

# Department of Biology

**George Murphy, Chair**  
**Davis Science Building 128**

The Department of Biology offers the Master of Science as well as a minor at the graduate level. Required application materials include official transcripts, Graduate Record Examination (GRE) scores, three letters of recommendation, and a personal statement. The personal statement should outline the student's interest in graduate study and indicate a potential area of research interest and thesis advisor. Students receiving unconditional admission typically will have a 3.0 overall (in biology coursework) undergraduate grade point average and overall GRE scores above 1000, with minimum scores of 450 on both the verbal and quantitative sections.

While applications for admission are accepted year-round, preference for admission will be given to students adhering to the following deadlines: Summer/Fall enrollment, March 1; Spring enrollment, October 1. All application materials, either for admission or for a graduate teaching assistantship, should be forwarded directly to the College of Graduate Studies.

The department offers courses in three interdisciplinary Ph.D. programs: Molecular Biosciences (page 164), Computational Sciences (page 83), and Mathematics and Science Education (page 162).

The department also offers courses in the Master of Science in Professional Science degree. Complete information on the Professional Science program and its concentrations in Biotechnology, Biostatistics, and Health Care Informatics can be found on page 177.

## Requirements for the Master of Science

Candidate must

1. have an undergraduate minor (19 hours) in biology or its equivalent and 12 hours of chemistry (including one semester of organic chemistry or biochemistry).
2. complete a minimum of 30 semester hours including at least 21 hours at the 6000 level.
3. pursue a major of at least 16 semester hours which includes

BIOL 6620	Biological Research
BIOL 6640	Thesis Research
BIOL 6650	Seminar
BIOL 6660	Seminar

Students are expected to complete both seminars during the first year of graduate study. Additional courses to meet the 30-hour requirement may include approved graduate courses in biology, chemistry, mathematics, physics, or other related disciplines. A minor is optional, but if elected, must include a minimum of 12 semester hours.

4. complete 6 semester hours of approved research tools or two semesters (6 hours) of a foreign language in addition to the 30 hours.
5. complete BIOL 6620, Biological Research, and submit a Research and Thesis Approval Form and a copy of the research proposal to the graduate coordinator before the end of the second semester of study.
6. file a degree plan with the College of Graduate Studies prior to the completion of 21 credit hours.
7. successfully complete both written and oral comprehensive examinations (may be taken no more than twice) the semester before the semester of graduation.
8. present and successfully defend the thesis in a public forum.

## Courses in Biology [BIOL]

**5010 Embryology.** Four credits. Prerequisites: BIOL 1110/1111 and 1120/1121. Corequisite: BIOL 5011. Early development of the frog, chick, pig, and human. Living material, whole mounts, and serial sections used for the study of cleavage, germ layer formation, histogenesis, and organogenesis. Three lectures and one three-hour laboratory.

**5011 Embryology Lab.** Zero credits. Corequisite: BIOL 5010.

**5020 Comparative Anatomy of the Vertebrates.** Four credits. Prerequisites: BIOL 1110/1111 and 1120/1121. Corequisite: BIOL 5021. Vertebrate morphology and the development and function of systems and organs. Three lectures and one three-hour laboratory.

**5021 Comparative Anatomy of the Vertebrates Lab.** Zero credits. Corequisite: BIOL 5020.

**5030 Nonflowering Plants.** Four credits. Prerequisites: BIOL 1110/1111 and 1120/1121. Structure, physiology, methods of reproduction, and classification of the algae, fungi, liverworts, mosses, and ferns. Six hours lecture/laboratory.

**5040 General Entomology.** Three credits. Prerequisites: BIOL 1110/1111 and 1120/1121. Structure, classification, evolution, importance, and life history of insects. Five hours lecture/laboratory.

**5050 Parasitology.** Three credits. Prerequisites: BIOL 1110/1111 and 1120/1121. Corequisite: BIOL 5051. Life histories, host-parasite relationships, and control measures of the more common parasites of humans and domesticated animals. Two lectures and one three-hour laboratory.

**5051 Parasitology Lab.** Zero credits. Corequisite: BIOL 5050.

**5100 History and Philosophy of Biology.** Three credits. Prerequisites: BIOL 1110/1111 and 1120/1121. Development of biology; the philosophy, ideas, and contributions of outstanding biologists. Three lectures.

**5120 Flowering Plants.** Four credits. Prerequisites: BIOL 1110/1111 and 1120/1121. Structure and classification of seed plants and a survey of local flora. Six hours lecture/laboratory.

