

MASTER OF SCIENCE (M.S.) MAJOR IN AQUATIC RESOURCES (AQUATIC BIOLOGY CONCENTRATION)

Major Program

The Master of Science (M.S.) degree with a major in Aquatic Resources is a thesis-based degree that emphasizes research in Aquatic Ecosystems and the biological communities that they support.

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 review the International Admission Documents webpage (<http://mycatalog.txstate.edu/graduate/admission-documents/international>) for additional requirements.

- completed online ApplyTexas application
- \$40 nonrefundable application fee
- \$50 nonrefundable international evaluation fee (if applicable)
- baccalaureate degree in biology or a related field from a regionally accredited university
- official transcripts required from **each institution** where course credit was granted
- minimum 3.0 GPA in your last 60 hours of undergraduate course work (plus any completed graduate courses)
- official GRE scores required, preferably in the 50th percentile in both the verbal and quantitative sections
- mentor communication (intent to mentor letter) sent directly from a Biology Department faculty member.
- resume/CV
- statement of purpose describing professional aspirations and rationale for pursuing graduate study
- three letters of recommendation addressing the substance and quality of the student's preparation for graduate study

TOEFL or IELTS Scores

Non-native English speakers who do not qualify for an English proficiency waiver:

- official TOEFL iBT scores required with a 78 overall
- official IELTS (academic) scores required with a 6.5 overall and
 - minimum individual module scores of 6.0

This program does **not** offer admission if the scores above are not met.

Degree Requirements

The Master of Science (M.S.) degree with a major in Aquatic Resources concentration in Aquatic Biology requires 31 semester credit hours, including a thesis. All elective course work should be chosen in

consultation with the thesis advisor, thesis committee, and program director to fulfill the requirements for the degree. Students who do not have the appropriate background course work may be required to complete leveling courses.

Course Requirements

Code	Title	Hours
Required Courses		
BIO 5110	Seminar in Biology (Taken twice)	2
BIO 7405	Statistics and Experimental Design I	4
BIO 7406	Statistics and Experimental Design II	4
Concentration		
Choose 7 hours from the following:		7
BIO 5415	Ichthyology	
BIO 5419	Stream Ecology	
BIO 5470	Limnology	
BIO 7328	Integrated Waterbird Management	
BIO 7356	Pollution of Aquatic Ecosystems	
BIO 7422	Wetlands Ecology	
BIO 7471	Reservoir Ecology	
Free Electives		
Choose 8 hours of advisor-approved electives		8
Thesis		
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	
Total Hours		31

Comprehensive Examination Requirements

All candidates for graduate degrees must pass one or more comprehensive examinations.

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)

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 all with a grade 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. Prerequisites: PHYS 1420 and PHYS 1430 or consent of instructor.

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. Prerequisite: Undergraduate genetics course or its equivalent.

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. Prerequisites: BIO 1330/BIO 1130 and BIO 1331/BIO 1131 or BIO 1320 and BIO 1421.

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 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 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 5319D. 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 two or more weekend day trips, and two overnight weekend trips.

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 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): Topics

Grade Mode: Standard Letter

BIO 5319G. Omics Approach to Microbiology.

The course will discuss contemporary approaches, techniques and bioinformatic tools used to study function and ecology in microbial communities. Topics covered will include microbiome, next-generation sequencing, metaproteomics, and their applications to clinical, agricultural, environmental and industrial needs.

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

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: Student must be accepted into the Texas State in Ireland Study Abroad Program.

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: Must be accepted into the Texas State in Ireland Study Abroad Program.

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

Grade Mode: Standard Letter

BIO 5335. Fisheries Management.

An introduction to principles and techniques in fisheries management. Includes the study of artificial reproduction, carrying capacity, productivity, sampling procedures, population estimates, mortality, survival growth rates, and commercial and sport fisheries. (Spring, even years). Prerequisite: Ichthyology course or consent of instructor.

