

**Natural history:** Designed especially for students wishing to combine basic natural history and biological sciences with another field such as art, journalism, or creative writing. Option is not suitable for students planning a traditional career in the biological sciences.

**Teacher preparation in biology, Teacher preparation in general science:** Two separate options designed for students interested in a career teaching biology or broad-field science at the secondary level.

**High School Preparation:** In addition to general University admission requirements, chemistry, mathematics through pre-calculus, and a modern foreign language are recommended.

#### Special Degree Requirements

Refer to graduation requirements listed previously in the catalog. See index.

**Upper-Division Writing Expectation:** To meet the Upper-Division Writing Expectations for the major, biology students must take two or three partial writing courses (either three 1/3 writing courses or one 2/3 writing course plus one 1/3 writing course). Courses that are approved as 2/3 partial writing include: BCH 486 (BIOC 486), BCH 499 (BIOC 499), BIOE 371 (BIOL 341), BIOL 342, BIOB 499 (BIOL 499), BIOH 462 (BIOL 460), BIOM 410 (MICB 404), BIOB 411 (MICB 411) and BIOM 499 (MICB 499). Courses that are approved as 1/3 partial writing include: BCH 482 (BIOC 482), BIOO 470 (BIOL 304), BIOO 475 (BIOL 306), BIOO 320 (BIOL 316), BIOE 428 (BIOL 366), BIOE 403 (BIOL 403), BIOE 406 (BIOL 406), BIOO 434 (BIOL 445), BIOL 483, BIOL 484, BIOB 410 (MICB 410), BIOB 425 (BIOL 464), and BIOM 402 (MICB 412).

#### Option in Ecology and Organismal Biology

Forty-three credits in biology, biochemistry, and microbiology including BIOB 170N-171N (BIOL 108N-109N), 160N (BIOL 110N), 260 (BIOL 221), 272 (BIOL 223), BIOE 370-371 (BIOL 340-341); one organismal course chosen from BIOB 301 (BIOL 301), BIOE 403 (BIOL 403), BIOL 435, BIOO 433/434 (BIOL 444/445), BIOB 468 (BIOL 468); one course with a focus on a group of organisms chosen from BIOO 470 (BIOL 304), BIOO 475 (BIOL 306), BIOO 340 (BIOL 308), BIOO 320 (BIOL 316), BIOO 335 (BIOL 350), BIOM 427-428 (BIOL 400-401), BIOO 462 (BIOL 410), BIOM 423 (BIOL 418), BIOM 360-361 (MICB 300-301); one ecology course chosen from BIOE 428 (BIOL 366), BIOE 449 (BIOL 430), BIOL 442, WILD 346 (BIOE/BIOL 446), BIOE 447 (BIOL 447), BIOE 448 (BIOL 448), BIOM 415 (MICB 422), WILD 470 (WBIO 470); one evolutionary biology course chosen from BIOE 404 (BIOL 405), BIOE 406 (BIOL 406), BIOB 480 (BIOL 480), BIOE 482 (BIOL 482), BIOL 483, BIOL 484. Other recommended courses include BCH 380 or 480-482 (BIOC 380 or 481-482), BIOM 430 (MICB 423).

Also required: M 162 (MATH 150) or M 171 (MATH 152); one semester of statistics STAT 216 (MATH 241) or a full year of statistics STAT 451-457;452-458 (MATH 444-447, 445-448); one year of chemistry CHMY 121N, 123N-124N (CHEM 151N, 152N-154N) or two years of chemistry CHMY 141N, 143N, 221-222, 223-224 (CHEM 161N, 162N, 221-223, 222-224); PHSX 205N/206N-PHSX 207N/208N (PHYS 111N/113N, 112N/114N).

#### Option in Field Ecology

Forty-three credits in biology and microbiology including BIOB 170N-171N (BIOL 108N-109N), 160N (BIOL 110), BIOB 260 (BIOL 221), BIOB 272 (BIOL 223), BIOL 342 or BIOE 370-371 (BIOL 340/341). Choose FLBS courses from the Aquatic Emphasis, BIOL 451, 453, 454, 452, 492; or the Terrestrial Emphasis, BIOL 451, 458, 459, 452, 492. Choose an additional 8 credits of upper division Biology or Microbiology, with at least one from each category: course with a focus on a group of organisms from BIOO 470 (BIOL 304), BIOO 475 (BIOL 306), BIOO 340 (BIOL 308), BIOO 320 (BIOL 316), BIOO 335 (BIOL 350), BIOM 427-428 (BIOL 400-401), BIOO 462 (BIOL 410), BIOM 423 (BIOL 418), BIOM 360-361 (MICB 300/301); and an Evolutionary Biology course from BIOE 404 (BIOL 405), BIOE 406 (BIOL 406), BIOB 480 (BIOL 480), BIOE 482 (BIOL 482), BIOL 483 or BIOL 484. One of these classes must be an Upper Division Writing course. Other required courses are M 162 (MATH 150), STAT 216 (MATH 241) or STAT 451/457 and STAT 452/458 (MATH 444/447 and MATH 445/448); CHMY 121N & 123N/124N (CHEM 151N and 152N/154N) or CHMY 141N, 143N, 221-222 and 223-224 (CHEM 161N, 162N, 221/223 and 222/224); and PHSX 205N/206N-PHSX 207N/208N (PHYS 111N/113N, 112N/114N).

Students in Track A will also spend two summers at the Flathead Lake Biological Station

**Option in Cellular and Molecular Biology**

Forty-four to forty-nine credits in biochemistry, biology, and microbiology including BCH 480-482 (BIOC 481-482); BIOB 170N-171N (BIOL 108N-109N), BIOB 160N (BIOL 110N), BIOB 260 (BIOL 221), BIOB 272 (BIOL 223), BIOB 301 (BIOL 301), BIOE 370 (BIOL 340) and BIOB 425 (BIOL 464); BIOM 360-361 (MICB 300-301); one course chosen from BIOB 410 (MICB 410) or BIOM 435 (MICB 420); one course chosen from BIOL 435, BIOB 440 (BIOL 440), BIOC 433/434 (BIOL 444/445), BIOB 468 (BIOL 468), BIOL 483, BIOM 410 or 450 (MICB 404, or 450); and two lab courses chosen from BCH 486 (BIOC 486), BIOM 411 (MICB 405), BIOB 411 (MICB 411), BIOM 451 (MICB 451), or BIOM 490 (MICB 497).

M 162 (MATH 150); CHMY 141N-143N, 221-222-223-224 (CHEM 161N-162N, 221-222-223-224); one course chosen from CHMY 311, 360, 373 (CHEM 341, 370, 371); PHSX 205N/206N-PHSX 207N/208N (PHYS 111N/113N, 112N/114N) are also required.

**Option in Human Biological Sciences**

Forty-four to forty-eight credits in biology, biochemistry, and microbiology including BCH 380 or 480-482 (BIOC 380 or 480-482); BIOB 170N-171N (BIOL 108N-109N), BIOB 160N (BIOL 110N), BIOB 260 (BIOL 221), BIOB 272 (BIOL 223), BIOB 301 (BIOL 301), BIOH 365-370 (BIOL 312, 313), BIOE 370 (BIOL 340), BIOM 360-361 (MICB 300-301) (or BIOM 400 (MICB 302)) and two courses chosen from BCH 486 (BIOC 486), BIOE 403 (BIOL 403), BIOE 406 (BIOL 406), BIOL 435, 442, BIOH 462 (BIOL 460), BIOB 425 (BIOL 464), BIOB 468 (BIOL 468), BIOE 482 (BIOL 482), BIOL 483, BIOB 499 (BIOL 499), BIOM 410 (MICB 404), BIOB 410 (MICB 410), BIOM 402 (MICB 412), BIOM 427/428 (BIOL 400/401), BIOM 435 (MICB 420), BIOM 450 (MICB 450).

One year of chemistry CHMY 121N, 123N-124N (CHEM 151N, 152N-154N) or two years of chemistry CHMY 141N, 143N, 221-222-223-224 (CHEM 161N, 162N, 221-223-222-224); M 162 (MATH 150), STAT 216 (MATH 241); PHSX 205N/206N-PHSX 207N/208N (PHYS 111N/113N, 112N/114N); PSYX 100S (PSYC 100S) also are required.

Recommended Courses: Some graduate schools in the health professions may require additional course work, for example, in these areas: COMM 111A, Introduction to Public Speaking; NUTR 221N (HHP 236N), Nutrition; HHP 377-378, Physiology of Exercise and Laboratory; SOCI 101S (SOC 110S) Principles of Sociology, PSYX 230S (PSYC 240S), Developmental Psychology; PSYX 340S (PSYC 330S), Abnormal Psychology.

**Option in Natural History**

Forty-two to forty-four credits in biology including BIOB 170N-171N (BIOL 108N-109N), BIOB 160N (BIOL 110N), BIOB 260 (BIOL 221), BIOB 272 (BIOL 223), BIOC 320 (BIOL 316), BIOE 370-371 (BIOL 340-341), BIOC 335 (BIOL 350), BIOC 462 (BIOL 410); one course chosen from BIOC 470 (BIOL 304), BIOC 475 (BIOL 306), or BIOL 356; one course chosen from BIOE 404 or 406 (BIOL 405 or 406).

CHMY 121N, 123N-124N (CHEM 151N-152N, 154N) and GEO 101N-102N (GEOS 100N-101N) are required. Students also must complete at least 20 credits in cognate areas of anthropology, chemistry (excluding CHMY 121N, 123N-124N (CHEM 151N-152N, 154N)), geography, geology (excluding GEO 101N-102N (GEOS 100N-101N)), forestry, mathematics, physics/astronomy, and wildlife biology. No more than 10 credits from any one of these areas can be applied toward the 20-credit requirement. Students interested in combining this option with another subject area may, with the advisor's permission, substitute 20 credits in English-writing, journalism, photography, art, foreign language, business management, or other appropriate field.

**Teacher Preparation in Biology (Biological Education)**

Option in Biological Education Major Teaching Field of Biology: This option is designed for students seeking an endorsement in the major teaching field of biology.

A student must complete thirty-four credits in biology and microbiology including BIOB 170N-171N (BIOL108N-109N), BIOB 160N (BIOL 110N), BIOB 260 (BIOL 221), BIOB 272 (BIOL 223), BIOE 370-371 (BIOL 340-341), BIOC 433/434 (BIOL 444/445), BIOM 360-361 (MICB 300-301) and one course chosen from BIOB 301 (BIOL 301) or BIOL 435.

M 162 or M 171 (MATH 150 or 152) and STAT 216 (MATH 241) are required; CHMY 121N-123N, 124N, 485 (CHEM 151N-152N, 154N, 485); PHSX 205N/206N (PHYS 111N/113N); EDU 497 (C&I 426); GEO 105N (GEOS 105N) or GEO 108N (GEOS 108N) also are required.

For endorsement to teach biology, a student also must gain admission to the Teacher Education Program and meet all the requirements for teaching licensure (see the College of Education section of this catalog).

Biology qualifies for a single-field endorsement. However, there is a limited demand in most Montana high schools for teachers with a single endorsement in biology and students are advised to complete the requirements for a second teaching endorsement (major or minor).

**Minor Teaching Field of Biology:** For an endorsement in the minor teaching field of biology, a student must complete BIOB 170N-171N (BIOL 108N-109N), BIOB 160N (BIOL 110N), BIOB 260 (BIOL 221), BIOB 272 (BIOL 223); BIOM 360-361 (MICB 300-301); EDU 497 (C&I 426); GEO 105N or 108N (GEOS 105N or 108N), M 162 or 171 (MATH 150 or 152), STAT 216 (MATH 241); and CHMY 121N-123N, 485 (CHEM 151N-152N, 485). A student also must gain admission to the Teacher Education Program and must meet the requirements for teaching licensure (see the College of Education section of this catalog).

