Assessment Plan: Department of Ecology – 2017

Undergraduate Major and Degree Options:

The Department of Ecology offers four undergraduate degree options leading to a Bachelor of Science in Biological Sciences:

- Fish & Wildlife Ecology and Management
- Conservation Biology and Ecology
- Organismal Biology
- Biology Teaching

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Mission

The Ecology Department of MSU balances excellence in undergraduate education, graduate education, and scientific research. We provide education and research that advances ecological knowledge, scientific evaluation, and the management of populations and communities of fish, wildlife, and plants, and the ecosystems and landscapes that support them. We produce graduates with fundamental scientific and critical-thinking skills who are employed by natural resource agencies, academic institutions, non-government organizations (NGOs) and private businesses. We provide an integrated program in terrestrial and aquatic ecology and management. We are the primary source of lower division education in biology of organisms, populations, and communities at the University. At the upper division and graduate level, we provide a broad education in plant and animal ecology and fish & wildlife management. We actively partner with other departments at MSU with complementary strengths to achieve both educational and research objectives.

A major strength of the Department is a blend of basic and applied ecology that advances ecological theory, fosters interactions and problem solving among faculty and students, and provides knowledge and tools that help managers make informed decisions. Montana's fish, wildlife, and native plant populations, and its aquatic, forested, prairie, and agricultural landscapes are highly diverse and valuable to the state: these abundant resources allow our Department to make unique contributions to education and research that have major effects on many complex issues of natural resource management. Our educational and scientific contributions reach beyond the borders of Montana and include significant participation in basic and applied ecology, and fish & wildlife management in the region, nation, and internationally. The faculty, staff, location, and facilities of the Ecology Department make us exceptionally qualified to meet the challenges of scientific inquiry and natural resource management in the 21st century.

Assessment Management Structure

The primary responsibility for gathering data specific to each degree option and recommending changes to respective curricula resides in the faculty assigned to advise students in the respective options. All faculty are assigned advising responsibility for at least one option, and advisor assignments are revised if necessary to track changes in enrollment by option. Currently, nine faculty advise Fish & Wildlife students, four faculty advise Organismal Biology students, six faculty advise Conservation Biology and Ecology students, and the department head advises Biology Teaching students in collaboration with advisers from the Education Department in the College of Education, Health and Human Development. Faculty advisors for each option collaborate to review the requirements of the fields or programs graduates are expected to enter and compare the required coursework and electives selected by majors to those requirements. Recommended changes are presented to the full department faculty for approval.

The undergraduate affairs coordinator is responsible for compiling and disseminating data on the number of majors for each option, the distribution of students among years (freshman, sophomore, junior, senior), the number of transfer students into the department and the retention data by major. Student enrollment records are kept in an Access databases in the department office by the undergraduate affairs coordinator, and summary data are presented in reports or spreadsheets. This information is summarized and relayed to the faculty by the head as appropriate. The department head manages the student curriculum database, and presents oral and written reports to the faculty at regularly scheduled faculty meetings.

The ultimate responsibility for managing all curricula and ensuring that curricula meet the needs of students resides with the Department Head. All four degree options share many curricular elements. Fish & Wildlife Ecology and Management, Conservation Biology and Ecology and Organismal Biology share a single assessment plan with some elements specific to each degree option; Biology Teaching assessment is embedded in the Education Department accreditation process.

Degree Objectives:

Specific degree objectives differ among options, but share many attributes. Most positions for professional biologists require a graduate degree. Accordingly, the degree options in Fish & Wildlife Ecology and Management, Conservation Biology and Ecology, and Organismal Biology are intended to provide the requisite educational background for graduate programs. The Biology teaching options qualifies graduates to teach secondary school biology, and does not typically lead to additional graduate coursework or degrees.

