

Biology 2L06 Experimental Design in Biology COURSE OUTLINE, 2016-2017

Professor: Dr. Roger Jacobs

Office Hours: TBD, LSB-429

Office Address: LSB 429 Email: jacobsr@mcmaster.ca

Teaching Assistants: Danielle MacDuff and Lauren

Office Hours: By arrangement only, email to request a meeting

Email:

Course Coordinator: Alison Cowie

Office Hours: 9am – 10am Monday – Thursday in BSB201A

Email: cowieal@mcmaster.ca

Course Related Issues:

ALL STUDENTS taking Bio 2L06 are required to complete the Biosafety course HTH SCI 1BS0 (listed on MOSAIC). We cannot allow you to complete labs 2,3,4 or 6 in Biology 2L06 unless you have completed this safety course.

Lectures: Mon, Thurs 5:30 – 6:20pm in BSB B155 Labs: Tues, Wed 2:30-6:30 pm in LSB-108

Materials:

- Text: There is no required text. Readings will be linked to the course on Avenue <https://avenue.mcmaster.ca>.
- Lecture material related to experimental design can be explored further in two books available in Thode Reserve:
 - Experimental Design for the Life Sciences, GD Ruxton, QH 307.2 .R88 2006
 - Experimental Design for Biologists DJ Glass, QH 323.5 .G565 2007
- Lab manuals will be posted on Avenue.
- You must bring a lab coat and goggles to lab each week, you may not work in the lab without proper protection.
- You are required to use a hardcover Lab Notebook to record your work. This book will be submitted for assessment. You can use the remaining pages in your “Department of Biology Student Lab Notebook” from 1A03, or purchase another.

Course Objectives:

Prepare students for a career that involves scientific research or the critical interpretation of the research of others. Lay a strong foundation and provide essential preparation for a B.Sc. thesis or postgraduate thesis research. Open to students in Level II or III, but enrolment is limited.

Course Description and Format:

SEP: The course is centered upon 8 labs, each in a different discipline of biology (ecology, microbiology, plant biology, cell biology, physiology, genetics, behaviour and bioethics). Each lab will expose students to questions and techniques in different research specializations in Biology, while also highlighting different problems and issues in research that transcend the specializations. Thus students will become proficient in translating observations to a question, progressing from a hypothesis to experimental design (causative and correlative paradigms) and execution,

interpretation and communication of results.

Implementation:

- Dr. Jacobs leads all the labs and lectures dealing with experimental design.
- 8-10 guest lectures introduce specialization-specific orientation to the field and the question.
- 6 labs on a 2-4 week cycle interspersed with tutorials based on your lab work or teaching a new tool to use for analysis or presenting your lab results
- First Term – 2 weekly lectures – 1 as lab intro (most weeks) and 1 to explore research design and communication issues
- Second Term – 2 weekly lecture and one tutorial/lab where students will give oral presentations, participate in group debates or work in groups to design and develop a detailed research plan

COURSE AND LAB SCHEDULE:

Week 1: Sept 7

Course Introduction, TA introductions, expectations etc.

Week 2 and 3: Sept 11-15, 18-23- ECOLOGY

LECTURES: What makes a good question? -What makes a good hypothesis? (brainstorm) - Benchmark exercise in hypothesis formulation

Sept 14 — Guest Chad Harvey: Ecosystem health and Great Lake marshes

LAB 1: Ecological indicators and ecosystem health.

Focus on observation. Students will examine an issue of biodiversity related to organisms collected from the Hamilton Harbour/Cootes Paradise. Students are challenged to devise ways to describe and assess biodiversity. The objective is to make an observation that can be used to formulate a testable hypothesis.

Assessment: Ecology Data Analysis and 1 page Lay Abstract of work.

Weeks 4, 5 and 7: Sept 25-28, Oct 2-5, Oct 16-19 MICROBIOLOGY

LECTURES: More on hypothesis formulation -testability by experimentation or by observation (correlation vs causation) -case study of a good research fallacy -In class exercise TBA -Students will work in small groups (2-3)

Sept 26 – Guest Danielle Sexton: Quorum sensing in bacteria, mechanism, adaptive functions, role in pathogens.

LAB 2: Quorum sensing and agricultural pests

Students will culture a QSS strain of *Pseudomonas* in the presence of an indicator strain (*E. coli* pSB401) that fluoresces in the presence of ASL (Homoserinelactone) and in the presence of a competing strain that degrades ASL. The question is “Do ASL degrading cells outcompete quorum sensing cells?” Students must formalize their hypothesis and experimental design before coming to the lab. Time permitting, the experiment can be repeated on potato plants, to test for biological control of a plant pathogen.

