Soil Health Session 2

Soil Make-up and Interactions

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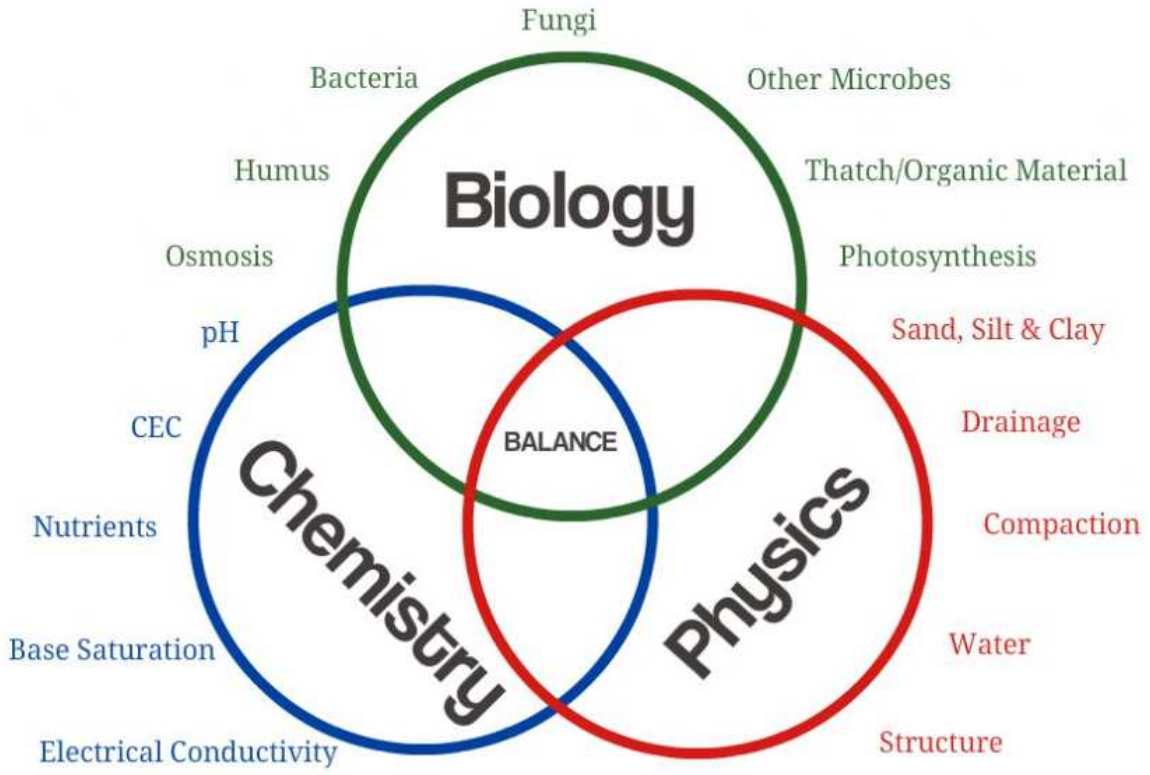
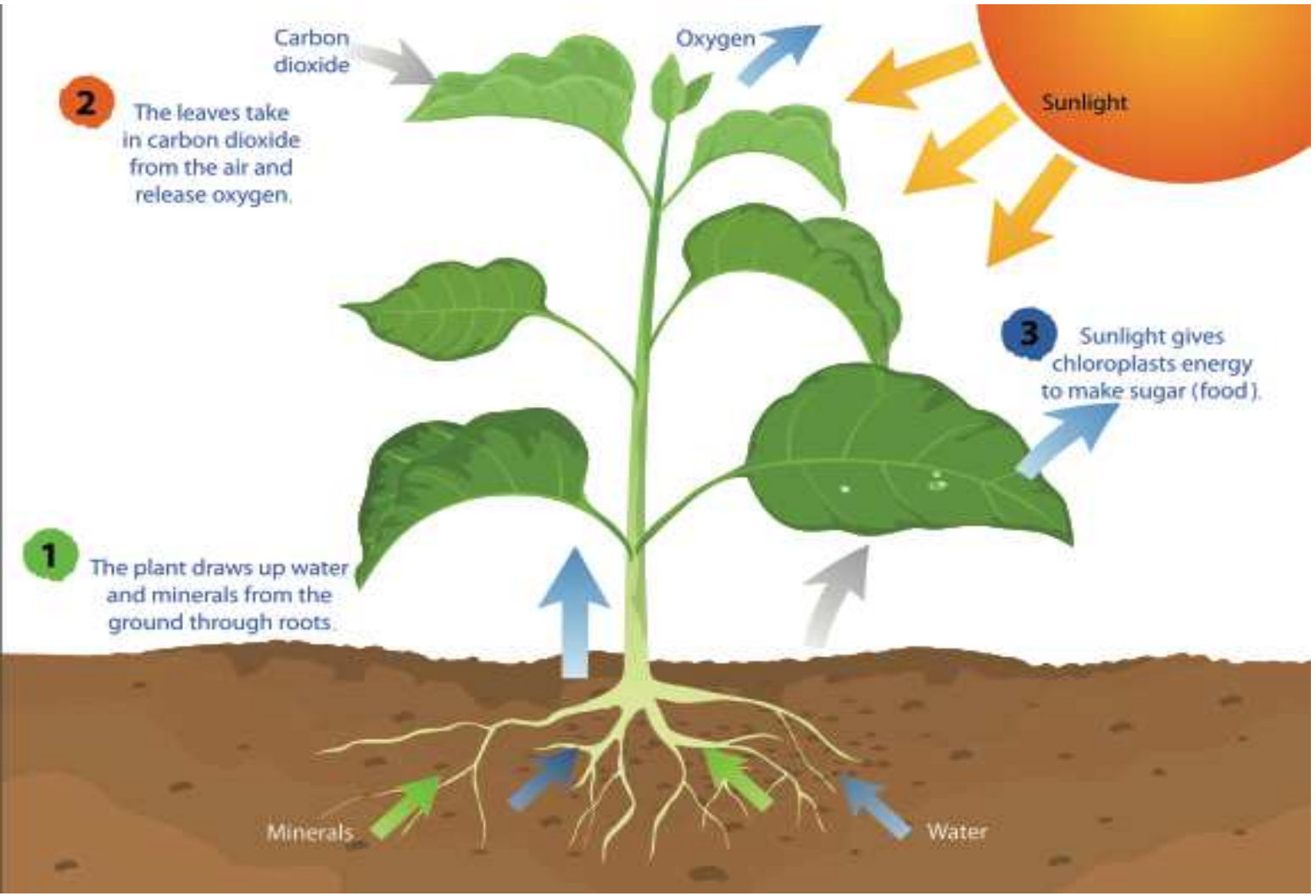