Fish & Wildlife Ecology and Management is a professional degree program designed for students seeking a career in fish & wildlife management with state or federal agencies, private consulting firms, or non-government organizations. Conservation Biology and Ecology shares with Fish & Wildlife Management an explicit focus on conservation, but is much broader in scope and emphasizes quantitative skills and social sciences as well as a foundation in biology and ecology. Organismal Biology provides a rigorous program of study in plant or animal biology at the whole-organism, species, population, and community levels, while allowing students the greatest flexibility in selecting those biology courses

which best meet their interests and objectives. Biology Teaching certifies graduates to be qualified to teach secondary school biology. It is similar to the Organismal Biology Option, but includes professional preparation courses required for state teacher certification.

All four degree options are basic science degree programs requiring at a minimum: (1) two semesters of chemistry, (2) mathematics through calculus, (3) statistics, and (4) significant coursework in biology. The degree options differ in extending these basic requirements in different directions, and adding requirements in varied fields. Each degree option has specific faculty advisors assigned who perform undergraduate advising and degree monitoring.

Expected Competencies:

Graduates in all four degree options are expected to have:

- a broad knowledge of biology, including cellular, molecular, and organismal biology; genetics; as well as extensive understanding of ecology including physiological, population, community, and behavioral ecology. Knowledge and understanding are evaluated primarily by written examination, and reinforced by integration throughout the curriculum.
- effective communication skills; the Fish & Wildlife option emphasizes both written and oral communication, while the other three options emphasize written communication. Students are required to demonstrate written communication skills in term papers, written lab reports, and essay exams.
- well-developed quantitative problem solving skills in mathematics and statistics. Students are required to demonstrate proficiency in applied calculus through population modeling exercises and examinations, and to demonstrate proficiency in population estimation, genetic analysis, and statistical analysis of ecological data in examinations and lab reports.

In addition, specific degree options emphasize:

- **Fish & Wildlife Management:** Expertise in planning and implementing resource management. Specific areas include knowledge of public laws governing the management of wildlife and other natural resources and the structure and function of wildlife management agencies at the state and federal level. Students are expected to be able to evaluate wildlife resources and trends, write management prescriptions to achieve resource objectives, and determine social and economic impacts of proposed activities.
- **Conservation Biology and Ecology:** Understanding natural and human-related processes that affect populations, species, communities, and ecosystems of the world, and methods to quantify and mitigate effects on these systems. Foci include physical environment and human dimensions of conservation, including economics, law, history and social science, and ecological consequences of climate change, with high standards for statistical, logical and quantitative skills.
- **Organismal Biology:** Advanced coursework in basic sciences and laboratory sciences, as well as a sequence of courses in a structured set of biology electives. Students

are required to declare an area of emphasis and in consultation with their advisor select a set of courses focused on their chosen area. Areas of interest can include both animal and plant biology at levels from physiological to populations or communities. Students are expected to master laboratory skills, identify critical questions in their chosen area of interest, and communicate effectively the outcomes of experiments or investigations in these areas.

- **Biology Teaching:** Extensive coursework in pedagogy and social science required for certification to teach secondary school. Licensure of teachers is controlled by the the Montana Office of Public Instruction. Students are expected to master all three basic sciences (biology, chemistry, and physics) with an emphasis on biology, as well as develop skills in curriculum development, classroom teaching, and student evaluation.

Assessment Plan:

The department's assessment effort is conducted at both the course and degree option levels.

