



# There Is Something About The Soil That Makes Us All Want To Play



# Soil Is Cool

- Research shows microbes in soil fight depression.
- Healthy soil can act as a carbon sink and sequester CO<sub>2</sub>.
- Healthy soil grows healthy food.

Some estimates say we have lost 70% of the soil that is suitable to grow food in.

It takes 500 years to for nature to create 1" of soil

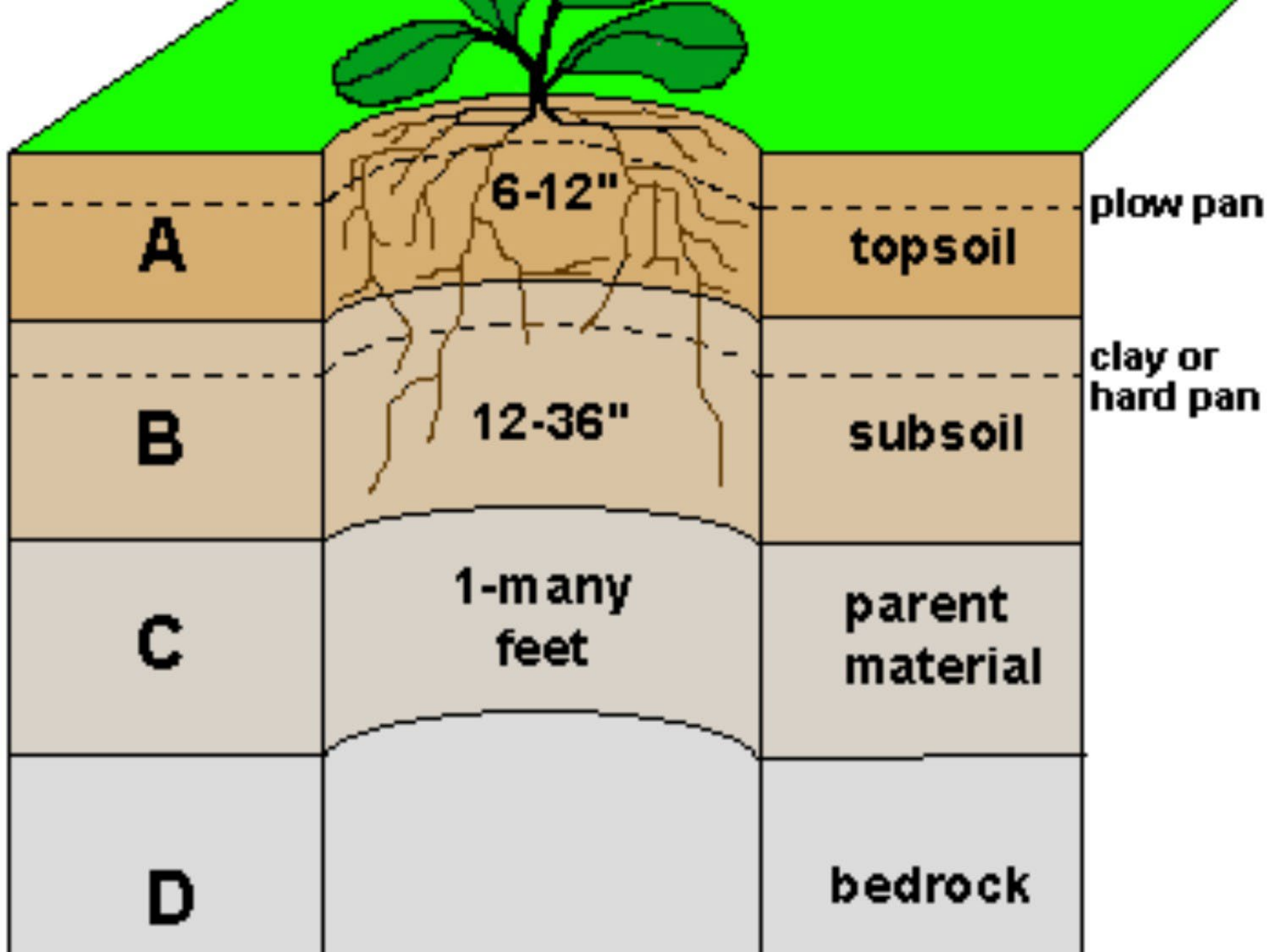


### Causes of Soil Loss

- overgrazing
- agricultural activities
- deforestation
- overexploitation of land to produce fuelwood
- industrialization

A wooden sculpture of a person sitting on a chair, rendered in a stylized, abstract manner. The figure is light-colored wood, possibly birch, and is positioned on the left side of the frame. The person is seated on a simple wooden chair, with their legs crossed at the ankles. The background is a dark, textured surface, possibly a piece of wood or a wall, which contrasts with the smooth, light wood of the sculpture. On the right side of the image, the text "Think Differently About Your Soil" is written in a bold, orange, sans-serif font, arranged in five lines. The overall composition is balanced, with the sculpture and text occupying the main visual space.

**Think  
Differently  
About  
Your  
Soil**



**A**

6-12"

topsoil

plow pan

**B**

12-36"

subsoil

clay or  
hard pan

**C**

1-many  
feet

parent  
material

**D**

bedrock



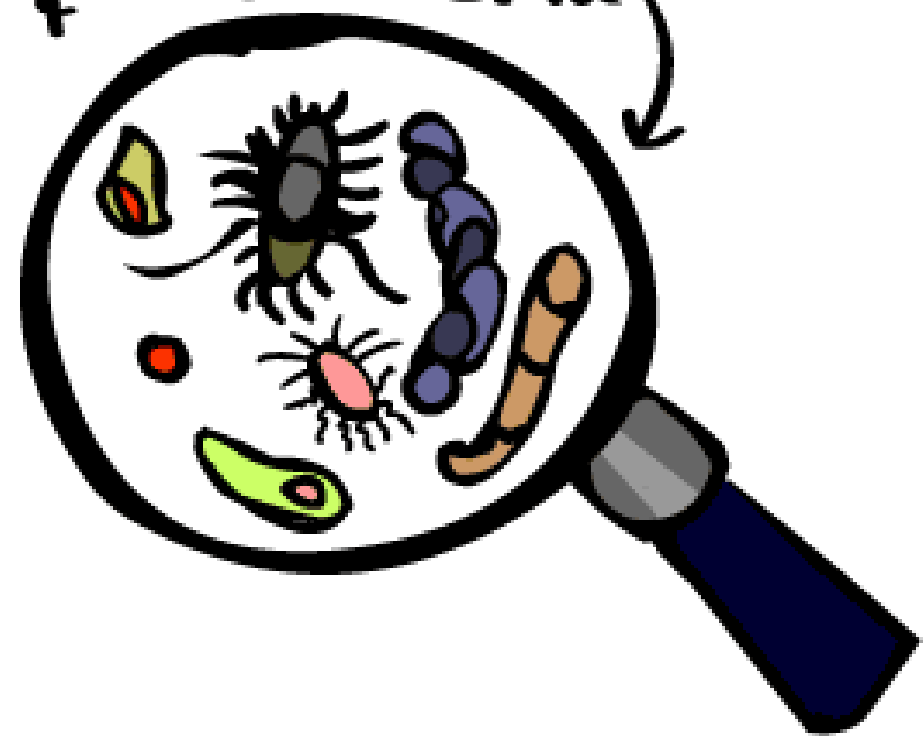
Soil is alive  
The action is down here

# DECOMPOSERS

They consume (eat) dead plants & animals and decomposes them - reduces them to simpler forms of matter.

