
THE COLLEGE OF

WOOSTER

Biochemistry and Molecular Biology

**HANDBOOK FOR
SENIOR INDEPENDENT STUDY**

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Table of Contents

| | |
|--|----|
| Required Events for 451/452 | 4 |
| CHAPTER 1 | 5 |
| Overview of Independent Study in Biochemistry and Molecular Biology | 5 |
| Courses | 5 |
| BCMB 40100. Introduction to Independent Study | 5 |
| BCMB 45100. SENIOR INDEPENDENT STUDY – SEMESTER ONE | 6 |
| BCMB 45200. SENIOR INDEPENDENT STUDY – SEMESTER TWO | 6 |
| Senior Year: Completing Your IS Research | 6 |
| Getting Started | 6 |
| Safety Training Sessions | 6 |
| Work Expectations | 6 |
| Meetings with I.S. Advisor | 7 |
| Keeping a Laboratory Notebook | 7 |
| Seminar Attendance | 7 |
| Seminar Presentation | 7 |
| Poster Presentation | 7 |
| Thesis Preparation | 8 |
| The Second Reader | 8 |
| Independent Study Oral Examination | 8 |
| Corrections to the Thesis | 8 |
| Final Checkout | 8 |
| Determination of Grades | 9 |
| CHAPTER 2 | 10 |
| Guidelines | 10 |
| I. Thesis | 10 |
| II. Research Seminar | 14 |
| III. Poster | 15 |
| Check-Out Obligations for BCMB Senior I.S. | 16 |

Required Events for 451/452

- Safety-Training Seminars: Held at the beginning of the academic year. Attendance is mandatory.
- BCMB Seminars: Senior BCMB students are required to attend designated BCMB seminars. Students will receive an email message regarding which seminars are BCMB. The seminar schedule is also available on the BCMB website.
- Senior Seminar: Spring semester of senior year BCMB majors are required to present their project results in a 10-12 minute seminar.
- Information will be sent out to you spring semester regarding submission of seminar information to the Department of Chemistry for posting in Ruth Williams Hall.
- Senior Poster Presentation: Senior BCMB students are required to present a poster outlining I.S. results at a poster session held in April.
- Final I.S. Project: Two bound copies of the I.S. thesis are due in the Registrar's Office by 5:00 PM on the first day of classes following Spring Recess (I.S. Monday). Here are details of submission that can also be found on the registrar's webpage: <http://www.wooster.edu/academics/registrar/is-submission/>
First, submit your digital I.S. online to the Libraries' Open Works website:
- Prepare your I.S. file as a single PDF. Word can save as a PDF.
 - Create an Open Works account. Use your wooster.edu email address.
 - Once you've verified your account, submit your I.S.
- Next, submit to the Registrar's Office:
- Two bound hard copies of the I.S.
 - Two additional copies of the I.S. cover page only (loose, not bound)
- You must submit your I.S. digitally before the hard copies will be accepted by the Registrar's Office.
- Oral Exams: Following I.S. Monday, schedule an oral examination with your I.S. advisor and second reader. Usually this should be scheduled the same day as your seminar.
- At the oral exam, turn over your laboratory notebook to your supervisor.
- After oral exams, all BCMB students must turn in a final corrected paper copy signed by your advisor and second reader and a digital copy in PDF format of the thesis and Symposium Poster to the administrative coordinator in the Department of Chemistry. Your advisors may also require a paper and electronic copy of your thesis, poster, and data.

CHAPTER 1

Overview of Independent Study in Biochemistry and Molecular Biology

During the three-semester Independent Study program in Biochemistry and Molecular Biology, students...

- identify research projects of interest,
- write a research proposal describing the significance, objectives and experimental design of their assigned project,
- conduct investigations to collect data addressing their objectives, and
- present their work orally and in writing.

This chapter provides additional information on the I.S. process in the Biochemistry and Molecular Biology major.

