Biology

To obtain specific admissions requirements on how to apply to Graduate School, prospective students should visit this page: https://www.uab.edu/cas/biology/graduate

Degree Offered	Ph.D., M.S., Fast Track M.S., Accelerated B.S./M.S.
Director:	Peggy R. Biga, Ph.D.
Phone:	(205) 934-9684
E-mail:	pegbiga@uab.edu
Website:	www.uab.edu/cas/biology/graduate

Program Information

Areas of Specialization

Graduate students in the M.S. and Ph.D. programs in biology may specialize in research activities at all levels of biological organization, with emphases on ecophysiology, cellular and molecular biology of plant and animal models, environmental microbiology, the biology of aging, bioinformatics, and ecology of aquatic organisms.

Admission

For admission in good standing, applicants must meet the following requirements, in addition to the Graduate School's standards: an undergraduate degree in biological science or a related field, B-level scholarship in all biology courses, two semesters of organic chemistry, two semesters of physics, mathematics through calculus, a *curriculum vitae*, a one-page statement of general research background and interests, and a personal statement of career goals. The GRE is optional. The graduate program director in biology must approve admission with deficiencies in one of the above requirements. Three letters of evaluation from individuals who have a thorough knowledge of the applicant's academic abilities and potential are also required. It is strongly recommended that a student contact a mentor before applying. Students may enter at the beginning of the Fall semester, with a **deadline of December 15 for all applicants**.

Coursework, Thesis, and Dissertation

A dissertation embodying the results and analysis of an original experimental investigation is required for Ph.D. candidates. Students in the M.S. program may write a thesis based on a research project (Plan I) or, alternatively, may elect to submit a nonresearch project incorporating a review and analysis of one or more topics of current or historical interest in biology (Plan II).

Since scientific problems encountered today are multifaceted and require multidisciplinary approaches, students are expected to acquire a broad background in the physical and life sciences. Doctoral students must complete formal course work in or have equivalent training related to five of the following nine areas: ecology, evolution, physiology, cell and/or molecular biology, developmental biology and embryology, genetics/molecular genetics, microbiology, organismal biology, and systems/computational biology and bioinformatics. Master's students must have competency in four of these life-science areas. Each student is also expected to satisfactorily complete a course in statistics and data modeling for biologists and any advanced courses designated by the student's graduate study committee consistent with the chosen area of specialization.

Each student must also enroll in three seminar or colloquium courses approved by his or her graduate study committee, and one of the seminars must be outside the student's primary area of specialization. Also, each student is required to demonstrate proficiency in teaching by delivering formal course lectures or by conducting instructional laboratories. Certificates for advanced training in teaching are also available.

Examinations

To qualify for candidacy, a student in the Plan I Master's program must satisfactorily complete either a written or an oral comprehensive examination. A doctoral student must take both written and oral comprehensive examinations. As part of a student's final defense of his or her dissertation or thesis, a public departmental seminar must be presented.

Class A Teaching Certification

Under the Alabama Department of Education's "Strengthened Subject Matter Option," students who complete the requirements for the master's degree in biology can also receive class A teaching certification, providing that certain prerequisites and requirements are met. Complete details are available from the School of Education Certification Office, Education and Engineering Complex, 1720 2nd Ave South, Birmingham, Alabama 35294-1250 (Telephone 205-934-5423).

Accelerated Learning Opportunities

Biology offers both a Fast-Track and Accelerated Bachelors/Masters (ABM) option for high-achieving undergraduate students. Deadlines to apply for admission: Summer - May 1, Fall - August 1, Spring - December 1. Students majoring is the sciences are eligible for the ABM program in Biology. Students pursuing a dual BS/MS in biology may specialize in research activities at all levels of biological organization, with opportunities to train in the biology of aging, climate change, food security, and aquatic sciences. Research activities range from cellular and molecular biology to endocrinology; genetics and genomic science to physiology; and epigenetics to population ecology. Graduates from this research-intensive program are prepared for careers in science and related fields, including research, teaching, biotechnology, science policy, medicine, conservation, and sustainability. Students in this program develop critical thinking, problem solving, and analytical skills preparing them for academic, government, non-profit or private sectors.

Both Thesis (Plan I) and Non-Thesis (Plan II) ABM programs are available, with both options including mentored research experience. Plan I students complete 10 credit hours of research (4 non-thesis; 6 thesis), while Plan II students complete 6 credit hours of non-thesis research. All ABM students complete 2 credit hours of colloquium/seminar/journal club and biology disciplinary coursework (Plan I - 12 credit hours; Plan II - 10 credit hours plus 12 credit hours of science electives). Plan I students complete 3 credit hours of statistics and 3 credit hours of Scientific Ethics.

The following courses are approved for shared credit for students pursuing an ABM in Biology: BY 501, BY 511, BY 512, BY 527, BY 530, BY 531, BY 535, BY 555, BY 567, BY 568, BY 569, BY 570, BY 605, BY 607, BY 614, BY 616, BY 618, BY 620, BY 626, BY 629, BY 633, BY 634, BY 636, BY 637, BY 640, BY 642, BY 644, BY 651, BY 655, BY 656, BY 656L, BY 668, BY 670, BY 674, BY 675, BY 680, BY 689,

BY 696, GGSC 610, GGSC 615, GGSC 620, GGSC 635, GGSC 670, GGSC 690, GGSC 691, MIC 600, MIC 601, MIC 602, MIC 603, MIC 604, CNBY 610, CNBY 620, CNBY 630, CNBY 640, CNBY 660, CNBY 670, INFO 601, INFO 602, INFO 603, INFO 612, NBL 620, NBL 625, NBL 633, NBL 634, NBL 644, PY 620, PY 653, PY 687, PY 693.

