

## Program Overview

Graduate study in biology integrates classroom and field or laboratory experience to help meet the current and future scientific needs of society.

The Biology department offers students opportunities to study in the field or in modern facilities with up-to-date instrumentation and resources, including a DNA-sequencing unit, an integrated microscopy facility, high-speed digital networks and computing centers, a GIS lab, greenhouses, wet labs and extensive plant, animal and paleobotanical collections.

## Application Requirements

The items listed below are required for admission consideration for applicable semesters of entry during the current academic year. Submission instructions, additional details, and changes to admission requirements for semesters other than the current academic year can be found on The Graduate College's website (<http://www.gradcollege.txstate.edu>). International students should view the International Admission Documents page (<http://mycatalog.txstate.edu/graduate/admission-documents/international/>) for additional requirements.

- completed online application
- \$55 nonrefundable application fee
- or
- \$90 nonrefundable application fee for applications with international credentials
- baccalaureate degree in biology or a related field from a regionally accredited university (Non-U.S. degrees must be equivalent to a four-year U.S. Bachelor's degree. In most cases, three-year degrees are not considered. Visit our International FAQs (<https://www.gradcollege.txst.edu/international/faqs.html>) for more information.)
- official transcripts from **each institution** where course credit was granted
- a minimum 3.0 overall GPA or a 3.0 GPA in the last 60 hours of undergraduate course work (plus any completed graduate courses)
- GRE not required
- resume/CV
- statement of purpose describing professional aspirations and rationale for pursuing graduate study in biology
- three letters of recommendation addressing the substance and quality of the student's preparation for graduate study
- mentor communication (intent to mentor letter) from a Biology Department faculty member.

### Approved English Proficiency Exam Scores

Applicants are required to submit an approved English proficiency exam score that meets the minimum program requirements below unless they have earned a bachelor's degree or higher from a regionally accredited U.S. institution or the equivalent from a country on our exempt countries list (<http://www.gradcollege.txstate.edu/international/language.html#waliver>).

- official TOEFL iBT scores required with a 78 overall
- official PTE scores required with a 52 overall

- official IELTS (academic) scores required with a 6.5 overall and minimum individual module scores of 6.0
- official Duolingo scores required with a 110 overall
- official TOEFL Essentials scores required with an 8.5 overall

## Degree Requirements

The Master of Science (M.S.) degree with a major in Biology requires 30 semester credit hours, including a thesis.

## Course Requirements

Code	Title	Hours
<b>Required Courses</b>		
Select one of the following seminar options:		3-4
Option A - Take 3 hours from the following:		
BIO 5110	Seminar in Biology	
BIO 7102	Seminar in Aquatic Resources	
BIO 7120	Population Biology Seminar	
Option B - Take 2 seminar courses from Option A and:		
BIO 5295	Fundamentals of Research	
<b>Electives</b>		
Choose 21 hours of 5000- or 7000-level courses		21
May choose 2 advisor-approved courses outside the department		
<b>Thesis</b>		
BIO 5399A	Thesis	3
Choose a minimum of 3 hours from the following		3
BIO 5199B	Thesis	
BIO 5299B	Thesis	
BIO 5399B	Thesis	
BIO 5599B	Thesis	
BIO 5999B	Thesis	
<b>Total Hours</b>		<b>30-31</b>

## Comprehensive Examination Requirement

All master's students are required to take a final, comprehensive examination. In the Biology Department this exam is administered by the student's committee. Students on academic probation or conditional status are not permitted to take the final, comprehensive examination.

Grading of the final exam is "pass" or "fail." In order to pass, a student must receive votes of confidence from the major professor and a majority of the committee members (including the major professor). A student can be failed over the advisor's positive vote if the majority of the committee votes not to pass. Such outcomes may be appealed to the Graduate Committee, whose decision is final.

For thesis students, the comprehensive examination is oral and is scheduled after the thesis is complete. This examination will normally take the form of a thesis defense and will be immediately preceded by a public presentation of the thesis work. Students should discuss the exam with their committee members beforehand to know their expectations and how best to prepare.

The time and place of the thesis presentation and defense must be announced to the Biology Department and the general public at least two weeks before the actual event. A link for electronic submission of this information is available on the Biology Department web site. It is the

student's responsibility to schedule this exam after receiving permission to proceed from his or her major professor.

