

Relax. Read Carefully. Think. Answer.

What is soil? We have discussed two broad definitions of soil.

a) **Soil (for natural sciences):** Unconsolidated mix of inorganic and organic materials, air, and water that can support plant life. The properties of the material are due to the integrated effects of conditions acting at the surface of the earth through time.

b) **Soil (for engineering):** Unconsolidated material mantling surface of the earth. The material can be excavated without any special equipment or blasting (i.e. it can be dug)

Unless stated otherwise, assume that the word soil refers to the definition used by **natural scientists**.

Part I: Essay (60 points; 20 points each): A high-quality response fully answers the question, explains the information presented, provides specific examples to support the explanation, & is well organized (and is clearly legible)

1. Answer question A or B

A. There are three dominant parent materials for soils in western North Carolina: alluvium, colluvium, and saprolite.

i. Based on textural characteristics only (i.e. size, sorting/grading, shape--**not** topographic setting), how can the three materials be distinguished.

ii. **Explain WHY** the textures are different.

B. i. **Define** two distinct soil properties of prime importance for engineering/construction purposes.

ii. **Explain** why these two properties are important.

I am answering question _____ (A or B).

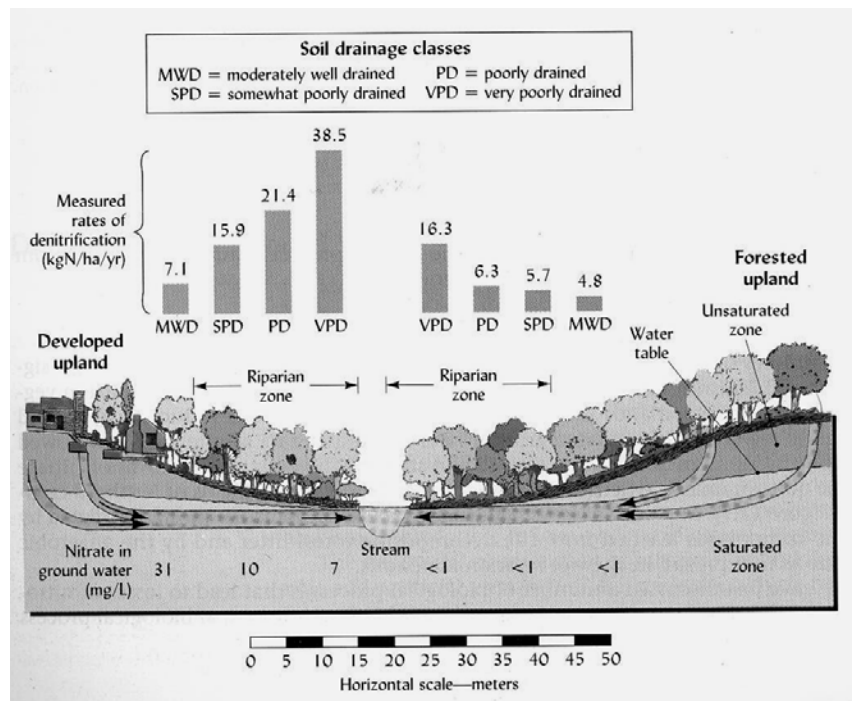
2. Answer question A or B

A. Examine the Figure to the right.

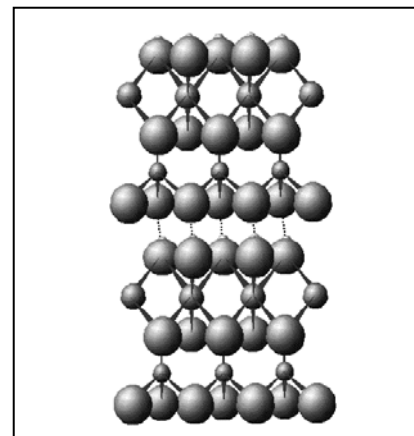
i. Note the values of nitrate entering the groundwater are higher on the left side of the diagram than the right side. Why are the incoming nitrate values of the entering groundwater higher on the left?

ii. Note, on the left side, that the concentration of nitrate in the groundwater decreases along the groundwater flow path. What is the likely reason that this occurs?

iii. Denitrification rates on both sides of the stream are highest toward the center. What is the likely reason that this occurs?



- B. Examine the clay mineral structure to the right.
- With an “O” for octahedral and a “T” for tetrahedral, label **each** sheet shown in the clay structure.
 - The general type of clay mineral structure shown is what? (ex. 1:1, 2:1, 2:2, 4:6)
 - What is the name of a clay mineral with this structure?
 - Is the cation exchange capacity of this clay relatively high or low?
 - Is this an expansive clay? yes or no
 - Explain/justify** your answer for parts iv. and v.