#### Teacher Preparation in General Science

**Extended Major Teaching Field of General Science:** A student is awarded a B.A. with a major in biology with an ecology option by completing the following 60 credits in astronomy, biology, chemistry, geology, mathematics and physics: ASTR 131N, 134N; BIOB 170N-171N (BIOL 108N-109N), BIOB 160N (BIOL 110N), BIOB 260 (BIOL 221), BIOB 272 (BIOL 223), BIOE 370-371 (340-341); CHMY 123N, 141N-143N, 485 (CHEM 152N, 161N-162N, 485); GEO 101N-102N (GEOS 100N-101N), and either GEO 105N or 108N (GEOS 105N or 108N); M 162 or 171 (MATH 150 or 152), STAT 216 (MATH 241) and PHSX 205N/206N-PHSX 207N/208N (PHYS 111N/113N, 112N/114N). EDU 497 (C&I 426) also is required

Highly recommended are BIOL 435, BIOM 360-361 (MICB 300-301), and CHMY 101N (CHEM 101N).

For an endorsement in the extended major teaching field of General Science, a student must gain admission to Teacher Education Program, complete EDU 497 (C&I 426) and meet the requirements for teaching licensure (see the College of Education section of this catalog.)

#### Suggested Course of Study

##### Biological Education Option

<b>First Year</b>	<b>A S</b>
BIOB 170N-171N (BIOL 108N-109N) Principles Biological Diversity and Laboratory	5 -
BIOB 160N (BIOL 110N) Principles of Living Systems	- 4
CHMY 121N (CHEM 151N) Introduction to General Chemistry	3 -
CHMY 123N (CHEM 152N) Intro to Organic and Biochemistry	- 3
CHMY 124N (CHEM 154N) Intro to Organic and Biochemistry Laboratory	- 2
WRIT 101 (ENEX 101) College Writing I	3 -
M 162 (MATH 150) Applied Calculus	4 -
PSYX 100S (PSYC 100S) Introduction to Psychology	- 4
Elective	- 1
	15 14
<b>Second Year</b>	<b>A S</b>
BIOB 260 (BIOL 221) Cell and Molecular Biology	4 -
BIOB 272 (BIOL 223) Genetics and Evolution	- 4
CHMY 485 (CHEM 485) Laboratory Safety	1 -
STAT 216 (MATH 241) Introduction to Statistics	4 -
BIOM 360-361 (MICB 300-301) General Microbiology & Laboratory	- 5
Lower-division writing course	- 3
General Education/Native American Studies Course	6 3
	15 15
<b>Third Year</b>	<b>A S</b>
BIOE 370-371 (BIOL 340-341) General Ecology and Laboratory	- 5
PHSX 205N-206N (PHYS 111N/113N) Fundamentals of Physics I and Laboratory	5 -
BIOO 433/434 (BIOL 444/445) Plant Physiology	- 4

EDU 202 (C&I 200) Early Field Experience	1 -
EDU 221 (C&I 303) Educational Psychology and Measurement	3 -
EDU 370 (C&I 306) Integrating Technology into Education	3 -
EDU 345 (C&I 410) Exceptionality and Classroom Management	3 -
HHP 233 Health Issues of Children and Adolescents	- 3
General Education Requirements	- 3
	15 15
<b>Fourth Year</b>	
	<b>A S</b>
EDU 395 (C&I 301 or 302) Field Experience	1 -
EDU 407E (C&I 407E) Ethics and Policy Issues	3 -
EDU 497 (C&I 426) Methods: 5-12 Science	3 -
EDU 481 (C&I 427) Content Area Literacy	3 -
EDU 495 (C&I 482) Student Teaching: Secondary	- 14
EDU 494 (C&I 494) Professional Portfolio	- 1
BIOL 435 Comparative Animal Physiology	3 -
GEO 108N Climate Change or GEO 105N Oceanography (GEOS 108N or GEOS 105N)	3 -
	16 15

**Cellular and Molecular Biology Option**

<b>First Year</b>		<b>A S</b>
BIOB 170N-171N (BIOL 108N-109N) Principles of Biological Diversity and Laboratory		5 -
BIOB 160N (BIOL 110N) Principles of Living Systems		- 4
CHMY 141N-143N (CHEM 161N-162N) College Chemistry I, II		5 5
WRIT 101 (ENEX 101) College Writing I		- 3
M 162 (MATH 150) Applied Calculus		4 -
General Education		- 3
Elective		1 -
		15 15
<b>Second Year</b>		<b>A S</b>
BIOB 260 (BIOL 221) Cell and Molecular Biology		4 -
BIOB 272 (BIOL 223) Genetics and Evolution		- 4
CHMY 221-222, 223-224 (CHEM 221-222, 223-224) Organic Chemistry I, II and Laboratories		5 5
BIOM 360-361 (MICB 300-301) General Microbiology and Laboratory		- 5
Lower-division writing course		3 -
General Education		3 -
Elective		- 1
		15 15
<b>Third Year</b>		<b>A S</b>
BCH 480-482 (BIOC 481-482) Advanced Biochemistry I, II		3 3
BIOM 410 (MICB 404) Microbial Genetics (or BIOL 435, BIOL 483, BIOB 440 (BIOL 440), BIOO 433/434 (BIOL 444/445), BIOB 468, BIOM 450 (MICB 450))		- 3
BIOM 411 (MICB 405) Experimental Microbial Genetics Laboratory (or BIOB 411 (MICB 411), BIOM 451 (MICB 451), BIOM 490 (MICB 497), or BCH 486 (BIOC 486))		- 1
PHSX 205N-206N, 207N-208N (PHYS 111N/113N, 112N/114N) College Physics I, II & Labs		5 5
General Education		3 3
Electives		4 -
		15 15
<b>Fourth Year</b>		<b>A S</b>
BIOE 370 (BIOL 340) General Ecology		- 3
BIOB 301 (BIOL 301) Developmental Biology		- 3
BIOB 425 (BIOL 464) Advanced Cellular & molecular Biology		- 3
CHMY 311 (CHEM 341) Analytic Chemistry-Quantitative Analysis		4 -
BIOB 410-411 (MICB 410-411) Immunology and Laboratory		5 -
Upper-division elective		3 3
General Education		3 3
		15 15

**Ecology and Organismal Biology Option with One Year of Chemistry**

<b>First Year</b>		<b>A S</b>
BIOB 170N-171N (BIOL 108N-109N) Principles of Biological Diversity and Laboratory		5 -
BIOB 160N (BIOL 110N) Principles of Living Systems		- 4
CHMY 121N (CHEM 151N) Introduction to General Chemistry		3 -
CHMY 123N (CHEM 152N) Introduction to Organic and Biochemistry		- 3
CHMY 124N (CHEM 154N) Introduction to Organic and Biochemistry Laboratory		- 2
WRIT 101 (ENEX 101) College Writing I		3 -
M 162 (MATH 150) Applied Calculus		4 -
General Education Requirement		- 3
Electives		- 3

	15 15
<b>Second Year</b>	<b>A S</b>
BIOB 260 (BIOL 221) Cell and Molecular Biology	4 -
BIOB 272 (BIOL 223) Genetics and Evolution	- 4
PHSX 205N/206N-207N/208N (PHYS 111N/113N-112N/114N) College Physics I, II & Labs	5 5
Lower-division writing course	3 -
Elective	3 -
General Education	- 6
	15 15

<b>Third Year</b>	<b>A S</b>
STAT 451/457 (MATH 444/447) Statistical Methods I and Comp. Lab	4 -
STAT 452/458 (MATH 445/448) Statistical Methods II and Comp. Lab	- 4
BIOE 370-371 (BIOL 340-341) General Ecology and Laboratory	- 5
BIOO 475 (BIOL 306) Mammalogy (or BIOO 470 (BIOL 304), BIOO 340 (BIOL 308), BIOO 320 (BIOL 316), BIOO 335 (BIOL 350), BIOM 427/428 (BIOL 400/401), BIOO 462 (BIOL 410) and BIOM 360/361 (MICB 300/301))	4 -
BIOE 406 (BIOL 406) Behavior and Evolution (or BIOE 404 (BIOL 405), BIOB 480 (BIOL 480), BIOE 482 (BIOL 482), BIOL 483, BIOL 484)	- 4
General Education Requirement	3 3
Electives	3 -
	14 16

<b>Fourth Year</b>	<b>A S</b>
BIOO 320 (BIOL 316) General Botany (or another UD biology elective)	- 5
WILD 346 (BIOL 446) Wildlife Physiological Ecology (or BIOE 428 (BIOL 366), BIOE 449 (BIOL 430), BIOL 442, BIOE 447 (BIOL 447), BIOE 448 (BIOL 448), BIOM 415 (MICB 422), or WILD 470 (WBIO 470))	3 -
BIOE 403 (BIOL 403) Vertebrate Design and Evolution (or BIOB 301 (BIOL 301), BIOL 435, BIOO 433/434 (BIOL 444/445))	5 -
Upper-division elective	5 -
General Education Requirement	- 3
Electives	1 8
	14 16

#### Ecology and Organismal Biology Option with Two Years of Chemistry

<b>First Year</b>	<b>A S</b>
BIOB 170N-171N (BIOL 108N-109N) Principles of Biological Diversity and Laboratory	5 -
BIOB 160N (BIOL 110N) Principles of Living Systems	- 4
CHMY 141N (CHEM 161N) College Chemistry I	5 -
CHMY 143N (CHEM 162N) College Chemistry II	- 5
WRIT 101 (ENEX 101) College Writing I	- 3
M 162 (MATH 150) Applied Calculus	4 -
STAT 216 (MATH 241) Intro to Statistics	- 4
	14 16

<b>Second Year</b>	<b>A S</b>
BIOB 260 (BIOL 221) Cell and Molecular Biology	4 -
BIOB 272 (BIOL 223) Genetics and Evolution	- 4
CHMY 221-222-223-224 (CHEM 221-222-223-224) Organic Chemistry I, II and Laboratories	5 5
Writing course	3 -
General Education	3 6
	15 15

<b>Third Year</b>	<b>A S</b>
BCH 480-482 (BIOC 481-482) Advanced Biochemistry I and II (or another UD biology, microbiology or biochemistry elective)	3 3
BIOE 370-371 (BIOL 340-341) Ecology and Laboratory	5 -
PHSX 205N/206N - PHSX 207N/208N (PHYS 111N/113N, 112N/114N) College Physics I, II & Labs	5 5
General Education	- 3
Elective	2 -
Upper-division electives	- 4
	15 15

<b>Fourth Year</b>	<b>A S</b>
BIOE 406 (BIOL 406) Behavior and Evolution (or BIOE 404 (BIOL 405), BIOB 480 (BIOL 480), BIOE 482 (BIOL 482), BIOL 483, BIOL 484)	- 4
BIOL 435 (or BIOB 301 (BIOL 301), BIOE 403 (BIOL 403), BIOO 433/434 (BIOL 444/445), BIOB 468 (BIOL 468))	3 -
BIOE 448 (BIOL 448) Terrestrial Plant Ecology (or BIOE 428/429 (BIOL 366), BIOL 442, BIOE 449 (BIOL 430), WILD 346 (BIOL 446), BIOE 447 (BIOL 447), BIOM 415 (MICB 422), WILD 470 (WBIO 470))	4 -
BIOO 470 Ornithology (or BIOO 475 (BIOL 306), BIOO 340 (BIOL 308), BIOO 320 (BIOL 316), BIOO 335 (BIOL 350), BIOM 427/428 (BIOL 400/401), BIOO 462 (BIOL 410), BIOM 360/361 (MICB 300/301), BIOM 423 (BIOL 418))	- 4
General Education Requirement	3 3
Upper-division elective	5 4
	15 15

#### Ecology Option for Teacher Preparation in General Science

<b>First Year</b>	<b>A S</b>
BIOB 170N-171N (BIOL 108N-109N) Principles of Biological Diversity and Laboratory	5 -

BIOB 160N (BIOL 110N) Principles of Living Systems	- 4
CHMY 141N-143N (CHEM 161N-162N) College Chemistry I, II	5 5
WRIT 101 (ENEX 101) College Writing I	- 3
M 162 (MATH 150) Applied Calculus	4 -
PSYX 100S (PSYC 100S) Introduction to Psychology	- 4

