

Dig In! Soil Basics

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THE OHIO STATE UNIVERSITY

COLLEGE OF FOOD, AGRICULTURAL,
AND ENVIRONMENTAL SCIENCES

Class Announcements

- Schedule check-in, we will catch up with the schedule by class 4.
 - Today we will finish out soil conversation.
 - May 10 we will go over garden basics & crop selection
 - Additional presentation will be provided for more Vegetables 101.
- May 3 is a break week for voting.
- In-person class begin after the election. May 10
 - Directions to the office will be part of your follow-up email.

Remember to hold questions until the break.

- Assigned reading over “break”

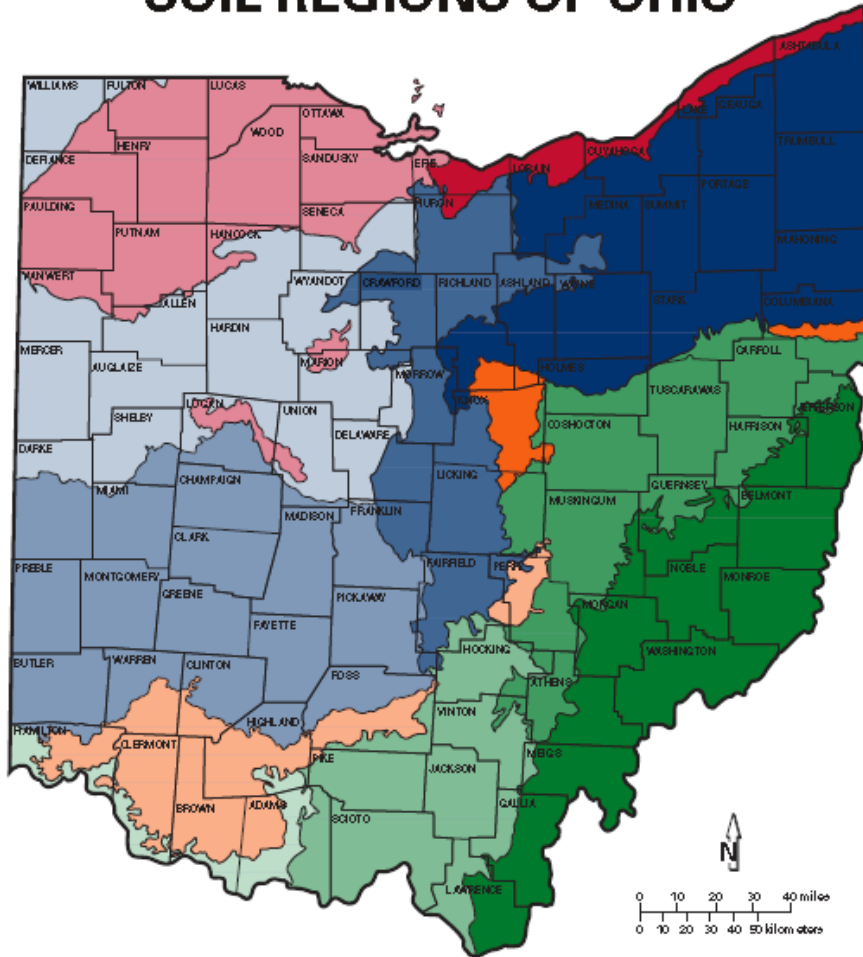
SOIL



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SOIL REGIONS OF OHIO



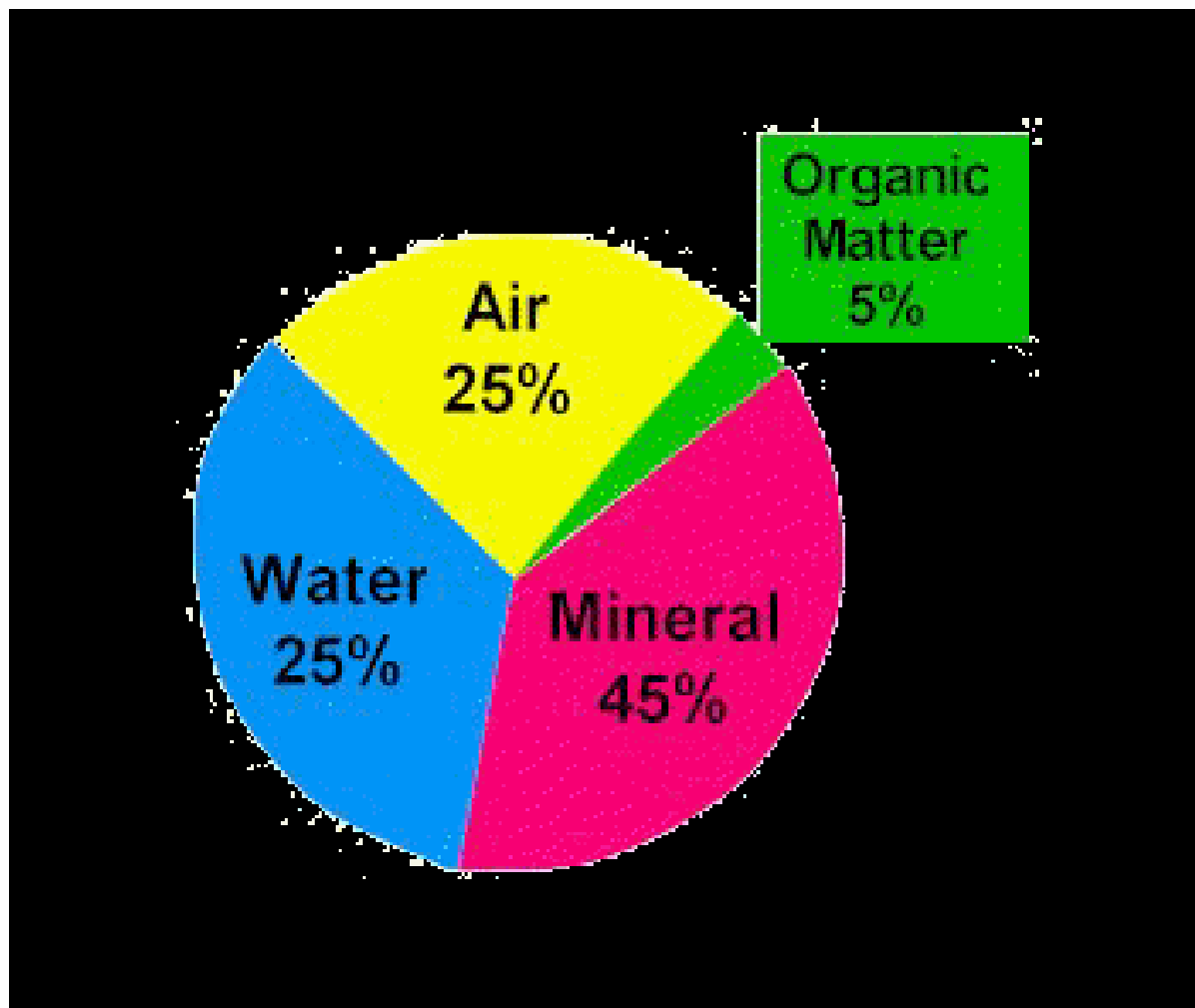
What makes
soils different?