Courses

BCMB 40100. Introduction to Independent Study

This course focuses on scientific writing, experimental design, and informational retrieval systems, including accessing and evaluating the growing collection of molecular databases. Students explore the literature related to their proposed senior I.S. thesis through a series of structured writing assignments that culminate in a research proposal for the senior project. In addition, students learn the mechanics of scientific presentations and give a brief seminar on their proposed project. Prerequisite: C- or better in CHEM 21100 and C- or better in either BIOL 30500 or BIOL 30600 or permission of instructor. Annually. Spring. -- The College of Wooster Catalogue

Assignment of I.S. Research Projects

The assignment of an Independent Study research project is a two-step process: First, you will identify three research projects that are of interest to you; then assignments will be made by the BCMB curriculum committee after examining everyone's preferences.

Possible Research Projects: During the first weeks of BCMB 401, students learn about research opportunities available at Wooster. Most research projects pursued by BCMB majors are closely tied with a professor's research interests or with an outside investigator near Wooster (*e.g.*, at the OARDC). If you desire to develop your own project, you must identify a research scientist willing to sponsor your research by providing intellectual and material support.

Assignments: Once all BCMB 401 students have submitted their list of preferred research projects, the BCMB curriculum committee makes I.S. project assignments. The intent is that each student will be assigned a project of interest, while evenly distributing I.S. assignments among participating faculty members.

Preparation of a Research Proposal

The major focus of BCMB 401 is the development of a research proposal. Full details concerning the preparation of this proposal and its evaluation are described in the BCMB 401 syllabus.

Policy on Double Majors

Students with double majors may complete their Senior Independent Study requirement, either by doing two separate theses/projects or through a joint thesis/project. If a student chooses the latter model, the relevance of using the two different methodologies to study the project should be clear in the proposal to the two departments. The Independent Study project of a double major should be formulated to reflect an interdisciplinary/multidisciplinary approach in a manner that represents four years of disciplinary engagement in each department/program. The student and advisors should have a joint meeting to establish the process for the project. The Double Major I.S. Agreement should be completed following this discussion with the advisors and submitted to the Dean for Curriculum and Academic Engagement as soon as possible but no later than the end of the fourth week of the semester in which I.S. 451 is undertaken. Advisors should sign the document indicating their approval. The goal of a joint Senior Independent Study thesis/project should be to examine a topic using approaches and methodologies of the two disciplines. If it is not possible to accomplish this goal, the student should complete two separate Senior I.S. projects rather than joining two separate pieces of work into one final project.

BCMB 45100. SENIOR INDEPENDENT STUDY – SEMESTER ONE

An original investigation is conducted, culminating in a thesis and oral defense of the thesis in the second semester. During the year each student gives at least one research poster and oral presentation on the research topic. A student normally has one research advisor. Prerequisite: C- or better in BCMB 40100.
-- The College of Wooster Catalogue

BCMB 45200. SENIOR INDEPENDENT STUDY – SEMESTER TWO

The thesis is evaluated by the research advisor and one other professor from the BCMB Curriculum Committee, in consultation with the other members of the BCMB Curriculum Committee. Prerequisite: BCMB 45100.-- The College of Wooster Catalogue

Senior Year: Completing Your IS Research

Getting Started

As each project has its own requirements, 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. In practice, the best-laid plans don't always work out. It is almost a certainty that the collection of data or the writing of the thesis, or both, will take longer than you anticipate. The message is simple: Get started immediately. It is far better to finish a little early than to reach for the panic button as the due date approaches!

Safety Training Sessions

Each student is required to attend safety-training sessions offered by the department of the I.S. advisor. These are typically held at the beginning of the academic year, so look for their announcement. Attendance is mandatory. Students will not be allowed to conduct laboratory research until the training sessions have been completed.

Work Expectations

Students are expected to work regularly and consistently on Independent Study. Of course, some weeks will be more productive than others, but overall BCMB 451/452 students are expected to average about

12 hours per week, working in the laboratory, analyzing data, searching for relevant articles, writing the thesis, etc.

Students should work safely in the laboratory and conduct themselves consistent with safe lab procedures, as introduced in the departmental safety training sessions and supplemented by your advisor. You should also follow appropriate lab etiquette, by respecting the rights, property and safety of others. This includes keeping common areas clean and quiet, sharing common equipment, including computers, with others, and ensuring that materials are returned to their original location or reordered.

