

---

THE COLLEGE OF  
**WOOSTER**

---

**Biology Senior  
Independent Study  
Handbook**

## Overview of Independent Study in Biology

Spring Junior Year	Biology 401 – JR IS / Biostatistics		<p>Biology Department Seminar Thursdays 11-12, G01 Mateer</p> <p><i>1<sup>st</sup> 2 weeks: off-campus researchers (potential co-advisors)</i></p>
	<p>Biostatistics</p> <ul style="list-style-type: none"> <li>meet T/R 9:30-10:50 during 1<sup>st</sup> week (Thursdays only thereafter)</li> <li>learn about experimental design and data analysis</li> </ul>	<p>Research Proposal</p> <ul style="list-style-type: none"> <li>work with a COW biology faculty member (IS &amp; academic advisor) to plan a research project that will be completed during SR IS</li> <li>may also have a co-advisor at another institution (e.g. OARDC, clinic)</li> <li>submit research project &amp; advisor preferences by end of 2<sup>nd</sup> week</li> <li>advisors assigned by early 3<sup>rd</sup> week</li> <li>schedule regular meetings with advisor (typically weekly, ~ 1 hour)</li> <li>culminates in a research proposal that includes an extensive literature review (guidelines specified by advisor)</li> </ul>	
	Grade: A-F (50% Biostatistics + 50% Research Proposal)		
Summer	<i>Some students may choose to collect data during the summer.</i>		
Fall Senior Year	Biology 451 – SR IS		<p>Biology Department Seminar Thursdays 11-12, G01 Mateer</p>
	<ul style="list-style-type: none"> <li>conduct research (<i>once, twice... it'll take a few attempts!</i>)</li> <li>some students may compile &amp; analyze data</li> <li>some students may begin writing their theses</li> <li>typically meet weekly with advisor</li> </ul>		
		Grade: S-N (assigned by advisor)	
Spring Senior Year	Biology 452 – SR IS		<p>Biology Department Seminar Thursdays 11-12, G01 Mateer</p>
	<ul style="list-style-type: none"> <li>some students may still be collecting/analyzing data early in semester</li> <li>most students will be writing &amp; revising their theses</li> <li>written thesis due Monday after spring break</li> <li>present 15-minute research seminar to Biology Department</li> <li>schedule oral exam with advisor and 2<sup>nd</sup> reader (assigned by faculty)</li> <li>make contribution to campus-wide I.S. Celebration</li> <li>typically meet weekly with advisor</li> </ul>		
		Grade: H / G / S / NC (assigned by advisor after consultation with Biology faculty)	

## **Senior Independent Study in Biology**

At the end of Independent Study in the Biology Department, you will have completed:

- (1) a departmental seminar,
- (2) a written thesis,
- (3) an oral examination and
- (4) a contribution to the campus I.S. celebration.

The text that follows provides detailed information on how to accomplish these goals.

### **Getting Started**

If all went well in Junior Independent Study you should arrive on campus for your senior year with an established thesis topic. As each project has its own requirements (some of you, for example, may have had to gather your data during the summer), it is not possible to draw up a schedule of events that will apply uniformly. Ideally, data collection will be completed during the first semester, and the thesis written in the second. For a general timeline, see the "Overview of Independent Study in Biology" (above). For information on funding your I.S. investigation, see the Biology Junior I.S. Handbook. In practice, the best-laid plans don't always work out. Things happen...the shipment of the animals or chemicals you ordered is delayed, or the electricity goes off in the middle of the night and ruins a reaction. It is almost a certainty that the collection of data, or the writing of the thesis, or both, will take longer than you anticipate. On average, you should expect to work 10-12 hours a week on I.S. The message is simple: Get started immediately. It is far better to finish a little early than to have to reach for the panic button as the due date approaches!

### **Off-Campus Research**

Data for I.S. research (field projects and laboratory investigations) may be gathered anywhere that is accessible to the student investigator. Before such a project is initiated, however, it must have the approval of the student's I.S. advisor. Field projects may have seasonal restrictions that require gathering data at a time other than the academic year. In such instances, the field work will often be in progress, or may be completed before the beginning of your senior year.