## PRIMARY DECOMPOSERS

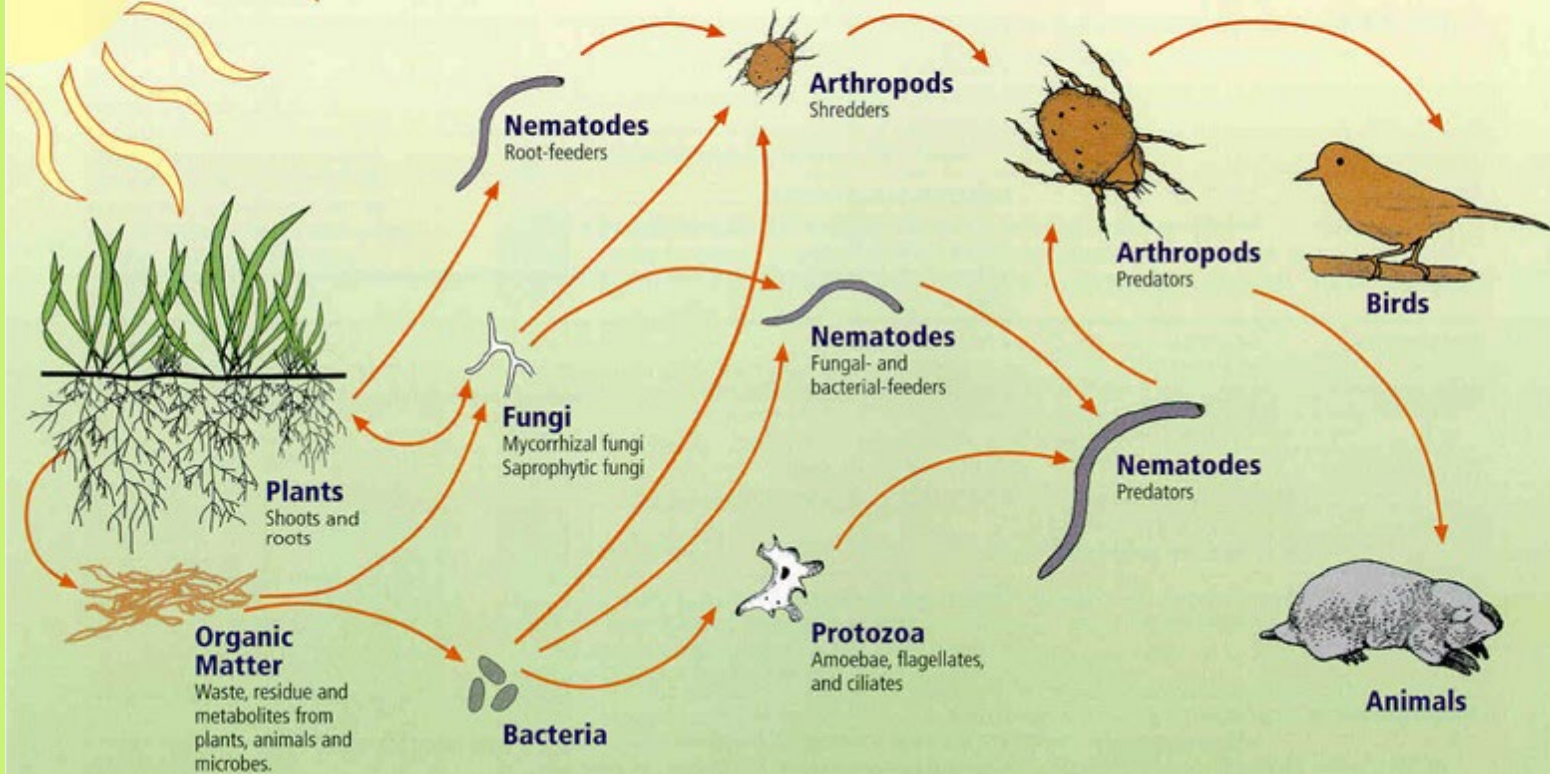
Fungi & Bacteria





# The Soil Food Web

It's a complex party



**First trophic level:**  
Photosynthesizers

**Second trophic level:**  
Decomposers  
Mutualists  
Pathogens, parasites  
Root-feeders

**Third trophic level:**  
Shredders  
Predators  
Grazers

**Fourth trophic level:**  
Higher level predators

**Fifth and higher trophic levels:**  
Higher level predators

Relationships between soil food web, plants, organic matter, and birds and mammals  
Image courtesy of USDA Natural Resources Conservation Service  
[http://soils.usda.gov/sqi/soil\\_quality/soil\\_biology/soil\\_food\\_web.html](http://soils.usda.gov/sqi/soil_quality/soil_biology/soil_food_web.html)



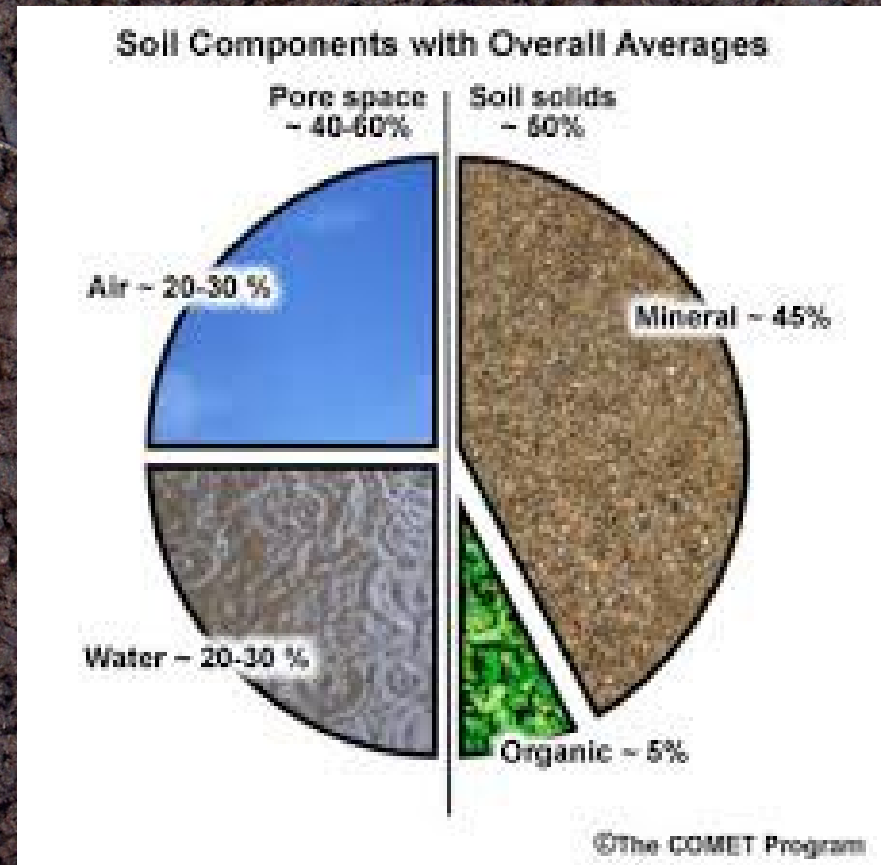
Figure 30-1 Biological Science, 2/e  
© 2005 Pearson Prentice Hall, Inc.

Mycorrhizal fungi are well known for their role in assisting plants in the uptake of phosphorus.

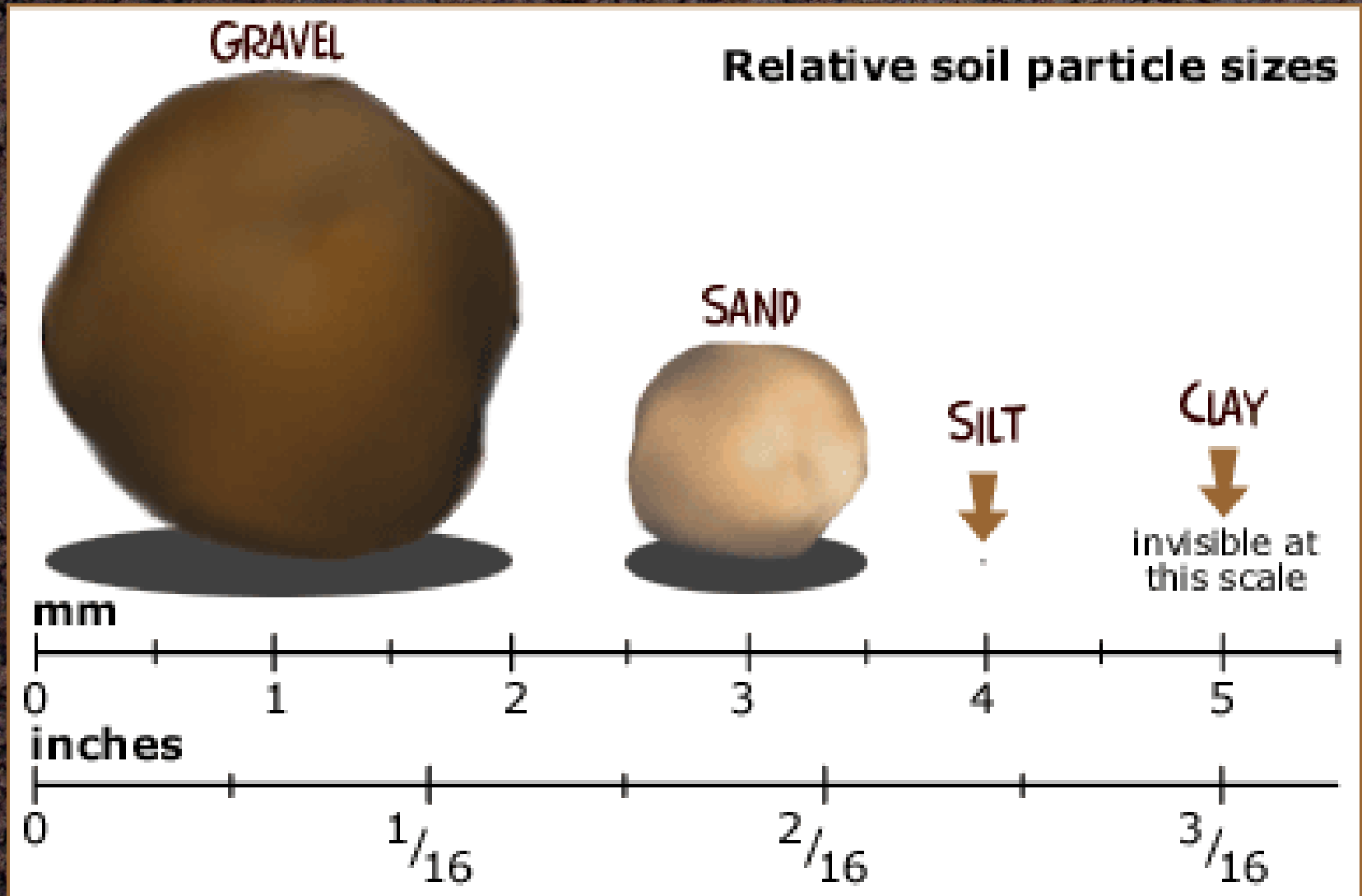
Ectomycorrhizal fungi can benefit plants by promoting root branching and increasing nitrogen, phosphorus and water uptake due to their large surface area and internal cellular mechanisms.