Starting Here

Soil Physics (function) = Green Plant Power



Plants are actually the 'Factories' and 'Power Plants' that power all life on our Planet!

And its all made possible by the ground beneath our feet, the precious thin layer of topsoil on the earths surface.

By taking in water and minerals through the roots, carbon dioxide from the air, and light energy from the Sun, plants can perform photosynthesis to make glucose (sugars), oxygen and useful compounds including carbohydrates, proteins, oils and active compounds. They thus supply, material, nutrition, medicine and decoration

- Our planet is solar powered. The solar cells aren't made in China they are made on the leaves of green plants. The medium supporting the solar cells is not silicon its soil!

- Soil has a vital role in the green plant power energy and carbon cycle that sustains all life on the planet:
- And being good managers and stewards of the soil is our part to play in the energy and life cycle

- The science of how soil works and how to work with it is one that ultimately is inseparably tied to human existence and wellbeing.

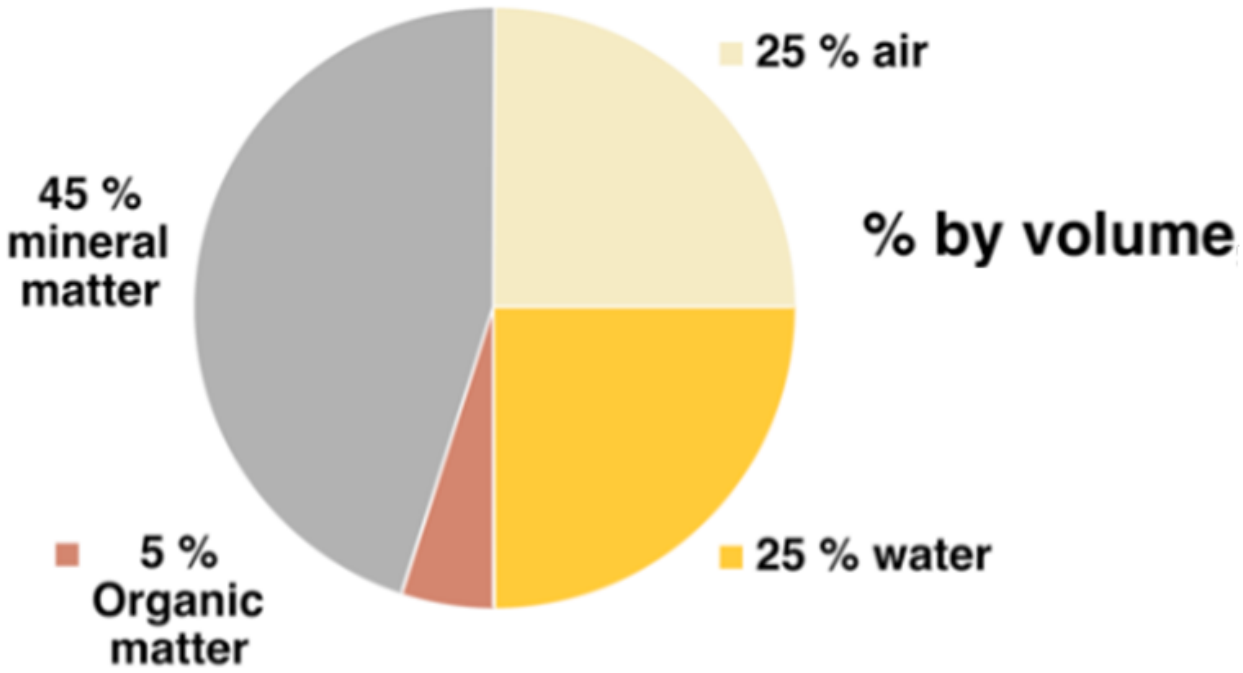
- **What should good/healthy soil look like?**
  (Gardening soil / Growing soil)
- **What does our soil look like?**
- **What can we do to make up the difference?**

(covered in subsequent lectures and particularly **Session 6 -Soil Restoration Approach & Application)**

Soil Make-up:

- **1) Composition:** percentage by volume of main ingredients (eg. cake mixture)
- **2) Texture:** Size and mixture of the soil particles.
- **3) Structure:** Physical property created by chemistry, biology and fibre

Soil Make-up:



(Ideal) **Composition:**

45% Minerals (soil particles: sand, silt, clay)

5% Organic Matter (plant material/compost-humus/roots/microbes)

25% Air (pores: tilling, worms, water suction)

25% Water (On and between particles)

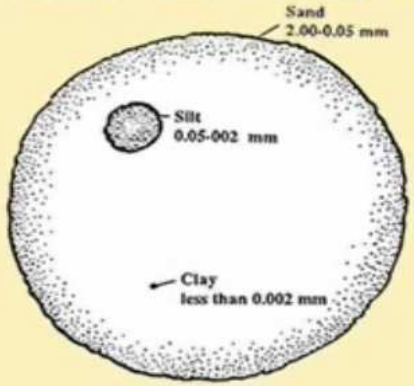
- How does this affect plant growth and nutrient availability**…….**

Texture:

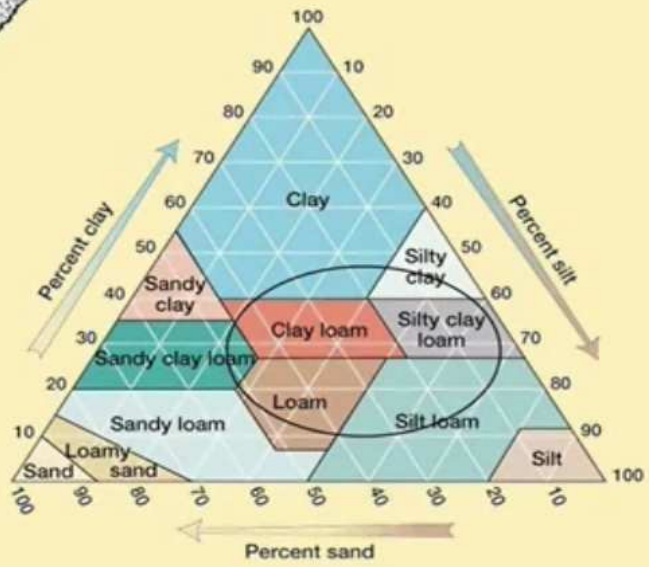
Soil Particle Sizes and Amounts (ratios).

