Find out more about your soil!
Soil plug-in for Google earth
California Soil Resource Laboratory
SoilWeb Earth

And this too!
https://casoilresource.lawr.ucdavis.edu/see/

Support Soil Science and Student Farming
100% of profits go to funding student internships!
(and get a t-shirt that MEANS something…!)

Go to: soilforward.org
Soil!
What it is and how it works.

James Cassidy – Oregon State University, Soil Science
President Oregon Society of Soil Scientists
Soilforward.org
2 of the 12 Soil Orders

Aridisol

Mollisol
Aridisol – 12% of the earth’s ice-free surface

Inceptisol – 17% of the earth’s ice-free surface
Oxisols

Very-fine, kaolinitic, isohyperthermic Typic Eutrotorrox

Plate 34  Molokai Oxisol growing sugarcane on Oahu, Hawaii. (A. R. Southard)
No Oxisols or Gelisols!
Spodosol
Oregon Coast
Andisols

Central Africa
Entisols

PLATE 4  Entisols—a Typic Quartzipsamment from eastern Texas. Scale in feet.
Inceptisols

- **A 0 – 5 cm**
- **AB 5-18**
- **Bw1 18 - 33**
- **Bw2 33 - 55**
- **BC 55 - 76**
- **C 76 – 100+**

**GEORGIA COARSE-LOAMY, MIXED, SEMIACTIVE, MESIC AQUIC DYSTRIC EUTRUTEPTS**
Soil is habitat!
Soil is a living thing! Not a chemical sponge!

B – Bacteria
A – Actinomycetes
My – Mycorrhizae
H – Saprophitic fungus
N – Nematode
CP – Ciliate protozoa
FP – Flagellate protozoa
M – Mite

< 1mm
Soil is:

• “Rotted” Rock
• Decomposed Organic Matter
The four components of soil:

- Mineral (Sand, silt, clay): 45%
- Water: 20–30%
- Organic: 5%
- Air: 20–30%
- Pore space
Rock – primary mineral

Granite
Clay is a secondary mineral
- formed at normal surface temperatures and normal surface pressures
- The product of dissolution and recrystallization
Rocks dissolve and recrystallize

Physical + Chemical weathering

Primary rock → Dissolved minerals

Physical + Chemical weathering

Dissolved minerals → Recrystallization

Recrystallization

Clay

- silicon, iron, alum.,
- mag., potassium,
- calcium...

Dissolved minerals

- sheets of silica
- and aluminum oxide
When rocks dissolve...

**Tetrahedron** - a 3D geometric form contained by four plane faces; a triangular pyramid.  
**Octahedron** - a 3D geometric form contained by eight plane faces.
...and recrystallize.
Clay – secondary mineral
and recrystallize.

Clay – secondary mineral
Isomorphous substitution

Within the silica tetrahedron and aluminum octahedron

What ions are present in the soil water solution is determined by the PM and the weathering environment.
Aluminum Octahedral sheet
Silica Tetrahedral sheet
Iron can substitute in for Silica
Magnesium can substitute in for Aluminum

Isomorphic Substitution…
a source of negative charge in soils!
EPK (Edgar Plastic Kaolin) - 25000x magnification

Courtesy of the SDSU Electron Microscope Facility
Fibrous illite (a clay mineral) in Tordillo sandstone, Neuquen basin, west-central Argentina
Nacrite, Lodève Basin, France

Field of view approx. 200 microns wide
Kaolinite

Well crystallized kaolinite from the Keokuk geode, USA

Field of view approx. 18 microns wide
...net negative charge due to isomorphous substitution on the secondary mineral called clay!!!
Clay

Fig. 1 Hydrated pesticide 2,4-D, adsorbed on Montmorillonite surface via Ca$^{2+}$ cation.
Soil is:

- “Rotted” Rock
- Decomposed Organic Matter
What is Organic Matter?

- **Air**: 20–30%
- **Water**: 20–30%
- **Pore space**:
- **Mineral** (Sand, silt, clay): 45%
- **Organic**: 5%
Sun

Producers

Consumers

Decomposers

air

water

soil

Humus (Organic Matter!)
Functions of Organic Matter

Organic Matter
...provides another source of charge in soils – twice that of clay!
Organic Matter – a random complex molecule!

http://virtual-museum.soils.wisc.edu/som/index.html
How a plant works
How a plant works

(a) Water film around soil particles

(b) Cation exchange in soil

Soil particle surrounded by film of water
Root hair
Water available to plant
Air space

H₂CO₃ → H⁺ + H⁺ + CO₃²⁻
Soil: The foundation of nutrition

Role of 18 nutrients necessary for plant growth and human health

Soil degradation leads to the loss of soil micro and macronutrients

Nutrient-poor soils are unable to produce healthy food with all the necessary nutrients for a healthy person

Over 2 billion people suffer from micronutrient deficiencies

Sustainable soil management for healthy soils, healthy food and healthy people

Healthy soils for a healthy life

Food and Agriculture Organization of the United Nations

With the financial support of the Russian Federation
Find out more about your soil!
Soil plug-in for Google earth
California Soil Resource Laboratory
SoilWeb Earth

Support Soil Science and Student Farming
Donate!
Buy a t-shirt that REALLY means something!
(100% of profits go to funding student internships!)

Go to: soilforward.org
soilforward.org
soilforward.org
ADD ORGANIC MATTER!!!

- Reservoir of plant nutrients
- Food/energy source for soil organisms
- Provides cation exchange capacity (200 cmol/kg)
- Increases water-holding capacity
- Decreases Al toxicity at low pH
- Improves soil structure (but doesn’t change soil texture)
  - Positive effects on physical characteristics: infiltration, drainage, aggregation potential, pore-size distribution, available water holding capacity, erosion potential, deep water storage, diverse habitat, increased function
  - Positive effects on soil chem: buffers for neutral pH, increases nutrient availability, increased vegetation...increasing organic matter...
Effect of OM on structure stability
Soil is habitat!
It's their world!

Live in the tiniest pores in soil

We just die in it!
Nematodes

Protozoa

Live in small pores in soil

20-200 kg/ha!
Microfauna

Protozoa

– Most abundant of all soil fauna
– One-celled
– Feed on bacteria (live and move in water films)
– Up to 30% of all mineralized N from protozoa
Mesofauna

Live in medium size pores in soil
Mesofauna

- Heterotrophs (detritivores, predators)
- Feed on fungi, protozoa, nematodes, mites
- Important in regulating populations of everything smaller
Other invertebrates

Mesofauna

pseudoscorpion
Worms

Voles!

Live in large pores in soil

Macrofauna