The thesis defense is in two stages, a public, 30 to 40-minute presentation of the thesis work followed by a closed examination by the thesis committee. After the presentation, questions from the audience will be entertained, but the actual examination phase will not begin until after the general audience has been excused. The exam performance is graded by the committee as "pass" or "fail." A grade of "pass" means that the thesis requires no or only minor revisions. Under such circumstances, the thesis committee signs the examination report and entrusts oversight of any needed revisions to the major professor. In the event a student fails the exam, the committee may recommend revisions to the thesis and upon the completion of these revisions, a new defense and oral examination; or the committee may require the student to undertake a new thesis under the supervision of the same, or a different, thesis committee; or the committee may recommend the student be dismissed from the Biology graduate program. Only one re-examination is permitted.

If a student elects to follow the thesis option for the degree, a committee to direct the written thesis will be established. The thesis must demonstrate the student's capability for research and independent thought. Preparation of the thesis must be in conformity with the *Graduate College Guide to Preparing and Submitting a Thesis or Dissertation*.

## Thesis Proposal ([http://www.gradcollege.txstate.edu/docs/Thesis\\_Diss\\_Guide.pdf](http://www.gradcollege.txstate.edu/docs/Thesis_Diss_Guide.pdf))

The student must submit an official Thesis Proposal Form (<http://www.gradcollege.txstate.edu/forms.html>) and proposal to his or her thesis committee. Thesis proposals vary by department and discipline. Please see your department for proposal guidelines and requirements. After signing the form and obtaining committee members' signatures, the graduate advisor's signature if required by the program and the department chair's signature, the student must submit the Thesis Proposal Form with one copy of the proposal attached to the dean of The Graduate College for approval before proceeding with research on the thesis. If the thesis research involves human subjects, the student must obtain exemption or approval from the Texas State Institutional Review Board prior to submitting the proposal form to The Graduate College. The IRB approval letter should be included with the proposal form. If the thesis research involves vertebrate animals, the proposal form must include the Texas State IACUC approval code. It is recommended that the thesis proposal form be submitted to the dean of The Graduate College by the end of the student's enrollment in 5399A. Failure to submit the thesis proposal in a timely fashion may result in delayed graduation.

## Thesis Committee

The thesis committee must be composed of a minimum of three approved graduate faculty members.

## Thesis Enrollment and Credit

The completion of a minimum of six hours of thesis enrollment is required. For a student's initial thesis course enrollment, the student will need to register for thesis course number 5399A. After that, the student will enroll in thesis B courses, in each subsequent semester until the thesis is defended with the department and approved by The Graduate College. Preliminary discussions regarding the selection of a topic and

assignment to a research supervisor will not require enrollment for the thesis course.

Students must be enrolled in thesis credits if they are receiving supervision and/or are using university resources related to their thesis work. The number of thesis credit hours students enroll in must reflect the amount of work being done on the thesis that semester. It is the responsibility of the committee chair to ensure that students are making adequate progress toward their degree throughout the thesis process. Failure to register for the thesis course during a term in which supervision is received may result in postponement of graduation. After initial enrollment in 5399A, the student will continue to enroll in a thesis B course as long as it takes to complete the thesis. Thesis projects are by definition original and individualized projects. As such, depending on the topic, methodology, and other factors, some projects may take longer than others to complete. If the thesis requires work beyond the minimum number of thesis credits needed for the degree, the student may enroll in additional thesis credits at the committee chair's discretion. In the rare case when a student has not previously enrolled in thesis and plans to work on and complete the thesis in one term, the student will enroll in both 5399A and 5399B.

The only grades assigned for thesis courses are PR (progress), CR (credit), W (withdrew), and F (failing). If acceptable progress is not being made in a thesis course, the instructor may issue a grade of F. If the student is making acceptable progress, a grade of PR is assigned until the thesis is completed. The minimum number of hours of thesis credit ("CR") will be awarded only after the thesis has been both approved by The Graduate College and released to Alkek Library.

A student who has selected the thesis option must be registered for the thesis course during the term or Summer I (during the summer, the thesis course runs ten weeks for both sessions) in which the degree will be conferred.

## Thesis Deadlines and Approval Process

Thesis deadlines are posted on The Graduate College (<http://www.gradcollege.txstate.edu/>) website under "Current Students." The completed thesis must be submitted to the chair of the thesis committee on or before the deadlines listed on The Graduate College website.

