**Learning Geoscience by Talking and Doing**

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**I began my teaching career over twenty years ago as an outdoor educator at Yosemite Institute in Yosemite National Park. I had massive granite formations, beautiful rivers and towering trees all around me for teaching students about the connections that link us to our planet, and the science behind these connections.**

**After three years of sharing the wonders of Yosemite with students ages 10 to 18, I wanted to try science myself. I completed my masters degree in earth science with a focus on biogeography at Montana State University. I immersed myself in studying the effects of legacy mining on ecosystems outside Yellowstone National Park, and learned a great deal about how science works. Although I enjoyed doing science, I realized my career passion was teaching science, so I transitioned to teaching high school science in an urban California setting.**

**Fast forward several years, and I now teach natural resources and environmental science to freshmen and sophomores at the University of Nevada Reno. My position includes teaching a core non-science majors course (Humans and the Environment) every semester, an introductory course for Natural Resources and Environmental Science (NRES) majors every fall, and assisting with a course where junior and senior science majors teach science lessons in elementary schools every spring. I also advise the majority of our freshmen, sophomore and transfer NRES majors (Ecohydrology, Environmental Science, Forest Management and Ecology, and Wildlife Ecology and Conservation).**

**In order to use geoscience methods (such as data analysis, data interpretation, observation, spatial and temporal awareness) students need practice and familiarity with basic geoscience concepts. Although I now teach lecture classes in big rooms rather than teaching outdoors with small groups, I engage students with opportunities to talk about science and do science. I find that the traditional lecture format of “sage on the stage” is not the best approach for improving student learning, particularly for entry-level undergraduates. My non-majors students often dislike or fear science, and even my new majors lack science experience and knowledge. I create a classroom environment where students can share and practice ideas to improve their knowledge and abilities.**

**At the start of each semester I assign students to a small group of 4 or 5 individuals. The students sit close to each other for the semester, and communicate during in-class discussions. This small step increases the comfort level as students come to know a few other individuals in the class. Now we can review concepts in class, discuss scientific ideas or interpret graphs and data. For example, students often struggle with biogeochemical cycles. As I present the basic components of the carbon cycle, I pause and put review questions on the screen for small group discussion. After describing EPA criteria air pollutants I direct small groups to quiz each other on the names and characteristics of each pollutant. If I have an important graph about energy sources I put questions alongside the graph and ask groups to discuss and write down their answers. I often use “pair-share” discussions during review questions to improve student learning.**

**Once my students are talking about science, I add doing science to the agenda. Again, I start at a very basic level that meets the needs of my students. Before we begin doing science in labs, we “do” science concepts in class. Because geoscience includes large picture conceptual thinking I start with conceptual diagrams in lecture. I typically give handouts with a key science concept diagram or graph that is missing labels or data. As we discuss a concept in class, students add notes and labels or data to the handout. This step helps students internalize concepts. For example, as we discuss layers of the atmosphere I describe temperature variation with altitude. Rather than simply showing the graph I give students a copy of the graph axes. I put data on the screen and students plot the points. Then students label the atmospheric layers by referring back to their notes. During a discussion on aquatic food webs I hand each group a predator/prey data sheet. Students sketch the food web using the data and a previous example to guide them.**

**My vision for students doing geoscience extends to our labs and fieldtrips. There are four lab experiences for my non-majors course and one full day fieldtrip for my introductory majors course. Both the labs and fieldtrip are designed so students can do science and connect the science to a local context. For example, the four non-majors labs all link to our local Truckee River watershed. Students begin by studying landscape patterns on a watershed map, then practice collecting transect data in a riparian area. They identify aquatic macroinvertebrates from the Truckee River and test water quality. As they gather and interpret data, then write about their findings, they see the connection between their local environment and how scientists gather and convey information.**

**In my experience, students learn to appreciate and enjoy geoscience as they talk and do science, both in the classroom and in labs. By the end of each semester I hope my non-majors students have a greater understanding of the science concepts and a greater willingness to engage with data and discuss scientific ideas. I hope my introductory majors have some basic science concepts and tools for moving on to their subsequent science classes.**