Meetings with I.S. Advisor

I.S. students should meet with their on-campus advisor regularly, typically on a weekly basis. During these meetings, you should come prepared to discuss your research progress and to address any research questions that you have. You should use this opportunity to explore ideas, troubleshoot problems in the laboratory, review a draft of your thesis, or discuss other aspects of your Independent Study research. You are encouraged to bring your laboratory notebook (see below) to each meeting.

Keeping a Laboratory Notebook

A complete record of your laboratory work is required. Your laboratory notebook must contain originals of all of the methods and results of the I.S. research and must be kept current throughout the two semesters of research. Consult with your advisor on the exact format of the notebook and bring it with you to your weekly I.S. meetings.

The complete record of the laboratory work should be brought to the I.S. oral examination, where it will be turned over to your supervisor. (You may wish to make a photocopy of your own beforehand.) Because it may be used as reference material during the oral examination and because it is important for future reference by subsequent researchers, the laboratory notebook must be completely and unambiguously labeled, indexed and cross-referenced.

Seminar Attendance

Communication of research findings is an integral part of the scientific process. BCMB 401/451/452 students are required to attend designated BCMB seminars. Attendance will be taken, and unexcused absences may negatively affect your grade. The BCMB seminar schedule will be posted on the BCMB web site.

Seminar Presentation

During the spring semester, senior BCMB majors will be required to present a final 10-12 minute seminar summarizing the results of their project. These presentations will be at the 11:00 AM Tuesday/Thursday seminar hour. The BCMB seminar schedule will be posted on the BCMB web site. If you are performing research off-campus (e.g., at the OARDC), you should invite your research supervisor to attend your seminar once you know the date.

Poster Presentation

Senior BCMB majors are required to present a poster describing their I.S. project at the Senior Research Symposium. Consult with your advisor about designing your poster. Instructions for poster printing will be communicated in the spring semester.

Thesis Preparation

As you write your thesis, you should expect to submit one or more drafts to your advisor for review. Consult with your advisor regarding deadlines and the review process. (For example, some advisors may review individual sections, while others may prefer the entire thesis.)

See Chapter 2 for detailed information on mechanics of the written thesis.

The Second Reader

Each thesis is read by your faculty advisor (the first reader) and a second reader from the Biochemistry and Molecular Biology curriculum committee or as approved by the committee in special circumstances. The second reader will be assigned to you by the BCMB committee and announced shortly after I.S. Monday. For double majors the second reader will typically be the advisor in the second department or program.

Independent Study Oral Examination

Your I.S. oral examination will take place following the submission deadline for I.S. theses, preferably on the same day as your I.S. presentation to the BCMB program. After you have been notified of your second reader, you should promptly arrange a specific time and place that is acceptable to you, your advisor, and the second reader. If you have done your work off campus (*e.g.*, at the OARDC), your off-campus advisor should be invited to participate. While this person may ask you questions and participate in the discussion during your oral examination, your grade on the thesis is determined solely by the first and second readers, in consultation with the BCMB curriculum committee (see below). The oral examination is focused around your I.S. thesis and may also delve into topics within the BCMB curriculum as a whole. Immediately following the examination, you will learn whether you have passed or failed; however, your final grade will be determined in consultation with the BCMB committee at a later date in the semester.

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 examination with a list of changes to be made and with the admonition that you will not receive a grade until the corrected thesis has been re-submitted (and you have complied with all expectations; see below).

Final Checkout

You should prepare a copy of the corrected thesis and turn it in directly to your I.S. advisor. The advisor may request that you permanently bind this copy for his/her archives. If you worked off-campus, be sure to provide your off-campus advisor with a copy of the final thesis. In addition, you must submit a complete paper and electronic version in PDF format (with all figures and tables) to the administrative coordinator in the Chemistry Department.

Details on submitting a corrected archival electronic copy of your I.S. can be found on the library's website.

The department administrator or laboratory manager of the building in which you worked will then certify that your workspace is clean and that all your research materials have been returned. The required checkout form can be found at the end of this handbook.

Finally, the Biochemistry and Molecular Biology committee will seek your assistance in assessing the program for continued improvement. To this end, all BCMB students are expected to complete a senior exit survey and an assessment exam during the final weeks of the semester.

