ACADEMIC & STUDENT AFFAIRS COMMITTEE

March 12, 2026

Roaden University Center, Room 282

AGENDA

I. Call to Order

II. Approval of Minutes for the December 4, 2025 Committee Meeting

III. Enrollment Update

IV. Provost's Report

V. New Academic Program Proposal (NAPP) for the Ph.D. in Integrative Biology

VI. Other Business

VII. Adjournment

ACADEMIC & STUDENT AFFAIRS COMMITTEE

December 4, 2025

Roaden University Center, Room 282

MINUTES

Meeting was streamed live via link found on this web page:
https://www.tntech.edu/board/board-and-board-committee-meetings.php

AGENDA ITEM 1 – CALL TO ORDER

The Tennessee Tech Board of Trustees Academic & Student Affairs Committee met on December 4, 2025, in Roaden University Center, Room 282. Chair Camron Rudd was absent; therefore, Board Chair Rhedona Rose was a voting member and acted as Chair of the Academic & Student Affairs Committee for this meeting as allowed per Policy 005. Chair Rhedona Rose called the meeting to order at 8:42 a.m.

Chair Rose asked Mr. Lee Wray, Secretary, to call the roll. The following members were present:

- Michael Allen
- Teresa Chasteen-Dunn
- Allen Foster
- Garry McNabb
- Rhedona Rose
- Braxton Westbrook

Other board members also in attendance were Trudy Harper, Tom Jones, Thomas Lynn, Fred Lowery (virtual), and Barry Wilmore. A quorum was met. Tennessee Tech faculty and staff and members of the public were also in attendance.

AGENDA ITEM 2 – APPROVAL OF MINUTES

Chair Rose asked for approval of the minutes of the September 25, 2025 Academic & Student Affairs Committee meeting. Trustee McNabb moved to approve the September 25, 2025

Academic & Student Affairs Committee minutes. Trustee Allen seconded the motion. Chair Rose called a voice vote. The motion carried unanimously.

AGENDA ITEM 3 – Provost's Report

Interim Provost Liu began his presentation by sharing quality assurance funding information with Board members. He gave an update on Tennessee Tech's score in 2025 and then compared that score with other universities' scores in the state. He also explained where the loss of points occurred.

Next, Provost Liu provided a Southern Association of Colleges and Schools Commission (SACSCOC) accreditation update. He explained that the accreditation is on a ten-year cycle and that this upcoming year there will be an on-site visit. He further explained that the review is split into two parts, an off-site review which has been completed and the upcoming on-site review. Provost Liu also updated Board members that recently SACSCOC made the Quality Enhancement Plan (QEP) optional.

President Oldham added to the presentation by giving new Board members a more in-depth explanation of the accreditation cycle and process. He shared the importance of the process, provided details of the previous results, and mentioned the Board's role during the upcoming on-site visit.

AGENDA ITEM 4 – Academic Program Modification (APM) for the BS in Artificial Intelligence

Interim Provost Liu began this presentation by updating Board members that Artificial Intelligence was recently elevated from a concentration to a major at Tennessee Tech. He provided an explanation of why this concentration was chosen for elevation. He explained that this program was approved by THEC and was being presented to the Board for informational purposes. He then shared examples of recent media coverage surrounding the new major at Tennessee Tech before answering questions from Board members.

AGENDA ITEM 5 – Academic Program Update: Post Approval Monitoring

Interim Provost Liu gave an annual update on new academic programs previously approved by the Board of Trustees over the last several years. He explained that relevance of programs is important and that we are continuously monitoring our current programs and potential programs to stay relevant.

AGENDA ITEM 6 – New Academic Program Proposal (NAPP) for the Master of Social Work

Interim Provost Liu began by informing Board members that the New Academic Program Proposal (NAPP) for the Master of Social Work requires Board approval. He explained that a grant was awarded to help start the program and shared some key features of the proposed program including potential candidates, the modality of the program, licensure information, as

well as accreditation plans for the program. Provost Liu then discussed the need for the program, as well as the targeted student population, before finishing with the enrollment projections, along with instructional cost and revenue projections.

Chair Rose asked for a motion and a second to move the New Academic Program Proposal (NAPP) for the Master of Social Work to the Board's regular agenda. Trustee Allen moved to send the NAPP for the Master of Social Work to the Board for approval and to place it on the Board's regular agenda. Trustee McNabb seconded the motion. Chair Rose asked for a roll call vote. The motion carried unanimously.

AGENDA ITEM 7 – TTU Policy 207 (Tenured Faculty)

Interim Provost Liu began his presentation by informing the Board members that Policy 207 (Tenured Faculty) is reviewed every four years or earlier as necessary and is an action item requiring Board approval. He also explained that this policy received all other necessary university approvals before being brought before the Board. Provost Liu explained who the policy covers and gave an overview of the proposed changes that were made, noting no major changes were made.

Provost Liu answered several questions from Board members regarding Policy 207 and Chair Rose asked for a motion and a second to move the policy to the Board's regular agenda. Trustee Allen moved to send Policy 207 to the Board for approval and to place it on the Board's regular agenda. Trustee McNabb seconded the motion. Chair Rose asked for a roll call vote. The motion carried unanimously.

AGENDA ITEM 8 – Student Affairs Update-Mental Health Services

Dr. Christina Mick, Director, Center for Counseling and Mental Health Wellness, provided an update on mental health services for the Center for Counseling and Mental Health Wellness. She began her presentation by sharing new initiatives in the center. She then shared information on student utilization of counseling and mental health services from 2021 through 2025. She then provided details on the number of counseling sessions per academic year for academic years 2021/2022 through 2024/2025. She also provided detailed information on the monthly distribution of appointments for year 2024-2025; as well as reasons for clinical sessions at appointment check-in.

Dr. Mick concluded her presentation by sharing information on campus innovative mental health solutions that are currently in place.

AGENDA ITEM 9 – OTHER BUSINESS

There was no other business.

AGENDA ITEM 10 – ADJOURNMENT

There being no further business, the Academic & Student Affairs Committee adjourned at 9:50 a.m.

Approved,

Lee Wray, Secretary

Agenda Item Summary

Date: March 12, 2026

Agenda Item: Enrollment Update

☐ **Review** ☐ **Action** ☒ **No action required**

PRESENTERS: Karen Lykins

PURPOSE & KEY POINTS: Vice President Karen Lykins will provide an update on enrollment for the upcoming semester.

Agenda Item Summary

Date: March 12, 2026

Agenda Item: Provost's Report

☐ **Review** ☐ **Action** ☒ **No action required**

PRESENTER(S): Interim Provost John Liu and Dean Daren Snider

PURPOSE & KEY POINTS: Interim Provost John Liu will give a quick update on the SACSCOC on-site review.

The Provost is also including a focused update on the College of Arts & Sciences to be presented by Dean Snider.

Agenda Item Summary

Date: March 12, 2026

Agenda Item: New Academic Program Proposal (NAPP) for the Ph.D. in Integrative Biology

☐ **Review** ☒ **Action** ☐ **No action required**

PRESENTERS: Interim Provost John Liu

PURPOSE & KEY POINTS:

The new degree program for which approval is sought is a Ph.D. program in Integrative Biology. Faculty of the Department of Biology in the College of Arts and Sciences are leading this proposal.

As a national research university, the doctoral degree program addresses critical needs in research, and prepares the next generation of scientists and societal leaders who will meet unprecedented challenges in life sciences and health sciences. The purpose of this program is three-fold:

- To advance university's research in life sciences in the "intersection" between the disciplines within the life sciences that form our public and private sector workforce.
- To advance scientific knowledge through integrative approaches that transcend traditional disciplinary silos.
- To train the next generation of scientists and researchers with innovative skills who can contribute to solving pressing biological and environmental challenges.

The program leverages Tennessee Tech's established relationships with key research partners including Oak Ridge National Laboratory, regional biotechnology firms, healthcare

research institutions, and state environmental agencies. These partnerships provide opportunities for collaborative research, internships, and direct pathways to employment, supporting THEC's goal of strengthening industry-education collaboration.

The proposed PhD in Integrative Biology requires 61 semester credit hours beyond the baccalaureate degree, structured to accommodate both direct-from-bachelor's and post-master's entry paths. The program is delivered on-campus.

New Academic Program Proposal for

Integrative Biology Ph.D.

College of Arts and Sciences

Tennessee Technological University

November 2025

Table of Content

SECTION 1: OVERVIEW

Program Information

Institution Name: Tennessee Technological University
Proposed academic program and concentration(s): PhD in Integrative Biology
Degree name: Integrative Biology (IB)
Degree designation: Doctorate of Philosophy
Proposed CIP code: 26.0101
CIP code definition: Biology/Biological Sciences, General.
Corresponding SOC codes and SOC definitions applicable for graduates of the program:

CIP CODE	CIP Title	SOC CODES	SOC Titles
26.0101	Biology/ Biological Sciences, General.	11-9121	Natural Sciences Managers
		19-1029	Biological Scientists, All Other
		19-1099	Life Scientists, All Other

Academic Program Liaison names and contact information

Dr. Steven Hayslette
hayslette@tntech.edu
931-372-3146
Tennessee Technological University

Proposed Implementation Date: Fall 2026

Estimated Timeline:

- LON submission - June 2025
- NAPP submission – October 2025
- Proposed dates for external reviewer site visit – January 2026
- Institutional governing board approval - March 2026
- THEC Action - May 2026
- Enroll students for Fall semester – Summer 2026
- First cohort begins coursework in program - August 2026

SECTION II: BACKGROUND

Purpose and nature of the academic program

General overview

Tennessee Tech University seeks authorization to establish a Doctor of Philosophy (PhD) program in Integrative Biology within the Department of Biology, College of Arts and Sciences, with an anticipated launch in Fall 2026. This innovative doctoral program takes a systems-based approach to biological research, preparing scholars to address complex biological questions

across multiple scales – spanning molecular, cellular, organismal, and ecosystem levels. The curriculum emphasizes the interconnections between biological systems while providing students with sophisticated analytical tools and research methodologies. A distinguishing feature is our focus on the rich biological diversity of the Upper Cumberland region, which serves as a living laboratory for studying genetic and organismal biodiversity, species interactions, and ecosystem dynamics.

Our program develops researchers who bridge traditional boundaries between subdisciplines of biology (e.g. molecular genetics and organismal physiology) and broader disciplinary divides (e.g. high-powered computing and ecological niche modeling). Students gain expertise in advanced experimental design, cutting-edge analytical techniques, and the integration of field and laboratory methodologies. This comprehensive preparation enables graduates to pursue impactful careers across sectors. Career paths include research positions at major universities, leadership roles in private industry (biotechnology, pharmaceutical research, environmental consulting), government agencies (Tennessee Wildlife Resources Agency, US Forest Service, US Fish and Wildlife Service, Environmental Protection Agency), conservation organizations (The Nature Conservancy, World Wildlife Fund).

The program addresses critical workforce needs in an era of unprecedented bioscience challenges. Emerging diseases, climate change, and habitat loss require researchers to synthesize data across biological subdisciplines. Our curriculum and faculty expertise provide advanced training in key areas such as molecular and cellular biology, ecological systems and environmental science, evolutionary biology and biodiversity, physiological adaptation and organismal biology, and bioinformatics and computational biology. Students benefit from Tennessee Tech's existing research infrastructure which includes advanced genomics and proteomics facilities, environmental monitoring systems, properties in diverse ecosystems, and existing partnerships with numerous state and federal agencies. Available resources include high-performance computing equipment and expertise, specialized research laboratories, and the Center for the Management, Utilization, and Protection of Water Resources (Water Center). These facilities support cutting-edge research which integrates across biological subdisciplines.

The program capitalizes on our unique geographical setting at the intersection of multiple ecological zones. This location provides exceptional opportunities for field research while developing expertise in contemporary laboratory and computational methods. Through this integrated approach, graduates emerge prepared to lead complex research initiatives and advance biological understanding in an increasingly interconnected world.

Short description of academic program

The PhD Program in Integrative Biology at Tennessee Tech University provides comprehensive training across fundamental biological disciplines, including cellular and molecular biology, physiology, ecology, evolution, conservation biology, and environmental science. Our program emphasizes the integration of multiple scales of biological organization, with particular attention to research opportunities in the unique ecological systems of Tennessee and the Upper Cumberland region. Through our state-of-the-art facilities and strategic location, students engage in both laboratory and field-based research that addresses critical questions in modern biology.

At Tennessee Tech, we recognize that graduate education represents a significant advancement beyond undergraduate studies, emphasizing independent research and scholarly development. Our program philosophy centers on flexibility and personalization, acknowledging that each student brings unique academic backgrounds, research interests, and career aspirations. Moreover, the program's integrative nature requires flexibility in the plan of study as each student will require a unique set of knowledge and skills from various subdisciplines. Through close

consultation with faculty advisors and advisory committees, students develop individualized research programs that build both depth in their chosen specialization and breadth across relevant biological disciplines, preparing them for successful careers in academia, government agencies, or the private sector.

The proposed PhD program in Integrative Biology differs fundamentally from traditional biology programs through its deliberate focus on biological processes that cross multiple scales of organization. While conventional Biology or Biological Sciences programs typically guide students toward specialization in particular subdisciplines (such as molecular biology, physiology, or ecology), Integrative Biology emphasizes the connections between these levels and trains researchers to work at their intersections. This cross-scale approach allows students to explore how molecular mechanisms influence cellular processes, how these affect organismal function, and ultimately how these dynamics shape ecological and evolutionary patterns. The program's research questions are inherently integrative, addressing complex biological challenges that cannot be fully understood through a single disciplinary perspective. Rather than producing specialists in isolated subfields, the program develops scientists who can synthesize knowledge across traditional boundaries to generate novel insights and approaches to biological research.

Additionally, the program's structure and methodological approach are distinctly different from traditional biology programs. Rather than organizing coursework around isolated biological subdisciplines, the Integrative Biology curriculum emphasizes integrative themes and problems that require multiple perspectives to solve. Students learn diverse research methodologies and analytical approaches to address complex biological questions that cannot be answered through a single disciplinary lens. The program's training emphasizes methodological pluralism, teaching students to select and integrate appropriate techniques from different biological subdisciplines based on the research question rather than disciplinary tradition. This integration of multiple research approaches prepares graduates with a unique skill set specifically designed to tackle multifaceted biological challenges in ways that traditionally trained biologists might not be equipped to address. Furthermore, the program cultivates a systems-thinking perspective that enables graduates to identify emergent properties and relationships that might be overlooked in more reductionist approaches, making them particularly valuable in research contexts requiring comprehensive biological understanding.

As such, the purpose of this program is three-fold:

- To design a new kind of degree program that seeks to exist in the “intersection” between the disciplines within the life sciences that form our public and private sector workforce
- To develop researchers with advanced analytical skills who can contribute to solving pressing environmental and biological challenges.
- To advance scientific knowledge through integrative approaches that transcend traditional disciplinary silos.

Purpose

The purpose of the proposed PhD program in Integrative Biology is to prepare scientific leaders to use rigorous research methodologies and cutting-edge technologies to advance biological understanding across scales of organization and guide evidence-based practices in research, industry, and policy. The target audience includes research scientists, industry professionals, and practitioners in biological settings. These professionals will learn to integrate multiple biological approaches - from molecular to ecological - while applying innovative technologies and quantitative methods to analyze complex biological phenomena and solve pressing environmental and biomedical challenges.

The research focus will emphasize the integration of molecular, cellular, physiological, and ecological approaches to understanding fundamental biological questions. Candidates will develop expertise in advanced research methodologies and computational analysis while learning to lead interdisciplinary research teams. This integrative training will prepare graduates to address critical questions in areas such as environmental change, disease mechanisms, and biological systems. The program's emphasis on both theoretical foundations and applied research will equip graduates to be innovative leaders who can advance scientific understanding while developing solutions to complex biological challenges facing society.

Through rigorous academic preparation and research experience, graduates will be prepared for leadership roles in academic institutions, research organizations, and government agencies. The program's focus on integrating multiple approaches to biological research, combined with training in advanced methodologies and leadership skills, will position graduates to make significant contributions to scientific advancement and innovation in Tennessee and beyond.

Summary of the program structure:

The proposed PhD in Integrative Biology requires 61 semester credit hours beyond the baccalaureate degree, structured to accommodate both direct-from-bachelor's and post-master's entry paths. The program consists of 13 required core credits, 30 graduate elective credits, and 18 research/dissertation credits. Core requirements include a Statistical Analysis or Experimental Design class (3 credits), Scientific Leadership and Management (BIOL 7210, 3 credits), a Biology elective outside the student's subdiscipline (3 credits), an elective outside the Biology Department (3 credits), and Dissertation Research Seminar (BIOL 7991, 1 credit). Students entering with a relevant master's degree may transfer up to 24 credits of approved graduate coursework toward their 30-credit elective requirement, subject to grade requirements (B or higher) and committee approval. The remaining 18 credits consist of Research and Dissertation hours (BIOL 7990) distributed across multiple semesters.

For students entering with an MS degree, the typical pathway involves completing 37 credits at Tennessee Tech (13 core SCH + 6 additional electives SCH + 18 research/dissertation SCH) plus up to 24 approved transfer credits. Students must complete all core requirements at Tennessee Tech regardless of previous coursework, and only 6 credits of 5000-level courses taken at Tennessee Tech count toward degree requirements. For students entering with only a bachelor's degree, all 61 credits are completed at Tennessee Tech, with up to 9 credits permitted at the 5000-level to provide foundational knowledge. These students typically complete more intensive coursework in years 1-2 before transitioning to primarily research credits. The Graduate Advisory Committee, appointed by the end of year one, approves each student's individualized program of study, ensuring appropriate preparation for dissertation research while maintaining program standards.

<u>Evaluation Process and Criteria for Accepting Credits from Previous MS Degree</u>

The evaluation of transfer credits from previous MS degree programs follows a structured review process overseen by the student's Graduate Advisory Committee in consultation with the PhD Program Coordinator. Upon admission, students requesting transfer credit must submit official transcripts, detailed course syllabi, and documentation of learning outcomes for each course they wish to transfer. The committee evaluates each course against three primary criteria: (1) equivalency to Tennessee Tech's graduate-level rigor, requiring courses to be at the 5000/6000/7000 level or equivalent from accredited institutions; (2) relevance to the student's proposed program of study and dissertation research area in integrative biology; and (3) currency of knowledge, with courses older than six years requiring additional justification or supplementary coursework. Only courses where the student earned a grade of B or higher are eligible for transfer,

and the committee may require the student to demonstrate competency through written or oral examination if course equivalency is uncertain.

Target audience

The proposed PhD in Biology targets biologists who have completed an undergraduate or master's degree and who are interested in becoming leaders, teachers, and scholars in their respective fields. This program will attract students from internal, regional, national, and international undergraduate and graduate Biology programs.