Assessment: Lab Book notes, submit a report on the hypothesis you developed, and describe the experimental design, procedure, and interpret the outcome.

Weeks 8 and 9: Oct 23-26, Oct 30- Nov 2 PLANT BIOLOGY

LECTURES: About experimental design

- designing meaningful controls, designing for statistical inference
- In class exercises in assessing experimental design- assignment
- Visual representation of Data -how to interpret a figure

Oct. 23 – Guest Robin Cameron - Disease Resistance in Plants

LAB 3: Disease Resistance in Plants

Observe and measure resi

and basal resistance) and disease in *Arabidopsis* and correlate symptoms with in planta bacterial growth and the expression of defense-associated genes. Students will try to match the plant genotype to the resistance phenotype.

Assessment: -First steps to write a Letter to Nature: Abstract and Results
 -how to represent your data
 -assignment: interpret a figure

Weeks 10: Nov 2-9 PHYSIOLOGY

LECTURES: - Nov 2 - Dr. Graham Scott- Autonomic control of the heart

Nov 7 - Dr. Robin Cameron - Systemic Resistance Lab Review in LSB 108

LAB 4: Autonomic Control of the Frog Heart

In this laboratory y

function of the heart in the frog and mimic the effects of autonomic control by applying adrenaline and acetylcholine directly to the heart. You will also attempt to determine the nature of the adrenergic and cholinergic receptors in the heart by the use of competitive blocking agents.

Assessment: Write a full letter to Nature.

Week 11-12: Nov 13 – 27

LECTURES: Visual representation of Data -how to interpret a figure -how to publish a paper

COURSE AND LAB SCHEDULE, Winter Term:

(further details will be available in December)

Week 1:**LAB 5: Cytoskeletal Regulation of Chromatophore Biology**

Students will learn how to isolate living chromatophores from fish scales, and prepare them for assays of chromatophore distribution. They will be presented with a number of reagents that alter the cytoskeleton or alter signal transduction. Students will progress from question to hypothesis to experimental design and execution to data analysis to writing an article.

Assessment: Interpretation of data, and presentation of data

LAB 6: Genetic Model Organisms: Physiology and Behaviour in *Caenorhabditis elegans***LAB 7: Bioinformatics****LAB 8: Hydra Behaviour and Ecotoxicology****Marking Scheme:**

10% Midterm exam (December take home)

15% Final exam (April take home)

20% Class Assignments

55% Lab Assignments

Policy on missed work, extensions, late penalties and missed exams:

If you are absent from the university for a minor medical reason, lasting fewer than 3 days, you may report your absence, once per term, without documentation, using the McMaster Student Absence Form. Absences for a longer duration or for other reasons must be reported to your Faculty/Program office, with documentation, and relief from term work may not necessarily be granted. When using the MSAF, report your absence to Alison Cowie, cowieal@mcmaster.ca. Then contact Alison Cowie immediately (normally within 2 working days) to learn what relief may be granted for the work you have missed. Normally, a missed lab will be completed with your lab-mate's data and both labs and assignments will be given an extension for submission. Please note that the MSAF may not be used for term work worth 25% or more, nor can it be used for the final examination.

Academic Integrity: You are expected to exhibit honesty and use ethical behavior in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity.

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behavior can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/ or suspension or expulsion from the university. It is your responsibility to understand what constitutes

academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at <http://www.mcmaster.ca/academicintegrity>

The following illustrates only three forms of academic dishonesty:

- Plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
- Improper collaboration in group work.
- Copying or using unauthorized aids in tests and examinations. [SEP]

The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes." [SEP] As a student enrolled in this course you have been granted permission to access an online learning management system, Avenue to Learn. Avenue to Learn course pages are considered an extension of the classroom and usage is provided as a privilege subject to the same code of conduct expected in a lecture hall (see relevant section of the student code of conduct below). This privilege allows participation in course discussion forums and access to supplementary course materials. Please be advised that all areas of Avenue to Learn, including discussion forums, are owned and operated by McMaster University. Any content or communications deemed inappropriate by the course instructor (or designated individual) may be removed at his/her discretion. Per the University Technology Services Code of Conduct, all members of the McMaster community are obligated to use computing resources in ways that are responsible, ethical and professional. Avenue to Learn Terms of Use are available at <http://avenue.mcmaster.ca>

[SEP] **Student Code of Conduct - Appendix D. Major Offences include, but are not limited to:**

- engaging in disruptive behaviour. Disruptive behaviour is behaviour in class or out of class that involves [SEP] substantial disorder and/or disrupts the operation of the University
- engaging in verbal or non-verbal behaviour or communication toward an individual or group which is considered to be intimidating, harassing and/or discriminatory