# What is Soil

- Soil is a mixture of materials that supports plant growth
- Inorganic – Weathered rock, air, and water
- Organic – Living, and dead animals, and plants



# 3 Textures of Soil



# Sand

- Soils with lots of sand have big spaces between the particles.
- It does not hold water or nutrients. Sand doesn't react with other chemicals.
- Sandy soils don't stick together very well. Plant roots can't hold onto this soil.
- But the big spaces do allow air into the soil. There are some plants that are able to grow in sandy topsoil by putting their roots deep, through the sand to the subsoil.



# Silt

- Too Light. Its finer than sand, but still feels gritty.
- Silt is commonly found in floodplains and is the soil component that makes mud.
- Soils with a lot of silt make excellent farm soil but erode easily. This is the soil blown away in dust storms and carried down stream in floods.

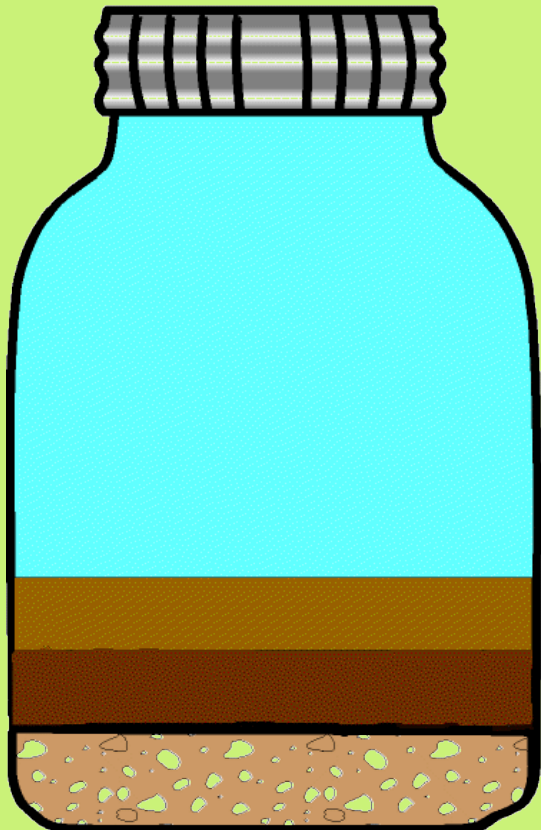
# Clay



- **Too Fine. clay makes the soil heavy and dense.**
- **The spaces between soil particles are very tiny.**
- **Dry Clay is like concrete roots can't push through it.**
- **No air can get in from the surface.**
- **Most bacteria and other soil organisms that need oxygen**
- **But clay is important because it can change the soil chemistry. Clays give off minerals and absorb acids.**

# Loam

## Loam Soil



Clay 20%

Silt 40%

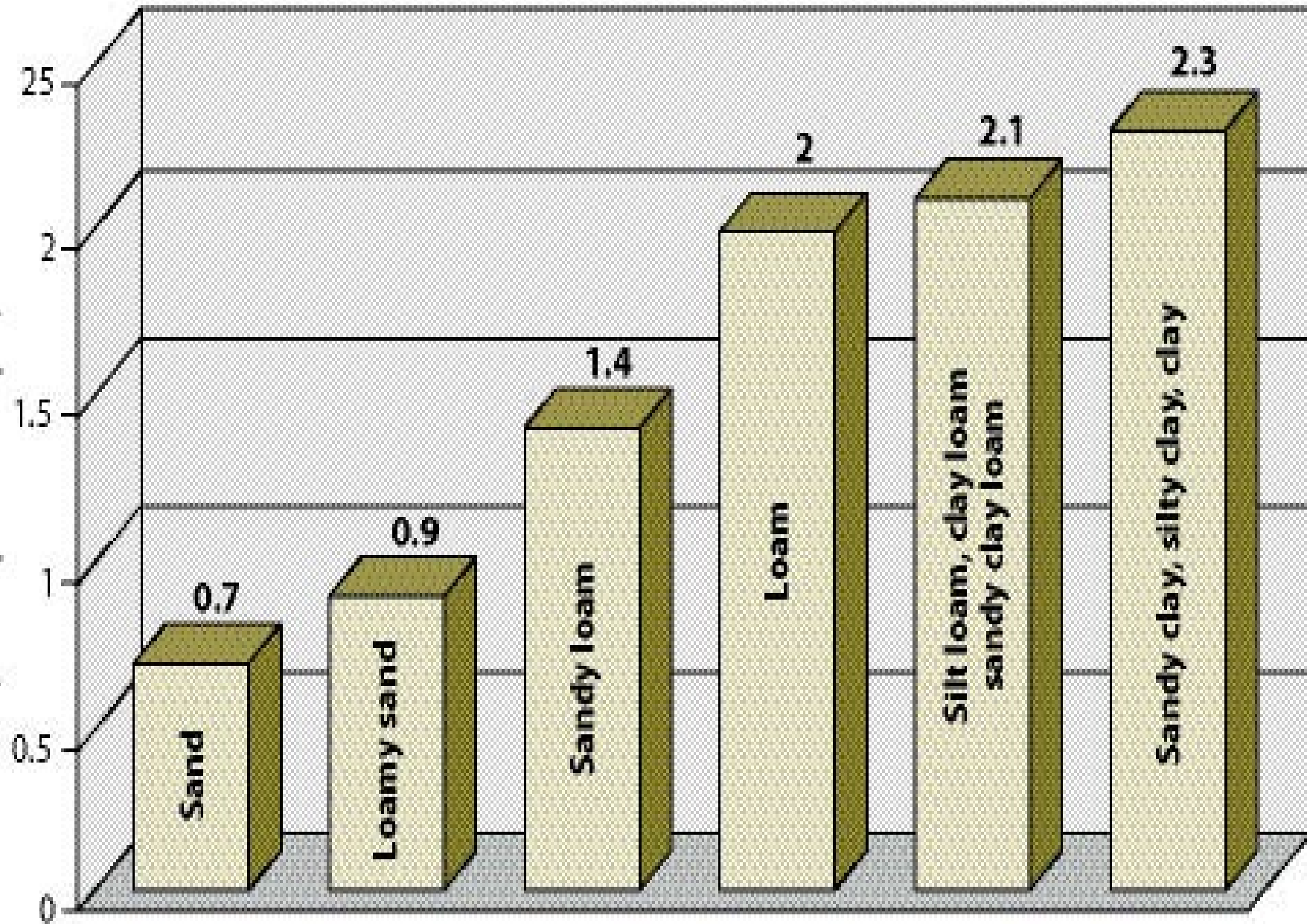
Sand 40%

- The perfect soil for plants and organisms
- This soil has enough large and small spaces for air and water to flow in. It also has enough clay to let it stick together and hold humus.
- When gardeners call a soil "loamy." It's the nicest thing they can say about soil.



# Available Water Holding Capacity

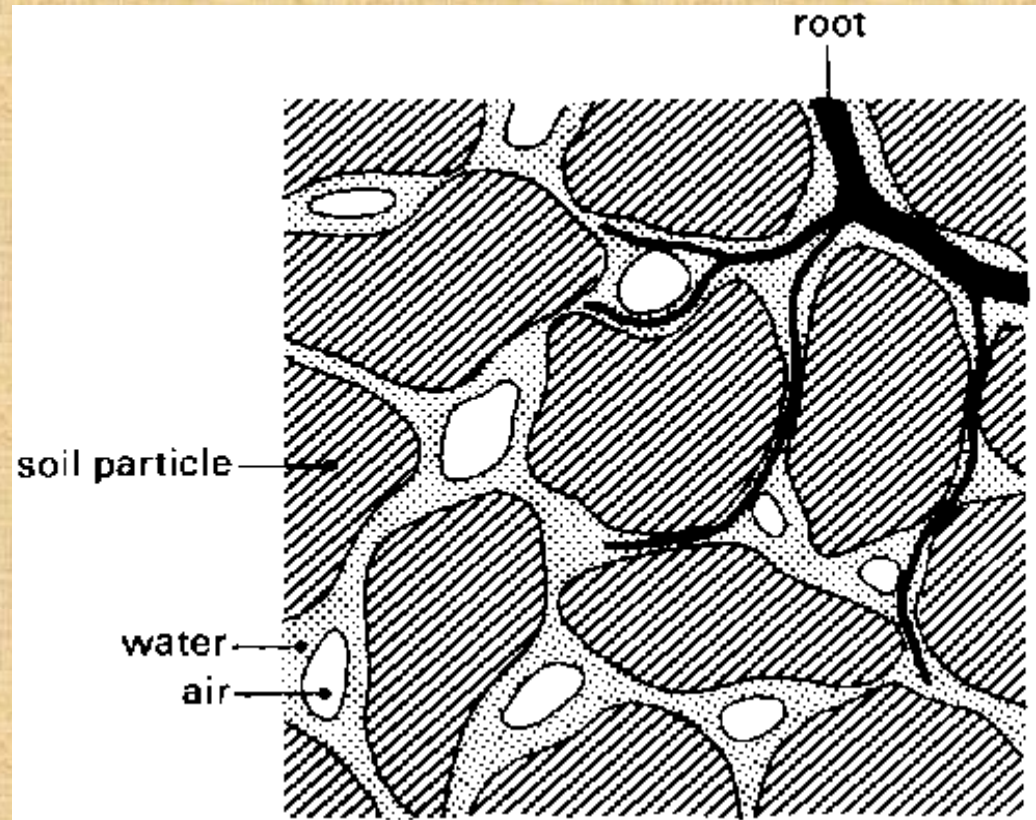
(inches per foot depth)



