Student Name: ______________________

Partner Name: ______________________

Laboratory Date: ______________________

FOR 2505 - Soil Texture Report 2017

Objectives of this report:

5 Marks
Objectives

Principles behind methods used to determine soil texture:

5 Marks
Principles

Personal Lab Results:

5 Marks
Lab Results

Soil Sample: ______________________

Hyd. Reading #1 (temp. corrected): __________

Hyd. Reading #2 (temp. corrected): __________

Sand % __________

Silt % __________

Clay % __________

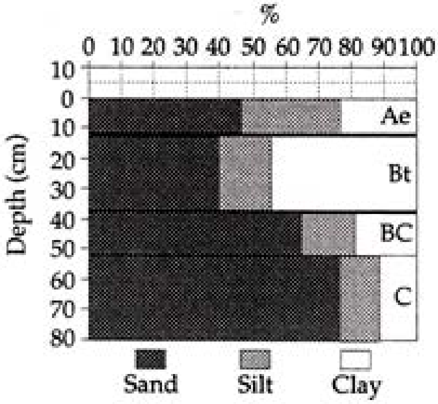
Soil Texture Class: __________

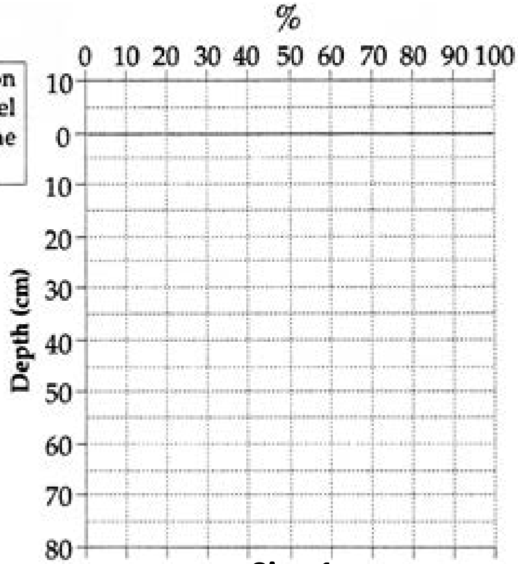
Apparatus Sketch

5 Marks
Sketch

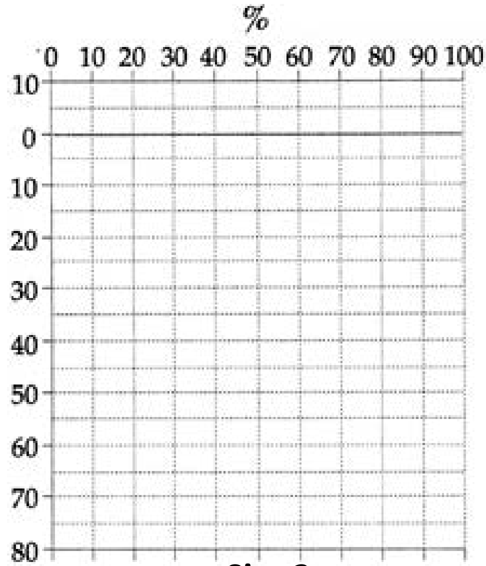
Results-Texture Graphs

Draw in straight lines where the horizon boundaries occur (see data above) and label them. Plot % sand, silt, and clay as in the example below.

