KALAMAZOO COLLEGE

HANDBOOK for BIOLOGY JUNIORS and SENIORS

2017 - 2018

IMPORTANT DATES for 2017-2018

Note: Dates may be subject to change. Changes in this schedule will be communicated to students by the BIOL 490 coordinator (Prof. M. Wollenberg for 2017-2018) or SIP coordinator (Prof. Moore for 2017-18).

JUNIOR SPRING (2017)

Entire quarter, TBD	Occasional meetings (times TBA) with BIOL490 coordinator, SIP coordinator and biology seniors.
Week 5	Attend as much of Diebold Symposium as possible; participate in Referee Teams
Friday, Week 5	Complete "Module One" of the online ethics tutorial available at http://nationalethicscenter.org/
TBD; ~Week 7	Participate in pre-SIP thesis discussion group with assigned faculty
Friday, Week 7	Applications for SIP Fellowship funding from Biology Dept. due to department chair
Monday, Week 9	Completed SIP registration form (see Registrar's website) along with (i) a summary of proposed SIP research and (ii) email to Biology SIP coordinator from student's on-site SIP supervisor acknowledging agreement to mentor the student in their senior thesis project due to Biology SIP coordinator.

SENIOR FALL (2017)

Friday, Week 2	Complete, properly formatted copy of biology SIP thesis due. On-site SIP supervisor must sign the cover page or email the Biology SIP coordinator indicating that s/he has read the thesis and approves it for review. Submit to Biology office.
Entire quarter	All senior majors participate in a SIP Thesis Review Team for peer review of biology SIP theses. The Biology faculty will contact you individually in this regard.
Friday of Homecoming	Attend Biology Department "Reflections and Connections Alumni Seminar"
TBD	Attend other Biology Department-sponsored seminars and events

SENIOR WINTER (2018)

Friday, Week 1	Final bound copy of SIP thesis due. Submit to Biology office. Upload PDF version of thesis to Moodle.
Friday, Week 3	SIP Reflections Essay due. Submit to Biology office.
Winter, date TBD	SIP Reflections lunch discussion with SIP Thesis Review Team and faculty leader
Monday, Week 5	Written Comprehensive Examination
TBD	Attend Biology Department-sponsored seminars and events

SENIOR SPRING (2018)

Entire quarter	Attend regular meetings of BIOL 490 (time TBD)
Thurs.-Sat., Week 5*	Attend entire Diebold Symposium and present your SIP project (* exact week may vary depending on schedule of keynote speaker)

Kalamazoo College, Department of Biology

Handbook for Juniors and Seniors 2017-2018

TABLE OF CONTENTS

This handbook consists of guidelines, requirements and outlines that will be helpful to biology majors over the course of the latter part of the junior year and throughout the senior year. Each of you will receive a PDF file of this handbook. It is also available on the Biology Department's web site: **https://reason.kzoo.edu/biology/**

SECTION ONE

GENERAL INFORMATION

A. REQUIREMENTS FOR A BIOLOGY MAJOR - FOR CLASS OF 2016

1. Course Requirements - A minimum of nine biology courses (five required and four electives) and four cognates exclusive of lab credit, all at C- or better are required to complete a major in biology.

   A. Biology core requirements include:
   Evolution and Genetics with Lab - BIOL 112
   Form and Function with Lab - BIOL 123
   Ecology and Conservation with Lab - BIOL 224
   Cell and Molecular Biology with Lab - BIOL 246
   Senior Seminar - BIOL 490

   B. Among biology electives, at least three must be at the 300 level or higher, one of which must be a lab course. Other than BIOL 112 and BIOL 123, students may not count 100-level courses towards units required for the major.

   C. The biology department will accept for credit in the major a maximum of one unit from one of the following sources:
   - A SIP in biology
   - AP/IB credit (if score on Biology AP exam is 4 or 5, or score on IB exam is 5 or above)
   - approved Study Abroad course in biology
   - Dual enrollment or transfer course in biology

2. SIP - A college requirement. Biology majors are encouraged, but not required, to complete their Senior Individualized Project in biology. Project proposals must be approved by the Biology Department before registration. Up to two units may be earned for a SIP in Biology; one of these units can be counted toward the nine units required for the major. If performed under the direction of another department, no Biology credit will be earned. The written report of all Biology SIPs must be submitted to the Biology faculty for final review. Making arrangements for your SIP is your responsibility. Biology faculty, however, are more than willing to provide assistance in fields related to their areas of interest.

3. Biology Comprehensive Examination – Senior Biology majors must take the departmental written comprehensive exam. See "Section Three" of this handbook for further details.

4. BIOL 490 – Senior Seminar. This senior seminar course will provide you with experiences and information that will help you gain a better understanding of what it means to be a biologist. *All components listed below* must be completed before you will receive a grade in BIOL 490 at the end of your senior year. BIOL 490 units of credit are apportioned as

follows: 0.2 FA; 0.2 WI & 0.6 SP, with Fall and Winter credits showing only as a grade of "CR" and a final letter grade worth 0.6 units awarded at the end of Spring quarter.

a. Attend all Biology meetings and seminars - During the junior Spring, sessions will help you to find a Biology SIP, understand what the SIP is, and what you might expect while doing your SIP. During the senior Fall and Winter there will be occasional required meetings called primarily to disseminate information. Senior Spring sessions will help you prepare for the Diebold Symposium. Some seminars each quarter will feature outside speakers discussing research or other recent developments in Biology. Attendance will be recorded at each meeting and this contributes to your grade in BIOL 490.

b. Complete Online Ethics Tutorial - All Biology majors must complete "Module One – Rights and Obligations" of the online ethics tutorial available at https://nationalethicscenter.org/ (see details on page 9). Complete this by Friday, Week 5 of junior Spring. Date of completion is automatically recorded under the department account.

c. Participate in a Thesis Review Team - Each team will consist of a small group, usually 4-5 peers and a faculty member. Members of these peer groups will read and critique drafts of SIP theses written by the other students on their team. All Biology majors participate in this process and your performance as a reviewer contributes to your grade in BIOL 490. Biology theses are due by Friday of second week of the Fall so that members of the team to which you are assigned can begin critiquing and revising theses as early in the Fall Quarter as possible.

d. Submit SIP Reflections Essay - This essay is completed during Winter Quarter of your senior year. It provides an opportunity for reflection on the significance of your SIP to your professional and/or personal development. Essays also serve as a starting point for discussion during lunch with your thesis review team and faculty leader. The completed essay is due by Friday of Week 3, Winter Quarter and is graded as either pass or fail.

e. Complete the Written Comprehensive Exam – The Biology Department administers the Educational Testing Service "Field Test in Biology" as the written comprehensive exam. The exam is written in Week 5 of Winter Quarter. Your grade earned on the written comprehensive exam contributes to your overall grade in BIOL 490. Failure to show up for and write the comprehensive exam at the arranged time will result in a grade of "F" and zero points toward your BIOL490 grade. No make-up exam will be offered.

f. Serve on a Referee Team for preparation and presentation of peers at the Diebold Symposium - Each oral and poster presentation is refereed by at least two other senior majors and two or three juniors. Each senior practices her/his presentation with the referees whose responsibilities are to suggest improvements. This mechanism helps to ensure conciseness and clarity in the presentations. Each senior major serves as a referee for at least two classmates. Your performance as a referee contributes to your grade in BIOL 490. Performance is assessed using peer evaluation of your attendance

and input during practice sessions, and by the quality of referee team members' presentations at the Diebold Symposium.

g. Attend entire Diebold Symposium - As a senior Biology major you must attend all sessions of the Diebold Symposium. Attendance is taken at all sessions and contributes to your grade in BIOL 490.

h. Present SIP at Diebold Symposium - You will present your SIP, irrespective of the discipline in which it was done, to your peers and the Biology faculty during the Diebold Symposium in the Spring Quarter of your senior year. You may do this in either a poster or oral presentation format. You will be evaluated on the basis of content, graphics and effectiveness of your presentation, in addition to effectiveness of fielding questions following your presentation. Consult the evaluation forms for Diebold presentations in "Section Two" of this handbook for more details.

i. Complete the Biology Department Skills Survey and Senior Questionnaire - Information collected through the skills survey and senior questionnaire help the Biology Department assess the Biology curriculum. In the survey, we will ask you to report your level of proficiency in many skills used by biologists (a similar survey will be sent to your SIP mentor for feedback on the preparation our program provides to students). In the senior questionnaire, we will ask you to provide us with information such as GPA, GRE or MCAT scores (if you took one of the tests), graduate or professional programs to which you have applied (if you have), and what your plans are for the future. You will complete these online during the last weeks of senior Spring; we must receive notification that you have completed the survey/questionnaire before we will submit your grade for BIOL 490 to the Records Office.

