Institutional Effectiveness
2023-2024

Program: Wildlife and Fisheries Science BS
College and Department: Department of Biology
Contact: Steve Hayslette
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.

Attach Curriculum Map (Educational Programs Only):
See attached file.
Attached Files: See Appendix 1

Outcome 1: Improved Critical Thinking

Define Outcome:
Graduating seniors in the WFS Program within the Department of Biology will demonstrate critical thinking skills by meeting or exceeding the national average score on the California Critical Thinking Skills Test.

Assessment Methods:
The California Critical Thinking Skills Test (CCTST) will be used. This test is administered as a senior exit exam for all graduating TTU seniors, and the results reported to the Department of Biology.

Criteria for Success (Thresholds for Assessment Methods):
Average score for all graduating WFS seniors will meet or exceed the national average on the CCTST.

Link to 'Tech Tomorrow' Strategic Plan:
2.B Research, Scholar, Intellect, and Creativity

Results and Analysis:
Graduating seniors in the Wildlife and Fisheries Science major exceeded the national average in the California Critical Thinking Skills Test (CCTST; Table 1) in four of the last five years, meeting our criterion for success for this learning outcome. CCTST scores for WFS majors were below the national average during the first year of the COVID pandemic (2020-21) but have rebounded since, returning to the pre-pandemic level this past year.

Table 1. Average score for Wildlife and Fisheries Science (WFS) majors, along with sample size (n), on the California Critical Thinking Skills Test during the past 5 academic years.

Academic Year	Tennessee Tech WFS	*n*	National Average
2019-2020	75.0	10	74.0
2020-2021	73.2	15	74.0
2021-2022	74.1	39	73.3
2022-2023	73.8	34	73.3
2023-2024	75.0	38	72.8

Use of Results to Improve Outcomes:
We are pleased that our Wildlife and Fisheries Science students generally have scored above the national average with respect to critical thinking, but clearly there is room for improvement. The Department of Biology has a committee in place to evaluate our introductory (General Biology) courses, with an eye toward improving the skill sets of our students, including critical thinking/active learning.

Outcome 2: Experiential Learning

Define Outcome:
Students majoring in WFS will gain real-world experience in their chosen fields by participating in some type of experiential learning (coops, internships, research), with 10% of our students involved in some type of experiential learning during their time at TTU.

Assessment Methods:
On the department senior questionnaire, students are asked to indicate whether they have had any type of experiential learning: coops, internships, undergraduate research, job shadowing, or other related activities.

Student involvement in internships is traced via enrollment in WFS 4900, Internship in Biology.

Undergraduate research activity is tracked via Faculty annual reports, where faculty are asked to include a list of undergraduates who have worked in their research lab over the preceding year.

Criteria for Success (Thresholds for Assessment Methods):
Combining data from all three assessment methods, a minimum of 10% of graduating seniors will show evidence of some type of experiential learning during their time at Tennessee Tech.

Link to 'Tech Tomorrow' Strategic Plan:
1.A Experiential Learning,2.B Research, Scholar, Intellect, and Creativity

Results and Analysis:
Participation in internships and co-op assignments has traditionally been examined using our departmental senior questionnaire, given at the time of the major field exam. In 2020-2021, due to the COVID pandemic, this test was moved online, and no questionnaires were given. In 2021-2022, few seniors returned their questionnaire, so we used information from enrollment in our Internship in Wildlife and Fisheries Science course (WFS 4900). Although participation in experiential learning could not be estimated in 2020-2021, such participation exceeded our goal in all other reported years, including dramatic increases in the last two years.

Beginning in 2022-2023, we were once again able to get good response rates using our senior questionnaires, and we expanded our definition of experiential learning to include students engaged in undergraduate research. This information was obtained from faculty annual reports in 2022-23 and from senior questionnaires in 2023-24. This was done following discussion that indicated that many faculty consider research as another type of experiential learning, and an important one at that. Using this updated measure, we found that as many as one third of graduating WFS seniors engaged in one of the three types of experiential learning (Table 2).

