

Improving *Your* Soil Quality



Rob Bennaton

Bay Area Urban Agriculture Advisor

University of California Cooperative Extension

100 Years of Cooperative Extension

Practical. Connected. Trusted.

- UC Agriculture & Natural Resources is celebrating the centennial of the passage of the Smith-Lever Act and the beginning of Cooperative Extension in California.
- Local programs:
 - Master Gardeners
 - 4-H
 - Viticulture
 - Weed Science
 - IPM
 - Livestock & Natural Resources
 - Watershed Management
 - Food Systems
 - Commercial Farming

Soils Formation

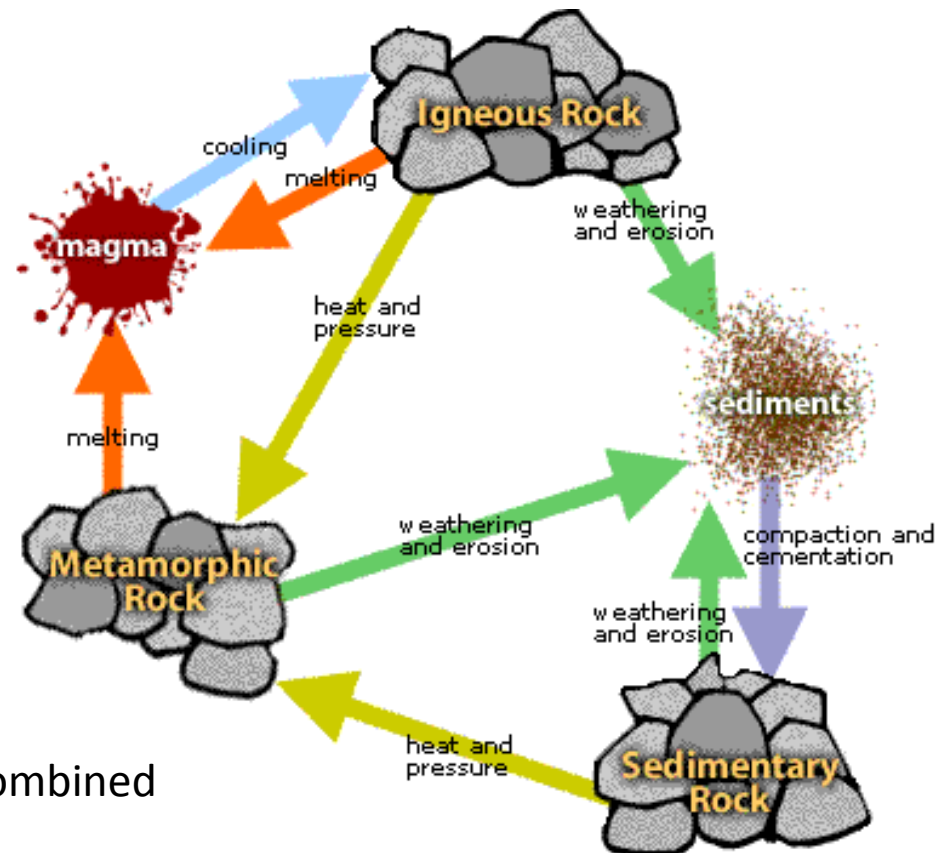
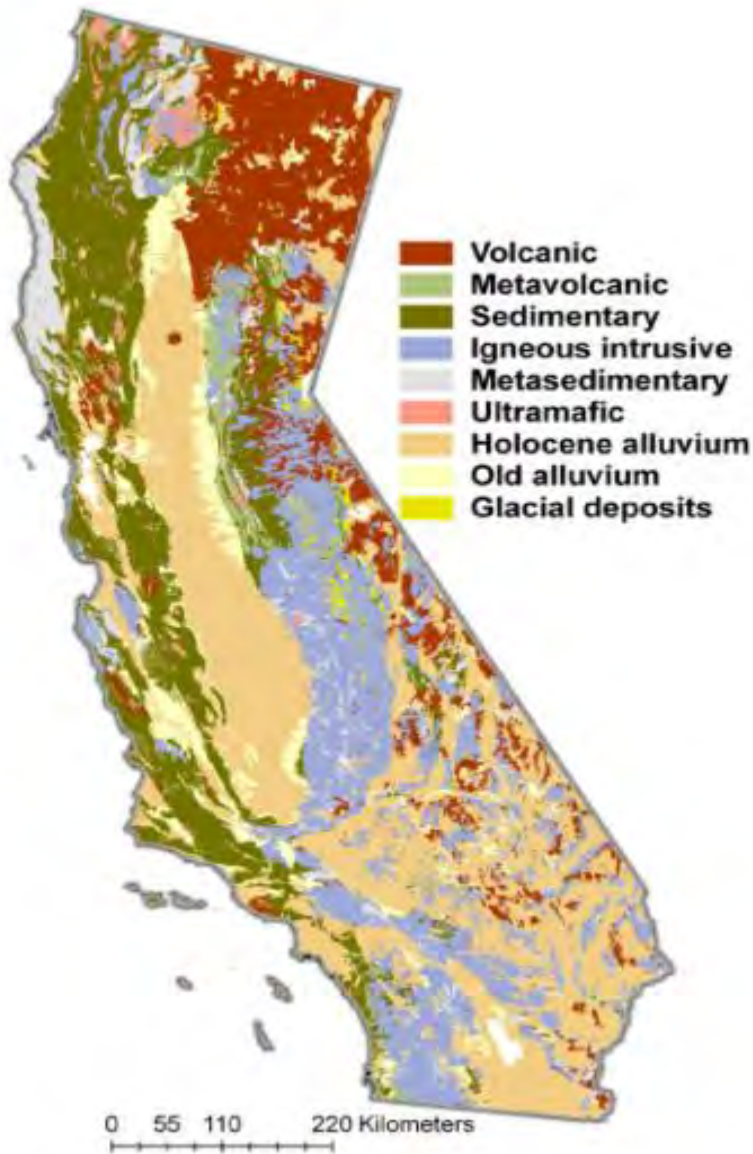
-Weatherization and Glaciation



Soil Formation

Concept:

- Parent Material → Particle Size/Density



Based on Temperature, Pressure, Weather Combined

What is Organic Matter?

- H Hydrogen
- O Oxygen
- N Nitrogen
- C Carbon

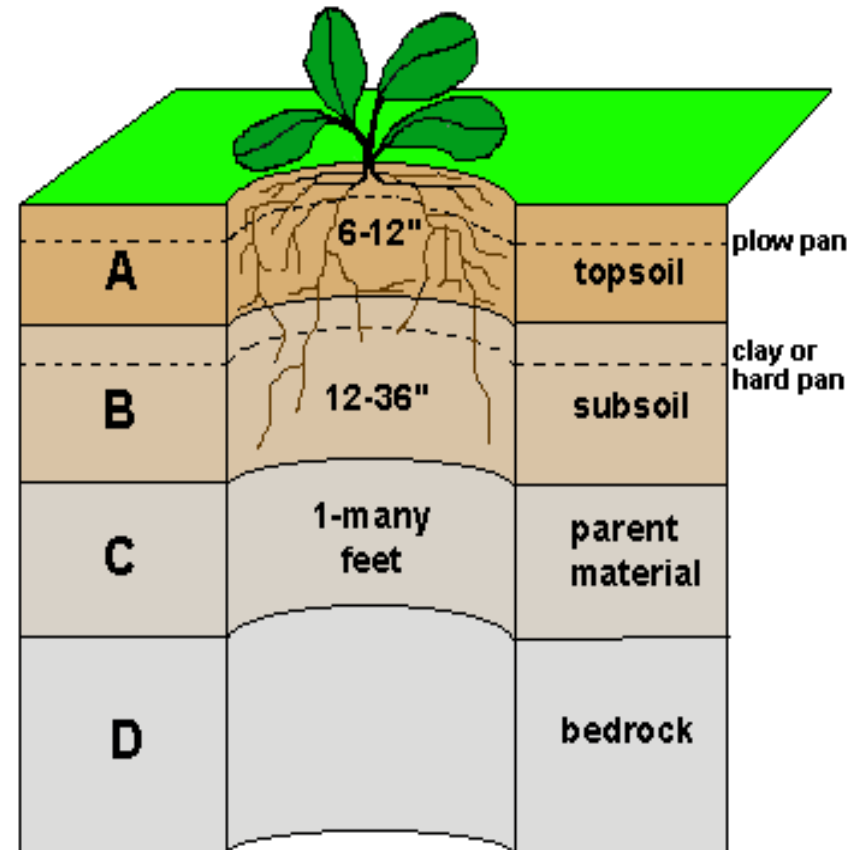
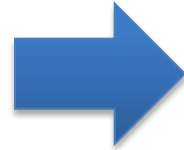
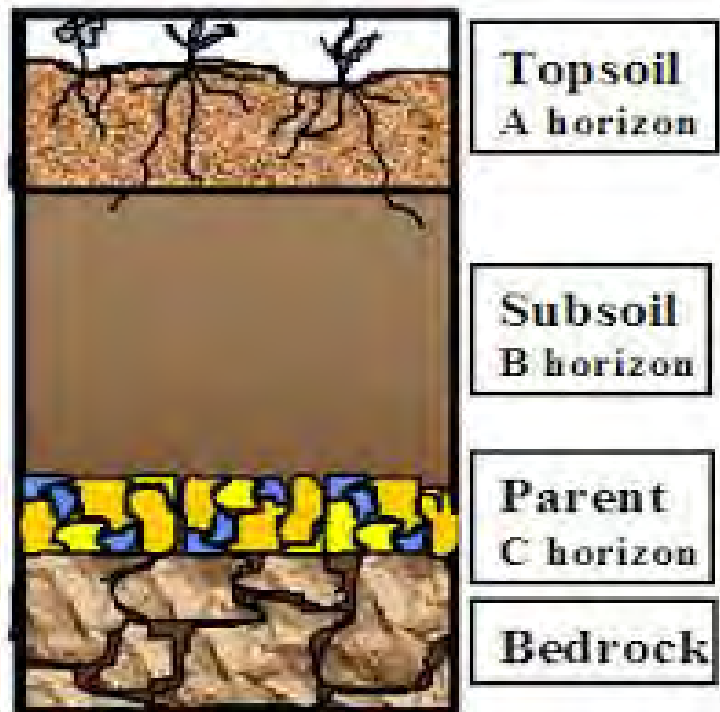
HONC Your Horn!!!

