BIOLOGY 3IR3 / MOLECULAR BIOLOGY 3I03
INDEPENDENT RESEARCH PROJECT
COURSE OUTLINE, PERMISSION FORM AND GUIDELINE ON COURSE EVALUATION

Course Coordinator: Ana Campos (camposa@mcmaster.ca) LSB-541, Ext. 23095
Course Administrator: Rebecca Woodworth (biology@mcmaster.ca) LSB-215, Ext. 23049

Prerequisite(s): Registration in level III or IV of any Honours Biology program. Biology 2L06 is recommended preparation. Permission of the department is required. Students are expected to have a C.A. of at least 8.0 for Biology 3IR3 and 9.0 for Mol Biol 3I03.

COURSE OUTLINE

The objective of this course is to give students the opportunity to gain experience in a research environment. Research is integral to the Biology Program. It supports the development of a number of relevant and highly transferable skills. Students enrolled in Biol 3IR3/Mol Biol 3I03 gain valuable experience in preparation for a career in the private sector, professional schools or for advanced studies at the graduate level. Therefore completion of a research project is a major contributor of a successful undergraduate education. An independent research project offers a great opportunity to experience a potential work place, network with Professors and peers and engage in hands on learning.

The course consists of a twelve-week research project conducted during one term under the supervision of a full time or associate faculty member from the Department of Biology or any other department at McMaster University. While the workload is comparable to that of a 3-unit course, Biology 3IR3 / Molecular Biology 3I03 differs from other courses by the independent nature of the work and the degree of initiative required to complete a research project. Students should consider the time commitment to be around **8-10 hours per week** (scheduling arranged by supervisor). If you are working with a supervisor outside the Department of Biology, you will require a co-supervisor within the Biology Department. Your co-supervisor will communicate with the supervisor in determining a final mark for the course. An information session with the Course Coordinator, on the expectations and logistics of the course, takes place at the beginning of the semester. The course coordinator is available throughout the term for consultation and guidance as needed. The course administrator is responsible for entering the permission and final marks. Students may receive credit in only one of Biology 3IR3 and Mol Biol 3I03.

Finding A Suitable Research Supervisor and Project

It is the responsibility of the student to make arrangements with a supervisor (and co-supervisor in case the supervisor is not associated with the Department of Biology). A research project is agreed upon following discussion by the supervisor and the student. It must be focused and suitable for the twelve-week period of the term. The supervisor is responsible for providing the information and guidance on the research project, explaining the assessment scheme and submitting the evaluation at the end of the term. The student must obtain permission to enroll in the course by completing and submitting the *permission form* (attached) and a one-page *research proposal* to the Course Administrator in LSB-215. After review and approval by the Course Coordinator, the permission will be entered on-line.

Acknowledgement of Previous Work Related to the Project
Any work completed prior to the student's registration in Biology 3IR3 / Molecular Biology 3I03 **should not be included** as part of the student's evaluation or final report without clearly identifying and acknowledging it. Students who may have previously worked in the same laboratory in which they are completing a research project in Biology 3IR3 / Molecular Biology 3I03 are asked to provide a one-page summary of any work that is related to the project being undertaken in the course. This summary should be submitted with the research proposal.

Evaluation Rubric
The assessment in the course is based on the **laboratory performance** (approximately 8-10 hrs per week in one term), on keeping a proper **laboratory notebook** or equivalent record of research activity and data gathering and a **mid term progress report** and a final **written report**.

- Mid-term progress report 20%
- Laboratory performance 30%
- Laboratory notebook 20%
- Final report 30%

Safety Training and Liability Issues
Appropriate safety training (i.e. WHMIS, Radiosafety, Biosafety, Fire Safety) must be completed prior to beginning laboratory work. It is the responsibility of the supervisor to ensure that students have received the required safety training. The information regarding safety training can be found on the Biology web site. The student is responsible for bringing written confirmation of training dates and location of training to Biology Reception Desk, LSB-215

Application Deadlines
Fall, Term 1: July 1st;
Winter, Term 2: November 1st;
Fall/Winter, Term 3 July 1
Spring/Summer, Term 1, 2 or 3: March 15

Academic Dishonesty
Academic dishonesty consists of misrepresentation by deception or by other fraudulent means and 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. For information on the various kinds of academic dishonesty, please refer to the Academic Integrity Policy located at:

http://www.mcmaster.ca/policy/Students-AcademicStudies/AcademicIntegrity.pdf

The following illustrates only three forms of academic dishonesty:

