



# HOBART AND WILLIAM SMITH COLLEGES



## Biology Student Handbook

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# Welcome

Congratulations on choosing biology as your major (or minor)! Your time in the department will be rewarding, interesting, and challenging. This handbook contains an introduction to the biology department and the faculty at HWS, a detailed description of curriculum, and a list of resources and opportunities to take advantage of during your time at HWS.

We wish you all the best,  
*The Faculty of the HWS Biology Department*



# Mission

Over the course of your major, you will gain an understanding of the complexity of the biological world and its interconnectedness. To achieve this type of understanding, you will participate in hands-on laboratory and field-based coursework and collaborate with department faculty. Obtaining the skills necessary to acquire new knowledge is an essential part of your success as a biologist.

Understanding life requires multiple perspectives. For example, **suppose you're interested in the behavior of running in humans. You could investigate how running is facilitated by the musculoskeletal and cardiovascular systems, or how genetic processes affect the development of running behavior over a lifetime. You can also investigate evolutionary hypotheses about why humans run (e.g., to hunt prey or escape danger), or why humans have high running endurance relative to other mammals.** Fully understanding biological traits requires elucidating proximate mechanisms about structure and function ("how" questions), as well as the historical and evolutionary factors that shape variation in traits among individuals, populations, and species ("why" questions).



*Understanding life requires multiple perspectives.*

The ensemble of courses in your major will allow you to:

**Describe core concepts of biology and explain how these concepts are interconnected.**

These concepts include:

- 1) evolution as a unifying concept
- 2) information flow, exchange, and storage
- 3) relationship between structure and function
- 4) transformation pathways of energy and matter

Recognize that a complete understanding of a biological trait requires integrating four complementary approaches: understanding the trait's structure and function, development, adaptive significance, and phylogenetic history.

**Engage in scientific inquiry by:**

- a) asking biological questions
- b) designing experiments and observational studies
- c) analyzing data and drawing conclusions
- d) communicating the results

# Getting to know your faculty

## Office hours

All biology faculty have office hours, which are scheduled times faculty are free to meet and answer your questions about course material or talk about topics of mutual interest. The times are listed in course syllabi and often posted on faculty office doors. If you cannot make the scheduled times, faculty can meet with you at other times, just email them for an appointment.

Taking advantage of office hours can be one of the most helpful ways to improve your understanding of course material and get advice on summer positions, careers and life beyond your undergraduate years. Here are some helpful tips for making the most of office hours:

1. Visit office hours early in the semester to introduce yourself and learn about expectations for a course. Don't wait to visit office hours until you are struggling.
2. Write down a list of prepared questions ahead of time so that you can refer to them during your meeting. Some students find it helpful to keep a list of questions in the margins of their class notes to reference during office hours.
3. Bring your notes and assignments. If you had trouble with an exam or quiz, it's helpful to bring that with you. If you're working on a paper, bring what you have written.

## Biology department seminar series

The biology department sponsors several research seminars each semester that are typically given by scientists from other institutions. Their talks are pitched for YOU to learn about exciting areas of biology. Everyone in the audience, including your professors, will have questions about their work or find points confusing. Those moments are great opportunities to ask questions of the speaker or of faculty in the department. **The schedule of seminars is distributed to students by email.**

Seminars are also a good time to discuss your interests with Biology faculty. Before the seminar there are refreshments and casual time to interact. Talk with faculty about your specific area(s) of interest and ask them for advice about professional societies and summer programs. Faculty can provide insight and advice that is unique to biology.



## Selecting your adviser

Your advisor will help you navigate through the major. You select your advisor from the department faculty, and you can change your advisor if you find your interests or style is better suited to another professor. Often students declare with a professor they had for introductory biology, biostats or a 200-level class. If you have questions before you declare, any professor in the department can help.

# Department Faculty and Staff



## Dr. Meghan Brown

*Associate Professor of Biology*

**Office:** Eaton 212

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**Research:** Aquatic biology and Invasion ecology

**Courses:** Aquatic Biology (BIOL 238)

Invasion Biology (BIOL 325)

Suspended Animation: How and why organisms put life on hold (BIOL 460)

Biostatistics (BIOL212)

I am an ecologist who studies plankton, the microscopic ensemble that makes the world go round. I spent my childhood on the shores of Lake Michigan—a place both comforting and inspiring that has shaped my academic path. I fished with my grandfather on the lake, swam endless days in its blue-green water, and spent college summers crewing tall ships on its rolling waves. The romance of this incredible place was punctuated by equally strong experiences with its vulnerability: each spring my favorite bays were blanketed with decaying fish carcasses of non-native alewives, and, by my teenage years, the soft sands were pitted with sharp zebra mussel shells. Of the hundreds of non-native species that have taken up residence in North America there is one group in particular that has captured my attention for the last decade, Crustaceans. My interdisciplinary research utilizes these zooplankton and their dormant stages to resolve questions concerning species establishment and environmental change. The arrival of non-native species offers the opportunity to explore dispersal and survival patterns.

**TIP:** Dig-in to the questions that you're curious about and seek out the resources here at HWS to explore them more fully.



## Dr. Sigrid Carle

*Professor of Biology*

**Office:** Rosenberg 205

**Email:** carle@hws.edu

**Research:** cancer biology

**Courses:** Introductory Biology: Dangerous Diseases (BIOL 167)

Cell Biology (BIOL 232)

Cancer Biology (BIOL 327)

A number of years ago, a group of professors (myself and Profs Mowery, Miller, and Pelkey) wrote a grant to integrate organic chemistry II and cell biology labs. The organic chemistry students synthesize anti-cancer compounds called histone deacetylase inhibitors or HDACi, and the cell students test the compounds on cancer cells. This project has become the focus of my research program. Using a variety of molecular and cellular techniques, my research students and I determine the cellular effects of HDACi on cancer cells. Hopefully, the chemists will synthesize a potent HDACi that will one day be used to treat patients. My advice to biology majors/minors would be to keep your mind open to potential careers. Initially, I thought I would teach high school biology. Then, I thought I would become a veterinarian. While teaching high school students I realized I was very interested in the material and high school level biology didn't satisfy my curiosity. Shadowing a veterinarian confirmed my interest in biology over treating patients. In the end I decided to go to graduate school for a Ph.D. in biology.

