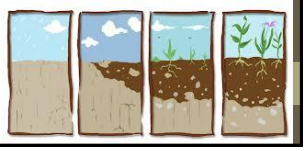
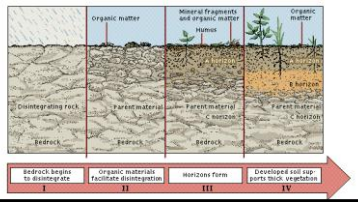
Soil Formation

- The creation of soils from parent material is called "pedogenesis"
- Represented as a function of several aspects of an environment
  - Aspects include climate, type of parent material, relief/topology, fauna, and flora
  - Soil = f(C, PM, R, O, V,) x time
  - Over time, all of these factors influence soil quality and composition



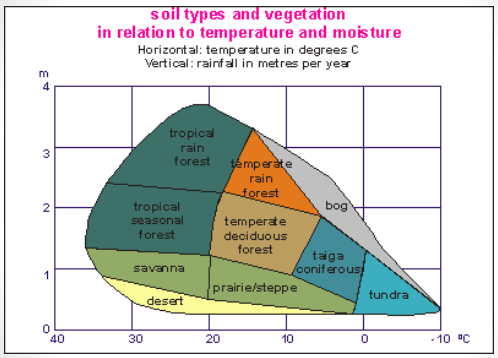
Soil Formation

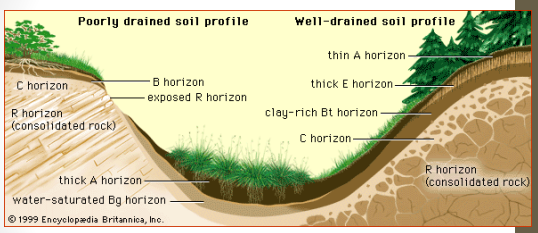
- Soils are initially weathered down from a parent material by wind, water or glacial movement (mechanical), or chemical means
- Most soils in a given area were not formed by the parent material beneath them because soils move around a LOT
- Recall succession!



Soil Formation
(All generalizations are on average!)

- Climate: soils weather and are created faster in warmer, wetter climate
  - Wind and heavy rains can also move soil
  - Warmth promotes bacterial growth which better breaks down organic debris = often richer soils
- Topography (Relief): slopes lose parent material and soils faster (next week!)



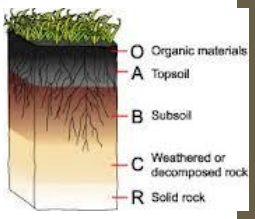


Soil Formation: Biological Factors

- Plants are incredibly important for soil health for several reasons
  - Roots can break down and break up parent material, loosen soil, etc.
  - Provide the main source of organic matter
  - Roots prevent erosion and soil loss by holding dirt in place
- Animals also influence soil richness by fertilizing, burrowing, and affecting plants

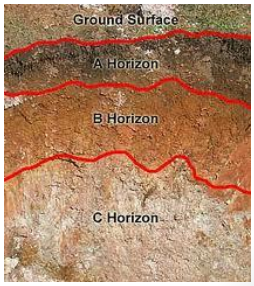
Soil Horizons

- O: organic material and humus, most rich with lots of fallen leaves and decomposers
- A: Topsoil layer. Important for plant growth and nutrient retention
- B: Intermediate soil with less organic material but still broken down



Soil Horizons

- C: Weathered of decomposed rock (very nutrient poor, rough, not good for growing plants)
- R: Bedrock or unbroken down rock layer

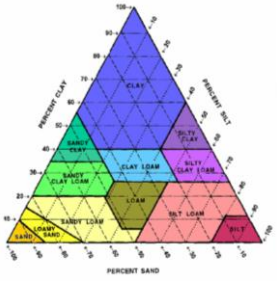


Soil characteristics

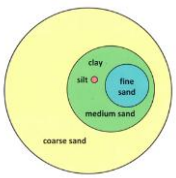
- We define, class, and judge soil "quality" based on several important characteristics:
  - Texture
  - Biotic components
  - Fertility
  - Percolation rate: how fast water passes through
  - Moisture Content: water retention
  - Porosity: spaces between particles

Soil Texture

- Describes percentage breakdown for different soil particle sizes
- Does not include organic materials
- Use a soil triangle to determine soil class after knowing particle size proportions



Soil Particles

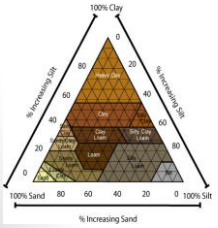


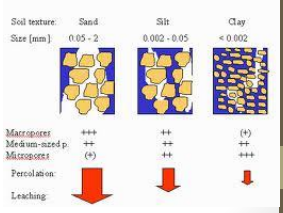
Clay = dot on paper in this diagram

- Sand: largest soil particles
  - 0.05-2.0mm in diameter (graded within this size range from "very fine" to "very coarse")
  - Poor water retention, good drainage
- Silt: mid-sized soil particles
  - 0.002-0.05mm in diameter
- Clay: smallest soil particles
  - Less than 0.002mm in diameter
  - Incredible water retention

Significance of Texture

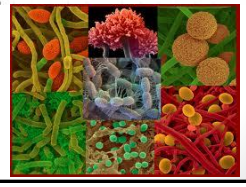
- Need a variety of soil particles to balance properties and provide ideal conditions for plant growth
- Example: need a mixture of water retention and drainage