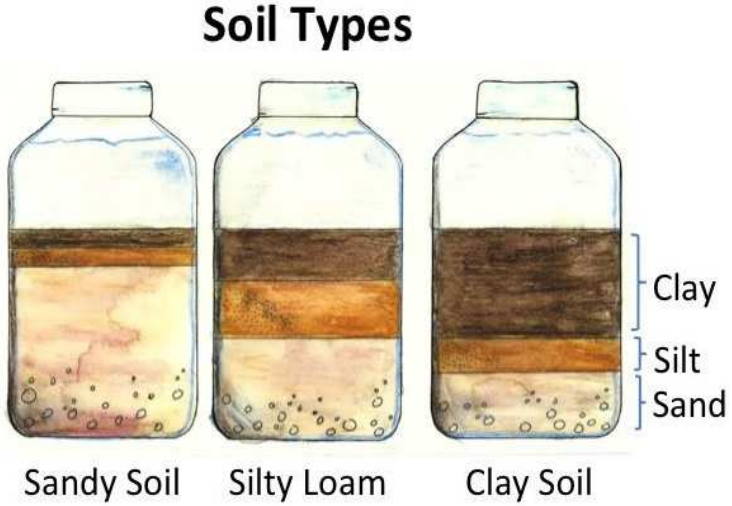
Soil texture: a reference to the size of soil particles

