EARTH LADY

# What Do You See?

MODIS Image,
courtesy NASA

EARTH LADY

What do you see?

Land?

Water?

Clouds?

Snow?

Trees?

Atmosphere?

Earth satellite image courtesy NASA's Moderate Resolution Imaging Spectroradiometer (Terra/MODIS).

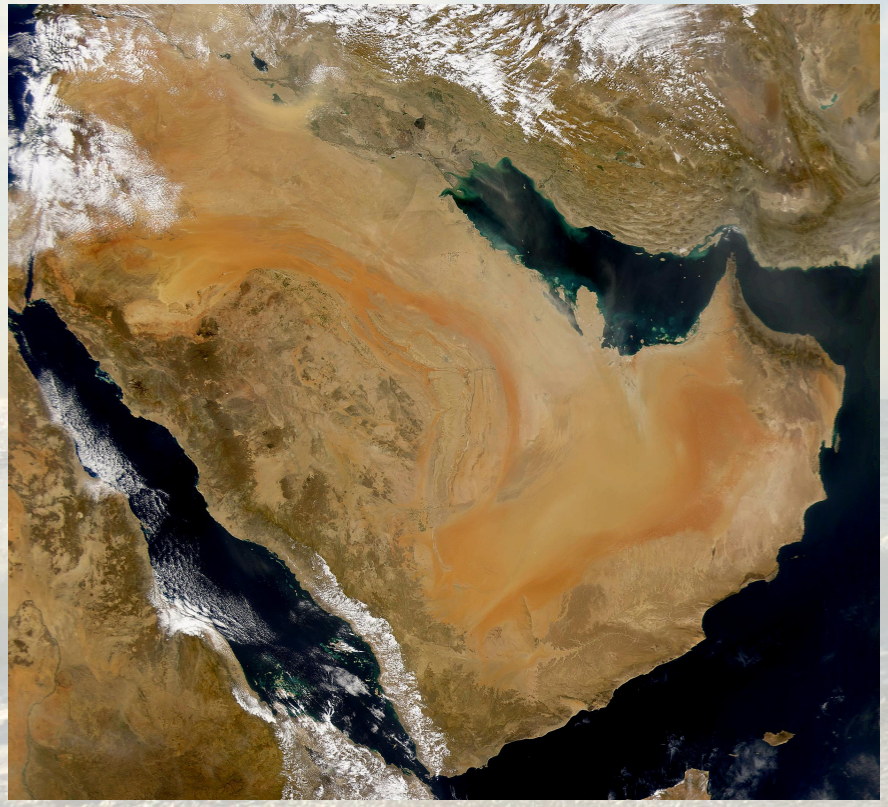
These are all great answers!

EARTH LADY

# Let’s Zoom In!

Earth satellite image courtesy NASA’s Moderate Resolution Imaging Spectroradiometer (Terra/MODIS).

EARTH LADY



To study soil, scientists need to be up close and personal. That's where you come in!

With soil characterization, you provide the research that no one else can do. You help us see the whole picture.

Arabian Peninsula satellite image: NASA Sea-viewing Wide Field-of-View Sensor (SeaWiFS) image

EARTH LADY

Before we continue, why do we study the soil?

Why is it important? What does the soil do?

Let’s Take A Look.

EARTH LADY

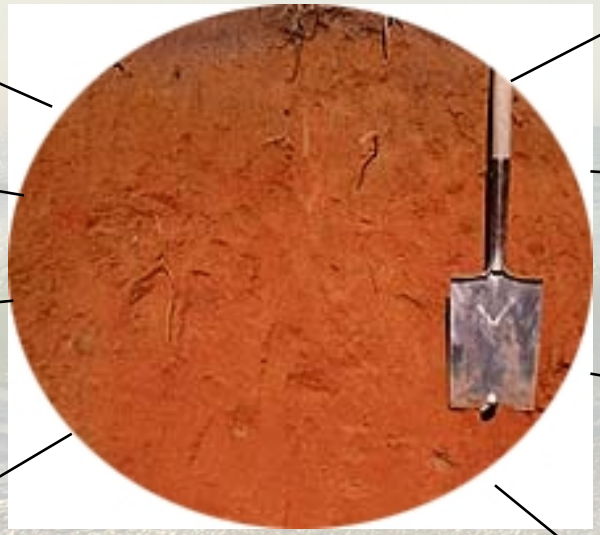
# We Study Soil Because It's A(n)

Medium of crop production

Great integrator

Snapshot of geologic, climatic, biological, and human history

Producer and absorber of gases



Waste decomposer

Medium for plant growth

Source material for construction, medicine, art, etc.

Home to organisms (plants, animals and others)

Filter of water and wastes

Essential natural resource

Soil horizon oval image courtesy, NASA

EARTH LADY

Why would we study soil? What does the soil do? What are some of its uses?

Let’s start with the basics. The Soil grows our food.

Breakfast Image courtesy Izolda Trakhtenberg

EARTH LADY

Soil and Food: Some Questions

Did you eat Breakfast today?

What did you eat?

How does what you ate relate to soil?

What about lunch?

Can you relate what you ate to soil?

Did any of the components of your meals grow in soil?

EARTH LADY

# How about these foods? How are they related to soil?

Salad bar

Chili cooking in crock pot

Hot dogs, buns, potato chips, vegetables

Salad

EARTH LADY

# What Are Some Foods That Are Not Related To Soil?

Salad bar

Chili cooking in crock pot

Hot dogs, buns, potato chips, vegetables

Salad

Images courtesy Izolda Trakhtenberg

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Let's look at some numbers.

Total Coarse Grain Area, Yield, and Production

| Country / Region | Area (Million hectares) | | | | Yield (Metric tons per hectare) | | | | Production (Million metric tons) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Prel. | 2015/16 Proj. | | | Prel. | 2015/16 Proj. | | | Prel. | 2015/16 Proj. | |
| | 2013/14 | 2014/15 | Jun | Jul | 2013/14 | 2014/15 | Jun | Jul | 2013/14 | 2014/15 | Jun | Jul |
| **World** | 322.59 | 322.15 | 321.51 | 322.50 | 3.97 | 4.01 | 3.97 | 3.95 | 1,280.98 | 1,290.43 | 1,276.00 | 1,274.97 |
| **United States** | 39.81 | 37.74 | 37.46 | 37.77 | 9.22 | 9.99 | 9.69 | 9.60 | 367.09 | 377.12 | 362.81 | 362.47 |
| **Total Foreign** | 282.79 | 284.40 | 284.05 | 284.73 | 3.23 | 3.21 | 3.21 | 3.20 | 913.89 | 913.31 | 913.19 | 912.50 |
| **China** | 38.38 | 39.07 | 39.68 | 39.83 | 5.86 | 5.69 | 5.91 | 5.91 | 225.07 | 222.17 | 234.50 | 235.50 |
| **European Union** | 31.39 | 30.81 | 30.72 | 30.87 | 5.07 | 5.51 | 5.19 | 5.04 | 159.02 | 169.63 | 159.48 | 155.70 |
| **South America** | | | | | | | | | | | | |
| Brazil | 16.81 | 16.30 | 15.78 | 15.98 | 4.91 | 5.19 | 4.92 | 4.98 | 82.60 | 84.60 | 77.58 | 79.58 |
| Argentina | 5.93 | 5.01 | 5.32 | 5.33 | 6.01 | 6.38 | 6.28 | 6.27 | 35.67 | 32.00 | 33.45 | 33.46 |
| **Former Soviet Union - 12** | | | | | | | | | | | | |
| Russia | 15.49 | 16.73 | 15.90 | 15.90 | 2.31 | 2.41 | 2.41 | 2.44 | 35.74 | 40.39 | 38.30 | 38.80 |
| Ukraine | 8.78 | 8.44 | 7.38 | 7.38 | 4.55 | 4.66 | 4.49 | 4.49 | 39.92 | 39.35 | 33.13 | 33.13 |
| Kazakhstan | 2.26 | 2.31 | 2.39 | 2.39 | 1.55 | 1.47 | 1.44 | 1.44 | 3.51 | 3.39 | 3.44 | 3.44 |
| Belarus | 1.23 | 1.21 | 1.22 | 1.22 | 3.10 | 3.50 | 3.29 | 3.29 | 3.79 | 4.24 | 4.00 | 4.00 |
| **Africa** | | | | | | | | | | | | |
| Nigeria | 13.25 | 13.65 | 13.10 | 13.10 | 1.46 | 1.39 | 1.37 | 1.37 | 19.29 | 19.02 | 17.95 | 17.95 |
| South Africa | 3.30 | 3.31 | 3.42 | 3.42 | 4.72 | 3.56 | 4.12 | 4.12 | 15.58 | 11.79 | 14.07 | 14.07 |
| Tanzania | 5.17 | 5.25 | 5.25 | 5.25 | 1.26 | 1.18 | 1.27 | 1.27 | 6.51 | 6.19 | 6.69 | 6.69 |
| Burkina | 4.08 | 3.85 | 3.85 | 3.85 | 1.11 | 1.12 | 1.17 | 1.17 | 4.54 | 4.29 | 4.50 | 4.50 |
| Ethiopia | 6.16 | 5.89 | 5.84 | 5.84 | 2.35 | 2.27 | 2.36 | 2.36 | 14.47 | 13.35 | 13.79 | 13.79 |
| Egypt | 0.94 | 0.97 | 0.97 | 0.97 | 7.10 | 7.04 | 7.05 | 7.05 | 6.66 | 6.82 | 6.86 | 6.86 |
| Mali | 3.02 | 3.20 | 3.20 | 3.20 | 1.15 | 1.41 | 1.38 | 1.38 | 3.48 | 4.50 | 4.40 | 4.40 |
| **India** | 25.86 | 24.25 | 25.00 | 25.00 | 1.67 | 1.67 | 1.67 | 1.67 | 43.21 | 40.39 | 41.63 | 41.63 |
| **Southeast Asia** | | | | | | | | | | | | |
| Indonesia | 3.12 | 3.14 | 3.14 | 3.14 | 2.92 | 2.99 | 3.06 | 3.06 | 9.10 | 9.40 | 9.60 | 9.60 |
| Philippines | 2.58 | 2.57 | 2.73 | 2.70 | 2.91 | 2.99 | 3.12 | 3.07 | 7.53 | 7.69 | 8.50 | 8.30 |
| Vietnam | 1.18 | 1.25 | 1.30 | 1.30 | 4.40 | 4.50 | 4.62 | 4.62 | 5.19 | 5.63 | 6.00 | 6.00 |
| Thailand | 1.15 | 1.13 | 1.13 | 1.13 | 4.31 | 4.34 | 4.38 | 4.38 | 4.96 | 4.91 | 4.96 | 4.96 |
| **Mexico** | 9.39 | 9.22 | 9.18 | 9.18 | 3.41 | 3.47 | 3.49 | 3.49 | 32.02 | 31.94 | 31.98 | 31.98 |
| **Canada** | 5.40 | 4.43 | 4.91 | 4.88 | 5.33 | 4.95 | 4.86 | 4.80 | 28.75 | 21.92 | 23.85 | 23.40 |
| **Australia** | 5.19 | 5.26 | 5.46 | 5.64 | 2.34 | 2.16 | 2.25 | 2.23 | 12.16 | 11.35 | 12.28 | 12.58 |
| **Middle East** | | | | | | | | | | | | |
| Turkey | 4.24 | 4.28 | 4.33 | 4.33 | 3.08 | 2.21 | 3.11 | 3.11 | 13.08 | 9.48 | 13.48 | 13.48 |
| Iran | 2.07 | 2.01 | 2.04 | 2.04 | 2.59 | 2.87 | 2.88 | 2.88 | 5.36 | 5.76 | 5.86 | 5.86 |
| **Others** | 66.45 | 70.89 | 70.83 | 70.87 | 1.46 | 1.45 | 1.45 | 1.45 | 96.71 | 103.14 | 102.95 | 102.86 |

World and Selected Countries and Regions; Coarse Grain includes: Barley, Corn, Millet, Mixed Grains, Oats, Rye and Sorghum

Foreign Agricultural Service/USDA, July 2015, Office of Global Analysis

Almost every bit of these grains and other crops are grown in soil.

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# Soil and Clothing

What clothes did you wear today?

How does what you wore relate to soil?

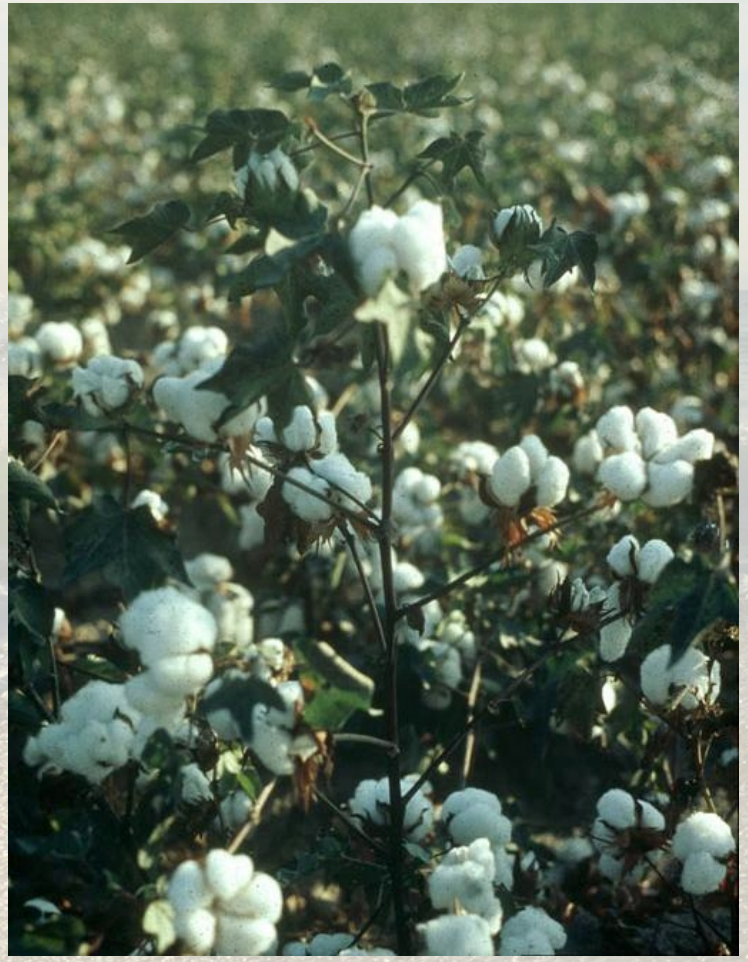
Does it relate? If so, how?

