

## BIOLOGICAL SCIENCES (BSC)

210 Julian Hall, (309) 438-3669

BIO.IllinoisState.edu

**Chairperson:** Craig Gatto.

**Graduate Program Director:** Steven Juliano

**Graduate Faculty:** Anderson, Armstrong, Borowicz, Bowden, Byers, Capparella, Casto, Cook, Edwards, Eggert, Garris, Gatto, Gougis, Hammond, Juliano, Kirik, Larson, Moore, A. Mortimer, N. Mortimer, N. Nichols, W. Nichols, Perry, Preston, Sadd, Sakaluk, Sedbrook, Stein, Thompson, Vidal Gadea, Vogel, Whitman, Wilkinson.

**Biology-Chemistry Joint Appointments:** Friesen, Jones, Weldon.

**Biology-Psychology Joint Appointments:** Heidenreich.

### Programs Offered

M.S. in Biological Sciences with sequences in: Behavior, Ecology, Evolution, and Systematics; Bioenergy Sciences; Biomathematics; Biotechnology; Conservation Biology; Neuroscience and Physiology; and a Ph.D. degree in Biological Sciences with sequences in: Behavior, Ecology, Evolution, and Systematics; Molecular and Cellular Biology; and Neurosciences.

### Master's in Biological Sciences Program requirements

All master's degree students are required to complete a research thesis and at least 30 semester hours, which must include at least 2 semester hours of BSC 420 Seminar. The School will determine additional coursework specific to each individual's plan of study. All master's degree programs require a minimum of 50 percent of the non-thesis credit hours applied to the degree to be 400-level courses or above.

### Behavior, Ecology, Evolution, and Systematics (BEES) Sequence:

Students may elect to pursue a sequence in Behavior, Ecology, Evolution, and Systematics, a course of study that provides students with a strong conceptual background in whole-organism biology. The sequence is designed to enhance students' understanding of the underlying concepts that unite research in the areas of behavior, ecology, evolution, and systematics while providing the opportunity for training in specific taxa and in subjects ranging from molecular and cellular biology to neurobiology, physiology, and advanced research techniques. This 30 hour sequence requires:

- 2 hours of BSC 420
- 4 hours of thesis (BSC 499)

- 7 hours of sequence core courses: BSC 420A27, 470, and 490
- 9-12 hours: chosen from BSC 325, 330, 335/336, 375/376, 404, 405, 406, 486, 488
- 5-8 hours of elective courses are selected through consultation among the major professor, the student's committee, and the student

### Bioenergy Sciences Sequence:

This course of study provides students with a strong conceptual background in biological and environmental aspects of using and engineering plants and microbes for the production of bio-based fuels. Students successfully completing this sequence should be competitive for admission into Ph.D. programs and/or for acquiring bioenergy-related jobs in industry, non-profits, government agencies, or academia. Students can choose between a biotechnology-based track and an ecology/conservation biology-based track.

This 30 hour sequence requires:

#### For the Biotechnology-based track:

- 20 hours: BSC 353, 354, 365, 415, 419, 420A38, 420Axx (student's choice), 450A45
- 4 hours of thesis (BSC 499)
- 6 hours of electives

#### For the Ecology/Conservation Biology-based track:

- 19 hours: BSC 365, 404 or 405, 406, 420A27, 420A38, 470, 490
- 4 hours of thesis (BSC 499)
- 7 hours of electives

### Biomathematics Sequence:

This cross-disciplinary sequence provides students with a unique and strong cross-disciplinary training in biology and mathematics. The sequence is designed first to give students a solid foundation in mathematics (core courses), then training in one of two biological areas that use specific types of mathematical applications to address biological questions (emphases). Before entering the sequence, students should have two semesters of calculus and one semester of linear algebra.

This 32 hour sequence requires:

- 2 hours of BSC 420 A36
- 4 hours of thesis BSC 499
- 14 hours of sequence core courses: MAT 340, 350, 351, and 442

## Biological Sciences

Transfer credit can be offered for the core math classes provided that students take at least two courses from the Mathematics Department while at Illinois State University.