Targeting international students

We recognize that declining international graduate enrollment presents a significant challenge that requires proactive strategies. National data shows international graduate enrollment in STEM fields has decreased by approximately 5-10% since 2020 due to visa restrictions, competitive global opportunities, and changing immigration policies. To address these trends, the Integrative Biology PhD program will implement several recruitment and support strategies. First, the department will leverage existing and create new partnerships with international universities through faculty research collaborations, creating direct pipelines for student recruitment with clear pathways from undergraduate/graduate programs abroad to our PhD program. Second, the program will leverage Tennessee Tech's existing international student services to provide dedicated visa support, cultural orientation, and year-round housing options that address common barriers to international enrollment. Third, guaranteed funding packages of $28,000 annually plus tuition waivers will be prominently featured in recruitment materials, as financial security remains a primary concern for international students comparing U.S. programs with fully-funded opportunities in Canada, Europe, and Australia.

Delivery Method

100% On-ground

Alignment with State Master Plan and institutional mission profile

The proposed PhD program in Integrative Biology at Tennessee Tech University demonstrates exemplary alignment with the Tennessee Higher Education Commission's 2020 Master Plan "Enabling the Competitive Edge." This detailed analysis examines how the program advances THEC's strategic priorities while addressing critical workforce needs in Tennessee's evolving knowledge economy.

Student Success Integration

The program's approach to student success reflects deep integration with THEC's vision for comprehensive academic excellence. At its foundation, the program provides an academically rigorous curriculum that combines cutting-edge biological research methodologies with advanced technological training. This integration ensures students develop sophisticated analytical capabilities across multiple biological scales - from molecular to ecosystem levels. The program's structure deliberately builds both theoretical understanding and practical research competencies, creating a robust framework for professional development.

The curriculum design particularly emphasizes the development of transferable skills in data analysis, research design, and project leadership - capabilities identified as critical in THEC's assessment of future workforce needs. By incorporating both individual research projects and

collaborative team-based work, the program ensures graduates can both conduct independent research and lead complex scientific initiatives. This dual focus directly supports THEC's goal of preparing graduates who can immediately contribute to Tennessee's research and innovation ecosystem.

Family Prosperity Enhancement

The program's contribution to family economic advancement extends beyond simple career preparation. Labor market analysis demonstrates that PhD-level biological scientists in Tennessee command competitive starting salaries ranging from $75,000-$120,000 at research institutions, national laboratories, state agencies, and private industry. More significantly, these positions often serve as entry points for career advancement into senior research leadership roles, with corresponding increases in compensation and responsibility. Research Directors typically earn between $110,000-$150,000, while Principal Scientists and Laboratory Directors earn between $95,000-$140,000. Senior Research Managers can expect compensation between $90,000-$125,000. This earning potential directly supports THEC's vision of higher education as a catalyst for family economic mobility and long-term prosperity.

Future Workforce Development

The program's alignment with workforce development priorities is particularly comprehensive, addressing multiple strategic objectives. In terms of research leadership capacity, the program develops sophisticated capabilities through advanced training in research methodology, experimental design, grant writing, research funding skills, and project coordination. These competencies directly address Tennessee's need for research leaders who can drive innovation and scientific advancement.

The curriculum's technological foundation reflects THEC's emphasis on preparing graduates for an increasingly digital research environment. Students develop expertise in advanced biological research technologies, computational analysis methods, bioinformatics, data science applications, and emerging research instrumentation and methodologies. This technological integration ensures graduates are prepared for the evolving demands of modern research environments.

The program leverages Tennessee Tech's established relationships with key research partners including Oak Ridge National Laboratory, regional biotechnology firms, healthcare research institutions, and state environmental agencies. These partnerships provide opportunities for collaborative research, internships, and direct pathways to employment, supporting THEC's goal of strengthening industry-education collaboration.

Strategic Value Proposition

The program advances Tennessee's economic competitiveness through several key mechanisms. By developing researchers capable of leading complex scientific initiatives, the program strengthens Tennessee's capacity for basic scientific research advancement, applied research and development, technology transfer and commercialization, and cross-disciplinary innovation.

The program supports economic development in the Upper Cumberland region by attracting research funding and investment, supporting technology-based business development, providing highly skilled workers for knowledge-intensive industries, and strengthening the region's research

infrastructure. This regional impact aligns with THEC's goal of leveraging higher education to support economic development across Tennessee.

This comprehensive alignment demonstrates how the proposed PhD program would serve as a strategic asset in advancing Tennessee's educational and economic objectives while addressing critical workforce needs in the state's growing research and biotechnology sectors. The program represents a thoughtful investment in Tennessee's future research and innovation capabilities, directly supporting THEC's vision for enabling competitive advantage through higher education excellence.

Tennessee Tech Mission Alignment

The mission of the institution says: “Tennessee’s technological university creates, advances, and applies knowledge to expand opportunity and economic competitiveness. As a STEM-infused, comprehensive institution, Tennessee Tech delivers enduring education, impactful research, and collaborative service.” The proposed PhD in Integrative Biology aligns with this mission by offering an advanced STEM-focused program that prepares graduates for research and leadership roles in biological sciences while supporting regional economic development.

The program supports Tennessee Tech's mission in four key ways: (1) delivering rigorous, technology-enhanced biological education that expands research opportunities and economic competitiveness in Tennessee, (2) providing advanced training on cutting-edge instrumentation and analytical approaches that strengthen the university's position as a leader in technological education, (3) developing a highly skilled STEM workforce that will drive innovation and economic growth in the Upper Cumberland region and across Tennessee, and (4) fostering collaborative partnerships with regional industries, government agencies, and research institutions to advance scientific knowledge and create economic opportunities. Through this alignment, the PhD program in Integrative Biology will enhance Tennessee Tech's capacity to deliver impactful research and strengthen its role as the state's technological university.

Institutional Capacity to Deliver the Proposed Academic Program

Tennessee Technological University (Tennessee Tech) possesses the institutional capacity to deliver the proposed Ph.D. program in Integrative Biology. The Department of Biology, housed within the College of Arts and Sciences, has a solid foundation of research-active faculty, modern laboratory facilities, and access to diverse field sites and research partnerships that will support the academic and research endeavors of doctoral students.

Tennessee Tech's Department of Biology comprises a group of faculty with expertise in subdisciplines including ecology, physiology, genetics, microbiology, health science, and conservation biology as applied to an array of organismal models from plants to fungi to wildlife. Faculty members maintain active research programs supported by external funding from agencies such as the National Science Foundation, the U.S. Geological Survey, U.S. Department of Agriculture, U.S. Fish and Wildlife Service, and the Tennessee Wildlife Resources Agency. The department also houses the Tennessee Cooperative Fishery Research Unit led by two full-time federal research staff which connects graduate students to funding and mentorship opportunities across federal agencies. The interdisciplinary nature of ongoing research aligns with the integrative approach of the proposed Ph.D. program, ensuring that students will receive comprehensive training across biological subdisciplines.

The department maintains strong collaborative relationships with various internal and external research partners which will support doctoral students in research funding, training, professional

development, and job placement. Tennessee Tech's Center for the Management, Utilization, and Protection of Water Resources (Water Center) is a hub for aquatic and environmental research, providing Ph.D. students with opportunities to engage in interdisciplinary projects with faculty and students in chemistry, engineering, geology, and environmental science. Externally, the department collaborates with state and federal agencies, including the Tennessee Wildlife Resources Agency, the U.S. Fish and Wildlife Service, and the Tennessee Department of Environment and Conservation, facilitating access to critical field sites and applied research opportunities. Students will benefit from access to unique field sites such as Gulf Coast Marine Lab and numerous state and private managed lands including Standing Stone State Forest, Bridgestone Nature Reserve at Chestnut Mountain, where students can conduct field-based research. Finally, students and faculty in the program will have access to a national network of federal agencies coordinated by the Cooperative Ecosystem Studies Units (CESU) which organizes research opportunities in the Southern Appalachian Mountains and Great Rivers regions of the U.S. These partnerships enhance the breadth of research experiences available.

The Ph.D. program in Integrative Biology will be supported by Tennessee Tech’s existing infrastructure, which includes modern laboratory, teaching, and office spaces in the Lab Sciences Commons (LSC), a $90 million, 160,000 square-foot teaching and research facility constructed in 2020. The LSC houses state-of-the-art core research facilities for cell and molecular biology and biochemistry, including microscopy suites, genomics laboratories, and climate-controlled research environments that will support dissertation research and training in cutting-edge methods. Pennebaker Hall serves as the home to the Department of Biology, and houses research labs, classrooms, and faculty dedicated to organismal and wildlife research including the Hollister Herbarium which houses over 40,000 museum-quality plant specimens. Students will have access to the Water Center’s Environmental Quality Laboratory which is equipped to conduct research-grade environmental testing in compliance with the Environmental Protection Agency, Tennessee Department of Health, Tennessee Department of Environment and Conservation, American Society for Testing and Materials (ASTM), and the U.S. Geological Survey. Tennessee Tech’s Shipley Farm functions as an agricultural and ecological research station that supports studies in conservation biology, ecophysiology, and environmental sciences. Additionally, the university-wide iCube and Innovation Labs provide access to advanced technologies, including GIS mapping, bioinformatics tools, and molecular imaging systems. Student research will be further enhanced by access to faculty expertise and computing power in the High-Performance Computing and Systems Laboratory housed within TN Tech’s College of Engineering.

This program will complement existing graduate programs at Tennessee Tech. It has been developed in collaboration with the director of the Environmental Science Ph.D. program to ensure that it extends current academic offerings beyond environmental science to include cellular, molecular, and organismal bioscience research. Given that the Environmental Science Ph.D. is currently the only option for doctoral students pursuing a biology concentration, we expect enrollment in the Environmental Science – Biology program to temporarily decrease slightly as students choose which Ph.D. program best fits their needs. However, this is an overall net benefit for both programs as we do not anticipate taking resources from the Environmental Science Ph.D. program and any decrease in biology students will free up resources (i.e., teaching assistantships) for additional students in the Environmental Science – Biology concentration as well as in the Environmental Science Agriculture, Chemistry, Geosciences, and Integrated Research concentrations. Limited resources for these growing programs results in extreme competition that will be partly alleviated by the addition of the proposed degree option. Additionally, there are no other similar or potentially competing graduate programs at Tennessee Tech, further solidifying the necessity and unique value of this new program.

Existing programs offered at public and private Tennessee universities

Table 1 provides a list of the PhD programs with similar CIP codes in the public and private universities within the State of Tennessee.

Table 1. List of PhD Programs with Similar CIP Codes at Tennessee Public and Private Universities.

Program with Similar CIP Code					Degrees Awarded		
Institution	Public or Private	Degree	Program	CIP Code	2021-22AY	2022-23AY	2023-24AY
East TN State University	Public	Ph.D.	Biomedical Sciences	18.26.0102.00	5	5	11
Middle TN State University	Public	Ph.D.	Molecular Biosciences	18.26.0204.00	5	3	--
Tennessee State University	Public	Ph.D.	Biological Sciences	18.26.0101.00	13	6	5
University of Memphis	Public	Ph.D.	Biology	18.26.0101.00	6	4	4
		Ph.D.	Epidemiology and Biostatistics	18.26.1311.00	0	0	2
University of Tennessee- Knoxville	Public	Ph.D.	Biochemistry and Cellular and Molecular Biology	18.26.0202.00	8	5	5
		Ph.D.	Comparative and Experimental Medicine	18.26.9999.00	3	8	8
		Ph.D.	Ecology and Evolutionary Biology	18.26.1301.00	10	4	5
		Ph.D.	Life Sciences	18.26.9999.02	4	9	2
		Ph.D.	Microbiology	18.26.0503.00	9	8	4
University of Tennessee Health Science Center	Public	Ph.D.	Biomedical Sciences	18.26.0102.00	19	20	17
		Ph.D.	Health Outcomes and Policy Research	18.26.1102.00	2	3	3
Vanderbilt University	Private	Ph.D.	Biological Sciences	26.0101	9	8	13
		Ph.D.	Biochemistry	26.0202	5	10	5
		Ph.D.	Chemical & Physical Biology	26.0210	10	13	4
		Ph.D.	Cell and Developmental Biology	26.0406	12	7	15
		Ph.D.	Microbe-Host Interactions	26.0502	11	15	9

Ph.D.	Human Genetics	26.0806	6	3	8
Ph.D.	Molecular Physiology and Biophysics	26.0902	3	2	8
Ph.D.	Molecular Pathology and Immunology	26.0910	6	6	5
Ph.D.	Cancer Biology	26.0911	5	8	8
Ph.D.	Pharmacology	26.1001	8	8	5
Ph.D.	Biostatistics	26.1102	4	6	3
Ph.D.	Biomedical Informatics	26.1103	1	0	2
Ph.D.	Epidemiology	26.1309	3	12	1
Ph.D.	Neuroscience	26.1501	17	15	11

The proposed Integrative Biology PhD program at Tennessee Tech University distinguishes itself from other biology-related doctoral programs in the state, such as Biomedical Science, Molecular Bioscience, and Biology PhD programs, through its unique interdisciplinary curriculum that emphasizes a holistic understanding of biological systems and the freedom to explore diverse research areas. In contrast to a Biomedical Science PhD, which typically focuses on the application of biological principles to human health and disease, the Integrative Biology program offers a broader perspective on biological systems. The curriculum encompasses not only human biology but also the study of plants, animals, and ecosystems, allowing students to investigate the complex interactions between organisms and their environments. This holistic approach enables students to develop a comprehensive understanding of the processes that shape life on Earth, rather than focusing solely on clinical research and translational medicine.

Similarly, the Integrative Biology program differs from a Molecular Bioscience PhD, which tends to concentrate more narrowly on the molecular and cellular mechanisms underlying biological processes. While the Integrative Biology curriculum includes coursework in molecular biology and bioinformatics, it also places a strong emphasis on organismal biology, ecology, and evolutionary biology. This broader perspective allows students to explore how molecular and cellular processes influence the form and function of whole organisms, and how these organisms interact with each other and their environments. By not limiting students to a single level of biological organization, the program encourages them to develop a more comprehensive understanding of biological systems.

The Integrative Biology program also stands apart from a traditional Biology PhD program in its interdisciplinary approach and flexibility. While a Biology PhD may require students to specialize in a particular subfield of biology, such as genetics, physiology, or ecology, the Integrative Biology program allows students to develop a broad foundation across multiple subdisciplines. This approach prepares students to tackle complex biological questions that span multiple levels of

organization, from molecules to ecosystems, and encourages them to explore the interconnections between different areas of biology. The Integrative Biology program's unique curriculum, which balances breadth and depth across biological subdisciplines, is a key distinguishing factor.

Traditional Biology PhD programs often require students to take a set of core courses and then specialize in a particular area. In contrast, the Integrative Biology program allows students to customize their coursework to their specific research interests and career goals. This flexibility enables students to develop a personalized educational experience that aligns with their unique strengths and aspirations, and encourages them to explore diverse research areas rather than confining themselves to a single niche. By emphasizing a holistic understanding of biological systems, encouraging students to explore diverse research areas, and providing opportunities for collaborative, interdisciplinary research, the program prepares students to tackle the complex biological challenges of the 21st century.

CIP Code Justification

The selection of CIP code 26.0101 (Biology/Biological Sciences, General) for the Integrative Biology PhD program was deliberate and strategic, particularly regarding the breadth of career opportunities it represents. This code's associated SOC classifications directly align with high-demand positions our graduates will pursue: Natural Sciences Managers (SOC 11-9121), who earn median salaries of $110,000-$150,000 in Tennessee while overseeing research facilities and scientific teams; Biological Scientists, All Other (SOC 19-1029), which captures the growing demand for interdisciplinary researchers in biotechnology firms, environmental consulting, and government agencies where starting salaries range from $75,000-$115,000; and Life Scientists, All Other (SOC 19-1099), encompassing emerging career paths in fields like conservation technology, bioinformatics, and One Health initiatives.

The general Biology/Biological Sciences designation precisely reflects the program's stated purpose to "prepare scientific leaders to use rigorous research methodologies and cutting-edge technologies to advance biological understanding across scales of organization." This alignment is evident in the curriculum structure, which requires students to take coursework both within and outside their biological subdiscipline, including a required Biology elective outside the student's subdiscipline and an elective outside the Biology Department entirely. This curricular design embodies the comprehensive approach that the 26.0101 code represents, ensuring graduates develop the broad biological literacy necessary to integrate knowledge across traditional boundaries. The program's core learning outcomes—particularly the ability to "synthesize and apply knowledge from multiple biological subdisciplines" and "integrate knowledge across biology subdisciplines"—directly mirror the general, comprehensive nature of the 26.0101 classification.

Unlike more restrictive CIP codes such as 26.0202 (Biochemistry) or 26.1301 (Ecology), which might limit graduates to specialized roles, the 26.0101 designation signals to employers that our graduates possess comprehensive biological training applicable across sectors. This general classification accurately represents the program's flexibility in allowing students to develop individualized programs of study that span from molecular mechanisms to ecosystem dynamics, as described in the program's philosophy that "each student brings unique academic backgrounds, research interests, and career aspirations." The 61-credit curriculum's structure—with 30 credits of graduate electives that can span any biological subdiscipline—exemplifies the breadth that the general biology code encompasses. Furthermore, the program's emphasis on developing researchers who can "bridge traditional boundaries between subdisciplines of biology and broader disciplinary divides" is fundamentally incompatible with narrow CIP codes that would misrepresent this integrative mission.

This breadth is particularly valuable in Tennessee's diversifying life sciences economy, where employers increasingly seek PhD scientists capable of leading cross-functional teams, managing complex research programs spanning molecular to ecosystem scales, and translating biological discoveries into practical applications. The code also maintains consistency with peer institutions like University of Memphis, Tennessee State University, and Vanderbilt, ensuring our graduates are recognized as having equivalent foundational training while offering the additional advantage of integrative, cross-scale expertise that addresses modern workforce needs in both traditional research roles and emerging interdisciplinary positions.

Distinguishing the Integrative Biology PhD from Other Tennessee Programs

The proposed Integrative Biology PhD program at Tennessee Tech University distinguishes itself from other biology-related doctoral programs in the state through its unique interdisciplinary curriculum that emphasizes a holistic understanding of biological systems and the freedom to explore diverse research areas. Unlike traditional programs that often require early specialization within narrow subdisciplines, our program allows students to customize their coursework across multiple biological domains based on their research needs. This flexibility enables students to address complex biological questions that span traditional disciplinary boundaries.

In contrast to a Biomedical Science PhD, which typically focuses on the application of biological principles to human health and disease, the Integrative Biology program offers a broader perspective on biological systems. For example, while the Biomedical Sciences PhD at East Tennessee State University concentrates on cancer biology, pharmacology, and infectious disease research, Tennessee Tech's program encompasses not only human biology but also the study of plants, animals, and ecosystems. This allows students to investigate complex interactions between organisms and their environments—such as studying how environmental toxins affect both wildlife populations and human health through shared watersheds, or examining disease transmission between wildlife and domestic animals. Students can explore evolutionary medicine, conservation genetics, or the ecological basis of human health, connecting biomedical questions to broader biological contexts. The program's integrative approach recognizes that understanding biological processes at one level often requires knowledge of mechanisms operating at other organizational levels, from molecules to ecosystems.

