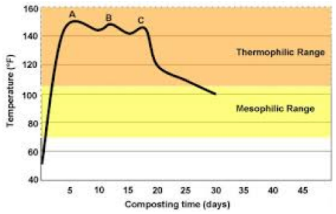
Maintaining a Hot Composting Pile

- **Days 3 – 14:**
  Monitor & Turn Often
  Thermophilic Range, 140°F-150°F ideal
- **Days 15 – 30:**
  Monitor & Turn
  Thermophilic - Mesophilic Range
  100°F-140°F ideal



- **Days 31 – 60: Monitor & Turn Occasionally**
  Mesophilic Range, 70°F – 90°F ideal
- **Days 61 – 90 or longer: Complete the Process**
  Psychrophilic Range, 50°F – 70°F ideal

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Maintaining a Hot Composting Pile

Days 3 – 14: Thermophilic Range

Check temperature in several locations. If it doesn't heat up, check green/brown mix, moisture level and air exposure. The ideal temperature is 140°F-150°F uniformly throughout the pile. Avoid temperatures exceeding 160°F (creates ash which is low in nutrients).
Turn compost pile a minimum of once per week with a spade or fork, ideally every 2-3 days for the first 2 weeks. If turning is not possible, use an aeration tool to allow oxygen and water to enter the pile. It's normal for the pile to be steaming.
While turning, look for dry spots, add water as needed (normally a pile needs some water at this stage). Make it as wet as a wrung out sponge -- not dripping wet, not dry.

Days 15 – 30: Thermophilic - Mesophilic Range

Check temperature of compost pile in several locations. The ideal temperature is 140°F-150°F at the beginning, then approximately 100°F towards the end of 30 days (uniformly throughout the pile). If it's not, check moisture and air levels.
Turn compost pile a minimum of once per week. If turning is not possible, use the aeration tool to allow oxygen and water to enter the pile.
While turning, look for dry spots, add water as needed. Make it as wet as a wrung out sponge.

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Maintaining a Hot Composting Pile

Days 31 – 60: Mesophilic Range
Turn the compost pile every 2 - 3 weeks. If turning is not possible, use an aeration tool to allow oxygen and water to enter the pile. The temperature should be between 70°F – 100°F.
While turning, look for dry spots, add water as needed (normally needs a small amount of water at this stage).
The pile will not be steaming, but still warm to the touch.
Bugs and worms may join in to assist the decomposition process.

Days 61 – 90 or longer: Completing the Process (Psychrophilic Range)
Let the compost mature. The temperature should be approximately 50°F – 70°F (depends on the ambient temperature). Use an aeration tool to allow oxygen to enter the pile. Add water if needed (normally not needed).

Adapt the "recipe"to fit your backyard, materials on hand, time available and how the composting process is progressing. It's like cooking or baking, each time you do it -- you can get a different result.

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Troubleshooting a Hot Compost Pile

Why Won't My Pile Get Hot?

- Not enough volume
  - A small yard/garden generates about 1 - 3 cubic ft. of material per week (varies by season).
    27 cubic ft. is needed to initiate a hot compost pile.
- Materials not chopped fine enough
  - Ideal size for raw materials is 0.5" – 1.5"
- Improper C:N ratio (25-30:1 is ideal)
  - If there's too much nitrogen, the pile quickly "burns out", cools, and becomes soggy.
  - If too little nitrogen, the pile never heats up.
- Not enough water
  - A dry pile decays very slowly, if at all.
- Not enough oxygen
  - All the oxygen inside the pile has been used up by the rapid decomposition process. Turn the pile to aerate it.

