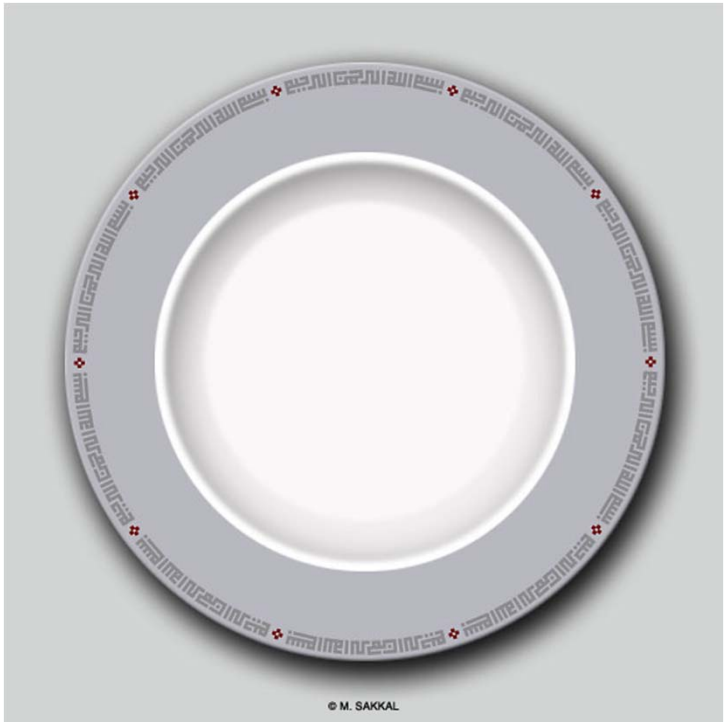
Moderate Resolution Imaging Spectroradiometer (Terra/MODIS).

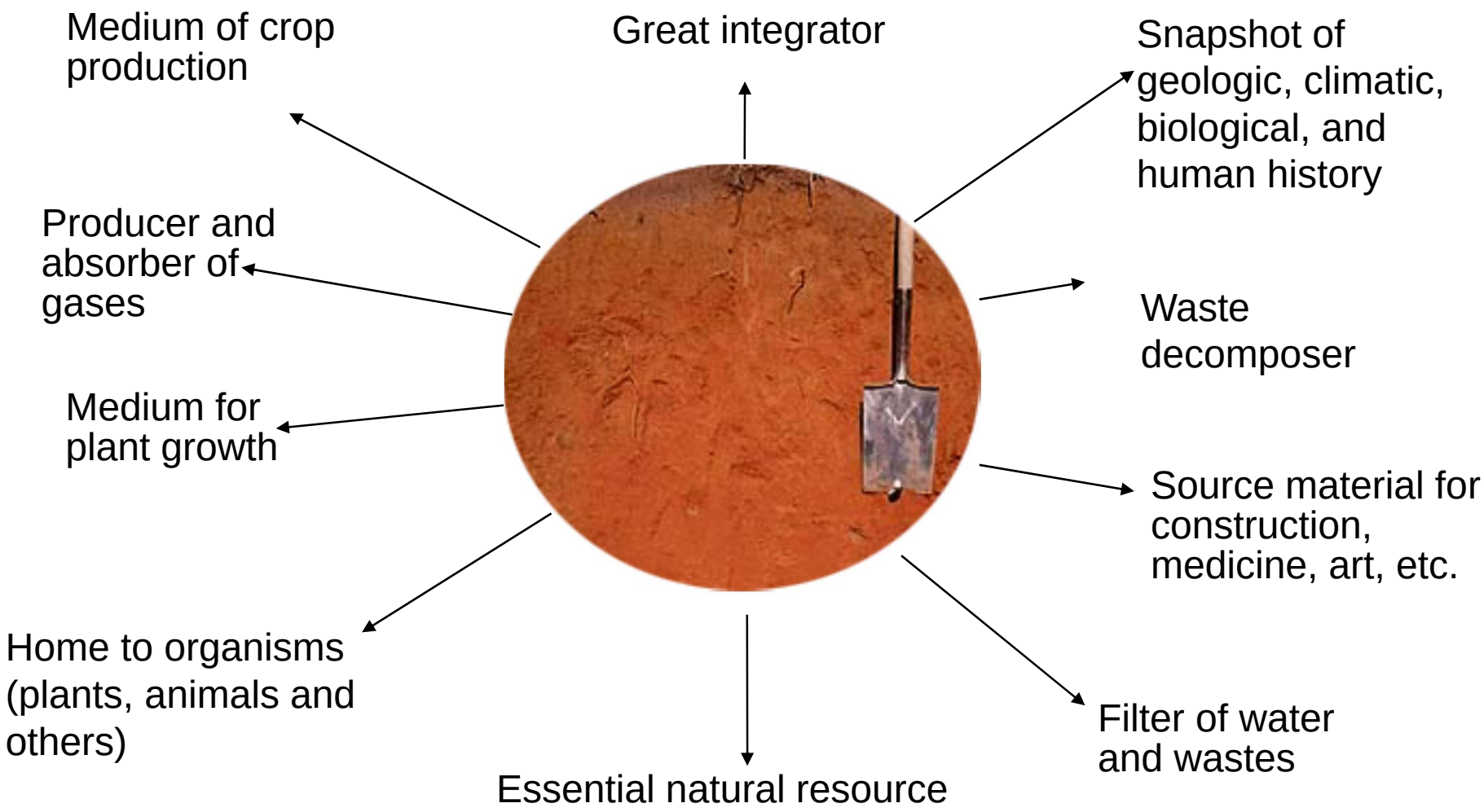

© M. SAKKAL


i.d.
bareMinerals


AVEDA
AVEDA
AVEDA

African Mud Cloth (Bogolanfini)

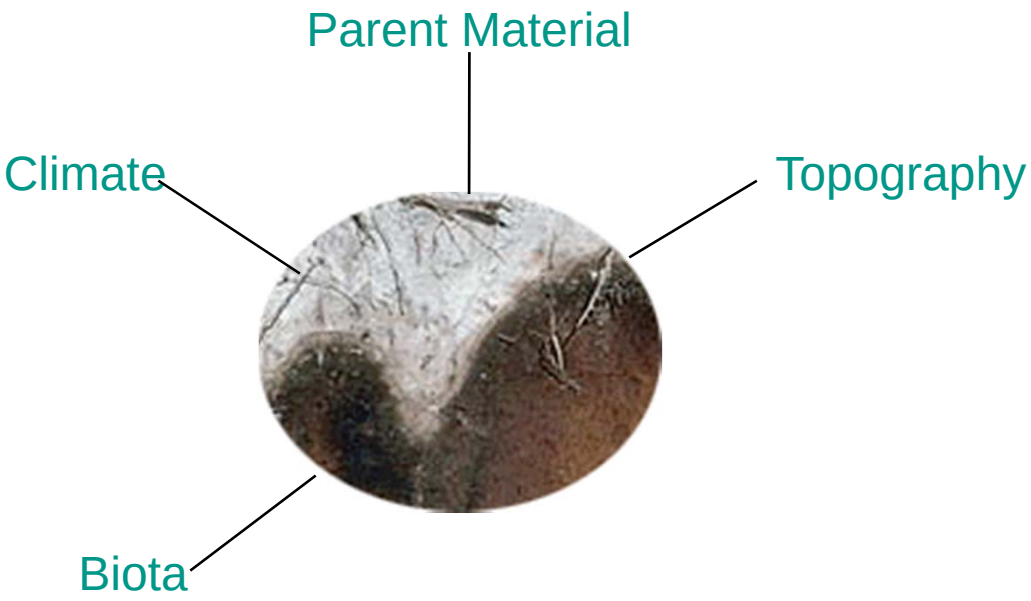
We Study Soil Because It's A(n)



A Soil's Story

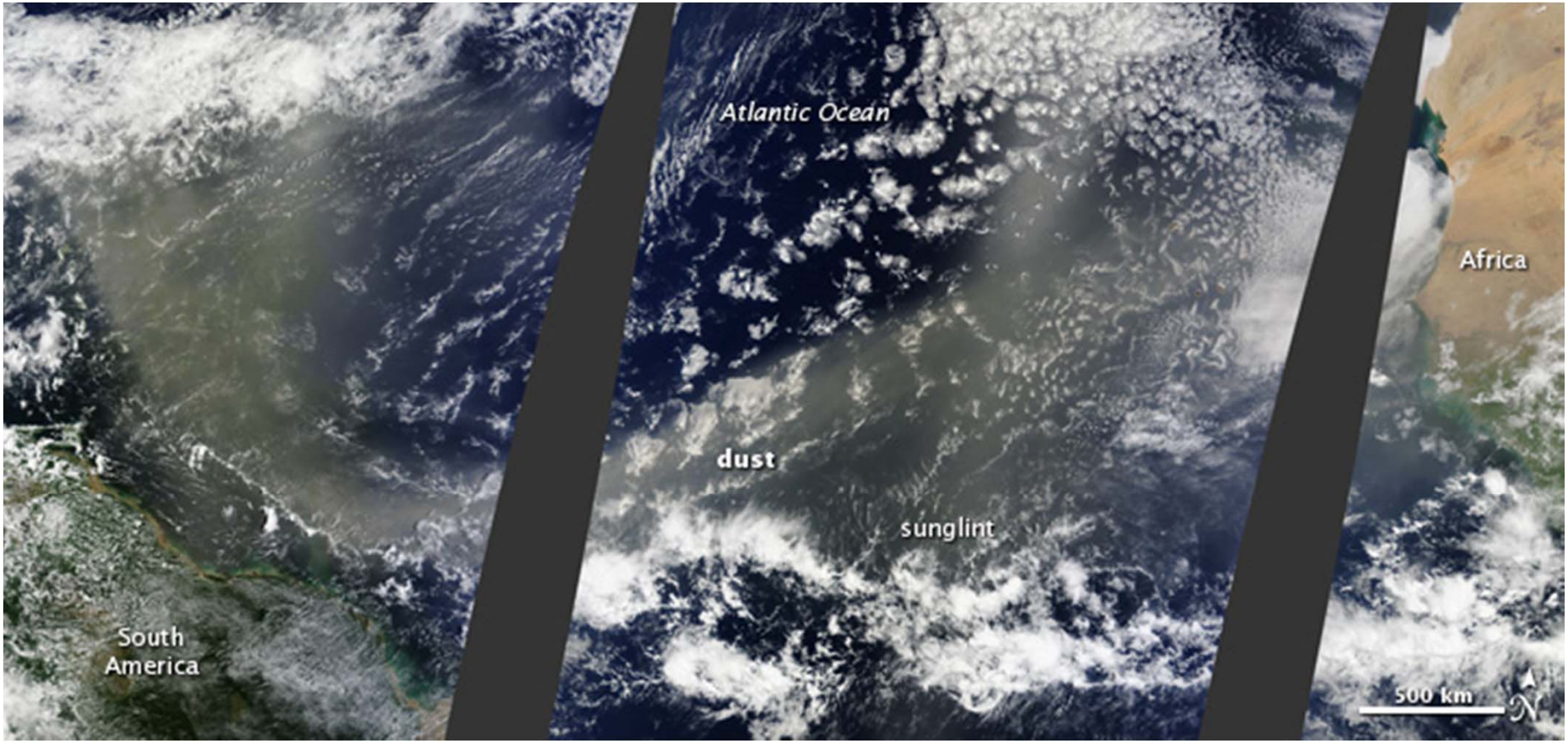
A Maryland Soil (Photo © Dr. Ray Weil, University of Maryland)

Soil Forming Factors

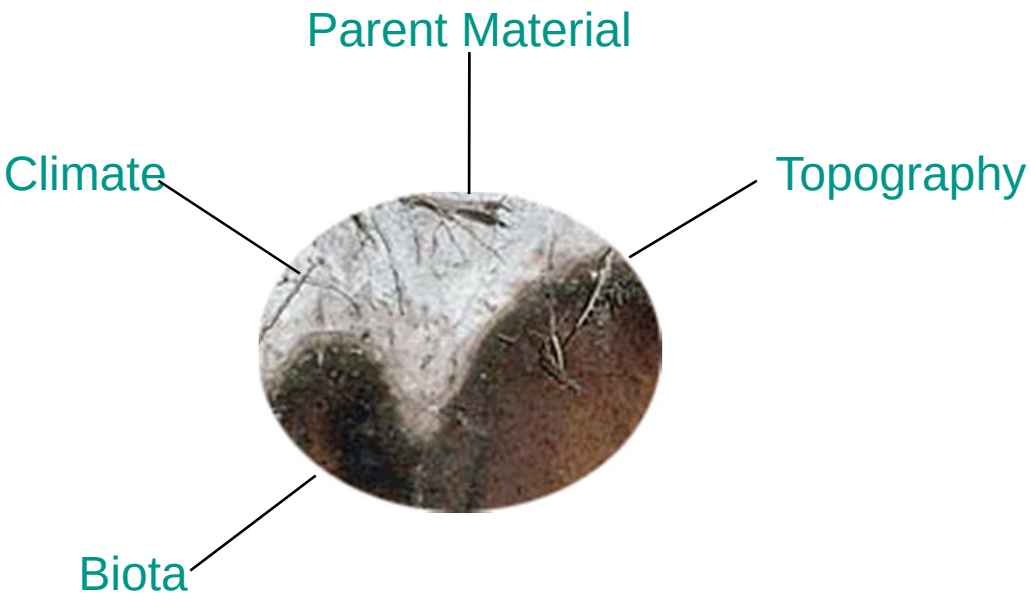


Forest Soil in Florida, USA

What is happening here?

