Institutional Effectiveness

2019-2020

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 competed 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

The Department of Biology has monitored enrollment trends for several years and used these trends to develop strategies to meet this goal [Program Goal 1 (Table 1)]. In 2019, enrollment surpassed all recent years with 24 M.S. students, due primarily to an increase in externally-funding grants, enabling faculty to bring in more students on research assistantships. Retention of M.S. students has been approximately 100% since 2005, with all but two students graduating.

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

Fall	Number of Graduate Students
2015	21
2016	16
2017	20
2018	19
2019	24

PG 2: Increase diversity

Efforts to increase diversity have met with mixed results (Table 2). Very few minorities have enrolled in our graduate program; four were enrolled in 2017, with this percentage being the highest in recent history. During all but the most recent two years, at least 50% of our M.S. students have been female.

Since the majority of our graduate students conduct natural resource research, NAUFWP data for 2010-2011 indicate that females represent approximately 44% of graduate students enrolled in natural resource graduate programs. The percent females in our program exceed this during the last five years except 2019. NAUFWP data for 2010-2011 also indicate that minorities represent approximately 13% of students in natural resource graduate programs. Minority representation in our graduate program is low. NAUFWP survey data is to be collected again in 2020-21, and these updated numbers will be used in next year's report.

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

Year	Percent Minority Graduate Students	Percent Female Graduate Students
2015	0.0	52.4
2016	12.5	62.5
2017	20.0	50.0
2018	0.0	42.1
2019	4.2	33.3

PG 3: Increase faculty involvement in research

Three promotions occurred in the last five years (Table 3); one Assistant Professor received tenure and was promoted in 2017, and two Assistant Professors received tenure and were promoted in 2018.

Table 3. Number of faculty promoted to the rank of Associate Professor and Professor.

Fall	Associate Professor	Professor
2015	0	0
2016	0	0
2017	1	0
2018	2	0
2019	0	0

To date three members of the faculty have selected the research option over the past 5 years. The majority of faculty members selected the standard option, and one of the senior-most faculty members (who retired after Fall 2019) selected the teaching option. However, the number of faculty members actively engaged in research with graduate students has been consistently at or above 80% (Table 4).

Table 4. Number of graduate faculty members actively engaged in research with graduate students.

Fall	Number of Faculty Conducting Research with Graduate Students	Percent of Departmental Faculty
2015	14	82.4
2016	14	81.3
2017	13	92.3
2018	12	80.0
2019	13	81.3

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

All students successfully passed their oral exams during the first attempt in the 2019-2020 academic year, and many demonstrated a mastery of the subject matter of which they were tested by presenting either oral or poster presentations at scientific meetings at the local, regional, or national level (Table 5). This number would likely be higher if a number of meetings were not canceled due to COVID-19 during the Spring and Summer of 2020.

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

Year	Number of Graduate Students Presenting	Total Number of Graduate Students	Percent of Students Presenting
2015-16	11	21	69
2016-17	12	16	60
2017-18	3	20	16
2018-19	4	19	17
2019-20	7	24	25

SLO 2: Participate in extracurricular activities

Almost all graduate students participated in extracurricular activities; in particular, many assist with projects other than their own research. We are especially pleased that many graduate students attended at least one scientific meeting per year, and many presented their research findings at these meetings via oral or poster presentations (Table 5).

SLO 3: Use scientific reasoning

Comprehensive Oral Exams All students successfully passed their oral exams during the first attempt, and many demonstrated a mastery of the subject matter of which they were tested (Table 6).

Graduate Seminar Evaluation The high graduation rate (Table 6) and written demonstration of scientific reasoning in theses and oral demonstration in seminars are indications that Learning Outcome 3 is being achieved. Graduate students in the Department of Biology are extremely serious about seminar presentations, and most of them deservedly receive A's for this component of their program.

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

Year	Number of Graduates
2014-2015	5
2015-2016	5
2016-2017	9
2017-2018	7
2018-2019	8
2019-2020	6

Modifications for Improvement

PG 1: Increase graduate student enrollment

This goal will remain unchanged as we are filling all the institutionally sponsored assistantships and recruiting some students through external funds. Likewise, our retention and graduation rate are very high indicating our current model is working well.

