Biology Majors' Handbook 2024-2025

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I. Biology Department Faculty & Staff

A. Faculty

Arielle Cooley, Professor (Sci 375): 527-4988; cooleya@whitman.edu
- Evolutionary developmental biology; developmental genetics

Heidi Dobson, Professor & Chair (Sci 201): 527-5141; dobsonhe@whitman.edu
- Botany, plant ecology, agricultural science, plant-animal interactions, entomology

Mysia Dye, Lecturer (Sci 366): 527-4965; dyem@whitman.edu
- Animal communication, mate choice, and speciation

Delbert Hutchison, Associate Professor (Sci 209): 527-5135; hutchidw@whitman.edu
- Evolutionary biology, population genetics, natural history, conservation biology

Kate Jackson, Professor (Sci 200): 527-5227; jacksok@whitman.edu
- Herpetology, vertebrate anatomy, systematics and biodiversity (on leave Spring semester 2018)

Tom Knight, Associate Professor (Sci 368): 524-2010; knightt@whitman.edu
- Cognitive neuroscience, systems neurophysiology, biostatistics

Alexa Maine, Adjunct Assistant Professor – Fall 2024 only (Sci 166): 522-4430; mainea@whitman.edu
- Life history, restoration, and conservation of freshwater mussels and lampreys

Sabrina Mostoufi, Visiting Assistant Professor (Sci 172): 526-4700; mostoufs@whitman.edu
- Wolbachia and Drosophila host-microbe associations, meiotic recombination plasticity, population genetics

Britney Moss, Associate Professor (Sci 301): 527-5306; mossbl@whitman.edu
- Plant hormone signaling pathways, cell signaling dynamics, synthetic biology

Tim Parker, Professor (Sci 210): 526-4777; parkerth@whitman.edu
- Ecology, natural history, avian evolutionary ecology, scientific inference

Matthew Tien, Assistant Professor (Sci 300): 527-5748; tien@whitman.edu
- RNA biochemistry, computational biology, microbial genetics and engineering

Ben Vernasco, Research Scientist (Sci 207): 522-4441; vernascb@whitman.edu
- Wildlife Management and Conservation, Integrative Organismal Biology

Dan Vernon, Professor (Sci 311): 527-5326; vernondm@whitman.edu
- Molecular biology, plant developmental genetics and genomics

Chris Wallace, Professor (Sci 212): 522-4421; wallacecs@whitman.edu
- Neuroplasticity, neural development

Rachel Wilson, Visiting Assistant Professor (Sci 166): 522-4430; wilsonr@whitman.edu
- Comparative physiology, reproductive biology, endocrinology

Ginger Withers, Professor (Sci 303): 527-5053; withersgs@whitman.edu
- Neurobiology, developmental biology

B. Staff

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Michelle Shafer, Lab and Imaging Coordinator for Cell and Molecular Biology (Sci 324)
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II. Curriculum

A. Biology Department Learning Goals for Majors

- **Students will understand core biological concepts including:**
  - evolution (the process creating the diversity of life-forms and the phylogenetic relationships among major groups)
  - structure and function (the basic units of biological structures that control the functions of living things)
  - information flow, exchange and storage (the influence of genetics on the control of the development of phenotypes)
  - pathways and transformations of energy and matter (the ways in which chemical transformation pathways and the laws of thermodynamics govern biological systems)
  - the nature of complex systems
- **Students will be capable of understanding, interpreting, and critically evaluating scientific information presented in multiple forms (e.g., numeric, graphical, written**
- **Students will be capable of conducting a structured scientific inquiry and thoroughly communicating scientific biological knowledge**

B. The Biology Major at Whitman College

Biology courses deal with the science of living organisms in their various forms and their interactions with their environments. The curriculum emphasizes the integration of biological investigation all levels from molecular to ecological, with evolution as a unifying theme across all the courses. For a list of our courses see the college catalog at https://catalog.whitman.edu/biology

To engage students in the scientific process, we require all seniors to complete a year-long research project that includes lab and/or field work, thesis writing, and oral scientific communication.

The department serves students who expect to work in a biological field or related profession such as medicine, as well as those who elect biology as part of their general education.

Required courses for the Biology major

- Required Courses Outside the Major:

Chemistry 125, 126, 135, 136, or Chemistry 140; 245; and demonstrated mastery of math/statistics/computation through two semesters of college courses as listed in the catalog. (For Bio-ES, a course in statistics is strongly recommended for meeting the math requirement.)

