Zoology

A major in Zoology is an appropriate beginning for those planning careers in teaching, research, or other employment in animal biology, environmental biology, fisheries biology, veterinary medicine, or wildlife biology. Students majoring in Zoology are required to develop an individualized curriculum in consultation with a faculty advisor within the department.

A student majoring in Zoology may work toward either a Bachelor of Arts (B.A.) or Bachelor of Science (B.S.) degree. The B.A. with a major in Zoology provides the opportunity for a broad, liberal arts education by allowing students to take 20-25 hours of courses in areas of interest outside the major. The B.A. is appropriate for students who desire a strong background in zoology, but have interests in biology-associated careers in business, law, journalism, zoo keeping, or other fields.

Students seeking a B.S. with a major in Zoology must choose one of five specializations: animal biology, environmental biology, fisheries biology and aquatic conservation, pre-veterinary science, or wildlife biology and conservation. The B.S. requires more courses in physical sciences and mathematics than does the B.A., and is appropriate for students planning careers as practicing zoologists in one of the emphasized fields, particularly those who wish to pursue graduate studies. Each B.S. student will complete an independent-study project under the supervision of their faculty mentor, submit a written summary of the project, and present their results as part of ZOOL 482 (Senior Seminar), to be taken during the final year of study.

To prepare for a major in Zoology at SIU Carbondale, students should have a solid high school background in biology, mathematics, and physical sciences, as well as practiced writing skills and a sustaining curiosity about animal life. Students transferring to SIU after two years at a community college should have completed introductory biology, introductory chemistry, and pre-calculus sequences.

Zoology majors must take ZOOL 215 (Sophomore Seminar) immediately after completing BIOL 211 and BIOL 213, or (for transfer students) during the first semester of enrollment at SIU. ZOOL 215 provides students with an orientation to the department and requirements of the major, and assigns them faculty advisors who will act as mentors until graduation.

B.A. and B.S. degrees require a minimum of 41 semester hours of biology or zoology courses. No more than 11 semester hours of biology or zoology courses that are used to satisfy degree requirements for another major may be used to meet the Zoology requirements.

SIU has an affiliate agreement with the University of Southern Mississippi's Gulf Coast Research Laboratory (GCRL). Qualified students can enroll in credit-bearing courses at GCRL with credits articulating as free electives in Zoology at SIU.

Bachelor of Arts Degree in Zoology, College of Science

<table>
<thead>
<tr>
<th>Degree Requirements</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>University Core Curriculum Requirements³</td>
<td>39</td>
</tr>
<tr>
<td>College of Science Academic Requirements</td>
<td>7-9</td>
</tr>
</tbody>
</table>

³Credit hours vary due to electives selected.
### Biological Sciences: completed with the Zoology major
Mathematics: MATH 108 and MATH 109, or MATH 111 or MATH 141 or MATH 150
Physical Sciences: completed with the Zoology major. Supportive Skills: at least six credit hours chosen from QUAN 402 or MATH 282 or PLB 360 or ZOOL 360; CS 105 or CS 200B, CS 201 or CS 202; ENGL 290 or ENGL 291; any two-semester sequence of a foreign language (Chinese, French, Latin, German, Greek, Japanese, Spanish)

### Requirements for Major in Zoology

<table>
<thead>
<tr>
<th>Degree Requirements</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 211, BIOL 212, BIOL 213, BIOL 304, BIOL 305, and BIOL 307 CHEM 200, CHEM 201, CHEM 202 CHEM 210, CHEM 211 and CHEM 212; or GEOL 220 and GEOL 223; or GEOL 221 and GEOL 224; or PHYS 203A, PHYS 253A ZOOL 215 and ZOOL 220 20 hours of 300-and 400-level Biology or Zoology courses. One of the following quantitative skills courses: QUAN 402 or MATH 282 or ZOOL 360 CS 201 or CS 202 MATH 141 or MATH 150</td>
<td>54-56</td>
</tr>
</tbody>
</table>

### Electives

<table>
<thead>
<tr>
<th>Electives</th>
<th>16-21</th>
</tr>
</thead>
</table>

Total: 120

1 A total of nine hours of biological science, mathematics, and physical science course work is accounted for in the University Core Curriculum.

2 The foreign language requirement can also be met by one of the following: (a) earning eight hours of 100-level credit in one language by proficiency examination; (b) completing three years of one language in high school with no grade lower than C.

3 A grade of C or better in ZOOL 220 is required for completion of the Zoology B.A. BIOL 304, BIOL 305, and BIOL 307 are required courses and may not be used as electives. A maximum of three credit hours of ZOOL 491, ZOOL 492, and ZOOL 493 together may be used as Zoology electives. Courses used to satisfy College of Science requirements may not be used to satisfy the quantitative skills requirement of the major. Only one of MATH 282, QUAN 402, and ZOOL 360 may be counted toward the supportive skills or major requirements.

### Bachelor of Science Degree in Zoology (Animal Biology Specialization) Degree Requirements

The Animal Biology specialization is designed for students who wish to obtain a broad background in zoology, but especially those contemplating graduate studies of animal behavior, biodiversity, evolution, natural history, or systematics.

### Animal Biology Specialization Degree Requirements

<table>
<thead>
<tr>
<th>Degree Requirements</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>University Core Curriculum Requirements ¹</td>
<td>39</td>
</tr>
<tr>
<td>Degree Requirements</td>
<td>Credit Hours</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>College of Science Academic Requirements</td>
<td>7-9</td>
</tr>
<tr>
<td>Biological Sciences: completed with the Zoology major</td>
<td></td>
</tr>
<tr>
<td>Mathematics: MATH 108 and MATH 109, or MATH 111</td>
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<tr>
<td>Physical Sciences: completed with the Zoology major.</td>
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<tr>
<td>Supportive Skills: QUAN 402 or MATH 282 or PLB 360 or ZOOL 360; ENGL 290 or ENGL 291 or ENGL 391, or JRNL 310</td>
<td></td>
</tr>
<tr>
<td>Requirements for Major in Zoology</td>
<td>68-72</td>
</tr>
<tr>
<td>BIOL 211, BIOL 212, BIOL 213, BIOL 304, BIOL 305, BIOL 306, BIOL 307, and BIOL 409</td>
<td></td>
</tr>
<tr>
<td>CHEM 200, CHEM 201, CHEM 202, CHEM 210, CHEM 211, and CHEM 212</td>
<td></td>
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<tr>
<td>CHEM 340, CHEM 341, CHEM 350, and CHEM 351; or GEOL 220, GEOL 221, GEOL 223, and GEOL 224; or PHYS 203A, PHYS 203B, PHYS 253A, and PHYS 253B</td>
<td></td>
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<tr>
<td>CS 200B or CS 201 or CS 202</td>
<td></td>
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<tr>
<td>MATH 139 or MATH 141 or MATH 150</td>
<td></td>
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<tr>
<td>ZOOL 215, ZOOL 220, and ZOOL 482</td>
<td></td>
</tr>
<tr>
<td>At least one credit hour of ZOOL 491, ZOOL 492, ZOOL 493, ZOOL 496, or ZOOL 497</td>
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<tr>
<td>At least 15 hours from the following: BIOL 306; ZOOL 320, ZOOL 385, ZOOL 405, ZOOL 407, ZOOL 408, ZOOL 409, ZOOL 410, ZOOL 413, ZOOL 414, ZOOL 415, ZOOL 418, ZOOL 425, ZOOL 426, ZOOL 433, ZOOL 434, ZOOL 435, ZOOL 438, ZOOL 444, ZOOL 450, ZOOL 461, ZOOL 465, ZOOL 467, ZOOL 471, ZOOL 472, ZOOL 473, ZOOL 478, ZOOL 490, ZOOL 491, ZOOL 492, ZOOL 493</td>
<td></td>
</tr>
<tr>
<td>Electives</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>120</td>
</tr>
</tbody>
</table>

1 A total of nine hours of biological science, mathematics, and physical science course work is accounted for in the University Core Curriculum.
2 A minimum grade of C is required in these courses for completion of the Animal Biology specialization.
3 A minimum grade of C is required in these courses for completion of the Animal Biology specialization.
4 Enrollment in these independent study courses must be coordinated and approved by a faculty mentor.
5 A maximum of three credit hours of ZOOL 491, ZOOL 492, and ZOOL 493 together may be used as Zoology electives.
Bachelor of Science Degree in Zoology (Environmental Biology Specialization), College of Science

The Environmental Biology specialization is designed for students interested in biological approaches to the study of environmental quality. Students in this program should also consider the Environmental Studies minor.

