

Name: _____

**Crandall University
GEOGRAPHY 103**

Lab 6: Soils

Print this lab off. Complete it. And then scan/photo it and send it as ONE PDF document through Canvas. Please do send it as ONE PDF document with the pages in order. Before you send it, make sure it is legible. If you cannot read it, neither can I 😊

This lab looks at soils and different criteria used for classifying soils.

I. Soil Texture Classification

Soils are classified by various physical and chemical characteristics. Texture, or size distribution of soil particles, is one of the attributes of soil used in its classification. Texture is also important in determining the nutrient and water holding capacities of the soil.

The proportions of various size classes of soil particles is commonly measured by passing dried soil samples through nests of sieves, each with a successively smaller diameter, and/or by measuring the specific gravity of a suspension of soil particles in water using a hydrometer.

The texture of a soil is usually given as:

percentages of **sand** (0.0625 - 2.00 mm diameter),
silt (.002 - .0625 mm), and
clay (< 0.002 mm).

These three sizes of particles make up the ***fine earth fraction*** of a soil.

In your notes, you learned that soil drainage and fertility are related to the relative percentages of these sizes of particles:

- A high clay percentage will result in poor drainage, but good nutrient retention.
- A low clay percentage will result in good drainage but no nutrient retention
- A moderate clay percentage will result in adequate drainage and nutrient retention – best! The most fertile soils have a moderate amount of clay. The most fertile soils of all have a balance of sand, silt, and clay.

For this section you will need to refer to Figure 18.4, "Soil texture triangle," 4CE p.575 (3CE p. 559).

A. Classifying soils by texture

1. Using Figure 18.4, give the texture classifications and relative drainages (poor, adequate, good) for these soils. For drainage, the clay percentage is the critical factor. A high percentage of clay means poor drainage. A low percentage of clay (especially when combined with a high percentage of sand) means good drainage. A moderate percentage of clay means moderate drainage.

Study the examples – 1, 2, 3 – in your text to help you.

I have done one example for you, too.

% sand	% silt	% clay	Soil texture class	Drainage
60	30	10	Sandy loam	Good
30	60	10		
60	10	30		
5	90	5		
10	20	70		
80	15	5		
10	45	45		
45	40	15		
90	5	5		

2. Which soil (of the 9 examples above) do you think is the best drained (give the soil texture class name)?

Why (pick the best answer)?

- ___ this soil has the highest % of clay, lowest % of sand
- ___ this soil has the highest % of clay, lowest % of silt
- ___ this soil has the highest % of silt, lowest % of clay
- ___ this soil has the highest % of silt, lowest % of sand
- ___ this soil has the highest % of sand, lowest % of silt
- ___ this soil has the highest % of sand, lowest % of clay

3. Which soil (of the 9 examples above) do you think is the most poorly drained (soil texture class)?

Why (pick the best answer)?

- ___ this soil has the highest % of clay, lowest % of sand
- ___ this soil has the highest % of clay, lowest % of silt
- ___ this soil has the highest % of silt, lowest % of clay
- ___ this soil has the highest % of silt, lowest % of sand
- ___ this soil has the highest % of sand, lowest % of silt
- ___ this soil has the highest % of sand, lowest % of clay

II. Classifying soil by pH

The pH scale measures the relative acidity and alkalinity of soils. See Figure 18.7, "The pH scale" (4CE p.579, 3CE, p. 562). Also see the discussion of "Soil acidity and alkalinity" in your text (4CE p.579, 3CE, pp. 561-2). Notice that the scale indicates that humid regions tend to have acidic soils – most of the positively charged ions are leached/washed out. Dry regions tend to be alkaline – without moisture the positively charged minerals accumulate, particularly at the surface.

1. From Figure 18.7 and the written text, complete this chart with the correct answer from column 1:

Answer options	Hot, humid tropical rainforest	Cool, dry mid-latitude grassland
Expected soil pH: Acid OR Alkaline		
Soil is rich in negative anions (H-) OR positively charged cations (Ca ⁺ , Mg ⁺ , K ⁺ , Na ⁺)		
Soil requires calcium carbonate (CaCO ₃) – cations – to make it fertile: Yes OR No		

2. Commercial fertilizer has three main chemical components:
- Nitrogen (N) – an anion
 - Phosphorus (P) – an anion
 - Potassium (K) – a cation

Which would you add to balance the nutrients in acidic soil? _____

Which would you add to balance the nutrients in alkaline soil? _____

(This may even be useful to you ... and your garden/lawn!)

III. Soil Classification in Soil Orders

In the Canadian Soil Classification System (4CE, pp. 582-599 [3CE, pp. 564-582]), there are 10 major divisions called Orders.