- Major Courses:

A minimum of 33 credits in biology, including Biology 101,102; four credits from each of the three categories of upper-level courses (Molecular/Cell Biology, Organismal Biology, Ecology/Evolution); Biology or BBMB 490; Biology 499; and additional courses in biology and/or BBMB courses numbered 200 and above to earn a minimum total of 33 credits in biology and/or BBMB. Departmental policy does not allow a P-D-F grade option for biology or BBMB courses that count toward the major.

Course descriptions in Biology and BBMB are given in the College Catalog (https://catalog.whitman.edu/biology and https://catalog.whitman.edu/biochemistry-biophysics-and-molecular-biology). To search which courses are offered in the current academic year, see https://selfservice.whitman.edu/Student/Courses

Advice on Curricular Planning

The department recommends that students considering a major in biology consult with a biology adviser and begin with Chemistry 125, 126, 135, 136; or 140; and Biology 101. This should be followed by Biology 102, Chemistry 245, and courses fulfilling the math/statistics/computation requirement.

For students planning to pursue graduate programs in biology, a year of physics (with labs), a full year in organic chemistry, a year of foreign language, as well as statistics and competency with computers, are highly recommended.

For students planning to pursue post-graduate studies in health-related professions, please be sure to contact Kimberly Mueller (Sci 164; muelleka@whitman.edu), the college's health profession advisor, early in your curricular planning.

Senior Year Requirements (see section IV for more detail)

The senior year is a busy year that has multiple deadlines and complex scheduling, all of which requires careful time management.

1) The Senior Assessment consists of oral and written components.

- Oral component: a one-hour comprehensive exam is administered by a committee of two biology faculty in either the Fall or Spring of the senior year. This oral exam addresses fundamental material covered in the required courses in the major (especially introductory courses) and application of basic concepts learned across a student's biology education.
- Written component: the department uses the Senior Thesis to meet this component.

2) The Senior Thesis is the capstone experience for all senior Biology majors, and is based on research that students complete either at Whitman or at an off-campus location. The research project is usually completed during the summer of the sophomore or junior years or during a study abroad program, and more rarely at Whitman during the academic year. Students receive course credit for the writing of the thesis by enrolling in Biol-490 or BBMB-490 for both semesters in their senior year, for a total of 3 credits. In Biol/BBMB-490, students work with their thesis advisors to analyze their data, write a research thesis describing the work, and present their findings as a seminar to the department. Typically, seniors enroll in 1 credit in the fall and 2 credits in the spring, but this can be reversed with the thesis advisor's approval; furthermore, December graduates may need to enroll for all 3 credits in their final semester if they complete the research project during the preceding summer.

3) The Senior Seminar (Biol-499) must be taken during the spring semester of the senior year. In this course, each senior gives a 15-minute seminar on their thesis research to their peers and the department faculty. A couple of class meetings will be workshops on resume/cv writing and job search/networking.

III. Study Abroad

Biology faculty encourage off-campus studies (in the junior year), which are particularly feasible if all supporting courses (Chemistry and Mathematics/Statistics) and the introductory courses (101, 102) are completed by the end of the sophomore year or fall of the junior year. We strongly encourage majors considering off-campus study to work with their academic advisor in a timely manner to make sure off-campus study plans in the junior year fits into a student's academic plans and leaves time for fulfilling all graduation requirements.

The academic advisor and the staff at the Off-Campus Studies office can help determine which courses taken abroad may satisfy distribution requirements or major requirements. The organization of biology upper-level course requirements into three categories makes it possible for major courses taken elsewhere to satisfy requirements for the major. However, such courses must be approved before a student finalizes their study off-campus. We recommend strongly against taking courses for the major at sites where instruction takes place in languages other than either English or the primary language of the student (assessed on a case-by-case basis).

Biology majors have a range of options for off-campus study. Please visit the website of the Off-Campus Studies (https://www.whitman.edu/off-campus-studies) to view the list of programs and the ones that our students have successfully incorporated into their Whitman biology education (https://www.whitman.edu/off-campus-studies/advising-by-major/biology). Note that new programs are constantly being added and others removed, so the website and advisers in the OCS office are your best resource. The programs that have field components typically include research that students can use for their biology Senior Thesis.

Some examples of programs for Biology majors:

School for Field Studies (SFS) See http://www.fieldstudies.org/
SFS creates transformative study abroad experiences through field-based learning and research in different parts of the world. Their educational programs explore the human and ecological dimensions of the complex environmental problems faced by their local partners, contributing to sustainable solutions in the places where students live and work. The SFS community is part of a growing network of individuals and institutions committed to environmental stewardship. A primary feature of the SFS program are their multi-year Directed Research projects designed to accumulate substantive data and results based on student research which serve to address local needs. This program is designed for a wide range of majors, but with an over-arching environmental focus. You are able to derive a thesis from the group project done in this program if it has a biological focus.