Soil Formation



Concept:

- Particle Size, Pore Size and Organic Matter
→ Aggregate Stability



Your Goal:



The Four Things Plants Need?

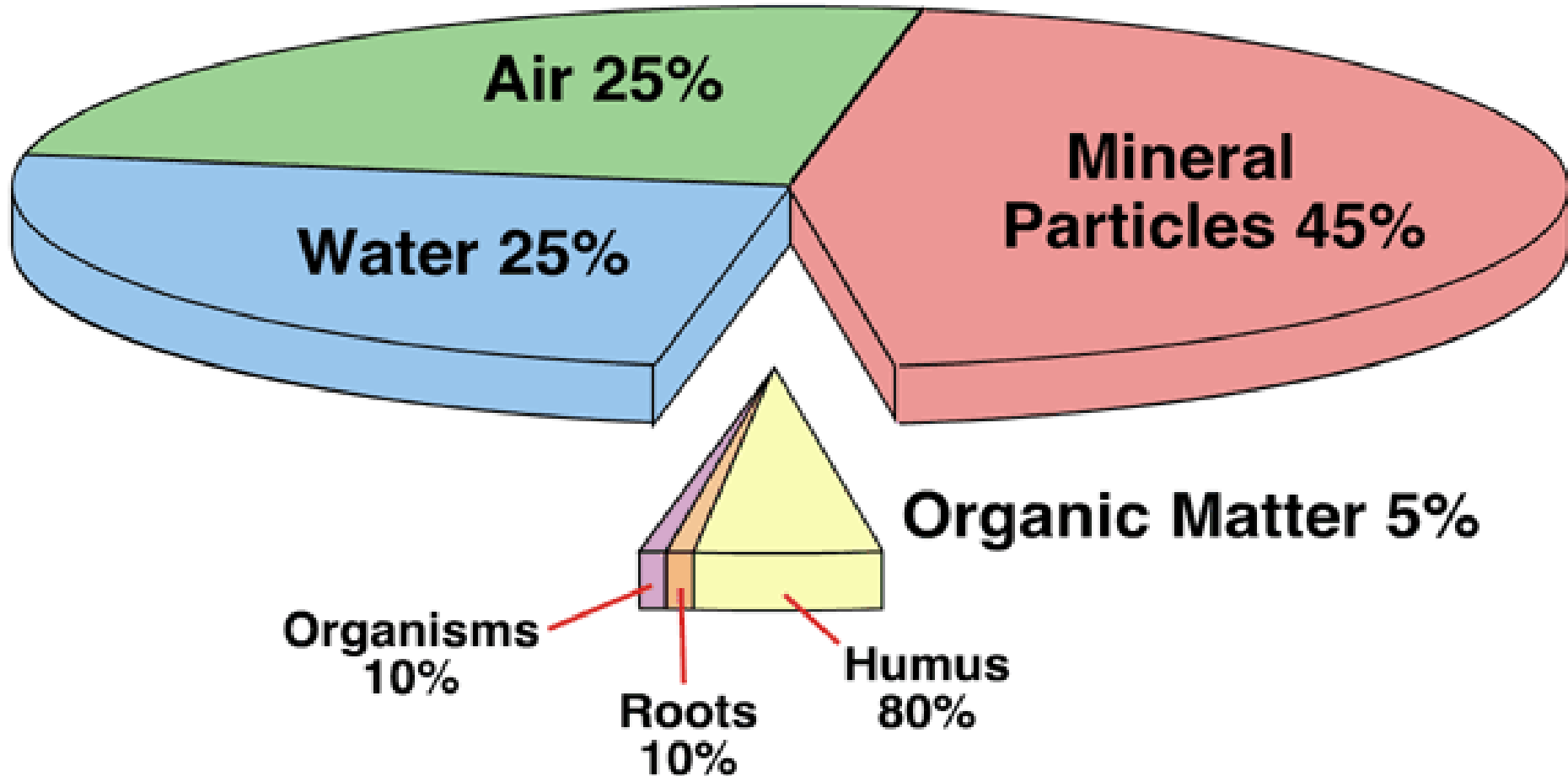
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The Soil Matrix Pie Chart

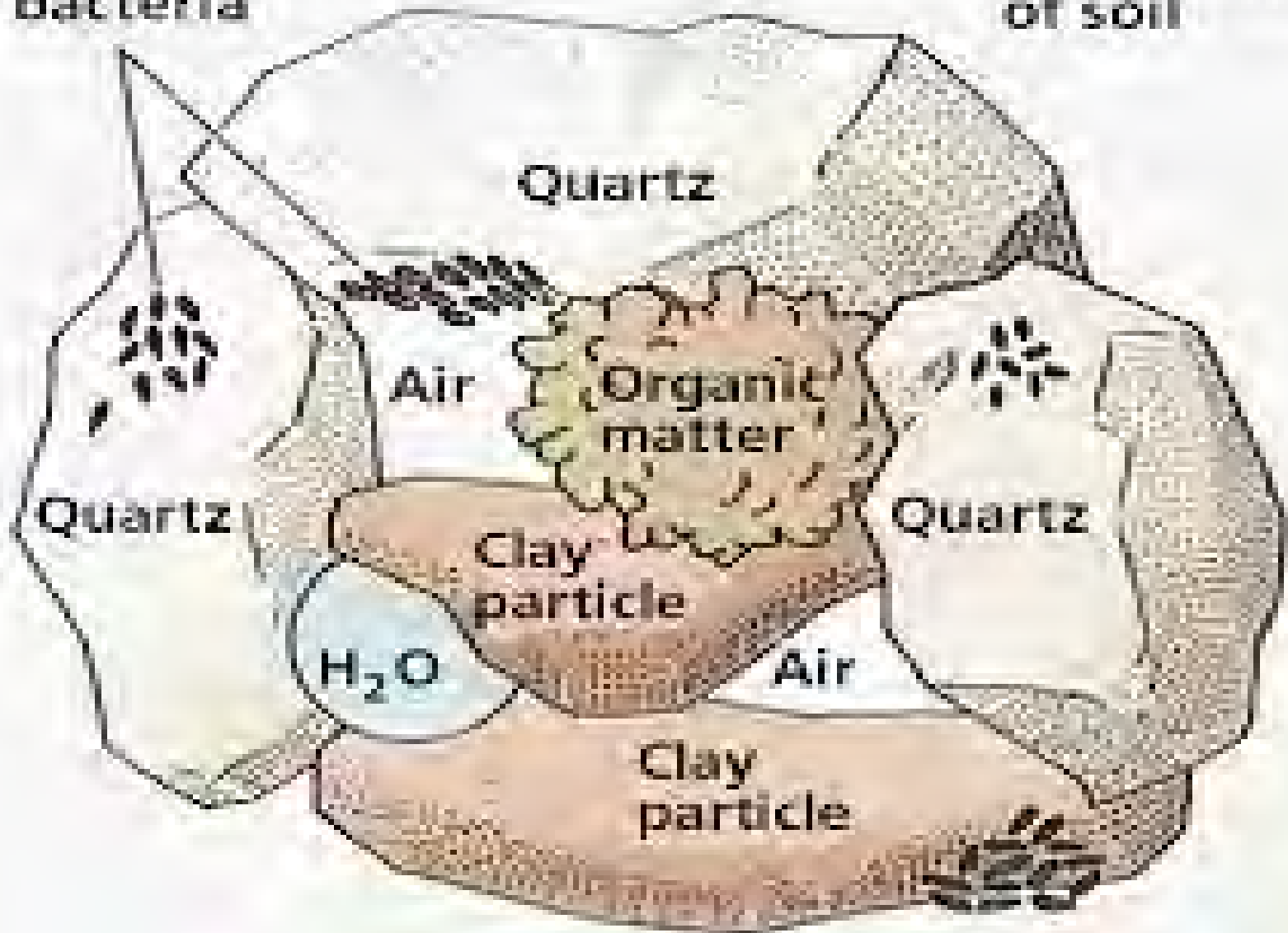


Soil is a matrix of minerals, Organic Matter, O₂, H₂O & living organisms.

