BIOLOGICAL SCIENCES

Biology is an extensive field that covers biochemistry, molecular biology, cell biology, microbiology, genetics, anatomy, physiology, embryology, ecology, evolution, field biology, and animal behavior. The Bachelor of Science in Biological Sciences is recommended for students who wish to study biology as part of an undergraduate liberal arts degree, to prepare for graduate study in biology or any of the health professions, or to study for a secondary teaching certificate in biology.

Dearborn Discovery Core Requirement

The minimum GPA for the program is 2.0. In addition, the DDC permits any approved course to satisfy up to three credit hours within three different categories. Please see the General Education Program: The Dearborn Discovery Core (http://catalog.umd.umich.edu/undergraduate/general-information/general-education-program-dearborn-discovery-core) section for additional information.

Foundational Studies

Written and Oral Communication (GEWO) – 6 Credits (http://catalog.umd.umich.edu/undergraduate/general-information/general-education-program-dearborn-discovery-core/#gewo)

Upper Level Writing Intensive (GEWI) – 3 Credits (http://catalog.umd.umich.edu/undergraduate/general-information/general-education-program-dearborn-discovery-core/#gewi)

Quantitative Thinking and Problem Solving (GEQT) – 3 Credits (http://catalog.umd.umich.edu/undergraduate/general-information/general-education-program-dearborn-discovery-core/#geqt)

Critical and Creative Thinking (GECC) – 3 Credits (http://catalog.umd.umich.edu/undergraduate/general-information/general-education-program-dearborn-discovery-core/#gecc)

Areas of Inquiry

Natural Science (GENS) – 7 Credits (http://catalog.umd.umich.edu/undergraduate/general-information/general-education-program-dearborn-discovery-core/#gens)

- Lecture/Lab Science Course
- Additional Science Course

Social and Behavioral Analysis (GESB) – 9 Credits (http://catalog.umd.umich.edu/undergraduate/general-information/general-education-program-dearborn-discovery-core/#gesb)

Humanities and the Arts (GEHA) – 6 Credits (http://catalog.umd.umich.edu/undergraduate/general-information/general-education-program-dearborn-discovery-core/#geha)

Intersections (GEIN) – 6 Credits (http://catalog.umd.umich.edu/undergraduate/general-information/general-education-program-dearborn-discovery-core/#gein)

Capstone

Capstone (GECE) – 3 Credits (http://catalog.umd.umich.edu/undergraduate/general-information/general-education-program-dearborn-discovery-core/#gece)

Foreign Language Requirement

Complete a two-semester beginning language sequence.

<table>
<thead>
<tr>
<th>Language</th>
<th>Course Code</th>
<th>Course Code</th>
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</thead>
<tbody>
<tr>
<td>Ancient Greek I and II</td>
<td>MCL 105</td>
<td>MCL 106</td>
</tr>
<tr>
<td>Arabic I and II</td>
<td>ARBC 101</td>
<td>ARBC 102</td>
</tr>
<tr>
<td>Armenian I and II</td>
<td>MCL 111</td>
<td>MCL 112</td>
</tr>
<tr>
<td>Chinese I and II</td>
<td>CHIN 101</td>
<td>CHIN 102</td>
</tr>
<tr>
<td>French I and II</td>
<td>FREN 101</td>
<td>FREN 102</td>
</tr>
<tr>
<td>German I and II</td>
<td>GER 101</td>
<td>GER 102</td>
</tr>
<tr>
<td>Latin I and II</td>
<td>LAT 101</td>
<td>LAT 102</td>
</tr>
<tr>
<td>Spanish I and II</td>
<td>SPAN 101</td>
<td>SPAN 102</td>
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</tbody>
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Pre-Major Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>BIOL 130</td>
<td>Intro Org and Environ Biology</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 140</td>
<td>Intro Molec &amp; Cellular Biology</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 134</td>
<td>General Chemistry IA</td>
<td>4</td>
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<tr>
<td></td>
<td>or CHEM 144 Gen Chemistry IB</td>
<td></td>
</tr>
<tr>
<td>CHEM 136</td>
<td>General Chemistry IIA</td>
<td>4</td>
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<tr>
<td></td>
<td>or CHEM 146 General Chemistry IB</td>
<td></td>
</tr>
<tr>
<td>CHEM 225</td>
<td>Organic Chemistry I</td>
<td>8</td>
</tr>
<tr>
<td>&amp; CHEM 226 &amp; CHEM 227 and Organic Chemistry I Laboratory</td>
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<tr>
<td>Select one of the following:</td>
<td>8</td>
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<tr>
<td>PHYS 125 &amp; PHYS 126 and Introductory Physics I</td>
<td></td>
<td></td>
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<tr>
<td>PHYS 150 &amp; PHYS 151 and General Physics II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MATH 113</td>
<td>Calc I for Biology &amp; Life Sci</td>
<td>4</td>
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<tr>
<td>or MATH 115 Calculus I</td>
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<tr>
<td>Select one of the following:</td>
<td>3-4</td>
<td></td>
</tr>
<tr>
<td>MATH 114</td>
<td>Calc II for Biology &amp; Life Sci</td>
<td></td>
</tr>
<tr>
<td>MATH 116</td>
<td>Calculus II</td>
<td></td>
</tr>
<tr>
<td>STAT 301</td>
<td>Biostatistics I</td>
<td></td>
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<tr>
<td>STAT 455</td>
<td>Environmental Statistics</td>
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</tbody>
</table>