Similarly, the Integrative Biology program differs from a Molecular Biosciences PhD, such as the one at Middle Tennessee State University which focuses primarily on biochemistry, biotechnology, and cell biology at the molecular level. While Tennessee Tech's Integrative Biology curriculum includes coursework in molecular biology and bioinformatics, it also places strong emphasis on organismal biology, ecology, and evolutionary biology. This broader perspective allows students to explore how molecular and cellular processes influence the form and function of whole organisms, and how these organisms interact with each other and their environments. For instance, a student could study gene expression changes in response to environmental stressors while simultaneously examining population-level effects and ecosystem impacts. The program encourages students to consider how molecular mechanisms scale up to influence organismal performance, population dynamics, and community structure. This multi-level integration is essential for addressing contemporary challenges such as understanding how organisms will respond to climate change or how molecular innovations drive evolutionary diversification.

The Integrative Biology program also stands apart from traditional Biology PhD programs like those at the University of Memphis or Tennessee State University, which often require students to specialize early in a particular subfield. At the University of Memphis, doctoral students typically focus on either ecology, physiology, or systematics, creating artificial boundaries between interconnected biological disciplines. In contrast, Tennessee Tech's Integrative Biology program

allows students to customize their coursework across multiple subdisciplines based on their research needs and interests. A student studying amphibian decline, for example, could combine coursework in disease ecology, molecular diagnostics, climate modeling, and conservation genetics—a breadth difficult to achieve in more traditionally structured programs. This flexibility is particularly valuable for students whose research questions naturally span multiple areas, such as those investigating how genomic variation influences species' responses to environmental change or how developmental mechanisms constrain evolutionary trajectories. The program recognizes that many of the most pressing biological questions require expertise that crosses traditional subdisciplinary boundaries.

The program's location in the Upper Cumberland region provides unique research opportunities not available to programs in urban centers like Nashville or Memphis. Students have direct access to some of North America's highest freshwater biodiversity, including over 230 fish species and 90 mussel species in nearby watersheds, as well as diverse terrestrial ecosystems ranging from grasslands to old-growth forests. This contrasts with programs at Vanderbilt or UTHSC, which, while excellent in biomedical research, lack comparable access to diverse natural ecosystems for field-based integrative studies. The region's karst geology, varied topography, and relatively intact natural areas provide exceptional opportunities for studying ecological processes, evolutionary dynamics, and conservation biology. Students can conduct long-term field studies, experimental manipulations, and comparative analyses across diverse habitats and taxa. The program's partnerships with state and federal agencies, as well as conservation organizations, provide additional opportunities for applied research that directly informs management decisions and policy development.

Furthermore, Tennessee Tech's program uniquely emphasizes the development of both laboratory and field research skills, ensuring graduates are competent in diverse methodological approaches. Unlike the University of Tennessee – Knoxville's separate programs in Ecology/Evolutionary Biology versus Biochemistry/Cellular and Molecular Biology, which tend to produce specialists in either field or lab work, Tennessee Tech's program ensures graduates are competent in both domains. Students learn to use next-generation sequencing technology while also conducting population surveys, or combine remote sensing with molecular markers to track species distributions and genetic connectivity. This methodological breadth is increasingly important as biological research becomes more interdisciplinary and as funding agencies prioritize projects that integrate multiple approaches. The program also emphasizes quantitative skills, bioinformatics, and computational methods, recognizing that modern biology requires facility with large datasets and complex analytical techniques. Students gain experience with statistical modeling, phylogenetic analysis, and genomic data analysis, preparing them for careers in an increasingly data-driven field.

Distinction from Tennessee Tech's Environmental Sciences PhD Program

The Integrative Biology PhD program differs fundamentally from Tennessee Tech's existing Environmental Sciences PhD program in scope, focus, and methodological approach. While the Environmental Sciences program emphasizes interdisciplinary training across environmental chemistry, geology, agriculture, and social policy to address environmental problems, the Integrative Biology program focuses specifically on biological systems and processes across multiple levels of organization. The Environmental Sciences program is designed to train students to tackle environmental challenges through a broad interdisciplinary lens that includes non-biological disciplines, requiring core courses in environmental chemistry, geology, agriculture, and social policy. In contrast, the Integrative Biology program concentrates on understanding biological phenomena through an integrative biological approach, with coursework spanning molecular biology, organismal biology, ecology, evolution, and related biological subdisciplines. Students in Environmental Sciences might study water quality impacts on aquatic communities, while Integrative Biology students would focus on the biological mechanisms underlying those

impacts, such as physiological responses, population genetic consequences, or evolutionary adaptations to environmental change.

The two programs also differ in their research methodologies and career outcomes. Environmental Sciences students typically employ interdisciplinary approaches that may include chemical analysis, policy evaluation, or engineering solutions alongside biological methods, preparing them for careers in environmental consulting, government agencies, or policy organizations. Integrative Biology students, while also capable of interdisciplinary collaboration, are specifically trained in biological research methods and theory, preparing them for careers in biological research, university teaching, biotechnology, conservation biology, or related biological fields. The Environmental Sciences program's emphasis on addressing practical environmental problems complements the Integrative Biology program's focus on advancing fundamental understanding of biological systems. While there may be some overlap in research interests, particularly in areas like conservation biology or ecological restoration, the two programs approach these topics from different perspectives and with different methodological toolkits. The Environmental Sciences program views biological systems as one component of complex environmental challenges, while the Integrative Biology program places biological systems at the center of inquiry, seeking to understand how they function, evolve, and interact across multiple scales of organization.

Accreditation

The proposed Ph.D. in Biology does not constitute a substantive change under the SACSCOC Substantive Change Policy. Therefore, the University is not required to seek approval from SACSCOC. The program will participate in THEC's program review process with external peer review according to a pre-approved review cycle. The University will notify SACSCOC after the program is approved by THEC Commission.

SECTION III: FEASIBILITY

Employment Opportunities

Employment Outlook and Industry Demand

According to the U.S. Bureau of Labor Statistics and Tennessee Higher Education Commission's 2024 Supply and Demand Report, employment for biological scientists is projected to grow significantly through 2032. Specifically, careers in biological research and development are expected to grow by 9% nationally, creating approximately 11,900 new positions. In Tennessee, employment of biological scientists and related research positions is projected to grow by 7.2% through 2032, outpacing the overall state employment growth rate of 6.8%.

The proposed PhD program directly addresses workforce needs by preparing graduates for senior research positions and leadership roles in biological sciences. Primary employment opportunities include research directors, principal investigators, and senior scientists in academic institutions, government research facilities, and private industry. Based on current labor market data, there is particular demand for PhD-level scientists who can lead interdisciplinary research teams and manage complex biological research programs.

Regional Employment Opportunities and Partnerships

According to the U.S. Bureau of Labor Statistics (BLS) Occupational Outlook Handbook,

employment of biological scientists is projected to show strong growth from 2023 to 2033. The BLS also notes that in the biological sciences field, "Doctoral degree holders are expected to have the best opportunities for employment and advancement, particularly in research and academia" (U.S. Bureau of Labor Statistics, 2021). The National Science Foundation's Survey of Earned Doctorates (SED) provides data on the post-graduation plans of doctoral degree recipients. According to the National Science Foundation's Survey of Earned Doctorates, in 2022, 70.8% of biological and biomedical sciences doctoral recipients had definite employment or postdoctoral study commitments upon graduation. Of those with definite employment commitments (excluding postdoctoral positions), 18.7% were in academia, 66.5% in industry or business, with the remainder in government and nonprofit organizations. This represents a significant shift toward industry employment, as industry commitments have increased from 38.0% in 2002 to 66.5% in 2022, while academic commitments decreased from 41.6% to 18.7% over the same period (National Science Foundation, 2024).

Tennessee and the region are uniquely situated to maximize the opportunity for those graduating with a PhD in Integrative Biology because of the strong presence of academic institutions, government agencies, and industry partners focused on biological research and innovation. The state is home to several major research universities, including Vanderbilt University, the University of Tennessee, and Oak Ridge National Laboratory, which provide diverse opportunities for collaboration and employment in cutting-edge biological research (National Science Foundation, 2024). Additionally, Tennessee's strategic location in the southeastern United States, known for its rich biodiversity and unique ecological systems, offers ample opportunities for field research and applied conservation work (Tennessee Wildlife Resources Agency, 2024). The region's thriving biotechnology sector, with a growing number of companies focused on drug discovery, molecular diagnostics, and biomanufacturing, presents a wealth of career opportunities for integrative biology graduates. Companies such as August Bioservices, a Nashville-based contract development and manufacturing organization specializing in sterile injectable medications that has invested over $215 million since 2020 and created more than 290 jobs, and Nashville Biosciences, a genomics company leveraging Vanderbilt University innovation for drug discovery and development, require doctoral-level researchers with interdisciplinary expertise to drive innovation and translate basic research findings into practical applications (Life Science Tennessee, 2024). Other notable biotech companies in the region include Aegis Sciences Corporation, a Nashville-based forensic toxicology and healthcare laboratory founded in 1990 that provides science-driven testing and consulting services, and Triad Life Sciences, a Memphis-based company focused on tissue-based solutions for wound treatment and regenerative applications (Life Science Tennessee, 2024).

Specifically, Tennessee offers unique employment opportunities through several major research institutions and facilities. Oak Ridge National Laboratory, specifically its Biosciences Division, regularly employs PhD-level biological scientists, with current median salaries ranging from $85,000 to $120,000 annually. Vanderbilt University Medical Center and St. Jude Children's Research Hospital also maintain active research programs requiring PhD-level scientists, with entry-level research positions starting at $75,000-$85,000 annually. The Tennessee Valley Authority hires PhD scientists for managing research projects, analyzing complex ecological data, and guiding conservation decisions in Tennessee Watershed.

State agencies including the Tennessee Department of Health, Tennessee Department of Environment and Conservation, and Tennessee Wildlife Resources Agency employ PhD-level biological scientists in research director and program manager positions, with current salary ranges of $70,000-$95,000. These positions typically involve overseeing research programs, managing scientific staff, and directing collaborative research initiatives.

Additionally, private sector opportunities are expanding in Tennessee's growing biotechnology sector. Recent economic development data show that over 20 biotechnology companies have established or expanded operations in Tennessee since 2020, creating new demand for PhD-level scientists to lead research and development programs. These positions typically offer starting salaries between $90,000-$115,000 annually. Moreover, Tennessee Economic and Community Development identifies life sciences (pharma, research & testing labs, medical devices) as targeted growth sectors for the state, and private job boards show hundreds of biology, environmental-biology, data-science and biotech jobs in Tennessee indicating active hiring by private firms. Such evidence for local demand is summarized in Table 2.

Table 2. Evidence of Local Demand for graduates of the Integrative Biology PhD program.

Evidence	Key metric / finding	Relation to Integrative Biology PhD	Source
State bioscience employment	48,258 bioscience workers in TN (2023); 60% growth in 4 years; Research/Testing/Medical Laboratories increased by 164%	Shows rapid industry expansion and more employer capacity for biology PhDs in labs, pharma, testing, and R&D roles.	LifeScienceTN industry report. (Life Science TN)
State cluster & sector strategy	TN Economic Development & TNECD identify life sciences (pharma, research/testing, med devices) as targeted growth sectors	Demonstrates state-level strategic support and incentives that attract companies who will hire PhD scientists.	TNECD whitepapers / Supply & Demand report. (tnecd.com, Tennessee State Government)
Major federal R&D employers	Oak Ridge National Lab posts biology/environmental science PhD roles regularly (research, modeling, bioenergy, applied biology)	ORNL provides local, well-funded PhD jobs and collaborations (industry partnerships, contract research).	ORNL Jobs listings. (jobs.ornl.gov)
On-the-market job postings	Hundreds of biology, environmental biology, data science, and biotech job listings in TN on job boards (Indeed, ZipRecruiter, Glassdoor)	Real-time evidence that private firms and consultancies are hiring people with advanced biological, computational, and applied skills.	Indeed / ZipRecruiter / Glassdoor job counts / searches. (Indeed, ZipRecruiter, Glassdoor)

Employer ecosystem (companies)	51 biotech employers with ~58 locations in TN (startups and established firms)	Demonstrates an employer base that could absorb PhD graduates (biotech startups, contract labs, pharma).	Biotech employer directory. (biotech-careers.org)
State occupational estimates	BLS OES (TN) provides occupation counts/wages for relevant categories (biological scientists, environmental scientists, lab roles)	Allows projection of likely employment opportunities by occupation and helps justify PhD training aligned with employer needs.	BLS OES Tennessee (May 2023). (Bureau of Labor Statistics)

Competitive Analysis and Market Position

Currently, no public institution in Tennessee offers a PhD specifically focused on integrative biological sciences. While related programs exist in ecology, molecular biology, and biomedical sciences, Tennessee Tech's proposed program would uniquely prepare graduates to lead research programs that bridge multiple biological disciplines. This aligns with increasing employer demand for scientists who can direct research spanning molecular, cellular, physiological, and systems-level approaches.

Future Growth Areas and Salary Trends

The program specifically prepares graduates for careers showing strong growth projections:

- Research Directors/Principal Investigators in academic institutions (12% projected growth, median salary $110,000)
- Senior Scientists in biotechnology industry (15% projected growth, median salary $105,000)
- Government Research Program Managers (8% projected growth, median salary $95,000)
- Biological Research Laboratory Directors (10% projected growth, median salary $100,000)

Labor market data indicates particular demand for PhD scientists who can:

- Direct large-scale research programs and supervise research teams
- Manage complex biological research facilities
- Develop and oversee research collaborations between institutions
- Lead interdisciplinary biological research initiatives
- Direct the application of emerging technologies in biological research

This analysis demonstrates strong market demand for graduates with advanced training in integrative biological sciences who can assume leadership and research director positions. The proposed program would fill a critical gap in Tennessee's educational landscape while preparing graduates for well-compensated careers directing biological research programs across academic, government, and private sector settings.

The proposed Integrative Biology PhD program is strategically designed to address the growing demand for highly skilled research leaders who can navigate the complexities of modern

biological research. By providing students with a comprehensive foundation in multiple biological subdisciplines, as well as advanced training in research methodologies, data analysis, and scientific leadership, the program aims to bridge the gap between employer needs and the current educational landscape in Tennessee. As the life sciences become increasingly interdisciplinary, employers are seeking candidates who can effectively integrate knowledge from various subfields to address complex research questions. Graduates of the program will be well-equipped to lead cross-functional research teams, drawing upon their expertise in molecular biology, organismal biology, ecology, and bioinformatics to guide innovative research projects.

Moreover, the program's focus on hands-on research experience and professional development will prepare students for the leadership roles that are in high demand across academic, government, and private sector settings. Through coursework in grant writing, project management, and research ethics, as well as opportunities to collaborate with faculty on cutting-edge research projects, students will gain the skills necessary to secure funding, oversee research facilities, and manage large-scale research initiatives. These experiences will be invaluable for employers seeking candidates who can effectively manage complex biological research programs and collaborate with diverse stakeholders. The Integrative Biology degree also positions graduates to capitalize on emerging technologies and research methods that are transforming the biological sciences. From genomic sequencing and bioinformatics to remote sensing and data visualization, the program's curriculum will expose students to the latest tools and techniques in the field. This expertise will be highly sought after by employers looking to harness these technologies to drive scientific discovery and innovation. By staying at the forefront of technological advancements, graduates of the program will be well-prepared to lead cutting-edge research initiatives and adapt to the evolving needs of the field.

Finally, by filling a critical gap in Tennessee's educational landscape, the Integrative Biology program will help to attract and retain top research talent in the state. As the demand for doctoral-level biological scientists continues to grow, particularly in the biotechnology and research sectors, the program will play a vital role in supplying the highly skilled workforce needed to support economic growth and scientific advancement in the region. In summary, the Integrative Biology PhD program is carefully tailored to address the specific skills, knowledge, and leadership attributes that are in high demand among employers in the biological sciences. By providing students with a comprehensive, interdisciplinary education and a strong foundation in research leadership, the program will help to bridge the gap between employer needs and the current educational landscape, while positioning graduates for successful and impactful careers in a rapidly evolving field. Through its focus on cutting-edge research, professional development, and technological innovation, the program will serve as a catalyst for scientific advancement and economic growth in Tennessee and beyond.

Bridging the Employer Demand and Skill Preparation Mismatch with an Integrative Biology PhD

The proposed Integrative Biology PhD program at Tennessee Tech University is specifically designed to bridge the growing gap between the skills employers need in advanced biological research roles and the training provided by traditional, narrowly-focused biology graduate programs. As the life sciences become increasingly data-intensive, technology-driven, and

collaborative, employers are seeking PhD graduates with the ability to work across disciplines, integrate diverse methodologies, and apply advanced quantitative and computing skills to complex biological problems. However, conventional Biology PhD programs often produce graduates with deep expertise in a single sub-discipline but limited preparation for the breadth and adaptability required in modern research environments.

The Integrative Biology PhD addresses this mismatch in several key ways:

1. **Methodological breadth:** By requiring coursework and research experiences that span molecular, organismic, ecological, and evolutionary scales, the program trains scientists who can draw upon a diversity of approaches to tackle multifaceted research questions. This breadth prepares graduates to work fluidly across disciplinary boundaries and adapt to emerging research areas, key skills sought by employers in both academia and industry.
2. **Quantitative emphasis:** With required training in statistics the program produces graduates well-equipped for an increasingly data-rich and computationally-intensive research landscape. Employers consistently report demand for biologists with strong quantitative skills, programming abilities, and experience with cutting-edge instrumentation. The Integrative Biology PhD makes these competencies a core element of the curriculum.
3. **Research versatility:** Through collaborations and a flexible curriculum, the program cultivates scientists capable of thriving in a variety of research environments. Whether working in an academic lab, government agency, or industry setting, graduates will have the agility to contribute productively to diverse teams and projects. This versatility is essential as employers increasingly seek adaptable talent rather than narrow specialists.
4. **Soft skill development:** The program's professional development class, which includes training in communication, collaboration, leadership, project management, and ethics, produces well-rounded graduates primed for the teamwork, networking, and professionalism demanded in the contemporary STEM workforce. According to recent reports (https://bidenwhitehouse.archives.gov/wp-content/uploads/2023/06/Building-the-Bioworkforce-of-the-Future.pdf), employers note that these are critical skill sets in the modern science-workforce environment.
5. **Real-world engagement:** By embedding research and fostering collaborations collaborations into the training experience, the Integrative Biology PhD builds both skills and networks directly relevant to future employment pathways. This practical experience and early career exposure is highly valuable to employers who seek graduates who can contribute immediately without extensive on-the-job training.

