

Institutional Effectiveness

2021-2022

Program: Biology MS

College and Department: College of Arts & Sciences – Department of Biology

Contact: Christopher Brown

Mission: The primary mission of the Department of Biology at Tennessee Tech is to promote biological education in, and advance biological knowledge for, the region, state, and nation through teaching, research, and public service.

The Department of Biology has three degree programs (B.S. in Biology, B.S. in Wildlife and Fisheries Science, and M.S. in Biology). Each degree program has a separate report. Program Goals and Student Learning Outcomes for the undergraduate programs are similar since Wildlife and Fisheries Science is applied Biology; however, assessment results differ for most goals and outcomes based on the assessment techniques used. The graduate program has a unique set of goals and learning outcomes.

Program Goals:

PG 1: Increase graduate student enrollment and thus graduation rates through recruitment, retention, and marketing.

Increase graduate student enrollment by 10% annually, and thus increase graduation rates, through recruitment, retention, and marketing.

PG 2: Make significant progress toward increasing diversity.

The Department of Biology will make significant progress toward desegregation and affirmative action objectives.

PG 3: Increase faculty involvement in research and the graduate program.

Increase faculty involvement in research and the graduate program through differential teaching loads to interested tenure-track or tenured faculty members.

Student Learning Outcomes:

SLO 1: All Master of Science candidates in the Department of Biology will demonstrate a command of principles within general biology and the specialized disciplines in their area of interest.

The Department of Biology desires an outcome that 100% of Master of Science candidates demonstrate a command of principles within general biology and the specialized disciplines in their area of interest through successful completion of oral comprehensive examinations.

SLO 2: All Master of Science candidates in the Department of Biology will participate in extracurricular activities related to their disciplines.

All Master of Science candidates in the Department of Biology will participate in extracurricular activities related to their disciplines. These activities will include student organization

membership, special field trips that are not class related, involvement in research activities of other graduate students, and attendance at scientific meetings.

SLO 3: All Master of Science candidates in the Department of Biology will acquire abilities to use scientific reasoning as codified by the structured process commonly known as the scientific method.

All Master of Science candidates in the Department of Biology will acquire abilities to use scientific reasoning as codified by the structured process commonly known as the scientific method. This outcome will be demonstrated through their research, written thesis, and oral comprehensive examinations.

A departmentally developed curriculum map can be found in Appendix 1 that shows the connections between courses and student learning outcomes.

Assessment Methods:

PG 1: Increase graduate student enrollment

1. Enrollment

The Office of Institutional Assessment, Research and Effectiveness provides institution-wide data concerning enrollment, demographics, and retention. The enrollment component of this goal is assessed by comparing enrollments from year to year.

PG 2: Increase diversity

1. Enrollment and demographics

The Office of Institutional Assessment, Research and Effectiveness provides institution-wide data concerning enrollment, demographics, and retention.

2. National Association of University Fish and Wildlife Programs Data

We use the National Association of University Fish and Wildlife Programs Data to compare the gender and race/ethnicity to other programs in the nation. These reports summarize data compiled from 21 member universities that have fish and wildlife academic programs.

PG 3: Increase faculty involvement in research

1. Faculty Annual Report:

Conducted annually in the Spring semester. Each faculty member submits a Faculty Annual Effort report to the chairperson that discusses their efforts for the previous calendar year.

On-going progress towards promotion, research projects and proposals, external funding, publications and presentations, extracurricular activities involving graduate students, and number of graduate students are summarized and included in the Departmental Annual Report submitted by the chair to the Dean of the College of Arts and Sciences. In 2016, the Department of Biology modified promotion guidelines such that research and graduate student mentorship were required for promotion to the ranks of Associate Professor and Professor. In addition, the department has a differential teaching load policy that provides faculty actively involved with research and graduate student mentorship with a reduced teaching load should they select the

research track. The departmental chair monitors the number of faculty promoted and the number of faculty agreeing to the research track on an annual basis.

SLO 1: Demonstrate a command of general biology concepts and principles

1. Comprehensive Oral Exams:

Comprehensive Oral Exams are conducted at end of each graduate student's degree program. These exams are administered by individual graduate faculty committees near the completion of each student's program.