If not...

Let’s take a look.

EARTH LADY

# What is this plant?

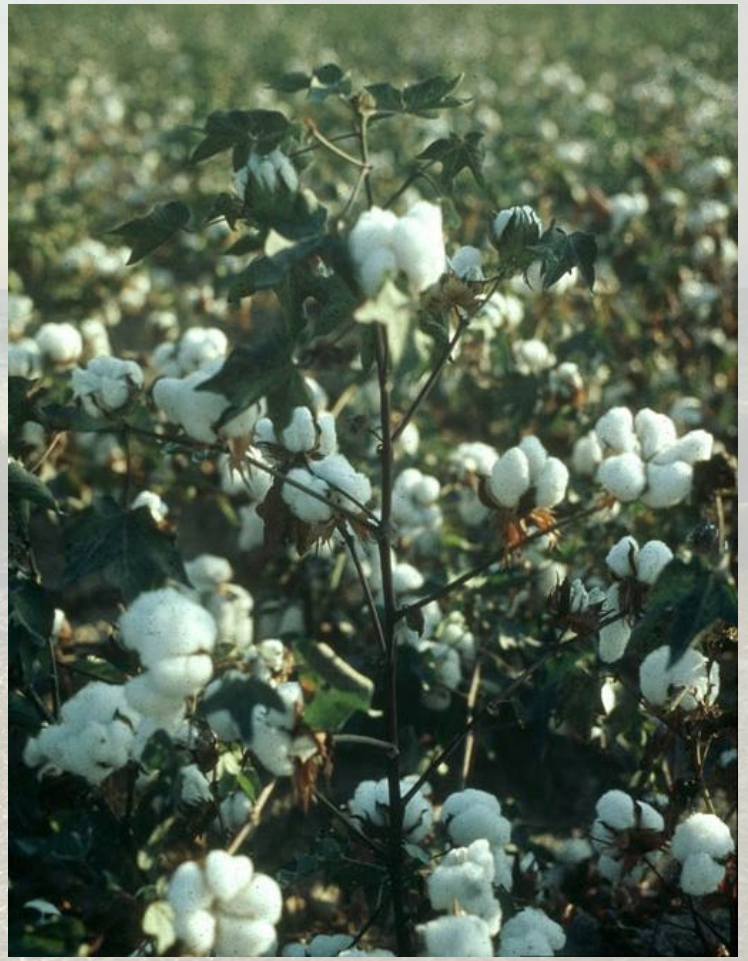


Public Domain Image of cotton plants
Ashish Wankhade: https://en.wikipedia.org/wiki/User:Wankash
https://commons.wikimedia.org/wiki/File:Cotton_Plant.png

EARTH LADY

# It’s Cotton.

Leg wearing jeans: Image courtesy, Izolda Trakhtenberg

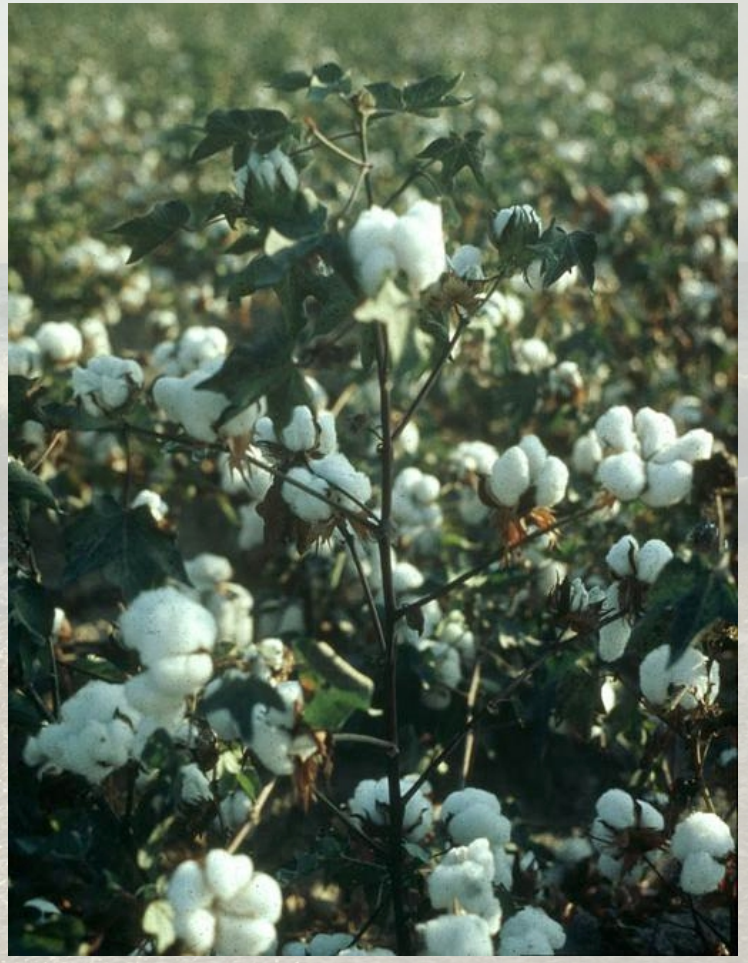


Public Domain Image of cotton plants
Ashish Wankhade: https://en.wikipedia.org/wiki/User:Wankash
https://commons.wikimedia.org/wiki/File:Cotton_Plant.png

EARTH LADY

# Cotton Makes Jeans, Among Other Clothing.

Leg wearing jeans: Image courtesy, Izolda Trakhtenberg



Public Domain Image of cotton plants
Ashish Wankhade: https://en.wikipedia.org/wiki/User:Wankash
https://commons.wikimedia.org/wiki/File:Cotton_Plant.png

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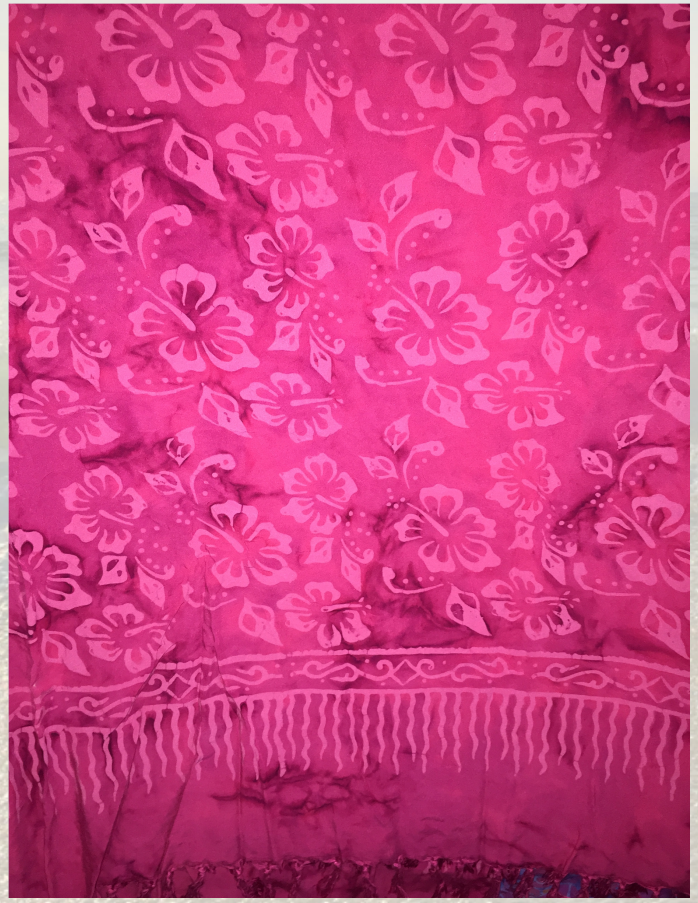
This sarong is made of Rayon. Rayon is made of cellulose from wood fiber.



Pink sarong with hibiscus flowers Image courtesy Izolda Trakhtenberg

EARTH LADY

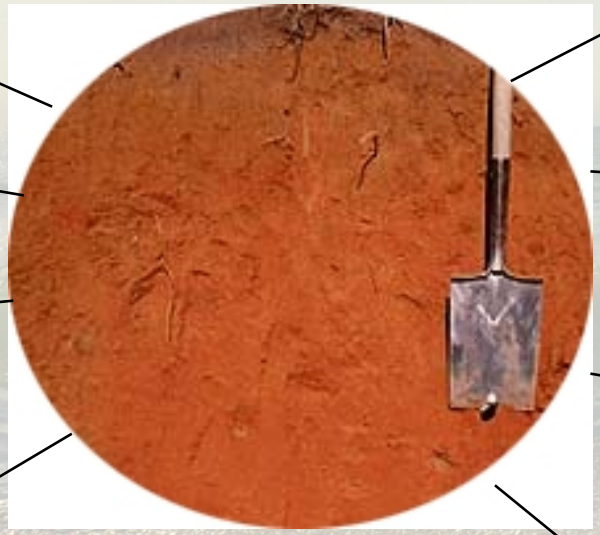
# We Study Soil Because It's A(n)

Medium of crop production

Great integrator

Snapshot of geologic, climatic, biological, and human history

Producer and absorber of gases



Waste decomposer

Medium for plant growth

Source material for construction, medicine, art, etc.

Home to organisms (plants, animals and others)

Filter of water and wastes

Essential natural resource

Soil horizon ovular Image courtesy NASA

EARTH LADY

# Soil as Construction Material

Brick building Image courtesy Izolda Trakhtenberg

Bricks are used to build homes and other buildings. Look on the next slide to see another way soil is used as a building material.

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# Soil as Construction Material

Woman standing in doorway of soil home in Ethiopia Courtesy Dr. Ray Weil, University of Maryland

Ethiopia (clay soils mixed with water on a framework of sticks)

EARTH LADY

# Soil and Ceramics

Ceramic mug image courtesy: Izolda Trakhtenberg

Ceramic bowl image courtesy: Izolda Trakhtenberg

What are these made of?

EARTH LADY

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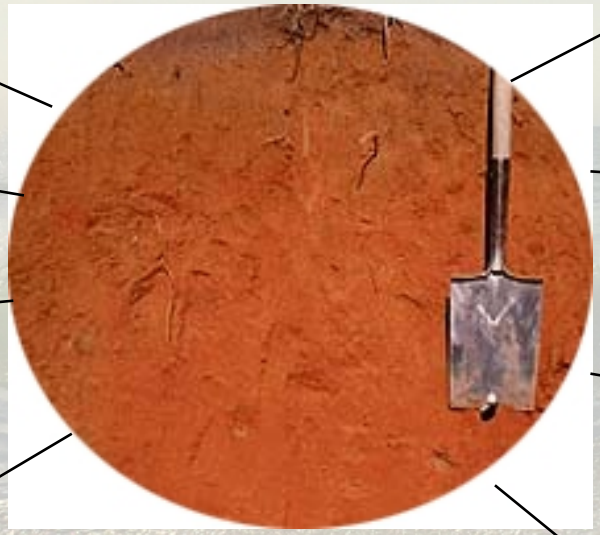

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Soil horizon ovular Image courtesy NASA

EARTH LADY

# Soil as Art Sand Painting and Sculpture


Public Domain Image: Navajo Sand Painting:
https://commons.wikimedia.org/wiki/File:Navajos_sandpainting.jpg

Public Domain Image: Sand Castle
https://commons.wikimedia.org/wiki/File:Castleboomy08.jpg

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African Mud Cloth (Bogolanfini)

African Mud Cloth in tans, browns, and blacks image courtesy Izolda Trakhtenberg

This technique that originated in the west coast of Africa uses the soil as a dye.

EARTH LADY

# Soil and Trees

Single tree in morning mist image courtesy, Izolda Trakhtenberg

Deciduous trees in autumn
image courtesy, Izolda Trakhtenberg

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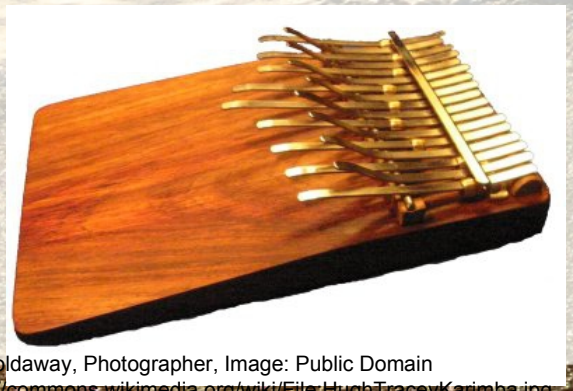
# Soil, Trees, and Musical Instruments

Wooden Darbouka: Public Domain Image
https://upload.wikimedia.org/wikipedia/commons/2/2a/Wooden_darbouka.jpg



Tin Holdaway, Photographer, Image: Public Domain
https://commons.wikimedia.org/wiki/File:HughTraceyKarimba.jpg

Guitar and Violin Images courtesy Izolda Trakhtenberg

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# Soil as Medicine

Medicines like Neosporin (a topical antibioltic ointment) and Kaopectate (an anti-diarrheal) come from the soil.

The active ingredient in Neosporin comes from a Microorganism that lives in the Soil.

Microorganism: Streptomyces Fradiae Waksman (Fam. Streptomycetaceae)

Kaolinite Clay was the original absorbent in Kaopectate.

