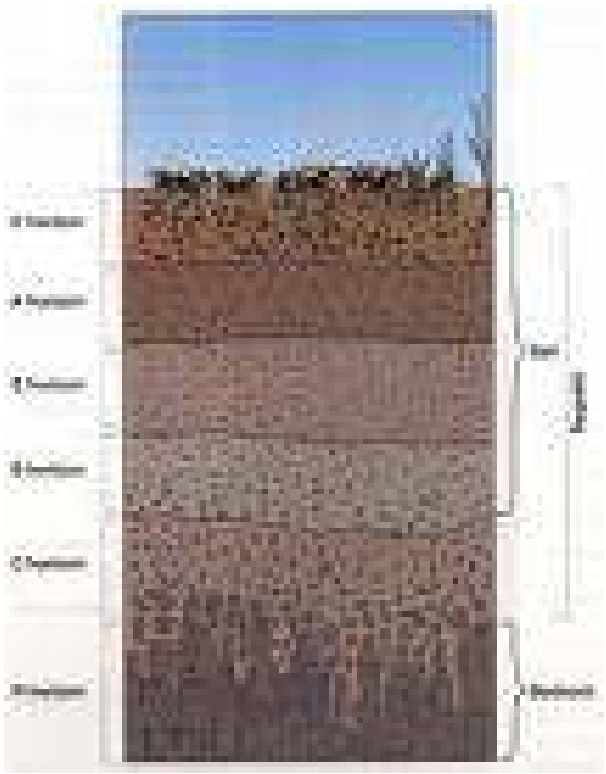
Soils



Item	Number of
Paper Plates	1
6 oz. Spray Bottle	6
Soil Probs	2
Fiskars Nyglass Trowel Palustre Small Digging Shovels	5
Munsell Soil Color Charts	1
Taylor Soil Thermometer	2
Hubbard Scientific: Screen Sieves	1
Turf Profiler	1
Soil pH Meter	1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Station 3- Soils

Introduction

Soils are a mixture of different things; rocks, minerals, and dead, decaying plants and animals. Soils can be very different from one location to another, but generally consists of organic and inorganic materials, water and air. The inorganic materials are the rocks that have been broken down into smaller pieces. The size of the pieces varies. It may appear as pebbles, gravel, or as small as particles of sand or clay. The organic material is decaying living matter. This could be plants or animals that have died and decay until they become part of the soil.

The amount of water in the soil is closely linked with the climate and other characteristics of the region. The amount of water in the soil is one thing that can affect the amount of air. Very wet soil, like you would find in a wetland, probably has very little air. The composition of the soil affects the plants and therefore the animals that can live there.

http://library.thinkquest.org/J003195F/soil1.htm

Activity suggestions before visiting the Nature Park

- Research living things that are inside soil
- Practice with the tools in the Station Kit before going to the Nature Park

Activity suggestions during your visit to the Nature Park

We request all testing be done on site and all soils left on the premise. Please feel free to modify any of the activities as necessary to compliment your curriculum or objectives.

- Determine soil compositions throughout the Nature using the soil sieves park. (see Activities Section below)
- Determine the root bases throughout the Nature Park using the turf profiler. (see Activities Section below)
- Determine soil horizons throughout the Nature Park using the soil probe. (see Activities Section below)
- Determine free carbonates of various types of soil. (see Activities Section below)
- Determine the soil pH of various types of soil. (see Activities Section below)
- Determine the soil textures of various types of soil see Activities Section below)
- Determine soil colors (see the Munsell Soil Color Chart)

Activity suggestions after visiting the Nature Park

- Complete all activities for soils located around town and in the school yard. Compare and contrast the findings.

Resources in the travelling trunk

- 2 Soil testing probes
- Squirt bottles
- Turf profiler
- Soil pH Meter
- 5 small shovels
- Paper plates
- 2 soil sieves
- 2 soil thermometers
- 1 soil pH meter

On line references

How to create your own soil profiles, http://soils.usda.gov/education/resources/k_12/lessons/profile/

What is the soil profile?, http://www.tqnyc.org/2004/NYC040803//Soillayers.html

Soil color, http://soils.usda.gov/education/resources/k_12/lessons/color/ and http://nesoil.com/properties/color/sld001.htm

12 Orders of Soil, http://soils.usda.gov/technical/soil_orders/

Activities Section

Soil Composition using soil sieves

Soil sieves are a useful tool for separating the coarse sand, fine sand, silt, and clay fractions from a soil sample. The relative proportions of these particle sizes are used to classify soils and give them generic names such as loam, fine sandy loam, silty clay, and so on.