These orders represent soils that have distinctive characteristics.

- A. Take a look at the map of Soil Orders of the CSSC (4Ce Figure 18.11, p. 585 [3CE, Figure 18.9 p. 567].

- What is the dominant soil order in Atlantic Canada and southern Quebec? _____
- What is the dominant soil order in northern Ontario (southwest of Hudson's Bay – pink)? _____
- What is the dominant soil order in southern Alberta? _____
- What is the dominant soil order in northern Saskatchewan? _____
- What is the dominant soil order in Nunavut, northern Yukon, and NWT? _____

B. The following pages, (4CE, pp.584-599 [3CE, pp. 568-582]) map, describe each of these orders – and have pictures. These orders are, in part, caused by the vegetation on them, AND influence what can grow on them

1. Find the section on your dominant Atlantic-Quebec soil. What vegetation is characteristic of this area?

☐ grassland
☐ boreal/coniferous/evergreen forest
☐ peat/bog vegetation and coniferous forest
☐ no trees/Arctic scrub vegetation
☐ mixed coniferous forest and grassland

How fertile is this soil (i.e. how rich in nutrients and thus good for agriculture)

☐ low
☐ medium
☐ high

2. Find the section on the dominant northern Ontario soil (pink). What vegetation is characteristic of this area?

☐ grassland
☐ boreal/coniferous/evergreen forest
☐ peat/bog vegetation and coniferous forest
☐ no trees/Arctic scrub vegetation
☐ mixed coniferous forest and grassland

How fertile is this soil?

☐ low
☐ medium
☐ high

3. Find the section on the dominant southern Alberta soil. What vegetation is characteristic of this area?

☐ grassland
☐ boreal/coniferous/evergreen forest
☐ peat/bog vegetation and coniferous forest
☐ no trees/Arctic scrub vegetation
☐ mixed coniferous forest and grassland

How fertile is this soil?

☐ low
☐ medium
☐ high

4. Find the section on the dominant northern Saskatchewan soil. What vegetation is characteristic of this area?

☐ grassland
☐ boreal/coniferous/evergreen forest
☐ peat/bog vegetation and coniferous forest
☐ no trees/Arctic scrub vegetation
☐ mixed coniferous forest and grassland

How fertile is this soil?

☐ low
☐ medium
☐ high

5. Find the section on the dominant Nunavut soil. What kind of vegetation is characteristic of this area?

- ☐ grassland
- ☐ boreal/coniferous/evergreen forest
- ☐ peat/bog vegetation and coniferous forest
- ☐ no trees/Arctic scrub vegetation
- ☐ mixed coniferous forest and grassland

How fertile is this soil?

- ☐ low/not applicable
- ☐ medium
- ☐ high

C. Soil orders are further subdivided or classified based on the presence of certain diagnostic characters. The following is a very simplified summary of some of these diagnostic characteristics used to classify soils at the Soil Order level in Canada.

For more details on what all the letters mean, see 4CE Table 18.a, p. 584 (3CE Table 18.1-2, pp. 566-7).

In general:

Soil horizons (A, B, C) are described by the following letters:

- e** – indicates a horizon characterized by *eluviation* (Downward translocation) of clay, iron, aluminum or organic matter ... a lot of precipitation and weathering. Usually gray or brown in colour.
- f** – indicates presence of iron (Fe), aluminum or other metallic minerals. Often reddish in colour.
- g** – indicates a gleyed horizon ... a lot of water logging: gray or mottled in colour.
- h** – indicates a horizon enriched with organic matter (humus) ... not a lot of precipitation or weathering, usually dark in colour and very fertile.
- m** – indicates a horizon slightly affected by chemical processes including hydrolysis, oxidation or solution.
- s/sa** – indicates horizons rich in salts (when dry, a whitish, crusty appearance). Usually not very fertile.
- t** – indicates a horizon rich in clay minerals.

The presence of these characteristics in soil horizons can be used to identify the soil's order.