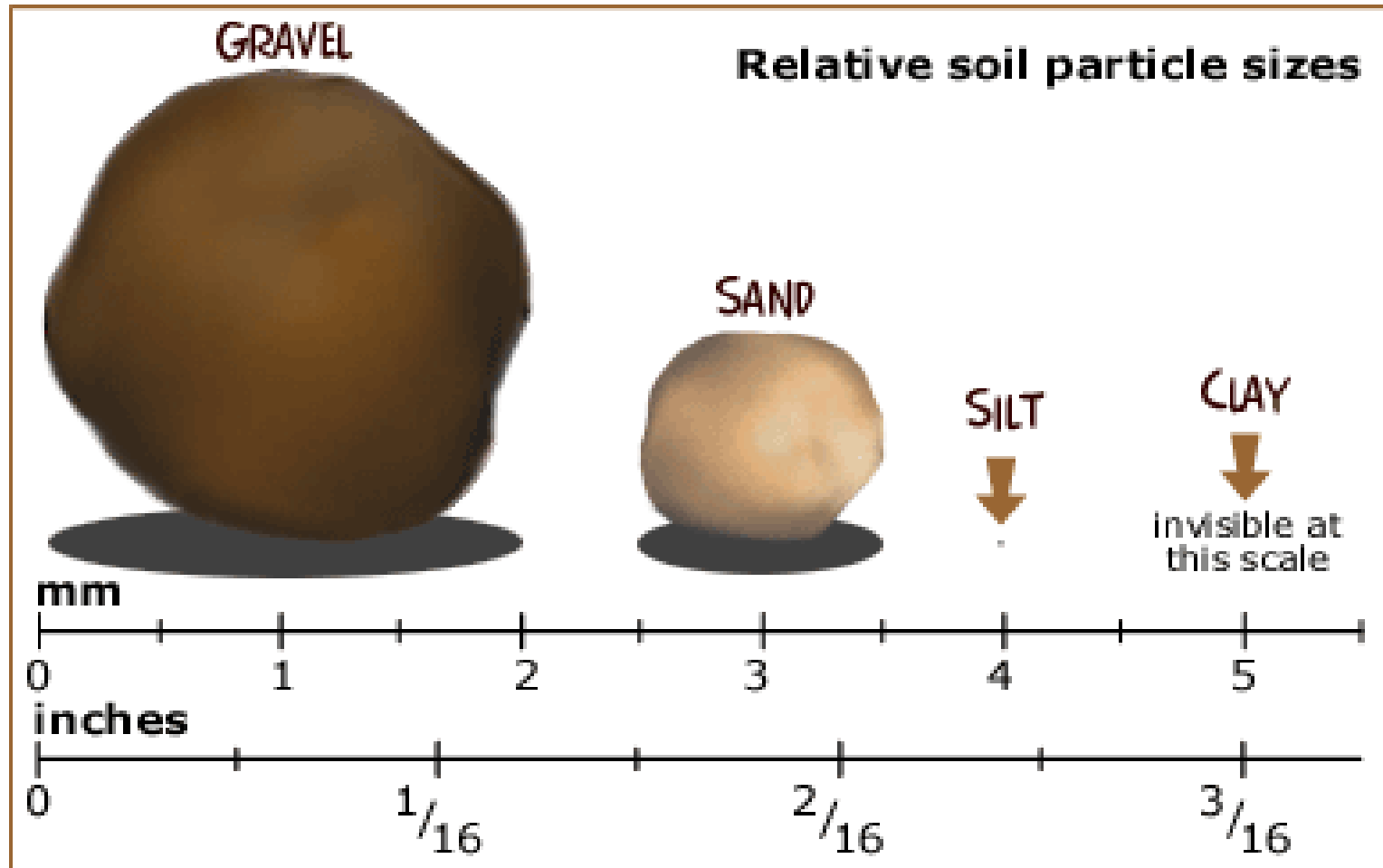
The Soil Matrix

Microcolonies
of bacteria

The complexity
of soil



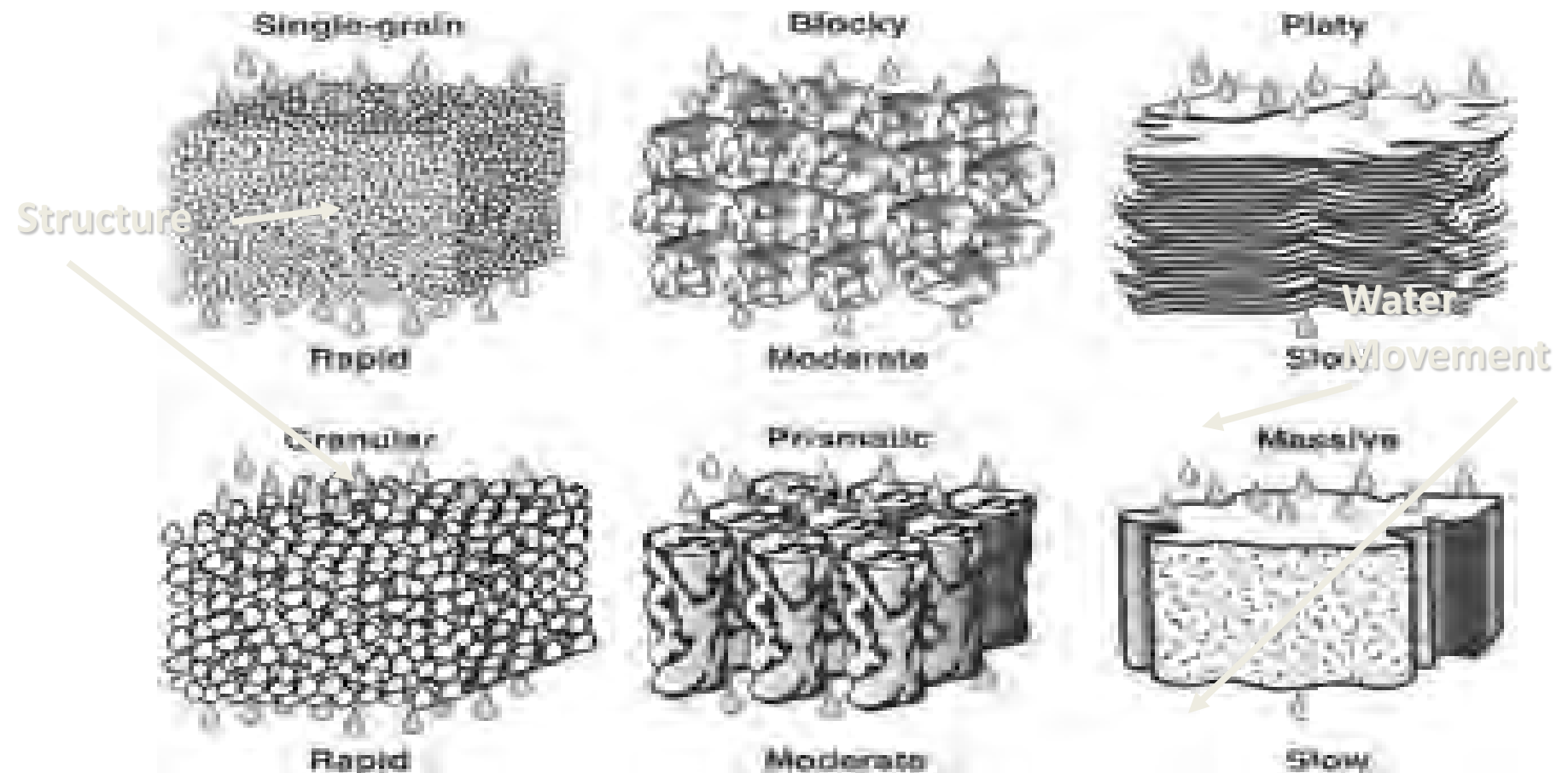
Particle Size



Porosity

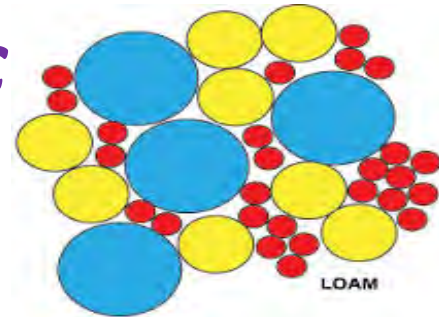
- *Soil porosity* is the % of a soil that is pore space or O₂/H₂O.
-
- The average soil has a porosity of about 50%
- Sands have larger pores, but less total pore space than clays.

Concept: Think About Water & Air Movement



<http://ohioline.osu.edu/b905/images/006.jpg>

CONCEPT: How does structure affect water movement in soils?



- **Good Structure → pore space is large:
Good water and air movement.**
- **Well-developed structure →
important in clayey soils.**
- **Clayey soils with poor structure:
Reduces water and air movement.**

Physical Indicators of Soil Quality

- **Color**
 - Visual Test
- **Soil Texture**
 - Texture-by-Feel
 - Ribbon Test
 - Soil Suspension/Sedimentation Test: % of Sand, Silt & Clay



Soil Texture is the single most important physical property of the soil.