Environmental Biology Specialization Degree Requirements

<table>
<thead>
<tr>
<th>Degree Requirements</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>University Core Curriculum Requirements</td>
<td>39</td>
</tr>
<tr>
<td>College of Science Academic Requirements</td>
<td>7-9</td>
</tr>
<tr>
<td>Biological Sciences: completed with the Zoology major</td>
<td></td>
</tr>
<tr>
<td>Mathematics: MATH 108 and MATH 109, or MATH 111</td>
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<tr>
<td>Physical Sciences: completed with the Zoology major</td>
<td></td>
</tr>
<tr>
<td>Supportive Skills: QUAN 402 or MATH 282 or PLB 360 or ZOOL 360; ENGL 290 or ENGL 291 or ENGL 391, or JRNL 310</td>
<td></td>
</tr>
<tr>
<td>Requirements for Major in Zoology</td>
<td>70-71</td>
</tr>
<tr>
<td>BIOL 211, BIOL 212, BIOL 213, BIOL 305, BIOL 307, BIOL 409</td>
<td></td>
</tr>
<tr>
<td>CHEM 200, CHEM 201, CHEM 202, CHEM 210, CHEM 211, CHEM 212, CHEM 340, CHEM 341</td>
<td></td>
</tr>
<tr>
<td>MATH 139 or MATH 141 or MATH 150</td>
<td></td>
</tr>
<tr>
<td>ZOOL 215, ZOOL 220, ZOOL 410, ZOOL 411, ZOOL 432, ZOOL 433 or ZOOL 434, and ZOOL 482</td>
<td></td>
</tr>
<tr>
<td>At least 12 hours from the following Zoology electives: BIOL 304; ZOOL 351, ZOOL 415, ZOOL 426, ZOOL 435, ZOOL 438, ZOOL 443, ZOOL 444, ZOOL 445, ZOOL 458, ZOOL 490, ZOOL 491, ZOOL 492, ZOOL 493</td>
<td></td>
</tr>
<tr>
<td>At least 6 hours from the following environmental science electives: CHEM 350 and CHEM 351; CSEM 240; FOR 429; GEOG 310I, GEOG 320, GEOG 330, GEOG 401, GEOG 404, GEOG 422, GEOG 424, GEOG 426, GEOG 430, GEOG 434, GEOG 439, GEOG 471; GEOL 220 and GEOL 221 and GEOL 224, GEOL 222 and GEOL 223; MICR 301; PHSL 310; PLB 438, PLB 440, PLB 443, PLB 444, PLB 452</td>
<td></td>
</tr>
</tbody>
</table>
Electives: 1-4

Total: 120

1 A total of 12 hours of biological science, mathematics, and physical science coursework is accounted for in the University Core Curriculum.

2 A minimum grade of C is required in BIOL 211, BIOL 212, BIOL 213, BIOL 305, and BIOL 307 for completion of the Environmental Biology specialization.

3 A minimum grade of C is required in ZOOL 220 for completion of the Environmental Biology specialization.

4 A maximum of three credit hours of ZOOL 491, ZOOL 492, and ZOOL 493 together may be used as Zoology electives.

Bachelor of Science Degree in Zoology (Fisheries Biology and Aquatic Conservation Specialization), College of Science

Fisheries Biology and Aquatic Conservation Specialization is designed for students whose primary interest is in the ecology and management of fishes and aquatic ecosystems. This emphasis is appropriate for those with career goals involving fisheries management, aquaculture, aquatic ecosystem management, or graduate studies in applied fish biology.

Fisheries Biology and Aquatic Conservation Specialization Degree Requirements

<table>
<thead>
<tr>
<th>Degree Requirements</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>University Core Curriculum Requirements ¹</td>
<td>39</td>
</tr>
<tr>
<td>College of Science Academic Requirements</td>
<td>7-9</td>
</tr>
<tr>
<td>Biological Sciences: completed with the Zoology major</td>
<td></td>
</tr>
<tr>
<td>Mathematics: MATH 108 and MATH 109, or MATH 111</td>
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<tr>
<td>Physical Sciences: completed with the Zoology major</td>
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</tr>
<tr>
<td>Supportive Skills: QUAN 402 or MATH 282 or PLB 360 or ZOOL 360; ENGL 290 or ENGL 291 or ENGL 391, or JRNL 310</td>
<td></td>
</tr>
<tr>
<td>Requirements for Major in Zoology</td>
<td>68-70</td>
</tr>
<tr>
<td>BIOL 211, BIOL 212, BIOL 213, BIOL 304, BIOL 305, BIOL 307, and BIOL 409 ²</td>
<td></td>
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<tr>
<td>CHEM 200, CHEM 201, CHEM 202, CHEM 210, CHEM 211, and CHEM 212</td>
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</tr>
</tbody>
</table>

¹ University Core Curriculum Requirements are accounted for in the degree requirements.
² Maximum of three credit hours of ZOOL 491, ZOOL 492, and ZOOL 493 together may be used as Zoology electives.
Degree Requirements | Credit Hours
---|---
CHEM 340, CHEM 341, CHEM 350, and CHEM 351; or PHYS 203A, PHYS 203B, PHYS 253A, and PHYS 253B |
MATH 141 or MATH 150 |
ZOOL 215, ZOOL 220, ZOOL 415, ZOOL 465, ZOOL 466, ZOOL 477, and ZOOL 482 ³ |
At least 9 hours from the following: ZOOL 320, ZOOL 385, ZOOL 414, ZOOL 418, ZOOL 426, ZOOL 433, ZOOL 434, ZOOL 458, ZOOL 473, ZOOL 490, ZOOL 491, ZOOL 492, ZOOL 493 ⁴ |
Electives | 2-8
Total | 120

1 A total of nine hours of biological science, mathematics, and physical science course work is accounted for in the University Core Curriculum.
2 A minimum grade of C is required in BIOL 211, BIOL 212, BIOL 213, BIOL 304, BIOL 305, and BIOL 307 for completion of the Fisheries Biology and Aquatic Conservation Specialization.
3 A minimum grade of C is required in ZOOL 220 for completion of the Fisheries Biology and Aquatic Conservation Specialization.
4 A maximum of three credit hours of ZOOL 491, ZOOL 492, and ZOOL 493 together may be used as Zoology electives.

Bachelor of Science Degree in Zoology (Pre-Veterinary Science Specialization), College of Science

The Pre-Veterinary Science specialization is designed for Zoology majors planning to enter veterinary school. Students in this program must register with the College of Science Pre-Health Professions Advisement Office.