There are likely other ways in which soil is used as medicine.
In some parts of the world, for example, pregnant women eat soil. See:
http://www.ncbi.nlm.nih.gov/pubmed/10390045

EARTH LADY

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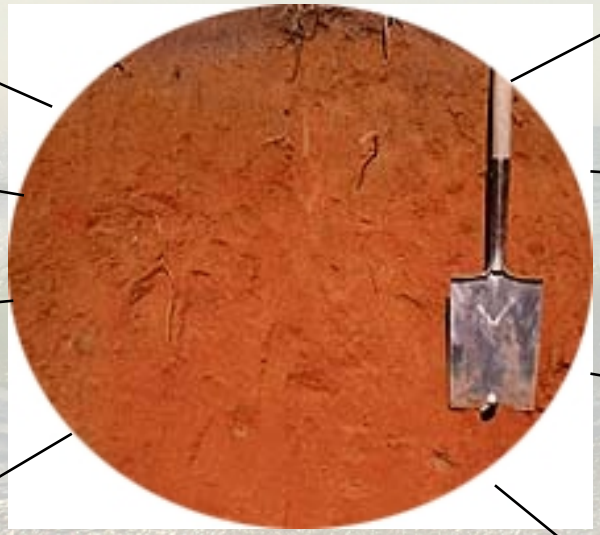

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Essential natural resource

Soil horizon ovular Image courtesy NASA

EARTH LADY

This Prairie Dog is just one example of the billions of Organisms that live in the soil. Can you name some others?

Prairie Dog eating image courtesy Izolda Trakhtenberg

EARTH LADY

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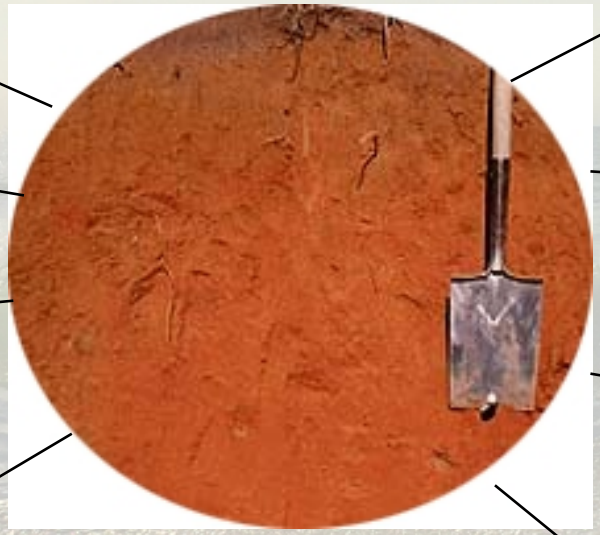

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Soil horizon ovular Image courtesy NASA

EARTH LADY

# Soil and Water

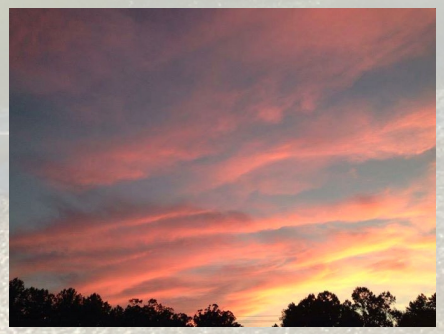
The amount of water in the soil and how well the soil filters water through greatly affect plant growth, water quality, relative humidity, evaporation, and many other aspects of the Earth System.

The absorbed water is held on soil particle surfaces and in pore spaces between particles. This water is available for use by plants during times of little precipitation.

Some of this water evaporates back into the air; some drains through the soil into groundwater.

Water For Plant Use

Water Storage



Atmospheric Humidity

Evaporation Rates
(Lic. By Freeimages.com)

Images courtesy, Izolda Trakhtenberg. Illustration courtesy, Rich Potter

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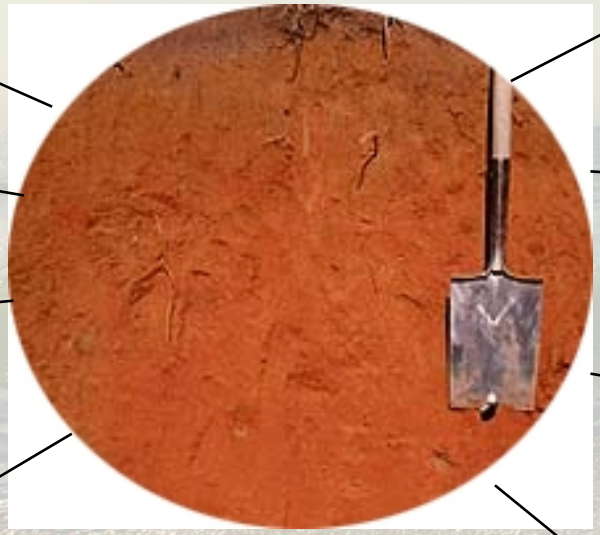

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Soil horizon ovular Image courtesy NASA

EARTH LADY

## A Soil's Story

Soils form slowly. When different forces act on them, their characteristics change.


A Maryland Soil profile (Photo © Dr. Ray Weil, University of Maryland)

Story by Dr. Ray Weil

EARTH LADY

# A Soil's Story

This is a soil profile.

Describe what you see.


A Maryland Soil (Photo © Dr. Ray Weil, University of Maryland)

Soils form slowly. When different forces act on them, their characteristics change.

EARTH LADY

# A Soil's Story

This is a soil profile.

Describe what you see.

Are there changes in the soil profile?

If so, what are they?


A Maryland Soil (Photo © Dr. Ray Weil, University of Maryland)

EARTH LADY

# A Soil's Story

This is a soil profile.

Describe what you see.

Are there changes in the soil profile?

If so, what are they?

The layers are called Horizons.

What is the gray, powder-like substance at Horizon 3C3?


A Maryland Soil (Photo © Dr. Ray Weil, University of Maryland)

EARTH LADY

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See if you can determine what this gray powder might be.


A Maryland Soil (Photo © Dr. Ray Weil, University of Maryland)

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What is the gray, powder-like substance at Horizon 3C3?

See if you can determine what this gray powder might be.


The fine-gray powder was deposited in this stream bed approximately 150-250 years ago over a period of 100 years. What do you think it is?

A Maryland Soil (Photo © Dr. Ray Weil, University of Maryland)

EARTH LADY

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It's ash from forest fires. How did these forest fires last almost a hundred years?

A Maryland Soil (Photo © Dr. Ray Weil, University of Maryland)

EARTH LADY

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Slash and Burn Agriculture. The results of some of that practice of burning down forest to make room for farms was deposited in this stream bed.

A Maryland Soil (Photo © Dr. Ray Weil, University of Maryland)

EARTH LADY

# A Soil's Story

What are the nodules at 4C4?

What is this horizon's story?


A Maryland Soil (Photo © Dr. Ray Weil, University of Maryland)

EARTH LADY

# A Soil's Story

What are the nodules at 4C4?

What is this horizon's story?


The nodules below that horizon were deposited in this stream bed about 250-350 years ago. They are clam and oyster shells? How did they get there?

A Maryland Soil (Photo © Dr. Ray Weil, University of Maryland)

EARTH LADY

# A Soil's Story

What are the nodules at 4C4?

What is this horizon's story?


The nodules below that horizon were deposited in this stream bed about 250-350 years ago. They are clam and oyster shells? How did they get there?

The people indigenous to this geographic regions caught clams, oysters, and fish in this region. These shells were what they left behind.

A Maryland Soil (Photo © Dr. Ray Weil, University of Maryland)

EARTH LADY

# A Soil's Story

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What is this horizon's story?


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The soil in this stream bed is formed and changed by these factors.

A Maryland Soil (Photo © Dr. Ray Weil, University of Maryland)

EARTH LADY

# A Soil's Story

As we look at this soil's story, what are the soil forming factors that played a role in its formation?


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The soil in this stream bed is formed and changed by these factors.

A Maryland Soil (Photo © Dr. Ray Weil, University of Maryland)

EARTH LADY

# A Soil's Story

As we look at this soil's story, what are the soil forming factors that played a role in its formation?


The parent material of this soil is partially formed of the ash from the forest fires.

The biota or living organisms affected this soil's formation by depositing the ash and also the shells from other living organisms into the soil.

The topography of the soil's location, a stream bed, affected how the materials were deposited and how they remain as part of this soil profile.

A Maryland Soil (Photo © Dr. Ray Weil, University of Maryland)

EARTH LADY

# Soil Forming Factors

In addition to the parent material, the biota, and the topography, what are some other factors that contribute to soil formation?

Go the next slide to see another reason we study soil and learn about more of the Soil Forming Factors.

Forest Soil in Florida, USA
Image courtesy NRCS

EARTH LADY

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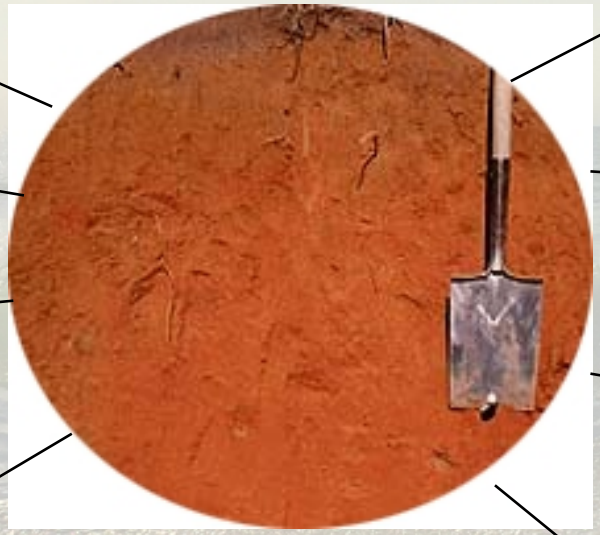

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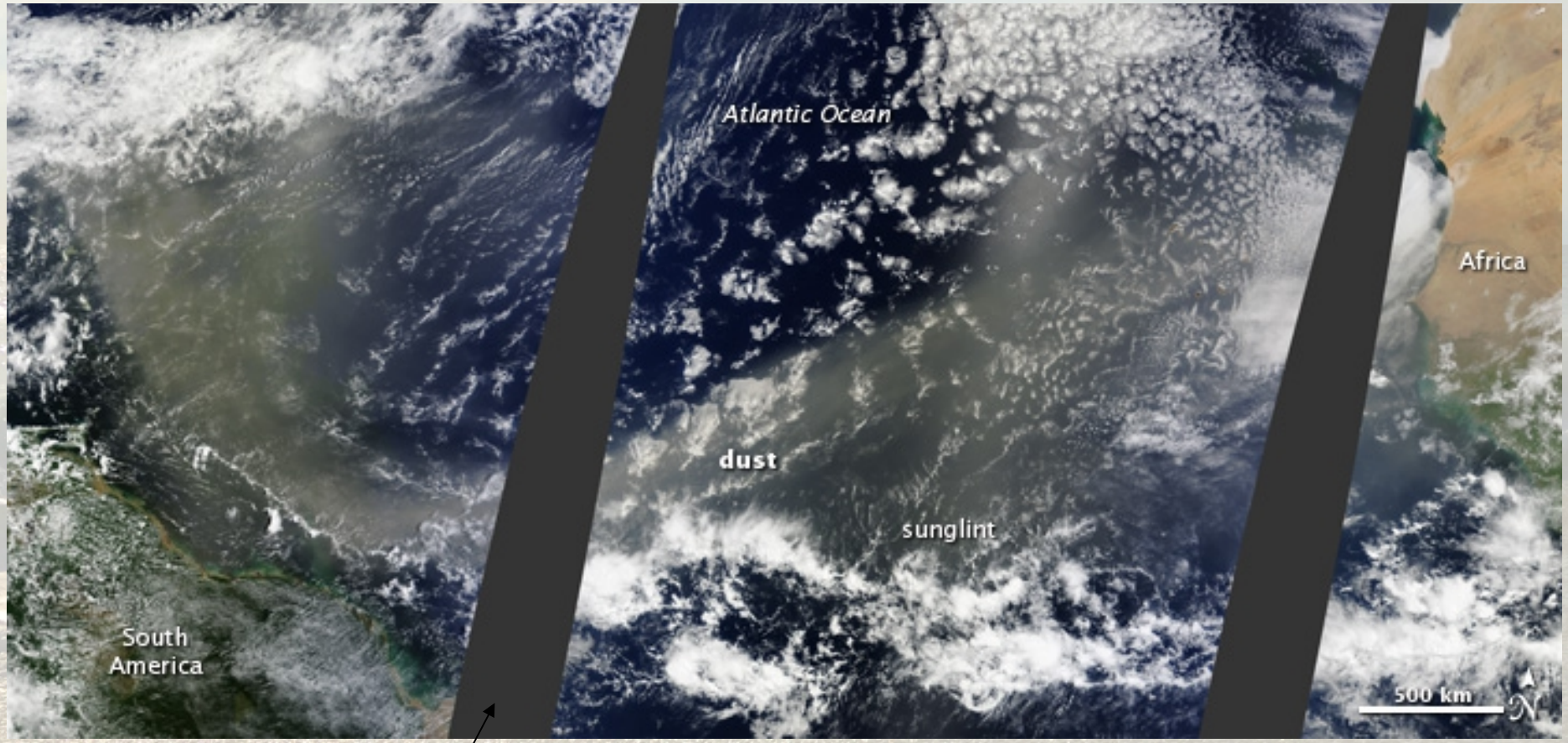
Soil horizon ovular Image courtesy NASA

EARTH LADY

What do you see?

