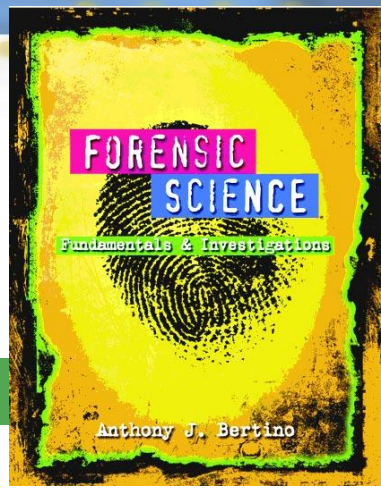
Chapter 12 *Soil Examination*

By the end of this chapter you will be able to:



- Recognize various soil types
- Discuss soil horizons
- Explain the chemistry of soils
- Distinguish the different kinds of sand
- Describe the collection and examination of soil evidence

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Introduction

- Factors affecting soil
  - Temperature
  - Rainfall
  - Chemicals and minerals in the soil
- Soil physical and chemical characteristics vary by location
- Soil analyses help link:
  - Suspects to crime scenes
  - Locating burial sites

Soil as Evidence

The value of soil as evidence rests with its prevalence at crime scenes and its transferability between the scene and the criminal.

Most soils can be differentiated by their appearance.

History of Forensic Soil Examination

- Dr. Hans Gross—
  - *Criminal Investigation* (1893)
  - One of the first to recognize the importance of physical evidence
- Georg Popp
  - First to use soil evidence to solve a crime
  - Linked soil samples found on a suspect with samples found at the crime scene

Soil Composition

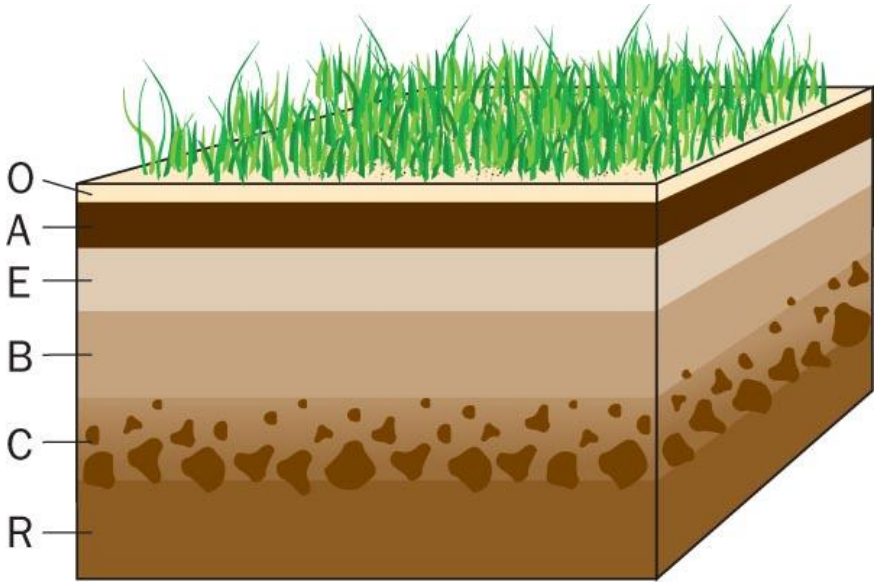
- Part of the top layer of Earth's crust
- Minerals
- Decaying organisms
- Water
- Air
- All in varying amounts

Soil Texture

- The 3 main grain sizes in soil are: in order of smallest to largest grain size.
  - Sand
  - Silt
  - Clay
- The 3 subcategories of soil:
  - Loam
  - Peat
  - Chalk