Council on International Educational Exchange (CIEE) See https://www.ciee.org/
The main CIEE program we work with in biology is the Monteverde Tropical Ecology and Conservation in the cloud forest of Costa Rica. This is a rigorous and popular program that emphasizes field ecology and natural history, field trips to different parts of Costa Rica, local human ecology, and individual research projects designed by each student, which can be used for the senior thesis.

School for International Training (SIT) See http://www.sit.edu/
SIT is a pioneer in experiential, field-based study abroad, and Whitman is affiliated with a program in Ecuador that is strong in biology. You are able to derive a thesis from the research project completed in this program.

DIS (Danish Institute for Study Abroad) See http://www.dis.dk/
Based in Copenhagen (Denmark) and Stockholm (Sweden), DIS is designed for students exploring career opportunities within biotechnology & biomedicine, and sustainability. Students take a core course is a specific area of interest and then electives from a wide range of offerings, all taught in English. The program includes extended study tours to offer insight into biotechnology-based methods for diagnosis and treatment of disease; an understanding of the dynamics of drug discovery and development; and an interdisciplinary perspective on how biotech research and biotech business work together. Students also take a course in Danish/Swedish language and culture. Thesis projects are not a main focus of this program, although possibilities might exist for

independent research during extended stays dedicated to this purpose (ask the program coordinators for more information).

Universities
There are a number of international universities (e.g., University of Otago in New Zealand or University of Edinburgh in Scotland) where our students have elected to complete off-campus studies, but enrolling directly in a university presents greater academic and logistic challenges that students much be prepared for and there are generally few research opportunities that can serve as thesis projects. Therefore, we strongly encourage taking courses that will fulfill distribution requirements or major requirements and/or take courses that expose you to the uniqueness of that area (e.g., ecology with field trips).

IV. Senior Year Requirements

The senior year is a busy time with several requirements and important dates to keep in mind. **The key to a successful senior experience is organization and time management.**

Please **see the Senior Handbook, on the Registrar's Office webpage**, that summarizes all of the general requirements and dates of the senior year https://www.whitman.edu/registrar/services-for-students-and-alumni/senior-handbook

A. Graduation and Commencement forms

All seniors must complete the online Graduation Application and Commencement Information forms, which are emailed to students by the Registrar's office based on graduation date: they due in early November for May and September graduation dates, and in February for December graduation.

B. Senior Assessment in Biology

1) Comprehensive oral exam ("orals")

These take place in Fall (late October/early November) and Spring (February). The department will schedule your oral exam. You will be contacted by the department chair in last summer, requesting your preference for fall of spring orals, and we will try to honor your preference.

Two faculty will be assigned to your orals based on their scheduling availability – this is done blindly by staff members. At least two weeks prior to the exam date, you will be notified of the date, time, location, and names of the two faculty serving on your examination committee. You are *officially* excused from all of your classes on the day of your oral exam; if your scheduled exam conflicts with a class, please inform your professor that you will miss class because of your senior oral exam.

The purpose of the exam is to gauge your overall grasp of fundamental biological principles and concepts by assessing your ability to think on your feet and to present/discuss them using the vocabulary of the field and making drawings on the board. Faculty members are looking for basic knowledge and the ability to synthesize concepts. There is NOT a pre-determined set of questions for any exam; questions may come from any area in Biology, but will tend to come mainly from the topics covered in the introductory course; some may be questions for which we do not have a specific answer but for which we want to explore the boundaries of your understanding and see how you approach and think through the issue at hand. You may ask examiners to clarify questions; this is a conversation, rather than an interrogation experience.

The oral exam will last ~ 50 minutes, after which the committee will ask you to step outside briefly while they discuss your exam. You will be informed immediately thereafter of the results, which may take the form of pass, pass with distinction, or no-pass. Passing with distinction requires a *truly impressive* performance. A no-pass necessitates a retake of the exam, which will focus on the areas where the student's performance was weak; the retake oral exam officially can occur only after *at least two weeks* following the first exam date, which gives students time to prepare.

2) Written exam

The Biology Department will use the Senior Thesis to fulfill the written exam component of senior assessment in 2024-25. As such, **final *drafts*** of all senior theses must be submitted to the Biology 499 canvas site no later than 2 weeks prior to the end of classes (**Monday April 28, 2025**); students will receive a pass, pass with distinction, or no-pass. Passing with distinction requires a truly impressive thesis as determined by at least two biology faculty. A no-pass will be given for *incomplete* theses (all aspects listed in the thesis rubric, available on

the biology major canvas site, must be present for a thesis to be considered complete) and necessitates a retake, which involves resubmitting the thesis prior to the end of classes.