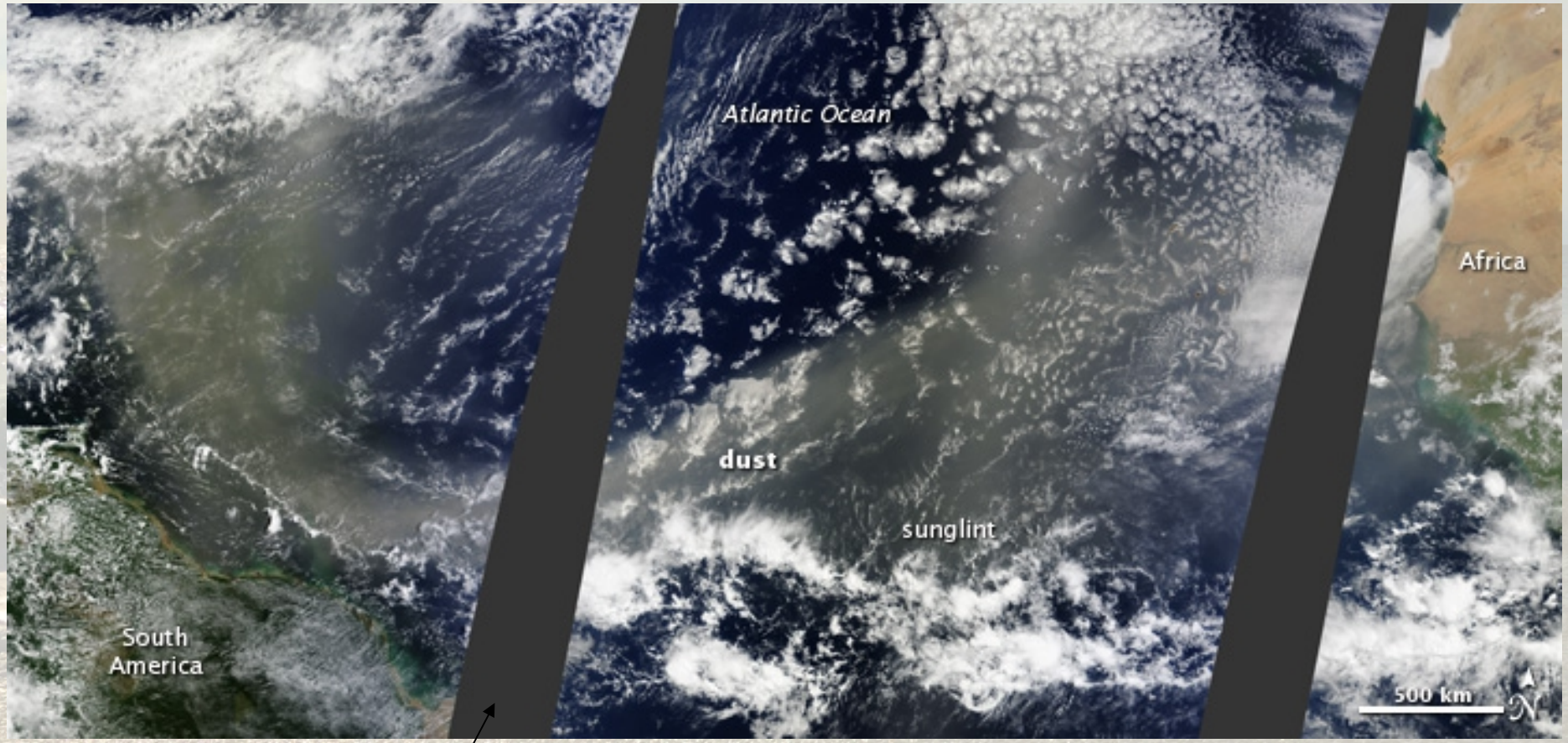



These bars are there to account for the roundness (curvature) of the Earth.

Satellite Image courtesy, NASA

EARTH LADY

What is happening here?

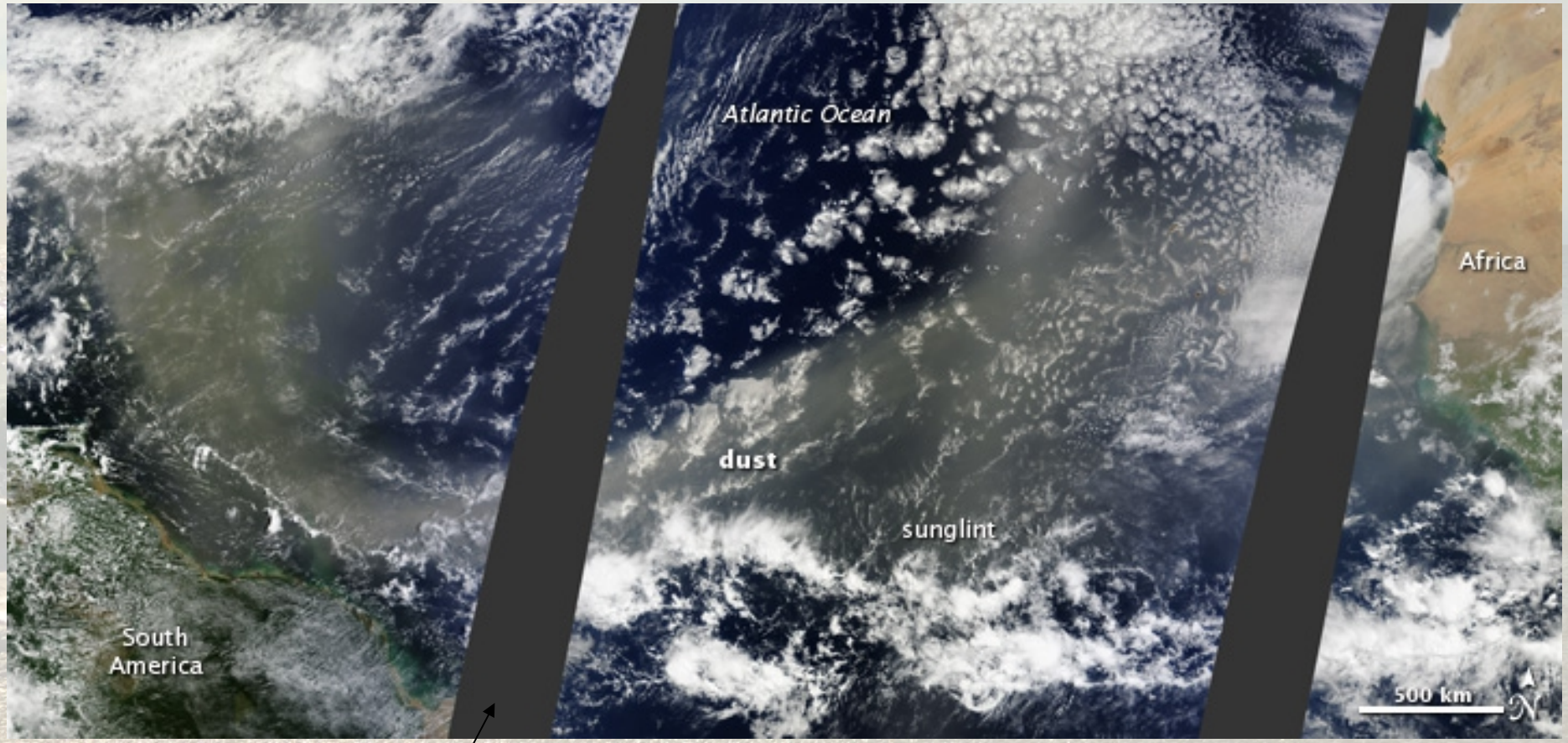



These bars are there to account for the roundness (curvature) of the Earth.

Satellite Image courtesy, NASA

EARTH LADY

What part of the Earth is this?




These bars are there to account for the roundness (curvature) of the Earth.

Satellite Image courtesy, NASA

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Let's look at it Geopolitically? Does that inform what we see?

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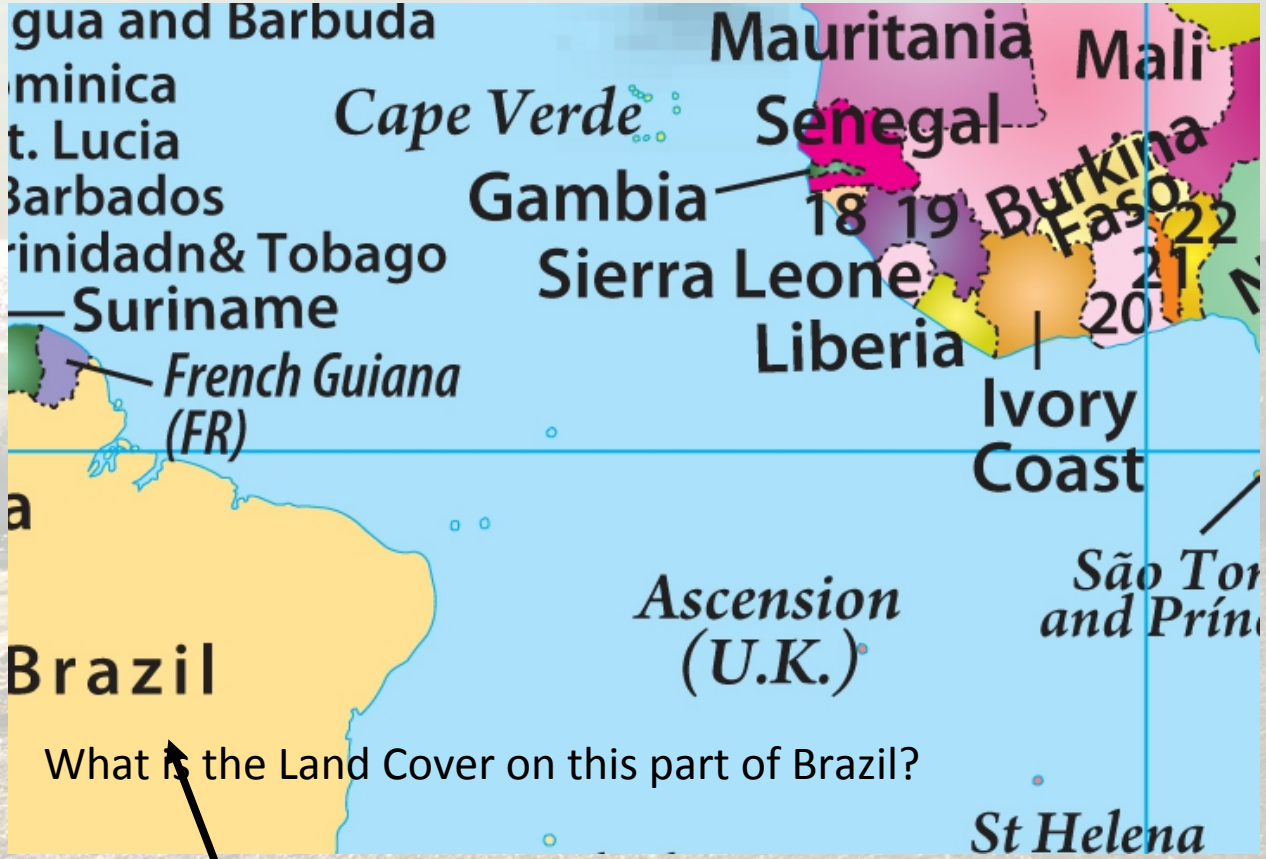
What if we zoom in? How does that change it?




What is the Land Cover on this part of Brazil?

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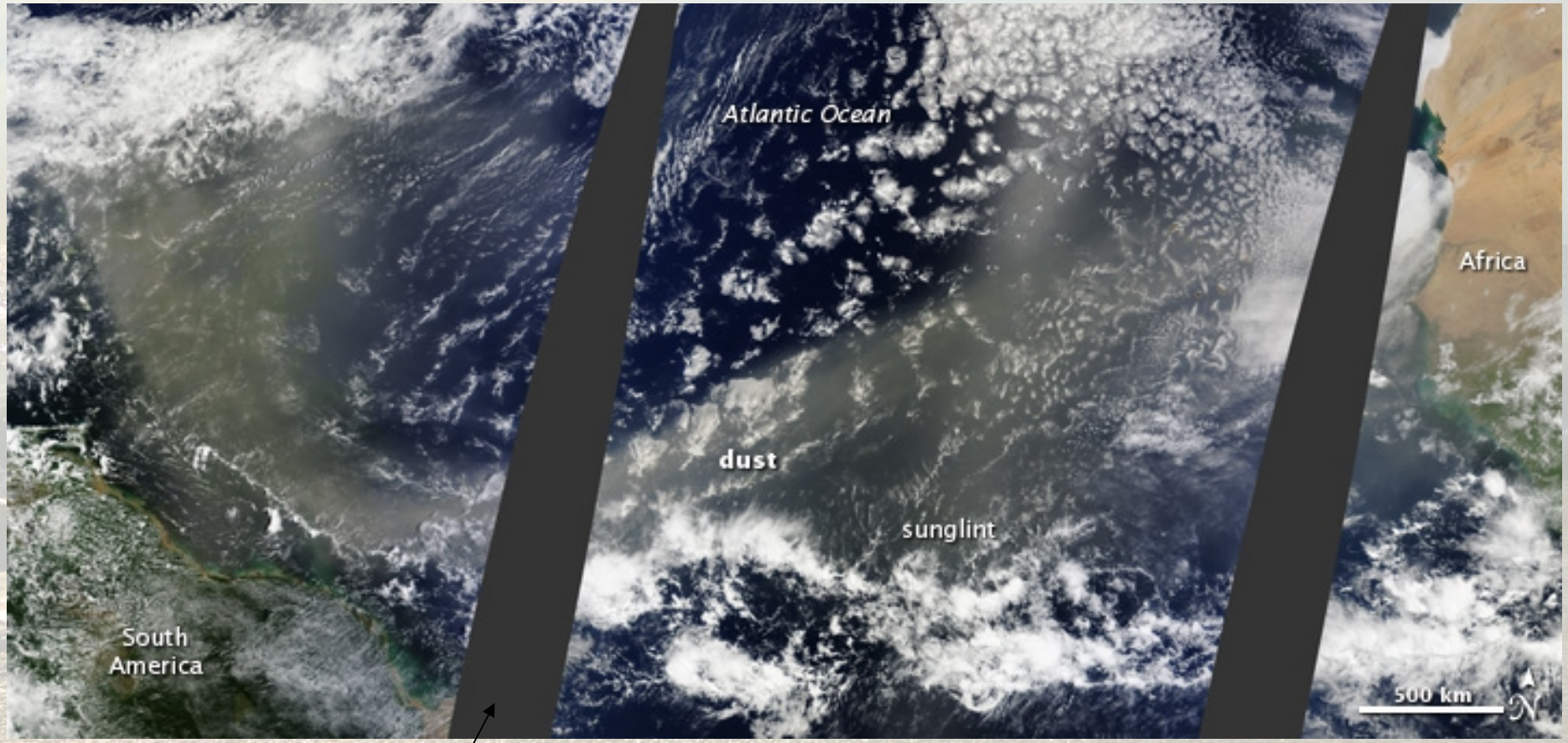
Why Does this Dust Matter to the Amazon Rainforest?