It helps the grower recognize:

1. Water flow potential & holding capacity
2. Fertility potential
3. Suitability for urban uses like bearing capacity

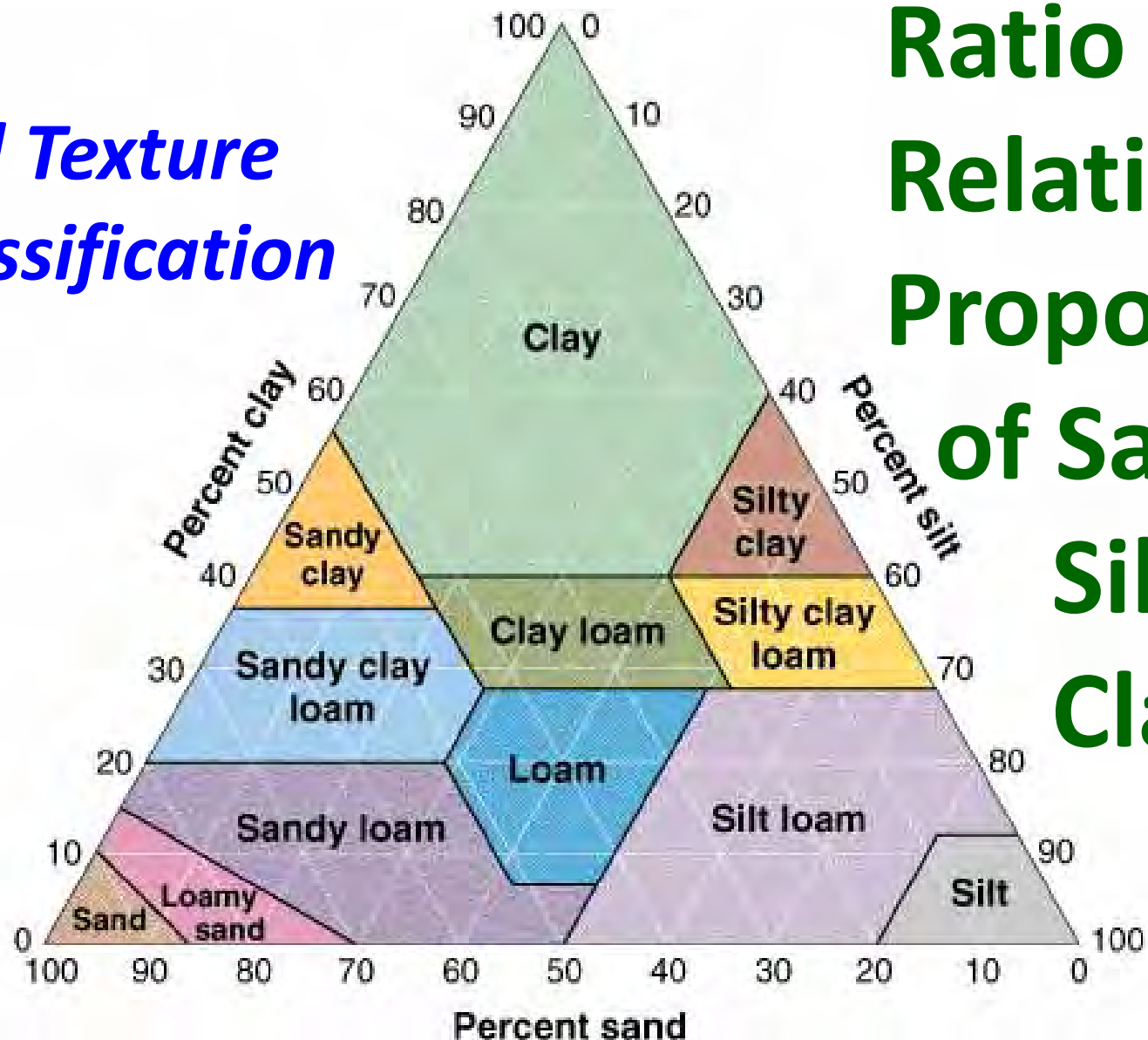


Physical Indicators of Soil Quality

*See Soil
Suspension/Sedimentation
Test Instructions*

Physical Indicators of Soil Quality

Soil Texture Classification



**Ratio or
Relative
Proportions
of Sand to
Silt to
Clay**

Chemical Indicators of Soil Quality

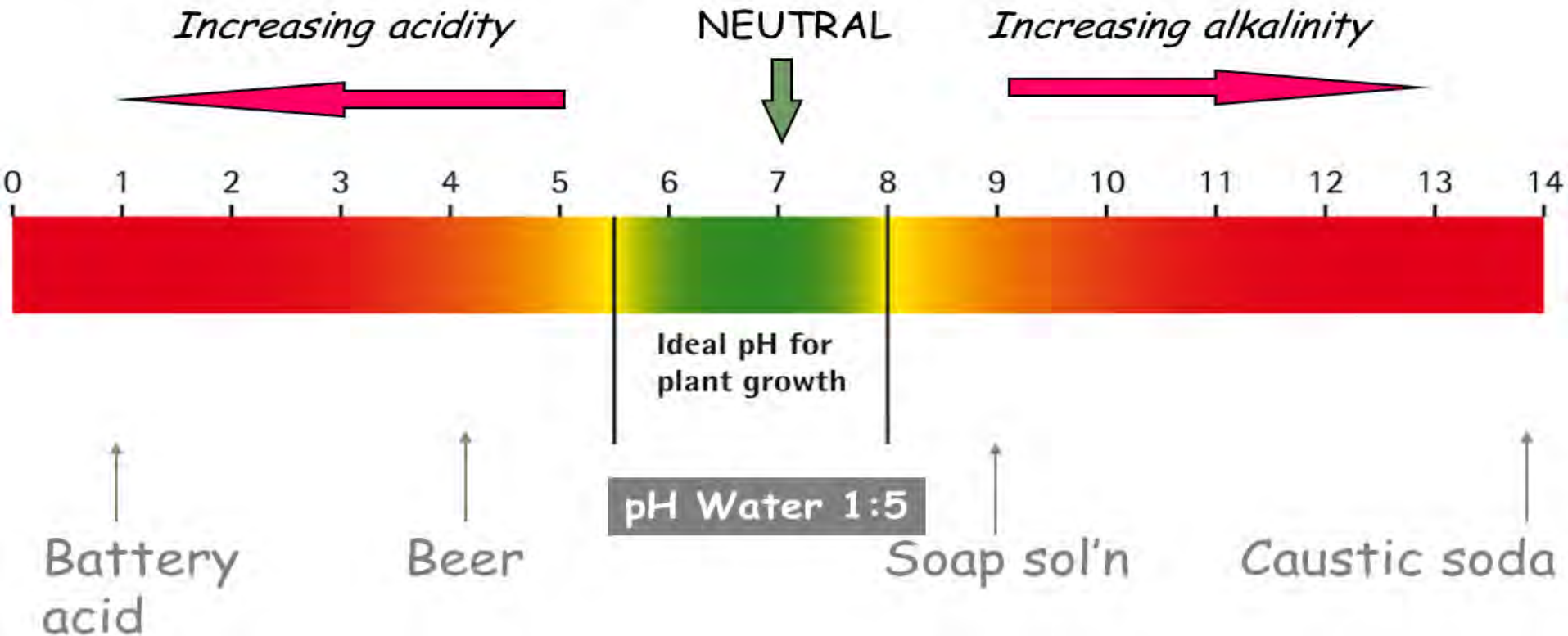
- pH Test (Range: 0-14)
- Electro-Conductivity Test
for Soluble Salts (Unit: PPM)
- Cation Exchange Capacity

Chemical Indicators of Soil Quality

- *Soil pH Scale*

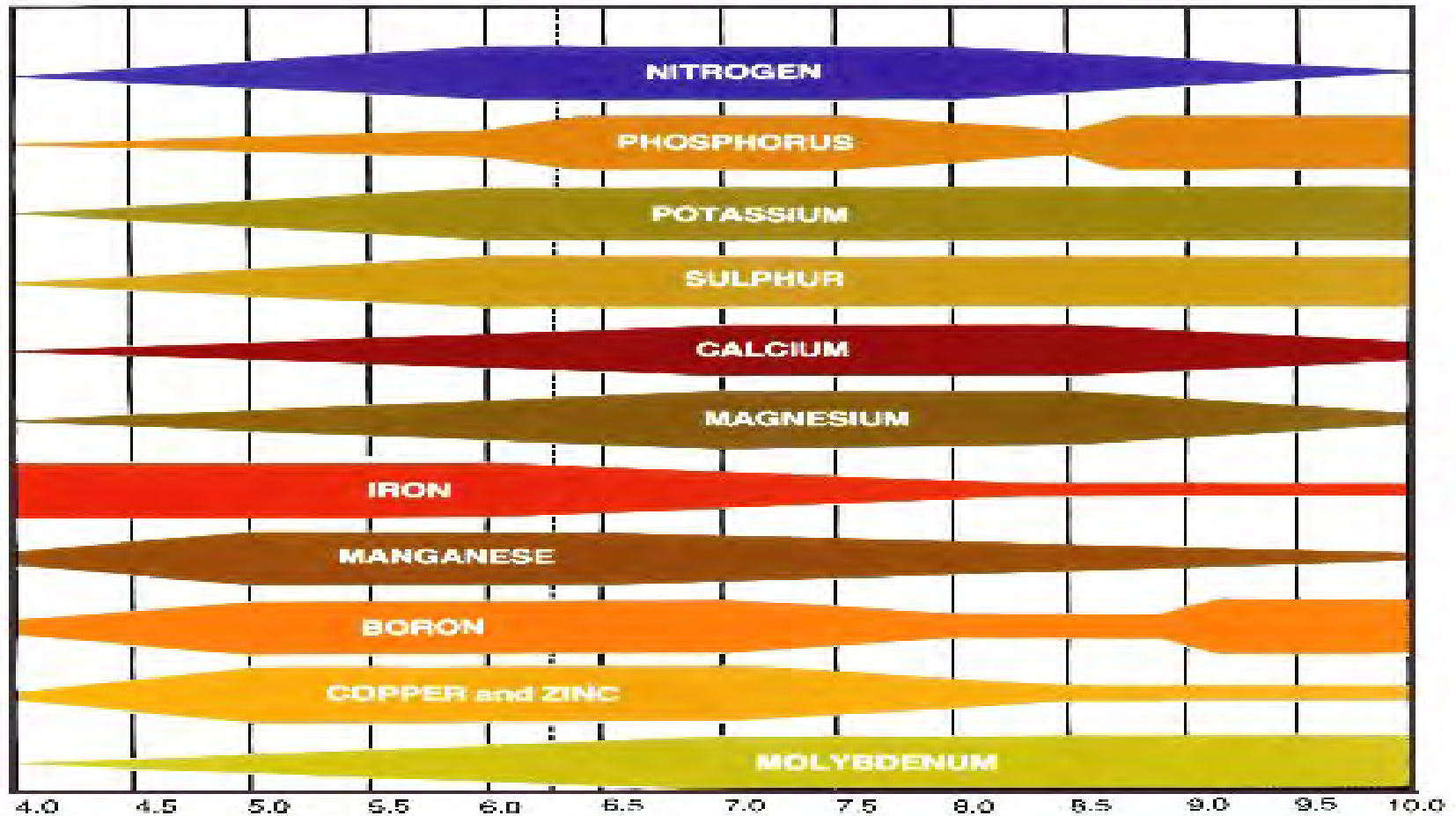
Soil pH - what is it?