**TIP:** Keep your minds and options open. Explore the field of biology so you know your options.



### Dr. Bradley Cosentino

*Assistant Professor of Biology*

**Office:** Eaton 203  
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**Research:** Evolution and Ecology  
**Courses:** Population Genetics (BIOL 215)  
Conservation Biology (BIOL 316)  
Biostatistics (BIOL 212)

**TIP:** Avoid tunnel vision: *step outside your comfort zone and take a breadth of classes. Now is the time to wrestle with new ideas.*

My research focuses broadly on evolutionary biology and ecology, with an emphasis on how human land use affects wildlife. Unlike many people who go into evolution and ecology, I grew up in the suburbs of Chicago and never really had an interest in wildlife. (Baseball captured most of my attention). I originally majored in biology in college because I wanted to be a medical doctor, but I didn't really know why. Luckily I had a college professor who got me excited about amphibians and the fascinating ideas evolution and ecology had to offer. Taking classes in those fields made me think about the world in a different way; my perspective on human origins and diversity—and *why* living organisms are the way they are—was changed forever. I went on to obtain a summer research experience studying stream salamanders in the mountains of New Hampshire, and I realized that I could actually make a living stomping around in forests and streams, testing ideas about life.



### Dr. Susan Cushman

*Director of Introductory Biology Laboratories  
Research Scientist at Finger Lakes Institute*

**Office:** Eaton 226  
**Email:** cushman@hws.edu  
**Research:** Stream and Fish Ecology  
**Courses:** Introductory Biology Labs (BIOL 167)  
Dispersal Ecology (BIOL 460)  
Restoration Ecology (BIO 315)  
General Ecology (BIOL 225)

**TIP:** *Seek out various research experiences to figure out what really interests you – you might surprise yourself!*

I am a freshwater ecologist who primarily studies stream ecosystems, focusing on benthic macroinvertebrates and fish, as well as water quality, in the Finger Lakes region. Although the glamor of marine biology caught my attention for a while in college, my love for stream ecology developed during my environmental science Master's program when I learned about the plethora of life below the waters' surface in my stream ecology course. Ok, it had something to do with wearing waders and using electricity to catch fish too! I became fascinated with land-water-air interactions – what we do on land (and in the air) ultimately impacts what happens in the water from pollution to habitat destruction and everything else in between. What was even more interesting was that while many fish species tolerances don't allow them to persist in poor conditions (such as urban streams), there were other fish that capitalized on the available resources in their absence. Adaptations like this, result in the immense diversity of life across habitats. My current research spans not only how these aquatic communities are impacted by their environment, including response to habitat restoration, biomagnification of mercury, and invasive species.



## Dr. Mark Deutschlander

*Professor of Biology*

**Office:** Rosenberg 209

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**Research:** Physiological ecology and sensory biology of migration

**Courses:** Introductory Biology: AnimalMinds  
Physiology (233)

**TIP:** Find and foster your passion(s) in life, and turn one of those passions into your job. Imagine what you would do if money was not an issue. Then do that, and you'll find a career that will satisfy and satiate you for a lifetime.

My research focuses on migration in birds, particularly the sensory cues they use to navigate and energetic influences on migration. How does one come to study such things? Often by turning a hobby of watching birds into a career of studying them. But this was not my path. As a child growing up with a cleft palate and some associated problems, I became intimately familiar with doctors' offices and hospitals (I had 19 surgeries by the time I was 17). That might have drawn me towards a medical career, but again this was not the case. In high school, I was most interested in music and playing guitar, bass, and occasionally drums. But I also really enjoyed biology (I had a fascinating, quirky high school biology teacher), and was (and still am) an avid watcher of television programs about wild animals. When it came time to go to college I decided to go to a strong liberal arts college to "keep my options open" for careers. At one time, I recall trying to decide between pursuing a career as musician, a biologist (and possibly veterinary medicine), and studying theology in seminary. Well you know what I chose; my choice was largely because of one professor (Bob Beason), who tutored me for 3 years in his lab where he studied magnetic orientation in bobolinks. Bob, my mentor and now good friend, was a role model of a teacher-scholar who I wanted to be when I grew up. Well, I grew up and I followed in his footsteps. Along the way I studied magnetic orientation in salamanders and hamsters, ultraviolet vision in amphibians, and polarized light vision and orientation in trout and I've had the opportunity to conduct research in some fantastic places like Trinidad, Australia, and Mexico. But when I had to create my own laboratory at an undergraduate institution, I returned to studying birds just like when I started research at Geneseo. I now conduct most of my research at the Braddock Bay Bird Observatory on southern shore of Lake Ontario.



## Dr. David Droney

*Professor of Biology*

**Office:** Rosenberg 206

**Email:** droney@hws.edu

**Research:** Behavioral Ecology and Evolution

**Courses:** Evolution (Biol 336)  
Behavioral Ecology (Biol 227)  
Biostatistics (Biol 212)

**TIP:** Reflect on the kind of person you are and about what it is about biology that excites you, including where you see yourself being in 20 years, and then pursue your goals with high energy and complete commitment.

My research focuses on why animals behave as they do—especially how and why animals within species vary in their behavior in surprising and “clever” ways. These types of questions are central to my sub-discipline of Behavioral Ecology—the study of animal behavior from an evolutionary perspective. My research centers on sexual interactions of males and females, (mostly in insect mating systems), especially the evolution of female mate choice and male alternative reproductive tactics (these behaviors relate to sexual selection, which is an evolutionary process also elucidated by Darwin). As an undergraduate I chose biology as a major, and specifically cell and molecular biology, although I honestly had no understanding of why I did. Only much later did I realize that I am excited by the process of knowing in science, as well as the amazing details of the living world, but my passion lies in understanding why things are the way they are. This realization allowed me to pursue my studies in a manner that matched my passions. I enjoy integrating information from diverse areas of biology to answer “why” questions. Also, I realized I like to “spread the news”—being a biology professor is a perfect fit for me.