These bars are there to account for the roundness (curvature) of the Earth.

Satellite Image courtesy, NASA

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# Why Does this Dust Matter to the Amazon Rainforest?

Mangrove and woodland near the Amazon river - Salinopolis - Para – Brazil
Public Domain Image: Cesar Paes Barreto http://www.freeimages.com/photographer/cesarpb-30975 http://www.freeimages.com/photo/amazonian-river-1411558
https://commons.wikimedia.org/wiki/File:River_in_the_Amazon_rainforest.jpg

The soils in the Amazon Rainforest tend to filter water through quickly and they contain a lot of iron but not necessarily many other nutrients. Yet they support the richest variety of flora and fauna on the Earth.

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# Why Does this Dust Matter to the Amazon Rainforest?

Mangrove and woodland near the Amazon river - Salinopolis - Para – Brazil
Public Domain Image: Cesar Paes Barreto http://www.freeimages.com/photographer/cesarpb-30975 http://www.freeimages.com/photo/amazonian-river-1411558
https://commons.wikimedia.org/wiki/File:River_in_the_Amazon_rainforest.jpg

The plants in the Amazon Rainforest provide Oxygen.

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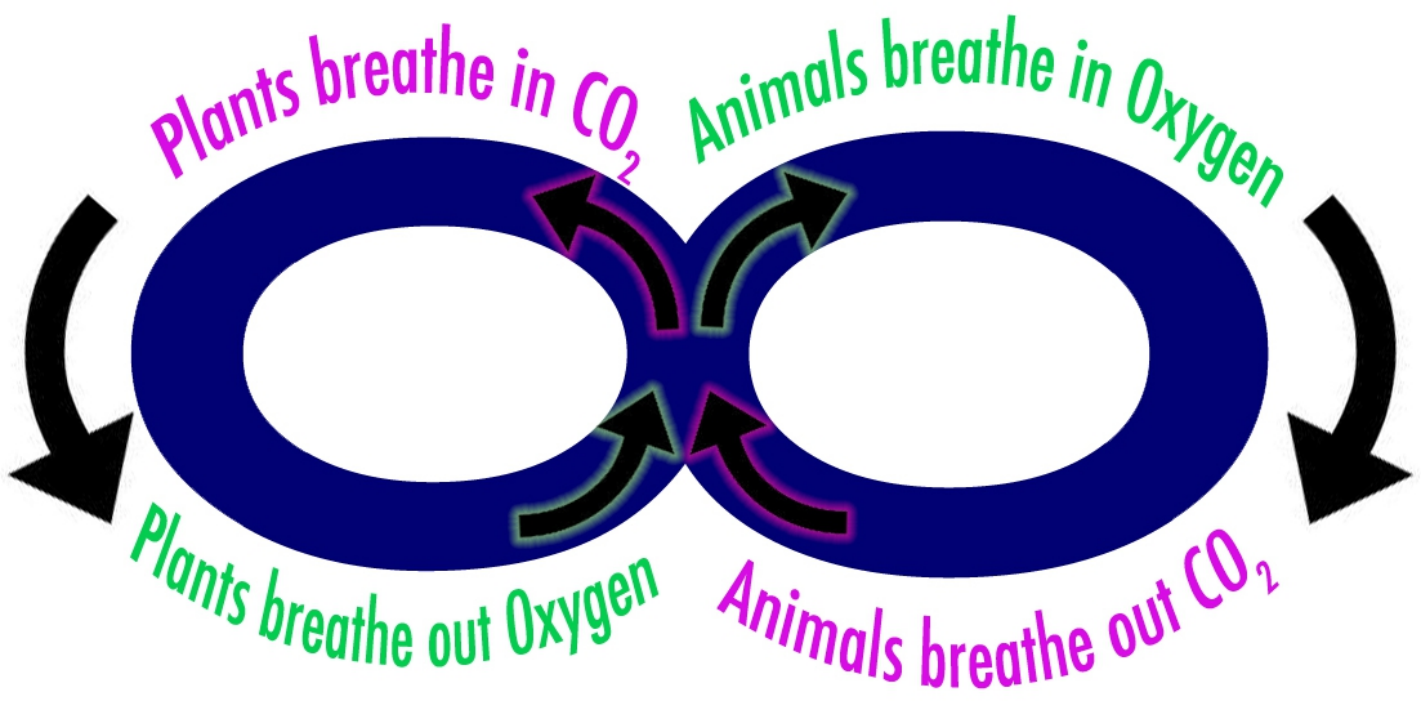
Why Does this Dust Matter to the Amazon Rainforest?




Carbon dioxide is taken in by plants and during photosynthesis is combined with water and energy to form oxygen and carbohydrates. The stored carbohydrates are used to fuel plant respiration and growth. And the oxygen is used by everyone.

Graphic courtesy Izolda Trakhtenberg

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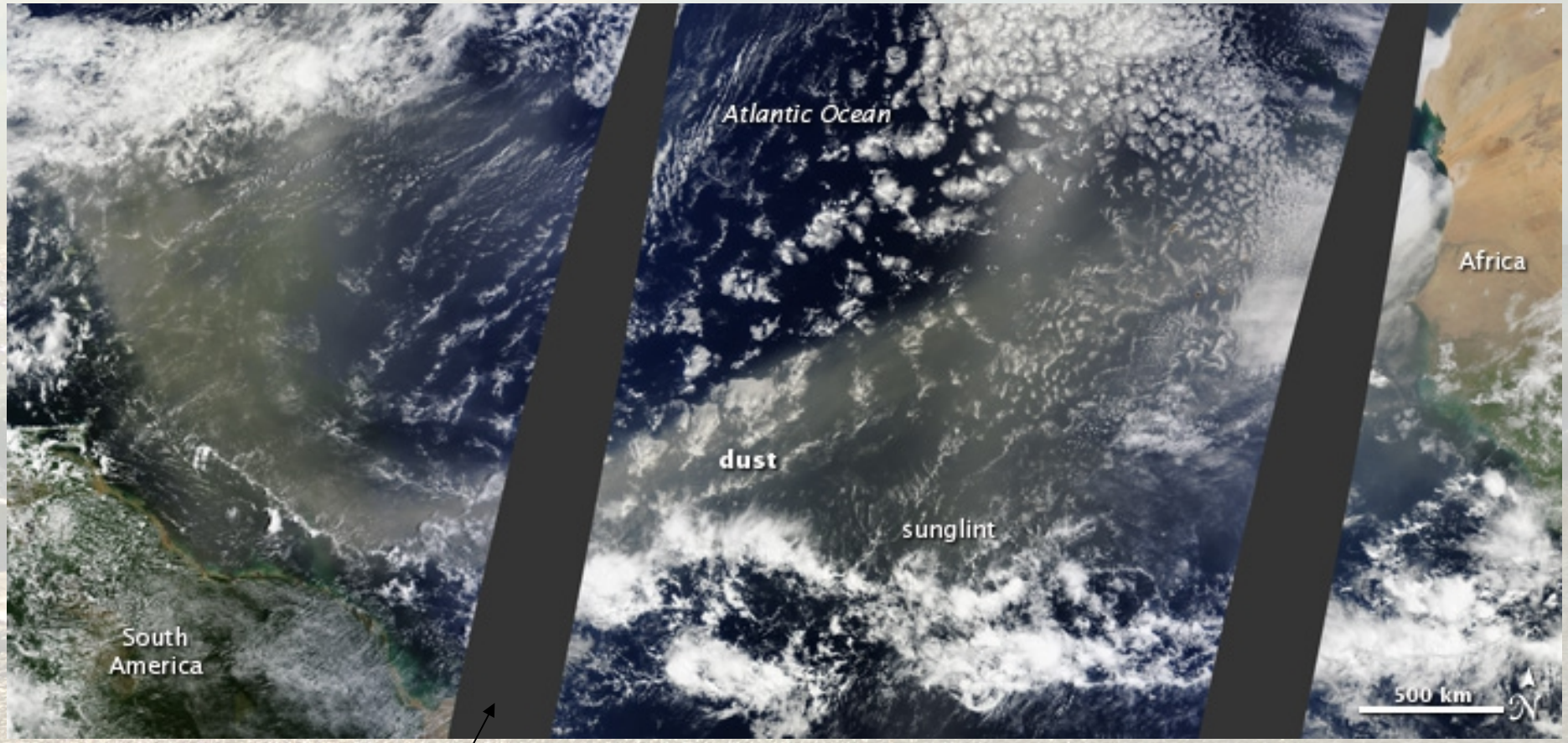
So where do they get their nutrients?




These bars are there to account for the roundness (curvature) of the Earth.

Satellite Image courtesy, NASA

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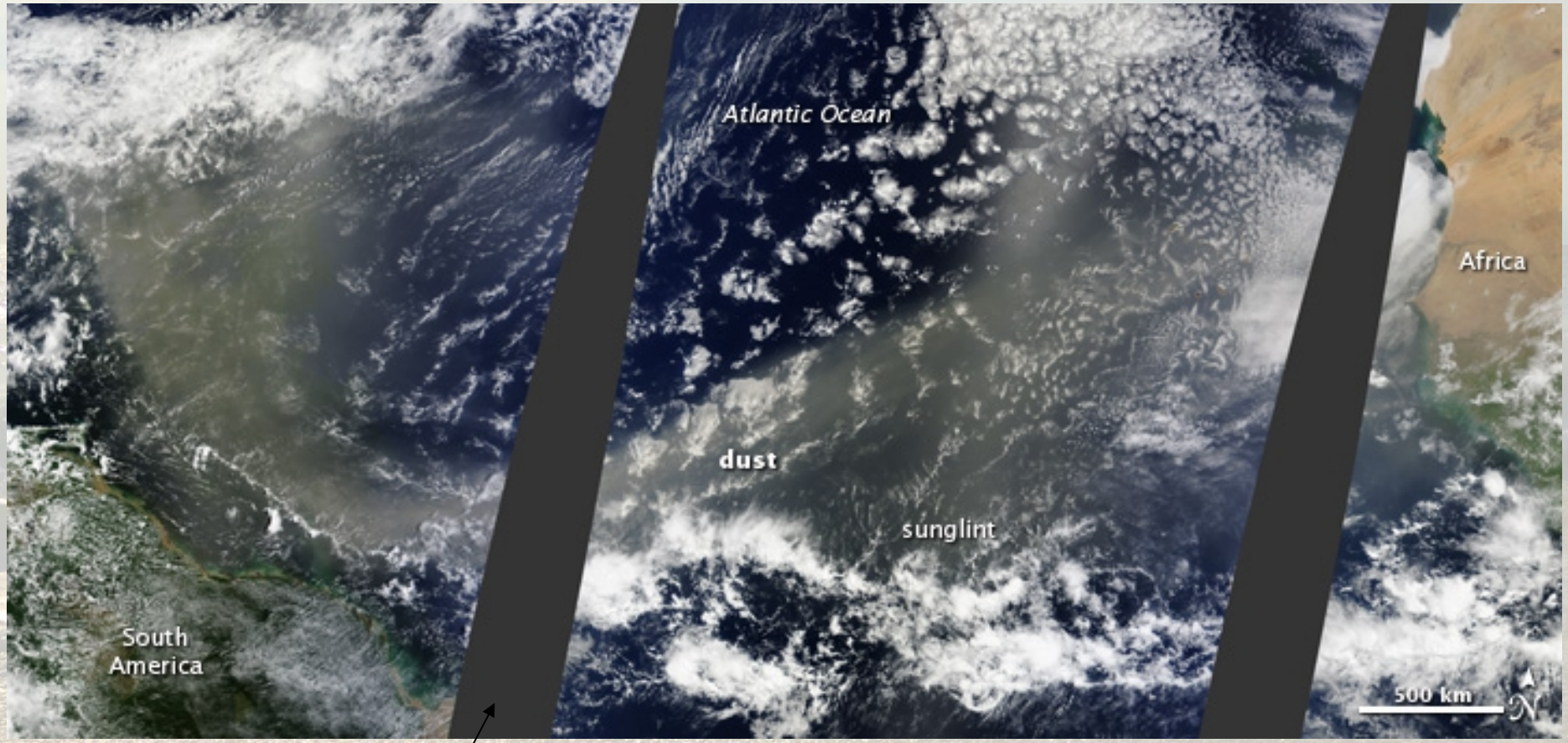
This dust provides a lot of them and helps form the soil.




These bars are there to account for the roundness (curvature) of the Earth.

