APPENDIX B

Class Session Descriptions for Biological Inquiry and Analysis (BIO 116)

The primary objective of the course is to provide students with experiential and inquiry-based learning experiences at the outset of their undergraduate studies. The two types of course sessions are described below. The course syllabus is available on-line at http://campus.murraystate.edu/academic/faculty/terry.derting/bio116/bio116_syllabus.htm; a link to the course schedule of class activities is located at the end of the syllabus.

Hands-on Research (3-h class session)

In the first module of the course, termites (or other invertebrate species) was used to engage students in their first exposure to science as a process of derived inquiry. The module was conducted as a guided inquiry. All students conducted their research on the same question, "Does pen ink affect the orientation of termites?" after reading a short article about insect pheromones and observing termite movement in relation to various types of pen ink. As a class, students decided upon a testable hypothesis about termite behavior, developed an experiment to test the hypothesis, collected data, and presented their initial conclusion(s) to their peers. During the second week, students searched for and read scientific literature about termites and pheromones, learned how to design experiments, and developed a second hypothesis that they then tested experimentally. During the remaining two weeks of the module, students learned about basic statistics (e.g., mean, standard deviation, and standard error), analyzed their data, and individually wrote a research paper about the work that they had conducted. Students exchanged and peer-reviewed initial drafts of their research papers using evaluation lists and rubrics developed by the students and the Teaching Assistant. A final draft of the research paper was submitted to the Instructor.

In the second module, student research teams selected their own biological question to study. The focus was on ecology and projects were conducted in the field. Following initial observations and reading of scientific literature, each research team developed a list of hypotheses about their ecological topic. They then chose one of their hypotheses for testing. During the next week's class, each research team gave an oral presentation, stating their hypothesis and proposed methods of testing that hypothesis. All students completed written evaluations of the oral presentations that were then given to the presenters for revision of their research plan. Over the next two weeks, students conducted their proposed research, developed a second hypothesis based on the results of their first study, and tested their second hypothesis. During the final two weeks, students learned about basic statistical analyses (i.e., t-test, correlation analysis, and chi-square test) and learned to use the statistical program *Statview*. As research teams, students wrote a research paper of their work and conducted peer reviews of the initial draft papers.

The third module was similar to the second except that the topic for the student research projects was animal behavior and students communicated their research results in the form of a poster, rather than a written paper. Faculty within the Department of Biological Sciences as well as students in the course evaluated the poster presentations. Student selected a species from

among four species that were provided (i.e., crickets, minnows, earthworms, and cockroaches), or provided their own specimens.

Discussions and Simulations (2-h class session)

The discussion/problem-solving portion of the course focused on broad concepts in biology that were related to the research activities of the students. Students increased their knowledge base for these discussions through assigned readings. During the first module, the discussions addressed approaches to knowing (e.g., inductive and deductive reasoning), what constitutes science and non-science, and methods of finding meaning in data. During one discussion session (see Course Activity #2, Science and Non-science; http://campus.murraystate.edu/academic/faculty/terry.derting/bio116/science_nonscience.html), students first read a short article of general interest ("Some dogs are not a child's best friend", Science News, June, 1994). As individuals, students wrote responses to questions regarding the validity of the claims made in the article. As groups, students then discussed the reasoning used by each student to evaluate the validity of the claim(s). The class also critically evaluated published editorials about the validity of the author's claim (Science News, 1994). During another class session (http://campus.murraystate.edu/academic/faculty/terry.derting/bio116/If_scientists_think.html) students focus on the types of thinking and evidence which scientists use to study historical events in biology. The topic is the age of the earth. In groups, students provide answers to various statements, each of which begins with "If scientists think the earth is about 4.5 billion years old, then they must have …...". The remainder of the statement addresses topics such as "… found or discovered or observed…", "…hypothesized…", and "… measured". Groups shared their responses on white boards, deleting or corrected any responses which they believed were incorrect.

During the remainder of the course the focus was on evolution and continued practice of scientific research using simulations. Beginning with activities modified from "What on earth is Evolution? The geological perspective of teaching evolutionary biology effectively" (A. Cherif, J. Adams, and J. Loehr, 2001, American Biology Teacher), web-based activities were developed and posted on the course website (http://campus.murraystate.edu/academic/faculty/terry.derting/bio116/bio116intropage.html. These activities use the topic of evolution as a basis for helping students understand what scientists do, how the theory of evolution came about, and what is evolution. Students are introduced to the topic of evolution using excerpts from original statements by individuals who contributed to a major revolution in the history of biology (National Academy of Sciences, 2003, Teaching about Evolution and the Nature of Science). The small group and class discussions which ensue follow the activity posted at http://campus.murraystate.edu/academic/faculty/terry.derting/bio116/evolution_readings.html. Students in all sections of the course also view the video Judgement Day: Intelligent Design on Trial, which is scheduled for viewing one weekend early in the semester.

Students learn about evolution and its assumptions and requirements through simulations which are based on scientific experimentation. Thus, students continue to gain practice in designing experiments to answer scientific questions, data compilation and interpretation, and critical evaluation of results. For example, a free on-line simulation offered by PBS is used to study natural and sexual selection in guppies (Course Assignment #8,

http://campus.murraystate.edu/academic/faculty/terry.derting/bio116/PBS_guppy.html). On-line simulations are also purchased from vendors including Biology Labs On-line (http://www.biologylabsonline.com/) and EvoBeaker (http://simbio.com/products-college/EvoBeaker).