Soil Textural Classes

# Soil Structure

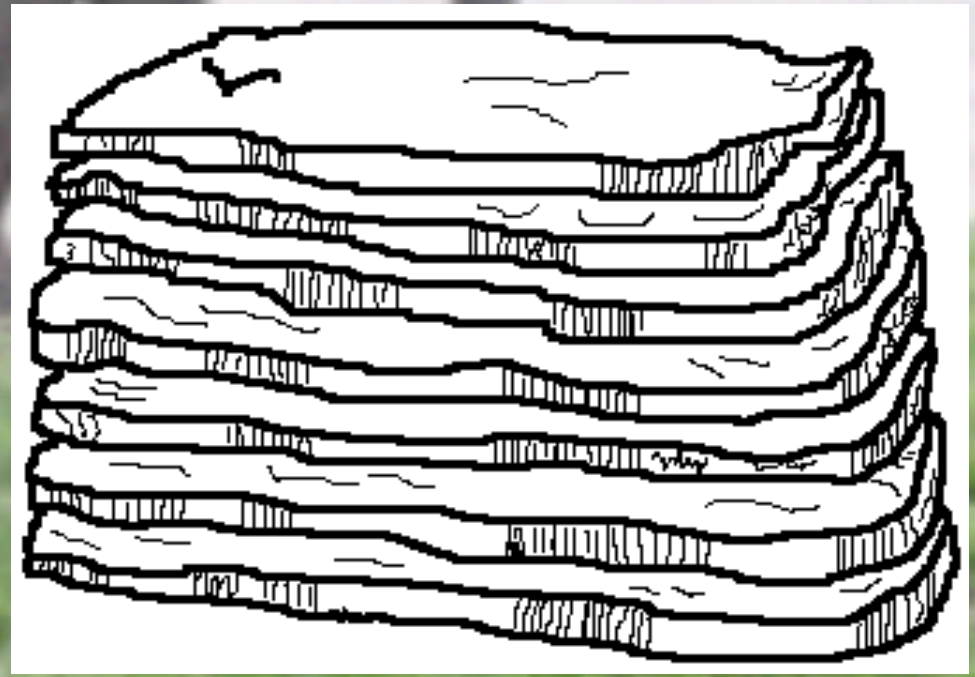
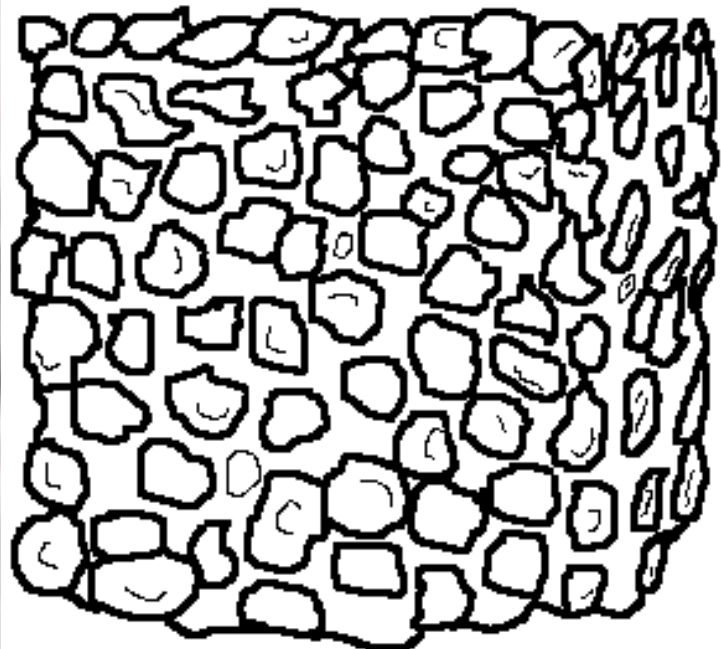
- Soil structure describes the arrangement of the solid parts of the soil and of the pore space located between them



Its dependent on:

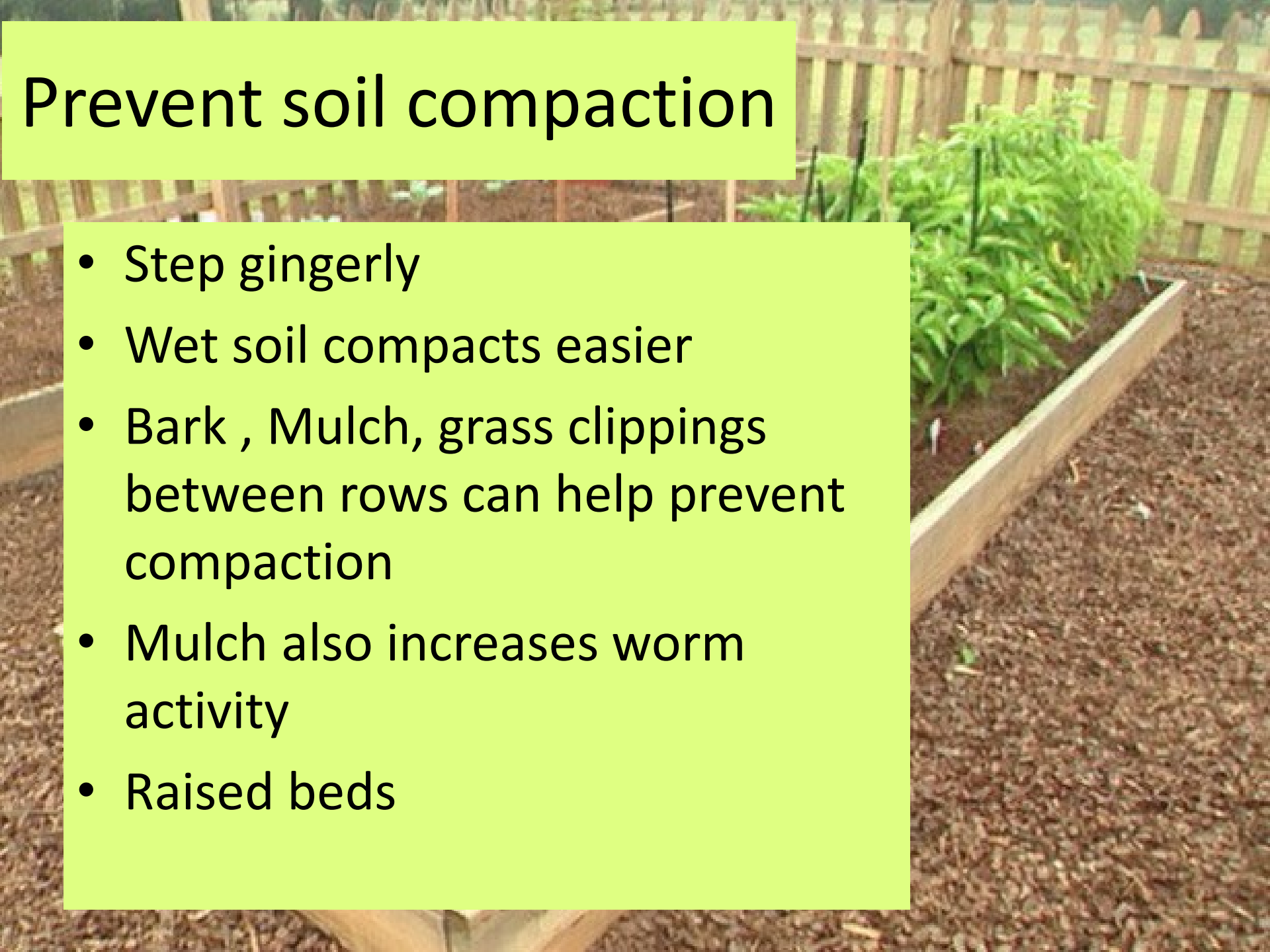
what the soil developed from the environmental conditions under which the soil formed; the clay present, the organic materials present; and the recent history of management

# Soil Compaction



# Prevent soil compaction

- Step gingerly
- Wet soil compacts easier
- Bark , Mulch, grass clippings between rows can help prevent compaction
- Mulch also increases worm activity
- Raised beds



# Repairing soil compaction

- Soil compaction is hard to repair ...So prevent it.
- Till or turn organic material into top 6 to 8 inches of soil



# What Plants Need To Grow

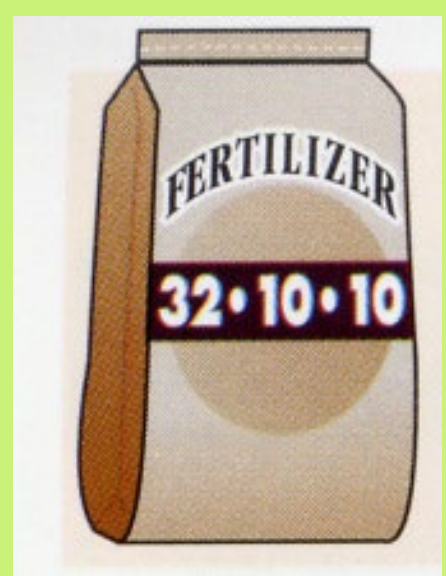
- Food
- Air
- Water
- Most plants sun



# What Plants Need To Grow

## Primary Macronutrients

- nitrogen (N) Vegetative Growth
- phosphorus (P) Root development, seed production, and plant maturity
- potassium (K) Controls plant's ability to function.
- These major nutrients usually are lacking from the soil first because plants use large amounts for their growth and survival.



