

## Instructional Objectives for Topic 2 (Solid Phase)

After we conclude Topic 2 in the notes you should be able to do the following:

1. Distinguish between a rock and a mineral; a primary and secondary mineral, and inorganic and organic solids, giving examples of each.
2. Based on the radius ratio, calculate the coordination environment (number of oxygen atoms in the coordination sphere) of a cation.
3. Based on the charge of a cation and its coordination number, calculate the strength of the bond to each oxygen using the electrostatic valency principle.
4. Describe how crystal structures form using Pauling's Rules.
5. Classify the primary minerals based on the arrangement of silica tetrahedra.
6. Identify each primary silicate mineral class using the computer generated models in Crystalmaker . Give a common mineral example in each class.
7. Explain the difference in primary mineral stability based on their structure.
8. Explain in your own words the difference between dioctahedral and trioctahedral sheets and distinguish between the two.
9. Explain in your own words the term isomorphous substitution. Also, identify cations involved with isomorphous substitution given the unit cell formula of a phyllosilicate mineral.
10. Identify the different clay minerals in each phyllosilicate class.
11. Describe the bonding mechanisms between platelets in each of the phyllosilicate minerals discussed in class.
12. Based on the location and magnitude of isomorphous substitution and the bonding mechanisms between platelets, classify the shrink-swell capability of the phyllosilicate minerals.
13. Given the unit cell formula of a phyllosilicate mineral, calculate the CEC.
14. Identify minerals in the remaining classes and identify the type of soil environment in which they are found.
15. Explain the difference between nitrogen and EGME for surface area measurements.

16. Explain the difference between permanent and pH-dependent or variable surface charge and describe how each is formed.
17. Based on the structure and charge development of secondary minerals, explain the relative differences between their specific surface area and CEC.
18. Explain in your own words the basics of X-Ray diffraction and how it is used in soil chemistry.
19. List the basic pools of organic matter and briefly describe each.
20. Identify the important functional groups present in organic matter which are responsible for CEC in soils.
21. List common functions of organic matter in soils.
22. Describe the different theories that are used to explain humic substance-metal interactions in soils and sediments.
23. Explain the difference between stepwise and overall stability constants for metal-organic interactions.
24. Describe important environmental impacts of humic substances.