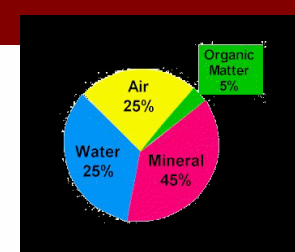
5 main factors:

- Climate
- Organisms
- Parent material
- Landscape
- Time

<http://www.dnr.state.oh.us/tabid/9073/default.aspx>

WHAT IS SOIL?



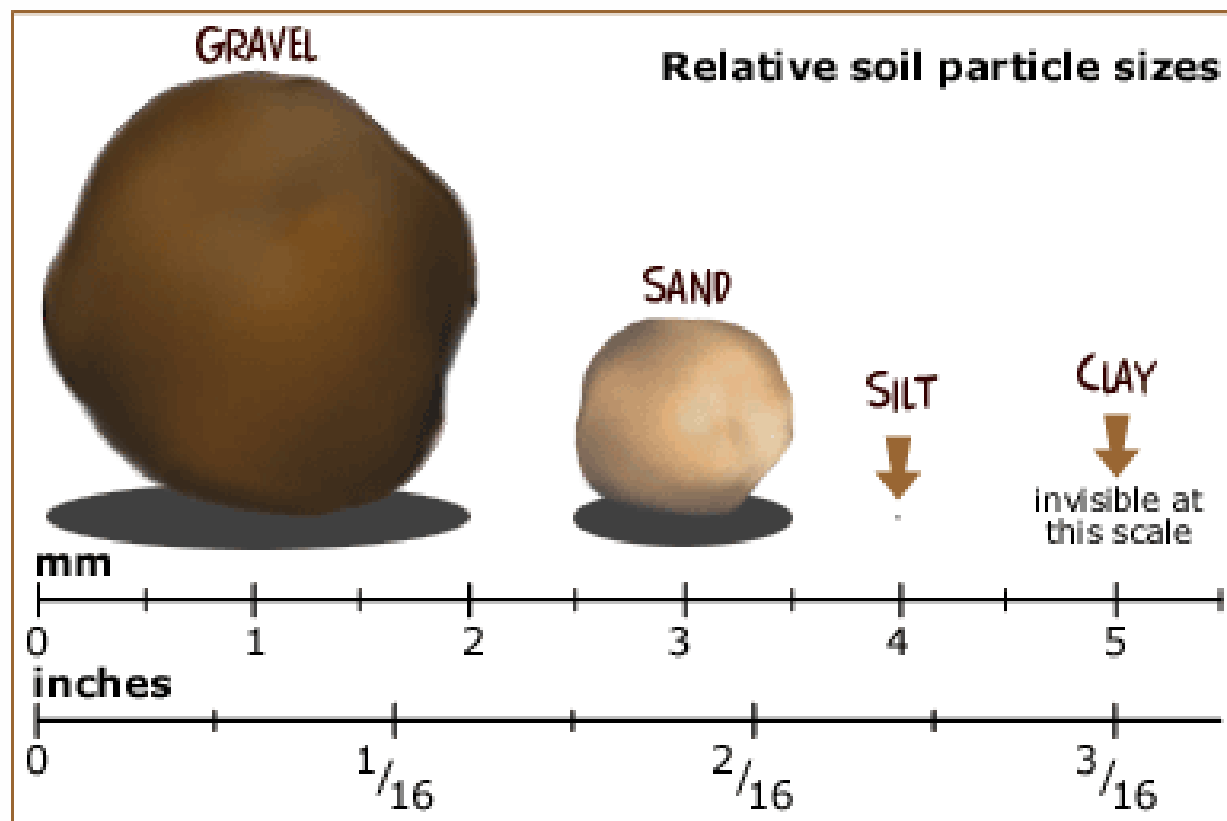


Mineral components, Soil Texture

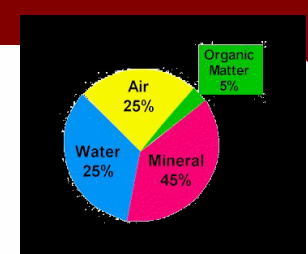
SAND

SILT

CLAY

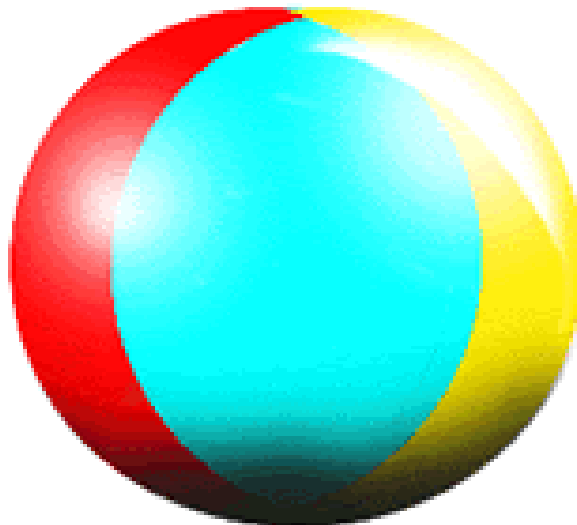


http://school.discoveryeducation.com/schooladventures/soil/name_soil.html



USDA Standard Relative Particle Size

Beachball



Sand

Sand (2.00 - 0.05 mm)

Silt (0.05 mm - 0.002 mm)

Clay (< 0.002 mm)

Frisbee

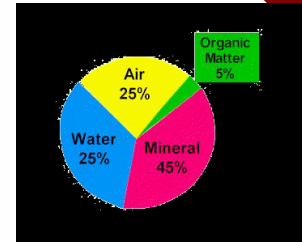


Silt

Dime



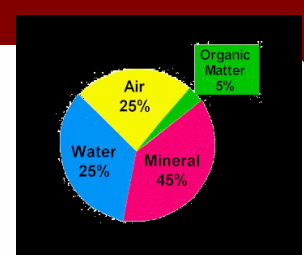
Clay



Loam – mix of all three (most soils are on the loam scale)

Clay loam, sandy loam, silt loam





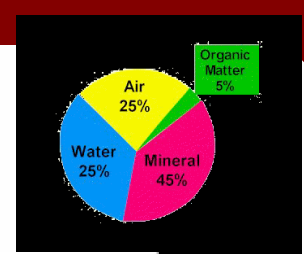
Jar Shake Test

Shake and observe how particles settle out—largest settle to the bottom.

Tip, to get good results you have to shake for solid 3 minutes.