- 12 hours of electives from two areas of emphasis. A minimum of 12 non-thesis hours must be from the School of Biological Sciences. A minimum of 14 hours (not including 499) outside of the core courses and BSC 420A36 must be at the 400 level.
- Biological Statistics and Modeling area of emphasis: with a choice of courses from BSC 343, 404, 405, 406, 450A37, 486; MAT 353, 356, 362, 378, 450, 453, 455, 456, 458
- Computation and Bioinformatics area of emphasis: with a choice of courses from BSC 350, 353, 355, 415, 419, 467, 470; MAT 356, 361, 363, 461

**Biotechnology Sequence:**

This sequence is a discipline linking cell biology, molecular biology, biochemistry, neurobiology, genetics, microbiology, developmental biology, and immunology. It is designed to enhance students' competency in the theoretical and applied aspects of biotechnology principles, techniques, and their application. This 30 hour sequence requires:

- 2 hours of BSC 420
- 4 hours of thesis BSC 499
- 9 hours of electives
- 15 hours of sequence courses, to include: BSC 353, 354, 415, 419 and 450A45

**Conservation Biology Sequence:**

This sequence is a discipline linking ecology, genetics, evolution, and systematics to applied problems in biodiversity preservation and ecosystem function and maintenance. This 30 hour degree requirements include:

- 8 hours of sequence core courses (BSC 406, 420A29, 490/420A27)
- 4 hours of thesis BSC 499
- 1 hour of another BSC 420
- 17 hours of elective courses distributed across four groups (I-IV) of electives. Group I (Ecology): BSC 375/376, 404, 405. Group II (Genetics and Evolution): BSC 470, 488. Group III (Taxon Focus): BSC 301, 330, 333, 335/336, 396. Group IV (Other Electives): BSC 311, 325, 353, 486; GEO 303, 304, 305

**Neuroscience and Physiology Sequence:**

This sequence provides students with a strong conceptual background in these two fields of biological sciences, and is designed to enhance students' understanding of the canonical concepts that underlie neuroscience and physiology, including biostatistics, while providing the opportunity for training in related fields such as cell and molecular biology, chemistry, behavior and psychology. This 30 hour sequence requires:

- 2 hours of BSC 420
- 4-6 hours of thesis BSC 499
- 10 hours of sequence core courses (BSC 430, 435, 490, and 420A27)
- 14 hours of sequence elective courses chosen from BSC 411, 415, 418, 419, 425, 450A37, 450A40, 450A47, 486, and 470. To complete these 14 hours of sequence elective courses, no more than two of the following may also be taken: BSC 301, 325, 327, 345, 346, 353, 354, 355, 367, and 396; CHE 442, 444, and 464; PSY 418, 421, and 468.
- Additional elective courses are selected through consultation among the major professor, the student's committee, and the student. For further information, see the Department's website at [BIO.IllinoisState.edu](http://BIO.IllinoisState.edu).

**Ph.D. in Biological Sciences Program Requirements**

Doctoral students may design an individual plan of study in consultation with advisors, or they may elect to pursue a sequence within the Ph.D. program in (1) Behavior, Ecology, Evolution, and Systematics (BEES), (2) Molecular and Cellular Biology, or (3) Neuroscience and Physiology, each of which includes specific requirements (see below).

Degree requirements include:

- 4 hours BSC 420
- Most Ph.D. students take 30-40 semester hours of coursework
- Take and pass the Ph.D. qualifying exam
- 15+ hours: BSC 599
- A sequence (requirements follow) or an individual plan of study

**Behavior, Ecology, Evolution, and Systematics (BEES) Sequence:**

The sequence is designed to enhance students' understanding of the underlying concepts that unite research in the areas of behavior, ecology, evolution, and systematics while providing the opportunity for training in

specific taxa and in subjects ranging from molecular and cellular biology to neurobiology, physiology, and advanced research techniques. Degree requirements include:

- 7 hours of sequence core courses (BSC 420A27, 470, and 490) and 3 additional sequence courses (9-12 hours) chosen from BSC 325, 330, 335/336, 375/376, 404, 405, 406, 486, 488
- Elective courses (unspecified hours) are selected through consultation among the major professor, the student's committee, and the student