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

Course Attribute(s): Lab Required

Grade Mode: Standard Letter

Course Fee: \$20; Fee - Lab BIO

BIO 5350G. Medical Microbiology.

This lecture-based course will cover pathogenic bacteria and their ability to cause disease, emphasizing the biological basis for virulence, and research strategies for investigating infectious diseases. Prerequisite: BIO 2400 or equivalent. Students may take only one of BIO 5350G or BIO 5445 for credit.

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

Course Attribute(s): Topics

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. Permission of instructor is required.

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 5350L. Graduate 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 epigenetics and post-transcriptional regulation involving small non-coding RNA.

3 Credit Hours. 3 Lecture Contact Hours. 3 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 5350P. Tropical Ecology and Conservation Lab.

This laboratory course complements the lecture course BIO 5350O, in which 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. Corequisite: BIO 5350O.

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

Co-requisite(s): BIO 5350O

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

Grade Mode: Standard Letter

BIO 5350Q. Biological Oceanography.

Students will be introduced to the principles of oceanography and will understand anthropogenic impacts on the oceans. Topics to be investigated will include: ocean formation and destruction, sediments, ocean circulation, waves, tides, estuaries, life in the oceans, hydrothermal vents, coral reefs, fisheries, marine pollution, and climate change.

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 5350R. 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 is designed on topics of applied microbiology recommended by American society of Microbiology.

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 5350T. Field Biology of Ireland.

In this course, students will use multiple techniques to explore biodiversity across multiple ecosystems in Ireland. Must be accepted into the Texas State in Ireland Study Abroad Program.

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

Course Attribute(s): Topics

Grade Mode: Standard Letter

BIO 5350U. 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): Exclude from 3-peat Processing|Topics

Grade Mode: Standard Letter

BIO 5350X. 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: Student must be accepted into the Texas State in Ireland Study Abroad Program. Corequisite: BIO 5350T.

3 Credit Hours. 1 Lecture Contact Hour. 3 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: Accepted into the summer Texas State Study Abroad program in Ireland.

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 5362. Environmental Impact Analysis.

Current government regulations regarding environmental impact, content of environmental impact statements, how to proceed with an impact study, application of ecological principles to impact studies, and steps in the review process for environmental impact statements are considered. (Spring, odd years). Prerequisite: Consent of instructor.

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

Course Attribute(s): Lab Required

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 all with a grade of "C" or better.

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 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

Course Fee: \$20; Fee - Lab BIO

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

Course Fee: \$25; Fee - Lab BIO

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

Course Fee: \$25; Fee - Lab BIO

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

Course Fee: \$25; Fee - Lab BIO

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

Course Fee: \$20; Fee - Lab BIO

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. Prerequisites: Biology undergraduate botany course and General Chemistry I and II, or consent of instructor.

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

Course Attribute(s): Lab Required

Grade Mode: Standard Letter

Course Fee: \$20; Fee - Lab BIO

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. Prerequisites: Biology undergraduate botany course, and General Chemistry I and II, or consent of instructor.

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

Course Attribute(s): Lab Required

Grade Mode: Standard Letter

Course Fee: \$20; Fee - Lab BIO

BIO 5413. Parasitology.

The biology and biological significance of the common parasites of man and animals. Prerequisite: Biology undergraduate zoology course or consent of instructor.

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

Course Attribute(s): Lab Required

Grade Mode: Standard Letter

Course Fee: \$20; Fee - Lab BIO

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. Prerequisite: Biology undergraduate zoology course or consent of instructor.

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

Course Attribute(s): Lab Required

Grade Mode: Standard Letter

Course Fee: \$20; Fee - Lab BIO

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 5419. Stream Ecology.

Class covers ecological theories, concepts, and processes occurring at the population, community, and ecosystem levels of organization in running water. Lab includes sampling methods, description and comparative studies, experiments, critical discussion of literature and experience in writing manuscripts. Prerequisite: Consent of instructor.

