Definition, Justification, and Benefits of Using Compost

Bernalillo County Master Composters
May 22, 2010

“Essentially, all life depends upon the soil ... There can be no life without soil and no soil without life; they have evolved together.”

--- Charles E. Kellogg, USDA Yearbook of Agriculture, 1938

Topics

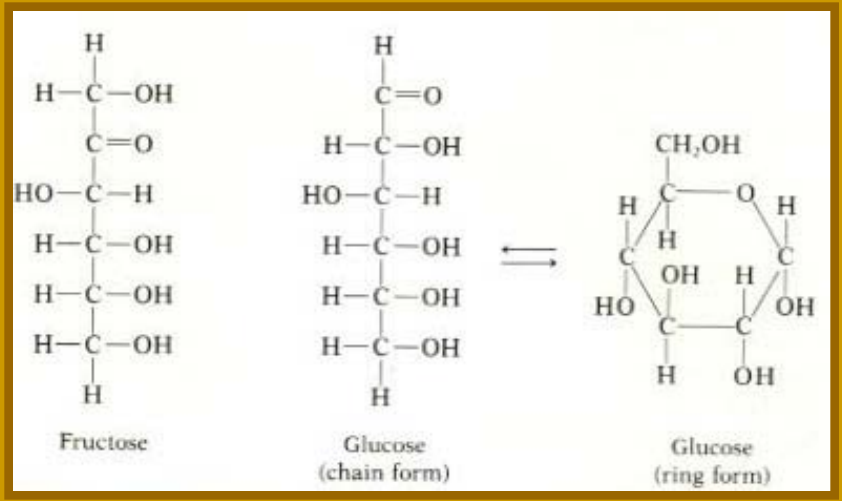
- What is composting?
- Why produce compost?
- Benefits of adding compost to soil
- Other benefits of composting
- Typical uses of composted materials

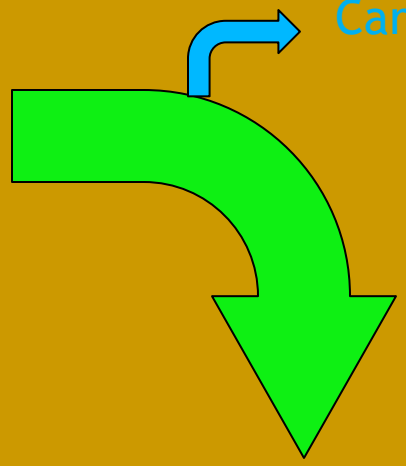
What is composting? (aka Organics Recycling!)

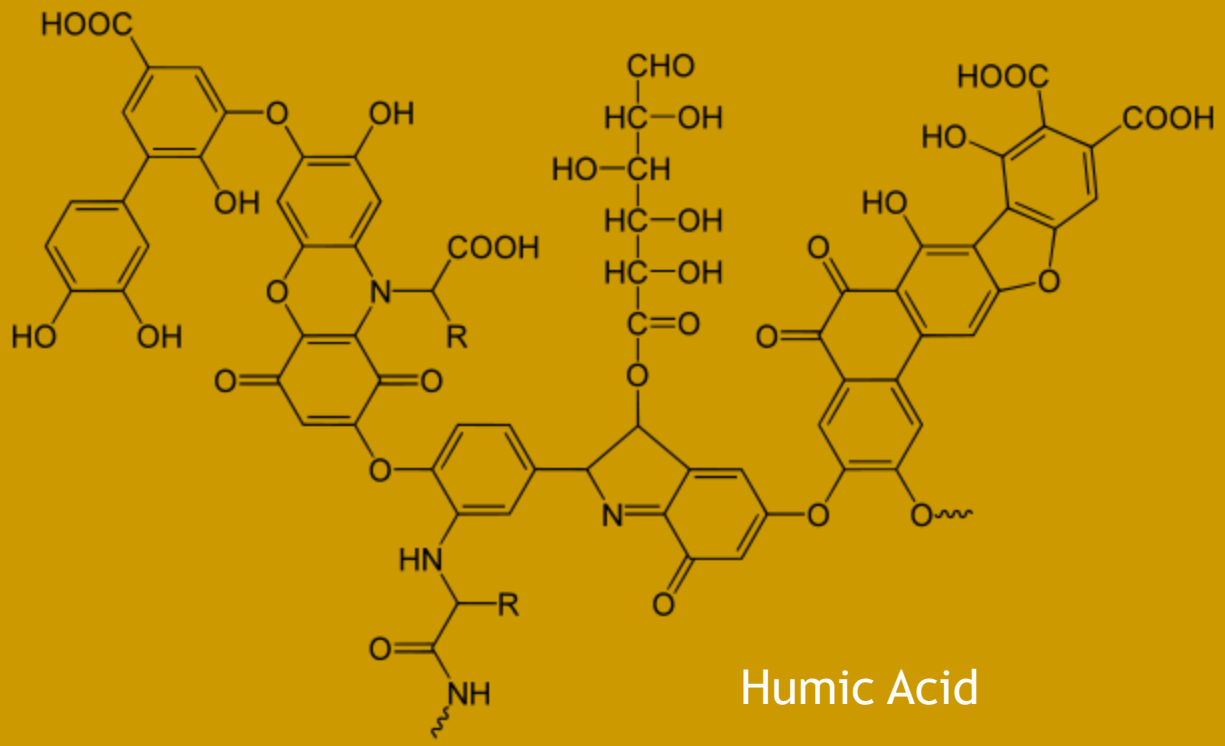
- A biological way to speed up the decay process of organic material ...
  - While ...
    - drying the material
    - killing pathogens (especially if using biosolids)
    - sterilizing weed seeds
  - Under the right conditions of ...
    - oxygen, water, carbon, nitrogen

What is composting? (continued)

- Microorganisms consume digestible carbon and generate heat
  - Carbon is converted from long-chain carbohydrates (sugars & starches) to stabilized humic acid
  - Microbial decomposition employs enzymes to snip off carbon atoms and produce cellular energy, H_2O and CO_2
  - Energy use <100% efficient □Heat is produced


Fructose
Glucose
(chain form)
Glucose
(ring form)


Carbon dioxide
Microbiological
decomposition

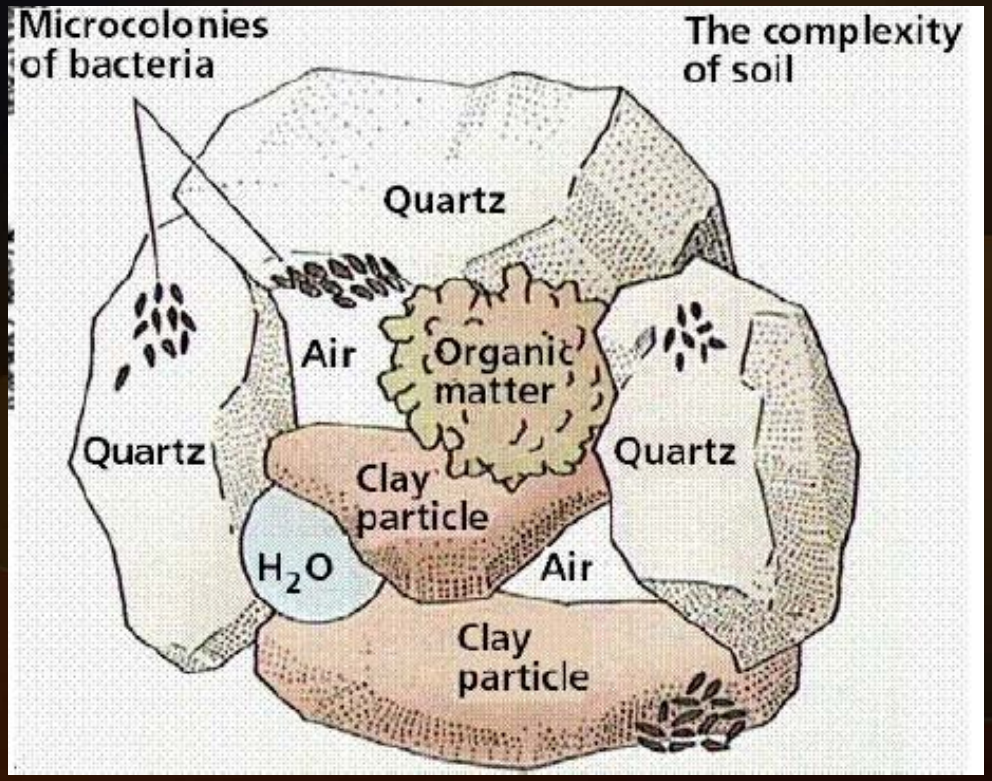

Humic Acid

Why Produce Compost?