#### **Molecular and Cellular Biology Sequence:**

The sequence is designed to enhance the student's competency in molecular and cellular biology principles, techniques, and their application for becoming leaders in solving tomorrow's problems in molecular cell biology. Degree requirements include:

- 8 hours of core courses (BSC 415, 419, 420A37)
- at least three graduate elective courses (9-12 hours). Elective courses will be selected from the area of the student's specialization and will be decided by the student in consultation with his/her advisor and/or student dissertation committee. Elective courses may be selected from among, but not limited to, the following representative courses: BSC 325, 329, 330, 343, 345, 350, 353, 354, 355, 361, 367, 411, 418, CHE 342, 343, 344, 440, 442, 444

#### **Neuroscience and Physiology Sequence:**

The sequence is designed to enhance students' understanding of the canonical concepts that underlie neuroscience and physiology, including biostatistics, while providing the opportunity for training in related fields such as cell and molecular biology, chemistry, behavior and psychology. Degree requirements include:

- 10 hours of sequence core courses (BSC 430, 435, 490, and 420A27)
- 12 hours of sequence elective courses chosen from BSC 411, 415, 418, 419, 425, 450A37, 450A40, 450A47, 486, and 470. To complete these 12 hours of sequence elective courses, no more than two of the following may also be taken: BSC 301, 325, 327, 345, 346, 353, 354, 355, 367, and 396; CHE 442, 444, and 464; PSY 418, 421, and 468
- Additional elective courses are selected through consultation among the major professor, the student's committee, and the student. For further information, see the Department's website at [BIO.IllinoisState.edu](http://BIO.IllinoisState.edu)

#### **Biology Geographic Information Systems (GIS) Graduate Certificate**

Graduate students in the School of Biological Sciences may elect to pursue a Biology Geographic Information Systems (GIS) Graduate Certificate. To earn the certificate, students must take GEO 303, 304, and 305.

#### **Biological Sciences Courses**

##### **301 ENTOMOLOGY**

**4 sem. hrs.**

Biology and taxonomy of insects. Lecture, lab, and field trips. Materials charge optional. Prerequisites: BSC 196, 197, and 201.

##### **306 REGIONAL AND AREA STUDIES**

**1-9 sem. hrs.**

Intensive on-site studies of organisms and their environments. Field work. Prerequisite: Consent of the instructor.

##### **311 RAIN FOREST ECOLOGY**

**3 sem. hrs.**

Introduction to the natural history and ecology of rain forests; intensive tropical field work and investigative learning. Foreign travel and field work required. Formerly BSC 306A08 REGIONAL AND AREA STUDIES: COSTA RICAN RAIN FOREST. Prerequisites: BSC 201 and consent of the instructor.

##### **325 ECOLOGICAL PHYSIOLOGY OF ANIMALS**

**3 sem. hrs.**

Exploration of the physiological adaptations animals have evolved in response to habitat variation. Prerequisites: BSC 196 and 197; a minimum of 45 hours completed.

##### **27 HORMONES, BRAIN AND BEHAVIOR**

**3 sem. hrs.**

Exploration of relationships among hormones, brain, and behaviors associated with reproduction, aggression, stress, parenting, affiliation, homeostasis and development in animals. Prerequisite: BSC 283 or 286 or consent of the instructor.

##### **329 HUMAN GENETICS**

**3 sem. hrs.**

Detection, expression, transmission, and molecular manipulation of human traits; emphasis on medical genetics. Lecture. Prerequisites: BSC 203 and 219.

##### **330 BIOLOGY OF ALGAE**

**4 sem. hrs.**

Origin, evolution, diversity, systematics, cell biology, biochemistry, physiology, and ecology of terrestrial, freshwater, and marine algae. Lecture and lab. Formerly PHYCOLOGY. Prerequisite: One of the following: BSC 201, 203, 212, 219, 260 or consent of the instructor.

