Soil and Glass

Come in and get your notebooks out. We have notes today!
What is Soil?

- The top layer of Earth’s crust where most plants grow
- It contains minerals, decaying organisms, water, and air
- It is divided into horizons, which are layers parallel to the Earth’s surface in which the soil forms
Horizons
• **O Horizon**: also called *humus*, it is made up of decaying organic matter
Horizons (cont.)

- A Horizon:
  also called *topsoil*, the soil is dark in color; it is made up of humus and minerals; seed sprout and plant roots grow in this layer.
Horizons (cont.)

- **E Horizon:**
  light in color, it is made up of sand and silt

- **B Horizon:**
  also called *subsoil*; it is a mixture of clay and minerals
Horizons (cont.)

- **C Horizon:**
  made up of partially broken rock; no plant roots or humus are found in this layer

- **R Horizon:**
  layer made up of solid rock
Soil Texture

• Describes the size of the mineral particles that make up soil
• There are 3 types of grain sizes:
  • Sand
  • Silt
  • Clay
• Sand describes the largest size and clay is the smallest
Sand

- Formed by the action of wind and water (*weathering*)
- It has a gritty feel
- Found in deserts, beaches, and riverbeds
- Contains large visible particles and loses water quickly
Sand (cont.)

- Sand from different locations contain different combinations of minerals.
- The most common mineral in sand is quartz.
- There are four basic sources of sand:
  - **Continental sand**: made up of quartz, micas, feldspars and dark-colored minerals.
Sand (cont.)

- **Volcanic sand**: usually dark in color; found in mid-ocean and hot spot volcanoes; has little or no quartz
- **Skeletal (Biogenic) sand**: made of the remains or marine organisms; has a high amount of calcium carbonate
• **Precipitate sand**: formed when the water mixed with minerals evaporates and the minerals precipitate out; calcium carbonate will precipitate out of seawater forming layers; the layers eventually form small, round structures called **oolites**
Silt

- Composed of medium-sized particles
- Has a crumbly, slippery feel
- Found in sediment in riverbeds
- Has good drainage
Clay

- Composed of small particles adhering to each other
- Has a sticky feel
- Clumps and has poor drainage
Soil Subcategories

- **Loam**: made up of sand, silt and clay
- **Peat**: has over 20% organic material
- **Chalk**: alkaline soil that contains various-sized pieces of a solid, but soft, rock called *chalk*
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Several tests and observations are done to create a soil profile including:

- Color
- Texture
- Odor
- Presence of animal or plant debris
- Density
- pH
- Nitrogen content
- Phosphorus content
Mineral Composition of Sand

• Sand may contain one of more minerals
• Quartz—the most common mineral in sand
• Crystal—sand with one mineral
• Rounded or angular sand depends on the amount of weathering and mineral composition
Chemistry of the Soil

• Acidic or basic (alkaline)—the pH scale

• What affects the pH level?
  • Materials that make up a soil
  • Rainfall
  • Pollution
  • Fertilizer

• The pH value of a soil sample helps scientists match it to other samples

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<th>pH value (approximate)</th>
<th>Strong acid</th>
<th>weak acid</th>
<th>neutral</th>
<th>weak base</th>
<th>strong base</th>
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<td>Orange juice</td>
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<td>Vinegar</td>
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<tr>
<td>Rain (not acid)</td>
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<tr>
<td>Milk</td>
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</table>

Some common examples include:

- Acidic substances
  - Battery acid
  - Lemon juice
  - Orange juice
  - Vinegar
  - Breads, pasta
  - Rain (not acid)
  - Milk

- Basic substances
  - Baking soda, sea water
  - Milk of Magnesia
  - Detergents
  - Ammonia water
  - Bleaches, oven cleaner
  - Lye (drain cleaner)
Sand—Weathering

• Breaking down rock into sand with wind and water forces
• Wind is a faster agent—grains strike each other directly
• Water is a slower agent—water acts as a buffer
Density

• All materials have a specific density and as such, substances can be identified by their density

• Density is defined as the mass of a substance per unit volume of:
  \[ \text{density} = \frac{\text{mass}}{\text{volume}} \]

• Objects will float at the level of their density

• Based on this principle, density columns can be used to find the density of an object
Density Columns

- A density column is created by placing very dense liquids on the bottom of a column and “floating” less dense liquids on top of the more dense liquids
- An object dropped into the column will sink to the place where its density just equals the density of the surrounding liquid
- An object that sinks completely is more dense than the most dense liquid in the column
- An object that floats on the surface is less dense than the least dense liquid in the column
Nitrogen and Phosphorus

• Nitrogen is important in soil because plants use it to make chlorophyll, the green pigment needed for photosynthesis

• Phosphorus helps plants grow strong and helps in the production of flowers and fruit; phosphorus is especially important for the root part of the plant
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Collecting Evidence

• Photograph and sketch the crime scene and note where the soil samples were obtained

• Only about one cup of the top layer of soil needs to be collected

• Do not remove soil stuck to shoes, clothing or tools; package these separately in appropriate containers

• Carefully remove soil from vehicles and package these soil samples separately

• Collect additional soil samples from the four compass points within a few feet of the crime scene and another set 20-25 feet from the crime scene
Soil Collection — Chain of Custody

A chain of custody log is essential

1. Bag, identify, seal, and sign
2. Each subsequent user opens bag on a “new” side
3. Return contents to original bag evidence bag, seal it in another bag, and sign the evidence log
Soil Examination

• Unique soil samples provide better evidence

• Layers of soil or sand taken from shoes or the wheels of vehicles can show a suspect was present at a series of locations
Soil Examination

• Macroscopic analysis
  • Size, shape and color of soil
  • Amount of plant and animal material
  • Particle size

• X-ray diffraction
  • X-rays deflected off a soil sample indicate a pattern unique to each mineral present

• Other tools test density and moisture content