The Department of Biological Sciences offers a supportive training environment across the full spectrum of biology, bridging the disciplines of cell and molecular biology, physiology, development, genetics, molecular systematics, microbiology, neurobiology, ecology, and evolutionary biology. Through course selection both within and outside the department, our students are prepared to enter research and professional training programs (health, secondary education, law, etc.) or enter careers in government and a broad range of businesses that rely on a technology-literate workforce with analytical and problem-solving skills.

For information on advanced degrees in biology, see the Graduate School Catalog (http://catalog.uark.edu/graduatecatalog/programsofstudy/biologicalsciencesbisc/).

University and College Requirements for a Bachelor of Science in Biology

In addition to the Fulbright College of Arts and Sciences graduation requirements (see under Degree Completion Program Policy), the following course requirements must be met.

State minimum core (http://catalog.uark.edu/undergraduatetocatalog/gened/stateminimum/) requirements may vary by individual, based on placement and previous course credit earned. Once all core requirements are met, students may substitute with general electives in consultation with their academic advisor.

<table>
<thead>
<tr>
<th>State Minimum Core</th>
<th>35</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics</td>
<td>4</td>
</tr>
<tr>
<td>MATH 2554 Calculus I (ACTS Equivalency = MATH 2405)</td>
<td></td>
</tr>
<tr>
<td>Statistics</td>
<td>3-4</td>
</tr>
<tr>
<td>Choose one statistics (STAT) course from the following:</td>
<td></td>
</tr>
<tr>
<td>STAT 2303 Principles of Statistics (ACTS Equivalency = MATH 2103)</td>
<td></td>
</tr>
<tr>
<td>STAT 2823 Biostatistics</td>
<td></td>
</tr>
<tr>
<td>STAT 3003 Statistical Methods &amp; STAT 3001L and Statistics Methods Laboratory</td>
<td></td>
</tr>
<tr>
<td>Chemistry</td>
<td>19</td>
</tr>
<tr>
<td>CHEM 1103 University Chemistry I (ACTS Equivalency = &amp; CHEM 1101L CHEM 1414 Lecture) and University Chemistry I Laboratory (ACTS Equivalency = CHEM 1414 Lab)</td>
<td></td>
</tr>
<tr>
<td>Physics</td>
<td>8</td>
</tr>
<tr>
<td>Choose one two-semester sequence from the following:</td>
<td></td>
</tr>
<tr>
<td>PHYS 2013 College Physics I (ACTS Equivalency = PHYS &amp; PHYS 2011L 2014 Lecture) and College Physics I Laboratory (ACTS Equivalency = PHYS 2014 Lab)</td>
<td></td>
</tr>
<tr>
<td>PHYS 2033 College Physics II (ACTS Equivalency = PHYS &amp; PHYS 2031L 2024 Lecture) and College Physics II Laboratory (ACTS Equivalency = PHYS 2024 Lab)</td>
<td></td>
</tr>
<tr>
<td>-or-</td>
<td></td>
</tr>
<tr>
<td>PHYS 2054 University Physics I (ACTS Equivalency = PHYS 2034)</td>
<td></td>
</tr>
<tr>
<td>PHYS 2074 University Physics II (ACTS Equivalency = PHYS 2044 Lecture)</td>
<td></td>
</tr>
<tr>
<td>Philosophy</td>
<td>3</td>
</tr>
<tr>
<td>Choose one philosophy (PHIL) course from the following:</td>
<td></td>
</tr>
<tr>
<td>PHIL 2103 Introduction to Ethics (ACTS Equivalency = PHIL 1003)</td>
<td></td>
</tr>
<tr>
<td>PHIL 2203 Logic (ACTS Equivalency = PHIL 1003)</td>
<td></td>
</tr>
<tr>
<td>PHIL 3113 Environmental Ethics</td>
<td></td>
</tr>
<tr>
<td>PHIL 4213 Philosophy of Science</td>
<td></td>
</tr>
<tr>
<td>Biology</td>
<td>40</td>
</tr>
<tr>
<td>BIOL 1584 Biology for Majors (ACTS Equivalency = BIOL 1014 Lecture)</td>
<td></td>
</tr>
<tr>
<td>BIOL 2533 Cell Biology</td>
<td></td>
</tr>
<tr>
<td>BIOL 2323 General Genetics</td>
<td></td>
</tr>
<tr>
<td>BIOL 3023 Evolutionary Biology</td>
<td></td>
</tr>
<tr>
<td>BIOL 3863 General Ecology</td>
<td></td>
</tr>
<tr>
<td>and a minimum of one lab chosen from the following:</td>
<td></td>
</tr>
<tr>
<td>BIOL 2531L Cell Biology Laboratory</td>
<td></td>
</tr>
<tr>
<td>BIOL 2321L General Genetics Laboratory</td>
<td></td>
</tr>
<tr>
<td>BIOL 3861L General Ecology Laboratory</td>
<td></td>
</tr>
</tbody>
</table>

At least 23 credit hours in biology (BIOL) or biology-related electives, including:

1. At least 18 credit hours in biology (BIOL) courses numbered 3000-level or higher, of which at least 12 credit hours must be numbered 4000-level or higher.

2. At least two lab courses numbered 2000-level or higher. This includes Biology Core labs not previously completed. Courses whose course descriptions explicitly exclude them from counting toward this requirement may not be used. Lab courses may also include BIOL 480V Special Topics in Biological Sciences and BIOL 499V Research in Biology Sciences (and their honors equivalents).
3. No more than four credit hours numbered at the 1000-level are permitted. BIOL 1543/BIOL 1541L Principles of Biology/Principles of Biology Laboratory may not apply to this requirement.

4. A biology (BIOL) course that meets the Fulbright College Writing Requirement. This may be satisfied by a) Enrolling in BIOL 498V Senior Thesis; b) completing a term paper with a grade of a ‘B’ or higher in a biology (BIOL) course numbered 3000-level or higher on a topic approved by the instructor; or c) Completing an honors thesis. Students may not use a paper written for another BIOL course for BIOL 498V Senior Thesis.

Note: Biology-related electives that are not taught by the Department of Biological Sciences must be approved by a departmental faculty member using the “Exception Request for Major or Minor Requirements” form.

General Electives
8
Total Hours 120

A student who, after completing BIOL 1543/BIOL 1541L Principles of Biology/Principles of Biology Laboratory with a grade of a ‘B’ or better in both courses, wishes to substitute BIOL 1543/BIOL 1541L for the required BIOL 1584 Biology for Majors may petition the Department of Biological Sciences to do so. These petitions will be considered on a case by case basis.

Writing Requirement: The college writing requirement for majors in biology may be met by one of the following:

1. Completion of an honors thesis,
2. Completion of a senior thesis (BIOL 498V) supervised by a faculty member in biological sciences,
3. Completion of a required term paper with a grade of B or above in a BIOL course numbered 3000 or above on a topic approved by the instructor, or
4. Completion of a paper, supervised by a Biological Sciences faculty member, in Special Topics (BIOL 480V)

Note: A student exercising Option 3 or 4 may not use the paper written for that option for credit in BIOL 498V

B.S. in Biology
Eight-Semester Degree Plan

Students enrolling in the eight-semester degree plan should review the Eight-Semester Degree Completion Policy (http://catalog.uark.edu/undergraduatecatalog/academicregulations/eightsemesterdegreecompletionpolicy/).

State minimum core requirements may vary by individual, based on placement and previous credit granted. Once all core requirements are met, students may substitute with general electives in consultation with their academic advisor.