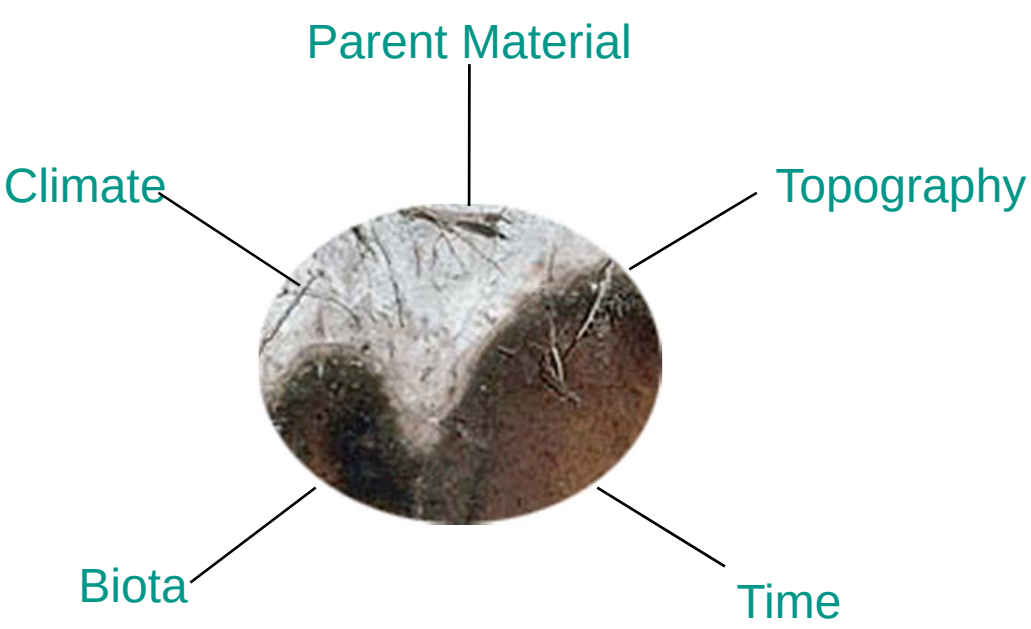


Soil Forming Factors

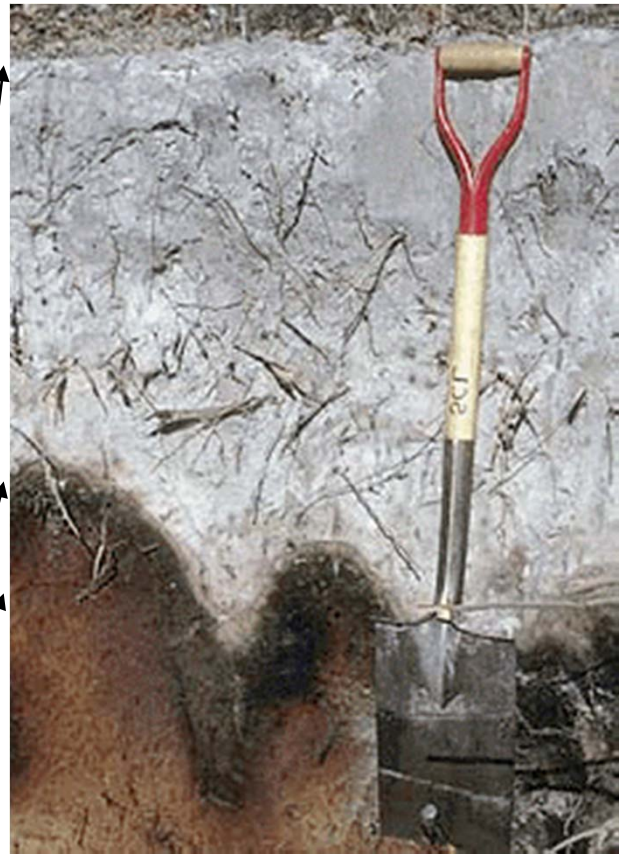


Forest Soil in Florida, USA

Soil Forming Factors



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



Forest Soil in Florida, USA

Soil Investigation

Soil Characterization Site Definition Sheet

Study Site Name: SCS-_____

Location: Latitude: _____° ❒ N or ❒ S Longitude: _____° ❒ E or ❒ W

Elevation: ___ meters Slope: _____° Aspect: _____°

Source of Location Data (check one): ❒ GPS ❒ Other _____

Method (choose one):

- ❒ Pit
- ❒ Auger
- ❒ Near Surface

Is Soil Characterization site:

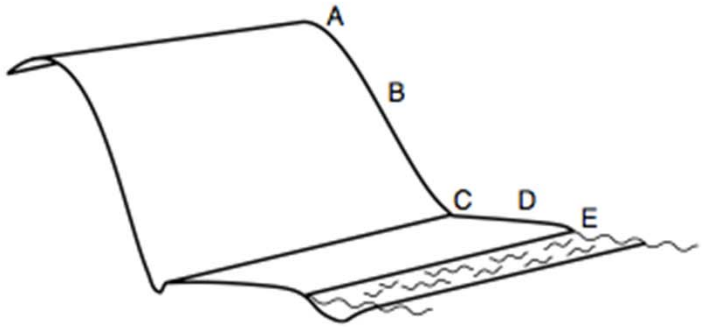
- ❒ On School Grounds
- ❒ Off School Grounds

Site Location (choose one):

- ❒ Near the Soil Moisture Study Site
- ❒ Near the Soil Moisture and Atmospheric Study Sites
- ❒ Near the Atmosphere Study Site
- ❒ In the Biology Study Site
- ❒ Other_____

Landscape Position (choose one):

- ❑ A. Summit
- ❑ B. Slope
- ❑ C. Depression
- ❑ D. Large Flat Area
- ❑ E. Stream Bank



Cover Type:

- ❑ Bare Soil
- ❑ Rocks
- ❑ Grass
- ❑ Shrubs
- ❑ Trees
- ❑ Other_____

Parent Material:

- ❑ Bedrock
- ❑ Organic Material
- ❑ Construction Material
- ❑ Marine Deposits
- ❑ Lake Deposits
- ❑ Stream Deposits (Alluvium)
- ❑ Wind Deposits (Loess)
- ❑ Glacial Deposits (Glacial Till)
- ❑ Volcanic Deposits
- ❑ Loose Materials on Slope
- ❑ Other_____

Land Use:

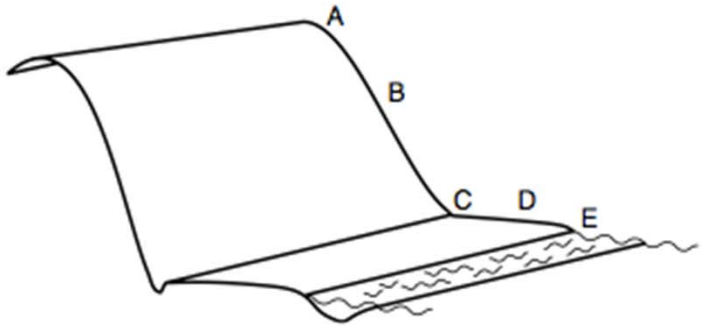
- ❑ Urban
- ❑ Agricultural
- ❑ Recreation
- ❑ Wilderness
- ❑ Other_____

Distance from Major Features (up to 50 meters): _____

Other Distinguishing Characteristics of this Site: _____

Landscape Position (choose one):

- ☐ A. Summit
- ☐ B. Slope
- ☐ C. Depression
- ☐ D. Large Flat Area
- ☐ E. Stream Bank



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Parent Material:

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- ☐ Volcanic Deposits
- ☐ Loose Materials on Slope
- ☐ Other_____

Land Use:

- ☐ Urban
- ☐ Agricultural
- ☐ Recreation
- ☐ Wilderness
- ☐ Other_____

Distance from Major Features (up to 50 meters): _____

Other Distinguishing Characteristics of this Site: _____

Soils In Different Environments

Soil Characterization

For this protocol, we will

1, dig a pit or hole
2, describe
3, sample
4, analyze the soils from horizons of different profiles.

Sample at least *two* sites

1. near the Soil Moisture study site
2. within the Biology study site

Field measurements are done once at each site

Three replicate samples from each horizon are taken and reported one time for each site.

Finding and Describing Horizons

Soil formed under very dry or arid conditions in New Mexico, USA

Starting from top, observe profile to determine properties and differences between horizons.

Place golf tee or marker at the top and bottom of each horizon to clearly identify it.

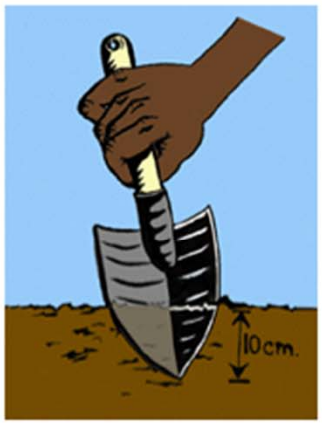
Look for: different colors, shapes, roots, the size and amount of stones, small dark nodules (called concretions), worms, or other small animals and insects, worm channels, and anything else that is noticeable.

Finding and Describing Horizons

Surface Sample Technique

In situations where it is not possible to expose the top meter of soil, another option is to use the top 10 cm of soil as a horizon sample for soil characterization.

1. Use a garden trowel or shovel to carefully remove the top 10 cm of soil from a small area and set it on the ground.



2. Treat this sample as a horizon and proceed to characterize its properties.

Horizon Properties

Soil Characteristics

Look, Look, Press, Squeeze Method

Structure

Look

Color

Look

Consistence

Press

Texture

Squeeze

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

Horizon Properties

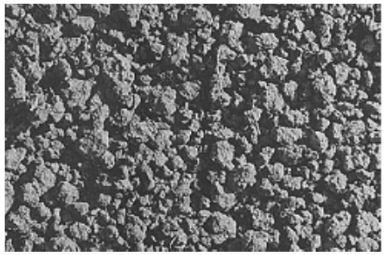
Soil Structure

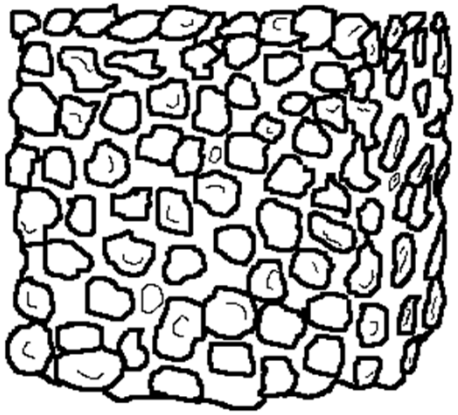
Will the worms and the water get through?

Soil structure is the shape that each soil **ped** takes. Water, heat, air, plant roots, and critters move through the spaces in between. Possible choices of soil structure are:

With Structure:

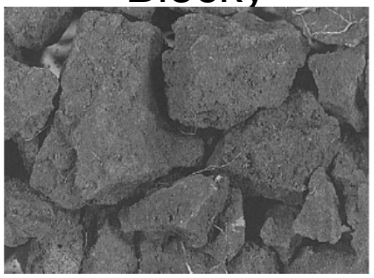
Granular

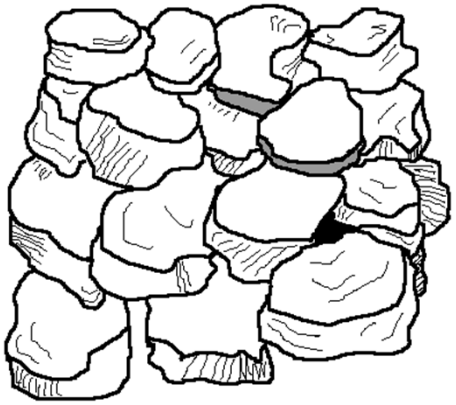




Granular: Resembles cookie crumbs and is usually less than 0.5 cm in diameter. Commonly found in surface horizons where roots have been growing

Blocky





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

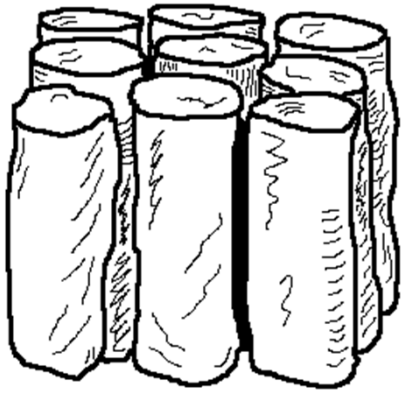
Horizon Properties

Soil Structure

Take a sample of undisturbed soil in your hand. Look closely at the soil in your hand and examine its structure.

