Vermiculture:
Composting with Worms

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What is Vermiculture?

- Red worms transform decaying organic matter into worm castings
- Also known as “Vermicomposting” or “Worm Composting”
- Castings contain **available** plant nutrients
- Not “hot” composting
- **But**…Univ. Wisconsin research has shown that pathogens and weed seeds can be killed by worms
- Usually done in containers, indoors or out

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Worms are not "gross", they are superstars!

Darwin, C. R. 1881. *The formation of vegetable mould, through the action of worms, with observations on their habits*. London: John Murray.

QUOTE: "It is a marvelous reflection that the whole of the superficial mould over any such expanse has passed, and will again pass, every few years through the bodies of worms. The plough is one of the most ancient and most valuable of mans inventions; but long before he existed the land was in fact regularly ploughed, and still continues to be thus ploughed by earth-worms. It may be doubted whether there are many other animals which have played so important a part in the history of the world, as have these lowly organized creatures."

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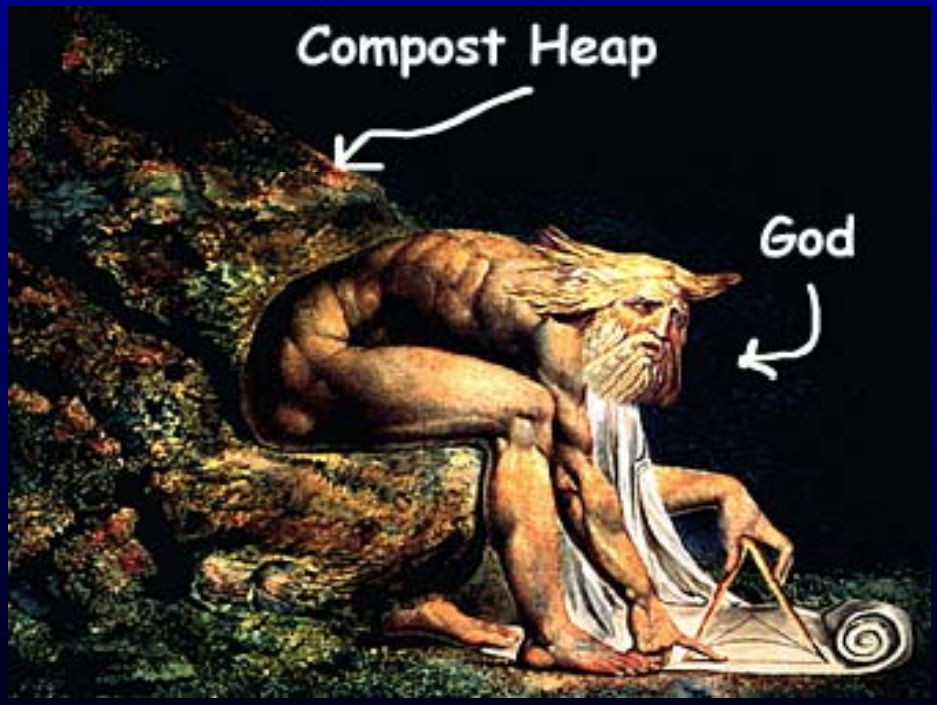
Worms are not "gross", they are superstars!

QUOTE: "My whole life has been spent waiting for an epiphany, a manifestation of God's presence, the kind of transcendent, magical experience that lets you see your place in the big picture. ***And that is what I had with my first compost heap.***"



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Why compost with worms?

- Ideal for small spaces
- Good for small amounts of green waste (food scraps)
- Requires less physical activity - little effort
- Produces excellent soil amendment!

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Composting Worms

- Two main species:
  - Most common: *Eisenia fetida*
  - Next: *Lumbricus rubellus*

aka **Red Wigglers & Red Worms**

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Composting Worms

- Redworms are not soil-dwelling worms, require large amounts of organic material
- Natives of litter layers of forests, manure piles, and backyard compost heaps
- Nightcrawlers are not suitable for worm composting - dig burrows & require lots of soil

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Worm species: Red Wigglers

Eisenia fetida

- most common composting worm
- processes large amounts of organic matter
- in ideal conditions, eats its body weight daily
- reproduces rapidly
- tolerant of variations in growing conditions

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Worm Anatomy

- No eyes, but sensitive to light
- No ears, but sensitive to vibrations
- 5 hearts!!
- No teeth
  - gizzard, which contains small grains of sand and mineral particles - muscular contractions grind food
- Breathe thru their skin
  - No lungs
  - skin must stay moist to allow it to respire or it will die