- Turns nuisance-causing waste into valuable commodity
  - Saves landfill space
  - Can decrease tipping fees
- Can produce revenue from soil conditioner sales
- Benefits are long term

Why Produce Compost?

- Improves properties of Soil
  - Physically (Structurally)
  - Chemically (Nutritionally)
  - Biologically (Microorganisms)



Why Produce Compost? (continued)

- Provides N and other micro nutrients
  - Organic N must convert to inorganic N to be used by plants
  - Organic N mineralizes slowly (~10-30% per year)

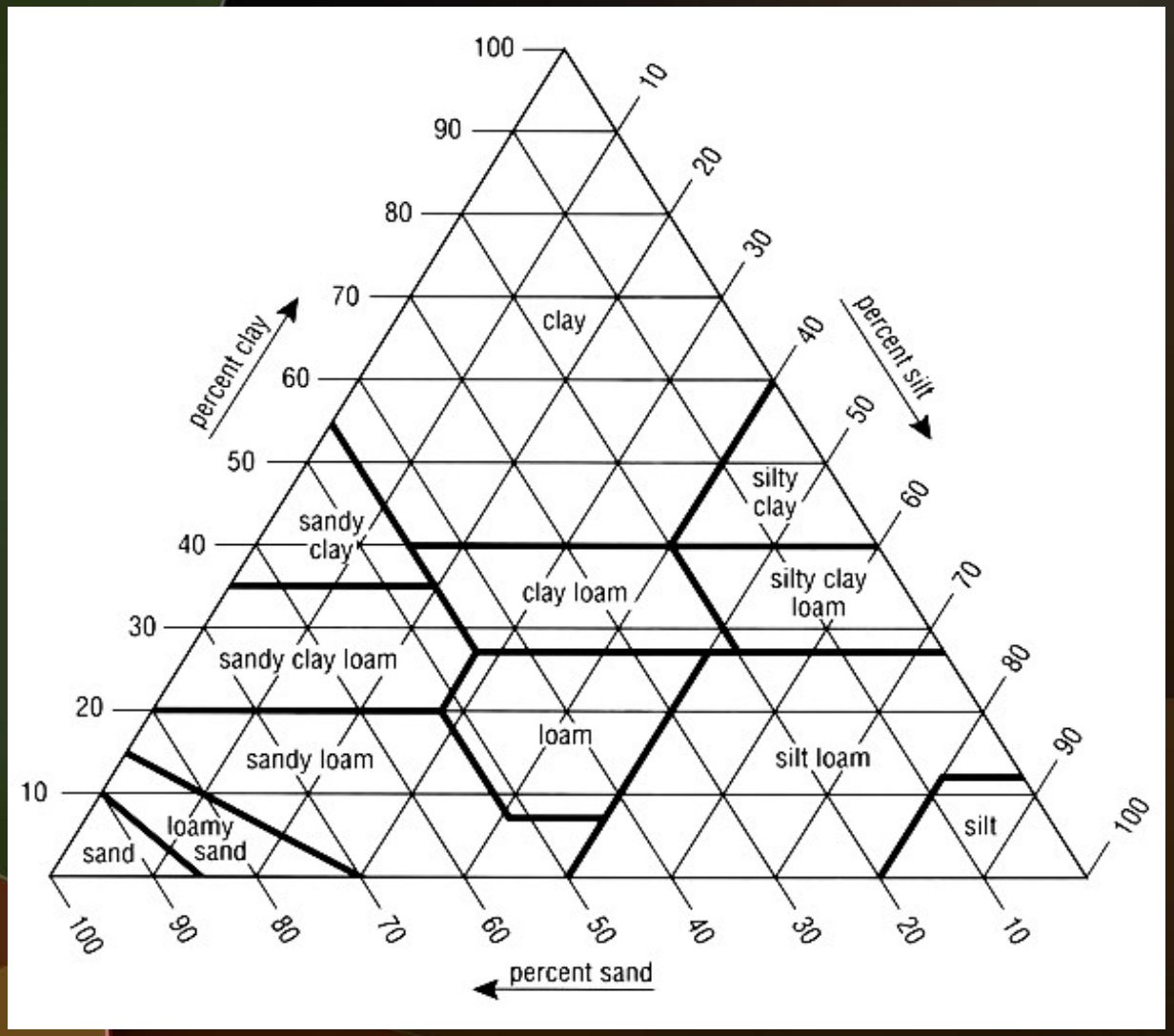
C:N Ratio	%N Released
7	60%
10-15	10%
18	15%
>35	5%

  - Copper, iron, manganese, zinc, etc. - for healthy plants
- Nutrients are organically bound to humus
  - "Slow release" source of nutrients
    - Nutrients released at rates plants can absorb
    - Nutrients do not leach to groundwater
  - Chemical fertilizers are "fast release"
    - Amounts exceeding plant uptake leach to groundwater

Why Produce Compost?
(continued)

- Compost adds organic matter, humus, & beneficial microorganisms to soil
- Compost is stabilized
  - Stores well vs. manure: Fewer odor and fly problems
  - Can be applied at convenient times of the year

Soil Composition Chart



Name	Size (mm)
Very coarse sand:	2.0-1.0 mm
Coarse sand:	1.0-0.5 mm
Medium sand:	0.5-0.25 mm
Fine sand:	0.25-0.10 mm
Very fine sand:	0.10-0.05 mm
Silt:	0.05-0.002 mm
Clay:	< 0.002 mm

As gardeners we grow soil and use the plants as feedback

http://soils.usda.gov/technical/manual/images/fig3-16_large.jpg

Soil Benefits of Compost
Physical

- Compost Benefits for sandy soil
  - Humus improves soil fertility
    - Holds water - lowers H_20 bill
    - Holds micronutrients
  - Compost adds beneficial microorganisms
  - Humus improves soil aggregation
    - Soils more resistant to erosion

Soil Benefits of Compost
Physical

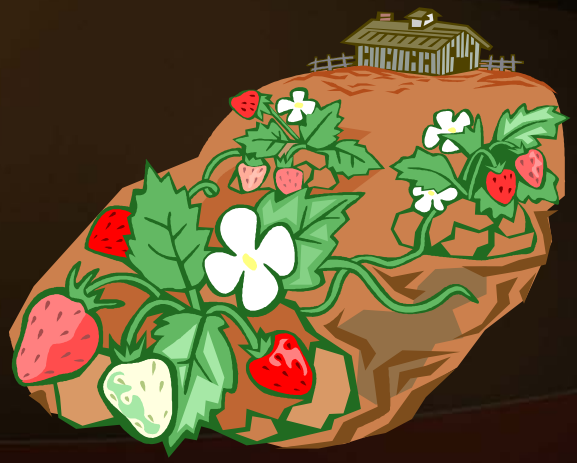
- Compost benefits for clayey soils
  - Humus, organic matter breaks up clumps of fine soil grains
    - More air in root zone
    - Reduced bulk density
  - Improves soil drainage & porosity

Soil Benefits of Compost
Physical

- Soil/vegetation more resistant to drought
- Allows moisture dispersion
  - Allows water to move laterally from application point

Soil Benefits of Compost
Physical

- Improves tilth (workability)
- Increases gas & water permeability
    - Reduces erosion
    - Resists compaction
- Weed Control-immature compost (mild herbicide)



Soil Benefits of Compost
Chemical

- Makes current fertilizer programs more effective
- Soil retains nutrients longer which reduces nutrient loss by leaching
- Keeps nutrients in root zone

Soil Benefits of Compost Chemical

- Compost has the ability to bind heavy metals & other contaminants - can't be leached
- Same binding effect allows compost to be used as a filter media for storm water
- Degrades some toxic compounds
  - Petroleum hydrocarbons
- Weed Control-immature compost (mild herbicide)

Soil Benefits of Compost Biological

- Provides Soil Biota: Bacteria, Fungi, Actinomycetes, Protozoa
- Soil Biota dependent on Organic Matter
- Research shows increased population of certain microorganisms may suppress specific plant diseases such as pythium, fusarium, phytophera, nematodes

Other Benefits

- Compost changes wastes to resources
  - Biosolids (WWTP sludge)
  - Post consumer foods - grocery, restaurants
  - Yard trimmings, leaves (was “yard waste”)
  - Animal bedding (chicken, horse, cattle, etc)
  - Ag waste: Gin trash, chile skins, pecan hulls & trimmings (15%-25% orchard pruned per year)
  - If bedding manures applied they have high C:N ratio and rob soil of N - compost lowers C:N ratio to more acceptable level
  - And… yes "You can use beer in compost piles -- both before and after you drink it."