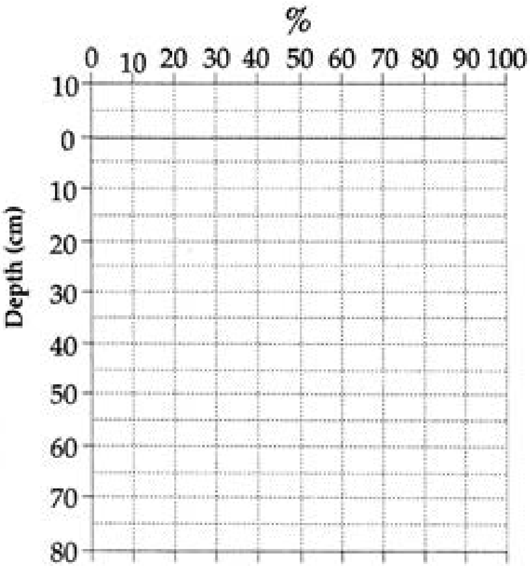




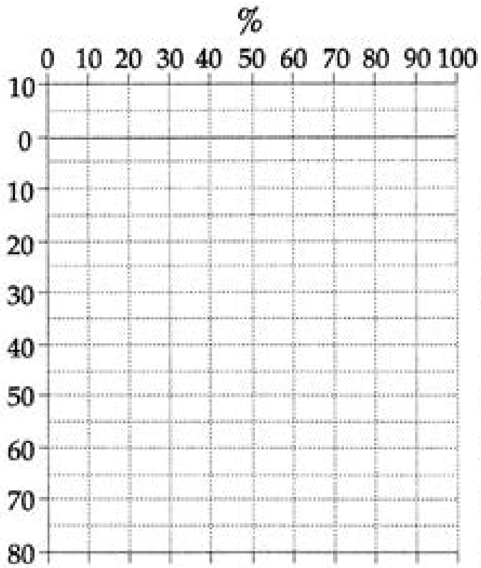
- Site 1 -
Woodlot RP Plantation



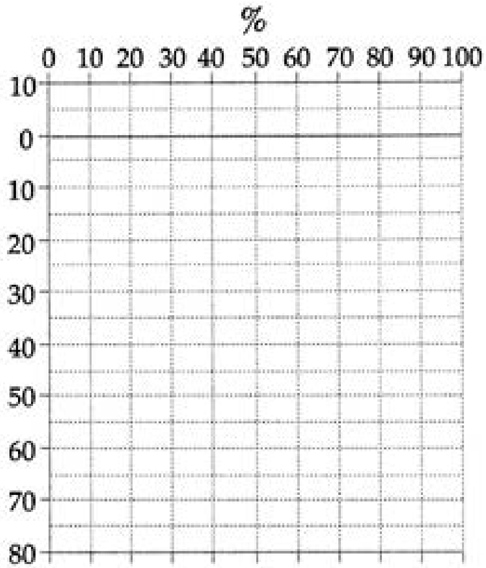
- Site 2 -
Odell Mixedwood



- Site 3 -
Currie Mountain Basalt



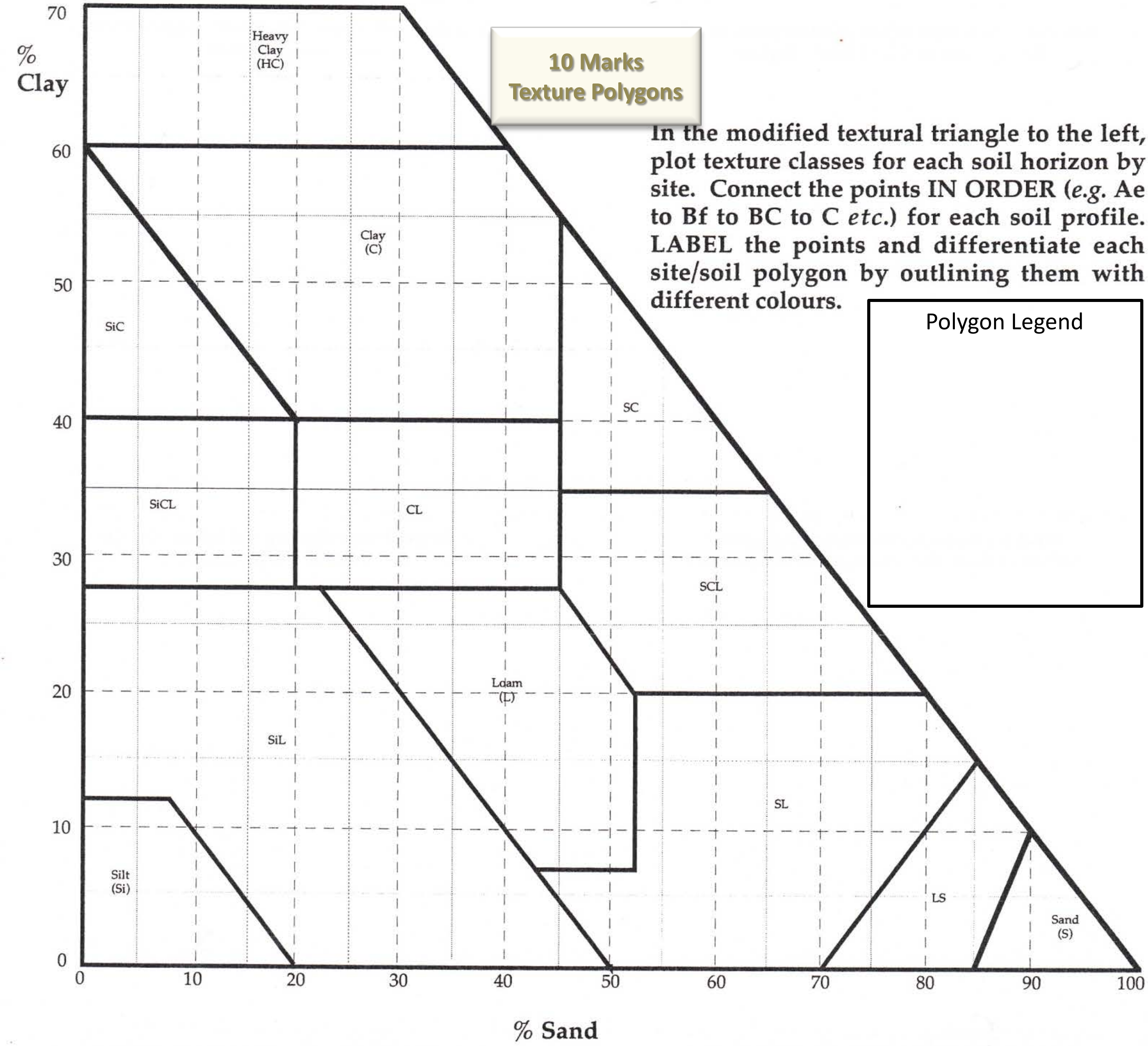
- Site 4 -
Killarney Lake Esker



- Site 5 -
Sunset Dr. EWP PLT

10 Marks
Texture Graphs

10 Marks
Texture Polygons



In the modified textural triangle to the left, plot texture classes for each soil horizon by site. Connect the points IN ORDER (*e.g.* Ae to Bf to BC to C *etc.*) for each soil profile. LABEL the points and differentiate each site/soil polygon by outlining them with different colours.

Polygon Legend

In general, what can you learn from the shape of the texture polygons?

Can the texture polygons tell you anything about parent material? Explain.

10 Marks
Observations

How does soil texture influence water percolation?