Total Credit Hours 39-40

Mathematics and chemistry are essential to success in biology and should be taken as early as possible. Chemistry and mathematics course serve as prerequisites for many biology courses.

Major Requirements

30 credit hours of 300/400; 3000/4000 level biological sciences (BIOL) courses.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>BIOL 306</td>
<td>General Genetics</td>
<td>3</td>
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<tr>
<td>Ecology:</td>
<td></td>
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<tr>
<td>Select one of the following:</td>
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<tr>
<td>BIOL/ESCI 304</td>
<td>Ecology</td>
<td>4</td>
</tr>
<tr>
<td>BIOL/ESCI 337</td>
<td>Plant Ecology</td>
<td>3</td>
</tr>
</tbody>
</table>
BIOL 456 Behavioral Biology

Evolution:
BIOL 360 Population Genetics & Evolution

Physiology:
Select one of the following:
- BIOL 303 Comparative Animal Physiology
- BIOL 305 Anatomy and Physiology II
- BIOL 335 Plant Physiology

Cell & Molecular:
Select one of the following:
- BIOL 301 Cell Biology
- BIOL/BCHM/ CHEM 370 Principles of Biochemistry
- BIOL 385/ MICR 405 Microbiology

Capstone Experience (CACY)
Select one from the following:
- BIOL 402 Physiology of Excitable Cells
- BIOL 404 Mech. Chronic Human Disease
- BIOL/MICR 405 Applied & Environ Microbiology
- BIOL 412 Vertebrates
- BIOL 419 Behavior and Evolution
- BIOL/ESCI 420 Advanced Field Ecology
- BIOL/ESCI 422 Conservation Biology
- BIOL 452 Med & Env Toxicology
- BIOL 476 Cancer Cell Biology
- BIOL 491 Capstone Course in Biology
- BIOL 492 Capstone Research Experience
- BIOL 493 Capstone Teaching Experience

Additional Upper Level (300+) Biology Courses (BIOL)

Minor or Integrative Studies Concentration Requirements

A minor or concentration consists of 12 credit hours of upper-level courses in biological sciences (BIOL). Note that all BIOL courses include prerequisites in biology and some include prerequisites in chemistry or mathematics.

BIOL 100 Principles of Biology 3 Credit Hours
A lecture course introducing non-science concentrators to major areas of biology, including cell biology, genetics, human physiology, plant biology, ecology, and evolution. Topics of current interest are discussed. Students cannot use both BIOL 100 and NSCI 120 to satisfy the Natural Sciences distribution requirements. Three hours lecture. (F,W).

BIOL 103 Anatomy and Physiology I 4 Credit Hours
The structural and functional relationships of the human body at the cellular, tissue, organ, and system levels are analyzed. Students identify the major anatomical parts and relate these to the physiological activities of the circulatory, skeletal, nervous, muscular, and digestive systems. The homeostatic effects of fluids, electrolytes, and acids and bases throughout the integrated human body are analyzed. Four hours lecture, three hours laboratory. (F).

Corequisite(s): BIOL 103L

BIOL 105 Anatomy and Physiology IIA 4 Credit Hours
The major anatomical parts of the cardiovascular, respiratory, reproductive, endocrine, nervous, and urinary systems of the human body are identified and related to the physiological activities of these systems. Emphasis is placed on the homeostatic effects of fluids, electrolytes, acids, and bases throughout the integrated human body. Four hours lecture, three hours laboratory. (W)

Prerequisite(s): BIOL 103

Corequisite(s): BIOL 105L

BIOL 130 Intro Org and Environ Biology 4 Credit Hours
An introduction to organismal and environmental biology, with emphasis on plant and animal diversity, structure, physiology, and development; ecology; and evolution. This course complements BIOL 140, which need not be taken as a prerequisite; together they constitute an introduction to biology. This course is intended for science concentrators. Three hours lecture, four hours laboratory/recitation. (F,W,S).