- measure of the acidity or alkalinity of a soil
- concentration of hydrogen ions (H^+) in the soil solution

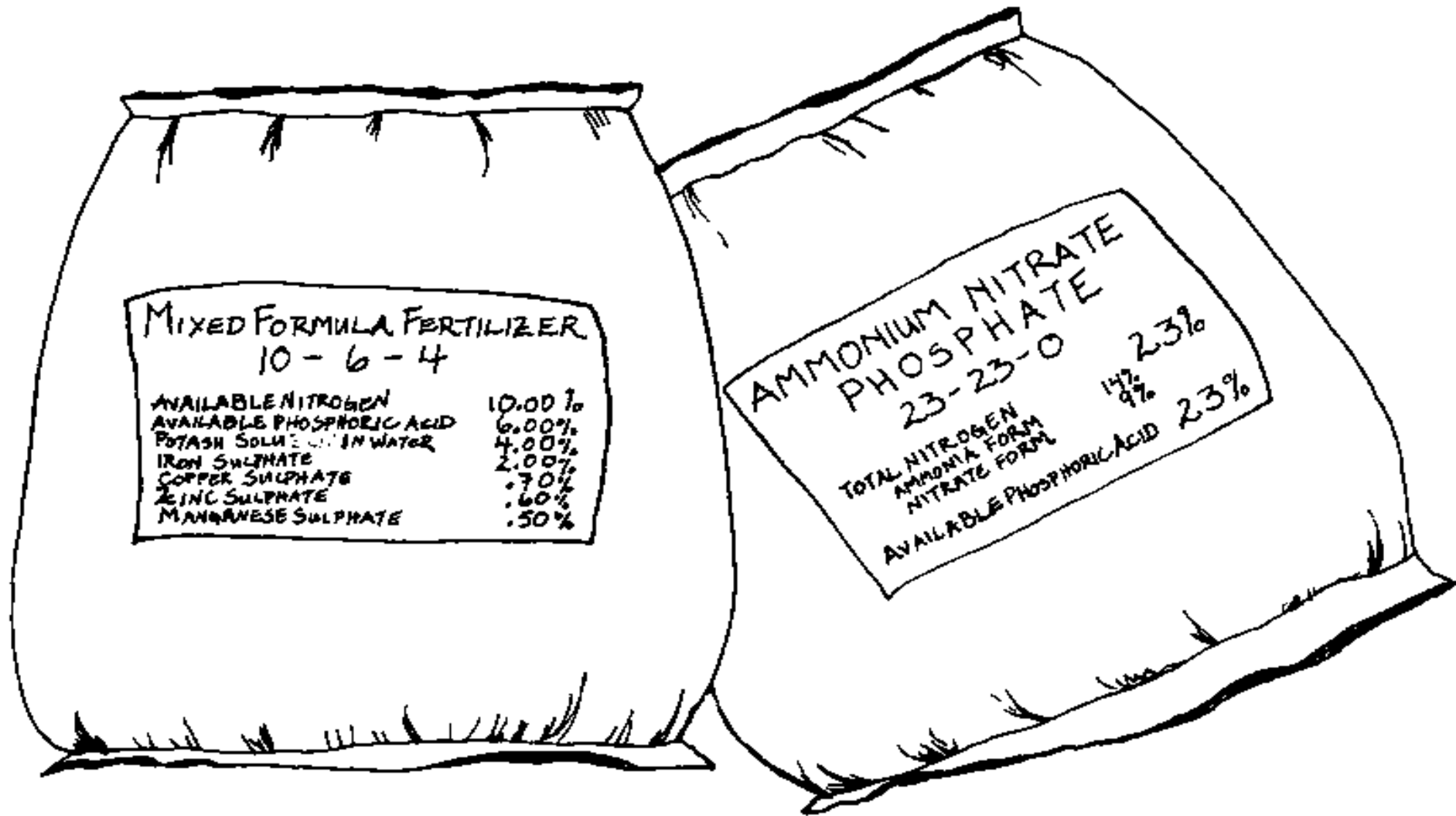


Chemical Indicators of Soil Quality

pH ~ Macro/Micro-Nutrient Absorption

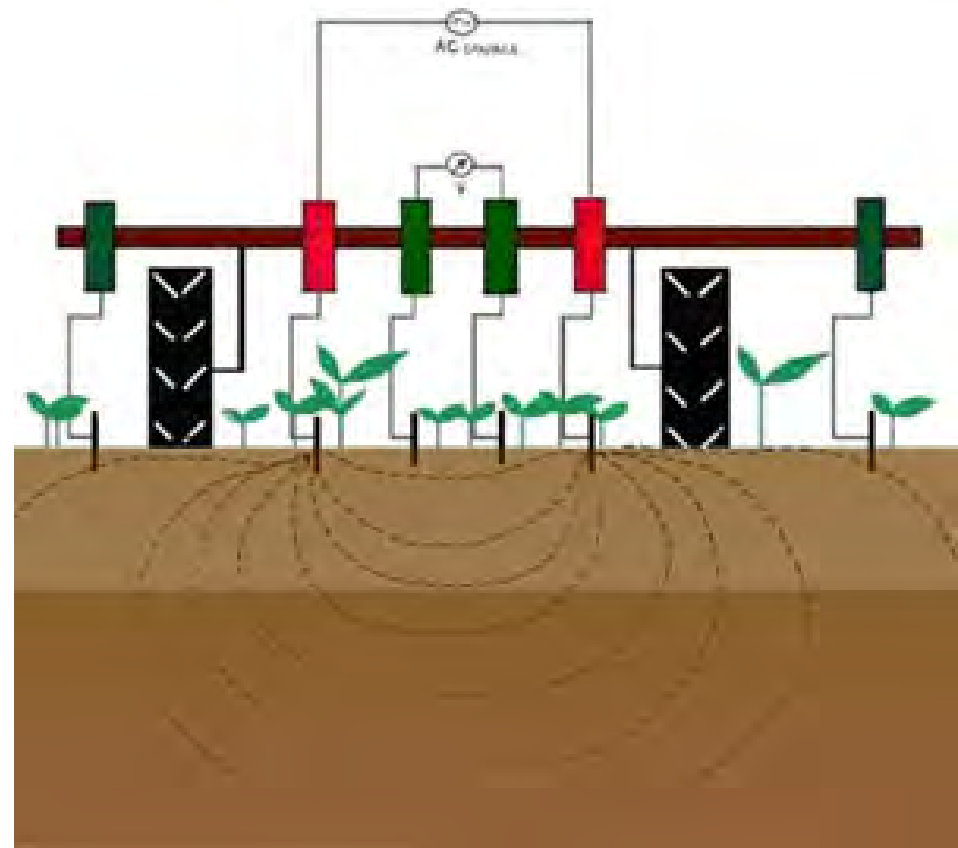


N P K



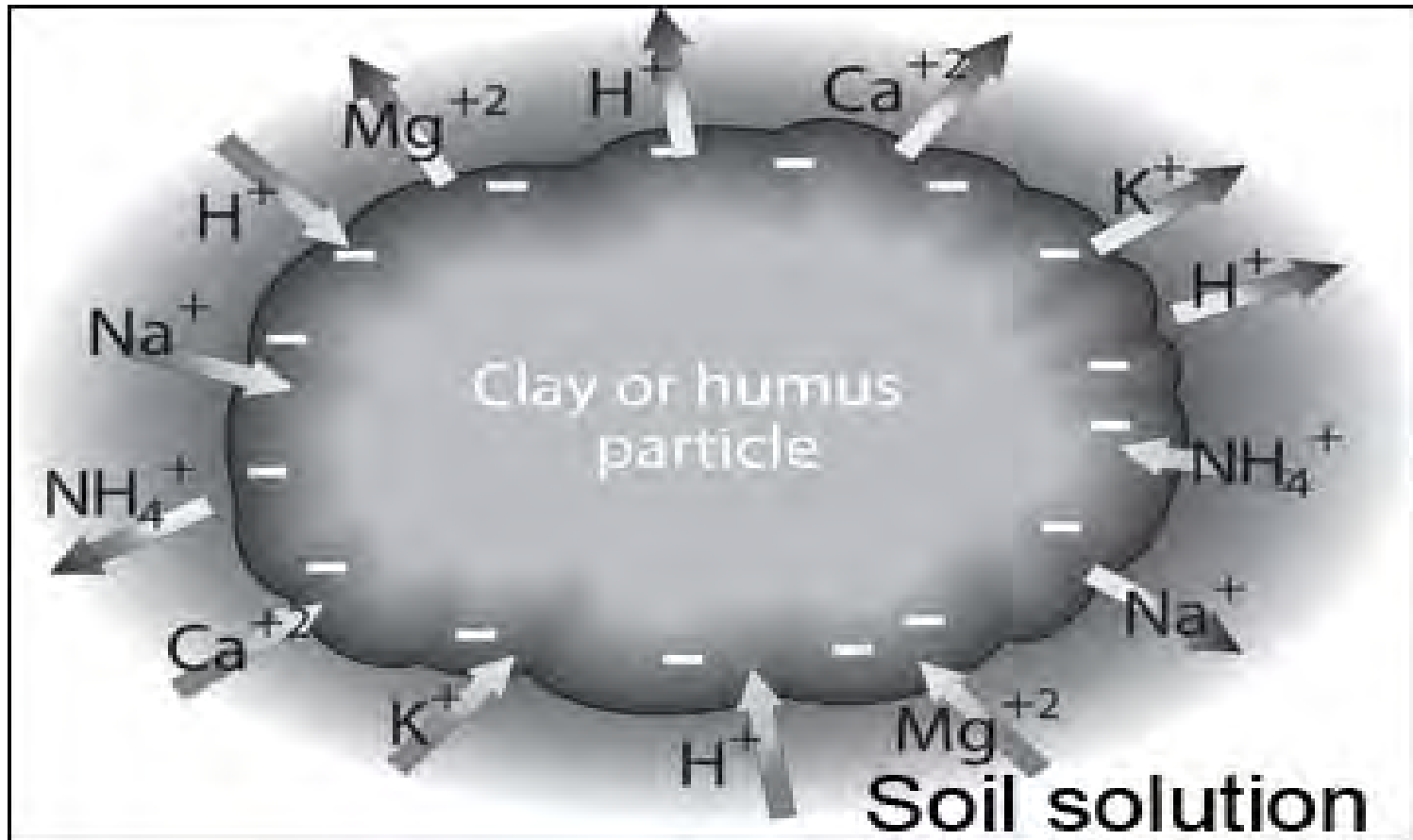
