TUTOTIAL – PRACTICE QUESTIONS

https://monoliths.soilweb.ca/tutorial/how-to-read-a-soil-monolith/

To be able to classify soils, one 1st needs to develop soil identification skills. These include ability to identify soil horizons and parent material types. Soil horizon identification is important to decide on the diagnostic soil horizon, while parent material identification helps with understanding of soil properties and its response to management practices. Both identification of soil horizons and parent materials are based on visual interpretation skills, which can be developed by viewing and reviewing numerous soil pits in the field and/or monolith photographs.

Practice questions listed below address (1) identification of parent material or (2) identification of soil horizons.
By clicking on the links provided below in specific questions, you will be taken to a page with monolith's photo and description. Enlarge the photo and carefully observe it. You might want to refer back to the monolith description.

Attempt to answer the questions on your own and then check the answers shown in the attached pdf document.

Questions re. identification of parent material

NOTE - to review different types of soil parent material visit our website entitled "***Soil Formation and Parent Material***" in which you will find short video clips of all major types of parent materials. Please go to the "Parent Material" page https://monoliths.soilweb.ca/parent-material-index/

1) In the monolith **no. 7-49** (https://monoliths.soilweb.ca/7-49/), the parent material is identified as lacustrine. What properties are typical for this type of parent material? Can you observe these properties on the photo?

Lacustrine parent material is characterized by alternating thin layers of fine-grained particles that reflect annual deposition of sediment. This material is very well sorted (i.e. consists of particles of the same size) and it does not have any coarse particles (diam. > 2 mm). The fine-textured, thin layers are clearly visible in the monolith no. 7-49.

2) Monoliths **no. 1-11, 4-01,** and **5-05** (https://monoliths.soilweb.ca/1-11/ , https://monoliths.soilweb.ca/4-01/ , and https://monoliths.soilweb.ca/5-05/ , respectively) also have lacustrine parent material. Take a close look at the C horizons of these 3 monoliths and compare them to the C horizon of the monolith no. 7-49 (https://monoliths.soilweb.ca/7-49/). Do you see the most typical property of the lacustrine parent material in the monoliths no. 1-11, 4-01, and 5-05? Is the property in question more or less pronounced in these three monoliths than in monolith no. 7-49?

   Presence of thin layers in the lacustrine parent material is its most typical property. But these layers will not always be perfectly visible in all soils. Monoliths no. 1-11, 4-01, and 5-05 all have the lacustrine parent material; however, layers in parent material of these 3 soils are discontinuous and not always perfectly parallel to the soil surface. Hence, you should not expect to always see the layers in lacustrine parent material as clearly as in the most typical examples (e.g. monolith no. 7-49).

3) In the monolith **no. 7-40** (https://monoliths.soilweb.ca/7-40/), the parent material is identified as glacial till. What properties are typical for this type of parent material? Can you observe these properties on the photo?

   Glacial till is unsorted, and non-stratified (i.e., there are no layers or strata) sediment that consists of a mixture of particles that range from fine clay to coarse (often angular) gravel, cobbles and boulders. Range of sizes of the mineral particles are clearly visible in the IIC horizon of the monolith no. 7-40.

4) In the monolith **no. 8-02** (https://monoliths.soilweb.ca/8-02/), the parent material is identified as colluvium. What properties are typical for this type of parent material? Can you observe these properties on the photo?

   Colluvium parent material is a heterogeneous, unsorted deposit that contains very sharp, angular individual rock fragments, which would accumulate at the base of steep slopes. Most of the monolith no. 8-02 (i.e. from 5 to 59 cm depth) is dominated by these sharp, angular rock fragments.

5) In the monolith **no. 1-01** (https://monoliths.soilweb.ca/1-01/), the parent material is identified as glacio-fluvial. What properties are typical for this type of parent material? Can you observe these properties on the photo?
Glacio-fluvial parent material is coarse textured, usually dominated by gravels and/or sands while fine particles (silt and clay) are missing. Material is often stratified, having alternating layers of sand, gravel, and sometimes finer particles. The meltwater streams have reworked the rock debris carried by the glacier; so that coarse fragments present in the glacio-fluvial material vary from sub-angular to well rounded. The finer particles (silt and clay) have often been removed by the meltwater. Range of sizes of the mineral particle and their rounded edges are clearly visible in the C horizon of the monolith no. 1-01.

Questions re. identification of soil horizons

NOTE - to review the most typical properties of 10 soil orders (the broadest, most general classification category) and their diagnostic horizons visit our website entitled "***Soil Classification: Canadian Soil Orders***" available at https://classification.soilweb.ca/ . The website features 10 short video clips illustrating characteristics of 10 soil orders.

1) In the monolith **no. 9-01** (https://monoliths.soilweb.ca/9-01/), locate the Bnt horizon. What soil property (or properties) makes this horizon a Bnt?
Bnt horizon is characterized by two processes, namely (1) accumulation of sodium ions, which leads to the formation of distinctive prismatic or columnar soil aggregates and (2) accumulation of clay particles.
The prismatic aggregates are quite large and clearly visible in the Bnt horizon of the monolith no. 9-01. Since individual mineral particles within the Bnt horizon are not visible to the naked eye that would indicate that this horizon has a fine texture. This type

of texture would be determined by hand-texturing in the field, but it cannot be fully determined on a monolith.