<https://www.azlca.com/uploads/documents/jar-soil-test-activity-sheet.pdf>





Ribbon Test and more

Type of loam
1" ribbon



Type of clay loam
1-2" ribbon

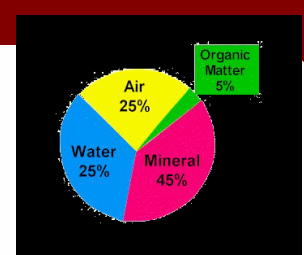


Type of clay
2" ribbon



©International Programs, UC Davis

<https://s3.wp.wsu.edu/uploads/sites/2076/2018/04/C221-DIY-Soil-Tests.pdf>

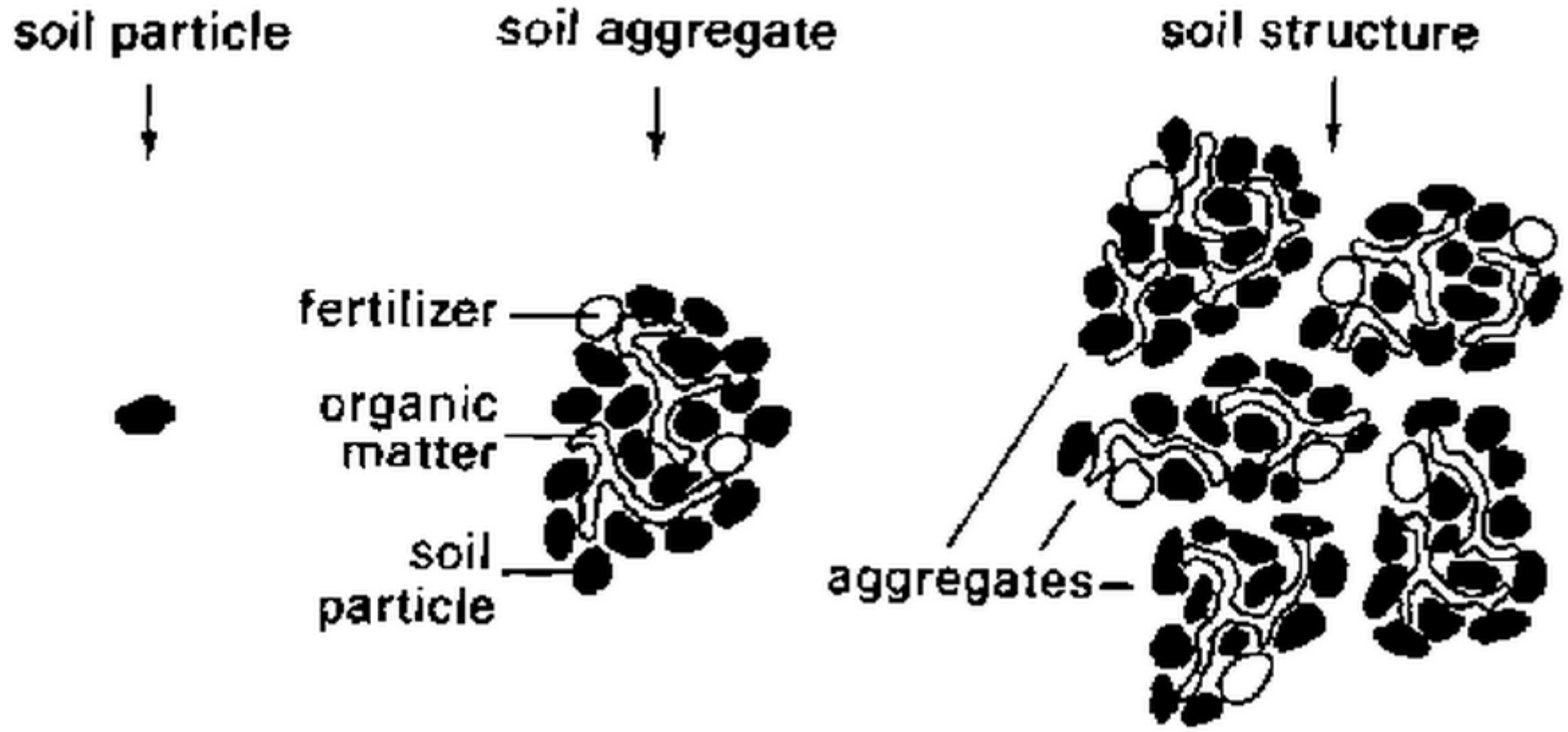
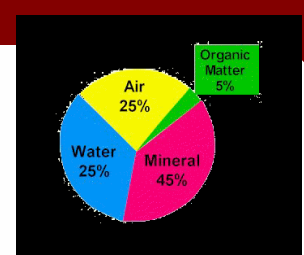


Some properties of sand, silt and clay

<u>Property</u>	<u>Sand</u>	<u>Silt</u>	<u>Clay</u>
Water-holding Capacity	Low*	Medium to high	High*
Aeration	Good	Medium	Poor
★ Drainage rate	Fast	Slow to medium	<u>Very Slow</u>
Decomposition of Organic Matter	Rapid	Medium	Slow

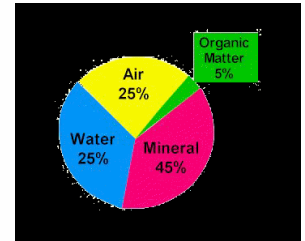
Soil texture does not change

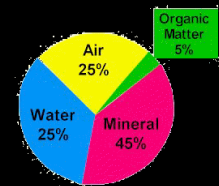
Soil Structure



Soil is sand, silt, and clay AND
how they come together!

Soil Structure





soil particle



soil aggregate



soil structure

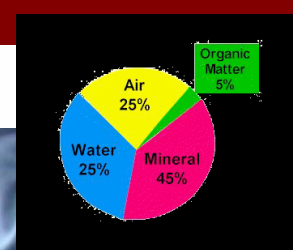


fertilizer

organic
matter

soil
particle

aggregates—



(cracked soil image by Ana de Sousa from [Fotolia.com](http://www.fotolia.com))



(Source: <http://www.kansasgreenyards.org/fullsize884.ashx>)

Bad structure= crusted, compact, light color indicates lack of organic matter

Good structure= crumbly, darker color indicates higher amounts of organic matter

Soil Structure can be changed

Ways to influence:

- Incorporate organic matter
- Limit soil disturbance
- Avoid compaction
- Avoid working soil when it is too wet