The following must be submitted to The Graduate College by the thesis deadline listed on The Graduate College website:

1. The Thesis Submission Approval Form bearing original (wet) and/or electronic signatures of the student and all committee members.
2. One (1) PDF of the thesis in final form, approved by all committee members, uploaded in the online Vireo submission system.

After the dean of The Graduate College approves the thesis, Alkek Library will harvest the document from the Vireo submission system for publishing in the Digital Collections database (according to the student's embargo selection). **NOTE: MFA Creative Writing theses will have a permanent embargo and will never be published to Digital Collections.**

While original (wet) signatures are preferred, there may be situations as determined by the chair of the committee in which obtaining original signatures is inefficient or has the potential to delay the student's progress. In those situations, the following methods of signing are acceptable:

- signing and faxing the form
- signing, scanning, and emailing the form

- notifying the department in an email from their university's or institution's email account that the committee chair can sign the form on their behalf
- electronically signing the form using the university's licensed signature platform.

If this process results in more than one document with signatures, all documents need to be submitted to The Graduate College together.

No copies are required to be submitted to Alkek Library. However, the library will bind copies submitted that the student wants bound for personal use. Personal copies are not required to be printed on archival quality paper. The student will take the personal copies to Alkek Library and pay the binding fee for personal copies.

Master's level courses in Biology: BIO

## Courses Offered

### Biology (BIO)

#### **BIO 5100. Professional Development.**

This course is seminar-based and covers topics related to teaching, research, and employment responsibilities. Completion of the course is required as a condition of employment for graduate assistants. This course does not earn graduate degree credit. Repeatable with different emphasis. Graded on a credit (CR), no-credit (F) basis.

**1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.**

**Course Attribute(s):** Graduate Assistantship|Exclude from Graduate GPA

**Grade Mode:** Leveling/Assistantships

#### **BIO 5110. Seminar in Biology.**

Interactive discussion of timely issues and problems, designed to expose students to the current literature in their fields of interest and its critical analysis. This course is repeatable for credit.

**1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing|Header

**Grade Mode:** Standard Letter

#### **BIO 5114. Collaborative Research.**

This course allows master's level graduate students to initiate, conduct, and participate in research in collaboration with graduate faculty of the Department of Biology that is in addition to thesis research conducted under BIO 5399A or BIO 5399B. This course recognizes the collaborative nature of scientific investigation. See also BIO 5214 and BIO 5314.

**1 Credit Hour. 1 Lecture Contact Hour. 1 Lab Contact Hour.**

**Grade Mode:** Standard Letter

#### **BIO 5166. Medical Microbiology Laboratory.**

This graduate laboratory-based course will cover pathogenic bacteria emphasizing identification of selected groups of pathogens and the biological basis for virulence. Prerequisites: BIO 2400 and BIO 2450 both with grades of "C" or better.

**1 Credit Hour. 0 Lecture Contact Hours. 1 Lab Contact Hour.**

**Grade Mode:** Standard Letter

#### **BIO 5176. Microbial Biotechnology Laboratory.**

This laboratory-based course will cover use of microbes for biotechnological applications and is designed to provide practical explorations into fields of biotechnology. Topics include laboratory techniques for recombinant protein purification, fermentation, identification of markers in genetically modified food and bio-remediation of pollutants. Corequisite: BIO 5376.

**1 Credit Hour. 0 Lecture Contact Hours. 3 Lab Contact Hours.**

**Grade Mode:** Standard Letter

#### **BIO 5199B. Thesis.**

This course represents a student's continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Cannot be taken unless a Thesis Proposal has been submitted. Students working toward the M.A. or M.S. with a thesis are expected to enroll in thesis each semester in which faculty supervision is received or laboratory facilities are utilized.

**1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.**

**Grade Mode:** Credit/No Credit

#### **BIO 5214. Collaborative Research.**

This course allows master's level graduate students to initiate, conduct, and participate in research in collaboration with graduate faculty of the Department of Biology that is in addition to thesis research conducted under BIO 5399A or BIO 5399B. This course recognizes the collaborative nature of scientific investigation. See also BIO 5314.