Other Benefits

- Provides way to recycle solid wastes bound for landfill
  - Approximately 20 % of landfill volume
  - Approximately 20 % of tipping fees
  - Approximately 70 % could be composted
  - Less methane production and subsidence of cap
- Very cost competitive w/ other soil amendments like peat moss (Canada)
- Biosolids compost is stable vs. lime treated, irradiated, or flash-dried (Milorganite)

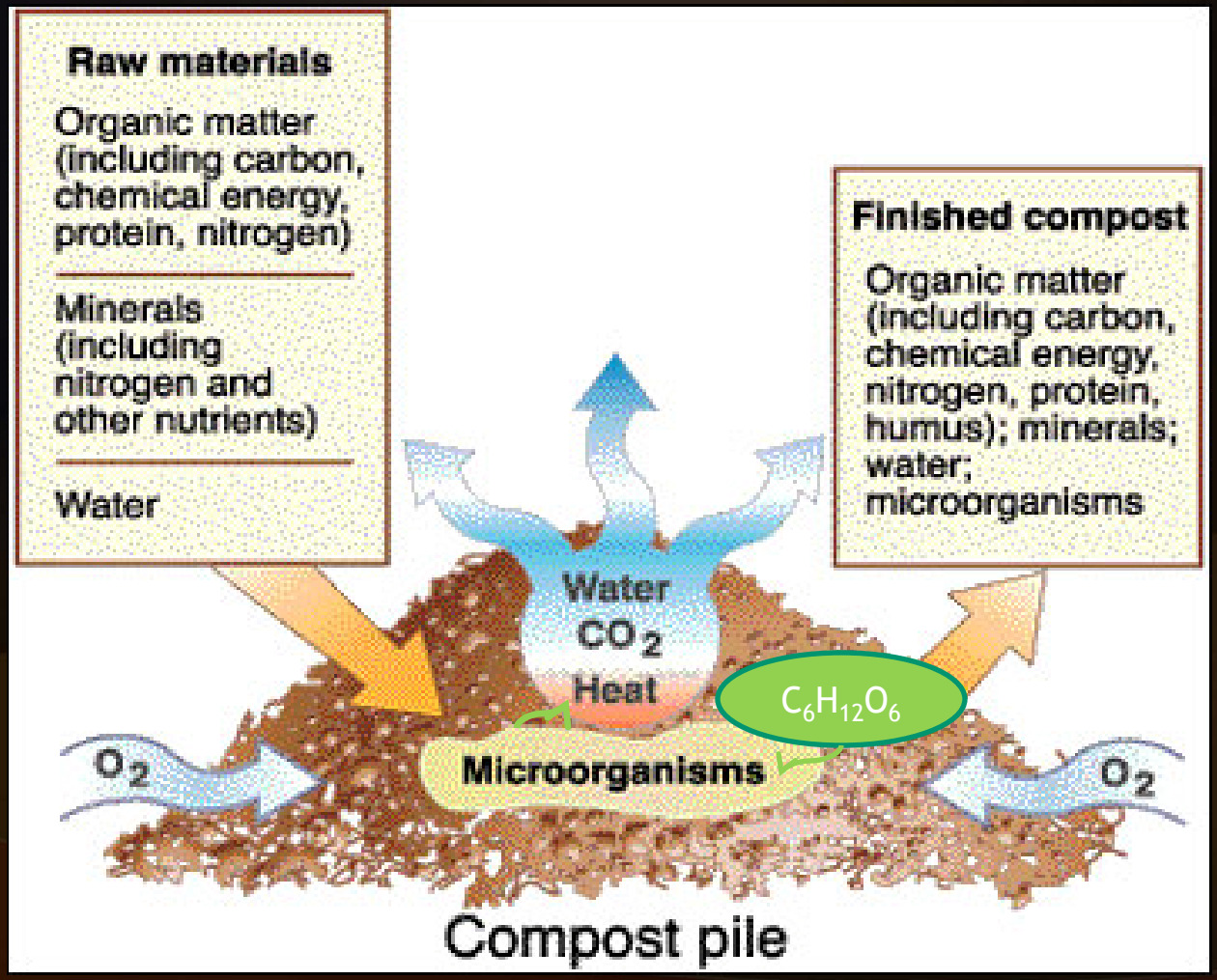
Typical uses of compost

- Turf grass - parks
  - amending poor soil, bare areas
  - Under swings, heavily traveled areas
- Golf courses
  - 1/2” minus (particle size) needed
  - Numerous courses in Albuquerque, Angel Fire, Santa Ana, etc.
  - Typical Mix below
    - 15% compost
    - 65% sand - cushion

Typical uses of compost

- Landscaping
  - Surface mulch - flower beds, trees, gardens, commercial gardens
  - Potting soil component for nursery, home
  - Seed bed material
- Landscape Reclamation
  - Highways - NMDOT