Chemical Indicators of Soil Quality

*Electro-Conductivity Measures
Soluble Salts and Fertilizer Tie Up (PPM)*

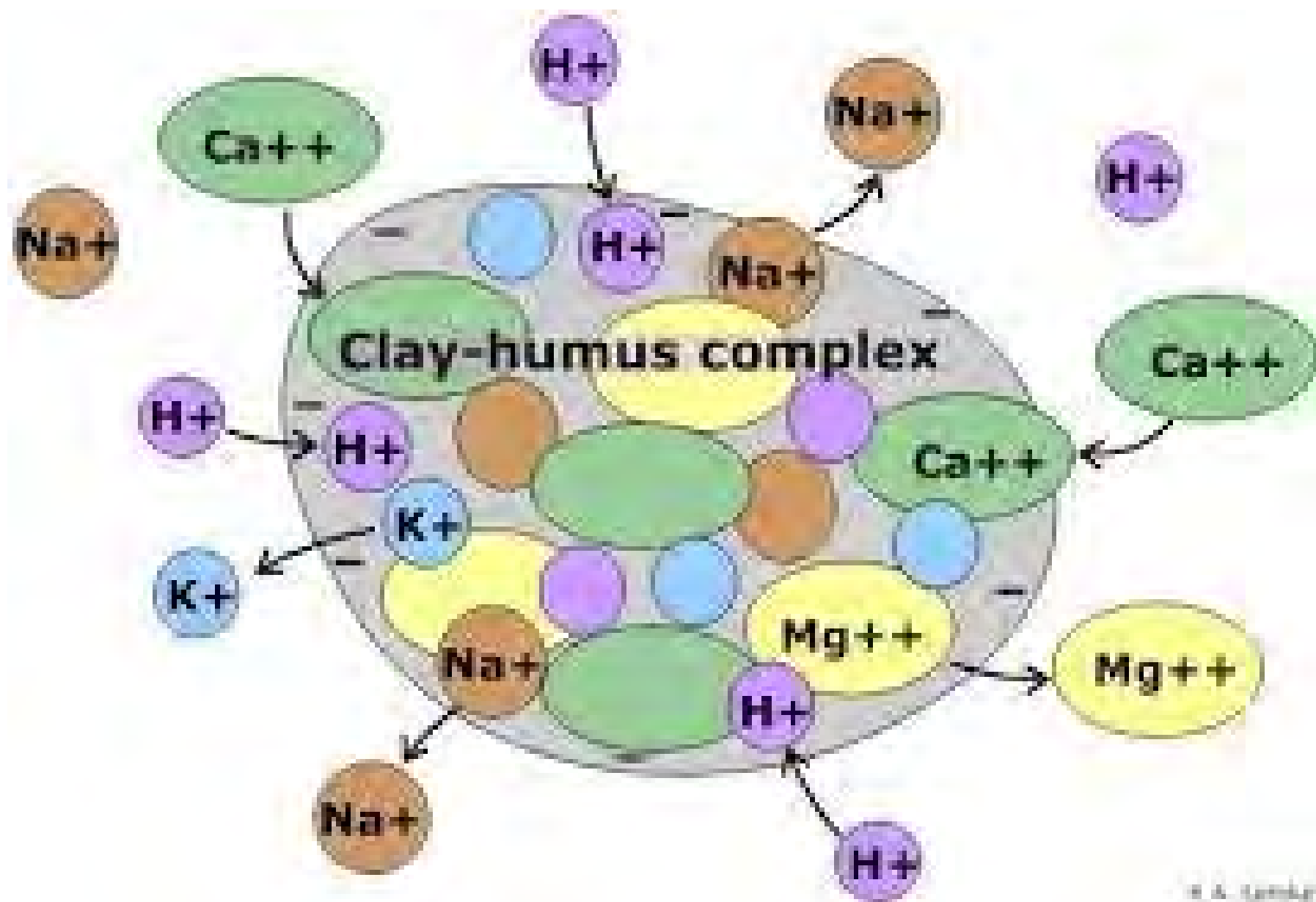


Chemical Indicators of Soil Quality

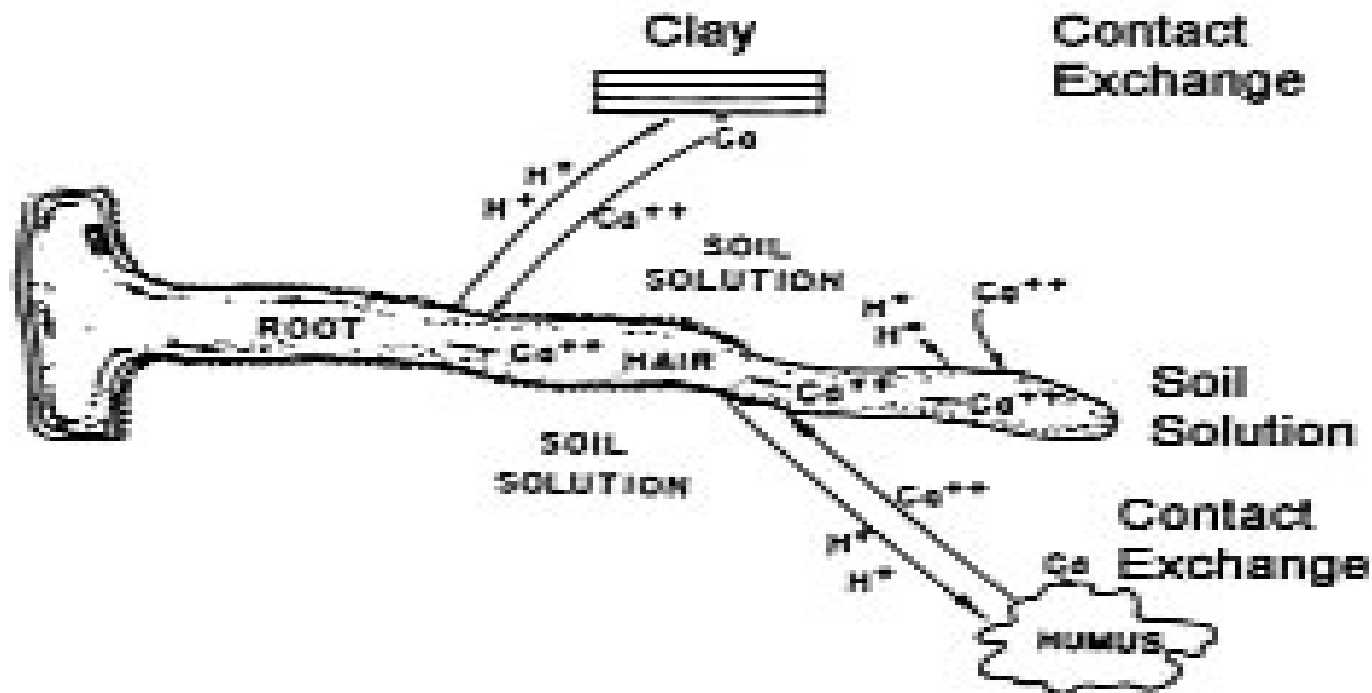
Cation Exchange Capacity



Soil CEC measures a soil's negative charge!