**2 Credit Hours. 2 Lecture Contact Hours. 2 Lab Contact Hours.**

**Grade Mode:** Standard Letter

#### **BIO 5295. Fundamentals of Research.**

Designed to acquaint the beginning graduate student with materials and methods of research in the biological sciences. It is recommended that a graduate student take this course the first semester in residence.

**2 Credit Hours. 2 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

#### **BIO 5299B. Thesis.**

This course represents a student's continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Cannot be taken unless a Thesis Proposal has been submitted. Students working toward the M.A. or M.S. with a thesis are expected to enroll in thesis each semester in which faculty supervision is received or laboratory facilities are utilized.

**2 Credit Hours. 2 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Credit/No Credit

#### **BIO 5300. Neurobiology.**

This course presents the biology of the nervous system with emphasis on the human nervous system. Topics presented in lecture include neuroanatomy, cellular neurobiology, neurophysiology, developmental neurobiology, and neuronal plasticity.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 5301. Evolution.**

Basic genetic principles applied to natural selection, adaptation, populations, and speciation. Consideration is given to the origin of life, nature of chromosomal variation, evolution of genetic systems, and certain other selected topics.

**3 Credit Hours. 3 Lecture Contact Hours. 2 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 5304. Wildlife and Recreation: Impact and Management.**

Students will be introduced to the impact human recreational activities have on wildlife habitats and populations. Management practices to enhance human-wildlife encounters or to minimize detrimental effects on wildlife populations will be presented.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 5305. Methods of Nature Study for Teachers.**

This course provides a comprehensive survey of natural events. It includes laboratory and field work emphasizing observation, collection and discovery of relationships. It is creditable only for those seeking elementary or middle school certification and is required for those seeking grade 4-8 Science or Science/Mathematics teaching certification. This course must be taken the semester immediately prior to student teaching.

**3 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 5307. Ecology of Rarity.**

This course will examine the ecology of rarity and its ability to inform public awareness and environmental policy. This course will explore how we define rarity, persistence and viability. Is rarity more or less common than might be expected, and is there anything we can or should do about it?

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Dif Tui- Science & Engineering

**Grade Mode:** Standard Letter

**BIO 5311. Cancer Biology.**

Cancer Biology provides a foundation for understanding the complex molecular, biochemical, and cellular processes associated with cancer development. Topics include the role of tumor suppressor genes, oncogenes, DNA repair, apoptosis, ECM, cell-cycle control, cell signaling pathways, immune function and cancer-causing viruses. Emerging diagnostics and/or therapeutics will also be discussed.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 5314. Collaborative Research.**

This course allows master's level graduate students to initiate, conduct, and participate in research in collaboration with graduate faculty of the Department of Biology that is in addition to thesis research conducted under BIO 5399A or BIO 5399B. This course recognizes the collaborative nature of scientific investigation.

**3 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 5317. Interpretive Biology Programming and Design.**

In this course, students will explore the methods and principles used by the National Park Service, museums, environmental centers, and state park systems to interest a variety of audiences as well as interpret biology and natural environments effectively. Students will practice skills in both personal and non-personal interpretation by creating science outreach programs, interpretive literature, brochures, path waysides, and other interpretive media.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 5319C. Ecotoxicology.**

Topics to be covered include sources, types, and fates of toxicants, organism response to toxicants, toxicant effects at the population, community, and ecosystem levels, and monitoring and risk assessment. Examination of current literature will form the core of the course.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Topics

**Grade Mode:** Standard Letter

**BIO 5319F. Watershed Management Frameworks and Applications.**

Introduction to integrated watershed assessment and management tools for identifying programmatic water quality and quantity issues and their root causes and solutions, and their practical application. The scientific and socio-economic elements are considered within the context of planning and developing watershed protection plans and programs. Prerequisite: Instructor approval.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing|Topics

**Grade Mode:** Standard Letter

**BIO 5324. Natural History and Conservation of Large Mammals.**

This course will introduce students to advanced details of natural history, research, and conservation of large mammals. Topics considered will include natural history, range and population status (historic and current), importance to and interaction with humans, research design and analysis, and the development of conservation and management plans.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 5327. Issues in Irish Biodiversity and Conservation.**

In this course, students will learn about Irish flora and fauna, ecosystems, conservation strategies in areas of high ecological concern, and public involvement. Emphasis will be placed on case studies and service-learning opportunities. Prerequisite: Instructor approval.