**333 PLANT DIVERSITY****4 sem. hrs.**

History and diversity of plants and other green organisms covering major events, groups of organisms, and their phylogenetic relationships. Lecture and lab. Formerly BSC 222. Prerequisite: One of the following: BSC 211, 212, 223, or graduate standing.

**335 PLANT TAXONOMY****3 sem. hrs.**

Classification taxonomy, and phylogeny of seed plants; distinguishing characteristics of major groups; use of botanical nomenclature and reference materials. Prerequisites: One of the following: BSC 211, 212, 223; concurrent registration in BSC 336.

**336 LABORATORY IN PLANT IDENTIFICATION****1 sem. hr.**

Plant identification; identification tools and methods; descriptive morphology and terminology; field identification of flowering plants and major plant families; specimen collection, documentation and curation. Prerequisite: Concurrent registration in BSC 335.

**343 INTRODUCTION TO NEUROBIOLOGY****3 sem. hrs.**

Cellular and molecular aspects of neuronal function; neurotransmitter families; central nervous system development, anatomy and function; and neuropathology. Prerequisites: BSC 196 and 197 or consent of the instructor.

**345 INTRODUCTION TO ENDOCRINOLOGY****3 sem. hrs.**

Cellular and molecular coordination of tissues which secrete chemical compounds to regulate growth, reproduction, metabolism, and ion homeostasis. Prerequisite: BSC 203 or consent of the instructor.

**346 DEVELOPMENTAL BIOLOGY****3 sem. hrs.**

Molecular mechanisms of cell differentiation and tissue patterning during embryonic and post-embryonic development in different organisms. Prerequisites: BSC 203 or consent of the instructor. BSC 219 is recommended.

**350 MOLECULAR BIOLOGY****3 sem. hrs.**

DNA structure and replication, the Genetic Code, transcription, translation, genetic regulation, RNA splicing, and transposons. Lecture. Prerequisites: BSC 203 and 219; CHE 220, or 230 and 231. CHE 242 or 342 is recommended.

**351 CELL SIGNALING AND REGULATION****3 sem. hrs.**

Molecular mechanisms by which cells communicate

and make decisions. Includes signal transduction pathways; regulation of cell form, growth, division, differentiation. Prerequisites: BSC 197 and 203.

**353 BIOTECHNOLOGY LABORATORY I: DNA TECHNIQUES****3 sem. hrs.**

Application and theory of molecular techniques using prokaryotic systems, including DNA and protein analysis, DNA cloning and bacterial genetics. Lecture and lab. Material charge optional. Prerequisites: BSC 219; CHE 220 or CHE 230-232.

**354 BIOTECHNOLOGY LABORATORY II: CELL BIOLOGY TECHNIQUES****3 sem. hrs.**

Application and theory of cell biology to study eukaryotic systems using biochemistry, cell culture, and immunology techniques. Lecture and lab. Material charge optional. Prerequisites: BSC 203 required. CHE 220 or 230-232 recommended.

**355 GENOMICS AND BIOINFORMATICS****3 sem. hrs.**

Concepts and practice of genome sequencing and analysis, postgenomic applications and bioinformatics. Prerequisites: BSC 203 and 219.

**361 MICROBIAL PATHOGENS****4 sem. hrs.**

Pathogenesis, identification, cultivation and classification of bacteria, viruses, fungi and animal parasites associated with diseases of man. Lecture and laboratory. Materials charge optional. Prerequisites: BSC 203 and 260.

**365 BIOENERGY PLANT/MICROBE BIOLOGY AND THE ENVIRONMENT****3 sem. hrs.**

The molecular, cellular, and organismal biology of microbes and plants as a source of alternate energy and associated global change. Prerequisite: One of the following: BSC 201, 203, 212, 219, 260, or consent of the instructor.

**367 IMMUNOLOGY****4 sem. hrs.**

Molecular, cellular, transplantation, and tumor immunology; antimicrobial immunity; immunochemistry. Lecture and laboratory. Materials charge optional. Prerequisite: BSC 203.