The COMPOST PILE as found in nature




QUALITY
SPEED
PRICE

FIRST INGREDIENT CARBON

AKA the Brown Stuff (dead and dried)-

excellent sources of carbon

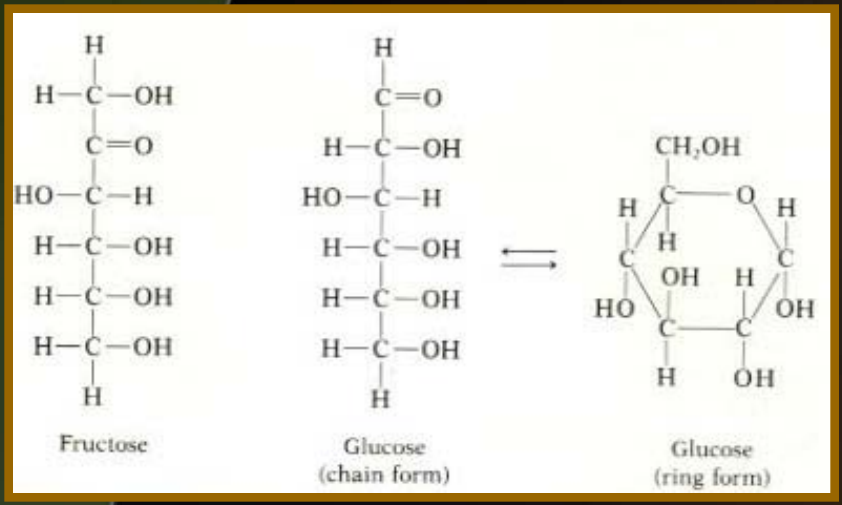
Paper

Dried Leaves

Straw

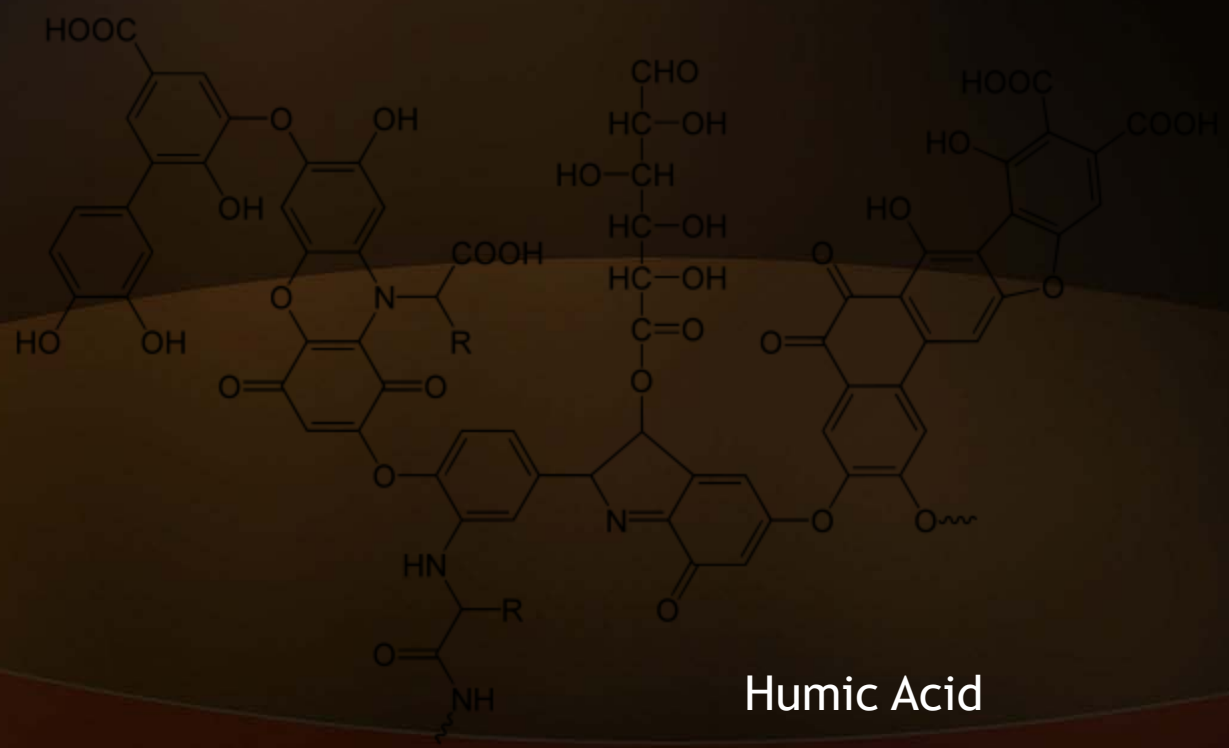
Chipped branches and tree trimmings

C:N greater than 30:1



Carbon dioxide

Microbiological decomposition



Humic Acid

SECOND INGREDIENT NITROGEN

AKA the Green Stuff –

excellent sources of Nitrogen

Vegetable Kitchen Scraps

Green leaves

Grass clippings

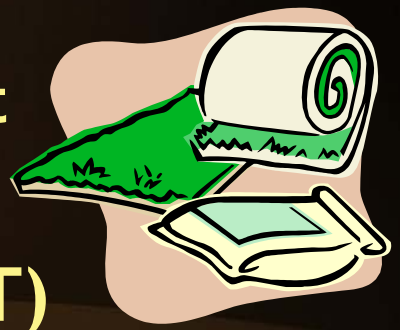
Coffee grounds

C:N ratio less than 30:1

COMPOST QUALITY

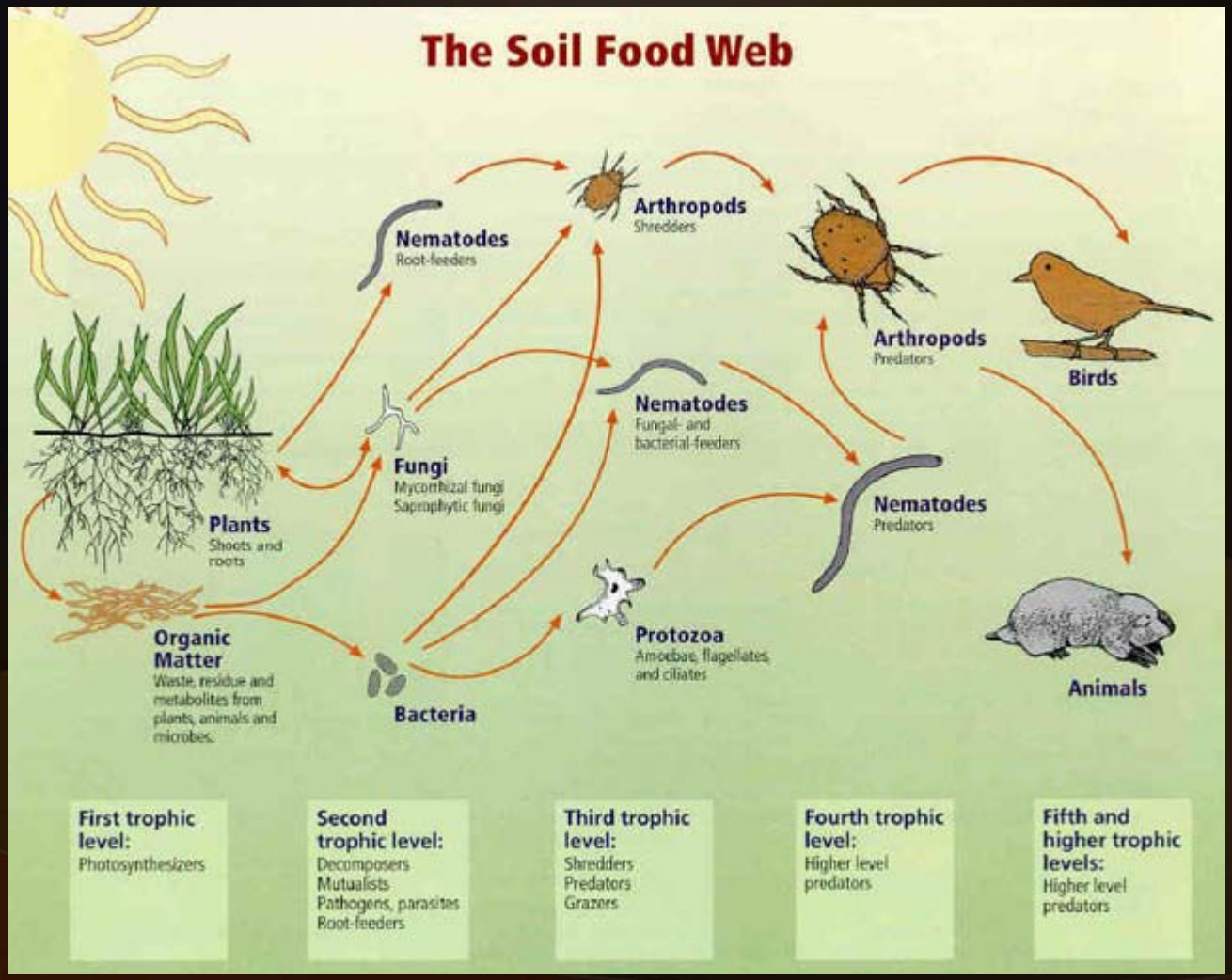
Compost Nutrients

- NPK
  - Percentage of Nitrogen, Phosphorus, Potassium
    - Estimates macronutrient content
    - Usually near 1:1:1 for compost
  - Lab test ~$20 (e.g. NMSU SWAT)
  - Compost is *not* fertilizer
    - Works in tandem with inorganic fertilizers
    - Allows reduction in fertilizer use