Corequisite(s): BIOL 130L

BIOL 140 Intro Molec & Cellular Biology 4 Credit Hours
An introduction to molecular and cellular aspects of biology with emphasis on cell structure and function, biochemistry, genetics, cell growth, and the origin of life. This course complements BIOL 130; together they constitute an introduction to biology. This course is intended for science concentrators. Three hours lecture, four hours laboratory/recitation.

Prerequisite(s): CHEM 134* or CHEM 144*

Corequisite(s): BIOL 140L

BIOL 240 Great Experiments in Biology 3 Credit Hours
An individualized-learning course that portrays the development of modern biological science. The course does not require attendance in classes since it can be completed at home and in the library by means of study guides, audio cassettes, slide/tape presentations, and computer-assisted instruction. (F,W,S).

Notes:
1. A maximum of 6 credit hours in BIOL 492, BIOL 493, BIOL 495, BIOL 497, BIOL 498 and BIOL 499 can be applied toward the 30 credit major requirement.
2. A maximum of 50 hours in biological sciences courses may be applied toward the 120-credit-hour total required for graduation.
3. In the 30 credit hours required for the major, students may use either BIOL 370/BCHM 370/CHEM 370 or BIOL 470/BCHM 470/CHEM 470 and/or BIOL 471 / BCHM 471 /CHEM 471.
4. At least 15 of the 30 upper level hours required in the BIOL major must be elected at UM-Dearborn.
5. A maximum of 6 credit hours combined of independent study/research in any natural science discipline may be applied toward the 120 credit hours required for degree.

1 Credit cannot be earned for both BIOL 105 and BIOL 305. BIOL 105 cannot be used in the biology major.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
<th>Prerequisite(s)</th>
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</thead>
<tbody>
<tr>
<td>BIOL 242</td>
<td>Great Experiments Laboratory</td>
<td>1</td>
<td>BIOL 250*</td>
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<tr>
<td>BIOL 290</td>
<td>Topics in Biology and Society</td>
<td>3</td>
<td>BIOL 240*</td>
</tr>
<tr>
<td>BIOL 291</td>
<td>Biology and Society Laboratory</td>
<td>1</td>
<td>BIOL 290</td>
</tr>
<tr>
<td>BIOL 301</td>
<td>Cell Biology</td>
<td>4</td>
<td>BIOL 130 and BIOL 140 and (CHEM 124 or CHEM 134 or CHEM 144)</td>
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<tr>
<td>BIOL 303</td>
<td>Comparative Animal Physiology</td>
<td>4</td>
<td>BIOL 130 and BIOL 140 and (MATH 104 or MATH 105 or MATH 113 or MATH 115 or MATH 116)</td>
</tr>
<tr>
<td>BIOL 304</td>
<td>Ecology</td>
<td>4</td>
<td>BIOL 130 and BIOL 140</td>
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<tr>
<td>BIOL 305</td>
<td>Anatomy and Physiology IIB</td>
<td>4</td>
<td>BIOL 130</td>
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<tr>
<td>BIOL 306</td>
<td>General Genetics</td>
<td>3</td>
<td>BIOL 130 and BIOL 140</td>
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<tr>
<td>BIOL 306R</td>
<td>General Genetics Recitation</td>
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<td>BIOL 306</td>
</tr>
<tr>
<td>BIOL 307</td>
<td>General Genetics Laboratory</td>
<td>1</td>
<td>BIOL 306</td>
</tr>
<tr>
<td>BIOL 309</td>
<td>Introduction to Mycology</td>
<td>4</td>
<td>BIOL 306</td>
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<tr>
<td>BIOL 310</td>
<td>Histology</td>
<td>4</td>
<td>BIOL 306</td>
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<tr>
<td>BIOL 311</td>
<td>Embryology</td>
<td>4</td>
<td>BIOL 306</td>
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<tr>
<td>BIOL 313</td>
<td>Plant Taxonomy and Systematics</td>
<td>4</td>
<td>BIOL 306</td>
</tr>
<tr>
<td>BIOL 315</td>
<td>Aquatic Ecosystems</td>
<td>4</td>
<td>BIOL 306</td>
</tr>
<tr>
<td>BIOL 320</td>
<td>Field Biology</td>
<td>4</td>
<td>BIOL 101 or BIOL 130 or NSCI 120 or NSCI 233</td>
</tr>
</tbody>
</table>
BIOL 324  Invertebrate Zoology  4 Credit Hours
This course introduces students to the diversity of invertebrate animals from a functional evolutionary perspective. The lecture will focus on the unique aspects of the morphology, physiology, and ecology of major phyla in light of the selective forces that have favored their evolution, as well as consider the intersection of invertebrates and humans. Through dissection, prepared slides and field observations, the laboratory will introduce the diversity of invertebrate phyla and subgroups, with emphasis on form and function.
Prerequisite(s): BIOL 130