Pre-Veterinary Science Specialization Degree Requirements

| Degree Requirements | Credit Hours |
---|---|
University Core Curriculum Requirements ¹ | 39 |
College of Science Academic Requirements | 7-9 |
Biological Sciences: completed with the Zoology major |
Mathematics: MATH 108 and MATH 109, or MATH 111 |
Physical Sciences: completed with the Zoology major |
Degree Requirements

| Supportive Skills: QUAN 402 or MATH 282 or PLB 360 or ZOOL 360; ENGL 290 or ENGL 291 or ENGL 391, or JRNL 310 |

| Requirements for Major in Zoology | 71-72 |

| BIOL 211, BIOL 212, BIOL 213, BIOL 304, BIOL 305, BIOL 306 and BIOL 409 ² |

| CHEM 200, CHEM 201, CHEM 202, CHEM 210, CHEM 211, CHEM 212, CHEM 340, CHEM 341, CHEM 350 and CHEM 351 |

| CS 200B or CS 201 or MATH 139 or MATH 141 |

| PHYS 203A, PHYS 203B, PHYS 253A, and PHYS 253B |

| ZOOL 215, ZOOL 220, and ZOOL 482 ³ |

| At least nine hours of zoology electives from the following: ZOOL 320, ZOOL 407, ZOOL 409, ZOOL 413, ZOOL 418, ZOOL 426, ZOOL 432, ZOOL 433, ZOOL 434, ZOOL 438, ZOOL 440, ZOOL 461, ZOOL 467, ZOOL 471, ZOOL 478, ZOOL 491, ZOOL 492, ZOOL 493 ⁴ |

| At least six hours of pre-vet electives from the following: ANS 337; BIOL 307; MICR 301, MICR 302, MICR 403, MICR 460; PHSL 310, PHSL 410A, PHSL 410B, PHSL 430 |

| Electives | 0-1 |

| Total | 120 |

1 A total of nine hours of biological science, mathematics, and physical science course work is accounted for in the University Core Curriculum.

2 A minimum grade of C is required in BIOL 211, BIOL 212, BIOL 213, BIOL 304, BIOL 305, and BIOL 306 for completion of the Pre-Veterinary Science specialization.

3 A minimum grade of C is required in ZOOL 220, for completion of the Pre-Veterinary Science specialization.

4 A maximum of three credit hours of ZOOL 491, ZOOL 492, and ZOOL 493 together may be used as Zoology electives.

Bachelor of Science Degree in Zoology (Wildlife Biology and Conservation Specialization), College of Science

The Wildlife Biology and Conservation Specialization is designed for students whose primary interests are in wildlife ecology, management, and conservation. Course requirements in this track include those specified by The Wildlife Society’s certification program.
Wildlife Biology and Conservation Specialization Degree Requirements

<table>
<thead>
<tr>
<th>Degree Requirements</th>
<th>Credit Hours</th>
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<tbody>
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</tr>
<tr>
<td>College of Science Academic Requirements</td>
<td>7-9</td>
</tr>
<tr>
<td>Biological Sciences: completed with the Zoology major</td>
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</tr>
<tr>
<td>Mathematics: MATH 108 and MATH 109, or MATH 111</td>
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<tr>
<td>Physical Sciences: completed with the Zoology major</td>
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<tr>
<td>Supportive Skills: QUAN 402 or MATH 282 or PLB 360 or ZOOL 360; ENGL 290 or ENGL 291 or ENGL 391, or JRNL 310</td>
<td></td>
</tr>
<tr>
<td>Requirements for Major in Zoology</td>
<td>70-72</td>
</tr>
<tr>
<td>BIOL 211, BIOL 212, BIOL 213, BIOL 304, BIOL 305, and BIOL 307</td>
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<tr>
<td>CHEM 200, CHEM 201, CHEM 202, CHEM 210, CHEM 211, CHEM 212</td>
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<tr>
<td>MATH 139 or MATH 141 or MATH 150</td>
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<tr>
<td>CSEM 240; PHYS 203A and PHYS 253A</td>
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<tr>
<td>ZOOL 215, ZOOL 220, ZOOL 410, ZOOL 468, and ZOOL 482</td>
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<tr>
<td>Three hours of policy from the following: CMST 412; FOR 325; GEOG 422, GEOG 426, GEOG 471; ZOOL 464</td>
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<tr>
<td>Three hours of management from the following: FOR 405, FOR 451; ZOOL 445, ZOOL 462A and ZOOL 462B, ZOOL 469</td>
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</tr>
<tr>
<td>Six hours of wildlife biology from the following: ZOOL 408, ZOOL 461, ZOOL 462A and ZOOL 462B, ZOOL 467, ZOOL 478</td>
<td></td>
</tr>
<tr>
<td>At least three hours of zoology electives from the following: ZOOL 320, ZOOL 385, ZOOL 407, ZOOL 408, ZOOL 413, ZOOL 414, ZOOL 418, ZOOL 433, ZOOL 434, ZOOL 461, ZOOL 462A, ZOOL 462B, ZOOL 465, ZOOL 466, ZOOL 467, ZOOL 469, ZOOL 471, ZOOL 478, ZOOL 491, ZOOL 492, ZOOL 493</td>
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</table>
### Degree Requirements

<table>
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<tr>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>120</td>
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</tbody>
</table>

**At least three hours of plant systematics from the following:**
- FOR 202, PLB 300, PLB 304, PLB 449, PLB 451

**At least three hours of botany from the following:** FOR 201; PLB 300, PLB 320, PLB 400, PLB 415, PLB 440, PLB 443, PLB 445

**Electives** 0-4

### Total

**Electives** 0-4

<table>
<thead>
<tr>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>120</td>
</tr>
</tbody>
</table>

1 A total of nine hours of biological science, mathematics, and physical science course work is accounted for in the University Core Curriculum.

2 A minimum grade of C is required in BIOL 211, BIOL 212, BIOL 213, BIOL 304, BIOL 305 and BIOL 307 for completion of the Wildlife Biology and Conservation specialization.

3 A minimum grade of C is required in ZOOL 220 for completion of the Wildlife Biology and Conservation specialization.

4 No course duplications are allowed between elective categories. A maximum of three credit hours of ZOOL 491, ZOOL 492, and ZOOL 493 together may be used as Zoology electives.

5 No course duplications are allowed between elective categories. A maximum of three credit hours of ZOOL 491, ZOOL 492, and ZOOL 493 together may be used as Zoology electives.

6 No course duplications are allowed between elective categories. A maximum of three credit hours of ZOOL 491, ZOOL 492, and ZOOL 493 together may be used as Zoology electives.

7 No course duplications are allowed between elective categories. A maximum of three credit hours of ZOOL 491, ZOOL 492, and ZOOL 493 together may be used as Zoology electives.

8 No course duplications are allowed between elective categories. A maximum of three credit hours of ZOOL 491, ZOOL 492, and ZOOL 493 together may be used as Zoology electives.

### Zoology Minor

A minor in Zoology consists of BIOL 211, BIOL 212, BIOL 213, ZOOL 220, and 12 hours of ZOOL courses suitable for majors. One course from BIOL 304, BIOL 305, BIOL 306, BIOL 307, and BIOL 409 may also be counted toward the 12-hour requirement, but no University Core Curriculum courses may be included.

### Honors Program

An honors program is available to those juniors and seniors in zoology who maintain a grade point average of 3.25 or better, overall and in the major. To enroll in Zoology 493, the student must complete a departmental form that requires the project title; a description of the proposed project; and the signatures of the student, the faculty advisor, and the chair of the department. The student must complete six hours of 493 with a grade of B of better, file with the department a final report on the research, and present the results at a public seminar in order to graduate with departmental honors in zoology. At the time of graduation, an indication of participation in the program is made on the diploma and transcript for students who complete the requirements. Concurrent participation in the University Honors Program is encouraged.
Zoology Courses

ZOOL115 - General Biology 115-3 General Biology. (Same as PLB 115) (University Core Curriculum) [IAI Course: L1 900L] Introduction to fundamental biological concepts for non-life science majors interested in learning about interrelationships of human, plant and animal communities. Integrated lecture and laboratory cover topics that include structure and function of living systems, reproduction and inheritance, evolution, biological diversity and environmental biology. Laboratory applies scientific methods to the study of living systems. Laboratory/field trip fee: $15.

