

BIOLOGICAL SCIENCES (Updated July 20, 2022)

The mission of the Biological Sciences Program is to offer a superior undergraduate education in biology. The structure of the program allows students substantial freedom to individualize their course of study, while still ensuring that each receives a broad exposure to fundamental areas in the field of biology, as well as solid foundations in chemistry and mathematics. The laboratory experiences offered by the program require that students develop competence in the use of modern biological techniques, and in the analysis, interpretation, and presentation of data.

The program offers courses designated to meet the needs of students preparing for professional careers in industry, government, and education; and to provide a strong foundation for students preparing for graduate work. Courses that develop an understanding and appreciation of the living world as a part of a liberal education are provided for all students. Appropriate courses also are offered to meet requirements for pre-professional work in pre-medical, pre-dental, pre-pharmacy, pre-physical therapy, pre-veterinary, and other paramedical areas.

The Biological Sciences program offers both a Bachelor of Arts Degree in Biology and a Bachelor of Science Degree in Biology. Within the Bachelor of Science Degree in Biology, five options/tracks are offered: General Biology, Pre-health Sciences, Teacher Licensure, Wildlife and Field Biology, and 3 + 3 Doctor of Chiropractic.

The ETS Major Field Test for Biology must be taken by graduating seniors with the score to appear on the student transcript.

Recommended Chemistry Course Sequence for Pre-health Sciences (Pre-Dental, Pre-Medical, Pre-Optometry, Pre-Osteopathy, Pre-Pharmacy, Pre-Physical Therapy, Pre-Physician Assistant, and Pre-Veterinary) Biology Majors: The vast majority of our majors benefit from taking CHM 1034 General Chemistry I during their freshman year, prior to enrolling in CHM 1014 University Chemistry I. The general chemistry to university chemistry course sequence recommended for pre health sciences biology majors, based on a long-proven track record, provides the greatest likelihood of success in this portion of the curriculum. Pre-health sciences students are encouraged to work closely with the advisor in their particular focus area to help ensure timely and successful progression of coursework to graduation. The Chemistry program and Biochemistry program recommends a score of 22 or higher on the Mathematics component of the ACT and/or prior completion of MTH 1243 college Algebra to enroll directly in CHM 1014. Medical school admissions committees generally place considerable emphasis on the GPA achieved in the chemistry curriculum and this carries a great deal of weight in evaluating the potential for applicants' prospects of success. Depending on the previous school attended and courses completed, transfer students may have additional considerations, and should seek advice from their program advisor as soon as possible.

Note: pre-medical biology majors are not required to take CHM 1034 to earn the biology degree; however, it is highly recommended as a preparation for CHM 1014 (see previous paragraph for additional details). If the student chooses to take it, he/she will be better prepared for success in subsequent chemistry courses and the MCAT. If CHM 1034 is taken, it may require at least one summer class to be prepared to take the MCAT during the junior year.

Major Requirements for the Bachelor of Arts Degree in Biology

The Bachelor of Arts in Biology is an option for students who want an in-depth education in biology without completing all of the physical science courses required for the Bachelor of Science in Biology. The Bachelor of Arts in Biology is recommended for students who desire biology-related careers in business, health sciences, or industry. This degree option provides students with broad but focused exposure to a wide-range of biology courses and topics, supported by physical sciences and mathematics, but with additional emphasis on the humanities, social sciences, and world languages. The Bachelor of Science in Biology is recommended for students interested in pursuing pre-professional options (pre-dental, pre medical, pre-optometry, pre-osteopathy, pre-pharmacy, pre-physical therapy, pre-physician assistant, and pre-veterinary, along with certain biology graduate program appointments, post-graduation.

Highly Recommended Courses:

BIO 1023 General Biology for Science Majors
BIO) 1021 Introduction to Biology Laboratory

Core Requirements (20 hrs):

BIO 2104 General Botany
BIO 2114 General Zoology

Biology majors are required to enroll in and successfully complete botany (BIO2104) and zoology (BIO2114) within their first four semesters at HSU. Students must meet with their program advisor to determine the schedule appropriate for them.

BIO 3054 Genetics
BIO 3524 General Ecology
BIO 4214 Cell Biology

Anatomy and Evolution: Choose one course from the following (4 hrs):

BIO 3084 Comparative Anatomy and Evolution of Vertebrates
BIO 3244 Comparative Morphology and Evolution of Plants
BIO 4194 Animal Histology

Physiology: Choose one course from the following (4 hrs):

BIO 3304 Plant Physiology
BIO 3314 Animal Physiology
*BIO 3544, 3554 Human Anatomy and Physiology I and II

*Two semesters of Human Anatomy and Physiology are required to satisfy the physiology and anatomy requirement.

