# B.A. IN GENERAL SCIENCE EDUCATION 5-8

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>BIO 120 &amp; BIO 120D</td>
<td>Introduction to Molecular and Cellular Biology and Introduction to Molecular and Cellular Biology Lab</td>
<td>4</td>
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<tr>
<td>PHY 112 &amp; PHY 112D</td>
<td>Introduction to Astronomy and Introduction to Astronomy Lab</td>
<td>4</td>
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<tr>
<td>GEL 168 &amp; GEL 168D</td>
<td>Geology and Geology Lab</td>
<td>4</td>
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<tr>
<td>CHE 113 &amp; CHE 113D</td>
<td>General Chemistry I and General Chemistry I Lab</td>
<td>4</td>
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<tr>
<td>CHE 214 &amp; CHE 215</td>
<td>General Chemistry II and General Chemistry II Lab</td>
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<tr>
<td>PHY 102 &amp; PHY 102D</td>
<td>Physics of Everyday Life and Physics of Everyday Life Lab</td>
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<tr>
<td>MAT 123M or PSY 230M</td>
<td>Precalculus and Introduction to Statistical Methods and Experimental Design</td>
<td>3-4</td>
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<tr>
<td>EDU 200</td>
<td>Introduction to Education</td>
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<tr>
<td>EDU 201</td>
<td>Introduction to Education Field Experience</td>
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<tr>
<td>EDU 203</td>
<td>School Health and Drugs</td>
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<tr>
<td>EDU 220</td>
<td>Introduction to Middle Level Education</td>
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<td>EDU 240</td>
<td>Educational Psychology</td>
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<td>EDU 241</td>
<td>Educational Psychology Field Experience</td>
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<td>EDU 317GZ</td>
<td>Educational Equity</td>
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<tr>
<td>EDU 320</td>
<td>Pedagogy and the Young Adolescent Learner</td>
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<tr>
<td>EDU 321</td>
<td>Integrated Literacy in the Content Areas</td>
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<tr>
<td>EDU 428</td>
<td>Methods in Teaching 5-8 Science</td>
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EDU 429 Science Education Practicum in Grades 5-8 or 5-12 1
EDU 490 Student Teaching Block 14

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
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<tr>
<td></td>
<td>Major</td>
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<td></td>
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<td></td>
<td>Electives 2</td>
<td>10</td>
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<td></td>
<td>Total Credits</td>
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1 In order to meet requirements for endorsements and dual-majors this number is subject to change. Students should consult with their advisor.
2 Since several courses in the major fulfill/meet General Education requirements, students have room for additional electives.

Courses whose number is followed by a letter fulfill a General Education requirement.

Students must earn a grade of C or better in each content area and education course in the major (CHE, PHY, MAT, EDU). Courses with grades of C- or lower must be repeated.

**BIO 100 • Principles of Biology** 3 Credits. Basic principles of modern biology. Topics include the scientific method, biology of the cell, genetic principles, anatomy and physiology of humans, plant biology, and environmental biology. Corequisites: Registration in BIO 100D is required. Offered: Occasionally.

**BIO 100D • Principles of Biology Lab** 1 Credit. Laboratory experience accompanying BIO 100. Corequisites: Registration in BIO 100 is required. Offered: Occasionally.

**BIO 104 • Human Biology** 3 Credits. Study of the biological aspects of the human species. Includes basic molecules of life, human cell biology, tissue types, anatomy and physiology of the 10 systems, human embryology and development, human genetics, nutrition, disease, and health. Corequisites: Registration in BIO 104D is required. Offered: Fall, Spring.

**BIO 104D • Human Biology Lab** 1 Credit. Laboratory experience accompanying BIO 104. Corequisites: Registration in BIO 104 is required. Offered: Fall, Spring.
**BIO 105 • Medical Terminology** 2 Credits.
Study of medical terms. Students study material independently and take proctored examination to demonstrate knowledge of medical language.
Prerequisites: Permission of instructor. Offered: Fall, Spring

**BIO 114D • Introduction to Biodiversity, Ecology, and Adaptation** 4 Credits.
An introduction to the diversity, interrelationships, and origins of living organisms. Focuses on three themes: an overview of kinds and diversity of organisms found in six kingdoms, the interaction of organisms with each other and their environment, and the change of organisms through time.
Offered: Occasionally.

**BIO 120 • Introduction to Molecular and Cellular Biology** 3 Credits.
An introduction to cellular and subcellular aspects of living organisms. Includes a study of basic chemistry, biological molecules, cells, enzymes, metabolism, classical genetics, and molecular genetics.
Corequisites: Registration in BIO 120D is required.
Offered: Fall, Spring. Special Notes: This course is intended for Nursing and other science related majors.

**BIO 120D • Introduction to Molecular and Cellular Biology Lab** 1 Credit.
Laboratory experience accompanying BIO 120.
Corequisites: Registration in BIO 120 is required.
Offered: Fall, Spring.

**BIO 122 • Introduction to Organismic Biology** 3 Credits.
An introduction to how living things work. Focuses on two main themes: the correlation between structure and function, and the capacity of organisms to adjust their internal environment in response to short-term and long-term fluctuations in the external environment.
Corequisites: Registration in BIO 122D is required.
Offered: Fall, Spring.

**BIO 122D • Introduction to Organismic Biology Lab** 1 Credit.
Laboratory experience accompanying BIO 122.
Corequisites: Registration in BIO 122 is required.
Offered: Fall, Spring.

**BIO 124 • Integrative Biology: Genes, Cells, Change** 3 Credits.
In a complex world, understanding challenges like infectious disease or environmental change requires a fundamental knowledge of biology. Using relevant examples, students will explore molecules, DNA, biotechnology, evolution, populations, ecosystems, disease, and human systems (e.g. digestive, immune) to gain a perspective on global health and personal responsibility to life.
Prerequisites: Declared major in Biology, Environmental Science, Environmental Studies, Biochemistry/Molecular Biology, Neuroscience, or Secondary Education Life Science OR a declared minor in Biology. Corequisites: BIO 124D. Offered: Fall, Spring.

**BIO 124D • Integrative Biology: Genes, Cells, Change Lab** 1 Credit.
Laboratory experience accompanying BIO 124.
Corequisites: BIO 124. Offered: Fall, Spring.

**BIO 126 • Integrative Biology and Global Health** 3 Credits.
Cancer. Climate change. Infectious disease. These are some of the challenges before biologists; challenges that require knowledge and skills that are not confined to one sub-discipline to solve. Through real world, case-based problems encompassing cells to ecosystems, this course unpacks what it means to be a biologist today. Concepts include genetics, evolution, population, community and ecosystem ecology and global change.
Corequisites: Registration in BIO 127 is required.
Offered: Fall.

**BIO 127 • Integrative Biology and Global Health Lab** 1 Credit.
Laboratory experience accompanying BIO 126.
Corequisites: Registration in BIO 126 is required.
Offered: Fall.
BIO 128 • Integrative Biology: Metabolism, Energy, Biodiversity 3 Credits.
Living organisms face challenges requiring them to either adapt, move, acclimate or perish. Through real-world examples, students will gain a fundamental understanding of homeostasis, enzymes, metabolism, energy flow, movement, human systems (e.g., circulatory, nervous, excretory), photosynthesis, cellular respiration, extinction, biodiversity, transformation of matter and acclimation.
Prerequisites: Declared major in Biology, Environmental Science, Environmental Studies, Biochemistry/Molecular Biology, Neuroscience, or Secondary Education: Life Science OR Declared minor in Biology. Corequisites: Concurrent registration in BIO 128D is required. Offered: Fall, Spring.

BIO 128D • Integrative Biology: Metabolism, Energy, Biodiversity Lab 1 Credit.
Laboratory experience accompanying BIO 128. Corequisites: BIO 128. Offered: Fall, Spring.

BIO 130 • Introduction to Neuroscience 3 Credits.
An introduction to the biological basis of behavior. Focuses on two main themes: the cellular, molecular, and genetic processes that form the foundation of nervous system function and the systems-level organization of the nervous system that forms the foundation of human and animal behavior.
Corequisites: Registration in BIO 130D is required. Offered: Spring. Special Notes: Carries cross-credit in Psychology and Neuroscience.

BIO 130D • Introduction to Neuroscience Lab 1 Credit.
Laboratory experience accompanying BIO 130. Corequisites: Registration in BIO 130 is required. Offered: Spring. Special Notes: Carries cross credit with Neuroscience and Psychology.

BIO 132 • The Science of Birds 3 Credits.
An overview of the Minnesota avifauna and bird biology. Bird identification is discussed and practiced in the field. Selected topics from bird biology (migration, flight, reproduction, behavior, food, and conservation) are presented through lectures, numerous slide shows, and videos. These topics provide an introduction to the prevailing themes in modern biology.
Corequisites: Registration in BIO 132D is required. Offered: Occasionally Spring.

BIO 132D • The Science of Birds Lab 1 Credit.
Laboratory experience accompanying BIO 132. Corequisites: Registration in BIO 132 is required. Offered: Occasionally Spring.

BIO 214 • Human Anatomy 3 Credits.
Detailed study of the anatomy and histology of the human body in relation to its functional systems. Laboratory includes human cadaver dissections.
Prerequisites: One of the following: BIO 104/104D, BIO 120/120D, BIO 122/122D, BIO 124/124D, BIO 128/128D. Corequisites: Registration in BIO 215 is required. Special Notes: Not open to students who have taken BIO 238/239 except by department consent. Offered: Fall.

BIO 215 • Human Anatomy Lab 1 Credit.
Laboratory experience accompanying BIO 214. Corequisites: Registration in BIO 214 is required. Offered: Fall.

BIO 216 • Human Physiology 3 Credits.
Integration of basic principles of cell biology and mechanisms of physiology to the functions of the major organ systems of the human body; centered around the theme of homeostasis.
Prerequisites: BIO 214/215; One of the following: BIO 104/104D, BIO 120/120D, BIO 218. Corequisites: Registration in BIO 217 is required. Special Notes: Not open to students who have taken BIO 238/239 except by department consent and a course in chemistry is a recommended prerequisite. Offered: Spring.