- Sand
- Silt
- Clay

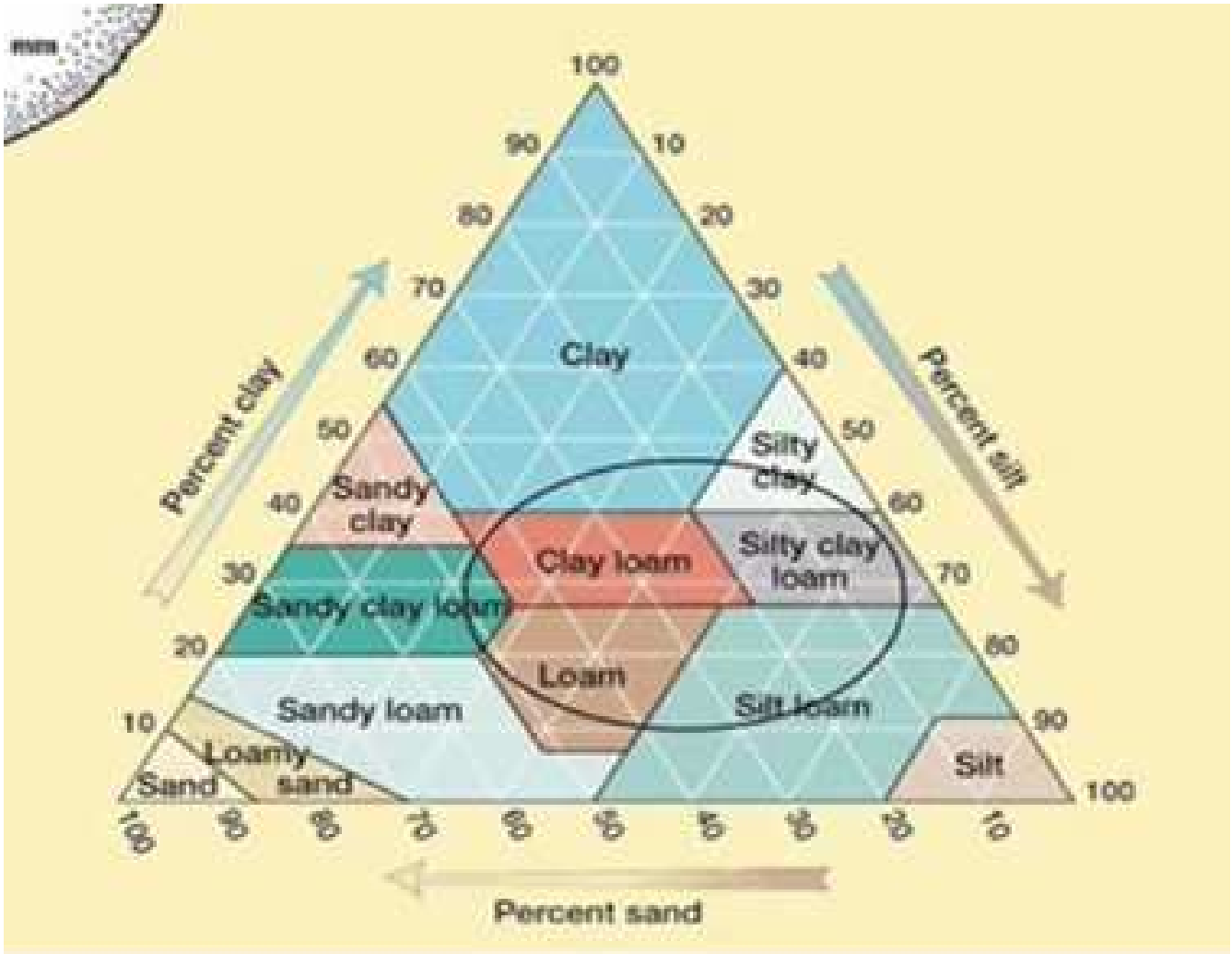


- Texture indicates potential capacity to hold water and nutrients
- Gives an indication of friability





- ***Most soil types are an uneven mixture often too sandy or heavy clay, the best soil type is a mixture of small and large particles.***
- *All types can be improved*



CLAY: over 30%, takes over

SAND: 50-70% gets dominantly sandy

SILT: over 40%, don't come across it much accept around water bodies depositing silt layers.

- **Ideal is a 'LOAM' of some sort that has a good mixture of both Sand and Clay with the benefits of both.**