Table 2. Percent of graduating seniors in Wildlife and Fisheries Science indicating participation in an experiential learning opportunity. From 2019-20 through 2021-22, an experiential learning opportunity was defined as an internship or a coop assignment; starting in 2022-23, this was expanded to include undergraduate research participation.

Academic Year	Sample Size (*n*)	Percent
2019-2020	16	18.8
2020-2021	N/A	N/A
2021-2022	43	20.9
2022-2023	32	37.5
2023-2024	37	29.7

Use of Results to Improve Outcomes:
Increases in the percentage of Wildlife and Fisheries students participating in experiential learning since the pandemic may have been related to concerted efforts to make students aware of such opportunities via our program email lists and other outlets. Inclusion of research experience as experiential learning also likely contributed to the increases we documented in the last two years, and increased response rates for our senior questionnaire may have been involved, as well. In 2024-25, we will continue to promote internship involvement by disseminating information about these opportunities via email to advisors and students. We will also promote these opportunities on our recently-established social media accounts.

Outcome 3: Understanding Scientific Reasoning

Define Outcome:
Students majoring in WFS will demonstrate an understanding of scientific reasoning by having 80% (or more) of students obtaining a perfect score on the departmental Scientific Method Questionnaire.

Assessment Methods:
Scientific Method Questionnaire, developed internally by the Department of Biology. This is administered to graduating seniors either during BIOL 3920 (Biological Communication Skills) or at the time they take the ACAT major field exam.

Criteria for Success (Thresholds for Assessment Methods):
A minimum of 80% of students will achieve a perfect score on the Scientific Method Questionnaire.

Link to 'Tech Tomorrow' Strategic Plan:
2.B Research, Scholar, Intellect, and Creativity

Results and Analysis:
Biological Communication Skills (BIOL 3920) is a course taken by all Biology and Wildlife and Fisheries Science majors, typically during their junior or senior year. Average scores on the departmental scientific method quiz have been in the high 80s - low 90s over the past five years (Table 3). The percentage of students who score a perfect 100% has continually been below the department's goal of 80%, but has shown some improvement over the past five years (Table 3).

Table 3. Student performance on the scientific method quiz administered to Biology department students (including Wildlife and Fisheries Science students) in BIOL 3920 (Biological Communication Skills). All data are given as percentages.

Academic Year	Average Score (%)	100% Correct (%)
2019-2020	88.5	46.2
2020-2021	91.4	52.9
2021-2022	90.7	56.0
2022-2023	92.4	64.3
2023-2024	90.1	54.3

Use of Results to Improve Outcomes:
With the demise of our BIOL 1000 course, we've adjusted this outcome to reflect only performance by our upper-level students.

We are in the process of looking at our freshmen Biology sequence, and part of that process will likely include discussions of how to better include ideas related to the scientific method in these courses (as well as carry that through to our upper-level classes).

Also, as a department, we decided this year to adjust our criteria for success in this outcome. Rather than use the percentage of students achieving a perfect score on our scientific method questionnaire alone, we added an overall performance criterion of 90% on the Questionnaire. We also lowered our perfect-score criterion to 50%, which we feel is more realistic. In recent years, even students who achieved overall high (90%+) scores on the Questionnaire rarely scored perfectly. We will assess our progress with this outcome using these new criteria in future years.

Outcome 4: Command of General WFS Concepts

Define Outcome:
Students majoring in WFS will demonstrate a command of general biological information in selected fundamental areas of study by having all graduating seniors score at or above the national average in a minimum of 3 of the 5 tested categories.

Assessment Methods:
The ACAT exam is given as the department major field exam to all graduating seniors each Fall and Spring semester. We test our students in 5 categories: ecology; invertebrate zoology; vascular botany; vertebrate zoology; and forestry & wildlife. Exams are taken online, and scores are reported back to the department by the test providers. Each student has an aggregate score, as well as a score for each of the 5 subject areas.