Organismal Biology: Choose one of the following (4 hrs):

BIO 2094 Microbiology
BIO 3294 Plant Taxonomy
BIO 3404 Herpetology
BIO 4034 Ornithology
BIO 4074 Dendrology
BIO 4164 Entomology
BIO 4224 Ichthyology
BIO 4344 Phycology
BIO 4354 Mammalogy

Environmental and Systems Biology: Choose one of the following (3-4 hrs):

BIO 3494 Biogeography
BIO 4044 Neotropical Ecology
BIO 4204 Aquatic Ecology
BIO 4324 Tropical Marine Biology
BIO 4414 Infection and Immunity
BIO 4504 Behavioral Ecology
BIO 4563 Biology of Cancer
CHM 3193 Environmental Chemistry

Additional requirements:

CHM 1034, 1044 General Chemistry I and II
CHM 1014, 1024 University Chemistry I and II
MTH 1243, STA 2053 College Algebra and Applied Biostatistics, or more advanced courses, with approval. PHY 2034, 2044 General Physics I and II

Total hours required for a major in biology, Bachelor of Arts degree: 65-67 hours

Biology Courses: 35-36 hours

Physical Science and Mathematics Courses: 30-31 hours

- Students must have a “C” grade or better in all courses in the major field and also in the courses listed as “additional requirements.”
- 6-12 hours of foreign language is required for the bachelor of arts degree. Students must complete six hours at the intermediate level or above of a principle modern foreign language. Credit in two or more languages will not satisfy the requirement. If foreign language is used as a minor, 15 semester hours of credit are required.

- The Biological Sciences program highly recommends that students achieve competence in the use of computers for word processing, graph and spreadsheet construction, and PowerPoint presentations before enrolling in upper-level courses. Students should consider enrolling in Introduction to Computers (CSC 2003) if their background in computer use is weak.

Major Requirements for the Bachelor of Science Degree in Biology, General Biology Option

The Bachelor of Science in Biology, General Biology track, provides both broad and in-depth exposure to essential knowledge and concepts, along with an integrated mix of experiential, hands-on approaches to understanding technical and laboratory methods, essential for a solid understanding of biological sciences at the undergraduate level. The General Biology option also provides rich opportunities for exposure to a diverse curriculum, research experiences, and travel abroad opportunities.

Highly Recommended Courses:

BIO 1023 General Biology for Science Majors
 BIO 1021 Introduction to Biology Laboratory
 CHM 1034 General Chemistry for Non-Majors
 CHM 1044 General Organic and Biochemistry for Non-Majors

Required Courses:

BIO 2104 General Botany
 BIO 2114 General Zoology

Note: Biology majors are required to enroll in and successfully complete botany (BIO2104) and zoology (BIO2114) within their first four semesters at HSU. Students must meet with their faculty advisor to determine the schedule appropriate for them.

BIO 2094 Microbiology
 BIO 3054 Genetics
 BIO 3524 General Ecology
 BIO 4214 Cell Biology

Choose one of the following:

BIO 3304 Plant Physiology
 BIO 3314 Animal Physiology

Choose one of the following:

BIO 3084 Comparative Anatomy and Evolution of Vertebrates
 BIO 3244 Comparative Morphology and Evolution of Plants

A minimum of two additional upper-level courses in biology must be selected. These may be from the courses listed above, if not already used to fulfill another requirement, or from the list below. Two semesters of Human Anatomy and Physiology will satisfy one of these requirements. BIO 4251, BIO 4371-3, BIO 4451-3, and BIO 4823 cannot be used for this requirement —

Choose two from the following:

BIO 3084 Comparative Anatomy and Evolution of Vertebrates
 BIO 3244 Comparative Morphology and Evolution of Plants
 BIO 3294 Plant Taxonomy
 BIO 3304 Plant Physiology
 BIO 3314 Animal Physiology
 BIO 3404 Herpetology
 BIO 3494 Biogeography
 BIO 3544, 3554 Human A&P I and II (both required to count as 1 elective)

BIO 4034 Ornithology
BIO 4044 Neotropical Ecology
BIO 4074 Dendrology
BIO 4164 Entomology
BIO 4194 Animal Histology
BIO 4204 Aquatic Ecology
BIO 4224 Ichthyology
BIO 4234 Mycology
BIO 4324 Tropical Marine Biology
BIO 4344 Phycology
BIO 4354 Mammalogy
BIO 4383 Wildlife Biology and Conservation
BIO 4393 Wildlife Management Techniques
BIO 4414 Infection and Immunity
BIO 4504 Behavioral Ecology
BIO 4563 Biology of Cancer

Additional requirements:

CHM 1014, 1024 University Chemistry I and II (including laboratories)
CHM 3063, 3073 Organic Chemistry I and II
CHM 3051, 3131 Organic Chemistry I and II Laboratories
MTH 1243 College Algebra and STA 2053 Applied Biostatistics, or equivalent/more advanced courses, with program approval.
PHY 2034, 2044 General Physics I and II

Total hours required for a major in biology: general biology track: 68-71

Biology Courses: 38-40 Hours

Physical Science and Mathematics Courses: 30-31 Hours

- Students must have a “C” grade or better in all courses in the major field and in the courses listed as “additional requirements.”
- The Biological Sciences program highly recommends that students achieve competence in the use of computers for word processing, graph and spreadsheet construction, and PowerPoint presentations before enrolling in upper-level courses. Students should consider enrolling in Introduction to Computers (CSC 2003) if their background in computer use is weak.