BIOL 333  Plant Biology  4 Credit Hours
A thorough survey of the evolutionary trends in plant reproduction and morphology will be considered. This survey will extend into the field of plant anatomy, but not plant physiology, which is covered in a separate course. Major groups to be studied include: bacteria, algae, fungi, liverworts, lichens, mosses, ferns, and seed plants. Certain less familiar groups will also be emphasized. Plant diversity will be examined from the perspective of its import to civilizations of the past and future.
Three hours lecture, four hours laboratory. (F, S).
Prerequisite(s): BIOL 130
Corequisite(s): BIOL 333L

BIOL 335  Plant Physiology  4 Credit Hours
Physiological principles as they apply to the major plant groups. Topics include cellular metabolism, water balance, translocation, photosynthesis, mineral nutrition, growth and development and production of secondary substances. Three hours lecture, four hours laboratory. (W).
Prerequisite(s): BIOL 130 and BIOL 140
Corequisite(s): BIOL 335L

BIOL 337  Plant Ecology  3 Credit Hours
This course focuses on different aspects of the relationship between plants and their environment. Topics include interactions of plants with the physical environment, life cycles of the environment acts to shape plant populations through evolution; c) intra- and interspecific interactions among individuals; and d) large-scale patterns and processes at the landscape-level. Three hours lecture.
Prerequisite(s): BIOL 130

BIOL 350  Introduction to Neurobiology  4 Credit Hours
An introduction to nervous systems and how they function. This course includes the cellular physiology and anatomy of nervous systems in vertebrates and invertebrates, and how these cellular activities are integrated into systems to produce complex, coordinated behavior. Three hours lecture. (W).
Prerequisite(s): BIOL 130 and BIOL 140
Corequisite(s): BIOL 350L

BIOL 352  Endocrinology  3 Credit Hours
This class will provide intermediate and advanced undergraduates with a basic understanding of the function of the endocrine system. The course will progress from a consideration of basic concepts and mechanisms to the physiology (function) of specific endocrine systems. Interactions between organ systems will also be emphasized. Specific sections of the course will focus on function of the endocrine system during stress, fluid balance, metabolism (including calcium, glucose, lipid, and proteins), reproductive growth, development, and aging.
Prerequisite(s): BIOL 140 and BIOL 130 and CHEM 134

BIOL 353  Ornithology  3 Credit Hours
A study of the unique features of birds as representatives of vertebrates, including their morphology, anatomy, physiology, physics of flight, mating systems, social structure, vocalizations, orientation and migration, origin and evolution, growth and development, and issues in avian conservation. Students learn about the current research on bird migration at the Rouge River Bird Observatory on campus. Students develop individual species analysis of life and natural histories. Three hours lecture.
Prerequisite(s): BIOL 130

BIOL 357  Human Physiology  3 Credit Hours
Systems of the human body and their function are investigated individually and as part of an integrated natural living system. Topics include cell structure and function of nerves, muscles, the lungs, heart, blood vessels, kidneys, digestive tract, endocrine glands, brain, and reproductive organs.
Prerequisite(s): (BIOL 130 and BIOL 140) or (BIOL 103 and BIOL 105)

BIOL 360  Population Genetics & Evolution  3 Credit Hours
Processes which change the genetic composition of populations: mutation, gene flow, genetic drift, and natural selection. The origin of subspecies, species, and higher taxa. Evidence of evolution from the geological record, comparative anatomy, comparative biochemistry and other sources. Three hours lecture. (F,W)
Prerequisite(s): BIOL 130 and BIOL 140 and (MATH 104 or MATH 105 or MATH 113 or MATH 115 or Mathematics Placement with a score of 116)

BIOL 361  Population Genetics & Evolution Lab  1 Credit Hour
A laboratory course to accompany BIOL 360. Four hours laboratory. (OC).
Prerequisite(s): BIOL 360*

BIOL 370  Principles of Biochemistry  3 Credit Hours
A concise but comprehensive survey of various areas of biochemistry designed for non-biochemistry majors. The course follows the standard approach to the subject including a description of cells, their structure and constituent macromolecules (proteins, nucleic acids, carbohydrates and lipids), enzymology, bioenergetics, intermediary metabolism and gene regulation. Students cannot take both BCHM 370 and 470 or 471 for any combination of concentration, cognate or minor requirement. Three hours lecture. (F).
Prerequisite(s): BIOL 140 and CHEM 226

BIOL 380  Epidemiology  3 Credit Hours
Introduces the methods for infectious disease epidemiology (occurrence and spread in population) and case studies of important disease syndromes and entities. Methods include definitions and nomenclature, outbreak investigations, disease surveillance, case-control studies, cohort studies, laboratory diagnosis, molecular epidemiology, dynamics of transmission, and assessment of vaccine field effectiveness. Case-studies focus on acute respiratory infections, diarrheal diseases, hepatitis, HIV, tuberculosis, sexually transmitted diseases, malaria, and other vector-borne diseases. This course emphasizes methods of study that would contribute to understanding diseases etiology.
Prerequisite(s): BIOL 140