C. Senior Research Thesis and Seminar (Biology 490 and 499)

1) Senior Research Thesis

All biology students must do a research project in some area of the biological sciences and write a thesis based on this work; credit is received for writing the thesis (Bio/BBMB 490). The research involves testing a hypothesis or collecting initial descriptive data in the laboratory or field; this may include clinical/epidemiologic research or analysis of previously collected data. The Whitman Biology Department is flexible with regard to this requirement, and there is no predetermined minimum number of hours for an acceptable research project.

Research project

The research projects can be done at any time during a student's last 2-3 years at Whitman, including during the academic year or over a summer (most common), and may take place with a member of the Whitman faculty or under the supervision of a qualified advisor off-campus.

It is crucial that you start thinking about finding a research project **no later than** the fall/winter of your junior year. If you wish to work with a Whitman faculty, you should speak with them early to learn of research opportunities; identify faculty who have research expertise most closely related to your interests (look at their course offerings, web pages). If you wish to do research off campus and have located an off-campus project and research supervisor, you should discuss it with a Whitman faculty member BEFORE committing to that project in order to confirm that it is suitable for a thesis.

Ideas for finding research opportunities off-campus are given in **Appendix B**, along with a list of recent senior theses and where or with whom those students did their research. The department does not endorse student-designed projects conducted without mentorship from an expert (whether a Whitman professor or off-campus scientist); this professional mentorship is essential to the process of developing and carrying out an effective research project for the thesis.

We *strongly* recommend against waiting for your senior year to initiate a research project. If you do, you will be assigned a research adviser who will give you a thesis project; you will NOT have the flexibility to choose your own project.

Thesis advisor

Students get credit for writing the thesis (includes data analysis) during the entire senior year in the course **Bio/BBMB 490** (3 credits total: usually with 1 credit in Fall and 2 credits in Spring). Each student will write the thesis under the guidance of a specific Whitman faculty, who serves as the student's **Thesis Advisor** (this is separate from the academic major advisor, although they may be the same person); the thesis advisor will give students consent to register in their specific Bio 490 section (each faculty has a different section); they determine the student's thesis grades for Bio 490 (fall and spring). The thesis advisor is also the person who guides the student in preparing their thesis seminar for the Bio 499 course in the spring semester, and this presentation is taken into account in determining the spring Bio 490 grade.

You can select who will be your thesis advisor by contacting Whitman Biology faculty whose expertise lies in the area of your research and determining if they can advise you. If you do not finalize thesis advisor arrangements prior to mid-August leading into your senior year, the department will assign one to you at the start of the semester.

Thesis format

We hope that all students will strive for produce an excellent thesis. The general rubric for the senior thesis

followed by the Biology Department is in Appendix A. To achieve an excellent thesis, students must work closely with their thesis advisor to understand and meet the advisor's additional individual criteria in thesis assessment. Writing the thesis is a process, with multiple revisions of each thesis section, and it is important to give it the time the thesis needs to reach the quality that you desire.

2) Senior Seminar

All seniors must take Senior Seminar course, Bio 499, during the Spring of their senior year. To get credit for this required course, students must give a seminar presentation of their research and attend the seminars of their peers. Bio 499 organization and credit assignment is overseen by the chair of the Biology Department.

D. Honors in Major Study

In biology and biology-combined majors, students do NOT apply for admission to candidacy for honors. Rather, students who meet all the requirements listed below may be granted Honors by the Biology department faculty. The biology department chair will then notify the Registrar of the students earning Honors in Major Study, and the registrar will retroactively change each student's registration in Bio 490 to Bio 498. This is an automatic process and requires no action from students.

To qualify for honors at Whitman, seniors must meet the three following requirements:

1. earn a minimum GPA requirement of 3.5 in the major (after completing all degree requirements)
2. pass the Biology oral exams with distinction
3. pass the Biology written exams with distinction: submit an excellent senior thesis of distinction and Honors quality, as determined by at least two biology faculty (including the thesis advisor), on the thesis submission date for all biology seniors

All students earning Honors in Major Study must meet the Honors Thesis requirements as outlined by Penrose Library (https://libguides.whitman.edu/thesis) and file it in the library no later than Reading Day (or last day of classes for December graduates)**.** All students granted Honors by the Department of Biology can make minor edits to the thesis in response to comments from faculty reviewers (and thesis advisor) prior to submitting the final thesis to Penrose Library.