- Degree option reviews: Individual degree options are assessed on a continual basis by the advisors for that option. All advisors are certification officers for their assigned option, and so are intimately familiar with both the required courses and the electives chosen by their advisees. The department follows the university policy and requires a C- or higher grade on all courses taken to meet requirements, whether specifically required by options or chosen in the biology electives elements of the degree options. A more formal assessment occurs on a biennial basis to monitor changes in available coursework within the department and across campus, and to assess the degree to which the current degree requirements meet our objectives. When necessary, new course proposals are prepared and submitted to the university curriculum committee to revise the courses in degree options.
- Retention and completion rate: The department maintains an ongoing assessment of student progress, including transfers into and out of the degree options and department, leaves of absence or withdrawals, and graduation rates. This database is maintained by the academic coordinator and provided to the department head in written summary.
- Capstone courses: All degree options require a capstone course experience where we assess the degree to which the curriculum is producing students with the specific knowledge and skills identified above by individual project assessment. In the Fish & Wildlife capstone (WILD 401) students develop and present wildlife management proposals to address specific management issues. This exercise essentially models the future professional activities of students in Fish & Wildlife careers, and allows us to assess their readiness for professional career activities. In the other capstone course (BIOE 499) students develop and prepare written treatises on current issues in ecology and evolutionary biology that allow us to gauge their preparation for graduate school by comparing their performance to the expectations we have for our own incoming graduate students.

- Student participation in decisions: When important decisions about the curriculum or course fees are considered, the department head visits core classes with numerous majors and directly queries the students about their views on potential changes. This is the most timely and effective approach for getting a large number of responses.
- Professional preparation: The Fish & Wildlife Ecology and Management degree option has both Federal and State curriculum guidelines that constrain or determine course requirements within the degree. The Department Head and the Director of the Fish & Wildlife Program in the department monitor the relevant specific job requirements published by the Office of Personnel Management and meet periodically with the Director or management staff of relevant management agencies to assess the preparation of our graduates with respect to current professional requirements.
- Professional assessment: Many of our students take a professional internship during their academic program, which requires formal assessment of the student's performance by the sponsoring agency. These assessments help identify shortcomings in our programs. In addition, the faculty advisors of the student chapters of the professional societies meet both formally and informally with practicing professionals in fisheries and wildlife management or conservation biology to review trends and changing needs of professional agencies. These interactions often result in modifications to existing courses to better incorporate current needs, or in some cases lead to new courses.

Implementation Plan

All of the assessment activities identified above are ongoing and will continue.

In summary, individual faculty are responsible for collecting information on their advisees and the degree to which their degree programs are successful which is collated with other advisees in that option, and then presented to the full faculty in regularly scheduled faculty meetings. The academic coordinator is charged with maintaining the database on student progress, including transfers into and out of degree options, annual progress in degree programs, and graduation rate. The department head is responsible for collating all information and presenting the data to the faculty at regularly scheduled faculty meetings.

Data-driven Changes to Curriculum

Based on information solicited from the sources described above, a number of changes have been made to the curriculum.

- The largest change was to the degree options themselves. In 2014 we determined that the previously offered degree option in Ecology & Evolution was too similar to Organismal Biology and did not really offer a unique experience that justified maintaining a separate degree option. At the same time, we recognized that a broader option in conservation would meet the interests and needs of many students, professional organizations and government agencies, and began offering the degree option in Conservation Biology and Ecology. Conservation Biology has now become the second largest option in the department.

- To develop better field skills in our undergraduates we have developed and implemented significant new components to the Fish & Wildlife Ecology and Management core course (WILD 401) as well to Rocky Mountain Vegetation (BIOE 408) and Research in Freshwater Ecology (BIOE 427). These components were added after meeting with professional fisheries and wildlife professionals, student chapters of the professional societies, and students in classes. These components add valuable field skills to the experiences students gain in our programs.
- To further increase field opportunities, we requested new field trip fees or increases in existing lab fees from the MUS Board of Regents to provide funds for vehicles and field expenses for a number of courses. We were largely successful in our request, and field labs have been be added to several existing courses.
- In response to student needs assessment we petitioned the Dean of the College of Letters and Science for an additional Graduate Teaching Assistantship (GTA) to provide additional support in the laboratories of Ichthyology and Ornithology.
- To better meet US Office of Personnel Management and Wildlife Society certification requirements, as well to increase the breadth of offerings to non-Fish & Wildlife students, an upper division course in Plant Ecology was added to the curriculum.
- Based on a need expressed by the leadership of Montana Fish, Wildlife & Parks, we added a course on "Human Dimensions" to the Fish & Wildlife program. Unfortunately, due to contractual limitations, we have only been able to offer the course at the graduate level to date.
- To improve graduate student access to courses in the department and to provide a more rigorous upper-division course for undergraduates we have cross-listed Conservation Biology (BIOE 440R/521) and Conservation Genetics (BIOB 480/548) as senior/graduate-level courses.