**TIP:** Seek out a variety of experiences in the major. Take a broad array of courses, participate in diverse research experiences, and look for the connections among them that excite you.



**TIP:** Take as many different courses as you can and connect with as many scientists as possible. Learn their stories – a single conversation can have a profound impact on your career plans.

## Dr. Brielle Fischman

Visiting Assistant Professor of Biology

**Office:** Rosenberg 107  
**Email:** Fischman@hws.edu  
**Research:** Evolution, Ecology, and Genomics  
**Courses:** Introductory Biology: Secret Life of Bees (BIOL 167)  
Anatomy (BIOL 324)  
Genetics (BIOL 220)

My research interests center on the evolution and molecular mechanisms of social behavior in insects, with a particular focus on bees. I entered college torn between majoring in biology or English. It was during a writing intensive evolutionary biology course that I fell in love with the field and left each class with my head buzzing with new ideas and a new way of viewing the world around me. I wanted to understand the entire process of evolutionary change from DNA mutations to the diversification of species. I sought out opportunities at both ends of this spectrum, assisting in research on molecular evolution in butterflies and taking upper level courses in neurobiology and behavior. This broad range of study finally converged when the professor of my Animal Social Behavior course came into class with a naked mole-rat. Naked mole-rats are one of the only mammals to exhibit eusociality, a complex form of social organization characterized by a sterile worker caste and reproductive queen caste. Understanding how the sterile worker caste persists has been a problematic topic in evolutionary biology and explaining how a single genome can underlie such wildly different caste traits has been a challenge for the field of genetics. I realized that eusociality stood at the intersection of all the biological topics that excited me. After a three-year stint honing my molecular biology skills in a fruit fly lab in San Diego, I felt ready to commit to graduate school. I joined a lab focused on genomics and behavior in the eusocial Western honey bee and started a new line of study investigating how social traits evolved from a solitary ancestor in honey bees and what genetic changes were involved in this evolutionary process.

## Dr. Kristy Kenyon

Associate Professor of Biology

**Office:** Rosenberg 208  
**Email:** kenyon@hws.edu  
**Research:** Developmental Biology and Neuroscience  
**Courses:** Introductory Biology: A Biotech World (BIOL 167) Genetics (BIOL 220)  
Developmental Biology (BIOL 341)  
Stem Cells & Human Disease (BIOL 460)  
Politics of Reproduction (BIDS 214)

My research interests are focused in the area of developmental biology. My laboratory studies questions sensory development (eye, ear, central nervous system) in two animal systems: *Xenopus laevis* (African clawed frog) and *Drosophila melanogaster* (fruit flies). My career path can be traced back to a college experience at a research station in Maine. I was taking a summer course in neurobiology and met a developmental biologist at a breakfast gathering. I learned that she had grown up on a dairy farm, much like the one that my family owned in Penn Yan, NY. A conversation about cow genetics led to a deeper connection that ultimately helped me secure a job in her laboratory, at a medical school in Washington, DC. In this position, I learned how to observe and manipulate frog embryos at the earliest stages of embryogenesis (2-cell, 4-cell). Seeing frog embryos develop in real-time was exciting and these experiences changed my perspective on many levels. This work led me to pursue a degree in developmental neuroscience and the trajectory that brought me to HWS. My fascination with the field has continued to expand into new areas such as stem cell biology and reproductive medicine.





**TIP:** Take the time to find your passion and don't feel you have to know what your life goal is by graduation.

## Dr. Patricia Mowery

*Associate Professor of Biology*

**Office:** Rosenberg 207

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**Research:** Microbiology and cancer therapeutics

**Courses:** Introductory Biology: HIV and Related Topics (BIOL 167)

Microbiology (BIOL 222)

Immunology (BIOL 302)

Viruses (BIOL 460)

My research focuses on two different projects. First, I collaborate with organic chemistry professors to test small molecules in tissue culture cells with the goal of identifying molecules that inhibit cancer. ~~Second~~, I study how proteins control bacterial movement. Investigating these processes is central to better understanding many pathogenic diseases, and can tell us interesting information about the evolutionary relationships among bacteria. This is a long way from where I began when I was a college student! I initially earned a degree in sociology, worked for a few years, and had no idea what to do with my life. I ended up taking a night course in chemistry and developed a passion for science. I went back to school for a degree in biochemistry, and now enjoy merging disciplines and working with "little things" like one cell organisms, proteins, and DNA.

## Dr. Jim Ryan

*Professor of Biology*

**Office:** Eaton210

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**Research:** Mammalian Anatomy and Neuroscience

**Courses:** Introductory Biology: Genomes &

Disease (BIOL 167) Vertebrate Biology

(BIOL 234) Anatomy (BIOL 324)

Neurobiology (BIOL 340)

My research interests are diverse. Early in my career I worked in Africa surveying remote regions for mammalian biodiversity. That research led me to Madagascar, Uganda, Kenya, and Ghana. More recently my research has focused on the morphology and evolution of bats. My interest in bats stems from a trip I took as an undergraduate to the rainforest of Ecuador. Each of us had to do an independent research project and I chose to study mobbing behavior in fruit bats. Working alone in the jungle at night was exciting; the jungle really comes to life at night. Needless to say, I was hooked. Later I studied the motor neurons in the spinal cord that control flight muscles in bats, muscle physiology in vampire bats, and photoreceptor pigments in bat retinas. I have been collaborating with colleagues at the Cornell Veterinary School on studies of vampire bats as well as studies of the early development of native little brown bats (*Myotis lucifugus*). Over the years, several undergraduate research students and I have co-authored publications on bat morphology in scientific journals. Along the way I have also explored muscle function in racehorses, the phylogeny of kangaroo rats and their allies, and the ecology of pygmy shrews. Today my research students and I are exploring the embryonic development of insectivorous bats using micro CT scanning.