First Year
Units
Fall Spring
ENGL 1013 Composition I (ACTS Equivalency = ENGL 1013) (Satisfies General Education Outcome 1.1)
3 3
Select one of the following (Satisfies General Education Outcome 2.1).
3-4

BIO 1584 College Algebra (ACTS Equivalency = MATH 1103)
MATH 2113 Plane Trigonometry (ACTS Equivalency = MATH 1203)
MATH 1284C Precalculus Mathematics (ACTS Equivalency = MATH 1305)
MATH 2554 Calculus I (ACTS Equivalency = MATH 2405)
BIOL 1584 Biology for Majors (ACTS Equivalency = BIOL 1014 Lecture) (Satisfies General Education Outcome 3.4)
CHEM 1103 University Chemistry I (ACTS Equivalency = CHEM 1414 Lecture)
& CHEM 1101L University Chemistry I Laboratory (ACTS Equivalency = CHEM 1414 Lab)

ENGL 1023 Composition II (ACTS Equivalency = ENGL 1023) (Satisfies General Education Outcome 1.1)
MATH 1213 Plane Trigonometry (ACTS Equivalency = MATH 1203) (if needed--otherwise take general electives)
MATH 1284C Precalculus Mathematics (ACTS Equivalency = MATH 1305)
MATH 2554 Calculus I (ACTS Equivalency = MATH 2405)
CHEM 1123 University Chemistry II (ACTS Equivalency = CHEM 1424 Lecture)
& CHEM 1121L University Chemistry II Laboratory (ACTS Equivalency = CHEM 1424 Lab)
State Minimum Core—U.S. History (Satisfies General Education Outcome 3.2, 3.3, and 4.2)

Year Total: 15 15

Second Year
Units
Fall Spring
State Minimum Core—Fine Arts (Satisfies General Education Outcome 3.1)
Philosophy (PHIL) requirement
BIOL 2533 Cell Biology (take BIOL 2531L if needed)
CHEM 3603 Organic Chemistry I 
& CHEM 3601L Organic Chemistry I Laboratory
General Electives
State Minimum Core—Social Science (Satisfies General Education Outcome 4.1)
BIOL 2323 General Genetics (take BIOL 2321L if needed)
CHEM 3613 Organic Chemistry II 
& CHEM 3611L Organic Chemistry II Laboratory
BIOL Electives

Year Total: 15 15
A minimum of 120 hours is required, including:

1. **BIOL 1584 Biology for Majors.** Majors may substitute another 1000-level BIOL course (BIOL 1603/BIOL 1601L Principles of Zoology or BIOL 1613/BIOL 1611L Plant Biology) for BIOL 1584; a maximum of four 1000-level credits may be applied toward the major. A student who, after completing BIOL 1543/BIOL 1541L Principles of Biology/Lab with a grade of B or better in both courses, wishes to substitute BIOL 1543/BIOL 1541L Principles of Biology for BIOL 1584 may petition the Department of Biological Sciences to do so. These petitions will be considered on a case by case basis for approval.

2. An additional 26 hours of biological sciences, including:

   a. **Biology Core (13 hours):**
      - BIOL 2533 Cell Biology
      - BIOL 2323 General Genetics
      - BIOL 3023 Evolutionary Biology
      - BIOL 3863 General Ecology
      - BIOL Electives

   b. **Biology Electives (13 hours):** must include at least 9 hours of courses numbered 2000 or higher with a laboratory. (Laboratory courses also include BIOL 480V, BIOL 480VH, BIOL 499V, and BIOL 499VH.)

   c. **State Minimum Core—Humanities (Satisfies General Education Outcome 5.1)**
      - BIOL Electives

   d. **State Minimum Core—General Education Outcome 6.1**
      - General Electives

   e. **State Minimum Core—Humanities (Satisfies General Education Outcome 1.2)**

   f. **General Electives (14 hours):**

3. Requirements in cognate science and mathematics include:

   a. **CHEM 1103 & CHEM 1101L**
      - University Chemistry I (ACTS Equivalency = CHEM 1414 Lecture)
      - University Chemistry I Laboratory (ACTS Equivalency = CHEM 1414 Lab)

   b. **CHEM 1123 & CHEM 1121L**
      - University Chemistry II (ACTS Equivalency = CHEM 1424 Lecture)
      - University Chemistry II Laboratory (ACTS Equivalency = CHEM 1424 Lab)

   c. **CHEM 3603 Organic Chemistry I**
      - & CHEM 3601 and Organic Chemistry I Laboratory
      - CHEM 3613 and Organic Chemistry II
      - CHEM 3611 and Organic Chemistry II Laboratory

   d. **CHEM 2613 Organic Physiological Chemistry (ACTS Equivalency = CHEM 2611) & CHEM 2611L Organic Physiological Chemistry Laboratory (ACTS Equivalency = CHEM 2611 Lab)

   e. **CHEM 2630 Organic Chemistry II**
      - & CHEM 2603 and Organic Chemistry II Laboratory
      - CHEM 2613 and Organic Chemistry II
      - CHEM 2611 and Organic Chemistry II Laboratory
PHYS 2013 & PHYS 2011L  College Physics I (ACTS Equivalency = PHYS 2014 Lecture) and College Physics I Laboratory (ACTS Equivalency = PHYS 2014 Lab)  4

PHYS 2033 & PHYS 2031L  College Physics II (ACTS Equivalency = PHYS 2024 Lecture) and College Physics II Laboratory (ACTS Equivalency = PHYS 2024 Lab)  4

C.

MATH 2043  Survey of Calculus (ACTS Equivalency = MATH 2203)  3-4

or MATH 2554  Calculus I (ACTS Equivalency = MATH 2405)

D.

Select one of the following:  3-4

STAT 2823  Biostatistics
STAT 2303  Principles of Statistics (ACTS Equivalency = MATH 2103)
STAT 3003  Statistical Methods
MATH 2183  Mathematical Reasoning in a Quantitative World

4. Requirement in Philosophy
Select one of the following:  3

PHIL 2103  Introduction to Ethics (ACTS Equivalency = PHIL 1003)
PHIL 2203  Logic (ACTS Equivalency = PHIL 1003)
PHIL 3113  Environmental Ethics
PHIL 4213  Philosophy of Science

5. Students must complete a minimum of 20 credit hours at the 3000-level or higher from requirements 2, 3, and 4 listed above or from a combination of requirements 2, 3, and 4 above and from additional 3000-level or higher BIOL upper-level electives.

Writing Requirement: The college writing requirement for majors in biology may be met by one of the following:

1. Completion of an honors thesis,
2. Completion of a senior thesis (BIOL 498V) supervised by a faculty member in biological sciences,
3. Completion of a required term paper with a grade of B or above in a BIOL course numbered 3000 or above on a topic approved by the instructor, or
4. Completion of a paper, supervised by a Biological Sciences faculty member, in Special Topics (BIOL 480V)

Note  A student exercising Option 3 or 4 may not use the paper written for that option for credit in BIOL 498V

Biology B.A.

Eight-Semester Degree Program

Students wishing to follow the eight-semester degree plan should see the Eight-Semester Degree Policy (http://catalog.uark.edu/undergraduatecatalog/academicregulations/eightsemesterdegreecompletionpolicy/) for university requirements of the program. Core requirement hours may vary by individual, based on placement and previous credit granted. Once all core requirements are met, students may substitute a three-hour (or more) general elective in place of a core area.

First Year

<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>ENGL 1013 Composition I (ACTS Equivalency = ENGL 1013) (Satisfies General Education Outcome 1.1)</td>
<td></td>
</tr>
<tr>
<td>3-4</td>
<td>Select one of the following (Satisfies General Education Outcome 2.1):</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MATH 1213 Plane Trigonometry (ACTS Equivalency = MATH 1203)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MATH 1284C Precalculus Mathematics (ACTS Equivalency = MATH 1305)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MATH 2554 Calculus I (ACTS Equivalency = MATH 2405)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>BIOL 1584 Biology for Majors (ACTS Equivalency = BIOL 1014 Lecture) (Satisfies General Education Outcome 3.4)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Satisfies General Education Outcome 3.4:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CHEM 1103 University Chemistry I (ACTS Equivalency = CHEM 1414 Lecture)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CHEM 1101L University Chemistry I Laboratory (ACTS Equivalency = CHEM 1424 Lab)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>General Elective</td>
<td></td>
</tr>
<tr>
<td>0-1</td>
<td>ENGL 1023 Composition II (ACTS Equivalency = ENGL 1023) (Satisfies General Education Outcome 1.1)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>MATH 2043 Survey of Calculus (ACTS Equivalency = MATH 2203)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>or MATH 2554 Calculus I (ACTS Equivalency = MATH 2405)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>CHEM 1123 University Chemistry II (ACTS Equivalency = CHEM 1424 Lecture)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>CHEM 1121L University Chemistry II Laboratory (ACTS Equivalency = CHEM 1424 Lab)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Select one of the following (Satisfies General Education Outcome 4.2:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HIST 2003 History of the American People to 1877 (ACTS Equivalency = HIST 2113)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HIST 2013 History of the American People, 1877 to Present (ACTS Equivalency = HIST 2123)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Fine Arts State Minimum Core (Satisfies General Education Outcome 3.1)</td>
<td></td>
</tr>
</tbody>
</table>