To use the sieves, stack them from the largest mesh to the smallest. Place a dry sample in the top, largest mesh, put the lid on, and shake gently over a tray for several minutes. Mass and or volume comparisons will give relative percent values for each particle size in the sample. You may wish to retain materials of a given particle size for use in future activities.

The grain size analysis is widely used in classifying soils. The data from grain size test is used to…

- design filters for earth dams and to determine suitability of soil for road construction, air field etc.
- predict soil water movement
- define the ability of the soil to allow a crop to grow
- help farmers and those that grow crops to know if they need to irrigate (add water to the soil during the dry months)

BenMeadows.com

Root Bases using the turf profiler

Push the turf profiler into the soil until the top bars are touching and parallel with the top of the soil. Pull the profiler out. The profiler in this kit can take a 4"W x 7"D x 1"-thick sample of turf or soil. Then you can remove one screw, check out your sample and then either replace the wedge of soil you have removed it. Use the profiler to analyze root structure or soil stratification.

BenMeadows.com

Soil Horizons using the soil probe

Push the soil probe into the soil (moist soil is the best and easiest to push the soil probe down into). Pull the probe up and examine the many different layers of soil. Taking many probe samples in many different areas of the park will demonstrate the wide variety of soils in a flood plain. It may also show roots, insects, or other life inhabiting soil.

http://ipm.ncsu.edu/Scouting_Fraser_Fir/Fir_images/soil_probe.JPG

Soil Free Carbonates

What are carbonates and why are they important?

Carbonates mainly consist of calcium and magnesium in the soil. Calcium and magnesium are very basic/ alkaline (which could mean that there is potential for high soil pH if in abundance). Plants need both calcium and magnesium for proper growth and yield. The reason the soil will bubble when squirted with vinegar is that vinegar is very acid and it will try to neutralize anything alkaline. (hydrogen vs calcium and magnesium). The "opposite side of that coin" is if baking soda (very alkaline) comes in contact with acid corrosion on a battery terminal it will also bubble because baking soda is trying to neutralize the acid on the battery. (carbonate vs acid----in this case sulfuric acid).

Carbonates raise pH so plants can grow and yield. Too high a concentration of carbonates equals a pH that is too high for proper plant growth

Materials

Soil
Vinegar
Paper plates

Procedure

1. Using a hand full of your soil, make a line of soil around your paper plate. Squirt vinegar in a straight line onto all of the soil. If free carbonates are present, they will “effervesce” or bubble when the vinegar reacts with them.
2. Record one of the following based on your observation:

None: you observe no reaction (the soil has no free carbonates).

Slight: you observe a slight amount of bubbling (the soil is coated with some carbonates).

Strong: you observe a strong reaction (many bubbles) (the soil has many carbonate coatings present.

Soil pH

pH is a measure of how acidic or basic things are and is measured using a pH scale between 0 to 14, with acidic things having a pH between 0-7 and basic things having a pH from 7 to 14. For instance, lemon juice and battery acid are acidic and fall in the 0-7 range, whereas seawater and bleach are basic (also called "alkaline") and fall in the 7-14 pH range. Pure water is neutral, or 7 on the pH scale.

