UNIVERSITY OF WATERLOO | Department of Biology

BIOL499 Senior Honours Project

General Information Document

Introduction and Eligibility

Biology 499 is a two-term experimental research course (BIOL499A, BIOL499B) with a total credit value of 1.0. While other one term lecture/lab courses involve 5-6 hours of participation per week, the time commitment for BIOL499 is less predictable. If you are considering taking BIOL499 based on the minimum number of hours required, you are likely not an appropriate individual for this course. Rather, it is for students who want to experience 'real life' science and the irregular time commitments and thrills involved. It is open to students who are entering their 4th year. Eligibility is limited to students in Honours Biology, Honours Biochemistry, Honours Biomedical Sciences, Honours Environmental Science (Ecology specialization), and Honours Life Physics (Biophysics specialization). Students in other programs may be considered if space is available but priority goes to students in Department of Biology programs. Only students attaining > 73% cumulative major average are normally accepted, although students with > 78% major average in their two most recent terms (normally 3A & 3B) may also be accepted. BIOL499 may not be taken by students before they reach the fourth year of their program. Normally, the project will be done on campus and it must not be part of a Co-op work term or a USRA funded term.

Prerequisite

It is strongly recommended that students enrolling in BIOL499 take BIOL361 Biostatistics and Experimental Design. Other relevant preparatory coursework will depend on the nature of your 499 research. When applying to the program you will be asked to list relevant coursework that has prepared you for the 499 research program. For example, if your proposed supervisor studies animal physiology it would be helpful for you to have taken BIOL370 & BIOL371, but if you hope to join a lab that works in bioinformatics then BIOL365 would be important.

Finding a Project and a Supervisor

Before you complete Co-op Term 3B or the winter term of year Three Regular, you should research potential supervisors and their research programs. To get an idea of the kind of research that is conducted in the Department of Biology, check out the Research Areas of the departmental website. Eligible 499 supervisors include research-active Faculty Members in the Department of Biology as well as faculty members from other departments that have an active Cross-Appointment in Biology. You may then visit those faculty members whose research areas appeal to you to discuss further details. These visits are for information and discussion only and no commitment on either your part or on the faculty member's part is implied. If you are interested in working with a cross-appointed faculty member, it is important to ensure that their cross-appointment is still in force as these appointments are not permanent and expire after a period. Note that not

all faculty members have active research programs, and of those that do not all will supervise 499 students, and those that do typically have a limited number of positions available. Lecturers typically do not supervise BIOL499 students, and will only be approved as supervisors under special circumstances. Opportunities to join a lab as a 499 student are assigned on a competitive basis. There may be many students apply to work with a prospective supervisor, but only 1 or 2 positions available in their lab. It is best to consider multiple options in case your first choice is not available.

Application Procedure

After having read this information package and visited with faculty members whose research appeals to you, it is time to fill out your application. Apply at https://uwaterloo.ca/biology/undergraduate-studies/biology-courses-and-instructors/application-enroll-biol-499. The form asks for information about you, your grades, your preferred supervisors, related coursework you have completed, and requires a short paragraph outlining your interest in the BIOL499 program.

Once a student has been approved for academic requirements by the course coordinator, BIOL499 applications are passed on to the faculty members listed by the student for acceptance. Students may have to go through the course selection process before they know whether they have been accepted into the BIOL499 program. In this case, it is recommended that students select (and enroll if necessary) in an alternate course but pursue the possibility of finding a 499 supervisor. If accepted into the program and a supervisor agrees to take the student, enrollment in BIOL499 will be completed by Biology Administrative Staff, Undergraduate Studies, and a course swap with an alternate course will be completed if necessary. Students cannot enroll themselves in BIOL499; this must be done by personnel in the Biology Undergrad Office (students will be contacted by email as necessary).

Students may begin 499A in either F, W or S terms provided this is acceptable to the supervisor. Due to the large number of applicants wishing to start in the Fall term there is a posted application deadline (usually late March) for fall entry to the program. Any student wishing to apply to BIOL499 after the deadline will be considered on an individual basis. Winter and Spring 499 cohorts are typically smaller and do not have set deadlines. Applications are considered on an individual basis, but it is recommended that students submit their application at least 6 weeks before the start of the term.

