



# Soil Prep for Vegetable Gardens

May 2017



**University of California**  
Agriculture and Natural Resources

UCCE Master Gardener Program  
Monterey and Santa Cruz Counties

# What You Will Get

- The basics of soil science and why you should care
- What makes healthy, fertile soil good
- How to improve your own soil
- Hands-on soil prep tips and tricks



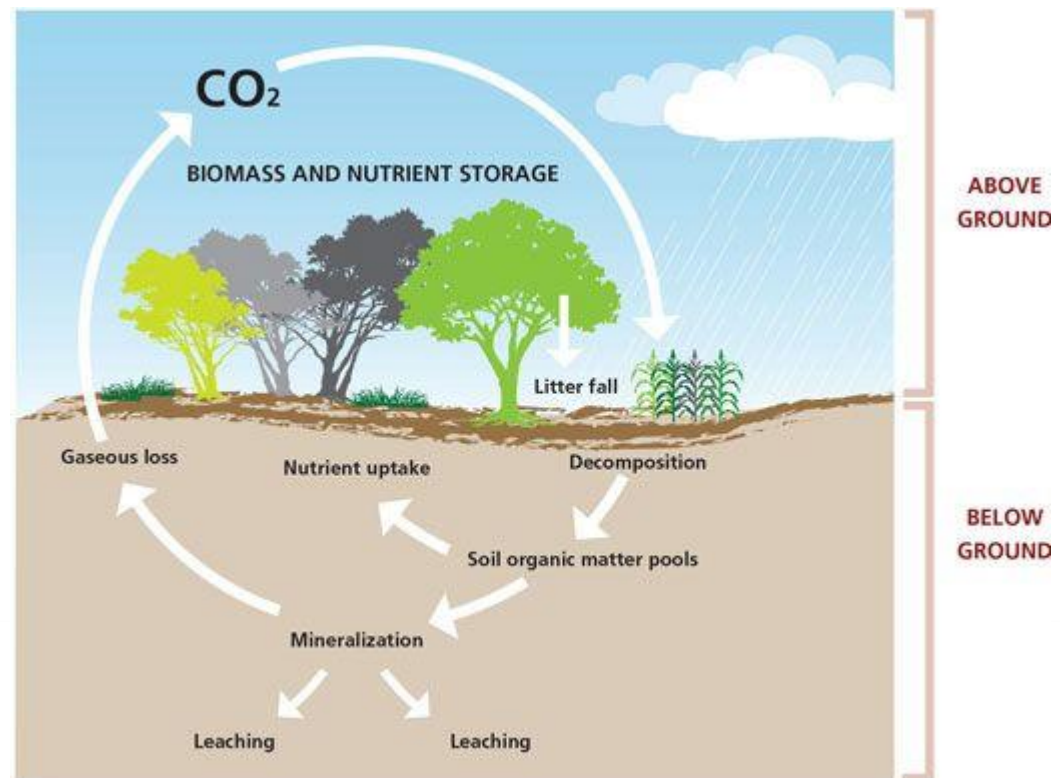
“Humankind  
owes its  
existence to a  
six-inch layer of  
topsoil and the  
fact that it  
rains.”

~Anonymous



# Why Should I Care About My Soil?

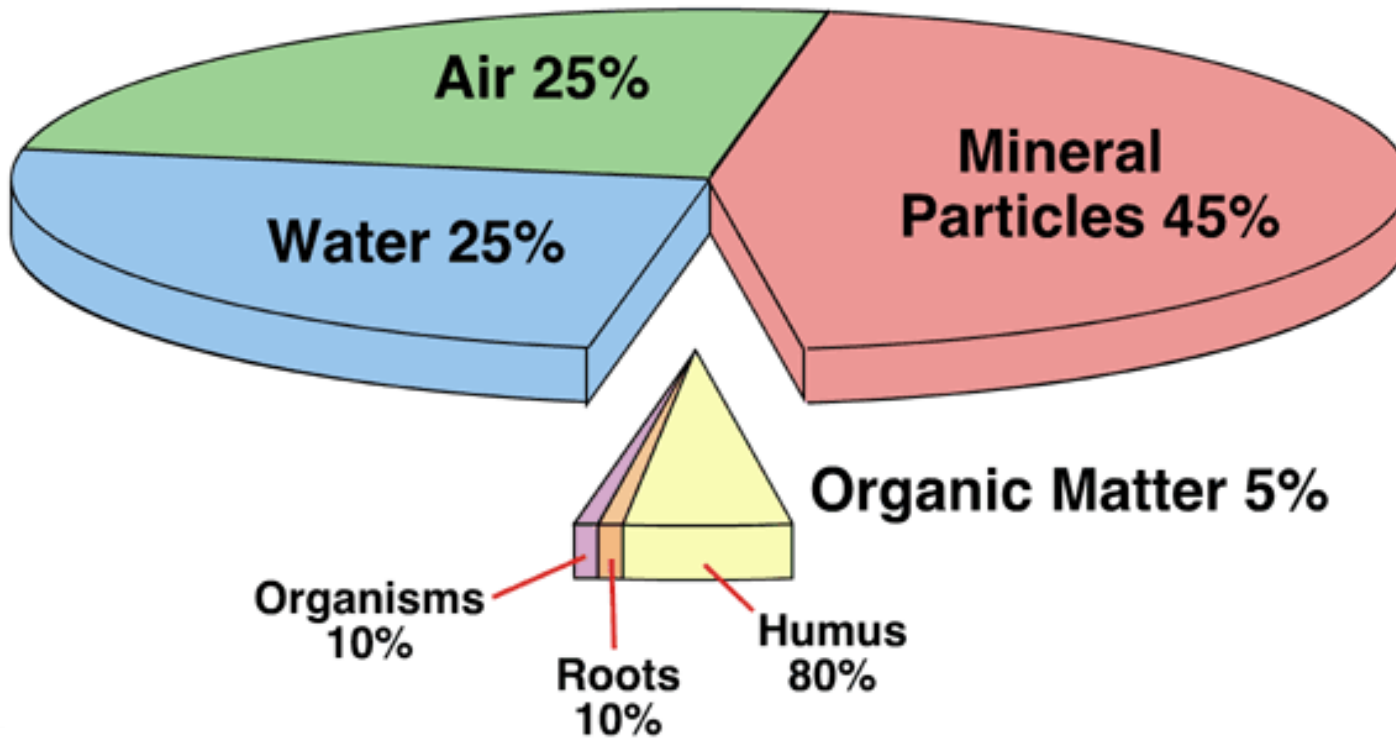
- Your life depends on it
- It's the second largest carbon sink (3%)
- Sustainably higher yields
- Easy to work
- Conserves water
- Fewer weeds
- Diverts landfill