Major Requirements for the Bachelor of Science Degree in Biology, Pre-health Sciences Option

The Bachelor of Science in Biology, Pre-health Sciences track, is designed to optimally prepare students to enter into and be successful in pre-professional programs (Pre-Dental, Pre-Medical, Pre-Optometry, Pre-Osteopathy, Pre-Pharmacy, Pre-Physical Therapy, Pre-Physician Assistant, and Pre-Veterinary).

Highly Recommended Courses:

BIO 1023 General Biology for Science Majors
BIO 1021 Introduction to Biology Laboratory
CHM 1034 General Chemistry for Non-Majors
CHM 1044 General Organic and Biochemistry for Non-Majors

Required Courses:

BIO 2104 General Botany
BIO 2114 General Zoology

Note: Biology majors are required to enroll in and successfully complete botany (BIO2104) and zoology (BIO2114) within their first four semesters at HSU. Students must meet with their program advisor to determine the schedule appropriate for them.

BIO 2094 Microbiology
BIO 3054 Genetics
BIO 3084 Comparative Anatomy and Evolution of Vertebrates
BIO 3314 Animal Physiology
BIO 3524 General Ecology
BIO 3544 Human Anatomy and Physiology I
BIO 3554 Human Anatomy and Physiology II
BIO 4214 Cell Biology

Choose ONE of the following upper-level electives:

BIO 4194 Histology
BIO 4414 Infection and Immunity
BIO 4563 Biology of Cancer

Additional Requirements:

CHM 1014, 1024 University Chemistry I and II
CHM 3063, 3073 Organic Chemistry I and II
CHM 3051, 3131 Organic Chemistry I and II Laboratories
MTH 1243 College Algebra (or higher level math), AND STA 2053 Applied Biostatistics, OR equivalent/more advanced courses, with program approval.
PHY 2034, 2044 General Physics I and II

Total hours required for a major in biology, pre-health sciences track: 73-75

Biology Courses: 43-44 hours

Physical Science and Mathematics Courses: 30-31 hours

- Students should investigate the admissions requirements for the dental, medical, veterinary, etc. school(s) that they wish to attend post-graduation from HSU.
Note: CHM4283 Biochemistry I also is required for students planning to attend dental, medical, or optometry school (see specific notes under degree plan on subsequent page for additional details). MTH1295 Calculus I is required for students planning to attend pharmacy school.
- Students must have a “C” grade or better in all courses in the major field and also in the courses listed as “additional requirements.”
- The Biological Sciences program highly recommends that students achieve competence in the use of computers for word processing, graph and spreadsheet construction, and PowerPoint presentations before enrolling in upper-level courses. Students should consider enrolling in Introduction to Computers (CSC 2003) if their background in computer use is weak.

Major Requirements for the Bachelor of Science Degree in Biology, Teacher Licensure Option

The Bachelor of Science in Biology, Teacher Licensure Track, is designed to provide adequate content knowledge in biology and prepare students to successfully attain teacher licensure in biological science for the state of Arkansas. Teacher licensure in biology, in addition to the required curriculum for the major, also requires 29 additional hours of education courses and one three (3)-hour methods course.

Highly Recommended Courses:

BIO 1023 General Biology for Science Majors
BIO 1021 Introduction to Biology Laboratory
CHM 1034 General Chemistry for Non-Majors
CHM 1044 General Organic and Biochemistry for Non-Majors

Required Core Courses:

BIO 2104 General Botany

BIO 2114 General Zoology

Note: Biology majors are required to enroll in and successfully complete botany (BIO 2104) and zoology (BIO 2114) within their first four semesters at HSU. Students must meet with their program advisor to determine the schedule appropriate for them.

BIO 2094 Microbiology

BIO 3054 Genetics

BIO 3423 Teaching Methods in Biological Sciences

BIO 3524 General Ecology

BIO 4214 Cell Biology

Choose ONE of the following upper-level electives:

BIO 3084 Comparative Anatomy and Evolution of Vertebrates

BIO 3244 Comparative Morphology and Evolution of Plants

BIO 3304 Plant Physiology

BIO 3314 Animal Physiology

Choose ONE additional upper-level elective:

This course may be from the upper-level electives listed in the above section, if not already used as the upper-level elective, or another upper-level biology course listed in the Henderson catalog, provided it has not been used in one of the above categories. BIO 4251, BIO 4373, and BIO 4451 may not be used for this requirement. Two semesters of Human Anatomy and Physiology will satisfy one requirement.

Additional Science and Mathematics Requirements:

CHM 1014, 1024 University Chemistry I and II (including laboratories)

MTH 1243 College Algebra (or higher level math), AND STA 2053 Applied

Biostatistics, OR equivalent/more advanced courses, with program approval.