**5130 Histology.** Four credits. Prerequisites: BIOL 3250/3251; CHEM

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2030/2031 or 3010/3011. Corequisite: BIOL 5131. Microscopic anatomy of vertebrate cells, tissues, and organs. Three lectures and one three-hour laboratory.

**5131 Histology Lab.** Zero credits. Corequisite: BIOL 5130.

**5140 Invertebrate Zoology.** Four credits. Prerequisites: BIOL 1110/1111 and 1120/1121. Corequisite: BIOL 5141. Structure, functions, life histories, and economic importance of the invertebrate phyla. Laboratory work comprises detailed studies of representative specimens. Three lectures and one three-hour laboratory.

**5141 Invertebrate Zoology Lab.** Zero credits. Corequisite: BIOL 5140.

**5170 Endocrinology.** Three credits. Prerequisites: BIOL 3250/3251, 4110/4111, or 2020/2021; CHEM 2030/2031 or 3010/3011. Structure, function, and integrative mechanisms of vertebrate endocrine organs, with additional attention to invertebrate hormones. Three lectures.

**5180 Vertebrate Zoology.** Four credits. Prerequisites: BIOL 1110/1111 and 1120/1121. Corequisite: BIOL 5181. Structure, life history, and classification of fish, amphibians, reptiles, birds, and mammals. Local representatives emphasized. Three lectures and one three-hour laboratory.

**5181 Vertebrate Zoology Lab.** Zero credits. Corequisite: BIOL 5180.

**5220 Ichthyology.** Four credits. Prerequisites: BIOL 1110/1111 and 1120/1121. Corequisite: BIOL 5221. The morphology, physiology, taxonomy, and ecology of fishes. Three lectures and one three-hour laboratory.

**5221 Ichthyology Lab.** Zero credits. Corequisite: BIOL 5220.

**5250 Limnology.** Four credits. Prerequisites: BIOL 1110/1111, 1120/1121; CHEM 1110/1111. Corequisite: BIOL 5251. Biological, chemical, and physical aspects of lakes and streams. Not open to students who have had Aquatic Ecology. Three lectures and one three-hour laboratory.

**5251 Limnology Lab.** Zero credits. Corequisite: BIOL 5250.

**5260 Nature Study.** Three credits. Prerequisites: BIOL 1110/1111 and 1120/1121. Identification of local plants and animals and a consideration of the ecological principles governing them. Four hours lecture/laboratory.

**5320 Seminar: Advancements in Biology.** Two credits. A broad overview of biological principles and recent research developments. Two lectures.

**5330- Biome Analysis.** One to four credits. Prerequisite: Permission of department. An intensive classroom and on-site study of a specific biome with special emphasis on data collection and analysis. Consult department head for specific credits and costs.

**5331 Biome Analysis - Cedar Glade**

**5332 Biome Analysis - Marine**

**5333 Biome Analysis - Desert**

**5390 Ethology.** Four credits. Prerequisite: BIOL 1110/1111. Corequisite: BIOL 5391. Innate and learned animal behavior in primitive and advanced animals including behavior associated with space, reproduction, and food getting. Three lectures and one three-hour laboratory.

**5391 Ethology Lab.** Zero credits. Corequisite: BIOL 5390.

**5460 Human Genetics.** Three credits. Prerequisite: BIOL 3250/3251. Corequisite: BIOL 5461. Application of the fundamental laws of inheritance to humans. Two lectures and one two-hour laboratory.

**5461 Human Genetics Lab.** Zero credits. Corequisite: BIOL 5460.

**5500 Plant Physiology.** Four credits. Prerequisites: BIOL 3250/3251; CHEM 2030/2031 or 3010/3011. Plant growth; development and metabolism at the cellular and whole plant levels. Six hours lecture/laboratory.

**5510 Food/Industrial Microbiology.** Four credits. Prerequisite: BIOL 2230/2231. The interaction between microorganisms and food and industrial processes of importance to humans. Six hours lecture/laboratory.

**5520 Plant Anatomy.** Four credits. Prerequisite: BIOL 1120/1121. Plant cells, tissues, and organs. Emphasis on the survival value of the plant's various structural features. Six hours lecture/laboratory.

**5540 Topics in Environmental Education.** One to four credits. Prerequisite: Junior standing or above. An intensive classroom and field study of natural science and resources in Tennessee. Special emphasis on data collection, analysis, and problem solving. Target groups are graduate students and upper-division undergraduates in the areas of biology and education. Consult the department chair for specific credits and costs. This course will not apply to the biology major or minor.