Year Total: 15 16

Second Year

<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>BIOL 2533 Cell Biology (BIOL 2531L optional)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Select from the following:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CHEM 3603 Organic Chemistry I</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&amp; CHEM 3601L Organic Chemistry I Laboratory</td>
<td></td>
</tr>
</tbody>
</table>


**Biological Sciences (BISC)**

<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 2323 General Genetics &amp; BIOL 2321L General Genetics Laboratory</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>State Minimum Core Social Sciences (Satisfies General Education Outcome 3.3)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>State Minimum Core Social Sciences (Satisfies General Education Outcome 3.3)(as needed) or General Elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>General Elective (Select a course that satisfies General Education Outcome 4.1)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Select one of the following:</td>
<td>3-4</td>
<td></td>
</tr>
<tr>
<td>BIOL 2323 General Genetics &amp; BIOL 2321L General Genetics Laboratory</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Biology elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>BIOL 3023 Evolutionary Biology</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Select one of the following:</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>PHIL 2103 Introduction to Ethics (ACTS Equivalency = PHIL 1003) (Satisfies General Education Outcomes 3.2 and 5.1)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>PHIL 2203 Logic (ACTS Equivalency = PHIL 1003)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>PHIL 3113 Environmental Ethics</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>PHIL 4213 Philosophy of Science</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>State Minimum Core Social Sciences (Satisfies General Education Outcome 3.3) (if needed)</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>PHIL 2103 Introduction to Ethics (ACTS Equivalency = PHIL 1003) (Satisfies General Education Outcomes 3.2 and 5.1)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>PHIL 2203 Logic (ACTS Equivalency = PHIL 1003)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>PHIL 3113 Environmental Ethics</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>PHIL 4213 Philosophy of Science</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Year Total:</td>
<td>16</td>
<td>16</td>
</tr>
</tbody>
</table>

**Third Year**

<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>One of the following:</td>
<td>3-4</td>
<td></td>
</tr>
<tr>
<td>BIOL 3023 Evolutionary Biology</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>BIOL 3863 General Ecology &amp; BIOL 3861L General Ecology Laboratory</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Biology elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>PHYS 2013 College Physics I (ACTS Equivalency = PHYS 2014 Lecture) &amp; PHYS 2011L College Physics I Laboratory (ACTS Equivalency = PHYS 2014 Lab)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Select one of the following:</td>
<td>3-4</td>
<td></td>
</tr>
<tr>
<td>STAT 2823 Biostatistics</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>STAT 2303 Principles of Statistics (ACTS Equivalency = MATH 2103)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>STAT 3003 Statistical Methods &amp; STAT 3001L Statistics Methods Laboratory</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MATH 2183 Mathematical Reasoning in a Quantitative World</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Select one of the following as needed:</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>State Minimum Core Social Sciences (Satisfies General Education Outcome 3.3) (if needed)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>PHIL 2103 Introduction to Ethics (ACTS Equivalency = PHIL 1003) (Satisfies General Education Outcomes 3.2 and 5.1)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>PHIL 2203 Logic (ACTS Equivalency = PHIL 1003)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>PHIL 3113 Environmental Ethics</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>PHIL 4213 Philosophy of Science</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Year Total:</td>
<td>18</td>
<td>18</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fourth Year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIOL 3000-4000 Level Biology Elective</td>
<td>3-4</td>
<td></td>
</tr>
<tr>
<td>BIOL 3000-4000 Level Biology Elective</td>
<td>3-4</td>
<td></td>
</tr>
<tr>
<td>General Electives</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>BIOL 3000-4000 Level Biology Elective</td>
<td>3-4</td>
<td></td>
</tr>
<tr>
<td>BIOL 3000-4000 Level Biology Elective</td>
<td>3-4</td>
<td></td>
</tr>
<tr>
<td>Upper Level Elective in Fulbright College (if needed for 24-hour rule) or General Elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>General Electives (as needed to total 120 degree hours)</td>
<td>3-4</td>
<td></td>
</tr>
<tr>
<td>Year Total:</td>
<td>12</td>
<td>9</td>
</tr>
</tbody>
</table>

**Total Units in Sequence:** 120

**General Education Outcome 6.1: Biology Capstone Experience**

Biology Capstone Experience and the Fulbright College writing requirement may be met by one of the following:

1. Completion of an Honors research project and preparation of a thesis (BIOL 499VH): Students will prepare an Honors thesis on original research and an oral presentation of the research to an Honors defense committee followed by defense. Students using this approach will satisfy General Education outcome 1.2 and partially satisfy General Education outcome 6.1 (additional requirement below).

   or
2. Completion of a senior thesis (BIOL 498V) supervised by a faculty member in Biological Sciences following the guidelines defined by the Department of Biological Sciences. Students must enroll in BIOL 498V with the supervising faculty member in the semester they are preparing the thesis. Students using this approach will partially satisfy General Education outcome 6.1 (additional requirement below).

3. In addition to one of the above: All Biology majors, Honors and non-Honors, must complete and submit a 1,250-word document demonstrating at least three of the five skills and abilities listed below that were used in their Capstone Experience. In completing the document, students should reflect on the skills and abilities gained through Learning outcomes 1 through 5 and how these were utilized in completing the integrative project (To complete General Education outcome 6.1).
   a. Written, oral, and/or multimodal communication abilities
   b. Quantitative literacy
   c. Characteristics of inquiry and action in the major and in one of the Learning Outcomes under Goal 3 besides the disciplinary area of the major
   d. Diversity awareness and/or intercultural competency
   e. Critical thinking and/or ethical reasoning

1 Students have demonstrated successful completion of the learning indicators identified for learning outcome 2.1, by meeting the prerequisites for MATH 1213, MATH 1284G, or MATH 2554.
2 The Fine Arts Elective courses which satisfy General Education Outcome 3.1 include: ARCH 1003, ARHS 1003, COMM 1003, DANC 1003, LARC 1003, MLIT 1003, MLIT 1003H, MLIT 1013, MLIT 1013H, MLIT 1333, THTR 1003, THTR 1013, or THTR 1013H.
3 Meets 40-hour advanced credit hour requirement. See College Academic Regulations (http://catalog.uark.edu/undergraduatecatalog/collegesandschools/jwilliamfulbrightcollegeofartsandsciences/).
4 Meets 4-hour rule (24 hours of 3000-4000 level courses in Fulbright College), in addition to meeting the 40-hour rule. See College Academic Regulations (http://catalog.uark.edu/undergraduatecatalog/collegesandschools/jwilliamfulbrightcollegeofartsandsciences/).
5 The Social Sciences Elective courses which satisfy General Education Outcome 3.3 include:
6 Courses which satisfy the General Education Outcome 4.1 include:
7 The Humanities Elective courses which satisfy both General Education Outcomes 3.2 and 5.1 include:
   CLST 1003, CLST 1003H, CLST 1013, HUMN 1124H, PHIL 2003, PHIL 2003C, PHIL 2003H, PHIL 2103, or PHIL 2103C.
8 Courses which satisfy the General Education Outcome 1.2 include:
   ACOM 3143, ACOM 3143H, AGED 3133, AGED 4003, CATE 4013, CATE 406X, COMM 1313, ENGL 1033, ENGL 1033H, INST 3303, INST 3503, INST 4603, NURS 4092, NURS 4112, or NURS 4701.