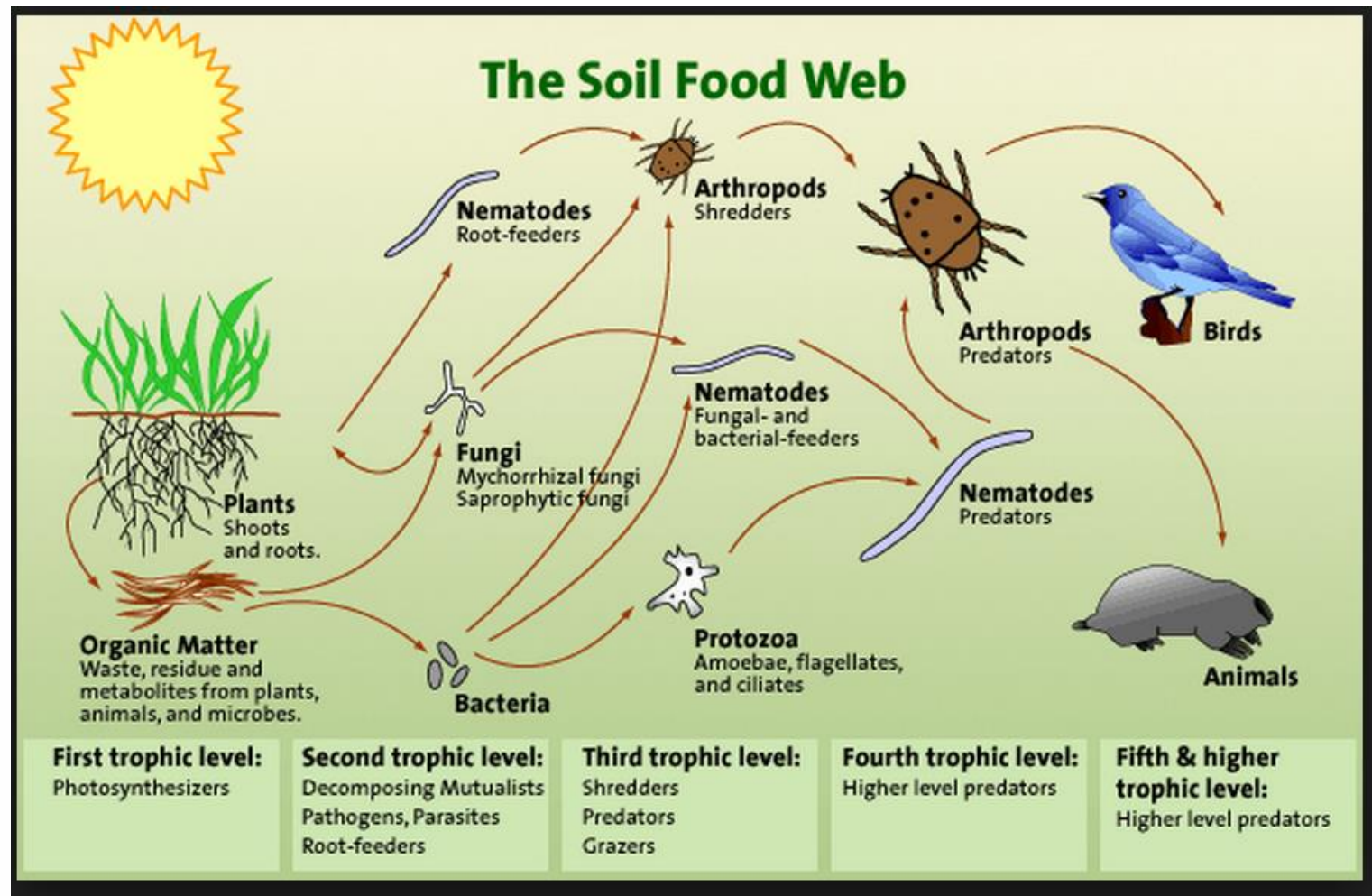


Soil Organic Matter

Three parts of soil organic matter:

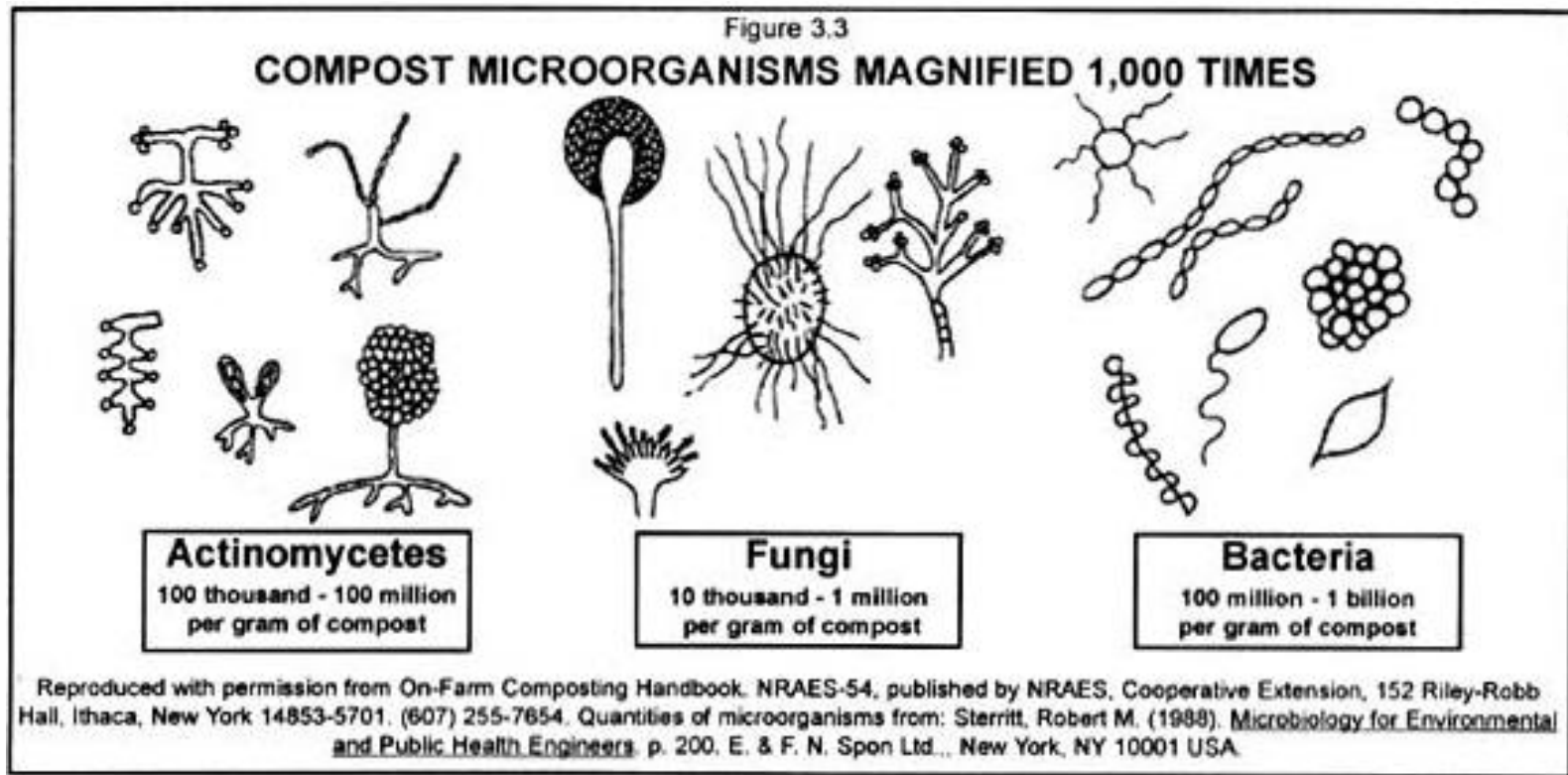
- Living-
 - Burrowing, digesting, relating, excreting hormones and enzymes
- Dead-
 - Main supply of food for various organisms—
needs to continually be replenished!
- Very Dead-
 - Well-decomposed residues-stable-humus

Living Parts of Soil Organic Matter



<http://www.coopext.colostate.edu/boulder/ag/susag.shtml#soils>

Microscopic organisms in soil



Organic Matter

We control much of the organic matter that is in our soil

- -roots from plants
- -leaves and debris that fall on soil
- -compost added to garden
- -humus – decomposed organic matter
- -dead organisms and organism waste

Soil Problems to Avoid

- Erosion
- Compaction
- Nutrient & pH imbalances



Erosion is lost soil

Wind and water can cause



Mulch is a Solution

Mulching:

- Reduces erosion from wind and water
- Reduces evaporation
- Reduces crusting
- Provides habitat
- Increases water infiltration rates
- Reduces soil borne diseases



What else is
mulch good for?