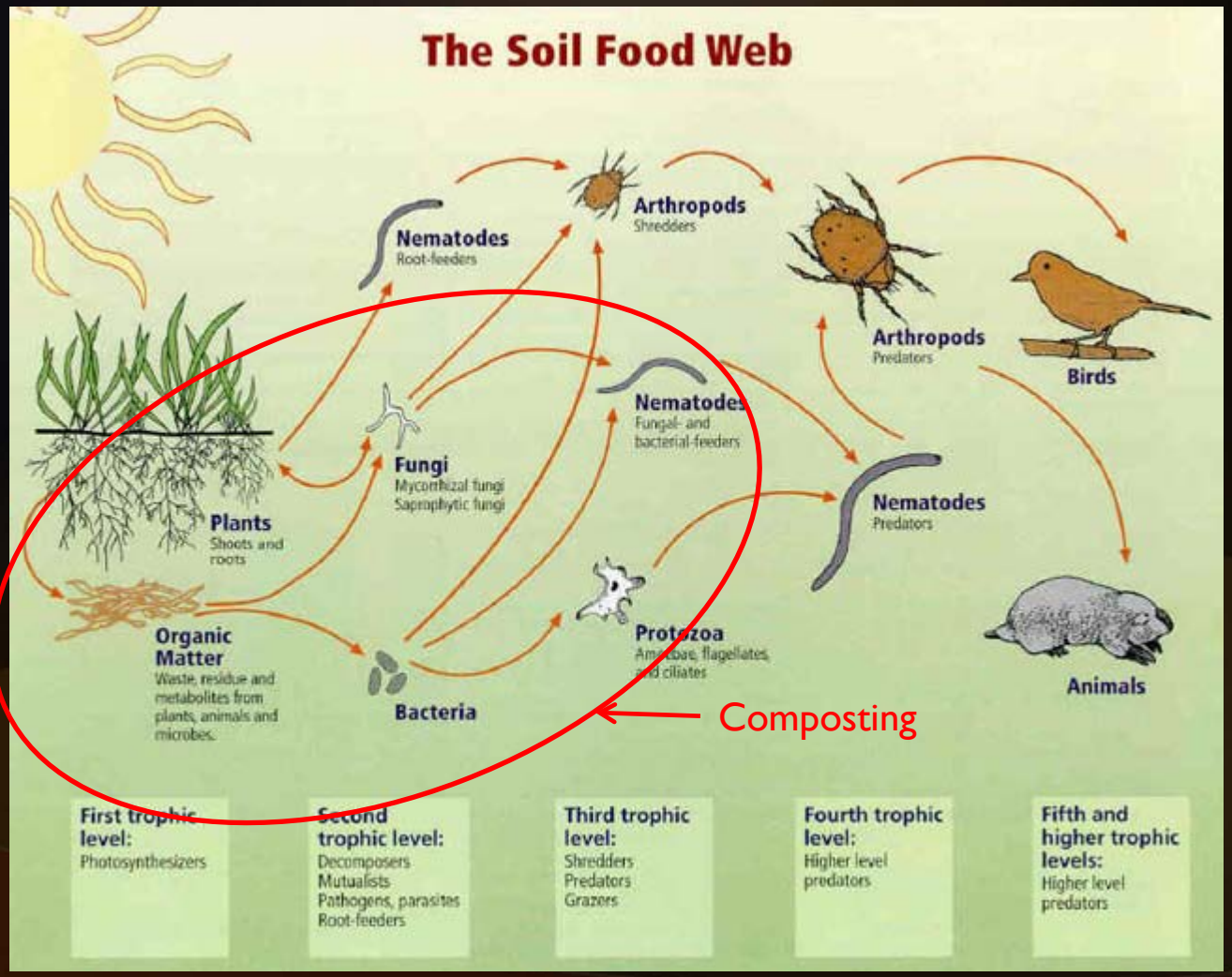


COMPOST MICROBES

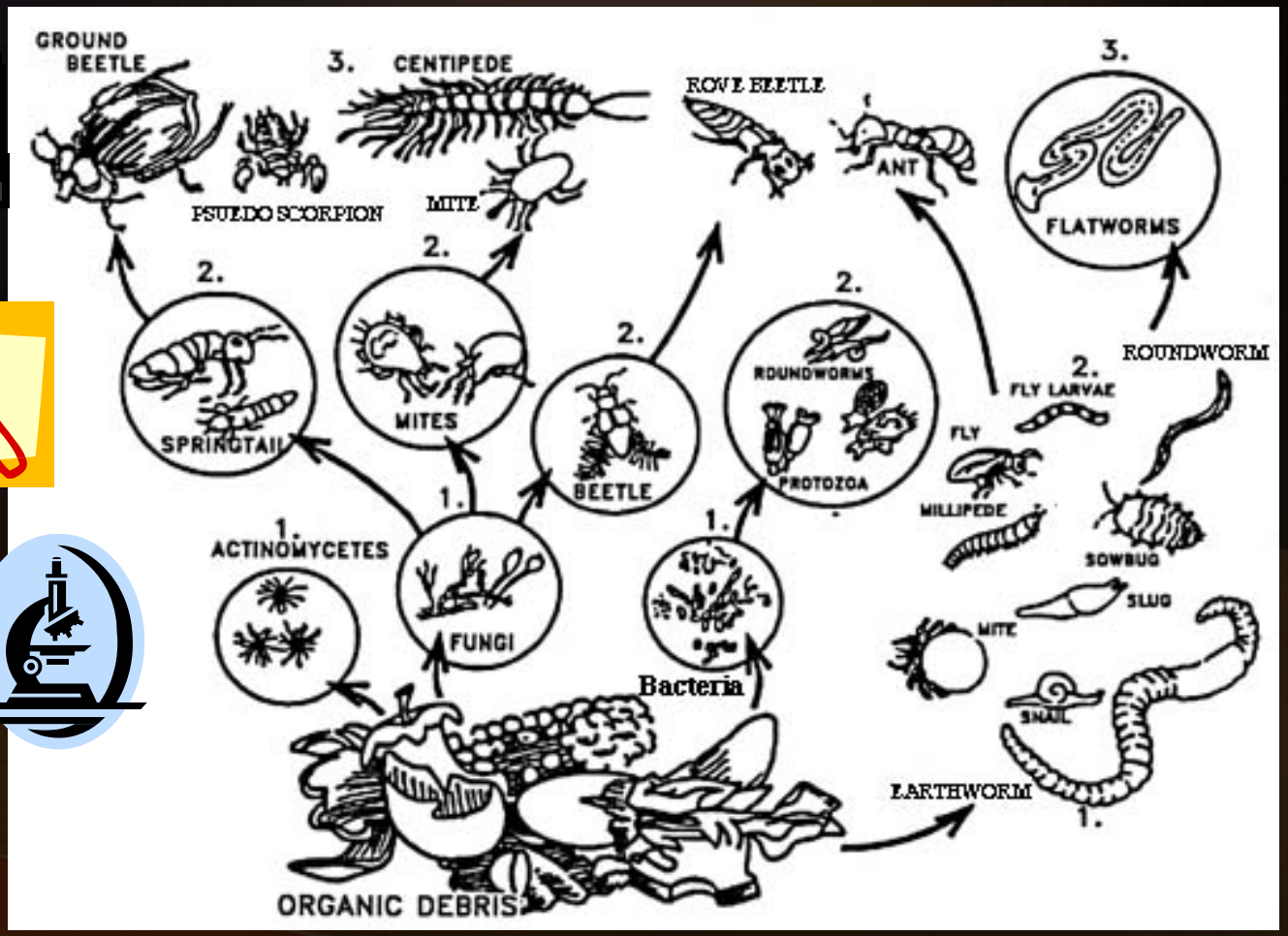
The Soil Food Web



The Soil Food Web



Compost Food Web



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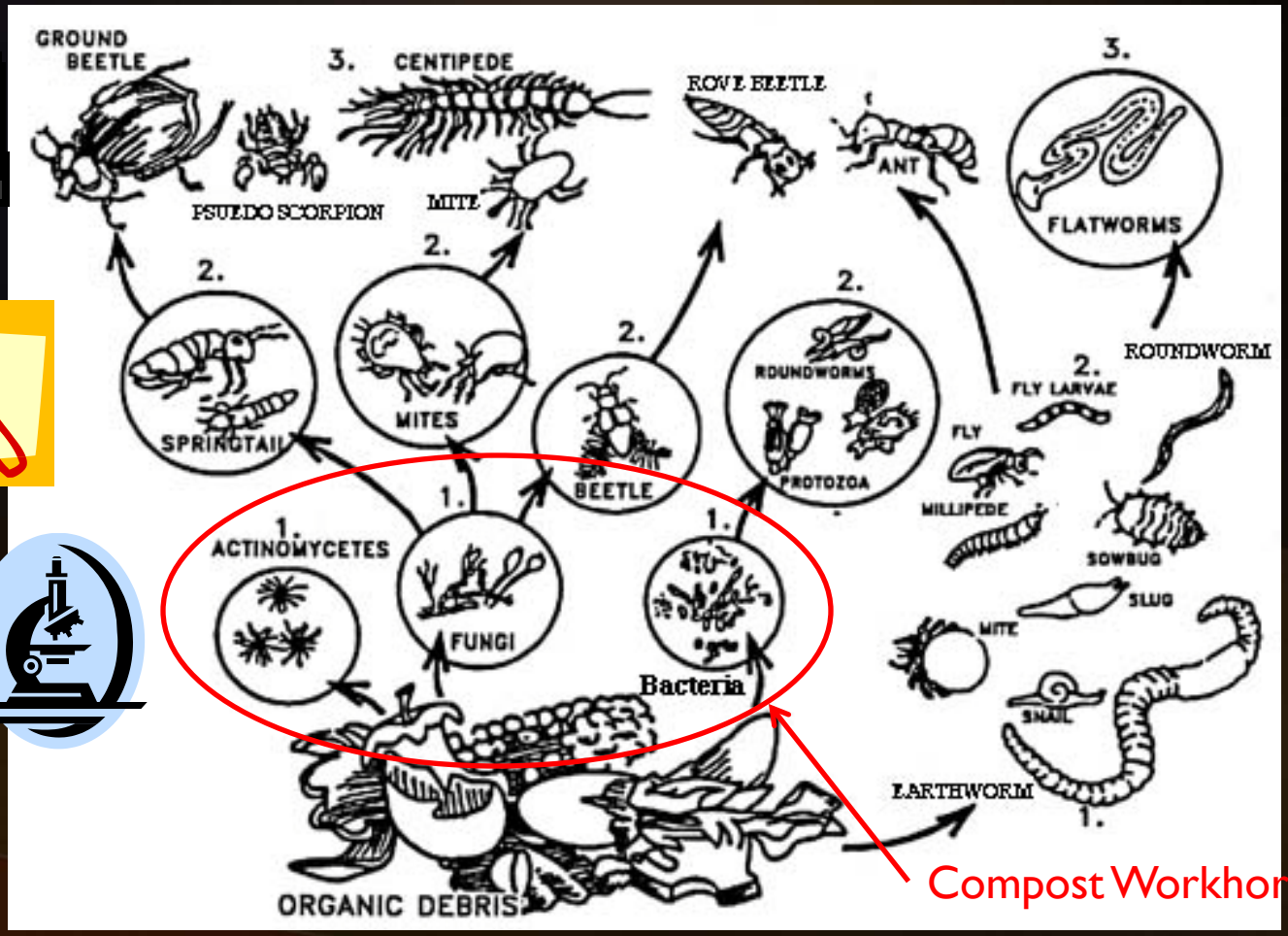
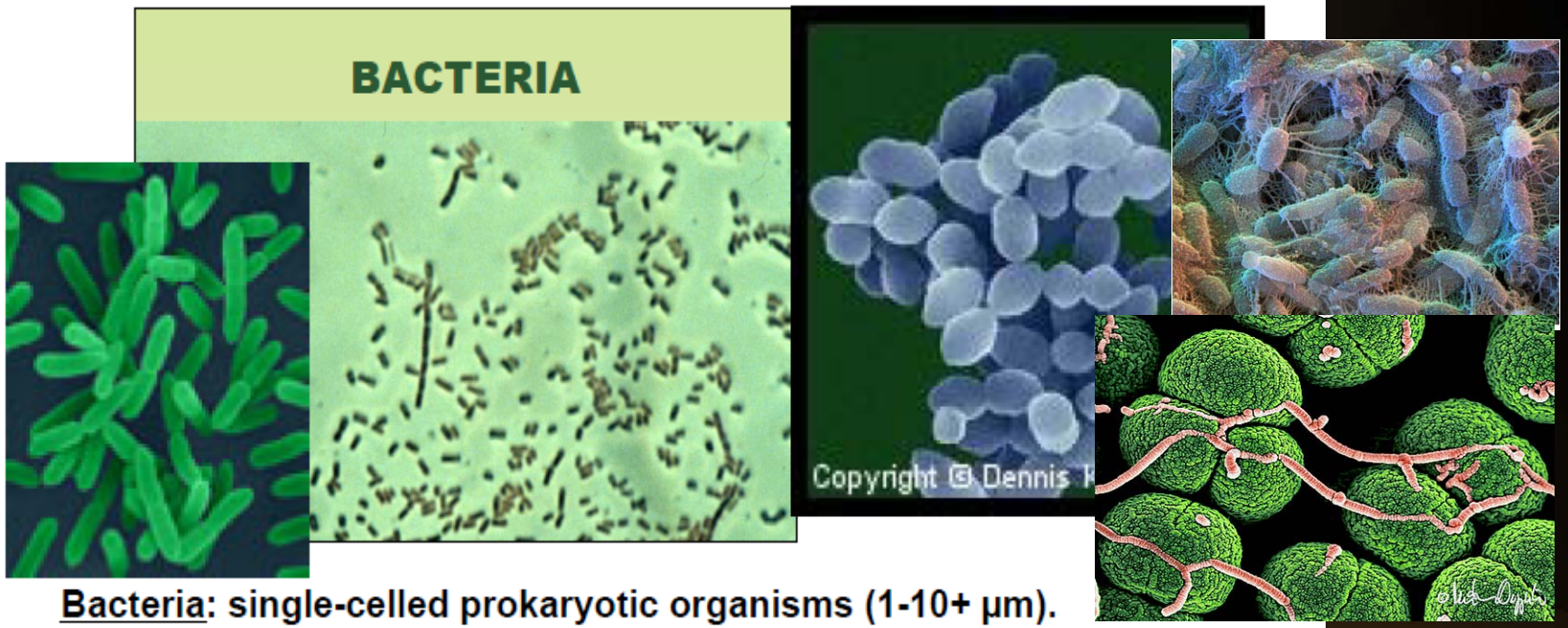


