Doctoral Independent Study
Fall, Spring, Summer. 1 to 10 credits. A student may earn a maximum of 20 credits in all enrollments for this course. R: Approval of school.
Special projects, directed reading, and research arranged by an individual doctoral candidate and a faculty member in areas supplementing the regular course offerings.

Special Topics
Fall, Spring, Summer. 1 to 10 credits. A student may earn a maximum of 25 credits in all enrollments for this course. R: Approval of school.
Special topics supplementing regular course offerings proposed by faculty on a group study basis for doctoral students.

Seminar in Musicology
Spring. (3-3-0) A student may earn a maximum of 18 credits in all enrollments for this course. R: Open only to graduate students in School of Music.
Topics in musicology such as early notations, music editing, or historical performance practices.

Doctoral Recital Performance
Fall, Spring, Summer. 1 to 12 credits. A student may earn a maximum of 30 credits in all enrollments for this course. R: Open only to doctoral students in Music Performance.
Directed experience in recital performance in partial fulfillment of requirements for the Doctor of Musical Arts degree.

Doctoral Concert Conducting
Fall, Spring, Summer. 1 to 12 credits. A student may earn a maximum of 30 credits in all enrollments for this course. R: Open only to doctoral students in Music Performance.
Directed experience in concert conducting in partial fulfillment of requirements for the Doctor of Musical Arts degree.

Doctoral Music Composition
Fall, Spring, Summer. 1 to 12 credits. A student may earn a maximum of 30 credits in all enrollments for this course. R: Open only to doctoral students in the Music Composition major.
Directed experience in composition in partial fulfillment of requirements for the Doctor of Musical Arts degree.

Doctoral Dissertation Research
Fall, Spring, Summer. 1 to 40 credits. A student may earn a maximum of 40 credits in all enrollments for this course. R: Open only to doctoral students in School of Music. Approval of school.
Doctoral dissertation research.

College of Natural Science


Preprofessional Freshman Seminar
Fall, Spring. (1-1-0) A student may earn a maximum of 4 credits in all enrollments for this course. Interdepartmental with Agricultural and Natural Resources; Engineering; Social Science. R: Approval of college.
Overview of human health care professions with emphasis on academic and nonacademic undergraduate preparation, campus resources, communication and computer skills, and collaborative learning.

Environmental Issues Seminar
Fall, Spring. (1-1-0) A student may earn a maximum of 4 credits in all enrollments for this course. Interdepartmental with Agricultural and Natural Resources; Engineering; Social Science; Communication Arts and Sciences. R: Open only to students in the College of Agriculture and Natural Resources or College of Engineering or College of Natural Science or College of Communication Arts and Sciences or College of Social Science. Approval of college.
Environmental issues and problems explored from a variety of perspectives, including legal, scientific, historical, political, socio-economic, and technical points of view.

Science Problem Solving Seminar I
Fall, Spring. (2-2-0) P.M.: (MTH 1825 or concurrently MTH 116 or concurrently or MTH 132 or concurrently) R: Approval of college.
Problem solving principles and strategies used in the disciplines of science and mathematics. Activities reflecting the types of problems encountered.

Science Problem Solving Seminar II
Spring. (2-2-0) P.M.: (NSC 201) R: Approval of college.
Continuation of NSC 201.

Drew Laboratory Directed Studies
Fall, Spring, Summer. 1 to 2 credits. A student may earn a maximum of 6 credits in all enrollments for this course. P.M.: (NSC 202) R: Open only to Drew laboratory students.
Using topics related to a faculty member's ongoing research, students explore the relationship between science and technology and social issues.

Science for Elementary Schools
Fall, Spring. (3-3-0) RB: Completion of an ISB and ISBL or ISP and ISPBL course. Completion of the majority of complementary studies coursework in science and math. R: Open only to students in the Elementary Teacher Education Program.
Topics in earth science, life science, and physical science explored through discussion, demonstrations, readings, presentations, and field trips.

Introduction to Theory and Applications of Modern Microscopy
Spring. (2-1-2) R: Open only to juniors or seniors.

Special Problems
Fall, Spring. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Approval of department.
Faculty directed individualized study of an interdisciplinary problem.

Science Laboratories for Secondary Schools (W)
Fall. (4-2-6) R: Open only to seniors in the BA degree in Chemistry, or the BS degree in Biological Science-Interdepartmental or Earth Science-Interdepartmental or General Science-Interdepartmental or Physical Science-Interdepartmental major or their associated LBS majors. Laboratory equipment, supplies, demonstrations, exercises, and safety. Care of live organisms. Disposal of biological and chemical wastes. Field trips required.