**370 TOPICS IN MOLECULAR AND CELLULAR BIOLOGY****3 sem. hrs.**

In-depth investigation of a current area of research within molecular and cellular biology. Multiple enrollments allowed for credit if content is different. Prerequisites: BSC 197, 203, 219.

**370A01 GENETICS OF BEHAVIOR****3 sem. hrs.**

The course examines the primary scientific literature to understand how different genes and environmental factors influence the behaviors of a variety of organisms. Prerequisites: BSC 197, 203, 219.

**370A02 MOLECULAR AND CELLULAR BASIS OF HUMAN PATHOPHYSIOLOGY****3 sem. hrs.**

This course provides the student with knowledge of the basic molecular and cellular mechanisms underlying human pathophysiological processes. Prerequisites: BSC 196 and 197. BSC 203, 219, or 283 are recommended.

**375 STREAM ECOLOGY LECTURE****3 sem. hrs.**

Introduction to the structure and function of stream ecosystems examining hydrology, geomorphology, chemistry, and ecology of stream ecosystems. Prerequisites: BSC 196, 197; a minimum of 45 hours completed, or consent of the instructor.

**376 STREAM ECOLOGY LABORATORY****1 sem. hr.**

The integration of the geology, chemistry, zoology, and ecology of flowing waters and their conservation and restoration. Materials charge optional. Prerequisite: Concurrent registration in BSC 375.

**396 AVIAN BIOLOGY****4 sem. hrs.**

Origin, evolution, diversity, systematics, biogeography, morphology, physiology, ecology, behavior, and conservation biology of birds. Lecture, lab and field trips. Materials charge optional. Prerequisites: BSC 196 and 197.

**400 INDEPENDENT STUDY****1-4 sem. hrs.**

See General Course Offerings. Multiple enrollments allowed.

**404 POPULATION ECOLOGY****4 sem. hrs.**

Demography, population regulation, metapopulation dynamics, competition, and implications of theory for conservation and management. Lecture and laboratory. Prerequisite: BSC 201.

**405 COMMUNITY ECOLOGY****4 sem. hrs.**

Diversity and stability of natural communities, niche theory, resource partitioning and species packing, co-evolution of plants and animals. Lecture and laboratory. Prerequisite: BSC 201.

**406 CONSERVATION BIOLOGY****3 sem. hrs.**

Principles of conservation ecology, conservation genetics, and conservation systematics, with applications to biodiversity preservation and ecosystem function maintenance. Lecture. Prerequisites: BSC 201 and 219, or equivalent.

**411 CONFOCAL MICROSCOPY IN BIOLOGY****2 sem. hrs.**

Theory and practice of confocal microscopic analysis of biological samples, including time-lapse and 3-D acquisition. Prerequisite: Consent of the instructor.

**415 ADVANCED CELL BIOLOGY I****3 sem. hrs.**

Analysis of structure and function of eukaryotic cells, including nuclear organization, membrane dynamics, protein trafficking, and signal transduction mechanisms. Lecture. Prerequisites: BSC 203 and 219 or equivalents; CHE 242 or 342 recommended.

**418 BIOLOGICAL MICROSCOPY****4 sem. hrs.**

Theory and practice of scanning and transmission electron microscopy and advanced light microscopy, including specimen preparation and presentation of images. Lecture and lab. Prerequisite: Consent of the instructor.

**419 ADVANCED MOLECULAR BIOLOGY****4 sem. hrs.**

Major RNA/DNA transactions in the cell, replication, recombination, mutation, genomics, processing, and regulation. Lecture. Formerly MOLECULAR BIOLOGY OF THE GENE. Prerequisite: Consent of the instructor.

**420 GRADUATE SEMINAR IN BIOLOGY****1 sem. hr.**

Topics in various fields of biology (See topics below). Multiple enrollments allowed for credit.

**420A02 GRADUATE SEMINAR IN GENETICS****1 sem. hr.**

Current topics in genetics research are explored through primary literature. Prerequisite: Bachelor's degree in a biology-related field or consent of the instructor.

**420A03 GRADUATE SEMINAR IN ECOLOGY****1 sem. hr.**

Current topics in ecological research are explored through primary literature. Prerequisite: Bachelor's degree in a biology-related field or consent of the instructor.