**TIP:** Be curious: continue to ask why. Explore diverse disciplines within biology and continue your explorations outside the classroom on semester abroad or via research with biology faculty.



## Dr. Shannon Straub

*Assistant Professor of Biology*

**Office:** Eaton 221

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**Research:** Plant Phylogenomics and Plant Organellar Genome Evolution

**Courses:** Introductory Biology: Plants and People (BIOL 167)

Genetics (BIOL 220)

Genomics (BIOL 380)

**TIP:** *Be open to many possible careers paths, even ones you don't yet know exist. Get involved in research or find summer internships in fields you think you'd like for your career to really find out what you do and don't like and what kind of work inspires you.*

As a generally curious undergraduate student, I sampled different majors, switching from Journalism to Molecular and Cellular Biology to Sociology to English/Creative Writing, before finding my home in Environmental, Population and Organismic Biology. I was set on applying to veterinary school until I took a required Plant Systematics course, and learned about the incredible diversity of flowering plants and methods for using morphological characteristics and DNA sequences to understand their evolutionary relationships. I can still remember the feeling of excitement I felt walking into lab each week and seeing the myriad colors, shapes, textures, and sizes of flowers, fruits, and leaves our professor had prepared. Later, I travelled to Costa Rica and my desire for a future as a professional plant biologist was solidified as I hiked through the cloud forest in awe of organisms who could manufacture their own food through photosynthesis, defend themselves, and reproduce without ever moving from the spot where they germinated. I just had to know where they came from! How were they related? How, when, and where did they evolve? I have been studying plant diversity and evolution ever since, while more recently adding genome sequencing to my toolbox and genome evolution to my research interests. My current research focuses on understanding the evolutionary relationships of North American milkweeds (*Asclepias*) and the evolution of the chloroplast and mitochondrial genome in these plants.

## ADMINISTRATIVE/SUPPORT STAFF



**Pat Wallace**, *Biology Department Technician*

Office: Rosenberg 002  
Phone: 781-3591  
Email: [Wallace@hws.edu](mailto:Wallace@hws.edu)

Patricia Wallace graduated with a B.S. in Biology/Secondary Education and a minor in coaching. She worked as a Lab Technician for 22 years at Cornell University's New York State Agricultural Experiment Station, specializing in plant tissue culture and use of Gene Gun prototypes for genetic transformation experiments. Pat has been a Lab Technician with the HWS Department of Biology since 2011.



**Jim Norwalk**, *Animal & Plant Care Technician*

Office: Eaton 302  
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Jim Norwalk has a B.S. in Natural History and a Master of Forestry. He studied the life history of Swainson's Warbler (*Lymnothlypis swainsonii*) in timber-managed hardwood forests in the coastal plain of South Carolina. He serves on the Geneva Green Committee, The Geneva Shade Tree Committee, and is the Treasurer of the Geneva Generals Youth Hockey Organization and currently coaches at the U10 age level. He has worked as a wildlife biologist throughout the Pacific Northwest and Alaska. His interests include environmental causes, birdwatching, ice hockey, general mischief, and home brewing.

**Kelly Crawford**, *Science Division*

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# Major & Minor Requirements

All sub-disciplines in biology use the process of science to understand living systems, including ecosystems, species, populations, multicellular or unicellular organisms, cells, or molecules. **As a biology student you will learn how to approach questions in these sub-fields (formulating hypotheses and predictions) and obtain a sophisticated understanding of how the data are collected, analyzed, and interpreted.** Biology is not a collection of facts; concepts in biology are based on well-designed observational and empirical studies.

Biologists in different sub-disciplines ask different kinds of questions and have different ways of thinking and knowing. An important part of your progression through the major is to expose yourself to as many of these different questions as possible. The major will give you a solid foundation in biology providing breadth through an array of course topics and the opportunity for advanced coursework and independent investigation.



## Navigating the biology major

A timeline of completing biology classes for the major is given below (Table 1). Keep in mind that there can be variation from this general timing. The best thing you can do is talk with your advisor about your research interests and to make a plan for your four years.

**Table 1.** Typical year of completion for biology courses and cognates.

Course	Typical time of completion
Introductory Biology (BIOL167)	FY
200-level electives	FY and SO
Biostatistics	SO after a 200-level elective
300-level electives	JR and SR
Senior Seminar (BIOL 460)	SR
CHEM 110, CHEM 240, MATH 130	FY, SO, or JR
Other natural science courses	FY, SO, JR, SR

- Introductory Biology familiarizes students with the core concepts in biology and the types of questions biologists ask before taking elective classes at the 200-level.
- Biostatistics exposes students to statistical analysis necessary to make decisions about biological hypotheses. Biostatistics is required for 300-level courses, and should be completed by the end of the sophomore year. One 200-level biology elective must be completed before taking biostats.
- Elective classes at the 200-level are generally taken during the spring of the first year and during either or both semesters of the sophomore year.
- Class at the 300-level generally require more independent investigation, exploration of the primary literature, and use and interpretation of statistical analyses than 200-level classes. These electives are taken during the junior and senior year.
- The Senior Seminar is a capstone course taken during the senior year, and students should strive to complete most 300-level electives before taking the seminar.
- Cognate courses in chemistry and math should be taken before the senior year.

## Elective courses

Elective courses (200- and 300-level) are organized into two categories (A and B) that primarily represent different levels of organization in biology (Table 2). Category A classes tend to focus on biological processes within individuals (e.g., cells and molecules), whereas category B classes tend to focus on processes involving individual organisms and populations. All of the core concepts and types of questions biologists ask (see *Mission* above) can be addressed in any biology class regardless of category.