# Secondary Macronutrients

- calcium (Ca)
- magnesium (Mg)
- sulfur (S).
- There are usually enough of these nutrients in the soil
- Also, large amounts of Calcium and Magnesium are added when Lime is added to acidic soil.
- Sulfur usually comes with slow decomposition of soil's organic matter.



# Micronutrients

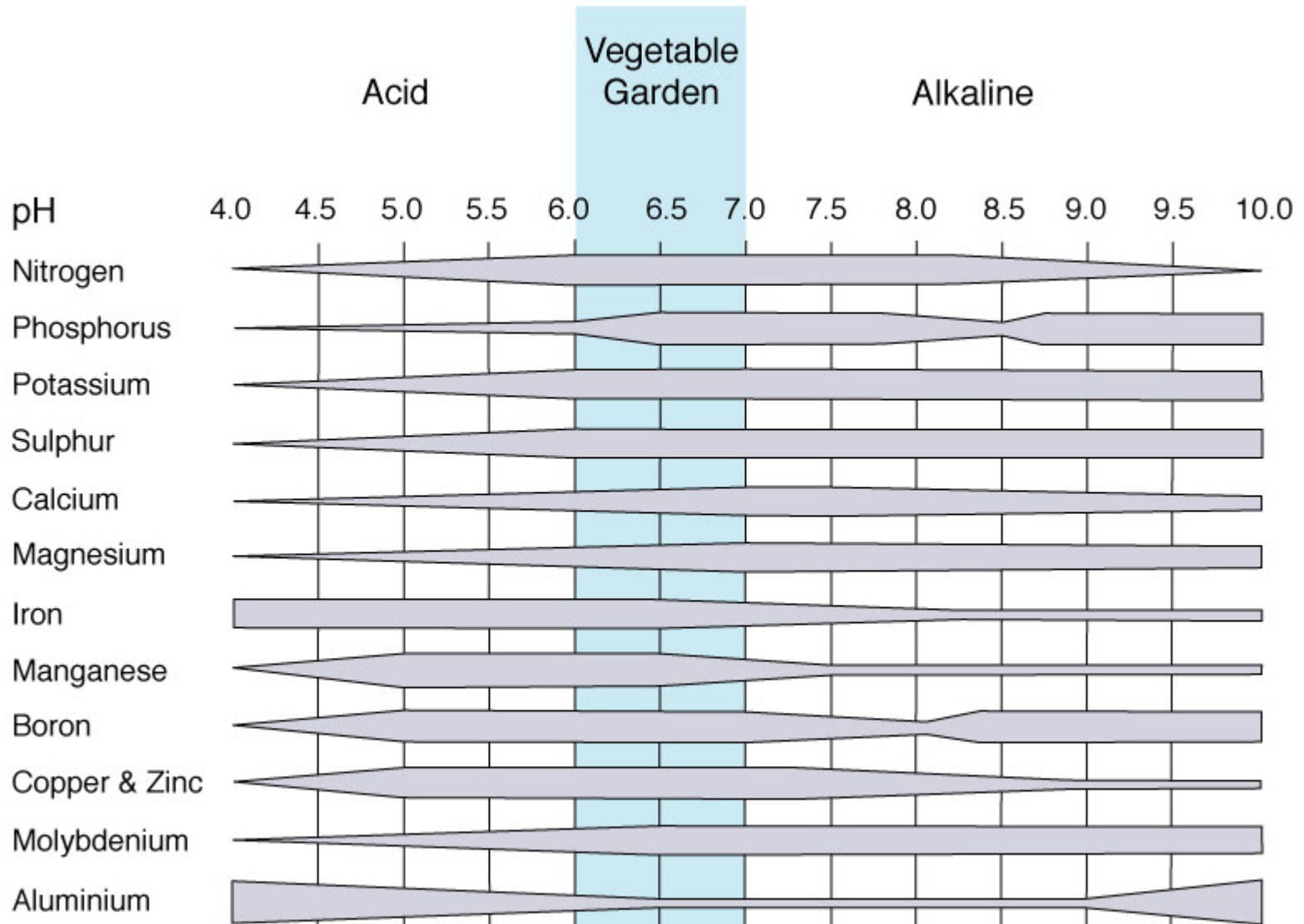
- boron (B)
- copper (Cu)
- iron (Fe)
- chloride (Cl)
- manganese (Mn)
- molybdenum (Mo)
- zinc (Zn).
- Organic matter such as grass clippings and tree leaves is an excellent way of providing micronutrients (as well as macronutrients) to growing plants

# All soil is not equal

- Have soil tested
- Best is 6.0 to 6.8
- 7.0 is Neutral
- Lower = acid
- Higher = Alkaline
- Organic Content
- Get it tested



Soil pH is an affects the availability of nutrients to plants and the activity of soil microorganisms.



# Organic Material In Soil

- Organic material is like sponge, with the ability to absorb and hold up to 90 percent of its weight in water. Organic matter will release most of the water that it absorbs to plants.
- Slow-release nutrients.
- Builds soil structure.
- Prevents erosion.



### **Saturation**

All pores are full of water. Gravitational water is lost



### **Field Capacity**

Available water for plant growth



### **Wilting Point**

No more water is available to plants

# Gardens Love Mulch



Unity  
Gardens

# Keeping Soil Healthy Feed It !

- Mushroom Compost
- Worm Castings
- Wood Chips
- Leaf Mulch/ Mold
- Pine Bark Fines
- Peat Moss (retains water)
- Compost, food waste
- Coconut Coir
- Leaves
- Grass Clippings
- Aged Manure, Chicken, Cow, Horse ,  
Bunny
- Coffee Grounds in moderation Acidic
- Fish Emulsion
- Compost Tea

## Bad things for healthy soil

- No bare soil
- No Pesticides
- No over tilling
- Soil Compaction
- No cat, dog or human manure

# Protect & Feed with mulch

- ***Grass Clippings*** – Cut grass before it goes to seed. Clippings will add nitrogen to the soil. About 2” at a time , not near stems.
- ***Newspaper*** – Avoid using paper with colored inks; it can blow away in the wind.
- ***Yard waste*** – Cut up any branches or woody material. . Takes a long time to decompose.
- ***Compost*** – Needs to be ‘finished’ compost so as not to attract pests. Compost is a good early season mulch, but as the plant begins fruiting, you should withhold sources of nitrogen.



# More Mulches

- **Hay** – Good mulch – weed seeds may be introduced.
- **Straw** – Good source of carbon; excellent mulch
- **Fine bark** – Can be acidic. You may need to add lime
- **Wood Shavings** – Avoid shavings from chain saws or tools that leave oil .
- **Leaves** – A valuable source of carbon, leaves make excellent mulch.
- **Forest duff** – Pine needles, twigs, woody bits are useful, but can be acidic.
- Woody mulches are great in walkways ...not planting beds.

# Cover Crops – Living Mulch

- Improved soil structure and nutrient content
- Improved aeration
- Increased water absorption
- Increased ability to hold nutrients
- Habitat for beneficial insects and microorganisms
- Legume green manure hosts bacteria that fix nitrogen, which then becomes available as a plant nutrient
- Weed suppression (thanks to the shade created on the soil as the crop grows)
- Erosion control



*A field of cover crops: in between the collards in this field is a cover crop mix of rye, hairy vetch and crimson clover, which provides a lush cover protecting the soil from harsh winds and eroding/compacting rains.*



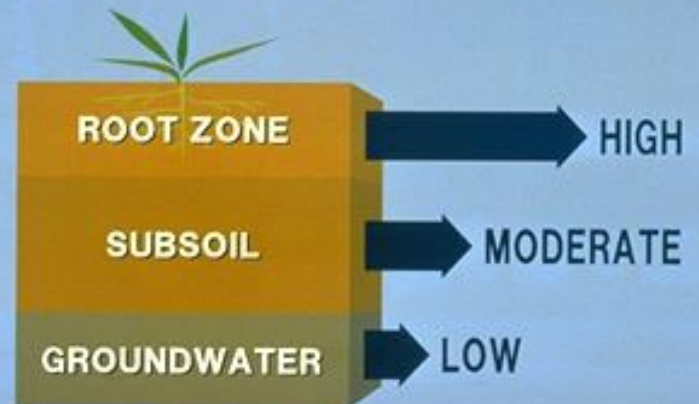
Among the most popular ones are Rye grain, Crimson Clover (strains), Garden Pea (strains), Vetch; Alfalfa, Oats, Buckwheat etc. These can be planted individually or they are often mixed and planted as a blend because of the various benefits the different crops offer

# Why not till Every Year

- Soil is more than just dirt its alive with worms, spiders, small invertebrate animals Fungi, bacteria.
- All this Supports Soil Structure.
- Deep tilling means repeatedly cutting up soil with a roto-tiller.
- This does not apply to Hoeing, Shovel turning soil, or tilling in a new garden
- This does not apply to tilling in green manure. Or organic soil amendments.



