Decoding-the-Discipline Sample Questions

1. Topics covered: Importance of soils

   Assumption challenged: This question will be used to introduce the immense importance of soil to our life on Earth.

   How important is soil in your daily life?

   a) I can't exist without it.
   b) Important, but not necessary for life on Earth.
   c) It is relatively unimportant.

2. Topics covered: Soil horizonation; soil additions; rates of organic matter accumulation

   Assumption challenged: This question is intended to make students think about what materials can be added to the soil and how quickly they can accumulate.

   There are zones in the soil that accumulate material. On a stable landscape (i.e., no erosion), which zone would you expect material to accumulate faster?

   a) Surface layers
   b) Deep layers

3. Topics covered: Sedimentation and drag forces

   Assumption challenged: It is widely known that two objects released near the surface of the Earth will fall at the same rate regardless of their mass. Students often misapply this knowledge, however, outside a vacuum where drag forces become important. The question challenges this misapplication and will be used as a segue into how settling rates can be used to workout the size-distribution of solid soil particles.

   Imagine a large piece of gravel and a small sand-particle falling in a column of water. Which one settles to the bottom first?

   a) Large piece of gravel
   b) Small sand particle
   c) They both settle at the same rate

4. Topics covered: Saturation, pore space, and soil air

   Assumption challenged: Many students don't think about the need for air to escape in order for all the pore space to be saturated in a soil. This question will be used to teach the need for wetting a soil from the bottom up in order to completely saturate it with

water. It will also challenge the common incorrect assumption that a soil can be fully saturated following a heavy rainstorm.

Which is the best way to completely saturate a soil clod?

a) Submerge the clod in water.
b) Place the bottom of the clod in a little water.
c) Squirt water on the top of the clod.

5. Topics covered: Weathering, mineralogy, and parent material

Assumption challenged: Students often assume that minerals that crystallize at low temperatures and pressures are more unstable than other minerals. This question challenges that assumption.

As a body of magma cools, there are minerals that crystallize at high temperatures and pressures and others that crystallize at lower temperatures and pressures. Which minerals are more stable at the Earth's surface?

a) Minerals that crystallize at high temperatures and pressures
b) Minerals that crystallize at low temperatures and pressures
c) The crystallization temperature and pressure doesn't make a difference with respect to stability.

6. Topics covered: Clay properties; clay dominance in soils

Assumption challenged: This question challenges students to think why small particles such as clay are more important to the overall properties than larger particles.

Clays tend to dominate the physical/chemical properties of a soil. (Think about the size of the clay area on the textural triangle.) This is primarily because:

a) Their higher density
b) Their higher surface area
c) Their irregular shapes

7. Topics covered: Surface charge; ion mobility

Assumption challenged: Many properties of clay minerals arise from isomorphous substitution. This question highlights the causal relationship between isomorphous substitution and ion mobility.

As weathering proceeds, higher valence cations tend to substitute for lower valence cations in clay minerals. This results in a charge imbalance. Knowing this, which ion do you think would move the deepest in the soil following a heavy rainstorm?

a) NO_3^-
b) NH_4^+

8. Topics covered: Bulk density methods; Archimedes' principle; buoyancy

Assumption challenged: This question introduces students into the connection between the volume of an object, the mass of a fluid of equal volume, and the density of water.

A beaker of 500 mL of water weighs x amount. The same beaker of water with an impermeable rock suspended within the water weighs y amount. The rock is completely submerged in the water but is not touching the sides or bottom of the beaker. Which of the following are true?

a) $x > y$
b) $x < y$
c) $x = y$

9. Topics covered: Texture, particle morphology, and bulk density relationships

Assumption challenged: Most students think that sand is lighter than clay because "heavy" is often used to describe clay. This question challenges that assumption and will be used to introduce pore space and clay particle shape.

To make a little extra money you decide to work at a construction site. Your boss gives you the option of either pushing a wheelbarrow full of dry sand or a wheelbarrow full of dry clay. If you want to do the least amount of work that day, which would you chose?

a) Sand
b) Clay

10. Topics covered: Matric potential; water flux

Assumption challenged: This question challenges the assumption that water will only be hung up when it runs into a material of low saturated hydraulic conductivity.

Imagine two cases: 1) Sandy loam horizon (high Ksat) overlying a silty clay (low Ksat) and 2) a silty clay horizon overlying a sandy loam. As water moves through this profile, which situation will hang up water at the contact between the two horizons?

a) Case 1
b) Case 2
c) Both case 1 and 2
d) Neither case 1 nor 2