**As you progress in the major from 100- to 200- and then 300-level classes, you will delve more deeply into the biology objectives. The 200-level courses can be taken after BIOL 167 is completed, and the 300-level courses can be taken after completion of BIOL 212 and two 200-level courses. All 300-level courses require at least one 200-level course in the same category as a pre-requisite.**

**Table 2.** Categories of biology classes.

Course level	Category A (cells, molecules)	Category B (individuals, populations)
<b>200</b>	BIOL 220: Genetics BIOL 222: Microbiology BIOL 232: Cell Biology BIOL 233: Physiology	BIOL 215: Evolutionary Genetics BIOL 225: Ecology BIOL 227: Behavioral Ecology BIOL 228: Plant Biology BIOL 234: Vertebrate Biology BIOL 238: Aquatic Biology
<b>300</b>	BIOL 302: Immunology BIOL 324: Anatomy BIOL 327: Cancer Biology BIOL 340: Neurobiology BIOL 341: Developmental Biology BIOL 380: Genomics	BIOL 316: Conservation Biology BIOL 325: Invasion Ecology BIOL 336: Evolution BIOL 356: Ornithology

## Requirements for the major

The biology major can be completed as a B.A. or B.S. degree (Table 3).

**Table 3.** Requirements of the B.A. and B.S. degrees in biology.

B.A. Degree	B.S. Degree
BIOL 167: Introductory Biology BIOL 212: Biostatistics Three 200-level electives* Three 300- level electives* BIOL 460: Senior Seminar MATH 130: Calculus CHEM 110: General Chemistry CHEM 240: Organic Chemistry I	BIOL 167: Introductory Biology BIOL 212: Biostatistics Three 200-level electives* Three 300-level electives* BIOL 460: Senior Seminar MATH 130: Calculus CHEM 110: General Chemistry CHEM 240: Organic Chemistry I One additional 200- or 300-level biology elective* Three additional courses in the natural sciences**

\*Three electives must be category A classes, and three electives must be category B classes.

\*\*Natural sciences include biology, chemistry, physics, geosciences, mathematics, computer science, and psychology

### Important Notes:

- All courses for the major must be taken for a grade and completed with a grade of C- or better.
- At least six courses must be unique to the major.
- At least seven biology courses must be HWS courses or HWS-sponsored abroad courses.
- At least five biology courses must have a laboratory.
- Bi-disciplinary courses do not typically count toward the biology major.
- Any courses repeated must be repeated in full (both laboratory and lecture need to be repeated).

## Requirements for the minor

The minor requires BIOL 167 Introductory Biology and five additional biology electives. Students minoring in biology should work with a biology advisor to select courses that best compliment your major and your career goals.

# Frequency Asked Questions

## *Can I develop my own research project for credit?*

Yes! Independent study and honors are semester or year-long experiences available to any major or minor. These are collaborations between students and faculty on a project of mutual interest. We encourage you to talk to professors in the department about your ideas. Independent Study (BIOL 450) substitutes for a 300-level biology course. You will need to work with your adviser to determine whether the independent study counts as an A or B category. On semester of Honors (BIOL495) substitutes for Senior Seminar (BIOL 460). More description of these opportunities can be found in the Research Opportunities of this handbook.

## *How do I go about getting credit for courses I took at another US college or university?*

You may petition the department to have a course taken at a different institution count for the biology major or minor. Talk to your advisor about the petition process *BEFORE* taking the course. Be sure to bring information about the course to the meeting with your advisor, particularly a syllabus that indicates the course description, format (lecture/lab/field), and schedule. You'll discuss with your advisor how the course may fit into your academic plan. Petitions submitted after taking a course elsewhere are not guaranteed approval for substitution.

If the decision is to move forward with a petition, you will fill out the formal petition ([http://www.hws.edu/academics/biology/course\\_petition.pdf](http://www.hws.edu/academics/biology/course_petition.pdf)), which requires a description of the reason for the petition and submission of a syllabus and updated declaration/audit form indicating how the transferred course will be counted. Your advisor will submit the petition to the department for consideration. Departmental approval is not guaranteed.

For non-transfer students, a maximum of two courses can be counted for the biology major or minor via petition. Petitions are typically substitutions for 200- or 300-level biology courses. Petitions are not permitted for BIOL 460 Senior Seminar. Courses taken abroad do not count as transferred credit but still require approval (see below).

## *Can I use another statistics course to meet the biostats requirement?*

Statistics courses in other departments at HWS (ECON202, GEO207, PSY210) can be substituted with the permission of your adviser, whereas statistics courses from off campus require a petition for course approval (see last question).

## *How do I plan for going abroad as a biology student?*

You should consult with your advisor well in advance to discuss the possibility of going abroad and completing the biology major on time. Students who travel abroad typically do so during the sophomore or junior year. Most courses in biology in HWS-sponsored abroad programs require only an introductory level background in biology (e.g., BIOL 167), and such courses can be substituted for 200-level electives. If two biology courses are taken in abroad programs, students are generally given credit for one category A and one category B elective.

Substituting abroad courses for electives almost always requires a petition for course approval ([http://www.hws.edu/academics/biology/course\\_petition.pdf](http://www.hws.edu/academics/biology/course_petition.pdf)). Biology courses taken abroad should generally have a laboratory component in order to substitute for a 200-level course.

The only abroad biology courses that do not require a petition are the two courses associated with the University of Queensland (Terrestrial Ecology and Marine Ecology), because these are part of a faculty-led program with standing classes.



# Course descriptions

## Required courses

### 212 Biostatistics

This course is about decision-making. As scientists and in your day-to-day lives, you will need to draw conclusions from data. Statistics is a framework for answering questions with data, and as such, it is a critical component of scientific inquiry. Emphasis will be on using statistics to make decisions about hypotheses in light of uncertainty.

*Prerequisite: BIOL 167 and one 200-level biology course*

Faculty: Brown, Droney, Cosentino

Offered every semester

### 460 Senior Seminar

This is a capstone course that integrates the goals of the major. You will delve into scientific reading and writing on a particular topic, and integrate the biology teachings from your elective courses. The course is completed during the senior year. Honors research in Biology (BIOL 495) may substitute for BIOL 460 with an advisor's permission. Topics that have been offered recently include: Dispersal, Viruses, Suspended Animation and Evolutionary Medicine.

