Teaching Statement

Paul J. Hurtado

My experience teaching graduate and undergraduate students in mathematics and biology courses during the past eight years has afforded me a unique teaching and mentoring philosophy. That philosophy is rooted in teaching traditions from both mathematics and the biological sciences, refined to meet student needs at the interface of these two disciplines, and it reflects the ever-increasing value of strong computational skills.

Below, I describe the core principles that guide my teaching and mentoring activities – first in the context of mathematical biology and then more generally – and how I put them into practice.

Teaching at the Interface of Mathematics & Biology

> *"Paul was extremely approachable and very willing to help whenever I had any difficulties. He also seemed to have an extremely good command of the material."*
>
> – *Student*

The current quantitative revolution in biology provides many opportunities to show students how pure and applied mathematics play an important role in solving problems of broad public interest, including problems in medicine, public and environmental health, biodiversity, sustainability and agriculture. Plus, the highly interdisciplinary approaches used to tackle these problems are fueling both new scientific advances and new research in mathematics. As an educator, my responsibility is to help prepare students for rewarding careers in this interdisciplinary environment – careers that advance our knowledge of science and mathematics, and contribute positively to society.

The following core concepts of my teaching philosophy guide how I teach and mentor students:

I encourage mathematics students to be scientifically literate, and biology students to be mathematically literate. This core tenant of my teaching philosophy benefits students and their respective fields of study. I strive to provide students with important scientific context and broader mathematical insights relevant to the material at hand. As a mathematician and biologist, I have found that I am particularly well suited to showcase these connections across disciplines. I do this through thoughtfully chosen examples, supplementary materials, and student projects.

Scientific inquiry and mathematical rigor are mutually beneficial. I encourage my students to use scientific inquiry in their approach to mathematics, and (likewise) to use mathematical tools and concepts to incorporate careful, quantitative thinking into their approach to conducting science.

> *"Thanks for teaching me* `R`*. My skills were a huge asset when applying for my new job and I wouldn't have them without the hours you spent ... explaining the inner workings of everyone's favorite statistical software package."*
>
> – *Student*

Computational Thinking. Computing skills are a valuable tool for research in pure[1] and applied mathematics, and throughout the biological sciences. My academic training and my experience as an educator have shown me the immense value of "computational thinking" skills, and the negative effects their absence can have on a student's education. As I've taught various aspects of computational thinking to mathematicians and to biologists (two very different audiences with different quantitative backgrounds and different expectations regarding computing), I'm well versed in navigating the challenges students face in developing these skills.

[1]For example, the youngest NSF Mathematical Sciences Institute, the Institute for Computational and Experimental Research in Mathematics (ICERM) at Brown University is devoted to the use of high performance computing to help advance computational and experimental methods in pure mathematics.

I help students become "T-type individuals." An individual's expertise is most valuable to an interdisciplinary team when they can work well with experts in other disciplines. Borrowing the phrase from Kirk Jordan (Associate Program Director at IBM Research), a **"T-type individual" is someone with a high degree of expertise, and the necessary breadth of knowledge in related fields that allows them work across disciplines**. (The '**T**' mirrors an inverted histogram with different subject areas on the horizontal axis.) I encourage students to be creative in seeking out that mathematical and scientific breadth. In class, I facilitate that by providing opportunities to interact with their peers in other areas of study.

Broader Teaching Principles

"Paul was always quick to reply to emails, offered very clear guidance, and had lots of patience!"
– Student

Teaching any topic well requires certain basic considerations on the part of the instructor: patience, enthusiasm, preparedness, command of the material, clear expectations of students, clear and open communication in the classroom (and one-on-one), and the ability to uncover the source of (and help correct) a student's misunderstanding. Differences in how individual students communicate and learn, and differences in student cultural, social and economic backgrounds must also be taken into account to ensure all students have equal opportunities in the classroom.

Communication skills. It's important for students to communicate well with others in their field, with the broader research community, and with the general public. I help them develop those skills by providing guidance and feedback on written work, the proper use of scientific terminology and jargon, and the different meanings of some terms in different fields. I also stress the importance of non-verbal communication, including both how to act professionally and how to design and use informative graphics in written works and presentations.

Students as independent learners. Teaching students to work independently and efficiently can be just as important as teaching curriculum content. Student led projects provide an excellent tool for teaching these skills. I also share with students ways of improving their productivity. Many students (young mathematicians and scientists alike) benefit from something as simple as introducing them to the use of script-based computing (as opposed to using menu-driven software) to generate reproducible figures and analyses.

Students as cooperative and experiential learners. In class, I encourage cooperation among students and give clear goals and expectations to help them focus on learning instead of competing with one another. Student led projects provide important hands-on learning opportunities, but can also be used to bring together students to work towards a common goal. This gives many students their first taste of research, insights into how research is conducted, and an opportunity to engage in active, experiential learning.

Assessment. In addition to the usual forms of student assessment (quizzes, homework, exams, etc.), I also use questionnaires, class discussions and project reports to monitor student progress and to tailor my lecture plans. Early in the course, I like to establish a baseline sense of what students know by using questionnaires and class discussions. These also allow students to share their expectations and any concerns related to the course. I follow institutional norms in grading student work, though where possible I like to design quizzes and exams that allow top students to separate themselves from the rest of the students while still fairly assessing the other students. No two students think or learn alike, so I always ensure my assessments are fair to all students regardless of backgrounds.

Teaching & Mentoring Experience

My experience as an educator includes teaching standard undergraduate mathematics courses (e.g. Calculus), teaching mathematics and computing to biologists, and overseeing graduate and undergraduate research projects in the classroom and during summer research programs. Mentoring students and overseeing mathematical biology research projects is exciting for me, particularly because there are so many interesting student research opportunities that exist at the interface of mathematics and biology (for example, over the past few years I have kept a folder of student project ideas, many of which could yield publications). For further details, please see my CV.