**5550 Biotechnology.** Three credits. Prerequisites: BIOL 2230/2231 and senior/graduate level. Instruction in both theory and application of current research methodologies in biology and molecular biology. Topics included immunochemistry, polymerase chain reaction, restriction enzyme analysis, and electrophoresis. Five hours lecture/laboratory.

**5560 Neurobiology.** Four credits. Prerequisites: BIOL 1110/1111 and 1120/1121. Corequisite: BIOL 5561. Introduces comparative neurobiology. Topics include the basic structure and function of the nerve cell and organization of nervous systems of representative species of invertebrate and vertebrate animals. Three hours lecture and one three-hour laboratory.

**5561 Neurobiology Lab.** Zero credits. Corequisite: BIOL 5560.

**5570 Principles of Toxicology.** Three credits. Prerequisites: BIOL 1110/1111, 1120/1121; CHEM 1110/1111, 1120/1121, 3010/3011. Corequisite: BIOL 5571. Adverse effects of chemical agents on living organisms; current toxicological techniques in laboratory portion of course. Two hours lecture and one three-hour laboratory.

**5571 Principles of Toxicology Lab.** Zero credits. Corequisite: BIOL 5570.

**5580 Marine Biology.** Four credits. Prerequisites: BIOL 1110/1111, 1120/1121; CHEM 1110/1111, 1120/1121. Corequisite: BIOL 5581. Biological, chemical, and physical characteristics of major marine environments and their associated flora and fauna. Three lectures and one three-hour laboratory.

**5581 Marine Biology Lab.** Zero credits. Corequisite: BIOL 5580.

**6060 Advanced Dendrology.** Three credits. Prerequisite: BIOL 1120/1121. Woody plants with special emphasis on classification, identification, and literature of important timber trees of North America. Five hours lecture/laboratory.