Data may also be obtained from experiments carried out in laboratories other than those on the Wooster campus. In such cases, the student is expected to work with the same independence as is expected for projects conducted at the College. The off-campus advisor may wish to make contact with your Wooster faculty advisor, or vice versa, to make sure that the work you do is appropriate for an I.S. project. Projects conducted away from campus typically will be done in the summer prior to the senior year unless they are performed at the OARDC which can be reached easily from the College.

Students may pursue investigations that are closely related to other research being performed in the same facility. This can occur at Wooster where the student's project is a part of a professor's overall research program or at another research location. In either of

these settings, however, the student cannot serve merely as a technician and count this as I.S. research. I.S. research is an independent, self-generated study including original observations as part of a project designed by the student.

The I.S. thesis advisor must be kept fully informed about all phases of data gathering regardless of where they occur. Students collecting data away from the campus have a special obligation to keep their advisors informed about their activities and progress. Likewise, they are expected to follow a work schedule agreeable to the host laboratory.

Students working off campus should share their results with the host institution. This is typically done by giving a copy of the thesis to the person in charge of the laboratory. Assistance and advising by persons away from the campus should be identified and acknowledged in the thesis.

### **Departmental and Campus-wide Presentations**

Each senior will give a Powerpoint presentation to the Biology Department in the spring on their I.S. project. Each presentation lasts approximately 15 minutes and is given to an audience consisting of biology students and staff, along with any other interested parties. Depending on how many seniors are involved, and in what sequence they are scheduled, your seminar might occur before your investigation is complete (and thus take the form of a progress report). Most likely, however, you will be presenting the final results of your I.S. project. It is advisable to give your seminar to your advisor (and perhaps others) prior to the actual presentation. This will help you hone the presentation and avoid common errors. With your seminar in mind, you may wish to photograph some of your procedures as your investigation proceeds. If you had an off-campus advisor for your project, you should consider inviting them to your seminar. Your presentation will play a role in the final grade you receive on your I.S. project.

In addition to your departmental I.S. seminar, you are required to also make a contribution to the campus-wide I.S. celebration. This can take the form of an oral presentation or a poster presentation. However, this should be geared toward a more general audience than your departmental seminar presentation.

Lastly, remember that seniors are **required** to attend weekly departmental seminars throughout **both** semesters. Lack of attendance at departmental seminars will influence your final I.S. grade.

### **The Independent Study Thesis**

The I.S. thesis in Biology is to be written in the form of a scientific paper (i.e., with an Introduction, Materials and Methods, Results and Discussion sections). The thesis should be formatted as described later in this Handbook. You should work on a timeline that allows you to ask your advisor to read and comment on one or more drafts of the thesis. This permits your advisor to help you with any problems of grammatical or logical clarity, and should help to ensure that your thesis document is appropriate and complete when you submit it to the registrar. Advisors differ in the number of drafts they will read, the deadlines they impose, and the comments they will make, but they are generally available to help make sure that your thesis reflects your best work. However, you should

submit your final draft to your advisor as early as possible, certainly before the draft deadline imposed by your advisor (often the week before Spring Break). You should not expect your advisor to be available during the break. Advisors are not expected to edit your thesis line by line and all errors and omissions remain the responsibility of the student. Two copies of the **completed** thesis are due in the registrar's office at 4:00 p.m. on the first day of classes after spring break ("I.S. Monday"). Do not bind your thesis permanently at this stage, just hand it to the Registrar in a folder or three-ring binder.

The College and the Department may request additional electronic or paper copies of the thesis for archiving purposes. Check with the College Registrar and the Biology Department administrative assistant for the current requirements.

## **Evaluation of the Thesis**

### ***The Second Reader***

Each thesis is read by your faculty advisor (the first reader) and another member of the department faculty (the second reader). Soon after I.S. Monday, the second reader will be assigned to you by the department. Your second reader will be chosen based on their expertise and on the need to spread readerships equally among faculty members. Your second reader will probably not be an expert in your area of research, therefore endeavor to write your thesis with such clarity that it will be understandable by someone who is not directly acquainted with your area of research.