1. Plagiarism, e.g. the submission of work that is not one's own, any text or ideas from books, the internet or journals, or work for which other credit has been obtained.
2. Improper collaboration in group work.
3. Copying or using unauthorized aids in tests and examinations

BIOLOGY 3IR3 / MOLECULAR BIOLOGY 3I03 INDEPENDENT RESEARCH PROJECT PERMISSION FORM

STEP 1. Student to complete the following:

Student Name _____ Student No. _____
SURNAME GIVEN NAME

MACID _____ Preferred E-mail _____

Current Program: _____

I wish to be considered for enrolment in:

☐ Fall Term 1 ☐ Winter Term 2 ☐ Summer Term

STEP 2. Obtain the permission of a Supervisor:

Supervisor _____ Signature_____
please print

Department_____

E-mail Address _____ Telephone Ext._____

Office Address _____ Mailing Address_____

Student will be working in Room _____ Ext._____

Project Title

If you are working with a supervisor outside the Department of Biology, you will require a co-supervisor within the Biology Department. Your co-supervisor should be provided with a copy of the mid-term progress report and the final report and will communicate with the supervisor in determining a final mark for the course.

STEP 3. Obtain the permission of a co-supervisor.

Supervisor _____ Signature_____
please print

Department_____

E-mail Address _____ Ext._____

Office Address _____ Mailing Address_____

STEP 4. Student and supervisor to review course evaluation rubric and deadlines, and agree upon format of the final report and the laboratory notebook (please consult "Guidelines on course evaluation written submissions and deadlines" below).

Final mark must be submitted to Ms. Woodworth before the end of exam period of the academic term in which the research project occurred (LSB-215, biology@mcmaster.ca) Please consult McMaster calendar for precise dates (http://registrar.mcmaster.ca/category/dates/sessional/).

- Mid-term progress report 20%
- Laboratory performance 30%
- Laboratory notebook 20%
- Final report 30%

Supervisor _____ Student _____

STEP 5. Attach a ONE-PAGE summary of the research proposal

Students who may have previously worked in the same laboratory in which they are completing a research project are asked to provide an additional one-page summary of any work that is related to the project being undertaken in the course. Any work completed prior to the student's registration in Biology 3IR3 / Molecular Biology 3I03 cannot be included as part of the student's final report without clearly identifying and acknowledging it.

STEP 6. The Communication Agreement must be reviewed and signed by the student and both supervisors.

Mol Biol 3I03 Bio 3IR3 Communication Agreement

1. Should the Supervisor be unavailable for more than 2 weeks, adequate supervision by a colleague, postdoctoral fellow or senior graduate student must be arranged and communicated in advance to both the Student and Course Coordinator.
2. The Supervisor will ensure that the Student has completed the required Health and Safety Training prior to beginning work in the laboratory.
3. The Student is responsible for ensuring the entire Supervisory Committee [Supervisor, Co-Supervisor(s) or other Supervisory individuals if any] are kept up-to-date on progress and change in research topic or experimental procedure throughout the course.
4. Supervisors are expected to communicate grades for each component in a timely manner. The Student should consult with the Course Coordinator if a mark for the first two course components has not been received within one week of the due date (see List of Important Dates).
5. Any modifications of the mark breakdown for the course must be discussed and approved by the Supervisor, Student and the Course Coordinator.
6. Any change in submission deadline for the final thesis or project report must be justified at least 5 days in advance, and in writing to the Course Coordinator. The Course Coordinator reserves the right to penalize late submissions by up to 5% per day.

I acknowledge that I have read, understood and accept the above course requirements:

_____

Signature of Student Date

_____

Signature of Supervisor Date

_____

Signature of Co-Supervisor Date

STEP 7. Return this form and a ONE-PAGE summary of the research proposal to Rebecca Woodworth (LSB-215) for final approval by the Course Coordinator. The Course Coordinator will consider the application only after submission of the ONE-PAGE summary and all forms completed and signed.

The information gathered on this form is collected under the authority of The McMaster University Act, 1976. The information is used for the academic, administrative, and statistical purposes of the Department of Biology including, but not limited to, maintaining records; academic counseling and the administration of examinations. Personal student information provided on this form will not be used for any unrelated purpose without the consent of the student. This information is protected and is being collected pursuant to section 39(2) and section 42 of the Freedom of Information and Protection of Privacy Act of Ontario (RSO 1990). Questions regarding the collection or use of this personal information should be directed to the Manager of Instructional Programs, Department of Biology, McMaster University.