Information Meetings

An information session for students interested in BIOL499 is typically held in late January or early February. At this meeting, the BIOL499 coordinator will provide additional information about the 499 Program, application procedures, and provide an opportunity for students to ask any questions that they might have.

In the first month of each semester, the BIOL499 Coordinator will meet with BIOL499A students. This is an “orientation”, wherein students will meet other members of their cohort, and the BIOL499 Coordinator will review course requirements (i.e., contents of this document) and set the official due date for proposal submission.

A second general information meeting for students will be scheduled during the second month of the second term (i.e., in BIOL499B), and will provide further information about

oral presentations and final reports, including colloquium date and deadlines for abstracts and final reports.

Beginning BIOL499

In early September (or January, or May), students accepted into the program should meet with their research supervisor to ensure that no problems have arisen, and to let the supervisor know you have returned to campus as planned. After beginning the research program, all further discussions or problems should be sorted out with your research supervisor, who is responsible for ensuring that you are working effectively on the project, and who will be checking on your progress and making suggestions and recommendations throughout the program. Lack of satisfactory progress in the first term will be brought to the attention of the BIOL499 Coordinator (and/or Biology Associate Chair Undergrad, if appropriate). The BIOL499 coordinator should be contacted by either the student or the supervisor when serious problems arise during 499A. Efforts will be made to sort out such problems. **Failure to complete both BIOL499A and BIOL499B will result in no credit for either term**.

BIOL499 requirements and deliverables

Second Reader. All deliverables for BIOL499 will be evaluated by your supervisor and a second reader. The BIOL499 thesis program is, in many ways, operated similar to a graduate program. In the same way that graduate students have a committee that supports their research and evaluates their work, BIOL499 has a supervisor and second reader for this purpose. The second reader is someone that can be an extra resource, may provide research support and advice, and will provide an evaluation of your proposal, presentation, and thesis (see below for details).

The second reader is almost always another faculty member, but can sometimes be someone that works in government or industry and is equivalent to a research professor in rank (must be approved by the BIOL499 coordinator). Less commonly a PhD student can serve as a second reader, but MSc students are not eligible. One member of the advisory committee must be a Department of Biology faculty member. If your supervisor is cross-appointed to biology, the second reader must have a primary appointment in the Department of Biology.

A note on deadlines. The BIOL499 program is an excellent introduction to scientific research. Scientific researchers face constant deadlines, whether for funding proposals, budget timelines, conference abstract deadlines, publication submission deadlines, grant reporting and more. Missing these deadlines has severe consequences. If a grant proposal is not submitted by the deadline it is not considered for funding. If a conference abstract is not submitted by the deadline then the researcher does not get to present their research at the conference. If grant reports and not submitted on time it can affect future funding. Therefore, deadlines are taken just as seriously in BIOL499. Extensions are generally not granted and are only approved under exceptional circumstances. *Extensions can only be approved by the BIOL499 coordinator, not your supervisor or second reader.*

Deliverables:

1) Project Proposal. At the beginning of the BIOL499A term, students will prepare a written proposal describing the relevant background and the details of their proposed research project. Proposal due date is set by the BIOL499 coordinator each term, but is typically around the end of the 4th week of the term. If you think you cannot meet the set deadline due to extenuating circumstances, consult with your supervisor and contact the BIOL499 coordinator.

For the proposal, as well as other deliverables in the 499 program, you will be graded by your supervisor and a second reader. The second reader is another researcher that is knowledgeable in your research field, with background and experience sufficient to evaluate your research. Your supervisor may select the second reader, or may ask for your input on identifying a suitable second reader. Typically the second reader will evaluate all aspects of your research (proposal, presentation, final report) but it is possible to indicate a different evaluator if the initial second reader is not available for subsequent deliverables.

The proposal should include:

A. Title page. Including title of the project, student name, student ID, supervisor name, name of second reader, date of submission.

B. Introduction. A 2 – 3 page review of literature on the topic and a statement of objectives.

C. Summary of proposed experiments. Explain how the objectives are to be achieved, including experimental design, treatments, controls, and statistical analyses as appropriate. A time line should also be include in this section.

D. Results of research to date (if any). Include data from experiments completed or in progress and indicate their significance. The majority of students have few/preliminary/no results to report this early in the project.