Appendix 1: General Biology Department Thesis Rubric

	Excellent	**In progress**	**Needs work**
Title	Concisely captures the main focus of the thesis. The reader can figure out what was being studied, and in what system, by reading the title.	Relates to the main focus of the thesis.	Missing or not clearly related to the thesis.
Abstract	All of the major points from the Intro, Methods, Results, and Discussion are concisely presented. Transitions are smooth. Overall, it clearly explains and gives context for what was asked, what was done, what was found, and why it matters.	Points from the Intro, Methods, Results, and Discussion are presented.	The thesis is only incompletely represented by the Abstract.
Introduction	Begins with a broad research question or topic; then, provides background information in a logical sequence that leads the reader to a clear understanding of the context and importance of the specific question(s) addressed by the thesis research; transitions to specific research question(s); ends with brief overview of the project. Claims are well supported by appropriate references.	Includes research questions, and some mention of the project. Cites journal articles, but citations insufficient.	Several components of an introduction are missing. Few or no references.
Methods	Methods are clear and complete enough so that a researcher could re-create them, but without non-essential details. The purpose and design of each component of the study is clear. Brief justifications are provided ('to accomplish X, we did Y…'). No typos.	Methods occasionally lack detail or provide details that are not necessary to repeating the experiment.	Many details are lacking. The organization of the Methods is confusing and hard to follow. The purpose of several study components is unclear.
Results	Results are clearly and sufficiently summarized in the text, including statistics where appropriate. The order of results in the text matches the order of figures/tables, as well as the order in the Methods. Figures and tables are easy to read, completely labeled, and are each accompanied by informative captions. Each figure and table is cited in the text.	Results are summarized, including some statistics. Figures and tables are present and are referred to in the text.	Results are incomplete and often lack support (statistic, table/figure references) for the claims that are made. Figures and tables are incompletely labeled and difficult to interpret.
Discussion	Begins with clear summary of main findings linked explicitly to initial question;then explores findings in greater depth; compares to other similar studies in the literature; acknowledges limitations and suggests solutions; ends with well-developed future directions and broader importance of the work. The writer convincingly builds a case for why this area of research is compelling. Relevant literature is seamlessly incorporated into the writing in a way that supports the writer's argument. Ideas for future research directions reflect considerable thought and understanding of the topic.	Findings are presented and explored. The writer makes a case for why this area of research is compelling. Relevant literature is incorporated into the writing. Ideas for future research directions reflect some thought and understanding of the topic.	It is unclear what was found; why it matters; what similar work has previously been done; or what ought to be done next.

Acknowled-gements	Includes both people and funding.	Present	Absent
References	All articles that are cited in the text are listed in a separate References/Literature Cited section, including author names; date; paper title; journal title; issue number; page numbers. No typos. Consistent formatting for all references. No references that are not cited in the text.	Nearly all articles that are cited in the text are listed in a separate References section. Few typos. Mostly consistent formatting for all references.	The References section is incomplete. It has many typos and the formatting is inconsistent across references.
Writing process	Student is self-motivated; meets deadlines; communicates effectively with thesis instructor about writing progress; asks questions and seeks to improve; and fully incorporates instructor feedback.	Student meets deadlines; communicates with thesis instructor; and incorporates most instructor feedback.	Deadlines are not met; communication with thesis instructor insufficient; feedback not incorporated.
Writing quality	Clearly and concisely written, excellent transitions, no typos.	Improvements to writing clarity needed. Few typos.	The writing is difficult to understand. Many typos.

Appendix 2: Research Projects: Information and Examples

A. Research projects at Whitman

Many professors in Biology and BBMB secure funds to support students during the summer and sometimes during the school year. There is also a Whitman Internship Program that provides stipends to students for summer work conducted off campus (contact the Career and Community Engagement Center for information).

B. Research projects elsewhere

There are multiple approaches you can take to find a research project outside of Whitman

1) The Biology department receives many email announcements of research opportunities throughout the year and these are forwarded to the biology majors list-serve, so pay attention for those announcements as they arrive in your email. Many students get research opportunities through these communications. You can also talk to seniors doing research of interest to you and see if you can work in the same lab.

2) You can contact researchers at universities, government agencies, or other institutions in your home town or in some location where you would like to spend the summer. Some of these people may have money to hire summer researchers; if they have no funding, you can apply to the Whitman Internship Grant (WIG) program for funding (https://www.whitman.edu/career-prep/career-and-community-engagement-center/career-development/internships/whitman-internship-grant-(wig)), which has made summer research possible for many biology majors; some scientists without funding for you may at least be willing to have volunteers to work in their labs.