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**Second Year****A S**

ASTR 131N, 134N Elementary Astronomy and Laboratory	4 -
BIOB 260 (BIOL 221) Cell and Molecular Biology	4 -
BIOB 272 (BIOL 223) Genetics and Evolution	- 4
CHMY 123N (CHEM 152N) Introduction to Organic and Biochemistry	- 3
GEO 101N-102N (GEOL 100N-101N) Introduction to Physical Geology	- 4
STAT 216 (MATH 241) Intro to Statistics	4 -
General Education/Native American Studies course	- 3
Lower-division writing course	3 -
Elective	- 1

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**Third Year****A S**

CHMY 485 (CHEM 485) Laboratory Safety	1 -
EDU 202 (C&I 200) Early Field Experience	- 1
EDU 221 (C&I 303) Educational Psychology and Measurement	- 3
EDU 370 (C&I 306) Integrating Technology into Education	- 3
EDU 345 (C&I 410) Exceptionality and Classroom Management	- 3
GEO 105N or 108N (GEOS 105N or 108N) Oceanography or Climate Change	3 -
PHSX 205N-206N & 207N-208N (PHYS 111N/113N-112N/114N) College Physics I, II & Labs	5 5
General Education	6 -

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**Fourth Year****A S**

BIOE 370-371 (BIOL 340-341) General Ecology and Laboratory	5 -
EDU 395 (C&I 301 or 302) Field Experience	1 -
EDU 407E (C&I 407E) Ethics and Policy Issues	3 -
EDU 497 (C&I 426) Methods: 5-12 Science	3 -
EDU 481 (C&I 427) Content Area Literacy	3 -
HHP 233 Health Issues of Children and Adolescents	- 3
Upper-division biology writing course	- 4
General Education	- 3
Electives	- 5

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**Fifth Year****A S**

EDU 495 (C&I 482) Student Teaching: Secondary	14 -
EDU 494 (C&I 494) Professional Portfolio	1 -

**Field Ecology Option (Track A, two summers)****First Year****A S**

BIOB 170N-171N (BIOL 108N-109N) Principles of Biological Diversity and Laboratory	5 -
CHMY 121N (CHEM 151N) Introduction to General Chemistry	3 -
M 162 (MATH 150) Applied Calculus	4 -
WRIT 101 (ENEX 101) College Writing I	3 -
Elective	1 1
BIOB 160N (BIOL 110N) Principles of Living Systems	- 4
CHMY 123N (CHEM 152N) Introduction to Organic and Biochemistry	- 3
CHMY 124N (CHEM 154N) Introduction to Organic and Biochemistry Lab	- 2
General Education Requirement	- 3
Lower Division Writing Requirement	- 3

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**Second Year****A S**

BIOB 260 (BIOL 221) Cell and Molecular Biology	4 -
STAT 451/457 (MATH 444/447) Statistical Methods I/Computer Analysis	4 -
General Education Requirement	3 -
Electives	5 -
BIOB 272 (BIOL 223) Genetics and Evolution	- 4
STAT 452/458 (MATH 445/448) Statistical Methods II/Computer Analysis	- 4
General Education Requirement	- 6
Elective	- 2

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**Summer (at Biological Station)**

BIOL 342 Field Ecology	5 -
Upper Division Electives	5 -

<b>Third Year</b>		<b>A S</b>
BIOL 484 Plant Evolution (or BIOE 404 (BIOL 405), BIOE 406 (BIOL 406), BIOB 480 (BIOL 480), BIOE 482 (BIOL 482), BIOL 483)		3
PHSX 205N/206N (PHYS 111N/113N) College Physics I & Lab		5 -
General Education Requirement		6 -
Electives		2 -
BIOO 320 (BIOL 316) General Botany (or BIOO 470 (BIOL 304), BIOO 475 (BIOL 306), BIOO 340 (BIOL 308), BIOO 335 (BIOL 350), BIOM 427-428 (BIOL 400-401), BIOO 462 (BIOL 410), BIOM 423 (BIOL 418), BIOM 360-361 (MICB 300/301)		- 5
PHSX 207N/208N (PHYS 112N/114N) College Physics II & Lab		- 5
Electives		- 7
		16 17
<b>Second Summer (at Biological Station)</b>		
BIOL 451 Landscape Ecology		3
BIOL 458 Ecology of Forests & Grasslands		3
BIOL 459 Alpine Ecology		3
BIOL 452 Conservation Ecology		3
BIOL 492 Seminars in Ecology & Resource Management		1
		13
<b>Field Ecology Option (Track B one summer)</b>		
<b>First Year</b>		<b>A S</b>
BIOB 170N-171N (BIOL 108N-109N) Principles of Biological Diversity and Laboratory		5 -
CHMY 141N (CHEM 161N) College Chemistry I		5 -
M 162 (MATH 150) Applied Calculus		4 -
Elective		1 -
BIOB 160N (BIOL 110N) Principles of Living Systems		- 4
CHMY 143N (CHEM 162N) College Chemistry II		- 5
WRIT 101 (ENEX 101) College Writing I		- 3
General Education Requirement		- 3
		15 15
<b>Second Year</b>		<b>A S</b>
BIOB 260 (BIOL 221) Cell and Molecular Biology		4 -
CHMY 221/222 (CHEM 221/223) Organic Chemistry I & Lab		5 -
STAT 216 (MATH 241) Introduction to Statistics		4 -
Lower Division Writing Requirement		- 3
BIOB 272 (BIOL 223) Genetics and Evolution		- 4
CHMY 223/224 (CHEM 222/224) Organic Chemistry II & Lab		- 5
General Education		- 3
		13 15
<b>Third Year</b>		<b>A S</b>
BIOE 370/371 (BIOL 340/341) General Ecology and Lab		5 -
PHSX 205N/206N (PHYS 111N/113N) College Physics I and Lab		5
General Education		3 -
PHSX 207N/208N (PHYS 112N/114N) College Physics II and Lab		- 5
General Education Requirements		- 6
Electives		- 1
		13 12
<b>Summer Semester at Flathead Lake Biological Station</b>		
BIOL 451 Landscape Ecology		3
BIOL 453 Lake Ecology		3
BIOL 454 Stream Ecology		3
BIOL 452 Conservation Ecology		3
BIOL 492 Seminar in Ecology & Res. Management		1
		13
<b>Fourth Year</b>		<b>A S</b>
BIOO 340 (BIOL 308) Biology and Management of Fishes (or BIOO 470 (BIOL 304), BIOO 475 (BIOL 306), BIOO 320 (BIOL 316), BIOO 335 (BIOL 350), BIOM 427-428 (BIOL 400-401), BIOO 462 (BIOL 410), BIOM 423 (BIOL 418), BIOM 360-361 (MICB 300/301)		4 -
Upper Division electives		8 -
BIOE 406 (BIOL 406) Behavior and Evolution (or BIOE 404 (BIOL 405), BIOB 480 (BIOL 480), BIOE 482 (BIOL 482), BIOL 483, BIOL 484)		- 4
Upper-division elective		- 5
General Education		- 3
		12 12
<b>Human Biological Sciences Option with One Year of Chemistry</b>		
<b>First Year</b>		<b>A S</b>
BIOB 170N-171N (BIOL 108N-109N) Principles Biological Diversity and Laboratory		5 -
BIOB 160N (BIOL 110N) Principles of Living Systems		- 4
CHMY 121N (CHEM 151N) Introduction to General Chemistry		3 -
CHMY 123N/124N (CHEM 152N/154N) Introduction to Organic and Biochemistry and Laboratory		- 5

WRIT 101 (ENEX 101) College Writing I	3 -
M 162 (MATH 150) Applied Calculus	4 -
PSYX 100S (PSYC 100S) Introduction to Psychology	- 4
Elective	1 1
	16 14

**Second Year**

BIOB 260 (BIOL 221) Cell and Molecular Biology	4 -
BIOB 272 (BIOL 223) Genetics and Evolution	- 4
PHSX 205N/206N-207N/208N (PHYS 111N/113N-112N/114N) College Physics I, II & Labs	5 5
General Education	- 3
STAT 216 (MATH 241) Introduction to Statistics	4 -
Lower-division writing course	3 -
Electives	- 3
	16 15

**Third Year**

BIOH 365, 370 (BIOL 312, 313) Human A&P I and II for Health Professions	4 4
BIOB 301 (BIOL 301) Developmental Biology	- 3
BIOM 400 (MICB 302) Medical Microbiology (or BIOM 360/361 (MICB 300/301) General Microbiology & Lab)	3 -
BCH 380 (BIOC 380) Biochemistry	4 -
General Education	3 3
Upper-division elective	- 4
Elective	- 1
	14 15

**Fourth Year**

BIOE 370 (BIOL 340) General Ecology	3 -
BIOE 403 (BIOL 403) Vertebrate Design & Evolution (or another upper-division course from list that meets the UD biology writing requirement)	5 -
BIOH 462 (BIOL 460) Principles of Medical Physiology (or another upper-division course from list that meets the UD biology writing requirement)	- 3
Upper Division Elective	- 6
General Education	3 3
Electives	4 3
	15 15

**Human Biological Sciences Option with Two Years of Chemistry****First Year**

BIOB 170N-171N (BIOL 108N-109N) Principles Biological Diversity and Laboratory	5 -
BIOB 160N (BIOL 110N) Principles of Living Systems	- 4
CHMY 141N-143N (CHEM 161N-162N) College Chemistry I, II	5 5
WRIT 101 (ENEX 101) College Writing I	- 3
M 162 (MATH 150) Applied Calculus	4 -
PSYX 100S (PSYC 100S) Introduction to Psychology	- 4
	14 16

**Second Year**

BIOB 260 (BIOL 221) Cell and Molecular Biology	4 -
BIOB 272 (BIOL 223) Genetics and Evolution	- 4
CHMY 221-222-223-224 (CHEM 221-222-223-224) Organic Chemistry I, II and Laboratories	5 5
BIOM 360-361 (MICB 300-301) General Microbiology and Laboratory (or BIOM 400 and 2 credits of upper division elective)	- 5
Lower-division writing course	3 -
STAT 216 (MATH 241) Introduction to Statistics	4 -
	16 14

**Third Year**

BIOH 365, 370 (BIOL 312, 313) Human A&P I and II for Health Professions	4 4
BIOB 301 (BIOL 301) Developmental Biology	- 3
PHSX 205N/206N-207N/208N (PHYS 111N/113N-112N/114N) College Physics I, II & Labs	5 5
Upper-division elective	3 3
General Education	3 -
	15 15

**Fourth Year**

BIOE 370 (BIOL 340) General Ecology	- 3
BIOB 425 (BIOL 464) Advanced Cellular and Molecular Biology (or another upper-division course from list that meets the UD biology writing requirement)	- 3
BCH 480-482 (BIOC 481-482) Advanced Biochemistry I, II	3 3
BIOB 410 (MICB 410) Immunology (or another upper-division course from list that meets the UD biology writing requirement)	3 -
General Education	6 6
UD Elective	2 -
Elective	1 -
	15 15

**Natural History Option**



<b>First Year</b>		<b>A</b>	<b>S</b>
BIOB 170N-171N (BIOL 108N-109N) Principles Biological Diversity and Laboratory	5	-	
BIOB 160N (BIOL 110N) Principles of Living Systems	-	4	
CHMY 121N (CHEM 151N) Introduction to General Chemistry	3	-	
CHMY 123N (CHEM 152N) Introduction to Organic and Biochemistry	-	3	
CHMY 124N (CHEM 154N) Introduction to Organic and Biochemistry Laboratory	-	2	
WRIT 101 (ENEX 101) College Writing I	3	-	
M 121 (MATH 111) College Algebra	3	-	
General Education	-	6	
Elective	1	-	
	15	15	
<b>Second Year</b>		<b>A</b>	<b>S</b>
BIOB 260 (BIOL 221) Cell and Molecular Biology	4	-	
BIBO 272 (BIOL 223) Genetics and Evolution	-	4	
BIOO 335 (BIOL 350) Rocky Mountain Flora	-	3	
GEO 101N-102N (GEOL 100N-101N) Introduction to Physical Geology and Laboratory	4	-	
Lower-division writing course	3	-	
General Education	-	3	
Modern/Classic Language I, II	5	5	
	16	15	
<b>Third Year</b>		<b>A</b>	<b>S</b>
BIOE 370 (BIOL 340) General Ecology	3	-	
BIOE 371 (BIOL 341) General Ecology Laboratory	2	-	
BIOO 320 (BIOL 316) General Botany	-	5	
Cognate course	3	4	
Upper-division cognate course	-	7	
General Education	6	-	
	14	16	
<b>Fourth Year</b>		<b>A</b>	<b>S</b>
BIOO 475 (BIOL 306) Mammalogy (or BIOO 470 (BIOL 304), BIOL 356)	4	-	
BIOE 406 (BIOL 406) Behavior and Evolution (or BIOE 404 (BIOL 405))	-	4	
BIOO 462 (BIOL 410) Entomology	-	4	
Cognate course	3	-	
Upper-division electives	3	4	
General Education	3	-	
Electives	1	3	
	14	15	

#### Requirements for a Minor

To earn a minor in biology, the student must complete a minimum of 25 credits in biology including BIOB 170N/171N (BIOL 108N-109N), BIOB 160N (BIOL 110N), BIOB 260 (BIOL 221) and BIOB 272 (BIOL 223) and 8 credits in Biology at the 300-400 level. All courses must be taken for a traditional letter grade.