- 6070 Plants and Man.** Three credits. Prerequisite: BIOL 1120/1121. Human dependence on plants emphasized. Topics include origin of agriculture, fruits and nuts, grains and legumes, vegetables, spices and herbs, oils and waxes, medicinal plants, psychoactive plants, beverages, fibers and dyes, tannins, wood and ornamental plants. Three lectures.
- 6080 Advanced Mycology.** Four credits. Prerequisites: Graduate standing plus BIOL 1120/1121. Corequisite: BIOL 6081. Fungi, with emphasis on taxonomy, morphology, culture, and importance to humans. Three lectures and one three-hour laboratory.
- 6081 Advanced Mycology Lab.** Zero credits. Corequisite: BIOL 6080.
- 6120 Aquatic Ecology.** Three credits. Physical, chemical, and biotic conditions of freshwater lakes and streams and of population structure and dynamics in these environments. Not open to students who have had Limnology. Five hours lecture/laboratory.
- 6130 Ornithology.** Three credits. Corequisite: BIOL 6131. Structure, taxonomy, natural history, and identification of birds. Emphasizes field work. Two lectures and one three-hour laboratory.
- 6131 Ornithology Lab.** Zero credits. Corequisite: BIOL 6130.
- 6180 Mammalogy.** Three credits. Corequisite: BIOL 6181. Morphology, physiology, systematics, and the development of mammals. Two lectures and one three-hour laboratory.
- 6181 Mammalogy Lab.** Zero credits. Corequisite: BIOL 6180.
- 6200 Speciation.** Three credits. Prerequisite: BIOL 3250/3251. Mutation, natural selection, adaptation, isolating mechanisms, genetic drift, hybridization, ploidy in the process of species formation, and a history of the development and ideas of evolution. Two lectures.
- 6210 Protozoology.** Three credits. Corequisite: BIOL 6211. Morphology, physiology, reproduction, ecology, taxonomy, and life cycles of the protozoa. Two lectures and one three-hour laboratory.
- 6211 Protozoology Lab.** Zero credits. Corequisite: BIOL 6210.
- 6220 Herpetology.** Three credits. Prerequisite: BIOL 3400/3401. Corequisite: BIOL 6221. Morphology, natural history, and identification of amphibians and reptiles. Local representatives emphasized. Two lectures and one three-hour laboratory.
- 6221 Herpetology Lab.** Zero credits. Corequisite: BIOL 6220.
- 6270 Cell Metabolism and Human Disease.** Three credits. Prerequisites: BIOL 4110/4111 or 6330/6331; CHEM 3010/3011, 3530/3531. Metabolic pathways of mammalian cells and the diseases that result from genetic defects that disrupt their normal function.
- 6290 Advanced Scanning Electron Microscopy.** Four credits. Prerequisite: Permission of instructor. Application of scanning electron microscopy to study materials with emphasis on theory of scanning electron microscopy and preparation of biological specimens for microscopy. Seven hours lecture/laboratory.
- 6330 Principles of Physiology.** Four credits. Prerequisites: BIOL 3250/3251; CHEM 2030/2031 or 3010/3011. Corequisite: BIOL 6331. Physical and chemical properties of protoplasm, cells, and organisms and their relationships to life processes. Three lectures and one three-hour laboratory.
- 6331 Principles of Physiology Lab.** Zero credits. Corequisite: BIOL 6330.
- 6350 Biostatistical Analysis.** Four credits. Prerequisites: BIOL 3250/3251; MATH 1910. Corequisite: BIOL 6351. Intermediate-level introduction to biostatistical procedures used in research. Three lectures and one three-hour laboratory.
- 6351 Biostatistical Analysis Lab.** Zero credits. Corequisite: BIOL 6350.
- 6360 Energy Dispersive X-Ray Theory and Analysis.** One credit. Prerequisite: BIOL 4290 or 6290. Theory of X-ray analysis and elemental analysis of materials using an energy dispersive X-ray system with scanning electron microscopy. One three-hour laboratory.
- 6380 Experimental Immunology.** Four credits. Prerequisite: BIOL 2230/2231. Corequisite: BIOL 6381. Mechanisms of immunity including the more recent developments in immunology. Three lectures and one three-hour laboratory.
- 6381 Experimental Immunology Lab.** Zero credits. Corequisite: BIOL 6380.
- 6390 Advanced Cell and Molecular Biology.** Four credits. Prerequisites: BIOL 2230/2231, 3250/3251; CHEM 2030/2031 or 3010/3011. Corequisite: BIOL 6391. Molecular biology of the cell with emphasis on current experimental techniques. Three lectures and one three-hour laboratory.
- 6391 Advanced Cell and Molecular Biology Lab.** Zero credits. Corequisite: BIOL 6390.
- 6400 Medicinal Plants.** Three credits. Prerequisite: BIOL 1120/1121. Plants affecting human health, including poisonous, psychoactive, and remedial plants. Ethnobotanical and modern medicinal uses considered. Three lectures.
- 6410 Advanced Transmitting Electron Microscopy.** Four credits. Prerequisite: Permission of instructor. Ultrastructure of the cell using basic and specialized techniques. Seven hours lecture/laboratory.
- 6430 Clinical and Pathogenic Microbiology.** Four credits. Prerequisite: BIOL 2230/2231. Comprehensive coverage of the most recent discoveries and techniques used for the identification of pathogenic organisms and their relationships to disease processes. Six hours lecture/laboratory.
- 6440 Advanced Virology.** Four credits. Prerequisites: BIOL 2230/2231; CHEM 1110/1111 and 1120/1121. Emphasizes the main virus families and their biochemical composition. Experimental approaches and techniques will be developed in order to identify and manipulate viruses. Six hours lecture/laboratory.
- 6450 Advancements in Molecular Genetics.** Four credits. Prerequisites: BIOL 2230/2231 and 3250/3251; CHEM 1110/1111 and 1120/1121. Recent advancements in microbial genetics and gene manipulation with emphasis on applications of molecular genetics, including gene regulation and recombinant DNA technology. Six hours lecture/laboratory.
- 6460 Conservation Biology.** Four credits. Prerequisite: BIOL 3400/3401. Measuring biodiversity: species, ecosystem, and genetic diversity. Topics include conservation ethics, extinctions, habitat degradation, exotic species, and management of populations and ecosystems. Six hours lecture/laboratory.
- 6500 Special Problems in Biology.** Four credits. Prerequisite: Permission of department. Plan, implement, and interpret a research problem in some area of biology. Available topics limited to areas of graduate faculty interest and expertise.