BIO 217 • Human Physiology Lab 1 Credit.
Laboratory experience accompanying BIO 216. Corequisites: Registration in BIO 216 is required. Offered: Spring.

BIO 218 • Biology in a Changing World 3 Credits.
Through the exploration of interactions between genes and their environments, students articulate integrative topics (e.g., evolution, transformation of matter, and energy, information flow, systems and structure/function), identify career options and desired skill sets, make a growth plan and articulate an intellectual autobiography, including faith integration.
Prerequisites: BIO 124/124D; BIO 128/128D. Offered: Fall, Spring.
BIO 234 • Microbiology 3 Credits.
Microorganisms and viruses with respect to their structure, physiology, genetics, identification, control, host-microbe relationships, and exploitation by humans. Topics include pathogenic organisms, the infectious diseases they cause, and the events and products of vertebrate immune responses.
Prerequisites: One of the following: BIO 218 (may be taken concurrently), BIO 120/120D; One course in chemistry (A second course in chemistry is recommended). Corequisites: Registration in BIO 235 is required. Offered: Spring.

BIO 235 • Microbiology Lab 1 Credit.
Laboratory experience accompanying BIO 234. Corequisites: Registration in BIO 234 is required. Offered: Spring.

BIO 238 • Human Anatomy and Physiology 3 Credits.
Anatomy and physiology of the human body, with a major emphasis on the principle of homeostasis.
Prerequisites: One of the following: BIO 104/104D, BIO 120/120D, BIO 218, (may be taken concurrently). Corequisites: Registration in BIO 239 is required. Special Notes: A course in chemistry is a recommended prerequisite. Not open to students who have taken BIO 214/215, BIO 216/217. Offered: Spring.

BIO 239 • Human Anatomy and Physiology Lab 1 Credit.
Laboratory experience accompanying BIO 238. Corequisites: Registration in BIO 238 is required. Offered: Spring.

BIO 244 • Pathophysiology and Pharmacology 3 Credits.
An integrated exploration of disease processes and the drugs used to treat them. The functional and structural changes that accompany a particular injury, disease, or syndrome are correlated with the study of drugs and their actions on the body.
Prerequisites: BIO 214/215; BIO 216/217 (may be taken concurrently); BIO 218, (may be taken concurrently); two semesters of Chemistry. Corequisites: Registration in BIO 245 is required. Offered: Spring.

BIO 245 • Pathophysiology and Pharmacology Lab 1 Credit.
Laboratory experience accompanying BIO 244. Corequisites: Registration in BIO 244 is required. Offered: Spring.

BIO 248 • Clinical Pathophysiology and Pharmacology 3 Credits.
An integrated exploration of disease processes and the drugs used to treat them. The functional and structural changes that accompany a particular injury, disease, or syndrome are correlated with the study of drugs and their actions on the body.
Prerequisites: Acceptance into the Nursing program or consent of instructor. Corequisites: Registration in BIO 249 is required. Offered: Spring. Special Notes: Not open to students who have taken BIO 244/245.

BIO 249 • Clinical Pathophysiology and Pharmacology Lab 1 Credit.
Laboratory experience accompanying BIO 248. Corequisites: Registration in BIO 248 is required. Offered: Spring.

BIO 316 • Wildlife Ecology and Management 3 Credits.
Analysis of terrestrial vertebrate populations, communities, and habitats. Exploration of how these analyses are applied to the manipulation, exploitation, protection, and restoration of animal populations and communities.
Prerequisites: BIO 218 (may be taken concurrently) or two of BIO 122/122D, BIO 128/128D, ENS 104/104D; Junior or senior standing. Corequisites: Concurrent registration in BIO 317 is required. Special Notes: Carries cross-credit in environmental science. Offered: Spring, even # years.

BIO 317 • Wildlife Ecology and Management Lab 1 Credit.
Laboratory experience accompanying BIO 316. Includes some outdoor and off-campus investigations. Corequisites: Registration in BIO 316 is required. Offered: Spring, even # years.

BIO 318KZ • Ecology in the Tropics: Natural History and Future Prospects 4 Credits.
Travel in Kenya or Ecuador surveying the land, climate, plants, animals, homes, transportation, and industries, noting especially the impact of human presence. Ecuador includes the Amazon rainforest, Andean cloud forests, volcanic mountains, highlands, towns, cities, and the Galapagos Islands. Kenya includes Nairobi, African savanna, the Rift valley, and Masai Mara.
Prerequisites: Laboratory Science (D) course; Mathematics (M) course. Offered: Interim. Special Notes: Carries cross-credit in environmental science and general studies.
BIO 324 • Human Ecology 3 Credits.
Interrelationships between humans and the natural environment. Overpopulation, resource use, and pollution studied from biological, social, and economic standpoints, and skill development in the critical examination of the impacts of humans and our technology on the natural world. Prerequisites: One year of Chemistry; BIO 218 (may be taken concurrently) or both BIO 122/122D and ENS 104/104D; Junior or senior standing. Corequisites: Registration in BIO 325 is required. Offered: Occasionally.

BIO 325 • Human Ecology Lab 1 Credit.
Laboratory experience accompanying BIO 324. Corequisites: Registration in BIO 324 is required. Offered: Occasionally.

BIO 326 • Vertebrate Histology 3 Credits.
Microscopic structure of cells, tissues, and organs in vertebrate animals, with special emphasis on the way structural units are integrated. At all times efforts are made to correlate structure with specific physiological functions. Prerequisites: BIO 218. Corequisites: Registration in BIO 327 is required. Offered: Spring, odd # years.

BIO 327 • Vertebrate Histology Lab 1 Credit.
Laboratory experience accompanying BIO 326. Corequisites: Registration in BIO 326 is required. Offered: Spring, odd # years.

BIO 328 • Invertebrate Biology 3 Credits.
A survey of invertebrate groups from protozoa to prochordates with emphasis on organizational, functional, and ecological significance. Special attention is given to the morphology, life histories, and physiology of invertebrates within the context of survival in specialized environments. Prerequisites: BIO 218 (may be taken concurrently) or two of the following: BIO 122/122D, BIO 128/128D, ENS 104/104D. Corequisites: Registration in BIO 329 is required. Offered: Spring, odd # years.

BIO 329 • Invertebrate Biology Lab 1 Credit.
Laboratory experience accompanying BIO 328. Corequisites: Registration in BIO 328 is required. Offered: Spring, odd # years.

BIO 330 • Ecology 3 Credits.
Structure and function of wild nature. Topics include interrelationships of organisms with their environments, factors that regulate such interrelationships, and various roles that humans play in modifying patterns and processes of nature at organism, community, and ecosystem levels. Prerequisites: BIO 218 (may be taken concurrently) or two of the following: BIO 122/122D, BIO 126/127, BIO 128/128D, ENS 104/104D. Corequisites: Registration in BIO 331 is required. Special Notes: This is a designated research course. Offered: Fall, odd # years.

BIO 331 • Ecology Lab 1 Credit.
Laboratory experience accompanying BIO 330. Corequisites: Registration in BIO 330 is required. Offered: Fall, odd # years. Special Notes: This is a designated research course.

BIO 332 • Genetics 3 Credits.
Principles that control inheritance, with examples chosen from plant and animal research, population genetics, cytogenetics, molecular genetics, and current work on human genetics. Prerequisites: BIO 218 (may be taken concurrently) or BIO 120/120D; Two courses in chemistry. Corequisites: Registration in BIO 333 is required. Offered: Fall.

BIO 333 • Genetics Lab 1 Credit.
Laboratory experience accompanying BIO 332. Corequisites: Registration in BIO 332 is required. Offered: Fall.

BIO 336 • Entomology and Parasitology 3 Credits.
A comparative study of the major invertebrate groups from anatomical, physiological, and ecological perspectives with attention to insects and parasitic invertebrates. Prerequisites: BIO 218 (may be taken concurrently) or two of the following: BIO 122/122D, BIO 128/128D, ENS 104/104D. Corequisites: Registration in BIO 337 is required. Offered: Occasionally.

BIO 337 • Entomology and Parasitology Lab 1 Credit.
Laboratory experience accompanying BIO 336. Corequisites: Registration in BIO 336 is required. Offered: Occasionally.
BIO 338 • Endocrinology 3 Credits.
Processes by which hormones exert control over many aspects of reproduction, development, growth, metabolism, and behavior. Topics include the chemical nature of hormones, receptors and signaling pathways, morphology and histology of endocrine organs, regulation of hormone synthesis and secretion, and mechanism of action in target tissues.
Prerequisites: BIO 218 (may be taken concurrently) or BIO/NSC/PSY 130/130D; BIO 120/120D; BIO 122/122D. Corequisites: Registration in BIO 339 is required. Offered: Fall, even # years. Special Notes: A course in physiology is a recommended prerequisite.

BIO 339 • Endocrinology Lab 1 Credit.
Laboratory experience accompanying BIO 338. Work is largely experimental, using bioassay procedures.
Corequisites: Registration in BIO 338 is required. Offered: Fall, even # years.

BIO 342 • Aquatic Biology 3 Credits.
Biological and physical aspects of natural, freshwater ecosystems, including fish and other aquatic animals, aquatic plants, algae, and their interrelationships with each other and the unique aqueous environment in which they live.
Prerequisites: BIO 218 (may be taken concurrently) or two of the following: BIO 122/122D, BIO 128/128D, ENS 104/104D. Corequisites: Registration in BIO 343 is required. Offered: Fall, even # years.

BIO 343 • Aquatic Biology Lab 1 Credit.
Laboratory experience accompanying BIO 342. Includes some outdoor and off-campus investigations.
Corequisites: Registration in BIO 342 is required. Offered: Fall, even # years.

BIO 346 • Animal Behavior 3 Credits.
Behavior from primitive invertebrates to advanced mammals, highlighting trends in behavior systems. Natural setting studies in the ethology tradition, comparative psychology studies, and biosociological principles with their implications for human social systems.
Prerequisites: PSY 100 or BIO 218 (may be taken concurrently); Junior or senior standing. Corequisites: Registration in BIO 347 is required. Special Notes: Carries cross-credit in psychology. Offered: Fall, even # years.

BIO 347 • Animal Behavior Lab 1 Credit.
Laboratory experience accompanying BIO 346. Corequisites: Registration in BIO 346 is required. Offered: Fall, even # years.