#### Courses

U = for undergraduate credit only, UG = for undergraduate or graduate credit, G = for graduate credit. R after the credit indicates the course may be repeated for credit to the maximum indicated after the R. Credits beyond this maximum do not count toward a degree.

#### Biology (BIOL)

**U 130N Evolution and Society 3 cr.** Offered spring. A focus on relationships between evolutionary biology and important social issues, including the evolution of drug-resistant diseases, the construction and use of genetically-modified organism, human evolutionary biology, and experimental laboratory evolution.

**U 135N Biology of Yellowstone Hot Springs 3 cr.** Offered autumn alternate years. A field and laboratory based exploration of the microbial diversity of the thermal features of our first national park. Topics to be discussed include how these communities are shaped by the physical and chemical conditions of the environment and how microorganisms can thrive at life's extremes. Includes a field trip to Yellowstone National Park.

**U 265 Human Sexuality 3 cr.** Offered autumn. Same as ANTY 227 (ANTH 201). Biological, behavioral, cross-cultural aspects of human sexuality to help students place their own sexuality and that of others in a broader perspective. Includes sexual anatomy, physiology, development, reproduction, diseases, determination, as well as gender development and current

issues.

**U 315 Peer Advising 1 cr.** (R-6) Offered every term. Prereq., consent of instr. Supervised training and internship for peer advisors who will gain knowledge and ability to communicate degree requirements and relate the various degree offerings to professional and career goals. No more than two credits are allowed toward upper-division major requirements.

**U 342 Field Ecology 5 cr.** Offered summers only at Flathead Lake Biological Station. Prereq., BIOB 272 (BIOL 223) and one year of college math, including statistics. The principles and practices of the study of animals and plants in their natural environments, including human influences, with focus on the Crown of the Continent area of the Rock Mountains and taught entirely outdoors.

**U 343 Ecological Methods and Analysis 5 cr.** Offered summers only at Flathead Lake Biological Station. Prereq., BIOL 342 or BIOE 370/371 (BIOL 340/341). The methods and tools for conducting observational and experimental research in field ecology with emphasis on experimental design, hypothesis testing, data gathering and analysis and presentation of scientific research in ecology.

**U 356 Ecology of Birds 4 cr.** Offered summers only at Flathead Lake Biological Station. Prereq., BIOB 272 (BIOL 223) or equiv. Offered summers only at Flathead Lake Biological Station. The identification, natural history, and behavior of western Montana birds.

**UG 407 Global Biogeochemical Cycles 3 cr.** Offered spring odd numbered years. Same as NRSM 408 (FOR 408), GEO/CCS 407. Exploration of how variations in the availability or utilization of critical Earth elements influences the atmosphere, the oceans, and the terrestrial biosphere including the natural and agricultural ecosystems on which we depend.

**UG 415 Field Methods in Fisheries Biology and Management 1-4 cr.** Offered autumn. Prereq., BIOO 340 (BIOL 308); Consent of instr. Same as WBIO 441. Field instruction by practicing biologists in techniques for evaluating and managing aquatic habitats and fish populations.

**UG 435 Comparative Animal Physiology 3 cr.** Offered autumn. Prereq., BIOB 260 (BIOL 221) or equivalent. Animal physiology with emphasis on diversity of functional processes, with strong links to broader ecological and evolutionary contexts.

**UG 442 Ecology of Infectious Diseases 3 cr.** Offered autumn even-numbered years. Prereq., BIOB 272, BIOE 370 (BIOL 223, 340). Introduction to the field of disease ecology, focusing on diversity of parasites, parasite population biology and causes and consequences of host-parasite interactions.

**UG 449 Plant-Animal Interactions 4 cr.** Offered summers only at Flathead Lake Biological Station. Prereq., a college course in ecology. Concepts and techniques for understanding the interdependent relationships between plants and animals. Emphasis given to ecological and behavioral studies.

**UG 451 Landscape Ecology 3 cr.** Offered summers only at Flathead Lake Biological Station. Prereq., BIOL 342 or BIOE 370/371 (BIOL 340/341). Biophysical processes that determine landscape and ecosystem structure and function using remote sensing tools, geographic information systems and dynamic models to demonstrate landscape change.

**UG 452 Conservation Ecology 3 cr.** Offered summers only at Flathead Lake Biological Station. Prereq., BIOL 342 or BIOE 370/371 (BIOL 340/341). Concepts and approaches for sustaining biodiversity and other natural goods and services provided by terrestrial and aquatic systems.

**UG 453 Lake Ecology 3 cr.** Offered summers only at Flathead Lake Biological Station. Prereq., BIOL 342 or BIOE 370/371 (BIOL 340/341), CHMY 121N (CHEM 151N) and CHMY 123N (CHEM 152N). The physical, chemical and biological characteristics of lake ecosystems with an emphasis on nutrient cycling, food web interactions and water quality.

**UG 454 Stream Ecology 3 cr.** Offered summers only at Flathead Lake Biological Station. Prereq., BIOL 342 or BIOE 370/371 (BIOL 340/341), CHMY 121N (CHEM 151N). The biota and biogeochemical processes of running waters with unifying principles and contemporary research approaches.

**UG 458 Ecology of Forests and Grasslands 3 cr.** Offered summers only at Flathead Lake Biological Station. Prereq., BIOL 342 or BIOE 370/371 (BIOL 340/341). Patterns and processes of the forests and grasslands of the northern Rocky Mountains in the context of principles of population community and ecosystem ecology.

**UG 459 Alpine Ecology 3 cr.** Offered summers only at Flathead Lake Biological Station. Prereq., BIOL 342 or BIOE 370/371 (BIOL 340/341). Distribution, abundance and life cycles of plants and animals and their unique ecophysiological adaptations to life in the rigorous environments of the high mountains above the timberline, with emphasis on the Crown of the Continent area.

**U 483 Molecular Phylogenetics and Evolution 3 cr.** Alternating spring semesters. Phylogenies, or evolutionary trees, provide insights into the history of life on Earth, including our own origins. This course focuses on the theoretical foundations of popular methods of reconstructing phylogenies from molecular sequence data and how to implement these methods with computational software for real data sets. Other current methods for testing evolutionary hypotheses with sequence data will also be introduced. Same as MICB 483.

**UG 484 Plant Evolution 3 cr.** Offered fall, alternate years. Prereq., BIOB 272 (BIOL 223). Lecture, reading and discussion on the evolutionary processes that shape major patterns of plant diversity. Topics include but are not restricted to: local adaptation, floral and mating system evolution, polyploidy, genome evolution, and speciation.

**UG 492 Seminars in Ecology and Resource Management 1 cr.** Offered summers only at Flathead Lake Biological Station. Prereq., BIOL 342 or BIOE 370/371 (BIOL 340/341) or taken concurrently with BIOL 342. Seminar course that meets weekly for 2 hours in the evening. Includes seminar speaker and discussion.

#### **Biology-General (BIOB)**

**U 101N (BIOL 100N) Discover Biology 3 cr.** Offered every term. Contemporary exploration of the organization and complexity of living organisms and the systems in which they live. The central question of biology--relationship between form and function, acquisition and use of energy, and continuity between generations will be addressed through lectures and laboratory investigations. Credit not allowed toward a major in biology. Credit not allowed for both BIOB 101N and BIOB 160N (BIOL 100N and 110N).

**U 160N (BIOL 110N) Principles of Living Systems 4 cr.** Offered spring and summer. Unifying principles of biological structure-function relationships at different levels of organization and complexity. Consideration of reproduction, genetics, development, evolution, ecosystems, as well as the inter-relationships of the human species to the rest of life. Lab experiences illustrate biological principles underlying growth, reproduction, development, genetics and physiology. Credit not allowed for both BIOB 101N and 160N (BIOL 100N and 110N).

**U 170N (BIOL 108N) Principles of Biological Diversity 3 cr.** Offered autumn and summer. Survey of the diversity, evolution and ecology of life including prokaryotes, viruses, protista, fungi, plants and animals.

**U 171N (BIOL 109N) Principles of Biological Diversity Laboratory 2 cr.** Offered autumn and summer. Coreq., BIOB 170N (BIOL 108N). The diversity of life including prokaryotes, viruses, protista, fungi, plants and animals including structure and evolutionary relationships.

**U 191 (BIOL 195) Special Topics Variable Credit (R-6)** Offered intermittently. Experimental offerings of visiting professors, experimental offerings of new courses, or one-time offerings of current topics.

**U 198 (BIOL 198) Internship Variable Credit (R-6)** Offered intermittently. Prereq., consent of Division. Extended classroom experience that provides practical application of learning during placement off campus. Prior approval must be obtained from the faculty supervisor and the Internship Services office. A maximum of 6 credits of Internship (198, 298, 398, 498) may count toward graduation.

**U 240 (BIOL 240) Introduction to Biostatistics (Honors) 3 cr.** Offered autumn even-numbered years. Prereq., calculus and consent of instr. Same as WILD 240 (WBIO 240). Introduction to statistical ecology: distributions, hypothesis testing, and fitting models to data with emphasis on problems in ecological sampling.