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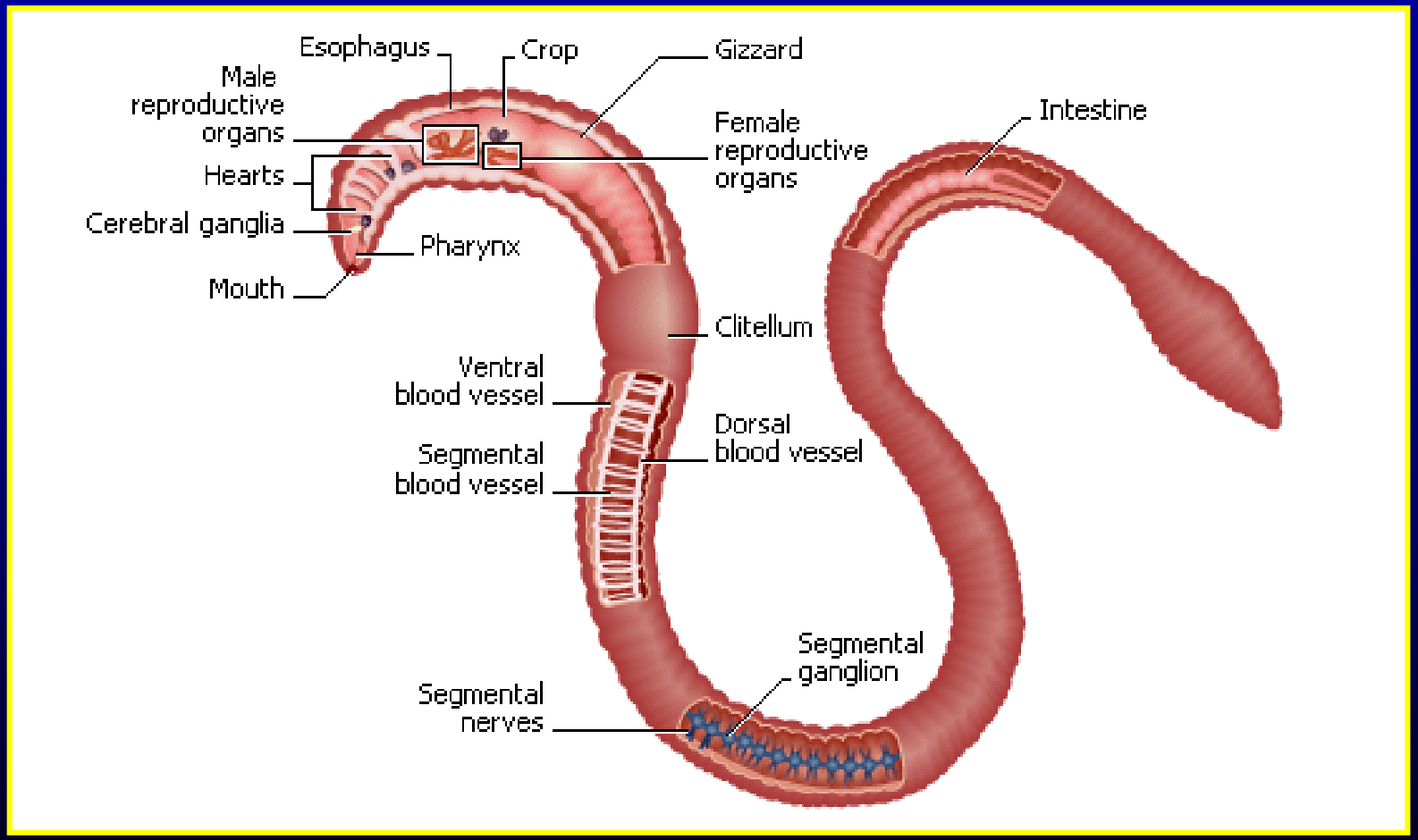
Worm Anatomy



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Worm Anatomy & Reproduction

- **Hermaphrodites**, equipped with both male and female organs
- When conditions are favorable:
  - mature redworm (2 months old) mates & produces 2-3 cocoons/week
  - 2-5 baby worms hatch from each cocoon
  - Cocoons are lemon-shaped, the size of a match head

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Worm Reproduction- quick fact

- Very prolific, but they understand population control
- If worms are removed, e.g. for starting another worm bin, population quickly returns to its former level

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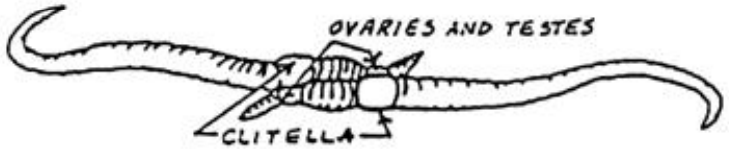
Worm Reproduction

Each worm has BOTH ovaries and testes.