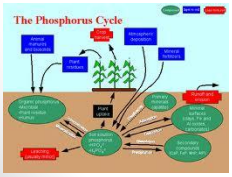
Soil Biotics

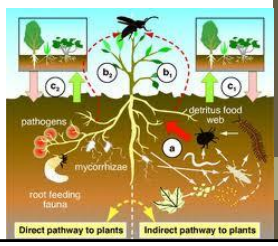
- Comprise of living microorganisms and deceased organic matter that adds to soil nutrition
- Microorganisms make dirt "alive"—hundreds of applications in composting and biotechnology found in the dirt!
- Percent organic matter: amount of soil that is or was once living—higher content means more fertile soil



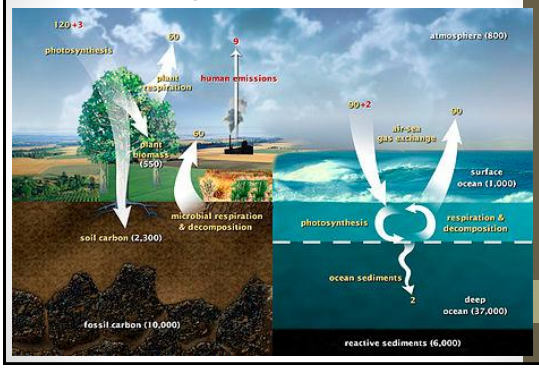
Nutrient Cycle Review

- Remember that all nutrients cycle through the Earth with matter neither being created nor destroyed
- Nitrogen, Carbon, and Phosphorus are the most important nutrient cycles

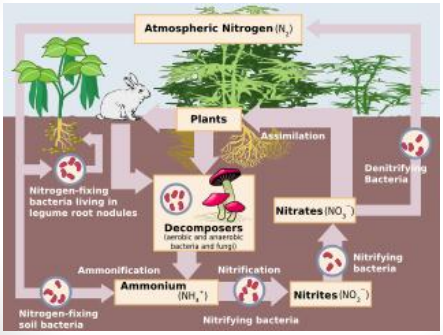




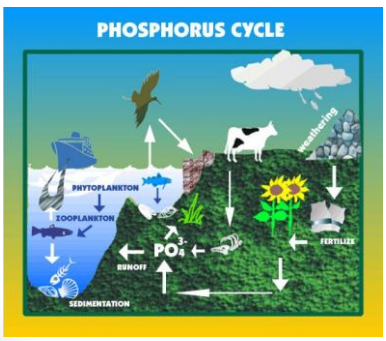
Carbon Cycle



Nitrogen Cycle



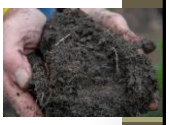
Phosphorus Cycle



Soil Fertility

- Fertility = measure of how easy it is to grow plants on land
- Need moderate to high organic matter, balanced soil particles, moisture retention with some percolation
  - Balance important!
- Important to conserve and maintain fertile soils with smart crop systems and sustainable agriculture!



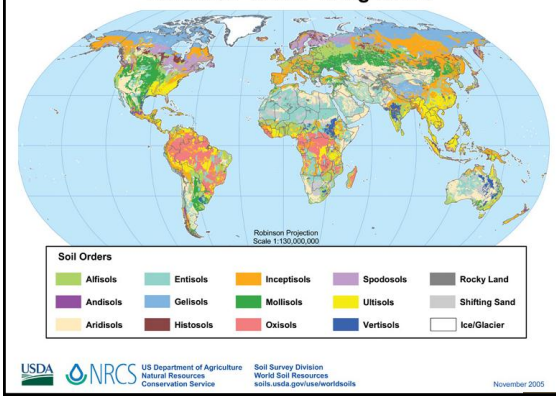


Soil Types

- Many different types of soils classed by their nutrients, soil particle size, sand, clay, silt distributions, etc.
- Generally need even distributions of the three particle sizes for proper agriculture
- 12 soil orders

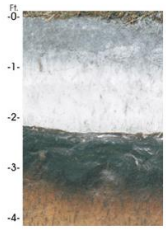
Soil Order	Formative Terms	Pronunciation
Alfisols	Alf, meaningless syllable	Pedalfer
Andisols	Modified from ando	Ando
Aridisols	Latin, aridies, dry	Arid
Entisols	Ent, meaningless	Recent
Gelisols	Latin gelare, to freeze	Jell
Histosols	Greek, histos, tissue	Histology
Inceptisols	Latin, incepum, beginning	Inception
Mollisols	Latin, mollis, soft	Mollify
Oxisols	French oxide	Oxide
Spodosols	Greek spodos, wood ash	Odd
Ultisols	Latin ultimus, last	Ultimate
Vertisols	Latin verto, turn	Invert

Global Soil Regions



USDA NRCS US Department of Agriculture Natural Resources Conservation Service
Soil Survey Division World Soil Resources soils.usda.gov/use/worldsoils
November 2005

Myakka: The Florida State Soil



Myakka Soil Profile

Surface layer: gray fine sand
Subsurface layer: light gray fine sand
Subsoil: dark reddish brown fine sand with organic stains
Substratum: brown and yellowish brown fine sand

Soil Erosion

- The removal of soil from a given area
- Difference between "background" and "accelerated" erosion
  - Background: natural erosion that occurs at roughly the same rate as soil formation
  - Accelerated: faster than soil replacement, often caused by humans
- Need to conserve soils as soil takes a VERY long time to make


Soil Deterioration

- Different from erosion: soil still in place, but poorer in quality
- Nutrient imbalances (over or under-nutrifying, could lead to depleted soils or toxic soils)
- Removal of roots reduces nutrients and promotes erosion
- Salinization: addition of too much salt—salt is good in small amounts but irrigation can oversalinate and make soils toxic
- Grazing, deforestation, and agriculture
- Compaction: reduced porosity makes is harder for plants to grow and take root

Case Study: The Dust Bowl

- http://www.youtube.com/watch?v=MYOmjQO_UMw