## MICROBIAL ACTIVITY:





**Double Digging**

# Broad Fork



Happy Soil

=

Happy Garden

=

Happy Gardener






# Composting 101

A close-up photograph of a person's hands holding a small, clear plastic cup filled with dark, rich compost. The hands are positioned in the center of the frame, with the cup held between the palms. The background is a large, dark-colored compost bin filled with similar compost. A metal shovel is visible on the right side of the bin. The overall scene is brightly lit, suggesting an outdoor setting.

Just rotting material or Something  
More

- 
- Organics such as food scraps, food preparation residuals, food soiled paper products, leaves, grass clippings, brush and tree trimmings comprise over 60% of our waste

# Why Compost ?

- Improves soil structure – it gives it a crumbly texture, beneficial for root growth.
- Improves water-retention in soils.
- Provides a source of slow-release, organic fertilizer for your plants
- Boosts the community of microorganisms and other creatures beneficial for enhancing nutrient uptake and fighting plant diseases



# How to use Compost

- For raised beds mix with 20% Top Soil
- Use as side dressing for plant rows.
- Mix directly in soil.
- Seed Starting Mix :
  - 4 parts screened compost
  - 1 part perlite
  - 1 part vermiculite
  - 2 parts sphagnum peat moss and/or coir

# Composting Outdoors



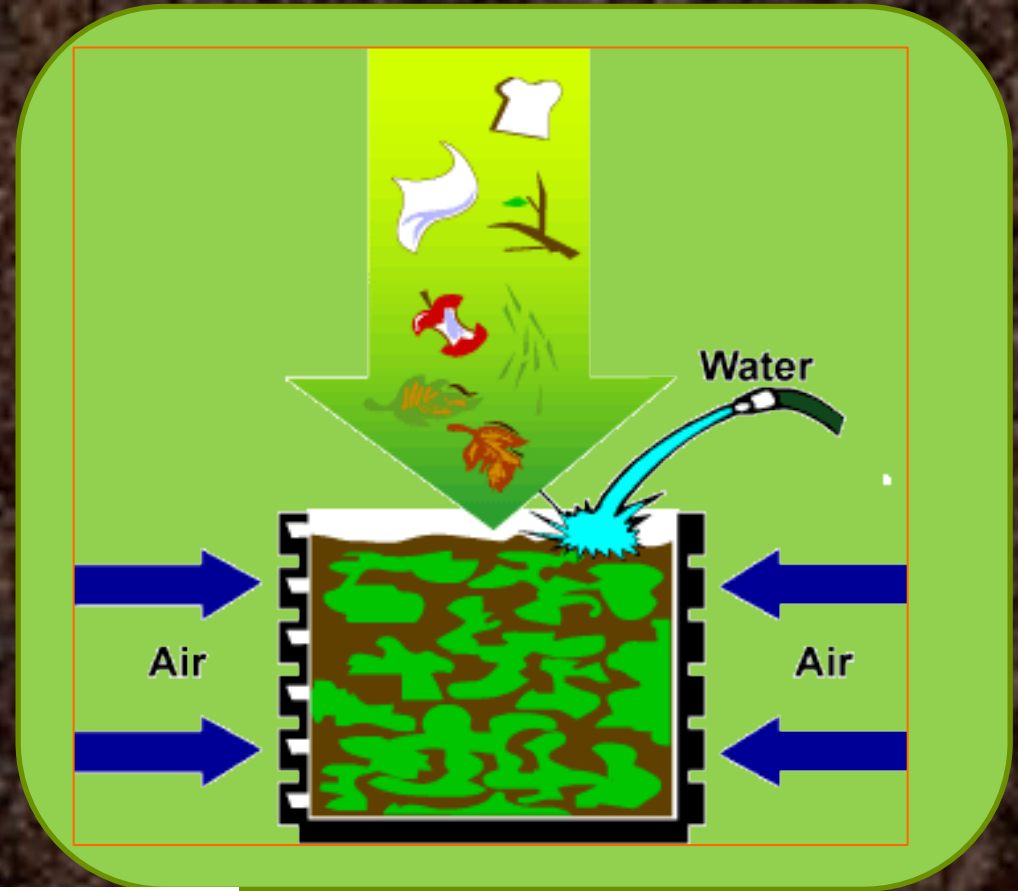
# Simple Outdoor Piles or Bins



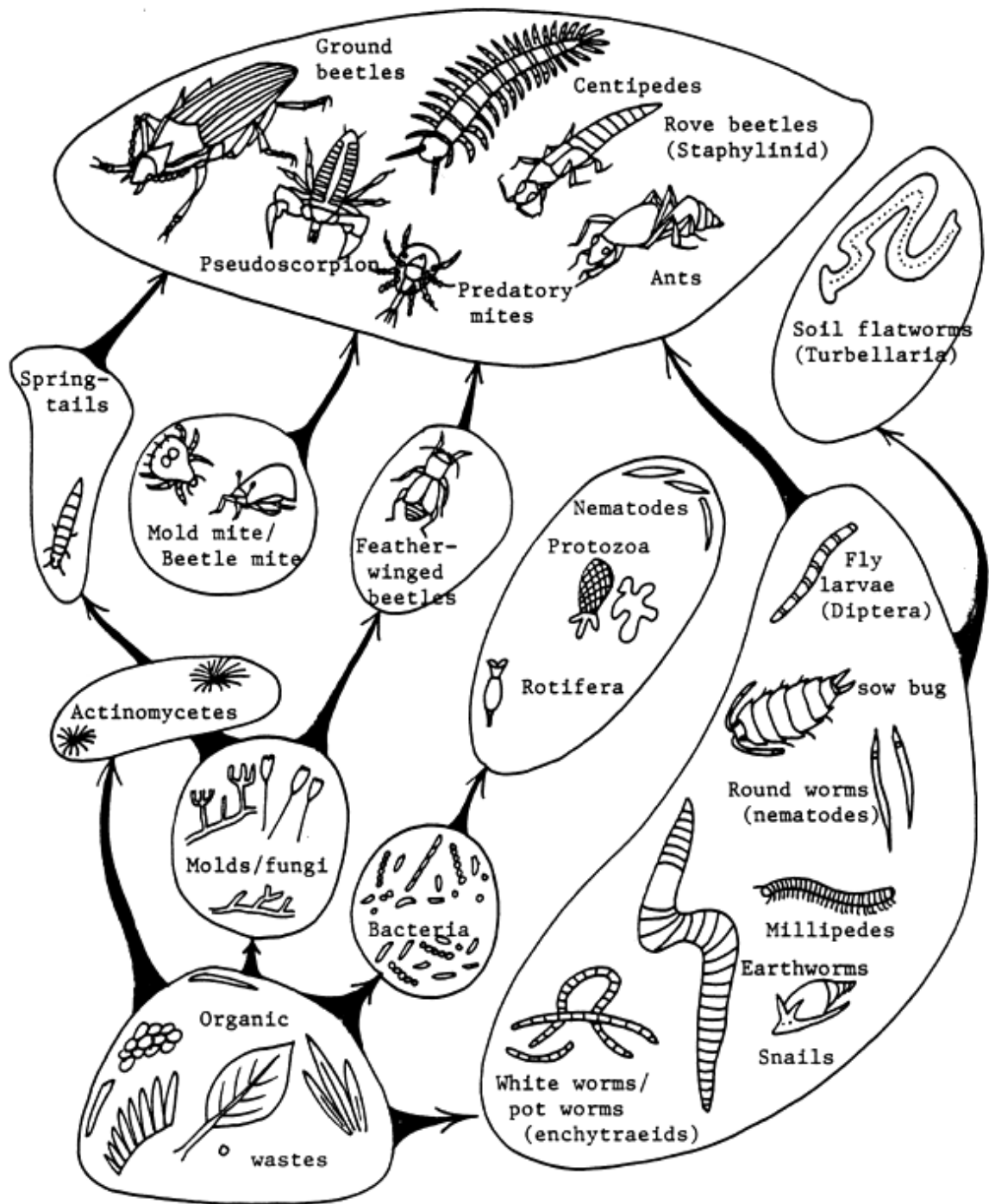


# Lets get started

Air , Water ,  
Food







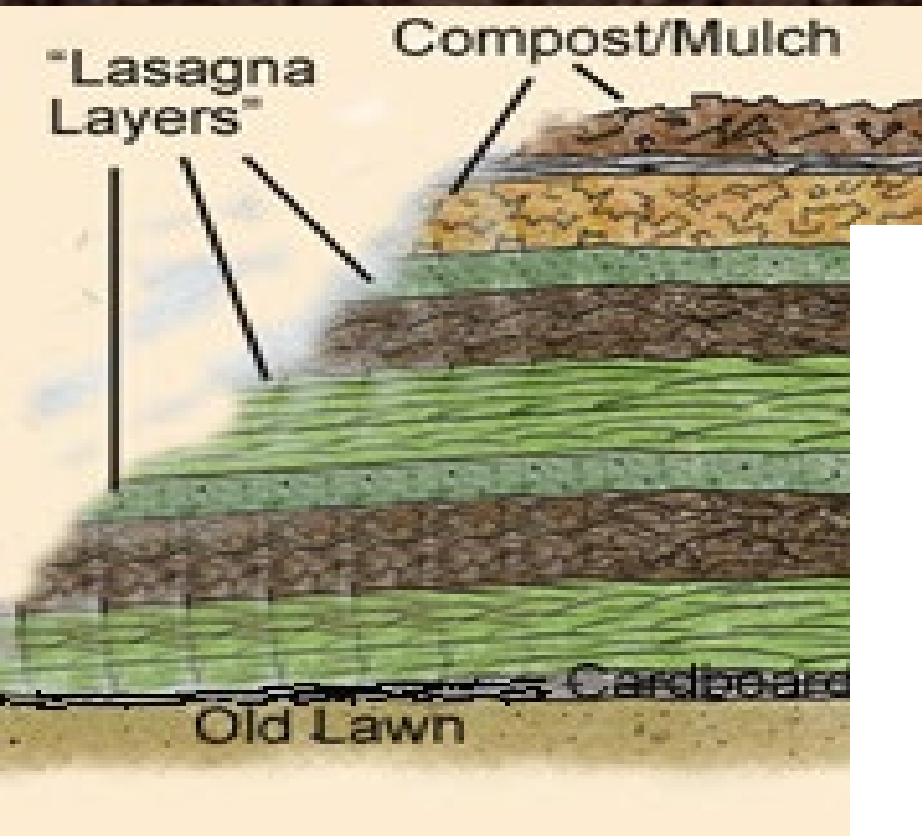
# Composting

- Good composting is a matter of providing the proper environmental conditions for microbial life.
- Compost is made by billions of microbes (fungi, bacteria, etc.) that digest the yard and kitchen wastes (food) you provide for them.
- These living things need air, water, and food.

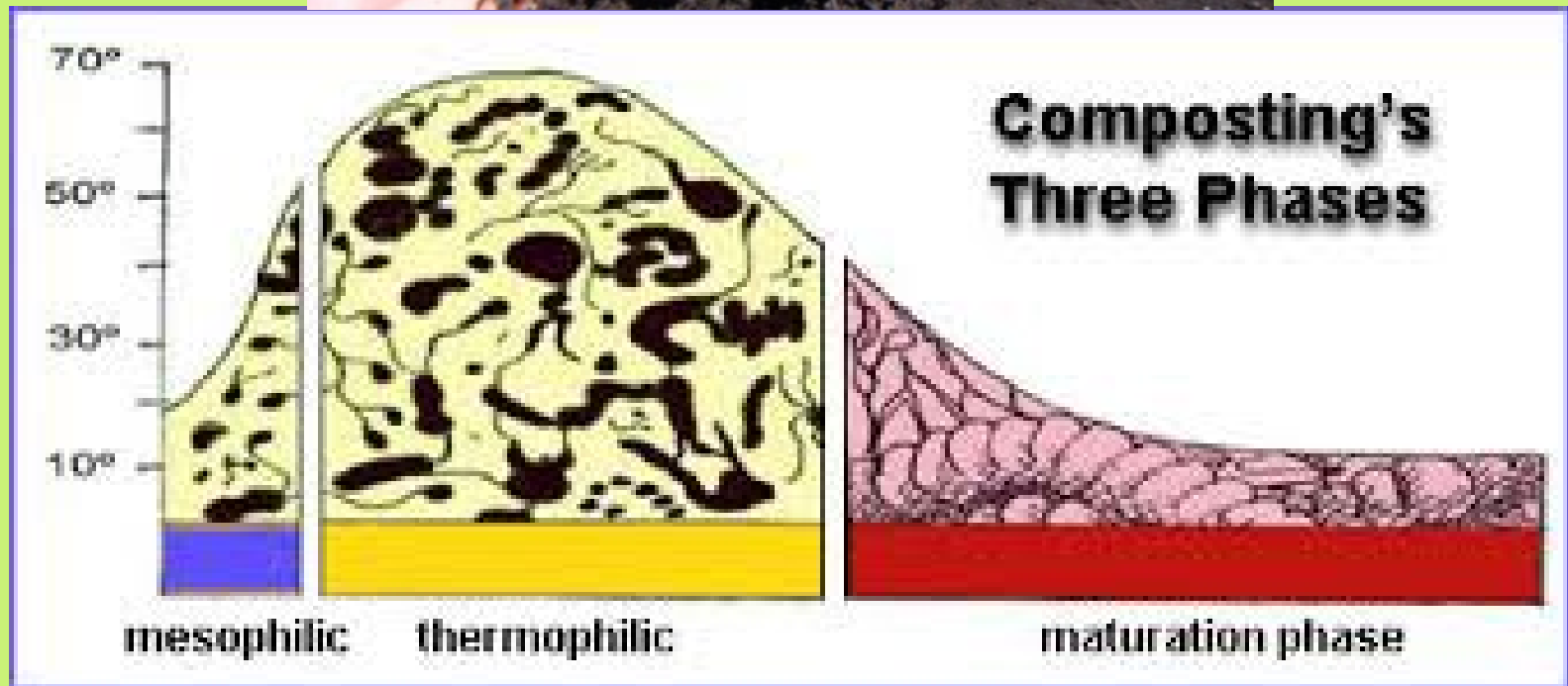
# Constructing a Pile

- Hotter piles decompose a bit faster.
- Hotter = more microbes or conditions that allow the microbes to have faster metabolisms = faster composting
- For a pile to get hot and stay hot a minimum pile size is 3' x 3' x 3'
- Smaller piles just cannot insulate themselves well enough to remain hot for long.
- You can also provide additional insulation to a pile by stacking bales straw, or bags of dry autumn leaves, around your system.

# Build in Layers Size Matters







- As the pile cools worms, insects, and their relatives will help out the microbes. All of these will slowly make compost out of your yard and kitchen wastes.



# Cold Composting

- You can cold compost
- Mostly dead Material
- Does not get hot enough to kill weed seeds or disease
- Takes longer
- Some Studies show better nutrients