***** To find a soil order, work your way down through the chart on Page 6 (a simplified version of the CSSC)**

- **Look at the first possibility (regosol). Does this fit? If so, that's your soil!**
- **If not, consider the next soil. Does it fit?**
- **Work your way, one by one, down the chart, stopping when you find the first soil that "fits" your profile! Go one at a time, from top down. Stop as soon as a classification fits!**
- **This is a process of elimination ... I have purposely listed them in order, so go down, working your way through each possibility till you find one that fits.**

SOIL ORDER CLASSIFICATION CHART

Identifying Feature

Soil Order

The first three orders are relatively uncommon and do not fit the “usual” patterns. FIRST, check to see if you have one of these soils first. If one of these descriptions fits ... congratulations! You have your soil. **Stop as soon as you find a soil classification that fits:**

- | | |
|--|----------------|
| 1. little soil development (no distinguishable soil horizons) | Regosol |
| 2. some soil development, horizons are affected by cryoturbation (mixing by ice), permafrost close to the surface, organic surface layer is common | Cryosol |
| 3. very thick organic accumulations (soil is > 30% organic matter [O]) | Organic |

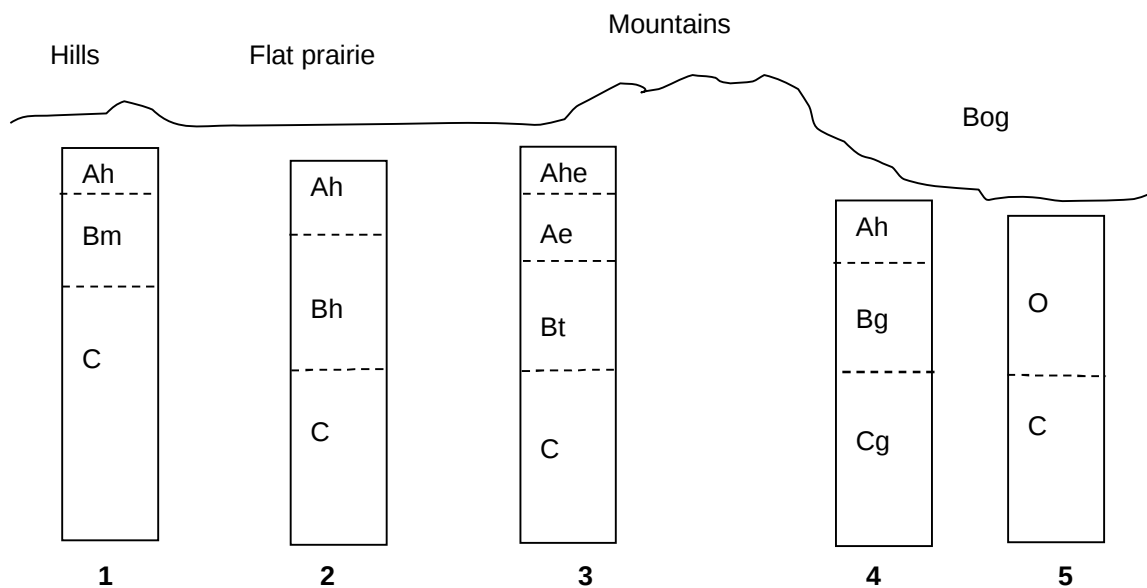
*IF NONE OF THOSE THREE FIT, then consider the next four orders. These are characterized by distinctive B Horizons is the key: Check to see if you have one of these horizons. If you do, that's your soil! For example, if you have a **Bg** horizon, you have a gleysol ... end of story! If not, carry on to the next page ...*

- | | |
|---|-----------------|
| 4. a grey or mottled B horizon (gleying; poor drainage) (Bg) | Gleysol |
| 5. a reddish brown to black B (accumulation of iron/aluminum compounds, (Bf)) | Podzol |
| 6. a brownish B (due to accumulation), lacking Podzol characteristics (no iron/aluminum), usually a Bm horizon | Brunisol |
| 7. a B horizon that is hard when dry, sticky and impermeable when wet, because salts have accumulated (Bs or Bsa horizons) | Solonetz |

IF YOU HAVE NOT FOUND YOUR SOIL YET (and only if you haven't found your soil yet!), it will be one of these ... these last two orders are identified on the basis of diagnostic A horizon

- | | |
|---|------------------|
| 8. dark brown to black A horizon due to organic content (Ah), usually with a B horizon also rich in organic material (Bh), little affected by leaching or eluviation (downward translocation) | Chernozem |
| 9. dark brown to black A horizon due to organic content (Ah), usually with a B horizon rich in organic material and also affected by leaching or eluviation (downward translocation) (Bhg or Bg) | Vertisol |
| 10. light-coloured A due to leaching/eluviation/lesseavage (Ae) usually with a clay-rich B (Bt). A richer Ahe horizon may also be present. | Luvisol |

Consider these soils:



- Using the Soil Order Classification Chart on the previous page, Page 6, give a soil order name (e.g. chernozem, podzol) for each of the five soil profiles (work through *The Soil Order Classification Chart* on the previous page, from top to bottom, systematically eliminating each order, until you find the correct one):

Soil 1: _____

Soil 2: _____

Soil 3: _____

Soil 4: _____

Soil 5: _____

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