Additional Information & Mailing Address

Deadline for Entry Terms:	Fall semester
Deadline for All Application Materials to be in the Graduate School Office:	December 15
Number of Evaluation Forms Required:	Three
Entrance Tests	TOEFL TWE, DuoLingo or IELTS are required for international applicants whose native language is not English.
Documents Required to Apply:	CV, 1-page research interests statement, 1-page career goals statement

Contact Information

For detailed information contact Dr. Peggy R. Biga, Graduate Program Director.
Telephone 205.934.9684
Fax 205.975.6097
E-mail **pegbiga@uab.edu** (**sawatts@uab.edu**)
Web https://www.uab.edu/cas/biology/graduate

Master of Science in Biology

Plan 1

Requirements		Hours
Biology Coursework [1]		**7**
Statistics Requirement		**3**
BY 655	Statistics and Modeling for Biologists	
Professional Training		**2**
GRD 715	Preparing TAs to Be Effective Teachers	
Seminar/Colloquium		**3**
BY 618	Colloquium in Biology of Aging	
BY 679	Colloquium in Evidenced Based Teaching	
BY 680	Epigenetics Discussion	
BY 681	Colloquium in Physiological Ecology	
BY 682	Colloquium in Immunology	
BY 684	Colloquium in Microbial Ecology	
BY 683	Colloquium in Physiology	
BY 685	Colloquium in Cell Biology	
BY 686	Colloquium in Mammalian Development	
BY 687	Colloquium in Endocrinology	
BY 688	Colloquium in Algal Ecophysiology	
BY 689	Colloquium in Genetics	
BY 690	Colloquium in Cellular Physiology	
BY 691	Colloquium in Botany	
BY 692	Colloquium in Ecology	
BY 693	Colloquium in Embryology	
BY 694	Colloquium in Microbiology	
Biology Dept. Seminar		**0**
BY 678	Biology Graduate Seminar (enrollment required every fall and spring semester while degree-earning student)	
Research		
BY 698	Nonthesis Research	9
BY 699	Thesis Research	6
Total Hours		**30**

[1] 7 credits of Biology courses from BY 501:597, 600:697

Plan 2

Requirements		Hours
Biology Coursework [1]		**10**
Other Science Related Coursework [2]		**6**
Statistics Requirement		**3**
BY 655	Statistics and Modeling for Biologists	
Professional Training		**2**
GRD 715	Preparing TAs to Be Effective Teachers	
Seminar/Colloquium		**3**
BY 618	Colloquium in Biology of Aging	
BY 679	Colloquium in Evidenced Based Teaching	
BY 680	Epigenetics Discussion	
BY 681	Colloquium in Physiological Ecology	
BY 682	Colloquium in Immunology	
BY 683	Colloquium in Physiology	
BY 684	Colloquium in Microbial Ecology	
BY 685	Colloquium in Cell Biology	
BY 686	Colloquium in Mammalian Development	
BY 687	Colloquium in Endocrinology	
BY 688	Colloquium in Algal Ecophysiology	
BY 689	Colloquium in Genetics	
BY 690	Colloquium in Cellular Physiology	
BY 691	Colloquium in Botany	
BY 692	Colloquium in Ecology	
BY 693	Colloquium in Embryology	
BY 694	Colloquium in Microbiology	
Biology Dept. Seminar		
BY 678	Biology Graduate Seminar (enrollment required every fall and spring semester while degree-earning student)	
Research		**6**
BY 698	Nonthesis Research	
Total Hours		**30**

[1] Biology coursework selected from BY 501:697
[2] Science Related Coursework selected from CH 500:597, CH 600:697, PH 500:597, PH 600:697, EPI 500:597, EPI 600:697, BST 500:597, BST 600:697, ENH 500: 597, ENH 600:697, GBS 500:597, GBS 600:697, GBSC 500:597, GPSC 600:697, GRD 717

PhD in Biology

Requirements		Hours
Statistics Requirement		**3**
BY 655	Statistics and Modeling for Biologists	
BY 755	Statistics and Modeling for Biologists	
BST 601	Biostatistics	
BST 611	Intermediate Statistical Analysis I	
Professional Training		**5**

GRD 715	Preparing TAs to Be Effective Teachers	
GRD 717	Principles of Scientific Integrity	
Additional Discipline Coursework [2]		**21-38**
Seminar/Colloquium [1]		**3**
BY 718	Colloquium in Biology of Aging	
BY 780	Epigenetics Discussion	
BY 781	Colloquium in Physiological Ecology	
BY 782	Colloquium in Immunology	
BY 783	Colloquium in Physiology	
BY 784	Colloquium in Microbial Ecology	
BY 785	Colloquium in Cell Biology	
BY 786	Colloquium in Mammalian Development	
BY 787	Colloquium in Endocrinology	
BY 788	Colloquium in Algal Ecophysiology	
BY 789	Colloquium in Genetics	
BY 790	Colloquium in Cellular Physiology	
BY 791	Colloquium in Botany	
BY 792	Colloquium in Ecology	
BY 793	Colloquium in Embryology	
BY 794	Colloquium in Microbiology	
Biology Department Seminar		
BY 678	Biology Graduate Seminar (enrollment required every fall and spring semester while degree-earning student)	
Research		**6-16**
BY 798	Nondissertation Research	
Dissertation Research		**12-24**
BY 799	Dissertation Research	
Total Hours		**72**

1 Seminars from BY 681:695, BY 781:795, GBS 737, GBS 777, GBS 792, GBSC 701, NTR 690, NTR 728, NTR 788, NTR 789

2 Discipline Coursework from: **BY** 500:697, 700:797, **CH** 600:697, 700:797, **PH** 600:697, 700:797, **EPI** 600:697, 700:797, **BST** 600:697, 700:797, **ENH** 600:697, 700:797, **GBS** 600:697, 700:797, **GBSC** 600:697, 700:797, **GRD** 600:697, 701:713, 716, 719:797, **NTR** 600:697, 700:797

Graduate Certificate in Science Policy

The Science Policy Graduate Certificate program is aimed at training students to solve key societal problems using science and innovation. This program will train students in scientific fields to learn about the policy making process & ethical technology development, while training students in non-scientific fields about contemporary science as they pertain to policy needs. Trainees will develop key core competencies that link science and society together making them valuable resources to academic, public, and private job sectors. The program will focus on effective science communication, the impact and processes of establishing policies, and the real time assessment of innovations for society at local, national, and global level. Participants will gain essential skills to be applied in solving real world problems and develop leadership skills through the science policy community of practice. The certificate is geared to trainees from diverse programs including, but not exhaustively, biology, chemistry, physics, sociology, public health, biomedicine, public administration, political science, communications, and computer science.