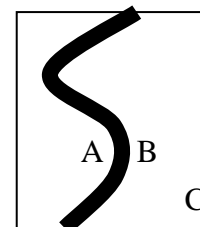


3. **Answer question A or B**

- A. i. The nutrient value of mineral matter in soils tends to be greatest in which climatic zone?
 a) arid b) temperate c) tropical
- ii. Why?
- B. Explain how an analysis of stream water chemistry (such as pH, conductivity, types of ions) could be used to infer soil and weathering processes/properties in a watershed.

Part II: Multiple Choice—choose the single best answer. Write your answer to the left of the question in the space provided (40 points; 2 points each)

- ___ 1. Which horizon is most likely to have the highest concentration of secondary clay?
 O B A C E R
- ___ 2. Which mineral horizon is enriched with organic matter without any original structure of parent material or underlying rock?
 O B A C E R
- ___ 3. Which horizon is a slightly weathered mineral horizon commonly showing many characteristic of the parent material?
 O B A C E R
- ___ 4. The presence of clays in soil generally indicates...
 a. transformation b. translocation c. losses d. additions e. stratification
- ___ 5. The presence of mottles in a soil generally indicates
 a. translocation
 b. seasonally high water table
 c. high strength
 d. a prismatic structure
 e. clay-rich texture
- ___ 6. Examine the figure showing a map view of a meandering stream. Soil at which location would likely have the highest percent of sand?
 a. A b. B c. C d. all have the same % sand e. not enough information
- ___ 7. Water sampling of a stream during an intense storm found a large amount of suspended sediments. Which chemical was also likely high when this water sample was taken?
 a) N₂ b) NO₃⁻ c) phosphorous d) uranium e) kryptonite



- ___ 8. In which conditions is a soil most likely to contain gypsum that originated as a secondary mineral?
- a region with dense vegetation and high amounts of precipitation
 - a region with high amounts of acidic precipitation
 - a mountainous region with intense freeze-thaw cycles
 - an arid region with sparse vegetation
- ___ 9. The pH of natural, unpolluted rain water is about
- 4.5
 - 5.5
 - 6.5
 - 7.0
 - 7.5
- ___ 10. Which of the following would **not** likely be associated with a topsoil enriched with a lot of organic matter?
- thick A horizon
 - high nutrient availability
 - high soil density
 - high moisture retention
- ___ 11. Different clay minerals are associated with different intensities and/or time exposed to weathering. Which sequence of clay-type minerals listed below goes from least weathered to most weathered?
- feldspar, vermiculite, muscovite
 - kaolinite, vermiculite, muscovite
 - hematite, kaolinite, montmorillonite
 - montmorillonite, kaolinite, Fe-Al oxides
- ___ 12. The amount of hydrogen ions (H⁺) in the soil solution is indicated by the _____.
- Eh
 - CEC
 - H-index
 - texture
 - pH
- ___ 13. Many soils contain minerals that when weathered can effectively buffer the acid inputs of acid rain. A soil containing which minerals would most likely **not** be acidic?
- olivine, quartz
 - feldspar, calcite
 - pyrite, quartz
 - mica, amphibole
- ___ 14. What type of plate boundary was responsible for the origin of the Atlantic Ocean **after** the formation of the Appalachians?
- divergent
 - convergent
 - transform
 - seismic
 - lithic
- ___ 15. As a mature soil gets older and older, it will _____.
- have fewer horizons
 - increase in organic matter and sand
 - become redder and more acid
 - become thicker and more fertile
- ___ 16. To increase the speed of chemical weathering of rocks, it would be best to
- increase the temperature and add more water
 - reduce the amount of water and add more air
 - increase the humidity and reduce the temperature
 - keep the rock exposed to the sun and keep it dry.
- ___ 17. Soils in western North Carolina vary significantly in age. In general, on which parent material are the **least mature** soils likely to be found in this region?

a. alluvial
b. colluvial

c. residual
d. eolian

e. youthsol

- ___ 18. Common **rock** types of western North Carolina are
- a. gneiss, schist, amphibole, quartz, mica
 - b. schist, gneiss, quartzite, gabbro
 - c. mica, amphibole, quartz, feldspar
 - d. granite, slate, limestone, shale
 - e. basalt, gneiss, granite, schist, sandstone
- ___ 19. When a soil undergoes additions, losses, transformations, and translocations the ____.
- a) weathering of rocks and minerals will take place.
 - b) surface layer will become thinner
 - c) soil horizons will develop
 - d) a polypedon will form
- ___ 20. Which form of nitrogen is most common in groundwater?
- a) N_2
 - b) NO_3^-
 - c) NH_4^+
 - d) NO_2^-
 - e) organic-N