ZOOL118 - Principles of Animal Biology 118-4 Principles of Animal Biology. (Advanced University Core Curriculum course) [IAI Course: L1 902L] Introduction to the basic concepts of animal biology including chemical organization of protoplasm; organization of matter into cells, tissues, organs and organ systems; classification and distribution of animals; ecology; heredity and organic evolution; economic biology and conservation, and animal behavior. Credit may not be used toward a major in zoology. Three lecturers and one 2-hour laboratory per week. Prerequisite: high school biology. Laboratory fee: $30.

ZOOL215 - Sophomore Seminar Zoology 215-1 Sophomore Seminar in Zoology. Development of the skills and background knowledge required to be a modern zoologist. Students will receive an orientation to the Zoology Department and the requirements of their major, be assigned a faculty advisor, introduced to philosophy of science, critical thinking, and scientific literature, and learn the basics of scientific writing and oral presentation. One meeting per week. Prerequisites: BIOL 200A and BIOL 200B, or BIOL 212 and BIOL 213, or BIOL 212 and BIOL 213, with grades of C or better.

ZOOL220 - Animal Diversity 220-5 Animal Diversity. (Advanced University Core Curriculum course) Diversity and taxonomy of animals, emphasizing structure, function, life cycles, behavior, and phylogeny. Three lectures and two two-hour laboratories per week. Prerequisite: BIOL 200A and BIOL 200B, or BIOL 212 and BIOL 213 with grades of C or better. Laboratory/field trip fee: $40.

ZOOL312I - Conservation Natural Resources 312I-3 Conservation of Natural Resources. (University Core Curriculum) [IAI Course: L1 905] This course adopts an interdisciplinary approach to the study of conservation of natural resources. It integrates environmental science and environmental economics. By examining the costs and benefits of resource consumption, we will attempt to determine the socially optimal level of resource utilization. We will look at ways in which governments attempt to achieve socially optimal resource use, and the effects of these government policies on the environment. Topics considered in the course include: solid waste, energy consumption, air pollution, agriculture and global environment change.

ZOOL320 - Vertebrate Zoology 320-3 Vertebrate Zoology. Evolution and diversity of fishes, amphibians, nonavian reptiles, birds, and mammals, including consideration of fossils, taxonomy, anatomy, physiology, ecology, behavior, and conservation. Prerequisite: ZOOL 220 with a grade of C or better.

ZOOL351 - Ecological Methods 351-3 Ecological Methods. (Same as PLB 351) Basic ecological field techniques for analysis of community structure and functional relationships. Two 3-hour laboratories per week. Prerequisite: BIOL 307. Laboratory/field trip fee: $25.

ZOOL360 - Introductory Biostatistics 360-3 Introductory Biostatistics. (Same as PLB 360) Introduction to basic statistical concepts and methods as applied to biological data. Includes descriptive techniques such as measures of central tendency, variability, hypothesis testing, analysis of variance and simple linear regression and correlation. Analysis of computer generated output and report writing will be required. Prerequisite: MATH 108.

ZOOL385 - Intro Marine Biology 385-3 Introduction to Marine Biology. Principles of marine biology including physical and chemical characteristics of marine ecosystems, biology of important marine organisms, and descriptions of specific marine habitats ranging from coastal to pelagic and surface to deep benthic. The course will include a mandatory 5-day field trip to a coastal marine station over spring break, which will incur a cost to students of approximately $500. Two 1-hour lectures and one 2-hour lab per week. Prerequisite: ZOOL 220 with a grade of C or better.

ZOOL405 - Systematic Zoology 405-3 Systematic Zoology. Estimation, analysis, and interpretation of phylogenetic trees; concepts, delimitation, and description of species; biological taxonomy and systems
of classification; application of phylogenetics to the study of evolution. Prerequisites: BIOL 304 and MATH 108 with grades of C or better.

**ZOOL407 - Parasitology** 407-4 Parasitology. Principles, collection, identification, morphology, life histories, and control measures. Two lectures and two 2-hour laboratories per week. Prerequisite: ZOOL 220 with a grade of C or better. Laboratory/Field Trip Fee: $15.

**ZOOL408 - Herpetology** 408-3 Herpetology. Taxonomic groups, identification, morphology, and natural history of amphibians and reptiles. Two lectures and one 2-hour laboratory per week. Prerequisite: ZOOL 220 with a grade of C or better. Laboratory/Field Trip Fee: $15.

**ZOOL409 - Vertebrate Histology** 409-4 Vertebrate Histology. Microscopic structure of organs and tissues with emphasis on mammalian material. Two lectures and two 2-hour labs per week. Prerequisite: ZOOL 220A,B or ZOOL 220. Laboratory/Field Trip Fee: $15.

**ZOOL410 - Conservation Biology** 410-3 Conservation Biology. An introduction to patterns of global biodiversity and threats to that diversity. Course emphasizes how principles from numerous biological disciplines are involved in conserving and managing biodiversity, and how social, economic, and political factors affect conservation strategies. Prerequisites: BIOL 307 and MATH 108 with grades of C or better.

**ZOOL411 - Environmental Risk Assessment** 411-3 Environmental Risk Assessment. Risk assessment can be defined as the process of assigning magnitudes and probabilities to the adverse effects of human activities or natural catastrophes. Prerequisites: BIOL 307 and CHEM 340 with grades of C or better.

**ZOOL413 - The Invertebrates** 413-4 The Invertebrates. Structure, phylogeny, distinguishing features and habitats of the invertebrates. Two lectures and two 2-hour laboratories per week. Prerequisite: ZOOL 220A or ZOOL 220. Laboratory/Field Trip Fee: $15.

**ZOOL414 - Freshwater Invertebrates** 414-4 Freshwater Invertebrates. Taxonomic groups, identification, distribution, and habitats of the North American freshwater invertebrate fauna. Two lectures, two 2-hour laboratories per week. Prerequisite: ZOOL 220A or ZOOL 220. Laboratory/Field Trip Fee: $15.

**ZOOL415 - Limnology** 415-3 Limnology. (Same as PLB 416) Lakes and inland waters; the organisms living in them, and the factors affecting these organisms. Two lectures and one 4-hour laboratory alternate weeks. Prerequisite: BIOL 307 with a grade of C or better. Laboratory/Field Trip Fee: $15.

**ZOOL418 - Vertebrate Anatomy Lab** 418-3 Vertebrate Anatomy Laboratory. Comparative anatomy and dissection of representative vertebrate specimens. Three 2-hour laboratories per week. Prerequisite: ZOOL 220 with a grade of C or better. Prior or concurrent registration in ZOOL 320 recommended. Laboratory fee: $50.

**ZOOL425 - Invertebrate Paleo & Paleoecol** 425-3 Invertebrate Paleontology and Paleoecology. (Same as GEOL 425) Concepts of paleontology and paleoecology. Emphasis on functional morphology, lifestyles and habitats of fossil invertebrates and algae. The nature and evolution of marine and coastal paleocommunities. The effects of extinction events on paleocommunities and biodiversity. Laboratory. Field trips required. Prerequisite: GEOL 325 or ZOOL 220 with grade of C or better. Expense will vary in proportion to distance traveled and locations visited and will be determined before each semester. Field trip fee not to exceed $199.