Application for the Certificate Program

To complete the Graduate Certificate in Science Policy, students must be admitted as a graduate student as defined by the UAB Graduate School. These requirements include an earned undergraduate degree from an accredited institution. Prospective students must also complete the application form and submit it to the Graduate Program Director (pegbiga@uab.edu) prior to the application deadline.

Courses

Students must obtain a grade of at least B in any course used to satisfy the certificate requirements. 12 of the 15 required credit hours must be earned at UAB, and 12 of the credits must be at or above 600-level.

Graduate Certificate in Science Policy [1,2,3]

Requirements		Hours
Core Course Requirement		**3**
BY 617	Science Policy	
or MPA 61	Science Policy	
Foundational Knowledge Skills		**3**
BY 647	Contemporary Political Issues in Science	
or MPA 64	Contemporary Political Issues in Science	
MPA 601	The Public Policymaking Process	
MPA 602	Scope of Public Administration	
MPA 604	Human Resources Management	
SOC 620	Public Sociology	
MPA 682	Economic Development	
Humanistic Knowledge Skills		**3**
MPA 600	Administrative Ethics	
SOC 626	Applied Sociology	
SOC 627	Applied Social Psychology	
SOC 645	Sociological Practice	
HA 616	Biomedical Ethics	
ANTH 524	Transitional Justice and Human Rights	
ANTH 641	Anthropology of Human Rights	
ANTH 624	The Law of Historical and Cultural Resources	
PY 619	Diversity, Equity and Inclusion in Research and the Workplace	
PY 734	Applied Developmental Psychology	
Meta Knowledge Skills		**3**
SOC 715	Program Evaluation	
SOC 770	Techniques of Population Analysis	
SOC 772	Medical Demography	
MPA 689	Program Evaluation	
MPA 605	Information Management for Government	
MPA 603	Public & Nonprofit Budgeting	
BY 670	Scientific Communication	
or BY 770	Scientific Communication	
CM 604	Analysis of Communication Audiences	
CM 605	Communication Effects	
CM 616	Health Communication	
CM 620	Persuasion	
PY 718	Advanced Research Design	
ANTH 521	Technological Monitoring of Cultural Resources, Human Rights and Conflict	
Capstone		**3**
BY 677	Design Thinking to Solve Problems through Science Policy	
Total Hours		**15**

[1] The student must obtain a grade of at least a B in any course used to satisfy the certificate requirements
[2] 12 of the 15 required credit hours must be earned at UAB
[3] 12 of the credits must be at or above the 600-level

BY-Biology Courses

BY 501. Advanced Genetics for Teachers. 4 Hours.
Explore the basic and advanced concepts of genetics, including the principles and mechanisms of inheritance, gene structure, function, and regulation, along with the application of molecular genetic technology in fields such as human health and agriculture. This course provides a strong foundation for advanced biology studies. Additionally, students will actively participate in practical experimentation, where they will explore into the fundamental and advanced principles of genetics, molecular biology, and genomics through a combination of lectures and laboratory work.

BY 501L. Advanced Genetics for Teachers Laboratory. 0 Hours.
Advanced Genetics for Teachers Lab required with BY 501 lecture.

BY 502. Botany for Teachers. 3 Hours.
Provides understanding of human structural and functional relationships essential in modern biology. Corequisite: BY 503.

BY 503. Advanced Biology for Teachers III. 1 Hour.
Laboratory supplementing lecture (BY 502) through use of human specimens, models, and demonstrations.

BY 504. Life Science for Middle School Teachers. 3 Hours.
Life Science for Middle School Teachers.

BY 507. Microbial Ecology. 3 Hours.
Microorganisms in nature; interactions with each other and with environment. Independent project required. Prerequisite: BY 271.

BY 511. Molecular Genetics. 3 Hours.
Prokaryotic and eukaryotic gene structure and function. Independent project required.
Prerequisites: BY 210 [Min Grade: D] and BY 330 [Min Grade: D] and CH 234 [Min Grade: D]

BY 512. 21st Century Gene Editing. 3 Hours.
The course will cover basic concepts of molecular genetics, including an introduction to the DNA biology (structure and function), the use of model organisms and experimental approaches for molecular genetic analysis and an understanding of human genetic disorders and possible genetic therapies. The first part of the course, while dealing with introductory material through lectures and discussions, will give students a hands-on experience with well-known molecular techniques like DNA isolation and polymerase chain reaction (PCR), and how these techniques are used in the context of gene editing. The participants will also have direct exposure to working with zebrafish (Danio rerio) embryos (<3 days old, therefore exempt from detailed IACUC regulations) and roundworms (C. elegans) as an alternate model system to use the CRISPR-Cas9 technology. These broadly applicable techniques will be reiterated in the second part of the course with a special emphasis on the CRISPR-Cas9 technology. The activities involved in these two parts will provide an opportunity for rich pedagogical discussion on fundamental concepts in biology, chemistry, the process of scientific experimentation, and the nature of evidence. In-service teachers will learn how to design and implement a meaningful high school lesson module on the CRISPR-Cas9 technology and complete formative and summative assessment for that module.

BY 515. Human Anatomy for Educators. 4 Hours.
Principles of vertebrate structure with emphasis on gross and microscopic human anatomy. Survey of human embryology and evolution. Lecture and laboratory.Graduate project/presentation required.