NOTE: It is your responsibility to make sure that these requirements are met prior to graduation

B. THE LAST FIVE QUARTERS: AN OVERVIEW

Biology majors are expected to complete a number of requirements during their last five quarters as a student at Kalamazoo College. The major areas of requirements are as follows:

1. Senior Seminar (BIOL 490) - Students must complete each of the following components of this course:
    a. Attend all BIOL 490 meetings during Senior Spring, and participate in Biology Department seminars throughout the year
    b. Complete "Module One" of the online ethics tutorial – Junior Spring
    c. Participate in a thesis review team – Senior Fall
    d. Submit a SIP Reflections Essay – Senior Winter
    e. Complete the Written Comprehensive Exam – Senior Winter
    f. Serve on a Referee Team for other students' Diebold presentations - Jr. & Sr. Springs
    g. Attend the entire Diebold Symposium - Senior Spring
    h. Give an oral or poster presentation of your SIP - Senior Spring
    i. Complete the Biology Dept. Skills Survey and Senior Questionnaire – Senior Spring

    Students must register for BIOL 490 each quarter during their senior year. BIOL 490 units of credit are apportioned as follows: 0.2 FA; 0.2 WI & 0.6 SP, with Fall and Winter credits showing only as a grade of "CR" and a final letter grade worth 0.6 units awarded at the end of Spring quarter. Biology majors are expected to attend and participate in all departmental seminars during all quarters in which they are on campus. The grade for BIOL 490 is based on *all components of the course*.

2. Senior Individualized Project (BIOL 593) - Most Biology majors elect to do their SIP in Biology. Typically two units of credit are awarded, depending on the nature of the project, but only one unit of credit may count toward the Biology major (the biology department will accept for credit in the major a maximum of one unit from one of the following sources: a SIP in biology; AP/IB credit if score on Biology AP exam is 4 or 5, or score on IB exam is 5 or above; approved Study Abroad course in biology; Dual enrollment or transfer course in biology).

    Recognizing that training, personalities and interests of students vary, several different types of SIP experiences are acceptable. SIPs in Biology are basically investigative, and normally involve laboratory/field research projects. This research may be conducted on campus with a faculty member or off campus at another research facility. On rare occasions SIPs based solely on library research are acceptable; these normally receive one unit of credit. All Biology SIP projects must be approved by the department in advance.

The standard procedure for registering and undertaking a Biology SIP:

a. Fill out a SIP Registration Form indicating 2 units of SIP credit (BIOL 593) to be carried out as one unit in the Summer and one unit in the Fall, or alternatively, as two units during the Summer. Append a summary description of the proposed SIP project acknowledged and approved by your SIP mentor, and submit both documents to the Biology SIP coordinator for review no later than **Friday of 9th week of Spring Quarter**.

Your on-site SIP supervisor's approval must include his/her acknowledging agreement to mentor you in your senior thesis.

b. Once your project is approved, the SIP coordinator will sign your SIP Registration Form, which you then submit to the Registrar's Office by Friday of 10th week of Spring quarter. This will officially register you for SIP credit.
c. Carry out the SIP and write the thesis; see guidelines in "Section Two" of this handbook.
d. Have your thesis reviewed and edited by your SIP mentor before leaving the research facility where you conducted the work.
e. Submit the first complete version of your SIP thesis for preliminary review to the Biology Office by **Friday of 2nd week of Fall Quarter** of your senior year. **ANY SIP THESIS NOT SUBMITTED BY THIS TIME WILL AUTOMATICALLY RECEIVE A GRADE OF "No Credit" (NC)**. Under such circumstances the student must register again for the SIP at a later time. Note also that your SIP supervisor needs to sign the cover page or email the Biology SIP coordinator indicating that s/he has read the thesis and approves it for review.
f. Your thesis will be given a preliminary review by a faculty member. If it is not satisfactory, it will be returned for additional revision. If satisfactory, the thesis will then go through the peer review process during Fall Quarter.
g. Prepare the final version of your SIP thesis using comments from members of your thesis peer review team.
h. Submit one bound copy of the final version of your SIP thesis to the Biology office by **Friday of Week 1 of Winter Quarter** of your senior year. **IF A SIP THESIS IS NOT SUBMITTED BY THE DEADLINE, A GRADE OF "NO CREDIT" (NC) MAY BE AWARDED, IN ACCORDANCE WITH COLLEGE POLICY REGARDING** SIPs (see https://reason.kzoo.edu/registrar/Academic_planning/sip/).
i. Your SIP thesis is reviewed and graded by members of the Kalamazoo College Biology faculty. Each SIP will awarded a grade of Honors, High Pass, Pass, Low Pass, or Fail.
j. The thesis will be returned to the SIP coordinator who will record the grade awarded by the Biology faculty readers. A grade of Honors (H), Credit (CR) or No Credit (NC) is reported to the Registrar's Office. This is your grade for BIOL 593 (your SIP).

3. Diebold Symposium Preparation and Presentation - You will also present your SIP to the department orally, either as a seminar or as a poster presentation. These public presentations are made during the department's annual Diebold Symposium in **Spring quarter**. Follow the Guidelines found in "Section Two" (under Diebold Symposium Presentation) of this handbook when preparing your presentation. When preparing the SIP presentation, a few other students will serve as referees, who will help to ensure that your talk/poster presentation is clear, fits the allotted time, and that the audio-visual aids are appropriate. You will also serve as a referee to a group of your peers.

   All Biology majors are required to give a BIOL 490 presentation, generally at the Diebold Symposium, whether or not the SIP was in Biology.

4. SIP Reflections Essay - Each Biology major must submit a SIP reflections essay by **Friday of 3rd Week of Winter Quarter** and before taking the written comprehensive exam. Guidelines for the essay are provided in "Section Two" on the SIP.

5. Written Comprehensive Examination - Senior Biology majors must take the departmental written comprehensive exam that is administered during **Winter Quarter (typically 5th Week)**. This exam is the Educational Testing Service "Field Test in Biology," a nationally-normed test of competency in Biology. Your grade earned on the written comprehensive exam contributes to your overall grade in BIOL 490. Failure to show up for and write the comprehensive exam at the arranged time will result in a grade of "F" and zero points toward your BIOL490 grade. No make-up exam will be offered.

Sample schedule and anticipated activities for the LAST FIVE QUARTERS

Junior Spring:

1. Make arrangements to carry out your SIP during the summer.
2. Work as a member of a referee team to help seniors prepare for the Diebold Symposium.
3. Attend the Diebold Biology Symposium. Juniors who attend the symposium develop a better grasp of the nature of the SIP and obtain good ideas for their own projects.
4. Attend all relevant meetings of BIOL 490 if possible; attend any other meetings convened by faculty coordinators.
5. Complete "Module One – Rights and Obligations" of the online ethics tutorial at https://nationalethicscenter.org/ by **Friday of 5th Week**. Date of completion is automatically recorded under the department account after you successfully complete the tutorial. [Instructions: go to the link above; hover on the "Members" tab and click on "Groups"; enter KalamazooBiology in the "Find a group" search field; create a personal log-in and access the module.]
6. If intending a Biology SIP, submit a completed SIP Registration Form and project description to the Biology SIP coordinator by **Friday of 9th Week** for approval. Before the SIP registration form can be signed, students must also arrange to have their SIP mentor email the SIP coordinator acknowledging agreement to mentor the student in their senior thesis.
7. Register for BIOL 593 (SIP) by submitting the signed copy of the SIP Registration Form to the Registrar's Office by **Friday of 10th Week**, with the appropriate number of SIP units indicated.

Junior Summer:

1. Carry out your SIP (BIOL593) and write (and re-write!) your SIP thesis.

Senior Fall:

1. Submit completed SIP thesis to the Biology office by **Friday of 2nd week**.
2. Participate in a thesis review team and revise your thesis.
3. If appropriate, arrange to take GRE's and explore graduate school opportunities.

Senior Winter:

1. Submit final copy of SIP thesis to the Biology office for evaluation by **Friday of 1st week**.
2. Submit the SIP Reflections Essay (due **Friday of 3rd week**).
3. Prepare for and take the Written Comprehensive Examination (**Week 5**).

Senior Spring:

1. Attend all meetings of BIOL 490 as required.
2. Work with referee and advisory team to prepare for Diebold Symposium.
3. All seniors are required to attend all sessions of the Diebold Symposium (**typically 5th week).** SIPs done during the previous summer will be presented at this time.
4. Complete the Biology Department Skills Survey and Senior Questionnaire.

NOTE: Be aware of and attend ALL required meetings for Biology majors during any of the last five quarters. And, please remember, YOU are responsible for completing all requirements.

