

**Institutional Effectiveness
2022-2023**

Program: Wildlife and Fisheries Science BS

College and Department: College of Arts & Sciences

Contact: Chris 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.

Attach Curriculum Map (Educational Programs Only): *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.

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 declined somewhat during the two primary years of the COVID pandemic, but scores have begun to rebound during the past two academic years.

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	<i>n</i>	National Average
2018-2019	76.0	36	74.0
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

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 created a committee this academic year to examine our introductory (General Biology) courses, concurrent with the university's re-evaluation of its General Education program. Inclusion of more critical thinking/active learning components in these courses could further improve our WFS students' critical thinking skills.

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.

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). Participation in experiential learning fell short of our goal of 10% during 2018-2019 and could not be estimated in 2020-2021, but such participation exceeded our goal in 2019-2020 and 2021-2022 (Table 2).

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. 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 greater than 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 2018-19 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 (<i>n</i>)	Percent
2018-2019	22	9.1
2019-2020	16	18.8
2020-2021	NA	NA
2021-2022	43	20.9
2022-2023	32	37.5

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 large jump we documented this year. Efforts in 2023-24 will include making *all advisors* in this program aware of experiential learning opportunities (e.g., internships), as well as our students. Successful in securing internships in Wildlife and Fisheries Science often involves (and sometimes requires) the involvement of an advisor, and we hope that making them aware of these opportunities will improve participation in these experiences.

Response rates in the questionnaire used to estimate this percentage were greatly improved this year, as it was administered in person during our departmental senior exit exam. The

department will continue to seek ways of improving this response rate, including the possibility of incorporating the survey into a required course.

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.

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 also continuously improved over each of 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 (%)
2018-2019	86.9	40.7
2019-2020	88.5	46.2
2020-2021	91.4	52.9
2021-2022	90.7	56.0
2022-2023	92.4	64.3

Use of Results to Improve Outcomes:

Despite efforts to include instruction in the scientific method in several of our introductory biology classes, our students clearly are falling short of our desired level of mastery when it comes to this topic. The Department of Biology has created a committee this academic year to examine these introductory (General Biology) courses, concurrent with the university's re-evaluation of its General Education program. One possible outcome of this committee's work could be an increased emphasis on the process of scientific inquiry in these classes, which should lead to better general understanding of the scientific method.

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.

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 one year (2020-2021), in four of the five content areas during three years (2018-19, 2019-20, and 2021-2022), and in three of the five content areas during the most recent year (2022-23). Wildlife and Fisheries students generally have scored highest in Ecology and Vascular Botany, meeting or exceeding the national average in all five reported years. Students met or exceeded the

national average during in four of the five reported years in two content areas, Vertebrate Zoology and Forestry and Wildlife. Student performance has been lowest in Invertebrate Zoology, with students meeting or exceeding the national average in only two reported years.

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. 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.

Year (<i>n</i>)	Ecology		Invertebrate Zoology		Vascular Botany		Vertebrate Zoology		Forestry and Wildlife	
	Score	%ile	Score	%ile	Score	%ile	Score	%ile	Score	%ile
2018- 19 (22)	513	55	526	46	531	62	529	61	529	61
2019- 20 (19)	516	56	525	44	528	61	507	53	533	63
2020- 21 (15)	500	50	554	55	512	55	529	61	500	50
2021- 22 (19)	527	60	561	53	543	67	530	62	479	42
2022- 23 (33)	522	59	472	39	515	56	481	43	511	54

Use of Results to Improve Outcomes:

Our Wildlife and Fisheries students have met our desired outcome with respect to ACAT Exam results and associated subject matter knowledge, but 1) some subject areas have not been as strong as others, and 2) results were not as strong this year as in past years. The Department of Biology has created a committee this academic year to examine our introductory (General Biology) courses, concurrent with the university's re-evaluation of its General Education program. 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.

OUTCOME 5: DIVERSITY IN WFS

Define Outcome:

The Department of Biology will seek diversity amongst students majoring in Biology by having a minimum of 10% of WFS majors be from underrepresented groups as determined by department enrollment information.

Assessment Methods:

Percentage of students in underrepresented groups (e.g., minority students) will be obtained from enrollment data provided by the Office of Institutional Assessment, Research, and Effectiveness (IARE).

Criteria for Success (Thresholds for Assessment Methods):

A minimum of 15% of students majoring in WFS will come from underrepresented groups, as determined by data from IARE.

Results and Analysis:

For the purposes of this Outcome, minority students were defined using the sum of the percentages of all non-White racial/ethnic categories from the Tennessee Tech Institutional Dashboard. With regard to the percentage of students identifying as a racial/ethnic minority, the Wildlife and Fisheries Science program in the Department of Biology has improved toward its goal of 10% over the last five years, exceeding that goal during the 2021 academic year (Table 5).

Female enrollment as a percentage of total enrollment in Wildlife and Fisheries was steady during the pre-pandemic and pandemic years but has increased nearly 10% since the pandemic; nearly 40% of Wildlife and Fisheries students identified as female in 2022.

Table 5. Percent of Wildlife and Fisheries Science majors identifying as a minority student or as a female student. Data are based on enrollments at the start of the Fall semester of the corresponding year.

Year	Minority Students (%)	Female Students (%)
2018	5.2	30.2
2019	7.4	29.1
2020	7.6	30.8
2021	12.2	37.2

Use of Results to Improve Outcomes:**Summative Evaluation:**

Outcome 1: The Department of Biology has created a committee this academic year to examine our introductory (General Biology) courses, concurrent with the university's re-evaluation of its General Education program. Inclusion of more critical thinking/active learning components in these courses could further improve our WFS students' critical thinking skills.

Outcome 2: Efforts in 2023-24 will include making all students *and advisors* in this program aware of experiential learning opportunities (e.g., internships). Successful in securing internships in Wildlife and Fisheries Science often involves (and sometimes requires) the involvement of an advisor, and we hope that making them aware of these opportunities will improve participation in these experiences. The department will continue to seek ways of improving this response rate, including the possibility of incorporating the survey into a required course.

Outcome 3: The Department of Biology has created a committee this academic year to examine these introductory (General Biology) courses, concurrent with the university's re-evaluation of its General Education program. One possible outcome of this committee's work could be an increased emphasis on the process of scientific inquiry in these classes, which should lead to better general understanding of the scientific method.

Outcome 4: The Department of Biology has created a committee this academic year to examine our introductory (General Biology) courses, concurrent with the university's re-evaluation of its General Education program. 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.

Assessment Plan Changes:

none

Appendix 1: Curriculum Map, Wildlife and Fisheries Science

Table 16. Curriculum support for learning outcomes of the undergraduate programs in the Department of Biology.

Course No.	Title	Learning Outcomes			
		Critical Thinking	Extra-curricular Activities	Scientific Method	Demonstrated Knowledge
BIOL 1000	Intro. to Biol. Methods	X	X	X	
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 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
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	X
BIOL 4100	Evolutionary Biology	X	X	X	X
BIOL 4110	Microbial Evolution	X		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 4170	Pop. & Conserv. Genetics	X			X
BIOL/WFS 4220	Biostatistics	X		X	X
BIOL/WFS 4230	Animal Behavior	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	X
WFS 4500	National Wildlife Policy	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
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	
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			X
WFS 4870	GIS for Wildlife & Fish.				X
BIOL/WFS 4900	Internship				X
BIOL/WFS 4991-4	Advanced Topics	X	X		X