E. References.

The proposal should be approximately six pages in length (double-spaced, not including Title Page, References, Tables, or Figures). Refer to the *Checklist for Written Reports* at the end of this document for specifics.

Penalty: Late Proposals will be penalized at 5% per day.

Proposal submission. When a good draft of the proposal has been prepared, it should be turned in to the supervisor for editing. Plan ahead for time to respond to edits, and be aware that some supervisors may suggest multiple rounds of back and forth revision. Details on the submission procedure will be provided by the BIOL499 coordinator. Once available, marks will be posted on the course Learn site. Students are strongly encouraged to retrieve their marked Project Proposals, so that any comments and/or feedback from the markers can be noted and incorporated into the subsequent presentation and final report. It is the student's responsibility to seek out their graded work.

A checklist for written reports is included at the end of this document. Consult this checklist to ensure you have met all requirements.

2) BIOL499 Poster Session. At the end of BIOL499B, students will present the results of their research at a BIOL499 Poster Session. The specific date is set by the BIOL499 coordinator each semester, but is typically during the last week of classes. Students enrolled in BIOL499A are welcome, and encouraged, to attend to learn about other undergraduate research and help plan for their own poster presentation.

The BIOL499 Coordinator will hold an information session for BIOL499B students to provide details of the poster session, and how to prepare a poster. Students will also be required to submit an abstract for the presentation which is required 1 week prior to the poster session. Abstracts will be compiled and included in an Abstract Booklet for distribution.

3) BIOL499 Final Report. At the end of the BIOL499B term students will submit a comprehensive Final Report. The specific date is set by the BIOL499 coordinator each term, but is typically around the last day of classes for the semester. The final written report will be read and graded by your supervisor and second reader. The information here is meant to serve as a guide and is not intended to be exhaustive. Your supervisor is your best guide for help with format, style, how much material to include, and in what detail. The supervisor will likely have copies of previous submissions, journal articles, graduate student theses, etc. for your inspection and guidance.

General instructions and advice for the Final Report:

A. Laboratory work must be finished before the Final Report is submitted. It isn't possible to report the results of research that hasn't yet been completed. There are lots of things happening at the end of the semester, so plan ahead. Extensions are not normally approved and will only be granted under exceptional circumstances.

B. The report should be formally presented, as if a graduate thesis, or a report to a government agency, or a manuscript for submission to a scientific journal, or similar. The specific format of your report should be decided in advance through discussion with your supervisor. Examples of research reports and scientific publications are readily available. Look at what is commonly done in your field and follow suit. Biology is a diverse field, with different standards and presentation styles among the diverse sub-disciplines. Your supervisor is your best source of advice on expectations for your Final Report.

C. The first page should list the Title of the project, the author, the date of submission, names of the supervisor and second reader, and that the report is submitted as a requirement of BIOL499, Senior Honours Project.

D. The next page should be Acknowledgements and should thank the research supervisor, lab mates, collaborators, and any other Faculty or Department members who have been especially helpful with any aspect of the project.

E. The next page should be a Summary or Abstract, not normally more than half a page, concisely summarizing what is presented in the report. The

abstract/summary must be informative, highlighting any important information or conclusions. The abstract/summary must also be self-contained and should not include any references to outside material or other sections of the report.

F. The Summary or Abstract is followed by a Table of Contents, including a List of Tables and a List of Figures. The Acknowledgments, Abstract, and Table of Contents should be numbered as pages i, ii, iii, etc., and the Body of the report (starting with item G below) should begin with regular page numbers 1, 2, 3 ....

G. The body of the report will usually be written under main headings such as:

Introduction: A brief outline of what the project is about and why it was started. It should include an outline of previous work in the area and clear statements of hypotheses tested and/or the main objectives. Ensure that relevant peer-reviewed literature is cited.

Materials and Methods: Sufficient experimental details to enable another worker to duplicate your work or continue it. This section should also include site descriptions if it is a field project.

Results: A description of what you accomplished, including figures, tables and diagrams etc. Take a look at the results sections of peer-reviewed publications to get a sense of how to present your results. This section should be written in full narrative paragraph structure (as for the rest of the report) and should not simply be a list of bullet points or only contain figures and tables. Ensure that all figures and tables are cited in the text.