- 6590 Environmental Toxicology.** Four credits. Prerequisites: BIOL 1110/1111, 1120/1121; CHEM 1110/1111, 1120/1121, and 3010/3011. Ecological effects of chemicals in the environment and techniques currently utilized to assess these effects. Current environmental assessment techniques, including biomonitoring, will be covered in the laboratory. Six hours lecture/laboratory.
- 6620 Biological Research.** Three credits. Prerequisite: Permission of department. Selection of a research problem, review of pertinent literature, and execution of the research.
- 6640 Thesis Research.** One to six credits. Prerequisites or corequisites: BIOL 6620 and permission of department. Completion of the research problem begun in BIOL 6620; preparation of the thesis. Once enrolled, student should register for at least one credit hour of master's research each semester until completion. Minimum of three credits required for M.S. degree. S/U grading.
- 6650 Seminar.** One credit. Discussion and critical evaluation of the primary scientific literature. Responsible conduct of research topics including data management, publication practices, peer review, and collaborative science emphasized. One two-hour session.
- 6660 Seminar.** Two credits. Development of written and oral communication skills relevant to obtaining research funding and presenting research results. Responsible conduct of research topics including mentor/trainee relationships, human subjects, animal research, research misconduct, and conflicts of interest emphasized. Two one-hour sessions.
- 6700 Plant-Animal Interactions.** Three credits. Prerequisite: BIOL 1110/1111, 1120/1121. Corequisite: BIOL 6701. Evolutionary and ecological perspectives on how plants attract and repel symbionts and how those symbionts influence plant fitness. Topics include angiosperm evolution, the coevolution of plants with pollinators, herbivores, mycorrhizae, and N-fixing bacteria, and how plant secondary metabolites facilitate or mitigate these interactions. Two hours lecture and three hours lab.
- 6701 Plant-Animal Interactions Lab.** Zero credits. Corequisite: BIOL 6700.
- 6710 Biostatistical Analysis II.** Three credits. Prerequisite: BIOL 4350 or 6350. Advanced-level applied, multivariate biological statistics. Three lectures per week.
- 6720 Advanced Animal Development.** Four credits. Prerequisites: BIOL 3250/3251; BIOL 4210/4211 or 6390/6391 recommended. Corequisite: BIOL 6721. Processes and underlying molecular mechanisms by which a single fertilized egg develops into an adult organism. Focuses on vertebrate development, including insights gained from other model organisms. Three hours lecture and two hours lab.
- 6721 Advanced Animal Development Lab.** Zero credits. Corequisite: BIOL 6720.
- 6730 Advanced Microbial Physiology and Biochemistry.** Four credits. Prerequisites: BIOL 2230/2231; CHEM 1110/1111, 1120/1121, and 2030/2031 or 3010/3011 or consent of instructor. Survey of the physiology and biochemistry of prokaryotic and eukaryotic microorganisms. Six hours lecture/laboratory.
- 6740 Brain Development and Learning Disabilities.** One credit. Prerequisite: Permission of department. Biology and psychology underlying dyslexia and other common learning disabilities encountered in the school setting. Addresses practical classroom applications utilizing this background information. Five three-hour class meetings.
- 6750 Advanced Plant Biotechnology.** Four credits. Prerequisites: BIOL 1110/1111, 1120/1121, 3250/3251. Processes and reasoning behind the human manipulation of plant species for agricultural and technological purposes. Topics include traditional breeding techniques, tissue culture, plant cell transformation, and general plant molecular biology techniques as well as current debate over genetically modified organisms. Six hours lecture/laboratory.
- 6760 Bioinformatics.** Four credits. Prerequisites: BIOL 1110/1111 and 1120/1121 and CSCI 1170 or consent of instructor. Explores the emerging field of bioinformatics which involves the application of computer science to biological questions. Bioinformatics specifically applies to the computational aspects of data gathering, processing, storage, analysis, and visualization methods for use in revising and testing biological hypotheses. Student should have a strong background in either computer science or biology, be willing to learn about the other field in an accelerated fashion, and be willing to work cooperatively as part of an interdisciplinary team. Four hours of lecture/problem solving per week.
- 6770 Issues in Biotechnology.** Two credits. Prerequisite: BIOL 4550/4551, 5550/5551, or 4750/6750. Explores current and emerging issues in biotechnology. Students will be asked to solve problems drawn from biotechnology industry. Seminars, field trips, and case study work.
- 6999 Comprehensive Examination and Preparation.** One credit. Open only to students who are not enrolled in any other graduate course and who will take the master's comprehensive examination during the term. The student must contact the graduate advisor during the first two weeks of the term for specifics regarding the details of this comprehensive examination preparatory course. Credit may not be applied to degree requirements.
- 7010 Analysis of Genetic Markers.** Four credits. Prerequisites: BIOL 3500 and 6350/6351 or STAT 6020. Overview of the use of genetic markers to answer ecological and evolutionary questions. Applications of phylogenetics, population genetics, and identification of individuals. Labs integrated with lectures to cover major algorithms and software. Four hours of lecture/problem solving per week.

## Field Station Affiliation

MTSU is an affiliate of the Gulf Coast (Miss.) Research Laboratory. Certain courses in marine biology may be taken for graduate credit and transferred to MTSU. See department head for list of courses.