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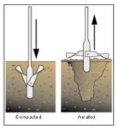
Composting Tools

Pitch Fork, Shovel, Spade

Compost Thermometer

Shears, Pruners, Chipper/shredder

Compost Aerator



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Harvesting Compost

- The pile is ready to harvest when:
  - Material has turned to a dark brown and *original* materials are *no longer* identifiable
  - The smell is mild and earthy
  - Little or no heat is being produced in a hot pile
- Screening can be used to remove large pieces that are not fully decomposed
  - Mainly needed for cold piles
  - It's easy to build your own screen

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Using Compost

- Typical Applications:
  - Incorporate in soil prior to planting
  - Amend potting mixes
  - Mulch or "top dress" planted areas
  - Liquid extract or compost drench
  - Compost tea: Aerated liquid extract abundant in active bacteria and fungi
- Well-made compost is a nutrient-rich soil conditioner
- Benefits:
  - Improves soil structure by adding **humus** and **micro organisms**
  - Restores top soil
  - Inoculates soil with a wide variety of bacteria and fungi that feed the plants
  - Holds moisture
  - Saves money

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Healthy Soil is Alive

One teaspoon of good garden soil to which compost has been added contains

- **100 million bacteria**
- **800 feet of fungal threads**

PENNSTATE College of Agricultural Sciences

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Grasscycling

- Recycle grass easily by leaving clippings on lawn when mowing
- Grass clippings decompose quickly (within 2 weeks), returning valuable nutrients back to the soil

- Optimal grasscycle techniques include:
  - Cutting no more than 1/3 the length of the grass
  - Cutting when grass is dry to the touch
  - Cutting when grass height is between 3 and 4 inches
  - Ensure the the mower blade is sharp
- Reduces fertilizer and water requirements, minimizes chemical runoff entering storm drains and polluting creeks, rivers, and lakes
- **MAKES SENSE!**

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Vermicomposting a.k.a Worm Composting

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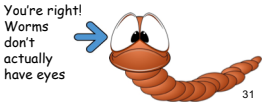
Vermicomposting

Cultivating worms to eat our food and paper waste and produce the best fertilizer for our plants



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Vermicomposting

- Worm composting is neat, easy, and odorless – when properly maintained
- A great way to turn hard-to-dispose food waste and some paper waste into fertilizer
- Can be done indoors, in garage, on the patio or porch, or in any moderate temperature place (50ºF - 90ºF)
- **Compost year round**
- **Limited space is ok**

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Vermicomposting

- And… the finished product, worm castings, is a nitrogen rich fertilizer which can be used on plants both indoors and outdoors
- Reduces or eliminates the need for purchased fertilizer
- Is of great interest to children and adults alike, the well-behaved and silent creatures become pets.

Gardener's Black Gold

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Worms for Composting

- Thousands of worm species live in the soil, we find some in our gardens and compost piles
- Only a few species are feasible for vermicomposting:
  1) Red Wiggler (Eisenia fetida), aka brandling worm, tiger worm
  2) Red Tiger (Eisenia andrei), often confused with red wiggler
  3) Blue Worm (Perionyx excavatus) for tropical climate
  4) Red Worm or Red Earthworm (Lumbricus rubellus)
  5) African Nightcrawler (Eudrilus engeniae)
  6) European Nightcrawler (Eisenia hortensis)
- Best compost worm for our area is the Red Wiggler

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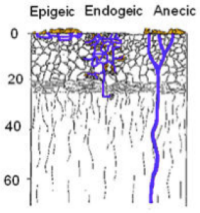
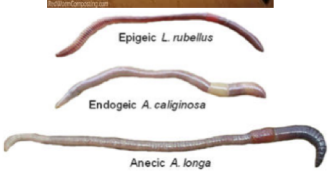
Species of Worms

There are more than 4400 different types of worms!





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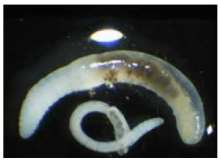
Common Mis-Identification

These guys are **not** baby compost worms



- They are White Worms (Enchytraeids)
  - a.k.a. Pot Worms
  - A very distant relative of the red wriggler
  - Large numbers indicate that the bin is acidic

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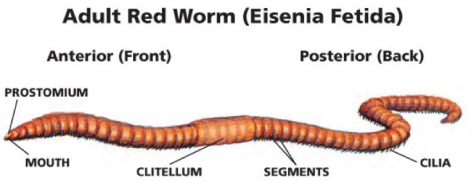
What are the parts of a Worm?