PHY 2034, 2044 General Physics I and II

Education Requirements:

PLT Module I

EDU 2000 Teacher Education Orientation

EDU 2423 Introduction to Education

EDU 2043 Educational Technology

PLT Module II

SPE 3013 Psychology of the Exceptional Child

EDU 3123 Educational Psychology

PLT Module III

EDU 4402 Assessment and Educational Measurement (grades 7-12)**

EDU 4113 Classroom Management (grades 7-12)**

Professional Semester

EDU 4216 (grades 7-12) Internship Content** EDU

4256 (grades 7-12) Internship Clinical**

**Must be admitted to Teacher Education Program

**Teacher Education Program Admission

- Minimum GPA of 2.7 overall
- A minimum grade of a "C" in English A and B, Oral Communication, College Algebra, or approved equivalent • Earn "CR" in EDU 2000 Teacher Education Orientation
- Pass Admissions Interview
- Meet the established guidelines on the ACT or Praxis CORE

Total hours required for a major in biology, Bachelor of Science, Teacher Licensure track: 86-88

Biology Courses: 35-36 hours

Physical Science and Mathematics Courses: 22-23 hours

Education Courses: 29 hours

PRAXIS II TESTS

- Candidates should take specific Praxis II-Biology: Content Knowledge exam before the senior year and must pass at the Arkansas cut-off score prior to internship.
- Praxis II-Principles of Learning and Teaching must be passed prior to graduation, but may be taken earlier. Students must have a “C” grade or better in all courses in the major field and also in the courses listed as “additional requirements.”

Students must have a “C” grade or better in all courses in the major field and also in the courses listed as “additional requirements.”

The Biological Sciences program highly recommends that students achieve competence in the use of computers for word processing, graph and spreadsheet construction, and PowerPoint presentations before enrolling in upper-level courses. Students should consider enrolling in Introduction to Computers (CSC 2003) if their background in computer use is weak.

Major Requirements for the Bachelor of Science Degree in Biology, Wildlife and Field Biology Option

The Bachelor of Science in Biology, Wildlife and Field Biology track, prepares students for employment as professionals and for admission into graduate programs in wildlife and field biology. This track offers in-depth exposure to and multiple experiential learning opportunities in organismal and field-based biology, along with a strong emphasis in the biology of wildlife and the associated conservation practices and management techniques.

Highly Recommended Courses:

BIO 1023 General Biology for Science Majors

BIO 1021 Introduction to Biology Laboratory

Biology Core Courses (26 hrs):

BIO 2104 General Botany

BIO 2114 General Zoology

Note: Biology majors are required to enroll in and successfully complete botany (BIO2104) and zoology (BIO2114) within their first four semesters at HSU. Students must meet with their faculty advisor to determine the schedule appropriate for them.

BIO 3054 Genetics

BIO 3524 General Ecology

BIO 4074 Dendrology

BIO 4383 Wildlife Biology

BIO 4393 Wildlife Management Techniques

Organismal Courses — Choose 2 of the following – must include at least one animal course (8 hrs):

BIO 3294 Plant Taxonomy

BIO 3404 Herpetology

BIO 4034 Ornithology

BIO 4164 Entomology

BIO 4224 Ichthyology

BIO 4344 Phycology

BIO 4354 Mammalogy

Field Ecology — Choose 1 of the following (4 hrs):

BIO 3494 Biogeography
BIO 4044 Neotropical Ecology
BIO 4204 Aquatic Ecology
BIO 4324 Tropical Marine Biology
BIO 4504 Behavioral Ecology

Organismal Anatomy — Choose 1 of the following (4 hrs):

BIO 3084 Comparative Anatomy and Evolution of Vertebrates
BIO 3244 Comparative Morphology and Evolution of Plants

Electives — Choose 1 of the following if not used above to fill another requirement (4 hrs):

BIO 2094 Microbiology
BIO 3084 Comparative Anatomy and Evolution of Vertebrates
BIO 3244 Comparative Morphology and Evolution of Plants
BIO 3294 Plant Taxonomy
BIO 3304 Plant Physiology
BIO 3314 Animal Physiology
BIO 3404 Herpetology
BIO 3494 Biogeography
BIO 3544, 3554 Human A&P (both required to count as 1 elective)
BIO 4034 Ornithology
BIO 4044 Neotropical Ecology
BIO 4164 Entomology
BIO 4204 Aquatic Ecology
BIO 4224 Ichthyology
BIO 4324 Tropical Marine Biology
BIO 4344 Phycology
BIO 4354 Mammalogy
BIO 4504 Behavioral Ecology

Additional requirements:

*Note: the Wildlife and Field Biology track has two physical science options. Some graduate programs in wildlife biology or conservation biology, along with certain higher-level state and federal positions, may require completion of CHM 1014, 1024 University Chemistry I and II, CHM 3063, 3073 Organic Chemistry I and II, CHM 3051, 3131 Organic Chemistry lab I and II, and PHY 2034, 2044 General Physics I and II, in addition to the required biology courses for the wildlife and field biology track and degree. See directly below for physical science options (if option two is selected, the aforementioned physical science courses would replace CHM 1034 and 1044 General Chemistry for Non-majors and General Organic and Biochemistry, PHS 1053 Earth Systems and the Environment, and the 12-13 hours of physics and quantitative sciences).

Students who complete physical science option two, including organic chemistry, have a better chance of entering the job market at higher pay. For example, the US government has a payscale with 15 grades (GS1-GS15). Applicants for government jobs are assessed to determine the scale at which they may enter the Federal system, and applicants with more demanding degrees tend to qualify for better compensation.

