DISCUSSION QUESTIONS: CH. 1

1. Explain the “rock cycle”; give an example of how each type of rock can be transformed into another type.

2. Give an example of where in Georgia you might go to find each of the three types of rocks (igneous, metamorphic, sedimentary). Explain briefly how each type of rock got there.

3. What forces power “plate tectonics”? Explain briefly how it works to make continents “drift”.

4. How, and why, has sea level changed over geologic time? How has that change affected the geology of Georgia?

5. Contrast nearly level landscapes with steep landscapes, in terms of: relief, stream gradient, soil wetness, and soil development, using Georgia landscapes as examples.

6. Explain the differences between “depositional” vs. “erosional” landscapes. Where in Georgia do these occur? Explain why/how.

7. Compare “upland” soils with “bottomland” soils. What are the parent materials of these two landscape positions? How does this affect soil profile features/development?

8. What kind of geologic formation is Stone Mt.? What does it tell us about the history of the Piedmont landscape?

9. What does soil color (e.g., red vs. grey) tell you about a soil? Explain why this is true in terms of Fe chemistry.
1. You are at a friend’s house, looking at their vegetable garden. They give you a handful and ask, “What do you think of my soil?” What factors would you consider in your answer?

2. Compare physical and chemical weathering of rocks; which do you think is actually more important in creating parent material? Defend your answer.

3. Discuss how oxidation and reduction of iron (Fe) works, and why it is important in soil formation and in determining soil properties.

4. How does climate affect the weathering rate of parent materials? Give some specific examples of how climatic factors influence weathering reactions.

5. What is the idea behind transported parent material? Give some examples of transported parent materials, and where in the landscape you would find them.

6. Compare soil formation on nearly level land with land that has a steep slope. What processes associated with slope affect things like soil depth and B horizon thickness?

7. Compare/contrast soils that have formed on felsic-type rocks with those that form on mafic-type rocks. Explain why these differences occur.

8. Tell the story of the bison, the Indians, and the prairie soils of the Great Plains.

9. Define translocation; describe its role in creating soil horizons within a soil profile.
DISCUSSION QUESTIONS: Ch. 3

1. Define “pedon”; what is its role in soil classification (e.g., Soil Taxonomy)?

2. Compare/contrast the properties of the following horizons:
   A. mollic vs. umbric
   B. argillic vs. oxic

3. For each of the soil orders listed below, define their diagnostic horizons, say something about which Soil Forming Factors are important in their formation, and give a state in the US where you might find them.
   A. Entisol
   B. Inceptisol
   C. Alfisol
   D. Spodosol
   E. Mollisol
   F. Ultisol
   G. Oxisol
   H. Histosol

4. Which of the above soil orders above are either rare or not found in Georgia (probably 3 of them). Explain why, based on the Five Factors.

5. A fresh pile of weathered parent material is deposited in a subtropical climate like Georgia. Trace how soil horizons and soil orders develop over a million years or so in this material. Assume the site is initially well-drained, with hardwood native vegetation.

6. Explain what a “seasonal high water table” is. How does this idea explain the occurrence of low-chroma redox features and gleyed horizons along a hillslope catena?
DISCUSSION QUESTION: CH. 4

1. Explain why soil texture is the most important soil property in terms of use and management.

2. Compare the surface areas (in $m^2/g$) of sand, silt, and clay; what is the importance of this difference?

3. What is the importance of soil structure? What does structure have to do with porosity, especially macroporosity?

4. How does granular structure form, and what makes it stable, in topsoils?

5. How does stable granular structure in A horizons increase infiltration and reduce soil erosion?

6. Explain the relationship between total porosity and bulk density of soils.

7. What soil and management factors determine a soil’s bulk density? What types of soils tend to have high bulk densities, and what types tend to have low BD’s?

8. Define the term “pan”. What is the difference between a tillage pan and a traffic pan?

9. Describe and explain several management practices that can improve granular structure in topsoils.
DISCUSSION QUESTIONS: CHAPTER 5

1. List the two “types” of colloids in soils, based on how they develop their electric charge. Give examples of each, and describe (briefly) how they generate this charge.

2. Clay minerals are often referred to as “layer alumino-silicates” Why is this name appropriate? How does the structure of clay minerals determine their behavior?

3. Explain isomorphous substitution; give examples of how it occurs in clay minerals, and describe how it results in permanent negative charge.

4. Define “pH”; show how (H+) and pH are different in acid and alkaline solutions.

5. Use a hydroxyl (-OH) functional group to show how both positive and negative charge can develop on variable charge colloids at different pH’s.