Satellite Image courtesy, NASA

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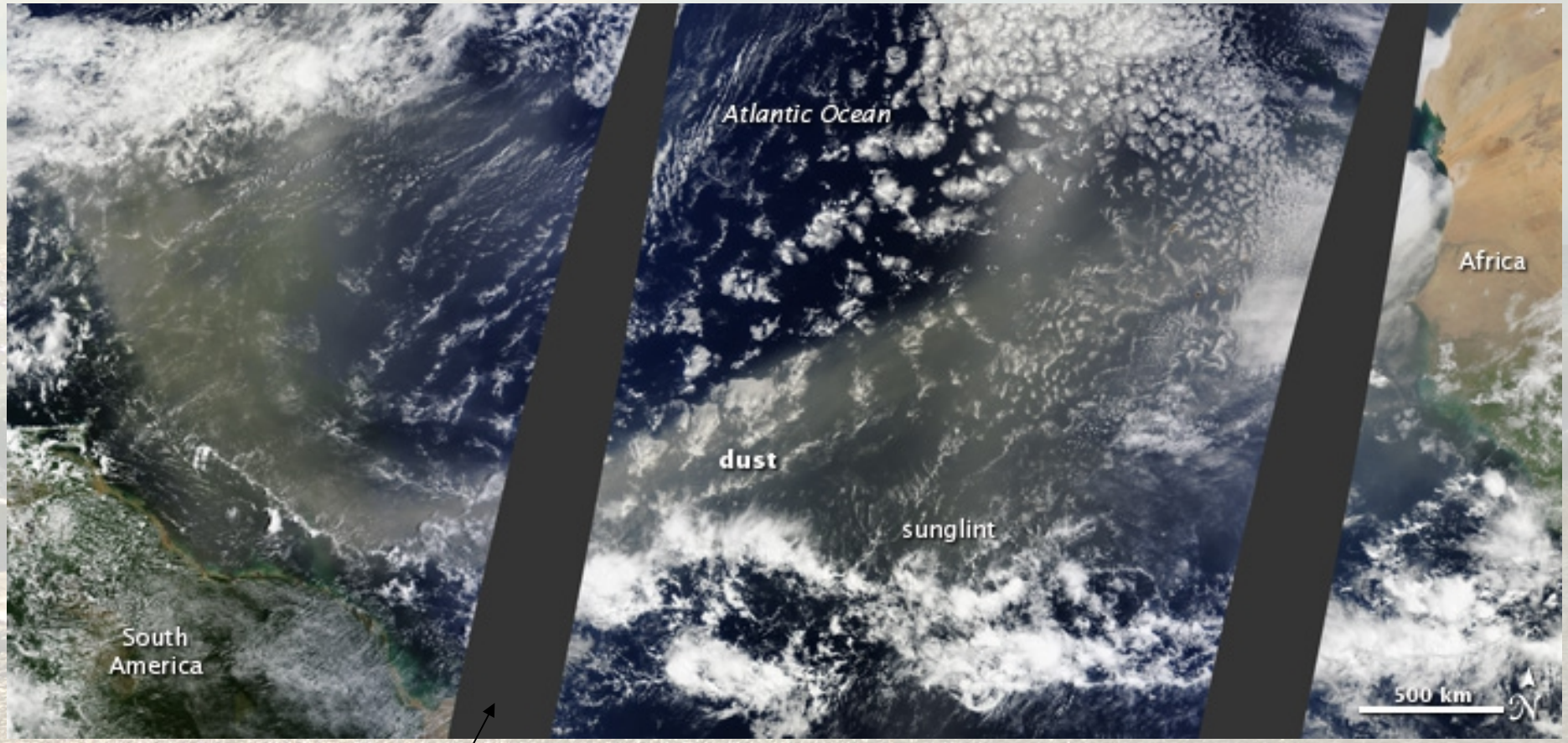
The soil provides a medium of plant growth.




These bars are there to account for the roundness (curvature) of the Earth.

Satellite Image courtesy, NASA

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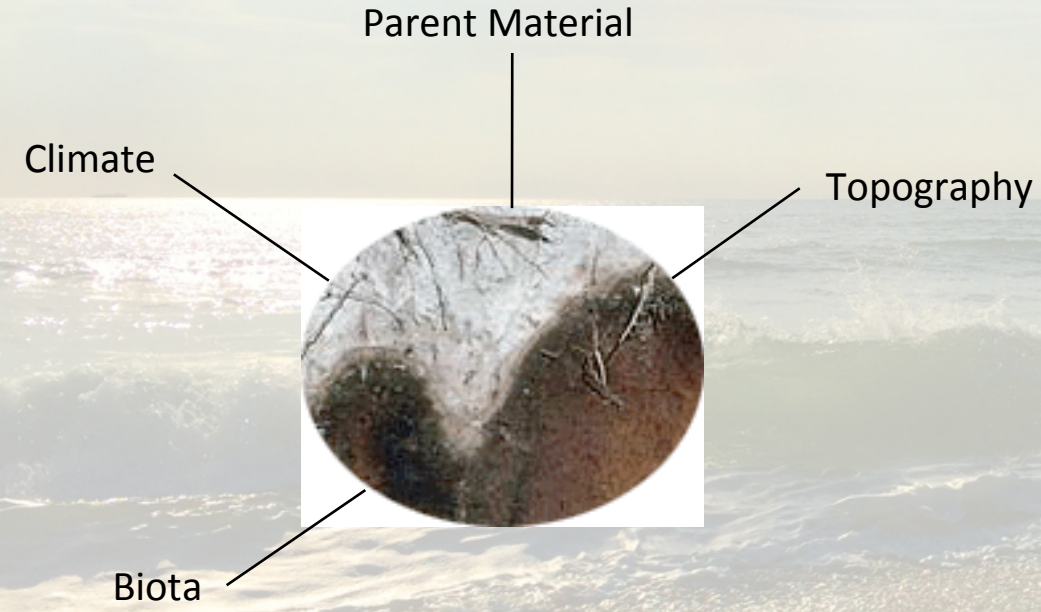
Soil Forming Factors

What are the Factors Involved in Soil Formation?




We have covered the first four Soil Forming Factors. What makes them important? And what is the fifth one?

Forest Soil in Florida, USA
Image courtesy, NASA

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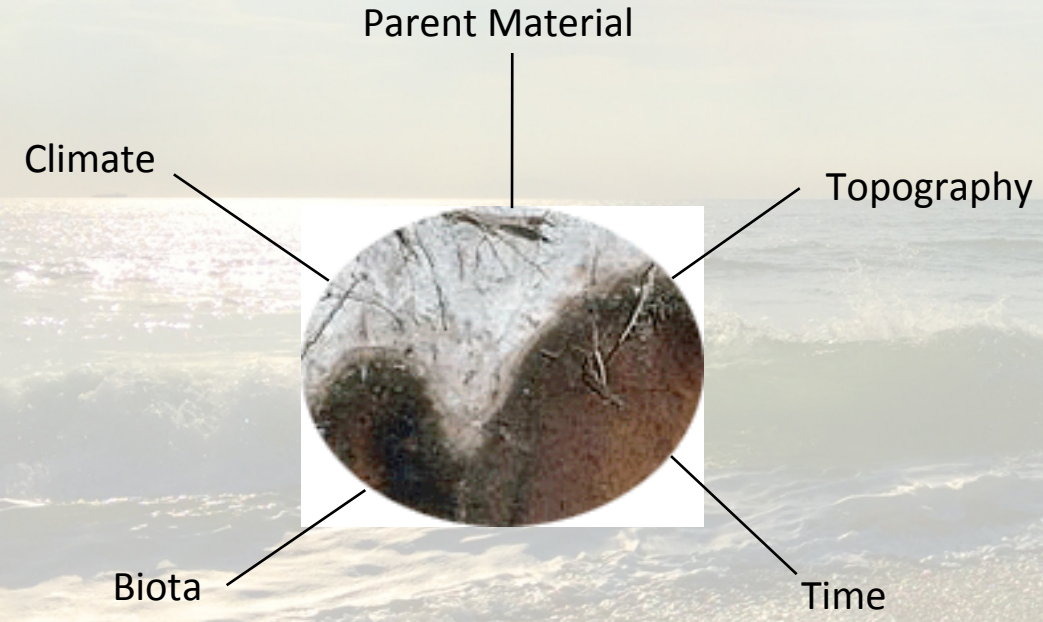
# Soil Forming Factors




These five factors work together to create a unique soil profile made of layers called horizons.

Forest Soil in Florida, USA
Image courtesy, NASA

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The Five Soil Forming Factors Affect the Formation of All the Soils on Planet Earth.

It is important to know and understand the soil forming factors in order to study Soil characterization and Soil Moisture.

The degree to which the various soil forming factors affect The soil will produce different soil profiles.

Maintained lawn and woodland image courtesy Izolda Trakhtenberg

Athletic field image courtesy Izolda Trakhtenberg

Do soil under different types of vegetation or land cover differ? How?

What are the needs of the plants in the left image? Water? Drainage? A certain soil structure?

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The Five Soil Forming Factors Affect the Formation of All the Soils on Planet Earth.

The degrees to which each soil forming factor affects soil formation will vary greatly. That will yield a large variety of soil types. Each soil type will have different characteristics and potential to grow food, store and filter water, and produce and exchange gases.

If the characteristics of soils differ, then we can categorize them.

We can study and determine the soil characterization and soil moisture of soils all over the world.

We can learn to identify the soils' characteristics by sampling soils, describing them, and analyzing them.

Forest Soil, USA

Image courtesy of the Natural Resources Conservation Service

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# The Soils on Planet Earth.

By studying the soil in your area and by providing these data, you will make an invaluable contribution to our knowledge of planet Earth.

As you conduct your soil studies, remember that you are the only ones who will study your specific soil. For much of this critical information, there exists no other way to study the soil in your community. Your contribution to science will be important and unique.

To learn more, click this link to the GLOBE Teacher's Guide Pedosphere section:
http://www.globe.gov/do-globe/globe-teachers-guide/soil-pedosphere


Organic soil image courtesy of the Natural Resources Conservation Service

# Soil Characterization Data Sheet

School Name: _____ Class Period: ____ Date: _____ Time: _____

Students' Names:

_____

_____

**Soil Structure: (The Shapes into which the soil breaks). Circle One.**

| Granular | Blocky | Prismatic | Columnar | Platy | Single Grained | Massive |
|---|---|---|---|---|---|---|
| Like Cookie Crumbs | Like Hunks of Chocolate | Like Crystals | Like Crystals wearing hats | Like Plates stacked up | Like sand at the beach | Like one big clod |

**Soil Color. Write the color name/number below the paint chip in the Soil Color Book: _____**

**Soil Consistence. (How easily a soil Ped breaks apart). Circle one.**

| Loose | Friable | Firm | Extremely Firm |
|---|---|---|---|
| Like Sand at the beach. You can't even pick up a single ped. | Breaks easily. "Pops" apart. | It takes a good bit of pressure. | It's hard to break apart, you would need a hammer. |

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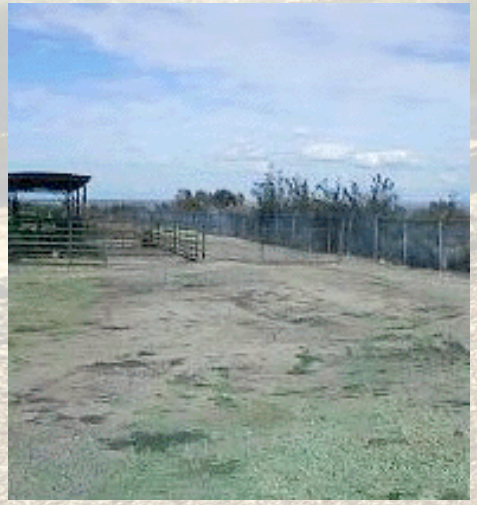
# Soils In Different Environments



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# Soil Characterization

## Surface Sample Technique

Soil sample on trowel. Image courtesy, Izolda Trakhtenberg

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# Soil Characterization

## Surface Sample Technique

### Determining and Describing Horizons

In soil characterization a deeper soil profile analysis like a pit or an augered profile is preferable.

In situations where it is not possible to expose the top meter of soil another option is to take a near soil surface sample.

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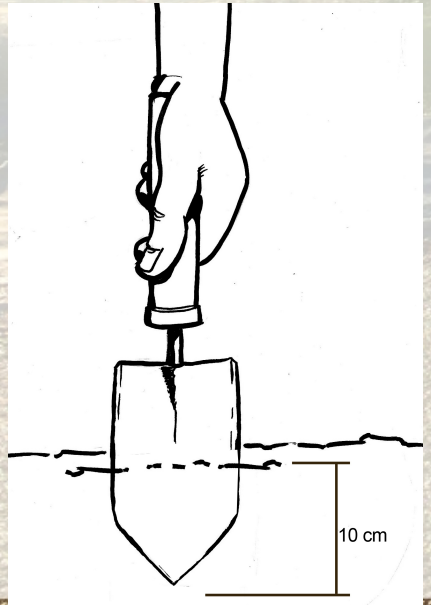
# Soil Characterization

## Surface Sample Technique

### Determining and Describing Horizons

Use a trowel to dig three samples of the top 10 cm of soil as a horizon sample for soil characterization.

1. Use a garden trowel or shovel to sample only the top 10 cm of soil.
2. Treat this sample as a horizon and proceed to characterize its properties.




Sampling soil to 10 cm depth. Illustration courtesy, Rich Potter

Soil sample on shovel illustration courtesy, Rich Potter

**Hint** Remember the top depth of the top horizon is always 0cm. The bottom depth is unknown unless the top horizon clearly ends before the 10cm depth.