(Sandy loam vs. Clay Loam) - Explain

How does soil texture change with increased soil weathering? Explain.

What are the principle soil-binding agents?
Which of these agents lead to soil cementation?

Distinguish the following soil layers: Cgx , Cc
...in terms of soil permeability

30 Marks
Texture Questions

How does soil texture (sand, silt, clay) influence forest vegetation on wet sites?

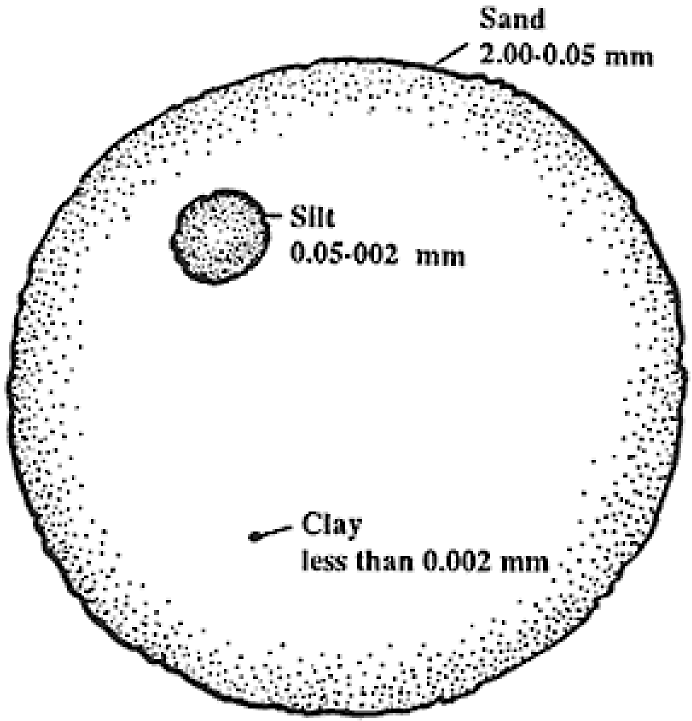
How does soil compaction affect soil permeability?

Draw and label a single, two-dimensional picture (*i.e.* a geological cross section) that shows the: (1) hypothetical soil landscape conditions of the five sites visited, and (2) coloured, continuing texture "profiles" at each site (see page 2 for data). Use different colours/shading for different texture classes. Also, indicate soil parent material and vegetation as they vary across the landscape.