BIO 354 • Cell Biology 3 Credits.
The molecular organization and function of cells and their organelles. Understanding how cell biology information is obtained experimentally.
Prerequisites: Two courses in Chemistry (CHE 224 recommended); BIO 218 (may be taken concurrently) or BIO 332/333 or both PSY 100 and BIO/PSY/NSC 130/130D. Corequisites: Registration in BIO 355 is required. Special Notes: This is a designated research course. Offered: Spring.

BIO 355 • Cell Biology Lab 1 Credit.
Laboratory experience accompanying BIO 354. Corequisites: Registration in BIO 354 is required. Offered: Spring. Special Notes: This is a designated research course.

BIO 358 • Neurobiology 3 Credits.
Nervous system of animals and humans. Includes comparative anatomy and physiology of humans with other vertebrates and invertebrates, as well as interactions of sensory, motor, and integrative mechanisms of nervous system control.
Prerequisites: BIO 218 (may be taken concurrently) or PSY 100 and BIO/NSC/PSY 130/130D; Junior or senior standing. Corequisites: Registration in BIO 359 is required. Offered: Fall, even # years.

BIO 359 • Neurobiology Lab 1 Credit.
Laboratory experience accompanying BIO 358. Corequisites: Registration in BIO 358 is required. Offered: Fall, even # years.

BIO 362 • Developmental Biology 3 Credits.
The basic question of developmental biology is “How does a single fertilized egg give rise to all the different cell, tissue, and organ types of the adult organism?” The developmental processes that give rise to these different cell, organ, and tissue types along with the mechanisms underlying those processes are studied at the cellular, genetic, molecular, and biochemical levels.
Prerequisites: BIO 120/120D or BIO 124/124D; BIO 218 (may be taken concurrently) or 8 credits of BIO courses not including BIO 124/124D and BIO 128/128D; Two courses in chemistry. Corequisites: Registration in BIO 363 is required. Special Notes: This is a designated research course. Offered: Spring, even # years.
BIO 363 • Developmental Biology Lab 1 Credit.
Laboratory experience accompanying BIO 362. Includes surgical manipulation of living organisms to elucidate developmental principles. Corequisites: Registration in BIO 362 is required. Offered: Spring, even # years. Special Notes: This is a designated research course.

BIO 368 • Structure and Development of Vertebrates 3 Credits.
An integrated and systematic approach to descriptive embryology and comparative anatomy of vertebrate species. Prerequisites: BIO 218 (may be taken concurrently). Corequisites: Registration in BIO 369 is required. Offered: Fall, odd # years.

BIO 369 • Structure and Development of Vertebrates Lab 1 Credit.
Laboratory experience accompanying BIO 368. Observational studies of live embryos, microscopic examination of representative vertebrate embryos, and dissection of representative vertebrate types. Corequisites: Registration in BIO 368 is required. Offered: Fall, odd # years.

BIO 372 • Plant Taxonomy and Ecology 3 Credits.
Identification and distribution of flowering plants, including field work, keying, and laboratory preservation. Biogeography and factors important in plant distribution. Prerequisites: BIO 218 (may be taken concurrently) or two of the following: BIO 122/122D, BIO 126/127, BIO 128/128D, ENS 104/104D. Corequisites: Registration in BIO 373 is required. Offered: Fall, odd # years.

BIO 373 • Plant Taxonomy and Ecology Lab 1 Credit.
Laboratory experience accompanying BIO 372. Corequisites: Registration in BIO 372 is required. Offered: Fall, odd # years.

BIO 376 • Animal Physiology 3 Credits.
Comparative physiology of animal nerves, muscles, hormones, circulation, respiration, excretion, digestion, and the way those systems function intact with processes of feeding, energetics, osmoregulation, metabolism, locomotion, biomechanics, and temperature regulation necessary for an organism's survival. Prerequisites: Two courses in Chemistry; BIO 218 (may be taken concurrently) or both PSY 100 and BIO/NSC/PSY 130/130D. Corequisites: Registration in BIO 377 is required. Offered: Spring, even # years.

BIO 377 • Animal Physiology Lab 1 Credit.
Laboratory experience accompanying BIO 376. Corequisites: Registration in BIO 376 is required. Offered: Spring, even # years.

BIO 380 • Environmental Plant Biology 3 Credits.
Exploration of the significant roles plants play in the environment - driving and responding to carbon, water availability, nutrient levels and light. The influence of abiotic factors on photosynthetic pathways, productivity and the movement of matter and energy will reveal how plants respond to rapid environmental changes. Course includes experiences working with data and statistics. Prerequisites: BIO 218 (may be taken concurrently) or two of the following: BIO 122/122D, BIO 126/127, BIO 128/128D, ENS 104/104D; one semester of Chemistry. Corequisites: Registration in BIO 383 is required. Special Notes: This is a designated research course. Offered: Spring, odd # years.

BIO 383 • Environmental Plant Biology Lab 1 Credit.
Laboratory experience accompanying BIO 380. Includes some outdoor and off-campus investigations. Corequisites: Registration in BIO 380 is required. Offered: Spring, odd # years. Special Notes: This is a designated research course.

BIO 384 • Immunology 3 Credits.
Study of the molecular and cellular mechanisms that allow organisms to recognize, control, and eliminate “nonself” entities such as bacterial pathogens, foreign tissue grafts, and even transformed (cancerous) cells. Prerequisites: Two semesters of Chemistry and either BIO 218 (may be taken concurrently) or BIO 120/120D and BIO 122/122D. (One of the following: BIO 234/235, BIO 332/333, BIO 354/355 is strongly recommended). Corequisites: Registration in BIO 387 is required. Special Notes: This is a designated research course. Offered: Fall, odd # years.

BIO 387 • Immunology Lab 1 Credit.
Laboratory experience accompanying BIO 384. Corequisites: Registration in BIO 384 is required. Offered: Fall, odd # years. Special Notes: This is a designated research course.
BIO 388 • Biochemistry I 3 Credits.
Physical and chemical properties of living systems with an emphasis on macromolecular interaction, structure, and function. Structure, classification, purification, and function of nucleic acids, proteins, carbohydrates, and lipids, including membrane transport and enzymology. 
Prerequisites: BIO 120/120D or BIO 124/124D; CHE 226/227 (BIO 128/128D recommended).
Corequisites: Registration in BIO 389 is required.
Special Notes: Not open to students who have taken CHE 304/305, Carries cross-credit in chemistry.
Offered: Fall.

BIO 389 • Biochemistry I Lab 1 Credit.
Laboratory experience accompanying BIO 388. Techniques include spectroscopy, chromatography, centrifugation, electrophoresis, and enzyme kinetics.
Corequisites: Registration in BIO 388 is required.
Offered: Fall.

BIO 396 • Molecular Biology 3 Credits.
Modern advanced molecular genetic research. Topics covered include regulation of gene expression during development, molecular biology of cancer, animal virology, eukaryotic gene organization, and methods in gene manipulation.
Prerequisites: BIO 332/333; one additional biology course; CHE 224/225; CHE 226/227. Corequisites: Registration in BIO 397 is required 
Special Notes: This is a designated research course.
Offered: Spring.

BIO 397 • Molecular Biology Lab 1 Credit.
Laboratory experience accompanying BIO 396. Consists of research projects utilizing recombinant DNA/genetic engineering techniques.
Corequisites: Registration in BIO 396 is required.
Offered: Spring. Special Notes: This is a designated research course.

BIO 399 • Introduction to Research 1 Credit.
An introduction to research methodology in the biological sciences, with experience in the use of biological literature and an examination of how to distinguish and evaluate different types of scientific writing and presentations. Experience in the development of a research proposal.
Prerequisites: BIO 218; major in biology or related field; Junior standing. Special Notes: Carries cross-credit in environmental studies.
Offered: Fall, Spring.

BIO 400 • Ultrastructure 3 Credits.
Electron microscopy as a tool in the sciences with emphasis on its use in biological investigation. Students prepare a portfolio of micrographs on a variety of material. Demonstrations, discussions, seminars, field trips, and individual practice.
Prerequisites: BIO 124/124D; Junior or senior standing. Corequisites: Registration in BIO 401 is required. Offered: Occasionally.

BIO 401 • Ultrastructure Lab 1 Credit.
Laboratory experience accompanying BIO 400. Corequisites: Registration in BIO 400 is required. Offered: Occasionally.

BIO 409 • Advanced Human Gross Anatomy 4 Credits.
For the undergraduate pre-health professions student. A regional approach to the study of anatomy through the supervised and directed student dissection of human cadavers. Identification of detailed structures and understanding their significance to the body.
Prerequisites: BIO 214/215 or consent of instructor. 
Offered: Interim.

BIO 481 • Internship in Biology 1-4 Credits.
A learning/practicing experience in which the student applies biological understanding and skills in an off-campus professional setting.
Prerequisites: Major or minor in Biology; Junior or senior standing. Offered: Fall, Spring.

BIO 493 • Literature Review in Biology 1 Credit.
Thorough review of the primary and secondary literature pertaining to a particular question, problem, or phenomenon in the biological sciences. Culminates in written report that is presented orally in BIO 499.
Prerequisites: BIO 399; Senior standing; consent of instructor. Offered: Fall, Spring.

BIO 495 • Biology Seminar 1-2 Credits.
Readings and discussions of topics that relate biology to one's Christian faith.
Prerequisites: BIO 399; Senior standing. Offered: Fall.

BIO 496 • Biology Research 1 Credit.
Students collect original data through independent laboratory research or field research under the supervision of a faculty member.
Prerequisites: BIO 399; Completion or co-completion of a tagged research course; consent of instructor. Special Notes: May be repeated once for credit.
Offered: Fall, Spring.
BIO 497 • Advanced Biology Research 1 Credit.
Working under the supervision of a faculty mentor, students analyze the results of their original research completed in BIO 496 and write up their findings in a formal scientific paper. Results will be presented in class and possibly outside venues.
Prerequisites: BIO 496; consent of instructor.
Offered: Fall, Spring.