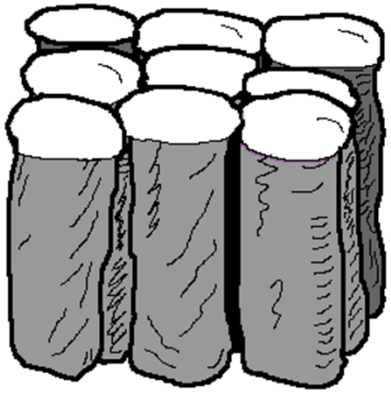
With Structure:

Prismatic



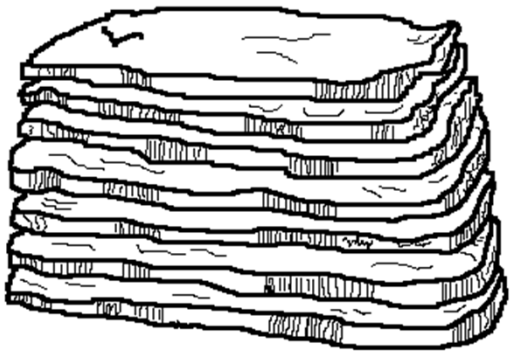
Prismatic: Vertical columns of soil that might be a number of cm long. Usually found in lower horizons.

Columnar



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

Platy

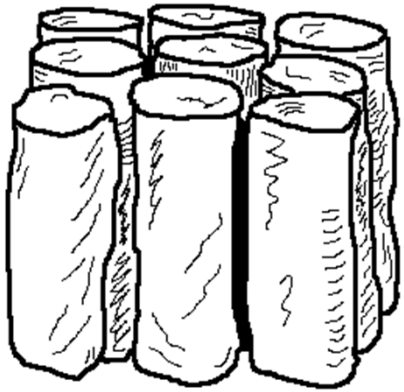


Platy: Thin, flat plates of soil that lie horizontally. Usually found in compacted soil.

Horizon Properties

Soil Structure

Prismatic



Arid climate soil in New Mexico, USA

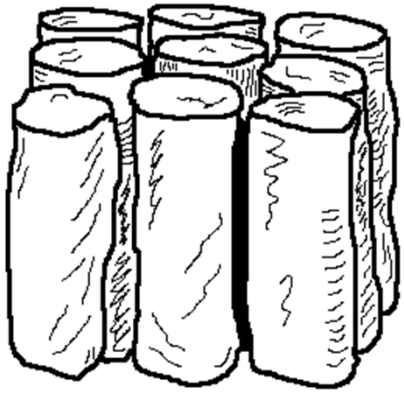
Horizon Properties

Soil Structure

Take a sample of undisturbed soil in your hand. Look closely at the soil in your hand and examine its structure.

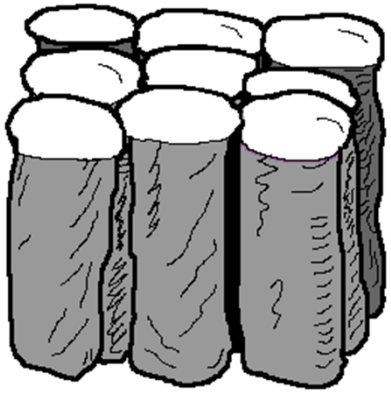
With Structure:

Prismatic



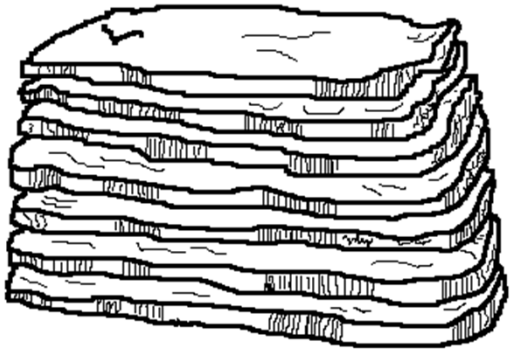
Prismatic: Vertical columns of soil that might be a number of cm long. Usually found in lower horizons.

Columnar



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

Platy



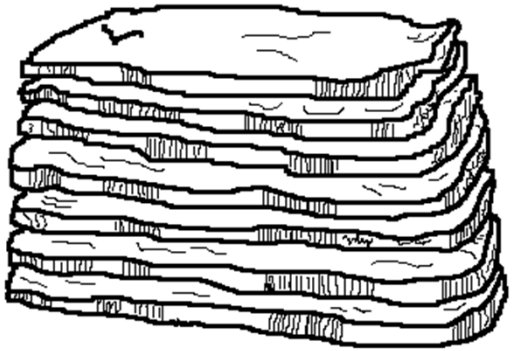
Platy: Thin, flat plates of soil that lie horizontally. Usually found in compacted soil.

Horizon Properties

Soil Structure

Soils in urban areas have Platy structure.

Platy



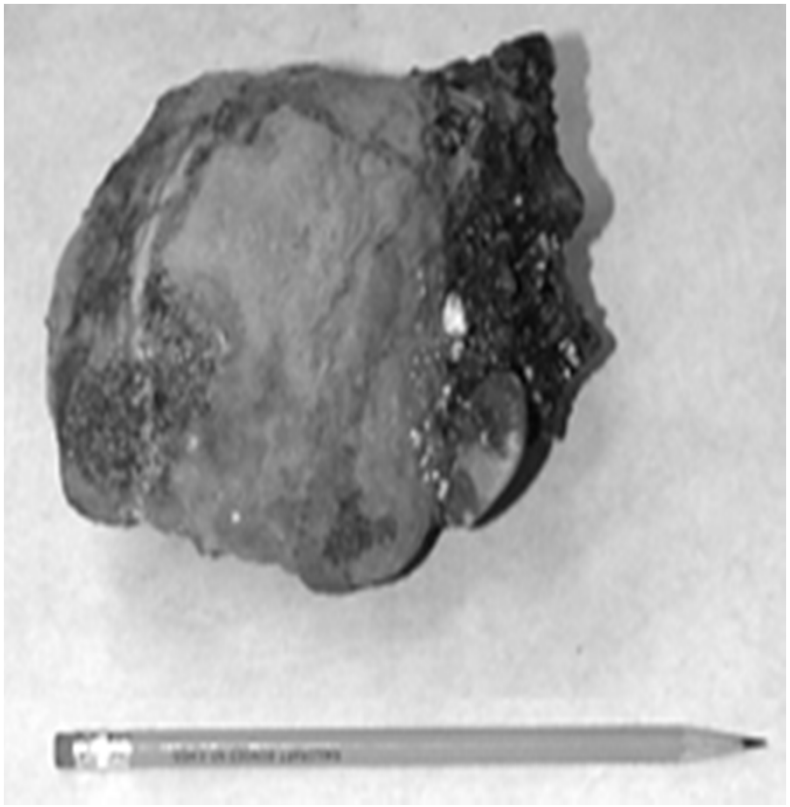
Platy: Thin, flat plates of soil that lie horizontally. Usually found in compacted soil.

Soil Structure (continued)

