**BIOLOGY 3IR3 / MOLECULAR BIOLOGY 3I03 – Independent Research Project 2014-15**

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## Course Guidelines

Research is an important component of the Biology Program. The objective of this course is to give the students the opportunity to gain laboratory training in a research environment. The course consists of a twelve week research project conducted in a laboratory in the Department of Biology. Therefore, the students gain an invaluable experience in preparation for a career in the private sector or for advanced studies at the graduate level. An information session on the expectations and logistics of the course will take place at the beginning of the semester with the Course Coordinator.

## Expectations

The assessment in the course is based on:

- laboratory work (approximately 12 hrs per week in one term)
- keeping a proper laboratory notebook
- final written report

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.

## Finding a Suitable Research Supervisor and Project

- It is the responsibility of the student to make arrangements with a supervisor in Biology.
- Following discussion, a suitable research project is agreed upon by the supervisor and the student. The research project 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

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.

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.

**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.

**Grading and Assessment**

The final grade will be based on the three following components:

a) Mid-term progress report 20%
b) Laboratory performance 30%
c) Laboratory notebook 20%
d) Final report 30%

**NOTE: Copies of the Laboratory notebook and final report MUST be provided to the Course Coordinator for review before a final grade can be submitted.**

**a) Mid-term Progress Report (20%)**
**Term 1: submitted to supervisor October 24, 2014**
**Term 2: submitted to supervisor February 13, 2015**

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) Laboratory Performance (30%)**

This component of the evaluation will look into the daily work of the student in the laboratory. In this component, the work habits (10%), ability at research (10%) and initiative of the students in the laboratory (10%) will be evaluated by the supervisor. Learning in a research environment requires students to interact and communicate adequately with their lab mates. Problem solving is an acquired skill that is essential for all students who want to become independent investigators. This skill requires good work habits (approximately 12 hours per week), ability in research and a good degree of initiative. Students are encouraged to explore alternative interpretations of data or to suggest what line of investigation.

**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.

**c) Laboratory notebook – preliminary review (20%)**

**Term 1: submitted to supervisor October 27, 2014**
**Term 2: submitted to supervisor February 16, 2015**

Maintaining a good laboratory notebook 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 the accuracy and organization of your notebook. 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 to 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".

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 resubmission of Laboratory notebook**
**Term 1: submitted to supervisor and course coordinator by November 28, 2014**
**Term 2: submitted to supervisor and course coordinator by April 3, 2015**

The final report must be submitted directly to the supervisor before the last day of classes. The report should follow the format of a standard journal in Biology (see the general guidelines provided below) and include the following sections:

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

7. Table of Contents (with page numbers)

8. 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

9. Abstract:

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

10. 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.

11. 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.

12. 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.

13. 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.

14. References:

Any standard style of referencing used in scientific journals is acceptable. Accuracy is important. Include the most relevant and current papers on the subject. The use of a referencing program (ex. Endnote) is strongly recommended.

15. General Guidelines:

- 20-30 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

**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

**PLEASE RETAIN THIS INFORMATION FOR FUTURE REFERENCE.**