BIO 499 • Biology Symposium 1 Credit.
The presentation of scientific research and literature. Culminates in departmental symposium in which students present their original research or literature review.
Prerequisites: BIO 493 or BIO 496. Special Notes: Carries cross-credit in environmental studies.
Offered: Fall, Spring.

CHE 101 • Introduction to Chemistry 3 Credits.
Overview of atoms—their composition, their ability to form bonds, and their ability to interact as molecules. Designed for nursing and allied health fields.
Corequisites: Registration in CHE 101D is required.
Offered: Fall, Spring.

CHE 101D • Introduction to Chemistry Lab 1 Credit.
Laboratory experience accompanying CHE 101. Provides a hands-on extension of course topics in a collaborative, laboratory environment. Topics include: reactions, thermodynamics, acids and bases, nuclear decay, and others.
Corequisites: Registration in CHE 101 is required.
Offered: Fall, Spring.

CHE 107 • Modern Alchemy: Chemistry for Non-Scientists 3 Credits.
The chemical world including, for example, food, agriculture, household chemicals, plastics, drugs, environmental concerns, and energy production. An overview of chemical concepts with an emphasis on applications of chemistry and their implications for society.
Corequisites: Registration in CHE 107D is required.
Offered: Interim.

CHE 107D • Modern Alchemy: Chemistry for Non-Scientists Lab 1 Credit.
Laboratory experience accompanying CHE 107.
Corequisites: Registration in CHE 107 is required.
Offered: Interim.

CHE 113 • General Chemistry I 3 Credits.
Chemical properties and principles, structure and reactivity, stoichiometry, thermodynamics, atomic and molecular theory, and states of matter. Laboratory includes application of these principles in exploring chemical properties and reactivity, and computer data collection and modeling.
Prerequisites: Two years of High school Math; High school Chemistry or consent of instructor.
Corequisites: Registration in CHE 113D is required.
Offered: Fall

CHE 113D • General Chemistry I Lab 1 Credit.
Laboratory experience accompanying CHE 113 to improve experimental skills such as accurate observation, data collection, and analysis while mastering techniques used by chemists for the precise measurements of mass, volume, and concentration. Small group collaboration and experimental design are included.
Corequisites: Registration in CHE 113 is required.
Offered: Fall.

CHE 200 • Laboratory Safety and Chemical Hygiene 1 Credit.
High standards of safety and chemical hygiene make the science laboratory a safe, comfortable, interesting place to work. This course reviews the standards and federal/state guidelines pertaining to safety and hygiene in the laboratory.
Prerequisites: One year of High school Chemistry; one semester of college-level science. Offered: Fall, Spring.

CHE 208 • Accelerated General Chemistry 3 Credits.
Chemical properties and principles, stoichiometry, structure, reactivity, atomic theory, states of matter, solutions, thermodynamics, kinetics, equilibria, acids and bases, electrochemistry, descriptive inorganic chemistry, and nuclear chemistry. Intended for science and engineering students who have a strong math background.
Prerequisites: MAT 124M (may be taken concurrently). Corequisites: Registration in CHE 208D is required.
Offered: Fall. Special Notes: Meets the same requirements of CHE 113/113D and CHE 214/215.

CHE 208D • Accelerated General Chemistry Lab 1 Credit.
Laboratory experience accompanying CHE 208.
Corequisites: Registration in CHE 208 is required.
Offered: Fall.
CHE 214 • General Chemistry II 3 Credits.
Study of solutions, chemical kinetics, thermodynamics, solution equilibria, acids and bases, electrochemistry, descriptive inorganic chemistry, and nuclear chemistry.
Prerequisites: CHE 113/113D. Corequisites: Registration in CHE 215 is required. Offered: Spring

CHE 215 • General Chemistry II Lab 1 Credit.
Laboratory experience accompanying CHE 214.
Corequisites: Registration in CHE 214 is required. Offered: Spring.

CHE 224 • Organic Chemistry I 3 Credits.
Structure, classification, and function of organic compounds; bonding theory, stereochemistry, organic reaction mechanisms, energy relations, and spectroscopy.
Prerequisites: CHE 214/215 or CHE 208/208D. Corequisites: Registration in CHE 225 is required. Offered: Fall

CHE 225 • Organic Chemistry I Lab 1 Credit.
Laboratory experience accompanying CHE 224. Topics include an introduction to organic chemistry laboratory techniques used in the preparation and purification of organic compounds. Infrared spectroscopy, nuclear magnetic, resonance spectroscopy, and computational chemistry techniques are also introduced.
Corequisites: Registration in CHE 224 is required. Offered: Fall

CHE 226 • Organic Chemistry II 3 Credits.
Continuation of CHE 224, in which the structure, nomenclature, function, and reactivity of additional organic compounds are explored. Topics include the reactions of aromatic and carbonyl containing compounds, carbon-carbon bond-forming reactions, multi-step synthesis, and polymer chemistry. The chemistry of biological compounds such as carbohydrates, DNA, proteins, and lipids is also explored.
Prerequisites: CHE 224/225. Corequisites: Registration in CHE 227 is required. Offered: Spring.

CHE 227 • Organic Chemistry II Lab 1 Credit.
Laboratory experience accompanying CHE 226. Laboratory includes single- and multi-step synthesis, purification, and identification of organic compounds. Infrared spectroscopy, 1D and 2D nuclear magnetic resonance spectroscopy, mass spectroscopy, and computational chemistry will be used to explore the outcomes of organic reactions and their mechanisms.
Corequisites: Registration in CHE 226 is required. Offered: Spring.

CHE 234 • Essentials of Biochemistry 3 Credits.
A survey of the structure, function, interactions, and chemical properties of the four major macromolecules: proteins, nucleic acids, lipids, and carbohydrates. Examination of primary metabolic pathways, bioenergetics, regulation, and homeostasis.
Prerequisites: CHE 224/CHE 225; BIO 120/BIO121. Not open to students who have taken BIO 388/BIO 389 or CHE 388/CHE 389. Corequisites: Registration in CHE 305 is required. Offered: Fall

CHE 305 • Essentials of Biochemistry Lab 1 Credit.
Laboratory experience accompanying CHE 304.
Corequisites: Registration in CHE 304 is required. Offered: Fall.

CHE 306 • Advanced Organic Chemistry 3 Credits.
Bonding, kinetics, mechanisms of reactions, stereochemistry, and structure determination of organic compounds.
Prerequisites: CHE 226/227; CHE 344/345. Corequisites: Registration in CHE 307 is required. Offered: Occasionally

CHE 307 • Advanced Organic Chemistry Lab 1 Credit.
Laboratory experience accompanying CHE 306.
Corequisites: Registration in CHE 306 is required. Offered: Occasionally.

CHE 312 • Quantitative Analysis 3 Credits.
Prerequisites: CHE 214/215 or CHE 208/208D. Corequisites: Registration in CHE 313 is required. Offered: Spring.

CHE 313 • Quantitative Analysis Lab 1 Credit.
Laboratory experience accompanying CHE 312.
Corequisites: Registration in CHE 312 is required. Offered: Spring.
CHE 320 • **Instrumental Analysis** 3 Credits. Methods of instrumental analysis. Study of chemical and physical principles and practical application of spectroscopy, spectrometry, chromatography and electroanalysis. Fundamental electronic circuitry and computer data acquisition and control. 
Prerequisites: CHE 312/313 or CHE 226/CHE 227. Corequisites: Registration in CHE 321 is required. Offered: Fall.

CHE 321 • **Instrumental Analysis Lab** 1 Credit. Laboratory experience accompanying CHE 320. Corequisites: Registration in CHE 320 is required. Offered: Fall.

CHE 344 • **Thermodynamics, Kinetics, and Statistical Mechanics** 3 Credits. Physical chemistry of the laws of thermodynamics and their application to phase and chemical equilibria. Chemical kinetics of reaction rates and reaction mechanisms. Statistical mechanics as it relates spectroscopy with thermodynamics and kinetics. 
Prerequisites: CHE 214/215 or CHE 208/208D; PHY 292/292D; PHY 296/297; MAT 125. Corequisites: Registration in CHE 345 is required. Offered: Fall.

CHE 345 • **Thermodynamics, Kinetics, and Statistical Mechanics Lab** 1 Credit. Laboratory experience accompanying CHE 344. Includes hands-on experience with physiochemical systems and computational modeling. Corequisites: Registration in CHE 344 is required. Offered: Fall.

CHE 348 • **Quantum Chemistry and Spectroscopy** 3 Credits. Physical chemistry of the laws of quantum mechanics applied to atoms and molecules. Quantum mechanical solutions of model systems and their application to chemical spectroscopy. 
Prerequisites: CHE 208/208D or CHE 214/215; PHY 292/292D; PHY 296/297; MAT 125. Corequisites: Registration in CHE 349 is required. Offered: Spring.

CHE 349 • **Quantum Chemistry and Spectroscopy Lab** 1 Credit. Laboratory experience accompanying CHE 348. Includes hands-on experience with physiochemical systems and computational modeling. Corequisites: Registration in CHE 348 is required. Offered: Spring.

CHE 364 • **Advanced Inorganic Chemistry** 3 Credits. Chemistry of elements and their compounds, including symmetry, bonding theories, solid-state chemistry, coordination compounds, organometallics, and bioinorganic compounds. 
Prerequisites: CHE 344/345; One year of Organic Chemistry or Junior standing. Corequisites: Registration in CHE 365 is required. Offered: Spring.

CHE 365 • **Advanced Inorganic Chemistry Lab** 1 Credit. Laboratory experience accompanying CHE 364. Laboratory includes synthesis and characterization of inorganic compounds. Corequisites: Registration in CHE 364 is required. Offered: Spring.

CHE 388 • **Biochemistry I** 3 Credits. Physical and chemical properties of living systems with an emphasis on macromolecular interaction, structure, and function. Structure, classification, purification, and function of nucleic acids, proteins, carbohydrates, and lipids, including membrane transport and enzymology. 
Prerequisites: BIO 120/120D or BIO 124/124D; CHE 226/227 (BIO 128/128D recommended). Corequisites: Registration in CHE 389 is required. Offered: Fall. Special Notes: Not open to students who have taken CHE 304/305; Carries cross-credit in biology.