Requirements for a Minor in Biology:

Students must complete at least 19 credit hours of BIOL courses that include:

1. BIOL 1584 Biology for Majors (ACTS Equivalency = BIOL 1014 Lecture) or BIOL 1543 Principles of Biology (ACTS Equivalency = BIOL 1014 Lecture/BIOI 1541L Principles of Biology Laboratory (ACTS Equivalency = BIOL 1014 Lab)
2. Three of the four biology core courses: BIOL 2533 Cell Biology, BIOL 2323 General Genetics, BIOL 3023 Evolutionary Biology, BIOL 3863 General Ecology.
3. Two additional BIOL courses, one of which must be a BIOL course numbered 3000 or above. This may include an additional BIOL core course.

Students must notify their academic dean’s office of their intent to minor in biology.

Requirements for Departmental Honors in Biology:
The biological sciences honors program is designed to provide students an opportunity to investigate questions in biology through an expanded reading program and research experience. Biological science majors may apply to enter the program between the second semester of the sophomore year and the end of the junior year. Application is made through both Honors Studies (MAIN 517) and the Department of Biological Sciences (SCEN 601). Applicants must have a 3.5 grade-point average. Students should consult with their adviser to identify and contact a potential faculty research mentor. The student’s research activities will then be directed by the departmental faculty member who agrees to sponsor the student.

Students may enroll for up to four hours of credit in BIOL 499V during the junior year and up to eight hours of credit in BIOL 499V during the senior year. A maximum of six of these credits may be applied toward a major. Participants must complete and defend an honors thesis and take 12 hours in Honors Studies, which may include six hours of thesis. The honors thesis is based on an original research project and presented orally before a committee composed of two faculty from the biological sciences, a person from outside the biological sciences, and a representative from the Honors Council. This committee makes a recommendation concerning the award of the honors distinction to the Honors Council. Students who successfully complete the departmental honors program usually graduate as “Departmental Scholar Cum Laude.”
Higher degree distinctions are recommended only in exceptional cases and are based upon the candidate’s entire involvement in the honors program. Completion of an honors thesis fulfills the writing requirement in biological sciences, which precludes credit for BIOL 498V (Senior Thesis) for the same body of work.

Biology/Life Science Teacher Licensure Requirements:

Students interested in pursuing a minor in STEM Education or Secondary Teacher Licensure in mathematics, biology, chemistry, physics, or
Faculty

Airubaye, Adnan A., Ph.D., M.Ed. (University of Arkansas), M.Sc. (University of Baghdad), Assistant Professor, 2016, 2021.

Alverson, Andrew James, Ph.D. (University of Texas at Austin), M.S. (Iowa State University), B.S. (Grand Valley State University), Associate Professor, 2012, 2018.

Bailey, Tameka A., Ph.D. (University of Arkansas), B.S. (University of Arkansas-Pine Bluff), Research Assistant Professor, 2017.

Beaulieu, Jeremy M., Ph.D. (Yale University), M.S., B.S. (California Polytechnic State University), Associate Professor, 2016, 2021.

Beaupre, Steven J., Ph.D. (University of Pennsylvania), M.S., B.S. (University of Wisconsin), Professor, 1995, 2006.

Catanzaro, Donald G., Ph.D. (University of Arkansas), A.B. (University of California, Los Angeles), Research Assistant Professor, 2014.

Ceballos, Ruben M., Ph.D. (University of Montana), M.A. (University of Alabama-Birmingham), B.S.(University of Alabama-Huntsville), Assistant Professor, 2016.

DeGregorio, Brett A., Ph.D. (University of Illinois at Urbana-Champaign), M.S. (Purdue University), B.S. (University of Massachusetts at Amherst), Research Associate Professor, 2019.

Douglas, Marlis R., Ph.D., M.S., B.S. (University of Zurich), Professor, Bruker Life Sciences Chair, 2012.

Douglas, Michael Edward, Ph.D. (University of Georgia), M.S., B.S. (University of Louisville), Professor, 21st Century Chair in Global Change Biology, 2011.

Du, Yuchun, Ph.D. (Kagoshima University, Japan), B.S. (Shaanxi University of Technology, China), Associate Professor, 2007, 2013.

DuRant, Sarah Elizabeth, Ph.D. (Virginia Polytechnic Institute and State University), B.S. (University of South Carolina), Associate Professor, 2017, 2021.

Durdik, Jeannine M., Ph.D. (Johns Hopkins University), B.S. (Purdue University), Professor, 1994, 2004.


Evans, Timothy A., Ph.D. (Indiana University), B.S. (Slippery Rock University), Associate Professor, 2013, 2019.

Evans-White, Michelle Allayne, Ph.D. (University of Notre Dame), M.S., B.S. (Kansas State University), Professor, 2008, 2018.

Forbes, Kristian M., Ph.D. (University of Jyväskylä), M.P.H. (Latrebo University), B.Sc. (Latrebo University), Assistant Professor, 2018.

Henry, Ralph Leroy, Ph.D., M.S. (Kansas State University), B.S.E. (University of Kansas), Distinguished Professor, W.M. Keck Endowed Professorship, 1996, 2012.

Ivey, Mack, Ph.D., B.S. (University of Georgia), Associate Professor, 1992, 1998.

Iyer, Shilpa, Ph.D. (University of Georgia), M.Sc., B.Sc. (University of Pune, India), Assistant Professor, 2016.


Lehmann, Michael Herbert, Ph.D., Diploma in Biology (Philips University of Marburg, Germany), Professor, 2002, 2018.

Lessner, Daniel J., Ph.D. (University of Iowa), B.S. (University of Wisconsin-Stevens Point), Professor, 2008, 2020.

Lessner, Faith H., Ph.D. (University of Iowa), B.S. (Cornell University), Teaching Assistant Professor, 2016, 2018.

Lewis, Jeffrey A., Ph.D. (University of Wisconsin-Madison), B.S. (University of California-Santa Barbara), Associate Professor, 2013, 2020.


Magoulick, Daniel D., Ph.D. (University of Pittsburgh), M.S. (Eastern Michigan University), B.S. (Michigan State University), Research Professor, 2000, 2010.

McNabb, David S., Ph.D. (Louisiana State University Health Sciences Center), B.S. (University of Texas at Arlington), Associate Professor, 2000, 2006.

Mortensen, Jennifer, Ph.D. (Tufts University), M.S. (Villanova University), Teaching Assistant Professor, 2019.

Naithani, Kusum, Ph.D. (University of Wyoming), M.Sc. (G.B. Pant University of Agriculture and Technology-India), B.Sc. (University of Lucknow-India), Associate Professor, 2014, 2021.

Nakanishi, Nagayasu, Ph.D. (University of California, Los Angeles), B.S. (University of California, San Diego), Assistant Professor, 2017.

Ortega, Jason, B.S. (University of Texas-Pan American), B.S. (Cornell University), Instructor, 2019.

Paré, Adam C., Ph.D. (University of California, San Diego), B.S. (Cornell University), Assistant Professor, 2019.

Pinto, Ines, Ph.D. (Louisiana State University Health Sciences Center), M.S., B.S. (University of Chile), Associate Professor, 2000, 2006.

Rhoads, Douglas Duane, Ph.D. (Kansas State University), M.A., B.A. (Wichita State University), University Professor, 1990, 2006.

Shadwick, John D.L., M.S. (University of Arkansas), B.S. (University of Central Arkansas), Instructor, 2011.

Siepielski, Adam M., Ph.D. (University of Wyoming-Laramie), M.S. (New Mexico State University), B.S. (Pennsylvania State University-University Park), Associate Professor, 2015, 2019.

Stephenson, Steven Lee, Ph.D., M.S. (Virginia Polytechnic Institute and State University), B.S. (Lynchburg College), Research Professor, 2003.

Tipsmark, Christian K., Ph.D., M.S. (University of Southern Denmark), Associate Professor, 2010, 2016.

Walker, James M., Ph.D. (University of Colorado-Boulder), M.S., B.S. (Louisiana Polytechnic Institute), Professor, 1965.

Walker, Kate Iretun, M.S. (University of Arkansas), B.S. (Kansas State University), Instructor, 2014.

Westerman, Erica L., Ph.D. (Yale University), M.Sc. (University of New Hampshire), B.S. (Yale University), Assistant Professor, 2016.

Willson, John David, Ph.D. (University of Georgia), B.S. (Davidson College), Associate Professor, 2012, 2018.