Without Structure

Single Grained

Massive

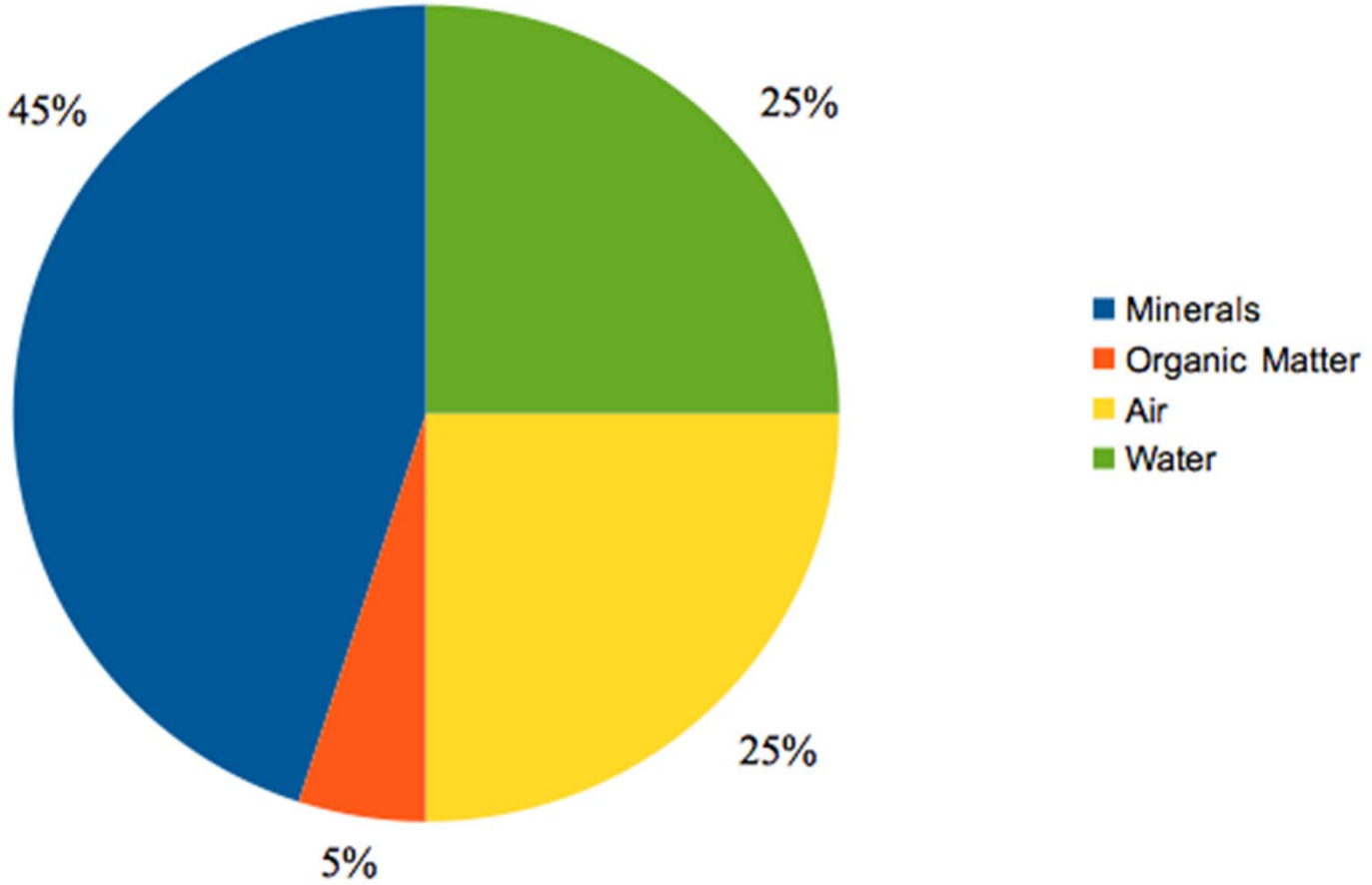


Pencil is 19 cm

Horizon Properties

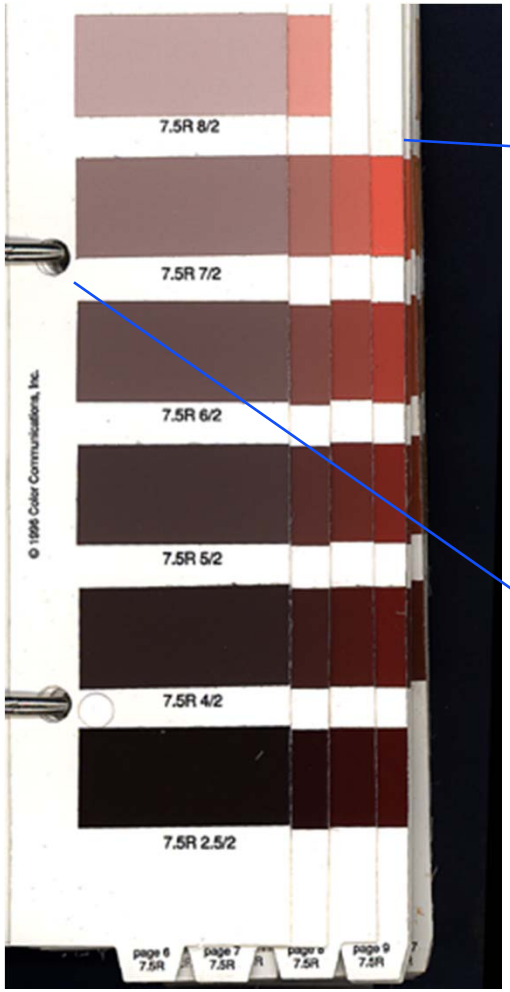
Soil Structure

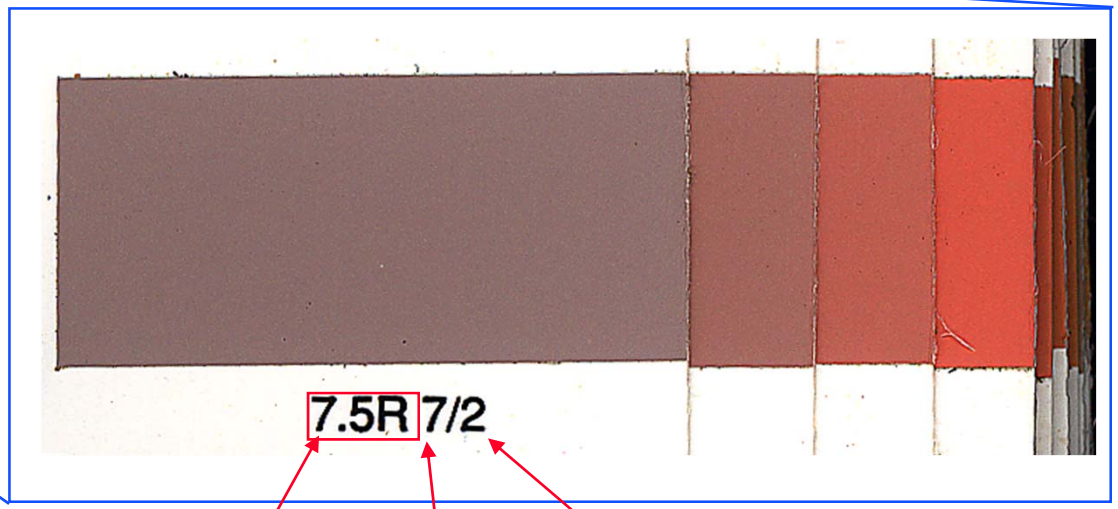
Ideal Soil



Soil Color

Munsell Notation

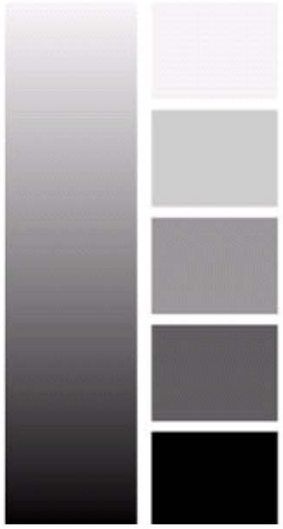




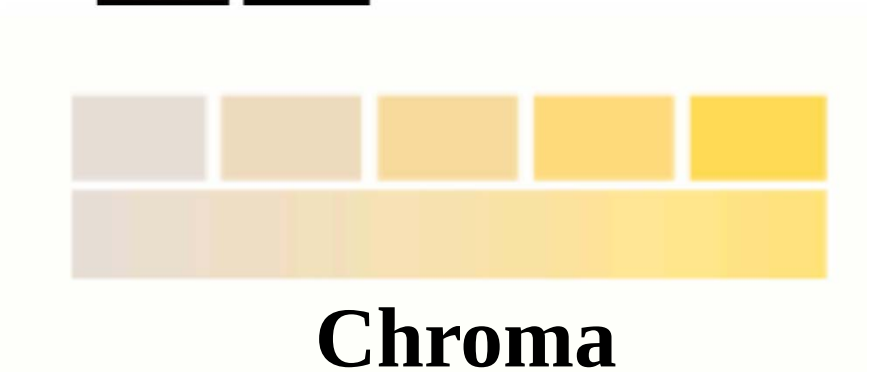
Hue **Value** **Chroma**

Munsell Notation

Hue
(position on the color wheel)



Value
(amount of black or white added to the color



Chroma
(amount of brightness of saturation of the color

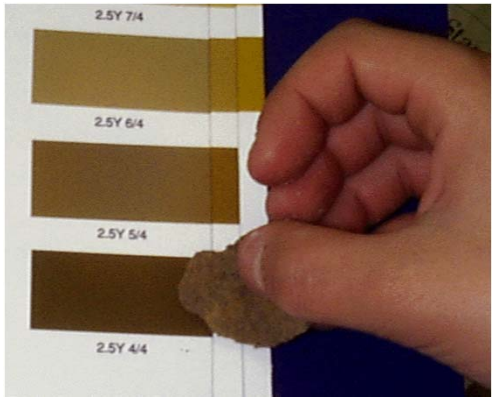
Horizon Properties

Soil Color (continued)

1. **Take a ped of soil from each horizon and note on the data sheet whether it is moist, dry or wet. If it is dry, moisten it slightly with water from your water bottle.**

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

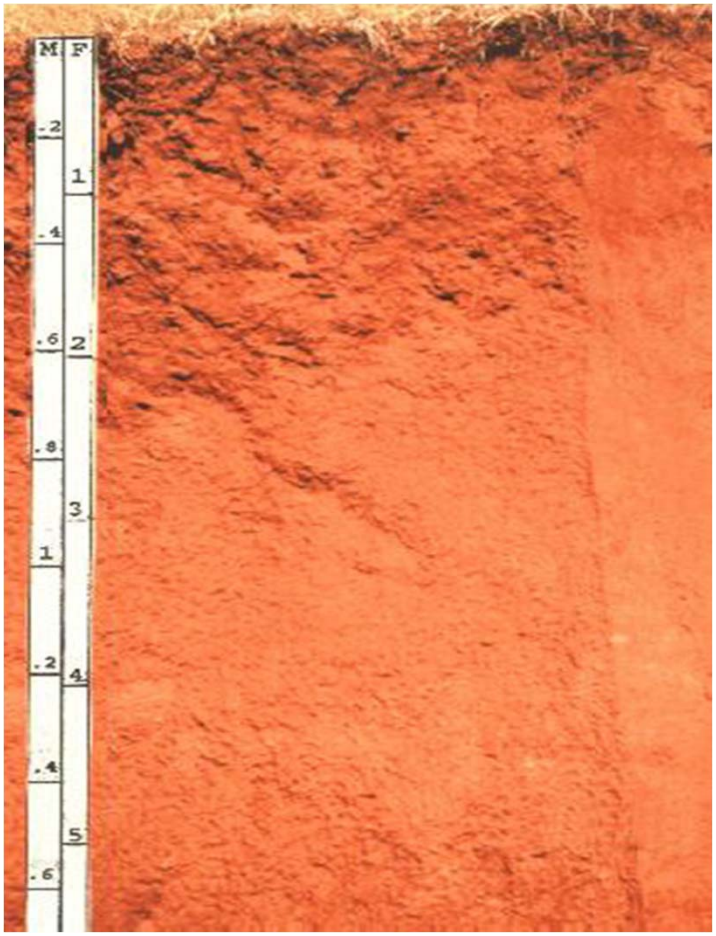
3. **Break the ped and compare the color of the inside surface with the soil color chart.**



Note: 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).

Soils can vary greatly in color depending on the soil forming factors and other conditions.

The soil lets water move through slowly and tends to be wet and low in oxygen (reduced)



The soil lets water move through easily and tends to be well drained and high in oxygen (oxygen)

Some soils are “mottled” meaning they have more than one color. In this case, record both on the Data Sheet.

Dark Color (Organic) and Granular Structure is Ideal

Mollisol

(Courtesy, USDA)

Soil Consistence

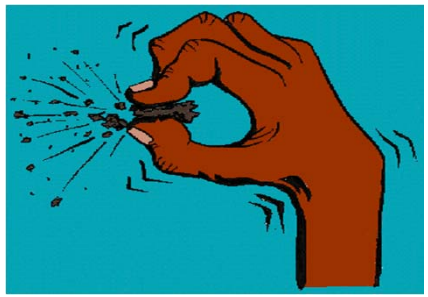
Press a moist soil ped to see if it is:

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

Friable The ped breaks with a small amount of

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

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

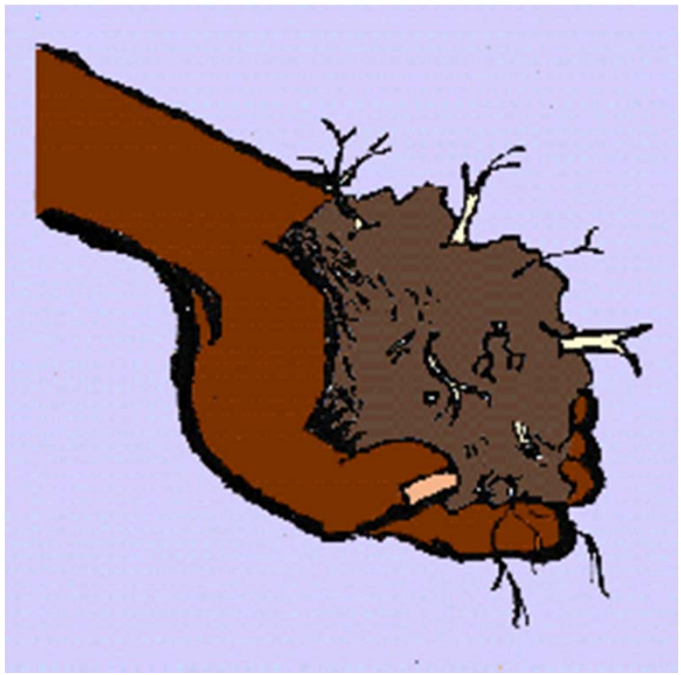


Extremely Firm

The ped can’t be crushed with your fingers (you need a hammer!).

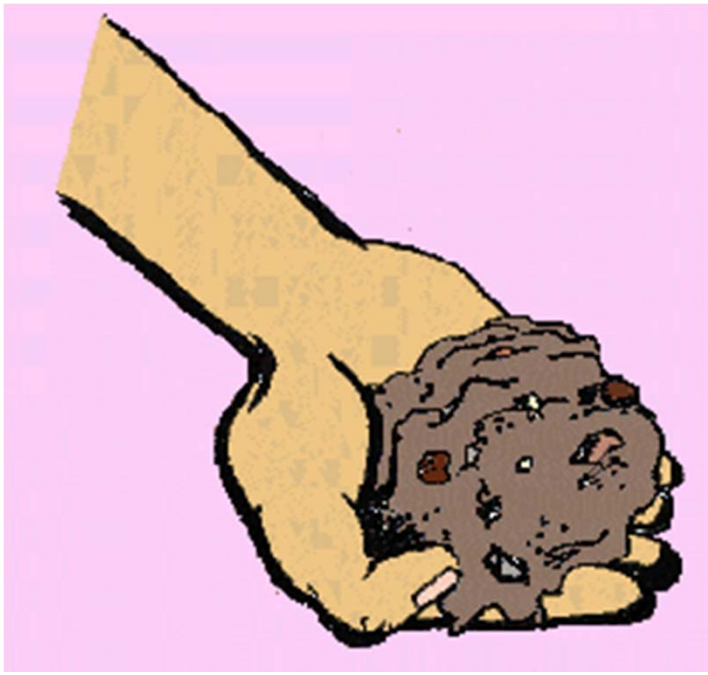
Horizon Properties

Presence of Roots and Rocks



Presence of Roots

Observe and record if there are none, few, or many roots in the horizon.



Presence of Rocks

Observe and record if there are none, few, or many rocks* in the horizon.

* A rock is defined as being larger than 2 mm in size.

Horizon Properties

Test For Free Carbonates

- **Free carbonates are compounds that coat soil particles. They form under certain conditions such as in dry climates where the pH is above 7. They are also found in some soil profiles that have parent materials made of carbonates (such as limestone).**

•Usually, only soils in dry climates or soil horizons that are close to the parent material that contains carbonates will effervesce

•In this soil, from Arizona USA, you can see the carbonates as white streaks in the middle and bottom of the soil profile

Horizon Properties

Soil Texture

- **We will do Soil Texture together outside.**

The GPS tells us where we are.

The compass tells us what direction we are facing.

The clinometer tells us the angle of slope at our study site.

Using a Compass

Parts of a compass.

Baseplate

Direction of Travel Arrow

Dial

Declination Marks

Needle (The Mouse)

Orienting Arrow (The House)

Using a Compass

Parts of a compass.

The Needle (The Mouse) always points North.

Using a Compass

Parts of a compass.