*Prerequisites: senior biology majors and one 300-level biology course*

Faculty: Staff

Offered annually, typically multiple sections in the Spring semester

## 200-level elective courses

### 215 Evolutionary Genetics

This course is about evolution. Evolution is the genetic transformation of populations over time, and population genetics provides a set of principles to explain the genetic mechanisms of evolution. Considerable time is devoted to examining how population genetics informs medicine, conservation, forensics, and our understanding of human evolution and history. In the laboratory, you will explore population genetic concepts with computer simulations, and you will participate in a term-length project to test hypotheses about evolution in a local wildlife species. *Prerequisite: BIOL 167.* Faculty: Cosentino

### 220 General Genetics

This course builds upon knowledge of principles that govern the organization, replication, and expression of genetic information. Course concepts are addressed in consideration of emerging applications such as personalized medicine and biotechnology. Techniques such as PCR, DNA sequencing, gene cloning, and microscopy will be used to investigate gene function, expression and transmission in model systems (animal/Kenyon; plant/Staub). *Prerequisite: BIOL 167.* Faculty: Kenyon, Straub

### 222 Microbiology

We explore questions in class and lab about individual microorganisms (e.g. how they move, make energy, live in extreme environments, resist antibiotics) and viruses (e.g. How they replicate, evade the immune system). But just as we do not live alone, neither do they. In class and lab we also examine the microbiome (millions of microbes in an environment like your gut, your skin, the ocean, the soil, etc.) and how they communicate to each other, fight each other, keep us healthy, and create toxins that harm us. We discuss microbes and the microbiome in terms of health, medicine, environment, and biotechnology. *Prerequisite: BIOL 167.* Faculty: Mowery

### 225 Ecology

The natural world is a complex web of interactions between organisms, and between themselves and their environment. What drives where species live and how many organisms there are? Who eats who and why? Natural histories of interesting species combined with ecological theory are used as case studies to understand all levels of biological organization (individuals to ecosystems). Journal articles combined with field and lab exercises focusing on various organisms and habitats in the Finger Lakes region incorporate different approaches to study important ecological hypotheses. Statistical techniques are taught to help quantify and give meaning to information collected from the field. *Prerequisite: BIOL 167.* Faculty: Brown, Cosentino

### **227 Behavioral Ecology**

The topic of this course is animal behavior - specifically the study of how evolutionary processes have shaped the behavior and behavioral variation we see today among individuals within species. *Prerequisite: BIOL 167.* Faculty: Droney

### **228 The Biology of Plants**

Using an evolutionary framework this course examines the diversity of plants—from tiny phytoplankton to giant trees—and the changes that took place in plant structure and physiology during the evolution of flowering plants. In lab we'll test hypotheses about the effect of environmental factors on plant physiology, tap sugar maple trees and produce maple syrup, and study the diversity of local plants during field trips to nearby conservation areas. *Prerequisite: BIOL 167.* Faculty: Straub

### **232 Cell Biology**

This course studies the components of cells in order to understand how cells function. The main topics covered are: proteins, cell signaling, cell motility, flow of genetic information, membranes, and metabolism. We study these components in the context of cancer. The lab portion of the course is linked with organic chemistry II. The organic students synthesize histone deacetylase inhibitors (HDACi) that the cell biology students test on cancer cells. Students involved in these cross-disciplinary experiments engage in a true scientific experience; promising compounds that students synthesize and test will be further evaluated for their potency as anticancer drugs. *Prerequisite: BIOL 167.* Faculty: Carle

### **233 General Physiology**

In this course, we uncover the major physiological processes of animals, from the level of cells and tissues to the whole organism. Students examine relationships between structure and function, mechanisms of regulation, control and integration, metabolism, and responses and acclimation to environmental challenges. Laboratory exercises include experiments, simulations, and demonstrations, to reinforce lecture topics and emphasize an investigative approach to the measurement of physiological processes. *Prerequisite: BIOL 167.* Faculty: Deutschlander

### **234 Vertebrate Biology**

This course is an exploration of the diversity of form and function of vertebrate animals. It is a question-oriented course in that we ask why a particular structure evolved and how it is used. How did jaws evolve and how did this lead to an explosion of diverse groups. In the lab you will learn about local vertebrates, go on field trips, and in the lab you will conduct experiments about vertebrate structures work. *Prerequisite: BIOL 167.* Faculty: Ryan

### **238 Aquatic Biology**

The overarching goal of this class is to deepen your understanding of biology using aquatic ecosystems as a model. To accomplish this, you will study the major global pressures on the biology of freshwater systems, which include nutrient pollution, biological pollution, thermal pollution and chemical pollution. We will focus on understanding how and why biological organisms and biological communities are impacted by these forms of pollution in the Finger Lakes region, including labs on Seneca Lake and the Hanley Preserve. *Prerequisite: BIOL 167.* Faculty: Brown

## **300-level elective courses**

### **302 Immunology**

At a detailed level we dissect the immune system at the molecular, cellular, and disease level. With medical cases and current scientific literature we explore the structure and function of the major immunological molecular players, the complex development and responses of immune cells, when and how the immune system fails (pathogenic diseases, autoimmune conditions, cancer), and the latest advances in medical technology in terms of vaccines, transplants, and disease treatments. *Prerequisites: BIOL 212 and at least two additional 200-level courses, one of which must be BIOL 220, BIOL 222, BIOL 232, or BIOL 233.* Faculty: Mowery

### **315 Advanced Topics in Biology**

An in-depth study of current research interest. This course may or may not have an associated lab. Recent examples of courses include: Restoration Ecology, Field Biology, and Behavioral Neurobiology. *Prerequisites: BIOL 212 and at least two additional 200-level courses in the category (A or B) associated with the course* Faculty: Staff