- U 260 (BIOL 221) Cell and Molecular Biology 4 cr.** Offered autumn. Prereq., BIOB 160N (BIOL 110N) or equiv. and either CHMY 123N or 143N (CHEM 152N or 162N). Description and analysis of biological structures and processes at the cellular and subcellular levels including molecular genetics, energy, metabolism and cell differentiation.
- U 272 (BIOL 223) Genetics and Evolution 4 cr.** Offered spring. Prereq., BIOB 160N (BIOL 110N) and either BIOB 170N/171N or BIOB 260 (BIOL 108N/109N or BIOL 221); and either M 121, 122, 151, 162, or 171 (MATH 111, 112, 121, 150, or 152). Principles and mechanisms of inheritance and evolution. Population genetics, fossil record, macroevolution, speciation, extinction, systematics, molecular evolution.
- U 291 (BIOL 295) Special Topics Variable cr.** (R-6) Offered intermittently. Experimental offerings of visiting professors, experimental offerings of new courses, or one-time offerings of current topics.
- U 298 (BIOL 298) Internship Variable cr.** Offered intermittently. Prereq., consent of Division. Extended classroom experience that provides practical application of learning during placement off campus. Prior approval must be obtained from the faculty supervisor and the Internship Services office. A maximum of 6 credits of Internship (198, 298, 398, 498) may count toward graduation.
- U 301 Developmental Biology 3 cr.** Offered spring. Prereq., BIOB 260 (BIOL 221); BIOB 272 (BIOL 223) recommended. An analysis of the origin and development of form and patterns in organisms, stressing the processes of growth and differentiation in plants and animals. Graded traditional letter grade only.
- U 375 General Genetics 3 cr.** Offered spring. Prerequisites: BIOB 160N, 170N and 272 (BIOL 110N, 108N and 223). This course will focus on the molecular genetics of eukaryotes, with special emphasis on transmission genetics and gene structure and regulation.
- U 390 (BIOL 397) Research 1-10 cr.** (R-10) Offered every term. Prereq., consent of instr. Independent research under the direction of a faculty member. Graded credit/no credit.
- U 391 (BIOL 395) Special Topics Variable cr.** (R-10) Offered intermittently. Experimental offerings of visiting professors, experimental offerings of new courses, or one-time offerings of current topics.
- U 398 (BIOL 398) Internship 1-6 cr.** Offered intermittently. Prereq., consent of the Division. Extended classroom experience that provides practical application of learning during placement off campus. Prior approval must be obtained from the faculty supervisor and the Internship Services office. A maximum of 6 credits of Internship (198, 298, 398, 498) may count toward graduation.
- UG 410 Immunology 3 cr.** Offered autumn. Prereq., BIOM 360-361 (MICB 300-301). Modern concepts and methods in immunology.
- UG 411 Immunology Laboratory 2 cr.** Offered autumn. Coreq., BIOB 410 (MICB 410). Modern techniques for analysis of immune responses.
- UG 425 (BIOL 464) Advanced Cell and Molecular Biology 3 cr.** Offered spring. Prereq., BIOB 260 and 272 (BIOL 221 and 223); BCH 380 (BIOC 380) strongly recommended. Cell structure and function, cell cycle, cellular signaling, molecular basis of cancer, regulated cell death, membrane transport, organelle dynamics, cytoskeleton, cell adhesion, and the molecular basis of learning and memory.
- UG 440 (BIOL 440) Biological Electron Microscopy 2 cr.** Offered spring. Prereq., senior standing or consent of instr. Theory of electron microscopy, recent developments in transmission and scanning electron microscopy. Limited experience with the instruments.
- U 468 (BIOL 468) Endocrinology 3 cr.** Offered alternate years. Prereq., BIOB 260 and 272 (BIOL 221 and 223). Integration of fundamental concepts of endocrinology (such as hormone release, hormone transport and receptor activation) into complex systems (such as reproduction).

**UG 480 (BIOL 480) Conservation Genetics 3 cr.** Offered autumn. Prereq., BIOB 272 (BIOL 223). Genetic basis for solving biological problems in conservation including the genetics of small populations, the application of molecular genetic techniques to conservation biology and case studies of the application of genetics to conservation problems.

**UG 490 (BIOL 497) Advanced Undergraduate Research 1-10 cr.** (R-10) Offered every term. Prereq., junior or senior standing and consent of instr. Independent research under the direction of a faculty member. Graded credit/no credit.

**UG 491 (BIOL 495) Special Topics Variable cr.** (R-10) Offered intermittently. Prereq., consent of instr. Experimental offerings of visiting professors, experimental offerings of new courses, or one-time offerings of current topics.

**U 492 (BIOL 493) Independent Study 1-10 cr.** Offered intermittently. Prereq., consent of instr. Independent work under the University omnibus option. See index.

**UG 494 (BIOL 494) Seminar in Biology 1 cr.** (R-3) Offered intermittently. Prereq., consent of instr.

**U 498 (BIOL 498) Internship 1-6 cr.** Offered intermittently. Prereq., consent of the Division. Extended classroom experience that provides practical application of learning during placement off campus. Prior approval must be obtained from the faculty supervisor and the Internship Services office. A maximum of 6 credits of Internship (198, 298, 398, 498) may count toward graduation.

**U 499 (BIOL 499) Undergraduate Thesis 3-6 cr.** (R-6) Offered every term. Prereq., senior standing and consent of instr. Preparation of a thesis or manuscript based on undergraduate research for presentation and/or publication. Student must give oral or poster presentation at the Biological Sciences Undergraduate Research Symposium or a scientific meeting. Graded credit/no credit.

**G 501 (BIOL 501) Graduate Issues and Policies 1 cr.** Prereq., graduate standing in biological sciences. Discussion of issues of importance to new graduate students, including the philosophy of graduate education, the mentor-student relationship, the role of the teaching assistant, handling ethical quandaries, library resources and bibliographic searches, animal use policies and issues, proposal writing and the publication process. Review of ongoing research by faculty in the organismal biology and ecology program.

**G 510 (BIOL 510) Avian Ecology 3 cr.** (R-6) Offered intermittently. Prereq., graduate standing in EVST, BIOL, WBIO; upper-division course in ecology; or consent of instr. Review of recent developments in avian ecology with special emphasis on scientific methodology.

**G 513 (BIOL 513) Community Ecology 3 cr.** Offered alternate years. Prereq., BIOE 370 (BIOL 340) or equiv., consent of instr. Current concepts of species interactions, succession, food webs, temporal and spatial patterns and quantitative characterization of community structure.

**G 517 (BIOL 517) Advanced Plant Ecology 3 cr.** Prereq., upper-division course in ecology or consent of instr. Offered alternate years. Review and discussion of recent advances in plant ecology.

**G 518 (BIOL 518) Plant-Consumer Interactions 3 cr.** Offered alternate years. Prereq. BIOE 370 (BIOL 340) or equiv. Ecology and evolution of plant-consumer interactions. Review of classic and contemporary literature on plant-consumer interactions.

**G 519 (BIOL 519) Fire Ecology 3 cr.** Offered autumn even-numbered years. Prereq., graduate standing or consent of instr. Review of fundamental principles and recent advances in fire ecology with the primary focus on biological effects.

**G 522 (BIOL 522) Readings in Morphology, Physiology and Ecology 1 cr.** (R-8) Prereq., graduate standing and consent of instr. Review and discussion of current literature in the fields of morphology, physiology, and ecology.

**G 524 (BIOL 524) Physiological Plant Ecology 3 cr.** Offered alternate years. Prereq., BIOE 370 and BIOO 433 (BIOL 340 and 444). The physiological basis of plant adaptation and response to the environment.

**G 526 (BIOL 526) Current Trends in Plant Ecology 2 cr.** (R-16) Prereq., graduate standing. Current concepts, theory, and

experiments in plant ecology.

**G 530 (BIOL 530) Advanced Topics in Physiology 1-4 cr.** (R-8) Prereq., consent of instr. Offered alternate years. Topics vary but emphasize aspects of comparative or environmental physiology of animals and/or plants.

**G 541 (BIOL 541) Electron Microscopy Laboratory Variable cr.** (R-6) Prereq. or coreq., BIOB 440 (BIOL 440) or equiv. Practical laboratory experience in the preparation of various samples and hands-on operation of the transmission and/or scanning electron microscopes.

**G 547 Experimental Molecular, Cellular and Chemical Biology 1 cr.** (R-8) Offered every term. Prereq., graduate standing or consent of instr. Focus on experimental design, methods, and presentation of experimental results for graduate students in laboratories with a molecular, cellular or chemical biological focus.

**G 551 (BIOL 551) Environmental Field Study 1-3 cr.** (R-3) Prereq. or coreq., ENSC 540 or ENST 560 (EVST 540 or 560). Same as ENSC 551 (EVST 551). Designing, executing, and interpreting environmental studies. Project oriented.

**G 561 (BIOL 561) Population Genetics Seminar 1-2 cr.** (R-12) Prereq., consent of instr. or graduate standing. Current topics in population genetics, evolutionary biology, molecular evolution and related topics.

**G 565 Membrane Dynamics Research Seminar 1 cr.** (R-8) Offered every term. Prereq., graduate standing or consent of instr. Focus on experimental design, methods, and presentation of experimental results for students conducting research in membrane cell biology, including membrane trafficking and intracellular signaling.

**G 575 (BIOL 575) Frontiers in Conservation Research 2 cr.** (R-6) Same as WBIO 575. Exploration of current topics in conservation biology.

**G 594 (BIOL 594) Seminar in Biology 1 cr.** (R-6) Prereq., graduate standing or consent of instr. A review and discussion of current research in biology. Topics vary.

**G 595 (BIOL 595) Special Topics 1-8 cr.** (R-8) Prereq., graduate standing and consent of instr. Experimental offering of new courses by resident or visiting faculty.

**G 596 (BIOL 596) Independent Study 1-8 cr.** (R-8) Prereq., consent of instr. Credit for independent research project unrelated to thesis or dissertation.

**G 597 (BIOL 597) Research 1-8 cr.** (R-12) Prereq., consent of instr. Library work involved with preparation of a thesis or dissertation proposal.

**G 598 (BIOL 598) Internship 1-8 cr.** (R-8) Prereq., consent of the Division, graduate standing. Extended classroom experience that provides practical application of learning during placement off campus. Prior approval must be obtained from the faculty supervisor and the Internship Services office.

**G 599 (BIOL 599) Thesis 1-10 cr.** (R-10) Prereq., masters student in biology. Field and laboratory research on, and writing of, a student's master's thesis.

**G 699 (BIOL 699) Dissertation 1-10 cr.** (R-20) Prereq., doctoral student in biology. Credit for field and laboratory research on, and writing of, a student's doctoral dissertation.

### **Biology-Ecology (BIOE)**

**U 172N (BIOL 121N) Introductory Ecology 3 cr.** Offered autumn. An introduction to ecological principles, stressing the structure and function of natural communities and examining human's role in these ecosystems.

**U 370 (BIOL 340) General Ecology 3 cr.** Offered autumn and spring. Prereq., BIOB 272 (BIOL 223). Analysis of the distribution and abundance of plants and animals. Includes individual, population and community-level processes (e.g., population growth and regulation, competition, predation, succession, nutrient cycling, energy flow and community organization).

**U 371 (BIOL 341) General Ecology Laboratory 2 cr.** Offered autumn and spring. Prereq. or Coreq., BIOE 370 (BIOL 340) and either STAT 216 (MATH 241) or WILD 240 (WBIO 240). Methods of describing and testing alternative explanations for patterns in nature. The use of scientific methodology in ecology.

**U 394 (BIOL 339) Seminar/Workshop 2 cr.** Offered autumn. Preparatory readings and attendance at seminars on a wide variety of ecological and wildlife management topics followed by critiques.

**UG 403 (BIOL 403 ) Vertebrate Design and Evolution 5 cr.** Offered autumn. Prereq., BIOB 170N, 171N and 272 (BIOL 108N, 109N and 223) and PHSX 205N/206N or 215N/216N (PHYS 111N/113N or 211N/213N). Evolutionary patterns of animal morphology and the importance of body size on life history patterns. Phylogenetic study of major extant and extinct vertebrate groups. Laboratory includes systematic study of organ systems and workshops in experimental functional morphology.

**UG 404 (BIOL 405) Animal Behavior 3 cr.** Offered intermittently. Prereq., BIOB 272 (BIOL 223), senior standing or consent of instr. The description and evolutionary interpretation of animal behavior under natural conditions. Laboratory involves observation and recording of animal behavior.

**UG 406 (BIOL 406) Behavior and Evolution 4 cr.** Offered spring. Prereq., BIOB 272 (BIOL 223). Diversity of animal behavior in an evolutionary context including inheritance of behavior, diets, avoidance responses, mating systems and sexual selection, parental care, and evolution of animal groups and societies. Discussion sections examine both landmark and recent literature.

**UG 428 (BIOL 366) Freshwater Ecology 5 cr.** Offered autumn. Prereq., BIOB 160N (BIOL 110N) and either CHMY 123N or 143N (CHEM 152N or 162N). Physical and chemical dynamics of lakes and streams. Diversity, distribution and dynamics of freshwater organisms.

**UG 447 (BIOL 447) Terrestrial Ecosystem Ecology 3 cr.** Offered alternate years. Prereq., BIOB 160N (BIOL 110N) and any ecology-themed course or consent of instr. Introduction to systems thinking and the ecosystem concept, review of water and energy balance, carbon cycling and production processes, nutrient cycling, trophic dynamics, and species effects on ecosystem functioning.

**UG 448 Terrestrial Plant Ecology 4 cr.** Offered autumn. Prereq., an introductory college course in ecology. The interrelationships between plants and plant communities and their natural environment.