Raised Beds are a Solution

- Reduces erosion from wind and water because the sides contain soil
- Warm quicker in the spring
- No to low till



Cover Crops are a solution

Cover crops are plants that hold the soil:

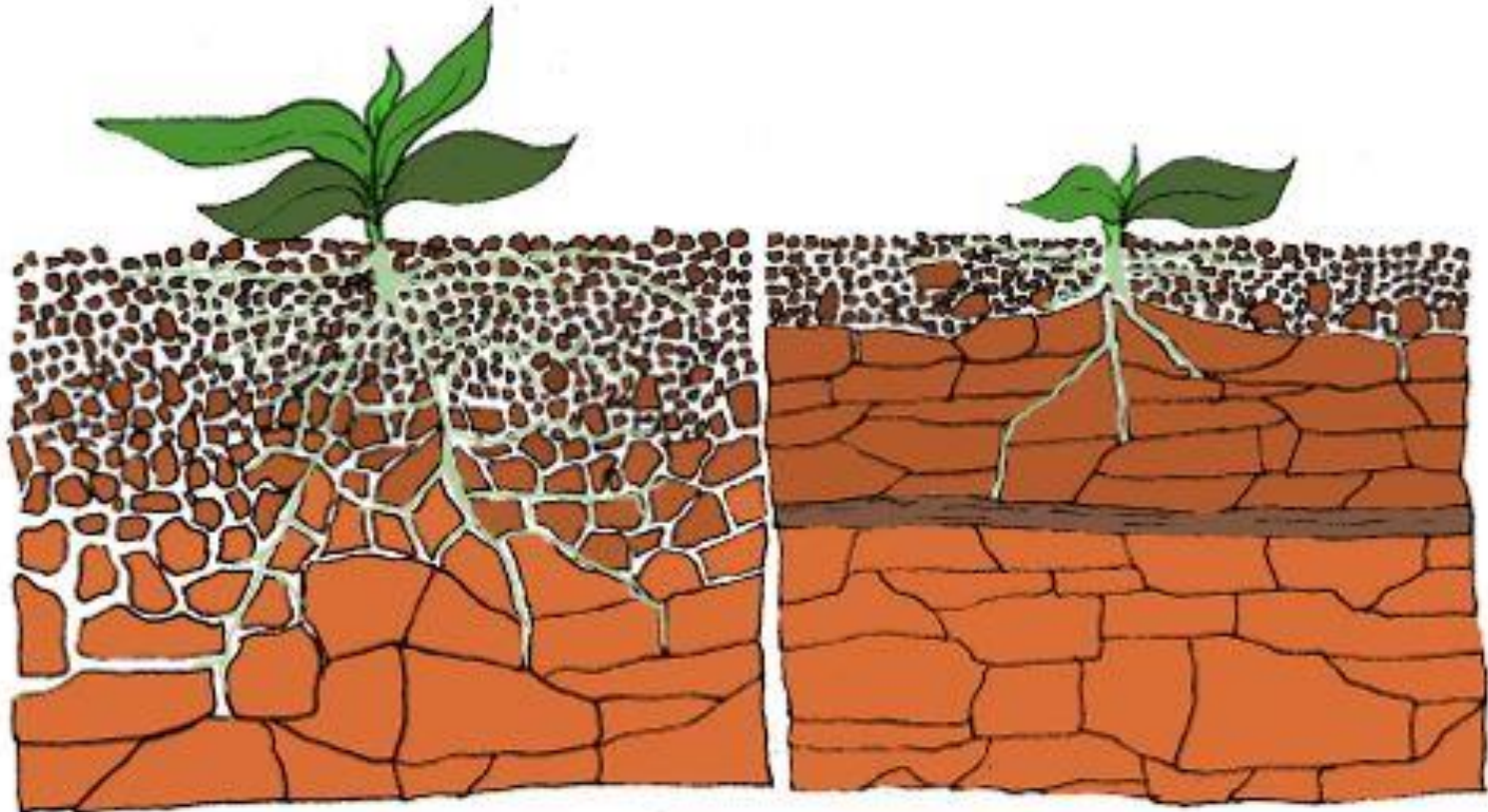
- Roots hold soil in place
- May add nutrients
- May break soil deep so water can drain



Compaction is compressed soil



Compaction is compressed soil



Make walking paths



Leave the soil when it's too wet!

Squeeze Test –helps determine if soil is ready to work

- Pick up a handful of soil and squeeze

If soil remains in a tight ball, wait

If soil crumbles, it's ready to work



Too wet



Ready to work



Drainage (percolation) test

- Did a hole 12" wide, 12" across
- and 12" deep
- Fill hole with water and allow it to drain
- Refill the hole with water and measure the depth of the water with a ruler
- Measure the amount of water that has drained after 15 minutes and multiply by 4 for the drainage in 1 hour
 - Good drainage 2"/hour
 - Less than 1"/hour drainage is too slow
 - More than 4"/hour drainage is too fast "droughty" soils



Nutrients are vitamins for plants

- Fertility/Nutrients



What does N-P-K stand for?

- These are the 3 main elements of chemical fertilizer represented by three numbers.

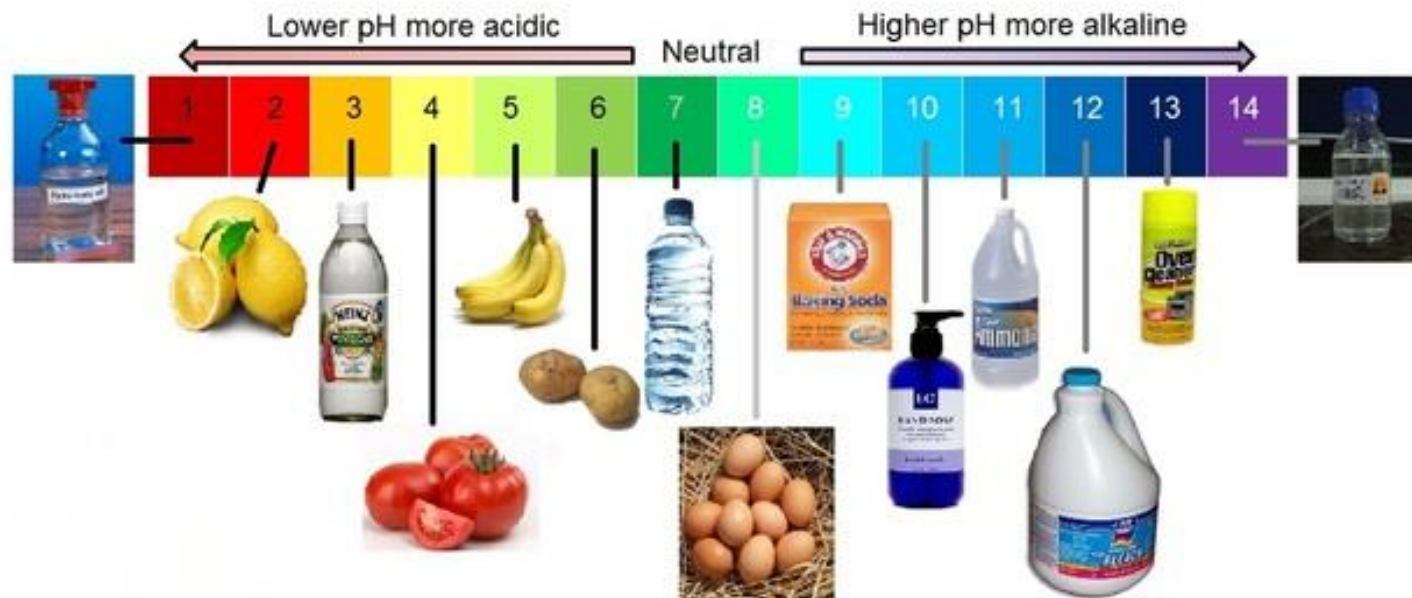
- Nitrogen (N) – Phosphorous (P) - Potassium (K)