Baseplate

Direction of Travel Arrow

Dial

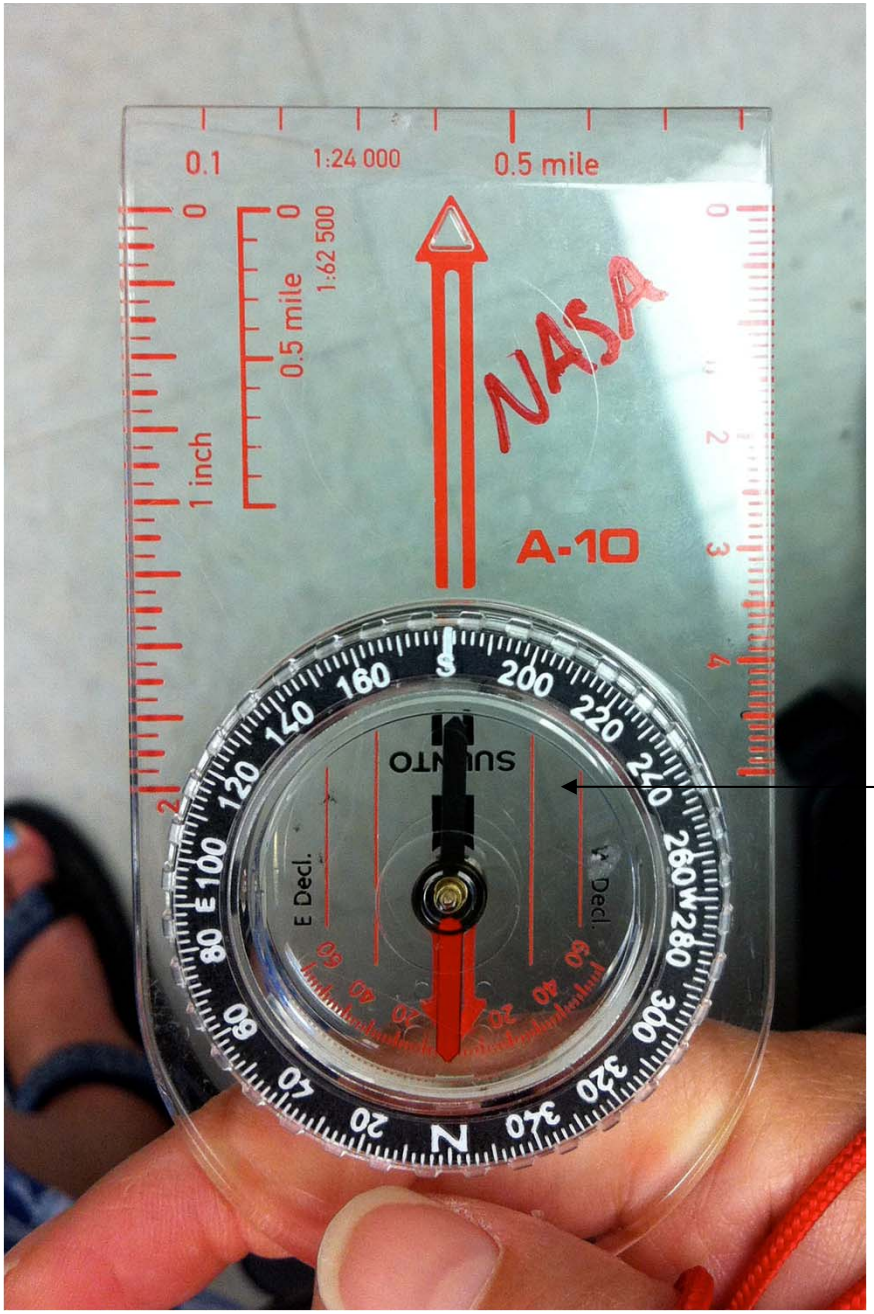
Declination Marks

Needle (The Mouse)

Orienting Arrow (The House)

Line up The Mouse, The House, the N, and the Direction of Travel Arrow all to one direction.

Stand and face that direction. You are now facing North.



Now, to find South, rotate the **Dial** , so the letter **S** faces the same direction as the big, hollow, red arrow.

Then, holding the compass in front of you, turn until you place the small, moving red arrow into the "house."

You are now facing South.

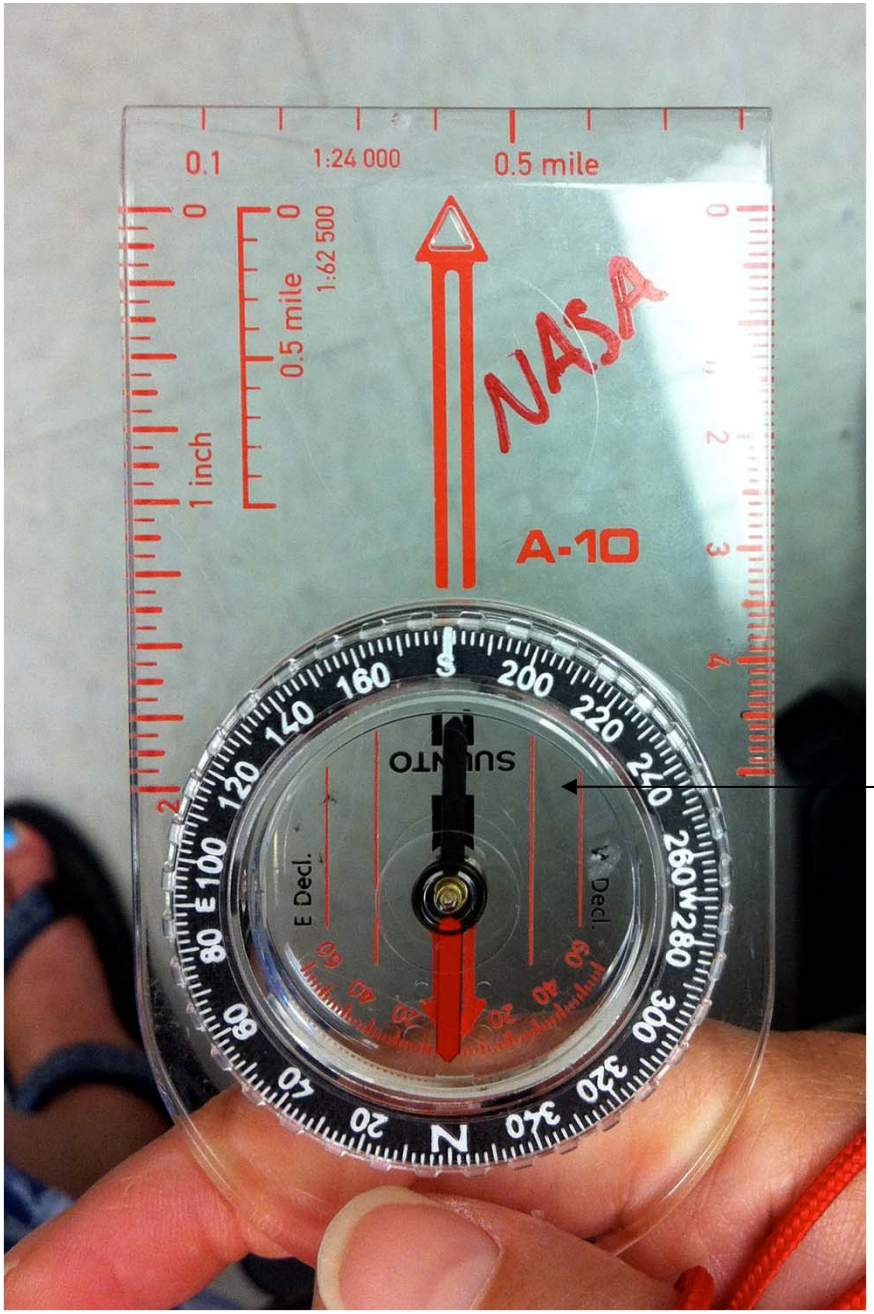
Using a Compass

The red arrow inside the compass points North.

Line up the red arrow, the N, and the big red arrow to all one direction.

Stand and face that direction.

Now, turn and face the direction of the greatest slope of the hill. If you are on flat ground, then you will mark 0° Slope.

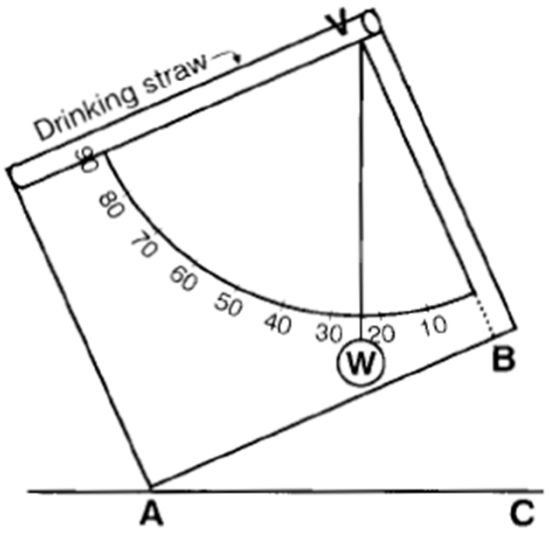


As an example, if the greatest slope is to the South, and you turn and face that direction while holding your compass, it ought to look something like this:

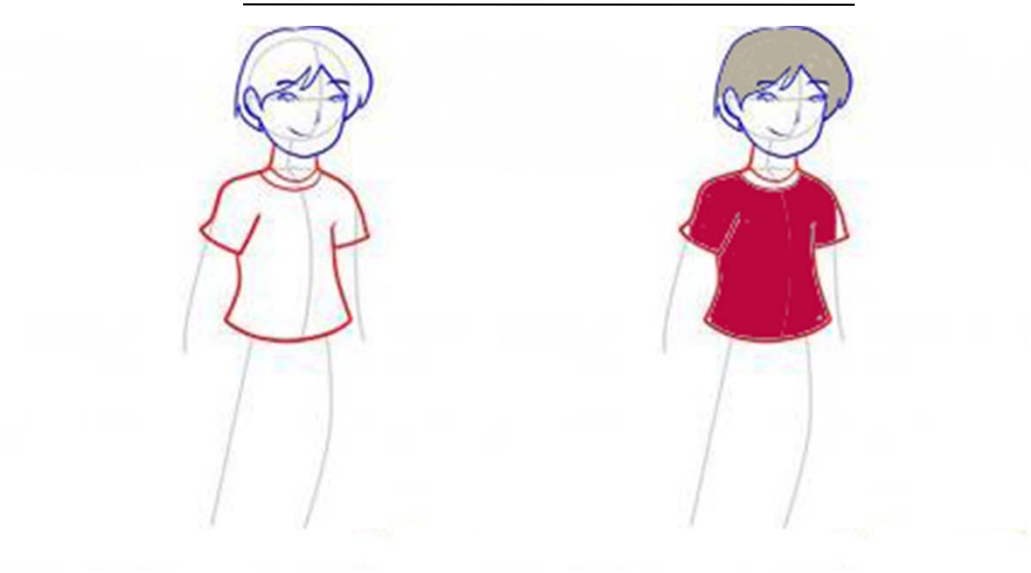
Record the Direction of Slope.

Record the Aspect Degree. In this case: the aspect 180°

USING A CLINOMETER TO DETERMINE ANGLE OF SLOPE



Two people who are the same height will need to conduct this experiment.



To determine the location and line of greatest angle of slope, we will need to:

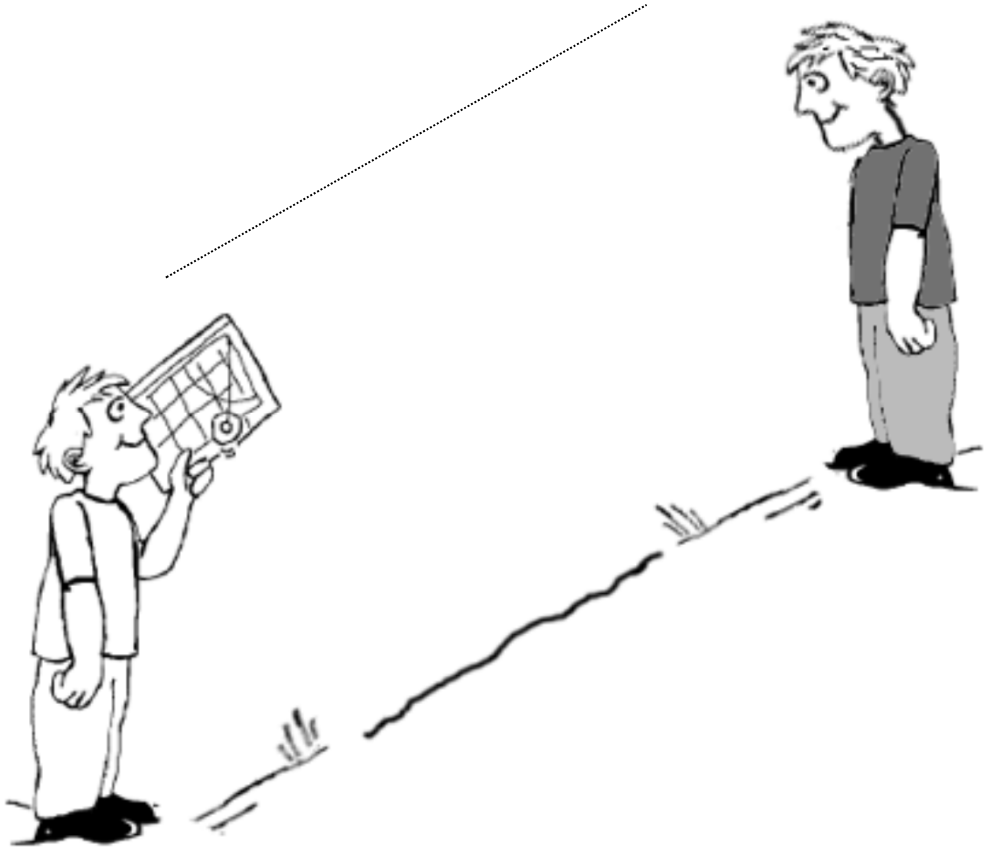
Determine the angle of slope along numerous trajectories and find the greatest angle. We will take three samples to find the greatest angle in degrees and general directions of slope.

Using a compass, we will determine the direction that slope is facing (aspect in degrees). Aspect is the direction a slope faces.