FOR DEPARTMENT USE:
COURSE COORDINATOR APPROVAL: _____

Retain a copy for your records and make sure that both supervisors have a complete copy of the signed forms.

BIOLOGY 3IR3 / MOLECULAR BIOLOGY 3I03 INDEPENDENT RESEARCH PROJECT GUIDELINE ON COURSE EVALUATION, WRITTEN SUBMISSIONS AND DEADLINES

A) <u>Mid-term Progress Report</u> (20%)
Term 1: submitted to supervisor third Friday of October
Term 2: submitted to supervisor third Friday of February

The mid-term progress report must be submitted directly to the supervisor. The report should represent the beginning outline of the final report. It is suggested you follow the format of a standard journal in Biology (discuss with your Supervisor which journal) and include the following sections:

1. Title Page:
   - Title of project
   - Student name and number
   - Supervisor name
   - Course name
   - Date submitted

2. Table of Contents (with page numbers)

3. Abstract:
   Provide a one-page concise summary of the question(s) asked, results and significance of the project.

4. Introduction:
   Briefly summarize the state of knowledge in the area of study, provide a rationale for the project, a statement of the question addressed in the project and approach(es) used in your studies.

5. Materials and Methods:
   This section should contain sufficient details of the experimental protocols for someone else to repeat the experiment. If the procedure has already been published in a journal article in detail, a reference will suffice. However, if a published procedure was modified, the alterations to the original protocol should be clearly outlined. Describe in detail any new techniques developed during the project.

B) <u>Laboratory Performance</u> (30%)
This component of the evaluation will take into consideration the daily work of the student in the laboratory. The supervisor will evaluate, the work habits (10%), ability at research (10%) and initiative of the students in the laboratory (10%). Learning in a research environment requires students to interact and communicate adequately with their laboratory colleagues. Problem solving is an acquired skill that is essential for all students who want to become independent investigators. Moreover good work habits (approximately 8-10 hours per week), ability in research and a good degree of initiative are all required to be a successful scientist as well as any other professional. Students are encouraged to explore alternative interpretations of data and to suggest lines of investigation to be undertaken.

Safety in any laboratory setting is first and foremost. Before performing any protocol, students should be familiar with the materials, reagents and possible hazards involved in the experiment. Students are reminded to consult the **Material Safety Data Sheets (MSDS)** for each reagent that they use. Don't hesitate to ask questions in case you are not confortable with any aspect of the experimental procedures.

C) Laboratory Notebook – preliminary review
Term 1: submitted to supervisor third Friday of October
Term 2: submitted to supervisor third Friday of February .

Maintaining a good laboratory notebook or any other kind of record of activities is essential in government, industrial and academic laboratories for many reasons. In government health laboratories, detailed records of procedures must be kept for later scrutiny. In the biomedical industry (e.g. pharmaceutical manufacturing), properly recorded laboratory notebooks must be supplied for patent applications. In academic laboratories and other research environments, the laboratory notebook also provides the "memory" or archives of the research project, containing detailed information on past procedures, results/data and pitfalls/problems encountered in the research project. Since research projects often span a period of several years, the amount of accumulated documentation can be considerable. It is therefore important to learn to keep good, complete and accurate notes in the laboratory notebook.

For this course, you are requested to purchase the Student Laboratory Notebook in the bookstore. The laboratory notebook should be thought of as a diary of activities that are described in sufficient detail to allow another scientist to follow your steps. The notebook section will be worth 20% of your final grade.

Important overall criteria for the evaluation of your laboratory notebook will be its accuracy and organization. As much as possible, you should write legibly all information and procedures required to understand the experiments and, if necessary, to repeat them even by an outside investigator who is not familiar with the project. Draw tables with rules (you may also create tables and graphs on the computer, print and paste them in) and clearly label the different subsections and figures of your writing so that others can easily comprehend what you did. We do not recommend first writing the information on a loose piece of paper and then transcribing the information in your laboratory notebook. This practice creates errors or omissions that are not compatible with proper research practices. We understand that errors may occur when notes are taken at the bench and do expect that laboratory notebooks may not always be "neat". It must however be complete and accurate.