# Soil Science in a Nutshell - Physical



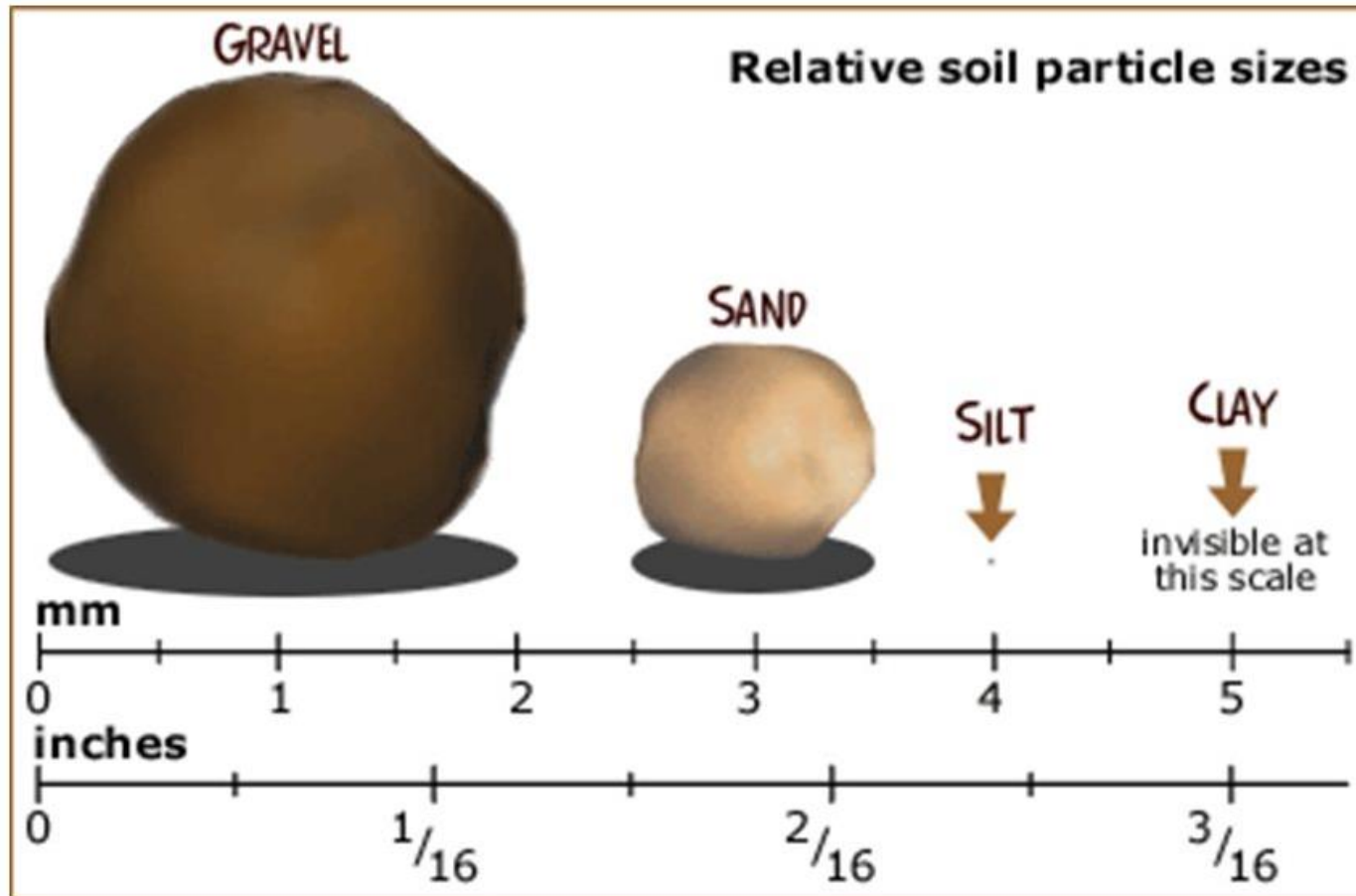
What is soil? Components



# Soil Science in a Nutshell - Physical



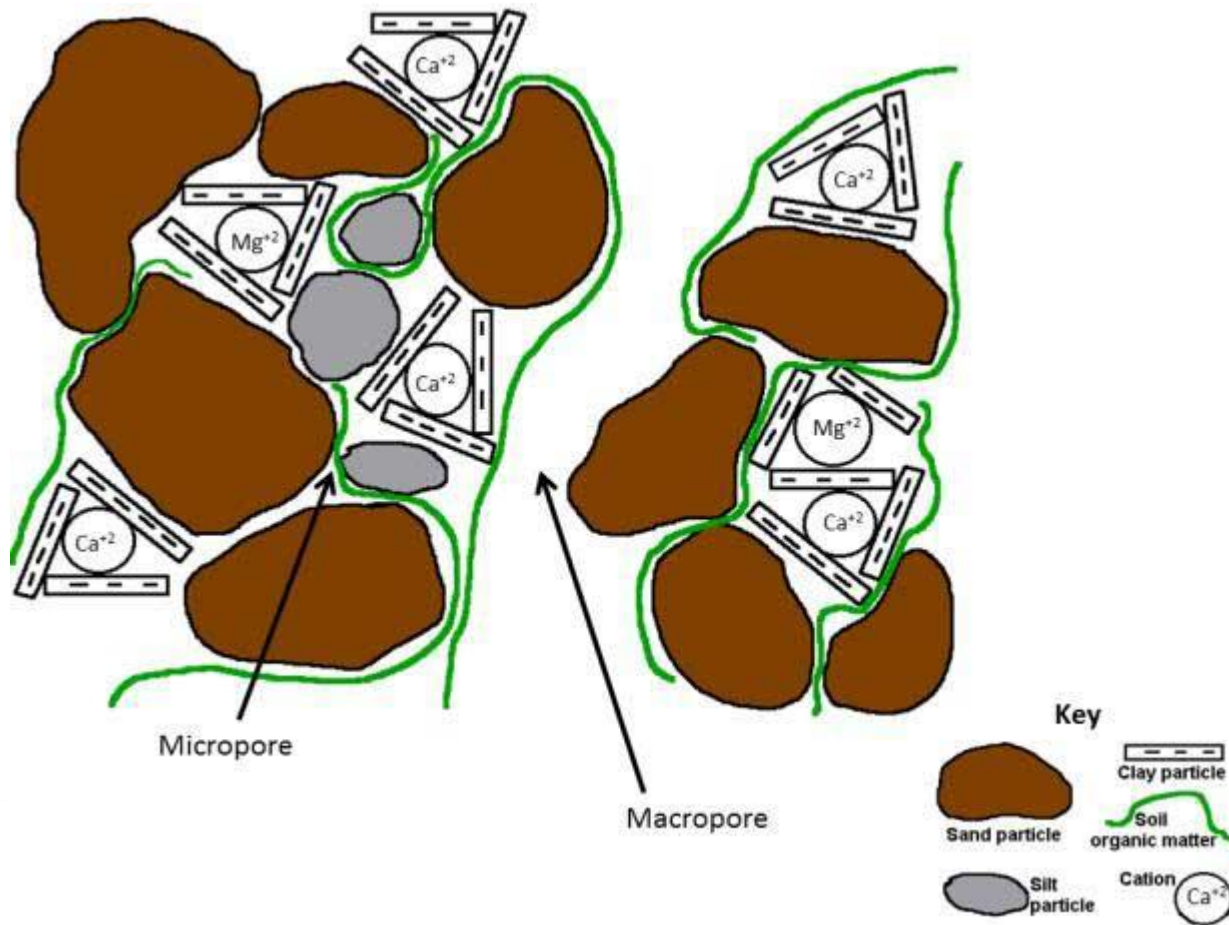
## Mineral Particle Types



# Soil