Determination of Grades

Your grade for BCMB 451 is determined by your I.S. advisor, using the College's two-level system. A grade of SP (Satisfactory Progress) indicates satisfactory progress has been made during the first semester of Independent Study; a grade of NC (No Credit) indicates unsatisfactory performance.

As noted above, your grade for BCMB 452 is assigned by your advisor in consultation with the second reader and the Biochemistry and Molecular Biology curriculum committee. Grades are assigned based on the quality of your research, thesis, presentations, oral examination and your ability to navigate these requirements in a timely and professional manner (see Chapter 2).

Final grades are available only after all oral examinations are completed in the BCMB program and the curriculum committee has met to discuss I.S. grades. To receive your grade, you must first complete the final checkout process (see above).

CHAPTER 2

Guidelines

I. Thesis

A. Organization of the Written Document

- i. Preliminary Pages
 - a. Cover Page—A cover page should be included like the sample on page 12.
 - b. Title Page—A title page should be included like the sample on page 13.
 - b. Table of Contents
 - c. Abstract
- ii. Introduction—This section should outline relevant background information in the field of research, first broadly and then in a focused way, to set up the scientific problem being investigated. The student should carefully review relevant literature and cite references where appropriate.
- iii. Experimental Procedures—This section should outline the materials that were obtained or generated for the project and include any and all information on experimental procedures necessary such that the work can be reproduced by another individual.
- iv. Results. This section should include findings from successful experiments that relate to the scientific problem. It may include any or all of the following, with text that provides explanation of the results.
 - a. Tables of data. See *The ACS Style Guide* or Pechenik's *A Short Guide to Writing about Biology* for suggestions on constructing tables.
 - b. Equations derived from the data. (Example: If kinetic data are presented, the rate equations should be included.)
 - c. Experimental schemes concerning chemicals, apparatus, techniques and methods of calculation, to the extent that they have a direct bearing on the results.
 - d. Figures, such as diagrams and data images (e.g., gel, spectra, graphs, etc.).
 - e. Additional guidelines:
 1. All figures and tables should be titled and numbered.
 2. Figures should be presented within proper margins. Reduce as necessary.
 3. Graph axes and spectra must be labeled and legible, including units and the scale for each axis.
 4. Indicate data points by circles, triangles, squares or crosses.
 5. Describe the figure in a separate caption.
 6. Include and explain any statistical analysis where relevant. See Pechenik's *A Short Guide to Writing about Biology* for proper presentation.
- v. Discussion. This should be a detailed, thoughtful analysis of all results presented as they fit into a larger context. Developing a hypothetical model or a reaction scheme that accounts for the results included is a useful way for developing this section. With special approval of your I.S. advisor, the Results and the Discussion sections may be combined into one section in your thesis.

- vi. Literature Cited. Include a complete citation for any references that were cited in the individual sections of the document. Students may wish to use Zotero or another reference manager to facilitate formatting and maintenance of all references cited.
- vii. Appendices. (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.)

Sample Cover Page



THE COLLEGE OF
WOOSTER

Biochemistry and Molecular Biology

Kinetic Analysis of Polymorphic Creatine Kinase Variants Isolated
from Fighting Scots

Esmeralda N. von Bingen

March 2019

Sample Title Page

The College of Wooster

Kinetic Analysis of Polymorphic Creatine Kinase Variants Isolated from Fighting Scots

A THESIS SUBMITTED TO THE FACULTY OF THE COLLEGE OF WOOSTER
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR
THE DEGREE OF BACHELOR OF ARTS

By

Esmeralda N. von Bingen

Accepted by Mark J. Snider _____ Advisor
James D. West _____ Second Reader

Wooster, Ohio

March 25, 2019

(This is the actual U.S. Monday date)

B. Formatting Guidelines.

- i. The thesis should be printed on 8 ½ x 11” printer paper. It can be printed back-to-back.
- ii. The **cover page** and **title page** should be blank on the back. (This will require inserting page breaks to create blank pages.) The **Kauke Image and Wooster logo** can be found at <https://wiki.wooster.edu/display/itdocumentation/Logos+and+Templates> (requires you to login).
- iii. Margins: All 1” (one inch)
- iv. Headings and Subheadings: Headings and subheadings for sections should be centered. Major headings should be indicated in ALL CAPS. All major sections should start on a new page.
- v. Spacing: Double spacing should be used throughout the document. Each subsection should be delineated with a quadruple space.
- vi. Page Numbers: All pages, including those containing only figures, should be numbered at the top of the page (at ¾” below the edge). The number should be omitted on page 1.