2) In the monolith **no. 4-01** (https://monoliths.soilweb.ca/4-01/), locate the Btg horizon. What soil property (or properties) makes this horizon a Btg?
   Btg horizon is characterized by two processes, namely (1) accumulation of clay particles and (2) gleying process characterized by the development of a gray color or mottling or both due to fluctuating anaerobic and aerobic conditions. The fluctuation is caused by changing height of the water table.
   Individual mineral particles within the Btg horizon are not visible, which indicates that this horizon has a fine texture. Note that the type of texture would be determined by hand-texturing in the field, but it cannot be fully determined on a monolith. Gleying is indicated by yellowish / orange spots (mottles) dispersed within the gray matrix of the Btg horizon.

3) In the monolith **no. 7-39** (https://monoliths.soilweb.ca/7-39/), would you characterize the texture of Bf1 and Bf2 horizons as fine or coarse? Is the observed texture typical for a Bf horizon?
   Both Bf1 and Bf2 horizons have a coarse texture since one can observe individual mineral particles with the naked eye. Coarse texture (coarser than clay textural class) is typical for Podzolic B horizons such as Bf.
   Bf horizons typically develop in coarse-textured, well-aerated soils because these conditions promote (1) iron oxidation, giving rise to the red colour and (2) organic matter decomposition, preventing the accumulation of large quantities of organic compounds. (Note the coloring on the particles of reddish-brown iron complexes in the Bf1 and Bf2 horizons.)

4) Monolith **no. 7-06** (https://monoliths.soilweb.ca/7-06/) has a prominent Bf horizon (actually there are Bf1, Bf2, and Bf3) characterized by a reddish color. What soil process is responsible for this red color of the Bf horizon?

   The red color of this Bf horizon (and any other Podzolic B horizon) is due to iron complexes (chelates) with organic matter. Red color is an indication that iron is in the oxidized state, which in turn points out that the Bf horizon is well-aerated.

5) In the monolith **no. 8-03** (https://monoliths.soilweb.ca/8-03/), no B horizon has been identified. Can this be the case? If yes, please explain what events could have prevented development of the B horizon.

   Absence of the B horizon is typical for the Regosols (such as monolith no. 8-03). Since the parent material for this monolith has been identified as alluvium, it is very likely that a sequence of flooding events that occurred over the years led to burial of Ah horizons. This also prevented further soil formation and development of the B horizon.

6) In the monolith **no. 5-28** (https://monoliths.soilweb.ca/5-28/), identify the types of soil structure present in A and B horizons. What soil formation process has been responsible for the change of structure in this Luvisolic soil?

   Soil structure changes from granular (in Ahe and Ae horizons) to blocky (in Bt1), prismatic (in Bt2), to massive (in C horizon). The change of structure from horizon to horizon is typical for Luvisols (such as monolith no. 5-28) and it is brought about by the presence of organic matter in the Ahe horizon and the presence of illuviated clay in the Bt1 and Bt2.

7) Compare monolith **no. 5-16** (https://monoliths.soilweb.ca/5-16/) to monolith no. 5-28 (mentioned above in question #6). Both soils are classified as Orthic Gray Luvisol and in both of them there is a change in soil structure from horizon to horizon. Is the change in soil structure equally noticeable in both monoliths?

   The change in soil structure (i.e., in type of soil aggregates) from horizon to horizon is typical for Luvisols and it is due to movement (or eluviation & illuviation) of clay particles within the soil profile. Monolith no. 5-28 is an excellent, clear example of clay movement (and associated change in soil structure), while this is somewhat less obvious (but still present) in the monolith no. 5-16. Hence, you should not expect to always encounter the most typical example of this (or any other) soil formation process in all soils that you are trying to classify.

8) Monolith **no. 2-11** (https://monoliths.soilweb.ca/2-11/) is classified as a Chernozem. What is the diagnostic horizon of a Chernozem? Locate this horizon on the profile. What clues did you use to locate it?

The diagnostic horizon for Chernozems is a **chernozemic A**. Chernozemic A horizons must be at least 10 cm thick, be dark in colour due to their high organic matter content, have organic C content between 1 and 17%, C/N ratio less than 17, have a good structure that is neither massive nor single grained, base saturation is more than 80% and calcium is the dominant exchangeable cation.

In monolith no. 2-11 (https://monoliths.soilweb.ca/2-11/), there is a chernozemic A horizon extending from 0 to 16 cm.

Clues that point out that this is the chernozemic A, include the dark colour and the change in structure at the boundary between the A and B horizons. This Ah horizon has a well-developed granular structure due to its high organic matter content.

9) Locate the B horizon of monolith **no. 1-04** (https://monoliths.soilweb.ca/1-04/). In your opinion, is it more likely to be a:

- Bf
- Bg
- Bm
- Bt

Justify your answer.

The B horizon of this monolith (https://monoliths.soilweb.ca/1-04/) is located below the Ah and extends from 10 to 40 cm. There is no red colour that would indicate the presence of a Bf with iron oxides accumulation, no dull grey colour or mottling that would indicate the presence of a Bg (gleying), and no marked structure or texture change that would indicate the presence of a Bt (illuviated clays). The only sign of soil development in the B horizon appears to be a slight enrichment in carbonates creating some light grey spots. As a result, the B horizon is a Bm.