Figures and Tables: Use figures and tables to present your findings, and possibly important aspects of methodology or conceptual frameworks. General guidance for figures and tables:

- Each figure our table must have a caption that explains the contents of the figure/table. All figures and tables must be cited in the main text.

- Consider which figures and tables are most appropriate for inclusion in the main body of the report. The main body of the report does not need to include every single piece of data and result that you collected. In cases with large numbers of tables and figures, discuss with your supervisor whether it may be appropriate to include some tables and figures in one or more appendices.

- Do not include titles for figures. Captions go below figures and above tables.

- All axes must be properly labelled, including units.

- Ensure that data are clearly presented and can be easily interpreted by the reader. Consider appropriate plotting symbols and ensure font sizes are large enough for easy reading.

- Include sample sizes, whether directly on the figure/table or in the caption.

- Where appropriate, ensure that uncertainty or error bars are included in figures and tables.

- When presenting data summaries, indicate how the data is presented (e.g., 'Data are presented as mean ± standard error).

- Colour can be used effectively in figures, but good practice is to ensure that figures can be interpreted even if printed in grayscale, whether accounting for printers that don't have colour, or for readers that may be colour blind.

Discussion: An interpretation of your results with reference to other published work and to the hypotheses and objectives stated in the Introduction. As for the Introduction, the Discussion section should include citations to relevant peer-reviewed literature.

In some circumstances, Results and Discussion sections may be combined. If you think this format may be appropriate for your report, discuss it with your supervisor.

H. References: The last pages should list all previous work to which reference was made. References should be listed alphabetically. Consult recent theses or journal papers in your field for an acceptable format. Be consistent in your formatting.

I. Appendices: Long tables of results, raw data, additional figures, or computer output may be included in one or more Appendices. Discuss with your supervisor to determine whether one or more appendices may be appropriate for your report. One common situation is the increasing prevalence of the Open Science approach, where raw data is made available for scientific publications. Datasets are often deposited in databases like GenBank or Data Dryad. If your Final Report will be in the format of a scientific publication, it may be appropriate to include your data in an Appendix, equivalent to making your data available from a repository.

J. The length of the report will vary with the project and its details. Organization, logical order of thought, clarity of expression, and attention to detail are important and will greatly influence your final mark.

Penalty: Late Reports will be penalized at 5% per day.

Instructions for submitting your Final Report will be provided by the BIOL499 Coordinator.

A checklist for written reports is included at the end of this document. Consult this checklist to ensure you have met all requirements.

Assessments and Calculation of Final Grade

Your final grade is based on the Project Proposal, Poster Presentation, Final Report, and Laboratory Participation. The BIOL499 coordinator does not have any input on your final grade except in the case of a dispute between two readers, either of whom may refer the dispute to the BIOL499 coordinator for resolution.

The Project Proposal, Poster Presentation, and Final Report are graded by your supervisor and second reader. In most cases one individual will serve as second reader for all three deliverables, but it may be necessary to substitute an alternate second reader in the case that the original second reader is not available.

The Laboratory Participation grade is assigned by your supervisor. At the end of the BIOL499B term, your supervisor will assess the quality and quantity of your day-to-day work. If you put in a good solid two terms of work and put good effort into each of your proposal, presentation, and final report, you can expect a fair grade, even if your experimental results did not turn out as expected. The Biology faculty are realistic and do not expect miracles, but they do expect effort, enthusiasm, responsibility, and reasonable experimental competence. Most students enjoy this field/laboratory/*in silico* project course and learn a lot from it.

Breakdown of Grades:

Project Proposal	15%
Oral Presentation	15%
Final Report	30%
Laboratory Participation	40%

Note**:** BIOL499A will be recorded as “IP” (in progress) on your transcript at the end of term 1. When BIOL499B is complete and the overall course grade is calculated, that mark will appear under both BIOL499A and BIOL499B on the transcript. **Not completing both BIOL499A and BIOL499B will result in no credit for either term.**

Checklist for Written Reports

Before submitting your Project Proposal or Final Report, you should go through this checklist of common errors in writing to optimize your grade in these portions of the course.