C. Printing and Binding

- i. Two-sided printing is permitted. Standard formatting for two sided copies has odd numbers are on the front of the page, and even numbers are on the back of the page.
- ii. The administrative staff will bind your thesis in Ruth Williams Hall (RWW090). When you are ready to have your thesis bound, send a Word document of your cover page via email to the Department Office personnel. They will print your cover page on cardstock and comb bind the printed thesis you provide to them. Allow at least one hour for binding.

II. Research Seminar

Each BCMB I.S. student will present a seminar during the spring semester. Talks should last no longer than 12 minutes. Following the talk, several minutes will be allotted for questions. Students should rehearse their talks with their advisor for guidance and to ensure that they can complete their presentation within the time limits.

A. Guidelines for Organizing Talks.

- i. Provide a brief overview of pertinent literature to introduce the topic. Start broadly, and then refine the focus to highlight the significance of your research objective.
- ii. The body of the presentation should contain the experimental setup and data obtained in the laboratory. Interpret your findings in the context of your original objectives and the larger field.
- iii. Summarize the goals, methods, results, and future directions to finish your presentation.
- iv. Students are encouraged to use visual aids and make presentations in PowerPoint.

III. Poster

All students enrolled in BCMB 452 will make a poster to present at the Senior Research Symposium in the spring. Attendance at the entire poster session is mandatory.

A. Poster Format and Guidelines.

- i. Poster size: 3' x 4' (the paper for the large format printer is 3' wide)
- ii. The student should consult his/her advisor to discuss format and content and can find specific rules for poster layout in *The ACS Style Guide* (on reserve in Timkin Science Library).
- iii. Software that can be utilized include PowerPoint and ChemDraw.
- iv. Consult the Technology@Wooster web site (<http://technology.spaces.wooster.edu>) for current instructions on poster printing.

B. Abstract Submission.

The Senior Research Symposium Poster Session Booklet will be prepared by the administrative coordinator in the Chemistry Department. Students must submit their abstract as directed in an email provided by the administrative coordinator.

- i. Abstracts should include Title, Authors (Senior I.S. student, advisor, and any other contributors) and text. It can include reactions, structures, or equations, within reason. The abstract should not include references.
- ii. Length: 200 words or less
- iii. Format: PDF

Check-Out Obligations for BCMB Senior I.S.

Name _____ Date _____

The following obligations must be taken care of once you have completed your oral exam. Once you have seen to these items and have the appropriate signatures, please turn in this page to Department Office personnel by the **Wednesday of finals week, 4:00 PM**. Senior Independent Study grades will not be released until this form has been completed and received by the Departmental Office personnel.

Check boxes are for advisor or staff

Signature of appropriate person

ADVISOR:

- Provided all required items to your advisor.
- Obtained advisor and second reader signatures on title page of thesis.
- Submitted one signed copy of your thesis.
- Submitted electronic version of thesis, poster and all associated files required by your advisor.
- Satisfied your advisor that your work space is in good order.
- Ensured that all computer files on department instruments or computers are in directories or labeled with your advisor's initials.

Advisor

LIBRARY:

Submitted of corrected thesis (openworks.wooster.edu).

Student

DEPARTMENT OF CHEMISTRY ADMIN. OFFICE:

- Submitted corrected copy of your signed thesis
- Submitted electronic PDF version of your thesis, poster, and any other digital files required by your advisor submitted via email or through an external storage device to the administrative coordinator (chemistry)
- Returned keys for Severance Hall labs or instrument rooms to the administrative coordinator (chemistry) (*if applicable*).

Administrative Coordinator
(Chemistry)