The departmental Graduate Policies Committee meets several times per year to analyze data and interpret results. Recommendations for enhancing the graduate program are discussed at departmental faculty meetings and policies affecting the program voted upon before implementation. The number of M.S. students should increase going forward, primarily the result of faculty obtaining grants that enable them to pursue research assistantships for students.

PG 2: Increase diversity

The department assigned an ad-hoc committee to assess what changes needed to be made to increase diversity within the program. Options were considered by the faculty during the 2016-2017 academic year. It was decided to allow recruitment of minorities by individual faculty members; that decision has already resulted in two minorities being accepted in the M.S. program for the 2017-2018 academic year. We plan to continue this process.

The departmental Graduate Policies Committee continues to monitor these data and make recommendations to the department concerning recruitment opportunities. We intend to target traditional minority institutions that have undergraduate programs compatible with our primary areas of research (i.e., environmental biology and wildlife and fisheries) and recruit through institutional contacts.

PG 3: Increase faculty involvement in research

No changes to the program goal will be made as there is still room for improvement. New hires, due to retirements, are expected to increase the number of faculty members involved in research and active with graduate students.

Newly hired faculty members are encouraged to develop their research and graduate programs upon arrival. With the implementation of the differential teaching load, faculty members are annually encouraged to select either the standard or research option when discussing agreements of responsibility with the chairperson.

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

No changes to the current learning objective will be made. A program review was provided for the M.S. program during the 2015-2016 academic year. One of the suggestions that is related to this outcome was to quantify the results beyond pass and fail. Following a faculty decision as to how this suggestion is to be addressed, we will modify the student learning outcome accordingly. However, there has been no strong desire to move to a letter-graded system among the graduate faculty.

We have been very pleased with the performance of our graduate students in these areas on comprehensive oral examinations. The departmental Graduate Policies Committee will continually monitor results of comprehensive oral exams to ensure that this outcome continues to be met. Faculty members on graduate committees are responsible for ensuring that consistency and quality of comprehensive oral examinations are maintained.

We have overall been very pleased with the performance of our graduate students on comprehensive oral examinations. One area for improvement here is to make this assessment more quantitative, and keep better records at the departmental level of percentage of questions answered correctly. Faculty chairs on graduate committees are responsible for keeping track of this for individual students, but we currently do not have a reporting requirement for these results, either to the department chair or to the Graduate Policies committee

SLO 2: Participate in extracurricular activities

No changes will be made to this learning objective as there is room for improvement.

Faculty graduate advisors report graduate student extracurricular activity participation to the departmental chair in their annual activity reports. The chair summarizes these data and includes them in the departmental Annual Report submitted to the Dean of the College of Arts and Sciences. The departmental Chair administers a questionnaire to those graduating. Even though the number of graduates each year is small, this provides a much-improved method for assessing progress towards this learning outcome.

SLO 3: Use scientific reasoning

No changes to the current learning objective will be made. A program review was provided for the M.S. program during the 2015-2016 academic year. One of the suggestions that was related to this outcome was to quantify the results. Following a faculty decision addressing this issue, we will modify the student learning outcome accordingly. However, there has been no strong desire among the graduate faculty to move beyond a pass/fail decision.

An ultimate produce of this outcome is the number of publications and presentations that include graduate students as the lead author or co-author. The departmental chair continues to monitor the number of publications and presentations resulting from graduate student research, as reported in faculty activity reports.

Appendices

1. Curriculum Map

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.

		Learning Outcomes		
Course No.	Title	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		
EVSB 6010	Environmental Biology	X	X	X
EVSB 7110	Environmental Approaches to Fish Management	X		X
EVSB 7120	Endangered Species Biology	X		X
EVSB 7130	Wetlands Ecology	X		X
EVSB 7140	Wildlife & Fisheries Nutrition	X		X
EVSB 7150	Pop. & Community Ecology	X		X
EVSB 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		