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Biology

The Hands-On Challenge in Online Introductory Biology Classes

In 2003, a team of personnel from the Biology Department and the Centre for Learning and Teaching at Dalhousie developed two fully online Introductory Biology classes. BIOL 1020 (Cell Biology, Genetics, and Evolutionary Biology) and 1021 (Organismal Biology and Ecology) are the Distance Education (DE) equivalents of the campus-based classes BIOL 1010 and 1011. Classes involve weekly readings, quizzes, assignments, a multi-stage term project, and midterm and final exams.

The online Biology courses do not have a traditional laboratory component; instead, students conduct virtual experiments and analyze lab data. One of our goals is to supplement existing activities with labs and field exercises that students can do from home to enhance students' experience of the concepts, processes, and challenges of scientific work.

In campus-based laboratory sessions, students are provided with materials and equipment, and are supervised by teaching staff who ensure that safety rules are followed and who provide immediate guidance. In adapting laboratory activities for home use, it was necessary to find materials and equipment that students could obtain easily from grocery stores

or pharmacies. Procedural changes included providing measurements in cups and teaspoons as well as milliliters, and having students use syringe barrels for more precise measurements. As DE students cannot be supervised while performing labs at home, ensuring safety awareness and correct handling and disposal practices was an important consideration. After reading safety information sheets for all potentially hazardous materials (household materials such as rubbing alcohol and detergent), students must write a safety quiz which includes a statement, devised by Dalhousie's legal department, that all material safety information has been read and understood. Students must score 100% on this safety quiz before lab protocols are released to them, and no lab assignments are accepted from students who have not achieved this score.

In the winter term of 2008 we piloted three labs for bonus marks, by adapting procedures from the campus-based classes² for online use. In a microscopy lab, students

prepared and stained cells using food colouring or a modified Gram Stain protocol, and used a personal digital microscope³ to capture and upload images of what they saw. In a DNA extraction lab, students obtained a crude sample of DNA

from bananas or strawberries. A third lab examined the activity of amylase, an enzyme present in saliva that breaks down starch. This activity was very similar to an existing virtual amylase lab⁴ assigned to

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students, providing them with a chance to reflect on the advantages of each approach. Because the virtual lab already assessed the effects of pH and temperature on the rate of digestion of starch, these activities were removed from the hands-on lab for the summer 2008 term, reducing the procedure to examine only the effects of amylase concentration. Many students preferred the virtual lab as being cleaner, faster, and certain to succeed, but also recognized the value of the hands-on method of performing the experiment. Some felt apprehensive about performing these labs without direct guidance, while some enjoyed working at

their own pace with the option to repeat the experiment. In the summer term of 2008, the DNA extraction lab was added to BIOL 1020, and the amylase assay lab was added to BIOL 1021; students submitted digital photographs of their results, and answered questions on the lab. Most students completed the lab successfully, submitting photographs of good quality results, and their assignment answers indicated that the labs helped them to understand the concepts that were presented.

Fieldwork is another important aspect of hands-on experience in Biology. Currently, students in BIOL 1021 research, write, and peer review profiles of Nova Scotian plant species for a class wiki (wiki.epigaea.ca). Students learn about plant species found in Nova Scotia, and also learn to use web pages, scientific journals, and library databases for research. They synthesize their findings and properly cite their sources in a short and engaging piece of scientific writing.

This project was developed with the aim of eventually combining this research and writing exercise with a field exercise, expanding the class wiki to include a set of Digital Herbarium Records (DHRs). Students use a digital camera to document occurrence of a species at a particular location and time; photos must include documentation of features needed to confirm its identification. This project was piloted during the summer 2008 term as a bonus exercise, and students produced several useful and high-quality DHRs. In developing these activities, we came to understand the need to provide support in a variety of print and online formats to students conducting lab exercises at home; at the same time, we feel that these lab exercises help further to develop students' abilities to work independently and problem-solve. We are continuing to develop hands-on lab and field exercises, as well as virtual activities for students in BIOL 1020 and 1021.

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1. David Patriquin retired in July 2008.
2. Welsh, E. and Bishop, T. 2007. *Biology 1010 Lab Manual Fall 2007*. Halifax: Dalhousie University.
3. Students came in to campus to use this microscope; Model MFL-82, C&A Scientific Co., Inc., Masassas VA
4. Web/CD Thinking as a scientist: What role does amylase play in digestion? In Campbell, N.A., Reece, J.B., Taylor, M.R., and Simon, E.J. 2005. *Biology: Concepts and Connections*. San Francisco: Pearson Benjamin Cummings.

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