Criteria for Success (Thresholds for Assessment Methods):
Students will meet or exceed the national average in at least 3 of the 5 subject areas on the ACAT exam.

Link to 'Tech Tomorrow' Strategic Plan:
2.B Research, Scholar, Intellect, and Creativity

Results and Analysis:
The ACAT exam is our departmental major field exam, given to students during their final semester before graduation. For students majoring in Wildlife and Fisheries Science, students are scored on each of five content areas, as shown in Table 4. Scores are scaled so that the national average is 500, and this score marks the 50th percentile. Our department goal is to have students score at or above the national average in at least 3 of the 5 content areas each year.

Graduating seniors in Wildlife and Fisheries Science have met our goal in each of the last five years. Students met or exceeded the national average in all five content areas during 2019-20 and 2021-22, although the 2019-20 data only reflect the fall semester that year. Students met or exceeded the national average in four of the five content areas during 2020-21 and in three of the five content areas during the last two years (2022-23 and 2023-24).Wildlife and Fisheries students generally have scored highest in Ecology, Vascular Botany, and Forestry and Wildlife, meeting or exceeding the national average in all or most of the five reported years. Results seem to indicate declines in the fields of Invertebrate and Vertebrate Zoology in the last two years, however.

Table 4. Average scores and average percentiles from the past five academic years for each of the five content categories from the ACAT Wildlife and Fisheries Science exam taken by graduating students majoring in Wildlife and Fisheries Science. Sample size (*n*) is given after the academic year, and includes both Fall and Spring semester data. Percentiles meeting or exceeding our goal of 50% are shown in bold. NOTE: Data from the Spring 2020 semester is not included; due to the COVID pandemic, very few students were able to take the exam that semester.

	Ecology		Invertebrate Zoology		Vascular Botany		Vertebrate Zoology		Forestry and Wildlife	
Year (*n*)	Score	%ile	Score	%ile	Score	%ile	Score	%ile	Score	%ile
2019-20 (19)	516	**56**	525	**60**	528	**61**	507	**53**	533	**63**
2020-21 (17)	506	**52**	555	**71**	513	**55**	527	**61**	487	45
2021-22 (19)	537	**64**	571	**76**	553	**70**	542	**66**	526	**60**
2022-23 (33)	523	**59**	473	39	515	**56**	481	42	511	**54**
2023-24 (35)	526	**60**	476	41	522	**59**	484	44	542	**66**

Use of Results to Improve Outcomes:

Our Wildlife and Fisheries students have consistently met our desired outcome with respect to ACAT Exam results and associated subject matter knowledge, but performance in some subject areas, notably the Zoology areas, seems to have declined over the past two years. The Department of Biology has created a committee this academic year to examine our introductory (General Biology) courses. Improvements in the content and/or delivery of these courses could better prepare students for learning more complicated material in upper-division courses, which may be reflected in future improvements in ACAT exam performance. Specific efforts to target improvements in Zoology instruction (e.g., our General Zoology - BIOL 1113 and Invertebrate Zoology - BIOL 4610 courses) are also planned for 2024-25.

Additionally, we decided this year as a department to fine-tune our ACAT assessment tool by varying the subject areas tested by concentration, rather than by major alone. This will allow us to better test students in the subject areas covered by coursework in their concentrations, as course content varies somewhat among the concentrations in our Wildlife and Fisheries Science degree. This ACAT adjustment will be implemented in the coming year.

List of Appendices:

Appendix 1: Wildlife and Fisheries Science Curriculum Map

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Curriculum support for learning outcomes of the undergraduate programs in the Department of Biology.