**3 Credit Hours. 1 Lecture Contact Hour. 3 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 5328. Field Biology of Ireland.**

In this course, students will use multiple techniques to explore biodiversity across multiple ecosystems in Ireland. Prerequisite: Instructor approval.

**3 Credit Hours. 0 Lecture Contact Hours. 12 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 5329. Raptor Ecology.**

This course will examine the evolution, taxonomy, ecology, behavior, anatomy, physiology, and conservation of birds of prey of the world with emphasis on diurnal raptors, including those from Texas. Field trips will include at least two overnight visits to significant migration and overwintering areas.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 5331. Human Dimensions of Wildlife and Fisheries Conservation.**

Humans play a role in nearly every aspect of wildlife and fisheries conservation. This course will provide students with principles, concepts, and case studies to understand how the human experience (e.g., culture, politics, economics) influences conservation outcomes. Students will also have an opportunity to integrate human dimensions into local decision-making.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 5332. Biology in Film and Television: An Analysis of the Biology in Fiction and Non-Fiction Film and TV.**

This course explores how biology is portrayed in popular motion pictures with an emphasis on analyzing biological accuracy, misconceptions perpetuated or portrayed, and investigating the rationale behind motion picture directors' and writers' decisions about how they portray biological content in the final product. As part of this course students will watch and discuss a curated list of films and television shows and write an analysis of each film or TV episode.

**3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.**

**Grade Mode:** Standard Letter

**BIO 5333. International Studies of Plant Ecology and Conservation.**

This course provides a first-hand understanding of the natural history, biodiversity, ecology, and conservation of plant ecosystems that do not occur in the United States. It is an immersive and intensive study abroad course combining traditional lecture and field-based instruction in the field. Topics covered include plant ecology, natural history, wildlife and human use, anatomy, and field identification. Corequisite: BIO 5334 with a grade of a "C" or better.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 5334. International Studies of Wildlife Ecology and Natural History.**

This course covers wildlife ecology, natural history, behavior, and identification through sight, sound, and sign. There will be field-based experiences viewing wildlife not native to the U.S. as well as identifying behaviors in the field, using wildlife sign including tracks, scat, and evidence of forage to identify mammals and birds, and using situational awareness to understand ecological processes and relationships. Lectures will cover mammalogy, herpetology, and ornithology, including natural history, behavior, ecology, and conservation. Corequisite: BIO 5333 with a grade of a "C" or better.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 5350I. Emerging Infectious Diseases.**

Current topics in the emergence of viral and bacterial diseases in humans. This course will include new diseases, diseases previously seen and increasing in incidence, and diseases not previously seen in this country. This course will be of interest to students who are pursuing advanced degrees and courses in microbiology, biochemistry, and cell and molecular biology.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Topics

**Grade Mode:** Standard Letter

**BIO 5350J. Environmental Physiology of Animals.**

This course is a study of how animals respond physiologically to changes in environmental temperature, moisture, salinity, partial pressure of gases, and toxins. Prerequisites: Instructor approval.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing|Topics

**Grade Mode:** Standard Letter

**BIO 5350K. Genomics.**

The course is a lecture course in modern genomics, including principles of genome function, the human genome, comparative genomics, genome sequencing, evolution and genomic change, databases and medicine, ethical, legal and social issues. The course also includes discussion of transcriptomics, proteomics, metabolomics, directed evolution, protein design, and systems biology.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing|Topics

**Grade Mode:** Standard Letter

**BIO 5350M. Wildlife Policy and Law in North America.**

This course provides the student with a historical and cultural context within which wildlife policy and law (federal treaties, statutes, case law, and regulations) have developed in North America, particularly in the United States. Graduate students will research the development of Wildlife law in representative states as well.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing|Topics

**Grade Mode:** Standard Letter

**BIO 5350O. Tropical Ecology and Conservation.**

Students will obtain a first-hand knowledge of the ecology, biodiversity, conservation, and culture of tropical ecosystems. It is an immersive and intensive study abroad course combining traditional lecture and field-based laboratory instruction in tropical ecosystems.