2015-16 Assessment* – Fish and Wildlife Ecology and Management

*used data from Fall 2015 and Spring 2016 semesters

Demonstrate effective written and oral communication

Successful completion rate (C- or above) of the following courses, threshold is >70% C- or above

WRIT 101:	80%
WRIT 201:	85%
WRIT 221:	60%
COM 111:	96%
CLS 101:	91%
WILD 201:	
<5 grammatical errors on 4 written reports	92%
WILD 401:	
Performance on 5 written assignments (L2, L5, L7, RP4, RP7)	
Mean,	90%

Demonstrate an understanding of the process by which scientific knowledge is generated and evaluated

WILD 401:

3 written assignments (L1, RP3, RP10) using scientific writing format and library searches for obtaining scientific information Mean, 88%

Demonstrate a basic understanding of fish and wildlife management and conservation techniques

Successful completion rate (C- or above) of the following courses, threshold is >70% C- or above

WILD 301:	92%
WILD 401:	97%

2016-17 Assessment* – Fish and Wildlife Ecology and Management

*used data from Fall 2016 and Spring 2016 semesters

Demonstrate an understanding of physical and chemical factors that influence organisms, their physiology, and ecosystem function

Successful completion rate (C- or above) of the following courses, threshold is >70% C- or above

BIOB 160:	83%
CHMY 121:	80%
CHMY 123:	81%
ERTH 101:	86%
ENSC 245:	91%
ENSC 272:	83%
BIOE 370:	90%
BIOO 412	90%

Demonstrate a basic understanding of demographic attributes of populations and the natural processes and the abiotic factors that influence population dynamics, as well as direct and indirect anthropogenic influences on populations

WILD 301:

Quiz2-4 short answer questions; Midterm-18 T/F, MC, short answer questions

Mean, 74%

Demonstrate a basic understanding of fish and wildlife management and conservation techniques

Successful completion rate (C- or above) of the following courses, threshold is >70% C- or above

BIOE 370:	90%
BIOE 408:	100%
BIOE 427:	95%
BIOE 428:	93%
BIOB 480:	100%

Fish and Wildlife Management and Ecology Option			
Outcome	**Indicator**	**Rubric**	**Threshold**
Demonstrate effective written and oral communication	WILD 201 WILD 401 WRIT 101/201/221; COMX 111US CLS 101US	<5 grammatical errors on 4 written reports Performance on 5 written assignments Successful completion of general and technical writing courses, public communication course	70% 70%
Demonstrate an understanding of physical and chemical factors that influence organisms, their physiology and ecosystem function	BIOB 160 CHMY 121,123, ERTH 101 ENSC 245/272 BIOE 370 BIOO 412	Successful completion of courses in chemistry, biochemistry, physics, general ecology, animal physiology, and soil resources or physical geography	70%
Demonstrate the ability to apply quantitative reasoning and appropriate mathematical and statistical methods to describe or explain phenomena in the natural world	STAT 216 BIOB 318 BIOE 370	Successful completion of statistics or biometry course Test questions on population growth statistics in general ecology and wildlife ecology courses	70%
Demonstrate basic understanding of the major disciplines in biology including physiology, anatomy, genetics, evolution, ecology, and taxonomy	BIOO 230/310 BIOO 412 BIOB 375/377 BIOB 420 BIOO 415/475/470	Successful completion of courses in animal physiology, comparative anatomy, genetics, evolution, ecology, and animal and plant taxonomy	70%
Demonstrate an understanding of the process by which scientific knowledge is generated and evaluated	WILD 401	3 written assignments using scientific writing format and library searches for obtaining scientific information	70%
Demonstrate a basic understanding of demographic attributes of populations and the natural processes and the abiotic factors that influence population dynamics, as well as direct and indirect anthropogenic influences on populations	WILD 301 BIOE 370 BIOB 480 BIOE 428 BIOE 408/427	Quiz 2-4 short answer questions; Midterm-18 T/F, MC, short answer questions Successful completion of courses in fish and wildlife management, ecology, conservation biology or conservation genetics, freshwater ecology, and aquatic or terrestrial field ecology	70% 70%