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# Horizon Properties: Soil Structure

Hand holding soil Image courtesy, Izolda Trakhtenberg

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# Horizon Properties: Soil Structure

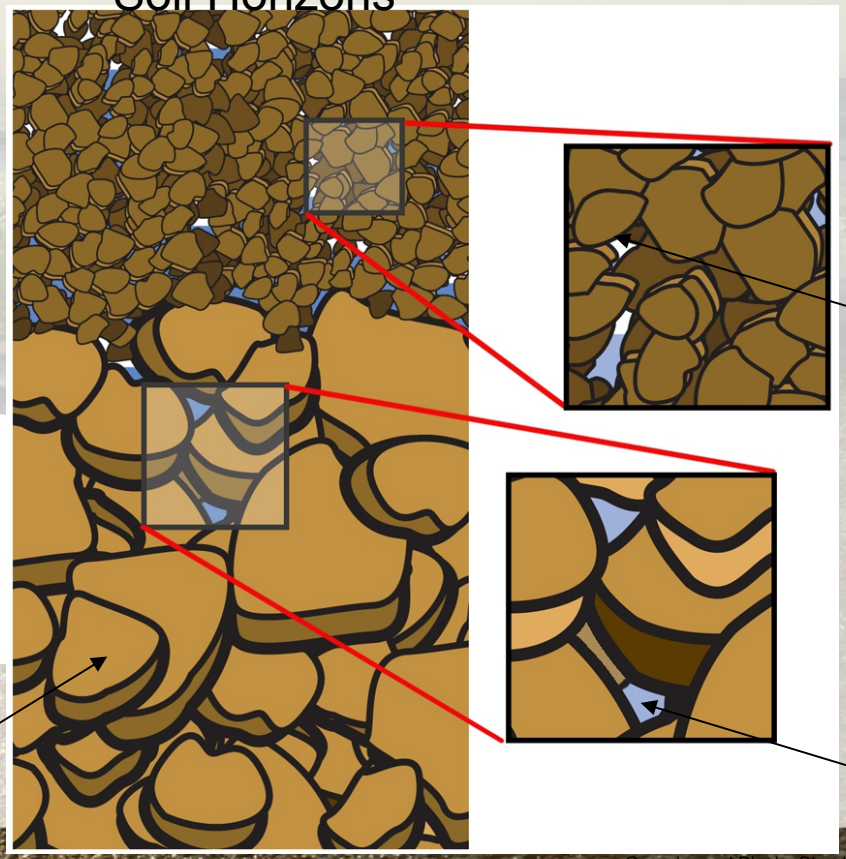
## Introduction

A soil horizon's structure refers to the natural shape of aggregates of soil particles, called peds, in the soil. The soil structure provides information about the size and shape of pore spaces in the soil through which water, heat, and air flow, and in which plant roots grow.

**Hint** A horizon with a smaller sized ped structure will have more but smaller air pockets.

**Hint** A horizon with a larger sized ped structure will have fewer but larger air pockets.

Soil Horizons




Granular and Blocky Structure examples illustration courtesy, Rich Potter

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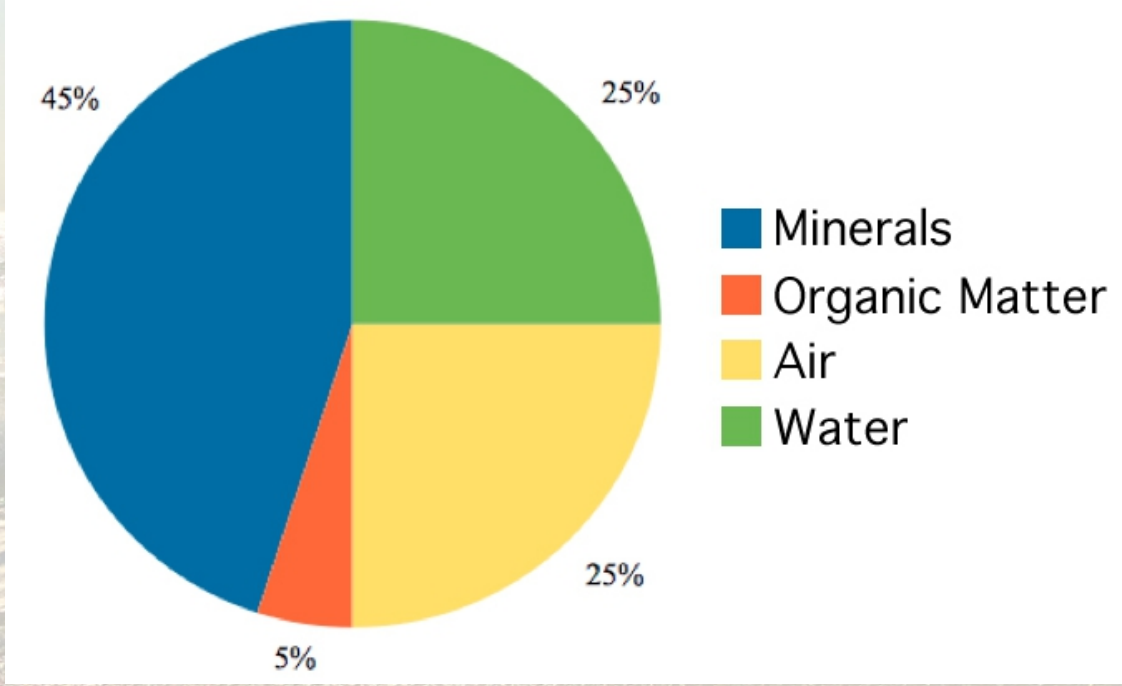
# Horizon Properties: Soil Structure

## Introduction

## Ideal Arable Soil




In an ideal arable soil, there is sufficient mineral content to allow growth and root purchase, there is sufficient water for plant nutrient uptake, and there is sufficient pore space for plant growth and for organism movement. **Soil structure plays a role in pore space availability**.

Ideal arable soil content graphic illustration courtesy, Izolda Trakhtenberg

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# Horizon Properties: Soil Structure

## Protocol

For each part of this protocol, start with a clump of soil or a soil “ped”

Hand holding soil ped image courtesy, Izolda Trakhtenberg

1. Use a trowel or other digging device to remove a soil sample from the horizon being studied.

2. Hold the sample gently in your hand and look closely at the soil to examine its structure.

3. Identify the type of soil structure of the horizon. Possible choices of soil structure are on the next few slides.

**Hint** Remember, you can change a soil’s structure by doing anything other than looking at it.

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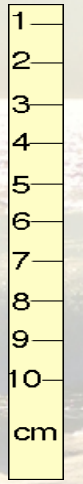
# Horizon Properties: Soil Structure

## Protocol

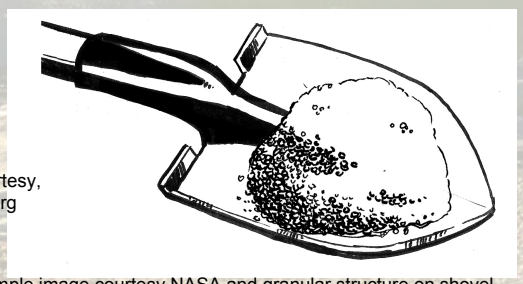
### Possible Choices of Soil Structure

**With Structure:**

Granular



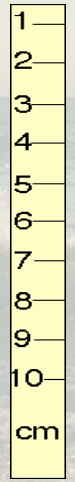

Ruler illustration courtesy, Izolda Trakhtenberg



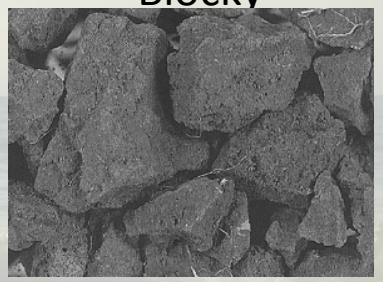
Granular sample image courtesy NASA and granular structure on shovel illustration courtesy, Rich Potter

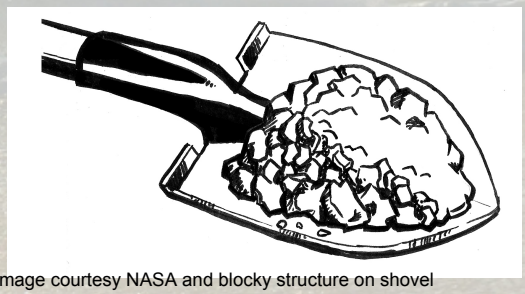
**Granular**: Resembles cookie crumbs and is usually less than 0.5 cm in diameter. Commonly found in surface horizons where roots have been growing.

Blocky




Ruler illustration courtesy, Izolda Trakhtenberg





Blocky sample image courtesy NASA and blocky structure on shovel illustration courtesy, Rich Potter

**Blocky**: Irregular blocks that are usually 1.5 - 5.0 cm in diameter.

Illustrations courtesy, Rich Potter

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# Horizon Properties: Soil Structure

## Protocol

### Possible Choices of Soil Structure

**With Structure:**

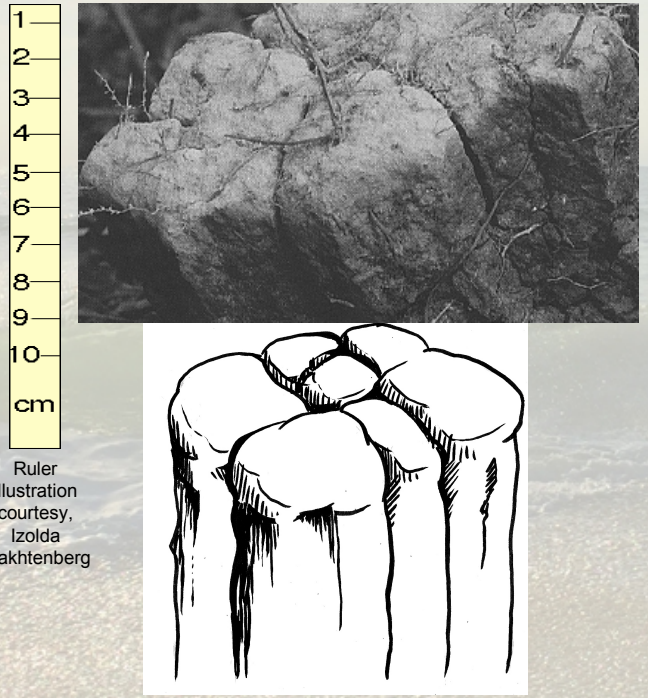
#### Prismatic


Ruler illustration courtesy, Izolda Trakhtenberg

Prismatic sample image courtesy NASA and prismatic structure illustration courtesy, Rich Potter

**Prismatic**: Vertical columns of soil that might be a number of cm long. Usually found in lower horizons.

#### Columnar




Ruler illustration courtesy, Izolda Trakhtenberg





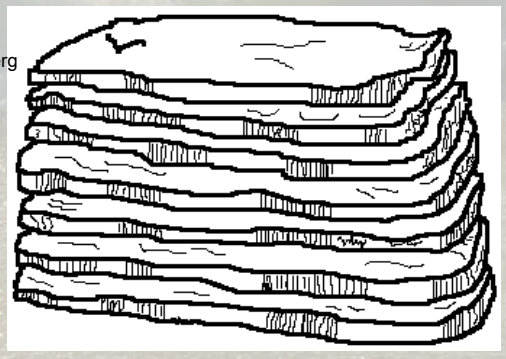
Columnar sample image courtesy NASA and columnar structure illustration courtesy, Rich Potter

**Columnar**: Vertical columns of soil that have a salt "cap" at the top. Found in soils of arid climates.

#### Platy


Ruler illustration courtesy, Izolda Trakhtenberg





Platy sample image courtesy NASA and platy structure courtesy, Izolda Trakhtenberg

**Platy**: Thin, flat plates of soil that lie horizontally. Usually found in compacted soil and/or in urban areas.

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# Horizon Properties: Soil Structure

## Protocol

If the soil lacks structure, it is described as either single grained or massive.

Single Grained

Single-grained sample image courtesy, Izolda Trakhtenberg

Massive

Massive structure juxtaposed with pencil for size comparison
courtesy, Izolda Trakhtenberg

Pencil is 19 cm

Hint* Soils with “single grained” structure **always** have loose consistence.

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Girl determining soil color via the color book image courtesy, Izolda Trakhtenberg

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# Horizon Properties: Soil Color

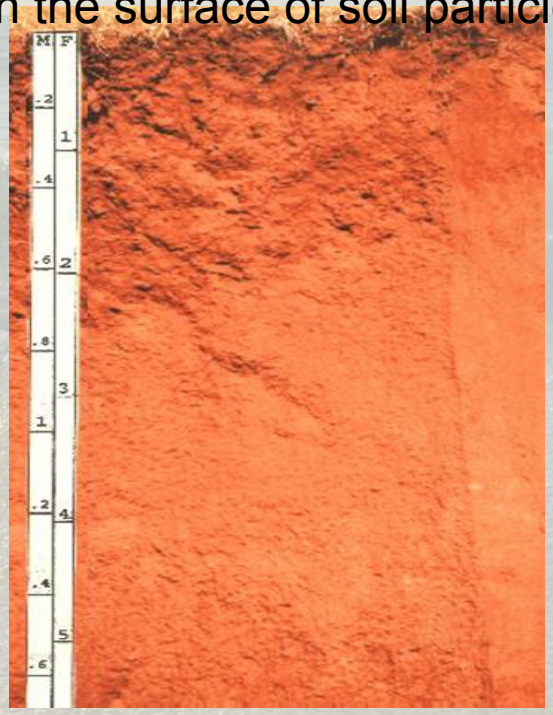
## Introduction

The color of soil is determined by the chemical coatings on soil particles, the amount of organic matter in the soil, and the moisture content of the soil.

For example, soil color tends to be darker when organic matter is present. Minerals, such as iron, can create shades of red and yellow on the surface of soil particles.

High organic matter content soil profile image courtesy, NRCS, USDA

High in Organic




Iron Oxide-rich soil profile image courtesy, NRCS, USDA

Contains Iron Oxide

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# Horizon Properties: Soil Color

## Required Instruments and Materials

To complete the protocol, you will need:

1. Sunny day

New York City garden image courtesy, Izolda Trakhtenberg

Observe soil color outside under the sun.

2. Ped of

Girl holding soil ped image courtesy, Izolda Trakhtenberg

A ped is an aggregate of soil particles.

3. Spray mist bottle

Hand holding spray mist bottle image courtesy, Izolda Trakhtenberg

To observe soil color, moisten the ped.

4. Soil Color Book

Hand holding soil color book image courtesy, Izolda Trakhtenberg

Use a GLOBE-approved Soil Color Book.