BY 515L. Human Anatomy for Educators - Laboratory. 0 Hours.
Principles of vertebrate structure with emphasis on gross and microscopic human anatomy. Survey of human embryology and evolution. Lecture and laboratory. Course is targeted to current and future Human Anatomy educators.

BY 527. Histology. 4 Hours.
Microscopic anatomy of cells, tissues, and organs of animals; correlation of structure and function. Techniques and methodology. Lecture and laboratory. Completion of additional independent project required for graduate credit.

BY 527L. Histology Laboratory. 0 Hours.
Histology Lab required with BY 527 lecture.

BY 530. Graduate Cell Biology. 3 Hours.
This course will introduce students to key concepts of cell biology with a focus on cellular components, cell metabolism, cell organization, molecular dogma, cellular trafficking, cell cycle, cell signaling, cancer and stem cells. Classical cell biology will be discussed in historical perspectives. Current techniques used in the study of cell biology will be discussed in the appropriate sections. The course is divided into three modules: weeks 1-6, weeks 7-11, and weeks 12-15. 3 Credit Hours. Graduate Project required.

BY 531. Advanced Recombinant DNA Technology. 3 Hours.
Manipulation of genes and their regulations, and techniques used in recombinant DNA technology. Independent project required. Prerequisites: BY 311, BY 330, CH 233 and CH 460 or 461.

BY 535. Natural History of Vertebrates. 4 Hours.
Adaptations of vertebrates for survival in particular environments. Survey and classification of local vertebrates. Two lectures, one laboratory or field trip per week. Independent project required.

BY 535L. Natural History of the Vertebrates Lab. 0 Hours.
Lab must be taken with BY 535 lecture.

BY 555. Biological Data Interpretation and Analysis. 3 Hours.
The course covers the basics of scientific investigation with an emphasis on understanding methods of the scientific process, experimental design, data analysis and data interpretation, and graphical presentation, and scientific writing. Special emphasis will be placed on the use of data management and the understanding of statistical packages language to address the most common types of data analyses used to investigate specific applications in biology. Quantitative Literacy is a significant component of this course. Recommend course is taken during the first year of graduate education.

BY 560. Advanced Invertebrate Zoology. 3 Hours.
Selected topics. Lecture and student projects. Prerequisite: BY 255.

BY 567. Tropical Ecology. 3 Hours.
An overview of the major tropical ecotypes with emphasis on ecology of terrestrial, aquatic, and marine tropical organisms. Major portion of course taught at a tropical field station in the Caribbean. Lectures, laboratory, and field trips. Library research paper required. Prerequisites: Graduate Standing and Permission of Instructor.

BY 568. Galapagos Ecology. 3 Hours.
The ecology of the Galapagos Islands, with an emphasis on terrestrial & marine organisms. Major portion conducted on the Galapagos Islands. Lecture & field trips. Library research paper required. Prerequisites: Graduate Standing and Permission of Instructor.
Prerequisites: BY 255 [Min Grade: D] or BY 256 [Min Grade: D] or BY 470 [Min Grade: D]

BY 569. Rain Forest Ecology. 3 Hours.
Overview of physical and environmental factors that structure the rainforest, biodiversity of life, and interactions of its organisms. A survey of prominent biota will be conducted. Major portion of course taught in Costa Rica. Lectures and field trips. Library research paper required. Prerequisites: Graduate Standing and Permission of Instructor.

BY 570. Ecology. 3 Hours.
The study of interactions between organisms and their environment. An introduction to ecological processes at individual, population, community, and ecosystem levels and their relevance to current environmental problems Lectures. Independent project required. Prerequisite: Graduate Standing.

BY 585. Northern Field Studies. 3 Hours.
Ecology of northern coniferous forest and tundra ecosystems. Major portion of course taught on site in Alaska. Lecture and field trips. Graduate project/paper required. 3 hours. (Irregular offering).

BY 595. Special Topics in Biology I. 1-4 Hour.
This course will consider graduate-level topics from the various disciplines in the biological sciences and the topics will differ each term. Course requirements may include lecture, laboratory, readings, discussion, reporting, and internships or fieldwork, which may be conducted on- or off-campus as well as online. May be taken more than once for credit.

BY 596. Special Topics in Biology II. 0-4 Hours.
This course will consider advanced graduate-level topics from the various disciplines in the biological sciences and the topics will differ each term. Course requirements may include lecture, laboratory, readings, discussion, reporting, and internships or fieldwork, which may be conducted on- or off-campus as well as online. May be taken more than once for credit.

BY 597. Investigative Techniques. 2 Hours.
This course focuses on the application of modern experimental techniques in solving research problems. Specifically, we will discuss important methodological advances in various subdisciplines of biology by examining seminal papers from the scientific literature. The articles might include a mix of historical and current articles. The class will use a journal club format for weekly discussions in person or virtually, with additional content provided CMS.

BY 598. MR Lev Non-Thesis Research. 1-10 Hour.

BY 605. Microbial Physiology. 3 Hours.
Microbial structure and function, growth, metabolism, and regulation of cellular activity. Independent project required. Prerequisites: Permission of instructor. 3 credit hours.

BY 607. Microbial Ecology. 3 Hours.
This course examines microorganisms in their natural habitats, with a focus on soil and aquatic ecosystems as well as symbiotic interactions between microbes and animals and plants. Students will learn both theory and practical techniques for studying microbial ecology, including hands-on exposure to modern bioinformatic analysis methods for microbial communities. Independent project required. 3 credit hours.

BY 610. Comparative Animal Physiology. 3 Hours.
Special physical and chemical processes occurring at cell tissue, and organ levels. Independent projects required.

BY 611. Advanced Human Anatomy. 4 Hours.
This course is a detailed, advanced examination of human anatomy and histology. In a laboratory setting, students will achieve course objectives from dissecting a human cadaver, and observing prosected cadavers and casted models.

