

# BIOL 293: Undergraduate Internship in Biology

## Spring 2020

### Instructors:

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### Course Goals

BIOL 293 allows students to obtain course and experiential education credit for conducting cutting edge biological research in off campus laboratories or field stations or developing scientific curriculum for informal science education centers like museums or aquariums.

### Course Expectations

Students must identify a research mentor and laboratory or field site in which to carry out the research internship or identify an internship that focuses on science outreach in the semester before the work is to be done. In addition, they must submit a course application with a brief description of the research project by the first day of classes. The research project must involve at least 135 hours of hands-on work by the student. The student is expected to review the research literature that informs the research project, learn the science behind the research methodologies and engage in data analysis. Finally, the student is expected to demonstrate comprehensive understanding of the research project in the final paper. The final course grade will be determined by the quality of the final paper and the effort dedicated to the research project, as reported by the principal investigator and research mentor. The principal investigator, research mentor and course director will work together to determine the final grade.

### Course Meetings

Students are expected to attend two course meetings during the 4<sup>th</sup> and 10<sup>th</sup> week of the semester. During these meetings, students are expected to provide a summary of their research project and an update on data collection and analysis. The meetings will also provide an opportunity for student to explore a model of a final paper and discuss the paper expectations in detail.

### Final Paper

Students will write a final paper (10 page minimum) describing the work on the project. The final paper must demonstrate an ability to discuss the primary research question, describe the research informing the question, the materials and methods, the research findings and how these findings inform the research question. Since one semester is often not enough time to complete a research project, the student will not be evaluated by the breadth or significance of the research findings, but by their ability to discuss research and its significance.

A draft of the introduction and methods section is due by Monday, March 9<sup>th</sup> and the final paper is due on the last day of classes for the spring semester, Friday, April 24<sup>th</sup>. Late papers will be subject to a one grade penalty (i.e. B→ C). Papers will not be accepted after Friday, May 1<sup>st</sup>.

# BIOL 293/295 FINAL PAPER FORMAT

## INTRODUCTION

The introduction allows you to demonstrate you understand the science behind your topic and the research that has informed and prompted your project. It should include:

- **A summary of what is already known about your topic.** For this section, you will start with a broader discussion/overview of your topic, then discuss the research findings that directly inform the focus of your project and, finally, state the specific focus/objectives of your study. For the sake of meeting the BIOL 293/295 expectations, the introduction has a broader focus and includes more background information and explanations than introductions in journal articles written for an expert audience. Make sure you properly cite the research studies you discuss. *Any* scientific statement that is not general knowledge (i.e. found in textbooks) must be followed with a citation listing the authors and year of the study. If you start a sentence with “Previous research/studies have...”, it must be followed with a citation. Different journals utilize slightly different citation styles so you should follow the citation style of your field’s major journal.
- **An explanation for why this research is significant and of scientific interest.** Your introduction should help the reader understand why your particular project is needed. It is important to *explicitly* state that your project answers a lingering question and/or has the potential support deeper understanding of phenomena and/or the development of new technologies or therapies.  
**The specific objectives of your study including basic details of your research design** and the specific questions your project is designed to answer. Not explicitly stating the research objectives of your study.
- **A statement of any hypotheses** you have.

The Introduction should answer the following questions

- What is already known about the research focus and how has previous research lead to the questions your project focuses on?
- Why is this research significant?
- What are the specific objectives of your study?
- What hypotheses are there about the topic?

## MATERIALS AND METHODS

The Materials and Methods section should:

- **Explain your experimental procedures in detail**, enough detail that another researcher to repeat your study. It is OK to reference a previously published procedure or published directions (i.e. for a commercial kit). If you had a complicated protocol, it may be helpful to include a diagram, table or flowchart to explain the methods you used. Do not discuss any results in this section.
- **Include a discussion on why you used the methods you did**, which is not included in a research paper. Therefore, make sure you understand the purpose of the various steps of your procedure and what is happening to the molecules, cells involved, etc.. Order your discussions chronologically and use past tense to describe what you did.