C. HONORS AND AWARDS IN THE BIOLOGY DEPARTMENT

The faculty of the Biology department determine graduation with **Honors in Biology**, taking into consideration multiple factors. To be considered for graduation with honors a student must have (1) completed a minimum of 7 on-campus courses in Biology (excluding the SIP and BIOL 490 Senior Seminar); (2) attained at least a 3.67 GPA in Biology; (3) demonstrated excellence in at least two of the following areas of senior work: the written comprehensive exam, the SIP thesis (normally requiring completion of a SIP in biology), the Diebold Symposium presentation; (4) exhibited strong moral character and ethical conduct within and outside the classroom; and (5) have the general support of the faculty.

The following awards are other means by which the Biology faculty gives special recognition to graduating senior Biology majors:

Robert Bzdyl Prize

Established by the Bzdyl family in memory of Robert ('K' '69) and awarded to one or more senior majors with demonstrated interest and ability in marine biology or related fields.

William E. Praeger Prize

Established by the Biology faculty and awarded to the most outstanding senior major(s) in Biology, based on academic achievement in the discipline.

H. Lewis Batts Prize

Established by the Biology faculty and awarded to one or more senior majors who has done the most to support activities of the Biology Department and foster the spirit of collegiality among students and faculty in the department.

Diebold Scholars

Students recognized for excellence with their Senior Individualized Project, as demonstrated by the oral or poster presentation of the SIP at the Diebold Symposium and by the written thesis.

SECTION TWO

SENIOR INDIVIDUALIZED PROJECT

A. BIOLOGY SIP POLICIES

1. A Biology SIP requires original research, entailing acquisition, analysis, and interpretation of new data in a field, laboratory, or clinical setting. The SIP is reported as a written thesis and is presented orally as a seminar or a poster.
2. Students normally register in the **junior Spring** for two SIP units (BIOL 593) that will be credited in the senior Fall as an Extended Fall SIP. Note: The Biology Department reserves the right to designate a proposed SIP project as a one-unit SIP. This might occur as a result of (i) late registration, (ii) a project with large components outside of the field of Biology, or (iii) insufficient progress or extenuating circumstances. The latter option can be ascertained at the time of first submission of the SIP thesis (see #4, below).
3. SIP research and initial writing of the SIP thesis are done in the Summer between the junior and senior years, and final revision of the SIP thesis is done during Fall of the senior year. Copies of past theses are available for viewing in the Biology Office or online through CACHE, the Kalamazoo College digital archive system (https://reason.kzoo.edu/dspace/). Students are advised to refer to those that received "Honors" grades as good models of SIP theses.
4. Students must submit one copy of the first complete version of their SIP thesis – properly formatted, and ready for peer review – by **Friday of 2nd Week of Fall Quarter**. Note: you must have your SIP supervisor email you his/her approval of the written SIP; provide the Biology SIP coordinator with a hard copy of that email along with your manuscript.
5. Biology faculty will assess the completion status of the initially submitted document. That assessment will influence the final grade. A thesis that appears to be written well and in an advanced stage of completion at this point will have a much better chance of earning a high grade than would a thesis in need of considerable revision. (The grade of "Honors" is rare, awarded only to those who have done outstanding work in *all* aspects of the SIP.)
6. If this version of the SIP thesis is suitable for review, copies will be made by the Biology Department for distribution to the SIP thesis review team, which will critique the thesis and return it with suggested revisions to the author.
7. Thesis Review Teams will be formed. Generally, these will consist of three or four students along with an advising faculty member. Each time the review team convenes, everyone in the group will have reviewed the same thesis and will share review comments and recommendations for revision. You will be graded on your performance as a reviewer.
8. Each student revises her/his SIP thesis during the remainder of Fall Quarter. One copy of the final version of the thesis must be submitted by **Friday of 1st week of Winter Quarter**. If a SIP thesis is not submitted by the deadline, a NC grade may be awarded, in accordance with College policy regarding SIPs (see https://reason.kzoo.edu/registrar/Academic_planning/sip/).
9. SIPs are presented at the Diebold Symposium in the **senior Spring**.

B. ACTIVITIES ASSOCIATED WITH THE SIP

There are five major activities that are part of a Biology SIP:

1. the research itself
2. gaining literacy in the project field
3. writing the thesis
4. revising the thesis
5. reviewing the thesis and revising it again

1. The research consists of the actual work in the laboratory and/or field, learning and utilizing experimental techniques, collecting and analyzing data, etc.

2. The second part of the SIP consists of becoming literate in the discipline through literature surveys, developing a command of the primary literature in the field, and developing an understanding of the broader context within which your investigation belongs. You need to be aware of what others have done in relation to your specific project and how your research supports or refutes other findings and advances the field. There should be some contextual framework within which your work is being conducted.

3. The third part of the SIP consists of writing your thesis. This can be a very challenging task since there are so many different issues of which the writer needs to be aware. Some aspects of writing that past students have struggled with initially include: 1) getting information into the correct section of the thesis; 2) translating jargon, *e.g.*, "lab slang" or "field codes" into terms that others can understand; 3) using standard scientific abbreviations (SI units) and correct spellings, grammar and syntax; and 4) developing a thorough, consistent, and accurate literature cited section. You should not expect to be able to sit down and write the final version of your thesis as your first draft. It is probably safe to say that no one, irrespective of writing experience, is capable of writing that well. Writing and revising are creative processes that should lead you to develop new ideas of how information can be presented more clearly and concisely. At the completion of this phase, the document is ready for review and further revision.

4. The fourth part of the SIP involves critiquing, editing, and revising the written manuscript. This process can be as demanding as the writing and begins with you reviewing and revising your original draft. After writing the initial draft (or at least the majority of it) you should wait a few days to remove yourself psychologically from the role of the writer, and the intensity that it requires, before reviewing it. Conduct your initial review from the perspective of a reviewer, not that of the writer. After making your initial revisions, ask someone else involved with the project to review your manuscript; revise it again. Then ask your supervisor to review and comment on it; revise it yet again. Before leaving the project site, be certain that your mentor has reviewed the entire manuscript. At this point, make all appropriate changes, review and revise it one more time so that it is ready to submit to the Biology Department for further review.

5. Reviewing involves not only working on your own thesis, but also providing helpful suggestions for other students with whom you will be working in the reviewing process. Initially, after submitting your thesis to the Biology Department, a faculty member will look through it to see if it looks complete. If there are glaring errors or problems, the thesis will be returned to you for additional revision before any further action is taken on it. The "initial" condition of the SIP will be assessed by the faculty member and that assessment will be included as part of your final grade. Acceptable theses will proceed to the next step. A review team consisting of fellow Biology majors and a faculty member will review your SIP thesis along with those of the other students in the group and make suggestions for revisions as appropriate. Students are graded on their performance as a reviewer of peers' theses. Finally, use suggestions made by all of your reviewers when revising your thesis for the last time. After completing this revision, submit your SIP thesis to the Biology Department no later than Friday of first week Winter Quarter for final grading.

Advice: If your thesis needs to be completely rewritten during the Fall Quarter, while you are taking classes and preparing for the comprehensive exam, you will be at a distinct disadvantage. A well-prepared manuscript (please see "activity" four) will make your life simpler and will take less time for the SIP review team to complete their work.

Words of wisdom from Aldo Leopold to a student, suffering through many drafts of a manuscript…

> Think of it this way. In spite of all the advances of modern science, it still takes seven waters to clean spinach for the pot…And for all my writings to this day, it still takes seven editings, sometimes seventeen, before I let it go off to press. Remember…We're all in the same boat.

C. SEARCHING FOR AND INVESTIGATING SIP OPPORTUNITIES

A suggested description of the SIP
(that you may use in a letter to a potential SIP mentor)

All Kalamazoo College students do a Senior Individualized Project (SIP; equivalent of a senior thesis) for one ten-week quarter during the senior year. Most Biology students do these projects during the summer prior to the senior year. The projects involve undertaking an original, full-time research project carried out with direction from scientists in academic, industrial, or government settings. Usually, students work on a small part of an ongoing project in the laboratory or field, but they must be able to collect and analyze a reliable set of data in the ten-week period that they can then use as the basis for writing a senior thesis. Long-term projects, involving the collection of data that cannot be interpreted until some future date, are not appropriate for the SIP. Each Biology student submits the results of her/his project as written senior thesis that is reviewed by classmates and faculty in Biology and then graded after further revision. Many SIPs have resulted in publications in peer-reviewed journals with the students as co-authors. The SIP is a college graduation requirement and students may do their work in any area, but Biology majors are required to present their work, as a seminar or a poster, during our annual Diebold Symposium in Spring quarter of the senior year.