BIOL 381  Biotechnology & Bioprocessing  4 Credit Hours
Biotechnology and Bioprocessing class is centered on the study of bioengineering applications found today in the medical and agricultural industries. Students use microorganisms, plant and animal tissue culture, and enzymes during the laboratory period, practicing the fundamentals of “hands-on” genetic engineering and material processing. Students establish and purify proteins from recombinant organisms. Besides technology, ethical and environmental concerns are discussed in the lecture. Three hours lecture, four hours laboratory.
Prerequisite(s): BIOL 140
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 385</td>
<td>Microbiology</td>
<td>4</td>
<td>The biology of microorganisms is considered through study of the properties of bacteria, fungi, algae, protozoa, and viruses. Microbial structures are discussed and correlated with their function.</td>
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<td>The interaction of microorganisms and their environment, animate and inanimate, is discussed with respect to the beneficial or harmful effects of the different microbial groups. Laboratory exercises introduce the student to basic, practical microbiological techniques and illustrate various principles of microbial life. Three hours lecture, four hours laboratory. (F, S).</td>
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<td><strong>Prerequisite(s):</strong> BIOL 140 and (CHEM 134* or CHEM 144*)</td>
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<td><strong>Corequisite(s):</strong> BIOL 385L</td>
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<tr>
<td>BIOL 390</td>
<td>Topics in Biology</td>
<td>1 to 4</td>
<td>Examination of problems and issues in selected areas of biology. Title in Schedule of Classes changes according to content. This course may be repeated for credit when specific topics differ. Permission of Instructor. (OC).</td>
</tr>
<tr>
<td>BIOL 402</td>
<td>Physiology of Excitable Cells</td>
<td>3</td>
<td>An in-depth analysis of the mechanisms underlying electrical communication within and between mammalian cells. The major emphasis is on excitable cells in the brain, heart, and skeletal muscle and their functional integration. Fulfills the Biology major capstone requirement.</td>
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<td><strong>Prerequisite(s):</strong> BIOL 130 and BIOL 140 and (BIOL 303 or BIOL 305 or BIOL 350)</td>
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<td><strong>Restriction(s):</strong> Can enroll if Class is Senior</td>
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<tr>
<td>BIOL 404</td>
<td>Mech. Chronic Human Disease</td>
<td>3</td>
<td>This course focuses on the biochemical, molecular and cellular mechanisms underlying the progression of chronic diseases, such as diabetes mellitus and atherosclerosis. Techniques in epidemiology, pathology, genetics, molecular biology, and biochemistry are used to understand how relevant physiological processes become pathological. The examination of chronic diseases provides an opportunity to understand biological processes across many scales of life, from extracellular matrix proteins to cells in blood vessel walls to risk factors in patient populations to the pharmacology of treatments. Use of primary literature is emphasized. Three hour lecture.</td>
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<td><strong>Prerequisite(s):</strong> BIOL 301 or BIOL 306 or BIOL 357 or BCHM 370 or BIOL 370 or CHEM 370 or BCHM 471 or BIOL 471 or CHEM 471</td>
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<td><strong>Restriction(s):</strong> Can enroll if Class is Senior</td>
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<tr>
<td>BIOL 405</td>
<td>Applied &amp; Environ Microbiology</td>
<td>4</td>
<td>The study of the diversity, structure and function of microorganisms as they interact with their environment. Emphasis will be placed on soil microbiology (fungi, bacteria, microalgae) and plant-microbe interactions (pathogens, symbioses). Ecological topics include decomposition, nutrient cycling, bioremediation and agroecosystems. Three hours lecture, four hours laboratory. (W).</td>
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<td><strong>Prerequisite(s):</strong> BIOL 385 or MICR 385</td>
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<td><strong>Restriction(s):</strong> Can enroll if Class is Senior</td>
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<tr>
<td>BIOL 406</td>
<td>Microbial Genetics</td>
<td>3</td>
<td>This molecular genetics course emphasizes bacteria and viruses. Topics include chromosome structure and replication, recombination, DNA repair, genetic mapping, mechanisms of gene transfer, regulation of gene expression, and mutagenesis. Three hours lecture. (W, YR)</td>
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<td><strong>Prerequisite(s):</strong> MICR 385 or BIOL 385</td>
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<tr>
<td>BIOL 410</td>
<td>Diversity Issues Health Care</td>
<td>3</td>
<td>This course will address the effect of race, age, gender, religion, and economic status on medical research and health care. Through an examination of clinical trials and case studies, students will learn how medical research is performed in the United States, and what health care treatments and options for patients are available. Medical treatment and disease topics will be selected and will be evaluated as to how they are influenced by the criteria listed. The examples will focus on both cultural differences and inequity, in national and global settings. (AY).</td>
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<td><strong>Prerequisite(s):</strong> BIOL 130 and BIOL 140</td>
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<td><strong>Restriction(s):</strong> Can enroll if Class is Junior or Senior</td>
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<tr>
<td>BIOL 412</td>
<td>Vertebrates</td>
<td>5</td>
<td>A comparative study of the morphology of living animals, including an analysis of structural and functional features, diversity, and macroevolution. The major emphasis is on the comparative functional anatomy of living vertebrates. Three hours lecture, eight hours laboratory. Fulfills the biology major capstone requirement. This course was formerly offered as 312; students cannot receive credit for both BIO 312 and 412. (W, AY)</td>
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<td><strong>Prerequisite(s):</strong> (BIOL 303 or BIOL 305 or BIOL 335) or BIOL 360</td>
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<td><strong>Restriction(s):</strong> Can enroll if Class is Senior</td>
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<tr>
<td>BIOL 414</td>
<td>Limnology</td>
<td>4</td>
<td>The study of the structural and functional relationships and productivity of organisms in lakes and streams as they are regulated by their physical, chemical and biotic environments. Laboratories will emphasize field study of area lakes and streams. Three hours lecture, four hours laboratory. BIO/ESCI 304 or ESCI 275 recommended.</td>
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<td><strong>Prerequisite(s):</strong> BIOL 130 and (CHEM 136 or CHEM 146)</td>
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<td><strong>Corequisite(s):</strong> BIOL 414L</td>
</tr>
<tr>
<td>BIOL 416</td>
<td>Stream Ecology</td>
<td>4</td>
<td>A study of the physical, chemical and biological characteristics of streams and rivers. Three hours lecture, four hours laboratory. (OC).</td>
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<td></td>
<td></td>
<td></td>
<td><strong>Prerequisite(s):</strong> BIOL 304</td>
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<td>BIOL 419</td>
<td>Behavior and Evolution</td>
<td>3</td>
<td>An in depth examination of how evolutionary processes shape behavior, focusing on the influence of natural, sexual, and kin selection. Topics include behavioral genetics, natural selection, sexual selection, kin selection, optimality, game theory, evolutionary stable strategies, phylogenetics, and the comparative method.</td>
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<td><strong>Prerequisite(s):</strong> BIOL 140 and BIOL 130</td>
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<td><strong>Restriction(s):</strong> Can enroll if Class is Senior</td>
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<td>Can enroll if Level is Undergraduate</td>
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<td>BIOL 420</td>
<td>Advanced Field Ecology</td>
<td>4</td>
<td>An intense study of behavioral ecology and field-oriented research at an advanced level, utilizing ecological habitats on campus and in surrounding urban areas. Focus will be on plant/animal interactions and will include pollination ecology, reproduction and distribution ecology, optimal foraging theory, as well as hypothesis testing of animal migration and distribution of species in extreme urban environments. Three hours lecture, four hours laboratory. (OC).</td>
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<td><strong>Prerequisite(s):</strong> BIOL 304 or BIOL 320</td>
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<td><strong>Restriction(s):</strong> Can enroll if Class is Senior</td>
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BIOL 422 Conservation Biology  3 Credit Hours
This course is a study of the historical and current preservation of global biodiversity. The value of biodiversity, extinction, threats to biodiversity, and both ex situ and in situ conservation strategies are considered. (W, AY)
Prerequisite(s): BIOL 304 or ESCI 304
Restriction(s):
Can enroll if Class is Senior
Can enroll if Level is Undergraduate