**420A04 GRADUATE SEMINAR IN ANIMAL BEHAVIOR****1 sem. hr.**

Current topics in animal behavior research are explored through primary literature. Prerequisite: Bachelor's degree in a biology-related field or consent of the instructor.

**420A27 BIostatistics LABORATORY****1 sem. hr.**

Practical laboratory experience in analysis of biological data. Prerequisites: Bachelor's degree in a biology-related field and concurrent registration in BSC 490 or consent of the instructor.

**420A28 GRADUATE SEMINAR IN EVOLUTION AND SYSTEMATICS****1 sem. hr.**

Current topics in evolution and systematics research are explored through primary literature. Prerequisite: Bachelor's degree in a biology-related field or consent of the instructor.

**420A29 GRADUATE SEMINAR IN CONSERVATION BIOLOGY****1 sem. hr.**

Current topics in conservation biology research are explored through primary literature. Prerequisite: Bachelor's degree in a biology-related field or consent of the instructor.

**420A31 GRADUATE SEMINAR IN IMMUNOLOGY****1 sem. hr.**

Current topics in immunology research are explored through primary literature. Prerequisite: Bachelor's degree in a biology-related field or consent of the instructor.

**420A33 GRADUATE SEMINAR IN CELL BIOLOGY****1 sem. hr.**

Current topics in cell biology research are explored through primary literature. Prerequisite: Bachelor's degree in a biology-related field or consent of the instructor.

**420A34 GRADUATE SEMINAR IN NEUROBIOLOGY****1 sem. hr.**

Current topics in neurobiology, such as neurobiology of drugs of abuse, compensatory adaptation in neurodegenerative diseases, and the etiology and treatment of Parkinson's Disease.

**420A35 GRADUATE SEMINAR IN ENDOCRINOLOGY****1 sem. hr.**

Current topics in endocrinology research are explored through primary literature. May include, but not limited to,

molecular endocrinology, developmental endocrinology, endocrine disruptors, therapeutic treatment of chronic endocrine disorders and other cutting edge research. No prior coursework in endocrinology is required. Multiple enrollments allowed for credit.

**420A36 GRADUATE SEMINAR IN BIOMATHEMATICS****1 sem. hr.**

Current topics in biomathematics research are explored through primary literature. Prerequisite: Bachelor's degree in a biology-related field or consent of the instructor.

**420A37 GRADUATE SEMINAR IN CELLULAR AND MOLECULAR BIOLOGY****1 sem. hr.**

Current topics in cellular and molecular biology research are explored through primary literature. Prerequisite: Bachelor's degree in a biology-related field or consent of the instructor.

**420A38 SEMINAR IN BIOENERGY SCIENCES****1 sem. hr.**

Current topics in bioenergy research are explored through primary literature (e.g. engineering plant / algae production, microbial conversion, environmental sustainability). Prerequisites: Bachelor's degree in a biology-related field or consent of instructor.

**420A39 POST-SECONDARY BIOLOGY EDUCATION****1 sem. hr.**

This course explores topics relevant to undergraduate-level biology instruction, including learning theory, well-documented misconceptions, evidence-based instruction, and underrepresentation. Prerequisite: Graduate or senior standing in a teacher education track in a science department (BSC, GEO, CHE, PHY).

**430 NEUROSCIENCE****3 sem. hrs.**

Study of neurons and their organization into nervous systems to mediate behavior. Lecture. Prerequisite: BSC 343 or the equivalent.

**435 MAMMALIAN PHYSIOLOGY****3 sem. hrs.**

Study of the organ systems of mammals and their functional integration. Lecture. Prerequisite: BSC 283 or the equivalent.

**450 ADVANCED STUDIES IN SPECIALIZED FIELDS****1-4 sem. hrs.**

Current advances in specialized fields of the biological sciences. Multiple enrollments allowed for credit in different fields; see the topics below. Pre-requisite: Consent of the instructor.