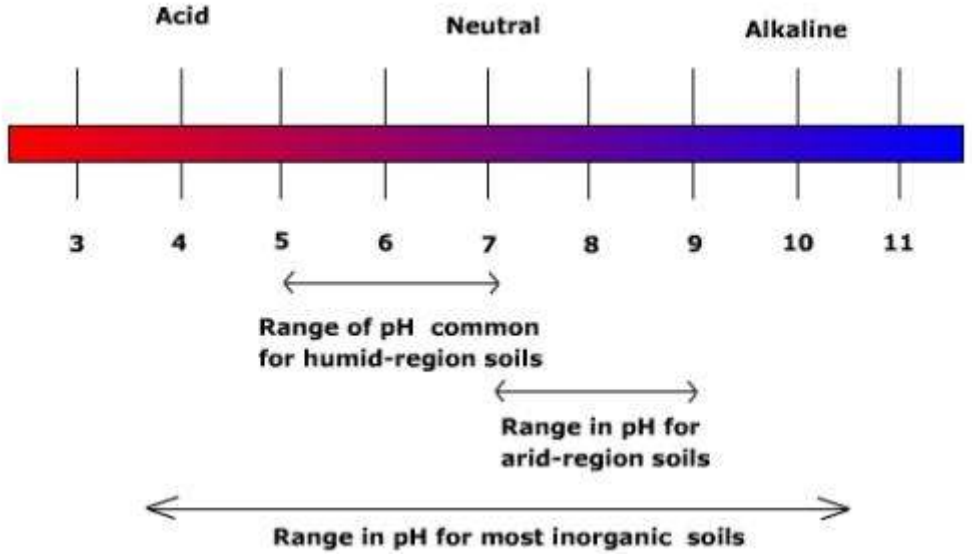
The Importance of pH

The pH of soil or more precisely the pH of the soil solution is very important because soil solution carries in it nutrients such as Nitrogen (N), Potassium (K), and Phosphorus (P) that plants need in specific amounts to grow, thrive, and fight off diseases.

If the pH of the soil solution is increased above 5.5, Nitrogen (in the form of nitrate) is made available to plants. Phosphorus, on the other hand, is available to plants when soil pH is between 6.0 and 7.0.

Certain bacteria help plants obtain N by converting atmospheric Nitrogen into a form of N that plants can use. These bacteria live in root nodules of legumes (like alfalfa and soybeans) and function best when the pH of the plant they live in is growing in soil within an acceptable pH range. For instance, alfalfa grows best in soils having a pH of 6.2 - 7.8, while soybean grows best in soils with a pH between 6.0 and 7.0. Peanuts grow best in soils that have a pH of 5.3 to 6.6. Many other crops, vegetables, flowers and shrubs, trees, weeds and fruit are pH dependent and rely on the soil solution to obtain nutrients.

If the soil solution is too acidic plants cannot utilize N, P, K and other nutrients they need. In acidic soils, plants are more likely to take up toxic metals and some plants eventually die of toxicity (poisoning). Herbicides, pesticides, fungicides and other chemicals are used on and around plants to fight off plant diseases and get rid of bugs that feed on plants and kill plants. Knowing whether the soil pH is acidic or basic is important because if the soil is too acidic the applied pesticides, herbicides, and fungicides will not be absorbed (held in the soil) and they will end up in garden water and rain water runoff, where they eventually become pollutants in our streams, rivers, lakes, and ground water.



http://www.uwsp.edu/gEo/faculty/ritter/images/biosphere/soils/ph.jpg

How to Use the pH meter

Consult the instructions included in the soil pH mater package

Soil Texture

Materials
Soil Texture Triangle
Spray Mist Bottle/Water
Ruler (in cm)

Texture:
Soil texture refers to the relative proportion of sand, silt and clay size particles in a sample of soil. Clay size particles are the smallest being less than .002 mm in size. Silt is a medium size particle falling between .002 and .05 mm in size. The largest particle is sand with diameters between .05 for fine sand to 2.0 mm for very coarse sand. Soils that are dominated by clay are called fine textured soils while those dominated by larger particles are referred to as coarse textured soils. Soil scientists group soil textures into soil texture classes**.**

Soil texture is how the soil feels and is determined by the amount of sand, silt, and clay particles in the soil, each of which is a different size. Human hands are sensitive to this difference in size of soil particles, so we are able to determine the texture or "feel" of the soil.

- Sand is the largest particle size group, and feels gritty to touch.
- Silt is the next size group, and feels smooth or floury.
- Clay is the smallest size group, and feels sticky and hard to squeeze.

The actual amount of sand, silt, and clay size particles in a soil sample is called the particle size.

- Sand is the largest soil particle size group
- Silt is intermediate in size
- Clay is the smallest.

Procedure
Step 1 (Get and Moisten Sample)

A. Place some of your soil (about the size of a small egg) in your hand and using the spray mist bottle, moisten the soil. DO NOT SOAK!!
B. Let the water soak in and then work the soil between your fingers until it is the same moisture throughout.
C. Once the soil is moist, try to form a ball. If the soil forms a ball, go on to Step 2. If the soil does not form a ball, go to Step 5.