Ultimately, the Integrative Biology PhD is carefully crafted to align doctoral training with the evolving needs of an increasingly data-driven and collaborative life sciences research enterprise. By producing adaptable and well-rounded graduates, the program will supply the 21st century talent required by employers, rather than perpetuating the narrowly-focused and sub-optimally skilled candidates generated by many traditional programs. As such, the Integrative biology PhD represents a forward-thinking approach to bridging the graduate preparation-employer demand divide in the competitive life sciences sector.

SECTION IV: IMPLEMENTATION TIMELINE

- Proposed dates for external reviewer site visit –January 2026
- Estimated date of submission of the external review report to THEC and the institution – February 2026
- Estimated date of institution's response to external review (within 30 days of external review receipt) – March 2026
- Institutional governing board approval - March 2026
- THEC Action - May 2026
- Recruit and enroll students for Fall semester – Summer 2026
- First cohort begins coursework in program - Fall 2026

SECTION V: STUDENT INTEREST AND COMMUNITY PARTNERSHIPS

The proposed PhD program directly addresses workforce needs by preparing graduates for senior research positions and leadership roles in biological sciences. Primary employment opportunities include research directors, principal investigators, and senior scientists in academic institutions, government research facilities, and private industry. Based on current labor market data, there is demand for PhD-level scientists who can lead interdisciplinary research teams and manage complex biological research programs. The program specifically prepares graduates for careers showing strong growth projections and high median salaries:

- Research Directors/Principal Investigators in academic institutions (12% projected growth, median salary $110,000)
- Senior Scientists in biotechnology industry (15% projected growth, median salary $105,000)
- Biological Research Laboratory Directors (10% projected growth, median salary $100,000)
- Government Research Program Managers (8% projected growth, median salary $95,000)

To understand trends in salary and job growth for careers suited for graduates with a PhD in Integrative Biology, we gathered data from the Bureau of Labor Statistics (BLS) Occupational Outlook Handbook (https://www.bls.gov/ooh/) and Tennessee Higher Education Commission's 2024 Supply and Demand Report. Employment prospects for PhD graduates in Integrative Biology appear favorable. Overall employment in life, physical, and social science occupations is projected to grow faster than the average for all occupations from 2023 to 2033, with about 148,400 openings projected each year due to growth and worker replacement. The median annual wage for this group was $78,980 in May 2024, which was much higher than the median wage for all occupations of $49,500. Specifically, the career pathways tracked by BLS and most relevant to Integrative Biology show strong growth projections. These include Data Scientists, Epidemiologists, Medical Scientists, and Biochemists which will observe exceptional growths over the next 10 years of 36%, 19%, 11%, and 9%, respectively. Additionally, Agricultural and Food Scientists, Environmental Scientists, Microbiologists, and Conservation Scientists will enjoy growth rates of 8%, 7%, 7%, 5%, which are equal to or greater than average job growth. BLS data are summarized in Table 3.

In Tennessee, employment of biological scientists and related research positions is projected to grow by 7.2% through 2032, outpacing the overall state employment growth rate of 6.8%. Tennessee offers unique employment opportunities through several major research institutions and facilities. Oak Ridge National Laboratory, specifically its Biosciences Division, regularly employs PhD-level biological scientists, with current median salaries ranging from $85,000 to $120,000 annually. Vanderbilt University Medical Center and St. Jude Children's Research Hospital also maintain active research programs requiring PhD-level scientists, with entry-level research positions starting at $75,000-$85,000 annually. State agencies including the Tennessee Department of Health, Tennessee Department of Environment and Conservation, and Tennessee Wildlife Resources Agency employ PhD-level biological scientists in research director and program manager positions, with current salary ranges of $70,000-$95,000. These positions typically involve overseeing research programs, managing scientific staff, and directing collaborative research initiatives.

Private sector opportunities are expanding in Tennessee's growing biotechnology sector. Recent economic development data shows over 20 biotechnology companies have established or expanded operations in Tennessee since 2020, creating demand for PhD-level scientists to lead research and development programs. These positions typically offer starting salaries between $90,000-$115,000 annually.

This analysis demonstrates strong market demand for graduates with advanced training in integrative biological sciences who can assume research leadership and director positions. The proposed program would fill a critical gap in Tennessee's educational landscape while preparing graduates for well-compensated careers directing biological research programs across academic, government, and private sector settings.

Table 3. Relevant National Occupations and Demand Trends for Integrative Biology PhD. Below are data from Bureau of Labor Statics which demonstrate growth and earnings for fields related to Integrative Biology. Importantly, the relevance of each field to the proposed PhD program is specifically stated.

Occupation	Projected Growth (2023–33)	Annual Openings (avg/year)	Relation to Integrative Biology PhD	Median Wage (May 2024 USD)
Data Scientists	36% (much faster than avg) (Bureau of Labor Statistics)	~20,800 (Bureau of Labor Statistics)	PhD may lead to leadership roles	$112,590 (Bureau of Labor Statistics)
Epidemiologists	19% (much faster than avg) (Bureau of Labor Statistics)	~800 (Bureau of Labor Statistics)	PhD often required for senior roles	$83,980 (Bureau of Labor Statistics)
Medical Scientists	11% (much faster than avg) (Bureau of Labor Statistics)	~8,900 (Bureau of Labor Statistics)	Doctoral or professional degree typically required	$100,590 (Bureau of Labor Statistics)
Biochemists & Biophysicists	7% (faster than avg) (DOL Blog)	~2,800 (DOL Blog)	Doctoral/professional typically degree required	$103,810 (DOL Blog)

Agricultural & Food Scientists	8% (faster than avg) (Bureau of Labor Statistics)	~3,100 (Bureau of Labor Statistics)	Bachelor's minimum; advanced degrees for leadership/research	$78,770 (Bureau of Labor Statistics)
Environmental Scientists & Specialists	7% (faster than avg) (Bureau of Labor Statistics)	~8,500 (Bureau of Labor Statistics)	Bachelor's minimum; PhD advantageous for research leadership	$80,060 (Bureau of Labor Statistics)
Microbiologists	7% (faster than avg) (DOL Blog)	~1,700 (DOL Blog)	Bachelor's entry-level; PhD needed for independent research	$81,990 (DOL Blog)
Conservation Scientists & Foresters	5% (as fast as avg) (Bureau of Labor Statistics)	~1,900 (Bureau of Labor Statistics)	Bachelor's typical; PhD often required for leadership roles	$67,950 (Bureau of Labor Statistics)

Student Interest Survey

To gauge student interest in applying to the program, we surveyed undergraduate students, graduate students, and recent graduates across numerous Tennessee universities. This section summarizes methods and results of an instrument used to gauge interest in the proposed PhD program in Integrative Biology.

Survey Methods

We created a survey which provided respondents with a short executive summary of the PhD program followed by a list of questions designed to gauge their interest and potential to apply to the program. The survey gathered basic background information from the respondents such as their current education status, their field of study, and their familiarity with the discipline of Integrative Biology. The survey was developed using Google Forms and data were analyzed via the statistical software R. The survey was distributed via email to three groups: current undergraduate students, current graduate students, and recent graduates of a bachelor's degree. The survey was delivered to all four-year public universities in Tennessee with permission and assistance from Biology (or similar) Department administrators. Some university administrators declined to participate. The survey was delivered via email to department administrators during July and August 2025. The end of the survey provided an open-ended question which allowed responded to provide "any additional thoughts on your interest in a PhD program in Integrative Biology".

Survey Results

We received responses from individuals across four universities: UT Knoxville, UT Chattanooga, TN Tech, and East TN State. Most respondents (94.1 %) were recent graduates, undergraduates, or master's students, which was our target audience as these individuals are at the best career stage to apply to a PhD program. Their field of study represented the diversity of fields most incorporated into an Integrative Biology program: Organismal Biology, Microbiology, Environmental Science, and Cellular and Molecular Biology. Most students were either very familiar or somewhat familiar (84.3%) with the discipline of Integrative Biology; therefore, these students should be competent to judge their personal interest in such a program. Most

respondents expressed interest in the proposed program (22% “very interested”; 41% “somewhat interested”) and demonstrated potential to apply to the program within the next three years (38% “Yes; 41% “Maybe”). Student interest data are summarized in Figure 1 and Table 4.

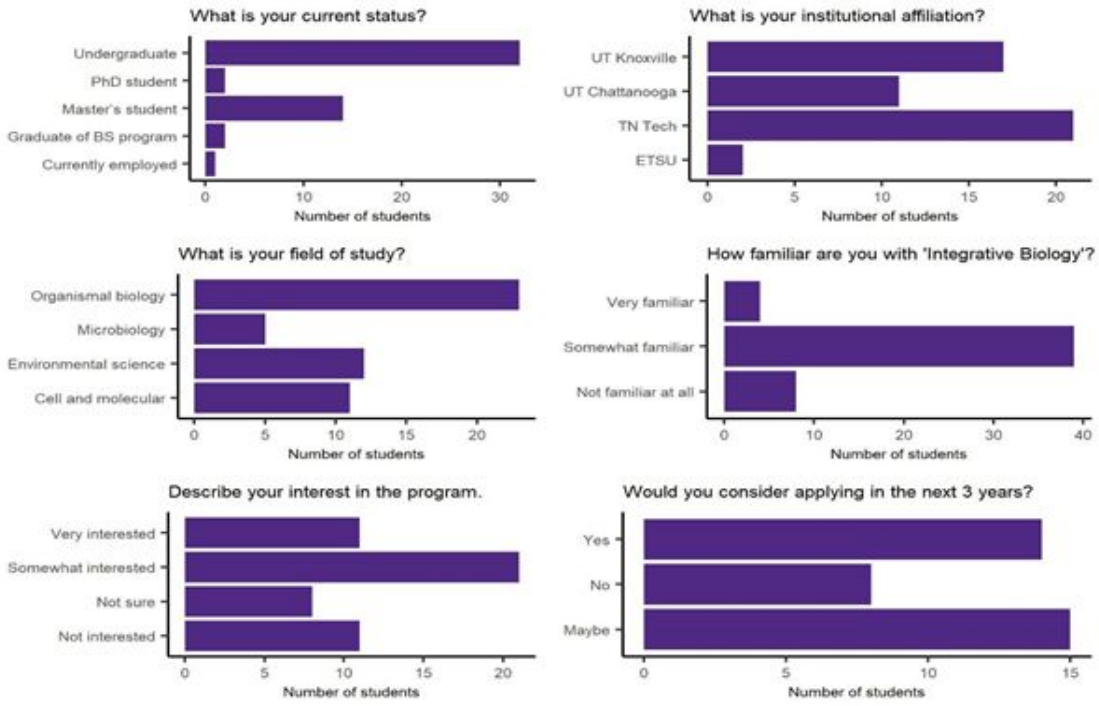


Figure 1. Summary of survey results of student interest in the Integrative Biology PhD. Respondents were provided with an executive summary of the program and asked a series of questions which gathered basic information including their interest in the program.

Table 4. Summary of student interest survey results. “Status” is the current status of the respondent regarding education and employment. “Field” is the respondents’ designated field of study. “Institution” is the respondents’ institutional affiliation. “Familiarity” is the respondents’ self-described familiarity with the discipline of Integrative Biology. “Interest” is the respondents’ self-described interest in applying to the program. “Apply” is the respondents’ interest in applying to the program within the next three years.

Variable	Category	Percent (%)
Status	Undergraduate	62.7
	Master’s student	27.5
	Graduate of BS program	3.9
	PhD student	3.9
	Currently employed	2.0
Field	Organismal biology	45.1

	Environmental science	23.5
	Cell and molecular	21.6
	Microbiology	9.8
Institution	TN Tech	41.2
	UT Knoxville	33.3
	UT Chattanooga	21.6
	Eastern TN State Univ	3.9
Familiarity	Somewhat familiar	76.5
	Not familiar at all	15.7
	Very familiar	7.8
Interest	Somewhat interested	41.2
	Very interested	21.6
	Not interested	21.6
	Not sure	15.7
Apply	Maybe	40.5
	Yes	37.8
	No	21.6

Responses to the open-ended question were generally positive, with many participants expressing enthusiasm for the concept of an Integrative Biology PhD program at Tennessee Tech. 35% provided explicitly positive statements, describing the program as “great,” “amazing,” “excellent,” or “essential.” These respondents often noted its potential to unify biology-related research, create a more well-rounded degree, or open new professional opportunities. Conditional interest was also common, with 30% indicating they would consider the program if specific conditions were met. Common conditions included competitive stipends, health insurance, clear specialization options, alignment with research interests (e.g., ornithology or microbiology), and strong institutional support. Neutral or uncertain views appeared in 20% of responses. These participants often noted unfamiliarity with the term “Integrative Biology” or stated they needed more details before forming an opinion. Taken together, the quantitative and qualitative data indicate strong initial interest in the proposed program.

We anticipate enrollment to initially be 10 students and grow to a saturation of 20-30 students (Table 5). Multiple lines of evidence support these projections. First, we anticipate that 10 teaching assistantships will be available for the PhD program in Integrative Biology. These will be fully funded positions including stipend, fees, and tuition. This should ensure 10 total students at a minimum for the program at any given time. These teaching assistantships will be leveraged to relieve our most productive research faculty from some teaching responsibilities, allowing more time for funding acquisition and grant writing. The TTU biology department already has a

mechanism by which these faculty can move to a “research track” to shoulder a heavier load of research responsibility. Given this support, we anticipate the program will grow to 2 to 2.5 times the number of students overall (20-30 students) with more students supported by research grants than teaching assistantships.

Evidence comes from our existing MS program in biology which consistently supports 20-30 MS students although we have only 12 student teaching assistantships available. Thus, at any given time, most of our MS students are supported by research grants. We anticipate similar success in recruiting and financially supporting PhD students. Moreover, the TTU biology department has historically supported 8-12 PhD through the TTU Environmental Science PhD program. These students have primarily been supported by research grants and fellowships which demonstrates the capacity for biology department faculty to acquire funding necessary to support PhD students. We anticipate the additional resources allocated to the program (Section VII) will allow the biology department to continue to effectively mentor PhD students from EVS while growing the PhD program in Integrative Biology. Finally, nation-wide data collected by the National Science Foundation indicate that two to three times as many doctoral students are supported by research grants and fellowships than teaching assistantships (ncses.nsf.gov). Therefore, our estimate of a 2.5:1 ratio of students supported by external funding as compared to teaching assistantships is in line with national trends.

Projected graduates are based on the national median time-to-degree for biological sciences which is approximately 4-6 years (Council of Graduate Schools: https://cgsnet.org/). Rates of attrition are often not specifically tracked by national databases (e.g. NSF - Survey of Earned Doctorates); however, these can potentially be as high as 20% in the life sciences (https://cgsnet.org/). Thus, we used these available data to estimate rates of attrition and graduation using our proposed enrollment.

Table 5 – Projected enrollments and graduates.

Projected Enrollments and Graduates				
Year	Academic Year	Projected Total Fall Enrolment	Projected Attrition	Projected Graduates
1	2026-2027	12	0	0
2	2027-2028	17	0	0
3	2028-2029	22	1	0
4	2029-2030	25	1	2
5	2030-2031	28	2	5
6*	2031-2032	30	2	7
7*	2032-2033	30	2	8

*Year 6 and 7 projections are only required for doctoral programs.

Community and Industry Partnerships

The proposed Integrative Biology PhD program at Tennessee Tech will be strengthened by a robust network of existing and anticipated partnerships with government agencies, research institutions, industry organizations, and conservation groups throughout Tennessee and the broader region. These partnerships will provide students with invaluable research opportunities, internship placements, career pathways, and access to cutting-edge facilities and expertise that complement the university's resources. Moreover, these partnerships offer numerous employment opportunities. Oak Ridge National Laboratory, specifically its Biosciences Division, regularly employs PhD-level biological scientists, with current median salaries ranging from $85,000 to $120,000 annually. Vanderbilt University Medical Center and St. Jude Children's Research Hospital also maintain active research programs requiring PhD-level scientists, with entry-level research positions starting at $75,000-$85,000 annually. State agencies including the Tennessee Department of Health and Tennessee Wildlife Resources Agency employ PhD-level biological scientists in research director and program manager positions, with current salary ranges of $70,000-$95,000. These positions typically involve overseeing research programs, managing scientific staff, and directing collaborative research initiatives.

Tennessee Wildlife Resources Agency (TWRA) and **Tennessee Department of Environment and Conservation (TDEC)** serve as cornerstone partners for wildlife ecology, conservation biology, and fisheries research. Staff expertise in native species management, habitat restoration, and biodiversity conservation will provide students with opportunities to conduct applied research on Tennessee's diverse ecosystems, from the Cumberland Plateau to the Mississippi River floodplains. Collaborative projects will focus on species monitoring, habitat assessment, and conservation strategy development. Moreover, students will benefit from access to TDEC's environmental monitoring networks, laboratories, and field research sites throughout the state. These agencies typically fund graduate student research through contracts for specific projects including wildlife population monitoring, habitat assessment, invasive species management, and evaluation of conservation efforts. Students may receive research assistantships on TWRA- or TDEC-funded projects or conduct dissertation research on agency-relevant topics while receiving in-kind support such as field site access, equipment loans, and mentorship from agency biologists. These agencies also receive federal grants through the U.S. Fish and Wildlife Service's Wildlife and Sport Fish Restoration Program, some of which may support university research partnerships.

Oak Ridge National Laboratory (ORNL) represents a world-class research partnership. As one of the nation's premier scientific institutions, ORNL's Biological and Environmental Systems Science Division offers access to advanced facilities, computational resources, and collaborative research opportunities in systems biology, bioenergy, environmental remediation, and computational biology. The historic partnership between ORNL and Tennessee universities provides established pathways for student research collaborations and career development. For example, Oak Ridge Institute for Science and Education (ORISE) Graduate Fellowships provides numerous research experiences for graduate students including stipends, health insurance, and travel allowances. Graduate students can receive funding through collaborative research projects between their university and ORNL, where they work directly with ORNL scientists on dissertation-relevant projects while receiving financial support from the laboratory. Additionally, ORNL/ORISE offers formal professional development training for graduate students and connects students with

potential federal employers such as the Environmental Protection Agency and US Department of Energy.

U.S. Geological Survey (USGS) and **U.S. Fish and Wildlife Service (USFWS)** are close research partners with TN Tech's biology department and will provide direct on-campus and near-campus access to expert mentorship and funding opportunities. The USGS Tennessee Cooperative Fishery Research Unit is housed in Tennessee Tech's Pennebaker Hall and consists of two federal USGS scientists who teach graduate courses, mentor graduate students, and conduct research on aquatic biology topics through projects funded by various federal and state agencies. The Tennessee Unit's strategic location at Tennessee Tech in Cookeville, positioned between the Tennessee and Cumberland Rivers, provides access to some of the world's most diverse freshwater fish and mussel communities, including numerous imperiled species across more than 30 impoundments and thousands of miles of free-flowing streams. The USFWS Tennessee Ecological Services Field Office, located in Cookeville and only a few miles from TN Tech's campus, offers additional partnership opportunities for graduate students conducting research on endangered species recovery, habitat conservation, and environmental compliance issues. These federal partnerships provide graduate students with direct access to federal funding streams, specialized expertise in aquatic and terrestrial ecology, and research opportunities that address critical conservation challenges while preparing students for careers in federal natural resource agencies. The co-location of these federal offices with the university creates an exceptional environment for collaborative research that bridges academic training with applied conservation science.