Science in a Nutshell - Physical



## Particles Aggregate



# Soil Science in a Nutshell - Physical



Soil components together

Minerals

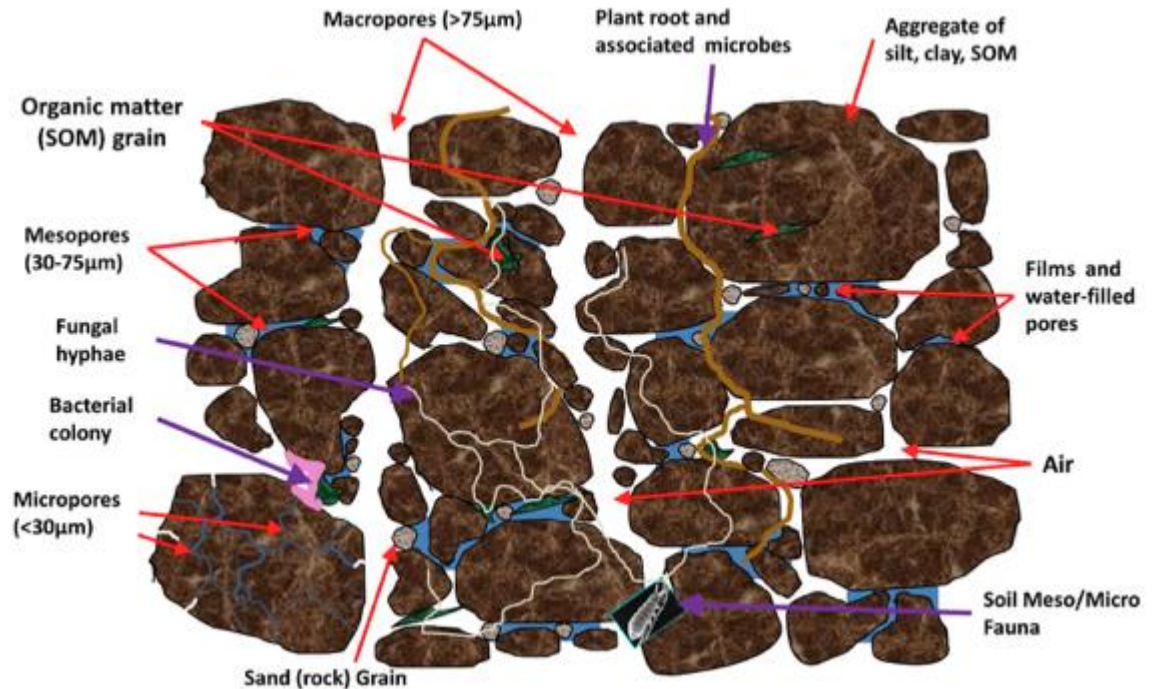
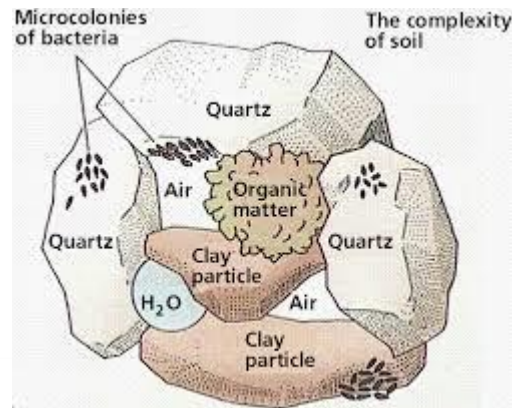
Water