CHE 389 • **Biochemistry I Lab** 1 Credit. Laboratory experience accompanying CHE 388. Topics include: buffers, protein expression and purification, electrophoresis, enzyme kinetics, and additional advanced techniques. Corequisites: Registration in CHE 388 is required. Offered: Fall.

CHE 393 • **Research** 1-4 Credits. Utilization of the techniques and understanding of chemical principles on a term project. Use of original literature to formulate and conduct an original laboratory or computational research project under the supervision of a chemistry faculty member. 
Prerequisites: Consent of department. Repeatable course May only be taken for credit once. Offered: Fall, Interim, Spring.
CHE 395 • Chemistry Seminar: Research and Professional Development 1 Credit.
Students search the chemical literature and develop a proposal for their capstone research project. Discussion of chemical careers, graduate and professional school preparation, and ethical conduct in science.
Prerequisites: CHE 200 (may be taken concurrently); Junior standing; must be a Chemistry or Biochemistry/Molecular Biology major. Offered: Fall.

CHE 396 • Biochemistry II 3 Credits.
Metabolic pathways, bioenergetics, metabolic regulation, and metabolism of macromolecules (carbohydrates, lipids, proteins, and nucleotides). Macromolecular synthesis of RNA, DNA, and proteins, including an introduction to biotechnology.
Prerequisites: CHE 388/389 or BIO 388/389. Corequisites: Registration in CHE 397 is required. Offered: Spring.

CHE 397 • Biochemistry II Lab 1 Credit.
Laboratory experience accompanying CHE 396. Laboratory includes mammalian cell culture techniques and bioassays, and plant biochemical techniques including lipid extraction and analysis. RNA and DNA, molecular cloning, PCR, and gene expression.
Corequisites: Registration in CHE 396 is required. Offered: Spring.

CHE 490 • Chemistry Seminar: Research 2 Credits.
Students pursue an original research project in Chemistry or Biochemistry supported by a faculty mentor. Required time commitment is approximately 3.5 hours per week per credit, including weekly meeting with faculty mentor.
Prerequisites: CHE 395; Consent of instructor. Offered: Fall, Spring.

CHE 491 • Research 1-4 Credits.
Students pursue an original research project in Chemistry or Biochemistry supported by a faculty mentor. Required time commitment is approximately 3.5 hours per week per credit, including weekly meeting with faculty mentor.
Prerequisites: CHE 490; Consent of department. Offered: Fall, Interim, Spring.

CHE 494 • Chemistry Seminar: Research Presentation 1 Credit.
Students prepare and deliver formal presentations of their research results. Seminar meets weekly for discussion of current topics.
Prerequisites: CHE 490. Offered: Fall, Spring

EDU 200 • Introduction to Education 3 Credits.
Contemporary issues in education in the light of history and educational thought. Various aspects of growth and development are included.
Prerequisites: EDU 201; 30 Credits. Offered: Fall, Interim, Spring.

EDU 201 • Introduction to Education Field Experience 1 Credit.
A field experience requiring four hours per week observing and serving in an elementary or secondary school classroom.
Corequisites: EDU 200. Offered: Fall, Interim, Spring. Special Notes: Designated times are set by the Education department.

EDU 203 • School Health and Drugs 2 Credits.
Examines the roles of teachers and schools in responding to adolescent health problems, including alcohol/drug problems, with particular attention to health promotion, prevention, and referral. Approaches adolescent drug/alcohol use from a variety of perspectives—behavioral, pharmacological, social, legal, and clinical. Emphasis is on the characteristics of effective comprehensive school-based drug abuse prevention programs.
Offered: Fall, Spring.

EDU 204UZ • Teaching and Learning in Guadalajara 3 Credits.
Onsite experiential course designed to introduce students to Mexican culture and education in the city of Guadalajara. Components include observing and teaching in a Christian school, a homestay with a Mexican family, creation of a classroom ethnography, and an opportunity to reflect on the culture and education process of one Mexican school.
Prerequisites: GES 130 or GES 244; written consent of instructor. Special Notes: Course may count as a Spanish elective provided all work is completed in Spanish. Offered: Occasionally interim.
EDU 220 • Introduction to Middle Level Education 3 Credits.
Identifies and defines the concept of exemplary and typical middle and junior high schools: philosophy, organizational structure, curriculum, and instructional characteristics. Students develop an understanding of the physical, emotional, social, cognitive, and moral stages of adolescent development and begin to develop the ability to relate middle-level program possibilities to adolescent developmental needs. 
Prerequisites: EDU 200; EDU 201; Admission to the Education program. Corequisites: May be taken concurrently with EDU 320. Offered: Fall, Spring.

EDU 236UZ • Exploring British Education and Culture 3 Credits.
Designed for students to immerse themselves in British culture and explore the educational system, with an emphasis on the diverse populations of Pakistani and Indian students and schools. Provides students with three learning experiences: 1) observation and participation in British elementary and secondary schools; 2) homestay with a British family; and 3) cultural exploration in London and surrounding areas. 
Prerequisites: EDU 200; EDU 201; GES 130 or GES 244; Admission to the education program. Offered: Occasionally interim.

EDU 240 • Educational Psychology 3 Credits.
Psychological foundations of education. Various aspects of growth and development, the nature and conditions of learning, implications for teaching, and evaluation. 
Prerequisites: EDU 200; EDU 201; Admission to the Education program. Offered: Fall, Spring. 
Special Notes: Intended for 5-8, 5-12, 9-12, and K-12 licensure students only.

EDU 241 • Educational Psychology Field Experience 1 Credit.
A field experience that requires four hours per week in an elementary or secondary school for observation and tutorial experience in a special education setting. 
Prerequisites: EDU 200; EDU 201; Admission to the education program. Corequisites: Must be taken concurrently with EDU 240. Offered: Fall, Spring. 
Special Notes: Designated times are set by the Education department.

EDU 250 • Educating the Exceptional Child 3 Credits.
Teacher candidates learn the historical and legal foundations of educating exceptional children. Instructional design, teaching, referral, assessment, team planning, and placement procedures are introduced. The role of the family is discussed. All of the above are accomplished in the context of cultural pluralism. 
Offered: Spring.

EDU 271 • Education Psychology and Pedagogy 2 Credits.
Foundational knowledge about the theories of learning, cognitive development, instructional planning and assessment practices, and professional reflection. 
Prerequisites: EDU 200; EDU 201; Admission to the education program. Corequisites: Must be taken concurrently with EDU 272; EDU 273; EDU 274; EDU 275. Offered: Fall, Spring.

EDU 272 • Language and Literacy Development for Young Learners (K-3) 5 Credits.
Foundational knowledge about language development, literacy development, instructional methods, assessment practices, the creation of a literate and motivating environment, and the encouragement of family engagement in literacy. 
Prerequisites: EDU 200; EDU 201; Admission to the education program. Corequisites: Must be taken concurrently with EDU 271; EDU 273; EDU 274; EDU 275. Offered: Fall, Spring.

EDU 273 • Primary Grade Practicum 1 Credit.
Application of effective practices done in a primary classroom, working with individual students and small reading groups. 
Prerequisites: EDU 200; EDU 201; Admission to the education program. Corequisites: Must be taken concurrently with EDU 271; EDU 272; EDU 274; EDU 275. Offered: Fall, Spring.

EDU 274 • Education Technology 1 Credit.
Methods of integrating technology into the primary grades classroom are considered. Focus on approaches with technologies that are research-based, enhance student learning, and are linked to effective instructional strategies. Professional growth/development and developing digital citizenship/responsibility are considered. 
Prerequisites: EDU 200; EDU 201; Admission to the education program. Corequisites: Must be taken concurrently with EDU 271; EDU 272; EDU 273; EDU 275. Offered: Fall, Spring.
EDU 275 • *Kindergarten Education* 1 Credit.
Characteristics of kindergarten children and the curriculum and teaching strategies appropriate for their developmental level.
*Prerequisites:* EDU 200; EDU 201; *Admission to the education program.* Corequisites: Must be taken concurrently with EDU 271; EDU 272; EDU 273; EDU 274. *Offered: Fall, Spring.*

EDU 292 • *Foundations of Early Childhood Education* 3 Credits.
History, philosophy, goals, content of early childhood education programs, and updated research in child development. Analysis of teaching strategies appropriate for the development of children ages three to five years. Career opportunities in early childhood education. *Offered: Fall.*

EDU 293 • *Foundations of Early Childhood Field Experience* 1 Credit.
Supervised observation and participation at Bethel University’s child development center or a partnering community early childhood education site.
*Corequisites: Must be taken concurrently with EDU 292. Offered: Fall.*

EDU 306 • *Curriculum in Early Childhood Education* 3 Credits.
Developmental appropriateness of current curriculum models, equipment, and materials in an early childhood education program.
*Prerequisites:* EDU 200; EDU 201; EDU 292; EDU 293. *Offered: Fall.*

EDU 307 • *Curriculum in Early Childhood Education Field Experience* 1 Credit.
Field experience at one of Bethel University’s child development centers or approved community partner sites utilizing strategies learned in EDU 306.
*Prerequisites:* EDU 200; EDU 201; EDU 292; EDU 293. Corequisites: Must be taken concurrently with EDU 306. *Offered: Spring.*

EDU 317GZ • *Educational Equity* 3 Credits.
Root causes and historical origins of the current disparity of opportunities in U.S. educational systems. Prepares future educators to be culturally competent and responsive critical thinkers who understand the barriers that perpetuate inequities. Address these challenges from a biblical and leadership perspective.
*Prerequisites:* [GES 130; GES 160; Contemporary Western Life and Thought (L) course; World Cultures (U) course] or [GES 244; World Cultures (U) course]. *Offered: Fall, Interim, Spring.* Special Notes: Includes experiential learning in schools and community events.

