Laura A. Miller – Teaching Statement

Teaching Summary

My interest and experience in teaching mathematics has focused on interdisciplinary education, particularly in mathematical biology. This experience includes teaching biology to mathematicians and mathematics to biologists. For example, I currently serve as a mentor for the IGERT program at the University of Utah, and my duties include running a mathematical biology journal club and helping mathematics graduate students form connections with experimental biologists around campus. I also have extensive experience teaching biology courses to mathematics students. I served as a teaching assistant for an introductory biology sequence targeted specifically for mathematics and physics majors and a mathematical biology course designed for math undergraduates and biology graduate students. I am also extremely interested in teaching mathematics to biologists. As a biology major that went into mathematics later in my career, I think that I have a unique perspective on working with biology students in mathematics. This semester, I am teaching a calculus course designed specifically for biology majors. This course focuses on biological applications, and I have designed a number of computer labs and experiments to enhance the material.

Teaching Philosophy

In my opinion, the ideal learning environment consists of an instructor and a student working one on one. In this situation, the instructor receives constant feedback from the student and can easily monitor his or her progress. The pace of the lesson and the material chosen can be tailored to the individual student. Of course, this situation is rarely possible in the real world, but every attempt should be made in the classroom to model individualized instruction. In my experience, regularly asking questions of the students and encouraging questions from the students is an excellent way to monitor student progress. This method works best in a welcoming and open classroom environment. Obtaining continuous feedback from a larger class presents more of a challenge. Giving weekly quizzes is one way to monitor the progress of the class and adjust the pace or review the material as needed. One method that I have used with success is to pose questions to the entire class during lecture and ask for a show of hands for several possible answer choices. Another method I would like to try is to assign multiple choice problems during class and ask the students to display a card with their answer. The advantage of this method is that every student is asked to actively participate, and the instructor can continuously monitor how well the students as a whole understand the material.

Teaching interdisciplinary classes can present another set of challenges and rewards. These classes often consist of students from a wide variety of backgrounds and mathematical skills. For instance, the mathematical biology classes I have taught have consisted of students from biology with weaker mathematical backgrounds, mathematicians with weaker biological backgrounds, computer scientists with yet another set of skills, and double majors with strong backgrounds in both areas. In such classes, it is extremely difficult to cover all background material while keeping students engaged. To meet this challenge, I usually prepare information packets that cover the mathematical background and the biological background of each subject presented. I emphasize the importance of using these materials to prepare for lectures outside of class. It is also useful to assign class projects that pair mathematicians with biologists. In this way, the knowledge base of each student can enhance the project, and students can learn other perspectives on how to approach problems.
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Teaching Experiences

I have taught a wide variety of mathematics courses as a graduate student and postdoctoral fellow. I have served as an instructor for basic courses such as Mathematical Thinking and Mathematics for Life Scientists to more advanced undergraduate courses such as Multivariable Calculus and Decision Analysis. In addition, I have served as a teaching assistant for Quantitative Reasoning, Precalculus, Mathematical Statistics, Advanced Calculus, and Mathematics in Medicine and Biology. This diverse range of experiences has left me very qualified to teach a number of subjects at a variety of levels in mathematics. For instance, I am well prepared to teach undergraduate courses in calculus for biologists, numerical analysis, mathematical biology and physiology. I am also well qualified to teach graduate courses in mathematical biology, biomechanics, numerical analysis, fluid dynamics, and partial differential equations.

I am currently teaching a calculus course at the University of Utah designed for life scientists. This course serves as an introduction to calculus, mathematical biology, and mathematical modeling. In lecture, I present basic calculus theorems, work through examples, and then apply the mathematics to biology. I have also designed supplemental computer exercises on bacterial growth dynamics, game theory in ecology, and plant biomechanics. To accompany the computer exercises, I have designed field labs where the students perform simple experiments and compare the results to those predicted by mathematical models. In one exercise, the students measure the height and natural frequencies of trees and use this data to calculate the forces that trees might experience in a storm. In another lab exercise, students are asked to hunt prey (beans) in patches, record their behavior, and compare the results to optimal foraging models.

I also have extensive experience teaching courses in the biological sciences. At the University of Chicago, I served as a teaching assistant for a three quarter introductory biology sequence designed for mathematics and physics majors. This sequence was a survey of mathematical applications to systems, developmental biology, biomechanics, neurobiology, cell biology, and ecology. At Duke University, I served as a teaching assistant for several courses that emphasized mathematical modeling in biology. For example, I served as a laboratory instructor for a course on animal physiology that focused on experiments and simple mathematical models in neurobiology and muscle mechanics. I also served as a teaching assistant for a course on plant functional morphology and biomechanics. For the laboratory component of this class, I developed an exercise that considered wind forces on plants and vortex shedding behind plant stems. Students performed wind tunnel experiments and compared drag forces and vortex shedding frequencies to those predicted by aerodynamic theory for cylinders.

In addition to teaching interdisciplinary mathematics, I have a strong interest in mentoring women and minorities in science and mathematics. I have worked periodically with Kaplan’s K-12 Mathematics Division to improve mathematics performance in urban and rural school districts. This work includes writing teachers’ guides on a number of subjects in high school mathematics, tests to evaluate student performance, and answer keys to help students understand these problems. I am also working with a riding instructor in Salt Lake City to start a summer program on horse biomechanics for teenage girls. Our goal is to introduce mathematical modeling, mechanics, and engineering concepts to girls by performing gait analyses on horses. We plan to use technology available in the racing and dressage industry to measure the velocities and forces produced during locomotion and to incorporate this data into mathematical models.