Help students think like soil scientists

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Emphasizing cross-disciplinary concepts in teaching soil science courses, such as mass-volume relationships, can help undergraduates learn real-world, problem-solving skills that are crucial to their success in soil science careers.

Drs. Josh Heitman and Michael Vepraskas, North Carolina State University Soil Science Department, highlighted this need for quantitative measurement skills in an article detailing the importance of teaching mass and volume relationships at the undergraduate level. The article is published in the recent issue of the *Journal of Natural Resources and* Life Sciences Education.

Basic physical concepts, such as mass and volume relationships, are found throughout different scientific disciplines. This provides a framework for cross-disciplinary communication that should be emphasized in undergraduate soils training. For soils students to develop these skills, undergraduate course work highlighting quantitative ways to characterize and describe soils is critical. Soil science-specific terminology can, and should, be maintained, but fundamental, cross-disciplinary definitions must be emphasized so that the terminology is clearly connected to what it means.

Subsidence (i.e. loss of horizon thickness) can provide a clear example to emphasize basic mass-volume concepts for problem solving in soils courses. Drainage of wetland soils for agriculture and other purposes has been a common practice for many years. However, drainage of organic soils results in subsidence through shrinkage, loss of buoyancy, and oxidation of organic matter. More recently, much work has focused on restoration of wetland soils to their original natural condition. Discussing restoration of an organic wetland soil can provide a practical problem solving lesson for teaching about subsidence and mass-volume relationships.

The question of how much the soil has subsided is important to consider. Restoration normally causes the water table to rise to the levels that existed before drainage and subsidence. If a soil has subsided 1 meter, for example, then when restored, the water table will be 1 m above the existing surface, creating ponding and impairing the growth of replanted vegetation. Determining how much soil has subsided can be difficult because there is typically no marker or baseline to indicate the position of the original soil surface prior to drainage. Data are only available to describe current conditions for a particular soil profile. Scientists must make use of mass-volume relationship and inference to assess the amount of subsidence that has occurred. Information about post-drainage and un-drained, offsite horizon thickness, bulk density, and mineral content can be used to develop an estimate of the amount of subsidence.

When approaching this problem, students should be encouraged to consider which mass and volume components of the three-phase (i.e. solid - mineral and organic, liquid, and gas) soil system have been altered by subsidence. Both primary (i.e. loss of buoyancy and shrinkage) and secondary (i.e. oxidation) subsidence must be considered. From there we consider what relationships (e.g. bulk density and mineral content) have changed among these soil phases. Students can evaluate soil profile data obtained from drained and un-drained sites including sand content, bulk density, and horizon thickness. They may then begin to solve the problem by developing their own assumptions or may be guided to the assumptions in the original study:

Careful explanation of this example problem to students in undergraduate course work provides a way to incorporate concepts of mass, volume, soil bulk density, mineral and organic fractions, and subsidence in a practical, problem-solving framework. This, in turn, makes for a better understanding of how to compute other mass-volume soil properties such as water contents and porosity that, in our experience, are difficult for our students to grasp. For instructors, considering this example may also suggest parallel problems involving other applications of important quantitative concepts. Addition of this or similar exercises to undergraduate soils course work can help to equip students with quantitative tools important to success in a multi-disciplinary career environment.

More information: The full article is available for no charge for 30 days following the date of this summary. It can be viewed at www.jnrlse.org/view/2009/e08-0007n.pdf .

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