### ***The Oral Examination***

An oral examination based on your thesis will take place in the weeks following the submission of the thesis. You are responsible for arranging a specific time and place for the exam that is acceptable to you, your advisor, and the second reader. The oral defense will typically last an hour or two and is best thought of as a conversation among scientists about a topic of shared interest (i.e., your I.S. thesis). If you have done your work off campus (e.g., at the OARDC), you should consider inviting your off-campus advisor to attend the oral examination. At the end of the oral examination, you will be asked to leave the room, so that your advisor and the other participant(s) can discuss your performance. You will then be asked back into the room and informed whether you passed I.S. or not. You will not receive an I.S. grade at this time. Your I.S. grade ('honors', 'good', 'satisfactory' or 'no credit') is determined by your first and second readers based on the criteria detailed later in this handbook. Final grades are available only after *all* the oral examinations are completed, and the faculty have met as a group to discuss and assign grades.

### ***Corrections to the Thesis***

It is likely that the oral examination will uncover minor problems that will require some final modification of the written thesis. These might be simple typographical errors or something more substantial. In any case, you are likely to leave the oral exam with a list of changes to be made, and with the admonition that you will not receive a grade until (1) the corrected thesis has been re-submitted, and (2) your work area has been cleaned up and all equipment and supplies have been returned to their proper place. You should prepare a copy of the corrected thesis, and turn it in directly to your IS advisor. She/he may request that you permanently bind this copy, for their archives. If you worked off-

campus, you should be sure to provide your off-campus advisor with a copy of the final thesis. The College also requests a final copy of your thesis for archival purposes to be turned into the Registrar's office.

***Am I Done Yet?***

The checklist on the last page of this handbook must be taken care of once you have completed your oral exam. Once you have seen to these items and have discussed them with your adviser, you can consider yourself finished!

## **Format for the I.S. Thesis**

The I.S. thesis should be prepared in the form of a scientific paper (see below for the required sections). For all issues related to appropriate style, grammar, content and presentation in the thesis, please refer to “A Short Guide to Writing About Biology” by Jan Pechenik. This book was required in some of your previous courses in biology at the College and we regard it as the final word on scientific writing for undergraduates. Refer to it frequently!

**I. TITLE PAGE** (SEE EXAMPLE BELOW)

**II. TABLE OF CONTENTS**

**III. ABSTRACT**

**IV. INTRODUCTION**

**V. MATERIALS AND METHODS**

**VI. RESULTS**

**VII. DISCUSSION**

**VIII. ACKNOWLEDGEMENTS**

**X. LITERATURE CITED**

**XI. APPENDIX** (Additional tables or figures may be appended to give details that are extra information, not suitably placed in the body of the thesis. The pages are numbered consecutively with the preceding pages.)

## Mechanics of the Thesis

### Margins

1. 1 1/2 inch margin at the top and left of the page.
2. 1 inch margin at the bottom and the right.

### Major Heading and Subheadings

1. Center all major headings and subheadings.
2. The major headings should be in capital letters; subheadings in small letters except for the first letter.
3. Start all major sections of the paper on a new page.

### Spacing

1. Double space throughout the body of the text.
2. Double space between references in the literature cited, but single space within each reference.
3. If using subheadings, triple space just before the subheading, but double space after it.

### Numbering Pages

1. Numbers are placed 3/4 of an inch from the **top** of the page, in the **center** of the page, and should have a hyphen on each side (e.g., -2-).
2. The page on which the introduction begins is the first page of the paper, but it is not numbered. The next page is numbered page -2-.
3. All pages except the title page, the table of contents, and the first page should be numbered. This includes pages containing illustrations exclusively.

### Illustrations

Illustrations, figures, graphs or tables can be embedded within the text of the document near to where they are first referred to. Alternatively, they can be placed after the literature cited at the end of the thesis.

