

## APPENDIX A

### Sample Class Sessions in The Cellular Basis of Life (BIO 115)

(From Annual Reports to NSF for grant # 9980913, section by D. Canning)

PRS questions were pre-posted to allow students out-of-class discussions prior to each class meeting. The PRS grading system contributed to 30% of each student's course grade. One or two essay assignments were made each semester. The essays were designed to increase the vocabulary usage of students in the area of cell & molecular biology. Most of the class sessions were organized to focus more on analytical skills and less on content.

1. The main topic for the class session was “Enzymes & Energy Conversion in Cells”. The overall goal was: Students will be able to demonstrate understanding of molecular machines in the form of protein-substrate catalysis reactions. Students were presented molecular visualizations of various enzyme interactions, using Java-based computer animations, Chime PDB coordinate files, and Quicktime movies. Based upon the introduction, students were asked to design a system of energy conversion with hypothetical molecular interactions. Each interaction was given a specific change in energy, with some common molecules between each interaction type. **Students worked in their assigned groups, and were asked to predict different consequences of enzyme reactions.** Students were ultimately shown how the problem was solved using coupled reactions and multistep processes. Students responded to questions which probed their understanding, using a PRS system.
2. The main topic for the class session was “Historical aspects of the scientific method, The age of experimentation”. The overall goal was: Students will be able to understand the way in which correlations by experimentation lead to conclusive proof. Students were presented a case study of William Harvey. His life history was described and the common theories on how the body functioned were described. Students were asked to show to a patient living in Harvey's time why their ailment is not due to their diet, but due to poor circulation. Students would need to demonstrate this experimentally. Students were shown how Harvey solved the problem of heart circulation and asked to compare this to their own answers. A second case study was discussed - that of Ignias Semmelweis. Students were asked to break down Semmelweis's experimentation on child-bed fever into the paradigms of the scientific method. Student's were shown how Semmelweis's process of experimentation had many facets of the scientific method, and could be considered in many different ways. The PRS system was used to evaluate the questions posed in class.
3. The main topic for the class session was “Chromosomes”. The overall goal was: Students will be able to explain the why chromosomes exist, and what happens when they contain defects. The fundamentals of chromosome structure were presented along with elements of the normal karyotype. Students were asked to examine a fictitious law-suit. "Susan has worked in the same factory for 30 years as a production line worker. the factory manufactures pharmaceutical drugs such as vinblastine and nocadazol. Unexpectedly she became pregnant and recently gave birth to a child that is now eight months old. The child appeared to have some developmental defects and Susan thinks that it may be due

to exposure to the drugs made in the factory, since she worked while she was pregnant. Examination of the child's white blood cells revealed the karyotype shown here. Describe what is wrong with the karyotype. Do you think that it could of been caused by exposure to the drugs in the factory? If so, explain why. Is there another explanation? If so explain why". Various paradigms of chromosomal abherations were discussed and students were shown the consequences on phenotype of each. The instructor provided different possible answers to the case study and abnormal karyotypes presented at the end of the session. The PRS system was used to assess student's comprehension of the case study.

4. The main topic for the class session was "Flicking gene switches". The overall goal was: Students will be able to apply the concept of gene-activation and repression to any transcription unit. Interactive Powerpoint presentation and Rasmol molecular visualization. The PRS system was used to evaluate the questions posed in class.
5. The main topic for the class session was "How cells talk to each other". The overall goal was: Students will understand the basics of cell signalling. Powerpoint presentation that covered the various pathways of signal transduction. Quicktime was used to demonstrate the role of second messengers, G-protein linked receptors and kinases. Students were asked to predict each stage in the process. Feedback was collected with the PRS system

The following are sessions that had less emphasis on inquiry-based learning, and more emphasis on the *learning of content*.

1. Session topic: Chemistry of Life - small & large molecules. Goal: Students will understand basic chemical principles. Format for the session: Interactive FilemakerPro database presentation. Student assessment of goal achievement: Discussion with the instructor in class and performance on tests.
2. Session topic: Looking at life in finer detail - Microscopy. Format for the session: Lecture given by Leon Duobinis-Gray. Student assessment of goal achievement: Discussion with the instructor in class and performance on tests.
3. Session topic: The cell membrane divides the Universe into two equal halves. Goal: Students will understand the basic function of the cell membrane. Format for the session: Interactive FilemakerPro database presentation. Student assessment of goal achievement: Discussion with the instructor in class and performance on tests.
4. Session topic: PCR and genetic engineering. Format for the session: Lecture given by invited professor. Student assessment of goal achievement: Discussion with the instructor in class and performance on tests.