		Learning Outcomes			
Course No.	Title	Critical Thinking	Experiential Learning	Scientific Method	Demonstrated Knowledge
BIOL 1010	Introduction to Biology	X		X	X
BIOL 1020	Diversity of Life	X		X	X
BIOL 1080	Concepts of Biology	X	X	X	X
BIOL 1113	General Biology I	X		X	X
BIOL 1123	General Biology II	X			X
BIOL 2000	Biological Terminology				X
BIOL 2010	Human Anat. & Phys. I	X		X	X
BIOL 2020	Human Anat. & Phys. II	X		X	X
BIOL 2310	General Botany	X	X		X
BIOL 2350	Intro. Anat. & Phys.	X			X
BIOL/WFS 2991-4	Topics				X
BIOL 3040	Comparative Vert. Anat.	X			X
BIOL 3120	General Ecology (no lab)	X		X	X
BIOL/WFS 3130	General Ecology	X		X	X
BIOL 3140	Cellular Biology	X	X	X	X
BIOL 3200	General Microbiology	X		X	X
BIOL 3230	Health Science Microbiol.	X		X	X
BIOL 3240	Field Botany	X		X	X
BIOL 3330	Entomology				X
WFS/CJ 3500	Wildlife Law Enforcement		X		X
BIOL 3530	Animal Physiology	X			X
WFS 3550	Wildlife Damage Manage.	X	X		X
BIOL 3700	Humanism in Medicine	X			X
BIOL 3810	General Genetics	X		X	X
BIOL 3920	Biol. Comm. Skills	X	X	X	X
BIOL 4000	General Parasitology	X			X
BIOL 4040	Immunology	X			X
BIOL 4060	Hormones/Chem. Comm.	X			X
BIOL 4070	Vertebrate Development	X			X
BIOL 4100	Evolutionary Biology	X	X	X	X
BIOL 4110	Microbial Evolution	X			X
BIOL 4130	Enviro. Microbiology	X		X	X
BIOL 4140	Pathogenic Bacteriology	X			X
BIOL 4150	Molecular Genetics	X			X
BIOL 4160	Genetic Engineering Lab				X
BIOL/WFS 4220	Biostatistics	X		X	X
BIOL/WFS 4230	Animal Behavior	X			X
BIOL 4240	Systematic Botany	X			X
BIOL 4250	Economic Botany	X			X

BIOL 4300	Plant Speciation and Evol.	X			X
BIOL 4310	Plant Anatomy	X			X
BIOL 4320	Plant Physiology	X	X	X	X
BIOL 4330	Plant Ecology	X		X	X
BIOL 4340	Plant-Animal Interactions	X			X
WFS 4500	National Wildlife Policy	X	X		X
BIOL 4610	Invertebrate Zoology	X		X	X
BIOL/WFS 4630	Ornithology	X			X
WFS 4640	Waterfowl Ecology & Mgt.	X			X
BIOL/WFS 4650	Marine Biology	X		X	X
WFS 4660	Wild Bird Ecology				X
WFS 4670	Wild Mammal Ecology				X
WFS 4700	Habitat Management	X		X	X
WFS 4710	Fisheries Management	X		X	X
WFS 4711	Fisheries Mgmt. (no lab)	X			X
WFS 4730	Conservation Biology	X	X	X	X
WFS 4740	Wildlife Principles	X		X	X
BIOL 4750	Medical Microbiology	X			X
WFS 4760	Fish Culture	X	X		X
WFS 4770	Nongame Species Mgmt.	X	X		X
BIOL 4780	Phycology	X		X	X
WFS 4790	Wildlife Techniques	X	X	X	X
WFS 4800	Conservation Techniques	X	X	X	X
BIOL/WFS 4810	Ichthyology	X	X		X
BIOL/WFS 4820	Mammalogy	X	X		X
BIOL/WFS 4830	Herpetology	X	X		X
BIOL/WFS 4840	Limnology	X		X	X
BIOL 4850	Applied Microbiology	X		X	X
BIOL 4860	Disease Prevention	X			
BIOL 4870	Microbiomes	X			
WFS 4870	GIS For Wildlife & Fish.				X
BIOL 4880	Bioethics	X			X
BIOL 4890	Histology				X
BIOL/WFS 4900	Internship		X		X
BIOL/WFS 4991-4	Advanced Topics	X	X		X