EDU 320 • *Pedagogy and the Young Adolescent Learner* 1 Credit.
The philosophy and pedagogy of teaching in a middle school is different than teaching in a junior high school. Course activities help students define, describe, and develop the following components of contemporary middle level schools: appropriate curriculum, interdisciplinary structure, and interdisciplinary teaching.
*Prerequisites:* EDU 220 (may be taken concurrently); EDU 240/EDU 241. Corequisites: Must be taken concurrently with EDU 321. *Offered: Fall, Spring.*

EDU 321 • *Integrated Literacy in the Content Areas* 1 Credit.
Understanding of literacy development strategies and the role of reading in teaching content material related to specific subject areas. Review of content area texts, assessment and practice in adapting content materials to student needs.
*Prerequisites:* EDU 220 (may be taken concurrently); EDU 240; 241. Corequisites: Must be taken concurrently with EDU 320. *Offered: Fall, Spring.*

EDU 331 • *Teaching and Learning* 3 Credits.
Provides a foundational knowledge of learning psychology and teaching methodology. Examines unique considerations for youth and adult learners, metacognition, formal/informal learning, multi-modal learning, learning in a variety of fields/contexts, and iterative program assessment.
*Corequisites:* EDU 332. *Offered: Fall, even # years.*
EDU 332 • Teaching and Learning Field Experience 1 Credit.
Teaching and Learning occurs in every field of practice to pass along skill and expertise. Students work with the instructor to find shadowing field experiences where teaching and learning occur in a field of interest and in conjunction with EDU 331.
Corequisites: EDU 331. Offered: Fall, even # years.

EDU 340 • Parent Child and Family Relationships 3 Credits.
The family as a social/cultural unit with emphasis on the parents’ interaction with the developing child. Parent-child relations, parenting skills, family systems, and family structure and function.
Offered: Spring.

EDU 342 • Observation, Assessment, Adaptation, and Referral in Early Childhood 4 Credits.
Strategies used in early childhood settings to observe and assess young children’s development and to design goals and experiences based upon those assessments. Issues of early identification, referral to special services, building effective parent/professional partnerships, and programming in inclusive early childhood classrooms are discussed.
Prerequisites: EDU 200; EDU 201; EDU 292; EDU 293; Admission to the education program. Offered: Fall.

EDU 344 • Health, Nutrition, and Safety with Young Children 2 Credits.
Issues in health, nutrition, and safety as related to early childhood settings, birth through age six.
Prerequisites: EDU 200; EDU 201; EDU 292; EDU 293.
Offered: Spring.

EDU 350 • Infant and Toddler Care 3 Credits.
Strategies used in early childhood settings to assess infant/toddler development and needs, develop goals, and design appropriate learning experiences and environments. Building positive relationships with infants/toddlers and their parents in group settings.
Prerequisites: EDU 200; EDU 201; EDU 292; EDU 293; EDU 306; EDU 307; EDU 340; Admission to the education program. Offered: Fall.

EDU 351 • Infant and Toddler Development and Learning Field Experience 1 Credit.
Field experience at the Bethel Child Development Center or approved partner infant and toddler setting to practice strategies learned in EDU 350.
Prerequisites: EDU 200; EDU 201; EDU 292; EDU 293; EDU 306; EDU 307; EDU 340; Admission to the education program. Corequisites: Must be taken concurrently with EDU 350. Offered: Fall.

EDU 363 • Health Curriculum and Methods 1 Credit.
Principles, curriculum, and methods of teaching health in grades K-6. Role of the teacher and school in responding to the special health needs of elementary-age children.
Prerequisites: EDU 200; EDU 201; Admission to the education program. Offered: Fall, Spring.

EDU 365 • Physical Education Curriculum and Methods 1 Credit.
Principles, curriculum, and methods of teaching physical education in grades K-6.
Prerequisites: EDU 200; EDU 201; Admission to the education program. Offered: Fall, Spring.

EDU 366A • Visual Arts Curriculum and Methods 1 Credit.
Methods, materials, and resources for teaching visual arts in grades K-6.
Prerequisites: EDU 200; EDU 201; Admission to the education program. Offered: Fall, Spring.

EDU 368A • Music Curriculum and Methods 1 Credit.
Methods, materials, and resources for teaching music in grades K-6.
Prerequisites: EDU 200; EDU 201; Admission to the education program. Offered: Fall, Spring.

EDU 370 • Math Curriculum and Methods 3 Credits.
Prerequisites: EDU 200; EDU 201; EDU 271-275; EDU 317GZ; MAT202M; NAS 101D; NAS 102D; NAS 103D; NAS 104D; Admission to the education program. Corequisites: Must be taken concurrently with EDU 371; EDU 372; EDU 373; EDU 374; EDU 375; EDU 376. Offered: Fall, Spring.
EDU 371 • Science Curriculum and Methods 3 Credits.
Methods, materials, and resources for teaching science in grades K-6. Emphasis placed on inquiry and discovery learning, planning, and teaching in a standards-based classroom.
Prerequisites: EDU 200; EDU 201; EDU 271-275; EDU 317GZ; MAT 202M; NAS 101D; NAS 102D; NAS 103D; NAS 104D; Admission to the education program.
Corequisites: Must be taken concurrently with EDU 370; EDU 372; EDU 373; EDU 374; EDU 375; EDU 376. Offered: Fall, Spring.

EDU 372 • Educational Psychology 3 Credits.
Psychological foundations of education continued from EDU 271 with an emphasis on grades 4-6. Various aspects of growth and development, the nature and conditions of learning, implications for teaching, awareness of student variability, and strategies for meeting the needs of students with disabilities. Teacher/student relationships and strategies for maintaining a classroom environment where learning can occur.
Prerequisites: EDU 200; EDU 201; EDU 271-275; EDU 317GZ; MAT 202M; NAS 101D; NAS 102D; NAS 103D; NAS 104D; Admission to the education program.
Corequisites: Must be taken concurrently with EDU 370; EDU 371; EDU 373; EDU 374; EDU 375; EDU 376. Offered: Fall, Spring.

EDU 373 • Reading/Language Arts Curriculum and Methods 3 Credits.
Reading methods and processes with a strong emphasis on comprehension and vocabulary development. Language arts skills: writing process, grammar, spelling, drama, listening and speaking skills, viewing skills for students in grades 4-6. A variety of creative and critical response modes to integrate literature across the curriculum.
Prerequisites: EDU 200; EDU 201; EDU 271-275; EDU 317GZ; MAT 202M; NAS 101D; NAS 102D; NAS 103D; NAS 104D; Admission to the education program.
Corequisites: Must be taken concurrently with EDU 370; EDU 371; EDU 372; EDU 374; EDU 375; EDU 376. Offered: Fall, Spring.

EDU 374 • Social Studies Curriculum and Methods: Planning 3 Credits.
Methods, materials, and resources for teaching social studies in grades K-6. Emphasis placed on the use of process skills of the social scientist. Long- and short-term planning including integration of curriculum across content areas, embedding Minnesota Graduation Standards.
Prerequisites: EDU 200; EDU 201; EDU 271-275; EDU 317GZ; MAT 202M; NAS 101D; NAS 102D; NAS 103D; NAS 104D; Admission to the education program.
Corequisites: Must be taken concurrently with EDU 370; EDU 371; EDU 372; EDU 373; EDU 374; EDU 375. Offered: Fall, Spring.

EDU 375 • Integrating Technology in the Content Areas 2 Credits.
Methods of integrating technology in various grade levels and content areas are examined. Students design, implement, and access strategies for assessment and learning. Emphasis on approaches to enhance student learning, increase motivation, and link to effective instructional strategies. Professional growth/development and developing digital citizenship/responsibility are considered.
Prerequisites: EDU 200; EDU 201; EDU 271-275; EDU 317GZ; MAT 202M; NAS 101D; NAS 102D; NAS 103D; NAS 104D; Admission to the education program.
Corequisites: Must be taken concurrently with EDU 370; EDU 371; EDU 372; EDU 373; EDU 374; EDU 375. Offered: Fall, Spring.

EDU 376 • Intermediate Grade Practicum 1 Credit.
Application of effective practices done in a 3rd-6th grade classroom, working with large groups as well as small groups, adapting lessons for students with special needs. Special focus on integrated planning.
Prerequisites: EDU 200; EDU 201; EDU 271-275; EDU 317GZ; MAT 202M; NAS 101D; NAS 102D; NAS 103D; NAS 104D; Admission to the education program.
Corequisites: Must be taken concurrently with EDU 370; EDU 371; EDU 372; EDU 373; EDU 374; EDU 375. Offered: Fall, Spring. Special Notes: A residency option is available by application. Residents stay in the same cooperating classroom for Block 2 and student teaching.
EDU 400 • Methods in Teaching K-12 English to Speakers of Other Languages 3 Credits.
Theories of language learning, language acquisition, and classroom methodologies at the elementary and secondary levels. Exploration of instructional resources, uses of technology, evaluative procedures, and classroom management. Development of a philosophy of English as a Second Language education and practice in unit planning and teaching.
Prerequisites: LIN 210Z; LIN 300; Admission to the education program. Offered: Fall.

EDU 401 • Middle Level Education Practicum in TESL 1 Credit.
Classroom-based practicum in an ESL class of young adolescent learners. Emphasizes evaluation and application of concepts and strategies introduced in EDU 400.
Corequisites: Must be taken concurrently with EDU 400. Offered: Fall.

EDU 406 • Methods in Teaching 5-8 English 3 Credits.
An examination of how middle level philosophy translates into practice in English classes in grades 5-8. It is designed to accompany a 1 credit practicum experience in a middle level school.
Prerequisites: EDU 240; EDU 241 OR EDU 271; EDU 272; EDU 273; Admission to the education program.
Corequisites: Must be taken concurrently with EDU 407. Offered: Spring.

EDU 407 • Middle Level Education Practicum in English 1 Credit.
Classroom-based practicum in an English class of young adolescent learners. Emphasizes evaluation and application of concepts and strategies introduced in EDU 408.
Prerequisites: EDU 240/EDU 241. Corequisites: Must be taken concurrently with EDU 406 or EDU 408. Offered: Spring.

EDU 408 • Methods in Teaching 5-12 English 3 Credits.
Methods and curriculum employed in teaching English in middle and high schools. Examines current technology in English education as well as interactive learning and teaching. Emphasizes vocabulary and academic language. Lesson and unit planning using best practices and developmentally appropriate principles.
Prerequisites: EDU 240; EDU 241; Admission to the education program. Corequisites: Must be taken concurrently with EDU 407. Offered: Spring.
Special Notes: EDU 320 is a strongly recommended corequisite.