Oral comprehensive examinations consist of two parts: questions regarding the thesis, and questions evaluating knowledge of general biological principles and topics within the student's area of specialization. Graduate committee membership includes a minimum of three faculty members; two from the Department of Biology whose research interests closely match those of the student, and one from an area outside the area of specialization that may come from another department. Major advisors record questions asked and the number of correct and incorrect responses. Successful completion of the oral examination requires a unanimous vote from all committee members that the student has passed both parts of the exam. The departmental chair tracks examination results and includes the data in the Departmental Annual Report submitted to the Dean of the College of Arts and Sciences.

SLO 2: Participate in extracurricular activities

1. Faculty Annual Report:

Conducted annually in the Spring semester. Each faculty member submits a Faculty Annual Effort report to the chairperson that discusses their efforts for the previous calendar year.

On-going progress towards promotion, research projects and proposals, external funding, publications and presentations, extracurricular activities involving graduate students, and number of graduate students are summarized and included in the Departmental Annual Report submitted by the chair to the Dean of the College of Arts and Sciences.

SLO 3: Use scientific reasoning

1. Comprehensive Oral Exams

2. Graduate Seminar Evaluation

Graduate Seminar Evaluations are conducted near the end of each graduate student's degree program. Departmental faculty attend graduate seminars where students formally present their research and ask questions to ensure that graduate students have a thorough understanding of the scientific method.

Masters of Science degree students nearing the completion of their degree programs must enroll in BIOL 6930 (Graduate Seminar). Departmental faculty members attend graduate seminars and each seminar is independently graded by three departmental faculty members that cannot include the graduate student's major advisor. A seminar evaluation form is completed by each of the three faculty members, and a common grade is assigned based on the three evaluations. The seminar evaluation form includes an evaluation of the research design, such that principles in the scientific method are evaluated. Questions regarding each student's

research are included to ensure that each student understands the implications of their research and the scientific method.

Results:

PG 1: Increase graduate student enrollment

After several years of increasing growth, enrollment in the master's program declined slightly in 2021 (Table 1). In part, this was due to two students leaving the program to pursue other interests. In addition, we have been in the midst of hiring three new faculty, and once these individuals become established master's enrollments should again increase. This is the first year since 2018 that we did not meet our goal of a 10% increase in enrollment.

Table 1. Number of graduate students (M.S.) enrolled as Biology majors by year.

Fall	Number of Graduate Students
2017	20
2018	19
2019	24
2020	28
2021	25

PG 2: Increase diversity

With the exception of 2017, minority enrollment in our master's program has been low (Table 2), with a maximum of two minority-identifying students. Since many of our students engage in wildlife/fisheries/conservation work, this is not completely surprising; nationally, enrollment of minority students in these areas lags behind enrollment in areas such as biomedical research or cellular/molecular biology.

After several years of declines in the percentage of female students, this went up this year and exceeded 50% for the first time since 2016.

Table 2. Percent of Biology M.S. students that identified as minority or female, by year.

Fall	Percent Minority Graduate Students	Percent Female Graduate Students
2017	20.0	50.0
2018	0.0	42.1
2019	4.2	33.3
2020	7.1	39.3
2021	4.0	56.0

PG 3: Increase faculty involvement in research

Three promotions occurred in the last five years (Table 3); two Assistant Professors received tenure and were promoted in 2017-18, and one Associate Professor was promoted this past year. This number should increase greatly over the next two years, as we will potentially have six faculty going up for promotion during this time.

Table 3. Number of faculty promoted to the rank of Associate Professor and Professor over the past five years. Note: This denotes the year that the faculty member went up for and was approved for promotion; the formal start of their time in rank would occur the following year.

Academic Year	Associate Professor	Professor
2017-2018	2	0
2018-2019	0	0
2019-2020	0	0
2020-2021	0	0
2021-2022	0	1

The percentage of faculty members capable of accepting graduate students (this excludes instructors and lecturers) who are serving as advisors for master's students dropped substantially in 2021-2022 after having been consistently at or above 80% for a number of years (Table 4). There were several reasons for this, including: the hiring of a new faculty member, who did not bring in any graduate students during his first semester; the nearing of retirement for one faculty member, who is not taking on new students; and a transitional time for several faculty who traditionally have graduate students, but had their previous ones graduate in Spring or Summer 2021. Given this, and the hiring of two new faculty, we expect this percentage to increase next year.

