

**Soil**

**“***We are overlooking soil as the foundation of all life on earth.”*Andres Arnalds, Asst. Director, Icelandic Soil Conservation Service

* **Definition:**
* **Composition – 4 Distinct Parts**
* **Importance:**
  + **Organisms, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, inhabit the soil & depend on it for shelter, food & water.**
  + **Plants anchor themselves into the soil, and get their nutrients and water. Terrestrial plants could not survive without soil, therefore, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**
* **Soil Formation**
  + **Parent Material**
    - **The rock that has slowly broken down into smaller particles by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**
    - **To form 2.5 cm (1 in.) it may take from \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_years.**
  + **Physical Weathering**
    - **Ex.**
  + **Chemical Weathering**
    - **A plant’s roots or animal cells undergo cell respiration and the \_\_\_\_\_\_\_\_\_\_\_\_produced diffuses into soil, reacts with H2O & forms \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (H2CO3). This eats parts of the rock away.**
  + **Renewable or Not?**
    - **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ produces new soil**
    - **But, in the tropical rainforests, all of the nutrients are caught in the trees and when cut down & burned the soil cannot get the nutrients back.**
* **Soil Properties:** 
  + **Texture**
    - **The percentages (by weight) of different sized particles of sand, silt and clay that it contains.**
    - **>2mm in diameter = gravel/stones (not actually considered soil because it doesn’t have direct value to plants.**
    - **\_\_\_\_\_\_\_\_\_\_\_\_ = sand (the largest soil particles) can be seen easily with the eye.**
    - **0.002 to 0.05mm = \_\_\_\_\_\_\_\_\_\_\_ – about the size of flour and barely visible with the eye.**
    - **\_\_\_\_\_\_\_\_\_ = clay (has the greatest surface value) – only seen under and electronic microscope.**
* **Soil Properties (Cont.):** 
  + **Structure**
    - **How soil particles are organized and clumped together. (Sand, silt, clay)**
  + **Friability**
    - **How easily the soil can be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**
  + **Porosity**
    - **A measure of the \_\_\_\_\_\_\_\_\_\_\_\_\_ of soil and the average \_\_\_\_\_\_\_\_\_\_\_\_\_ between the spaces.**
  + **Permeability**
    - **The rate at which \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ moves from upper to lower soil layers. It is distances between those spaces**
  + **Shrink-Swell Potential**
    - **Some soils, like clays, swell when H2O gets in them, then they dry and crack. This is bad for house foundations, etc.**
  + **pH**
    - **The pH of most soils ranges from \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**
    - **But, the soil of the Pygmy Forest in California is extremely acidic (2.8-3.9) and in Death Valley, California, it is very basic (10.5).**
    - **Plants are affected by pH because of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**
  + **Slope**
    - **Steep slopes often have little or no soil on them because of gravity.**
    - **Runoff from precipitation tends to erode the slope also. Moderate slopes and valleys may encourage the formation of deep soils.**
  + **Depth**
    - **Some soils are very shallow (like in some places in Dallas). It can be only two inches of soil and then you hit rock. Other areas can have soil \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ deep or more.**
  + **Color**
    - **Dark soil is rich with lots of organic matter.**
    - **Light soil (like sand) is not so rich with very little organic matter.**
* **Soil Horizons**
  + **Organic Layer (O-horizon)** 
    - **The uppermost layer; it is rich in\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**
    - **Plant litter accumulates in the O-horizon and gradually decays.**
    - **In \_\_\_\_\_\_\_\_\_\_\_\_\_\_ soils the O-horizon is completely \_\_\_\_\_\_\_\_\_\_\_\_\_, but in certain organically rich soils it may be the dominant layer.**
  + **Topsoil (A-horizon)**
    - **It is dark and rich in accumulated organic matter and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**
    - **It has a granular texture and is somewhat \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ due to the loss of many nutrient minerals to deeper layers and by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**
  + **Subsoil (B-horizon)**
    - **The light-colored subsoil beneath the A-horizon; it is often a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ where nutrient minerals have leached out of the topsoil and litter accumulate.**
    - **It is typically rich in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ compounds and \_\_\_\_\_\_\_\_\_\_\_\_\_\_.**
  + **Parent Material (C horizon)**
    - **This contains \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and borders the unweathered solid parent material. Most roots do not go down this deep and it is often saturated with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**
* **Erosion**
  + **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of soils are eroded from the U.S. each year; this would fill 320 million average-sized dump trucks that, if parked end-to-end, would extend to the moon and ¾ of the way back!**