# Food

## browns

CARBON

brown bags  
dried landscape  
waste  
fall leaves  
sawdust  
straw  
wood chips

## greens

NITROGEN

alfalfa meal  
coffee grinds  
crushed eggshell  
hair  
fresh landscape  
waste  
fruits & vegetables  
tea bags

no  
nos

fish bones  
meat dairy  
diseased plants

poop from  
people &  
meat eating  
animals

- **'Browns'** ( Carbon )are dry and dead plant materials such as straw, dry brown weeds, autumn leaves, and wood chips or sawdust. even newspaper, and cardboard
- A Because they tend to be dry, browns often need to be moistened before they are put into a compost system.

# Think Outside The Box



# Greens

- '**Greens**' are fresh (and often green) plant materials such as green weeds from the garden, kitchen fruit and vegetable scraps, green leaves, coffee grounds and tea bags, fresh horse manure, etc.
- Compared to browns, greens have more nitrogen in them..

# Greens



# Balance is Key

- **A good mix of browns and greens**

**2/3 Browns 1/3 Greens**

is the best nutritional balance for the microbes. This mix also helps out with the aeration and amount of water in the pile.

\*Browns tend to be dry and help with aeration

\*Greens add moisture

# Air .. Let it Breathe

- Composting microbes are *aerobic* -- they can't do their work well unless they can breathe.
- Some ingredients, such as green grass clippings or wet leaves, mat down, keeping air out.
- Other ingredients, such as straw, don't mat down easily and are very helpful in allowing air into the pile..
- To make sure that you have adequate aeration for your pile thoroughly break up or mix in any ingredients that might mat down.
- You can also *turn* the pile to get air into it

# Water...Keep It Moist

- Ideally, your pile should be as moist as a wrung-out sponge to fit the needs of compost microbes.
- If your pile is too wet, it will mat down and exclude air from the pile.
- If you are using dry ingredients, such as autumn leaves or straw, you'll need to moisten them as you add them to the pile.
- Kitchen fruit and vegetable wastes generally have plenty of moisture, as do fresh grass clippings.



# Speed up your pile !!

- Size
- Don't let it get dry
- Turn it often
- Add small amounts manure
- Chop or shred material
- Add human or animal urine once a month , but not too often it's a little salty for worms



# Common issues

- Pile is too wet and smells rancid.



- Not enough air, too wet, too much nitrogen ( Greens)



- Turn Pile
- Add Dry Browns like straw or sawdust

- Pile does not heat up



- Pile is too Small
- Pile is too dry



- Bigger pile or insulate
- Add water while turning.

# Common issues

- Pile is damp and sweet smelling , but will not heat up.



- Not enough nitrogen



- Add food scrapes or grass clippings.