D. FUNDING POSSIBILITIES FOR SENIOR INDIVIDUALIZED PROJECTS IN BIOLOGY

Before beginning the list of funding sources, it is important to point out that your SIP is meant to be a learning experience rather than an opportunity to make as much money as possible. If at all possible, try not to put income at the top of the list when choosing your SIP. It is, however, important to have enough financial support to cover your expenses while working on your SIP so that you don't have to work another job to feed yourself during those ten weeks. For this reason, we provide you with some suggested sources of support to which you may apply. The Biology website (https://reason.kzoo.edu/biology/research/) contains additional information.

Sources within Kalamazoo College

Diebold Research Fellowships: These fellowships are open to any Biology major and provide modest support for the SIP in Biology. Funds may be used for travel, food, housing, or supplies. Awards are based on the strength of the proposed research and financial need. Priority is given to those projects carried out in conjunction with faculty members of the Kalamazoo College Biology Department. Please see below for application information. Funding is generally capped at $1,500.

Batts Research Fellowships: These fellowships are open to any Biology major and provide modest support for the SIP in more organismal and ecological subfields of Biology. Other guidelines for these fellowships are the same as those for Diebold Fellowships. Please see below for application information. Funding is generally capped at $1,500

Various Endowed Fellowships: These "named" fellowships are made possible by generous financial support from outside donors. Students may not apply specifically for these fellowships; instead the faculty will choose a worthy recipient from among student fellowship applicants.

Center for International Programs (CIP): The CIP has fellowship programs designed to help defray the costs of a Senior Individualized Project or other College-related activity in an international location. Sources of funding for international work include The Beeler Fellowship, The Beeler Project Grant, and The Collins Fellowship. See the Student Projects Abroad (SPA) link on the CIP aid page for more information. Application deadline is typically mid-April (http://reason.kzoo.edu/cip/aid/)

Center for Career and Professional Development Internship Program: The CCPD Internship Program (CCPD-IP) offers structure and support from the CCPD to students conducting summer internships. Read more about program participation requirements and funding (up to $3000) on the CCPD website. Applications are reviewed on a rolling basis, due the 15th of each month, January through April.

Suggestions for external sources of support

NSF-REU and other Federal Grant Programs: There are numerous federally-funded undergraduate summer research programs at institutions across the country. The NSF-REU program has been a very good source of support for summer SIPs. Keep in mind that these are nationally competitive programs; application does not guarantee acceptance, but non-application guarantees you will not be considered. A selected listing can be found on our internships webpage (https://reason.kzoo.edu/biology/research/). Additional opportunities can be found by searching the web with keywords (e.g. undergraduate, summer research, biology, internship, fellowship)

Your SIP Institution: Many Kalamazoo College seniors have received stipends for fellowships from their host institution or from their mentor's research grants. Your SIP mentor should be able to guide you to information on these opportunities.

There are many opportunities available. It is up to you to initiate the search for grants to support your SIP and then get whatever help you need to procure funds.

Application for Department Funding

Awards:

These fellowships provide support for travel, food, housing or supplies for a 10-week SIP in Biology. The number of awards granted each year will vary depending on the return on the endowment, the number of eligible students and their individual needs. Preference will be given to supporting students conducting their SIP at Kalamazoo College with a member of the Biology Department.

Applications:

Applications should be made in the form of a letter to the Chair of the Biology Department. The letter should include the following:

1. A summary of academic preparation for the SIP, including courses in the major and other specific courses that may apply directly to your proposed project.
2. A summary of prior research experience, including any Research Apprenticeships or Career Development Externships or Internships.
3. An outline of the project to be done for your SIP.
4. A detailed budget showing how the Diebold or Batts funds will be used. Please include other funding sources you have applied to and/or received funds from (and amount received) to support your SIP, along with other sources of income (e.g. mentor contributions to salary, parental support, etc.). Please use the example budget below as a guide when preparing your own budget.
5. If you request funds to support travel, please calculate the carbon emissions associated with that travel. http://www.nativeenergy.com/travel.html (choose the tab corresponding to the appropriate mode of transportation when calculating emissions)
6. A statement of future career plans and goals.

Example Budget, for 10 weeks		**Total**
Rent	$80/week	$800
Groceries	$75/week	$750
Utilities	$40/week	$400
Transportation (to and from site, 300 miles each way)	$0.20/mile	$120
Public transit fare ($4.40/day)	$22.20/week	$222
Assets: CCPD Field Experience Funds	$100/week	-$1000
Total Requested		**$1292**

Deadline:

Applications must be received by the Department Chair by **Friday of 7th week of Spring Quarter**. Awards will be announced around Friday of 9th week.

E. THE WRITTEN THESIS

1. Thesis Layout and Formatting

You must use a word processing program (*e.g*. Microsoft Word) to prepare your manuscript. Be sure that the program you use is one to which you will have access when you are revising your SIP thesis. Back-up your work frequently.

The thesis should contain the following sections, in the order listed, with pages numbers as indicated below:

- Title page (this counts as the first page, but no number appears on it)

The following sections have page numbers in Roman numerals, starting at page "ii".

- Acknowledgements (p. ii)
- Table of contents, by section, with page references
- List of tables, with titles and page references
- List of figures, with titles and page references
- List of appendices, with titles and page references

The following sections have page numbers in Arabic numerals, starting at page 1.

- Abstract (p. 1)
- Introduction
- Materials and Methods
- Results
- Discussion
- Literature Cited
- Appendices (if applicable)

Page numbers should appear centered one-half inch above the bottom of the page.

Left and right margins should be 1.25 inches wide to allow for binding.

Top and bottom margins should be 1.0 inches.

Line spacing: double space your work throughout the thesis *except* for the Lists of Tables and Figures, Table and Figure captions, Literature Cited (with double space between references), quotations and footnotes. These should be single spaced.

Use greater spacing around equations and formulas when they are not imbedded in a line of text.

Figures and Tables should appear as closely as possible to the first citation in the text. Figures and tables may be embedded within the text body or placed on a separate page. In either case, avoid "orphaned" lines of text below or above a table or figure.

Quotations are occasionally necessary for documentation, but should be limited to essential passages; selected phrases are superior to long quotations requiring additional explanation. Unless the quotation is brief and to the point, a paraphrase is preferable. Under most circumstances direct quotations should be avoided.

Footnotes should also be avoided except when clearly necessary for presenting explanatory material that will not fit in the text or tables. Indicate a footnote in the text with a superscript

after the word or statement annotated. Number footnotes consecutively throughout the manuscript, starting with those on the title page.

Consult recently completed SIP theses on the library's digital archive site for examples (https://reason.kzoo.edu/dspace/). If this format is not followed, your SIP thesis will most likely be returned to you unread so that you may prepare an acceptable copy. Note that in this case, your SIP will not be considered for an Honors grade. Use a spell checker and grammar checker paying particular attention to quotations, citations, technical terms, and names of persons and places. Be sure to check numerical data in the text and tables. You might find it helpful to have an "uninformed" person read your manuscript to help you find errors.

Binding. The final copy of the SIP thesis (submitted Winter, Week 1) must be submitted in a Senior Individualized Project binder available for purchase from the Kalamazoo College Bookstore. The review-ready copy submitted in the Fall should be loose pages secured with a binder clip to facilitate photocopying for peer review.

Copyright Policy. Kalamazoo College is committed to the provisions of copyright laws. We affirm the inherent value of these laws, as stated by EDUCOM:
Respect for intellectual labor and creativity is vital to academic discourse and enterprise. This principle applies to works of all authors and publishers in all media. It encompasses respect for the right to acknowledge, right to privacy, and right to determine the form, manner, and terms of publication and distribution. *[EDUCOM. 1993. Using software: a guide to the ethical and legal use of software for members of the academic community. Washington, DC.]*
All members of the College community have the responsibility of adhering to copyright laws.

2. Details on Section Content

Outcomes of scientific investigations are reported in the form of a scientific paper. These instructions describe the scientific paper, and are provided for your use when writing your SIP thesis. Remember, a paper should go through several drafts before the penultimate version is submitted. So - PLAN AHEAD - and then write, rewrite, and write again. Stephen J. Gould's words of wisdom about scientific papers may be encouraging to those of you who dislike writing because you believe the first draft must be perfect:

On Scientific Papers

> Although the result is, I trust, tolerably ordered, this book arose in a haphazard way. Its genesis and execution were probably typical of most general treatises. We rarely separate the logical and psychological aspects of research and we tend to impute the order of a finished product to the process of its creation. After all, the abandoned outlines and unused note cards are in the wastebasket and the false starts are permanently erased from memory. It is for this reason that P.B. Medawar once termed the scientific paper a "fraud"; for it reflects so falsely the process of its generation and fosters the myth of rational procedure according to initial outlines rigidly (and brilliantly) conceived.

S. J. Gould - from Acknowledgements in *Ontogeny and Phylogeny*[1]

[1] Gould, S.J. 1977. *Ontogeny and Phylogeny*. Harvard Univ. Press, Cambridge.