BY 612. CIRTL-Biology. 1-4 Hour.
This discipline specific seminar course in CIRTL (The Center for the Integration of Research, Teaching and Learning) - Biology is specially designed to offer students a hands-on opportunity to do an in-depth analysis on various effective teaching techniques that can be utilized in a typical college classroom setting. In the light of this analysis, students are expected to deliver a presentation simulating a classroom lecture on any topic related to Biology or if they prefer, they can also give an oral presentation on any pedagogical topic.

BY 613. CIRTL Service-Learning Workshop. 1 Hour.
This workshop offered by the Department of Biology for CIRTL (The Center for the Integration of Research, Teaching and Learning) @UAB is specially designed to offer students a hands-on opportunity on designing a service-learning course in the realm of their study with an added emphasis on the importance of service-learning in today's classroom.

BY 614. Advanced Cell Biology. 3 Hours.
This course will focus on understanding cell signaling, function, and dynamics, which is the core of modern cell biology topics. This course is targeted to students who are interested in the advanced level current topics of Cell Biology. Topics include the cellular organization and function, cell cycle, autophagy, apoptosis, stem cell and cellular signaling pathways. This course also includes reading of primary literature, and writing and presenting a research proposal. Graduate project required.

BY 616. Cellular Physiology. 3 Hours.
Structure and function of cells and their components at the molecular level. Laboratory experience using modern equipment and biochemical methods. Independent project required.

BY 617. Science Policy. 3 Hours.
Science and technology intersect with multiple areas of public policy. Think of the growing concerns over technological surveillance, the debates over policy for climate change mitigation, the challenges posed due to global health crises, or the fear that American research and development competitiveness is eroding in a globalized economy. These issues reflect important questions about the relationship between science, technology, and public policy. Are scientific and technological developments governable, and if so, how and by whom? Is more and better science always better for policymaking? Who is the best judge of the value of scientific research programs and the validity of scientific findings? Are scientific and technological innovations generally socially beneficial, and who decides? What role should policymakers play in regulating science?.

BY 618. Colloquium in Biology of Aging. 1 Hour.
The course will focus on readings and interpretation of scientific papers, data, and experimental results relevant to endocrinology and aging. In addition to readings, oral presentations, discussions, and a research proposal are the major components of the course.

BY 619. Reproductive Physiology. 3 Hours.
Comparative reproductive physiology in animals with emphasis on mammals. Independent project required.

BY 620. General Endocrinology. 3 Hours.
The central theme of this course is the role of hormone chemical messengers in the regulation of physiological processes. Topics include structure of endocrine cells and glands, hormone synthesis and chemistry, physiological effects of hormones, and mechanisms of hormone action. Emphasis is placed on vertebrate systems, but instructive invertebrate systems are also considered. Term paper required.
Prerequisites: BY 256 [Min Grade: C]

BY 626. Evolutionary Medicine. 3 Hours.
An evolutionary approach to issues relating to human health and disease.

BY 628. Instruct Bio Labs: Teaching Techniques. 3 Hours.
Student will assist in instruction of an introductory biology laboratory. Responsibilities will also include preparation of quizzes and practicals and designing and conducting an instructional laboratory exercise.

BY 629. Evolutionary Biology. 3 Hours.
This course introduces the history of evolutionary thought and modern evolutionary theory. Discussions cover (but are not limited to) the history of life, mechanisms of evolutionary change, sexual selection, adaptation, speciation, and molecular evolution. Students will also be introduced to historical and contemporary studies of evolution on a wide variety of topics and organisms. Regular meetings outside of lecture will involve discussions of classic and contemporary research papers in the field.

BY 632. Biological Information Resources. 3 Hours.
The National Center for Biological Information (NCBI) website is a treasure house of information and tools for researchers in all areas of modern Biology. The goal of this course is to provide guidance for students who wish to become familiar with the NCBI website through an online learning experience. They will learn many of the features available at this site and will gain experience using some of the tools. The course will be taught completely online and will consist of 1) Guidelines for navigating through NCBI, 2) Study guide questions for students to answer online, 3) NCBI tutorials with questions to be answered online, 4) Assignments with questions to be answered online, 5) Online exams. Graduate levels require a graduate project.
Prerequisites: BY 123 [Min Grade: C] or BY 124 [Min Grade: C]

BY 633. Advanced Molecular Genetics and Medicine. 3 Hours.
Examination of the molecular genetics of eukaryotic organisms, including genomes, nucleosomes, chromosomes, transcription, splicing, transposition and signal transduction. The role of molecular biology in immune diversity and cell growth will also be studied.

BY 634. Functional Genomics and Systems Biology. 3 Hours.
Systems biology is an inter-disciplinary study underlying complex biological processes as integrated systems of many interacting components. This course will give students a foundation in understanding complex biological interactions at the molecular, network and genomic level. This course will cover state-of-the-art high throughput established and novel approaches used in genome sequencing, transcriptomics, proteomics and metabolomics to obtain, integrate and analyze complex data. The students will also get familiar with knowledge on experimental perturbation of genomes, gene regulatory networks, comparative genomics and evolution, basic bioinformatics. This course will be a combination of text based lectures and discussions of the current literature relevant to Functional Genomics and Systems Biology. Prerequisite: BY210 minimum grade of C.
Prerequisites: BY 210 [Min Grade: C]

BY 636. Biological Processes in Aging. 3 Hours.
The #1 threat to human health – far greater than cancer, heart disease, and Alzheimer's disease combined – is aging. Aging is also a fascinating biological puzzle. Why do we, and virtually every other species, age in the first place? Why can't nature simply maintain the body it built? This course will introduce you to the fascinating process of biological aging, its impact on human and animal life, how it evolved, and the manner in which its biology is investigated, the cellular and molecular process that underlie aging, and how efforts to slow human aging are progressing. We will cover the history of exceptionally long human and animal lives and also delve into current and historical approaches to alter the rate of aging in humans with an emphasis on current promising research areas. In covering this material we will also encounter some of the many colorful scientists who have worked on the problem of aging as well as the past and current frauds and charlatans who are just trying to make a buck off of people's fear of death and disability.
Prerequisites: BY 123 [Min Grade: C] and BY 210 [Min Grade: C]

BY 637. Epigenetics. 3 Hours.
This course provides a survey of the field of epigenetics, introducing the student to the diverse areas of epigenetic research in a variety of eukaryotic systems. The course combines lectures with discussion of primary literature and research talks from invited faculty speakers working in epigenetics. In addition to providing an overview of the field of epigenetics, this course emphasizes working with primary scientific literature and the development of critical reading skills. Additional assignments are required for graduate credit.