Composting Microorganisms

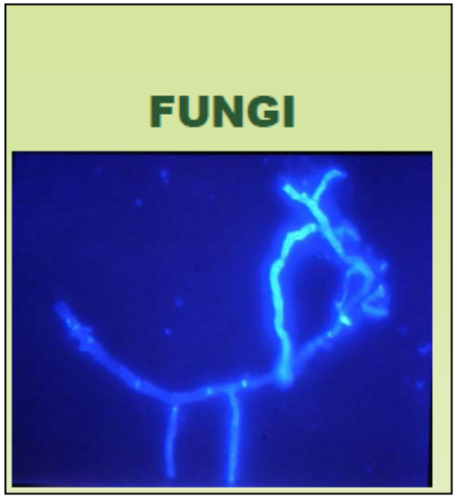


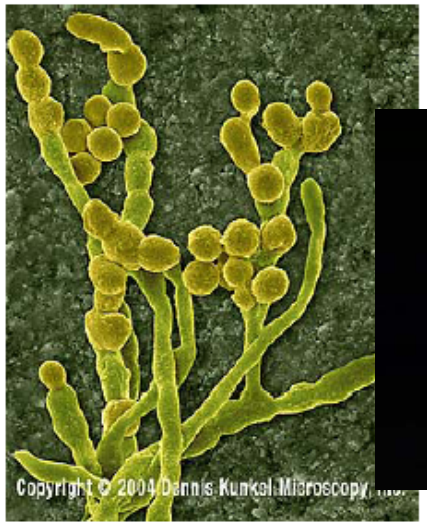
Bacteria: single-celled prokaryotic organisms (1-10+ µm).

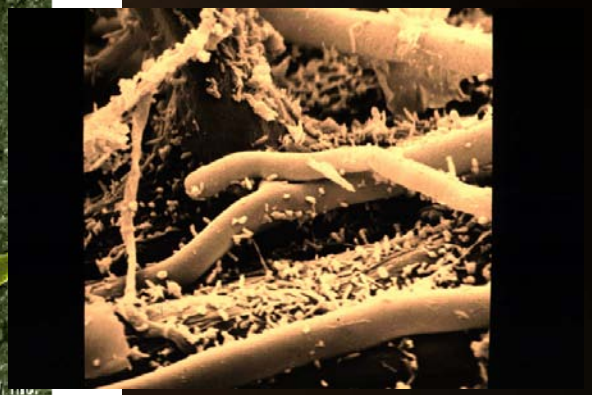
Dominate compost in thermophilic stages

- Feed on very easily degraded materials such as sugars & proteins
- Grow insanely fast – doubling time can be less than 1 hr. In one day 1 cell can become 20 million cells.
- Some can grow without oxygen, so dominate internal volume of compost piles.

Composting Microorganisms



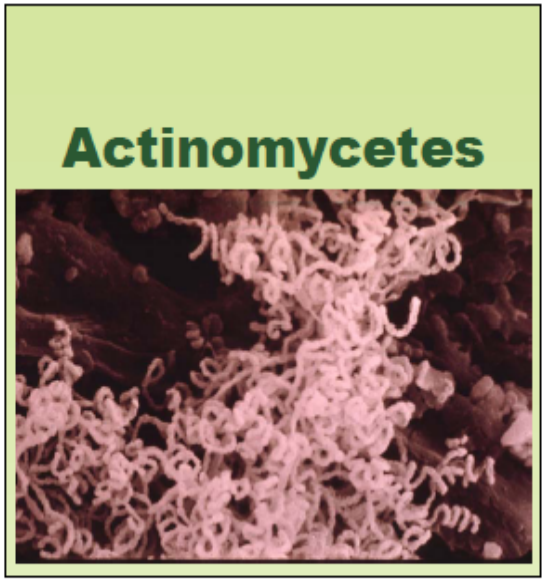


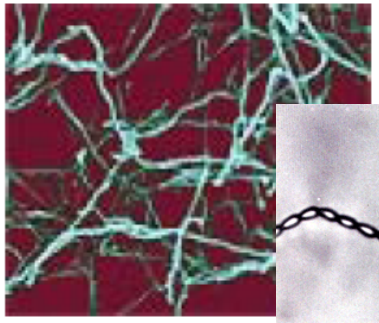


<u>Fungi:</u> grow as long threads (hyphae) 10-50 µm in diameter

- Different species feed on different foods: very simple to very complex.
- Like actino's, found in aerobic areas.
- Wood &other high C:N material favor fungi
- Acidic pH favors fungi

Composting Microorganisms





Actinomycetes: also single-celled prokaryotic organisms, but grow as threads (1-5 um diameter).

- Grow much more slowly than bacteria
- Feed on complex materials
- Usually relegated to outer layer of compost piles unless very dry or porous.