Cation Exchange at Root Tip

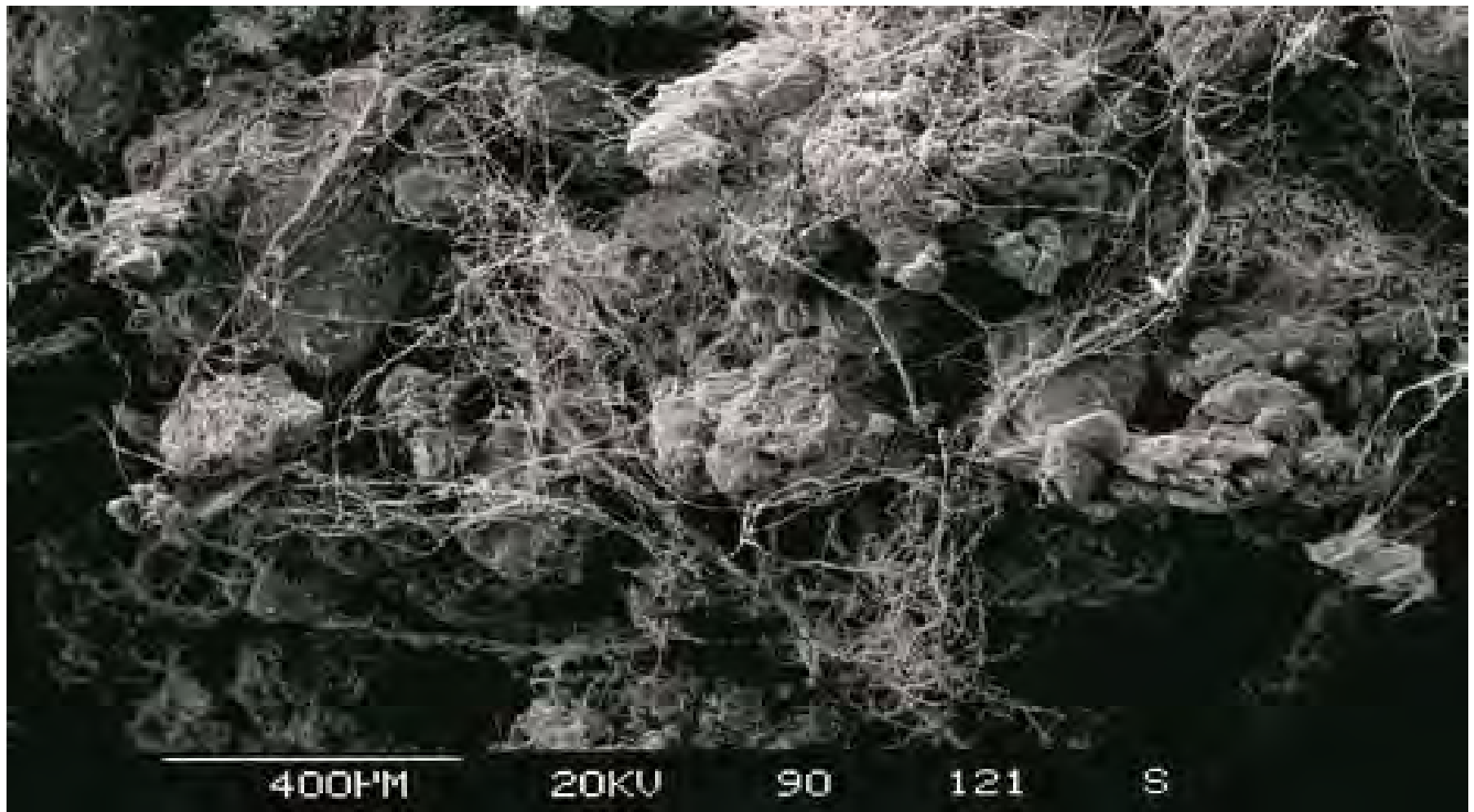


Diagrammatic scheme showing how root hair takes in nutrients from exchangeable ions on a clay crystal and on humus, and from soil.

Concept:

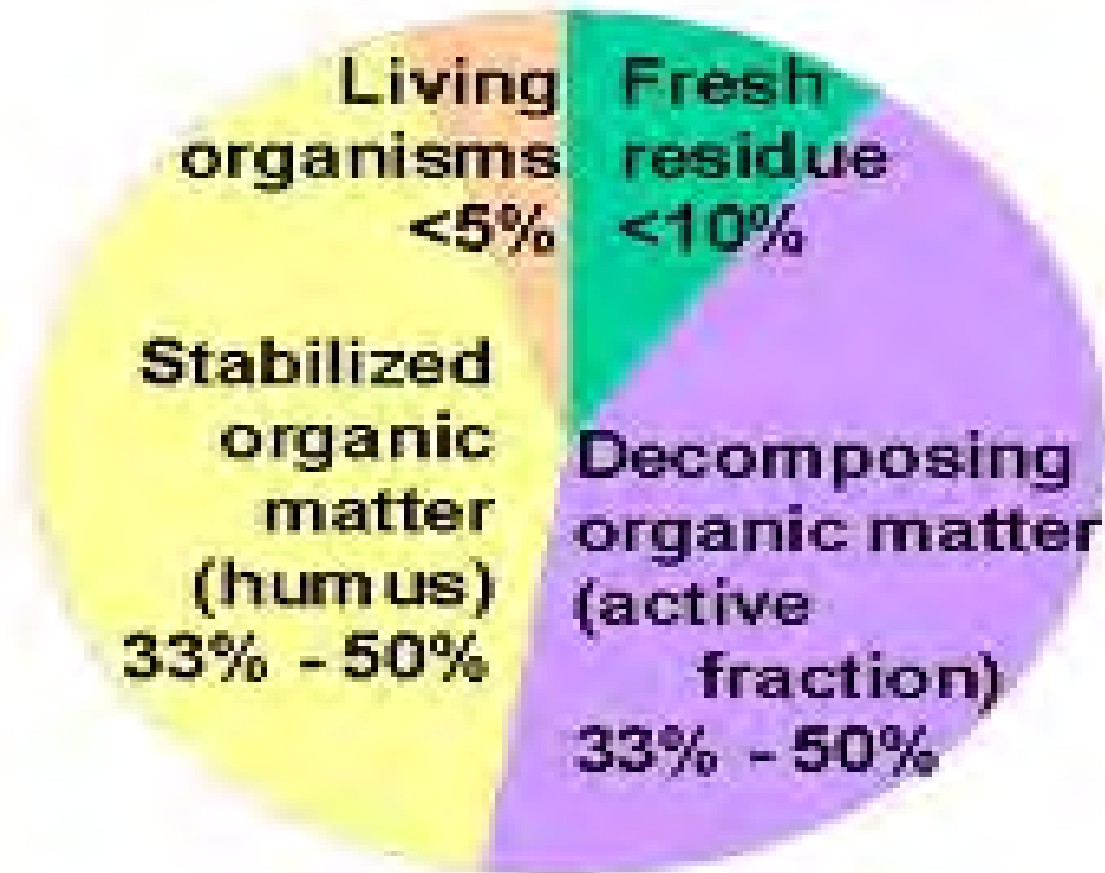
Organic Matter (and Clay)

- Has a Large Surface Area
- Incorporating OM Enhances Nutrient Exchange in Root Zone
- $\uparrow$ % *Organic Matter*
 $\rightarrow \uparrow$ *Cation Exchange Capacity*



Fungal networks: *Threadlike fungal networks hold soil particles and micro aggregates onto the surface of crop residues as part of the formation of stable soil aggregates. Cultivation disrupts soil aggregates whereas minimum till combined with stubble retention enhances aggregate stability, stimulates microbial growth and improves soil structure.*

Your Goal



Chemical Indicators of Soil Quality

CONCEPT:

Cation Exchange Capacity (CEC)

→ ~SOIL FERTILITY

***by Affecting Water Holding Capacity
& Nutrient Holding Capacity***



Biological Indicators of Soil Quality

Secret:

(Soil Biodiversity)

***Bacteria, Worms, Pill Bugs, Centipedes &
Millipedes, etc.***

SSShhhhhhhh.....

Don't scare the Micro-Ecosystems!



A root feeding nematode is trapped by a fungus; the fungus gives off a substance similar to that given off by the roots of plants.

