**Part 1: Context**

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**Institution:** Georgia State University

**Course:** Ecology (and future use in Experimental Methods in Field Ecology)

**Course description:**

Ecology (BIOL 4045) is an introductory ecology course for biology and environmental science majors. The course covers the principles governing distribution and abundance of organisms and the interactions of organisms with each other and their environment. This upper level course is a writing-intensive course with an integrated, investigation-based lab. While this is a 4000 level course, most of the students have had only minor introductions to ecology in previous courses. Pre-requisites: Introductory biology sequence and animal or plant biology. The course has a max enrolment of 24 students and is taught face-to-face with active lab sessions in which students engage in inquiry based labs. For biology majors this counts as an elective. For Environmental Science majors it is one of a few courses they could take to satisfy their writing and/or research methods requirement areas, or it may be chosen as an elective. Most of the students taking this course have had little exposure to ecology, though they are typically late in their academic career (some juniors, most seniors). Most are close to graduating and have had advanced math and many biology courses previously.

**Course Objectives**

Biology 4045K is designed to present biology majors with a comprehensive overview of the study of ecology in which they:

* 1. Build on basic knowledge of natural history (habitats and habits) of organisms.
  2. Understand how organisms interact with their environment and each other.
  3. Study the evolutionary dynamics of populations and communities in order to better understand how populations adapt and respond to changes in their environment.
  4. Read and interpret graphs and data, and demonstrate an ability to generate appropriate graphs and explain data.
  5. Use scientific reasoning to interpret information and draw conclusions.
  6. Think and write critically about ecological processes by: reading primary literature; discussing and summarizing case studies; and writing and presenting the results of experiments and field studies.

**Part 2: Implementation Details**

1. What module did you implement?

The case of the Missing Mountaintop

1. What learning objectives were you addressing using the selected module? Why did you decide that MathBench was a good approach for helping students achieve these learning objectives?

LO1: Review of biodiversity hotspots and characteristics of environments that lead to high species diversity. Use of EPT organisms’ in RBA relates organisms’ needs to habitat quality.

LO2: Biodiversity and measures of community composition in response to environment was targeted with this activity. Students learn about relative abundance and diversity indices in class, and this activity reinforced those concepts.

LO3: Students relate the effects of habitat change (degradation) to the species composition and interpret how the community composition is affected by the mining operation.

LO4: Students interpreted the results of this case study and had to write a summary of their findings.

LO5: Students use the data to draw conclusions about the impacts of mining on the watershed.

LO6: Students summarize and interpret the data from two streams and present their conclusions on the effect of the application of valley fill from the mining operation on stream biota.

1. How did you integrate the module into your other class activities? Briefly describe the pedagogical techniques you used to facilitate the module and reinforce the learning objectives you identified above.

Students were introduced to measures of diversity in class, and then did the module a few days later (after the test on this material, but before the final exam). They were given a worksheet to fill out while they completed the module. We discussed the concepts of stream monitoring in class and the local activities of Adopt a Stream in Georgia.

1. How did you incentivize students to engage fully with the module?

The worksheet was worth 10 points, the pre-module quiz was worth 1 point for simply filling it out, the post-module quiz was worth 5 points as a bonus on their final exam (though they didn’t know this until the time of the exam – they just knew material from the module would appear on the final). The worksheet was also a point of discussion in our last class, and they were instructed to bring the worksheet with them in order to review the concepts in advance of the exam.

1. How did you assess whether students learned the concept or skill that you were trying to teach?

The worksheet and class discussion allowed me to assess student engagement. The formal assessment of the quiz provided on MathBench was used to assess the material from the module as well as questions on the final exam related to biodiversity and relative abundance calculations.

**Part 3: Reflections**

1. Overall, how did your implementation go?

This went well. Students really liked this module and felt that relative abundance (called relative dominance in the module) and Simpson’s Diversity index made much more sense after completing the module. I would like to tie this in to an actual stream sampling activity and have the students analyze data from their own samples after doing this module. In the future I would have them do the virtual stream sampler mentioned in the module at a minimum. I also plan to have them read and analyze the Palmer et al. 2010 article on the consequences of mountaintop mining.

1. What feedback (positive or negative), if any, did you get from your students about this experience?

The students really liked this activity and were very engaged. When asked at the end of the semester “What activities did you feel enhanced your learning/what activities should be modified/eliminated?” A number of them listed this activity as one of the ones they felt enhanced their learning and should be kept/developed more.

1. What advice do you have for faculty who wish to implement this module in their own classes?

This is a great module. Be careful to align the terms with how you teach it in class. Since we discuss dominance as relative abundance in class as distinct terms, they were thrown off by “relative dominance” initially, though that was easily rectified by a quick post. I made them profile a salamander from the Facebook page on their worksheet, and some of them really engaged - posting pics, etc. I think reading the Science article could be an enriching activity, as well doing the virtual stream sampler, though I did not do that in this round. I also would have a follow up and give them a second set of data to be certain they can really calculate the indices, and that they aren’t just filling in the worksheet from what is posted on MathBench. The data can be used to reinforce other measures of community/diversity as well. I have them calculate the Shannon index for the data as well as do Sorenson’s coefficient and Percent Similarity. This is a great activity to illustrate that community analysis isn’t just a metric we profs designed to torture them with more math, but it can be used to measure impact, assess stream health, and possibly take action. I would like to pull some Adopt-A-Stream data as a follow up activity to have them test their skills, though they don’t measure abundance as part of the adopt-a-stream protocol. (<https://adoptastream.georgia.gov/>) I will be collecting data on local streams I can share that will include the abundances as well as the orders.