Zhuang, Xuan, Ph.D. (University of Illinois Urbana-Champaign), Assistant Professor, 2021.

Courses


Integrated lecture and laboratory focusing on the overriding principles of Biology. Designed to convey biological reasoning to non-science majors. May not count as prerequisite for advanced courses in BIOL. Corequisite: Lab component. (Typically offered: Fall, Spring and Summer)

BIOL 1541L. Principles of Biology Laboratory (ACTS Equivalency = BIOL 1014 Lab). 1 Hour.

Experimental and observational techniques used in biology with emphasis on the acquisition and interpretation of results that illustrate major biological principles. Corequisite: BIOL 1543. (Typically offered: Fall, Spring and Summer)
BIOL 1541M. Honors Principles of Biology Laboratory. 1 Hour.
This course is designed for the well prepared student in the Honors program. It focuses on teaching students experimental and observational techniques used in the science of biology. It emphasizes the acquisition and interpretation of results that illustrate the major principles of biology. Corequisite: BIOL 1543H or BIOL 1543. (Typically offered: Fall and Spring)
This course is equivalent to BIOL 1541L.

BIOL 1543. Principles of Biology (ACTS Equivalency = BIOL 1014 Lecture). 3 Hours.
Principles that unify biology with emphasis on scientific study that demonstrates how all organisms are the product of evolution and are parts of interacting systems from the molecular to the ecosystem level. Corequisite: BIOL 1541L. (Typically offered: Fall, Spring and Summer)

BIOL 1584. Biology for Majors (ACTS Equivalency = BIOL 1014 Lecture). 4 Hours.
Integrated lecture and laboratory course designed to prepare Biology Majors to enter the rest of the Biology Core of Cell Biology, General Genetics, Evolutionary Biology, and General Ecology. Pre- or Corequisite: CHEM 1103 or CHEM 1203. (Typically offered: Fall and Spring)

BIOL 1601L. Principles of Zoology Laboratory (ACTS Equivalency = BIOL 1054 Lab). 1 Hour.
Laboratory exercises illustrating animal structure, physiology, genetics, and ecology. Corequisite: BIOL 1603. (Typically offered: Fall and Summer)

Introduction to zoological principles relating to cells, organ systems, development, genetics, ecology, and animal phyla. Corequisite: BIOL 1601L. Prerequisite: BIOL 1584 or BIOL 1543 and BIOL 1541L. (Typically offered: Fall and Summer)

BIOL 1611L. Plant Biology Laboratory (ACTS Equivalency = BIOL 1034 Lab). 1 Hour.
Plant biology lab. Pre- or Corequisite: BIOL 1613. (Typically offered: Spring and Summer)

BIOL 1613. Plant Biology (ACTS Equivalency = BIOL 1034 Lecture). 3 Hours.
Consideration of basic flowering plant structure, growth, development, physiology, genetics, ecology, and a brief survey of other plant groups. Lecture 3 hours per week. BIOL 1611L is recommended as a corequisite and both are required for partial fulfillment of the Fulbright College natural sciences requirement. Prerequisite: BIOL 1584 or BIOL 1543 and BIOL 1541L. (Typically offered: Spring and Summer)

BIOL 1693. Biology Bridges. 3 Hours.
Prepares students for advanced biology courses including genetics, cell biology, ecology, and evolutionary biology, among others. Synthesizes sub-disciplines within biology using the underlying concepts of evolutionary theory found in scientific literature. Prerequisite: BIOL 1543 or BIOL 1584. (Typically offered: Spring)

BIOL 2011L. General Microbiology Laboratory (ACTS Equivalency = BIOL 2004 Lab). 1 Hour.
Techniques for handling microorganisms. Does not count toward BS in Biology. Corequisite: BIOL 2013. (Typically offered: Fall, Spring and Summer)

BIOL 2011M. Honors General Microbiology Laboratory. 1 Hour.
Techniques for handling microorganisms. Does not count towards BS in Biology. Corequisite: BIOL 2013. (Typically offered: Fall, Spring and Summer)
This course is equivalent to BIOL 2011L.

Basic concepts of microbiology including diversity, genetics, metabolism, growth, control of growth, pathogenesis, and immunology. Does not count towards BS in Biology. Corequisite: BIOL 2011L. Prerequisite: (BIOL 1543 and BIOL 1541L) or (BIOL 1584) and (CHEM 1073 and CHEM 1071L or CHEM 1103 or CHEM 1123 and CHEM 1121L or CHEM 1203 and CHEM 1201L). (Typically offered: Fall, Spring and Summer)

BIOL 2211L. Human Physiology Laboratory (ACTS Equivalency = BIOL 2414 Lab). 1 Hour.
Exercises include experiments on osmosis, reflexes, senses, muscle, cardiovascular system, ventilation, metabolism, renal function, etc. Data collection, analysis, and report writing. Does not satisfy the Fulbright College writing requirement. Does not count toward BS in Biology. Corequisite: BIOL 2213. (Typically offered: Fall and Spring)

BIOL 2213. Human Physiology (ACTS Equivalency = BIOL 2414 Lecture). 3 Hours.
Fundamental concepts of physiology with emphasis in the human. Does not count toward BS in Biology. Corequisite: BIOL 2211L. Prerequisite: (CHEM 1073 and CHEM 1071L) or (CHEM 1103) or (CHEM 1123 and CHEM 1121L) and MATH 1203. (Typically offered: Fall and Spring)

BIOL 2231L. General Genetics Laboratory. 1 Hour.
Analysis of genetic problems and experiments with emphasis on "hands-on" experience with a variety of organisms. May require time outside laboratory period. Laboratory 3 hours per week. Pre- or Corequisite: BIOL 2233. (Typically offered: Fall and Spring)

BIOL 2233. General Genetics. 3 Hours.
Surveys of Mendelian, molecular, and population mechanisms of inheritance and gene expression in prokaryotes and eukaryotes. Lecture 3 hours per week. Prerequisite: (BIOL 1584 or BIOL 1543 and BIOL 1541L) and (CHEM 1103 or CHEM 1203) and (MATH 1203 or higher or STAT 2823 or STAT 2303 or equivalent). (Typically offered: Fall and Spring)

BIOL 2441L. Human Anatomy Laboratory (ACTS Equivalency = BIOL 2404 Lab). 1 Hour.
Laboratory 3 hours exercises in mammalian anatomy. Cannot be taken without prior credit in BIOL 2443 or concurrent enrollment in BIOL 2443. Does not count toward BS in Biology. Corequisite: BIOL 2443. (Typically offered: Fall, Spring and Summer)

BIOL 2443. Human Anatomy (ACTS Equivalency = BIOL 2404 Lecture). 3 Hours.
Description of human body as a series of organ systems and their interrelationships. Does not count towards BS in Biology. Corequisite: BIOL 2441L. Prerequisite: Four hours of biological sciences. (Typically offered: Fall, Spring and Summer)

BIOL 2531L. Cell Biology Laboratory. 1 Hour.
Introduction to methods and techniques used in Cell Biology research. Laboratory experiences to highlight topics covered in BIOL 2533. Pre- or Corequisite: BIOL 2533. (Typically offered: Fall and Spring)

BIOL 2533. Cell Biology. 3 Hours.
Introduction to cell structure, cell processes, biological polymers, energetics, and diversity. An introduction to biochemistry and cell chemistry. Recommended: (CHEM 1123 and CHEM 1121L) or (CHEM 1223 and CHEM 1221L) or equivalent. Prerequisite: BIOL 1584, or BIOL 1543 and BIOL 1541L. (Typically offered: Fall and Spring)

BIOL 3001L. Principles of Plant Pathology Lab. 1 Hour.
Lab course in examination of the causes and symptoms of plant disease and the genetics of plant disease. Physiology, and ecology of host-pathogen interactions. Spread of disease and principles of disease control. Pre- or Corequisite: PLPA 3003 or BIOL 3003. (Typically offered: Fall)
This course is cross-listed with PLPA 3001L.
BIOL 3003. Principles of Plant Pathology. 3 Hours.
Examination of the causes and symptoms of plant disease and the genetics of plant disease. Physiology, and ecology of host-pathogen interactions. Spread of disease and principles of disease control. (Typically offered: Fall)
This course is cross-listed with PLPA 3003.