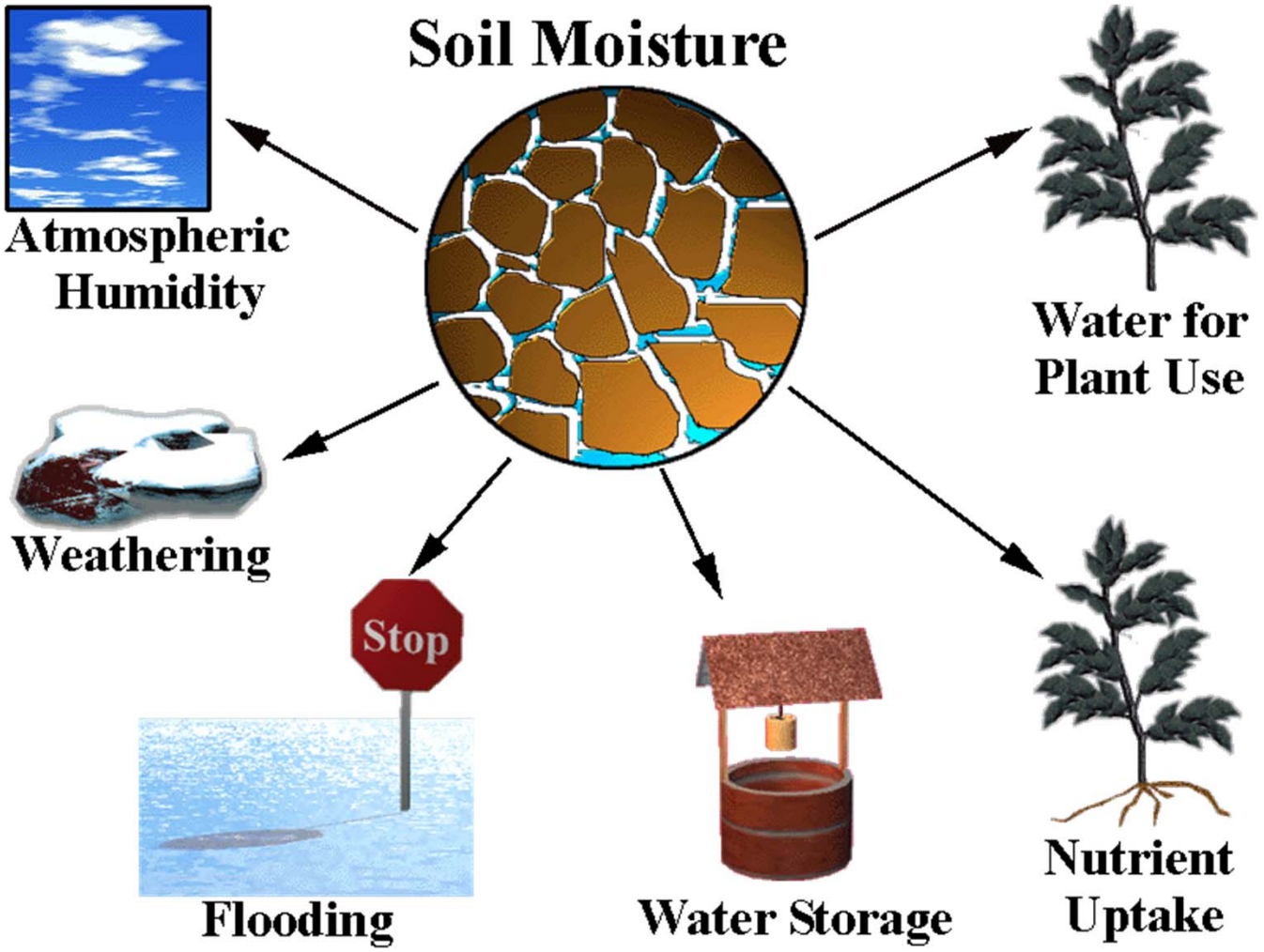
Measure the distance (in feet) from the top of the slope to the bottom of the slope using measuring tapes

Find the GPS (Latitude/Longitude) of the center point along that line.

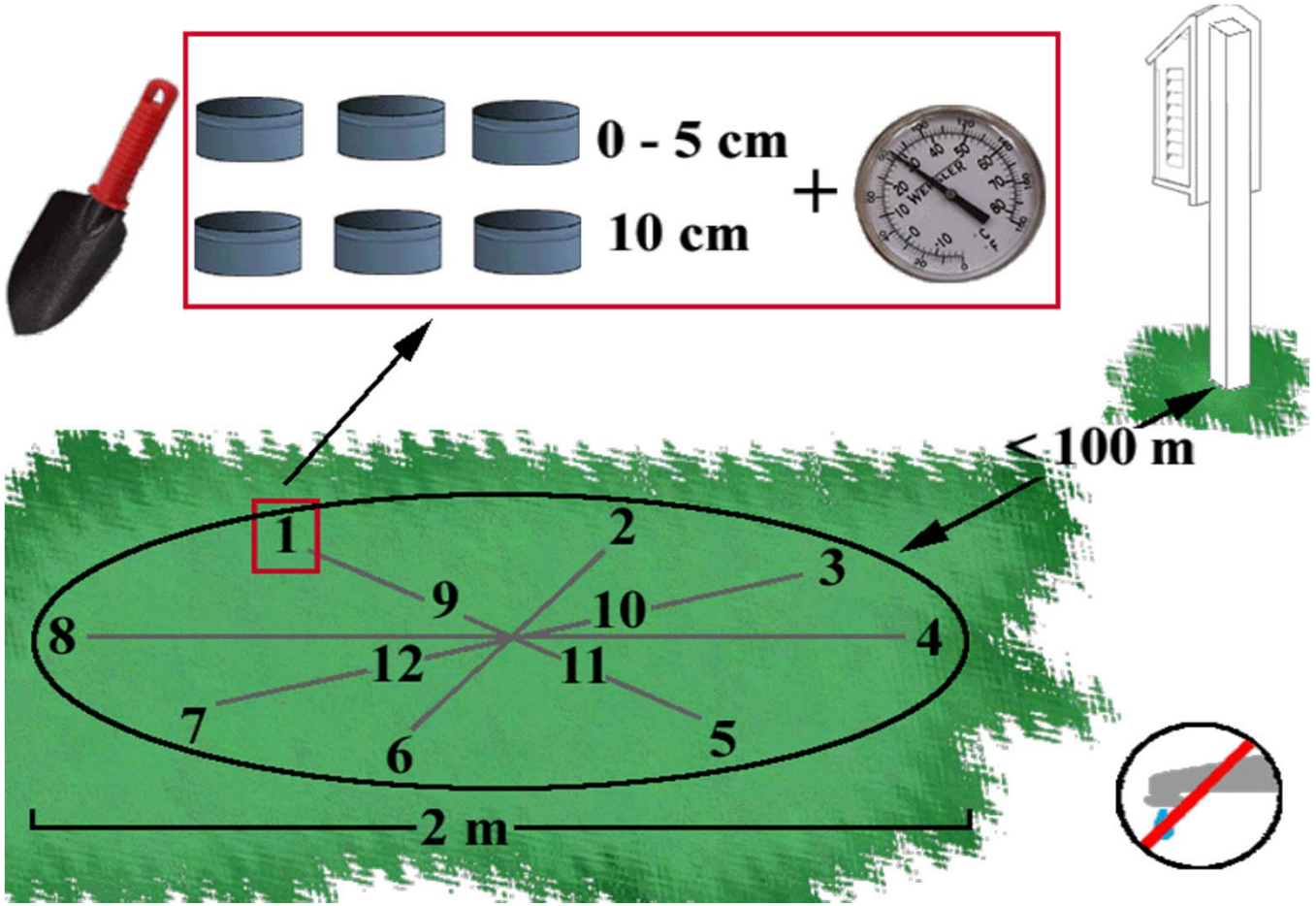
One person stands at the bottom of the hill (slope) and the other person stands at the top. They look for each other's eyes through the straw. Once they see each other's eyes. A third person reads the degree on the clinometer. That is the angle of slope of the hill.



Why We Study Soil Moisture



Where To Perform the Gravimetric Soil Moisture Investigation



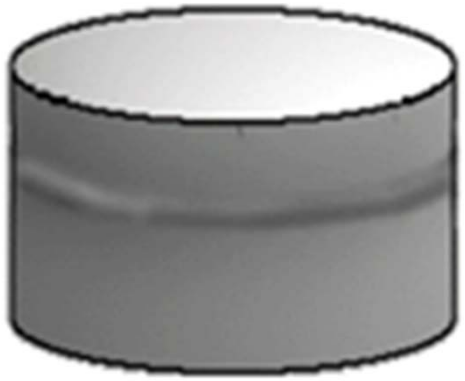
Each sample is taken one meter from the center of the star.

Taking the Gravimetric Soil Sample

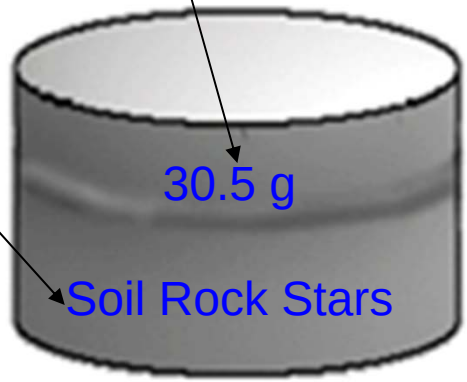
Get the mass of each of your empty cans to the nearest 0.1g.

Write the mass on the **side** of the can (not the top).

Write your “cool” group name on the **side** of the can (not the top).



Empty Can



Empty Can

Taking the Gravimetric Soil Sample

Take 3 Samples at 0 - 5 cm

Take 3 Samples at 10 cm

Take the Temperature at 5 and 10 cm in Triplicate

Taking Soil Moisture Depth Samples

Take 1 Sample at 0 - 5 cm

Take Additional Samples at 10, 30, 60 & 90 cm

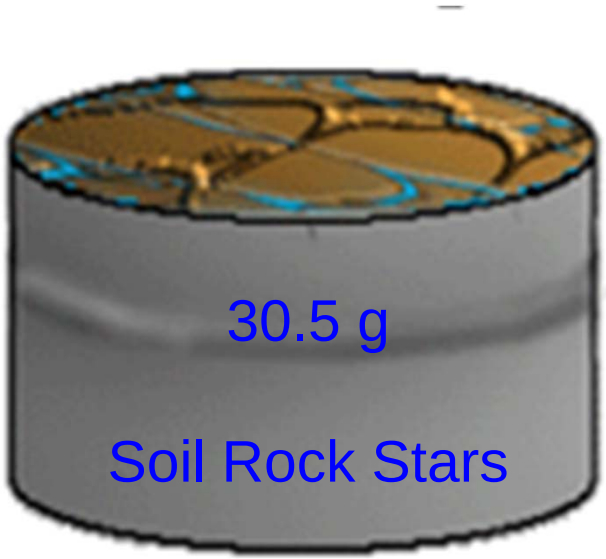
Take the Temperature at 5 and 10 cm in Triplicate

After Fieldwork

Get the mass of the cans (from 5cm and 10cm and “wet” soil sample (soil might not feel or seem wet, but this will be the pre-dried soil sample)

Note the masses for each on your Soil Moisture Data Entry Sheet.

Dry your samples in a soil drying oven at no more than 105°C. Why?



Mass of soil and can might be something like 129.7g.

Note mass on your data sheet.

To Be Continued on Thursday.

Frequency of Measurement

At least 12 regularly spaced intervals

Encouraged to sample the wet, intermediate and dry times surrounding major wet periods

Horizon Properties

Soil Texture

- **The way a soil “feels” is called the soil texture.**

Soil texture depends on the amount of each size of particle in the soil.

Sand, silt, and clay are names that describe the size of individual particles in the soil.