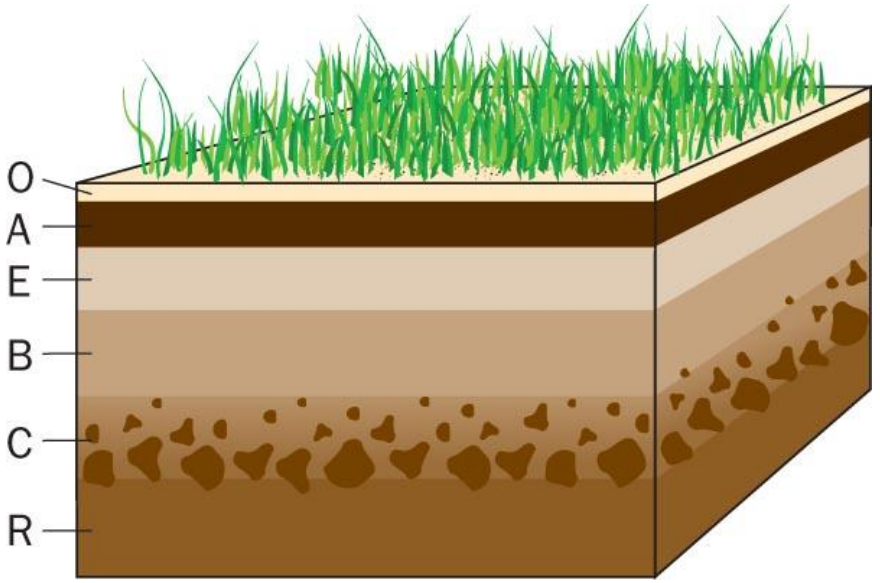
Soil Profiles

- Humus, the **O** horizon, is made of decaying organic matter (more than 50%)
- Topsoil, the **A** horizon, is a mixture of humus and minerals
- Sand and silt makes up the **E** horizon



Soil Profiles

- Subsoil, the B horizon, is made of clay and minerals
- Broken rock, the C horizon, has very little humus present
- Solid rock makes up the R horizon



Chemistry of the Soil

The pH scale measures the acidity or basicity of a solution

Strong acid				weak acid			neutral	weak base				strong base	
pH value = 1	2	3	4	5	6	7	8	9	10	11	12	13	14

Some common examples include: pH value (approximate)

Acidic substances		Basic substances	
Battery acid	1	Baking soda, sea water	8.5
Lemon juice	2.5	Milk of Magnesia	10.5
Orange juice	3.0	Detergents	10.0
Vinegar	3.5	Ammonia water	11.0
Breads, pasta	5.0	Bleaches, oven cleaner	12.0
Rain(not acid)	5.5	Lye (drain cleaner)	13.5
Milk	6.5		

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

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

Wind

Water

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

Mineral Composition of Sand

- Sand may contain minerals:
  - quartz
  - feldspars
  - micas
  - iron compounds
- Sand can contain organic materials
  - Coral
  - Seashells

Continental and Volcanic Sand

Source	Composition	Identifying Features
Continental sand	granite, quartz, feldspar, mica, dark minerals	quartz
Volcanic sand	dark color black basalt, green olivine, volcanic ash	dark color with green olivine, no quartz

- Continental sand contains quartz
- Volcanic sand contains no quartz

Skeletal and Precipitate Sand

Source	Composition	Identifying Features
Skeletal (biogenic) sand	broken shells, coral, coralline algae, sea urchin remains	shells indicate evidence of warm water life
Precipitate sand	calcium carbonate	oolithic, egg-shaped or round spheres of calcium carbonate from rock

- Skeletal sand emits bubbles when mixed with acid
- Oolite formation is an example of deposition, not weathering

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

Collection of Soil

Reference soils should be collected within a 100-yard radius of the crime scene

Soil found on the suspect must not be removed.

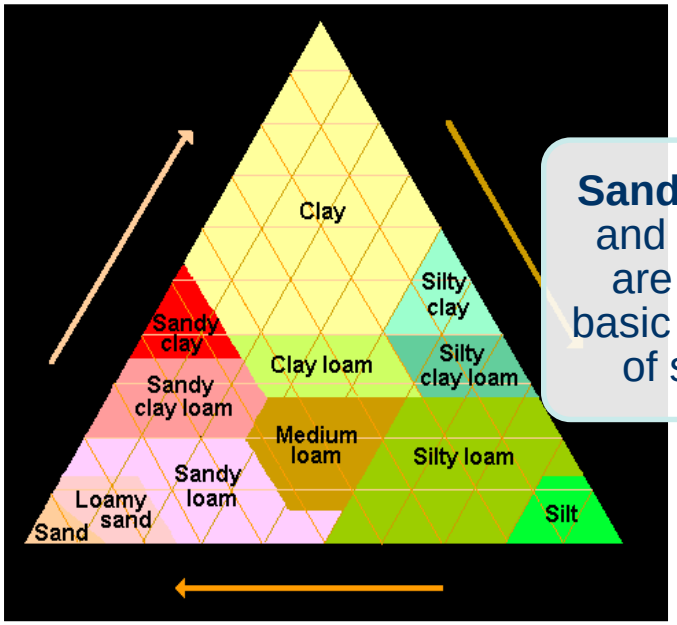
Each object should be individually wrapped in paper and transmitted to the laboratory.

Analysis Techniques

Side-by-side visual comparison

Look for **color** and **texture**

Composition



Sand, **silt**, and **clay** are the basic types of soil

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

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Summary

- There are three grain sizes and three subcategories of soil.
- Soil forms in horizons.
- The pH scale measures how acidic or alkaline different soils are.
- Sand is formed by the action of wind and water.
- Good collection procedures helps analysts determine if a suspect was at a crime scene.