**ZOOL426 - Comparative Endocrinology** 426-3 Comparative Endocrinology. (Same as ANS 426, PHSL 426) Comparison of mechanisms influencing hormone release, hormone biosynthesis, and the effects of hormones on target tissues, including mechanisms of transport, receptor kinetics, and signal transduction. Prerequisites: ANS 331 or ZOOL 220 or PHSL 310 with a grade of C. Laboratory/Field Trip Fee: $15.

**ZOOL432 - Principles of Toxicology** 432-3 Principles of Toxicology. This course will introduce students to the main topics in the field of toxicology. The emphasis will be on understanding physiological, biochemical, and molecular mechanisms of toxicity. Prerequisites: BIOL 200A and BIOL 200B; or BIOL 211, BIOL 212, and BIOL 213; with grades of C or better.

**ZOOL433 - Comparative Animal Physiology** 433-3 Comparative Animal Physiology. (Same as PHSL 433) Variations of physiological processes in animal phyla, comparison with human physiology, and physiological adaptation to environmental variation. Review of basic physiological principles and
comparative aspects of mechanism and function. Prerequisites: BIOL 200A or BIOL 211; BIOL 200B or BIOL 213, or PHSL 310; with grades of C or better.

**ZOOL434 - Environmental Physiology** 434-3 Environmental Physiology. Physiological adaptations to environmental conditions in animals and humans. Lab/lecture course explores molecular, hormonal, immunological, developmental, and phenotypic processes mediating responses to factors such as stress, disease, contaminants, nutrition, and life history trade-offs. Prerequisite: BIOL 307 or PHSL 310 or ZOOL 433 with a grade of C or better. Laboratory/field trip fee: $20.

**ZOOL435 - Plant-Insect Interactions** 435-3 Plant-Insect Interactions. (Same as PLB 435) Plants and insects have played major roles in influencing each other's evolutionary diversification. This course will be an evolutionary and ecological examination of the interactions between plants and insects. Topics will include herbivory, pollination relationships, ant-plant mutualisms, host plant choice, specialized vs. generalized relationships, seed and fruit dispersal, coevolution/cospeciation, and chemical ecology. Prerequisite: BIOL 307 with grade of C or better, or equivalent.

**ZOOL438 - Molecular Genetics Lab** 438-3 Plant and Animal Molecular Genetics Laboratory. (Same as PLB 438, PSAS 438, AGSE 438, CSEM 438) Arabidopsis and Drosophila model organisms, training in laboratory safety, reagent preparation, phenotype analysis, genetics, DNA and RNA analysis, PCR, cDNA construction, cloning and sequencing. Includes plant and bacterial transformation, and population level analysis of genetic variation using RAPD markers in grasses and Alu insertion in humans. Two 2-hr labs and one 1-hr lecture per week. Prerequisite: BIOL 305 or equivalent or consent of instructor. Lab fee: $30.

**ZOOL440 - Wildlife Nutritional Ecology** 440-3 Wildlife Nutritional Ecology. This course will provide an understanding of basic nutritional principles (including foraging, digestion, absorption, metabolism, and requirements), demonstrate their application to ecological relationships of wild terrestrial vertebrates with their environment, and stimulate students to critically evaluate published literature in this field of study. Prerequisite: BIOL 307.

**ZOOL443 - Restoration Ecology** 443-3 Restoration Ecology. (Same as PLB 443) Ecological restoration tests current understanding of ecosystem assembly and function. This course applies ecological theory to restoration, with an emphasis on factors influencing plant community assembly and evaluating restoration success. Two lectures a week and one four-hour lab alternate weeks. Prerequisite: BIOL 307 or equivalent.

**ZOOL444 - Ecological Analysis Communities** 444-4 Ecological Analysis of Communities. (Same as PLB 444) Includes concepts and methods pertaining to the analysis of ecological data. Approaches will include a variety of methods for analyzing multivariate ecology, diversity, pattern, and spatial data. Laboratory will include the computer application of these concepts and methods to field situations. Two lectures and one 4 hour lab per week. Prerequisite: PLB/ZOOL 360, BIOL 307. Lab fee: $15.

**ZOOL445 - Wetland Ecology & Mgmt** 445-3 Wetland Ecology and Management. (Same as PLB 445) This course provides students with experience in wetland ecology and management with an emphasis on wetland functioning, field sampling, and identification of common wetland plants. Prerequisite: either BIOL 200B or BIOL 213 or PLB 200; and BIOL 307; or consent of instructor. Two lectures and one 4-hour lab per week. Lab fee: $25.

**ZOOL450 - Genome Evolution** 450-3 Genome Evolution. (Same as PLB 455) This course introduces the diversity of genomes and the evolutionary forces shaping them. Molecular evolution from the level of single nucleotides to whole genomes will be covered. Prerequisites: BIOL 304 and BIOL 305.

**ZOOL458 - Multiple Stressors in Ecology** 458-3 Multiple Stressors in Ecology. In this class, students will use a step-by-step approach to evaluate an environmental issue or human concern compounded by climate change. The evaluation will begin with a conceptual model of the problem, followed by planned management strategies based on collaborative decision making. The class is designed to foster quantitative reasoning, include that reasoning in research, and articulate findings in terms that foster collaborative management and outreach. Examples of potential projects include climate change impacts in concert with disease propagation, habitat quality and quantity, pollutant uptake in ectotherms, coral bleaching, changing human coastal communities, or fire incidence.
ZOO461 - Mammalogy 461-3 Mammalogy. Taxonomic characteristics, identification, and natural history of mammals. Two 1-hour lectures and one 2-hour laboratory per week. Prerequisite: ZOOL 220B or ZOOL 220. Laboratory/Field Trip Fee: $10.

ZOO462A - Waterfowl Ecology 462A-2 Waterfowl Ecology and Management (Lecture). This class will explore the pertinence of basic life history theory and ecological principles to waterfowl management. Lecture topics include but are not limited to waterfowl life histories (i.e., productivity and mortality), foraging ecology, nutrition, habitat use, habitat management, migration, and the influence of harvest. Prerequisites: ZOOL 220, BIOL 307 with minimum grades of C. Co-requisite: ZOOL 462B.

ZOO462B - Waterfowl Laboratory 462B-1 Waterfowl Ecology and Management (Laboratory). This laboratory will meet 1 day/week for 2 hours. The primary objective will be waterfowl identification with a secondary emphasis on wetland plant identification and field techniques in waterfowl research and management. There will be 2-3 Saturday field trips. Prerequisites: none. Laboratory/field trip fee: $20.

ZOO464 - Wildlife Admin & Policy 464-3 Wildlife Administration and Policy. Responsibilities of private, state, and federal natural resources management agencies. Legal and political processes in areas of wildlife and natural resources. Three lectures per week. Special approval needed from the instructor.

ZOO465 - Ichthyology 465-3 Ichthyology. Anatomy, physiology, sensory biology, behavior, taxonomy, evolution, zoogeography, and ecology of fishes. Two lectures and one 2-hour laboratory per week. Prerequisite: ZOOL 220 with a grade of C or better. Laboratory/Field Trip Fee: $10.

ZOO466 - Fish Management 466-3 Fish Management. Sampling, age and growth, dynamics, habitat improvement, manipulation of fish populations, and management of freshwater and marine fish stocks. Two lectures per week and one 4-hour laboratory alternate weeks. Offered Fall term. Prerequisite: 10 hours of biological science or consent of instructor.

ZOO467 - Ornithology 467-3 Ornithology. Classification and recognition of birds and the study of their songs, nests, migratory habits, and other behavior. One lecture and one four-hour laboratory per week. Prerequisite: ZOOL 220B or ZOOL 220. Laboratory/Field Trip Fee: $10.