Spaces for air

Fauna

Fungi

Microbes

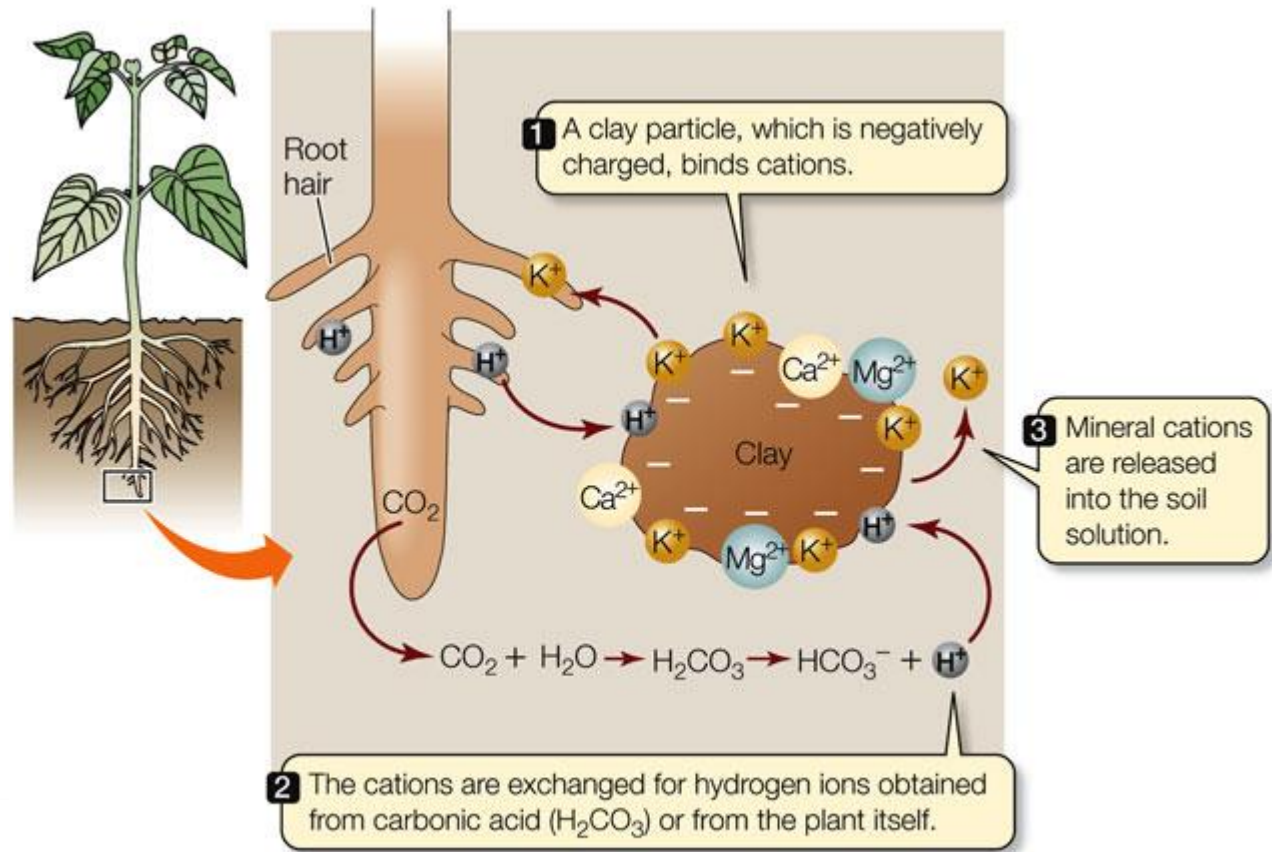




# Soil Science in a Nutshell - Chemical



It's chemistry baby



LIFE 8e, Figure 36.6

LIFE: THE SCIENCE OF BIOLOGY, Eighth Edition © 2007 Sinauer Associates, Inc. and W. H. Freeman & Co.



# Soil Science in a Nutshell - Chemical



Cation Exchange Capacity (CEC) a soil chemical property

+ Positive cations	- Negative anions
calcium (Ca <sup>2+</sup> )	chloride (Cl <sup>-</sup> )
magnesium (Mg <sup>2+</sup> )	nitrate (No <sup>3-</sup> )
ammonium (NH <sup>4+</sup> )	sulphate (S <sup>04</sup> )-2
potassium (K <sup>+</sup> )	phosphate (H <sup>2</sup> PO <sup>4-</sup> and PO <sup>4-</sup> )
hydrogen (H <sup>+</sup> )	borate (BO <sup>3-</sup> )
sodium (Na <sup>+</sup> )	molybdate (MoO <sup>4-</sup> )
aluminium (Al <sup>3+</sup> )	
iron (Fe <sup>2+</sup> )	
manganese (Mn <sup>2+</sup> )	
zinc (Zn <sup>2+</sup> )	
copper (Cu <sup>2+</sup> ).	



# Soil Science in a Nutshell – Chemical

**Nutrition:** *Macronutrients* are needed in relatively large amounts by plants.



Element	Symbol	Source	Form Used
Oxygen	O	Air/Water	H <sub>2</sub> O
Hydrogen	H	Air/Water	H <sub>2</sub> O
Carbon	C	Air/Water	CO <sub>2</sub>
<b>Nitrogen</b>	<b>N</b>	<b>Soil</b>	<b>NO<sub>3</sub><sup>-</sup>, NH<sub>4</sub><sup>+</sup></b>
<b>Phosphorus</b>	<b>P</b>	<b>Soil</b>	<b>H<sub>2</sub>PO<sub>4</sub> &amp; HPO<sub>4</sub><sup>2-</sup></b>
<b>Potassium</b>	<b>K</b>	<b>Soil</b>	<b>K<sup>+</sup></b>
Calcium	Ca	Soil	Ca <sub>2</sub> <sup>+</sup>
Magnesium	Mg	Soil	Mg <sup>2+</sup>
Sulfur	S	Soil	SO <sub>4</sub> <sup>-</sup>

**FERTILIZER**  
**21-3-20**  
**N P K**  
50 lbs.

Nitrogen: key nutrient in plant growth. 21% N in a 50 lb. bag = 10.5 lbs. N

Phosphorus: important for establishment. 3% P in a 50 lb. bag = 1.5 lbs. P

Potassium: will increase stress tolerance. 20% K in a 50 lb. bag = 10 lbs. K

P & K needed only as soil test indicates



# Soil Science in a Nutshell – Chemical



**Nutrition:** *Micronutrients* are needed in relatively small amounts by plants

Element	Symbol	Source	Form Used
Iron	Fe	Soil	$\text{Fe}^{2+}$
Manganese	Mn	Soil	$\text{Mn}^{2+}$
Boron	B	Soil	$\text{H}_2\text{BO}_3^-$
Molybdenum	Mo	Soil	$\text{MoO}_4^{2-}$
Copper	Cu	Soil	$\text{Cu}^{2+}$
Zinc	Zn	Soil	$\text{Zn}^{2+}$
Chlorine	Cl	Soil	$\text{Cl}^-$

[Slides on Nutrient deficiencies](#)