20 Marks
Landscape Drawing

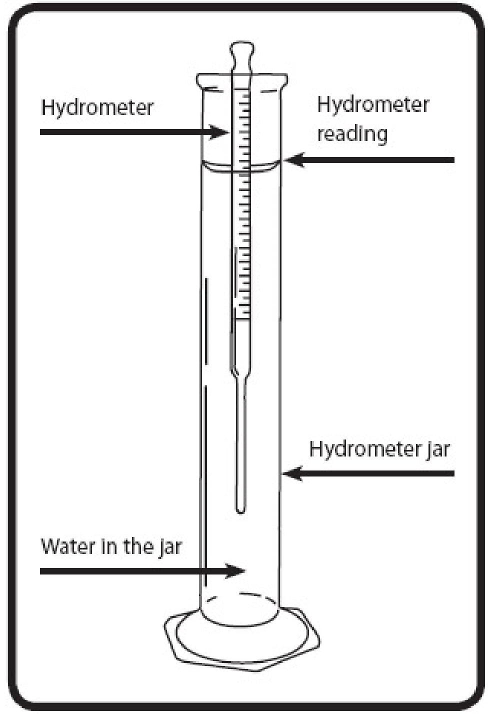
Some background information regarding soil texture analysis…

Soil Particle Sizes…



Soil Texture Classes…

- Sand (S)
- Loamy Sand (LS)
- Sandy Loam (SL)
- Loam (L)
- Silt Loam (SIL)
- Silt (SI)
- Sandy Clay Loam (SCL)
- Silty Clay Loam (SICL)
- Clay Loam (CL)
- Sandy Clay (SCL)
- Silty Clay (SIC)
- Clay (C)



A **hydrometer** is an instrument used to measure the specific gravity (or relative density) of liquids; that is, the ratio of the density of the liquid to the density of water.
A hydrometer is usually made of glass and consists of a cylindrical stem and a bulb weighted with mercury or lead shot to make it float upright. The liquid to be tested is poured into a tall container, often a graduated cylinder, and the hydrometer is gently lowered into the liquid until it floats freely. The point at which the surface of the liquid touches the stem of the hydrometer is noted. Hydrometers usually contain a scale inside the stem, so that the specific gravity can be read directly. A variety of scales exist, and are used depending on the context.

The operation the hydrometer is based on the Archimedes principle that a solid suspended in a fluid will be buoyed up by a force equal to the weight of the fluid displaced. Thus, the lower the density of the substance, the farther the hydrometer will sink.

Stokes' law, for the frictional force — also called drag force — exerted on spherical objects with very small Reynolds numbers (e.g., very small particles) in a continuous viscous fluid.

$$F_d = 6\pi\,\eta\,R\,V$$

where:

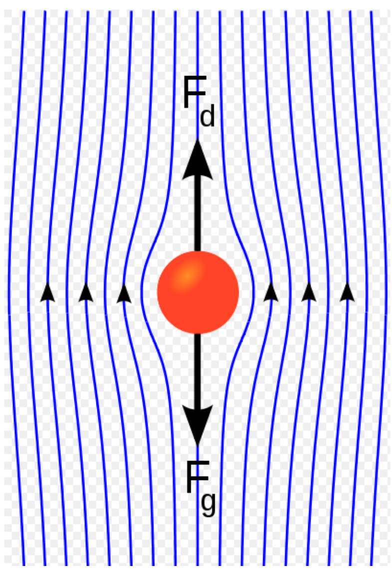
- F_d is the frictional force acting on the interface between the fluid and the particle (in N),
- η is the fluid's viscosity (in [kg m^{-1} s^{-1}]),
- R is the radius of the spherical object (in m), and
- V is the particle's velocity (in m/s).

If the particles are falling in the viscous fluid by their own weight due to gravity, then a terminal velocity, also known as the settling velocity, is reached when this frictional force combined with the buoyant force exactly balance the gravitational force.
The resulting settling velocity (or terminal velocity) is given by:[2]

$$V_s = \frac{2}{9}\frac{(\rho_p - \rho_f)}{\eta}\,g\,R^2$$

where:

- V_s is the particles' settling velocity (m/s) (vertically downwards if $\rho_p > \rho_f$, upwards if $\rho_p < \rho_f$),
- g is the gravitational acceleration (m/s^2),
- ρ_p is the mass density of the particles (kg/m^3), and
- ρ_f is the mass density of the fluid (kg/m^3).