- On small garden scale you can manipulate this by adding clay or sand.
- Large scale is harder.

SOIL TEXTURE COMPARISON

SOIL CHARACTERISTICS	 SAND	 SILT	 CLAY
Ability to Compact	Low	Moderate	High
Air Space	High	Moderate - High	Low
Soil Fertility	Low	Moderate - High	Moderate - High
Tendency to Form Clods	Low	Moderate	High
Water-Holding Capacity	Low	Moderate - High	High
Water & Air Permeability	High	Moderate - High	Low
Workability	High	Moderate - High	Low

Main Soil Classes according to pH:

<u>Acid Soils:</u>

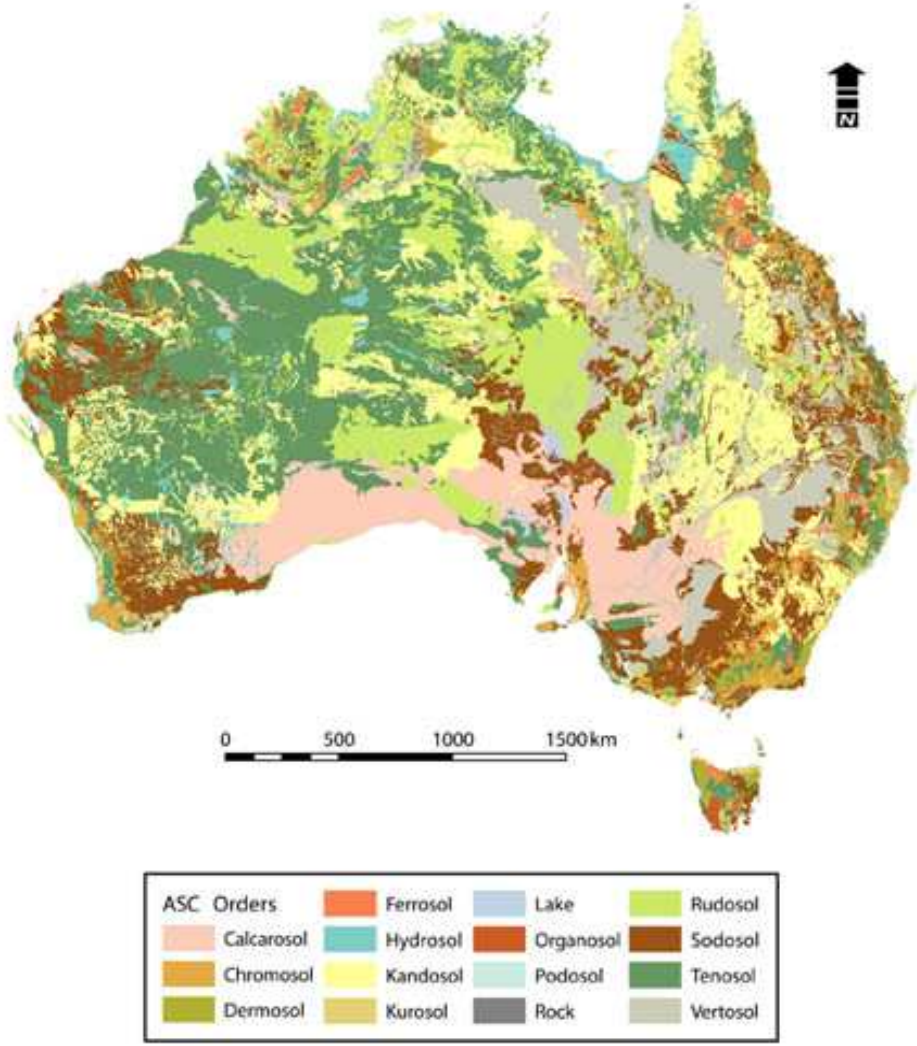
- pH below 7,
- Free Hydrogen H+ in base saturation
- 70% of the worlds land