3) The Whitman Career and Community Engagement Center (CECC) is a good resource for you to explore internships and research opportunities (https://www.whitman.edu/career-prep/career-and-community-engagement-center). You can make appointments to meet with staff (https://www.whitman.edu/career-prep/career-and-community-engagement-center/our-staff), among whom Lindsay Szramek and Jess Hernandez are the best people for biology students to talk to. The site has links to internships (https://www.whitman.edu/career-prep/career-and-community-engagement-center/career-development/internships) and to some excellent biology research programs that are offered directly through Whitman (https://www.whitman.edu/academics/research-opportunities.).

4) You can Google "undergraduate research opportunities biology" and find lots of sites. Many of these are posted by specific universities or labs looking for undergraduates, as well as by funding agencies that support undergraduate research, whereas other sites are dedicated to helping you in your search.

Among the most prominent of the research opportunities for undergraduates in biology are the Research Experiences for Undergraduates (REUs), Summer Undergraduate Research Fellowships (SURFs), Summer Undergraduate Research Programs (SURPs), and Summer Undergraduate Laboratory Internships (SULIs).

A sampling of a few sites that may be of interest to you:

- **Institute for Biology Education**
  https://wiscience.wisc.edu/biocommons/

- **National Science Foundation** The biggest and most diverse collection of undergraduate research opportunities in the U.S. is NSF's Research Experience for Undergraduates (REU) program. REU internships are full-time, paid summer research internships at numerous universities and research institutions that provide opportunities for undergrads from other institutions (like Whitman). You can get info on REUs from individual universities (or university departments that host REU students), or go

directly to the NSF website: http://www.nsf.gov/crssprgm/reu/reu_search.cfm You can search for opportunities by geographic location, research topic, etc. There are REU programs are all over the U.S.

- **NIH Summer Research Program** (any of the National Institutes of Health) https://www.training.nih.gov/research-training/pb/sip/

- **Institute for Broadening Participation (Science, Technology, Engineering, Medicine)** http://www.pathwaystoscience.org/

- **HHMI (Howard Hughes Medical Institute)** https://www.hhmi.org/programs/science-education-alliance

C. Examples of Recent Biology Senior Research Project Theses *(list is in progress)*

Margo Tkachenka 2024 (Bio-ES) Reporter gene-based examination of PIRL9 expression dynamics in guard cell development under high ambient temperatures [Research at Whitman with Vernon]

Ella Veljovich 2023 (Bio) Mutations in the *CDKN2A* gene influence the risk of malignant melanoma in families with pancreatic cancer [Research at Mayo Clinic - Whitman-Mayo Clinic SURF program]

Ilona Wall 2022 (Bio) *C. elegans* amyloid precursor-like protein (APL-1) is trafficked via the same molecular complex that transports AMPA-type ionotropic glutamate receptors [Research at University of Utah]

Holly Chan 2022 (Bio) Stable isotope analysis of sulfur amino acid metabolism in livers lacking the NADPH-dependent disulfide reductases [Research at Montana State University]

Fraser Moore 2023 (Bio-ES) Flower-insect community network in a xeric Garry oak ecosystem and recommendations for ecocultural restoration [Research at Whitman with Dobson]

Lauren O'Rourke 2024 (Bio) Flower-insect associations in a college native plant garden [Research at Whitman with Dobson]

Quinn Miller 2024 (Bio) Aquatic insect survey of Mill Creek: faunal composition and causative factors [Research at Whitman with Dobson]

Cali Anderson 2021 (Bio) Summer bat activity at roosting boxes in the Okanagan Valley region of British Columbia [Research with the British Columbia Community Bat Program]

Sophie Love 2020 (Bio-ES) Mammalian communities and land use plans in the Yaeda Valley of Tanzania [Research during SFS abroad program]

Kate Traylor 2022 (Bio) Habitual physical activity, disease severity, and quality of life in patients with idiopathic pulmonary fibrosis: investigating patient-reported SGRQ-I data and the self-limiting of routine physical activity [Research at University of Washington]

Beck Maguire 2024 (Bio) Exploring post-concussive gaze shift velocities with the antisaccade task to assess sports-related mild traumatic brain injury in female athletes [Research at Whitman with Knight]

Jerick Nomura 2021 (Bio) Effects of sport-related mild traumatic brain injury on the vestibular ocular reflex [Research at Whitman with Knight]

Lian Gamble 2020 (Bio) Assessing directional deficiencies in gaze gain in the saccade task relative to impact location in concussed college athletes [Research at Whitman with Knight]

Sofia Blair 2024 (Bio) Sagebrush shade increases recruitment in perennial bunchgrass seedlings via decreased microsite temperatures [Research at Whitman with Parker]

