CLFS 710: Experimental Biology

Syllabus

Overview
CLFS 710 is a six-credit graduate course that assists participants in developing the skills necessary to plan, conduct and analyze original biological experiments. The course is designed for teachers developing new innovative laboratories for their students, or participating in research projects with other investigators. While participants will learn many potentially useful laboratory and field data collection procedures, this course differs from more traditional laboratory courses in that it emphasizes the development of effective experimental designs. By the end of the course, participants will be expected to have designed, conducted and analyzed an original research project for presentation to the entire class.

The course is divided into three independent sections, each lasting two weeks and with a specific focus:

- **Part 1 -- Research Techniques** explores the methodologies used by researchers to produce the overall structure of an experiment. This portion of the course emphasizes the organizational frameworks that are used to maximize the quality of the data produced by experiments and facilitate the analysis of this data.
- **Part 2 -- Laboratory Techniques** focuses on the methodologies used to obtain data in bench-top experiments (e.g., light and electron microscopy, spectrophotometry, and electrophoresis).
- **Part 3 -- Field Techniques** examines the methodologies used by biologists for on-site investigations in natural settings (e.g., population estimation, community description, and pest management).

A fundamental component of the course is an experimental design package within the course website. This package consists of a hyperlinked 'Design Tool' that uses information provided by an investigator to identify appropriate experimental designs and analytical tools for a particular study. Further, the Design Tool is linked to conceptual overviews and customized spreadsheets of specific statistical tests and recommendations of the appropriate forms of tables and graphs to use with different experimental designs.

The course is based on a cooperative learning model, with participants assigned to research groups that work together to investigate the principles of experimental design and apply these principles to research problems presented in the course. This course contains a number of components that will help research groups (and individual participants) to develop effective designs for biological experiments (Course Schedule -- Excel file):
• **Topic lectures** are used to explain the theory behind the experimental designs and research methodologies used in biology. Lectures are presented by the course instructor, or an invited lecturer, in an open format to encourage interactions among the course participants.
  - In-class discussions are also led by the course instructor, but are less structured than topic lectures. Discussions are used to explore the practical and applied aspects of the topics presented in the lectures in greater depth.

• **Open discussions** are set aside to explore any aspect of biological research agreed upon by the course participants. These discussions are particularly useful for sharing ideas about laboratories and other resources for teaching biology. Each open discussion is led by a participant from the class.

• **Guest researcher lectures** are presentations of current research by Life Sciences faculty from the University of Maryland. These seminars serve two purposes: (1) to expose participants to the latest advances in particular areas of biological research, and (2) to introduce participants to researchers that could provide assistance in their own research projects.

• **Laboratories** are the most critically important portion of the course. In these exercises, research groups apply the experimental design principles they have learned to specific research problems. Unlike traditional laboratories, each research group constructs, implements and analyzes an experiment of their own design. Laboratories are led by the course teaching assistant.

• **Research symposia** occur biweekly and are used to discuss the results from experiments performed by the research groups. Research groups make oral presentations to the class for discussion and evaluation. The symposia help participants refine their experimental designs, while improving their ability to critically evaluate biological research. Symposia are led by the course instructor.

• **Field trips** provide the opportunity to explore a broader range of biological research activities. Field trips acquaint participants with additional aspects of biological research and with resources that can be used with their students. Each field trip is under the supervision of the course instructor or a host researcher.
  - Individual research projects are required of each participant. Each project is selected, designed and completed by an individual participant. A written project description and oral presentation are due on the last day of the course.

**Textbook**
There is an optional textbook for this course: Townend, John. 2002. *Practical Statistics for Environmental and Biological Scientists*. John Wiley and Sons, Ltd. 276 pp. This is a good, general introduction to experimental design in the life sciences. It can be used as a reference to supplement readings from the webtext in the course website.

**Webtext**
The course website contains an online, supplemental set of readings, A Conceptual Review of Experimental Design for the Life Sciences that provides a compact, essentially non-mathematical overview of experimental design.
**Laboratory Manual**

The laboratory manual is available online within the web site associated with the course. The manual consists of a series of research problems, each accompanied by reference articles and web sites on useful experimental procedures. Exercises are available in condensed, downloadable formats for use as hard copies away from networked computers.

**Grading**

Grades are determined by three, equally-weighted portions of the course:

150 points

*Oral presentations* by research groups during the three research symposia are graded on a 50 point scale, with the same numerical grade assigned to each group member.

150 points

*Individual portfolios* of three written laboratory designs. These designs are versions selected by each participant from those performed during the course and modified to be used with the participant's students.

150 points

*Original individual research project* performed during the course. This project is based on an experimental design conceived, executed, and analyzed by individual participants. Grading is based on 50 points for an oral presentation to the class and 100 points for the final written report.

450 points

**TOTAL**