Soils and Soil Science

Perspective

Earth Radius: 4000 miles
Surface area: 200 million mi^2
Oceans: 140 million mi^2
Land: 60 million mi^2

Circumference: 25,048 mi (25,000 mi)

When was it determined that the earth was round?

1492?

When was the circumference first calculated?

Martin Behaim

1492, constructed one of the first terrestrial globes, still preserved at the Nuremberg National Museum

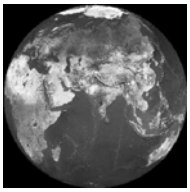
The Round Debate

Pythagoras 525 B.C. philosophical: the sphere is the perfect shape

Aristotle 350 B.C. New stars, ships, lunar eclipse

Eratosthenes 240 B.C. Calculated the earth's diameter

Physical Proof: 1522

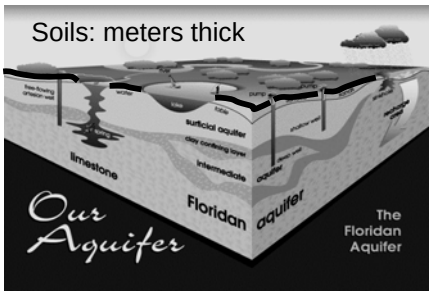


Earth's radius = 4000 miles

Average ocean depth?

Average soil depth?

Soils: meters thick



The interface, the first point of contact, between the earth's surface and the external environment.

Arcanum

Mysterious knowledge known only to the initiated

?

What is Soil?

What is Soil?

It is *not* Dirt

What is Soil?

…a natural body consisting of horizontal layers of mineral and organic constituents of variable thicknesses which differ from the original material in their morphological, physical, chemical, and mineralogical properties. At least some of these properties are due to soil-forming processes.

Joffe, 1949

What is Soil?

A dynamic natural body composed of mineral and organic materials and living forms in which plants grow. The collection of natural bodies occupying parts of the earth's surface that support plants and have varying properties due to the integrated effects of climate and life acting upon geologic materials, mediated by relief and time

Brady and Weil, 2000

What is Soil?

…unconsolidated surficial material

Short-sighted Engineer, 1985

What is Soil?

Agronomist

Forester

Horticulturalist

Engineer

Environmentalist

Ecologist

Functions of Soil

Functions of Soil

Medium for plant growth

Physical Support
Gas exchange
Water movement/retention
Temperature control
Nutrient source

Essential Nutrients

Air/Water	Soil Solids	Micronutrients
Carbon	Nitrogen	Iron
Hydrogen	Phosphorous	Manganese
Oxygen	Potassium	Boron
	Calcium	Zinc
	Magnesium	Chloride
	Sulfur	Cobalt
		Molybdenum
		Nickel

Macronutrients

Functions of Soil

Regulator of water supplies

Infiltration
Run-off
Storage/Movement
Purification

Functions of Soil

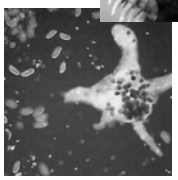
Recycler of Raw Materials

- Nutrient reservoir
- Organic -> mineral nutrients
- Carbon reservoir

Functions of Soil

Habitat for Soil Organisms

Macroorganisms
Microorganisms



Functions of Soil

Engineering Medium

Drainage
Mineralogy
Compressibility
Density

Functions of Soil

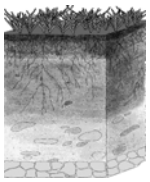
Medium for plant growth

Regulator of water supplies

Recycler of raw materials

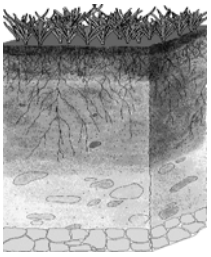
Habitat for soil organisms

Engineering medium



Functions of Soil

Reservoir
Conduit
Habitat
Buffer

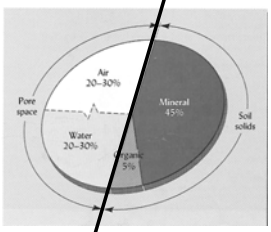


Components of Soils

Idealized Surface Soil

Voids | Solids

Avenues
Storage
Distribution
Movement



Interactive Media
Minerals
Organic matter
Reactivity

Components of Soil

Gas ~ 25%

	Atmosphere	Soil
Oxygen:	21%	5-10%
Carbon Dioxide:	0.035%	0.3-3%

Components of Soil

Liquid ~ 25%

Water + Dissolved and Suspended Constituents

Nutrients
Metals
Salts
Acids/Bases
Organic Compounds
Contaminants
Gases

→ Solid Phase

Components of Soil

Mineral + Organic ~ 50%

Solid soil particles and organic matter

Organic: decomposed plant and animal material

Mineral: Sands, silts, clays, oxides

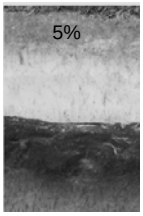
- reactivity
- Water movement/retention

Organic

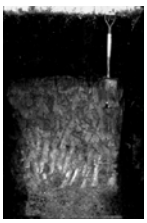
Components of Soil

Organic ~ 5%

Mineral Soil
< 20% O.M.



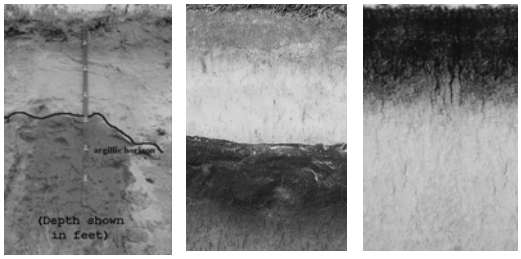
Organic Soil
> 20% O.M.



The Organic Component of Soil

Forested

Deciduous | Coniferous | Grasses



Components of Soil **Organic ~ 5%**

Generalizations

- **Soil color – the darker the color, the more OM.**
- **Soil structure – cementing agents, fibers.**
- **Soil nutrients –organically derived (P, S, N, Ca, Mg, K).**
- **Energy sources – energy for soil organisms.**
- **Soil Water – increases water holding capacity**
- **Soil productivity – O.M. increases productivity**

Mineral

Components of Soil Mineral **~ 45%**

Rocks, stones, gravel, particles, aggregates

Particles: primary minerals (quartz, feldspars)
secondary minerals (clays, oxides)

Rocks → Primary Minerals → Secondary Minerals

Can be highly reactive