Copying the content of a manual or other published sources is strictly forbidden and, when discovered, will be penalized (see statement on Academic Integrity).

For each experiment or study, the following format is recommended:

1. Date at the beginning of each section/experiment.

2. Title: e.g. Microscopy and Examination of Living and Stained Cultures

3. Objective: Briefly state what you are attempting to do/determine (measure, weight, stain, identify, infect…)

4. Materials and Methods: If the same as an established procedure (routinely used in the lab), used in previous studies described in your laboratory notebook or drawn integrally from a published source (ex. Textbook), provide the relevant reference. If different, state the modifications. For your own understanding, use flow charts to illustrate procedures.

5. Results: If possible, use table(s) and/or figure(s) to present raw data. Provide brief descriptions of what the data mean.

6. Discussion: Briefly discuss what you can conclude from your results. Sometimes experiments fail either because of an unanticipated variable or because of experimental error. If your results deviate from expectations, identify possible sources of error, provide alternative hypotheses, and suggest improvements for future experiments.

7. Sign each single page. This is an essential practice in government and industry labs.

The laboratory notebook should be submitted to the supervisor with the final report (see below) at the end of the term.

D) The final report (30%) and the laboratory notebook (20%) should be submitted to the supervisor (and co-supervisor if applicable) and course coordinator by the last official day of classes.

The final report should follow the format of a standard journal in Biology (see the general guidelines provided below) and include the following sections:

1. Title Page:
   - Title of project
   - Student name and number
   - Supervisor name
   - Course name
   - Date submitted

2. Table of Contents (with page numbers)

3. List of Abbreviations:
   Only describe abbreviations that are not commonly used; for instance, do not describe acronyms such as “DNA”, “RNA”, etc… or units of time and mass

4. Abstract:
   Provide a one-page concise summary of the question(s) asked, results and significance of the project.

5. Introduction:
   Review the state of knowledge in the area of study as published in the current scientific literature, provide a rationale for the project, state the question(s) and hypothesis addressed in the project and brief outline of approach (as) used in your studies

6. Materials and Methods:

This section should contain sufficient details of the experimental protocols for someone else to repeat the experiment. If the procedure has already been published in a journal article in detail, a reference will suffice. However, if a published procedure was modified, the alterations to the original protocol should be clearly outlined. Describe in detail any new techniques developed during the project.

7. Results:
   Summarize the data obtained from your experiments in figures and/or tables, as appropriate and including a proper heading (for tables) and figure legend. Figures and tables should be clearly labeled and easy to interpret. Proper statistical analysis is required in most cases or at least some statement about reproducibility. Include both positive and negative results, making mention of failed experiments.

8. Discussion:
   Provide the interpretations of your results in this section. Do not simply restate the conclusions but analyze the meaning of these results in the context of the question addressed in your project and stated at the end of your Introduction. If appropriate, use models to illustrate your point. Discuss the potential carats and pitfalls of the experiments. Discuss the reason(s) why an experiment may have failed and, if possible, provide an alternative experimental approach to alleviate the problem. Also include suggestions for future work.

9. References:
   All statements of facts that appear anywhere in your research proposal must be substantiated with a citation of a peer reviewed publication. Include the most relevant and current papers on the subject. In the case that the observation or conclusion described has not yet been published but has been directly communicated to you by members of your laboratory or colleagues in another Institution a statement to this effect must be included (e.g. S. Harper and J. Chretien data not published or E. Snowden and J. Assange, personal communication). Accuracy is important. The use of a referencing program (ex. Endnote) is strongly recommended. Any standard style of referencing used in scientific journals is acceptable. We request that the format chosen include the complete title of the article.

10. General Guidelines:
    - 10-20 pages in length
    - double-spaced throughout (but excluding the reference list)
    - 12 point font
    - 2.5 cm side margins
    - 3 cm top and bottom margins
    - all pages numbered consecutively, including title page, references, tables and figures
    - the report may be bound in any manner the student desires

50-59: Did not meet standards expected of third year student **(D)**
60-69: Met minimum standards expected of third year student **(C)**
70-76: Met average standards expected of third year student **(B to B-)**
77-79: Met above average standards expected of third year student **(B+)**
80-84: Readily exceeded expectations of third year student; shows promise in placement work **(A-)**
85-89: Greatly exceeds expectations of a third year student; demonstrated placement work competence **(A)**
90+: Greatly exceeded expectations of third year student; accomplished placement worker **(A+)**