i.e. 10 - 10 - 10

- Nitrogen promotes plant growth
- Phosphorous helps roots and flowers grow
- Potassium is important for overall plant health



pH is a measure of acidity



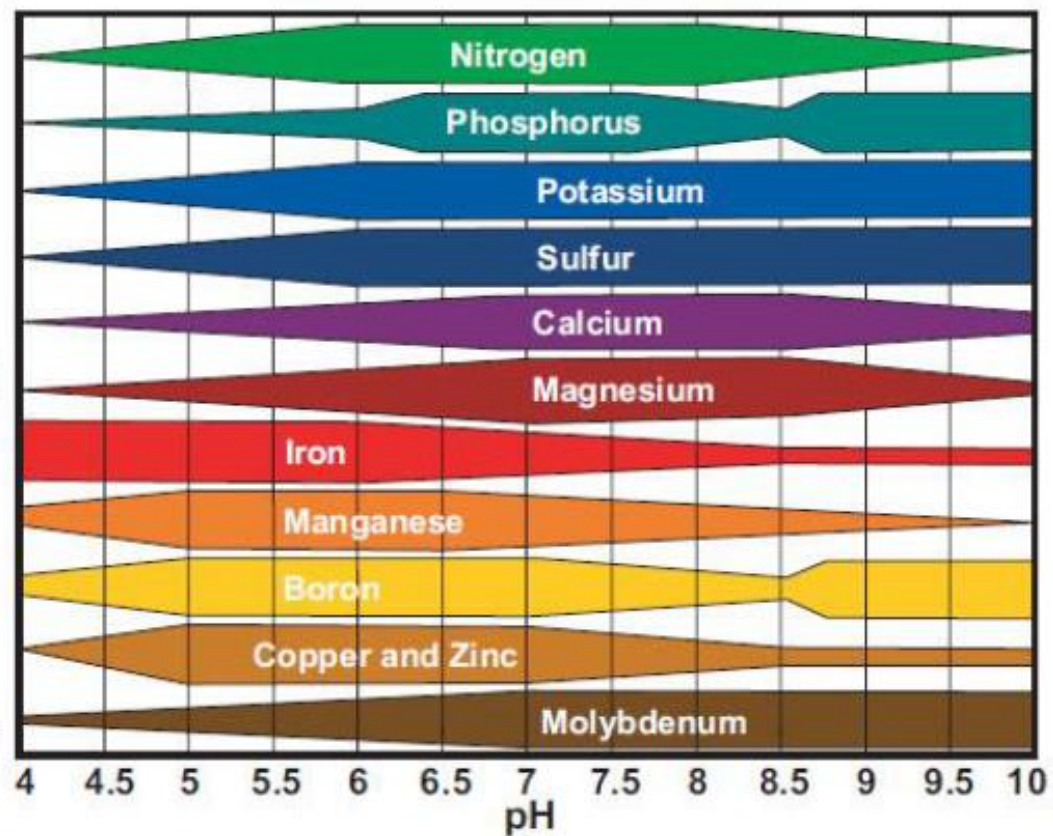
Most plants prefer a soil pH between 5.5 - 7.5 (vegetables more likely in 6 to 7 range)

pH Effect on Element Availability

When talking about fertilizers and fertility, begin by looking at soil pH.

Soil pH has an effect on fixation and release mechanisms in soil

Lime may be the cheapest “fertilizer”





***Don't guess
Soil Test***

Soil Testing

- A good policy might be to soil test every 2 to 3 years to track what is happening to soil fertility and pH
- Soil sample at the same season of the year to track soil pH and fertility
- A soil sample sent to a lab for analysis should consist of at least 10 to 20 sub-samples selected randomly from the garden plot/field. More samples are better
- Send separate samples for areas that are treated differently, have different physical features

Soil Testing

- Penn State

<https://agsci.psu.edu/aasl/soil-testing>

- Michigan State

<https://www.canr.msu.edu/spnl/>

- Umass (not open due to COVID-19)

<https://ag.umass.edu/services/soil-plant-nutrient-testing-laboratory>

Fertilizers and Amendments

Conventional

- have a label to tell you what is in them

Organic Sources

- compost, manure—no label
- other natural products may have a label or nutrient analysis.

Great Resource!

<https://pubs.extension.wsu.edu/fertilizing-with-manure>



Material	%N	%P	%K	Release Speed	Effectiveness	Comments
Alfalfa	2.5	0.5	2	Slow	2 to 6 months	Cover crop
Animal Tankage (dry)	7	10	0.5	Medium		
Bat Guano	5.5 to 8	4 to 8.6	1.5	Medium to fast		
Bat Guano (Peruvian)	12.3	8 to 11	2.5	Medium		
Blood (dried)	12	1.5	0.6	Medium to fast		
Blood Meal	12.5	1.5	0.6	Medium	6 to 8 weeks	
Bone Meal (raw)	2 to 6	15 to 27	0	Slow to medium	6 weeks	Can burn plants.
Bone Meal (steamed)	0.7 to 7	18 to 24	0	Slow to medium	2 to 4 months	
Castor Pomace	5	1.8	1	Slow		
Clover, Crimson	2	0.5	2	Slow	2 to 6 months	Cover crop
Cocoa Shell Meal	2.5	1	2.5	Slow		
Compost	1.5 to 3.5	0.5 to 1	1 to 2	Slow		
Cottonseed Meal (dry)	4 to 6	2.5 to 3	1.6	Slow to medium	4 to 6 months	Acidic
Crab Meal	10	0.25	0.05	Slow	4 to 6 months	
Crab Waste	30	21	5.5			
Cucumber Skins (burned)	0	11	27	Fast		
Eggshells (burned)	0	0.5	0.3	Fast		
Feather Meal	15	0	0	Slow	4 to 6 months	Best if ground up.
Fish Emulsion	5	1	1	Fast	2 weeks	Spray foliage or apply dilute solution to soil.
Fish Meal (dry)	10	4 to 6	0	Medium	4 to 6 months	

Oregon State University, values of organic fertilizers

SITE PREPARATION

To think about:

- Consider lead levels: are they above “low”?
- Debris in soil: are there large buried pieces of rock, metal, tree roots, or other materials?
- What do you want your garden to look like?
- Who will be gardening?
- What resources do you have available?
 - Lumber and soil to fill raised beds? People to build and fill them?
 - Access to machinery and someone to operate?
 - Access to hand tools and people to do the work?

Gardens come in two main flavors...