The purpose of a scientific paper or presentation is to convey information clearly and concisely to the reader. Among other criteria that must be kept in mind as a paper goes through various revisions is whether the paper has high "readability". At some point attention must be focused on explaining the project so that the reader can understand it. It is at least as important that the presentation be “reader friendly” as it is “writer friendly”. The written manuscript rarely reflects the chronology of the project. It is not a documentary account of exactly what occurred during the investigation. Many of the recommendations given here are from Pechenik (2007), which we encourage you to consult for further details and examples.

Title Page – an example can be found on the BIOL490 Moodle page. The title page must contain the following:

- the complete thesis project title. The title represents a key aspect of the paper because it serves to alert other investigators to the nature of the work being presented. It should consist of as few words as possible; they should adequately describe the content of the paper and allow someone not familiar with your work to decide if the paper will be relevant to their investigation (*i.e.* should they bother reading it?). FYI – Current Registrar guidelines allow only 25 characters of your SIP title to be recorded on your transcript. Longer titles will be truncated on the transcript.
- Author's name (your full name)
- Name and institution of the on-site research supervisor
- Name and department of the faculty SIP supervisor (the K biology professor who reads the thesis)
- The statement: "A paper submitted in partial fulfillment of the requirements for the degree of Bachelor of Arts at Kalamazoo College."
- Year

Acknowledgments – use this page to thank those who provided guidance, support and funding in order for you to complete your work. This includes your research mentor(s) and others involved in project at SIP location, members of your thesis review team (students and faculty member), sources of funding for the project, and any other individuals you wish to acknowledge and why.

Abstract - The abstract is usually a one or two paragraph summary of the paper, stating the problem you investigated, materials used, basic methods, major results, and principle conclusions. The abstract should never exceed 250 words, and will often be shorter. Generally, it is best to write the abstract after finishing the rest of the paper. Although it is intended to summarize the paper, it should not simply be a patchwork of sentences "lifted" from the main body sections.

Introduction - The purpose of the introduction is to supply the background necessary to enable the reader to understand and evaluate your study without having to refer to previous publications, and should provide the rationale for your study. In your introduction, therefore, you will orient the reader by summarizing pertinent literature in your field, making references to previous studies (literature cited), and noting similarities and/or differences between previous studies and the work you are about to describe. This will enable you to provide the rationale for your

investigation, outline your major objectives, and state a hypothesis to be tested (if there is one). You should not attempt to cover the entire subject area in your introduction; rather you should attempt to bring your particular investigation into focus as quickly as possible.

You should begin your introduction by "painting" a broad "picture" of your area of study and then progressively narrow the focus of your story, culminating in a statement of your purpose and/or hypothesis to be tested. You should minimize the number of digressions into areas of marginal relevance to the main focus of the study. If your investigation focused on a particular species, or group of organisms, then you should provide sufficient background about the life history of your focal organism in your introduction.

Materials and Methods - This section describes what you did in sufficient detail that any competent worker would be able to repeat your work and expect to get similar results. Describe your materials precisely. This includes the degree of purity (*e.g*. Reagent Grade) and source (company, city, state and country) of reagents. If appropriate, you should include a description of your study site(s), time of year when study was conducted, how samples were collected and preserved, how organisms were identified, number of samples taken and where or how often, how data were analyzed, etc. "Standard procedures" can be referred to through literature citations and fairly brief descriptions of the steps followed. If the project consisted of a number of smaller but somewhat separate studies, they should be clearly indicated in subsections within this section. Keeping the reader in mind when writing this section is extremely important.

Statistical methods should be used when designing an experiment or a series of observations and when analyzing and interpreting data from a completed investigation. Because statistical methods are based on probability, they neither support poorly designed and inadequately controlled experiments nor prove results beyond doubt.

When designing experiments, be aware of normal variations in biological materials, reliability of methods, and errors arising from sampling. Statistics cannot substitute for thought and common sense. When analyzing data, emphasize the biological results, not the statistical methods. A simple statement that statistical methods yielded certain results usually justifies interpretations and conclusions based on the data. Do not include unnecessary mathematical details. Long descriptions of statistical methods are a waste of manuscript space, except in papers dealing specifically with statistics. Be sure, however, to cite the source of any unusual methods.

Results - This section should contain the results from your study, without interpretation, and may often be the shortest section in the paper. This section should contain ONLY results – methods or discussion belong in their own sections. Use tables and figures to summarize data. Present your data only once – in the text, in a table, or in a figure. In the text, describe the results, referring to tables and figures by number where relevant. Results from statistical analyses must be used to support statements like "there is a difference between treatment A and treatment B." If the project involved a number of smaller but distinct studies, the results should be reported in the same sequence in which they were introduced in the previous section of the paper.

You should exercise care when presenting data such that a reader could draw the same conclusions as you when viewing them. Tables and graphs should contain enough information to illustrate particular points, but not crowded with so much information that they are indecipherable.

Tables should be numbered consecutively using Roman numerals (*i.e*. Table I, Table II, etc.) and each should have a descriptive title and summary above the Table that doesn't require the reader to refer to the text in the manuscript to understand it. Row and column headings should be easily understood. Use footnotes to the table, if necessary, to provide additional details.

Many kinds of data are best presented as figures, which are given their own consecutive Arabic numbers (Figure 1, Figure 2, etc.). Figures may be graphs or diagrams. In graphs, use clear symbols (circles, squares, etc.) to mark data points, and draw lines where appropriate to emphasize the trend of the data. Each figure must have a legend (beneath the figure) that tells the reader what is being presented and explains what the symbols represent. Do not interpret the data in the figure legend; just provide enough information for the reader to understand the figure. Remember, if data are presented as average (mean) values, they must be accompanied by some measure of the variation in the data (e.g. standard deviation or standard error). You should include a statement like "Data are presented as mean ± standard deviation" in your figure legend to indicate how the data are presented in the figure. Each Table or Figure must appear immediately after (the next page(s)) the first reference to it in the narrative. Use color only when absolutely necessary, and in general, minimize non-data ink.

Discussion - The purpose of the Discussion is to interpret the data and draw conclusions from the results. The initial part of the Discussion should focus specifically on that objective. What do the results mean in terms of the problem you posed in the introduction? Be sure to explain the reasoning that relates the data to your conclusion. Point out inconsistencies and unsettled points. Consider implications of your study, but do not extrapolate wildly beyond your data. While this is the only section of the paper where speculation and conjecture are permissible, they should be confined within reason. (If all the organisms died for completely unknown reasons, it is not worthwhile spending a paragraph speculating on why they died.)

You should begin your Discussion with an introductory paragraph in which you briefly describe the general findings of your investigation. This paragraph should contain, what amounts to be, a thesis statement, the organizing theme for the narrative that you develop in the paragraphs that follow. You should conclude your Discussion with a paragraph that brings closure to your narrative and that points to future investigations that are based on the one you just discussed.

Your narrative should be a series of paragraphs in which you interpret your results and compare them with those reported by other investigators. That is, you should indicate whether your results and those of others support the same general hypothesis or are contradictory. At least some of the works cited in this section should be the same as those cited in the Introduction. In this sense, the latter part of the Discussion should come “full circle” bringing the reader back to the issues introduced in the Introduction.

Literature Cited - Cite the source of all facts, methods, and ideas that are not your own. There are set ways of doing this in the text, and in the Literature Cited section at the end of the paper. Use the following formats when citing references to the literature in your writing.

3. Citing Sources

Citations within the Text

You should cite published sources of information using the (author, date) format by giving the author(s) and year of publication. Note that the format varies with the number of authors on the source (one, two or more than two) and depending on whether your make direct or indirect reference to the work.

The following are some examples.

1. When there is **one author**:

   Jones (1983) showed that these cells proliferate within the first two hours of treatment. or,

   Previous work (Jones, 1983) showed that cells proliferate within the first two hours of treatment.

2. When there are **two authors**, use the last names of *both* authors when citing

   Jones and Doe (1986) reported that . . . or,

   . . . but other reports (Jones and Doe, 1986; Smith, 2001) have contradicted this.

3. When there are **more than two authors**, use only the last name of the *first* author, followed by *et al.*, as in

   Halliday *et al.* (1985) report that . . . or,

   Some investigators (e.g. Halliday *et al*., 1985) have reported . . .

   NOTE the format of *et al*.: it is italicized and there is a period after *al*. and then a comma between *al*. and the year. The expression *et al.*is short for *et alia,* Latin for "and others."

4. When there are **two or more references** showing similar results, list the references chronologically, separated by a semicolon.

   Previous studies (Jones, 1983; Halliday *et al*., 1985; Jones and Doe, 1986) have yielded similar results.

5. For **more than one article by the same author(s) in the same year**, use lower case letters to differentiate them

   Jones (1983a,b) found that mutant lines were resistant to . . .