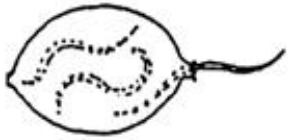
Two worms join by mucus from their clitella. Sperm then pass from each worm to the sperm storage sacs in the other worm.



Later, a cocoon forms on the clitellum of each worm. The worm backs out of the hardening cocoon.

Eggs and sperm are deposited in the cocoon as it passes over openings from ovaries and sperm storage sacs.

After being released from the worm, the cocoon closes at both ends. Egg fertilization takes place in the cocoon.



Two or more baby worms hatch from one end of the cocoon.

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Worm Ecology

- Tolerate a wide temperature range
- Prefer temperatures 55 - 77°F
- Need good air circulation
- Like moist, but not wet, environment

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Worm Ecology

- Eat between ½ and their full weight in organic material per day so…
- On average, 1 lb. of redworms will process about ½ lb. of food scraps per day

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What do worms eat?

- Vegetable & fruit scraps
- Pasta, bread, leftover cereal
- Egg shells – crushed up
- Food scraps
- Coffee grounds and filters
- Tea leaves, tea bags, paper towels, and napkins
- Shredded paper & newsprint
- Manure – if you have horses – put worms in manure piles

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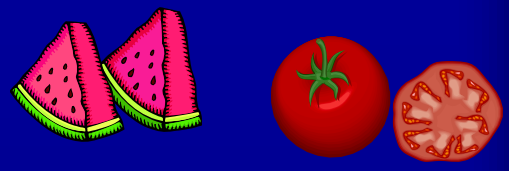
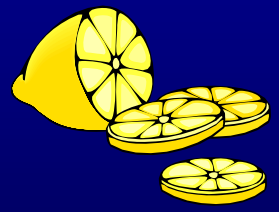
What does NOT go in the Bin?

- Seeds, e.g. tomatoes and melons - not broken down
- Woody yard waste
- Leaves, pine needles
- Citrus peels - small quantities, cut up
- Animal products, e.g. cheese, oils, bones, or meat
- Herbicide treated plants





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Worm castings: Nature's Fertilizer

- Contain plant-available, but stable nutrients
  - intestinal secretions make nutrients available to plants
  - release many micronutrients
- Biologically active
- 5 to 11 times richer in N-P-K than the material the worms consumed and pH neutral
- Contain plant hormones

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Nutrient Analysis for Worm castings/ vermicompost

60-75% moisture

Nutrient Parameter	Worm Compost	Compost
pH	6.3 - 7.4	
Organic Carbon (%)	27.4 - 49%	
Total nitrogen (%)	0.55 - 3.21%	1-8%
Total phosphate (%)	1.10-1.93%	0.5-1%
Total potassium (%)	0.4-1.5%	1-2%
C: N ratio	45.7-45.9	
Calcium (%)	1.5-2.3%	
Magnesium (%)	0.4-0.7%	
Iron (%)	0.1-0.72%	
Manganese (ppm)	295 ppm*	
Copper (ppm)	123 ppm*	
Zinc (ppm)	357 ppm*	
Boron (ppm)	75 ppm*	

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The Worm Bin

- Must be dark inside, as light can harm worms
- Lids -keep out flies and rodents
- Drainage holes in the bottom (¼" or smaller) for ventilation and drainage
- Many types of bins

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The Worm Bin

- Shallow (8 - 12" deep)
  - ✓Redworms are surface feeders, need air
  - ✓Too deep, moist materials pack down & reduce air space => anaerobic conditions
  - ✓shallow bins - bury food on a rotating basis