6. What is the most important charged functional group on humus? Show how it develops negative charge, and explain why this charge is pH-dependent.

7. Define % base saturation, and give the formula for how to calculate it.

8. Explain what a “milliequivalent” is; what is the meq weight (in mg/meq) of Zn\(^{2+}\) if its atomic mass is 65?

9. Explain the similarity between parts per million (ppm) and lbs per acre-furrow slice (lbs/afs). How can you easily convert from one of these units to the other?

10. Explain to someone who knows nothing about soil or chemistry what CEC is, and why it is important in plant production and environmental sciences.
DISCUSSION QUESTIONS CHAPTER 6

1. Who is Justus von Liebig? Why is he important in the study of soils and plant growth?

2. Is there any relationship between the total amount of any given nutrient in the soil compared to the amount taken up by plants? Explain why this is the case.

3. In reference to question 2) above, what factor(s) explain how plants take up nutrients from soils, in general?

4. Summarize briefly the general “idea” of nutrient cycling; what does this have to do with the “great circle of life” taught to us in The Lion King?

5. For each of the 3 macro-nutrients, briefly state the important factors affecting their plant availability in typical agricultural soils.

6. How are CEC, %BS, and plant-available Ca and Mg related?

7. Tell the basic story of acid rain, gypsum, and sulfur nutrition of plants (as told by Dr. Miller in lecture).

8. List the micro-nutrient cations. What factors determine their plant-availability? Under what soil conditions are they deficient vs. toxic?

9. List the micro-nutrient anions. What factors determine their plant-availability? Under what soil conditions are they deficient vs. toxic?

10. List several soil contaminants that act like micro-cations, and two that act like micro-anions. How would you reduce the solubility of these contaminants in soils to reduce their plant uptake and/or leaching to groundwater?
1. Write the chemical reaction for aerobic decomposition (also known as aerobic respiration, or C oxidation). How is this different (qualitatively) for fermentation? What is the opposite of this reaction called?

2. List several factors that determine how fast plant residues decompose in soils. Give several examples of materials that might be added to soils that decompose rapidly vs. slowly.

3. Define mineralization; write the chemical reaction for nitrogen (N) mineralization.

4. Define C:N ratio; how is this related to the N content (%N) in plant residues? Why is C:N ratio important in determining the decomposition rate of materials added to soil?

5. Describe what happens in a compost pile during decomposition, focusing on how microbial activity affects the amounts of C and N in the decomposing material. How does C:N ration change during this process?

6. List and briefly discuss the major environmental factors that determine levels of humus in soils. Explain why Mollisols of Minnesota have much higher humus levels than Ultisols of the SE.

7. Give some examples of crop and soil management practices that can influence humus levels in soils. If you wanted to increase humus in a soil, how would you change soil management? How long would it take to increase humus by a significant amount in a field soil (not a flower bed)?

8. List several soil and site factors that are likely to affect the productivity of a given land area for growing trees or other low-input crops.

9. Describe some of the major inputs used in agricultural management aimed at short-term production. What is the ultimate source of these inputs? How might these inputs (or our management of soils) change if our goal is to secure a greater long-term productivity?
DISCUSSION QUESTIONS CH. 8

1. State and briefly discuss the law of diminishing returns as it relates to crop response to fertilizer.

2. Define the point of maximum yield and the point of maximum profit on a fertilizer response curve.

3. What reagent is used to extract nutrients during routine soil testing in Georgia? What nutrient elements are measured in this extract?

4. Write the chemical reaction for the Haber process, including conditions under which the reaction proceeds (to the right). Why is this reaction so important in modern agriculture?

5. What is the primary source of P that is used to make P fertilizers? Describe briefly where this material is obtained, and how it is processed into the major P fertilizer.

6. Do the same as 5) for K fertilizer.

7. Give a list of pro’s and con’s to the use of organic fertilizers to meet nutrient needs on an agronomic (field) scale, comparing to the use of synthetic (“Chemical”) fertilizers.

8. Compare and contrast the two philosophies of nutrient management: the “soil building” approach that looks at longer-term results, compared to the “soil testing” approach that focuses more on short-term returns.

9. Describe how ag lime acts as a base to raise soil pH. Write some reactions showing how H and Al are neutralized by CaCO₃.

10. Define the term “analysis” as applied to fertilizers. Explain what the numbers “10-10-10” on a fertilizer bag refer to. How do you use the formula for analysis to actually compute amounts of fertilizer to apply if you are given a recommendation and a specific type of fertilizer?