<u>Alkaline Soils:</u>

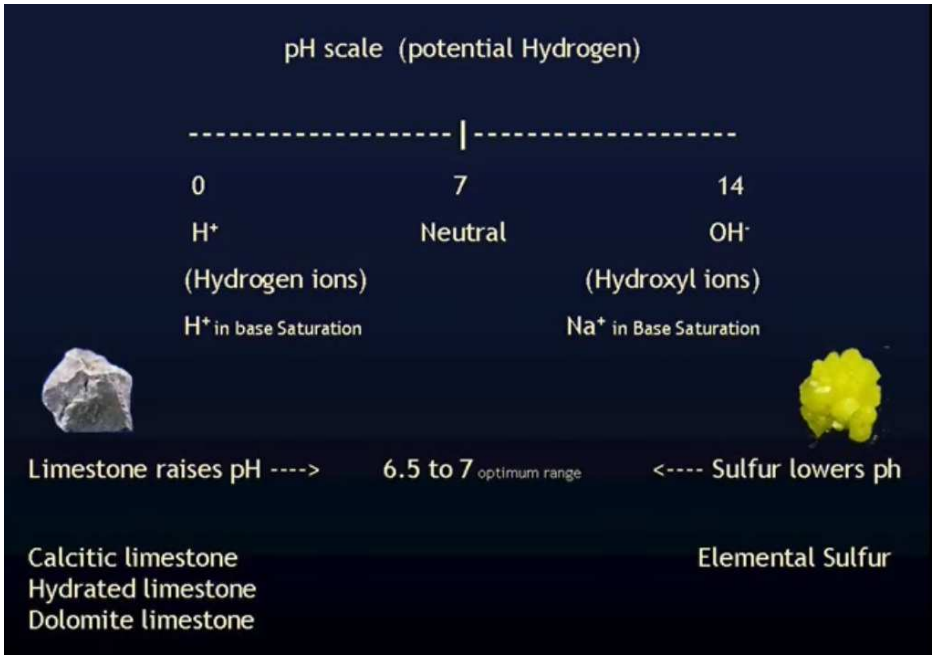
- Alkaline pH 7.1-8.3
- Contain Calcium and Magnesium carbonates and Phosphates (all alkaline)
- Can be very fertile, but alkalinity issues.