**3 Credit Hours. 6 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing|Topics

**Grade Mode:** Standard Letter

**BIO 5350Z. Diversity and Cultural Impact of Geoparks.**

Students will explore biological differences in diversity across Geoparks in the United States and Ireland. Additionally, students will study the cultural impact that Geoparks have on the local community and national policy by focusing on differences between science communication strategies and community engagement practices conducted at the parks. Prerequisite: Instructor approval.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing|Topics

**Grade Mode:** Standard Letter

**BIO 5351J. Comparative Immunology.**

While most textbooks would present the immune system of animals as a monolith with little variation between species, we are quickly learning that this is not the case. Indeed animal immune systems are immensely diverse. This class will consist of a taxonomic survey of metazoan immune systems, focusing on the evolutionary causes and ecological consequences of this diversity in immune systems across animals.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing|Topics

**Grade Mode:** Standard Letter

**BIO 5356. Plant Physiology.**

Basic principles of plant physiology are studied in lecture and laboratory. Previous courses in biochemistry and genetics are strongly recommended.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 5363. History of Medicine.**

This course covers significant concepts, developments, individuals, and events in the history of medicine from antiquity to modern day. Topics include the impact of disease on medical practice, the development of hospitals as sites for care, teaching, and research, how medical science and technology are continuously defined by social, cultural, and political ideas, and the historical roots of several themes in medical ethics. This course will be delivered as an Education Abroad course.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Standard Letter

**BIO 5364. Explorations in Physiology.**

This course will cover the basic principles of physiological systems and the function of organ systems with an emphasis on humans and other mammals. The focus will be on the interplay between and among multiple organ systems and holistic systems integration. Other topics include the pathophysiology underlying common diseases, drug therapies and treatments, and emerging physiological research. This course will also provide the opportunity for experiential learning gained in diverse cultural settings.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Exclude from 3-peat Processing

**Grade Mode:** Standard Letter

**BIO 5366. Medical Microbiology.**

This lecture-based course will cover pathogenic bacteria and their relationship to disease, emphasizing critical evaluation of research literature, disease transmission and the biological basis for virulence. Prerequisites: BIO 2400 and BIO 2450 both with grades of "C" or better.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 5374. Principles of Zoo Management.**

This course is designed to introduce the principles of captive animal management within conservation and education-based zoos. Zoo management requires a broad understanding of the life history and biological needs of many different species; we will explore the ways modern zoos address these needs and the ways in which future zoos could address them more effectively. Specific topics will include animal husbandry, welfare, nutrition, and behavior as well as environmental enrichment, captive breeding, conservation, zoo regulatory frameworks, ethical concerns, and zoo careers.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 5376. Microbial Biotechnology.**

This course provides an overview of how microbes (e.g., bacteria, viruses and yeast) are manipulated to solve practical problems through biotechnology. This course design is based on topics of applied microbiology as recommended by American society of Microbiology.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 5377. Genome Informatics.**

The course will cover basic knowledge on genomics and its bioinformatics tools. Students will learn current topics on genomics and bioinformatics, and will analyze genomic data using statistical software. All the analyses will be performed using a personal and a cluster computer.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 5388. Habitat Ecology.**

The course will emphasize and reinforce in students an appreciation for the importance of habitat in understanding a wide range of processes and patterns in Ecology. Course will explore the process of habitat selection, in the context of animal behavior, population dynamics, and modeling. Students will learn and apply methods and techniques of statistically analyzing the habitat associations of species. The central role of habitat in species conservation will also be discussed.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 5390. Problems in the Biological Sciences.**

Open to graduate students on an individual basis by arrangement with the faculty member concerned.

**3 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 5399A. Thesis.**

This course represents a student's initial thesis enrollment. No thesis credit is awarded until student has completed the thesis in BIO 5399B. Students working toward the M.A. or M.S. with a thesis are expected to enroll in thesis each semester in which faculty supervision is received or laboratory facilities are used.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Credit/No Credit

**BIO 5399B. Thesis.**

This course represents a student's continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Cannot be taken unless a Thesis Proposal has been submitted. Students working toward the M.A. or M.S. with a thesis are expected to enroll in thesis each semester in which faculty supervision is received or laboratory facilities are utilized.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Credit/No Credit

**BIO 5400. Plants Important for Wildlife.**

This course explores plant and plant part (specifically gall, fruit, seed, and twig) identification, phylogenetics, co-evolution of plant defenses, economic and ecological impacts of plant uses by wildlife.