**450A37 ADVANCED STUDIES IN BIostatISTICS****3 sem. hrs.**

Practical experience with advanced statistical techniques used by biologists, primarily in ecology, behavior, physiology, evolutionary biology, and neurobiology. Prerequisites: BSC 490 and 420A27, or equivalent graduate level course in applied statistics, or consent of the instructor.

**450A45 ISSUES IN BIOTECHNOLOGY****2 sem. hrs.**

The goal of this course is to familiarize students with various aspects of biotechnology such as applied genetic engineering, impacts of biotechnology on society, social and ethical issues, intellectual properties, patenting and commercialization of biotechnology products and careers in biotechnology industries. Pre-requisite: Consent of the instructor.

**450A47 PRINCIPLES OF NEUROPHYSIOLOGY****3 sem. hrs.**

This course covers the principles of how neurons function, interact and build circuits. It addresses cellular and synaptic physiology, explains methods for neural activity measurement, and demonstrates computational approaches as well as data recording and analysis. Prerequisite: Consent of the instructor.

**450A48 EVOLUTION AND ECOLOGY OF INFECTIOUS DISEASE****3 sem. hrs.**

This course delves into the realm of the evolution and ecology of infectious diseases and the host organisms that are bombarded by them. The course will also foster presentation skills, discussion, and critical thinking.

**450A49 NEUROETHOLOGY-NEURAL BASIS AND BEHAVIOR****3 sem. hrs.**

The study of neuroethology integrates concepts from a wide range of disciplines, including neuroscience, animal behavior, and genetics. In this course focus will be on selected model systems to introduce general neuroethological principles and gain an appreciation for the current primary literature and methods used in neuroethology. Prerequisite: Consent of the instructor.

**450A50 NEUROSCIENCE OF DOPAMINE****3 sem. hrs.**

Study of dopamine neurons and their relationship to behavior. Lecture. Prerequisite: BSC 343 or equivalent.

**470 EVOLUTION****3 sem. hrs.**

Origin of life, sources of genetic variation, molecular evolution, phylogenetic reconstruction, micro-and macroevolutionary processes. Lecture. Prerequisites: BSC 201, 219, and 297 or equivalent recommended.

**486 ETHOLOGY****4 sem. hrs.**

Behavior of animals under natural conditions. Lecture and laboratory. Prerequisite: Consent of the instructor.

**488 SYSTEMATIC BIOLOGY****3 sem. hrs.**

Species concepts; infra- and supraspecific categories; geographic variation; phylogenetic reconstruction; molecular and morphological characters; evolutionary, phenetic, and cladistic classification; nomenclature. Lecture. Prerequisite: BSC 219 or equivalent.

**490 BIostatISTICS****3 sem. hrs.**

Statistical techniques encountered in biological research with emphasis on proper use and interpretation of analyses. Lecture.

**491 INTERNSHIP IN COLLEGE TEACHING IN BIOLOGICAL SCIENCES****3 sem. hrs.**

Credit for the course is given in the School of Teaching Learning (see TCH 491). Prerequisite: Consent of School Director.

**495 GRADUATE RESEARCH IN BIOLOGICAL SCIENCES****1-3 sem. hrs.**

Field and/or laboratory research in one of the biological sciences involving a participation in the scientific process with faculty and other graduate students with the purpose of conducting independent research and/or developing additional research skills and technical expertise. Multiple enrollments allowed; maximum of 4 hours may be counted toward degree requirements. Prerequisite: Project proposals must be approved by a supervising faculty member, the student's graduate advisor (if in the thesis program), and chair of the graduate studies prior to registration. Students are expected to work on average a minimum of 3 hours per week for each hour of credit.

**499 MASTER'S THESIS****1-6 sem. hrs.**

Refer to Index for General Courses.

**499A90 MASTER'S THESIS: LAST TERM****1 sem. hr.**

Refer to Index for General Courses.

**599 DOCTORAL RESEARCH: BIOLOGICAL SCIENCES (Ph.D)**

1-15 sem. hrs.

Refer to Index for General Courses.

**599A90 RESEARCH IN BIOLOGICAL SCIENCES: FINAL TERM****1 sem. hr.**

Refer to Index for General Courses.