# Soil Science in a Nutshell – Chemical

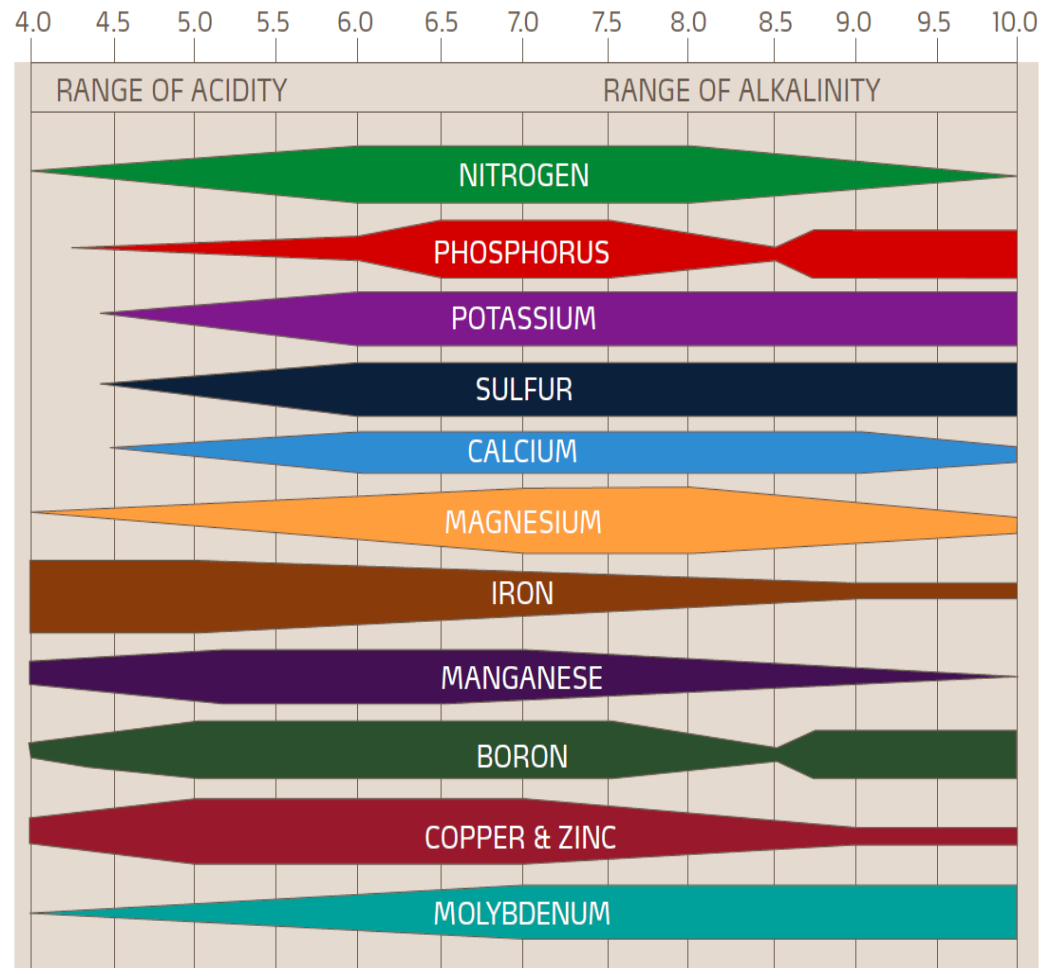


## Soil pH

pH is a figure expressing the acidity or alkalinity of a solution

- 7 is neutral
- lower values are more acid
- higher values more alkaline.

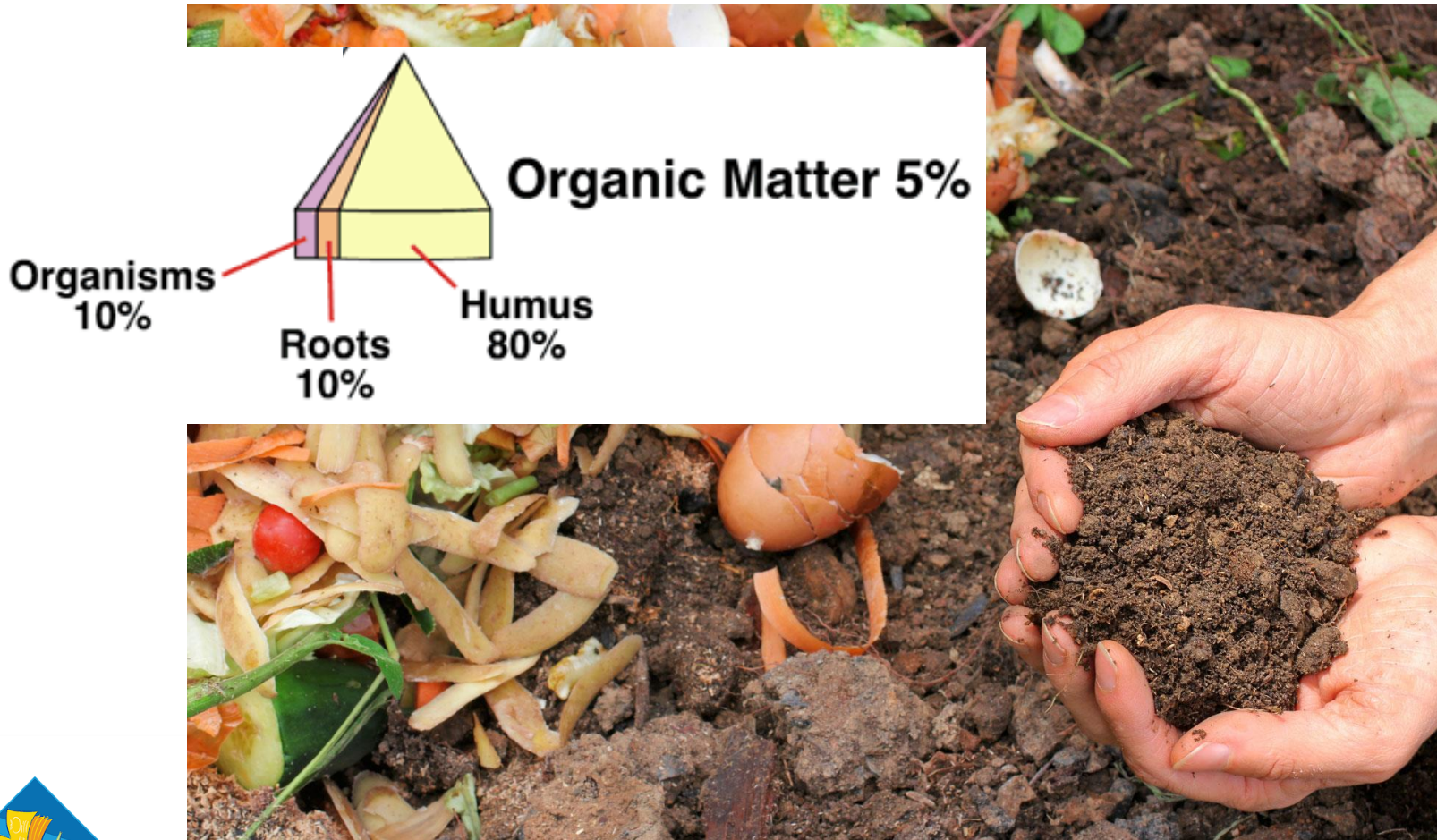
The Influence of Soil pH on Nutrient Availability



# Soil Science in a Nutshell - OM



So what matters about organic matter?