BIOL 3011L. Introduction to Insect Identification Lab. 1 Hour.
Introductory lab course on insect identification, collection, and curation techniques, primarily designed as an intensive add-on to BIOL 3013 for students wanting a more in-depth examination of insect diversity. Insect collection required. Course includes field trips. Students are encouraged to contact instructor before enrolling. Pre- or corequisite: BIOL 3013. (Typically offered: Fall)
This course is cross-listed with ENTO 3011L.

BIOL 3013. Introduction to Entomology. 3 Hours.
Fundamentals of insect biology including structure and function, development, ecology, behavior, plant feeding and disease transmission. Lecture 3 hours/week.
Students interested in a more intensive examination of insects, including collection, curation, and identification techniques, should sign up for the separate one credit lab BIOL 3011L. Students are strongly encouraged to take BIOL 1543 before registering for this course. (Typically offered: Fall)
This course is cross-listed with ENTO 3013.

BIOL 3023. Evolutionary Biology. 3 Hours.
An introduction to the mechanisms and patterns of evolutionary change. Seeks to develop logical, scientific skills and to apply them in understanding how life has changed during the history of the earth. Corequisite: Drill component. Prerequisite: BIOL 1584 or BIOL 1543, BIOL 1541L and BIOL 2323. (Typically offered: Fall and Spring)

BIOL 3043. Bones, Bodies, and Brains in Evolutionary Perspective. 3 Hours.
Reviews the anatomy of the human body, comparing this anatomy with primates, mammals, and vertebrates, and it will consider how the major features of the human body emerged throughout evolution. (Typically offered: Spring)
This course is cross-listed with ANTH 3043.

BIOL 3123H. Honors Prokaryote Biology. 3 Hours.
An in-depth coverage of prokaryote diversity, genetics, metabolism, growth, structures and functions. Prerequisite: BIOL 2533. (Typically offered: Spring)

BIOL 3273. Inquiry and Modeling in Science Education. 3 Hours.
Study of science practices with emphasis on modeling and inquiry for learning/teaching. Includes practical, philosophical, cognitive, and disciplinary specific dimensions of doing science in academic and nonacademic settings. Includes planning and implementing multiple scientific inquiries, engaging in reflective practices, writing and presenting scientific information. Safety and ethical issues are included. Prerequisite: 8 hours of BIOL courses. Corequisite: Drill component. (Typically offered: Fall)
This course is cross-listed with PHYS 3273, CHEM 3273.

BIOL 3404. Comparative Vertebrate Morphology. 4 Hours.
Anatomy of selected vertebrate animals with emphasis upon homologous structures in various animal groups. The recommended anatomy course for Biology BS majors. Lecture 2 or 3 hours, laboratory 4 or 6 hours per week. Corequisite: Lab component. Prerequisite: BIOL 1584 or BIOL 1543 and BIOL 1541L. (Typically offered: Fall and Spring)

BIOL 3861L. General Ecology Laboratory. 1 Hour.
General ecology lab. Pre- or Corequisite: BIOL 3863. (Typically offered: Fall)

BIOL 3863. General Ecology. 3 Hours.
Ecological principles and concepts; environmental factors and interactions that determine distribution and abundance of organisms. Prerequisite: 7 hours of biological science. (Typically offered: Fall and Spring)

BIOL 3923H. Honors Colloquium. 3 Hours.
Covers a special topic or issue, offered as part of the honors program. Prerequisite: honors candidacy (not restricted to candidacy in biological sciences). (Typically offered: Irregular) May be repeated for degree credit.

BIOL 4003L. Laboratory in Prokaryote Biology. 3 Hours.
Laboratory techniques in prokaryote culture, identification, physiology, metabolism, and genetics. Laboratory 6 hours per week. Prerequisite: BIOL 3123. (Typically offered: Fall and Spring)

BIOL 4013. Insect Behavior and Chemical Ecology. 3 Hours.
Basic concepts in insect senses and patterns of behavioral responses to various environmental stimuli. Previous knowledge of basic entomology is helpful, but not required. Lecture 2 hours, laboratory/discussion 2 hours per week. Corequisite: Lab component. (Typically offered: Spring Even Years)
This course is cross-listed with ENTO 4013.

BIOL 4024. Insect Diversity and Taxonomy. 4 Hours.
Principles and practices of insect classification and identification with emphasis on adult insects. Corequisite: Lab component. Prerequisite: ENTO 3013. (Typically offered: Fall Even Years)
This course is cross-listed with ENTO 4024.

BIOL 4043. Prokaryote Biology. 3 Hours.
An in-depth coverage of prokaryote diversity, genetics, metabolism, growth, structures and functions. Prerequisite: BIOL 2533. (Typically offered: Spring)

BIOL 4053. Insect Ecology. 3 Hours.
To develop understanding of important ecological concepts through study of dynamic relationships among insects and their environment. To become familiar with the literature of insect ecology, and interpretation and critique of ecological research. Previous knowledge of basic entomology and/or ecology will be assumed. Corequisite: Lab component. (Typically offered: Fall Even Years)
This course is cross-listed with ENTO 4053.

BIOL 4104. Taxonomy of Flowering Plants. 4 Hours.
Identifying, naming, and classifying of wildflowers, weeds, trees, and other flowering plants. Emphasis is on the practical aspects of plant identification. Lecture 3 hours, laboratory 3 hours per week. Corequisite: Lab component. Prerequisite: BIOL 1613 and BIOL 1611L and BIOL 2323 and BIOL 3023. (Typically offered: Spring)

BIOL 4114. Dendrology. 4 Hours.
Morphology, classification, geographic distribution, and ecology of woody plants. Lecture 3 hours, laboratory 3 hours per week, and fieldtrips. Corequisite: Lab component. Prerequisite: BIOL 3863. (Typically offered: Fall)

BIOL 4122. Food Microbiology. 2 Hours.
The study of food microbiology including classification/taxonomy, contamination, preservation and spoilage of different kinds of foods, pathogenic microorganisms, food poisoning, sanitation, control and inspection and beneficial uses of microorganisms. Prerequisite: BIOL 2013 and BIOL 2011L or BIOL 2533. (Typically offered: Fall)
This course is cross-listed with FDSC 4122.

BIOL 4133. Plant Disease Control. 3 Hours.
Principles, methods and mechanics of plant disease control. Emphasis is given to the integration of control measures and epidemiology of plant diseases. Lecture 3 hours per week. Prerequisite: PLPA 3003. (Typically offered: Fall)
This course is cross-listed with PLPA 4223.

BIOL 4153. Biology of Global Change. 3 Hours.
Covers the impacts of global change on sustainability and adaptability of biological systems. Corequisite: BIOL 4252. Prerequisite: (BIOL 1543 and BIOL 1541L) or BIOL 1584. (Typically offered: Spring)
BIOL 4163. Dynamic Models in Biology. 3 Hours.
Mathematical and computational techniques for developing, executing, and analyzing dynamic models arising in the biological sciences. Both discrete and continuous time models are studied. Applications include population dynamics, cellular dynamics, and the spread of infectious diseases. Prerequisite: MATH 2554. (Typically offered: Irregular)
This course is cross-listed with MATH 4163.

BIOL 4174. Conservation Genetics. 4 Hours.
Covers concepts of biodiversity identification and illustrates how genetic data are generated and analyzed to conserve and restore biological diversity. Corequisite: Lab component and drill. Prerequisite: BIOL 3023, BIOL 3863 and STAT 2823 (or equivalent), and Junior standing. (Typically offered: Spring)

BIOL 4213. Biological Regulation and Subcellular Communication. 3 Hours.
Combines lectures, review of primary literature, student presentations, and small group discussions to explore a diversity of topics related to mechanisms of biological regulation and subcellular communication. Prerequisite: BIOL 2323 and BIOL 2533. (Typically offered: Irregular)

BIOL 4223. Bacterial Lifestyles. 3 Hours.
Introduces students to bacteria as prokaryotic organisms, different from eukaryotes such as plants and animals. Model microbial systems will be studied to identify unique strategies that bacteria employ to thrive in their respective environments or develop special adaptations to harsh environments. Prerequisite: BIOL 2013 and BIOL 2011L or BIOL 3123. (Typically offered: Spring Odd Years)
This course is cross-listed with PLPA 4123.