Ecology, Law and Economics
Spring. (3-3-0) P.M.: (EC 201) R: Approval of college.
Review and integrate principles of ecology, fundamentals of law, and principles of economics into a conceptual model that describes interrelations among the natural system, the economy, and the state. Analyze and assess the legal-economic natural resource and environmental policies in the context of the integrated model. Relate the ecology-law-economics model to emerging paradigms of sustainable development, ecological economics, industrial ecology, and the Natural Step.

Special Problems
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Approval of department.
Faculty directed individualized study of an interdisciplinary problem.

Selected Topics
Fall, Spring. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Approval of department.
Selected interdisciplinary topics not normally covered in other courses.

Capstone in Human Biology (W)
Fall, Spring. (2-2-0) P.M.: Completion of Tier I writing requirement. R: Open only to seniors in the Human Biology major. Integration of human biology disciplines with a focus on health and disease.
Directed Study in Human Biology
Fall, Spring, Summer. 1 to 3 credits. P:M: Completion of Tier I writing requirement. Directed studies in human biology.

Internship in Human Biology
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. P:M: Completion of Tier I writing requirement. Practical experience applying human biology training outside the classroom setting.

Research in Human Biology
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. P:M: Completion of Tier I writing requirement. Research in faculty laboratories.

Research
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to juniors or seniors in the College of Natural Science with a teacher certification option. Research in faculty laboratories. Oral and written presentations.

Special Problems for K-8 Teachers
Fall, Spring, Summer. 1 to 5 credits. A student may earn a maximum of 10 credits in all enrollments for this course. R: Elementary teacher certification, 3 years teaching experience. Approval of department. Supervised study of problems in biological, physical, or earth sciences.

Physical Science I
Summer. 2 credits. R: Elementary teacher certification, 3 years teaching experience. The nature of matter and energy including energy transfer, density, and conservation of mass. Properties of elements, mixtures, and compounds.

Physical Science II
Summer. 2 credits. R: Elementary teacher certification, 3 years teaching experience. Electricity and magnetism, force and motion, heat and temperature, sound, and light.

Earth Science I
Summer. 2 credits. R: Elementary teacher certification, 3 years teaching experience. Approval of college. The solar system, including the sun, planets, earth, and its moon. Weather and the water cycle.

Earth Science II
Summer. 2 credits. R: Elementary teacher certification, 3 years teaching experience. Approval of college. Rocks, minerals, and fossils and the physical and geological processes that form them.

Life Science I
Summer. 2 credits. R: Elementary teacher certification, 3 years teaching experience. Approval of college. Structure, function, genetics, and classification of organisms, including protists, plants, animals, and decomposers.

Life Science II
Summer. 2 credits. R: Elementary teacher certification, 3 years teaching experience. Approval of college. Interrelationships among and between organisms and their surroundings. Ecosystems, habitats, food chains, cycles, and pollution.

Problems in Biological or Physical Science for Teachers
Fall, Spring, Summer. 1 to 8 credits. A student may earn a maximum of 8 credits in all enrollments for this course. R: Teacher Certification required. Approval of college. Supervised study of problems in biological or physical science.

Essentials of Electron Microscopy
Fall, Spring, 2(2-0) Principles of operation and uses of transmission and scanning electron microscopy. Related electron beam instruments. Specimen preparation and analytical methods.

Transmission Electron Microscopy Laboratory
Fall, Spring, Summer. 3(1-4) P:M: (NSC 802) Use of transmission microscope and preparative equipment. Preparation techniques for specimens, photographic and darkroom use, and interpretation of micrographs.

Scanning Electron Microscopy; Energy Dispersive X-ray Microanalysis
Fall, Spring, 3(2-2) P:M: (NSC 802 or concurrently) Use of scanning electron microscope and energy dispersive x-ray microanalysis. Machine variables, artifacts, quantitative analysis, specimen preparation, darkroom procedures.

Special Problems in Electron Microscopy
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 40 credits in all enrollments for this course. P:M: (NSC 802) and (NSC 810 or NSC 820) Use of electron microscopy techniques for selected research topics.

Nature and Practice of Science
Fall, Spring. 1 credit. Foundations of scientific inquiry. Recommended scientific best-practices including principles and practices of research integrity and professionalism. Evaluation of scientific quality and productivity.

Confocal Microscopy

Writing in the Sciences
Fall, Spring, Summer. 2(2-0) A student may earn a maximum of 6 credits in all enrollments for this course. Interdepartmental with Arts and Letters. Discussion and critique of students' writing in peer response workshop groups.