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

Course Fee: \$20; Fee - Lab BIO

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

Course Fee: \$20; Fee - Lab BIO

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

Course Fee: \$20; Fee - Lab BIO

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

Course Fee: \$20; Fee - Lab BIO

BIO 5424C. 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.

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

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 5426. Immunology.

A study of the immune response, antigen/antibody reactions, major histocompatibility complex, and immunopathology. Prerequisite: Biology undergraduate cellular biology course or BIO 3442 and organic chemistry, or consent of instructor.

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

Course Attribute(s): Lab Required

Grade Mode: Standard Letter

Course Fee: \$20; Fee - Lab BIO

BIO 5434. Herpetology.

A course treating the origin and evolution of amphibians and reptiles; their reproductive and physiological tactics; taxonomy/systematics; and population biology. Emphasis will be placed on North American species and those groups inhabiting Texas.

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

Course Attribute(s): Lab Required

Grade Mode: Standard Letter

Course Fee: \$20; Fee - Lab BIO

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

Course Fee: \$20; Fee - Lab BIO

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. Prerequisites: Cell biology, organic chemistry, or consent of instructor.

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

Course Attribute(s): Lab Required

Grade Mode: Standard Letter

Course Fee: \$20; Fee - Lab BIO

BIO 5442. Experimental Techniques.

Use of methods and instruments applicable to biological investigations, including colorimetry, UV-spectrophotometry, fluorescence, flame and atomic absorption spectrophotometry, paper, gas, gel filtration and ion exchange chromatography, radioactive counting, and electrophoresis.

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

Course Attribute(s): Lab Required

Grade Mode: Standard Letter

Course Fee: \$20; Fee - Lab BIO

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 5450. Physiological Ecology of Animals.

Course brings together the principle concepts of environmental physiology of animals. The biological problems associated with living in various ecological realms will be discussed, and the biochemical and physiological adaptations of animals to their diverse habitats will be studied. Prerequisites: Organic chemistry or consent of instructor.

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

Course Attribute(s): Lab Required

Grade Mode: Standard Letter

Course Fee: \$20; Fee - Lab BIO

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. Prerequisites: Undergraduate ecology course, undergraduate plant physiology course, and an undergraduate cellular biology course, or consent of the instructor.

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

Course Attribute(s): Lab Required

Grade Mode: Standard Letter

Course Fee: \$20; Fee - Lab BIO

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. Prerequisite: Biology undergraduate zoology course or consent of instructor.

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

Course Attribute(s): Lab Required

Grade Mode: Standard Letter

Course Fee: \$20; Fee - Lab BIO

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.

Prerequisite: Genetics course or consent of instructor.

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. Prerequisite: One year of chemistry, or consent of instructor.

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

Course Attribute(s): Lab Required

Grade Mode: Standard Letter

Course Fee: \$20; Fee - Lab BIO

BIO 5471. Reservoir Ecology.

Study of the physical, geological, chemical, and biological factors that influence and make up reservoir ecosystems. Prerequisites: Limnology course or consent of instructor.

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. Prerequisites: One course in statistics, or consent of instructor.

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

Course Attribute(s): Lab Required

Grade Mode: Standard Letter

Course Fee: \$30; Fee - Lab BIO

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

Course Fee: \$20; Fee - Lab BIO

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 5485. Scanning Electron Microscopy.

A course on theory of operation and practical use of the scanning electron microscope as applied to biological materials. The course includes aspects of specimen preparation, photomicroscopy, micrograph interpretation, and microscope maintenance procedures. The course will provide the student training necessary to independently do scanning electron microscopy.

4 Credit Hours. 2 Lecture Contact Hours. 6 Lab Contact Hours.

Course Attribute(s): Lab Required

Grade Mode: Standard Letter

Course Fee: \$20; Fee - Lab BIO

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