   Whereas chickadees were observed to cache seeds in early Winter (Gould and White, 1998a), a subsequent study showed that this only occurred when temperatures were below freezing (Gould and White, 1998b).

Citations in the Literature Cited Section

In this section, you should provide full information on each reference, listed alphabetically by the first author's last name. In all cases for the Literature Cited section, the name of the first author of a citation is given as - last name followed by initials; all other authors in the same citation are given as - initials followed by last name. Observe punctuation. Items in " " should appear exactly in the citation.

The format of the complete citation varies with the type of source.

1. For a journal article
   Author(s). Year. Title of paper (only first word capitalized). Journal name (full name and italicized) volume: first page-last page.

   One author:
   Reid, W.M. 1978. Will future generations of biologists write a dissertation? *BioScience* 28:657-654.

   Two authors:
   Anderson, J.A. and M.W. Thistle. 1947. On writing scientific papers. *Bulletin of the Canadian Journal of Research*, 31 December 1947, N.R.C. No 1691.

   Three or more authors (note: in the text the citation would be Fraser *et al*. 2002, but in the literature cited section all authors names are given)
   Fraser, A.M., T. Tregenza, N. Wedell, M.A. Elgar and N.E. Pierce. 2002. Oviposition tests of ant preference in a myrmecophilous butterfly. *Journal of Evolutionary Biology* 15:861-870.

2. For a book
   Author(s). Year. Title of book (italicized). Publisher, city of publication.

   Ebel, H.F., C. Bliefert and W.E. Russey. 1987. *The Art of Scientific Writing: From Student Papers to Professional Publications in Chemistry and Related Fields.* VCH, Weinheim and New York.
   Morse, D.H. 1980. *Behavioral Mechanisms in Ecology*. Harvard University Press, Cambridge, MA.

3. For a paper or chapter from an edited work (book where each chapter is by a different author)
   Author(s). Year. Title of paper or chapter. "In:" Editor(s) "(ed)". Title of book (italicized). Publisher, city of publication, chapter pages.
   Herrera, C.M. 2002. Seed dispersal by vertebrates. In: C.M Herrera and O. Pellmyr (eds.) *Plant-Animal Interactions: An Evolutionary Approach*. Blackwell Publishing, Oxford, pp. 185-208.

4. Items From The World Wide Web

You should be cautious when obtaining sources of information on the internet. Articles used should from reputable, peer reviewed web sites. (Remember, yahoos can put anything they want, information or misinformation, on the web.)

Note that articles that are accessed online from journals that are also available in print version (e.g. *Ecology*, *Conservation Biology, Molecular Biology of the Cell*) should be cited according to the printed journal format given above, and not as a web document. Only periodicals that are available only as an electronic source should be cited as web documents.

When citing web sites, include the author(s), year (if available), title of web page, retrieval date of the information and the Universal Resource Locater (web address or URL).

Generic format:
Author(s). Year (if available). Title of work. "Accessed" month day, year. Published at: URL.
Note: If the web site does not have an obvious author, cite the author as Anonymous.

Examples:

Anonymous. Undated. Discover life. Accessed November 2, 1998. Published at: http://www.discoverlife.org/.

Colwell, R.K. 2000. EstimateS: Statistical estimation of species richness and shared species from samples. Version 6.0b1. Accessed February 3, 2003. User's Guide and application published at: http://viceroy.eeb.uconn.edu/estimates.

Patterson D.J. and M.L. Sogin. 2000. Tree of Life Web Project: Eukaryotes. Accessed January 22, 2004. Published at: http://tolweb.org/.

Do not cite unpublished work unless the paper has been accepted for publication. Unpublished results may be mentioned as such in the text with the word "unpublished" in parentheses after the author's name if there is no alternative. Use "personal communication" sparingly.

Check all parts of each reference against the original paper. An inaccurate or incomplete reference wastes the to me of readers and librarians, and reflects poorly on the scholarship of the author.

Some "Handy" References

Anderson, G. 2004. How to write a paper in scientific journal style and format. Published at: http://abacus.bates.edu/~ganderso/biology/resources/writing/HTWtoc.html

Council of Biological Editors citation style (http://writing.wisc.edu/Handbook/DocCBE.html)

Day, R.A. 1988. *How to Write and Publish a Scientific Paper*. 3rd Edit. Oryx Press, Phoenix, New York.

Kalamazoo College Writing Center – "Resources for Writers" (https://reason.kzoo.edu/writingcenter/resources/)

McMillan, V.E. 1988. *Writing Papers in the Biological Sciences*. St. Martin's Press, New York.

Pechenik, J. 2007. *A Short Guide to Writing About Biology*. Pearson Longman, New York.

4. SIP Mentor Approval

Finally, you must have your SIP mentor (*i.e*. the person with whom you did your research) read all of your manuscript before you return to Kalamazoo College. Have your SIP mentor sign the cover page of your thesis draft or append a hardcopy of an email that indicates that s/he has read the thesis and approves it for review. Turn the manuscript in to the Biology SIP coordinator by Friday of Week 2 of Fall quarter. Having your SIP mentor read the thesis before you leave your SIP site allows you to incorporate as many of your mentor's valuable insights into your written product as possible, and you can get many of your difficult questions answered promptly. Also be prepared to contact your SIP mentor after leaving your SIP site for additional help when revising your manuscript. The manuscript you submit to the Biology Department for initial review should be the penultimate draft.

F. THE SIP: BEFORE RETURNING TO CAMPUS

1. Write a complete version of your SIP thesis. Pechenik (2007) is a very helpful guide to writing about biology effectively. Read it and refer to it frequently.

2. Review and revise your thesis looking especially for technical, grammatical, and typographical errors. Remember to use spell checker, but also remember that it won't catch all typographical errors or incorrect word usage. The following are reminders/suggestions, in no particular order, that will be helpful when writing and revising your SIP thesis.

   a. Use the correct format for the title page.

   b. Be sure to number the pages of your thesis, and use the correct format when doing so.

   c. Write a complete and gracious Acknowledgments section.

   d. Use the correct format for your Table of Contents

   e. If you have Figures and/or Tables in your SIP thesis, be sure to include pages listing Figures and Tables. Use the correct format for these pages.

   f. Be sure to include appropriately labeled sections, specified in "The Written Thesis" section of this handbook (*e.g.* Abstract, Introduction, Materials and Methods, etc.), in the body of your thesis.

   g. Be sure that all literature citations in the body of the thesis are listed in the literature-cited section and vice versa.

   h. Insofar as possible, you should obtain and read a copy of every publication that you cite. You may need to refer to them later.

   i. Minimize (avoid) references to "personal communication" as reliable sources of information. If information isn't written down, try your best to avoid saying anything about it or referring to it.

   j. Do not refer to newspaper or popular magazine articles. They typically are written by journalists who know very little science. Websites may be useful routes to published material, but generally should be avoided as citations in the bibliography.

   k. Avoid repeatedly citing the same source. This advice is especially important for review articles and texts.

   l. Use the SIP Thesis checklist and the grading rubric, included in this Handbook, as a guide for writing and revising your thesis.

3. Have your SIP mentor review and edit your manuscript before leaving your SIP location. Make sure you keep after her/him to read and revise it before you leave.

   a. Provide your SIP mentor with a set of the SIP writing guidelines developed by the Biology Department. Not everyone has exactly the same expectations for the contents and format of a thesis. Having your mentor review your thesis with these guidelines in mind may save you at least one step in revising your manuscript.

   b. Never leave your project site without copies of your final data. Raw data on discs often are more valuable than condensed or transformed data. If unique or distinctive statistical techniques were employed in your data analysis, you probably should get copies of the data in the analyzed form as well. Chances of getting the "final" data sent to you at a later date, after you have departed from the project site, are substantially less than getting your SIP thesis read and reviewed after you have left. Also make certain that you have illustrations and photographs needed both for the thesis and for your presentation at the Diebold Symposium.

4. Before submitting your thesis to the Biology Department, carefully read and review it one more time, after you have incorporated your SIP mentor's suggested changes.

G. GUIDELINES FOR REFLECTING ON YOUR SIP

As part of BIOL 490, you will compose a SIP Reflections Essay for the Biology Department. The completed essay is due by **Friday of Week 3, Winter Quarter** and is graded as Pass/Fail. Composing the essay provides an opportunity for reflection on the significance of conducting your SIP to your professional and/or personal development, regardless of the discipline in which you conducted your SIP. Essays also serve as a starting point for discussion during lunch with your thesis review team and faculty leader in Winter quarter.

The following essay guidelines are provided to help you recall (from your memory) evidence of what happened while working on your SIP (including thesis writing and review) so that you can effectively infer interpretations and conclusions from what took place. Reading these guidelines before conducting your SIP may also help you think more deeply about your experiences during the various stages of the SIP process.