Cell and Molecular Biology
Summer. 2 credits. P:M: Secondary certification in biology, 3 years teaching experience. R: Secondary certification in biology, 3 years teaching experience; approval of college. Molecular basis of structure and function of cells. Protein structure and function, cell physiology, metabolic energy and transmission of genetic information.

Cell and Molecular Biology Laboratory

Interdisciplinary Seminar in Biological Science
Fall, Spring, Summer. 1 credit. P:M: Secondary certification in biology; 3 years teaching experience. R: Approval of college. Interrelationships of biological science and technology. Role of society in regulation of research and technological innovations.

Environmental and Behavioral Biology
Summer. 3 credits. Spring: Given only at W.K. Kellogg Biological Station. P:M: Secondary certification in biology; 3 years teaching experience. R: Approval of college. Biotic and abiotic features of lakes, streams, forest ecosystems, and microbial ecosystems.

Environmental and Behavioral Biology Laboratory
Summer. 3 credits. Summer: Given only at W.K. Kellogg Biological Station. P:M: Secondary certification in biology, 3 years teaching experience. R: Approval of college. Laboratory and field examinations of lake, stream and forest ecosystems.

Problem Solving Techniques in Physical Science
Summer. 3 credits. P:M: (NSC 861 and NSC 862 and NSC 863) R: Secondary certification in chemistry or physics or earth science or physical science, 3 years teaching experience. Approval of college. Measurement and analysis of chemical, physical, and geological phenomena.

Chemistry for Teachers
Summer. 2 credits. P:M: Secondary certification in chemistry or physics or earth science or physical science, 3 years teaching experience. R: Approval of college. Intensive lecture and laboratory study of basic chemistry from a modern viewpoint.

Physics for Teachers
Summer. 2 credits. P:M: Secondary certification in chemistry or physics or earth science or physical science, 3 years teaching experience. R: Approval of college. Intensive lecture and laboratory study of basic physics from a modern viewpoint.
### NEUROLOGY AND OPHTHALMOLOGY

#### NEUROLOGY AND OPHTHALMOLOGY NOP

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<td>Medical Neuroscience</td>
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#### Department of Neurology and Ophthalmology

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### Neurology Clerkship

**Fall, Spring, Summer. 1 to 12 credits.** A student may earn a maximum of 12 credits in all enrollments for this course. **R:** Open only to inservice K-12 teachers with baccalaureate degrees. Research in faculty laboratories. Oral and written presentations.

### Master's Thesis Research

**Fall, Spring, Summer. 1 to 8 credits.** A student may earn a maximum of 10 credits in all enrollments for this course. **R:** Open only to master's students in the College of Natural Science. Approval of college. Master's thesis research.

### Neurology Clerkship

**Fall, Spring, Summer. 1 to 2 credits.** A student may earn a maximum of 12 credits in all enrollments for this course. **R:** Open only to students with secondary teacher certification in chemistry or physics or earth science or physical science or biology and 3 years of teaching experience. Approval of college. Weekend workshops with research faculty exploring background and latest findings in their area of research.

### Neurology Clerkship

**Fall, Spring, Summer. 1 to 2 credits.** A student may earn a maximum of 12 credits in all enrollments for this course. **R:** Open only to graduate-professional students in the College of Osteopathic Medicine. Completion of &mester 6 in the graduate-professional program. Study in general or specialty neurology and ophthalmology.

### Neurology Clerkship

**Fall, Spring, Summer. 1 to 2 credits.** A student may earn a maximum of 12 credits in all enrollments for this course. **R:** Open only to graduate-professional students in the College of Osteopathic Medicine upon completion of Units I and II. **SA:** PMR 656 Clinical exposure in neurology. Program structure developed to achieve proficiency in motor skills, aptitudes; comprehension of concepts and principles; patient evaluation, diagnosis, management, and therapy.

### Medical Neuroscience

**Spring. 4(3-2) Interdepartmental with Physiology; Radiology; Human Anatomy.** **R:** Graduate-professional students in colleges of Human Medicine and Osteopathic Medicine. **SA:** ANT 552 Correlation of normal structure and function of the human nervous system with clinical testing, classical lesions, and common diseases.

### Special Topics in Clinical Neuroscience

**Fall, Spring, Summer. 1 to 3 credits.** A student may earn a maximum of 12 credits in all enrollments for this course. **R:** Open only to doctoral students in the Neuroscience major. Methods of neuroscience research and the underlying principles on which these methods are based.