Did you know a worm has a crop, a gizzard, and 5 "hearts"?

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A Worm's Life Cycle

Worm Cocoon

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Selecting a Worm Bin

Build Your Own Bin – box style

Don't use chemically treated or highly aromatic wood

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Selecting a Worm Bin

Stacking trays

Flow-through bag

Worm bins are available in many designs and styles!

For Santa Clara County Residents: Special pricing on Wriggly Wranch worm compost bin

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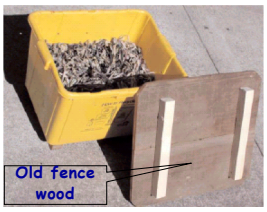
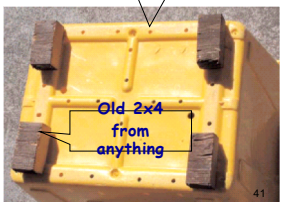
Making a Worm Bin

Many 1/4" holes for drainage and air circulation



Old fence wood



Old 2x4 from anything

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Any Size Bin Can Work

- A rule of thumb is two square feet of surface area per person or one square foot per pound of waste per week

- Start with a pound of worms (purchased or donated by a friend)
- Worms will reproduce to fill the box but will not overpopulate
  - hermaphrodites (both male and female organs)
  - reproduce at two months of age

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Locating the Worm Bin

- Ideal temperature is between 55°F and 77°F
- Plenty of air circulation

- In the shade during summer, especially if a plastic bin is being used
- Good locations include: under a shade tree or in covered patio, garage or laundry room, or under the kitchen sink

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Worm Food

- Vegetable and fruit scraps
  e.g., banana peel, apple core, lettuce, potato peel, carrot tops, etc.
  Cut into small pieces, bruise/pierce hard skins
- Pasta, cooked beans
- Coffee grounds, including paper filters
- Tea leaves, tea bags
- Paper towels, napkins (food soiled)
- Egg cartons (paper)
- Egg shells (crushed) worms need a small amount of grit!

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What to Avoid

- Animal products - meats, bones, fish, etc.
- Dairy products - cheese, milk, yogurt, etc.
- Pet wastes (from carnivores)
- Oils or plastics (petroleum products)
- Be careful with breads (for folks with mold allergies)
- Avoid seeds and nuts with hard hulls & shells – they break down slowly and may sprout later when conditions are right
- Avoid large amount of acidic or pungent produce – lemon, lime, orange, ginger, onion, garlic, etc.
- Yard clippings - may include herbicides, pesticides; branches & woody stems break down slowly, soft 'edible' leaves ok
- Soil (small amount ok)

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Bedding Material

- Shredded newsprint
  - Hand-shred or use paper shredder
  - "Spaghetti" shredder works best, cross-cut shredded paper tends to clump when moist
  - Avoid glossy inserts
- Shredded cardboard
  - Pizza boxes, cores from paper towel & toilet paper rolls
  - Cardboard is a valuable recyclable material, best in recycle bin
- Shredded office and junk mail paper
  - Use sparingly, mix with shredded newsprint
  - Can dry out faster than newsprint, or clump together
  - Some inks are petroleum-based, best avoided
- Dried, partially-decomposed leaves
  - Avoid leaves that decompose slowly

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Source of Worms

The Worm Dude (San Jose)
Jerry Gach – (408) 227-5267
http://www.thewormdude.com/
- One pound minimum order

Worms are safe to ship in mild temperatures

Sonoma Valley Worm Farm
(800) 447-6996
http://www.sonomavalleyworms.com/index.php
- Two pounds minimum order

Tips for starting a new worm bin:
- Set up the bin, add food & bedding
- Wait 1 – 2 weeks before adding worms
- Give worms a few days to recover from transportation and adjust to new environment

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Putting It All Together

Bedding + Moisture + Air + Food + Worms

Q: How much water?
A: As damp as a wrung-out sponge (moist, not dripping)

And a small amount of grit e.g., crushed egg shells, coffee grounds, fine sand, vermiculite, perlite, etc.