1. In-ground
2. Above ground, raised beds and containers



In-ground gardens

Pros

- Use of existing soil
- Economical
- Less start up work
- Less permanent
- Lower water requirements

Cons

- Harder to keep neat
- Undefined borders for people new to gardens/students
- Soil compaction
- Soil improvement (if needed)

Things to think about: **Breaking Ground**

Site Preparation: In-ground

Goals

- Get rid of what is there (grass, weeds, etc.)
- Loosen the soil enough to incorporate soil amendments and allow planting

Site Preparation: In-ground Tillage

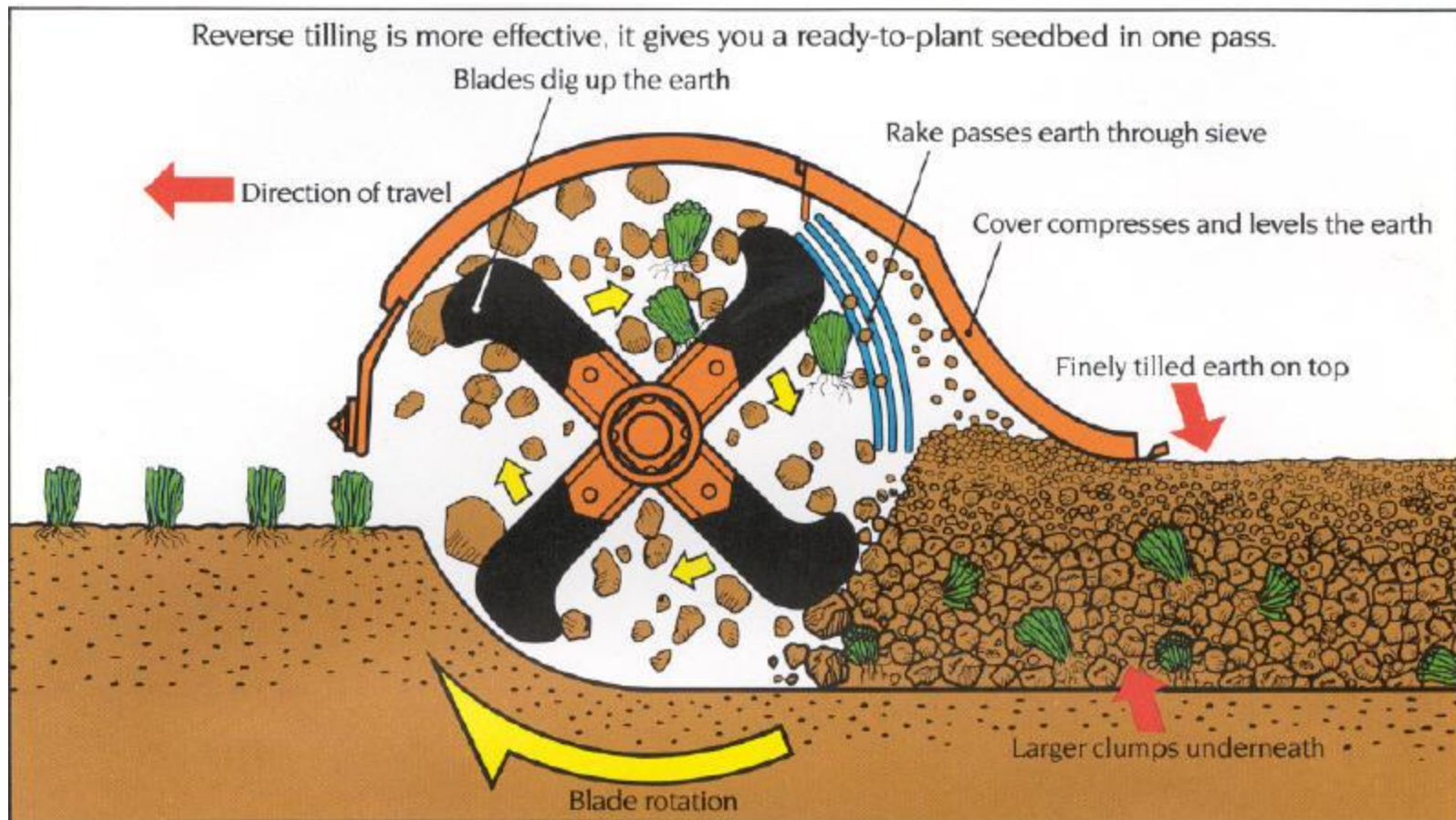
- What is tilling?
 - Digging, stirring, or overturning the soil using hand tools or machines
 - Primary tillage is done with a plow:
 - Breaks up soil; sometimes turns soil over
 - Secondary tillage is done by tilling or cultivating:
 - turn, break-up clods, and mix soil

Tiller



[maxresdefault.jpg](#)

Tiller



Tilling

Pros

- Easier for larger areas
- Can help initially break up soils and incorporate organic materials



Cons

- If over done, can contribute to compaction by altering soil structure
- Stirs up weed seeds
- Disturbing for soil microbes
- Releases Carbon!

Modified Till Garden Bed Preparation- Tools



Fork



Spade



Broadfork (U-Bar)



Mulch + Compost + Aerate + Don't Compact

Smothering

- Way to get rid of what is growing and make loosening the soil easier
- Blocks sunlight and air to kill grass and roots
- Needs time, the longer tarped the better

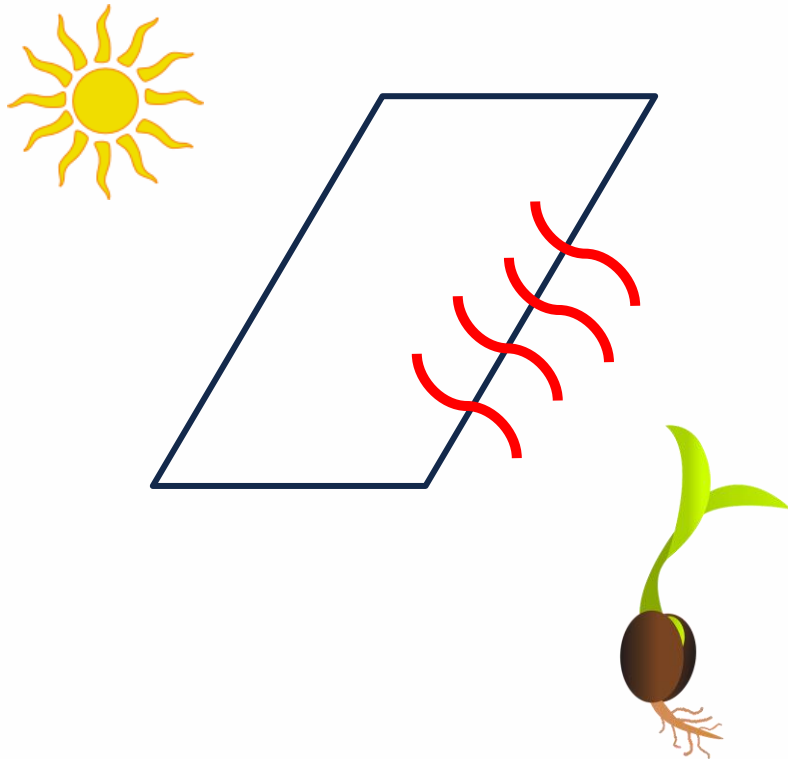


Smothering

- You can use a variety of materials but remember, you want them to be durable enough to last as long as you need them for.
- Compostable materials could be tilled in but carbon will suck nitrogen from soil.



Solarize



Solarize

- Bare soil technique, can be used with tilling
- Killing weed seeds, pathogens and nematodes that are at the top layer of soil
- Clear plastic with strong sun.



Above-ground gardens

Pros

- Defined borders for new gardeners or students
- Can be adapted for differing abilities
- Easier to maintain
- No soil compaction
- New, clean, rich soil

Cons

- Costly, needs investment of materials, (borders & soil)
- Takes time to start up
- More difficult to return to mow-able lot
- Must water more often

Things to think about: How will you maintain surroundings?