Demonstrate a basic understanding of the variety of interactions among communities of organisms and the integration of communities into ecosystems	BIOE 370 BIOE 428 BIOE 455	Successful completion of courses in general ecology, freshwater ecology, or plant ecology	70%
Demonstrate awareness of historical, political, economic, and social factors in fish and wildlife management and natural resource conservation	WILD 301 WILD 401	Quiz 1-5 short answer questions; Midterm-14 T/F, MC, short answer questions Successful completion of courses in conservation biology and fish and wildlife capstone course	70%
Demonstrate a basic understanding of fish and wildlife management and conservation techniques	WILD 301/401	Successful completion of courses in fish and wildlife management	70%

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Fish and Wildlife Management and Ecology Option

	Assessment Year			
Learning Outcome	2015-2016	2016-2017	2017-2018	2018-2019
Demonstrate effective written and oral communication.	X			
Demonstrate an understanding of physical and chemical factors that influence organisms, their physiology, and ecosystem function.		X		
Demonstrate the ability to apply quantitative reasoning and appropriate mathematical and statistical methods to describe or explain phenomena in the natural world.			X	
Demonstrate basic understanding of the major disciplines in biology including physiology, genetics, evolution, ecology and systematics.				X
Demonstrate an understanding of the process by which scientific knowledge is generated and evaluated.	X			
Demonstrate a basic understanding of demographic attributes of populations and the natural processes and the abiotic factors that influence population dynamics, as well as direct and indirect anthropogenic influences on populations		X		
Demonstrate a basic understanding of the variety of interactions among communities of organisms and the integration of communities into ecosystems			X	
Demonstrate awareness of historical, political, economic, and social factors in fish and wildlife management and natural resource conservation				X
Demonstrate a basic understanding of fish and wildlife management and conservation techniques	X			

Conservation Biology and Ecology Option of the BS in Biological Sciences.
Summary of undergraduate curriculum assessment for 2015 - 2017

For undergraduates within the Conservation Biology and Ecology Option of the BS in Biological Sciences, 6 broad elements of competence were assessed in this round of annual assessment, using 22 specific elements identified in Table 1 with data from 11 classes. The formal logic element has been dropped from the curriculum and was not assessed. In all but one of the 22 assessments, student scores exceeded the threshold identified in the assessment document. No changes to the curriculum are recommended on the basis of these data, as they reveal that 95% of the identified thresholds were met.

Below, each broad element of competence that was assessed is numbered, and specific elements within each broad element are identified with bullets.

For each element, either (A) **mean student scores are shown in bold** and compared to the *desired threshold shown in italics* or (B) the **percentage of students** above a *class grade threshold* is reported.

1. Demonstrate effective written and oral communication

- BIOE 455:
  - Grant proposal — mean = **89.4**% > *70%*
  - Proposal review — mean = **92.6**% > *70%*
  - Oral debates — mean = **90.7**% > *70%*

- BIOE 440:
  - Scientific review paper: — mean = **89%** > *70%*
  - Essay exams: — mean = **89%** > *70%*

- BIOE 428:
  - Literature discussion and written interpretation: — mean = **80%** > *70%*

- COM 110 or CLS 101*:* — **89% of students** > *C- class grade*
- WRIT 201: — **100% of students** > *C- class grade*

2. Demonstrate an understanding of physical and chemical factors that influence organisms, their physiology, and ecosystem function

