Information for Instructors
Introductory Bioinformatics Laboratory

Number of students and time required:

This course is designed for lab sections of 20 students each. The curriculum is completely computer-based and is designed to be completed in 5, 2-hour lab sessions. We taught the course with approximately 300 students divided into 15 sections. We had one instructor and one teaching assistant per lab section.

Computer set-up:

The lab could be taught in any computer lab that is equipped with Internet access. Most of the activities involve extensive Internet use. We used 20 iMac computers with OS 10.x, connected to the Internet, and with Swiss PdbViewer already available on the desktop. In addition, there was one laser printer in the room. We taught the lab with one student per computer, but encouraged students to sit near another student who worked on the same project and help each other with common questions.

Downloading Swiss-PdbViewer (DeepView) freeware:

Swiss PdbViewer is a program for viewing 3-D structures. It loads ".pdb" files, which contain the 3-D coordinates for molecular structures. Swiss-PdbViewer is easy and free to download on any computer (Mac of PC) and does not run in a browser. It is fairly easy to learn to use at the basic level and also has modeling capabilities. To download Swiss-Pdb Viewer for your own computer, the program is available for free and is easy to download from the following website. A help manual is also available here.

http://us.expasy.org/spdbv/

To run this program with Mac OSX, you must first change the monitor settings to "thousands of colors" instead of "millions of colors".

Storing Data:

Students stored data between sessions by emailing files to themselves or transferring the files to a department server. You could also instruct students to bring their own disks to store data between sessions.

Lab instruction:

Each lab session began with a 30 min introduction and demonstration of the websites and bioinformatics tools that the students would be using that particular day. These introductions consisted of a definition of terms, how to use each website or program, and how to interpret and analyze search results. Then the students worked on their own on their web-based research projects while the instructors walked around answering questions. We found it helpful to stop the students halfway through each lab and lead a short discussion about common questions and problems they were encountering.

General lab manual:

There is a general lab manual that each student purchased at the bookstore. This manual is also available to download in .pdf form from the website. The general manual contains a glossary of commonly used bioinformatics terms and websites, the syllabus, tutorials, a one-page description of each of the five lab sessions, and general step-by-step instructions for completing the web-based research.

Project manuals:

Ten different project manuals were created so that students could work on similar, but different projects. The students were given a project to work on at the first day of lab and asked to sit near another student working on the same project. In general, two students in each lab section worked on the same project. The project manuals were available for download from the lab website.

Each project focused on one protein that has been linked to a human genetic disease and is described in the OMIM (Online Mendelian Inheritance in Man) database. Each project also had a crystal structure of the human protein or a homologous protein available in the PDB database. The projects were similar in that each project begins with a cDNA sequence of a mutant form of the protein that is clinically relevant. For each project, students begin by translating the sequence, identifying the mutation, making a multiple sequence alignment, and learning about their protein from the SwissProt, LocusLink, KEGG, and OMIM databases. Finally students analyze the crystal structure and predict the possible effect that the mutation has on the function of the protein.

Lab website:
http://www.nslc.wustl.edu/courses/Bio3055/bio3055.html

The lab website contains the general lab manual, the glossary, links to the websites used in the lab, and separate pages for each of the projects. Each

project page contains the cDNA sequence to download, the reading assignments to download, and other relevant files for that project.

Final presentations:

The projects were planned to fit into five different disease or biochemical process categories. The projects in the same category had similar background reading assignments. This became important for the final day of lab when students present the results of their research in small groups. We had students meet in the disease category groups to present their findings. For example, the two students working on HMG-CoA reductase presented their results to the LDLR students and all four students had read about cholesterol synthesis and regulation, so understood something about the other project in their group. The website is also organized into these groups.

The students sat in the groups of four and presented their results informally. They generally presented background information about their protein, how it is related to human disease, and the effect they believe the mutation has on protein function. Sometimes students developed different hypotheses for the effect of the mutation for the same project and defended their results to the group.

After the presentations, a quiz was given to each group. This quiz was graded, but the students could work together as a group. There were questions about each project on the quiz, so each student needed to understand the others' projects in order to answer all the questions. This joint quiz helped generate discussion in the groups and ensure the students worked to understand the others' projects.

Reference texts:

Students used the Berg, et al. Biochemistry textbook in the lecture portion of the course. Chapter 7 includes an introduction to the BLAST algorithm, sequence alignments, and protein evolution. Reading assignments for the lab are also given from this textbook. Bioinformatics for Dummies was used as a reference book by the laboratory instructors.

Berg JM, Tymoczko JL, and Stryer L. Biochemistry, Fifth Edition. WH Freeman Co. NY, 2002. Chapter 7.

Claverie J-M, Notredame C. Bioinformatics for Dummies. Wiley Publishing, Inc. IN, 2003.