### Binder

1. The two copies of the thesis submitted to the Registrar on I.S. Monday should be bound using a three-ring binder or other similar device. This allows the pages to be removed by the reader as needed. Do **not** permanently bind your thesis at this stage!
2. Be sure to put the title of the paper, your **name** and the **year** on the outside of the cover.

## **Criteria Used for the Evaluation of Independent Study in Biology**

Your advisor will evaluate the following components of your performance in Independent Study. This evaluation will be used by your advisor, in consultation with the other biology faculty members, in assigning a grade for Biology 452 (Honors, Good, Satisfactory, or No Credit (not passing)). This is meant to give you a sense of what components are used for evaluation purposes. Note, however, that the components listed below are not necessarily weighted equally.

### **1. DEPARTMENTAL SEMINAR**

#### PROJECT DESCRIPTION

- Background information
- Clarity of goals / specific aims
- Explanation of experimental design
- Explanation of results
- Justification for conclusions

#### PRESENTATION MECHANICS

- Organization
- Clarity
- Responses to questions

### **2. RESEARCH PROCESS**

#### FIELD AND LABORATORY RESEARCH

- Competence with/understanding of techniques
- Independence in the lab or field and analysis of data
- Ability to troubleshoot (independently or by seeking appropriate guidance)

#### THESIS DEVELOPMENT

- Level of independence of writing and editing
- Finding and reading relevant primary research articles
- Ability to interpret results in the context of the literature
- Establishing & meeting goals and deadlines
- Attitude & willingness to go beyond minimum requirements

### **3. WRITTEN THESIS**

#### INTRODUCTION

- Organization
- Description of motivation for research
- Clarity of hypotheses/goals/specific aims
- Relevance and adequacy of background information

#### MATERIALS AND METHODS

- Organization
- Appropriate level of detail
- Description of data analysis
- Suitability of experimental design

#### RESULTS

- Organization
- Clarity and relevance of figures/tables
- Data analysis

#### DISCUSSION

- Organization
- Explanation of results in context of literature
- Integration of results with goals/hypotheses/specific aims
- Suggestion for future work

#### STYLE

- Mechanics and grammar
- Formatting
- Use of citations (e.g. was everything cited appropriately?)
- Clarity
- Professionalism/maturity of writing
- Understanding of target audience

### **4. ORAL EXAMINATION**

#### KNOWLEDGE OF SUBJECT MATTER

- Breadth and depth of knowledge
- Clarity of explanations
- Ability to respond to questions and discuss research
- Demonstration of critical thinking

#### UNDERSTANDING AND EXPLANATION OF PROJECT

- Understanding of techniques used in project
- Understanding of significance of results
- Understanding of project in the context of the area of study
- In the eyes of the examining committee, has the I.S. been a productive experience for the student?
- Did the student take ownership of his/her project, and demonstrate interest and enthusiasm in what was done and learned?

**SAMPLE TITLE PAGE**

**HOW LONG DOES IT TAKE CRICKET FROGS TO CROAK? A  
STUDY OF LONGEVITY AND SURVIVORSHIP IN BLANCHARD'S  
CRICKET FROG *ACRIS BLANCHARDI***

**DEPARTMENT OF BIOLOGY  
INDEPENDENT STUDY THESIS**

**Michael Callahan MacDonald**

**Adviser: Richard Lehtinen**

**Submitted in Partial Fulfillment of the Requirement for**

**Independent Study Thesis in Biology at the**

**COLLEGE OF WOOSTER 2009**

## STUDENT OBLIGATIONS AT THE END OF I.S.



Give your advisor all items which she/he requests i.e. a final copy of your thesis and poster (if applicable).

—

Clean your work space(s) to the satisfaction of your adviser.

—

Return all borrowed equipment and chemicals to the lab tech/stockroom manager. All chemicals and solutions made must be labeled with your name, date, and contents.

—

Turn in any keys that were issued to you (not applicable in all situations).

—

Turn in a corrected CD copy of your thesis to the Registrar's Office.

—

Complete Senior Survey (follow the link that was emailed to you).

—