*Physical Sciences Component — option one:

Chemical Sciences (8 hrs):

CHM 1034 General Chemistry for Non-Majors
CHM 1044 General Organic and Biochemistry

Note: Higher level CHM course(s) accepted, with program approval

Physics and Quantitative Sciences (12-13 hrs):

MTH 1243 College Algebra or MTH 1273 Pre-calculus Mathematics
STA 2053 Applied Biostatistics

PHS 1053 Earth Systems and the Environment

And choose 1 additional course from MTH (higher than MTH 1243), STA (higher than STA 2053), PHY (physics), or PHS (physical science)

Total hours required for a major in biology, wildlife and field biology track (option one): 66-67

Biology Courses: 46 Hours

Physical Science and Mathematics Courses: 20-21 Hours

****Physical Sciences Component — option two:**

Chemistry, Physics, and Mathematics (30 hrs):

CHM 1014, 1024 University Chemistry I and II

CHM 3063, 3073 Organic Chemistry I and II

CHM 3051, 3131 Organic Chemistry I and II Lab

MTH 1243, STA 2053 College Algebra and Applied Biostatistics or more advanced courses, with approval.

PHY 2034, 2044 General Physics I and II

Total hours required for a major in biology, wildlife and field biology (option two): 76

Biology Courses: 46 hours

Physical Science and Mathematics Courses: 30 hours

- Students must have a “C” grade or better in all courses in the major field and also in the courses listed as “additional requirements.”
- The Biological Sciences program highly recommends that students achieve competence in the use of computers for word processing, graph and spreadsheet construction, and PowerPoint presentations before enrolling in upper-level courses. Students should consider enrolling in Introduction to Computers (CSC 2003) if their background in computer use is weak.
- Students interested in particular graduate programs should consult closely with their advisors, as requirements may be different — *see physical science options I and II. Additional physical science courses will be required for option II.

Major Requirements for the Bachelor of Science Degree in Biology, 3+3 Doctor of Chiropractic Track with Logan University

Specific requirements for successful completion of the articulation agreement with Logan College of Chiropractic (3+3 Program)

Henderson State University and Logan College of Chiropractic (LCC) have established an articulation agreement that provides qualified students with the opportunity to earn a B.S. in Biology and a Doctorate of Chiropractic in six years, one year less than the normal time. Students will matriculate at HSU for a minimum of 96 semester hours, during which they will complete a minor field of study, fulfill the Liberal Arts Core, all specified biology courses, and an additional 27 hours in specified chemistry, physics and math courses. No more than 20 credits of required courses, and *none* of the science credits may be earned via examination or transfer from another school. Contact the Biological Sciences program advisor for more information and/or degree requirements for this program of study.

Transfer Credits:

Transfer students must successfully complete three upper-level biology courses at Henderson before biology courses taken elsewhere will be considered for transfer to their degree program here. A science course taken elsewhere as freshman/sophomore class but offered at Henderson as junior/senior class may be applied to the degree, upon substitution of a junior/senior class agreed upon by the program and the student. Students already enrolled in the program should consult with the program prior to enrolling in science courses at other institutions.

Registration Policy:

Priority registration for major's courses will be reserved for students enrolling in those courses for the first time. Biology majors wishing to repeat a course in biology must wait until the end of priority registration to enroll in that class. This

includes courses that were completed and courses in which the student withdrew or was dropped. Students with extenuating circumstances may petition the program for waiver of this requirement.

Standardized Examination:

In their final semester, students are required to take a standardized examination (ETS biology examination). The score will appear on the student's final transcript.

Requirements for a Minor in Biology

Required Courses:

BIO 2104 General Botany
BIO 2114 General Zoology

In addition to the two courses above, students choose any three of the following courses to complete a minor in biology:

BIO 2094 Microbiology
BIO 3054 Genetics
BIO 3084 Comparative Anatomy and Evolution of Vertebrates
BIO 3244 Comparative Morphology and Evolution of Plants
BIO 3524 General Ecology
BIO 3544, 3554 Human Anatomy and Physiology I and II
(Together count as one class)
BIO 4214 Cell Biology

Total hours required for a minor in Biology: 20

Courses in Biology

BIO 1013 (BIOL1004) Introduction to Biology for Non-science Majors: A study of basic biological concepts and principles. A general education course designed for non-science majors. The program recommends that students avoid taking this class during their freshman year. Three (3) hours lecture per week.

BIO 1021 (BIOL1004) Introduction to Biology Laboratory: Experiments are performed to demonstrate the principles covered in BIO 1013 and BIO 1023. Two hours laboratory per week. Prerequisite or corequisite: BIO 1013 or BIO 1023.

BIO 1023 General Biology for Science Majors: An in-depth investigation into the principles and concepts pertinent to a fundamental understanding of biological sciences. This course is designed specifically for science majors. Course emphasis will be placed on molecular and cell biology, physiology, genetics, organismal biology, diversity, and classification, ecology, and evolution. Three (3) hours lecture per week.

BIO 2094 (BIOL2004) Microbiology: A comprehensive study of microorganisms with emphasis on conceptual and applied microbiology. Three (3) hours lecture and (3) three hours laboratory per week. Prerequisites: 4 hours of biology and 4 hours of chemistry.

BIO 2104. (BIOL1034) General Botany: The study of biological principles and concepts applied to plants. Three (3) hours of lecture and three (3) hours of laboratory per week.