**4 Credit Hours. 3 Lecture Contact Hours. 2 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 5402. Earth Science I.**

A study of astronomy and meteorology through observation, description, and interpretation of earth phenomena. Includes field observations, methods of measurement and interpretation of data related to the physical environment and space technology. Requires independent scientific and science education research and presentation of findings in a professional context.

**4 Credit Hours. 3 Lecture Contact Hours. 4 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 5403. Earth Science II.**

The description and interpretation of earth phenomena considered from the standpoint of geology and oceanography. Includes field observations, methods of sampling and interpretation of data related to the physical environment. Requires independent scientific and science education research and presentation of findings in a professional context.

**4 Credit Hours. 3 Lecture Contact Hours. 4 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 5408. Science Processes and Research.**

Students will analyze scientific research design, design research, interpret data, and communicate results. Stress will be placed on broad-field structure and integration of major science concepts and research-based science pedagogy. This course must be taken the semester prior to student teaching and is required for those seeking 7-12 Life Science or Science teacher certification. This course may not count as one of the four upper-level Biology courses required of general Biology majors, or one of the three upper-level Biology courses required of Biology minors.

**4 Credit Hours. 3 Lecture Contact Hours. 4 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 5410. Field Biology of Plants.**

Ecological relationships and natural history of plants, including historical geology, geography, soils, and vegetational regions of Central Texas.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 5411. Morphology of the Vascular Plants.**

A phylogenetic survey of living and fossil vascular plants that focuses on external morphology and reproductive biology. Topics include phylogenetic reconstruction, the origin of vascular plants, seed reproduction, and the origin of angiosperms. Emphasis is on broad-scale evolutionary patterns and origin of major taxonomic groups.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 5412. Plant Anatomy.**

A descriptive and functional analysis of seed plants that focuses on internal structure. Topics include recognition and characterization of plant tissues, the structure of plant organs, and organ development. Emphasis is on pattern of tissue organization common to all seed plants and the functional basis for anatomical structure.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 5413. Parasitology.**

The biology and biological significance of the common parasites of man and animals.

**4 Credit Hours. 3 Lecture Contact Hours. 4 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 5415. Ichthyology.**

An introduction to the morphology, taxonomy, natural history, and evolution of fishes. Field trips will be made to collect specimens, and laboratory periods will be devoted to morphological and systematic analyses.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 5418. Field Ornithology.**

This course is designed to introduce and provide an advanced knowledge of the application of various field, laboratory, and statistical methods and techniques in the study of avian species. The course will include topics related to survey methodology, sampling design, marking/banding, measurement/sample extraction, and aging/sexing of avian species.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 5420. Natural History of the Vertebrates.**

Environmental relationships and natural history of vertebrates. Emphasis is on evolution taxonomy, speciation, behavior, and morphology. Laboratory will include field trips for the study and collection of vertebrates in their natural habitats. Students will assemble a representative collection of vertebrates.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 5421. Ornithology.**

Introduction to anatomy, behavior, ecology, and identification of the birds of Texas. Laboratory will emphasize field studies of birds and their habitat requirements.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 5422. Mammalogy.**

The taxonomy, distribution, ecology, behavior, and evolution of mammals with particular emphasis on wild mammals of the Southwest. Laboratory will emphasize anatomy, identification, preparation of specimens, and field exercises in methods of population analysis. Students may assemble representative mammal collection.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 5423. Wildlife Management.**

Application of ecological principles and natural history concepts to the management of wildlife habitats and populations. Laboratory will involve demonstrations and practice exercises with wildlife management techniques and instrumentation, and field trips to observe wildlife management projects.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 5424D. Vertebrate Endocrinology.**

This course teaches function and organization of the endocrine system. It describes the major endocrine glands, the synthesis and release of their hormone products, and the interaction with target tissues. Endocrine control of digestion, growth, reproduction, and homeostasis will be compared between mammals and other vertebrate groups.