- BIOE 428:
  - Material on biogeochemistry and ecosystem ecology: — mean = **80%** > *70%*

- BIOO 412:
  - Physiological mechanisms and their adaptation to ecological constraints, including osmoregulation, respiration, sensory systems and locomotion: — three exam means of **78.7%, 79,4% and 76%** > *70%*

- CHMY 141 — **82% of students** > *C- class grade*
- CHMY 143 — **100% of students** > *C- class grade*
- CHMY 211 — **47% of students** > *C- class grade*
- BCH 380 — **100% of students** > *C- class grade*

3. Demonstrate an understanding of the process by which scientific knowledge is generated and evaluated

- BIOE 440R:
  Scientific review paper — mean = **89%** > *70%*
- BIOE 103CS
  20 exam questions on scientific Method — mean = **74%** > *70%*

4. Demonstrate an understanding of the ways that ecological principles can be used to solve practical problems

- BIOE 455
  Selected exam questions — mean = **88.9**% > *70%*
- BIOE 428
  Selected assignments — mean = **84**% > *70%*

5. Demonstrate an understanding of current patterns of biodiversity and extinction, and understand why these patterns are of concern

- BIOE 440
  Essay exam on diversity and Extinction — mean = **86%** > *70%*

6. Demonstrate basic understanding of the ways that economic, legal and social issues affect conservation problems, policies and solutions

- Social Sciences Block — **94% of students** > *C- class grade*

Table 1: Assessment Design for Conservation Biology and Ecology Option, BS in Biological Sciences

	Curriculum Component	**Specific Element Assessed**	**Threshold**
Demonstrate effective written and oral communication.	WRIT 201 COM 110 or CLS 101US BIOE 440 BIOE 455	Completion of course entirely devoted to writing Completion of course with heavy emphasis on speaking Scientific review paper Grant proposal and mock review panel	≥C- ≥C- ≥70% ≥70%
Demonstrate an understanding of physical and chemical factors that influence organisms, their physiology, and ecosystem function.	CHMY 141, 143, 211 BCHM 380 or ENSC 245 PHYX 205 BIOO 412 or BIOO 433 BIOE 428	Completion of general and organic chemistry Completion of biochemistry or soil science Completion of general physics Selected questions on physiological ecology Selected questions on biogeochemistry, ecosystem ecology	≥ C- ≥ C- ≥ C- ≥70% ≥70%
Demonstrate the ability to apply quantitative reasoning and appropriate mathematical and statistical methods to describe or explain phenomena in the natural world.	STAT 216, 217, 410 BIOE 370 BIOE 440	Completion of 3 semesters of statistics Selected questions on population models Selected questions on population models	≥ C- ≥70% ≥70%
Demonstrate basic understanding of the major disciplines in biology including physiology, genetics, evolution, ecology and systematics.	BIOO 412 or BIOO 433 BIOB 375 BIOB 420 BIOE 370 BIOO 415,475, 470 or BIOE 428 BIOB 480	Completion of course entirely devoted to physiology Completion of course entirely devoted to genetics Completion of course entirely devoted to evolution Completion of course entirely devoted to ecology Selected questions on ecology, physiology, genetics and evolution Selected questions on genetics and evolution	≥ C- ≥ C- ≥ C- ≥ C- ≥70% ≥70%
Demonstrate an understanding of the process by which scientific knowledge is generated and evaluated.	BIOB 103CS BIOE 440 BIOE 4## Cons Biol Res BIOE 455 BIO 428	Selected questions on scientific method Scientific review paper Selected assignments emphasizing analysis & hypothesis testing Grade on primary literature discussions Literature discussions and written interpretations	≥70% ≥70% ≥70% ≥70% ≥70%
Demonstrate the ability to use logic and reasoning to evaluate one's own work and the work of others.	PHL 236 BIOE 4## Cons Biol Res	Completion of course entirely devoted to formal logic Selected assignments emphasizing interpretation of data and inferences	≥ C- ≥70%
Demonstrate understanding of the major areas of population ecology, interspecific interactions and interactions with the physical environment.	BIOE 370 BIOE 428 or 455	Selected questions on population ecology, interspecific interactions and interactions with the abiotic environment Selected questions on population ecology, interspecific interactions and interactions with the abiotic environment	≥70% ≥70%
Demonstrate understanding of ecological patterns and processes at levels of organization above the population, including community ecology and	BIOE 370, 455, 428	Selected exam questions	≥70%