- Concisely describe, in one or two paragraphs, what you did while working on your SIP. Describe what you saw and heard as well as what you read and thought. Include the process of writing your SIP thesis and SIP review as part of what you did.
- Describe the "self-talk" and "mental pictures" that arose from what you were doing. For example, self-talk can be that voice or mini-mentor inside your head that "walks" you through some procedure before it becomes so automatic that you don't even think about doing something until after you've done it. And, a mental picture can be an image of what something looks like when it has been done correctly, or perhaps a search image of some object. These often contain the seeds of creative thoughts or ideas that arise while we are working. Please describe these and what prompted them.
- If any of the following questions came to mind, please describe what prompted them and then describe your creative ideas/contributions to the project:
    - Why are we doing something (you choose the "something") the way we're doing it?
    - How could we do some part (you choose the "some part") of the project better?
    - What should we be doing next?
- While working on your SIP, what did you learn about doing biology that you didn't know before? Give specific examples, including the processes of writing and review as possible sources of insights.
- What did you learn about yourself as a result of the experiences you had while carrying out your SIP? Please provide some concrete illustrations.
- Thinking back over your work – what were some of the unexpected experiences you had? Why do you think they were unexpected?
- What could have been done that would have improved your research experiences? Be as specific as possible and consider including background and experiences over the past several years when thinking about "What could have been done."
- In what ways have your assumptions about what it is like to be a biologist changed as a result of your experiences this summer?
- What assumptions about being a biologist were confirmed? Articulate these as clearly as possible.
- What specifically inspired you (and what did not) while working on your SIP? In what ways do these experiences affect your thinking about your future trajectories?

H. SIP THESIS CHECKLIST

Title

_____ Concise

_____ Descriptive

Acknowledgments

_____ Thanks mentor and others involved in project at SIP location

_____ Thanks colleagues who reviewed thesis

_____ Acknowledges source of funding for project

Abstract

_____ Introduces and motivates study

_____ Touches on methods

_____ States noteworthy results

_____ Conveys significance and broader implications of results

Introduction

_____ Motivates study

_____ Provides relevant background information and creates context for study

_____ Cites references where appropriate

_____ States hypothesis(es) and/or objectives of study

Materials and Methods

Describes the following as applicable:

_____ Study site

_____ Study organism(s)

_____ Experimental design

_____ Procedures

_____ Data analysis and statistics

Results

_____ Concisely presented as a narrative with well-constructed paragraphs

_____ Presented in logical order

_____ Avoids interpreting or explaining results

_____ Figures or tables are used appropriately and all are referenced in the text

_____ All data presented correctly and with appropriate units

_____ Statistical support for assertions about presence or absence of significant differences

Figures and Tables

_____ Numbered correctly

_____ Captions placed correctly

_____ Title given as first sentence in caption; title is an assertion about data presented

_____ Captions clearly explain data within figure or table

_____ Statistics cited when appropriate

_____ Figures or tables readable and easy to follow

_____ Non-data ink minimized

Discussion

_____ Begins with an introductory paragraph stating general findings

_____ Avoids explicitly repeating results

_____ Effectively explains patterns observed in the data

_____ Presented as a narrative, with well-constructed paragraphs, that proceeds in logical order

_____ Compares/contrasts results with those in other studies

_____ Addresses whether hypothesis(es) is/are supported

_____ Includes concluding paragraph that conveys broader implications of study

Literature Cited

_____ Appropriate number of relevant citations used

_____ Follows correct format

Overall

_____ Writing concise and clear

_____ Active voice used

_____ Professional diction used

_____ Free from grammatical and spelling errors

_____ Follows correct format

_____ Narrative thread present (a clear story emerges)

I. GUIDELINES FOR PEER REVIEW OF THESIS **Reviewer** _____

SIP author: _____

Please comment on the various sections of the SIP as you review it. Put specific comments/annotations on the SIP itself.

Title: Is it clear, concise and descriptive? Any suggestions for changes?

Introduction
Does it start by providing you with a sense of the "big picture" within which this study falls?

Does it provide relevant background information, a sense of what has already been done in this area, and what further questions remain? (i.e. does it provide context and justification for the present study?)

Is the purpose of the study clearly stated?

Is the introduction logically organized?

Materials and Methods
Is there sufficient detail presented to follow what was done; any unnecessary details? any missing information?

Is this section well organized?

Results
Are results stated clearly and concisely, with appropriate reference to supporting statistics, tables and figures?

Any unnecessary tables or figures, redundant data (e.g. raw and summary)?

Is the organization of results logical (does a clear "story" begin to emerge)?

Discussion
Does the introductory sentence state general findings or significance of study? Is this in keeping with what the introduction said the study set out to do?

Does the discussion avoid explicitly repeating the results?

Does the discussion explain/interpret results (i.e. flesh out the "story"), by comparing results with other studies (even if they are on different, but relevant, systems)?

Does it emphasize strengths of the study, and point out problems with/shortcomings of study where appropriate?

Does it convey the significance and broader implications of the results? Does it suggest areas of further inquiry?

Literature Cited
Does it contain an appropriate number of relevant references?

Does it follow the correct and complete citation format compared with handbook specifications?

Are sources cited correctly within the text?

Abstract
After reading the entire thesis, does the abstract appear to provide motivation for the study, give a sense for what was done, state noteworthy results and touch on broader implications of the study?

Overall, how do you rate this manuscript? Excellent | Very good | Good | Fair | Poor

Other general comments for the author?

J. SIP Thesis Rubric in the Department of Biology

Thesis Feature	Honors (5)	High Pass (4)	Pass (3)	Low Pass (2)	Fail (1)	Rating **1** to **5**
Background, context, and establishing the research question.	Beautifully structured funnel from general concepts to specific questions. Perfect attention to audience. Richly referenced.	Well-structured funnel from general concepts to specific questions. Very good attention to audience. Solidly referenced.	Good structure from general concepts to specific questions. May overshoot or undershoot audience. Adequately referenced.	Poor structure from general concepts to specific questions. Significantly overshoots or undershoots audience. Poorly referenced.	No attempt to frame questions in general context. Completely misses audience. No primary references.	
Description of methodology.	Clear and unambiguous description of methodology. Appropriate level of detail.	Solid description of methodology. Good level of detail.	Adequate description of methodology. Some problems with level of detail—either too much or too little.	Poor description of methodology. Significant problems with level of detail.	No or uninterpretable description of methodology. Grossly misses on level of detail.	
Data presentation.	Very clear data presentation. Figures and Tables "speak for themselves". Concise, informative legends.	Clear data presentation. Figures and Tables are easy to read and follow. Informative legends.	Good data presentation. Figures and Tables are adequate, but require some work on the part of the reader to follow. Sparse legends.	Poor data presentation. Figures and Tables are substandard and require significant work on the part of the reader to follow. Unhelpful legends.	Uninterpretable presentation of data. Legends provide no help to reader.	
Data interpretation and analysis.	Highly effective narrative explaining the significance of the results. Clear story emerges. Great care taken to not overstate or understate significance.	Effective narrative explaining the significance of the results. Clear story emerges. Some sense of nuance.	Adequate narrative explaining the significance of the results. Some story emerges. Little nuance taken in relation to overstating or understating significance.	Poorly developed narrative. No clear story emerges. No nuance taken in relation to overstating or understating significance.	No attempt at narrative.	
Integration of results into broader literature.	In depth and sophisticated integration of results into broader context. Deep and significant insights and conclusions. Richly referenced.	Strong integration of results into broader context. Clear insights and conclusions. Solidly referenced.	Adequate integration of results into broader context. Some sustained effort at drawing insights and conclusions. Adequately referenced.	Very little integration of results into broader context. Trivial insights or conclusions. Perfunctory references	No integration of results into broader context. No insights or conclusions beyond stated results. No references.	
Writing mechanics (grammar, spelling, construction, voice).	Excellent writing style and mechanics. No errors. Beautiful flow.	Solid style and mechanics. Few errors. Good flow.	Adequate style and mechanics. Few errors.	Rudimentary style and mechanics. Many errors. Poor flow.	Poor style and mechanics. Multiple errors. Nearly unreadable.	
Overall Score:						

K. DIEBOLD SYMPOSIUM PRESENTATIONS

Public Presentation of the SIP

The annual Biology Department Diebold Symposium provides an opportunity for each senior to present publicly the results of his/her SIP experience, irrespective of the discipline in which it was conducted. The presentation will be evaluated by the Department faculty and will serve as one of the components of the grade for BIOL 490. We use a peer referee system to help presenters prepare concise, clear, and polished reports. Because the referees spend considerable time with, and actively participate in, preparing the seminar or poster, we grade these activities. Your performance as a referee is assessed using peer evaluation of your attendance and input during practice sessions and by the quality of presentations by referee team members at the Diebold Symposium. We provide the following guidelines to clarify expectations of the faculty for the seminar/poster and the role of the referees. At all times, however, you should remember that the ultimate responsibility for preparation of the presentation and the presentation itself is that of the presenter.