Four members of the faculty are currently on the research option, and a fifth will begin on this track in 2022-2023. The remaining faculty are on the standard option. Over the past five years, the teaching option has been used by only a single senior member of the faculty, who retired following the Fall 2019 semester.

Table 4. Number of graduate faculty members actively engaged in research with graduate students. NOTE: These numbers do not include the two members of the Fisheries Coop Unit, who both supervise master's students. Including these personnel would increase the values for the 2021-2022 year to 16 and 56.2%.

Year	Number of Faculty Conducting Research with Graduate Students	Percent of Departmental Faculty
2017-2018	13	92.3
2018-2019	12	80.0
2019-2020	13	81.3
2020-2021	12	80.3
2021-2022	14	50.0

SLO 1: Demonstrate a command of general biology concepts and principles

All students in this five-year cycle passed their oral exams and thesis defenses on the first try. These exams/defenses cover both general biological principles and areas related to the research focus. This meets our goal of 100% success in completion of the master's thesis defense.

SLO 2: Participate in extracurricular activities

Although graduate students participate in a variety of extracurricular activities (especially student organizations such as the Tennessee chapters of the Wildlife Society and the American Fisheries Society), we have chosen to focus on attendance and presentations at scientific meetings for this goal (Table 5).

After a lull due to COVID-related cancellations of many scientific meetings, master's students once again were able to attend meetings and give presentations. Both the number of students presenting, and the percentage of the total master's student population, were significantly higher than they've been at any time in the past five years.

Table 5. Number of graduate students and the percentage of graduate Master's students presenting research findings at scientific meetings by year.

Year	Number of Master's Students Presenting	Total Number of Master's Students	Percent of Students Presenting
2017-2018	3	20	16
2018-2019	4	19	17
2019-2020	7	24	29
2020-2021	4	28	14
2021-2022	12	25	48

SLO 3: Use scientific reasoning

The number of students graduating went up during the 2021-2022 year (Table 6), and this continues a trend of alternating cycles of increases and decreases in graduation numbers. As mentioned in the results for SLO 1, each of these students passed their oral exams and defense on their first try. In addition, each made grades of A or (much less frequently) B on their seminar presentation of their thesis results. Part of this grade is based on the talk itself, and part on the student's ability to answer questions related to their research project.

Table 6. Number of Master of Science graduates within the Department of Biology by year.

Year	Number of Graduates
2017-2018	9
2018-2019	7

2019-2020	8
2020-2021	6
2021-2022	10

Modifications for Improvement

This year, the Biology Department Planning Committee will begin examining modifications to the goals and student learning outcomes for both our bachelor's and master's programs. The committee is being reorganized to include faculty from all levels (tenured, tenure-track, and lecturers/instructors). We will revisit both the goals/outcomes and the methods of assessing each of these. This is a long overdue process, as well over half the current faculty have started since the last time these goals/outcomes were assessed and modified.

Appendices

1. Curriculum Map
2. Thesis Defense Rubric

Appendix 1: Curriculum Map

Curriculum support for learning outcomes of the graduate program in the Department of Biology. Some courses included on this list have been taught irregularly over the past 10 years. Several courses are dual-listed under both BIOL (Biology) and WFS (Wildlife and Fisheries Sciences); these are listed here under BIOL only.

Course No.	Title	Learning Outcomes		
		Demonstrate Knowledge	Extra-curricular Activities	Scientific Method
BIOL 5000	Parasitology	X		
BIOL 5040	Immunology	X		
BIOL 5060	Hormones & Chem. Comm.	X		
BIOL 5100	Evolutionary Biology	X		X
BIOL 5110	Microbial Evolution	X		X
BIOL 5120	Protozoology	X		
BIOL 5130	Environmental Microbiology	X		X
BIOL 5140	Pathogenic Bacteriology	X		X
BIOL 5150	Molecular Genetics	X		
BIOL 5160	Genetic Engineering Lab	X		
BIOL 5170	Pop. & Conservation Genetics	X		X
BIOL 5220	Biostatistics	X		X
BIOL 5230	Animal Behavior	X		X
BIOL 5300	Plant Speciation & Evolution	X		
BIOL 5310	Plant Anatomy	X		
BIOL 5320	Plant Physiology	X	X	X
BIOL 5330	Plant Ecology	X		X
BIOL 5340	Plant-Animal Interactions	X	X	
BIOL 5610	Invertebrate Zoology	X		X
BIOL 5630	Ornithology	X		X