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Inside a Worm Bin

Example: Worm Box

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Inside a Worm Bin

Example: Stacking Trays

Plastic lid

Cardboard layer and/or bedding

"Fresh" fruit & veggie scraps, bedding material

Partially decomposed

Ready to harvest

Base: Collector tray with spigot for liquid (leachate)

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Maintaining Your Worm Bin

- Check weekly (more often if temperatures are very low or very high)
- Move to a different location if needed
- Add food if previous batch is being eaten (disappearing)
- Don't over-feed! Remove food if there's too much (smelly)
- If bedding is dry -- add water (spray bottle)
- If bin is too moist -- add dry bedding & mix in to absorb
- Add moist bedding if bedding layer is thin
- Sprinkle a small amount of grit every month or so
- Preparing for vacation
  - Add extra food and moist bedding in thin layers (minimizes anerobic decomposition) and top with a thick layer of bedding
  - Creative long-lasting food can be: whole apple or potato with a small hole in skin, sprinkling of flour, cereal, raisins, etc.
  - Add extra moisture in summer time

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Harvesting Castings

Castings are toxic to worms and should be harvested when most of the bedding materials have become dark castings

There are many ways to harvest

- Worm box:
  - vertical harvest: take lower layers
  - horizontal harvest: move finished materials to one side and feed on the other side
  - dump and sort: spread out and pick out worms
  - Keep the worms to go back into the worm bin
- Stacking trays:
  - Harvest the "oldest" tray, normally the bottom one
  - If worms are still there, put the tray on top or the stack and leave the cover off. As moisture evaporates, worms head down to the tray below
- Use the castings to fertilize your plants!

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Using Worm Compost

- Slow Release Nitrogen-Rich Fertilizer
  - Use it instead of fish emulsion on bedding plants in greenhouse
  - Spread around potted plants
  - Spread around vegetables or flowering plants in the garden
  - Can be sifted onto lawns
  - Incorporate into soil around shrubs and trees
- Can be incorporated into a planting soil mix
- Preferred ingredient for brewing compost tea

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Troubleshooting a Worm Bin

Fruit Flies in Worm Bin

- Food scraps not adequately covered
- ❑ Add four or more inches of dry or slightly moist shredded paper over food scrap layer
- ❑ Set a bowl of vinegar in the bin on top of the shredded paper
- Fruit flies already present in food scraps before adding to bin
- ❑ Store food scraps in covered container or freezer before adding to the worm bin

Worms Die

- Worm box overheated (more than 100°F) common with plastic bins
- ❑ Keep worm bin in shady area
- ❑ Add a few ice cubes for quick cooling
- ❑ Consider using a wood worm bin if adequate shade can't be found
- Bedding material has dried out
- Check moisture when feeding, add extra water on hot, dry days
- No food scraps have been added for long period of time (weeks/months)
- ❑ Don't be mean to your pets, feed them as required!

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Where Do I Get Help?

UC CE University of California Cooperative Extension Santa Clara County

Composting Education Program COMMUNITY • HOME • CLASSROOM

The ROTLINE: (408) 918-4640
http://cesantaclara.ucanr.edu/Home_Composting_Education/

- **United States** Environmental Protection Agency (EPA), Composting At Home
  http://www2.epa.gov/recycle/composting-home
- **California**, CalRecycle, Backyard Composting
  http://www.calrecycle.ca.gov/organics/homecompost/
- **Bay Area Eco-Gardens** http://bayareaecogardens.org/
- **Libraries**
  Santa Clara County Library District (sccl.org) or your city's library
  Search for "home composting" to find related books, magazines and videos

Lots of Information Available!

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Hands-On Demonstration

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