BIO 2114 (BIOL1054) General Zoology: The study of animal relationships, with emphasis on principles, anatomy and ecology. Three (3) hours lecture and three (3) hours laboratory per week.

BIO 2174 Human Anatomy and Physiology I, (non-majors): A study of the structures and functions of human body systems. Three (3) hours lecture and three (3) hours laboratory per week. Prerequisite: BIO 2114 or BIO 1013 and BIO 1021.

BIO 2184 Human Anatomy and Physiology II, (non-majors): A continuation of BIO 2174. Three (3) hours lecture and

three (3) hours laboratory per week. Prerequisite: BIO 2114 or BIO 1013 and BIO 1021, BIO 2174 recommended.

BIO 2283 Environmental Science: A study of how ecosystems function in terms of nutrient cycles, energy flow, and population dynamics, with considerations of imbalances in various areas of human concern, such as agriculture, resource utilization, waste disposal, energy sources, and the human population. Three (3) hours lecture per week.

BIO 2324/3324 (WI) Tropical Marine Biology: A field course emphasizing study of tropical marine animals and plants, with extensive study of the diverse organisms of reefs, mangroves, rocky shores and seagrass beds. Includes a field component in Belize. Prerequisites: Ability to swim and consent of instructor. This course satisfies the liberal arts core nonwestern culture requirement. Two (2) hours lecture and two (2) hours laboratory per week plus two weeks in the field during summer.

BIO 3054 (WI) Genetics: A study of transmission genetics followed by molecular genetics. Three (3) hours lecture and (3) three hours laboratory per week. Prerequisite: BIO 2104 or 2114.

BIO 3084 Comparative Anatomy and Evolution of Vertebrates: Traces the evolutionary history of vertebrate animals through a comparative analysis of chordate anatomy with emphasis on the ten organ systems. Three (3) hours lecture and three (3) hours laboratory per week. Prerequisite: BIO 2114.

BIO 3244 (WI) Comparative Morphology and Evolution of Plants: Traces the evolutionary history of the plant kingdom through a comparative study of the structure and life cycles of representatives of the major groups of plants. Three (3) hours lecture and (3) three hours laboratory per week. Prerequisite: BIO 2104.

BIO 3294 Plant Taxonomy: A study of basic principles and concepts of plant identification, classification and nomenclature. Laboratory and field emphasis on the description and identification of representatives of major families of vascular plants. Three (3) hours lecture and three (3) hours laboratory per week. Prerequisite: BIO 2104.

BIO 3304 (WI) Plant Physiology: A study of plant processes including photosynthesis, carbohydrate metabolism, translocation, mineral nutrition, plant growth hormones, water relationships, and growth and development. Three (3) hours lecture and three (3) hours laboratory per week. Prerequisites: BIO 2104; CHM 1014 and 1024.

BIO 3314 Animal Physiology: A study of the functions of animal systems with emphasis on the human. Three (3) hours lecture and three (3) hours laboratory per week. Prerequisites: BIO 2114 and BIO 3544 or BIO 3084; CHM 1014, 1024.

BIO 3404 (WI) Herpetology: A comprehensive study of reptiles and amphibians with emphasis on specimens collected and studied in the field. Three (3) hours lecture and three (3) hours field or laboratory per week. Prerequisite: BIO 2114.

BIO 3423 Teaching Methods in Biological Sciences: Prepares pre-service students of the teacher licensure track in biological sciences for internship. Students integrate knowledge from prerequisite courses to meet current state science standards for High School Biology–Integrated. Teacher candidates will explore instructional approaches, planning and assessment strategies, curriculum, field experiences, laboratory experiences, and laboratory materials. Pre-requisites: successful completion of two of the three upper-division core courses (BIO 3054 Genetics, BIO 3524 General Ecology, BIO 4214 Cell Biology) with a grade of “C” or better. Three (3) hours lecture per week.

BIO/GEO 3494 Biogeography: An in-depth study and evaluation of the factors affecting the geographic distribution of life on earth. Primary emphasis will be placed on climatic, geologic, and human influence. Dispersal mechanisms, speciation, biodiversity, and evolutionary history will also be investigated. Three (3) hours lecture per week plus five (5) Saturday field trips. Prerequisite: BIO 2104 and BIO 2114.

BIO 3524 (WI) General Ecology: A study of principles of ecosystem structure and dynamics including energy flow, biogeochemical cycling, community composition and succession, and the distribution and abundance of populations. Includes laboratory and field experiences with ecological problems. Two Saturday field trips required. Three (3) hours lecture and three (3) hours laboratory per week. Prerequisites: BIO 2104 and 2114.

BIO 3544 Human Anatomy and Physiology I (Majors): A study of the structures and functions of human body systems. Three (3) hours lecture and three (3) hours laboratory per week. Prerequisite: BIO 2114.

BIO 3554 Human Anatomy and Physiology II (Majors): A continuation of BIO 3544. Three (3) hours lecture and three (3) hours laboratory per week. Prerequisite: BIO 2114, BIO 3544 recommended.