ecosystem ecology			
Demonstrate an understanding of the ways that ecological principles can be used to solve practical problems	BIOE 455 BIOE 428	Selected assignments or exam questions Selected exam questions	≥70% ≥70%
Demonstrate an understanding of current patterns of biodiversity and extinction, and why these patterns are of concern	BIOE 440	Selected essay questions	≥70%
Demonstrate an understanding of the ways that natural and human related factors alter population dynamics and extinction risk, community dynamics ecosystem function and evolutionary processes.	BIOE 440 BIOB 480 BIOE 428	Selected essay questions Selected exam questions Selected exam questions	≥70% ≥70% ≥70%
Demonstrate an understanding of the methods by which conservation problems are identified and addressed	BIOE 440 BIOE 440 BIOE 428	Review paper Selected essay questions Selected essay questions	≥70% ≥70% ≥70%
Demonstrate basic understanding of the ways that economic, legal and social issues affect conservation problems, policies and solutions	Social sciences block	Completion of 3 or more courses focusing entirely on environmental issues in economics, law or sociology	≥C-

Organismal Biology Degree Option of the BS in Biological Sciences.
Summary of undergraduate curriculum assessment for 2015-2017.

For undergraduates within the Organismal Biology Option fo the BS In Biological Sciences, six broad elements of competence were assessed in this round of annual assessment, using speciofic elements identified in Table 1. In all but one of the assessments student scores exceeded the threshold identified in the assessment document. Students struggled signifcantly with CHMY 211 (Organic Chemistry) with fewer than half of our students successing on their first attempt. This has bem an ongoing problem for many years, and the Chemistry and Biochemistry Department is making significant efforts to improve outcomes in their required courses. No changes in curriculum are proposed based on the assessment prsented here.

Below, each broad element of competence that was assessed is numbered, and specific elements within each broad element are identified with bullets.

For each element, either (A) **mean student scores are shown in bold** and compared to the *desired threshold shown in italics* or (B) the **percentage of students** above a *class grade threshold* is reported.

1. Demonstrate effective written and oral communication

- WRIT 101 — mean = 80% $\geq$ 70
- COMX 111US or CLS 101US — mean = 78% $\geq$ 70

2. Demonstrate an understanding of physical and chemical factors that influence organisms, their physiology, and ecosystem function

- CHMY 141 — mean = 87% $\geq$ 70
- CHMY 143 — mean = 87% $\geq$ 70
- CHMY 211 — mean = 48% $<$ 70
- PHYX 205 — mean = 76% $\geq$ 70
- PHSX 207 — mean = 92% $\geq$ 70
- BCH 380 — mean = 100% $\geq$ 70 (small sample size)
- BIOE 370 — mean = 90% $\geq$ 70

3. Demonstrate critical thnking skills

- BIOE 499 — mean = 91% $\geq$ 70

4. Demonstrate inquiry skills and use of the scientific method for gaining reliable knowledge

- BIOB 170 lab — mean= 85% $\geq$ 70

5. Demonstrate understanding of the relationship between genetics and evolution and the influence of of these disciplines on organismal diversity

- BIOE 499 — mean 91% $\geq$ 70

6. Demonstrate an understanding of the hierarchy of biology including the organismal scale and including population, community, and ecosystem ecological precesses.