Composting Microorganisms

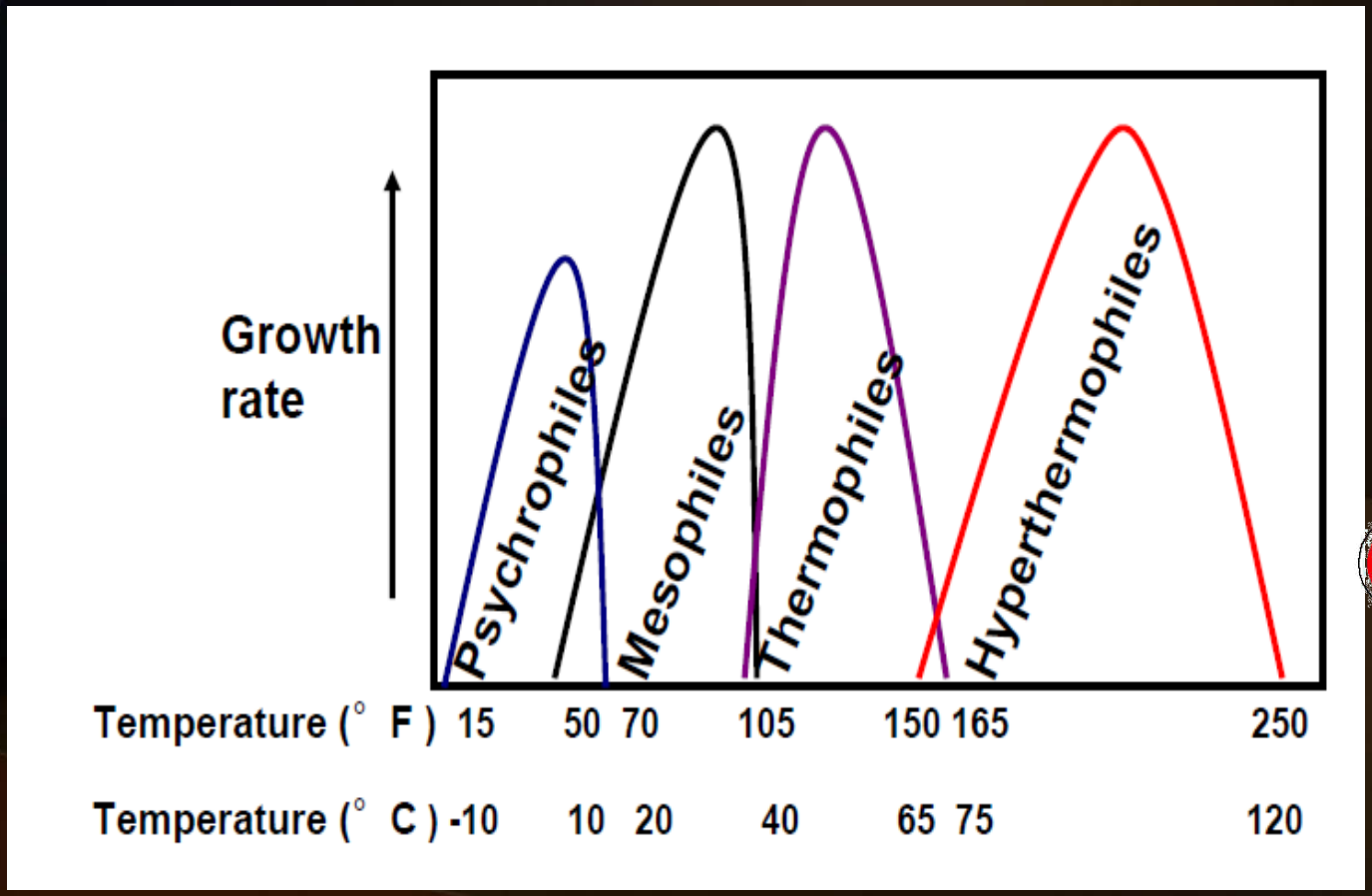
Protozoa

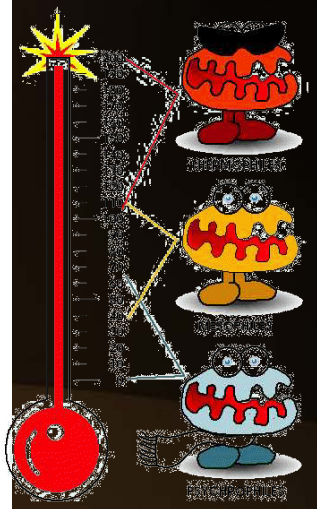
- Simplest form of animal organism
- Single-celled, but larger and more complex than bacteria
- Digest organic matter in the same way bacteria do
- Present in far fewer numbers than bacteria

Rotifers

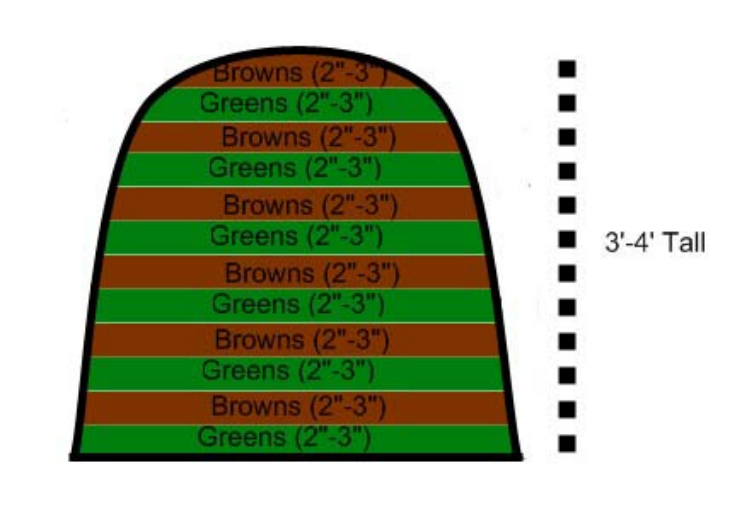
- Usually have one or two groups of vibrating cilia on head
- Bodies round, divisible into head, trunk, tail
- Found in water adhered to plant substances
- Feed on microorganisms.

Microbial Temperature Regimes

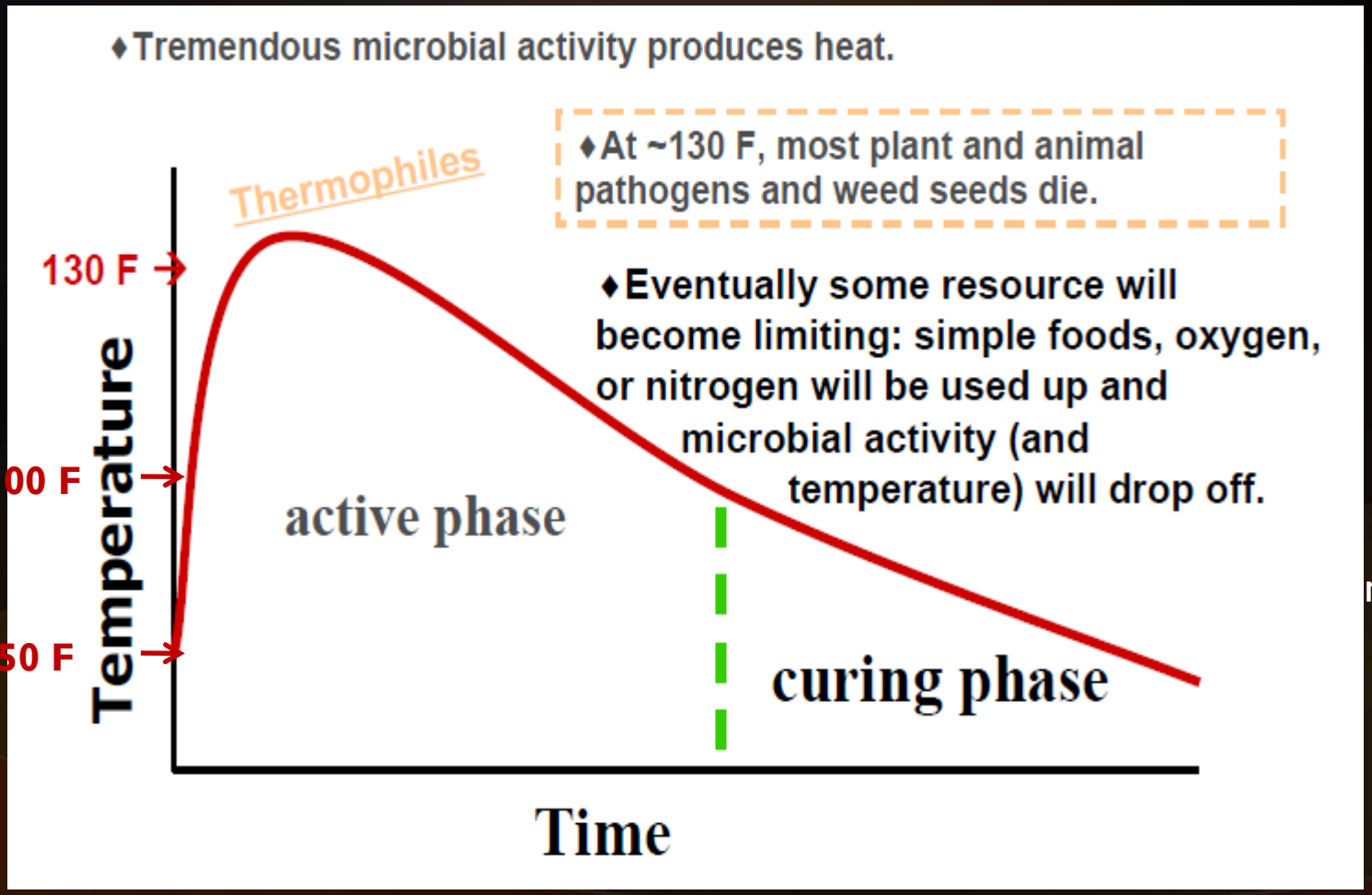




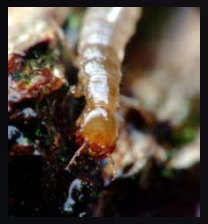
The Hot Compost Pile



Typical Compost Heating Cycle



Compost Grazing Organisms



Nematodes: Cylindrical, often transparent microscopic worms. Three categories: 1) those that live on decaying vegetation; 2) those that are predators on bacteria, algae, protozoa, etc.; and 3) those that can be serious pests in gardens. Optimal temperatures between 79-83°F, moderately moist conditions.