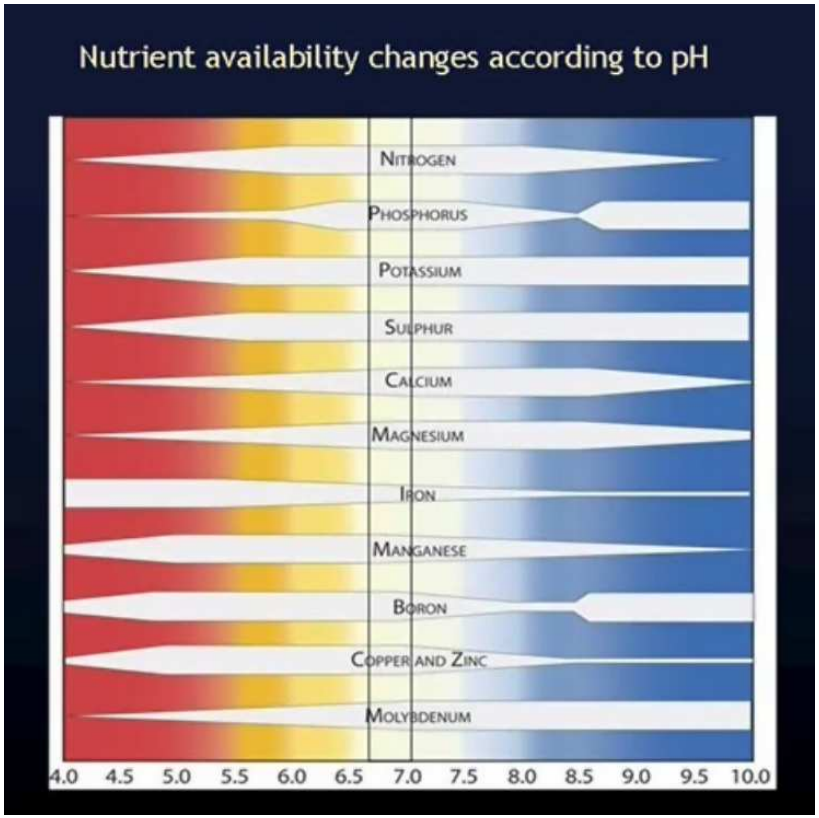
<u>Highly Alkaline Salty Soils (Sodic):</u>

- Highly alkaline, pH above 8
- Excessive free Sodium Na+ in base saturation (above 15%)
- poorly drained, poor water penetration
- Found in arid and semi-arid regions



- ***Soil pH:*** *(Acidity and Alkalinity)*
- Affects the availability of various minerals and the leaching/availability of minerals from the parent material. Usually wants to be slightly acid around pH of **6.5-7.0**, there are exceptions. (exception example Dysinger farm: on rock-phosphate iron ore, too much leeching causing detrimental excess, they needed to keep pH higher to limit leaching)
- Can be manipulated but **should be addressed in the soil Chemistry** (base saturation)