Tennessee Department of Health, University of Tennessee Health Science Center, **Vanderbilt University Medical Center,** and **St. Jude's Children's Research Hospital** will provide opportunities for graduate students focused on cellular and molecular biology to engage in research addressing environmental health impacts, disease surveillance and monitoring, and public health challenges facing Tennessee communities. For example, One Health initiatives in Tennessee involve collaborative efforts between the Tennessee Department of Health and academic institutions, focusing on workforce development, education and research initiatives, disease monitoring and surveillance, environmental health and conservation, and rapid response to emerging health threats. Graduate students can also benefit from partnerships with The University of Tennessee Health Science Center (UTHSC), which conducts basic science and clinical research across Tennessee through continuing relationships with research and healthcare facilities statewide, providing access to cutting-edge molecular biology research and clinical applications. Additional support may come through the **Tennessee Department of Agriculture** for research on food safety and agricultural health, and through state-university research centers that have received millions in grants to conduct research across public health issues of importance to Tennessee. These partnerships enable graduate students to conduct translational research that bridges fundamental molecular biology with applied health outcomes, preparing them for careers in public health, biomedical research, and health-related industries.

In addition to formal relationships with state and federal agencies, graduate students would benefit from partnerships with Tennessee's numerous conservation organizations, which could provide unique opportunities for community engagement, as these societies are often run by a wide variety of stakeholders including those from the private sector. Working alongside groups such as the **Tennessee Wildlife Federation, TennGreen Land Conservancy, Tennessee**

Herpetological Society, Tennessee Native Plant Society, American Eagle Foundation, Tennessee Ornithological Society, Tennessee Conservation Voters, and the **Wolf River Conservancy** (to name a few) would give students access to diverse field sites, long-term ecological data, and ongoing restoration projects that align directly with their research interests. These partnerships will also facilitate internships, joint grant proposals, and co-authored publications, while exposing students to local conservation challenges and solutions. By engaging with advocacy organizations like the **Tennessee Environmental Council** and the **Sierra Club's Tennessee Chapter**, students would gain experience in science communication, policy engagement, and public education—skills essential for both academic and non-academic careers. Collectively, these relationships would prepare graduates to integrate scientific expertise with practical conservation action, enhancing both their scholarly impact and their employability. Finally, **The Nature Conservancy (TNC)** is a national organization with a large footprint in Sparta, TN, just south of TN Tech: **Bridgestone Nature Reserve at Chestnut Mountain**. This expansive 5,763-acre reserve serves as a "living laboratory" for ecological research and conservation, preserving critical habitat for rare species and allowing scientific study of forest restoration, biodiversity, and carbon sequestration in the Cumberland Plateau region. TNC researchers have collaborated with TN Tech students and faculty for over a decade on conservation projects conducted on TNC properties.

Additional industry partnerships include those related to environmental consulting, biotechnology, agriculture, forestry, energy, and ecotourism, offering applied research opportunities, internships, and pathways to non-academic careers. Collaborations with environmental consulting firms like **Stantec, S&ME,** and **Gresham Smith** could immerse students in habitat assessment, environmental impact analysis, and regulatory compliance, building skills in GIS, species monitoring, and restoration planning. These partners each have offices in close proximity to TN Tech (Knoxville, Chattanooga, Nashville). Partnerships with biotechnology and life sciences companies—including **Nashville Biosciences, AgResearch** (in Oak Ridge), or biotech startups in the **BioTN Foundation** network—could give students experience in molecular tools, genetic conservation, and environmental DNA analysis and help launch careers in the private sector via resources that assist would-be entrepreneurs in life science fields. Agricultural and forestry industries, such as the **Tennessee Forestry Association, International Paper,** or **Jack Daniel's** (which has sustainability and water conservation initiatives; e.g. University of Tennessee Tree Improvement Program), could support research on sustainable land management, pest control, and climate resilience. Energy-sector partners like the **Tennessee Valley Authority (TVA)** or renewable energy companies could connect students to river basin ecology, fish passage projects, and environmental monitoring linked to hydropower and solar farms. Finally, ecotourism and outdoor recreation companies (e.g., **REI, Bass Pro/Cabela's, local paddling or climbing outfitters**) could provide outlets for science communication, citizen science, and conservation education for the public. Together, these partnerships would expose students to real-world applications of Integrative Biology, foster professional networks, and broaden their career prospects beyond academia.

SECTION VI: CURRICULUM

Academic Program Requirements

The PhD in Integrative Biology will require the successful completion of 61 student credit hours (SCH) beyond the baccalaureate degree. This will include a minimum of 43 SCH of graduate level course work (5000/6000/7000 level). A maximum of 6 SCH can be taken at the 5000 level. This also includes 13 credits of required core courses (listed below). Additional coursework may be required to address deficiencies in student preparation as identified by the PhD advisory committee. The program is designed for both students entering directly from earning a baccalaureate degree and those entering after earning a master's degree in Biology or a related discipline.

Students entering with a relevant master's degree may transfer up to **24 credit hours** of approved graduate coursework towards their Graduate Course Work Elective requirement, subject to the following conditions:

1. Courses must be at the equivalent of 5000/6000/7000 level.
2. A grade of **B or higher** must have been earned.
3. The student's Graduate Advisory Committee must approve the transfer as part of the Program of Study.

Admission Requirements

1. Applicants must hold a baccalaureate degree from an institution accredited by a recognized accrediting agency.
2. Applicants with a must have a minimum overall grade point average of 3.0 (on a 4.0 scale) for the highest degree earned.
3. Official transcripts from all previously attended institutions.
4. Three (3) letters of recommendation from individuals qualified to evaluate the applicant's preparedness for doctoral-level study.
5. A current resume or curriculum vitae.
6. Signed Graduate Advisor Acceptance Form (Appendix B)
7. International applicants are required to submit official TOEFL or IELTS scores, unless their baccalaureate degree was earned from an accredited English-speaking university.

Regular admission to the Integrative Biology PhD Program is granted based on the following criteria:

1. **Faculty mentorship availability**: Admission is contingent upon the availability of a faculty member willing to serve as the student's research director and program mentor. Given the essential nature of the student-faculty relationship in doctoral education, prospective applicants are strongly encouraged to establish contact with potential faculty advisors before submitting their application.

2. **Academic record**: The program maintains selective admission standards, with the GPA requirements outlined above serving as baseline criteria in the evaluation process.
3. **Professional recommendations**: Three letters of recommendation must be submitted as part of the complete application package. Application review will not commence until all required materials have been received.

Conditional admission may be considered in exceptional circumstances for applicants who do not meet standards for regular admission but possess outstanding research experience or professional training. Conditional admission must be approved by the PhD Program Coordinator. In such cases, a faculty sponsor must provide written justification explaining why the applicant deserves conditional admission and the sponsor's commitment to serve as the applicant's major professor. The student must apply for reclassification after having satisfactorily removed any conditions or requirements as stated on their admission form by using the "Application for Reclassification to Full Standing Form" (Appendix B).

Additional Requirements:

1. **Pre-admission faculty contact**: Students must establish communication with potential advisors during the application process and have a signed Graduate Advisor Acceptance Form.
2. **Committee formation and program planning**: Students must assemble their Graduate Advisory Committee and submit an approved program of study by the conclusion of their first year.
3. **Research prospectus approval**: A written research prospectus must receive approval from the Graduate Advisory Committee.
4. **Annual progress reporting**: Following prospectus approval, students must provide annual research progress reports to their doctoral committee.
5. **Comprehensive examinations and admission to candidacy**: A student may be admitted into PhD candidacy when both written and oral comprehensive examinations have been successfully completed.
6. **Dissertation completion and defense**: Students must complete a written dissertation and successfully defend it at a public research seminar. This final milestone must be achieved by the end of the sixth year for students entering with an M.S. degree, or by the end of the seventh year for students entering with only a baccalaureate degree.

Table 6. Integrative Biology PhD credit hour requirements.

Description	Course Number	SCH
Core Courses		13 credits
Statistical Analyses or Experimental Design course	See below	3 credits
Scientific Leadership and Management	BIOL 7210	3 credits
6000/7000 level Biology Elective (approved by		3 credits

committee; outside of individual's specific sub-discipline)		
Elective Outside of the Biology Department (this can be at any level and cannot count toward any other course requirement)		3 credits
Dissertation Research Seminar	BIOL 7991	1 credit
Course Electives	5000/6000/7000 level	30 credits
Research and Dissertation hours (BIOL 7990), as determined and approved by student's Graduate Advisory Committee.	BIOL 7990	18 credits
Total		**61 credits**

**Note: Only 6 SCH of 5000-level courses can be counted towards degree for students entering with a master's degree. Only 9 SCH of 5000-level courses can be counted towards degree for students entering with a baccalaureate degree.*

Table 7. Approved Statistical Analyses or Experimental Design courses for Integrative Biology PhD degree.

Courses Approved To Meet the Statistical Analyses or Experimental Design Requirement	
BIOL 6140	Fish & Wildlife Biometrics
BIOL 6810	Ecological Ordination
BIOL 7270	Advanced Bioinformatics
MATH 5470	Probability & Statistics I
MATH 5480	Probability & Statistics II
MATH 6070	Applied Linear Statistical Methods I
MATH 6080	Applied Linear Statistical Methods II
MATH 6170	Experimental Design I
MATH 6180	Experimental Design II
MATH 6270	Mathematical Statistics
MATH 6470	Environmental Statistics

Graduate Only Course Electives

Electives will be selected in consultation with the student's advisory committee and may include, but are not limited to courses in Table 8.

Table 8. Courses approved for meeting the 6000/7000-level elective requirements of the Integrative Biology PhD program.

Courses Approved To Meet the 6000/7000-level Graduate Course Elective Requirements	
BIOL 6060	Aquatic Toxicology
BIOL 6100	Advanced Microscopy
BIOL 6120	Fishery Science
BIOL 6130	Advanced Fisheries Management
BIOL 6140	Fish & Wildlife Biometrics
BIOL 6150	Reservoir Fisheries Management
BIOL 6310	Biological Literature
BIOL 6350	Management of Wetland Wildlife
BIOL 6360	Wetland Identification and Assessment
BIOL 6370	Management of Upland Wildlife
BIOL 6420	Water Resources Management Seminar
BIOL 6500	Biological Photography
BIOL 6600	Microbial Ecology
BIOL 6630	Animal Ecology
BIOL 6640	Stream Ecology
BIOL 6650	Physiological Ecology
BIOL 6660	Fish Ecology
BIOL 6670	Stream Ecology
BIOL 6680	Malacology
BIOL 6810	Ecological Ordination
BIOL 7250	Spatial and Landscape Ecology
BIOL 7270	Advanced Bioinformatics
BIOL 7310	Population Genetics
BIOL 7340	Advanced Virology and Epidemiology
BIOL 7440	Signal Integration
7470	Scientific Systems Modeling

Research and Dissertation

Students can register for BIOL 7990 – Research and Dissertation each semester. Research activities include proposal development, data collection and analysis, publication of peer-reviewed manuscripts, and completion of the dissertation.

Time Limit for Degree Completion

As per Tennessee Tech policy, students in a PhD program must complete all requirements for the degree within eight consecutive years. The time limit begins with the first semester the student is admitted and enrolled in a degree program.

Goals and Outcomes

Graduates of the program will demonstrate advanced knowledge across multiple biological subdisciplines and the ability to integrate concepts across organizational scales. They will be able to design and conduct original research addressing complex biological problems that require interdisciplinary approaches, applying advanced statistical, computational, and experimental design techniques to answer biologically-relevant questions. In addition, they will communicate scientific findings effectively to both professional and public audiences, and will exhibit leadership and project management skills relevant to careers in academia, government, or industry.

Program Learning Outcomes

Graduates of the Integrative Biology PhD program will achieve three learning outcomes:

1. Synthesize and apply knowledge from multiple biological subdisciplines to formulate and address interdisciplinary research questions that advance understanding of complex biological problems.
2. Develop and refine a range of transferable skills, including problem-solving, critical thinking, project management, and leadership, that prepare them to generate new knowledge, drive innovation, and apply biological theory and methods to address societal challenges in Tennessee and beyond.
3. Effectively communicate complex biological concepts, methods, and findings to diverse audiences, including scientists, students, policymakers, and the public.
4. Demonstrate a strong commitment to ethical conduct and professional integrity in all aspects of research and scholarship.

Assessment and Evaluation Plan for Program Learning Outcomes

At Tennessee Tech, Institutional Effectiveness, which is part of the Institutional Assessment, Research, and Effectiveness Office, supports planning and assessment by departments and programs. Campus Labs software “is used as a repository for student learning and program outcomes, assessment results, and modifications aimed at continuous improvement”. A staff member from Institutional Effectiveness works with programs to identify the best assessment tools and processes for continuous improvement.

The Biology Department chairperson, with assistance from the PhD Program Coordinator, will annually submit Institutional Effectiveness reports, which are given as part of the SACSCOC

accreditation process. These reports examine the degree of achievement of program and student learning outcomes with respect to identified thresholds. The Department of Biology Graduate Committee, working in coordination with the Coordinator of the PhD program, will be responsible for ongoing program oversight to ensure academic quality and student success.

The Biology Department will use the following data in conjunction with the annual program review to evaluate the effectiveness of the Integrative Biology PhD program:

1. Time-to-degree
2. Attrition and completion rates
3. Number of student publications, presentations, or conference abstracts
4. Grant and fellowship success rates
5. Scores for Qualifying exams, defense seminar, final oral exam (see below and Appendix B)
6. Teaching evaluations for students serving as teaching assistant or instructor
7. Results of graduate outcome survey (Appendix B)
8. Job placement statistics

These data will be collected by the faculty, Biology Department Chairperson, and PhD program Coordinator as appropriate. After graduation, the program outcomes will be evaluated using a “Graduate Outcome Survey” (Appendix B) which links the program to student job placement and professional success. Data will be evaluated annually by the faculty and improvements will be identified and implemented as needed.

In alignment with THEC policy, the program will undergo a formal review every five years to evaluate its effectiveness, outcomes, and alignment with institutional and state goals. The first academic program review would occur during the fifth year of the program. The above data will also be leveraged across the five-year period to demonstrate program effectiveness.

Student Learning Outcomes

Upon completion of the Integrative Biology PhD program, students will be able to:

1. Critically evaluate and synthesize primary literature to develop a comprehensive understanding of the current state of knowledge in their field of study.
2. Design and execute robust experimental and observational studies that effectively test hypotheses, demonstrating a mastery of scientific methodology and best practices in research design.
3. Select and employ appropriate statistical methods, computational tools, and data visualization techniques to analyze, interpret, and draw meaningful conclusions.
4. Communicate scientific findings and ideas effectively through compelling writing and oral presentations.

Assessment and Evaluation Plan for Student Learning Outcomes

Students will be evaluated on their progress toward the student learning outcomes through a variety of assessments conducted by multiple faculty members serving in different roles. Course instructors will provide evaluations of student performance in formal classes, focusing on mastery of content knowledge, critical thinking, and written and oral communication. Each student's graduate advisory committee will review progress annually through committee meetings, assessing milestones such as research planning, data collection, professional development, and timely progress toward degree completion. The committee will also evaluate student performance in written and oral qualifying examinations, ensuring readiness for independent research and synthesis of knowledge across biological disciplines. In addition, the biology faculty as a whole will assess student performance during the dissertation defense seminar, which serves as a capstone demonstration of research quality, disciplinary integration, and scientific communication. At each stage, structured assessment tools (Appendix B) will be employed to provide consistent, transparent, and constructive evaluations. Collectively, these multiple layers of assessment ensure that student progress is measured holistically, incorporating both disciplinary expertise and professional competencies essential for success in integrative biology.

An assortment of tools will be used to evaluate student progress. Most of these will be evaluated by an interdisciplinary team, the graduate advisory committee. Specific evaluation tools will include:

1. **Research Proposal –** evaluated by the Graduate Advisory Committee and should be submitted and approved within the first year of the program of study.
    a. Assesses the student's ability to design a feasible, rigorous, and original research project.
    b. Demonstrates mastery of relevant literature and identification of knowledge gaps.
    c. Provides an early measure of critical thinking, creativity, and independence.
2. **Written and Oral Qualifying Exams –** evaluated via the Graduate Advisory Committee using the "Student Qualifying Exam Rubric" and Written and Oral Evaluations (Appendix B). Exams should be completed by year three of the program of study.
    a. Evaluate breadth and depth of knowledge in the discipline.
    b. Test the student's ability to synthesize information, apply concepts, and think critically.
    c. Ensure readiness to advance to candidacy by confirming the foundation needed for independent research.
3. **Annual Graduate Advisory Committee Meeting –** evaluated using the Annual Student Progress Report (Appendix B) which should be completed once per year.
    a. Provides structured, regular feedback on progress toward degree completion.
    b. Allows for early identification of challenges and targeted mentoring support.
    c. Helps track professional development, research progress, adherence to program milestones, and professional accomplishments such as publications, presentations, seminars, and awards.

4. **Dissertation Defense Seminar –** Evaluated by the Biology Faculty using the Defense Seminar Rubric (Appendix B) and should be completed in the final semester of the program of study. The Dissertation Defense Seminar is presented to the Graduate Advisory Committee and Department and explains the student's dissertation research.
    a. Evaluates the student's ability to clearly present and communicate their research to a broad scientific audience.
    b. Provides evidence of the student's depth of understanding and ability to place their work in a broader context.
    c. Demonstrates scientific maturity and professional communication skills.
5. **Final Oral Exam –** Evaluated by the Graduate Advisory Committee using the "Final Oral Exam Rubric" (Appendix B) and should be completed in the final semester of the program of study. The Final Oral Exam is attended by the Graduate Advisory Committee and can include other members of the PhD Graduate faculty. The attendees of the Final Oral Exam ask questions to assess student's justification of research and depth of knowledge.
    a. Evaluates the student's depth of knowledge concerning their specific research topic as well as the methodological and statistical norms in their field.
    b. Evaluates the student's ability to integrate knowledge across biology subdisciplines and demonstrate how their research moves the field of integrative biology forward
    c. Provides evidence of scholarly independence, critical thinking, and readiness to contribute as a professional scientist
6. **Dissertation –** Evaluated by the Graduate Advisory Committee
    a. Represents the culmination of independent, original scholarship and demonstrates the capacity to conduct effective research in the future.
    b. Evaluates the student's ability to conduct rigorous research, analyze data, and draw meaningful conclusions.
    c. Serves as a lasting contribution to the field and the strongest indicator of readiness for independent research careers.