Alex Gerber 2022 (Bio) Climate related decline of a perennial grass of conservation importance [Research at Whitman with Parker]

Abby Hill 2020 (Bio-ES) Analyzing resilience: impacts of disturbance on a semi-arid perennial plant community [Research at Whitman with Parker]

Amina Youssef 2022 (Bio) Dissolved organic matter (DOM) influences microbial ecosystem function at Grinnell Glacier, Glacier National Park [Research at Montana State University]

Jared Van Blair 2022 (Bio) Population demographics of *Lobelia dortmanna* in a large oligotrophic lake in Northwestern Washington State [Research at Olympic National Park]

Clara Hoffman 2021 (Bio) Assessing the body condition and seasonal variation in white tailed deer (*Odocoileus virginianus*) via two methods [Research at the University of Washington]

Riley Kraft 2023 (Bio) Characterizing social anxiety in a neural circuit [Research at the University of Utah]

Haley Cornelison 2023 (Bio) An analysis on the effects of a complex environment on microglia morphology in the rat brain [Research at Whitman with Withers & Wallace]

Aidan MacPherson 2023 (Bio) Testing for nonpathogenic pericyte plasticity in the brain [Research at Whitman with Withers & Wallace]

Aidan Schutter 2023 (Bio) Profiling differences in astrocyte maturity in vitro [Research at Whitman with Withers & Wallace]

Elizabeth Williams 2023 (Bio) Analyzing contributions of biological sex in early neuron development [Research at Whitman with Withers & Wallace]

Jhunam Sidhu 2020 (Bio) The role of upper and lower face in the role of facial identity in dynamic stimuli [Research at the University of British Columbia]

Julian Hernandez 2024 (Bio) Auxin-induced degradation of PcIAA25 co-repressor protein in synthetic yeast system [Research at Whitman with Moss]

Anastasiya Redkina 2021 (Bio) Are the molecular mechanisms governing auxin perception dynamic in *Arabidopsis* conserved in *Zea mays*? [Research at Whitman with Moss]

Calvin Lincoln 2020 (Bio) Developing the shadow auxin biosensor: where it glows, plants will grow" [Research at Whitman with Moss]

Benjamin Tanner 2022 (Bio-ES) The effect of long-term inorganic nitrogen addition on the communities of soil fungi and bacteria in temperate forests [Research at Cedar Creek Ecological Reserve]

Joshua Shin 2023 (Bio) Analyzing anthocyanin spot formation in F2 *Mimulus* hybrids using a novel image analysis pipeline [Research at Whitman with Cooley]

Jackie Jones 2022 (Bio) Role of *MYB2b* and *MYB3a* in petal lobe anthocyanin evolution in *Mimulus cupreus* and *Mimulus naiandinus* [Research at Whitman with Cooley]

Appendix 3: Post–Graduation Plans

Immediately after graduation, Biology majors choose many different paths to future careers: immediate employment in academic, governmental, biotech labs, or non-governmental organizations; assignments in the Peace Corps, Teach for America, Americorps or other volunteer/service organizations; post-graduate fellowships or internships; and graduate or professional education.

A. JOB SEARCHING

In addition to emails sent around the biology listerve announcing positions and internships for post-graduates, staff at the CECC at Whitman can help you locate jobs, or you can find positions via direct inquiry to the institution or company (either specific lab/dept or to the HR dept).

Also, job placement ads are available in professional journals, such as *Science,* and on websites of some scientific societies, such as:

- Society for Conservation Biology: http://www.conbio.org/jobs/
- Texas A&M Dept. of Wildlife and Fisheries Sciences job board (wildlife positions from across the US are advertised here): http://wfscjobs.tamu.edu/job-board/
- Botanical Society of America: http://jobs.botany.org/
- Ecological Society of America: https://listserv.umd.edu/archives/ecolog-l.html
- Entomological Society of America: https://careers.entsoc.org/jobs/
- Animal Behavior Society: http://www.animalbehaviorsociety.org/web/news-members.php
- Ornithological Societies of North America: http://www.osnabirds.org/jobs.aspx

B. APPLYING TO GRADUATE SCHOOLS

Graduate school can lead to a Master's or Ph.D., and provide opportunities for advanced coursework and immersion in research. Students interested in pursuing graduate study in the life sciences or related fields should plan to submit applications by around Dec. 1 for admission the following fall.

A number of resources are available to help you select graduate programs and get accepted into a program. Early in the process you should talk with your adviser or other faculty about your plans, which can help you identify your main interests and the types of programs you wish to consider and consult with the CECC resources https://www.whitman.edu/career-prep/career-and-community-engagement-center/graduate-and-professional-school.