BIOL 424 Biology of Spiders  4 Credit Hours
An introduction to the biology of spiders and related arachnids. Lectures include spider anatomy, natural history, ecology, and evolution. Laboratory work includes specimen preparation, use of dichotomous keys, spider behavior, field methods, rearing and collecting techniques, and identification of spiders and their webs. Three hours lecture, four hours laboratory. Students cannot receive credit for both Biology 424 and Biology 524.
Prerequisite(s): BIOL 130
Restriction(s):
Cannot enroll if Class is Graduate

BIOL 430 Medical Virology  3 Credit Hours
A general description of the history and nature of animal virus disease. Emphasis is placed on the pathogenesis and clinical description of specific diseases.
Prerequisite(s): BIOL 385 or MICR 385

BIOL 440 Micro Genetics & Physi Lab  1 Credit Hour
This course emphasizes the use of advanced microbiological techniques for understanding the genetics and physiology of microorganisms. Experiments focus on the understanding of general microbial phenomena, such as nutrition, metabolism and biochemistry; protein and nucleic acid synthesis; energy generation, enzyme regulation, membrane transport, motility, differentiation, cellular communication and the behavior of populations.
Prerequisite(s): BIOL 385* or MICR 385* or BIOL 301* or BIOL 406* or MICR 406* or BIOL 485* or MICR 485*
Restriction(s):
Cannot enroll if Class is Freshman
Can enroll if Level is Undergraduate