1) Correct format

- standard font size (11 point Calibri, 10 point Arial, 12 point Times New Roman or equivalent)
- double spacing throughout
- all references in the literature cited are referred to in text
- all references in text listed in the literature cited
- uniform style of references (refer to a scientific journal in your field for format)
- for proposal: within the page limit (~6 pages, not counting the Title Page, References, Figures, Tables, or Appendices
- for final report: appropriate page length, as determined through discussion with your supervisor

2) Read the manuscript for typographical errors

- Take advantage of spell check and grammar check functionality of your word processor. Watch for the red underline for possible spelling mistakes and the blue underline for possible grammatical issues
- Even with a spell checking, errors can occur since the erroneous word might be a correctly spelled word but with a different meaning. Examples might include “fatal bovine serum” instead of “fetal bovine serum” or “temperature effects metabolic rate” instead of “temperature affects metabolic rate”

3) All paragraphs should be longer than one sentence

- If a paragraph is comprised of just a single sentence, it is a good indication that the idea of that sentence either requires additional support and context, or should be included in another paragraph
- Similarly, check to make sure that each paragraph represents just one main idea. Extra long paragraphs might indicate that there are multiple ideas included in the paragraph, and the text should be split into two or more paragraphs, each one representing a specific and separate idea.

4) No plagiarism

- Plagiarism is a very serious academic offence. For example, graduate students who include plagiarized material in their theses usually forfeit their degrees. Students that plagiarize any component of their proposal, colloquium presentation, or final report will be referred to the appropriate academic integrity office.
- Small sections of text can be quoted directly when set in quotation marks and the source is cited. However, it is rare that a direct quote is required. In general it is preferable to synthesize the ideas from the source material and express them in your own words, citing the original source. For example, instead of saying:

Gonyou and Morrison (1983) studied chickens and found that "cloth jackets effectively insulated the back and breast areas when feathers had been removed".

you could take the information from the original paper and express the ideas in your own words:

Naked chickens are warmer when they wear insulating sweaters (Gonyou and Morrison 1983)

5) Correct spacing

- Leave a space between a number and its unit, e.g., 10 cm.
- Do not leave a space between a number and a percent sign, e.g., 25%.
- With modern fonts, it is not necessary to begin each sentence with a double space. A single space after a period is sufficient.

6) Use brackets correctly

- Do not include one set of brackets inside another set when the two are identical, e.g. (….(…)…..). You can construct this with different brackets, e.g. [….(…)….].
- Do not use two sets of brackets next to each other, e.g. (…)(…). You can use (…;…).

7) Use semicolons correctly

- Semicolons are equivalent to a coordinate conjunction (and, but, or). They divide two complete sentences.

8) Always start a sentence with a capital letter and never with an abbreviation

- For example, you should not write:

E. coli is a Gram-negative bacteria

but rather should spell out the genus so the sentence doesn't start with an abbreviation

Escherichia coli is a Gram-negative bacteria

- Numbers at the start of a sentence should be written out, e.g., "Seven days ago…" and not "7 days ago…"

9) Use proper format to report species names

- Scientific names for species should always be italicizes, e.g., "*Turdus migratorius"* and not "Turdus migratorius"
- Scientific name must be given at first mention of a species
- Genus should be abbreviated after first use, e.g., "*T. migratorius*"
- Species may be referred to by either common or scientific names, as long as the scientific name is provided at first use, e.g., "The study species for my research is the Blue Whale (*Balaenoptera musculus*). One challenge of working with Blue Whales is that they are rare in the Region of Waterloo" or "The study species for my research is the Blue Whale (*Balaenoptera musculus*). One challenge of working with *B. musculus* is that they are rare in the Region of Waterloo"

10) Explain specialized terms and spell out abbreviations at first mention

- For example: "The tissue was treated with triiodobenzoic acid (TIBA) before …."

11) Use topic and concluding sentences in paragraphs

• This is essential in discussion-type sections, e.g., the Introduction and Discussion. A topic sentence introduces the content of the paragraph, while the concluding sentence ends it. The concluding sentence can be a link to the next paragraph. See note above about paragraphs presenting one single idea.

12) Last, but certainly not least, make sure there is a logical flow of ideas

• Remember, a poorly written report will lose marks regardless of the scientific content. You could discover the secret to eternal youth, but if your report is poorly written it will not receive a strong grade.