### **316 Conservation Biology**

This course will introduce you to the application of ecological and evolutionary theory to the conservation and management of biodiversity. The first half of the course focuses on the biology of small populations, and the second half of the course focuses on habitat management at the scale of landscapes and ecosystems. In the laboratory, you will gain experience with the quantitative techniques used to model the dynamics and extinction risk of small populations, and you will create your own research project to understand the ways in which humans impact wildlife. *Prerequisites: BIOL 212 and at least two additional 200-level courses, one of which must be BIOL 215, BIOL 225, BIOL 227, BIOL 228, BIOL 234, or BIOL 238* Faculty: Cosentino

### **324 Anatomy**

This course presents a systemic approach to the study of the human body. Course topics cover the gross and microscopic anatomy of major organ systems including skeletal, muscular, respiratory, digestive, urinary, nervous, cardiovascular and reproductive. Discussion of each organ system often involves explanations of relevant clinical disorders and treatments. During the laboratory component of the course, we handle and study anatomical models, perform dissections of preserved animals, and solve clinical case studies. *Prerequisites: BIOL 212 and at least two additional 200-level courses, one of which must be BIOL 220, BIOL 222, BIOL 232, or BIOL 233.* Faculty: Fischman, Ryan

### **325 Invasion Ecology**

Biological invasions are second only to habitat destruction in causing declines in native species and are the primary drivers of global environmental change. Species invasions also provide unique opportunities for testing basic theories in ecology and evolution. In this course you will study the process and underlying mechanisms of invasions, the effects of invasions on communities and ecosystems, and the management techniques employed to address invasions. *Prerequisites: BIOL 212 and at least two additional 200-level courses, one of which must be BIOL 215, BIOL 225, BIOL 227, BIOL 228, BIOL 234, or BIOL 238.* Faculty: Brown

### **327 Cancer Biology**

Cancer is not a single disease. Rather, it is a collection of related diseases that share similarities in origin, genetics, and development. This course will explore the complexities of cancer development. The course begins with understanding DNA damage and mutations, followed by the genetic differences between cancer and normal cells. Next, we move out of the cell to discuss the role of the tumor's environment, such as normal cells and immune cells, in tumor development. Review articles and research articles take the place of a textbook. The class format is a mix of lectures and class discussions. *Prerequisites: BIOL 212 and at least two additional 200-level courses, one of which must be BIOL 220, BIOL 222, BIOL 232, or BIOL 233.* Faculty: Carle

### **336 Evolution**

Evolution is the process that ties together all the biological facts and processes we study in biology. In this course we focus on why what we see in biology has come to be - from genome structure and function to ecological interactions of organisms. *Prerequisites: BIOL 212 and at least two additional 200-level courses, one of which must be BIOL 215, BIOL 225, BIOL 227, BIOL 228, BIOL 234, or BIOL 238.* Faculty: Droney

### **340 Neurobiology**

Neurobiology is revolutionizing our view of learning, memory, substance abuse, mental illness, and consciousness. Through lectures, discussions, readings, and demonstrations we will explore recent discoveries about the brain. Topics include how neurons process information, how the brain integrates this information, and how disease affects information flow. Labs are experimental in nature and include modules on electrophysiology, neuronal cell culture, and optogenetics. *Prerequisites: BIOL 212 and at least two additional 200-level courses, one of which must be BIOL 220, BIOL 222, BIOL 232, or BIOL 233.* Faculty: Ryan

### **341 Developmental Biology**

This course integrates principles from genetics, cell biology, evolution, anatomy and physiology to understand how a single fertilized cell develops into a complex adult form. Through the primary literature students examine, discuss and debate ideas emerging from research on the patterning of embryos, organogenesis and stem cell biology. In the laboratory, students study developmental processes of different animals using techniques such as immunohistochemistry and fluorescence microscopy. *Prerequisites: BIOL 212 and at least two additional 200-level courses, one of which must be BIOL 220, BIOL 222, BIOL 232, or BIOL 233* Faculty: Kenyon

### **356 Ornithology**

Birds instill wonder in many people due to their colorful and melodious communication, their incredible flight and migrations, and their ubiquitous presence everywhere humans live. Birds are also obvious sentinels of environmental change and disturbance such as pesticide use, habitat loss, pollution, and climate change. In this course, we will study local avifauna to learn about the diversity, natural history, and conservation of birds. You will develop identification skills in the many outdoor excursions to local bird hotspots, and learn and practice field techniques in ornithology. Lecture and discussion topics may include the evolution and systematics of extant birds, feathers and flight mechanics, migration and dispersal, foraging ecology, communication, parental and social behavior, and conservation. *Prerequisites: BIOL 212 and at least two additional 200-level courses, one of which must be BIOL 215, BIOL 225, BIOL 227, BIOL 228, BIOL 234, or BIOL 238.* Faculty: Deutschlander

### **380 Genomics**

Recent advances in DNA sequencing technology have revolutionized the study of genetics, evolution and medicine because of the massive amount of DNA sequence data that can be collected to address biological questions. This course introduces these technologies and the data analysis skills for working with “big data.” Building on knowledge of genome sequencing and characterization covered in the first part of the course, the use of genomes to understand organismal evolution (including phylogenetic relationships and novel traits) and provide data for personalized medicine (using your genome sequence to determine the proper course of treatment or drug dosage), personal genomics (using your genome to understand traits, disease risk factors, and ancestry), and metagenomics (studying environmental assemblages of microorganisms e.g., gut bacteria). The fast pace of this field lends itself to digging deep into the latest research papers, including those published during the course. *Prerequisites: BIOL 212 and at least two additional 200-level courses, one of which must be BIOL 220, BIOL 222, BIOL 232, or BIOL 233* Faculty: Straub

## **400-level elective courses**

### **450 Independent Study**

This is a one-credit academic research experience under the supervision of a biology professor. An independent study can be substituted for a 300-level elective, and thus carries the prerequisites and expectation of 300-level courses. At the end of each semester, students who complete an Independent Study give a poster presentation and complete a scientific paper on their research. *Prerequisites: BIOL 212 and at least two additional 200-level courses.*

### **456 Independent Study**

This is a half-credit academic research experience under the supervision of a biology professor. At the end of each semester, students who complete an Independent Study give a poster presentation and complete a scientific paper on their research. *Prerequisites: BIOL 212 and at least two additional 200-level courses.*