BY 640. Immunology. 3 Hours.
Immune system and functions of host humoral and cellular immune responses. Mechanisms of antigen and antibody reactions and basic immunological methods. Term paper required.

BY 642. Experimental Phycology. 4 Hours.
Introduction to algae. Experimental approaches to productivity. Algae as model systems. Independent project required. Concurrent enrollment in BY 642 lab required.

BY 642L. Experimental Phycology Lab. 0 Hours.
Lab must be taken concurrently with BY 642 lecture.

BY 644. Biological Experimental Design and Methods. 3 Hours.
This course focuses on advanced modern experimental design and its use in biological research. Specifically, we will discuss principles of open science and their implications for data management as they apply to commonly used methods in biological research. We will discuss experimental design, the use of appropriate controls, and the interpretations of the results obtained. Methods covered in detail will include for example PCR, DNA sequencing (Sanger and NGS), fluorescent microscopy, and bioinformatics. The class will use a combination of lecture, in-class activities, and discussion sessions, with additional content provided on Canvas.

BY 645. Neuroanatomy. 4 Hours.
This course will provide detailed lecture and laboratory experiences that describe the anatomy of the human brain, spinal cord, and peripheral nervous system. Students will culture rat hippocampal neurons and map the cerebral and cerebellar cortex on preserved human brains. Deep brain structures will be identified and their functional significance explored. Cranial nerves and major peripheral nerves will be described and identified through cadaveric dissections. Normal pathways will be contrasted with examples of abnormalities along with the resulting functional impairments. Graduate credit will be earned through the completion of additional term papers and/or projects.

BY 646. Techniques in Biological Research. 3 Hours.
Concepts and practical application of techniques pertinent to biological research.

BY 647. Contemporary Political Issues in Science. 3 Hours.
Our rapidly changing world faces significant, multi-faceted problems at the nexus of technology and society. The response to these socio-scientific issues will impact the future of the human condition. The scientific process has a role to play in finding timely, effective, and evidence-based solutions. This course showcases science as a dynamic and iterative process that includes collecting and connecting observations, making hypotheses based on the current understanding, and constructing models that are revised as new knowledge is acquired. It emphasizes the role of dialogue and communication in shaping responses to socio-scientific issues.

BY 648. Psychoneuroimmunology. 3 Hours.
Explores communication between neuroendocrine and immune systems.

BY 651. Advanced Plant Biology. 3 Hours.
This course introduces the student to the advanced concepts of plant biology including plant diversity, structure, physiology, metabolism, reproduction, genetics, molecular biology, evolution and ecology. It is targeted to Biology Graduate Students. This class brings together knowledge and methodologies from a number of different disciplines to provide students with an intensive and comprehensive plant curriculum from the molecular to the organismal level.

BY 652. Field Botany for Teachers. 4 Hours.
Principles and techniques of plant identification and classification; consideration of phylogenetic systems. Lectures and field trips. Independent project required.

BY 652L. Field Botany Lab. 0 Hours.
Lab must be taken with BY 652 lecture.

BY 655. Statistics and Modeling for Biologists. 3 Hours.
An introduction to a broad array of statistical and modeling techniques used to analyze and interpret biological data of different kinds. Emphasis will be on the design, application, and interpretation of statistical techniques. R programming will be used through the course. Prior knowledge of statistics and R programming is not required. Lecture, computer-based laboratory, and problem sets.

BY 656. Comparative Vertebrate Anatomy. 4 Hours.
Study of the anatomical systems of vertebrates in an evolutionary and functional context. Covers form, function, development and phylogeny of vertebrates, with overviews of organ systems, and the major adaptive events of vertebrate evolution. Labs complement lectures with dissections of representative species, and surveys of specializations in other forms. Lecture and laboratory.

BY 656L. Comparative Vertebrate Anatomy Lab. 0 Hours.
Comparative Vertebrate Anatomy Lab required with BY 656 lecture.

BY 662. Introductory Neurobiology. 3 Hours.
Introduction to biological basis of nervous system function. Comparative approach applying molecular, cellular, and systems' concepts to nervous system function is used to examine electrical and chemical signaling, neural circuitry, and cellular basis of behavior and neural development. Independent project required.

BY 667. Population Ecology. 3 Hours.
This course covers the structure and dynamics of populations with an emphasis on understanding how reproduction, mortality, and dispersal interact to control fluctuations in population size and structure. Special emphasis will be placed on the use of models to address specific applications in conservation biology and natural resource management. Independent project/paper required. Preqs: BY 570 & graduate stranding or permission of instructor.

BY 668. Ecological Genetics. 3 Hours.
This intensive course will introduce students to the genetic tools of modern population biology – which ones are available, practical, and useful for particular questions – and how these genetic analyses have been applied to a wide variety of ecological topics, including: dispersal, life histories, recruitment, habitat and mate choice, local selection, genetic differentiation, the conservation of biodiversity, and speciation. Importantly, this course is an opportunity to become proficient at applying molecular tools to bolster ecological studies. Time will be spent in lectures and learning practical coding and data analyses. Graduate-level assignments required.

BY 670. Scientific Communication. 3 Hours.
Becoming a professional biologist is challenging and requires mastering a variety of skills. This course complements the biological knowledge graduate students gain from other courses and their thesis research by providing training, experience, and critical feedback in the following areas.

BY 671. Biochemical Adapt Environment. 3 Hours.
Examination of physiological and biochemical adaptations of organisms to physical environment.