Particle Size Analysis (Hydrometer Method)

1. Application

The percentage of sand, silt and clay in the inorganic fraction of soil is measured in this procedure. The method is based on Stoke's law governing the rate of sedimentation of particles suspended in water.

2. Summary of Methods

The sample is treated with sodium hexametaphosphate to complex Ca++, Al3+, Fe3+, and other cations that bind clay and silt particles into aggregates. Organic matter is suspended in this solution. The density of the soil suspension is determined with a hydrometer calibrated to read in grams of solids per liter after the sand settles out and again after the silt settles. Corrections are made for the density and temperature of the dispersing solution.

3. Safety

Each chemical compound should be treated as a potential health hazard. The laboratory is responsible for maintaining a current awareness file of OSHA regulations regarding the safe handling of the chemicals specified in this method. A reference file of material handling data sheets should be made available to all personnel involved in the chemical analysis.

4. Interferences

The principal source of error in this procedure is the incomplete dispersion of soil clays. These clays are cemented by various chemical agents and organic matter into aggregates of larger size. Failure to effect complete dispersion results in low values for clay and high values for silt and sand. The rate of sedimentation also is affected by temperature and the density of the dispersing solution.

5. Apparatus and Materials

$$°F = °C \times 1.8 + 32$$

5.1 Glass cylinders, 1000-ml capacity
5.2 Thermometer, Fahrenheit
5.3 Hydrometer, Bouyoucos (Fisherbrand Model # 14-331-5c)
5.4 Electric mixer with dispersing cup
5.5 Balance sensitive to ± 0.01g

6. Reagents

6.1 Dispersing solution, 5%: Dissolve 50 g of sodium hexametaphosphate, Na6(PO3)6 in deionized water and dilute to 1 liter.

7. Methods

7.1 Mix 100 ml of the 5% dispersing solution and 880 ml of deionized water in a 1000 ml cylinder. This mixture is the blank. (Note: 100 ml + 880 ml = 980 ml. This blank is not diluted to 1000 ml; the other 20 ml is the volume occupied by 50 g of soil.). Done by instructor.
7.2 Weigh 50 g of soil and transfe r to a dispersing cup. Record weight to ± 0.01g.
7.3 Add 100-ml of 5% dispersing solution.
7.4 Attach dispersing cup to mixer and mix the sample for 30 – 60 sec.
7.5 Transfer the suspension quantitatively from the dispersing cup to a 1000 ml cylinder.
7.6 Fill to the 1000- ml mark with distilled water equilibrated to room temperature, or allow to stand overnight to equilibrate.
7.7 At the beginning of each set, record the temperature, and the hydrometer reading of the blank, using the procedure described below.
7.8 To determine the density insert rubber stopper (top of cylinder), and carefully shake mixture for 30 sec. until a uniform suspension is obtained. Remove stopper, rinse sediment from opening (begin 40 second timer) and gently insert the hydrometer into the suspension.
7.9 Record the hydrometer reading at 40 sec. This is the amount of silt plus clay suspended. The sand has settled to the bottom of the cylinder by this time. (Repeat 7.8 – 7.9 for each sample)
7.10 Record the hydrometer reading again after approx. 3 hours. This is the amount of clay in suspension. The silt has settled to the bottom of the cylinder by this time.

8. Calculations
8.1 Temperature and density corrections:
- add 0.2 unit to the readings of the samples for every 1° F above 68° F, and subtract 0.2 unit for every 1° F below 68° F. - subtract the density of the blank at each reading, from the corresponding density readings for the samples.
8.2 Percent clay: % clay = corrected hydrometer reading at 3 hrs. x 100/ wt. of sample
3 Particle Size (Hydrometer)
8.3 Percent silt: % silt = corrected hydrometer reading at 40 sec. x 100/ wt. of sample - % clay
8.4 Percent sand: % sand = 100% - % silt - % clay

9. Quality Control

9.1 Standard soil - a standard soil of known particle size content is analyzed with each batch of samples to check for instrument calibration and procedural accuracy.

10. Reporting

Results are reported as percentages of the mineral fraction, % sand, % silt, and % clay.
Soil texture is based on the USDA textural triangle.

11. References

11.1 Bouyoucos, G.J. 1962. Hydrometer method improved for making particle size analysis of soils. Agron. J. 54:464-465.