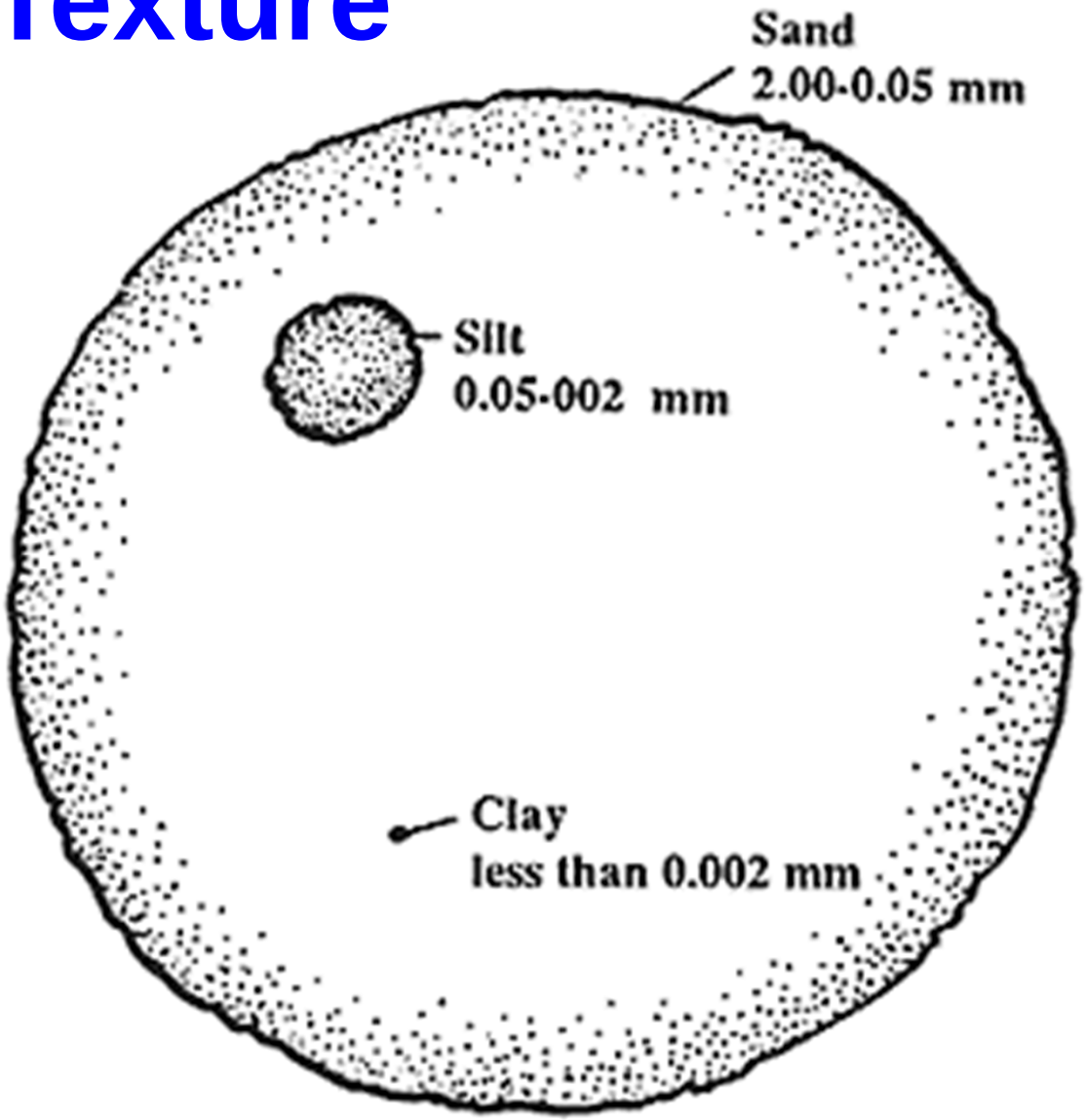
Sand are the largest particles and they feel “gritty.”

Silt are medium sized, and they feel soft, silky or “floury.”

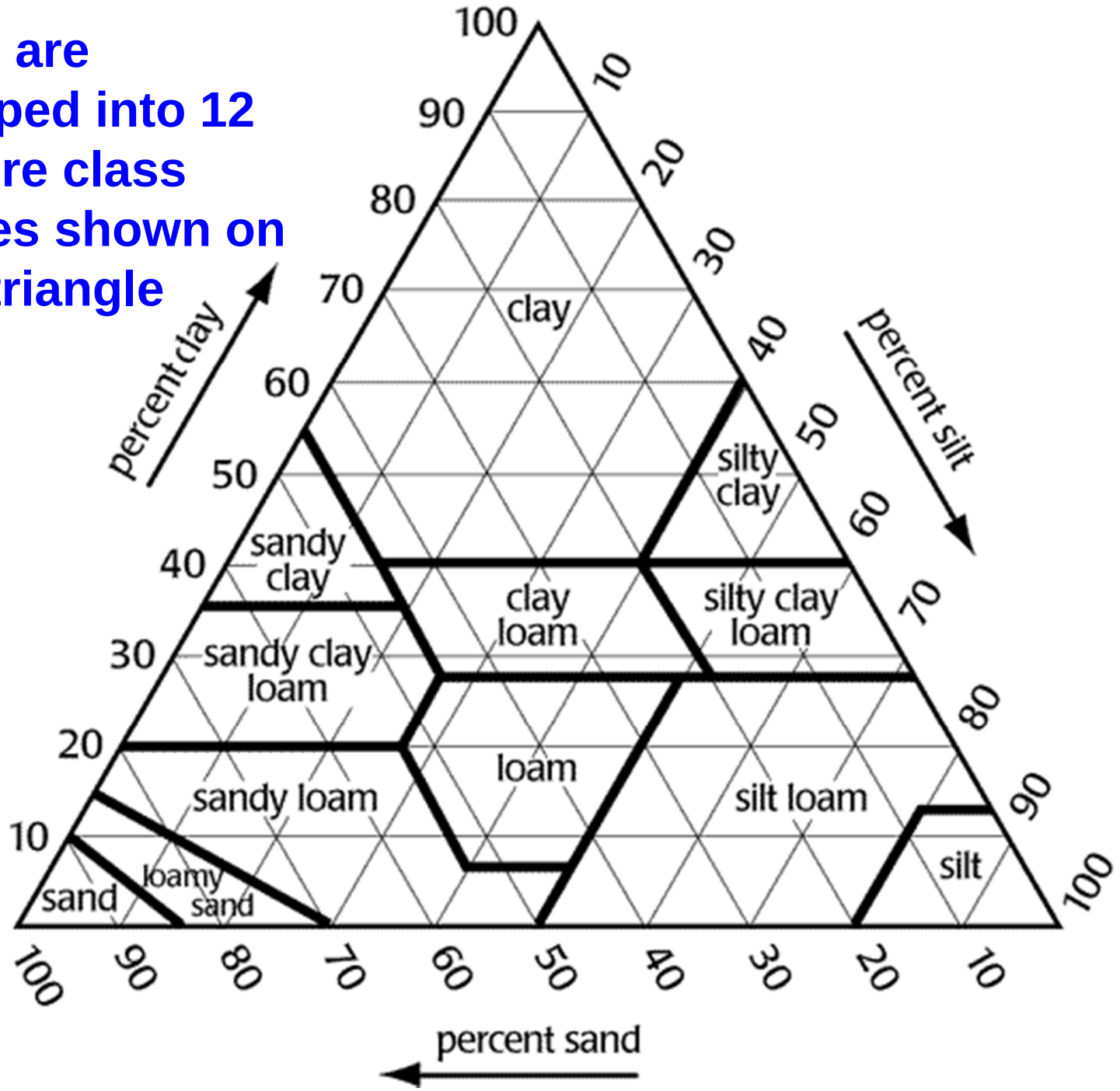
Clay are the smallest sized particles, and they feel “sticky” and they are hard to squeeze.

There are 12 different soil texture classes depending on how much sand, silt, and clay is in each sample and we use the “Texture Triangle” to define these classes

Soil Texture



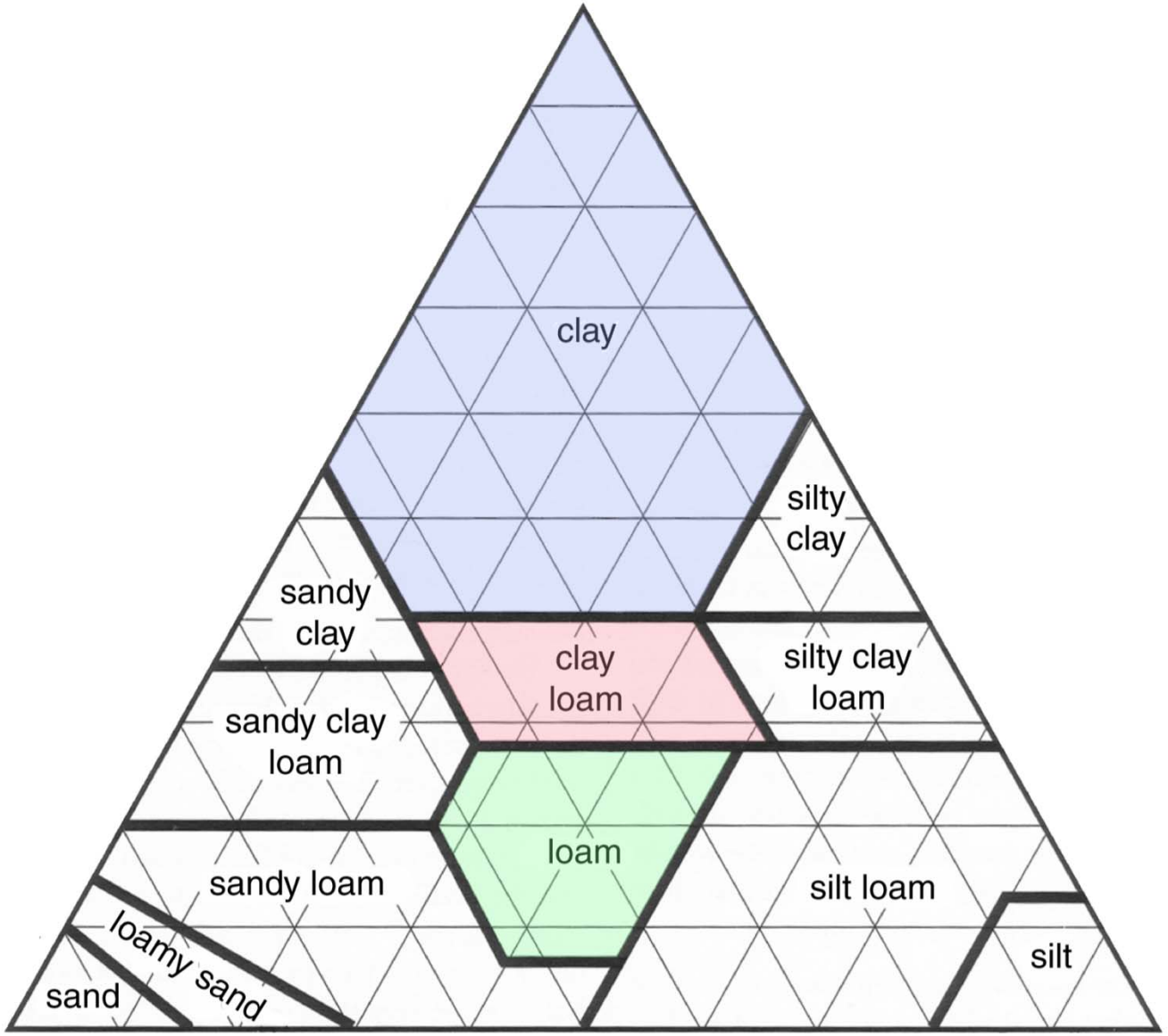
Soils are grouped into 12 texture class names shown on this triangle



To determine soil texture by feel, use the 3 step method:

Step 1:

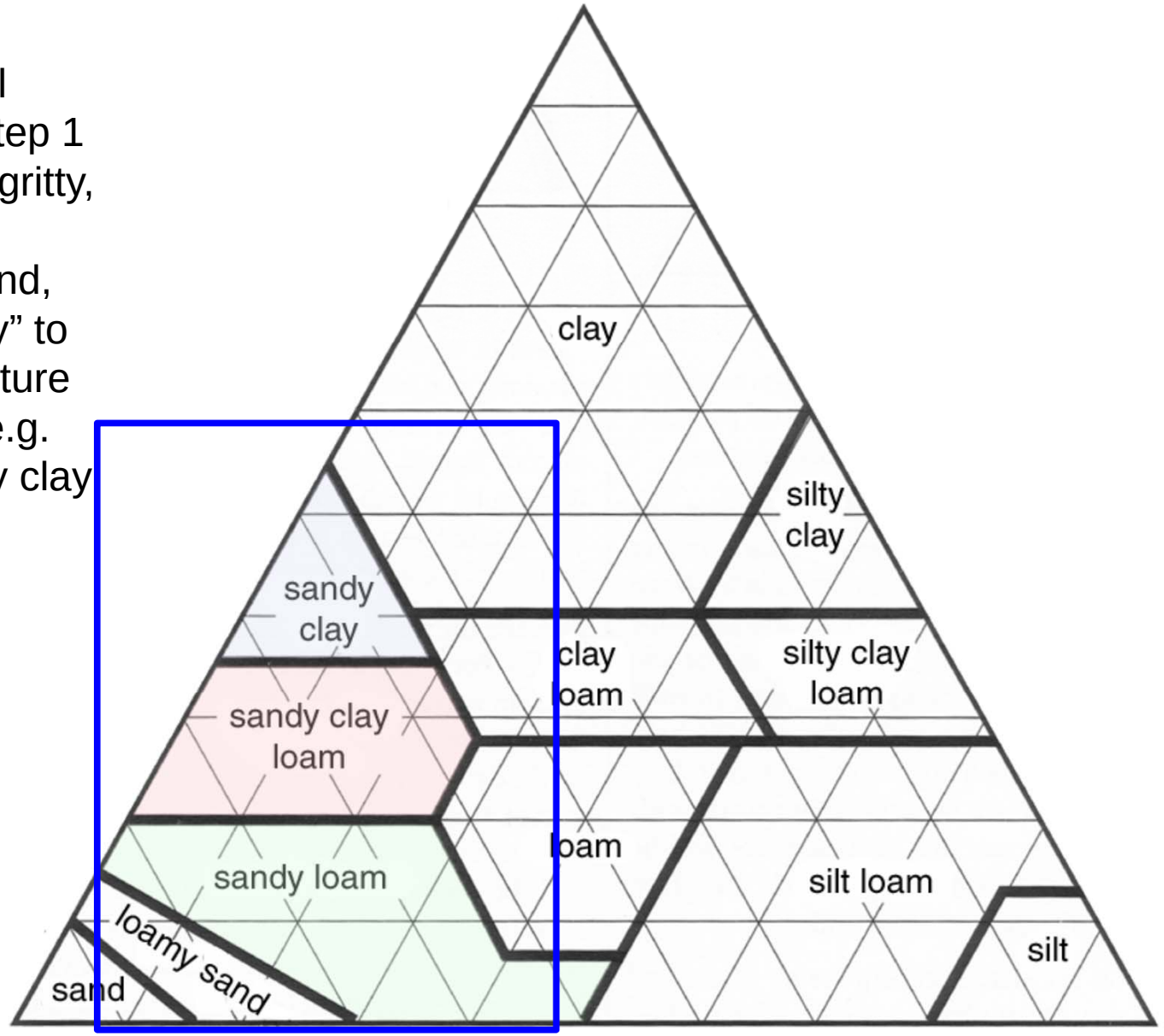
A. Take a handful of soil and moisten it to make a ball
B. Feel for clay (sticky, hard to squeeze, makes a **long** ribbon). If there is a lot of clay, call it “clay”.
C. If there is some clay but it is softer than a dense clay, and does not make as long a ribbon, call it clay loam.
D. If it is very soft with just a little clay, call it “loam, and move to step 2 (next slide).