Step 2 (Test for Clay)

A. If the soil:
    - Is really sticky
    - Hard to squeeze
    - Stains your hands
    - Has a shine when rubbed
    - Forms a long ribbon (5+ cm) without breaking,

    Call it **clay**, and go to Step 3.
    Otherwise, go to B.
B. If the soil:
    - Is somewhat sticky
    - Is somewhat hard to squeeze
    - Forms a medium ribbon (between 2-5 cm)

    Call it **clay loam** and go to Step 3.
    Otherwise, go to C.

C. If the soil is:
- Soft
- Smooth
- Easy to squeeze
- At most slightly sticky
- Forms a short ribbon (less than 2 cm)

Call it loam and go to Step 3.

<u>Otherwise,</u> go to D.

D. If the soil forms a ball but **no** ribbon, go to Step 4.

Step 3 (Refine Initial Soil Texture Classification from Step 2 for Relative Amounts of Sand and Silt)

Wet a small pinch of the soil in your palm and rub it with a forefinger.

If the soil:
- Feels very gritty, go to **E**
- Feels very smooth, with no gritty feeling, go to **F**
- Feels only a little gritty, go to **G**

E. Add the word **sandy** to the initial classification.
Soil texture is (circle one):
- Sandy Clay
- Sandy Clay Loam
- Sandy Loam

Soil Texture is complete.

F. Add the word **silt** or **silty** to the initial classification.
Soil texture is (circle one):
- Silty Clay
- Silty Clay Loam
- Silt Loam

Soil Texture is complete.

G. Leave the original classification of (circle one):
- Clay
- Clay Loam
- Loam

Soil Texture is complete.

Step 4 (Test for Loamy Sand or Silt)

If the soil:
- Forms a ball
- Forms **no** ribbon
- And is

H. Very Gritty
Soil texture is: Loamy Sand

Soil Texture is complete.

Or

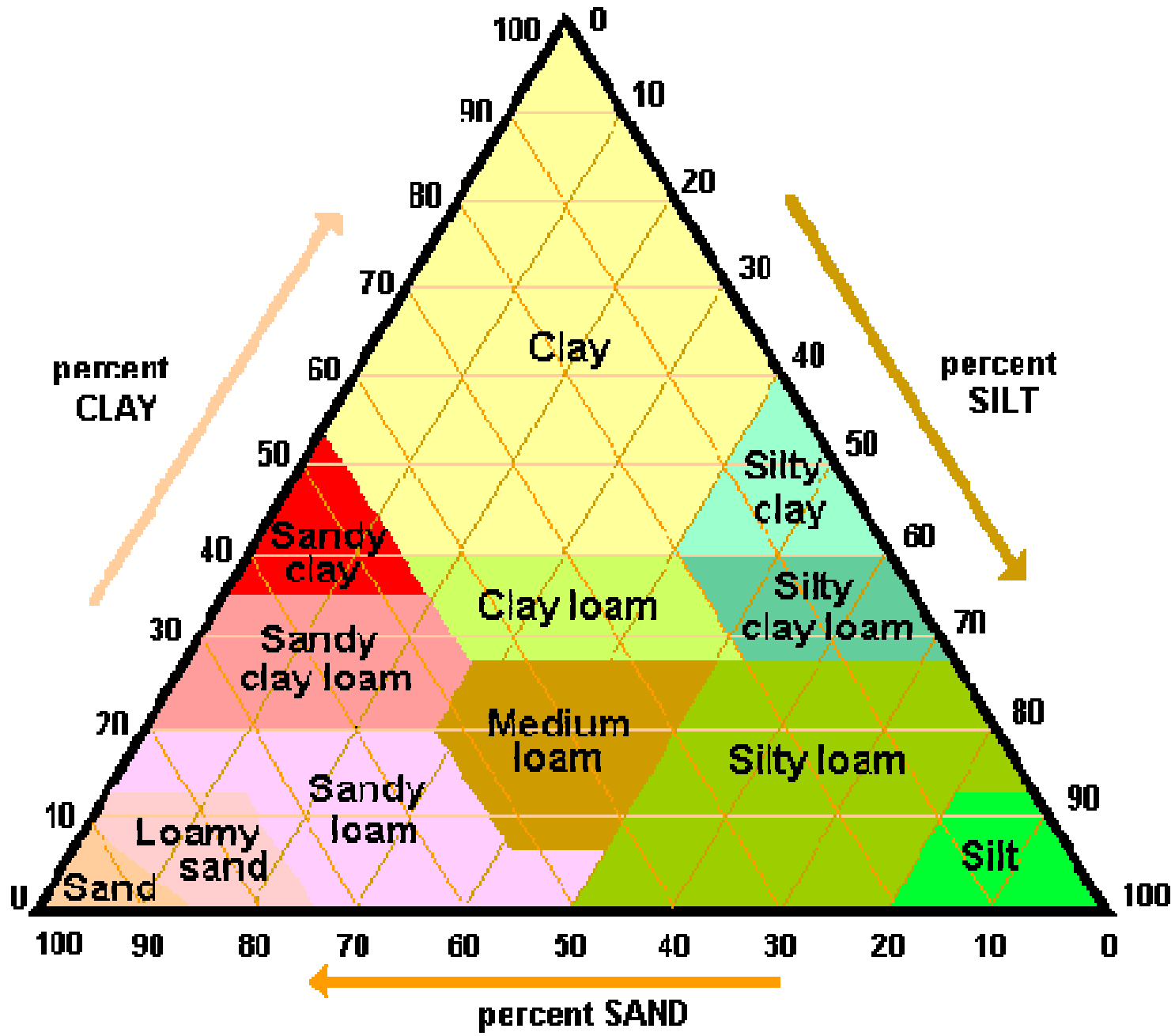
I. Very soft and smooth with no gritty feeling,
Soil texture is: Silt