ZOO469 - Wildlife Techniques 469-3 Wildlife Techniques. Field-oriented course with instruction in techniques for management of wild species and their habitat. One 1 1/2-hour lecture and one 3-hour laboratory per week, two of which may be field trips on Saturdays. Prerequisite: ZOOL 220A,B or ZOOL 220. Laboratory/Field Trip Fee: $30.

ZOO471 - Entomology 471-4 Entomology. Structure, classification, and life histories of insects. Two lectures and two 2-hour laboratories per week. Prerequisite: ZOOL 220A or ZOOL 220. Laboratory/Field Trip Fee: $10.

ZOO472 - Intro Systems Biology 472-3 Introduction to Systems Biology. (Same as PLB 471) The experimental and bioinformatics analysis of large genomic and post-genomic data sets. The goal is integration of gene regulation, protein interaction, metabolite and hormonal signaling molecules into an understanding of basic cellular circuitry networks. Examine redundancy, robustness and decision making in biological systems. Prerequisite: BIOL 305 or CS 330. Lab fee: $15.

ZOO477 - Aquaculture 477-3 Aquaculture. (Same as ANS 477) Production of food, game, and bait fishes. Design of facilities, chemical and biological variables, spawning techniques, diseases and nutrition. Two lectures per week and one four-hour laboratory on alternate weeks. Prerequisites: BIOL 200A or BIOL 211 or ZOOL 118 or ANS 121 with grade of C or better.

ZOO478 - Animal Behavior 478-3 Animal Behavior. Biological basis of the behavior of animals. Two lectures and one 2-hour laboratory per week. Prerequisite: One year of biological science or permission of instructor.

ZOO482 - Zoology Senior Seminar 482-1 Zoology Seminar for Seniors. Each student reports on a selected topic, the class discusses using original scientific literature, and the report. The course
emphasizes development of Oral and Written communication skills. One meeting per week. Not for graduate credit. Restricted to senior standing or 24 hours of life science completed.

**ZOOL485 - Special Topics in Zoology** 485-2 to 4 Special Topics in Zoology. Examination of topics of special interest not available in other departmental courses. Offered in response to student need and faculty availability. Special approval needed.

**ZOOL490 - Food Webs and Ecosystems** 490-3 Energetics, Food Webs, and Ecosystems. (Same as PLB 490) This course places conservation of particular species into the context of community and ecosystem management. Approaches to quantifying energy needs of individual species will be extended to models of trophic networks among multiple species. Food web structure and function, species interactions, and resilience to species loss species invasions, and environmental changes will be examined in light of landscape processes. Prerequisite: BIOL 307 or consent of instructor.

**ZOOL491 - Internship in Zoology** 491-1 to 6 Internship in Zoology. Supervised training in a formalized program with a zoological institution or agency. May not be used for minor in Zoology. For internships outside the department, a prospectus from the sponsoring agency with duties and duration of internship must be approved by a Zoology faculty supervisor and the Director of Undergraduate Studies before registration. No more than three hours per semester may be taken if student is on-campus. Mandatory Pass/Fail. Not for graduate credit. Prerequisite: ZOOL 220 with a grade of C or better and departmental approval. Specific internships have specific selection criteria. Of all credits that a student completes for ZOOL 491, 492, and 493, a maximum of three hours may count toward the major.

**ZOOL492 - Individual Research Zoology** 492-1 to 3 Individual Research in Zoology. Research on zoological problems. May not be used for minor in zoology. Some cost may be borne by student. A proposal describing the research project must be approved by a Zoology faculty supervisor and the Director of Undergraduate Studies before registration. Not for graduate credit. Of all credits that a student completes for ZOOL 491, 492, and 493, a maximum of three hours may count toward the major. Prerequisites: ZOOL 220 with grade of C or better, minimum of 2.75 GPA (A=4.00). Restricted to junior or senior standing. Special approval needed from the department.

**ZOOL493 - Honors Research Zoology** 493-1 to 6 Honors Research in Zoology. Individual research for honors students in zoology. May not be used for minor in Zoology. A research proposal must be approved by a Zoology faculty supervisor before registration and the Director of Undergraduate Studies. Not for graduate credit. Prerequisite: ZOOL 220 with a grade of C or better, minimum 3.0 cumulative GPA (A=4.00), participation in the University Honors Program, and departmental approval. Of all credits that a student completes for ZOOL 491, 492, and 493, a maximum of three hours may count toward the major.

**ZOOL496 - Zoology Field Studies** 496-1 to 3 Zoology Field Studies. Formal, individualized training in field zoology, including experiences that acquaint students with animals in various environments, methods of field study, specimen collection and preservation, management and conservation, or other relevant skills. A prospectus of the training experience must be approved by a Zoology faculty supervisor before registration. Credit hours may not be counted toward a minor or major in Zoology. Not for graduate credit. Mandatory Pass/Fail. Prerequisite: ZOOL 220 with a grade of C or better.

**ZOOL497 - Zoology Lab Studies** 497-1 to 3 Zoology Laboratory Studies. Formal, individualized training in laboratory zoology, including experiences that acquaint students with dissection, microscopy, museum preparatory and curatorial techniques, biotechnology, environmental chemistry assays, or other relevant skills. A prospectus of the training experience must be approved by a Zoology faculty supervisor before registration. Credit hours may not be counted toward a minor or major in Zoology. Not for graduate credit. Mandatory Pass/Fail. Prerequisite: ZOOL 220 with a grade of C or better.

**ZOOL505 - Wildlife Admin & Mgmt** 505-2 Wildlife Administration and Management Constituencies. This class will explore what motivates individuals to pursue outdoor activities, why individual user groups are often extremely passionate about their individual outdoor activity, how outdoor activities impact wildlife populations and habitat, outdoor ethics, how to safely interact with individuals who are often in possession of firearms or other potentially dangerous tools that are used for hunting, and how to resolve conflicts between user groups.
ZOOL510 - Evolutionary Biology 510-3 Evolutionary Biology. An introductory survey of evolutionary biology at the graduate level, emphasizing conceptual issues in evolutionary genetics, adaptation, systematics, and macroevolution. Prerequisite: BIOL 305 or equivalent.

ZOOL521 - Stream Ecology 521-3 Stream Ecology. The physical, chemical, and biological factors affecting organisms in streams. Two lectures per week and one four-hour laboratory alternate weeks. Prerequisite: ZOOL 415. Special approval needed from the instructor.

ZOOL530 - Wildlife Diseases 530-3 Wildlife Diseases. Introduction to the causes and nature of diseases of wildlife with emphasis on wild mammals and birds. The relationship of disease to the population ecology of species will be emphasized further. Two lectures and one two-hour laboratory per week. Offered Spring term. Special approval needed from the instructor.

ZOOL532 - Wildlife Toxicology 532-3 Wildlife Toxicology. Fate and effects of environmental toxicants in wildlife. Review of descriptive and mechanistic toxicology for environmental contaminants. Investigation of the relationship between individual and community responses to toxicant exposure. Examination of current hazard assessment protocols and associated regulatory agencies. Prerequisite: ZOOL 468 or consent of instructor.

ZOOL533 - Aquatic Toxicology 533-4 Aquatic Toxicology. This course will provide an overview of concepts and methodology for conducting tests in the field of aquatic toxicology. Specific topics to be covered include: acute and chronic bioassays, bioaccumulation tests including biotransformation processes and toxicokinetics, and modeling techniques using Quantitative Structure Activity Relationships and fugacity modeling. This class is recommended for students interested in learning about the applied methodology used in the rapidly evolving field of aquatic toxicology. Prerequisite: BIOL 307 and CHEM 340 or equivalent, or instructor's permission.