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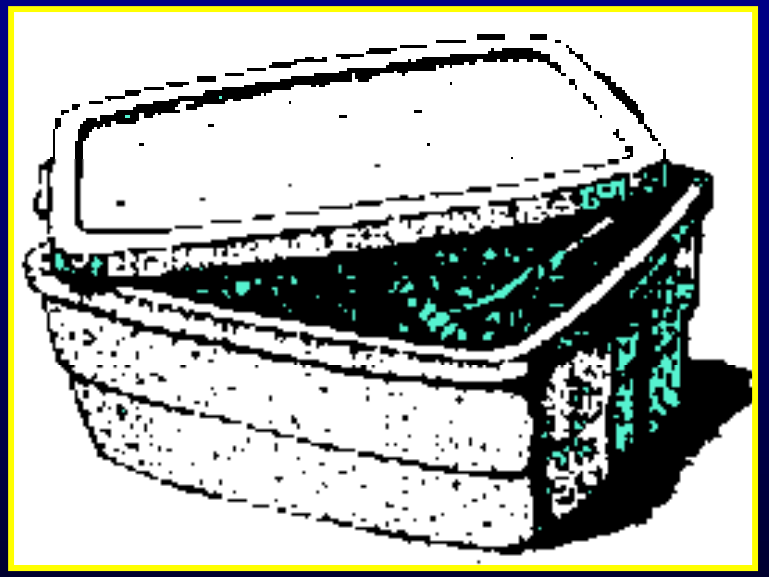
Plastic Worm Bins

PROs

- Shallow plastic storage boxes, 8-12” deep
- Easy to construct
- Last for many years



CONs

- Need good drainage & aeration
- Plastic doesn't breathe
  - contents may get soggy
  - need to check moisture
  - do not overfeed

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Wooden Worm Bins

- can be built to size
- Use exterior grade plywood since the box will be damp most of the time
- Don't use aromatic woods, e.g. redwood or cedar
- Don't use chemically treated woods
- Place on blocks or a platform to avoid contact with the ground & rapid rotting
- Latches & weather stripping on the lids reduce warping and keep out flies.

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Worm Bedding

- needed to hold moisture
- protect from light
- place to bury materials

  USE:

  - Shredded newspaper - not glossy sections
  - Shredded office paper
  - Cardboard, shredded corrugated boxes
  - Leaf Mold

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Setting Up A Worm Bin

1. Drill holes in bottom, around sides.
2. Fill bin with 4-6” of well-moistened bedding
3. Add redworms
4. Purchased worms: separate & spread worms over surface of the bedding
5. Expose the worms to the light for awhile so they migrate down into the bedding.

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Setting Up A Worm Bin

6. Once worms are inside the bedding, add food
7. Push aside some bedding, add ½ - 1” of food, cover food with 1-2” of bedding
8. Rotate the placement of food in the box each time materials are added
9. Worms need to adjust to their new environment, so add only small amounts of food at first

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Setting Up A Worm Bin

- Don’t overload your bin
- Anaerobic conditions can develop
- Correct problem by not adding materials for awhile
- With a supply of food, worms can go for weeks without being fed
- How often to feed depends on
  - temperature
  - rate of food generated in household
  - how finely food is chopped

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Critters in the bin

- Springtails
- Spiders
- Centipedes
- Millipedes
- Sowbugs & pillbugs
- Echytraeids
- Mites
- Fruit flies
- Ants
- Slugs, snails
- Beetles

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Harvesting Castings

- As worm castings increase, worms' environmental quality declines
- When much of the bedding in the box becomes casting, worm population will suffer.
- Castings should be harvested before the bedding is completely converted to castings

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Using Castings

- Castings are too fine grained & dense to use as a growing medium by itself
- Make planting mix with 1/5 -1/3 worm castings e.g. equal parts of worm compost, peat moss and coarse sand
- Use castings as soil conditioner for container plants
- Sift onto lawns
- Spread around the base of vegetable plants
- Work into the soil around shrubs & trees

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Troubleshooting

SYMPTOM	PROBLEM	SOLUTION
Worm bin smells bad	Not enough air circulation	Add fresh bedding
	Improper food scraps added	Remove meat, bones or other animal products
	Too much food	Feed the worms less
Worms are dying	Not enough food	Add food into bedding
	Bin too dry	Moisten contents until slightly damp
	Bin too wet	Add bedding
	Bedding is eaten, too many castings	Harvest castings and add fresh bedding
Fly infestation	Food exposed	Secure lid and line with latches and weather stripping, cover food scraps with bedding, cover worms and bedding with sheet of
Ant infestation	Food accessible	Coat legs of bin with TangleFoot or similar product. Set legs in cans of water or mineral oil.

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