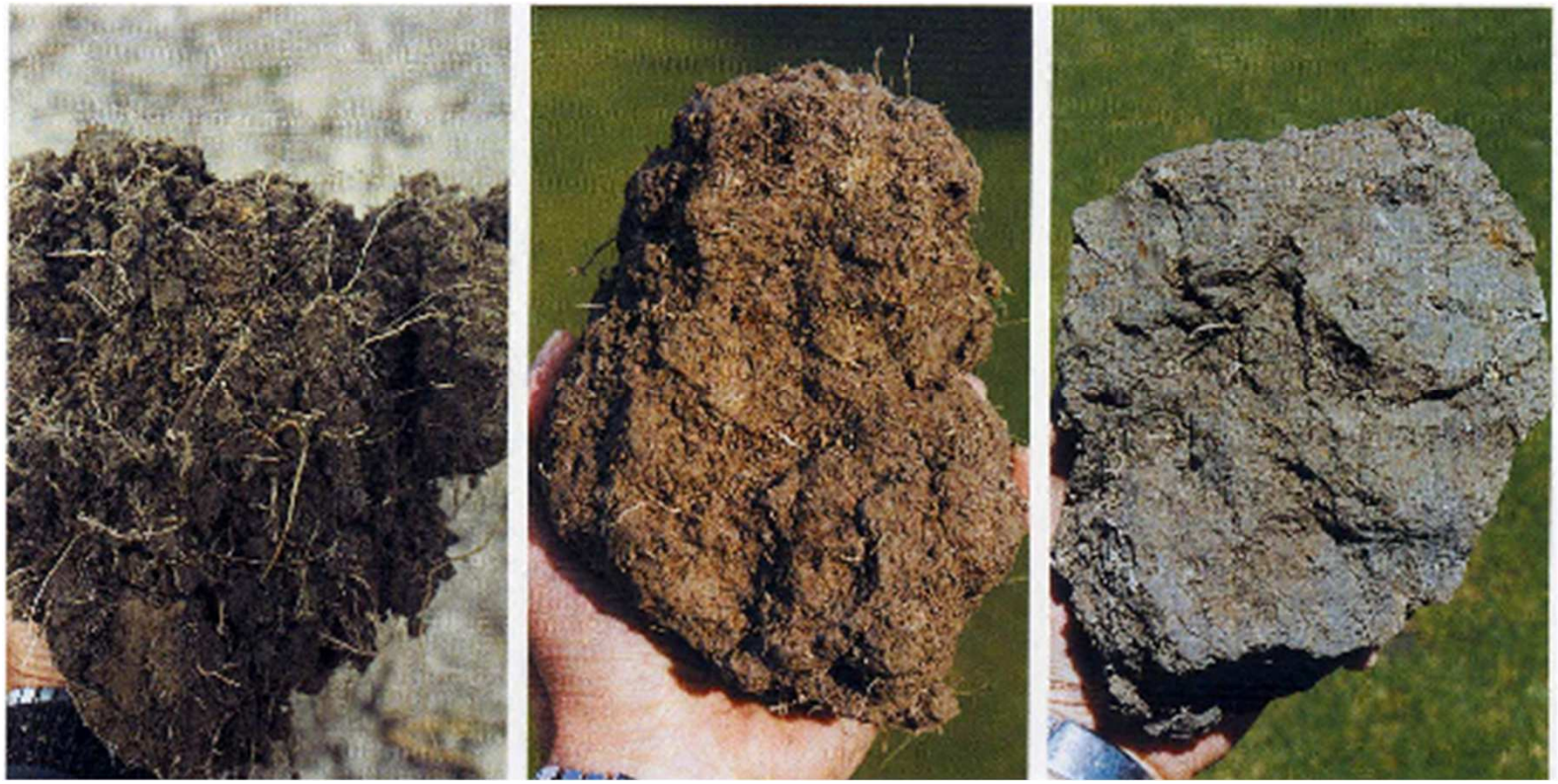




Soil Make-up: - STRUCTURE

Physical property created by chemistry, biology and fibers.

Think of a large house with many rooms and service cables and water pipes, if it got flattened by a cyclone or bulldozer, how would that effect its function and usefulness?



Archuleta Slake Test

Soil Make-up: - STRUCTURE

Factors:

- **Aggregate stability:** biological cementing glues which are hydrophobic – don't dissolve or fall apart in water = weather proof house
- **Porosity:** allows for water penetration without disrupting or destructing the structure. Spaces for air and water, sand more, clay not. (To hold air need big gap, to hold water small gap, so need lots of different 'room' sizes, biology does the hard work here.
- **Infiltration:** (ability to accept rain or water phobic) Observe if water is puddling or soaking in well. Does water pool in heavy rain.
- **Aeration** (ideal 25%) – Mottling(in clay with no air, chemistry changes and you see dark blue/purply mottling showing lack of air – vegetable roots wont thrive in that anaerobic environment.
- **Water / Moisture** (25% water) Inbuilt water tank

Soil Make-up: - STRUCTURE

Factors:

- **Cracking** (What Clays do), causes problems without moisture constant.
- **Compaction** (hard pan – stops root penetration because of compaction

'farming in a bucket', plough layer),

Tilling (rotary hoeing) often demolishes aggregate stability in that top plough layer, the clay that clouds in slaking and dispersion will travel down and settle out below causing a hard pan (dam under the soil) Using deep ripping, chemistry, and roots/biology is long term solution.

- **Soil temperature** (exposure to sun and colour),

Mulch protection

Both cold and heat cause biology to hibernate.

Roots prefer constant temperature, prefer not to freeze overnight and boil during the day. There are optimum temps for best nutrient uptake.

Rooting depth (How much do the plants have access to?)
Table (veg 30-60com) shows potential
(plants have genetic potential and generally we aren't reaching that)

Condition of the soil determines how deep pants will root, thus how much they access deeper water reserves.

Effective Rooting Depth for Various Crops at Maturity in Homogeneous Deep Soils

Crop	Stage (cm)	Crop	Stage (cm)	Crop	Stage (cm)
Lucerne	90-180	Grains	60-150	Safflower	90-180
Beans	50-90	Grapes	75-180	Soybeans	60-125
Citrus	120-150	Legumes	50-125	Strawberries	20-30
Cotton	75-170	Maize	75-160	Sugarbeet	60-125
Crucifers	30-60	Olives	100-150	Sugarcane	75-180
Cucurbits	75-125	Onions	30-75	Tomatoes	40-100
(cucumbers)		Pastures	60-100	Tobacco	45-90
Deciduous orchards	100-200	Peppers	40-100	Vegetables	30-60
Eggplant (aubergine)	75-120	Potatoes	30-75		

In Summary:

What type of soil we have, but more importantly how we work it and feed it will determine the character and thus the function and fruit that it can give.

"Inherited and Cultivated Tendencies"