***Doing Biology*** (By Joel Hagen, Douglas Allchin, and Fred Singer; http://www1.umn.edu/ships/db/)

Too often, when studying biology, students think that lone brilliant people discovered the concepts and phenomena they encounter in classrooms. *Doing Biology* is an online textbook that teaches biology through the lens of the individuals who devoted their lives to making some of the fundamental breakthroughs that occurred in the 20th century. Unfortunately, *Doing Biology* reinforces the notion of the individual toiling alone in the lab or in the field, and sometimes against the odds.

Written in 1996, *Doing Biology* is divided into four units. They include ecology and behavior, organismal biology, cellular biology, and evolution and diversity. Each unit is composed of chapters devoted to individual scientists who made legendary discoveries. By clicking on the picture of a legendary scientist, you are taken to a chapter that is presented as a downloadable PDF. In the copyright information, the authors present the chapters as "case studies," thereby encouraging teachers to consider using them as a collaborative inquiry tool. But lamentably, the text does not lend itself to 21st-century literacy strategies, to say the least.

Each chapter is about a dozen pages long and leads readers through some historical background, looking at the scientist's work through his or her eyes. The chapters are interrupted by a "problem" meant to engage students. Each chapter ends with questions that can be used for assessment or springboards for further classroom activity. A list of suggested readings follows.

In this day and age, our diverse student bodies require a more diverse "Hall of Fame," so to speak. Other than three women, the scientists are all white males. Students may be familiar with Thomas Hunt Morgan's contributions to genetic inheritance, and they may be interested to learn about the man behind the eponymous Krebs cycle. The chapter on Lynn Margolis and the endosymbiotic theory sheds a little bit of light on the difficulty of promoting an unorthodox idea. However, the story does little to describe her experience as a woman in science during the 1970s and 1980s. Rather than address multiculturalism, the questions and activities speak more to the empirical nature of science.

We can do more than write biographies to introduce students to the human side of science. While *Doing Biology* offers teachers a good starting point for introducing biography to biology, teachers might prefer PBS's "The Secret Life of Scientists and Engineers," an interactive website featuring a rainbow of scientists and engineers with unique stories who are currently doing research in their respective fields. Pressed for time in our classrooms, we need access to the most engaging stories the scientific community can offer, and *Doing Biology* just does not meet the challenges of the 21st century.

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**PhET Interactive Simulations: Biology** (University of Colorado Boulder; http://phet.colorado.edu/en/simulations/category/biology)

The *Next Generation Science Standards* encourage the use and development of models that facilitate students' ability to make predictions while learning about a particular topic. For years, PhET has successfully developed simulations to help teachers and students do so. Though typically and historically recognized as a resource for physics teachers, the PhET group at the University of Colorado Boulder has created a plethora of simulations pertinent to several STEM subjects, including biology.

These simulations engage students in exploratory activities that inherently solicit inquiry. In other words, students will find themselves tinkering with interactive components, noticing how different inputs affect outputs, and naturally wondering about the reasons behind the differences. About 23 simulations make up the collection housed under the "Biology" link. These range from molecular motors and membrane channels to reaction rates and gene expression. Each simulation comes equipped with layers of settings that facilitate students' conceptual development from basic to complex.

These interactive learning environments do not stand alone. Learning goals and teaching guides accompany each, as well as a variety of supplemental worksheets designed by educators specifically for the simulation selected. Each worksheet or teaching guide includes information about its authors, including e-mail addresses, allowing teachers to reach out for clarification and other resources.

Translating their work into more than two dozen languages and making it searchable by topic and grade level, the PhET team has gone over and beyond to ensure that the simulations are accessible to all. Each one runs online as a Java program, or teachers can download them to a USB drive and run them on a computer that may not have Internet access. Clearly, the team has thought carefully about creating resources that go beyond the basic interactive demonstration; these simulations will function as tools to stimulate learning in the life science classroom.

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