Materials and Methods should answer the following questions:

- What methods did you use to pursue your research question?
- Why did you use these methods?

## RESULTS

In the Results section, you present your findings in a clear and organized format by:

### **Describe trends in your data in text and portray data in tables and figures.**

- In your results section, you must describe your results in text as well as portray it in your figures and tables. A common mistake is for students to include data tables and graphs without describing the trends or data that are portrayed in the figure in words/text as well.
- All figures should have descriptive titles and legends describing the data that is portrayed in the tables, graphs and figures. It is essential that your legend provide the reader with information needed to know what is being portrayed in each figure.
- Do not worry if you do not have significant results. A single semester is rarely enough time to obtain significant findings. It is still important to describe the results you obtained.
- Do not discuss or speculate about why you obtained these results as such discussion belongs in the discussion section.

The results section should answer the following questions:

- What is your data?
- What trends can be identified in the data?

**DISCUSSION** → The Discussion section is where you describe what specific conclusions can be drawn from your research including:

- **The meaning of your findings**, i.e. how they help to answer the research question/s described in the introduction
- **Explain how your results relate to hypotheses** and to other findings in the literature you cited in your introduction. Don't ignore any deviations or unexpected data and explain them.
- **Discuss future research** would be necessary to answer the questions raised by your results. This section is very important when you do not have many findings as it will communicate your understanding of the next steps in the research process.

The Discussion section should answer the following questions:

- What is the significance of your data?
- How does it answer the research question?
- How does it support or refute any hypotheses?
- How do your findings guide future research efforts/next steps in the project?

## REFERENCES

The reference section provides information on research cited in text and should:

- **List all the references** for all studies cited in text.
- Different journals use different styles for referencing information so you should use the style utilized in the major journal of your field. See the author's resources section of the journal website for reference style.

### **Additional recommendations:**

- **START EARLY!** You can write a good portion of the paper before you get your first results.
- Write clearly and concisely with as few words as necessary.
- Read, re-read and have someone else read and re-read your paper. The paper should not have any typos.
- Get feedback from people in your lab, especially the PI, on drafts before submitting your paper.
- Submit drafts to Dr Coble ([jcoble@bio.unc.edu](mailto:jcoble@bio.unc.edu)) for review. Know that it can take a week to get feedback so drafts submitted after Tuesday, April 17<sup>th</sup> are not guaranteed to receive feedback.

## BIOL 293/295 Research Paper Rubric

<b>Introduction</b>	<b>Needs Revision</b>	<b>Proficient</b>	<b>Exemplary</b>
Introduction provides a clear, detailed overview of the studies that inform the project, providing proper citations for all findings.			
Introduction provides a clear explanation of how the data from the project will augment current scientific understandings and/or support the development of new technologies or therapies.			
Introduction clearly describes what the specific objectives of the study including hypotheses or expected outcomes.			
Introduction includes scientific explanations required for a non-expert to understand the background research and goals that guide the project.			
<b>Methods</b>			
The Methods section outlines experimental procedures in the level of detail required for replication. Diagrams or tables are included as needed to communicate complicated protocols or procedures.			
The Methods section included scientific explanations of all experimental procedures.			
<b>Results</b>			
The Results section discusses findings in a clear and organized format including descriptions of any trends.			
Tables and figures allow reader to see data and/or trends in the data. All tables and figures contain descriptive titles and legends that provide information on the data depicted in the figure.			
<b>Discussion</b>			
The Discussion section discusses the conclusions that can be drawn from the results, how the findings inform the research questions guiding the study and impact any hypotheses.			
The Discussion section includes a detailed description of additional research needed to answer study objectives or additional questions prompted by study findings.			
<b>References</b>			
Reference section includes citations for all studies cited in text in the reference style required by the leading journal in field.			
<b>Writing</b>			
Writing is clear, concise, well organized and easy to read.			