- Pile is attracting Animals



- Meat or dairy scraps
- Fresh foods scraps are not covered



- Cover food scraps
- No Meat or dairy

# Trench Composting

## Make your Garden a Compost Pile



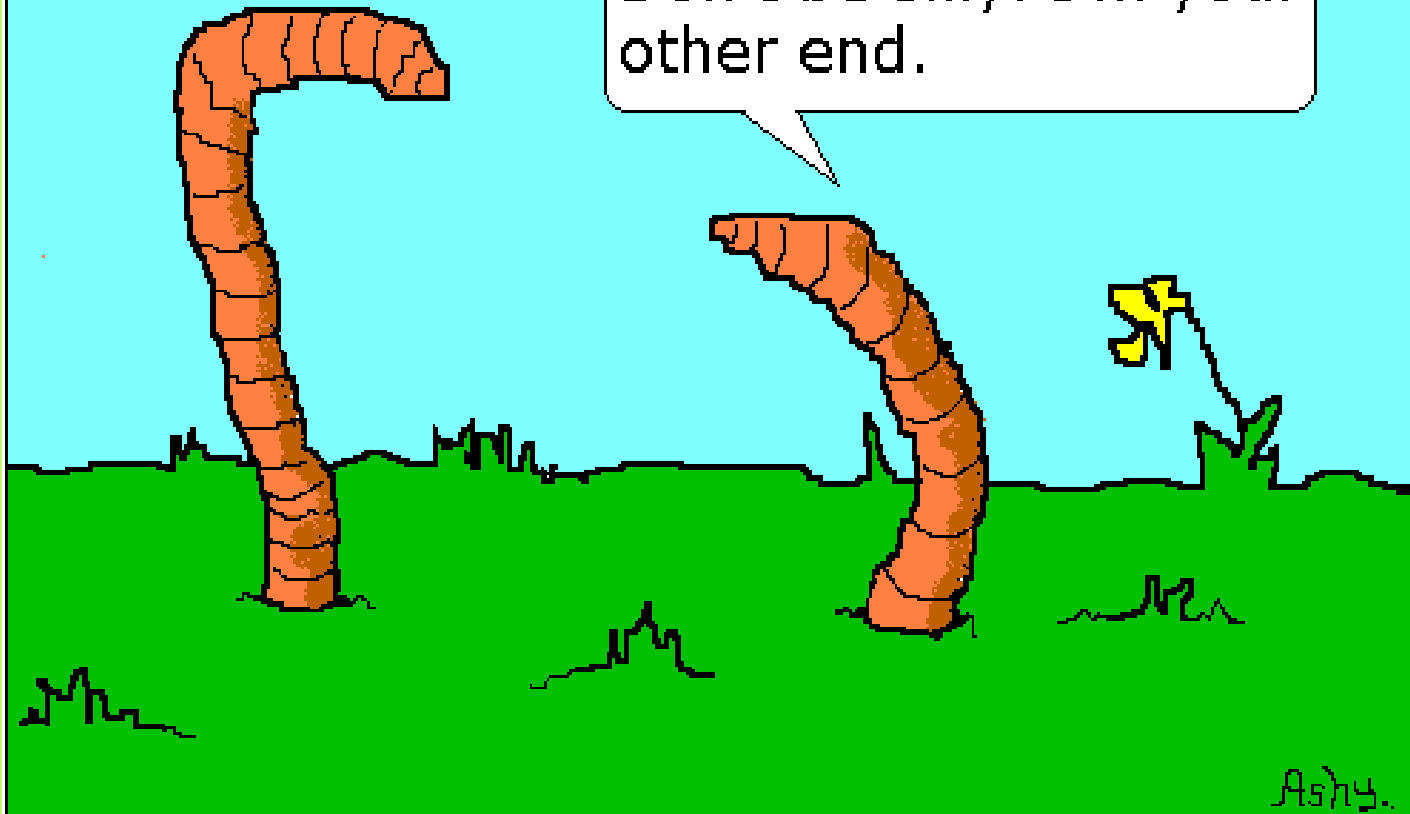
# Compost Indoors



# Worm Composting

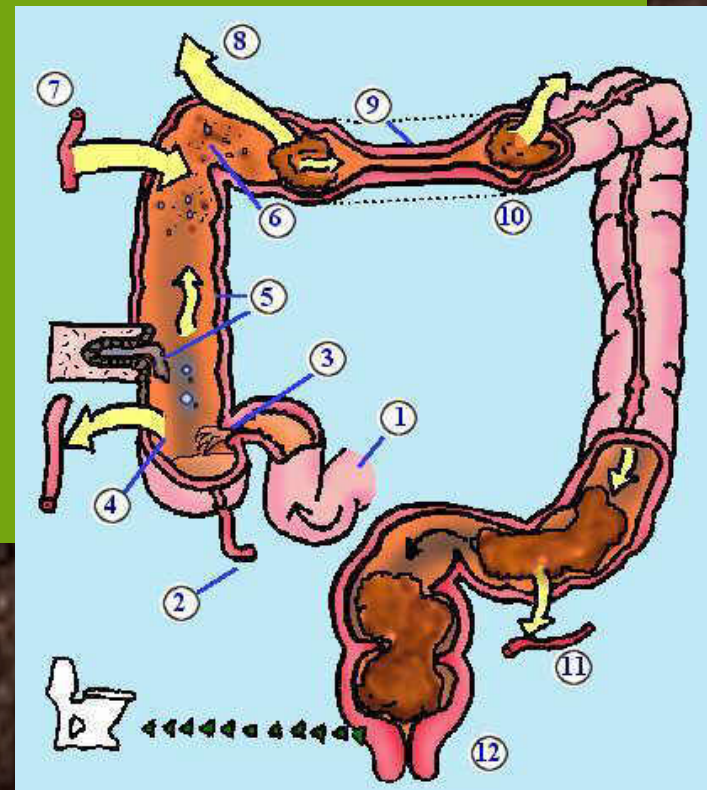
Haven't seen you around here before.

Don't be silly. I'm your other end.



# What Worms Need

- Air
- Water – Moisture from fruits and veggies should do it, only add water if extremely dry.
- Darkness
- Well Balanced Diet





# Worm Diet



- Worms can eat all of your vegetable kitchen scraps such as melon rinds, lettuce, banana peels, vegetable scraps, etc. They also eat coffee grounds and tea bags, crushed egg shells, cardboard egg cartons, newspaper and plain uncolored paper.
- Though worms can eat meat, I don't recommend this or dairy products in your worm bin due to the risk of attracting pests and developing smells

# Climate

The worms need to be kept between 50 and 80 degrees to continue to feed on your garbage.

The worms may survive in the 40's but will not survive below freezing temperature.

The worms are also at risk of dying at temperatures above 86 degrees.

Obviously this means that your worm bin may need to be moved during different seasons.

A perfect place for the bin is in the basement, laundry room or in the kitchen during extreme temperatures.

# What Type Of Worms ?

- The type of worms used in a worm bin are Red Wigglers or Red Worms.
- The scientific name is *Eisenia Fetida* or *Lumbricus rubellus*.
- These are a type of Earthworm, but not the type normally found in your garden.
- There are various species of Earthworms. Not all Earthworms are good composters.
- Not all composting worms will be able to survive deep in the dirt of your garden.

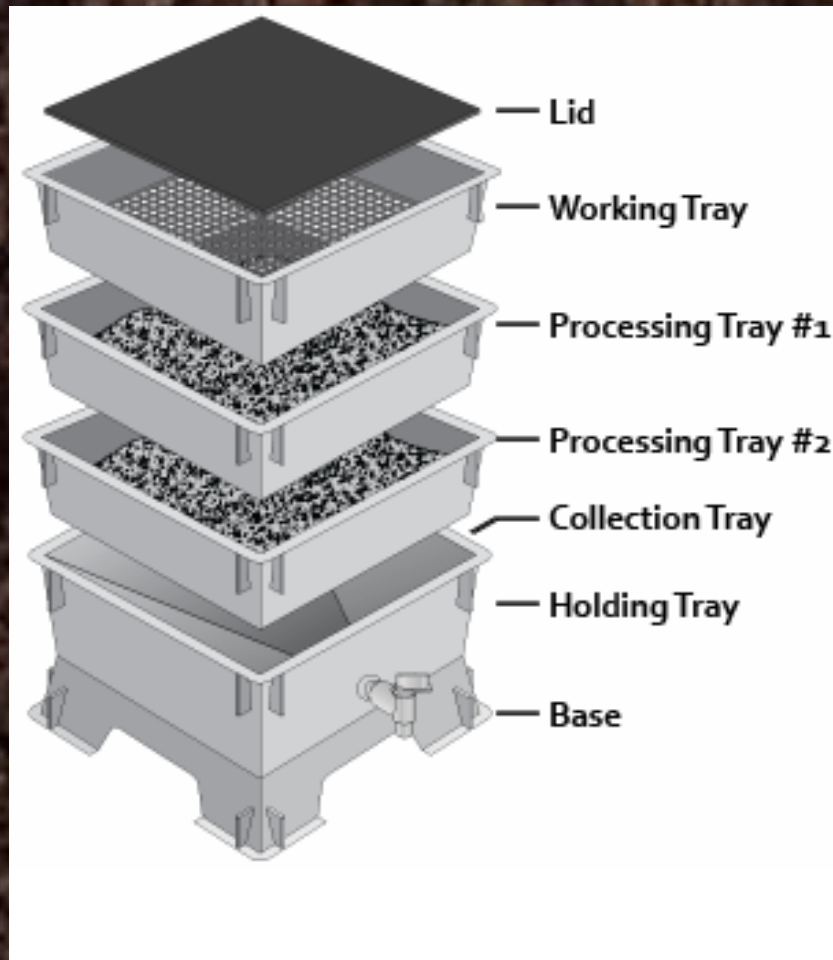
# Build Your Own Worm Bin



# Buy a Ready Made Bin



# How it Works ?



# Getting Started

- Good Drainage !
- Bedding
- Don't overfeed
- Start with Worms , Damp Bedding , and Very Little Food Scraps
- Keep Lights on for First Day