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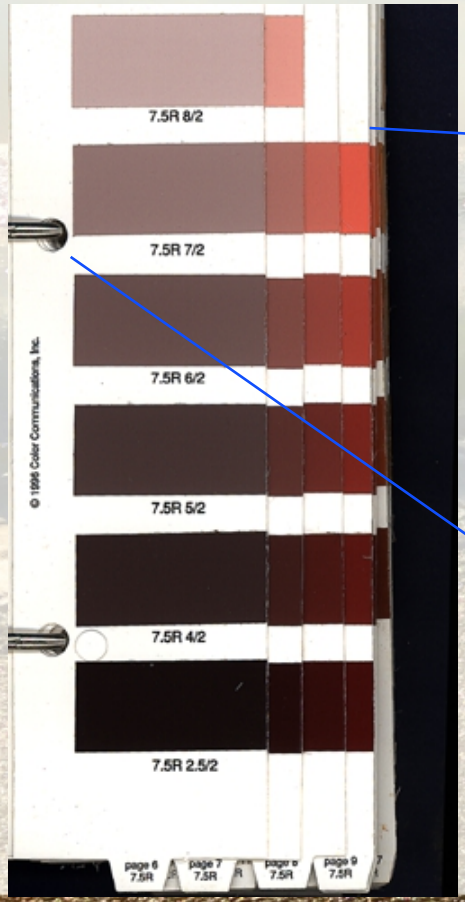
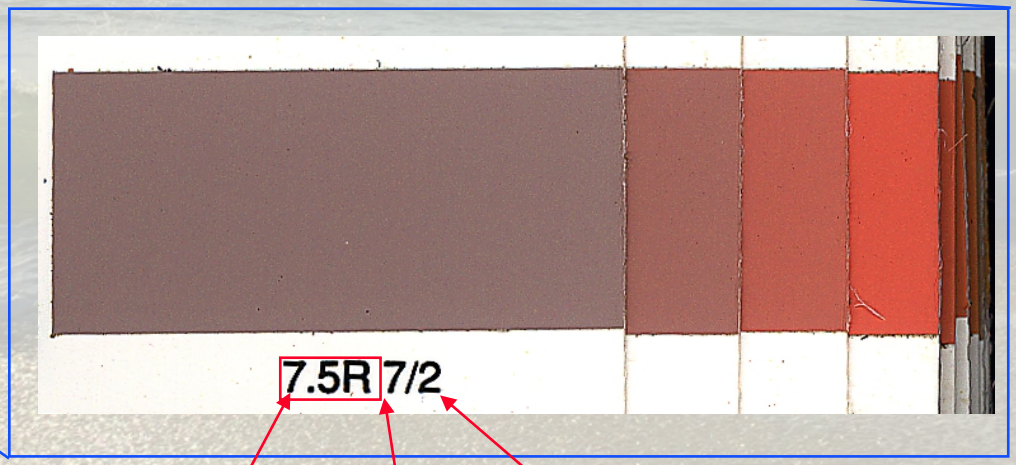
# Horizon Properties: Soil Color

## Soil Color Book

## Munsell Notation




Soil color book page and close-up of huge, value, and chroma image courtesy, Izolda Trakhtenberg

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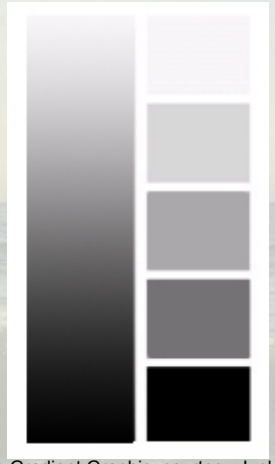
# Horizon Properties: Soil Color

## Soil Color Book

Simple Munsell Color Wheel Graphic courtesy, Izolda Trakhtenberg

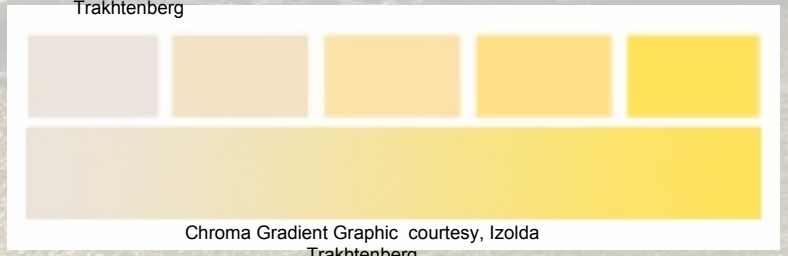
The **Hue** is the color's position on the Color Wheel.



Value Gradient Graphic courtesy, Izolda Trakhtenberg

The **Value** is the amount of black or white added to the color.

The higher the Value, the lighter the color. The lower the Value, the darker the color.



Chroma Gradient Graphic courtesy, Izolda Trakhtenberg

The **Chroma** is the amount of saturation of a color. The higher the Chroma, the more saturated the color. The lower the Chroma the more gray the color.

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# Horizon Properties: Soil Color

## Protoco

1. Take a ped of soil from a horizon and note on the data entry page whether it is moist, dry or wet.

   If it is dry, moisten it slightly with water from your water bottle. Wait for a minute for the water to soak into the ped.

2. Stand with the sun over your shoulder so that sunlight shines on the color chart and the soil sample you are examining.

**Hint** Be sure that no shadows fall on the color book.

Girl spraying soil ped image courtesy, Izolda Trakhtenberg

Girl correctly using soil color book with the sun at her back image courtesy, Izolda Trakhtenberg

Girl incorrectly reading soil color book with the her shadow on the book image courtesy, Izolda Trakhtenberg

**Hint** If the soil is too Loose to hold a single ped, place a sample on a trowel and complete the protocol.

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# Horizon Properties: Soil Color

## Protoco

3. Break the ped and compare the color of the inside surface with the soil color chart. Look through the entire book as some similar soil colors appear throughout the book.

Breaking ped open image courtesy, Izolda Trakhtenberg.

4. Determine Soil Color for every horizon in your so

Hand holding ped against soil color book image courtesy, Izolda Trakhtenberg.

**Hint** Sometimes, a soil sample may have more than one color. Record a maximum of two colors, if necessary, and indicate (1) the Main (dominant color) and (2) the Other (sub-dominant color)

Mottled color soil peds Image above courtesy, USDA NRCS

Soil sample with two distinct colors.

**This is only when your sample contains two distinctly different colors. It is not two estimates for the**

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# Horizon Properties: Soil Consistence

Girl holding soil ped image courtesy: Izolda Trakhtenberg

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# Horizon Properties: Soil Consistence

## Introduction

Consistence describes the firmness of the individual peds, or aggregates of soil particles, and the degree to which they break apart.

The terms used to describe soil consistence are loose, friable, firm, and extremely firm.

For example, a soil with friable consistence will be easier for roots, shovels, or plows to move through than a soil with firm consistence. On the other hand, a soil with extremely firm consistence will be harder for roots, shovels, and trowels to move through.

To complete the protocol, you will:

1. Feel a ped of soil
2. Spray mist bottle

Girl holding soil ped image courtesy, Izolda Trakhtenberg

Hand holding spray mist bottle image courtesy, Izolda Trakhtenberg

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# Horizon Properties: Soil Consistence

## Protocol

1. Take a ped from the soil horizon being studied. If the soil is very dry, moisten the face of the profile by squirting water on it, and then remove a ped for determining consistence.

Girl holding soil ped image courtesy, Izolda Trakhtenberg

Girl spraying soil ped image courtesy, Izolda Trakhtenberg

2. Holding the ped between your thumb and forefinger, gently squeeze it until it pops

Images courtesy, Izolda Trakhtenberg

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# Horizon Properties: Soil Consistence

## Protocol

Record one of the following categories of soil ped consistence on the Soil Characterization Data Entry Page.

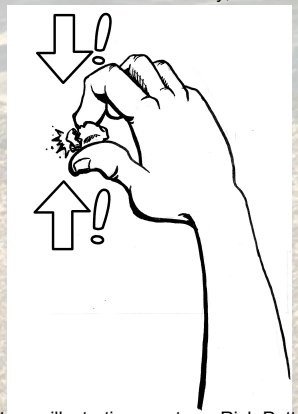
**Loose*** You have trouble picking out a single ped and the structure falls apart before you handle it.*

Loose consistence illustration courtesy, Rich Potter

**Friable** The ped breaks with a small amount of pressure.

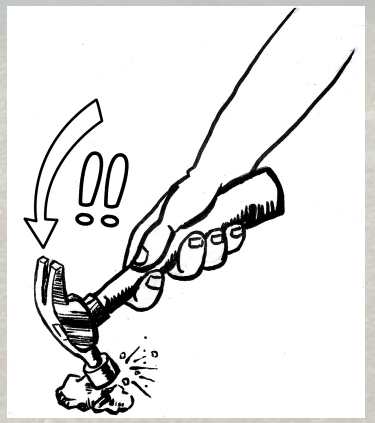
Friable consistence illustration courtesy, Rich Potter

**Firm** The ped breaks when you apply a good amount of pressure and dents your fingers before it breaks.



Firm consistence illustration courtesy, Rich Potter

**Extremely Firm** The ped can't be crushed with your fingers (you need a hammer!).



Extremely Firm consistence illustration courtesy, Rich Potter

Hint * Soils with "single grained" structure **always** have loose consistence.


# Just Passing Through

EARTH LADY

# How Water Filters Through Soils From Different Locales

Sand (courtesy, Izolda Trakhtenberg)

Organic (courtesy, Izolda Trakhtenberg)

Impervious (Creative Commons)

Clay (courtesy, USDA)

EARTH LADY

# How Water Filters Through Soils From Different Places

## What types of clouds are going to rain down on our soils?

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**Nimbostratus**

(Gentle Spring Rain)

**Cumulonimbus**

(Summer Thunderstorm)

Images courtesy: NASA S'COOL Project

EARTH LADY

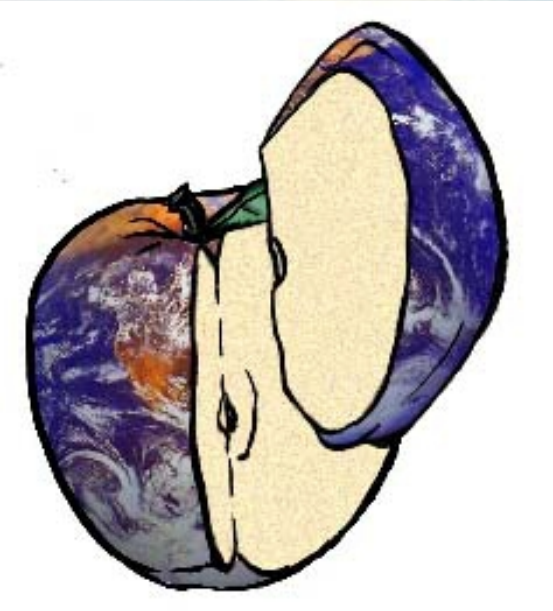
# How Much Soil Is There?

EARTH LADY

Pretend that this apple is the planet Earth, round, beautiful, and full of good things. Notice its skin, hugging and protecting the surface.Water covers approximately 75% of the surface.

Right away, cut the apple in quarters. Put three quarters (75%) aside.

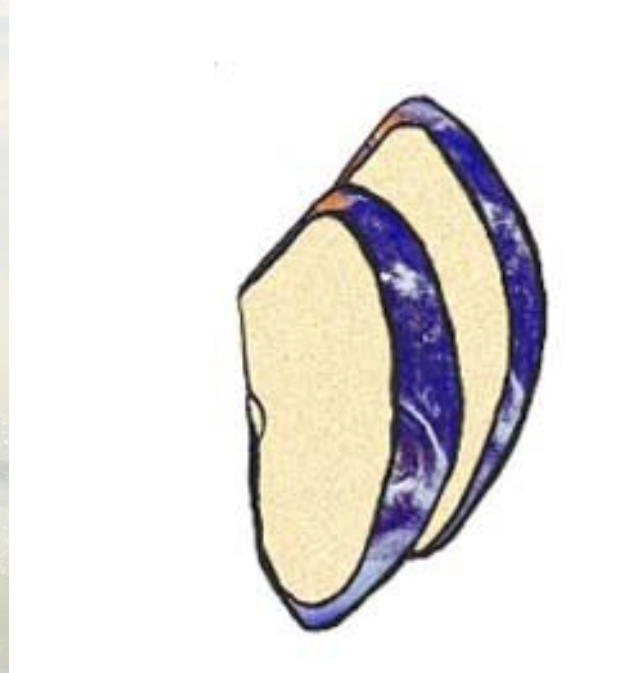
EARTH LADY



The three quarters (75%) you just removed represents how much of the earth is covered with water - oceans, lakes, rivers, streams. What is left (25%) represents the dry land.

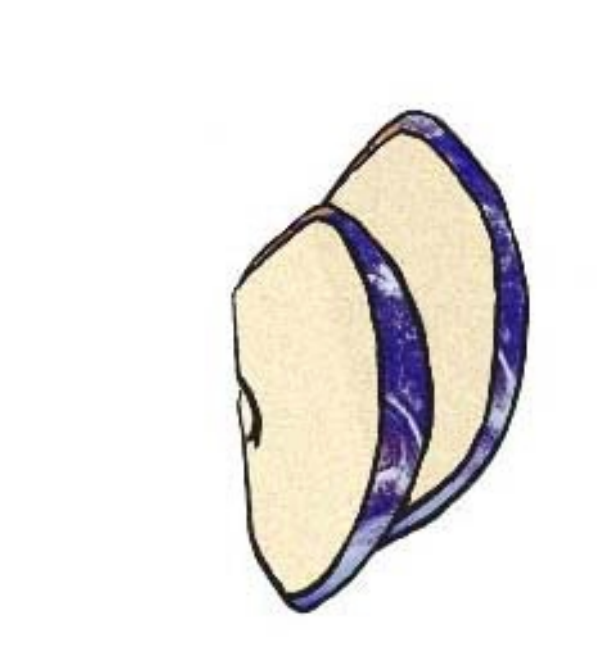
50% of that dry land is desert, polar, or mountainous regions where it is too hot, too cold or too high to be productive.

EARTH LADY



When 50% is removed, this is what is left. (12.5% of the original)

Of that 12.5%, 40% is severely limited by terrain, fertility or excessive rainfall. It is too rocky, steep, shallow, poor or too wet to support food production.



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EARTH LADY

The remaining 10% (approximately)- this small fragment of the land area - represents the soil we depend on for the world's food supply. This fragment competes with all other needs - housing, cities, schools, hospitals, shopping centers, land fills, etc., etc.