BIOL 4233. Genomics and Bioinformatics. 3 Hours.
Principles of molecular and computational analyses of genomes. Prerequisite: BIOL 2533 and BIOL 2323. (Typically offered: Spring)

BIOL 4234. Comparative Physiology. 4 Hours.
Comparison of fundamental physiological mechanisms in various animal groups. Adaptations to environmental factors at both the organismal and cellular levels are emphasized. Lecture 3 hours, laboratory 3 hours per week. Corequisite: Lab component. Prerequisite: BIOL 2533 and CHEM 3613 and (CHEM 3611L or CHEM 3612M). (Typically offered: Fall)

BIOL 4241L. Ichthyology Laboratory. 1 Hour.
Practical application of fish identification based on anatomy, fish sampling methods, and curation of fish specimen. Laboratory component of BIOL 4243. Corequisite: BIOL 4243. (Typically offered: Spring Odd Years)

BIOL 4241M. Honors Ichthyology Laboratory. 1 Hour.
Practical application of fish identification based on anatomy, fish sampling methods, and curation of fish specimen. Laboratory component of BIOL 4243H. Prerequisite: Honors standing. Corequisite: BIOL 4243H. (Typically offered: Spring Odd Years)
This course is equivalent to BIOL 4241L.

BIOL 4243. Ichthyology. 3 Hours.
Comprehensive overview of the diversity of fishes. Covers anatomy, physiology, evolution, taxonomy, ecology, behavior, zoogeography and conservation of marine and freshwater fishes. Lecture 3 hours per week. Prerequisite: Eight credits in Biology. Corequisite: BIOL 4241L. (Typically offered: Spring Odd Years)

BIOL 4243H. Honors Ichthyology. 3 Hours.
Comprehensive overview of the diversity of fishes. Covers anatomy, physiology, evolution, taxonomy, ecology, behavior, zoogeography and conservation of marine and freshwater fishes. Lecture 3 hours per week. Prerequisite: Eight credits in Biology and honors standing. Corequisite: BIOL 4241L. (Typically offered: Spring Odd Years)
This course is equivalent to BIOL 4243.

BIOL 4252. Biology of Global Change Seminar. 2 Hours.
Readings, essays, and group discussions that parallel the 27 lectures in BIOL 4153 and which dissect the resulting impacts of global change on sustainability and adaptability of biological systems. Corequisite: BIOL 4153. Prerequisite: BIOL 1584 or BIOL 1543 and BIOL 1541L. (Typically offered: Spring)

BIOL 4252H. Honors Biology of Global Change Seminar. 2 Hours.
Readings, essays, and group discussions that parallel the 27 lectures in BIOL 4153 and which dissect the resulting impacts of global change on sustainability and adaptability of biological systems. Corequisite: BIOL 4153. Prerequisite: BIOL 1584 or BIOL 1543 and BIOL 1541L. (Typically offered: Spring)
This course is equivalent to BIOL 4252.

BIOL 4263. Cell Physiology. 3 Hours.
In-depth molecular coverage of cellular processes involved in growth, metabolism, transport, excitation, signalling and motility, with emphasis on function and regulation in eukaryotes, primarily animals. Prerequisite: BIOL 2533 and BIOL 2323 and CHEM 3813 and PHYS 2033. (Typically offered: Fall)

BIOL 4273. Endocrinology. 3 Hours.
In endocrinology we study hormonal integration of living processes as all levels from molecule to organism. We will work with the mechanisms of hormone action, the endocrine control axes and hormones physiological role. The course will include paper discussions and student presentations on topics of special interest. Prerequisite: BIOL 2533 or equivalent. (Typically offered: Spring)

BIOL 4313. Molecular Cell Biology. 3 Hours.
In-depth molecular coverage of transcription, cell cycle, translation, and protein processing in eukaryotes and prokaryotes. Prerequisite: BIOL 2533 and BIOL 2323 and CHEM 3603 and CHEM 3610L and CHEM 3613 and CHEM 3611L. (Typically offered: Spring)

BIOL 4313H. Honors Molecular Cell Biology. 3 Hours.
In-depth molecular coverage of transcription, cell cycle, translation, and protein processing in eukaryotes and prokaryotes. Prerequisite: BIOL 2533 and BIOL 2323 and CHEM 3603 and CHEM 3610L and CHEM 3613 and CHEM 3611L. (Typically offered: Spring)
This course is equivalent to BIOL 4313.

BIOL 4323. Comparative Neurobiology. 3 Hours.
Exploration of modern research approaches to understanding the development and function of animal nervous systems, with emphasis on molecular and cellular approaches in non-human animal models commonly used in biomedical research. Format combines lectures, group discussions, and student presentations using examples from the primary neurobiology literature. Prerequisite: BIOL 2323 and BIOL 2533 or equivalents. (Typically offered: Irregular)

BIOL 4333. Biotechnology in Agriculture. 3 Hours.
Discussion of the techniques, applications, and issues of biotechnology as it is being used in modern agriculture. Coverage includes the basics of molecular biology, production of transgenic plants and animals, and new applications in the agricultural, food, and medical marketplace. Lecture and discussion, 3 hours per week. (Typically offered: Fall)
This course is cross-listed with PLPA 4333.

BIOL 4353. Ecological Genetics/Genomics. 3 Hours.
Analysis of the genetics of natural and laboratory populations with emphasis on the ecological bases of evolutionary change. Prerequisite: BIOL 2323 and BIOL 2321L and MATH 2554 and STAT 2823 or equivalents. (Typically offered: Fall Odd Years)

BIOL 4433. Principles of Evolution. 3 Hours.
Advanced survey of the mechanisms of evolutionary change with special emphasis on advances since the Modern Synthesis. Historical, theoretical, and population genetics approaches are discussed. Recommended BIOL 3023 and BIOL 2321L and BIOL 3861L. Prerequisite: BIOL 2323 and BIOL 3863. (Typically offered: Fall Even Years)
BIOL 4463. Physiological Ecology. 3 Hours.
Interactions between environment, physiology, and properties of individuals and populations on both evolutionary and ecological scales. Prerequisite: BIOL 3863 and BIOL 4234 and its lab component. (Typically offered: Spring Odd Years)

BIOL 4511L. Population Ecology Laboratory. 1 Hour.
Population Ecology Lab. Pre- or Corequisite: BIOL 4513. (Typically offered: Fall Even Years)

BIOL 4513. Population Ecology. 3 Hours.
Survey of theoretical and applied aspects of population processes stressing models of growth, interspecific interactions, and adaptation to physical and biotic environments. Prerequisite: BIOL 3863. (Typically offered: Fall Even Years)

BIOL 4523. Plant Ecology. 3 Hours.
To develop understanding of important ecological concepts through study of dynamics relationships among plants and their environment. To become familiar with the literature of plant ecology, and interpretation and critique of ecological research. Prerequisite: BIOL 3863. (Typically offered: Spring Even Years)

BIOL 4543. Developmental Biology. 3 Hours.
An analysis of the principles and mechanisms of development emphasizing the embryonic and postembryonic development of animals. Prerequisite: BIOL 2533 and BIOL 2323. (Typically offered: Irregular)

BIOL 4554. Developmental Biology with Laboratory. 4 Hours.
An analysis of the concepts of mechanisms of development emphasizing the experimental approach. Lecture 3 hours, laboratory 3 hours per week. Students may not receive degree credit for both BIOL 4543 and BIOL 4554. Corequisite: Lab component. Prerequisite: BIOL 2533 and BIOL 2323 or graduate standing. (Typically offered: Fall)

BIOL 4563. Cancer Biology. 3 Hours.
An introduction to the fundamentals of cancer biology. Prerequisite: BIOL 2533. (Typically offered: Fall)

BIOL 4573L. Introduction to Research in Animal Development and Evolution. 3 Hours.
Provides a hands-on introduction to investigation of problems in animal development and evolution. Emphasis on comparative molecular genetic approaches using non-traditional model organisms. Prerequisite: BIOL 2323. (Typically offered: Fall)

BIOL 4583. Genetic Engineering. 3 Hours.
Provides an overview of current methods for altering gene expression, as well as ethical concerns arising from genetic engineering. Special emphasis is placed on practical considerations and techniques necessary for implementing genetic engineering strategies. Prerequisite: BIOL 2323 and BIOL 2533. (Typically offered: Fall)

BIOL 4613. Primate Adaptation and Evolution. 3 Hours.
Introduction to the biology of the order Primates. This course considers the comparative anatomy, behavioral ecology and paleontology of our nearest living relatives. Prerequisite: BIOL 3023 or ANTH 1013. (Typically offered: Spring)
This course is cross-listed with ANTH 4613.