EDU 410 • Methods in Teaching 5-8 Mathematics 3 Credits.
Teaching methodologies, materials, assessment, historical and current trends and issues in curricular, development of a philosophy of mathematics education, and other topics related to teaching and learning mathematics in grades 5-8. Practice in planning lessons and units, implementing technology, and teaching.
Prerequisites: EDU 240, EDU 271; Admission to Education program. Corequisites: Must be taken concurrently with EDU 411. Offered: Fall.

EDU 411 • Mathematics Education Practicum in grades 5-8 or 5-12 1 Credit.
Students observe and participate in a high school and/or middle school mathematics classroom (minimum 40 hours on site). Develop deeper understanding of preadolescent and adolescent learners as well as curriculum, instruction, and assessment in the context of grades 5-12 school communities.
Prerequisites: EDU 240, EDU 271; Admission to the education program. Corequisites: Must be taken concurrently with EDU 410, EDU 412. Offered: Fall.

EDU 412 • Methods in Teaching 5-12 Mathematics 3 Credits.
Teaching methodologies, materials, assessment, historical and current trends and issues in curriculum, development of a philosophy of mathematics education, and other topics related to teaching and learning mathematics in grades 5-8 and 9-12. Practice in planning lessons and units, implementing technology, and teaching.
Prerequisites: EDU 240; EDU 241; Admission to the education program; Senior standing or permission of instructor. Corequisites: Must be taken concurrently with EDU 411. Offered: Fall.

EDU 413 • Methods in Teaching K-12 Art 3 Credits.
Materials, methods, and curriculum employed in teaching art at both the elementary and secondary levels. Historical survey of philosophy of art education and present trends. Studio time for exploration and application of media suitable for both elementary and secondary levels.
Prerequisites: EDU 240; EDU 241; Admission to the Education program. Corequisites: Registration in EDU 414 is required. Offered: Fall.
EDU 414 • **Middle Level Education Practicum in Art** 1 Credit.
Classroom-based practicum in an art class of young adolescent learners. Emphasizes evaluation and application of concepts and strategies introduced in EDU 413.
Prerequisites: EDU 240; EDU 241. Corequisites: Must be taken concurrently with EDU 413. Offered: Fall.

EDU 418 • **Methods in Teaching 9-12 Social Studies** 2 Credits.
Development of ability to take concepts from several component disciplines of social studies and communicate them effectively to, or direct their acquisition by, students in grades 9-12. Curriculum trends, materials, classroom methodologies, and teacher competencies are studied and applied.
Prerequisites: EDU 240; EDU 241; EDU 220; Admission to the education program. Corequisites: Must be taken concurrently with EDU 419. Offered: Spring.

EDU 419 • **5-8 Social Studies Methods and Practicum** 2 Credits.
Classroom-based practicum in a social studies class of young adolescent learners. Emphasizes evaluation and application of concepts and strategies introduced in EDU 418.
Prerequisites: EDU 240; EDU 241; EDU 220; admission to the education program. Corequisites: Must be taken concurrently with EDU 419. Offered: Spring.

EDU 420 • **Methods in Teaching 5-12 Science** 3 Credits.
Current methods and approaches used in the teaching of science in grades 5-12. Examination of ways to develop and present curriculum with emphasis on content, scientific investigation, inquiry, assessment, and safe laboratory practices.
Prerequisites: EDU 240; EDU 241; Admission to the education program. Offered: Fall. Special Notes: Requirements for this course are fulfilled through EDUC 681 Methods of Teaching 5-12 Science, which is taught in conjunction with the Bethel University Graduate School.

EDU 422 • **Curriculum and Methods of 5-12 Health Education** 3 Credits.
Exploration of the science and art of teaching health. Includes the skills of planning units, teaching lessons, writing measurable objectives, and evaluating lessons for students in grades 5-12 and the community. Major focus on learning and applying various teaching methods and strategies to the content areas within health education.
Prerequisites: EDU 240; EDU 241; HAS 130; HAS 340; Admission to the education program. Offered: Fall 2019 2020.

EDU 423 • **Middle Level Education Practicum in Health** 1 Credit.
Classroom-based practicum in a health education class of young adolescent learners. Emphasizes evaluation and application of concepts and strategies introduced in EDU 422.
Prerequisites: HAS 130; HAS 340. Offered: Fall 2019 2020.

EDU 424 • **Methods in Teaching K-12 Physical Education** 3 Credits.
Instructional process in physical education, grades K-12. Observation and practice of teaching skills and strategies, including: planning and delivering content, managing a class, and monitoring student progress.
Prerequisites: EDU 240; EDU 241; HAS 316 or consent of instructor; Admission to the education program. Offered: Fall 2019 2020.

EDU 425 • **Middle Level Practicum in Physical Education** 1 Credit.
Classroom-based practicum in a physical education class of young adolescent learners. Emphasizes evaluation and application of concepts and strategies introduced in EDU 424.
Prerequisites: EDU 240; EDU 241; HAS 247; HAS 316. Corequisites: Must be taken concurrently with EDU 424. Offered: Fall 2019 2020.
EDU 426 • Methods in Teaching K-12 World Languages and Cultures 3 Credits.
Theories of language acquisition, language learning, and classroom methodologies at the elementary and secondary levels. Exploration of instructional resources, uses of technology, evaluative procedures, and classroom management. Development of a philosophy of communicative language teaching and practice in unit planning and teaching. 
Prerequisites: EDU 240; EDU 241; Admission to the education program; Demonstration of Intermediate-High oral proficiency after study abroad via the OPIC or consent of instructor, or a major or minor offered through the World Languages and Cultures department. Offered: Fall.

EDU 427 • Middle Level Education Practicum in World Languages and Cultures 1 Credit.
Classroom-based practicum in a Spanish class of young adolescent learners. Emphasizes evaluation and application of concepts and strategies introduced in EDU 426. 
Prerequisites: EDU 240/241. Corequisites: Must be taken concurrently with EDU 426. Offered: Fall.

EDU 428 • Methods in Teaching 5-8 Science 2 Credits.
Current methods and approaches used in the teaching of science in grades 5-8. An examination of ways to develop and present curriculum with emphasis on assessment, instructional strategies, scientific investigations, safety training, and current issues in science education. 
Prerequisites: Admission to the education program; EDU 271; EDU 272; EDU 273; EDU 274; EDU 275. Corequisites: Must be taken concurrently with EDU 429. Offered: Fall.

EDU 429 • Science Education Practicum in Grades 5-8 or 5-12 1 Credit.
Students observe and participate in a high school and/or middle school science classroom (minimum 40 hours on site). Develop deeper understanding of preadolescent and adolescent learners as well as curriculum, instruction, and assessment in the context of grades 5-12 school communities. 
Prerequisites: EDU 240/241; admission to the education program. Corequisites: Must be taken concurrently with EDU 429. Offered: Fall.

EDU 432 • Methods in Teaching Elementary Music 3 Credits.
Methods and materials for teaching music in the elementary school. The skills of singing, playing, moving, improvising, reading, and listening are explored as a means of helping children gain an intuitive and theoretical understanding of musical principles. 
Prerequisites: EDU 240; EDU 241; major or minor in music; admission to the education program. Offered: Fall.

EDU 433 • Methods in Teaching Secondary Music 3 Credits.
Methods and materials for teaching music in the middle school, junior high, and high school vocal and instrumental programs. 
Prerequisites: EDU 432; major or minor in music; admission to the education program. Offered: Spring.

EDU 434 • Middle Level Education Practicum in Music 1 Credit.
Classroom-based practicum in a music class of young adolescent learners. Emphasizes evaluation and application of concepts and strategies introduced in EDU 433. 
Prerequisites: EDU 432; major or minor in music. Corequisites: EDU 433. Offered: Spring.

EDU 489 • Student Teaching in Preprimary 3 Credits.
Observation and student teaching in a pre-k setting in which a student will be licensed to teach. Includes participation in a seminar. 
Prerequisites: EDU 292/293, EDU 306/307; EDU 340; EDU 342; EDU 344; Admission to student teaching. Offered: Fall, Interim, Spring, Summer (depending on faculty availability).

EDU 490 • Student Teaching Block 1-15 Credits.
Observation and student teaching at appropriate level(s) for specified period(s). Includes participation in a seminar that meets regularly. Students earning a license to teach in two teaching majors must register for EDU 490 in the primary license and in the second license. Both student teaching placements can occur within the same semester. Some situations may require the addition of student teaching during Interim. Student teaching semester also includes a weekly seminar meeting by program. Students should communicate with their supervisors about meeting times and locations. 
Prerequisites: Admission to student teaching; 2.50 GPA. Special Notes: Graded on an S/U basis. Offered: Fall, Spring.
EDU 491 • Student Teaching in Middle Level 3 Credits.
Observation and student teaching in fields in which a student will be licensed to teach. This involves student teaching in a Middle Level endorsement area.
Prerequisites: Admission to student teaching.
Special Notes: Graded on an S/U basis. Offered: Fall, Spring.

GEL 168 • Geology 3 Credits.
A study of earth's structure and the forces that continue to shape it. The fragility, power, and patience of our geologic environment are considered, as well as land use patterns and decisions. Topics include minerals and rocks, geologic time, earthquakes, volcanoes, plate tectonics, glaciers, weathering and erosion, maps/aerial photos, GPS/GIS, groundwater, mineral resources, and streams.
Corequisites: Registration in GEL 168D is required. Offered: Fall.

GEL 168D • Geology Lab 1 Credit.
Laboratory experience accompanying GEL 168. Includes two field trips to exposed rock layers and fossil digs.
Corequisites: Registration in GEL 168 is required. Offered: Fall.

PHY 102 • Physics of Everyday Life 3 Credits.
Explores how physics concepts can be used to understand everyday phenomena in the world around us. Topics include mechanics, waves (including sound and light), thermodynamics, and atomic and nuclear physics. Lecture demonstrations and laboratories stress a clear understanding of observed phenomena.
Corequisites: Concurrent registration in PHY 102D is required. Offered: Interim.

PHY 102D • Physics of Everyday Life-Lab 1 Credit.
Laboratory experience accompanying PHY 102.
Corequisites: Concurrent registration in PHY 102 is required. Offered: Interim.