BIOL 450 Virology  4 Credit Hours
The first half of this course deals with bacterial viruses, with emphasis on classical events in this field. The second half surveys the field of animal viruses, with emphasis on recent discoveries, including replication, pathogenesis, and viral association with cancers. Three hours lecture, four hours laboratory. (AYW).
Prerequisite(s): CHEM 226 and (MICR 385 or BIOL 385)

BIOL 452 Med & Env Toxicology  3 Credit Hours
Mechanistic concepts of toxicity at the cellular and molecular levels. The course is taught from a human health perspective focusing on contemporary problems and environmental associations. Three hours lecture. (W, AY)
Prerequisite(s): BIOL 140 and CHEM 225 and (BIOL 370 or BIOL 470 or BIOL 301)
Restriction(s):
Can enroll if Class is Senior
Can enroll if Level is Undergraduate

BIOL 455 Immunology  4 Credit Hours
A detailed study of the field of immunology. Among the topics covered are various aspects of the immunological response, such as humoral or cell-mediated immunity, cell-cell interactions, and immunology as related to the cause and prevention of disease. Three hours lecture, four hours laboratory. (AY,F).
Prerequisite(s): BIOL 385 or BIOL 301 or MICR 385

BIOL 456 Behavioral Biology  4 Credit Hours
This course uses evolutionary and ecological theory to evaluate behavioral adaptations of organisms to their environment. Topics discussed include game theory, kin selection, sexual selection, eusociality, orientation and navigation, and signal evolution. Laboratory sessions include: observations of animal behavior, required manipulations of live animals, and field trips. Three hours of lecture, one four-hour laboratory. Students cannot receive credit for both BIOL 456 and BIOL 556. Student seeking graduate credit should elect BIOL 556.
Prerequisite(s): BIOL 130
Restriction(s):
Cannot enroll if Class is Specialist or Graduate or Doctorate

BIOL 459 Pathogenic Microbiology  4 Credit Hours
An introduction to pathogenic microorganisms and mechanisms of microbial pathogenicity. Disease-causing bacteria, fungi, viruses, and protozoa are studied. Laboratories emphasize clinical approaches to isolation, identification, and treatment. Three hours lecture, four hours laboratory. (AY,F).
Prerequisite(s): BIOL 385 or MICR 385

BIOL 470 Biochemistry I  3 Credit Hours
Life processes from a chemical viewpoint: structure/function relationships of biomolecules with emphasis on proteins, enzyme kinetics, and mechanisms of action. Three hours lecture. (W)
Prerequisite(s): (BIOL 130 and BIOL 140 and CHEM 134) or (CHEM 144 and CHEM 136) or (CHEM 146 and CHEM 225)

BIOL 471 Biochemistry II  3 Credit Hours
Intermediary metabolism, bioenergetics, energy transformation, metabolic interrelationships, biochemical regulation, highly structured subcellular biochemical systems. Three hours lecture. (F).
Prerequisite(s): BCHM 470 or BIOL 470 or CHEM 470

BIOL 472 Biochemistry Lab I  1 Credit Hour
The techniques of preparative and analytical biochemistry. Preparation and characterization of proteins and nucleic acids. Physical and chemical properties of proteins and nucleic acids. Four hours laboratory. CHEM 344 Recommended. (F).
Prerequisite(s): (BIOL 470* or BCHM 470* or CHEM 470*) and CHEM 227

BIOL 473 Biochemistry Laboratory II  1 Credit Hour
The techniques of preparative and analytical biochemistry. Preparation and characterization of lipids and carbohydrates. Methods in metabolism. Four hours laboratory. (W).
Prerequisite(s): (BCHM 471* or BIOL 471* or CHEM 471*) and (BCHM 472 or BIOL 472 or CHEM 472)
BIOL 474  Molecular Biology  4 Credit Hours
This course will emphasize the molecular biology of eukaryotes, and
topics will include genome organization and complexity, chromatin
structure and function, gene expression, DNA replication and repair,
genetic rearrangements, and the molecular biology of development. The
laboratory will emphasize the application of recombinant DNA technology
to the study of biological problems. Three hours lecture, four hours
laboratory. (W).
Prerequisite(s): (BCHM 470 or BIOL 470 or CHEM 470) or (BCHM 370 or
BIOL 370 or CHEM 370) and CHEM 227
Corequisite(s): BIOL 474L

