“Life is hard. Then you die. Then they throw dirt in your face. Then the worms eat you. Be grateful it happens in that order.”

—David Gerrold, American science fiction writer
Soil Analysis

Objectives: Learn to...

- Identify a soil’s common constituents
- Determine the origin of a soil sample
- Why soils can be used as class evidence
- When soils can be used as circumstantial evidence
Forensic Geology

- The legal application of earth and soil science
- Characterization of earthen materials that have been transferred between objects or locations and the analysis of possible origin or sources
A. Definition—naturally deposited materials that cover the earth’s surface and are capable of supporting plant growth

B. The Earth

75%—oceans, seas and lakes
15%—deserts, polar ice caps and mountains
10%—suitable for agriculture
Soil

C. Formation

- **Living matter**—plants, animals, microorganisms
- **Inorganic materials**
- **Climate**
- **Parent materials**
- **Relief**—slope and land form
- **Time**
Soil

D. Profile
- Topsoil
- Subsoil
- Parent material

E. Composition
- Sand
- Silt
- Clay
- Organic matter
### Soil

<table>
<thead>
<tr>
<th>F. Nutrients—macro</th>
<th>G. Nutrients—micro</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Nitrogen</td>
<td>- Manganese</td>
</tr>
<tr>
<td>- Phosphorus</td>
<td>- Iron</td>
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<tr>
<td>- Potassium</td>
<td>- Boron</td>
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<td>- Calcium</td>
<td>- Copper</td>
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<tr>
<td>- Magnesium</td>
<td>- Zinc</td>
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<tr>
<td>- Sulfur</td>
<td>- Molybdenum</td>
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<td></td>
<td>- Chlorine</td>
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Soil Comparisons

- May establish a relationship or link to the crime, the victim, or the suspect(s)
- Physical properties—density, magnetism, particle size, mineralogy
- Chemical properties—pH, trace elements
Probative Value of Soil

- Types of earth material are virtually unlimited. They have a wide distribution and change over short distances.
- As a result, the statistical probability of a given sample having properties the same as another is very small.
- Evidential value of soil can be excellent.
Increasing Probative Value

- Rare or unusual minerals
- Rocks
- Fossils
- Manufactured particles
Minerals

- More than 2000 have been identified
- Twenty or so are commonly found in soils; most soil samples contain only 3 to 5
- Characteristics for identification—size, density, color, luster, fracture, streak, or magnetism
Rocks

- Aggregates of minerals
- Types
  - Natural—like granite
  - Man-made—like concrete
- Formation
  - Igneous
  - Sedimentary
  - Metamorphic
Palynology

- The study of pollen and spores
- Important to know:
  - What is produced in a given area
  - The dispersal pattern
- Variation in size and weight
Soil Evidence

- **Class characteristics**—the type of soil may have similar characteristics at the primary and/or secondary crime scene, on the suspect or on the victim.

- **Individual characteristics**—only if the soil has an unusual or specialized ingredient such as pollen, seeds, vegetation, or fragments.
Sand Characteristics

- Composition is based on the material of the source; also gives the sand its color
- Texture is determined by the way the source was transported
  - Shape
  - Grain size
  - Sorting
Sand Evidence

“In every grain of sand is a story of earth.”
—Rachel Carson

- **Class characteristics**—the type of sand may have similar characteristics to the primary and/or secondary crime scene, on the suspect or on the victim.

- **Individual characteristics**—only if the sand has an unusual ingredient or contaminant.
Forensic Geology in the News

A 9-year-old’s body was found in a wooded area along a river in Lincoln County, South Dakota. A forensic geologist collected soil samples from the fenders of a suspect’s truck and the area where the body was found. Both soils contained grains of a blue mineral that turned out to be gahnite, a rare mineral that had never been reported in South Dakota. As a result, the soil tied the suspect to the crime.