Project Year
2012-2013

Project Title
Opportunities for Individualized Student Learning in Molecules and Cells

Project Team
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Audience
This fellowship will initially be designed for students in *Molecules and Cells* (580.221), a required Biomedical Engineering course.

Pedagogical Issue
A constant difficulty in teaching *Molecules and Cells* has been the wide-range of preparation of our students. Some students have completed AP Biology and Organic Chemistry courses, while others have not had biology since their freshmen year of high school. Students with a solid biological background can focus on more advanced topics, while students who lack such a background struggle to understand the most basic relationships between biological systems, before they can even understand the mathematics.

In an attempt to address this problem, in 2010-11 we made changes to the course to include more team-based learning exercises and discussion of clinical cases. We posted online notes and recorded lectures for students to use in preparation for the team activities. However, many students with weaker backgrounds still had a difficult time learning such a large amount of complex material on their own. The difficulty of the topics, as well as the rapid pace of the course, left many bright students struggling to keep up with their better-prepared peers.

Solution
We propose to increase the opportunity for individualized learning by developing a suite of online mini-lectures and computer simulations that will illustrate key concepts to the students in an intuitive, engaging, and educationally effective manner. With the advent of the Internet, there has been an upsurge of "online education." For example, Khan Academy now supplies more than 3000 free micro lectures through video tutorials. These 10-15 minute videos boast a new kind of teaching, summarizing topics into simple to understand educational themes. Our goal is to condense selected lecture material in *Molecules and Cells* into micro-lectures to assist students in understanding important topics.

Since BME courses are more mathematical than traditional molecular biology courses we also aim to improve the quality of the course by integrating simulations into the curriculum, providing students the opportunity to better comprehend these quantitative concepts.

Technologies Used

Video recording
Video editing
Flash

Faculty Statement

Successfully teaching students who come into an introductory course at both basic and advanced levels is challenging, for both the students and instructors. Course material can be either painfully redundant or overwhelmingly new and complex. Over the past ten years, increasing numbers of students have been exposed to portions of *Molecules and Cells* in high school through classroom and lab experiences. Consequently, students who have completed AP Biology, for example, encounter little new material during the initial portion of the course, (e.g. DNA replication, translation, and transcription). Conversely, students lacking this background are often at an unfair disadvantage because they are required to learn far more information and to do so at a rapid rate.

To better address the needs of students, especially those with weaker backgrounds, we propose to provide a suite of mini-lectures, computer simulations and animations to illustrate key concepts of the course. A subset of topics covered in the course, such as the energetics of binding, protein folding, enzyme kinetics, DNA replication, translation, and transcription, DNA recombinant technology, control of genetic expression, and membrane transport lend themselves to useful problem solving activities. This suite of software applications will be developed by students for students, which we believe will provide an extremely effective method to deliver content in an engaging way.

In *Molecules and Cells*, it is essential that each student feel confident enough in his/her understanding basic information to benefit from guest lectures, comprehend scientific papers, and feel productive working in a research lab. Equalizing the background for all our students would permit more class time to be devoted to team-based learning through the discussion of case studies and current research topics. We propose that a mix of traditional lectures, online animations and simulations, team-based learning (TBL), and clinical case studies will lead to better long-term retention of the material for all of our students. We anticipate this new paradigm of teaching will serve as a model for other large, lecture oriented courses.