# Soil Science in a Nutshell - OM



## Microbe jobs

### Decomposers

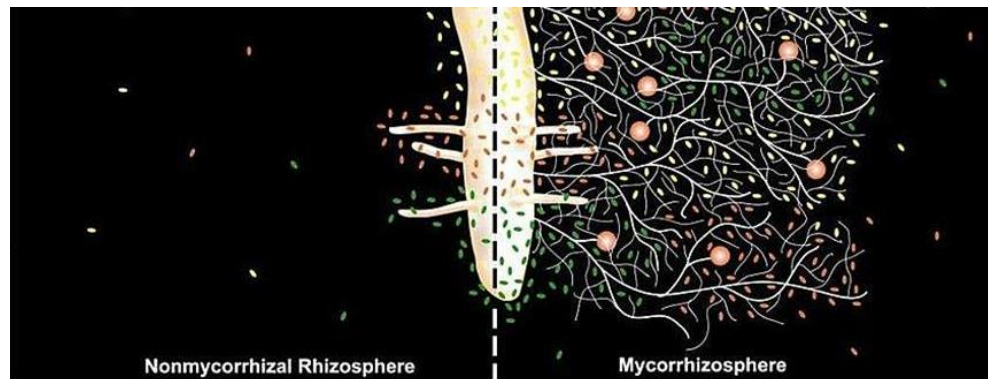
Worms and macro-fauna eat plant residue, aerate soil, excrete nutrient rich casts

### Saprophytes

Bacteria and fungi eat decaying plant material, recycle into nutrients and humus, make nutrients available to plants

### Symbionts

Form beneficial associations with plants such as nitrogen fixing bacteria and mycorrhizae root extensions



# Soil Science in a Nutshell - OM



What lives in 1 Gram of healthy soil?

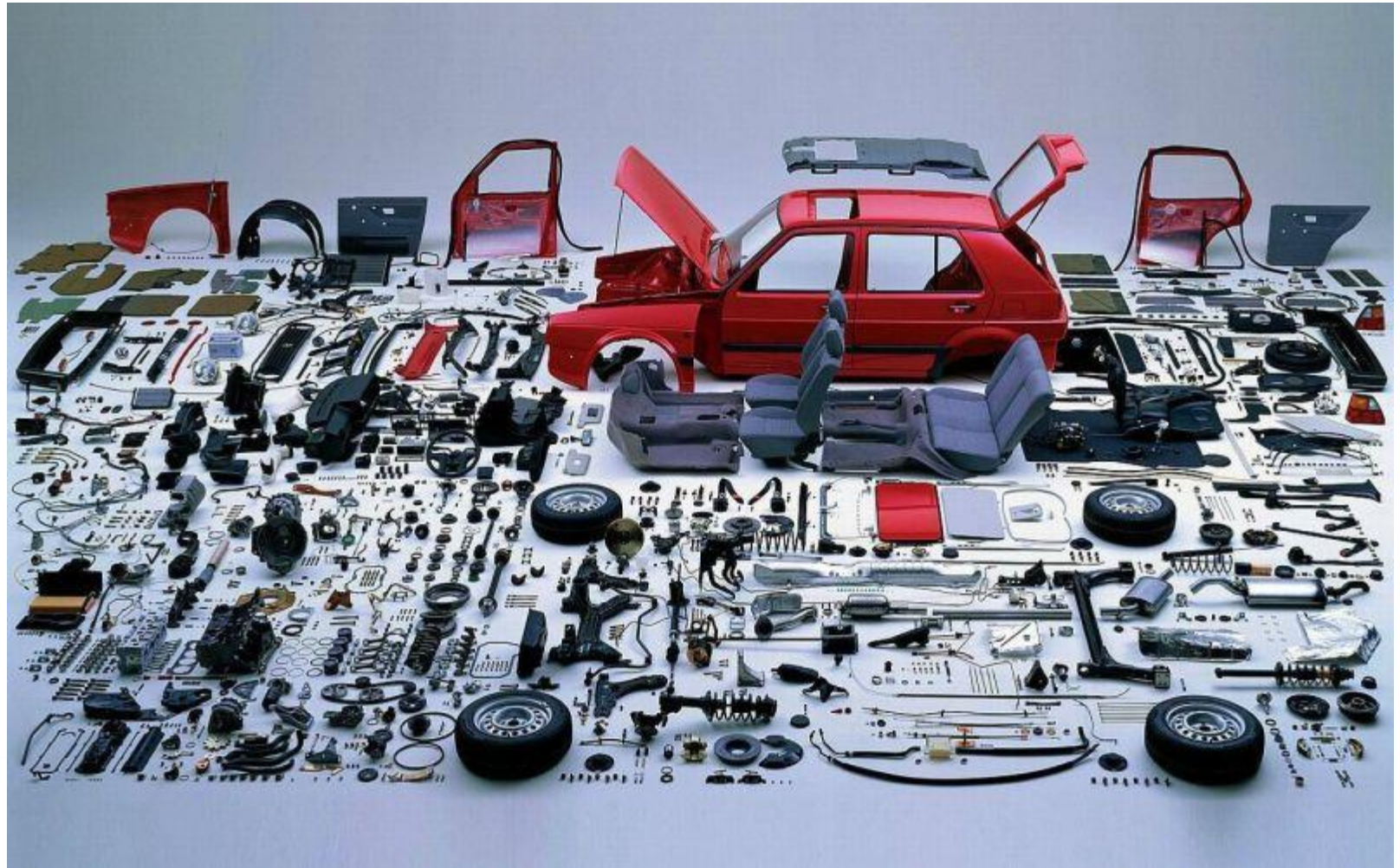


Bacteria	3,000,000 to 500,000,000
Actinomycetes	1,000,000 to 20,000,000
Fungi	5,000 to 1,000,000
Yeast	1,000 to 1,000,000
Protozoa	1,000 to 500,000
Algae	1,000 to 500,000
Nematodes	10 to 5,000





# Systemic Thinking



# Soil Science in a Nutshell - OM



## Review: Benefits of Organic Matter

<b>Chunky</b>	makes space for air and water
<b>Delicious</b>	provides food for decomposers
<b>Sticky</b>	produces compounds that improve particle aggregation which improves soil structure
<b>Balance</b>	corrects soil pH towards neutral
<b>Nutritious</b>	makes nutrients in solution available to the plant
<b>Retain</b>	aggregate structure holds pockets of water, like a sponge
<b>Drain</b>	chunky spaces help water ultimately drain through
<b>Store</b>	puts a little carbon back in the soil (aka sequestration)
<b>Resist</b>	diverse biome improves immunity to certain soil borne diseases
<b>Reduce Loss</b>	mulching helps retain water, protect soil surface and reduce weeds