BIOL 5650	Marine Biology	X		X
BIOL 5750	Medical Microbiology	X		
BIOL 5780	Phycology	X		X
BIOL 5810	Ichthyology	X	X	X
BIOL 5820	Mammalogy	X		X
BIOL 5830	Herpetology	X		X
BIOL 5840	Limnology	X		X
BIOL 5850	Applied Microbiology	X		X
BIOL 5860	Disease Prevention	X		
BIOL 6140	Fish & Wildlife Biometrics	X		X
BIOL 6150	Reservoir Fisheries Mgmt.	X		X
BIOL 6600	Microbial Ecology	X		X
BIOL 6630	Animal Ecology	X		X
BIOL 6660	Fish Ecology	X	X	X
BIOL 6670	Stream Ecology	X		X
BIOL 6680	Malacology	X		X
BIOL 6810	Ecological Ordination	X		X
BIOL 6930	Seminar	X	X	X
BIOL 6990	Research and Thesis	X		X
EVS 7900	Scientific Writing & Grantsmanship	X		
EVS 6010	Environmental Biology	X	X	X
EVS 7110	Environmental Approaches to Fish Management	X		X
EVS 7120	Endangered Species Biology	X		X
EVS 7130	Wetlands Ecology	X		X
EVS 7140	Wildlife & Fisheries Nutrition	X		X
EVS 7150	Pop. & Community Ecology	X		X
EVS 7230	Molecular Ecology and Evolution	X		X

WFS 5500	National Wildlife Policy	X	X	X
WFS 5640	Waterfowl Ecology & Mgmt.	X		X
WFS 5660	Wild Bird Ecology	X		
WFS 5670	Wild Mammal Ecology	X		
WFS 5700	Habitat Management			X
WFS 5710	Fisheries Management			X
WFS 5711	Fisheries Management			X
WFS 5730	Conservation Biology		X	X
WFS 5740	Wildlife Principles	X		X
WFS 5760	Fish Culture		X	
WFS 5770	Nongame Species Mgmt.	X	X	
WFS 5870	GIS for Wildlife & Fisheries	X		

Appendix 2: Thesis Defense Rubric

BIOLOGY DRAFT

EVALUATION RUBRIC: THESIS (M.S.) DEFENSE EXAM (Draft)

Candidate Name: _____ Date: _____

Title of Thesis: _____

Evaluation/Guidance	Does not meet Expectations	Meets Expectations	Exemplary Performance
1. Problem Definition: Has stated the research problem clearly, providing motivation for undertaking the research			
2. Literature and Previous Work: Demonstrated sound knowledge of literature in the area, and of prior work on the specific research problem			
3. Impact of Proposed Research: Demonstrated the potential value of solution to the research problem in advancing knowledge within the area of study			
4. Solution Approach: Has applied sound state-of-the-field research methods/tools to solve the defined problem and has described the methods/tools effectively			
5. Results: Analyzed and interpreted research results/data effectively			
6. Quality of Written and Oral Communication: Communicates research results clearly and professionally in both (a) written and (b) oral form	(a) _____ (b) _____	(a) _____ (b) _____	(a) _____ (b) _____
7. Critical Thinking: Has demonstrated capability to use scientific reasoning as codified in the scientific method			
8. Demonstrated a command of principles within general biology and specialized discipline in area of interest			
9. Participated in extracurricular activities related to discipline. Activities may include student/professional organizations, attendance at scientific meetings, etc.			

Based on evidence provided in the items above:

_____ Student Passes Thesis Defense Exam

_____ Student Does Not Pass Thesis Defense Exam

Name of Committee Chair: _____

Signature of Committee Chair: _____