BIO 4034 Ornithology: Taxonomic, behavioral, and ecological aspects of birds occurring in the local fauna. Three (3) hours lecture and three (3) hours field or laboratory per week. Prerequisite: BIO 2114.

BIO 4044 (WI) Neotropical Ecology: This course introduces students to the history, ecology, and evolution of ecosystems of the New World tropics, with emphasis on the natural history of the Galapagos Islands and mainland South America. Includes a strenuous and challenging 16 day component in Peru and Ecuador. One week is spent aboard a ship in the Galapagos Archipelago. Also includes study of the Inca Empire, and aspects of Peruvian and Ecuadorian culture and history. Two (2) hours lecture and two (2) hours laboratory per week plus two weeks in the field during summer. Prerequisites: BIO 2104 and BIO 2114, ability to swim, and consent of the instructor. This course satisfies the liberal arts core physical education activity requirement and the non-western culture requirement.

BIO 4074 Dendrology: A study of woody plants of the local flora with emphasis on field identification, classification, and economic importance. Three (3) hours lecture and three (3) hours field or laboratory per week. Prerequisite: BIO 2104.

BIO 4164 (WI) Entomology: A study of morphology, taxonomy, and metamorphosis of insects and related arthropods. Prerequisite: BIO 2114. Two (2) hours lecture and two (2) hours laboratory per week.

BIO 4194 Animal Histology: The study of the microscopic anatomy and function of animal tissues with emphasis on the human. Three (3) hours lecture and (3) three hours laboratory per week. Prerequisites: BIO 2114 and either BIO 3544 or 3084.

BIO 4204 (WI) Aquatic Ecology: A study of the structure and function of freshwater ecosystems, with emphasis on the dynamics of their physical, chemical and biological components. Two (2) hours lecture and two (2) hours laboratory per week. Prerequisites: BIO 2114, CHM 1014 and 1024.

BIO 4214 (WI) Cell Biology: The molecular biology of the cell with emphasis on structure-function relationships. Three (3) hours lecture and three (3) hours laboratory per week. Prerequisites: BIO 2104, 2114 and CHM 1014, 1024, or consent of the instructor.

BIO 4224 (WI) Ichthyology: A study of the classification, ecology, natural history, economic importance, techniques and methods of collection, identification, and preservation of fishes, with emphasis on taxonomy, ecology, and management. Three (3) hours lecture and three (3) hours field or laboratory per week. Prerequisite: BIO 2114.

BIO 4234 Mycology: A study of the biology of the fungi including economic relationships. Two (2) hours lecture and two (2) hours laboratory or field per week. Prerequisite: BIO 2104 or consent of instructor.

BIO 4251 Biological Laboratory Techniques: *For majors only.* Experience is given in planning and assisting in laboratory courses. Prerequisite: Consent of program. May be repeated once.

BIO 4331-3 Independent Study: Study under the direct supervision of a faculty member. May be repeated. Requires chair's approval.

BIO 4344 Phycology: A study of the taxonomy, morphology, ecology, and economic importance of freshwater algae. Three (3) hours lecture and three (3) hours laboratory or field per week. Prerequisite: BIO 2104.

BIO 4354 (WI) Mammalogy: A study of the classification, ecology, natural history, economic importance, techniques and methods of collection, identification, and preservation of mammals. Three (3) hours lecture and three (3) hours field or laboratory per week. Prerequisite: BIO 2114.

BIO 4371-3 Independent Research: Study of a contemporary biological problem under the direct supervision of a faculty member. A written scientific paper is required. Prerequisites: Twenty hours of biology and consent of the instructor. May not substitute for any core requirement. May be repeated once.

BIO 4383 Wildlife Biology and Conservation: An introduction to the biological basis for management strategies relating to habitats and populations of wildlife. Topics may include ecological concepts of populations and ecosystems, wildlife habitat needs, population ecology, commercial and recreational uses (hunting and trapping), conservation biology, role of predators, animal behavior and management, and wildlife diseases. Three (3) hours lecture per week. Prerequisite: BIO 2114.

BIO 4393 Wildlife Management Techniques: An applied examination of the techniques used in wildlife population management. Topics may include radio telemetry, animal capture and handling, animal surveys and monitoring, age, sex, and reproductive data collection, estimation of populations, assessment of habitat usage and needs in an ecological context, vegetation quantification, and mortality assessment. Three (3) hours laboratory per week. Prerequisites: BIO 4383 Wildlife Biology, BIO 4074 Dendrology.

BIO 4414 Infection and Immunity: An introduction to immunology and infectious diseases with emphasis on their interrelatedness. Three (3) hours lecture and three (3) hours laboratory per week. Course prerequisites are successful completion of BIO 2094 with a grade of "C" or better.

BIO 4451-3 Directed Internship Experience: Internship experience pertaining to a contemporary biology or biology related area under the direct guidance and supervision of a qualified agency or institution, and in cooperation with the HSU Biological Sciences program. A formal presentation and/or written scientific paper is required over the topic and outcome(s) of the internship. Prerequisites: Twenty hours of biology and program approval or consent of the program advisor. Grade awarded will be CR/NCR. May not substitute for any core requirement. May be repeated once (course cannot be repeated for identical internship experiences).