**PRACTICAL APPLICATION**

# What About MY Backyard?

## Test your soil texture



<http://projectzenstead.com/index.php/2016/03/08/how-to-test-soil-texture/>

<https://www.todayshomeowner.com/diy-soil-texture-test-for-your-yard/>

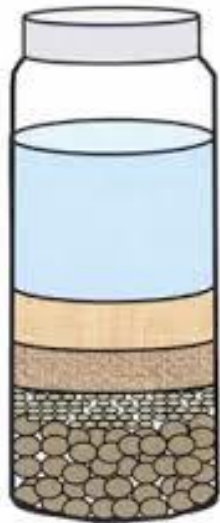


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# What About MY Backyard?

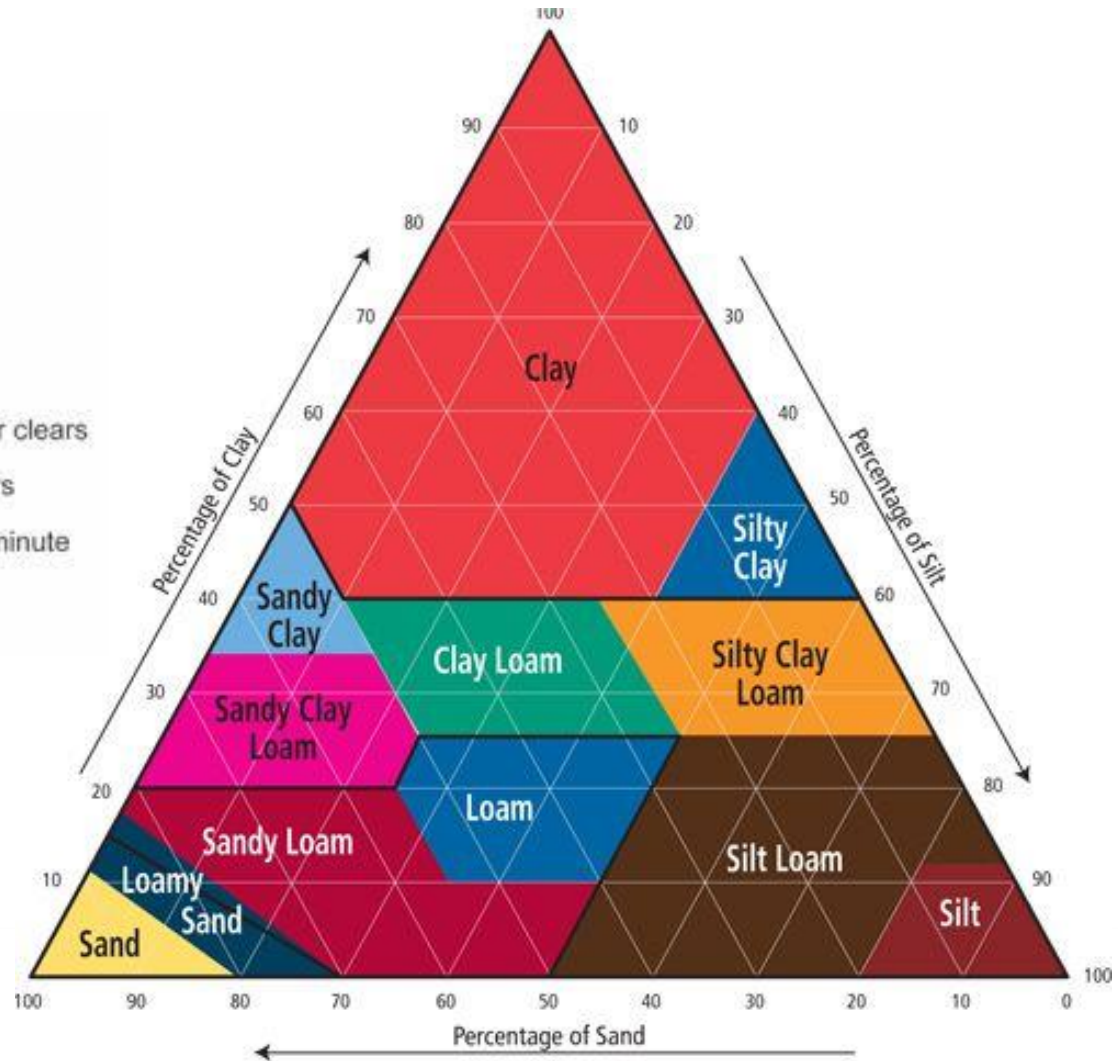
## Texture



Clay layer – water clears  
Silt layer – 2 hours  
Sand layers – 1 minute

Example:

% sand =  
 $\frac{\text{sand depth}}{\text{total depth}} \times 100$



# Fertilizer vs. Soil Amendment?

First it helps to know the difference between soil amendments and fertilizer.

Fertilizer	Soil Amendment
Affects the plant through the growth stage through nutrients	Indirectly affects the plant by improving soil physical and chemical properties
Bone meal	Manure
Fish Emulsion	Compost
Miracle Grow	Worm Castings
Kelp meal	Leaves and grass clippings
Cottonseed meal	Peat moss
Etc.	Etc.



# How Much Amendment?

Never Enough

- It takes years
- Replace 1-3 times a year
- 6 inch layer is a good start

example: 6 inches over 100 Sq ft = 25 two cubic ft. bags or 1.85 cubic yards

Coverage calculator:

<http://www.harvestpower.com/products/landscape-calculator/>



Type of soil	Amount of composted organic material
Limited organic matter	4-6 inches each planting season
Lots of organic matter	1-3 inches each planting season



# How Can I Get Some Organic Material?

## Sources

- Make your own compost
- Garden supply and landscape stores (bagged or bulk)
- Municipal green waste compost (the dump)
- Horse stables
- Worm castings
- Coffee grounds

## Materials for your compost pile

- Get some chickens or rabbits
- Compostable produce scraps at grocery stores
- Spent brewers grain at micro breweries
- Organic materials exchange

<http://www.omexchange.org/listings>





# What About MY Backyard?

## Test your soil chemistry

Find out your starting point:

- N=Nitrogen
- P=Phosphorus
- K=Potassium
- pH

How do I know?