ZOOL534 - Wildlife Habitat Analysis 534-3 Wildlife Habitat Analysis. Physical, biological and behavioral factors that influence habitat use and selection by wild vertebrate populations. Landscape level analysis of wildlife habitats. Modeling habitat suitability, environmental impact and wildlife population dynamics with habitat data. Application and use of remote sensing and geographic information systems in natural resource management and habitat evaluation. One two-hour lecture and one two-hour laboratory per week. Special approval needed from the instructor.

ZOOL535 - Quantitative Zoogeography 535-3 Quantitative Zoogeography. This course focuses on spatial analyses from the perspective of the organism (or a group of organisms) and the role of the environment in shaping its distribution. The course will cover topics associated with species distribution modeling, biodiversity quantification, landscape genetics, animal movement analyses, home range quantification, and landscape conservation prioritization from the perspective of conserving a single species. Prerequisite: familiarity with GIS and consent of instructor.

ZOOL536 - Spatial Analysis in Ecology 536-3 Spatial Analysis in Ecology. This course provides the ecological, GIS and statistical foundations needed to perform spatial analyses of ecological data at the landscape level. The course will cover the conceptual basis and practical application of GIS-based techniques for accounting for spatial autocorrelation, data reduction, batch processing of analyses (in Python, ArcGIS and R), spatial interpolation of spatial data, and building mixed predictive models aimed at assessing landscape level processes. Prerequisite: familiarity with GIS and consent of instructor.

ZOOL540 - Stable Isotope Ecology 540-3 Stable Isotopes in Ecology. This course will introduce students to fundamentals of stable isotope biogeochemistry, analytical techniques, and interpretation and analysis of stable isotope data. Students will become acquainted with a diverse array of applications of stable isotopes in ecological research in terrestrial and aquatic systems. Two lectures or discussions per week. Prerequisite: 6 hours of chemistry, 10 hours of biological science. Special approval needed from the instructor.

ZOOL545 - Ecosystem Ecology 545-3 Ecosystem Ecology. (Same as PLB 545) Fundamentals of and human modification to atmospheric chemistry and cycling of major nutrients in terrestrial ecosystems are covered in the context of global change. Laboratory exercises provide methodology and analytical approaches to studying ecosystem structure and function. Two lectures a week and one four-hour lab alternate weeks.
ZOOL550 - Vertebrate Populations 550-3 Analysis of Vertebrate Populations. This course provides instruction in the estimation of demographic parameters including but not limited to occurrence, abundance, mortality, birth, growth, philopatry, emigration, and immigration. Students will be introduced to and provided detailed instruction in the use of Program MARK to analyze data from individually marked organisms. Prerequisite: a course in statistics.

ZOOL556 - Phylogenetics 556-3 Phylogenetics. (Same as ANTH 556, MBMB 556, and PLB 556) An advanced introduction to modern methods of phylogenetic inference, emphasizing both theoretical background concepts and numerical approaches to data analysis. Topics include properties of morphological and molecular characters, models of character evolution, tree estimation procedures, and tree-based testing of evolutionary hypotheses. Special approval needed from the instructor.

ZOOL557 - Biostatistics 557-4 Biostatistics. (Same as PLB 557) Basic biostatistics procedures used by researchers in life sciences and related fields. Topics include descriptive statistics, probability and distributions, statistical models, likelihood methods, experimental design, analysis of variance, regression, correlation, and the use of statistical software.

ZOOL558 - Advanced Biostatistics 558-4 Advanced Biostatistics. (Same as PLB 558) Advanced biostatistical procedures used by researchers in life sciences and related fields. Topics include multiple and logistic regression, randomization tests, jackknife and bootstrap, Mantel tests, BACI designs, MANOVA, repeated measures analysis and the use of statistical software. Prerequisite: ZOOL 557, PLB 557 or equivalent.

ZOOL559 - Analytical Toxicology 559-4 Analytical Techniques in Toxicology. This is an advanced class for graduate students interested in the analytical tools used in the field of Environmental Toxicology. Prerequisite: CHEM 340 with C or better.

ZOOL564 - Aquaculture Techniques 564-1 to 2 Aquaculture Techniques. (Same as ANS 564) Practical experience in aquaculture techniques. Course consists of modules which require student participation in hands-on experience, (e.g., spawning, induction of spawning, production of fry, operation and grading, diagnosis and treatment of parasites and diseases, and transporting of fish). One credit for completion of two modules. Register any semester, one year to complete elected number of modules. Written report and examination required for each module. Cost incurred by student varies with modules selected. Prerequisite: ZOOL 477 or ANS 477 or consent of instructor.

ZOOL565 - Environment Physiology of Fish 565-3 Environmental Physiology of Fish. Synthesis of effects of pollutants on physiological processes of fish. Course begins with an overview of fish physiology. Topics include: concepts, methods, and measurements in aquatic toxicology; histopathological, physiological, and behavioral responses to pollutants; and toxicity of heavy metals, organics, particulates and other pollutants. Three lectures per week. Prerequisite: ZOOL 465 or consent of instructor.

ZOOL566 - Fish Stock Assessment 568-2 Fish Stock Assessment. Methods of characterizing fish populations including mortality rates, age growth analysis, population sampling, yield models, habitat evaluation procedures and creel survey techniques. Two one-hour meetings per week. Prerequisite: ZOOL 466 or consent of instructor.

ZOOL569 - Advanced Fisheries Mgmt 569-3 Advanced Fisheries Management. Advanced topics related to the management of fisheries including urban fisheries, native American fisheries, freshwater commercial fisheries, Great Lakes fisheries, impact of power generating plants on fishes, and in-depth consideration of indices of community structure and current topics in fish management. Three lectures per week. Prerequisite: ZOOL 466 or consent of instructor.

ZOOL570 - Advanced Aquaculture 570-3 Advanced Aquaculture. (Same as ANS 570) Special topics in aquaculture and practical methods for the production of coldwater, coolwater, warmwater, and tropical aquatic species. Prerequisite: ZOOL 477 or ANS 477 or equivalent with a grade of C or better.

ZOOL571 - Fish Reproduction & Breeding 571-3 Fish Reproduction and Breeding. (Same as ANS 571) Principles of finfish reproductive strategies, reproductive physiology and captive breeding. The role of genetics and the use of biotechnology and various breeding techniques in breeding programs will also be emphasized. The purpose of this course is to develop an understanding of fish reproduction and breeding techniques and to gain an appreciation of the complexity involved in managing a hatchery breeding
program. Two lectures a week and one four-hour lab alternate weeks. Prerequisite: ZOOL 477 or ANS 477 or equivalent with a grade of C or better.

**ZOOL573 - Physiological Ecology** 573-3 Physiological Ecology. The role of physiological, morphological, and behavioral adaptations and adjustments in the ecology of vertebrate organisms with special emphasis on examining the energy balance and environment as it influences vertebrate ecology. Two hours of lecture and one two-hour laboratory. Prerequisite: BIOL 307 or equivalent. Special approval needed from the instructor.

**ZOOL574 - Internship in Wildlife** 574-1 to 6 Internship in Wildlife Administration and Management. A minimum 2-month full-time internship will be conducted at a Fish and Wildlife Refuge, National Forest, State Wildlife Area, or other private or publicly held land trust. During the time of the internship, daily activities of the students will be supervised by agency personnel. In collaboration with agency personnel, students will be required to write and submit a land improvement proposal to an appropriate funding agency. Internships must be approved by the Director of the Professional Science Master's program in Zoology. Grading will be based on a rubric outlining student performance during the day to day activities internship and the final land improvement proposal.

**ZOOL575 - Topics Amphibian Biology** 575-3 Topics in Amphibian Biology. Readings, discussions, and student presentations on current research in the biology of amphibians.