Table 9 provides a summary of how each of the above evaluation tools relate to the specific student learning outcomes.

Table 9. Alignment of evaluation and assessment tools with the student learning outcomes.

Student Learning Outcome	Coursework evaluation	Additional evaluation	Specific Assessment Tool (Appendix B)
Critically evaluate and synthesize primary literature to develop a comprehensive understanding of the current state of knowledge in their field of study.	Coursework assignments and exams from elective courses	Research proposal; Annual committee meetings; Qualifying exams; Defense seminar	Annual Progress Report; Qualifying Exam Rubrics; Defense seminar rubric

Design and execute robust experimental and observational studies that effectively test hypotheses, demonstrating mastery of scientific methodology and best practices in research design.	Assignments/Exams from core class in Statistical Analysis or Experimental Design	Annual committee meetings; Qualifying exams; Defense seminar	Annual Progress Report; Qualifying Exam Rubrics; Defense seminar rubric
Select and employ appropriate statistical methods, computational tools, and data visualization techniques to analyze, interpret, and draw meaningful conclusions.	Assignments/Exams from core classes in Statistical Analysis/ Design and Scientific Leadership & Management	Research proposal; Annual committee meetings; Final oral exam; Defense seminar	Annual Progress Report; Final oral exam rubric; Defense seminar rubric
Communicate scientific findings and ideas effectively through compelling writing and oral presentations.	Core class in Scientific Leadership & Management and Elective Coursework	Research Proposal; Final oral exam; Defense seminar	Final oral exam rubric; Defense seminar rubric

Existing and new courses

In this section, we show current and new courses available at the graduate-student only level, which is 6000-level courses. Undergraduate classes can be taken as at the graduate-student level (5000-level course), and additional work beyond the undergraduate student level is required for grade assignment.

Existing courses

Table 10 shows the current graduate-level courses offered by the Biology department.

Table 10. Existing courses in the Biology catalog.

Class	Hours	Catalog Description
BIOL 6060 – Aquatic Toxicology	4	A study of the mechanisms of toxicity in terrestrial and aquatic organisms, including the measurement of response, uptake, metabolism, and excretion of toxicants. Design and interpretation of toxicity tests, hazard evaluation, risk assessment, and toxics reduction plans. Fate and transport processes and advanced approaches in automated, computer-assisted monitoring will be evaluated. Environmental policy and laws of national and international concern will be addressed.
BIOL 6100 – Advanced Microscopy	3	An applied course in the use and maintenance of research-grade microscopes and various optical systems. Topics also include computer image analysis, confocal laser scanning microscopy, photography, calibration, and measurement.
BIOL 6120 – Fishery Science	3	Current concepts and practices of fishery science, especially those environmentally related.

BIOL 6130 – Advanced Fisheries Management	4	An in-depth analysis of major historical developments in the theory and techniques of freshwater fisheries management.
BIOL 6140 – Fish & Wildlife Biometrics	3	Study and application of quantitative methods used to assess fish and wildlife populations. Estimation of parameters, hypothesis testing, and use of classical fisheries and wildlife statistical techniques.
BIOL 6150 – Reservoir Fisheries Management	3	A comprehensive introduction to basic and applied aspects of managing fisheries in man-made impoundments.
BIOL 6310 – Biological Literature	1	A survey of literature resources, experimental design, report writing, and rules adopted by the Council of Biological Editors.
BIOL 6350 – Management of Wetland Wildlife	4	Ecology and management of wildlife species occurring in wetland habitats, emphasis on waterfowl and southeastern fauna.
BIOL 6360 – Wetland Identification and Assessment	4	Advanced concepts of the physical, chemical, and biological properties of wetlands and how hydrology and geomorphology interact to create wetland ecosystems. Field techniques for distinguishing wetlands from non-wetlands and for assessing functional capacity of wetland ecosystems will be covered.
BIOL 6370 – Management of Upland Wildlife	4	Ecology and management of wildlife species occurring in upland habitats, emphasis on southeastern fauna.
BIOL 6420 – Water Resources Management Seminar	2	Current problems and research in water resources management.
BIOL 6500 – Biological Photography	3	Photographic principles applied to biological materials; photomicrography and photomacrography; preparation of black and white prints for publication and slides for presentation.
BIOL 6600 – Microbial Ecology	4	Topics will include role of microorganisms in nutrient cycling, techniques in sampling, enumeration, and activity measurements, distribution of microorganisms, diversity and adaptation, and microbial interactions including competition, symbioses, and predation.

BIOL 6630 – Animal Ecology	3	The relationship between animals and their environment; the structure, processes, and distribution of animal communities.
BIOL 6640 – Stream Ecology	3	Concepts in water chemistry and physics, hydrology, and sediments of lotic systems and their influences on ecological relationships. Stream production, metabolism, and energy flux relative to river continuum concepts will be emphasized through field studies and report preparation.
BIOL 6650 – Physiological Ecology	4	Advanced concepts in ecological structure and function and how they are governed by physiological processes. Resource utilization, mineral and nutrient cycling, and energy flux in maintenance, production, and reproduction of ecological population and communities will be addressed. Applications and tests of relevant approaches to data acquisition, processing, and interpretation are emphasized. Remote sensing technologies are included.
BIOL 6660 – Fish Ecology	3	Principles of the evolutionary ecology of fishes, including reproductive guilds, morphological and behavioral polymorphism, foraging, habitat selection, intraspecific and interspecific interactions, and stability of fish assemblages.
BIOL 6670 – Stream Ecology	4	Concepts in water chemistry and physics, hydrology, and sediments of lotic systems and their influences on ecological relationships. Stream production, metabolism, and energy flux relative to river continuum concepts will be emphasized through field studies and report preparation.
BIOL 6680 – Malacology	3	Identification, classification, and ecology of freshwater bivalves. Emphasis on ecology of Ohio River basin species.
BIOL 6810 – Ecological Ordination	3	Application of multivariate statistics in the study of ecology.

New Courses:

Table 11 shows new courses the Biology department will create for the Integrative Biology PhD program. Only Scientific Leadership and Management and Dissertation Research Seminar are required courses in the curriculum. Other courses are being added to the catalogue to expand the breadth and depth of course offerings for PhD students.

Table 11. New courses in the Biology catalogue.

Class	Hours	Catalog Description
BIOL 7210 – Scientific Leadership and Management	3	This professional development course equips graduate students with essential skills for success in academic and professional scientific careers. Students will develop competencies in networking, career preparation, stress management, productivity strategies, ethical conduct, peer review processes, and scientific communication for both professional and public audiences. The course emphasizes leadership development, research project management, and understanding diverse career pathways in the sciences.
BIOL 7250 – Spatial and Landscape Ecology	3	This course introduces students to fundamental concepts in spatial and landscape ecology, with emphasis on understanding how landscape complexity and spatial arrangement influence animal behavior, resource availability, and predation risk. Students will gain hands-on experience measuring spatial metrics at individual and landscape scales using program R, covering topics including space use, habitat selection, occupancy modeling, and movement ecology. The course integrates theory and methodology to address contemporary issues in conservation biology and resource management.
BIOL 7270 – Advanced Bioinformatics	3	This course provides skills for analyzing Next Generation Sequencing data through advanced computational workflows in high-performance computing environments. Students learn to integrate multi-omics datasets, apply machine learning methods, and develop reproducible pipelines using version control systems. The course emphasizes scientific principles of workflow reproducibility, scalability, and biological interpretation.
BIOL 7310 – Population Genetics	3	This course examines genetic structure of populations and evolutionary forces shaping genetic variation over time. Students conduct hands-on analyses using real datasets, covering Hardy-Weinberg equilibrium, population structure, coalescent theory, and natural selection. Practical skills include using molecular and bioinformatic tools such as SNP genotyping, RNA sequencing, and eDNA metabarcoding.
BIOL 7340 – Advanced Virology and Epidemiology	3	This course explores infectious disease epidemiology using viruses as model organisms, examining viral classification, host interactions, and transmission dynamics. Students learn to trace disease sources, identify risk factors, and track pandemic spread through genomic epidemiology and surveillance design. Topics include measures of disease frequency, bias assessment, and in-vitro and in-silico methods for studying viral epidemiology.

BIOL 7440 – Signal integration	3	Using plants as models, this course explores how organisms perceive environmental cues to alter cellular developmental programming. Students gain proficiency with molecular databases and data interpretation while learning to develop and test hypotheses about environmental impacts. Topics include gene regulation, transcription factors, non-coding RNAs, and cellular signal integration mechanisms.
BIOL 7470 – Scientific Systems Modeling	3	This course introduces mathematical modeling for exploring complex biological systems using STELLA and R platforms. Students learn to parameterize and evaluate models, extract literature data, and link equations to simulate system dynamics. Final projects include research posters and runnable R Markdown descriptions with organized Github repositories.
BIOL 7990 – Research and Dissertation	1-6	Students are expected to undertake the activities agreed upon with their thesis advisor, which may include: mastering and recording research techniques and scientific processes, creating and defining hypotheses for investigation, evaluating data and outcomes, and sharing discoveries and their broader implications
BIOL 7991 – Dissertation Research Seminar	3	This capstone seminar provides Ph.D. students the opportunity to present dissertation research in a 50-minute public presentation. Students develop skills in scientific communication, organization of complex findings, and effective audience engagement. The course emphasizes professional delivery, visual aid design, and demonstration of subject matter mastery.

Program of study

Table 12. Program of Study Example 1: Full-Time, Enters Program in Fall After Completion of M.S. Degree; 24 SCH Towards Graduate Course Work Elective Requirement Approved.

Year	Fall	Spring	Deadlines and Achievements
Year 1	Scientific Leadership & Management (BIOL 7210; 3 SCH) Graduate Elective (3 SCH)	Statistical Analyses or Experimental Design Course (3 SCH) Graduate Elective (3 SCH)	• Graduate Advisory Committee appointed • Program of study approved • Annual report submitted to Graduate Advisory Committee
Year 2	Course Outside Biology Department (3 SCH) Graduate Elective Courses as recommended and approved by Graduate Advisory Committee OR Research & Dissertation Hours	Outside Discipline Biology Course (3 SCH) Graduate Elective Courses as recommended and approved by Graduate Advisory Committee OR Research & Dissertation Hours	• Research prospectus approved • Annual report submitted to Graduate Advisory Committee
Year 3	Graduate Elective Courses as recommended and approved by Graduate Advisory Committee OR Research & Dissertation Hours	Graduate Elective Courses as recommended and approved by Graduate Advisory Committee OR Research & Dissertation Hours	• Written and oral comprehensive exams successfully completed • Student enters PhD candidacy • Annual report submitted to Graduate Advisory Committee
Years 4-5*	Graduate Elective Courses as recommended and approved by Graduate Advisory Committee OR Research & Dissertation Hours	Dissertation Research Seminar (BIOL 7991; 1 SCH) Graduate Elective Courses as recommended and approved by Graduate Advisory Committee OR Research & Dissertation Hours	• Written dissertation successfully completed and defended • Annual report submitted to Graduate Advisory Committee • Student graduates

*Expected mean graduation time from enrollment is 4.5 years.

Table 13. Program of Study Example 2: Full-Time Example, Enters Program in Fall After Completion of Baccalaureate Degree.

Year	Fall	Spring	Deadlines and Achievements
Year 1	Scientific Leadership & Management (BIOL 7210; 3 SCH) Graduate Electives (6 SCH)	Statistical Analyses or Experimental Design Course (3 SCH) Graduate Electives (6 SCH)	• Graduate Advisory Committee appointed • Program of study approved • Annual report submitted to Graduate Advisory Committee
Year 2	Course Outside Biology Department (3 SCH) Graduate Electives (6 SCH) Research & Dissertation Hours as Approved by Graduate Advisory Committee	Outside Discipline Biology Course (3 SCH) Graduate Electives (6 SCH) Research & Dissertation Hours as Approved by Graduate Advisory Committee	• Research prospectus approved • Annual report submitted to Graduate Advisory Committee
Year 3	Graduate Electives (6 SCH) Research & Dissertation Hours as Approved by Graduate Advisory Committee	Graduate Elective Courses as recommended and approved by Graduate Advisory Committee OR Research & Dissertation Hours	• Written and oral comprehensive exams successfully completed • Student enters PhD candidacy • Annual report submitted to Graduate Advisory Committee
Years 4-6*	Graduate Elective Courses as recommended and approved by Graduate Advisory Committee OR Research & Dissertation Hours	Dissertation Research Seminar (BIOL 7991; 1 SCH) Graduate Elective Courses as recommended and approved by Graduate Advisory Committee OR Research & Dissertation Hours	• Written dissertation successfully completed and defended • Annual report submitted to Graduate Advisory Committee • Student graduates

*Expected mean graduation time from enrollment is 5.5 years.

SECTION VII: PROJECTED COSTS AND REVENUES FOR THE PROPOSED PROGRAM

Costs

Faculty and instructional staff costs include the salary and fringe benefits for one biology department lecturer at $47,000 and $19,740 respectively, based on current salaries plus a 3% increase for hiring in the next year. Additionally, one tenure-track faculty member will be hired at a salary of $72,000 plus estimated $30,240 in fringe benefits, also based on current assistant professor salaries plus a 3% increase. The program also accounts for $13,000 for faculty release based on a one course per semester release for the Coordinator and additional release for two faculty members.

Non-instructional staff costs include half of an administrative assistant's pay at $16,000 plus estimated $6,720 in fringe benefits, based on current salaries with a 3% increase for hiring in the next year. This position will provide financial administration for both the MS and PhD degrees and alleviate the current departmental workload.

Graduate assistant costs are a significant portion of the program's expenses, with 10 graduate Teaching Assistantship stipends at $28,000 each, totaling $280,000. This stipend amount is designed to be competitive with other programs in Tennessee (whose mean stipend averages ~$27,000 often includes health insurance) and exceeds the living wage for Putnam County (if living with another adult). The program also budgets for graduate tuition at $13,284 per student, assuming 9 credits in the fall and spring semesters and 3 credits in the summer, for a total of $132,840.

The requested $2,000 annual marketing budget will support the development and distribution of professional recruitment materials, including printed brochures, website development and maintenance, and digital content showcasing student research and field opportunities in the region's unique biodiversity hotspots. The marketing budget will leverage design and production assistance from the Office of Communications and Marketing to create high-quality materials that effectively communicate the program's distinctive integrative approach and exceptional research opportunities, ensuring maximum impact in recruiting qualified doctoral students.

Equipment costs are estimated at $28,000 for general laboratory and fieldwork equipment, computation tools, and software licenses. Travel expenses of $20,000 are allocated for competitive travel grants for graduate students to conduct field research and attend conferences. Other operating costs of $80,000 are budgeted to support consumable lab supplies, permits, fees, publication costs, and miscellaneous expenses incurred by graduate students to support their progress through the program.

Tuition

Tuition revenue is projected based on a per-student tuition rate starting at $13,284 in Year 1 and increasing by approximately 3% each year. The program anticipates enrolling 12 students (10 TAs and 2 RAs) in Year 1, growing to 30 students by Year 6. Tuition revenue is expected to increase from $159,408 in Year 1 to $475,854 by Year 7 as enrollment grows.

Grants

No grants will be used to support the proposed program. However, indirect costs recovered will increase productivity of faculty and increase program revenues. Grant revenue is projected based on indirect costs recovered from federal grants, assuming a 43.5% overhead rate. The program expects to secure one federal grant in Year 1, growing to 8 grants by Year 7. The average NSF award amount is estimated at $117,528 in Year 1, with a 3% annual growth rate. Indirect cost recovery is projected to increase from $49,362 in Year 1 to $471,526 in Year 7. The expected number of grants is based on the grants at similar Tennessee universities and assumes increases in personnel will enhance faculty research productivity.

Other

The program anticipates increased state appropriations based on the number of graduates, with a rough estimate of $40,065.22 added to the TTU budget per additional PhD graduate, based on the 2023-24 State Appropriations Distribution Formula. However, these estimates are subject to many other factors and should be considered a very rough projection. State appropriations are expected to begin in Year 4 at $400,652 and grow to over $1 million by Year 7.

Overall, the total recurring expenditures for the Integrative Biology PhD program are projected to start at $745,540 in Year 1 and increase to $890,214 by Year 7. Revenues are expected to exceed costs starting in Year 4, with total revenues reaching nearly $2 million by Year 7 through a combination of tuition, grant indirect funds, and anticipated increases in state appropriations tied to graduation rates.

SECTION VIII: INSTITUTIONAL RESOURCES

Faculty resources

The Biology Department faculty represents 21 research and teaching professionals with the disciplinary breadth and scholarly credentials necessary to support doctoral education in Integrative Biology. All 17 tenure-track faculty hold terminal degrees from accredited institutions, with research specializations spanning molecular genetics, microbial ecology, conservation biology, physiological ecology, and evolutionary biology. The two USGS Cooperative Research Unit scientists contribute federal research expertise while maintaining regular graduate teaching responsibilities, effectively expanding mentoring capacity without additional institutional cost. Faculty distribution across academic ranks provides balanced mentorship combining emerging methodologies with established scholarly networks. The department's differential teaching load policy enables research-active faculty to research and graduate student mentoring through reduced course assignments.

Current faculty productivity metrics demonstrate alignment with doctoral program standards established by peer institutions and accrediting bodies. The department maintains a publication rate averaging 2.3 peer-reviewed articles per faculty member annually, with representation in discipline-specific and interdisciplinary journals. External funding from NSF, USDA, USFWS, and state agencies currently exceeds $2.5 million per year in active awards, providing both research support and graduate student funding opportunities. The university's tenure and promotion guidelines explicitly recognize doctoral mentoring and graduate program development as

significant scholarly contributions, incentivizing faculty engagement. The department's successful track record placing Biology MS graduates into positions at state agencies, federal agencies, and private industry validates faculty mentoring effectiveness. Annual faculty development funds support conference attendance, workshop participation, and collaborative visits essential for maintaining scholarly currency in rapidly evolving fields.

Quality assurance mechanisms ensure faculty resources meet external standards for doctoral education. Annual faculty evaluations incorporate graduate mentoring effectiveness, research productivity with graduate students, and graduate course evaluations as explicit performance criteria. The program's alignment with Council of Graduate Schools recommendations includes minimum committee sizes, required methodological training for mentors, and regular faculty development in responsible conduct of research. External program review every five years will evaluate faculty qualifications, productivity, and student outcomes against peer institution benchmarks.