There are several valuable references available on graduate programs, including:

1) One particularly useful source is *Peterson's Guide to Graduate Programs*, issued in several volumes. Each two-page listing describes such things as programs of study, facilities, costs, financial aid, community, application procedure, and faculty. Departments offering only a masters degree are included. All of these are available on-line at https://www.petersons.com/graduate-schools.aspx

2) Each year the biology department receives numerous e-mail announcements, which will be forwarded to the biology major list serve.

3) Online resources may be most important in your search for programs. Keep in mind, however, that your graduate school experience is more a function of your laboratory, your graduate advisor, and your individual accomplishments, rather than the university, department, or program.

As you search, keep in mind that different sub-disciplines and different universities and departments organize graduate programs and admission differently. In some cases, students apply to a department, and if accepted, they might rotate among labs for a pre-determined period before selecting a lab in which to work. In other cases, students first contact advisers directly via email and seek admission to a lab prior to completing the formal application to the program; these programs do not admit students who have not been endorsed by a faculty member. You need to make strong impressions on the faculty members you contact; this includes demonstrating knowledge of and sincere interest in the faculty's research, showing commitment to working in that field, and explaining how your previous experiences prepared you for graduate study in that adviser's lab. A good way to find labs is to search for research articles (and then the authors) that interest you, such as in the Web of Science and in journals of your area of interest.

Graduate school advisors are always on the lookout for excellent graduate students. They need students for their research work, but they also need to find students that can contribute and who have the skills and talents needed for productive research. Make sure you turn yourself into one of those people. Create a quality CV (contact your advisor and/or the CECC for help), give poster presentations or talks (i.e., bring your current senior research work to a successful conclusion), gain the trust and respect of your Whitman advisor (you'll need good letters of recommendation), and get as much research experience as you can. All these steps will make you more attractive to potential graduate advisors.

When it comes time to apply, you need to consider the following:

- Graduate Record Examination (GRE)

A number of graduate schools and fellowship programs require that applicants the general GRE test. This is computer-based and offered year-round at regional centers.

- Letters of recommendation

Usually, three evaluations will be required for each application; these letters are from faculty members or research mentors who know your work well and, if possible, have taught you in recent or upper-level courses. Writing good evaluations is a demanding task and you should give people writing on your behalf as much lead time as possible, with at LEAST 2-3 weeks for the first letter. Give them full and accurate information about the program, addresses to which the letters will be written, dates of submission, as well as a copy of your CV and a detailed statement from you explaining why you want this specific opportunity. Writers need good ammunition to write good letters and it is your job to give it to them.

- Visit the university:

Most programs that invite you to interview will pay for your visit (airfare, lodging, meals). Scheduling visits during the academic year can be challenging, but it's important. If you are fortunate enough to get an invitation, go prepared: show up in respectful attire, have an interested and positive demeanor, and come with questions and knowledge of the program and the faculty research going on. This is your opportunity to show them how much they want you.

- Financial considerations:

You should NOT pay for graduate school in the sciences. Nearly all programs pay you and cover all or most of your tuition and related expense. Stipends vary but can exceed $25,000 depending on the program. You WILL have to pay for graduate programs not designed to train scientific researchers (for instance professional programs such as medical schools).

C. POST-GRADUATE FELLOWHIPS

National Science Foundation (NSF) graduate fellowships
NSF fellowships provide full support for three years of graduate study at any U.S. university. At the time of application, you must designate your first choice institution, but you are not obligated to attend that institution. These are very prestigious and therefore competitive awards. Interested Whitman students should consult with their academic advisor and talk with the Director for Fellowships & Grants in the CCEC (https://www.whitman.edu/career-prep/fellowships-and-grants/contact) by their junior year for effective and timely advising.

Fellowships for International Study
Many fellowship, scholarship, and grant programs for graduate study abroad require that applicants be nominated by their undergraduate institution or benefit from an endorsement by the same. These include the Fulbright U.S. Student Program Study Awards, the Marshall and Rhodes Scholarships, and the Watson Fellowship. Generally, these programs carry certain restrictions such as location of study and career goals. Further details may be obtained from the Fellowships and Grants team in the CCEC (https://www.whitman.edu/career-prep/fellowships-and-grants/contact).

D. HEALTH PROFESSIONS and SCHOOLS

If you are considering a career in the health professions (such as, but not limited to, medicine, nursing, public health, pharmacy, dentistry, veterinary medicine), see the Health Professions advising information (https://www.whitman.edu/academics/careers-professions-and-the-liberal-arts/health-professions) and contact Kimberly Mueller, Health Professions Advisor, early in your junior year about application procedures (muelleka@whitman.edu).