BIOL 4693. Forest Ecology. 3 Hours.
Introduction to the various biological, ecological and historical aspects of forest communities, with particular emphasis on the forests of the central and southeastern United States. Prerequisite: BIOL 3863. (Typically offered: Irregular)

BIOL 4703. Mechanisms of Pathogenesis. 3 Hours.
A survey of the events causing human disease at the molecular, cellular and genetic levels. Seeks to develop an appreciation that both the tricks pathogens use and the body's own defenses contribute to pathology. Prerequisite: BIOL 2533. (Typically offered: Fall)

BIOL 4711L. Basic Immunology Laboratory. 1 Hour.
Basic immunology laboratory. Corequisite: BIOL 4713. (Typically offered: Spring)

BIOL 4713. Basic Immunology. 3 Hours.
A general overview of immunity with emphasis on the underlying cellular, molecular, and genetic events, and discussions of more specialized issues in immunology, such as disease states involving the immune system, and other interesting problems in modern immunology. Lecture 2 hours, laboratory 4 hours per week. Prerequisite: BIOL 2323 and BIOL 2533. (Typically offered: Spring)

BIOL 4713H. Honors Basic Immunology. 3 Hours.
A general overview of Immunity with emphasis on the underlying cellular, molecular, and genetic events, and discussions of more specialized issues in Immunology, such as disease states involving the Immune system, and other interesting problems in modern Immunology. Prerequisite: BIOL 2323 and BIOL 2533. (Typically offered: Spring)
This course is equivalent to BIOL 4713.

BIOL 4723L. Laboratory in Microbial Fermentation. 3 Hours.
An inquiry-based lab focusing on the microbiology of brewing. Introduces students to laboratory techniques used in molecular ecology, microbial physiology, genetics, and brewing. Laboratory 6 hours per week. Pre- or corequisite: FDSC 2723. Prerequisite: BIOL 2013 or BIOL 2323 or BIOL 2533. (Typically offered: Fall Even Years)

BIOL 4734. Wildlife Management Techniques. 4 Hours.
To familiarize students with techniques used in the management of wildlife populations. Students will be exposed to field methods, approaches to data analysis, experimental design, and how to write a scientific paper. Management applications will be emphasized. Lecture 3 hours, laboratory 3 hours per week. Corequisite: Lab component. Prerequisite: BIOL 3863. (Typically offered: Irregular)

BIOL 4744. Fish Biology. 4 Hours.
Morphology, classification, life history, population dynamics, and natural history of fishes and fish-like vertebrates. Lecture 3 hours, laboratory 3 hours per week. Corequisite: Lab component. Prerequisite: 12 hours of biological science. (Typically offered: Spring Odd Years)

BIOL 4763. Ornithology. 3 Hours.
Taxonomy, morphology, physiology, behavior, and ecology of birds. Lecture, laboratory, and field work. Corequisite: Lab component. Prerequisite: BIOL 3863 (Typically offered: Spring Even Years)

BIOL 4774. Biometry. 4 Hours.
Students learn biological statistics and experimental design by actually designing experiments and analyzing data, as well as through lecture, discussion, reading, writing, and problem solving. Lecture 3 hours, laboratory 3 hours each week. Corequisite: Lab component. Prerequisite: (STAT 2823 or STAT 2303 or equivalent) and BIOL 3863. (Typically offered: Spring Even Years)

BIOL 4793. Introduction to Neurobiology. 3 Hours.
Exploration of the neurological underpinnings of perception, action, and experience including: how sense receptors convert information in the world into electricity, how information flows through the nervous systems, how neural wiring makes vision possible, how the nervous system changes with experience, and how the system develops. Prerequisite: BIOL 2533. (Typically offered: Spring)

BIOL 480V. Special Topics in Biological Sciences. 1-6 Hour.
Consideration of new areas of biological sciences not yet treated adequately in other courses. Prerequisite: 8 hours of biological sciences. (Typically offered: Fall, Spring and Summer) May be repeated for degree credit.

BIOL 480VH. Honors Special Topics in Biological Sciences. 1-6 Hour.
Consideration of new areas of biological sciences not yet treated adequately in other courses. Prerequisite: 8 hours of biological sciences. (Typically offered: Fall, Spring and Summer) May be repeated for degree credit.
This course is equivalent to BIOL 480V.

BIOL 4833. Animal Behavior. 3 Hours.
Organization, regulation, and phylogeny of animal behavior, emphasizing diversity across animal taxa. Lecture, laboratory, and field work. Corequisite: Lab component. (Typically offered: Spring)
BIOL 4844. Community and Ecosystem Ecology. 4 Hours.
Survey of theoretical and applied aspects of community processes stressing structure, trophic dynamics, community interactions, and major community types. Corequisite: Lab component. Prerequisite: BIOL 3863. (Typically offered: Fall Odd Years)

BIOL 4863. Analysis of Animal Populations. 3 Hours.
Basic principles of design and analysis for population studies of fish and wildlife species. Students will be instructed in the use of the latest software for estimating population parameters. Focus will be on both concepts and applications. Management applications of estimated parameters will be emphasized. Lecture 2 hours, laboratory 3 hours per week. Corequisite: Lab component. Prerequisite: BIOL 3863. (Typically offered: Spring Even Years)

BIOL 4873. Microbial Molecular Genetics and Informatics. 3 Hours.
Fundamentals of microbial genomics and bioinformatics. Course covers microbial genetics, genetic structure, genome organization, proteome organization, approaches for the analysis of DNA, RNA, and proteins, cellular metabolic pathways, genetic regulation, small RNA molecules, functional genomics, metagenomics, and bioinformatics approaches for analysis of microbial genomes. Prerequisite: BIOL 2323 or BIOL 2533. (Typically offered: Fall)

BIOL 4883. Mammalian Evolution and Osteology. 3 Hours.
Focuses on describing the evolutionary history of mammals, a group of vertebrates that include over 5,000 species in 29 orders, and will provide an overview of living species and their identifying features. Prerequisite: ANTH 1013 and ANTH 1011L, or BIOL 1543 and BIOL 1541L, or instructor consent. (Typically offered: Fall Even Years)
This course is equivalent to ANTH 4703.

BIOL 496V. Culture and Environment: Field Studies. 1-6 Hour.
May be taken by students participating in overseas study programs or other domestic field study programs approved by the department. (Typically offered: Irregular) May be repeated for up to 12 hours of degree credit.

BIOL 496VH. Honors Culture and Environment: Field Studies. 1-6 Hour.
May be taken by students participating in overseas study programs or other domestic field study programs approved by the department. (Typically offered: Irregular) May be repeated for up to 12 hours of degree credit.
This course is equivalent to BIOL 496V.

BIOL 498V. Senior Thesis. 1-6 Hour.
Senior thesis. (Typically offered: Fall, Spring and Summer)

BIOL 499V. Research In Biological Sciences. 1-4 Hour.
Research. Prerequisite: Senior standing. (Typically offered: Fall, Spring and Summer) May be repeated for up to 8 hours of degree credit.

BIOL 499VH. Honors Research in Biological Sciences. 1-4 Hour.
Honors research. Prerequisite: Senior standing. (Typically offered: Fall, Spring and Summer) May be repeated for up to 8 hours of degree credit.
This course is equivalent to BIOL 499V.