BY 673. Biochemical Adaptation to the Environment. 3 Hours.

BY 674. Chemical Ecology. 3 Hours.
Study of chemical interactions between organisms or between organisms and their environment. Topics include chemical signaling between organisms, sensing of the chemical environment, and chemical defenses against predators, pathogens, biofoulers, or competitors. Students will be introduced to these topics in a wide variety of terrestrial and aquatic habitats. Independent project/paper required. Preq: Graduate standing.

BY 675. Comparative Developmental Biology. 3 Hours.
Mechanisms of development with emphasis on comparative biology. Graduate standing.
Prerequisites: BY 210 [Min Grade: D]

BY 677. Design Thinking to Solve Problems through Science Policy. 3 Hours.
This program capstone course includes the application of the basic tools of inquiry into social problems; basic ethical issues in contemporary science; analyzing the problem; analyzing any relevant policies; data validity and reliability; data-gathering techniques; data management; solution(s) generation; disciplinary standards for writing the proposal and reporting findings. Over the course of the semester, students will be exposed to different sectors that overlap science and society (public, private, non-profit).

BY 678. Biology Graduate Seminar. 0 Hours.
Graduate Students in Biology MS Plan I or PhD programs will participate in a series of departmental seminars exposing them to versatile sub-disciplines of Biology as well as various career paths. Departmental seminars are part of an enriching experience that lays the foundation for our students' future professional careers. Attendance will be required.

BY 679. Colloquium in Evidenced Based Teaching. 1 Hour.
This pedagogy based colloquium is designed to prepare the next generation of future STEM faculty members in evidence-based practices. The course will begin with an in-depth discussion related to the Vision and Change in Biology Undergraduate Education: A Call to Action. Specific chapters from this document will be assigned as "Reading Assignments" on a weekly basis. Furthermore, journal article discussions will be included to better understand innovative teaching strategies like active-learning, classroom-response system, inclusive learning environments and initiating team based learning activities.

BY 680. Epigenetics Discussion. 1 Hour.
This course provides the student with an exposure to a wide range of basic epigenetics research topics. It will promote scientific literacy, discussion skills, and critical thinking skills. In addition, students will gain experience developing lectures and providing constructive criticisms to their peers.

BY 681. Colloquium in Physiological Ecology. 1 Hour.
Current research.

BY 682. Colloquium in Immunology. 1 Hour.
Current research.

BY 683. Colloquium in Physiology. 1 Hour.
Current research.

BY 684. Colloquium in Microbial Ecology. 1 Hour.
Current research.

BY 685. Colloquium in Cell Biology. 1 Hour.
Current research.

BY 686. Colloquium in Mammalian Development. 1 Hour.
Current research.

BY 687. Colloquium in Endocrinology. 1 Hour.
Current research.

BY 688. Colloquium in Algal Ecophysiology. 1 Hour.
Current research in specific areas.

BY 689. Colloquium in Genetics. 1 Hour.
Current research.

BY 690. Colloquium in Cellular Physiology. 1 Hour.
Current research in specific areas.

BY 691. Colloquium in Botany. 1 Hour.
Current research developments.

BY 692. Colloquium in Ecology. 1 Hour.
Current research.

BY 693. Colloquium in Embryology. 1 Hour.
Current research.

BY 694. Colloquium in Microbiology. 1 Hour.
Current research in microbial ecology and microbial physiology.

BY 695. Special Topics in Biology I. 1-4 Hour.
This course will consider graduate-level topics from the various disciplines in the biological sciences and the topics will differ each term. Course requirements may include lecture, laboratory, readings, discussion, reporting, and internships or fieldwork, which may be conducted on- or off-campus as well as online. May be taken more than once for credit.

BY 696. Special Topics in Biology II. 1-4 Hour.
This course will consider advanced MS-level topics from the various disciplines in the biological sciences and the topics will differ each term. Course requirements may include lecture, laboratory, readings, discussion, reporting, and internships or fieldwork, which may be conducted on- or off-campus as well as online. May be taken more than once and may be repeated for no more than a total of 8 credits.

BY 697. Investigative Techniques. 1-2 Hour.
Application of modern experimental techniques in solving research problems.

BY 698. Nonthesis Research. 1-12 Hour.
Non-thesis research hours.

BY 699. Thesis Research. 1-10 Hour.
Prerequisite: Admission to candidacy.
Prerequisites: GAC M

BY 718. Colloquium in Biology of Aging. 1 Hour.
The course will focus on readings and interpretation of scientific papers, data, and experimental results relevant to endocrinology and aging. In addition to readings, oral presentations, discussions, and a research proposal are the major components of the course.

BY 732. Biological Information Resources. 3 Hours.
The National Center for Biological Information (NCBI) website is a treasure house of information and tools for researchers in all areas of modern Biology. The goal of this course is to provide guidance for students who wish to become familiar with the NCBI website through an online learning experience. They will learn many of the features available at this site and will gain experience using some of the tools. The course will be taught completely online and will consist of 1) Guidelines for navigating through NCBI, 2) Study guide questions for students to answer online, 3) NCBI tutorials with questions to be answered online, 4) Assignments with questions to be answered online, 5) Online exams. Graduate levels require a graduate project.
Prerequisites: BY 123 [Min Grade: C] or BY 124 [Min Grade: C]

BY 734. Functional Genomics and Systems Biology. 3 Hours.
Systems biology is an inter-disciplinary study underlying complex biological processes as integrated systems of many interacting components. This course will give students a foundation in understanding complex biological interactions at the molecular, network and genomic level. This course will cover state-of-the-art high throughput established and novel approaches used in genome sequencing, transcriptomics, proteomics and metabolomics to obtain, integrate and analyze complex data. The students will also get familiar with knowledge on experimental perturbation of genomes, gene regulatory networks, comparative genomics and evolution, basic bioinformatics. This course will be a combination of text based lectures and discussions of the current literature relevant to Functional Genomics and Systems Biology. Prerequisite: BY210 minimum grade of C.
Prerequisites: BY 210 [Min Grade: C]