Current faculty

The Biology Department at Tennessee Tech currently has 16 tenure-track and tenured faculty positions, one instructor position, and three lecturer positions. The Department Chair, Coordinator of the Water Center, and the Interim Provost and Vice President for Research are included in the tenured faculty population. Additionally, the Leader and Assistant Leader of the U.S. Geological Survey, Tennessee Cooperative Fishery Research Unit work within the Biology Department; although they are federal employees, they teach one graduate-level course a semester and have graduate students conducting research. Of the tenure and tenure-track ranks, 6 hold the rank of assistant professor, 4 associate professor, and 6 full professor, respectively. Given the breadth of general biology, the faculty body in diverse in academic background, having expertise in several areas related to microbiology, genetics and cellular biology, organismal biology, and ecology. The Biology faculty members are listed in Table 14 and listed online at https://www.tntech.edu/cas/biology/faculty.php. The Department of Biology has a “Differential Teaching Load” system to allow faculty members to select one of three tracks depending on their interests: (1) a track emphasizing teaching; (2) a standard track blending teaching and research; and (3) a track emphasizing research. Faculty on the teaching track teach five courses per year; those on the standard track teach four courses per year; and those on the research track teach three courses per year. (On all tracks, faculty also teach the laboratory sections that accompany their junior- and senior-level course assignments.)

Table 14. Current faculty roster.

Current Faculty Roster				
Faculty Name	Highest Degree	Rank	Full-time or Part-time	% of Time Devoted to Program
Christopher Brown	PhD	Associate Professor	Full-time	5%
David Beck	PhD	Assistant Professor	Full-time	5%
Brian Carver	PhD	Associate Professor	Full-time	10%
Bradley Cohen	PhD	Associate Professor	Full-time	10%
Brad Cook	PhD	Professor	Full-time	10%
Alba Frias-De-Diego	PhD	Assistant Professor	Full-time	10%

Josh Hall	PhD	Assistant Professor	Full-time	10%
Steven Hayslette	PhD	Professor; Department Chair	Full-time	10%
Carla Hurt	PhD	Professor	Full-time	10%
Hannah Kinmonth-Schultz	PhD	Assistant Professor	Full-time	10%
John Liu	PhD	Professor	Full-time	5%
Justin Murdock	PhD	Professor	Full-time	5%
Nikki Panter	PhD	Master Lecturer	Full-time	5%
Mostafa Rahnama	PhD	Assistant Professor	Full-time	10%
Mark Rogers	PhD	Professor; USGS Coop Unit	Full-time	10%
Amanda Rosenberger	PhD	Professor; USGS Coop Unit	Full-time	10%
Kit Wheeler	PhD	Associate Professor	Full-time	10%
James Woods	PhD	Assistant Professor	Full-time	10%
Shawn Zeringue-Krosnick	PhD	Professor	Full-time	10%

Percent of time devoted is based on the current research activity, teaching loads, and administrative responsibilities of each faculty member. Faculty with 5% Time are anticipated to teach at least 1 graduate-level course (i.e., 6000- or 7000-level) every year, serve on relevant student and faculty committees, or have a PhD student in the program. Faculty with 10% Time are anticipated to teach at least 1 graduate-level course every year, serve on relevant student faculty committees, and have at least 1 PhD student in the program. A PhD Program Coordinator will assist in administrative responsibilities, budgeting, and curricular responsibilities in conjunction with a new administrative assistant (50% Time devoted to all graduate-level administration) and the Department Chair.

Anticipated new faculty and instructional staff

Table 15 shows that two new faculty positions are planned with both positions to be filled for the 2026-2027 academic year.

Table 15. Anticipated faculty and instructional staff

Anticipated Faculty and Instructional Staff			
Faculty Rank or Job Title	Full-time or Part-time	Anticipated Salary	Anticipated Start Date
Open Rank Professor	Full-time	$72,000-110,000	Fall 2026
Lecturer	Full-time	$47,000	Fall 2026

The Biology Department at Tennessee Tech currently faces challenges balancing its undergraduate teaching obligations with the research and graduate mentoring demands necessary for a successful PhD program. With high undergraduate enrollment requiring substantial teaching resources, many faculty members who wish to transition to the research track and increase their scholarly productivity are unable to do so because they must maintain heavy undergraduate course loads. The department's differential teaching load system offers three tracks: teaching (five courses per year), standard (four courses per year), and research (three courses per year), but faculty cannot fully use the research track option when undergraduate teaching demands require their continued presence in some lower-division courses. This situation limits faculty availability for graduate course offerings, reduces time for grant writing and research supervision, and constrains the department's ability to provide the diverse graduate curriculum essential for doctoral education. The requested instructional staff positions directly address this structural challenge by providing dedicated teaching resources for undergraduate courses, thereby freeing research-active faculty to focus on graduate education, mentoring, and scholarly activities that will strengthen the PhD program.

The addition of one lecturer position will provide immediate relief to the undergraduate teaching burden by assuming responsibility for multiple sections of introductory biology courses and laboratories. This position will enable the department to reassign at least two tenure-track faculty members from teaching-intensive undergraduate courses to graduate-level courses and research activities. The lecturer will typically teach four to five course sections per semester, primarily focusing on high-enrollment introductory courses that currently consume significant faculty resources. This reallocation is critical because it allows research-active faculty to transition to the research track, where they can dedicate more time to securing external funding, supervising doctoral students, and developing specialized graduate courses in their areas of expertise. Furthermore, having dedicated instructional staff for undergraduate courses ensures consistency and quality in foundational biology education while allowing tenure-track faculty to focus their pedagogical efforts on advanced coursework where their specialized knowledge provides the greatest value.

The new tenure-track faculty position serves a dual purpose in supporting both the required PhD curriculum and alleviating undergraduate teaching pressures. This faculty member will have primary responsibility for helping teach the mandatory Scientific Leadership and Management course (BIOL 7210), ensuring this critical component of the PhD curriculum is consistently offered without burdening existing faculty. Additionally, this position will contribute to undergraduate teaching while maintaining an active research program that can support doctoral student mentoring and thesis supervision. The addition of this tenure-track line increases the department's capacity to offer specialized graduate electives, as it reduces the per-faculty undergraduate teaching load and creates scheduling flexibility. This position also enhances the program's research capacity by bringing in additional expertise and potential funding opportunities through grants and contracts.

Collectively, these strategic hires will expand the department's capacity to deliver a robust doctoral curriculum while maintaining undergraduate education quality. With the teaching burden more equitably distributed, every tenure-track and tenured faculty member will be able to teach at least one graduate course annually, ensuring PhD students have access to diverse expertise across biological subdisciplines. This enhanced teaching capacity will allow the department to offer specialized courses in areas such as advanced genomics, ecological modeling, conservation

biology, molecular ecology, and bioinformatics, which are courses essential for integrative biology training but currently difficult to schedule given undergraduate teaching demands. The improved faculty availability will also enable more team-taught interdisciplinary courses, smaller seminar-style classes, and increased opportunities for independent study courses tailored to individual student research needs. Furthermore, with reduced teaching loads, faculty will have greater capacity to serve on doctoral committees, provide thorough mentoring, and engage in the time-intensive activities of grant writing and manuscript preparation with their graduate students, ultimately strengthening both the educational experience and research

Faculty Capacity for PhD Supervision and Advisement

The Biology Department has strong capacity for doctoral supervision through our current mentoring activities and established track record. The 17 tenure-track faculty and 2 USGS faculty currently supervise 20-30 MS students annually, with each faculty member typically serving as major advisor for 1-4 master's students while participating on additional committees. Our faculty also currently mentor 8-12 PhD students through the Environmental Science program, and have proven experience with doctoral-level supervision including comprehensive exams, dissertation research guidance, and successful job placement.

The proposed enrollment of 20-30 PhD students at steady state distributed across 19 research-active faculty results in a favorable 1:1.5 ratio of faculty to PhD student. This ratio ensures each doctoral student receives adequate individual attention while preventing faculty overload. Our current external funding exceeding $2 million provides research assistantships that will also reduce faculty mentoring time compared to teaching assistantships, as RA-supported students integrate directly into funded research programs with established objectives and resources.

Faculty committee service requirements are structured to distribute advisory responsibilities while ensuring appropriate expertise. Each doctoral committee requires 4-5 members including the major advisor, with faculty typically serving on 3-4 committees beyond their advisees. This creates a sustainable load of 6-8 active doctoral students per faculty member across various advisory roles. The Integrative Biology PhD program's interdisciplinary nature will enhance capacity by encouraging committees spanning departments—reducing per-department burden while enriching student perspectives. External committee members from partner institutions (ORNL, TWRA, other universities) can further distribute workload while adding specialized expertise.

Non-instructional staff

The request for 50% effort of an administrative assistant position is essential to manage the substantial administrative burden that a PhD program creates beyond what currently exists for the department's MS program. A doctoral program generates significantly more complex administrative tasks than a master's program, including processing extensive application materials with faculty mentor matching, coordinating qualifying examinations and dissertation defenses across multiple committee members, tracking multi-year student progress through various milestones, managing more complex funding arrangements involving teaching and research assistantships, and handling federal reporting requirements for doctoral programs. The current departmental administrative staff are already fully occupied with undergraduate program management and existing MS program support, and adding PhD program responsibilities without additional staffing would compromise service quality across all programs. This half-time position will handle financial administration for both MS and PhD programs, process graduate student stipends and tuition waivers, coordinate recruitment activities and visiting student logistics,

maintain program records for accreditation and assessment, and serve as the primary point of contact for graduate student inquiries and issues. Without this dedicated administrative support, these duties would fall to faculty or the PhD Program Coordinator, significantly reducing their time for teaching, research, and student mentoring—ultimately undermining the program's academic mission and competitiveness.

Marketing and recruitment

The plan for marketing and recruiting students to the PhD in Integrative Biology program will follow the well-established current practice for recruiting graduate students in the College of Arts and Sciences (CAS) at Tennessee Tech. In addition, the program will participate in the recruiting activities conducted throughout the year by the College of Graduate Studies.

Recruiting will follow a multipronged approach, including the following activities:

- Develop brochures and a dedicated website for advertising the new program, highlighting unique research opportunities in the Upper Cumberland region's biodiversity hotspots.
- Send targeted emails and materials to undergraduate and MS students within Biology and related departments at Tennessee Tech and regional universities. Provide information about research assistantships, faculty expertise, and career outcomes.
- Attend and recruit at student-based professional society meetings on campus and at conferences such as the Association of Southeastern Biologists, Ecological Society of America, and the Society for Integrative and Comparative Biology.
- Present at undergraduate research symposia and McNair Scholars programs at regional universities, with particular emphasis on recruiting underrepresented populations in STEM.
- Attend graduate school recruitment fairs at regional colleges and universities, especially those with strong undergraduate biology programs but limited graduate offerings.
- Develop partnerships with faculty at regional universities (Austin Peay State University, Cumberland University, Tennessee State University) that have undergraduate biology programs but no doctoral programs, creating "pipelines" for student referrals.
- Leverage existing relationships with state and federal agencies (Tennessee Wildlife Resources Agency, U.S. Fish and Wildlife Service, Oak Ridge National Laboratory) to identify potential applicants among their staff seeking advanced degrees.
- Utilize the Biology Department's social media presence (Facebook, LinkedIn, Twitter/X) and create program-specific content highlighting student research, field work opportunities, and alumni success stories.
- Host an annual "Prospective Graduate Student Day" featuring lab tours, meetings with current graduate students, and presentations on faculty research areas.
- Develop targeted recruitment materials for international students, emphasizing guaranteed funding packages and support services available through Tennessee Tech's International Education office.

The brochures, website, and recruiting events listed above will emphasize the program's unique integrative approach and the exceptional biological diversity of the region as a living laboratory. The Office of Communications and Marketing will provide design assistance for print and digital media including brochures, video productions showcasing field research sites, photographs of student research activities, and social media content. This office will help ensure that marketing resources are utilized effectively and will serve as a consultant for marketing plans and materials.

Student support services

Various academic and professional development support services are available to all graduate students to help them with their academic studies, technical writing, and professional development. Other support services are available to help students with personal issues such as mental health wellness and financial assistance. Many of these resources are available both to on-campus students and to online students through the respective services' online access and telephone systems. The following university offices and services provide services to graduate students:

- The Volpe Library at TTU offers many academic support services. The library provides resources through online access to books, journals, and articles as well as print materials, interlibrary loan, Get It Now, archives, and special collections. The College of Arts and Sciences is assigned a library liaison, who provides specific support to engineering faculty and students including sessions on how to use library services/resources, how to obtain interlibrary loans, and how to request resources to be purchased. Because the Volpe Library subscribes to many online databases containing molecular, cellular, organismal biology and general technical publications, resources are as easily accessible to online students as to on-campus students.
- Information Technology Services (ITS) provides support for all computing needs including video conferencing, software, and a high-performance computing (HPC) cluster. Computer labs are available in various locations on campus.
- The Center for Innovation in Teaching and Learning (CITL) is available to help students navigate the iLearn system. The CITL also assists faculty with recommendations on methods to adopt for particular course needs.
- The College of Graduate Studies provides information and guidelines for graduate students through its website, handouts, and presentation sessions, and offers individual assistance in the office and by telephone.
- The Center for Career Development offers a range of services for students, faculty, and employers. Students can attend a series of professional development workshops and earn career readiness certificates. The Center staff members assist with resume development and practice interviews. Career fairs are held on campus, with at least two for engineering majors, and the Center facilitates employer interviews for student cooperative education experiences and internships, as well as for jobs after graduation. Other services can be found at https://www.tntech.edu/career/index.php.
- The Office of Financial Aid (https://www.tntech.edu/financialaid), the Office of Scholarships (https://www.tntech.edu/scholarships/index.php), the Office of Military and Veterans Affairs (https://www.tntech.edu/veterans/index.php), and the Bursar's Office (https://www.tntech.edu/bursar/index.php) together provide information and financial

resources, where assistance is justified and resources are available, to students seeking assistance to complete their degree programs.

- The Accessible Education Center (https://www.tntech.edu/disability/index.php) assists individuals with disabilities in gaining equal access to academic and physical environments through academic adjustments, assistive technology, software, and other support services.
- The Campus Health Services staff (https://www.tntech.edu/) offer acute and urgent care, preventive care, immunizations, physical exams, allergy injections, laboratory testing, and other services for enrolled students. Laboratory tests and medicines incur a small fee. Two health and accident insurance plans are available for reasonable rates for hospital and surgical coverage.
- The mission of the Center for Counseling and Mental Health Wellness (https://www.tntech.edu/counsel/about.php) is "to promote healthy student development during the college experience" by offering "a wide range of mental health, educational, and consultative services to students and other members of the campus community." The Center also "offers brief, short term, solution focused therapeutic interventions" for Tennessee Tech students.
- For students who wish to live on campus, the Office of Housing and Residential Life (https://www.tntech.edu/reslife/housing/index.php) provides options for campus housing and learning communities. Students who live on campus have free access to the Cookeville Area Transit System bus and Tennessee Tech's campus shuttles.
- Two offices assist students from underrepresented or underserved populations. The Office of Intercultural Affairs (https://www.tntech.edu/intercultural/about.php) promotes the "personal, cultural, social, and academic growth and development of students from underrepresented populations and encourages opportunities for all students to engage with others across differences". The Women's Center (https://www.tntech.edu/women/about.php) "leads and supports efforts for women's equity across campus and the community".

The PhD Program Coordinator, each student's advisory committee chair and members, and other graduate faculty members in the Biology Department are available to help with graduate student academic questions and needs. After the Graduate Advisory Committee is formed, the chair serves as the primary academic advisor, with input from the committee as previously explained in the section on Academic Standards: Advising and Retention Requirements. The advisory committee chair and other members help with issues related to coursework and the thesis or project, as applicable for the student's degree program.

These support services help to ensure success for all students, including underserved and historically underrepresented students.

Equipment

The Department of Biology maintains a suite of research facilities that support molecular biology, microbiology, biochemistry, imaging, and sequencing. These facilities are well-equipped to provide doctoral students with access to modern instrumentation that will enhance both training and research productivity.

The Cell and Tissue Culture Suite includes LabGard Class II biosafety cabinets, which provide sterile work environments for handling cell lines and microbial cultures. Cryogenic storage

facilities, including a bank of −80 °C ultra-low freezers and two liquid nitrogen tanks, allow for long-term preservation of biological samples, cell stocks, and tissue specimens.

The Microbiology and Biochemistry laboratories provide resources to culture, isolate, and characterize microorganisms. Students have access to incubators, autoclaves, and shaker systems for maintaining bacterial and fungal cultures, as well as standard equipment for preparing media and sterile supplies. These facilities support research in microbial genetics, host–pathogen interactions, and applied microbiology.

The Molecular Core Laboratory provides a wide range of equipment to support nucleic acid and protein research. Available equipment includes multiple Eppendorf gradient thermocyclers, Bio-Rad Gel Doc XR+ and related gel imaging systems for the visualization and documentation of electrophoresis results, and an Agilent Tapestation, and ThermoFisher 96-well plate reader for DNA library verification. We also recently acquired an Illumina NextSeq 1000 sequencing system that is capable of performing next-generation sequencing runs for amplicon sequencing, transcriptome sequencing, and genome sequencing applications. Students will also have access to high-speed and refrigerated centrifuges, including Sorvall X Pro and Eppendorf benchtop centrifuges. Additional resources include a SpectroLinker XL-1000 UV crosslinker for DNA binding, a NanoDrop spectrophotometer for rapid quantification of DNA, RNA, and proteins, and an Agilent 2100 Bioanalyzer for high-resolution analysis of nucleic acid quality and fragment size distribution.

The Imaging Facility provides advanced microscopy resources. High-resolution compound and dissecting microscopes allow for detailed examination of tissues, cells, and organisms, supporting research from organismal biology to cellular and developmental studies. Fluorescence microscopy capabilities enable visualization of labeled proteins, nucleic acids, and other cellular components, providing powerful tools for both teaching and research in cell biology, developmental biology, and molecular genetics.

Collectively, this equipment supports a wide range of experimental approaches—from routine PCR and cloning to next-generation sequencing and transcriptomics—providing Ph.D. students with the infrastructure necessary to develop advanced molecular skills and conduct cutting-edge research across biological disciplines. These instruments are maintained by trained faculty/staff; users receive safety and instrument-specific training. Shared scheduling ensures equitable access for graduate students and research groups. Preventive maintenance and service contracts are in place for critical instruments (e.g., sequencer, SPR, ULT freezers) to minimize downtime.

Information technology

Computer resources for students and faculty are provided centrally through the university's Information Technology Services (ITS) Department. ITS provides assistance with computing issues through the myTech Helpdesk, which can be accessed by telephone, e-mail, or walk-up, with Helpdesk personnel physically located on the second floor of the Angelo and Jennette Volpe Library building. The HelpDesk is staffed from 7:00AM to 6:00PM Monday through Friday. In addition, the College of Engineering has three technical personnel with IT-related backgrounds who work with ITS and are designated to provide computer hardware and software support for College of Engineering faculty and courses.