BIOL 476  Cancer Cell Biology  3 Credit Hours
Cancer is a disease of anti-social cell behavior. This course educates
students on the genetics, molecular and cellular changes that normal
cells undergo to become cancer cell. Major emphasis is on providing a
mechanistic insight into fundamental questions in cancer cell biology.
The course also discusses currently available therapeutic treatments
and emerging issues in cancer therapy research. Fulfills capstone
requirement for biology majors. Three hours lecture.
Prerequisite(s): BIOL 130 and BIOL 140 and (BIOL 301 or BIOL 306 or
BIOL 370 or BCHM 370 or CHEM 370 or BIOL 385 or MICR 385)
Restriction(s):
Can enroll if Class is Senior

BIOL 485  Physiology of Micro-organisms  3 Credit Hours
An in-depth examination of the physiology of microorganisms. Areas
of emphasis include the growth and nutrition of microorganisms, the
development of viruses, the microbial degradation of organic compounds,
the regulation of degradation reactions, and the biosynthesis of uniquely
microbial compounds and secondary metabolites, such as antibiotics
and toxins. Consideration is given to the natural environments of specific
microorganisms. Three hours lecture. (W, YR)
Prerequisite(s): (BIOL 385 or MICR 385 or BIOL 370* or CHEM 370 or
BCHM 370) and CHEM 225*

BIOL 489  Origins of Biological Sciences  3 to 4 Credit Hours
A study of the development of the science of biology as revealed in the
writing and experiments of major biologists of the past and present. (OC).

BIOL 490  Sem in Biology/Microbiology  1 to 6 Credit Hours
Directed research on a problem culminating in the preparation of a paper
and presentation of a public seminar. Tutorials, lectures and student
seminars are given on selection and formulation of research problems,
experimental design, and statistical treatment of data. May be repeated
for credit with permission of advisor. (OC).

BIOL 491  Capstone Course in Biology  3 Credit Hours
A culminating course for biology majors which focuses on an area
of current biological research and integrates material from different
subdisciplines of biology. Topic varies and is announced in the Schedule
of Classes. Three hours lecture.
Restriction(s):
Can enroll if Class is Senior
Can enroll if Major is Biological Sciences

BIOL 492  Capstone Research Experience  3 Credit Hours
An approved research experience with a UM-D biology faculty member
which integrates material from different subdisciplines of biology.
Research results are reported in a poster or seminar presentation or in a
manuscript submitted for publication.
Restriction(s):
Can enroll if Class is Senior
Can enroll if Major is Biological Sciences

BIOL 493  Capstone Teaching Experience  3 Credit Hours
An approved teaching experience which integrates material from different
subdisciplines of biology. Students work as a student teaching assistant/ 
student mentor in the laboratory portion of a biology course.
Restriction(s):
Can enroll if Class is Senior
Can enroll if Major is Biological Sciences

BIOL 494  EMRAP  2 to 3 Credit Hours
Full Course Title: Emergency medicine Research Associates Program
(EMRAP) at St.Mary Mercy Hospital. This course provides a unique
research experience through a partnership between the University of
Michigan-Dearborn Department. In the context of assisting with
ongoing clinical research programs, enrolled students will learn the basic
principles behind clinical research design, hypothesis testing, and results
interpretation, including discussion of issues involving human subjects in
research, informed consent and health information privacy. Students will
gain knowledge in the aforementioned areas through lecture and through
clinical shift work, including clinical provider shadowing, participant
enrollment, and data collection for several ongoing clinical trials within
the ED. This course runs for a full academic year (3 credits in fall and 2
credits in winter). (F,W,YR)

BIOL 495  Off-Campus Research Participat  1 to 3 Credit Hours
Participation in ongoing experimental research at an off-campus
laboratory (or in the field). Arrangements made between the off-campus
researcher, the student, and the Biology concentration advisor. No more
than six credit hours combined from BIOL 490, 495, 498, and 499 may be
counted toward the 120 hours required for a degree. Four to twelve hours
laboratory. Permission of instructor. (F,S).

BIOL 497  Seminar in Biology  1 Credit Hour
Topics of current interest in Biology will be presented by guest lecturers,
faculty members or students. Topics chosen will vary from term to term.
Can be elected up to three times. One hour seminar. (W).

BIOL 498  Independent Study in Biology  1 to 3 Credit Hours
Library research and independent study performed under the guidance
of a faculty member. Four to twelve hours readings. Permission of
instructor. (F,S).

BIOL 499  Laboratory in Biological Resrh  1 to 3 Credit Hours
Directed laboratory research performed under the guidance of faculty
member. Four to twelve hours laboratory. Permission of Instructor. (F,S).

* An asterisk denotes that a course may be taken concurrently.

Frequency of Offering
The following abbreviations are used to denote the frequency of offering:
(F) fall term; (W) winter term; (S) summer term; (F, W) fall and winter
terms; (YR) once a year; (AY) alternating years; (OC) offered occasionally