- BIOE 499 — mean 92% $\geq$ 70

Organismal Biology Option - Table 1

Outcome	Indicator	Rubric	Threshold
Demonstrate effective written and oral communication	WRIT 101 Com 110 or CLS 101	Completion of course entirely devoted to writing Completion of course with heavy emphasis on speaking	> = C- > = C-
Demonstrate an understanding of physical and chemical factors that influence organisms, their physiology and ecosystem function	CHMY 141,143, 211 PHSX 205, 207 BCH 380 BIOE 370	Completion of general and organic chemistry Completion of biochemistry Completion of general physics Completion of general ecology	> = C- > = C- > = C- > = C-
Demonstrate the ability to apply quantitative reasoning and appropriate mathematical and statistical methods to describe or explain phenomena in the natural world	MATH 171 STAT 216 or BIOB 318 BIOE 370 or BIOB 258	Completion of 1 semester of statistics Selected questions on population models in Ecology	>= C- >= 70% correct
Demonstrate basic understanding of the major disciplines in biology including general biology, physiology, genetics, evolution, and ecology	BIOB 160, 170 or BIOB 256, 260 BIOO 412 or 433 BIOB 375 BIOB 420	Completion of course entirely devoted to physiology Completion of course entirely devoted to genetics Completion of course entirely devoted to evolution Completion of course entirely devoted to ecology Selected questions on ecology, physiology, genetics and evolution Selected questions on genetics and evolution	> = C- >= C- >= C- >= C- >= 70%
Demonstrate critical thinking skills	Capstone	Graded presentation of reasoning	>= 70
Demonstrate inquiry skills and use of the scientific method for gaining knowledge	BIOB 170 lab	Required lab reports	>= 70
Demonstrate use of technology to effectively communicate results of literature reviews, research and analyses, and conclusions	Capstone courses	Graded presentation of techniques	>= 70
Demonstrate the ability to apply the interdisciplinary building blocks to understand integrated problems at the organism level	Capstone courses	Graded presentation of integration of concepts	>= 70
Demonstrate understanding of the relationship between genetics and evolution and the influence of these disciplines on organismal diversity	Capstone course	Written term paper	>= 70
Demonstrate an understanding of the hierarchy of biology including the organismal scale and including population, community, and ecosystem ecological processes	Capstone Course	Written term paper	>= 70
Identify and declare in consultation with an advisor(s) an advanced area of biological and/or ecological emphasis based on previous coursework, experience, ability, and interest	Advising sessions	Documented declaration of advanced area and course list	100%
Identify and declare in consultation with an advisor(s) an academic theme for coursework directed toward a specific career that incorporates biological sciences	Advising sessions	Documented declaration of biological academic theme and course list	100%

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Organismal Biology Option - Table 1

	Assessment Year			
Learning Outcome	2015-2016	2016-2017	2017-2018	2018-2019
Demonstrate effective written and oral communication.	X			
Demonstrate an understanding of physical and chemical factors that influence organisms, their physiology, and ecosystem function.		X		
Demonstrate the ability to apply quantitative reasoning and appropriate mathematical and statistical methods to describe or explain phenomena in the natural world.			X	
Demonstrate basic understanding of the major disciplines in biology including physiology, genetics, evolution, ecology and systematics.				X
Demonstrate an understanding of the process by which scientific knowledge is generated and evaluated.	X			
Demonstrate the ability to use logic and reasoning to evaluate one's own work and the work of others.		X		
Demonstrate use of technology to effectively communicate results of literature reviews, research and analyses, and conclusions			X	
Demonstrate the ability to apply the interdisciplinary building blocks to understand integrated problems at the organism level				X
Demonstrate understanding of the relationship between genetics and evolution and the influence of these disciplines on organismal diversity	X			
Demonstrate an understanding of the hierarchy of biology including the organismal scale and including population, community, and ecosystem ecological processes		X		
Identify and declare in consultation with an advisor(s) an advanced area of biological and/or ecological emphasis based on previous coursework, experience, ability, and interest			X	
Identify and declare in consultation with an advisor(s) an academic theme for coursework directed toward a specific career that incorporates biological sciences				X