Guidelines for Oral Presentations

1. Oral presentations are 15 minutes in duration. Plan on a 12 minute presentation with a three minute question and answer session. Referees should time the talk and suggest ways of fitting what needs to be said into the above time frame.

2. The seminar should be presented in much the same way a paper is written. The introduction is especially important because the audience must clearly understand the objectives of your project for them to follow the rest of the talk. The methodology should be limited to **only** that which is important in understanding the data presented in the talk. **Do not** present all of your raw data or all the data you collected **unless** it is itself directly important to illustrate your objectives and conclusions. Also, be sure that any graphs, tables, charts, etc. are easily visualized and not too busy (*i.e.*, containing too much to be readily comprehended). Referees can be invaluable here. As individuals not heavily invested in the project, they can determine if the report is clear and coherent and whether visual aids are useful. Referees should challenge the speaker when they do not understand what is said and help the speaker clarify ideas and weed out unnecessary material.

3. Referees should be familiar enough with the presentation so that they can initiate discussion through questions during the Diebold Symposium.

4. Each speaker should be introduced by one of the referees, who will provide the following information:

   Speaker's name
   Location of SIP
   Mentor of SIP
   Title of SIP

5. Referees are responsible for making sure that room lights are operated according to the needs of the speaker and that the computer projector is functioning properly.

6. Referees are also responsible for insuring that the speaker does not exceed the 15 minute time limit.

Guidelines for Poster Presentations

A poster presentation should be approachable at three levels: (1) a title and organization that inform the casual passerby of the general nature of your work; (2) a presentation method that would let a somewhat interested observer know the trends of your data and the nature of your conclusions; and (3) enough information to convince an individual working in the same area to stop and find out more about your project (*i.e.*, engage in conversation with the presenter). Remember, the major role of a poster, or of any presentation, is to communicate your results and ideas to the audience.

The poster itself is just the beginning of your SIP presentation. You will also need to prepare a BRIEF – approximately five minutes in duration - overview of your research that leads the audience through the information presented on your poster.

Most posters are composed in Microsoft PowerPoint and then printed using the large-format printer in Information Services. Technical guidelines for making and printing posters are available through curricular support and on their web page.

1. The size of the poster must not be excessive. Reasonable, maximum dimensions are approximately 36" high and 48" wide.

2. The title should be displayed clearly across the top in large letters. Beneath the title, and in smaller letters, should be the name of the presenter, the name of the presenter's mentor, and the institution or laboratory in which the work was done.

3. Text should be kept to a minimum. Written statements should be in large print, which is easily readable from a distance of 3 to 4 feet.

4. An abstract may be included, but space limitations may dictate that you concentrate on the more important components such as Introduction, Methods, etc.

5. The Introduction should be moderately brief and to the point so that the reader becomes immediately aware of the purpose of the investigation. It probably should be confined to one paragraph, and should be located at the upper left of the poster.

6. The Materials and Methods (or procedures) section should be labeled clearly as such, and should follow immediately after the Introduction. This section often lends itself to the diagrammatic presentation with a minimum of verbiage. Insofar as possible, easily followed flow diagrams should be used.

7. Results are the most important part of the poster and generally should occupy the center of the exhibit. The results should consist of a **maximum number of illustrations** (*i.e.*, graphs, photographs, etc.) which are simple and easy to read, and a **minimum of text**. Color-coding

graphs and figures facilitates ease of interpretation. Examples of award-winning posters are displayed on the Diebold Scholar Awards bulletin board outside the Biology stockroom.

8. Conclusions should be stated in a clear and especially concise fashion. Generally, this section would be located to the right of the results. Itemization (listing) of conclusions is legitimate and can facilitate comprehension. Discussion should be kept to a minimum and should include only the most important points.

9. Acknowledgements should recognize funding sources, peer review team members, research assistants, mentor (if not included in author title), and any other individuals or organizations that contributed to completion of the project.

10. Six is a reasonable number of figures on a poster, but the number of figures will depend on the subject matter being presented.

11. For investigations consisting of separate components, the sequence in which the components are described in Materials and Methods should be maintained in the Results and Conclusions sections.

REMEMBER – Even though your poster must stand alone as an informative presentation of your research, during the poster session of the Diebold Symposium you will give your BRIEF overview of your research (probably repeatedly) to groups of interested on-lookers.

Rubric for Evaluating the SIP presentation (talk or poster) in the Department of Biology

Presentation Feature	**A (4)**	**B (3)**	**C (2)**	**D (1)**	**F(0)**	Rating **0-4**
Introduction and context.	Elegantly presented context from general concepts to specific questions. Exceptionally clear purpose and objectives.	Well presented context from general concepts to specific questions. Clear purpose and objectives.	Adequate context. Somewhat muddled purpose and objectives.	Poor context. Significantly problems with conveying purpose and objectives.	No attempt to frame questions in general context. Unable to convey purpose and objectives.	
Methods	Clear and unambiguous description of methodology. Appropriate level of detail.	Solid description of methodology. Good level of detail.	Adequate description of methodology. Some problems with level of detail—either too much or too little.	Poor description of methodology. Significant problems with level of detail.	No or uninterpretable description of methodology. Grossly misses on level of detail.	
Data presentation and analysis.	Highly effective narrative explaining the results and their significance. Clear story emerges. Noteworthy command and appropriate use of statistics. In depth and sophisticated integration of results into broader context. Deep and significant insights and conclusions.	Strong narrative explaining the significance of the results. Clear story emerges. Appropriate use of statistics. Strong integration of results into broader context. Clear insights and conclusions.	Good data presentation. Adequate narrative explaining the significance of the results. Some inappropriate use of statistics. Some story emerges. Adequate integration of results into broader context. Some sustained effort at drawing insights and conclusions.	Poor data presentation. Poorly developed narrative. Inappropriate use of statistics. No clear story emerges.. Very little integration of results into broader context. Trivial insights or conclusions.	No attempt at narrative. Highly inappropriate use of statistics. No integration of results into broader context. No insights or conclusions beyond stated results.	
Quality of graphics	Very clear graphics. Figures and Tables "speak for themselves". Minimal non-data clutter.	Clear graphics. Figures and Tables are easy to read and follow. Some distractions with clutter.	Adequate graphics. Figures and Tables require some work on the part of the reader to follow. Substantial clutter.	Poor graphics. Figures and Tables are substandard and require significant work on the part of the reader to follow.	Uninterpretable graphics. Sloppy and highly cluttered.	
General style of presentation	Extremely well organized. Attentive to and in command of audience. Spoke clearly and audibly. Appropriate duration. Excellent handling of questions. Wow! factor.	Well organized. Some missing of audience. Spoke clearly and audibly. Appropriate duration. Good handling of questions	Some organizational problems. Conspicuous missing of audience. Some problems with clarity. Noticeably short or long. Adequate handling of questions.	Major organizational problems. No attention to audience. Unclear and/or difficult to hear. Extremely short of long. Poor handling of questions.	Insurmountable organizational problems. No attention to audience. Unclear and/or difficult to hear. Extremely short or long. Inability to handle questions.	
Overall Score:						

SECTION THREE

THE WRITTEN COMPREHENSIVE EXAMINATION

A. Requirement: Senior Biology majors must take the departmental written comprehensive exam that is administered during **Winter Quarter (typically 5th Week)**. This exam is the Educational Testing Service "Field Test in Biology," a nationally-normed test of competency in Biology.

Use the following information, along with a good *general biology* textbook, to review for the Written Comprehensive Exam in Biology:

B. Content: The test consists of approximately 200 multiple-choice questions, a number of which are grouped in sets toward the end of the test and are based on descriptions of laboratory and field situations, diagrams or experimental results.

The content of the test is organized into four major areas:

I. Cell biology
II. Molecular biology and genetics
III. Organismal biology
IV. Population biology, ecology and evolution

Approximately equal weight is given to each of these three areas.

The ETS website (http://www.ets.org/gre/subject/about/content/biology) contains more detailed information on topics covered in each subsection of the test. A practice test booklet can also be downloaded from the ETS website.

C. Grading: The written examination is sent to the Educational Testing Service for grading. Returned scores are used by Biology faculty to determine written comprehensive exam grades for students. Subscores from the different areas of the test help faculty assess the Biology curriculum on a continuing basis.

You will receive your written comprehensive exam letter grade, along with your ETS test scores, in a letter which you will collect from the Biology Office, generally late in Winter Quarter.

Your grade earned on the written comprehensive exam contributes to your overall grade in BIOL 490.