Raised beds

Pros

- Warm up faster
- Good drainage
- Creates order
- Easier to manage and access
- Less soil compaction



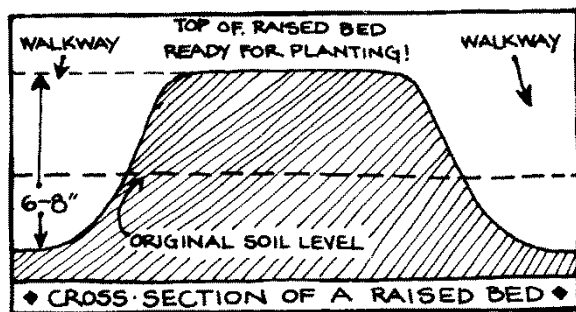
Cons

- May need to water more frequently, dry out quicker
- Cost of materials
- Increased start up work
- More permeant



Build raised beds

- What is a raised bed?
 - An area where the soil you are gardening in is raised a few inches higher than the surrounding soil
- Usually, 3-4 feet wide

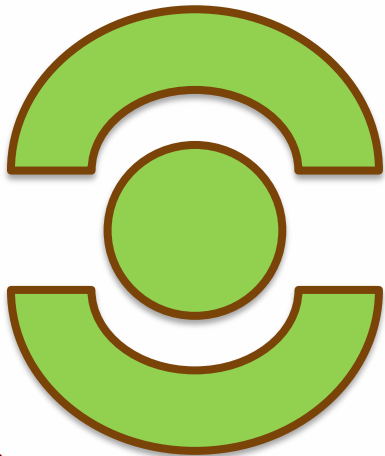


Raised bed size

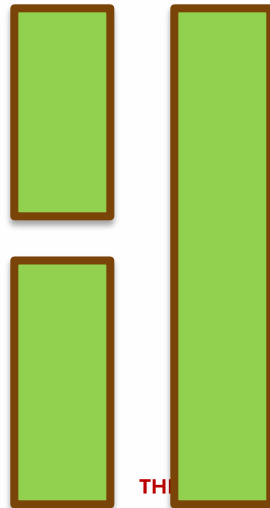
No more that 4 feet across

Minimizes soil compaction

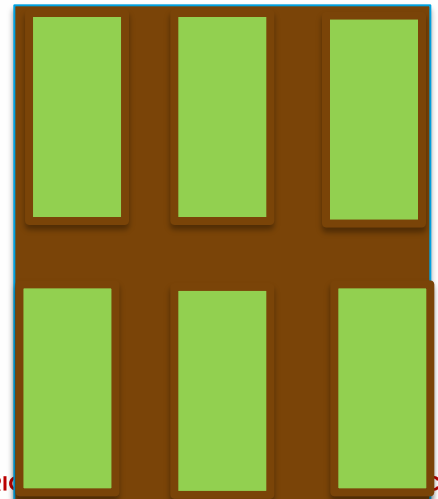
Can be any length, shape



OR

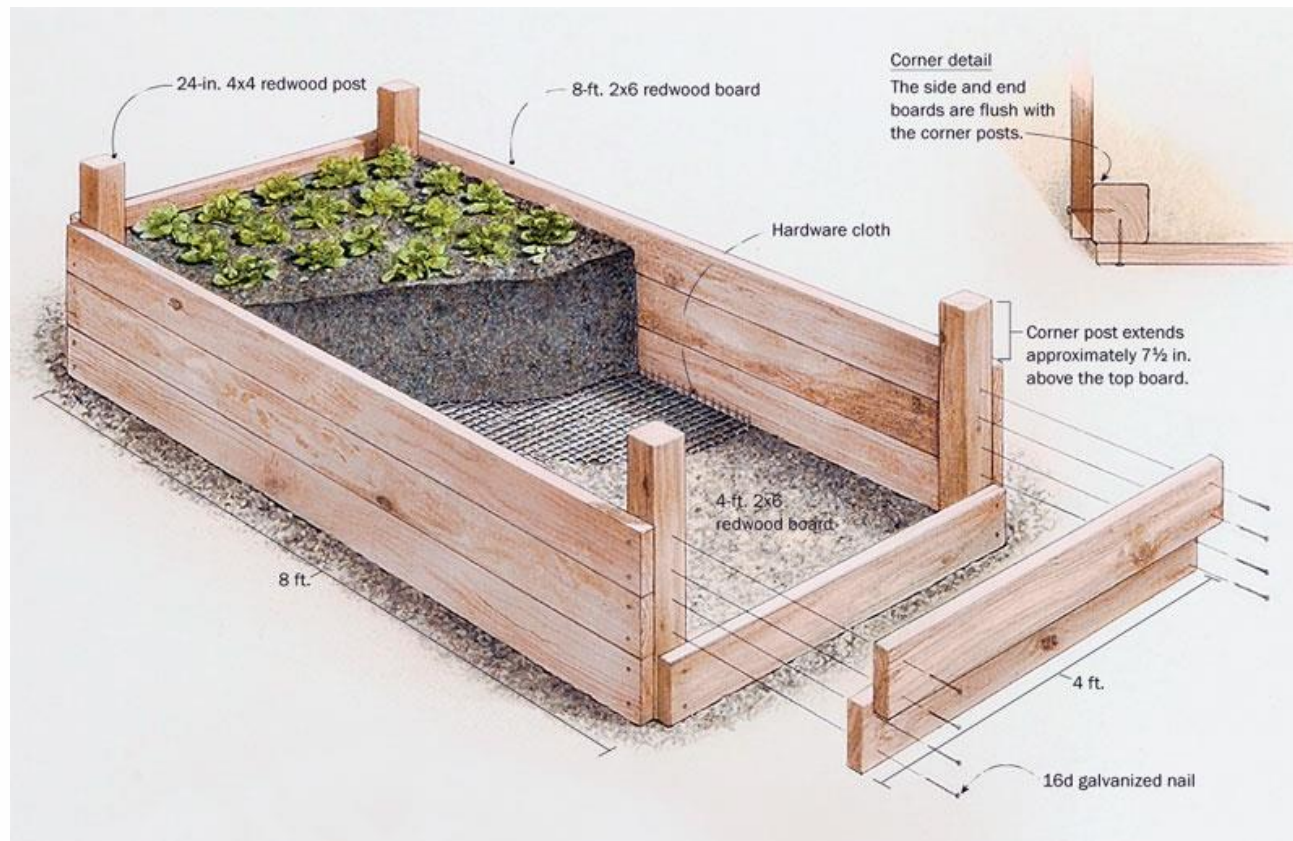


OR



Raised beds

- Traditional wooden raised beds



Raised beds

- Woven raised beds
- Concrete block raised beds



Container gardening



Not appropriate for container gardening.



Garden Planning & Design Lab

Suggested Reading in Book

1. Summer Sprout & City Garden Use Application –Part 1, section 1
2. Gathering a Core Team, Garden Mission & Vision – Part 1, section 1 & 2
3. Garden Design, Layout & Map – Part 2, section 3
4. Garden Rules, Roles, and Responsibilities – Part 2, section 4 and Part 3, section 5
5. Gardener Recruitment, Events, Community Outreach – Part 3, section 5 & 6