### **495 Honors**

Honors is a year-long, two-credit research-based project under the supervision of a biology professor. It involves independent research, a qualifying exam, and composition of a thesis, as well as an oral defense of the thesis. If you are interested in pursuing honors, we encourage you to talk with potential faculty advisors about project ideas. *Prerequisites: BIOL 212 and at least two additional 200-level courses.*

# Research Opportunities

- Discuss interesting science articles and literature with biology faculty. These conversations can lead to ideas about people, programs or research opportunities with specific scientists.
- Surf the web to find people, programs, institutions and organizations in the field of biology that interests you.
- There is a job board with postings for summer opportunities and graduate school positions outside of Rosenberg 207.
- A major in biology or biochemistry can be the starting point for careers in research, industry, academics or public service. These career paths may require an advanced degree such as a Master of Science (M.S.) degree and/or a Doctor of Philosophy (Ph.D.) in biology or biology-related fields.
- Students interested in health professions can find support and resources through the [Health Professions Advisory Program](#).



We strongly encourage our Biology majors to start making the transition from Biology student to working Biologist while they are still undergraduates. Many biology students actively engage in research each semester, both on-campus and off-campus with scientists, to get hands-on experience. These projects involve the study of life on Earth, from the workings of biological molecules, cells, the human body, to entire ecosystems. Independent research can be incredibly exciting, learning something about the world that nobody else knows and contributing new knowledge (although research can be tedious, difficult, and extremely frustrating at times!). From a more practical perspective, doing research can also enhance one's chances of getting into a high-quality professional school or graduate school and getting a good job in Biology.

## How do I get involved in research with an HWS faculty member?

All professors in the Biology Department are actively involved in research projects that involve undergraduates. Students wanting to participate in research should consider the following course of action:

1. Find out the type of research faculty members are engaged in by talking to your advisor, other faculty, and by looking at faculty webpages on the Biology Department's website.
2. Contact faculty members whose research is of interest to you and arrange to meet them in person.
3. In your face-to-face meeting with each faculty member, find out what types of projects they are pursuing and whether or not they are accepting new undergraduate students for those projects. Be prepared to describe what courses you have had, what your career goals are, and how much time per week you can commit to the effort.

### How do I learn academic credit or money conducting research at HWS?

**450 Independent Study** is a one-credit academic research experience under the supervision of a biology professor. An independent study can be substituted for a 300-level elective, and thus carries the prerequisites and expectation of 300-level courses. At the end of each semester, students who complete an Independent Study give a poster presentation and complete a scientific paper on their research. *Prerequisites: BIOL 212 and at least two additional 200-level courses.*

**450 Independent Study** is a half-credit academic research experience under the supervision of a biology professor. At the end of each semester, students who complete an Independent Study give a poster presentation and complete a scientific paper on their research. *Prerequisites: BIOL 212 and at least two additional 200-level courses.*

**495 Honors** is a year-long, two-credit research-based project under the supervision of a biology professor. It involves independent research, a qualifying exam, and composition of a thesis, as well as an oral defense of the thesis. If you are interested in pursuing honors, we encourage you to talk with potential faculty advisors about project ideas. More information about the honor's program can be found at: [http://www.hws.edu/academics/curr\\_honors.aspx](http://www.hws.edu/academics/curr_honors.aspx). Attendance at all biology seminars held throughout the semester is required of all students doing Honors. *Prerequisites: BIOL 212 and at least two additional 200-level courses.*

**Summer Research at HWS** supports summer scholars who work side-by-side with a faculty research mentor. Students experience the rigors and joys of research in an intense 6-10 week program. To be selected for the program, students must demonstrate a compelling interest in the field of study and the potential to be outstanding researchers. Mentors for student research are selected from the Biology faculty and from the faculty of the AgriTech, a division of Cornell University. The Summer Scholars are housed together by discipline so that they will continue to share information and develop friendships outside the laboratory, thus creating a research community.

### Are there other research opportunities in Geneva?

The department has a relationship with Cornell's AgriTech, located in Geneva, which provides an opportunity to conduct applied research while making important contributions to agricultural projects. We also work closely with scientists at the Finger Lakes Institute. Students interested in pursuing careers in medicine also have access to clinical internships, skill training and direct patient care experiences through a special partnership with Finger Lakes Health, a local health system with 75 staff physicians and a broad range of primary and specialty services located just one mile from campus.

### How do I request a letter of recommendation for a position outside HWS?

Ideal references are persons who know you personally, beyond simply grading your assignments, and hold you in high regard, perhaps because you worked under their supervision or had interesting conversations about biology together. Speak directly with faculty when requesting a letter of recommendation (stop by office hours, request an appointment). Make sure that you are giving letter writers as much lead-time as possible; two weeks to a month is appropriate. You should provide your references with the following:

- The name, title, and address of the person(s) to whom the letter should be written.
- The date that the letter is due, and how it is to be submitted.
- Any required form, with your part of the form filled out and signed (especially the "waiver of right to read the recommendation" - see below).
- A description of what you are applying for (job, scholarship, further schooling, etc.)
- A brief summary of your interests and qualifications or a statement of why you are seeking the job/experience/ further schooling.
- An up-to-date resume or curriculum vitae.

***Important note about waiving your right to inspect the recommendation:***

Most requests for recommendation include a form that asks you to indicate whether you “do waive” or “do not waive” your right to review the recommendation after it is submitted. You should always indicate that you do waive your right to read the recommendation. Almost all references, even ones that are going to give you a glowing recommendation, want their recommendation to be kept in confidence. Many references will politely refuse to provide a recommendation unless you have waived your right to review the recommendation.

It is appropriate to send a polite, tactful, reminder e-mail a few days before the due date if you have not heard back from the references since you requested the letter. You can also check with the receiving institutions (if the letter is being mailed directly) to make sure that the letters have arrived. Let the reference know the outcome of your application(s) as soon as you know. Your references probably care more about you than you might guess and will be eager to know the result!



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