Flatworms: General scavengers that graze on a wide variety of things including animal matter. Flat and usually quite small in their free-living form. Most are carnivorous and live in films of water within the compost structure.

Springtails: Small wingless insects that run in and around the particles in the compost. Small spring-like structure under the belly that catapults them into the air when disturbed. Chew on decomposing plants, pollen, grains, and fungi. Eat nematodes and droppings of other arthropods.

Feather-winged beetles: Smallest of all beetles and possibly of all insects. Distinguished by their feather-like wings. Some are blind and most live under bark in forests and woodland. Most species feed on fungi.

Other Types of Composting

- Cold - Sheet
- Vermicomposting
- Rain Sponges

Sheet Composting

Adding Nitrogen and Carbon

Sheet Composting

Adding compost Layer

Finishing Mulch

Vermicomposting

How do you know what side of a worm is it's head?

Tickle it in the middle and see which one laughs

Vermicomposting

Vermicomposting

WHAT – Process of using worms to recycle organic material and food scraps into worm compost, or vermicompost (vermiculture)

Vermicomposting

WHY

- Advantages

  Easy to do year-round

  SEVEN times richer in nutrients than regular compost

  No turning, no odor, & little watering – worms do the work

- Benefits

  Environmental

  Economic

  Soil health

  Plant growth and vigor

  Fun and educational

Vermicomposting

WHERE – Almost anywhere

- Indoors, Outdoors
- Dark, Warm, Moist, Ventilated

Vermicomposting

HOW

- Aerated container
- Bedding such as shredded newspaper
- Moisture and proper temperature
- Small amount of soil
- Redworms & food waste

Vermicomposting in Action

Aerated Container – Worm Bin

Vermicomposting in Action

Temperature Below 80° F

Red worms, specifically *Eisenia fetida*, are very hardy and can withstand temperature extremes better than many other species.

Ideal range between 68 and 72 ° F

Will happily continue working at a low range of 50 degrees all the way up to the low 80's

Vermicomposting in Action

Bedding

Vermicomposting in Action

Starter Soil & Redworms

Vermicomposting FAQ

Redworms (*Eisenia foetidaie* & *Lumbricus rubellus*)

- Live in the top 12 inches of soil
- Feed on organic decaying matter
- *Can* eat their body weight in food every day
- Generate 75% of body weight in worm poop (castings) each day
- Lay one cocoon every week or so
- Each cocoon produces 3 to 4 baby worms
- Begin breeding at 4 to 6 weeks of age
- Worms can double population every 90 days
- Live up to 2 years

Vermicomposting – The Cocoons

Worm Baby Food

Vermicomposting in Action

Food Waste

YES

Most fruits and veggies
Coffee grounds and filters
Tea leaves and bags
Egg shells
Most cereals and grains (oatmeal, pasta, rice, cornmeal, pancakes, breads)

MAYBE

Onions
Garlic
Ginger

Vermicomposting in Action

Food Waste

NO

Meat, fish, dairy, oil, or bones
Potato chips, candy, oils
Citrus

NO-NO's

Plastic
Rubber bands
Sponges
Aluminum foil
Glass

Vermicomposting in Action

Harvesting Vermicompost

Vermicomposting in Action

How to Use Vermicompost

- Excellent Soil Amendment; will not burn plants
- Use as mulch or soil conditioner in home garden
- Use in potting soil mixes for houseplants
- Use as top dressing for lawns
- Combine with potting soil mixes and use as medium for starting young seedlings

Rain Sponge

The Other Option Landfilling

Some Numbers to Consider

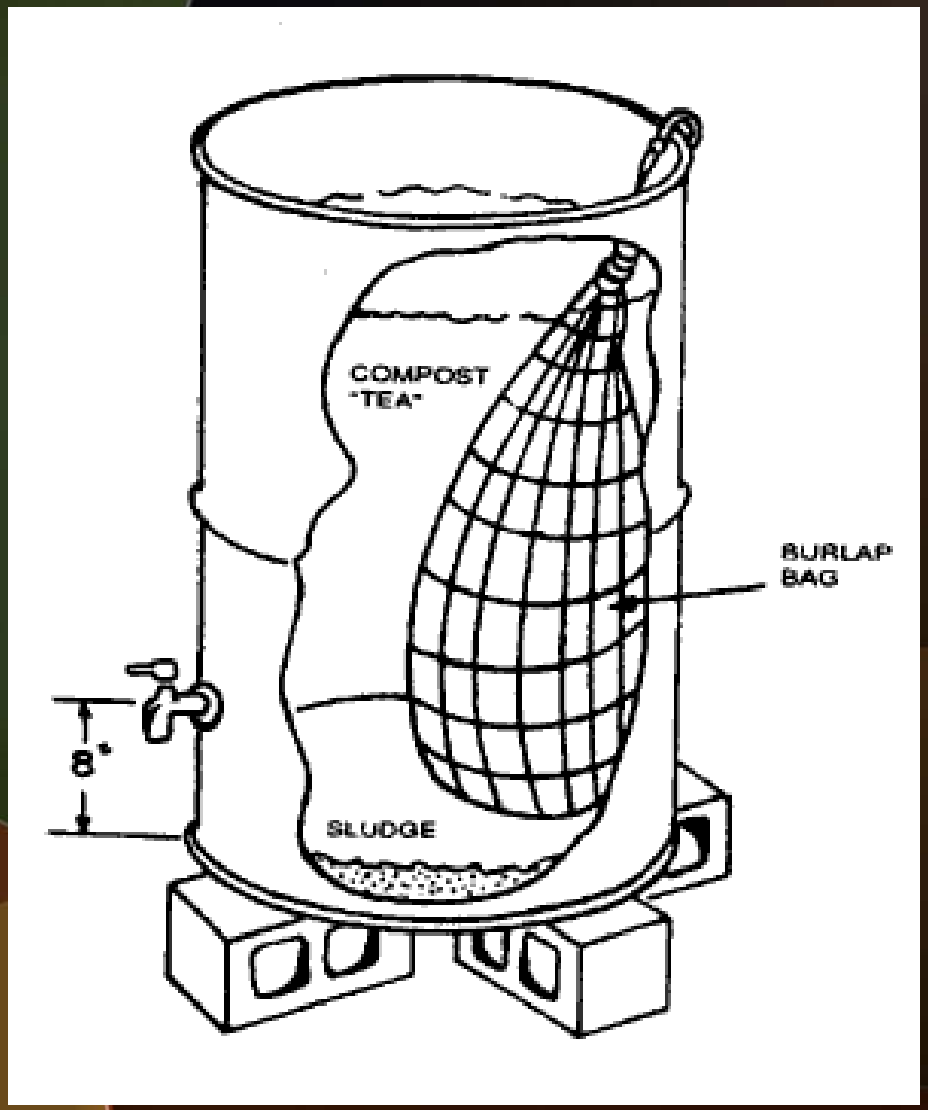
- Food and yard waste account for at least 25% of landfill materials
- CO_2 impact from edible food waste per person equates to taking 1 to 4 cars off the road
- CO_2, methane (CH_4), and nitrous oxide (N_2O) generates as organic waste decays in landfills
- CH_4 21 times worse and N_2O 300 times worse than CO_2
- Proper composting minimizes greenhouse gas emissions and extends life of landfills by saving space

Compost Tea

Compost Tea

- Liquid Gold manufactured from compost
- Protects plants from disease
- Improves nutrient retention
- Transforms compacted soil into healthy soil
- Reduces water usage
- Decreases run-off and leaching

Compost Tea



Fill porous bag with fully cured compost

Fill container ¾ full of water

Drop bag with compost into water

Stir twice a day or drop in an aerator

Happy Composting

For additional questions:

Bernalillo County Master Composters

http://bernalilloextension.nmsu.edu/mastercomposter/index.html

ABQ Master Gardeners

http://www.abqmastergardeners.org

"The Nation that destroys its soil destroys itself"

Franklin D. Roosevelt