<http://organicsoilsolutions.com/education-center/the-soil-food-web/>

Limiting Factor

- ***Limiting Factor for Plant Growth=Nitrogen***
- ***Limiting Factor for Plant-Nitrogen Availability=Carbon***
- ***Carbon:Nitrogen Ratios (3:1 or 2:1)***
(Think Compost Piles)

Soil Amendments to Improve Fertility

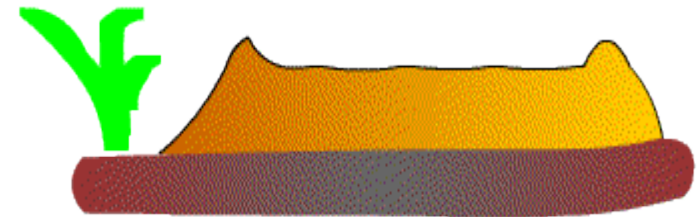
- *Manures*
- *Compost*
- *Nitrogen (Greens):Carbons (Browns),
& Nitrogen Tie-Up*
- *Organic Amendments: Composts & Manures*
- *Water Solubility & Synthetic Fertilizers*
- *Embedded Energy*

Effects of Soil Compaction

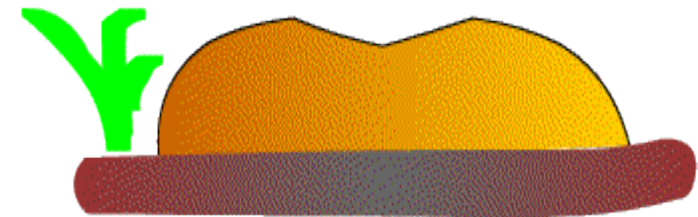
- *Reduced Root Penetration & Water Infiltration/Permeability*
- *Decreased Pore Size and Root Zone Soil-Temperature (Think Tomatoes)*

RESPONSE: RAISED BEDS

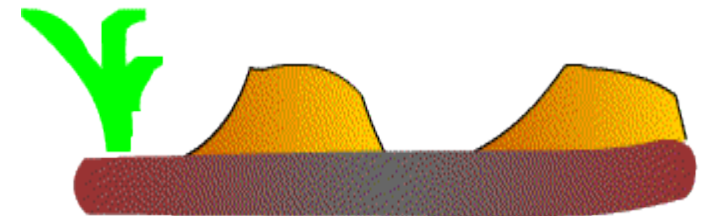
Raised Bed Styles



Flat, for light, sandy soil



Rounded for good humus



Trench in the middle,
more drainage

Soil Amendments for Managing Compaction:

***Mulches
Of Many Kinds.....***

Soil-Protection & Watering

***Cover Crops, Inter-Planting
& Companion Planting***

Sources of Heavy Metal/Lead Exposure

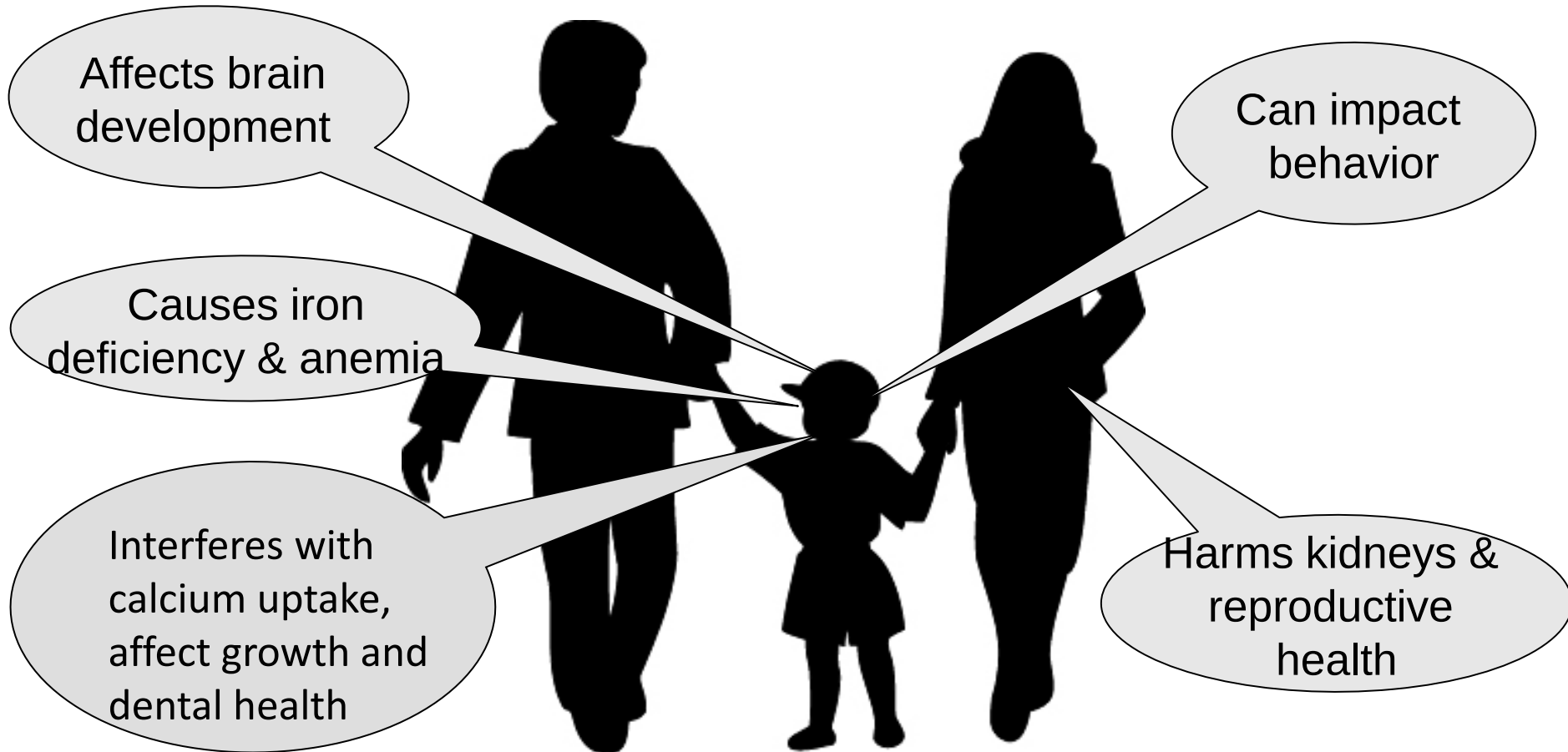
- Lead **paint** hazards
→ lead **dust** in homes;
from exterior prep work
& friction of windows
- Bare **soil** in yards with
lead contamination from
house paint or previous
use of leaded gasoline
- **Take-home** lead dust
from construction work
or other occupations



Understand: How do we get lead into our body while growing food?

- **Hands contaminated with leaded soil**
Contaminated hands touch mouth, food, drink container, cigarette
- **Hands contaminated with leaded paint**
Hands touch damaged lead paint and its dust. Then hands touch mouth, food, drink container, cigarette, etc.
- **Eating lead-containing soil or paint dust on unwashed produce, or eating produce that has lead uptake**

How Lead Toxicity Affects Health!!!



Children at most risk- their brains & bodies are still developing (& fetus, because lead easily crosses placenta).

Site History:

Possible Sources of Lead Risks

- *Contamination in existing soil from unknown sources*—particles from previous leaded gasoline use, demolition of building, etc.
- *History of Industrial Use*
- *Pre-1979 buildings with Chipping Paint*

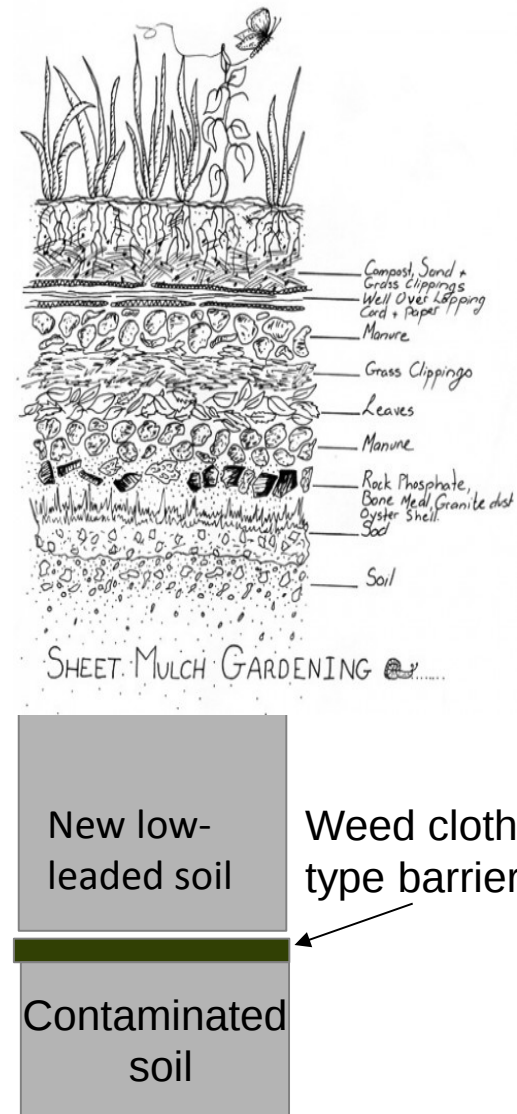
Best Practices to Reduce Heavy Metal Exposure from Growing Food

- *Wear Gloves & Practice Good Personal Hygiene*
- *Garden in low-leaded soil when possible*
 - *Test soils to confirm lead is < 80 ppm*
 - *Buy Organic Materials Review Institute (OMRI)*
- *Don't Let Kids Garden/Play in > 80 ppm Soils*
- *Be Aware of Soil Contamination →*

Watch for Site Risks!!!!!!!!!!!!

2 Ways To Garden Using New Soil

- In Raised Beds:
*No Pressure-Treated Wood,
or Recycled Painted Materials* ☹️
- 12-18" New Soil on top of the
existing soil with a barrier in
between, such as a weed cloth



Other Gardening Practices

Best Practices: UC Davis ANR Publication 8424:

- Amend Soil with OM: Clean Compost, Decomposing Leaves, Well-Rotted Manure
- Maintain Neutral pH: Add Limestone if Soil too Acidic

“Cleaning” Lead-contaminated Soil:

EPA Experiment in West Oakland:

EPA is adding imported fish bones from Alaska to bind lead into large molecules (pyromorphites) that plants cannot uptake. The lead-bound molecules then remain in the soil.

- Phyto-remediation: Grow plants that are good at lead uptake, such as sunflowers and dispose of plants offsite (rather than in your site-based compost pile)

***Happy & Safe
Growing!
From
UC Cooperative
Extension!***



We are all Connected, Like NY Telephone!