**UG 449 (BIOL 430) Plant Biogeography 3 cr.** Prereq., consent of instr. Offered alternate years. Description of the distribution of plants and animals at global, continental and regional scales. Analysis of ecological and historical factors influencing distribution and association.

**UG 482 (BIOL 482) Evolution and Development 3 cr.** Offered spring, alternate years. Prereq., BIOB 170N and 272 (BIOL 108N and 223). Lecture, reading and discussion of questions at the intersection of developmental and evolutionary biology. Questions include but are not restricted to: how novel traits arise; how diversity in animal form is generated; and how phenotypic plasticity (environment-sensitive expression of traits) is produced.

### **Biology-Human (BIOH)**

**U 112 (BIOL 112) Introduction to Human Form and Function I 3 cr.** Offered autumn. Explores the fundamentals of structure and function at basic cellular and tissue levels, in addition to the anatomy and physiology of the integumentary, musculoskeletal, and nervous systems.

**U 113 (BIOL 113) Introduction to Human Form and Function II 3 cr.** Offered spring. Explores the fundamental structures and functions of the endocrine, cardiovascular, respiratory, digestive, urinary and reproductive systems.

**U 291 Special Topics 1-6 cr.** (R-6) Offered intermittently. Experimental offerings of visiting professors, experimental offerings of new courses, or one-time offerings of current topics.

**U 330 (CSD 330) Anatomy and Physiology of the Speech and Hearing Mechanisms 3 cr.** Offered autumn. Prereq., LNG 240 (CSD 210). Introduction to anatomy and physiology of the speech and hearing mechanisms including the anatomical orientation and embryological development, the breathing mechanism, structures of phonation, articulators, audition and the nervous system.

**U 360 (BIOL 347) Introduction to Neuroscience 3 cr.** Offered autumn. Prereq., introductory chemistry and biology. Same as BMED 347. The molecular and cellular physiology of the human nervous system. Topics range from the basis of electrical and chemical signaling in neurons to the organization of the nervous system and its functions in generating behavior.

**U 365 (BIOL 312) Human A&P I for Health Professions 4 cr.** Offered autumn. Prereq., CHMY 121N (CHEM 151N) or CHMY 141N (CHEM 161N); BIOB 160N (BIOL 110N) or BIOH 112 or 113 (BIOL 112 or 113). Introduction to basic cellular structure and function. The fundamental facts and concepts of the anatomy and physiology of the integumentary, musculoskeletal, nervous and endocrine systems.

**U 370 (BIOL 313) Human A&P II for Health Professions 4 cr.** Offered spring. Prereq., BIOH 365 (BIOL 312). The fundamental facts and concepts of the anatomy and physiology of the endocrine, circulatory, respiratory, digestive, urinary and reproductive systems.

**U 405 (BIOL 309) Hematology 3 cr.** Offered autumn. Prereq., junior level or consent of instr., BIOM 360 (MICB 300). Study of blood and diseases of the circulatory system. Blood banking and serology.

**UG 462 (BIOL 460) Principles of Medical Physiology 3 cr.** Offered spring. Prereq., C (2.00) or better in BIOH 365, 370 (BIOL 312, 313), and either CHMY 123N or 143N (CHEM 152 or 162), ~~one-year college chemistry~~ or consent of instr. An advanced course in human physiology for students preparing for careers in health care.

**U 480 (BIOL 471) Teaching Anatomy and Physiology I 3 or 4 cr.** Offered autumn. Prereq., "A" or "B" in BIOH 365 and 370 (BIOL 312 and 313) or equiv. and consent of instr. This select group of students performs cadaver prosections; assists in preparation and grading of demonstrations and laboratory teaching materials; and provides laboratory anatomy and physiology instruction to undergraduate students enrolled in BIOH 365 (BIOL 312). Students enrolling for the 4 credit option will also provide occasional comparable assistance for BIOH 112 (BIOL 112).

**U 481 (BIOL 472) Teaching Anatomy and Physiology II 3 or 4 cr.** Offered spring. Prereq., "A" or "B" in BIOH 365 and 370 (BIOL 312 and 313) or equiv. and consent of instr. This select group of students performs cadaver prosections; assists in the preparation and grading of demonstrations and laboratory teaching materials; and provides laboratory anatomy and physiology instruction to undergraduate students enrolled in BIOH 370 (BIOL 313). Students enrolling for the 4 credit option will also provide occasional comparable assistance for BIOH 113 (BIOL 113).

**U 483 Instruction of A&P I & II 1 - 4 cr.** (R-4). Offered autumn and spring. Prereq. "A" or "B" in BIOH 112 and 113 (BIOL 112 and 113) or upper division anatomy and physiology coursework with cadaver lab and consent of instr. This select group of students teaches regularly scheduled cadaver lab prosection experiences for students enrolled in BIOH 112/BIOH 113 (BIOL 112/113); assists in preparation and grading of lecture and laboratory visit teaching materials; and assists with proctoring exams of undergraduate students enrolled in BIOH 112/BIOH 113 (BIOL 112/113).

**U 485 Human Anat/Phys Tutor/Honors 3 – 4 cr.** (R-4) Offered autumn and spring. Prereq. "A" or "B" in BIOH 365 and 370 (BIOL 312 and 313) or equiv. and consent of instr. This select group of students performs tutoring for students enrolled in BIOH365/BIOH370, cadaver dissection preparation (optional); assists in preparation and grading of lecture and laboratory course teaching materials to undergraduate students enrolled in BIOH 365/BIOH 370 (BIOL 312/313). Students enrolling for the 4 credit option will also provide occasional comparable assistance for BIOH 112 (BIOL 112).

### **Biology-Organismal (BIOO)**

**U 101N (BIOL 201N) Survey of Montana Wildlife & Habitats 3 cr.** Offered autumn. Prereq., one course in biology. Interpreting biological patterns associated with selected Montana wildlife species, including mammals, birds, reptiles and amphibians.



**U 105N (BIOL 120N) Introduction to Botany 3 cr.** Offered spring. ~~Prereq., consent of instr.~~ Introduction to the plant kingdom including anatomy, physiology and ecology.

**U 320 (BIOL 316) General Botany 5 cr.** Offered spring. Prereq., BIOB 170N-171N, 260 (BIOL 108N-109N, 221). Prereq. or coreq., BIOB 272 (BIOL 223). Anatomy, morphology, ecology and physiology of photosynthetic organisms.

**U 335 (BIOL 350) Rocky Mountain Flora 3 cr.** Offered spring and summer. Prereq., one college-level course in Biology or consent of instr. Elements of the evolution, geography and natural affinities of flowering plants. Identification using a manual of native plants of Montana.

**U 340 (BIOL 308) Biology and Management of Fishes 4 cr.** Offered autumn. Prereq., BIOB 272 (BIOL 223) and either STAT 216 (MATH 241) or WILD 240 (WBIO 240). Diversity, adaptations and ecology of fishes. Analysis and management of fish populations and communities.

**UG 409 (BIOL 408) Advanced Fisheries Science 2 cr.** Offered spring. Prereq., BIOO 340 (BIOL 308). Quantitative analysis and interpretation of fish population and community data for use in management. Selection, application and evaluation of management techniques.

**UG 433 (BIOL 444) Plant Physiology 3 cr.** Offered spring. Prereq., BIOB 170N-171N or BIOO 105N or BIOO 320 (BIOL 108N-109N, 120N or 316). The chemical and physical basis of water relations, photosynthesis, mineral nutrition, respiration, vegetative and reproductive growth of plants.

**UG 434 (BIOL 445) Plant Physiology Lab 1 cr.** Offered spring. Prereq or coreq., BIOO 433 (BIOL 444). Laboratory exercises designed to familiarize students with concepts and techniques in plant physiology.

**UG 462 (BIOL 410) Entomology 4 cr.** Offered alternate springs. Prereq. or Coreq., BIOB 272 (BIOL 223). The classification, morphology, anatomy, development, life-history, behavior and ecology of insects. Labs include identification of major insect groups, internal and external anatomy and student collections.

**UG 470 (BIOL 304) Ornithology 4 cr.** Offered spring. Prereq. or Coreq., BIOB 272 (BIOL 223). The classification, structure, evolution, behavior and ecology of birds.

**UG 475 (BIOL 306) Mammalogy 4 cr.** Offered autumn. Prereq., BIOB 272 (BIOL 223). The evolution, systematics, anatomy, physiology and ecology of mammals.

**UG 486 (BIOL 486) Field Techniques in Mammalogy 2 cr.** Offered autumn. Prereq., BIOO 475 (BIOL 306) or equiv. and consent of instr. A "hands-on" approach to lab and field techniques employed for the study of mammals. Includes mark/recapture live trapping methods, remote cameras, and tracking plates of non-invasive censusing.

### **Biology - Systems Ecology (BIOS)**

**G 532 Fundamentals of Ecosystem Ecology 3 cr.** Offered autumn every other year. Prereq. CHMY 141N (CHEM 161N) or the equivalent. Coreq. CHMY 143N (CHEM 162N) and BCH 111 (BIOC 111). This course includes the fundamentals of an ecosystem approach to ecological research by emphasizing relationships among physical, chemical, and biotic elements of interactive systems. It will provide a fundamental basis for more advanced Systems Ecology courses (e.g., Limnology, Integrated Systems Ecology, Landscape Genetics, etc.).

**G 534 Integrated Systems Ecology 3 cr.** Offered spring semester alternate years. Principles, theories and empirical studies that describe the complex attributes and processes of coupled natural and human systems. Landscape, climate, economic and social change dynamics and processes emphasized. Flagship course of the UM-DBS Systems Ecology Program. Students strongly advised but not required to take BIOS 532 Fundamentals of Ecosystem Ecology prior to this course.

### **Biological Station**

Jack A. Stanford (Bierman Professor of Ecology), Director

The University of Montana-Missoula operates its Flathead Lake Biological Station as a year-round research facility and academic center in ecological sciences. The Station is located on 80 acres at Yellow Bay on Flathead Lake, some 85 miles north of Missoula near Kalispell and Glacier National Park. Up to 110 students can room in cabins and the G. W. Prescott dorm/apartment facility; board is provided by the station's commissary. Several large academic and office structures complement the state-of-the-art Freshwater Research Laboratory at this field campus.

During the annual 8-week summer session, formal courses are offered which emphasize field investigations of the rich flora and fauna of the diverse aquatic and terrestrial habitats found at or near the Station. Faculty from UM and other universities throughout the United States and Canada teach the field-oriented courses of the summer program. The formal courses each carry three to five semester credits for either advanced undergraduate or graduate academic programs.

A Bachelor of Arts in Biology with an Option in Field Ecology is available through the Division of Biological Sciences which requires summer courses offered at the Flathead Lake Biological Station. This Field Ecology Option requires students to take advantage of at least one summer of courses at the Biological station, while allowing additional summers of coursework to apply to degree requirements as well. The required coursework includes Landscape Ecology, Conservation Ecology and either the Aquatic Emphasis (Stream ecology, Lake Ecology) or the terrestrial Emphasis (Ecology of Forests and Grasslands, Alpine Ecology). Students may complete BIOE 370/371 (BIOL 340/341) General Ecology and Lab on the UM campus or take BIOL 342 Field Ecology at the Biological Station. Students who plan their academic years and summer programs carefully and who enroll for two summer sessions at the Biological Station may be able to complete degree requirements in three years.

Biological Station courses can also substitute for major program requirements in the Division of Biological Sciences and Wildlife Biology. Credits are transferable to most universities in the United States and Canada. Students must have completed introductory courses in biology, ecology and chemistry before enrolling in courses of the program.

Biological Station courses are offered for two or four-weeks during the eight-week session.