PHY 112 • Introduction to Astronomy 3 Credits.
The concepts, techniques, and tools of astronomy and astrophysics for nonscience students. Includes historical overview; identification of constellations; telescopes; the nature of light, atomic spectra, and structure; the nuclear physics of stars; the life cycle of stars; and current theories of the fate of the universe.
Corequisites: Concurrent registration in PHY 112D is required. Offered: Fall.

PHY 112D • Introduction to Astronomy Lab 1 Credit.
Laboratory experience accompanying PHY 112. Includes optics, atomic spectra, and observations with simple instruments and telescopes.
Corequisites: Concurrent registration in PHY 112 is required. Offered: Fall.

PHY 202 • Introductory Physics I 3 Credits.
Mechanics, thermal properties of matter and mechanical waves.
Prerequisites: MAT 123M, MAT 124M, or solid understanding and competency in high school mathematics as demonstrated by at least one of the following: a Math ACT score of at least 23, 519 on the Math portion of the SAT, a Math Placement Test score of at least 3. Corequisites: Concurrent registration in PHY 202D is required. Offered: Fall.

PHY 202D • Introductory Physics I Lab 1 Credit.
Laboratory experience accompanying PHY 202.
Corequisites: Concurrent registration in PHY 202 is required. Offered: Fall.

PHY 206 • Introductory Physics II 3 Credits.
Electricity and magnetism, sound waves, optical phenomena, and modern physics.
Prerequisites: PHY 202/202D. Corequisites: Concurrent registration in PHY 207 is required. Offered: Spring.

PHY 207 • Introductory Physics II Lab 1 Credit.
Laboratory experience accompanying PHY 206.
Corequisites: Concurrent registration in PHY 206 is required. Offered: Spring.

PHY 260 • Careers in Engineering and Physics Seminar 1 Credit.
Focus on developing careers in high-technology fields such as engineering and physics. Emphasis on exploring some of the wide variety of specific careers possible through methods such as video, lecture, tours, and guest speakers. Development of practical professional skills such as writing resumes and personal statements, building professional networks and experience, and developing techniques for interviewing.
Prerequisites: PHY 296/297. Offered: Fall. Special Notes: Carries cross-credit in engineering.

PHY 292 • General Physics I 3 Credits.
Kinematics, mechanics, oscillations, fluids, and conservation principles.
Prerequisites: MAT 124M (may be taken concurrently). Corequisites: Concurrent registration in PHY 292D is required. Offered: Fall.
PHY 292D • General Physics I Lab 1 Credit.
Laboratory experience accompanying PHY 292.
Corequisites: Concurrent registration in PHY 292 is required. Offered: Fall.

PHY 296 • General Physics II 3 Credits.
Electricity, magnetism, thermodynamics, sound waves, and optics.
Prerequisites: PHY 292/292D (with a grade of C or better); MAT 125 (may be taken concurrently).
Corequisites: Concurrent registration in PHY 297 is required. Offered: Spring.

PHY 297 • General Physics II Lab 1 Credit.
Laboratory experience accompanying PHY 296.
Corequisites: Concurrent registration in PHY 296 is required. Offered: Spring.

PHY 302 • Electronics 3 Credits.
Fundamentals of digital and analog electronics intended for scientists and engineers.
Prerequisites: PHY 296/297 (grade of C or better); MAT 124M. Corequisites: Concurrent registration in PHY 303 is required. Offered: Fall.

PHY 303 • Electronics Lab 1 Credit.
Laboratory experience accompanying PHY 302. Extensive laboratory exercises and a choice of projects provide hands-on experience with circuits using transistors, operational amplifiers, logic gates, flip-flops, and other devices.
Corequisites: Concurrent registration in PHY 302 is required. Offered: Fall.

PHY 312 • Modern Physics 3 Credits.
Relativity, quantum theory, introductory wave mechanics, nuclear processes, elementary particles, and cosmology.
Prerequisites: PHY 296/297 (grade of C or better); MAT 223. Corequisites: Concurrent registration in PHY 313 is required. Offered: Spring.

PHY 313 • Modern Physics Lab 1 Credit.
Atomic and nuclear laboratory experiments accompanying PHY 312.
Corequisites: Concurrent registration in PHY 312 is required. Offered: Spring.

PHY 320 • Mathematical Methods in Physics and Engineering 4 Credits.
Development of skill in mathematical techniques useful in the solution of physics and engineering problems. Included are vector analysis; line and surface integrals; Fourier analysis; partial differential equations; and probability and statistics.
Prerequisites: MAT 222 (may be taken concurrently); MAT 223. Offered: Fall. Special Notes: Carries cross-credit in engineering.

PHY 332 • Optics 3 Credits.
Principles of geometrical and physical optics.
Prerequisites: PHY 312/313; MAT 223. Corequisites: Concurrent registration in PHY 333 is required. Offered: Spring, even # years.

PHY 333 • Optics Lab 1 Credit.
Laboratory experience accompanying PHY 332 emphasizing physical optics measurements, laser technology, and holography.
Corequisites: Concurrent registration in PHY 332 is required. Offered: Spring, even # years.

PHY 340 • Mechanics 4 Credits.
Particle dynamics, conservative motion, central forces, accelerated coordinate systems, and Lagrange's equations of motion.
Prerequisites: PHY 296/297 (grade of C or better); MAT 222; MAT 223. Offered: Fall.

PHY 352 • Computer Methods in Physics and Engineering 3 Credits.
Application of the computer to solving applied problems of interest to physicists and engineers. Computer techniques are developed for numerical methods, simulation models, and data acquisition and control in the laboratory.
Prerequisites: MAT 223; PHY 296/297, and PHY 302/303 (grade of C or better) or consent of instructor. Corequisites: Concurrent registration in PHY 353 is required. Offered: Spring. Special Notes: Carries cross-credit in engineering.

PHY 353 • Computer Methods in Physics and Engineering Lab 1 Credit.
Laboratory experience accompanying PHY 352. Corequisites: Concurrent registration in PHY 352 is required. Offered: Spring. Special Notes: Carries cross-credit in engineering.

PHY 365 • Physics Research Seminar 1 Credit.
An introduction to research in physics and the development of scientific writing skills. Emphasis placed on preparing for departmental research experiences such as PHY 490 and external research experiences such as those found in industry, summer fellowship programs, and graduate schools.
Prerequisites: PHY 260; PHY 312/313; Junior standing; a major in the physics department.
Offered: Spring.

PHY 400 • Electricity and magnetism 4 Credits.
Electrostatics and magnetostatics, electric and magnetic fields in free space and in materials, electromagnetic waves, and transmission lines.
Prerequisites: PHY 296/297 (grade of C or better); MAT 222; MAT 223. Offered: Fall, odd # years.
PHY 410 • Thermodynamics 4 Credits.
Laws of thermodynamics, conditions for thermodynamic equilibrium, and fundamentals of statistical mechanics.
Prerequisites: PHY 296/297 (grade of C or better); MAT 223. Offered: Spring, odd # years. Special Notes: PHY 312/313 is strongly recommended as a prerequisite.

PHY 422 • Fluid Mechanics 3 Credits.
Laws of statics, kinematics, and dynamics applied to fluid mechanics. Integral and differential conservation laws for mass, momentum, and energy. Dimensional analysis, viscous pipe flow, boundary layers, separated flows, and potential flow.
Prerequisites: PHY 296/297 (grade of C or better); MAT 223. Corequisites: Concurrent registration in PHY 423 is required. Offered: Fall, odd # years. Special Notes: Carries cross-credit in engineering.

PHY 423 • Fluid Mechanics Lab 1 Credit.
Laboratory experience accompanying PHY 422. Corequisites: Concurrent registration in PHY 422 required. Offered: Fall, odd # years. Special Notes: Carries cross-credit in engineering.

PHY 424 • Materials and Devices 3 Credits.
Theory and application of condensed matter and materials. Physical origin of electrical, optical, mechanical, thermal, and magnetic properties. Emphasis on devices such as pn junction diodes, LEDs, piezoelectrics, and sensors. An accompanying lab explores characterization of materials and the design, fabrication, and testing of devices.
Prerequisites: PHY 302/303, PHY 312/313. Corequisites: Concurrent registration in PHY 425 is required. Offered: Fall, even # years. Special Notes: Carries cross-credit in engineering.

PHY 425 • Materials and Devices Lab 1 Credit.
Laboratory component of PHY 424. Corequisites: Concurrent registration in PHY 424 required. Offered: Fall, even # years. Special Notes: Carries cross-credit in engineering.

PHY 432 • Topics in Contemporary Optics 3 Credits.
Fourier optics, theory of coherence, quantum optics, nonlinear optics, and the physics of lasers.
Prerequisites: PHY 312/313; MAT 223. Concurrent registration in PHY 433 is required. Offered: Spring, odd # years.

PHY 433 • Topics in Contemporary Optics Lab 1 Credit.
Laboratory experience accompanying PHY 432. Corequisites: Concurrent registration in PHY 432 is required. Offered: Spring, odd # years.

PHY 440 • Quantum Mechanics 4 Credits.
Concepts and techniques of quantum mechanics. Prerequisites: PHY 312/313; MAT 222; MAT 223. Offered: Fall, even # years.

PHY 450 • Topics in Applied Physics and Engineering 3-4 Credits.
Topics selected from various fields of engineering and applied physics for the purpose of illustrating the practical application of physical principles. Emphasis on developing the skills and viewpoints commonly used by engineers and industrial physicists. The field of engineering or applied physics is announced prior to registration.
Prerequisites: PHY 302; PHY 352 (may be taken concurrently); MAT 222. Repeatable course Course may be repeated when a different topic is emphasized. Special Notes: Carries cross-credit in Engineering. Offered: Occasionally.

PHY 481 • Internship in Physics 1-4 Credits.
A practical experience in an off-campus professional setting in which the student applies the skills and perspectives of a physicist. Designed by student in consultation with a faculty member.
Prerequisites: Major in applied physics or physics; Junior or senior standing. Offered: Fall, Spring.

PHY 490 • Research 3 Credits.
An opportunity for individual student projects under the supervision of the faculty. Prerequisites: Senior standing; PHY 365; Major in physics department. Offered: Fall, Spring.