**ZOOL576 - Seminar in Ecology** 576-1-12 hours; 1 per semester Seminar in Ecology. (Same as PLB 589A) Discussions of current and historical research and literature in various subject areas of ecology.

**ZOOL577 - Population Ecology** 577-3 Population Ecology. Principles of population dynamics as related to animals, with application to management and conservation of animal populations. Areas of emphasis include (A) an introduction to mathematical models and graphical theory of population dynamics, (B) application of theory to population management & conservation, and (C) empirical approaches to studying population persistence and regulation. Prerequisite: BIOL 307 or consent of instructor.

**ZOOL578 - Population Genetics** 578-3 Population Genetics. (Same as PLB 578) Genetic structure of populations, factors causing changes and principles governing rate and direction of change. Three lectures per week. Prerequisite: BIOL 304 or equivalent, and BIOL 305 or equivalent.

**ZOOL579 - Molecular Genetics Techniques** 579-3 Molecular Genetics Techniques. Practical experience in molecular genetics techniques currently used in zoology for population genetic analysis and for molecular systematics. Emphasis will be on methods for allozyme, mtDNA and nuclear DNA analysis. Class projects will focus on experimental design, data collection and analysis. Special approval needed from the instructor.

**ZOOL580 - Topics in Evolution** 580-1 Current Topics in Evolution. (Same as ANTH 580, MBMB 580) The Evolution Discussion Group meets weekly throughout the year to discuss current evolutionary literature and the research of participants. All students and faculty with an interest in evolutionary biology are welcomed to participate.

**ZOOL581 - Zoological Literature** 581-2 Zoological Literature. Diversity and functions of zoological literatures, scientific writing and the publication process. Two lectures per week. Restricted to graduate status in a biological science.

**ZOOL582 - Graduate Zoology Seminar** 582-1 to 4 (1,1,1,1) Graduate Zoology Seminar. Special topics in zoology. Consult department for each semester's topic. One meeting per week. Special approval needed from the instructor and department.

**ZOOL584 - Conservation Genetics** 584-3 Conservation Genetics. Application of principles from evolutionary and ecological genetics to conservation biology, fishery management, wildlife management, and aquaculture. Includes an overview of classical, molecular, population and quantitative genetics leading to an understanding of how managers can conserve genetic diversity and evolutionary potential of natural and captive populations. Prerequisite: BIOL 305 or consent of instructor.

ZOOL585G - Seminar in Parasitology  585G-3 per topic Seminar in Parasitology. Advanced study of special topics in zoology.

ZOOL585Z - Seminar in Selected Topics  585Z-3 per topic Seminar in Selected Topics. Advanced study of special topics in zoology. Special approval needed from the instructor or department.

ZOOL586 - Fisheries Seminar  586-1 Fisheries Seminar. Contemporary topics, literature, and oral and written communication in fisheries science. Enrollment required for zoology graduate students specializing in fisheries science for all fall and spring semesters until degree requirements are completed, unless exempted by the student's academic advisor. Only one 586 credit hour, however, may be used to satisfy degree requirements. One meeting per week.

ZOOL588 - Wildlife Seminar  588-1 to 4 (1, 1, 1, 1) Wildlife Seminar. Contemporary topics, literature, and oral and written communication in wildlife ecology. Enrollment required for zoology graduate students specializing in wildlife ecology for all Fall and Spring semesters until degree requirements are completed. Only four 588 credit hours, however, may be used to satisfy degree requirements. One meeting per week.

ZOOL589 - Zoology Colloquium  589-1 to 2 (1,1) Zoology Colloquium. Regularly scheduled presentations by invited seminar speakers on topics of current research interest in Zoology. Graded S/U. Only two credits of 589 may be used to satisfy degree requirements. Restricted to graduate status in Zoology.

ZOOL593 - Individual Research  593-1 to 12 Individual Research. Investigation in zoology other than those for theses. Only three hours may be credited toward a degree. Some costs may be borne by the student.

ZOOL596 - Research  596-1 to 66 (1 to 12 per semester) Research. Graded S/U only. Credit may not be used toward a degree in Zoology. Special approval needed from the instructor.

ZOOL597 - Advanced Zoological Techniques  597-1 to 12 Advanced Zoological Techniques. Individualized techniques or experimental procedures to prepare for dissertation research. May be taken at another university. Number of credits determined by committee. Graded on S/U basis following final report submitted to major adviser. Restricted to admission to Ph.D. degree program in Zoology. Special approval needed from the major adviser.

ZOOL598 - Research Paper  598-1 to 6 Research Paper. Research paper for Master of Science degree for Biological Sciences major. Some cost may be borne by the student. Graded S/U only. Special approval needed from the instructor.

ZOOL599 - Research & Thesis  599-1 to 36 (1 to 12 per semester) Research and Thesis. Thesis for Master of Science degree. Only six hours may count toward the degree. Some cost may be borne by student. Graded S/U only. Special approval needed from the instructor.

ZOOL600 - Research & Dissertation  600-1 to 32 (1 to 16 per semester) Research and Dissertation. Research and dissertation for Doctor of Philosophy degree. Some cost may be borne by student. Graded S/U only. Special approval needed from the instructor.

ZOOL601 - Continuing Enrollment  601-1 per semester Continuing Enrollment. For those graduate students who have not finished their degree programs and who are in the process of working on their dissertation, thesis, or research paper. The student must have completed a minimum of 24 hours of dissertation research, or the minimum thesis, or research hours before being eligible to register for this course. Concurrent enrollment in any other course is not permitted. Graded S/U or DEF only.

ZOOL699 - Postdoctoral Research  699-1 Postdoctoral Research. Must be a Postdoctoral Fellow. Concurrent enrollment in any other course is not permitted.

Zoology Faculty

Anderson, Frank E., Associate Professor, Ph.D., University of California, Santa Cruz, 1998. Anthoney, Terence R., Associate Professor, Emeritus, M.D., Ph.D., University of Chicago, 1968, 1975.
Boyles, Justin G., Assistant Professor, Ph.D., Indiana State University, 2009.
Brandon, Ronald A., Professor, Emeritus, Ph.D., University of Illinois, 1962.
Brooks, Marjorie L., Associate Professor, Ph.D., University of Wyoming, 2003.
Brown, Jason J., Assistant Professor, Ph.D., East Carolina University, 2006.
Burr, Brooks M., Professor, Emeritus, Ph.D., University of Illinois, 1977.
Eichholz, Michael W., Associate Professor, Ph.D., University of Alaska, 2000. Englert, DuWayne C.,
Professor, Emeritus, Ph.D., Purdue University, 1964.
Feldhamer, George A., Professor, Emeritus, Oregon State University, 1977.
Garvey, James E., Professor, Ph.D., Ohio State University, 1997.
Halbrook, Richard S., Associate Professor, Emeritus, Ph.D., Virginia Polytechnic Institute and State
University, 1990.
Heidinger, Roy C., Professor, Emeritus, Ph.D., Southern Illinois University, 1970.
Heist, Edward J., Professor, Ph.D., College of William and Mary, 1994.
Ibrahim, Kamal M., Associate Professor, Ph.D., University of Cambridge, 1989.
Jiminez-Ruiz, Francisco Agustin, Associate Professor, Ph.D., University of Nebraska-Lincoln, 2004.
King, David, Associate Professor, Emeritus, Ph.D., University of California at San Diego, 1975.
Kohler, Christopher C., Professor, Emeritus, Ph.D., Virginia Polytechnic Institute and State University,
1980.
Krajewski, Carey, Professor and Chair, Ph.D., University of Wisconsin, 1988.
Lovvorn, James R., Professor, Ph.D., University of Wisconsin, 1987.
Lydy, Michael J., Professor, Ph.D., Ohio State University, 1990.
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