- BIOL 342 Field Ecology
- BIOL 343 Ecological Methods & Analysis
- BIOL 451 Landscape Ecology
- BIOL 452 Conservation Ecology
- BIOL 453 Lake Ecology
- BIOL 454 Stream Ecology
- BIOL 458 Ecology of Forests and Grasslands
- BIOL 459 Alpine Ecology
- BIOL 492 Seminar in Ecology and Resource Management
- BIOB 490 (BIOL 497) Advanced Undergraduate Research
- BIOB 499 (BIOL 499) Undergraduate (Senior) Thesis in Field Ecology
- BIOB 596 (BIOL 596) Independent Study

In addition to these summer courses, the Biological Station offers opportunities for graduate studies in aquatic biology and ecology. After formal admission to a graduate degree-granting program, research programs leading to M.S. or Ph.D. degrees can be designed by the student, academic departments at the University and the faculty of the Station. Research assistantships are often available for students working on advanced degrees at FLBS. Numerous scholarships are also available annually for students enrolled at UM/FLBS.

#### **Enrollment Procedures**

Students interested in participating in the annual summer academic program must apply by mid-May. Application forms are available from the Biological Station website ([www.umt.edu/flbs](http://www.umt.edu/flbs)) or may be obtained in the Division of Biological Sciences office at UM.

Students interested in pursuing graduate work at FLBS should apply in writing to Graduate Admissions, Division of Biological Sciences, The University of Montana-Missoula, 32 Campus Drive #4824, Missoula, MT 59812-4824, or contact the Director.

For detailed information about academic and research opportunities at the Flathead Lake Biological Station, please visit the station web page ([www.umt.edu/flbs](http://www.umt.edu/flbs)) or contact:

Flathead Lake Biological Station  
 The University of Montana  
 32125 Bio Station Lane  
 Polson, MT 59860-6815  
 Phone: (406) 982-3301  
 Fax: (406) 982-3201  
 E-Mail: [flbs@flbs.umt.edu](mailto:flbs@flbs.umt.edu)  
 Web Page: [www.umt.edu/flbs/](http://www.umt.edu/flbs/)

## **Division of Biological Sciences**

**Charles H. Janson, Associate Dean for the Biological Sciences**

The Division of Biological Sciences offers undergraduate and graduate programs representing the full range of the biological sciences. The Division offers bachelor degrees in Biology (with a broad array of formal options including cellular and molecular biology, ecology and organismal biology, field ecology, human biological sciences, natural history, teacher preparation in biology, and teacher preparation in general science), Medical Technology, Microbiology including microbial ecology, and Wildlife Biology (a cooperative program administered by the College of Forestry and Conservation) and Biochemistry (an interdepartmental degree administered by the Chemistry Department). The Division also advises students in pre-health sciences and offers a series of courses during the summer at the University's Flathead Lake Biological Station (see separate listing in this section). The Division is one of the leading research units in the University. Research programs in the Division provide abundant opportunities for students to enhance their educational experience by participating in mentored research. Several sources of funding are available to support undergraduate student research, and the Division participates in the University of Montana Conference on Undergraduate Research each spring.

Graduate degrees offered by the Division of Biological Sciences include Master of Science degrees in Biochemistry, Microbiology, Organismal Biology and Ecology, and Systems Ecology. Doctor of Philosophy degrees are offered in Integrative Microbiology and Biochemistry, in Organismal Biology and Ecology, and in Systems Ecology. The Division participates in the graduate (M.S. and Ph.D.) program in Wildlife Biology, administered by the College of Forestry and Conservation and in the Ph.D. program in Biochemistry, administered by the Chemistry Department. Information on graduate study and program requirements is available from the Graduate School or the Division of Biological Sciences.

The Division of Biological Sciences is committed to providing coursework and experiences for non-science majors. The world faces many problems and opportunities that include significant biological components. Courses for non-science majors have the goal of fostering understanding of the process of science and enhancing biological knowledge as it relates to environmental, medical, social, and other issues. A number of introductory courses are open both to majors and non-majors. In addition, the Division offers courses designed specifically for non-majors: Microbiology for Health Sciences, Introductory Ecology, Survey of Montana wildlife and Habitats, and others.

Degree requirements and courses are described below (see the College of Forestry and Conservation for information about Wildlife Biology).

### **Faculty**

#### **Professors**

Fred W. Allendorf, Ph.D., University of Washington, 1975

Joel Berger, Ph.D., University of Colorado, Boulder, 1978 (John J. Craighead Endowed Chair)

Ragan M. Callaway, Ph.D. University of California at Santa Barbara, 1990

Kenneth P. Dial, Ph.D., Northern Arizona University, 1984

Douglas Emlen, Ph.D., Princeton University, 1994

Kerry R. Foresman, Ph. D., University of Idaho, 1977

James E. Gannon, Ph.D., University of Houston, 1981

Willard O. Granath, Ph.D., Wake Forest University, 1982

Erick P. Greene, Ph.D., Princeton University, 1989

F. Richard Hauer, Ph.D., North Texas State University, 1980

Walter E. Hill, Ph.D., University of Wisconsin, 1967

William E. Holben, Ph.D., University of New York, Buffalo, 1985

Richard L. Hutto, Ph.D., University of California at Los Angeles, 1977 (Director, Avian Science Center)

Charles H. Janson, Ph.D., University of Washington, 1985 (Associate Dean, DBS)

Ralph C. Judd, Ph.D., The University of Montana, 1979

J. Stephen Lodmell, Ph.D., Brown University, 1996

John L. Maron, Ph.D., University of California-Davis, 1996

Michael F. Minnick, Ph.D., Washington State University, 1987

Jack H. Nunberg, Ph.D., Stanford University, 1979 (Director for the Montana Biotechnology Center)

Frank Rosenzweig, Ph.D., University of Pennsylvania, 1991

Anna Sala, Ph.D., University of Barcelona, 1992

D. Scott Samuels, Ph.D., University of Arizona, 1991

Stephen Sprang, Ph.D., University of Wisconsin, Madison, 1977 (Director, Center for Biomolecular Structure and Dynamics)

Jack A. Stanford, Ph.D., University of Utah, 1975 (Bierman Professor; Director of the Biological Station)

H. Maurice Valett, Ph.D., Arizona State University, Tempe, 1991

#### **Associate Professors**

Creagh W. Breuner, Ph.D., University of Washington, 1998

Lila Fishman, Ph.D., Princeton University, 1998

Mark L. Grimes, Ph.D., University of Oregon, 1986

Jesse C. Hay, Ph.D., University of Wisconsin, Madison, 1994

Winsor H. Lowe, Ph.D., Dartmouth College, 2002

Gordon Luikart, Ph.D., The University of Montana, 1997

Michele A. McGuirl, Ph.D., Montana State University, 1999

Scott Miller, Ph.D., University of Oregon, 1999

Bret W. Tobalske, Ph.D., The University of Montana, 1994 (Director of the Field Station at Fort Missoula)

H. Arthur Woods, Ph.D., University of Washington, 1998

#### **Assistant Professors**

Sarah J. Certel, Ph.D., The University of Iowa, 1999

Jeffrey Good, Ph.D., University of Arizona, 2007

John P. McCutcheon, Ph.D., Washington University, 2006

Brent J. Ryckman, Ph.D., The University of Iowa, 2003

Ekaterina Voronina, Ph.D., Brown University, 2003

Scott A. Wetzel, Ph.D., Oregon Health and Science University, 2001

#### **Lecturers**

Heather Davis Labbe, M.S., The University of Montana, 2005

Laurie A. Minns, Ph.D., Dartmouth College, 2005

Kevin J. Murray, Ph.D., University of Nevada-Reno, 1994

#### **Research Faculty**

Jerry J. Bromenshenk, Ph.D., Montana State University, 1973

Dan Drecktrah, Ph.D., Cornell University, 1999

Bonnie Ellis, Ph.D., The University of Montana, 2006

John Kimball, Ph.D., Oregon State University, 1995

Evgueny Kroll, Ph.D., Hopkins School of Medicine, USA

Penny Kukuk, Ph.D., University of Kansas, 1980

Jean-Marc Lanchy, Ph.D., University; Louis Pasteur, StrasBourg, France

Tung-Chung Mou, Ph.D., The University of Texas at Dallas, 2001

Celestine Thomas, Ph.D., Indian Institute of Science, Bangalore, India, 2001

#### **Associated Faculty**

Thomas E. Martin, Ph.D., University of Illinois, 1982

L. Scott Mills, Ph.D., University of California, Santa, Cruz, 1993

## **Medical Technology**

### **Michael Minnick (Professor of Microbiology), Advisor**

Medical Technology or clinical laboratory sciences is a combined study of chemistry, physiology and microbiology (see <http://www.umt.edu/medtech/>). A medical technologist performs chemical, microscopic, and microbiological procedures used in the diagnosis, study and treatment of disease, under the supervision of a qualified physician or lab director. Medical technologists are in high demand in hospital labs, clinical labs, research institutions and government health departments. Although certification is required for clinical practice, individuals with a B.S. degree in Medical Technology are qualified microbiologists and can obtain positions in research labs as technicians. The degree is also

an excellent foundation for students planning to attend professional schools in the health sciences or graduate school in the molecular biosciences.

Four years are required to earn a B. S. degree in Medical Technology. The curriculum is devoted to development of a sound foundation in chemistry, biology, microbiology and clinical methods. The student is also encouraged to obtain an understanding of social science and cultural subjects.

To be certified by the Board of Registry, a student, after satisfying the minimum course requirements, serves a clinical internship of at least 12 consecutive months in an approved school of medical technology endorsed by the National Accrediting Agency for Clinical Laboratory Sciences (NAACLS) or American Society of Clinical Pathology (ASCP) of the American Medical Association. After completing a clinical internship and passing the Registry exam, the student receives a diploma from the Board of Registry with the professional designation of Medical Technologist M.T. ASCP.

The University of Montana has two coursework options for the medical technology degree:

**Option A** is a 4+1 curriculum in which the student completes the B.S. degree and subsequently does a one-year clinical internship if desired. Students who choose the 4+1 curriculum may do a clinical internship by applying in the fall of their senior year. Details and application forms can be obtained online at the following: <http://www.umt.edu/Medtech/>. Internship applications are typically due in the fall for enrollment the following summer.

**Option B** is a 3+1 curriculum designed to fast-track students who definitely want to become medical technologists. The first three years are completed at UM. The fourth year is applied and incorporates both classroom learning and a clinical internship at one of our affiliates (e.g. the Montana Medical Laboratory Science Training Program) in cooperation with several clinical sites located in Montana and the Midwest. Internship information is available online at <http://www.umt.edu/medtech/>. The B.S. degree and certification are granted after successful completion of the fourth year.

**High School Preparation:** In addition to the general University requirements for admission, it is recommended that high school preparation include algebra, geometry, trigonometry, chemistry, and a foreign language.

#### Special Degree Requirements

Refer to graduation requirements listed previously in the catalog. See index.

In addition to the General Education requirements, the following courses are required for either option leading to a Bachelor of Science in Medical Technology: Thirty or more credits (300-level or above) in biology, biochemistry and microbiology including BIOM 360-361 (MICB 300-301), BIOH 405 (MICB 309), BIOB 410 (MICB 410), BIOM 402-403 (MICB 412-413), BIOM 435 (MICB 420), BCH 380 (BIOC 380); BIOB 260, 272 (BIOL 221, 223), BIOH 365 (BIOL 312), BIOM 427-428 (BIOL 400-401); CHMY 141N, 143N, 221-222 (CHEM 161N-162N, 221-223) and M 162 or 171 (MATH 150 or 152) and STAT 216 (MATH 241). The 4+1 option also requires CHMY 223-224, 311 (CHEM 222-224,341); BIOM 407-408 (MICB 406-407); and BIOB 411 (MICB 411); and PHSX 205N/206N, 207N/208N (PHYS 111N/113N, 112N/114N). The 3+1 option also requires 37 credits of BIOM 498 (MICB 490) (Med Tech Internship).

**Upper-Division Writing Expectation:** To meet the Upper-Division Writing Expectation for the major, medical technology 4+1 students take BIOB 410 (MICB 410) and BIOB 411 (MICB 411); 3+1 students take BIOB 410 (MICB 410), BIOM 402 (MICB 412), and one class chosen from: BCH 482 (BIOC 482), BIOB 411 (MICB 411), or BIOM 499 (MICB 499).