BY 736. Biological Processes in Aging. 3 Hours.
The #1 threat to human health – far greater than cancer, heart disease, and Alzheimer's disease combined – is aging. Aging is also a fascinating biological puzzle. Why do we, and virtually every other species, age in the first place? Why can't nature simply maintain the body it built? This course will introduce you to the fascinating process of biological aging, its impact on human and animal life, how it evolved, and the manner in which its biology is investigated, the cellular and molecular process that underlie aging, and how efforts to slow human aging are progressing. We will cover the history of exceptionally long human and animal lives and also delve into current and historical approaches to alter the rate of aging in humans with an emphasis on current promising research areas. In covering this material we will also encounter some of the many colorful scientists who have worked on the problem of aging as well as the past and current frauds and charlatans who are just trying to make a buck off of people's fear of death and disability.
Prerequisites: BY 123 [Min Grade: C] and BY 210 [Min Grade: C]

BY 737. Epigenetics. 3 Hours.
This course provides a survey of the field of epigenetics, introducing the student to the diverse areas of epigenetic research in a variety of eukaryotic systems. The course combines lectures with discussion of primary literature and research talks from invited faculty speakers working in epigenetics. In addition to providing an overview of the field of epigenetics, this course emphasizes working with primary scientific literature and the development of critical reading skills. Additional assignments are required for graduate credit.

BY 746. Tech in Biological Research I. 3 Hours.
Concepts and practical application of techniques pertinent to biological research.

BY 755. Statistics and Modeling for Biologists. 3 Hours.
An introduction to a broad array of statistical and modeling techniques used to analyze and interpret biological data of different kinds. Emphasis will be on the design, application, and interpretation of statistical techniques. R programming will be used through the course. Prior knowledge of statistics and R programming is not required. Lecture, computer-based laboratory, and problem sets.

BY 767. Population Ecology. 3 Hours.
This course covers the structure and dynamics of populations with an emphasis on understanding how reproduction, mortality, and dispersal interact to control fluctuations in population size and structure. Special emphasis will be placed on the use of models to address specific applications in conservation biology and natural resource management. Independent project/paper required. Graduate standing or permission of instructor.

BY 768. Conservation Genetics. 3 Hours.
This intensive course will introduce students to the genetic tools of modern population biology – which ones are available, practical, and useful for particular questions – and how these genetic analyses have been applied to a wide variety of ecological topics, including: dispersal, life histories, recruitment, habitat and mate choice, local selection, genetic differentiation, the conservation of biodiversity, and speciation. Importantly, this course is an opportunity to become proficient at applying molecular tools to bolster ecological studies. Time will be spent in lectures and learning practical coding and data analyses.

BY 770. Scientific Communication. 3 Hours.
Becoming a professional biologist is challenging and requires mastering a variety of skills. This course complements the biological knowledge graduate students gain from other courses and their thesis research by providing training, experience, and critical feedback in the following areas.

BY 780. Epigenetics Discussion. 1 Hour.
This course provides the student with an exposure to a wide range of basic epigenetics research topics. It will promote scientific literacy, discussion skills, and critical thinking skills. In addition, students will gain experience developing lectures and providing constructive criticisms to their peers.

BY 781. Colloquium in Physiological Ecology. 1 Hour.
Current research.

BY 782. Colloquium in Immunology. 1 Hour.
Current research.

BY 783. Colloquium in Physiology. 1 Hour.
Current research.

BY 784. Colloquium in Microbial Ecology. 1 Hour.
Current research.

BY 785. Colloquium in Cell Biology. 1 Hour.
Current research.

BY 786. Colloquium in Mammalian Development. 1 Hour.
Current research.

BY 787. Colloquium in Endocrinology. 1 Hour.
Current research.

BY 788. Colloquium in Algal Ecophysiology. 1 Hour.
Current research in specific areas.

BY 789. Colloquium in Genetics. 1 Hour.
Current research in Genetics.

BY 790. Colloquium in Cellular Physiology. 1 Hour.
Current research in specific areas.

BY 791. Colloquium in Botany. 1 Hour.
Current research developments.

BY 792. Colloquium in Ecology. 1 Hour.
Current research.

BY 793. Colloquium in Embryology. 1 Hour.
Current research.

BY 794. Colloquium in Microbiology. 1 Hour.
Current research in microbial ecology and microbial physiology.

BY 795. Special Topics in Biology I. 1-4 Hour.
This course will consider graduate-level topics from the various disciplines in the biological sciences and the topics will differ each term. Course requirements may include lecture, laboratory, readings, discussion, reporting, and internships or fieldwork, which may be conducted on- or off-campus as well as online. May be taken more than once for credit.

BY 796. Special Topics in Biology II. 1-4 Hour.
This course will consider advanced graduate-level topics from the various disciplines in the biological sciences and the topics will differ each term. Course requirements may include lecture, laboratory, readings, discussion, reporting, and internships or fieldwork, which may be conducted on- or off-campus as well as online. May be taken more than once and may be repeated for no more than a total of 8 credits.

BY 797. Investigative Techniques. 1-2 Hour.
Application of modern experimental techniques in solving research problems.

BY 798. Nondissertation Research. 1-10 Hour.
Non-dissertation research hours.

BY 799. Dissertation Research. 1-10 Hour.
Dissertation research hours. Admission to candidacy required.
Prerequisites: GAC Z

MESC-Marine Environmental Sci Courses

MESC 541. Benthic Community Structure. 4 Hours.
Benthic Comunity Structure.

MESC 550. Marine Plant and Animal Interactions. 2 Hours.
Marine Plant and Animal Interactions.

MESC 595. Phytoplankton Ecology and Physiology. 2 Hours.
Phytoplankton Ecology and Physiology.

MESC 796. Special Topics in Marine Science. 1-6 Hour.