- Buy a soil test kit
- Get your soil tested by a lab
- Best guess



# How Much to Fertilize and When

It depends...

- Your starting point (soil test result)
- Type of plant
- Time of year
- Type of fertilizer
- Plant's stage of life
- Symptoms of deficiency (see Appendix)



# Soil Improvement Strategies

Trade off Time – Money - Effort

## ***The Blitz***

1 week plan

In a Hurry, got money

- Get truckload of compost delivered
- Hire people to dig it in
- Fertilize and plant

## ***The Long View***

6 month plan

Got time, got muscle

- Clear soil surface
- Rough up soil
- Plant a **cover crop**, water & let it grow
- Chop it down, turn it under, wait 3 weeks
- Plant

Cover crop resource guide



# Soil Improvement Strategies

Trade off Time – Money - Effort

## ***The Sweat Equity***

1 month plan

Got NO money but some muscle

- Collect free, collected materials
- Incorporate into soil
- Wait 3 weeks
- plant

## ***The Low Effort***

No-Dig plans

- Lasagna garden  
<https://www.thespruce.com/how-to-make-a-lasagna-garden-2539877>
- Straw bale garden  
<http://modernfarmer.com/2013/07/straw-bale-gardening/>



# Soil Improvement Strategies

Trade off Time – Money - Effort

## *The Classic Raised Bed*

1-2 month plan

- Build boxes
- Buy soil
- Plant



# Soil Improvement Strategies

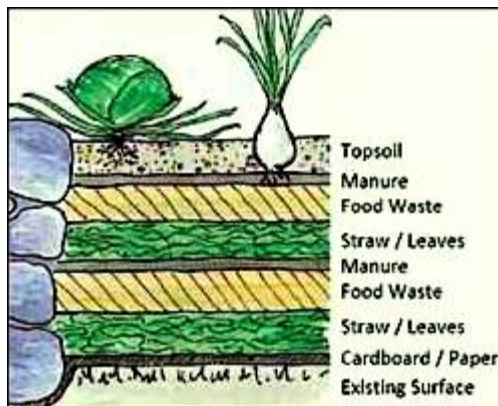
Trade off Time – Money - Effort

## *The Hybrid*

Start small with a straw bale or lasagna garden

AND

Plant a cover crop for the next season





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# Soil Steward Tips

## Maintain soil structure

- Cultivate (dig) when soil is moist but NOT soaking wet or bone dry
- Till or turn only when required to incorporate organic material, plant or weed – once per season
- Don't compact the soil – i.e. walk on it
- Keep soil covered – planted, mulched or both
- Add compost every year
- Rotate crops
- Minimize use of chemical herbicides, fungicides, fertilizers





# What About MY Backyard?

**WIN<sub>a</sub> Cover Crop Blend!**



**WIN<sub>some</sub> Alpaca Manure!**



# Outside!

Try these ideas things out

- Dig in some cover crops
- Build a lasagna garden bed
- Question and Answer

Remember! You can always address questions to the

## **Master Gardener Hotline**

<http://mbmg.ucanr.edu/hotline/>

831.763.8007



SAMPLE NO.	NAME	LOCATION/NOTES
1	Beta	Millhamburg Pk backyard
2	Alix	Bedstuy (H2A) Edway
3	Nery	Fort Trgm Pk.
4	Nery	INWOOD Pk.
5	Lee	Kensington, Bk
6	Ellie	Maria H. Bushwick
7	Ellie	CCNY
8	Ellie	Tradeschool



# APPENDIX

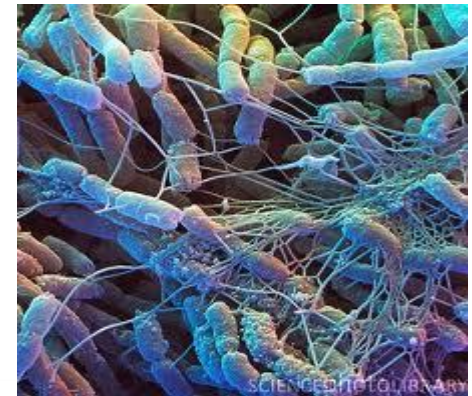


# Fun Fact!

At least one soil microbe acts as an anti depressant.



*Mycobacterium*  
*vaccae*



# Deficiency Symptoms - N

- General chlorosis.
- Chlorosis progresses from light green to yellow.
- Entire plant becomes yellow under prolonged stress.
- Growth is immediately restricted and plants soon become spindly and drop older leaves.



# Deficiency Symptoms - P

- Leaves appear dull, dark green, blue green, or red-purple, especially on the underside, and especially at the midrib and vein.
- Petioles may also exhibit purpling. Restriction in growth may be noticed.



Merlot with advanced P deficiency symptoms.



# Deficiency Symptoms - K

- Leaf margins tanned, scorched, or have necrotic spots (may be small black spots *which* later coalesce).
- Margins become brown and cup downward.
- Growth is restricted and die back may occur.
- Mild symptoms appear first on recently matured leaves.



# Deficiency Symptoms - Ca

- Growing points usually damaged or dead (die back).
- Margins of leaves developing from the growing point are first to turn brown.





# Deficiency Symptoms - Mg

- Marginal chlorosis or chlorotic blotches which later merge.
- Leaves show yellow chlorotic interveinal tissue on some species, reddish purple progressing to necrosis on others.
- Younger leaves affected with continued stress.
- Chlorotic areas may become necrotic, brittle, and curl upward.
- Symptoms usually occur late in the growing season.



# Deficiency Symptoms - Cu

- Leaves wilt, and curl become chlorotic, then necrotic.
- Wilting and necrosis are not dominant symptoms.



# Deficiency Symptoms - Fe

- Distinct yellow or white areas appear between veins, and veins eventually become chlorotic.
- Symptoms are rare on mature leaves.



# Deficiency Symptoms - Mn

- Chlorosis is less marked near veins.
- Some mottling occurs in interveinal areas.
- Chlorotic areas eventually become brown, transparent, or necrotic.
- Symptoms may appear later on older leaves.



# Deficiency Symptoms - Zn

- Leaves may be abnormally small and necrotic.
- Internodes are shortened.



# Deficiency Symptoms - B

- Young, expanding leaves may be necrotic or distorted followed by death of growing points.
- Internodes may be short, especially at shoot terminals.
- Stems may be rough, cracked, or split along the vascular bundles.



# Finnish Seniors Model Organic Materials