#### Suggested Course of Study

##### Option A (4+1)

	First Year	A	S
CHMY 141N,143N (CHEM 161N-162N)	College Chemistry I, II	5	5
+M 162 (MATH 150)	Applied Calculus	4	-
+WRIT 101 (ENEX 101)	College Writing I	3	-
BIOB 160N	Principles of Living Systems (prerequisite for BIOB 260)	-	4
General Education		3	6
Total		15	15
+Depends on placement exam			

<b>Second Year</b>		<b>A S</b>
BIOB 260 (BIOL 221) Cell and Molecular Biology		4 -
BIOB 272 (BIOL 223) Genetics and Evolution		- 4
CHMY 221-222, 223-224 (CHEM 221-222, 223-224) Organic Chemistry I, II and Laboratories		5 5
BIOM 360-361 (MICB 300-301) General Microbiology and Laboratory		- 5
Lower-Division Writing Course		3 -
General Education		3 -
Elective		- 1
Total		15 15
<b>Third Year</b>		<b>A S</b>
BIOH 365 (BIOL 312) Human A&P I for Health Professions		4 -
BCH 380 (BIOC 380) Biochemistry		4 -
BIOB 410-411 (MICB 410-411) Immunology and Laboratory		5 -
BIOM 402-403 (MICB 412-413) Medical Bacteriology and Mycology and Laboratory		- 5
General Education		- 6
STAT 216 Intro to Statistics		- 4
Electives		2 -
Total		15 15
<b>Fourth Year</b>		<b>A S</b>
CHMY 311 (CHEM 341) Analytical Chemistry-Quantitative Analysis		4 -
BIOM 427-428 (BIOL 400-401) General Parasitology and Lab		4 -
BIOH 405 (MICB 309) Hematology		3 -
BIOM 407-408 (MICB 406-407) Clinical Diagnosis and Laboratory		- 3
BIOM 435 (MICB 420) Virology		- 3
PHSX 205N-206N, 207N-208N (PHYS 111N-113N, 112N-114N) Fundamentals of Physics I, II and Labs		5 5
Elective		- 3
Total		16 14

### Suggested Course of Study

#### Option B (3+1)

<b>First Year</b>		<b>A S</b>
CHMY 141N-143N (CHEM 161N-162N) College Chemistry I, II		5 5
+WRIT 101 (ENEX 101) College Writing I		3 -
+M 162 (MATH 150) Applied Calculus		4 -
BIOB 160N Principles of Living Systems (prerequisite for BIOB 260)		- 4
General Education		3 9
Electives		- 1
Total		15 16
+Depends on placement exam		
<b>Second Year</b>		<b>A S</b>
BIOB 260 (BIOL 221) Cell and Molecular Biology		4 -
BIOB 272 (BIOL 223) Genetics and Evolution		- 4
BIOH 365 (BIOL 312) Human A&P I for Health Professions		4 -
CHMY 221-222 (CHEM 221-223) Organic Chemistry I and Laboratory		5 -
BIOM 360-361 (MICB 300-301) General Microbiology and Laboratory		- 5
Lower-Division Writing Course		- 3
General Education		3 3
Total		16 15
<b>Third Year</b>		<b>A S</b>
BCH 380 (BIOC 380) Biochemistry		- 4
BIOM 427-428 (BIOL 400-401) General Parasitology and Lab		4 -
BIOH 405 (MICB 309) Hematology		3 -
BIOB 410-411 (MICB 410-411) Immunology and Laboratory		5 -
BIOM 402-403 (MICB 412-413) Medical Bacteriology & Mycology and Laboratory		- 5
BIOM 435 (MICB 420) Virology		- 3
STAT 216 Intro to Statistics		4 -
General Education		3 3
Total		16 15
<b>Fourth Year - Summer</b>		<b>Su -</b>
BIOM 498 (MICB 490) Medical Technology Internship		12 -
<b>Fourth Year</b>		<b>A S</b>
BIOM 498 (MICB 490) Medical Technology Internship		13 12

### Microbiology

- Special Degree Requirements

## ◦ Suggested Course of Study

### ◦ Courses

Microbiology is the study of microorganisms, including the bacteria, yeasts, molds, viruses, protozoa and other microscopic parasites. A B.S. in Microbiology is offered as a general degree or with an option in microbial ecology. The microbiology general option emphasizes microbial structure, function, and interactions and relationships with humans. The microbial ecology option emphasizes microbial structure, function, and interactions and relationships with the environment and other organisms including plants and animals.

Initial work provides the student with a working knowledge of the basic principles of the physical and biological sciences and mathematics. The remaining study is devoted to a more intense and broadened training in microbiology and allied fields, and may include independent study which offers the student an opportunity to prepare for graduate work.

### Special Degree Requirements

Refer to the graduation requirements listed previously in the catalog. See index.

In accordance with American Society for Microbiology recommendations, the following courses must be completed in addition to the General Education requirements for the Bachelor of Science in Microbiology: Thirty-two upper-division credits (300-level or above) in biology, biochemistry and microbiology including BIOE 370 (BIOL 340); BCH 380 or 480-482 (BIOC 380 or 481-482); BIOM 360-361, 410-411, 415, 450-451 (MICB 300-301, 404-405, 422, 450-451); and at least 7-9 credits chosen from the following courses (with lab if available):

BIOH 405 (MICB 309), BIOM 427-428 (MICB 400-401), BIOM 407-408 (MICB 406-407), BIOB 410-411 (MICB 410-411), BIOM 402-403 (MICB 412-413), BIOM 423 (MICB 418), BIOM 435 (MICB 420), BIOM 430 (MICB 423), BIOM 490 (MICB 497), MICB 483.

Also required: BIOB 170N-171N, 160N, 260, 272 (BIOL 108N-109N, 110N, 221, 223); M 162 (MATH 150), STAT 216 (MATH 241); CHMY 141N-143N, 221-222, 223-224, 311 (CHEM 161N-162N, 221-223, 222-224, 341); PHSX 205N-206N, 207N-208N (PHYS 111N-113N, 112N-114N).

**Microbial Ecology Option:** In addition to the General Education requirements and the Upper-Division Writing Expectation described below, the following must be completed for the Bachelor of Science in Microbiology with an option in microbial ecology: Thirty-two or more credits (300-level or above) in biology, biochemistry, microbiology including BIOE 370 (BIOL 340); BCH 380 or 480-482 (BIOC 380 or 481-482); BIOM 360-361, 410-411, 415, 450-451 (MICB 300-301, 404-405, 422, 450-451), and at least 7-9 credits chosen from the following courses (with lab if available): BIOM 427-428 (MICB 400-401), BIOB 410-411 (MICB 410-411), BIOM 423 (MICB 418), BIOM 435 (MICB 420), BIOM 430, 490 (MICB 423, 497); BIOE 371 (BIOL 341), BIOE 428 (BIOL 366), BIOB 440 (BIOL 440), BIOO 433/434 (BIOL 444/445), BIOL 453, 454.

Also required are: BIOB 170N-171N, 160N, 260, 272, (BIOL 108N/109N, 110N, 221, 223); M 162 or 171, STAT 216 (MATH 150 or 152, 241); CHMY 141N-143N, 221-222, 223-224 or CHMY 121N, 123N, 124N, (CHEM 161N-162N, 221-223, 222-224 or CHEM 151N, 152N, 154N); PHSX 205N-206N (PHYS 111N-113N). In addition, choose at least 6 credits from: CHMY 311 (CHEM 341); CSCI 135 (CS 131); ENSC 245N (FOR 210N); GEO 482, 420 (GEOS 382, 480); M 172, 273 (MATH 153, 251) and STAT 451, 452, 457, 458 (MATH 444, 445, 447, 448); PHSX 207N/208N (PHYS 112N/114N).

**Upper-Division Writing Expectation:** To meet the Upper-Division Writing Expectations for the major, Microbiology students must take BIOM 410 (MICB 404) (required), plus one more course chosen from: BCH 482 (BIOC 482), BCH 486 (BIOC 486), BIOE 428 (BIOL 366), BIOO 434 (BIOL 445), BIOB 410, 411 (MICB 410, 411), BIOM 402, or 499 (MICB 412 or 499).

### Suggested Course of Study

#### Microbiology

	First Year	A	S
BIOB 170N-171N (BIOL 108N-109N) Principles Biological Diversity and Laboratory		5	-
BIOB 160N (BIOL 110N) Principles of Living Systems		-	4



CHMY 141N-143N (CHEM 161N-162N) College Chemistry I, II	5	5
+M 162 (MATH 150) Applied Calculus	4	-
+WRIT 101 (ENEX 101) College Writing I	-	3
STAT 216 (MATH 241) Introduction to Statistics	-	4
Total	14	16

+Depends on placement exam.

#### Second Year

**A S**

BIOB 260 (BIOL 221) Cell and Molecular Biology	4	-
BIOB 272 (BIOL 223) Genetics and Evolution	-	4
CHMY 221-222, 223-224 (CHEM 221-222, 223-224) Organic Chemistry I, II and Laboratories	5	5
BIOM 360-361 (MICB 300-301) General Microbiology and Laboratory	-	5
Lower-Division Writing Course	3	-
General Education	3	-
Elective	-	1
Total	15	15

#### Third Year

**A S**

BCH 480-482 (BIOC 481-482) (or 380 and two upper-division Biology or Microbiology*)	3	3
BIOB 410-411 (MICB 410-411) Immunology and Laboratory*	5	-
BIOM 415 (MICB 422) Microbial Diversity & Ecology & Evltn	-	3
PHSX 205N-206N, 207N-208N (PHYS 111N-113N, 112N-114N) College Physics I, II and Labs	5	5
General Education	-	3
Upper Division Electives	3	-
Total	16	14

#### Fourth Year

**A S**

BIOE 370 (BIOL 340) General Ecology	-	3
CHMY 311 (CHEM 341) Analytical Chemistry-Quantitative Analysis	4	-
BIOM 410-411 (MICB 404-405) Microbial Genetics and Experimental Microbial Genetics Laboratory	-	4
BIOM 435 (MICB 420) Virology*	-	3
BIOM 450-451 (MICB 450-451) Microbial Physiology and Laboratory	4	-
General Education	6	6
Total	14	16

\*Choose 7-9 credits from BIOH 405 (MICB 309), BIOM 427-428 (MICB 400-401), BIOM 407-408 (MICB 406-407), BIOB 410-411 (MICB 410-411), BIOM 402-403 (MICB 412-413), BIOM 423 (MICB 418), BIOM 435 (MICB 420), BIOM 430, 490 (MICB 423, 497).

#### Microbiology with Microbial Ecology Option

##### First Year

**A S**

BIOB 170N-171N (BIOL 108N-109N) Principles Biological Diversity and Laboratory	5	-
BIOB 160N (BIOL 110N) Principles of Living Systems	-	4
CHMY 141N-143N (CHEM 161N-162N) College Chemistry I, II	5	5
+M 162 (MATH 150) Applied Calculus	4	-
+WRIT 101 (ENEX 101) College Writing I	-	3
STAT 216 (MATH 241) Introduction to Statistics	-	4
Total	14	16

+Depends on placement exam.

##### Second Year

**A S**

BIOB 260 (BIOL 221) Cell and Molecular Biology	4	-
BIOB 272 (BIOL 223) Genetics and Evolution	-	4
CHMY 221-222, 223-224 (CHEM 221-222, 223-224) Organic Chemistry I, II and Laboratories	5	5
BIOM 360-361 (MICB 300-301) General Microbiology and Laboratory	-	5
Lower-Division Writing Course	3	-
General Education	3	-
Elective	-	1
Total	15	15

##### Third Year

**A S**

BCH 480-482 (BIOC 481-482) (or 380 and two upper-division Biology or Microbiology*) Advanced Biochemistry I, II	3	3
BIOE 370 (BIOL 340) General Ecology	3	-
ENSC 245N (FOR 210N) Soils+	-	3
BIOM 427-428 (MICB 400-401) General Parasitology and Laboratory	4	-
BIOM 415 (MICB 422) Microbial Diversity & Ecology & Evltn	-	3
General Education	3	3
Upper-division elective	-	4
Elective	1	-
Total	14	16

##### Fourth Year

**A S**

GEO 482 Global Change	-	3
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