BIO 4504 Behavioral Ecology: A study of how interactions with other organisms and the environment drive the evolution of adaptive behaviors. Behaviors that are manifest in the biology of animals such as life history, reproduction, resource acquisition, sociality, and survival will be examined. Three (3) hours lecture and three (3) hours laboratory per week. Prerequisite: BIO 3524.

BIO 4563 Biology of Cancer: A study of current concepts and characteristics of cancer, including cancer research and cancer treatment. This course will explore the cellular and molecular mechanisms underlying cancer development with the aim of understanding how changes in the normal growth and division processes lead to the formation of tumors. Topics include the natural history of cancer, oncogenes, tumor suppressors, cancer-causing viruses, epidemiology, health care policy and current therapeutic approaches to cancer treatment and prevention. Three (3) hours lecture per week. Prerequisite: BIO3054.

Two-year plan for the rotation of offerings of classes in the biology program. Note: Core courses should be offered exactly per this schedule, except when faculty are on sabbatical; however, need may determine the offering schedule of some elective courses (see next page for course rotation).

BIO4373 Independent Research

Even Years

	Fall (even)		Spring (even)
	Core		Core
	BIO1013 Introduction to Biology		BIO1013 Introduction to Biology
	BIO2094 Microbiology		BIO2094 Microbiology
	BIO2104 General Botany		BIO2104 General Botany
	BIO2114 General Zoology		BIO2114 General Zoology
	BIO3084 Comparative Anatomy and Evolution of Vertebrates		BIO3054 Genetics
	BIO3314 Animal Physiology		BIO3244 Comparative Morphology and Evolution of Plants
	BIO4214 Cell Biology		BIO3524 General Ecology
	BIO4383 Wildlife Biology		BIO4393 Wildlife Management Techniques
	Elective		Elective
	BIO2174 Human Anatomy and Physiology I (Non-majors)		BIO2184 Human Anatomy and Physiology II (Non-majors)
	BIO3544 Human Anatomy and Physiology I (Majors)		BIO3404 Herpetology
	BIO4074 Dendrology		BIO3494 Biogeography
	BIO4164 Entomology		BIO3554 Human Anatomy and Physiology II (Majors)
	BIO4251 Biology Lab Techniques		BIO4034 Ornithology
	BIO4333 Directed Study		BIO4414 Infection and Immunity
	BIO4354 Mammalogy		BIO4251 Biology Lab Techniques
			BIO4331 Independent Study

BIO4373 Independent Research

BIO4504 Behavioral Ecology

Summer 1 (even)

Core

BIO1013 Introduction to Biology

BIO2094 Microbiology

BIO2104 General Botany

Elective

BIO2174 Human Anatomy and Physiology I (Non-majors)

BIO3544 Human Anatomy and Physiology I (Majors)

BIO4251 Biology Lab Techniques

Summer 1 (odd)

Core

BIO1013 Introduction to Biology

BIO2094 Microbiology

BIO2104 General Botany

Elective

BIO2174 Human Anatomy and Physiology I (Non-majors)

BIO3544 Human Anatomy and Physiology I (Majors)

BIO4251 Biology Lab Techniques

Summer 2 (even)

Core

BIO1013 Introduction to Biology

BIO3054 Genetics

Elective

BIO2184 Human Anatomy and Physiology II (Non-majors)

BIO3324 Tropical Marine Biology (depending on need)

BIO3554 Human Anatomy and Physiology II (Majors)

BIO4044 Neotropical Ecology

BIO4373 Independent Research

BIO4331 Independent Study

Summer 2 (odd)

Core

BIO1013 Introduction to Biology

BIO3054 Genetics

Elective

BIO2184 Human Anatomy and Physiology II (Non-majors)

BIO3324 Tropical Marine Biology (depending on need)

BIO3554 Human Anatomy and Physiology II (Majors)

BIO4044 Neotropical Ecology

BIO4373 Independent Research

Odd Years

Fall (odd)

Core

BIO1013 Introduction to Biology

BIO2094 Microbiology

BIO2104 General Botany

BIO2114 General Zoology

BIO3084 Comparative Anatomy and Evolution of Vertebrates

BIO3304 Plant Physiology

BIO3314 Animal Physiology

BIO4214 Cell Biology

BIO4383 Wildlife Biology

Elective

BIO2174 Human Anatomy and Physiology I (Non-majors)

BIO3544 Human Anatomy and Physiology I (Majors)

BIO4133 Animal Histology

BIO4204 Aquatic Ecology

BIO4251 Biology Lab Techniques

BIO4331 Independent Study

BIO4344 Phycology

BIO4373 Independent Research

Spring (odd)

Core

BIO1013 Introduction to Biology

BIO2094 Microbiology

BIO2104 General Botany

BIO2114 General Zoology BIO3054

Genetics

BIO3524 General Ecology

BIO4393 Wildlife Management Techniques

Elective

BIO2184 Human Anatomy and Physiology II (Non-majors)

BIO3294 Plant Taxonomy

BIO3554 Human Anatomy and Physiology II (Majors)

BIO4224 Ichthyology

BIO4251 Biology Lab Techniques BIO4331

Independent Study

BIO4373 Independent Research

BIO4563 Biology of Cancer