Step 2:

A. Next, modify the soil texture class from step 1 by feeling for sand (gritty, scratchy)

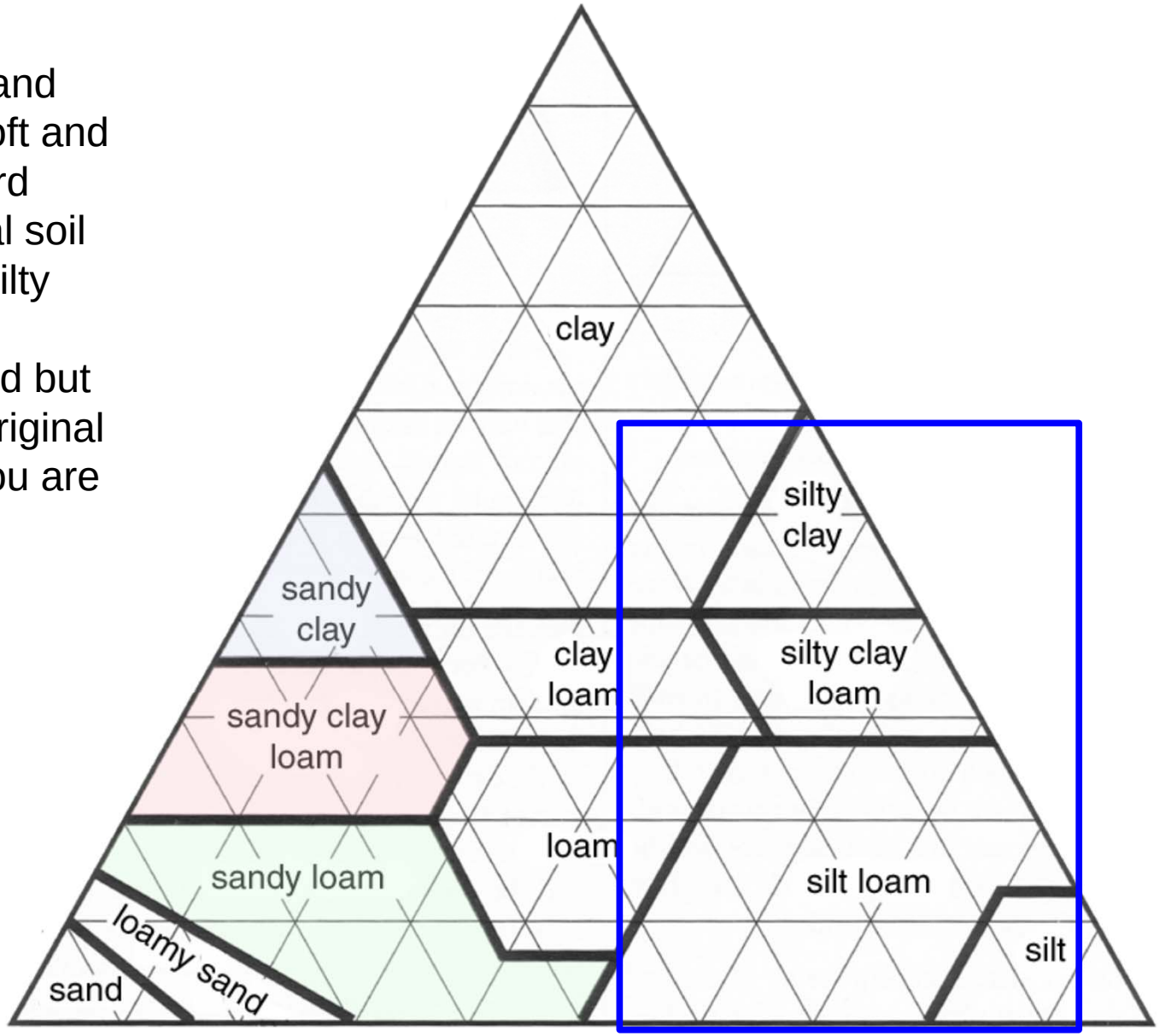
B. If there is a lot of sand, add the word “sandy” to your original soil texture name from step 1 (e.g. sandy clay, or sandy clay loam).



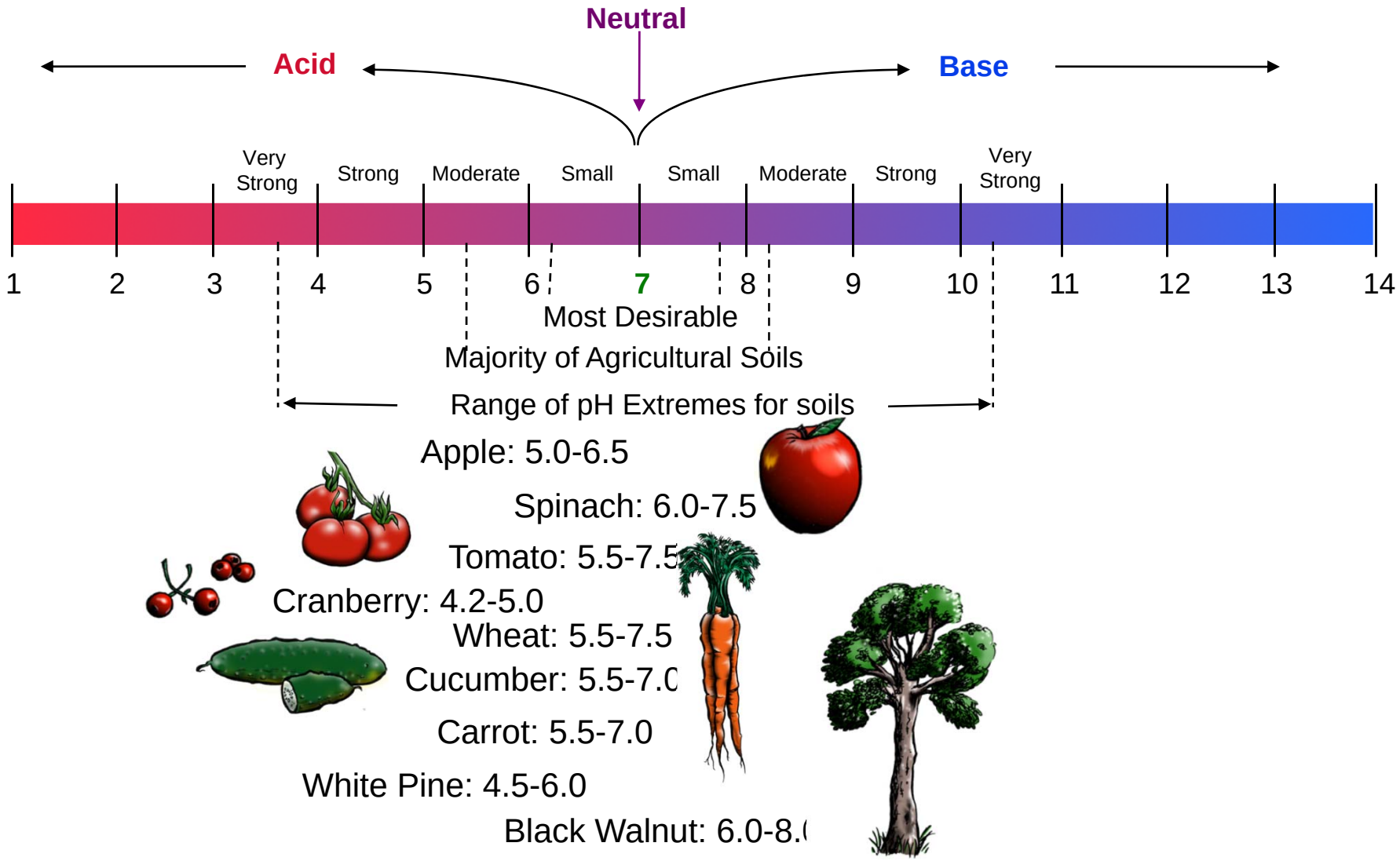
Step 3:

A. If there is NO sand and the soil feels very soft and smooth, add the word “silty” to your original soil texture name (e.g. silty clay, silty clay loam)

B. If there is a little sand but not a lot, keep the original step 1 name, and you are done!



Just Passing Through



Drawings courtesy: Rich Potter (www.awfulcute.com)

Soil Science Education Home Page
Soil.gsfc.nasa.gov

Soil Lady home page
Soillday.com

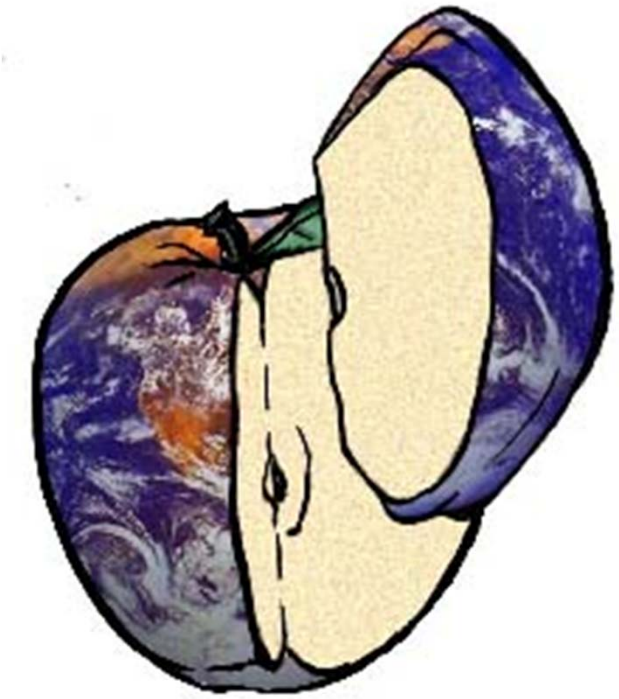
Globe.gov

Nrcs.usda.gov/scan

How Much Soil Is There?

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.

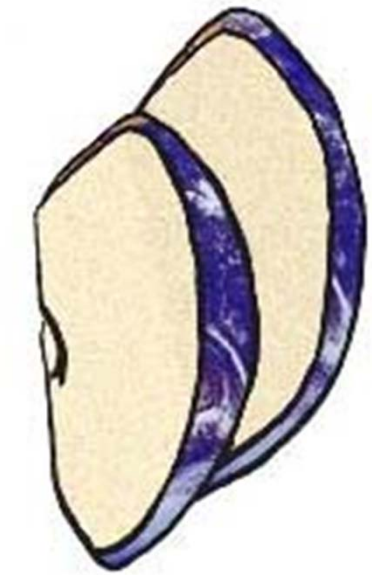


The three quarters (75%) you just removed represents how much of the earth is covered with water - oceans, lakes, rivers, streams. What is left (25%) represents the dry land.

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

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.



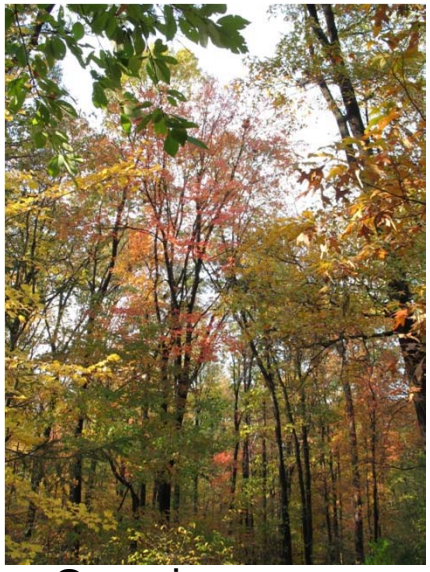
When 50% is removed, this is what is left. (12.5% of the original)

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.

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.

Just Passing Through

Just Passing Through
How Water Filters Through Soils From Different Locales



Organic (courtesy, Izolda Trakhtenberg)

Sand (courtesy, Izolda Trakhtenberg)

Impervious (Creative Commons)

Clay (courtesy, USDA)

What We'll Need In The Field

Data sheets
Field guides
Golf tees
Trowels
Soil thermometers
5 & 10 cm spacers
Spray mist bottle
Soil Color Book
GPS units
Meter Sticks
Compasses
Clinometers
Pencils


SOIL ROCKS!
I DIG SOIL
FUN WITH SOIL