Soil Texture is complete.

Step 5 (Test for Sand)

If the soil:
Forms no ball and falls apart in your hand,
Soil texture is: Sand

Soil Texture is complete.



Soil Texture Triangle

The sides of the soil texture triangle are scaled for the percentages of sand, silt, and clay. Clay percentages on the left side of the triangle are read from left to right across the triangle (dashed lines). Silt runs from the top to the bottom along the right side and is read from the upper right to lower left (light, dotted lines). The percentage of sand increases from right to left along the base of the triangle. Sand is read from the lower right towards the upper left portion of the triangle (bold, solid lines). The boundaries of the soil texture classes are highlighted in blue. The intersection of the three sizes on the triangle give the texture class. For instance, if you have a soil with 20% clay, 60% silt, and 20% sand it falls in the "silt loam" class.

http://www.uwsp.edu/gEo/faculty/ritter/geog101/textbook/soil_systems/soil_development_soil_properties.html

Sand, Loamy sand, Sandy loam
These are well drained and aerated and workable for most of the year. They are very light to handle and quick to warm up in spring. Unless they have a very high organic matter content they are prone to drying out too quickly, and additional watering will be needed. This extra watering will also help to wash out the plant foods and lime from the soil, so they are likely to be acid (except for some coastal soils). They are often referred to as “hungry” soils and need lots of extra feeding. With careful management however, they can be amongst the most productive soil types.

Medium loam, Sandy clay loam, Silt Loam
These are the “average” soil types. They achieve a good balance between the ability to be very productive and the minimum of attention. The medium loam group is probably the best in this respect.

Clay, Sandy clay, Clay loam, Silty clay loam, Silty clay, Silt
Although these soils are difficult to work and manage, they usually have good supplies of plant foods and lime. The main drawbacks are the high water holding capacity (which means they are late to get going in spring) and the effort required to work them. You will need to catch just the right weather conditions to avoid hard work and damage to the soil structure. The use of heavy machinery (and especially rotavators) should be avoided at all costs, particularly when the soil is wet.

Peat moss or Fen Soils.
Provided they are not too acid and have effective sub drainage, these are probably the best natural soils available. They are rich in plant foods, are easily workable and early. It is possible to convert your existing soil into peat type soil by adding large amounts of organic matter. Some of the keenest exhibition growers do just this. It can be time consuming and costly at first, but once you get there life becomes much easier. You must avoid making your soil too acid though, and careful choice of organic matter is needed.

Chalk soils and Limestone Soils
These are the soils that contain a high proportion of chalk or lime. So much in fact, that it overrides their normal particle size classification. They are often very shallow soils, and severely limit the types of plants that can be grown successfully in them. If you have a soil of this type and are not happy with the range of plants it will allow you to grow, probably the best thing you can do is move to a new area and check the soil out first. If you can’t move, the most sensible course of action is to limit yourself to the plants that will grow in chalky soils. Trying to change the soil is usually an uphill struggle and quite expensive. For the incurably intrepid, details are given later in the “Golden Rules for Difficult Soils” section.