  + **Definition: Erosion is the movement of soil components, especially surface litter and topsoil, from one place to another.**
  + **Importance**
    - * **In undisturbed ecosystems, the roots of plants help anchor the soil, and usually soil is not lost faster than it forms.**
      * **But, farming, logging, construction, overgrazing by livestock, off-road vehicles, deliberate burning of vegetation etc. destroy plant cover and leave soil vulnerable to erosion. This destroys in a few decades what nature took hundreds to thousands of years to produce.**
  + **Water Erosion**
    - **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ – water hits the soil at a severe angle (based on slope)**
    - **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ – when surface water moves down a slope or across a field in a wide flow and peels off \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of soil.** 
      * **Because the topsoil disappears evenly, sheet erosion may not be noticeable until too much damage has been done.**
    - **Mass Slippage – (like in California) where it is very wet and large amounts of soil slip away in large chunks (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_).**
    - **Rill – concentrated flow across the surface of soil. Leaves \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (micro channels).**
    - **Gully – rivulets of fast-flowing water join together and, with each succeeding rain, cut the channels wider and deeper until they become ditches or gullies. Gully erosion usually happens on steep slopes where all or most vegetation has been removed.**
  + **Wind Erosion**
    - **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ – one particle hitting another and being blown across the surface of the soil.**
    - **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ – airborne soil. Ex. soil from Lubbock is found in Temple, Texas.**
    - **Surface Creep – mountains/sand dunes; surface creeping slowly across. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_are an example of a very fast surface creep**
* **Erosion Control**
  + **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ – can reduce wind erosion. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are planted to partially block the wind. They can also help retain soil moisture, supply some wood for fuel, and provide habitats for birds.**
* **Erosion Control(Cont)**
  + **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ – (conservation tillage) to disturb the soil as little as possible while planting crops. (Tilling is the act of turning or agitating the soil.)**
    - **Special tillers break up and loosen the subsurface soil without turning over the topsoil, previous crop residues, and any cover vegetation.**
  + **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ –sloping your growing crops, etc.**
    - **You run terraces parallel to the ground to stop soil from running down a steep slope. Plowing and planting crops in rows across, rather than up and down, the sloped contour of the land.**
  + **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ – (what you use for contour farming.) A broad, staircase-like effect \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, helping to retain water at each level.**
  + **Strip Cropping – a row crop such as corn alternates in strips with another crop that completely covers the soil, reducing erosion. It catches and reduces water runoff and helps \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**
  + **Cover Cropping (alley cropping) – several crops are planted together in strips or alleys \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_that can provide shade (which \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ by evaporation) and helps to retain and slowly release soil moisture.**
* **Irrigation Techniques** 
  + **Conventional center-pivot irrigation- allows \_\_\_\_\_\_\_\_\_\_\_\_of the water input to reach crops**
  + **Gravity-flow irrigation- Valves that send water down irrigation ditches**
  + **Drip irrigation- Can raise water efficiency to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and reduce water use by 37-70%.**
  + **Floodplain irrigation- allowing the natural floods to irrigate the crops. Soils in flood zones tend to be nutrient rich and fertile.**
* **Soil Nutrients**
  + **Macronutrients**
    - **Macronutrients are larger in atomic structure. Ex. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Can be added to nutrient-poor soils with\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**
  + **Micronutrients**
    - **These are smaller in atomic structure. Plants need them in small amounts. Ex. Selenium, Zinc & Iron.**
  + **Fertilizers and Labels**
    - **Organic Fertilizers –**
    - **Inorganic Fertilizers – man-made from chemical compounds**
      * **Benefits – exact compositions are known; they are soluble & thus \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to the plant**
      * **Costs – quickly leach away; this \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_; doesn’t help the water holding capacity of the soil like organic fertilizers do.**
  + **Hydroponics: growing plants in fertilized water.**
    - **Costs:**
    - **Benefits:**