### Advanced Behavioral Neuroscience

**Spring. 3(3-0) Interdepartmental with Psychology.** **R:** Approval of Department of Psychology. **P:** NM: (PSY 894 or concurrently) **P:** NM: (PHM 827 and ANT 839 and PSY 811) **R:** Open only to doctoral students in the Neuroscience major.

### Advanced Neurology Techniques

**Laboratory. Summer. 3(0-9) Interdepartmental with Psychology; Pharmacology and Toxicology; Radiology; Physical Medicine and Rehabilitation.** **P:** NM: (NEU 894 or concurrently) **R:** Open only to graduate students in the Psychology and Neuroscience major.

### Physiology and Pharmacology of Excitable Cells

**Fall. 4(4-0) Interdepartmental with Pharmacology; Toxicology; Physiology; Zoology.** **R:** Approval of Department of Pharmacology and Toxicology. **R:** (PSL 431 or PSL 432 or BMB 461 or ZOL 402) **R:** Open only to graduate students in the Neuroscience major.

### Advanced Neurosciences Techniques

**Intensive lecture and laboratory study of basic earth sciences from a modern viewpoint.**

### Frontiers in Physical Science

**Fall, Spring, Summer. 1 to 4 credits.** A student may earn a maximum of 40 credits in all enrollments for this course. **R:** Open only to students with secondary teacher certification in chemistry or physics or earth science or physical science or biology and 3 years of teaching experience. Approval of college. Weekend workshops with research faculty exploring background and latest findings in their area of research.

### Frontiers in Biological Science

**Fall, Spring, Summer. 1 to 4 credits.** A student may earn a maximum of 36 credits in all enrollments for this course. **R:** Secondary certification in chemistry or physics or earth science or physical science or biology and 3 years of teaching experience. Approval of college. Weekend workshops with research faculty exploring background and latest findings in their area of research.

### Neuroscience Research Forum

**Fall, Spring, Summer. 1(1-0) A student may earn a maximum of 8 credits in all enrollments for this course.** **R:** Bachelor's degree in a Biological Science or Psychology. **R:** Open only to graduate students in the Neuroscience major.

### Independent Study in Neuroscience

**Fall, Spring, Summer. 1 to 4 credits.** A student may earn a maximum of 12 credits in all enrollments for this course. **R:** Bachelor's degree in neuroscience, biology, psychology, or related area. Supervised student research on a specialized research topic in basic or clinical neuroscience.

### Doctoral Dissertation Research

**Fall, Spring, Summer. 1 to 24 credits.** A student may earn a maximum of 99 credits in all enrollments for this course. **R:** Open only to doctoral students in the Neuroscience major.

### Neurosciences

**Fall. 202 Introduction to Nursing Practice I.** **Fall. 3(2-3) R:** Open only to students in the College of Nursing except students in PreNursing and Registered Nurses. Theoretical concepts of nursing necessary for professional practice. Assessment, interpersonal communication, documentation and decision-making.

### Neurosciences

**Fall, Spring, Summer. 1 to 12 credits.** A student may earn a maximum of 24 credits in all enrollments for this course. **R:** Open only to graduate-professional students in the College of Osteopathic Medicine. Completion of &mester 6 in the graduate-professional program. Study in general or specialty neurology and ophthalmology.

### Neurosciences

**Fall, Spring, Summer. 1 to 24 credits.** A student may earn a maximum of 12 credits in all enrollments for this course. **R:** Open only to students with secondary teacher certification in chemistry or physics or earth science or physical science or biology and 3 years of teaching experience. Approval of college. Weekend workshops with research faculty exploring background and latest findings in their area of research.

### Neurosciences

**Fall, Spring, Summer. 1 to 8 credits.** A student may earn a maximum of 10 credits in all enrollments for this course. **R:** Open only to inservice K-12 teachers with baccalaureate degrees. Research in faculty laboratories. Oral and written presentations.

### Neurosciences

**Fall, Spring, Summer. 1 to 8 credits.** A student may earn a maximum of 10 credits in all enrollments for this course. **R:** Open only to graduate students in the College of Natural Science. Approval of college. Master's thesis research.

### Neurosciences

**Fall, Spring, Summer. 1 to 4 credits.** A student may earn a maximum of 40 credits in all enrollments for this course. **R:** Open only to students with secondary teacher certification in chemistry or physics or earth science or physical science or biology and 3 years of teaching experience. Approval of college. Weekend workshops with research faculty exploring background and latest findings in their area of research.