# GLG 110 – Chapter 16 – Soils and Environment

- Soil: Earth material that may be removed without blasting (engineers); solid Earth material that can support rooted plant life (soil scientists); accumulated weathered sediments and/or organic materials at the Earth's surface (GLG 110)
- Soil forms in distinct layers or "horizons" defined by their position and composition (O, A, E, B, C)
    - O – organic horizon at the very surface (leaf litter, etc.)
    - A – mixture of organic materials and mineral fragments just below O
    - E – zone of leaching/eluviation, where infiltrating water has removed soluble materials; below A; very prominent in areas with extreme chemical weathering/rainfall (e.g., tropical rain forests)
    - B – zone of accumulation, where clay materials leached and/or transported from E zone accumulate; beneath E; absent in areas with too little (insufficient weathering to generate and transport enough clay) or too much (washes away) precipitation; important/prominent in soils in areas with moderate rainfall; in dry, alkaline desert environments, calcite/caliche can dominate this horizon, which is then known as a K horizon
    - C – zone of fragmented/slightly weathered bedrock; found beneath all other layers and just above solid bedrock; may dominate entire soil column in dry areas (deserts) where chemical weathering is minimal
- Soils are classified based on color, particle size, and structure (how particles are clumped together)
- Soil contains mineral and organic fragments (solids), air (gas), and water (liquid)
- Soil is its own ecosystem, with many living things present within it, including plants, insects (eggs, larvae and adults), worms, fungi, bacteria and other microscopic life forms
- Soil Texture – relative proportions of sand- (small, but visible to the naked eye), silt- (invisible to naked eye, but feels gritty between teeth), and clay-sized (invisible to naked eye and feels smooth between teeth) particles
- Structure – how soil particles cling together (in peds); granular, blocky, prismatic, platy
- Soil fertility – how well soils can supply nutrients (e.g., N, P, K) for plant life
- Water in soil – soils may be either saturated (all open space filled with water) or unsaturated (any amount of water that fills less than 100% of the pore spaces)
- Engineering properties of soils are important for environmental problems
    - Strength – how strongly soil resists deformation; also, how cohesive it is (holds together in a steep slope)
    - Sensitivity – how much soil strength changes when it is disturbed by shaking or excavation
    - Compressibility – soil's tendency to decrease in volume under pressure (soils with larger amounts of fines – clays and silts – tend to be more compressible)
    - Erodability – how easily soil can be removed by wind or water (sands and silts are highly erodable; clays and gravels are not)

    - Hydraulic Conductivity – ease of water passing through soil (higher for more granular soils; lower for clay-rich soils)
    - Corrosion Potential – ease of corrosion of materials, especially metals, in soils; depends on soil chemistry and amount of water present
    - Ease of Excavation – can soil be scraped off easily, or does it require ripping or even blasting?
    - Shrink-swell potential – tendency of soils to lose or gain water, and to change in volume as a result; soils that gain water and gain much volume are known as *expansive soils*, which may crack roads and building foundations; this is a big problem in clay-rich soils in AZ, especially up around Anthem, due to high volcanic ash-related clay content of the soils
        - Draining water away from house foundation, and not planting trees or other vegetation right up against the slab help reduce this risk
- Soil erosion rate – can be increased OR decreased by human activities
    - Intense farming, deep tilling, removal of vegetation (by fire, overgrazing or clear cutting), riding and walking on trails, mining, increasing slopes, and construction excavations can increase soil erosion
    - Planting of ground cover, compacting and/or paving over soils, and reducing slopes can decrease soil erosion
- Sediment pollution – increased amount of sediment eroded into streams and waterways due to increased soil erosion (see causes above)
    - May be reduced with conservation practices and sediment control basins
- Land Use and soils
    - Agriculture, if not done carefully, can vastly increase soil erosion and pollution of waterways
    - Techniques for reducing soil erosion in agriculture include:
        - Contour plowing – plowing along contours instead of down slopes, in order to slow down runoff and reduce erosion that way
        - No-till agriculture – never loosens the soil, so erosion is not increased by plowing
        - Terracing slopes – creating a stair-step pattern of fields, with each field nearly horizontal – decreases runoff from any given field
        - Planting multiple crops among thinned natural vegetation, with fallow years of non-use; great for sparse population – non-sustainable in heavily populated regions
    - Urbanization can result in much soil loss and disturbance during construction phase
    - Off-road vehicles typically devegetate areas and dig up/loosen soil, increasing greatly erosion in areas where ORVs are commonly used
- Soil pollution – addition of materials to soils that are detrimental to life
    - Occurs commonly in urban areas (oil, gas, antifreeze, industrial chemicals, landfills, etc.)
    - May occur deliberately or by accident, but results are the same
    - Dioxin (produced as byproduct from herbicide production and from burning plastics; commonly found in used oils) contamination of soils in Times Beach, MO, was so severe that the town was abandoned (probably

an overreaction, in retrospect); source of dioxin was oil sprayed on dirt roads for dust control

- Remediation of soils can involve:
  - excavation and replacement with clean soils (dirty soils then must be either cleansed, often by incinerations, or disposed of in proper facility)
  - vapor extraction - works for volatile organic compounds (VOCs)
  - bioremediation – ramping up of natural bacteria in soils that can "eat" the contaminants (works well for not-so-nasty hydrocarbons), using extra fuel (e.g., adding oxygen to the soil vapor space)

- Soil surveys promote proper land-use planning, which can decrease chances of environmental problems in the future