**4 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.**

**Course Attribute(s):** Exclude from 3-peat Processing|Topics

**Grade Mode:** Standard Letter

**BIO 5432. Microbial Genomics.**

The course will offer hands-on training on contemporary approaches, techniques, and bioinformatic tools used to study microbial genomes. Topics covered include: sequencing, genome assembly and annotation, amplicon analysis, metagenomics, and metatranscriptomics, all with a strong emphasis on genomic data handling and analytics. At the end of this course, students will be familiar with bioinformatics tools used to analyze genes and genomes.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 5435. Techniques in Wildlife Management.**

The basic methodology of practical wildlife management. This involves techniques in monitoring and data collection related to population dynamics and habitat parameters of wildlife species as well as field research.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 5436. Tropical Biology.**

This course entails an analysis and evaluation of the governing principles of tropical ecosystems, including wildlife ecologies, geological processes, and environmental-cultural interactions. In the laboratories, students will compare ecological relationships that influence tropical biology, discuss peer-reviewed literature and examine tropical flora and fauna during field trips to regional sub-tropical areas.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 5441. Cellular Physiology.**

Advanced cellular biology, including membrane physiology, thermodynamics, energy transduction and distribution, and cellular movement in non-muscle and muscle cells. Laboratory includes discussion of current research and exercises in cellular physiology.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 5443. Fish Physiology.**

This course examines the primary physiological functions in fish including how fish sense and interact with the environment, maintain their energetic metabolism (respiration, digestion and excretion), reproduce and maintain water balance. Students will learn about the diverse adaptations fish use to cope with environmental and physiological challenges.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 5448. Bacterial Genetics.**

This course will cover concepts and mechanisms involved in the genetics of Archaea and Bacteria. Graduate students will learn current strategies dealing with traditional molecular genetics including post-transcriptional regulation involving small non-coding RNA. In addition graduate students will also write a critical review on a research article from relevant topic.

**4 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.**

**Grade Mode:** Standard Letter

**BIO 5454. Plant Ecology.**

Functional ecology of terrestrial plants, plant populations, and communities. Laboratory emphasizes quantitative and experimental approaches to plant ecology and the use of field and laboratory physiology equipment.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 5465. General Entomology.**

Principles of morphology, physiology, and taxonomy of insects. Laboratory time will be devoted to a taxonomic study of the common orders and families of insects.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 5466. Phylogenetic Methods.**

Reconstructing phylogenies is important in most fields of biology. Course emphasis is on practical data collection, management, and analysis. Laboratory exercises will introduce phylogenetic and DNA analysis software, and WWW resources. Students will learn how to address questions in their own research using phylogenetic methodologies.

**4 Credit Hours. 2 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 5470. Limnology.**

Physical, chemical, and biological factors affecting productivity in lakes, ponds, and streams. Limnology sampling methods, chemical and biological analysis of samples, and hydrographic surveying are included in the laboratory.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 5472. Animal Behavior.**

This course presents all the major facets of the study of animal behavior, giving special attention to its evolution and ecological significance. We will discuss major conceptual models guiding past and present research in the field. Laboratories will emphasize experimental techniques and statistical analysis.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 5480. Cytology and Micro-technique.**

Study of cellular ultra-structure and electron micro technique. Lecture portion of course will cover cytology of all cell types and theoretical aspects of light microscopy and electron microscopy. Laboratory portion will train students to proficiency in microscopy.

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Course Attribute(s):** Lab Required

**Grade Mode:** Standard Letter

**BIO 5481. Internship in Biological Laboratory Technologies.**

The student will participate in the work of a selected biology unit (private, commercial, or governmental). A research paper reporting the internship experience conducted at the biological unit under the supervision of a faculty member will be required. This course may be credited toward a biology major with prior approval of the graduate advisor and department chair.

**4 Credit Hours. 0 Lecture Contact Hours. 15 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 5490. Principles of Developmental Biology.**

This course will cover basic principles of developmental biology in both plant and animal systems. The course will mainly address cell, molecular and genetic mechanisms underlying the development of model organisms, mainly focusing on *Drosophila* (animal) and *Arabidopsis* (plant).

**4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**BIO 5599B. Thesis.**

This course represents a student's continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Cannot be taken unless a Thesis Proposal has been submitted. Students working toward the M.A. or M.S. with a thesis are expected to enroll in thesis each semester in which faculty supervision is received or laboratory facilities are utilized.

**5 Credit Hours. 5 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Credit/No Credit

**BIO 5999B. Thesis.**

This course represents a student's continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Cannot be taken unless a Thesis Proposal has been submitted. Students working toward the M.A. or M.S. with a thesis are expected to enroll in thesis each semester in which faculty supervision is received or laboratory facilities are utilized.

**9 Credit Hours. 9 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Credit/No Credit