ITS provides and supports traditional desktop laboratories on campus but also supports a range of other opportunities for accessing software and storage space, along with technology assistance, as follows:

- TechAnywhere virtual desktops provide on- and off-campus access to a computer environment similar to those found in campus computer labs. This environment is divided into desktop pools. In addition to the Anywhere Computer Lab pool, a student's course enrollment may grant access to additional pools with specialized software.
- LabDrive is a file storage space available for faculty, staff, and students using any computer lab on campus. This storage provides up to 5GB of space, and is available from any desktop, laptop, or virtual (VDI) lab computer. It provides temporary storage only.
- The myTech HelpDesk offers first-level (Tier1) IT services to the Tennessee Tech community. These services include password resets for student password resets in network and e-mail accounts; network connectivity troubleshooting; general technology knowledge base; student PC Service, i.e., general assistance with computer-related issues for students currently enrolled at Tech; and Tier1 support for Tech-owned equipment and devices. Access is available by e-mail, telephone, and walk-up. A chat service is available during normal business hours.
- Tech provides a High-Performance Computing cluster and a staff member to support it. The staff member assists faculty and students with the use of the cluster, especially with ensuring that the cluster is used both efficiently and equitably across units that wish to use this resource. The staff member also provides short courses and other informal learning opportunities that support the optimal use of the cluster.
- LinkedIn Learning is an online learning portal offering video courses in multiple fields. It is available free to all Tennessee Tech faculty, staff, and students.
- Students can download a free copy of Microsoft Office as well as the current version of Windows used on campus. Faculty, staff, and students can also install Office 365 to work from home. Other software and hardware can be purchased at a discount. The software available in the computing facilities varies depending on the discipline; but for computer facilities used by multiple disciplines, the standard GIE deployment includes Zoom, SolidWorks, LabVIEW, Maple, MATLAB, MS Teams, MS Office, MS Project, MS Visio, MS Visual Studio, Minitab, PuTTY, Python, Ruby, SAS, and others.

Library resources

Existing Resources

Volpe Library Organization. The Angelo and Jennette Volpe Library has several services to support academic programs through online e-mail, chat, and telephone. The Volpe Library is regularly open 98 hours per week and keeps extended hours during projects week and final examinations week.

A comprehensive online learning and information resource environment is available to support teaching and learning, including the Center for Innovation in Teaching and Learning (CITL), online scientific research papers through the Get It Now feature, and online databases. The databases are available to any graduate student connected on-campus or remotely and logged in to the TechExpress secure connection.

The Volpe Library offers access to over 200,000 physical books and over one million electronic book titles. The library also has over 80,000 electronic journals. As a selective depository for U.S. government publications, the library receives materials from various government agencies. There

are approximately 17,000 bound volumes of government publications and approximately 4,000 maps. The variety of online databases offers on-campus and off-campus access to magazines, journals, and e-books, many with full text. Students needing help finding resources, print or electronic, can make appointments online to connect with a librarian.

Like most university libraries, the Volpe Library has transitioned from a focus on providing onsite resources to an approach of enabling access to online resources. Numerous online databases, along with e-journals and government publications, are available from the library's website; please see https://www.tntech.edu/library/databases.php.

EagleSearch is the Volpe Library's comprehensive search service for resources. Available from the library's homepage, it searches most of the Volpe Library databases for journal articles, books, and conference proceedings. Every Tech student has an account that allows searches and results to be saved, and the search capability is integrated with inter-library loans and RefWorks. Interlibrary loan is a free service for the Tech community to find and access full-text resources. Resources requested are delivered within two to three days, if digital, to the requestor's account and provide PDF file access. Through the inter-library loan program, students and faculty have easy access to the holdings of most of the libraries in the United States and Canada, as well as a few libraries in other countries.

RefWorks is an online citation management software system provided to Tennessee Tech students and faculty. These systems allow access to the library's holdings and electronic resources from on- and off-campus locations.

Tennessee Tech has partnered with several libraries that augment the library resources on campus. Students and faculty have access to the libraries of the University of Tennessee at Knoxville and a reciprocal borrowing program with Vanderbilt University, located in Nashville. Tech's faculty build most of the library's collection by making purchase requests to the library tailored to fit their instruction and research needs. Faculty may submit requests either directly to the library online, or through their departmental liaison. Final decisions on purchases are made by the Volpe Library staff. The funds available for this purpose are sufficient to cover all faculty requests of this type.

Center for Innovation in Teaching and Learning (CITL). The Volpe Library is also the home of the Center for Innovation in Teaching and Learning, which offers comprehensive support for the design and evaluation of courses. The CITL helps in several specific ways, as described below.

- Teaching and Learning: Faculty and graduate students can work with a trained teaching and learning expert to communicate learning outcomes, create instructional activities, and construct assessments in significant and transformative ways.
- Instructional design: The CITL also offers instructional design services specializing in online course and program development, design, and engagement. Services offered include coordination of new online course and/or program development and design; updating existing online offerings to increase engagement; recommendation or examination of Open Educational Resources (OERs) for use in online offerings; incorporating/increasing the use of iLearn into existing blended, hybrid, or in-person courses; and assistance with integration of supported technologies in collaboration with our technology specialists.

• Instructional Technology: Instructional Technology services support and train faculty in using software and equipment in the classroom from development to teaching and managing a class. They also offer individual consultation and assistance for supported software.

Other Resources in the Volpe Library. In addition to the resources previously discussed, other resources located in the Volpe Library are available for students and faculty. This access includes any enrolled on-campus or online student who may wish to come to campus to take advantage of these resources. The student's Tennessee Tech identification will enable that access.

- iCUBE: Tennessee Tech's iCube is a place where students and faculty "imagine, inspire, and innovate" (i3). The goal is to provide creative solutions to traditional problems through marketing, training, website and application development, public policy campaigns, and the application of emerging technologies, such as virtual reality.
- iMakerSpace: The iMakerSpace is a university-wide available, student-centered space under the leadership of the Colleges of Engineering and Business. It is a maker-space with additive manufacturing machines and a variety of other modern fabrication tools. The iMakerSpace serves as a focal point on campus to provide training, service, partnership, research, and evaluation in innovation and entrepreneurship to all disciplines and course activities.

Facilities

The Biology Department at Tennessee Tech University maintains comprehensive facilities across multiple buildings that will provide doctoral students in the Integrative Biology PhD program with exceptional research and educational spaces. The Lab Sciences Commons (LSC), a $90 million, 160,000-square-foot facility completed in 2020, houses state-of-the-art teaching laboratories, research laboratories, and core facilities specifically designed for modern biological research. Within the LSC, the department maintains dedicated research laboratories for cell and molecular biology, including a Cell and Tissue Culture Suite with multiple biosafety cabinets, a Molecular Core Laboratory with DNA sequencing and analysis equipment, and specialized microscopy suites with both compound and fluorescence microscopy capabilities. The building also contains climate-controlled research environments, multiple teaching laboratories for graduate-level courses, and collaborative spaces for student interaction. Additionally, the LSC houses shared instrumentation rooms, cold rooms, equipment preparation areas, and chemical storage facilities that support both teaching and research activities.

Pennebaker Hall serves as the primary home for the Biology Department and provides additional specialized research and teaching spaces critical to the PhD program. The building contains multiple research laboratories dedicated to organismal biology, ecology, and wildlife research, each equipped with benches, fume hoods, and/or standard laboratory equipment. The facility houses the Hollister Herbarium, which contains over 40,000 preserved plant specimens and serves as both a research resource and teaching collection. Pennebaker Hall also includes dedicated graduate student offices and workspaces, providing each doctoral student with desk space, computer access, and storage for research materials. The building contains seminar rooms for graduate courses and committee meetings, a department conference room for dissertation defenses and presentations, and faculty offices that facilitate close mentoring relationships. Notably, Pennebaker Hall also houses the U.S. Geological Survey Tennessee Cooperative Fishery Research Unit offices and laboratories, providing additional research space and resources through this federal partnership.

The Water Center's Environmental Quality Laboratory represents another critical facility supporting the PhD program, offering specialized analytical capabilities for environmental research. This laboratory maintains EPA-certified testing facilities capable of conducting research-grade water quality analysis, soil testing, and environmental monitoring in compliance with state

and federal standards. The facility includes wet chemistry laboratories with analytical instrumentation for nutrient analysis, heavy metal detection, and organic compound identification. Multiple temperature-controlled incubators and growth chambers support experimental work with aquatic organisms and environmental samples. The laboratory also provides sample preparation areas, chemical storage facilities, and data analysis workstations equipped with specialized software for environmental modeling and statistical analysis.

Field research capabilities are significantly enhanced through Tennessee Tech's diverse property holdings that serve as living laboratories for ecological and agricultural research. Tech Farms provides critical infrastructure for investigating the intersection between agricultural practices and ecological processes, offering research opportunities in livestock management impacts on animal occurrence and biodiversity. The facility includes experimental plots for controlled agricultural studies, livestock handling facilities for animal behavior and physiology research, and equipment storage buildings for field research gear and sampling equipment. The Austin Property in Crossville serves as an important research site for understanding urbanization effects on ecological processes, providing opportunities to study edge effects, habitat fragmentation, and how development pressures influence biological communities. These properties offer accessible field sites for long-term ecological monitoring, experimental manipulation studies, and training in field research methods. Additionally, students have access to the 5,763-acre Bridgestone Nature Reserve at Chestnut Mountain through established partnerships, which provides diverse habitats for ecological research ranging from forest dynamics to conservation biology studies.

Other resources

Tennessee Tech has a writing support center called WEST (Writing Excellence Studio at Tech; https://oudev.tntech.edu/cas/english/west.php) that provides many services to graduate students writing dissertations, journal publications, coursework assignments, and so forth.

SECTION IX: NAPP APPENDICES

Appendix A – Letters of Support

Appendix B – Curricular Tools and Assessment

Appendix C – Syllabi for New Courses

APPENDIX A – LETTERS OF SUPPORT

This appendix provides letters of support from the following organizations:

St. Jude's Children Research Hospital

Vanderbilt School of Medicine

U.S. Fish and Wildlife Service

Tennessee Aquarium Conservation Institute

Tennessee Wildlife Resources Agency (Game Species Section)

Tennessee Wildlife Resources Agency (Non-Game Species Section)

Tennessee Department of Environment and Conservation

St. Jude Children's Research Hospital
ALSAC • Danny Thomas, Founder

June 4th, 2025

To whom it may concern:

I am pleased to offer my support for Tennessee Tech University's proposed Ph.D. program in Integrative Biology, which will help to addresses a critical and growing need for interdisciplinary scientists in biomedical research. The program's emphasis on integrating molecular, physiological, and ecological approaches—combined with training in data analysis and systems biology—prepares graduates to meet the evolving demands of laboratory-based science in hospital and research settings.

We, like other research institutions, have a consistent need for highly trained research staff and postdoctoral fellows equipped to work across a variety of disciplines in biology and translational research and adaptable enough to navigate the complexities of modern biomedical problems. This program's systems-based curriculum and quantitative focus will produce scientists armed with the appropriate skills to contribute to collaborative, translational, and data-driven research initiatives, expanding our applicant pool for a variety of research positions.

We believe this new Ph.D. program will strengthen the pipeline of research talent in Tennessee and the region, and we enthusiastically support its establishment. We look forward to future opportunities to collaborate with or recruit its graduates.

Sincerely,

Christopher Calabrese, PhD
SVP and Deputy Director, Scientific Directors Office
St. Jude Children's Research Hospital
262 Danny Thomas Place, Memphis, TN 38105-3678
christopher.calabrese@stjude.org
901-595-4373 (office)

VANDERBILT
School *of* Medicine Basic Sciences

June 5, 2025

Joshua M. Hall, PhD
Assistant Professor
Department of Biology
Tennessee Tech University

Re: Letter of Support for PhD Program

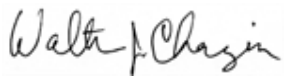
Dear Dr. Hall,

I am pleased to write this letter to offer my support for Tennessee Tech University's proposed Ph.D. program in Integrative Biology, which addresses a critical and growing need for interdisciplinary scientists in biomedical research. The program's emphasis on integrating molecular, physiological, and ecological approaches—combined with training in data analysis and systems biology—prepares graduates to meet the evolving demands of laboratory-based science in hospital and research settings. As Senior Associate Dean for Biomedical Research Education and Training (BRET) at Vanderbilt University, my office oversees graduate student and postdoctoral training in the School of Medicine. I am delighted to offer my backing for the conception of your program and to reaffirm BRET's role as a strategic partner in hiring future postdoctoral fellows to support your program's success.

At institutions like Vanderbilt, there is a consistent need for highly trained research staff and postdoctoral fellows who can work across biological scales and adapt to the complexity of modern biomedical problems. This program's systems-based curriculum and quantitative focus will produce scientists equipped to contribute to our collaborative, translational, and data-driven research initiatives. This will expand our local applicant pool for a variety of research positions.

We believe Tennessee Tech's new Ph.D. program will strengthen the pipeline of research talent in Tennessee and the region, and we enthusiastically support its establishment. We look forward to future opportunities to collaborate with or recruit its graduates.

Sincerely,



Walter J. Chazin, Ph.D.

Chancellor's Chair in Medicine, Departments of Biochemistry and Chemistry
Senior Associate Dean, Biomedical Research Education and Training, School of Medicine Basic Sciences
Director, Molecular Biophysics Training Program
Founding Director, Center for Structural Biology

Vanderbilt University
465 21st Avenue, S., Suite 5140, Nashville, TN 37240-7917
Tel. (615) 936-2210; FAX (615) 936-2211
Walter.Chazin@vanderbilt.edu
http://structbio.vanderbilt.edu/chazin/

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Tennessee Ecological Services Field Office
446 Neal Street
Cookeville, Tennessee 38501
(931) 528-6481

June 3, 2025

Subject/Re: Strong Support for Tennessee Technological University's PhD Program in Integrative Biology

To Whom It May Concern,

On behalf of the U.S. Fish and Wildlife Service, I am pleased to extend strong support for Tennessee Technological University's proposal to launch a Doctor of Philosophy program in Integrative Biology in Fall 2026. This innovative initiative is both timely and necessary, as it addresses critical regional and national workforce needs and will significantly enhance our capacity to tackle complex conservation challenges throughout the Southeastern United States.

The Southeast Region is home to some of the most biologically diverse ecosystems in the country, which are increasingly threatened by climate change, habitat fragmentation, and emerging diseases. These challenges underscore a pressing demand for a workforce proficient in integrative systems-based science. Tennessee Tech's proposed PhD program, with its focus on synthesizing molecular, physiological, and ecological processes, is uniquely positioned to cultivate professionals adept at addressing these multifaceted issues.

By emphasizing quantitative skills such as bioinformatics and systems modeling, this program will prepare graduates to handle complex ecological data effectively. This methodological rigor is essential for dynamic habitat modeling and for assessing the impacts of management actions, ultimately enhancing adaptive management strategies for effective conservation delivery. The integration of diverse biological and environmental variables is vital for developing comprehensive conservation solutions.

Students will be empowered to apply molecular-level insights to real-world conservation problems while gaining a deep understanding of how environmental stressors affect populations and habitats. This approach aligns directly with our emphasis on long-term population viability through resiliency, redundancy, and representation. By equipping students to assess and enhance the viability of wildlife populations, particularly through genetic health and disease resistance, this program will produce professionals capable of implementing targeted conservation strategies based on solid biological and ecological insights. The innovative research methods that bridge clinical and ecological perspectives will foster a holistic understanding of the interconnections between ecosystem health and human health outcomes. This comprehensive approach links species, habitats, and human systems, closely aligning with our core mission.

Tennessee Tech's advantageous location in the biologically rich Upper Cumberland region, coupled with its strengths in organismal physiology, genomics, and environmental monitoring, makes it ideally suited to host this program. The PhD in Integrative Biology will not only strengthen scientific capacity in

Tennessee but also yield long-term benefits to the greater Southeast Region by developing highly skilled leaders ready to confront the conservation challenges of the 21st century.
The program's emphasis on preparing graduates for high-demand roles across various biological disciplines will not only address workforce needs but will also substantially contribute to regional economic growth through technological innovation and research excellence. Graduates will enhance conservation efforts, inform policy decisions, and ultimately foster more robust and resilient ecosystems in Tennessee and beyond.

We commend Tennessee Tech's commitment to developing a workforce capable of engaging in and leading effective conservation initiatives. We eagerly anticipate future collaborations with its faculty and students.

Thank you for considering this pivotal initiative.

Sincerely,

Daniel Elbert
Field Supervisor

TENNESSEE AQUARIUM

PO BOX 11048 | CHATTANOOGA TN 37401-2048 | 423-265-0695 | tnaqua.org

Tennessee Aquarium Conservation Institute
175 Baylor School Road
Chattanooga, TN 37405

16 May 2025

To whom it may concern,

I am writing to express my support for the proposed PhD program in Integrative Biology at Tennessee Technological University.

As a conservation biologist working to protect and restore freshwater biodiversity in the southeastern United States, I see a clear need for advanced training opportunities in applied aquatic science. The southeastern U.S. is a global hotspot for freshwater species diversity, and Tennessee is at the heart of this richness. At the same time, our aquatic ecosystems face increasing pressure from land-use change, climate shifts, invasive species, and other threats that require multifaceted and science-driven solutions.

The proposed PhD program at Tennessee Tech offers a timely and valuable opportunity to train scientists who can approach these challenges with a broad and integrated biological perspective. By combining organismal, ecological, and molecular tools, the program has the potential to prepare students for careers in conservation science, environmental policy, academic research, and natural resource management.

The Tennessee Aquarium Conservation Institute is committed to evidence-based conservation and collaborative research. We regularly partner with universities, state agencies, and NGOs to conduct fieldwork, share data, and mentor students. I believe this new program would provide a strong foundation for such partnerships, and I would welcome the opportunity to support its students through research collaborations, internships, or future employment opportunities.

Graduates of this program will be well-positioned to contribute to the conservation of Tennessee's extraordinary freshwater ecosystems and beyond. I strongly encourage support for its development and implementation.

Sincerely,

Bernard Kuhajda
Aquatic Conservation Biologist
Tennessee Aquarium Conservation Institute

TENNESSEE WILDLIFE RESOURCES AGENCY
WWW.TNWILDLIFE.ORG
(615) 781-6500

STATE OF TENNESSEE
ELLINGTON AGRICULTURAL CENTER
5107 EDMONDSON PIKE
NASHVILLE, TN 37211

Connecting people with nature and empowering them to make informed decisions about water and wildlife.

May 15, 2025

Tennessee Technological University
1 William L Jones Dr
Cookeville, TN 38505

Subject: Integrative Biology PhD Program Support

To whom it may concern,

I am pleased to provide this letter of support for the proposed PhD program in Integrative Biology within the Department of Biology at Tennessee Technological University.

As Assistant Chief for the Game Species Section of the Tennessee Wildlife Resources Agency (TWRA) and previously working as a biologist in Florida, I have firsthand experience with the complex challenges facing wildlife conservation and management in our state and across the southeastern United States. Today's conservation professionals must navigate interconnected ecological systems while balancing scientific research, policy implementation, and diverse stakeholder interests. The proposed PhD program, with its emphasis on integrating multiple scales of biological research, directly addresses this need.

Providing this doctoral program at Tennessee Tech will significantly expand the pool of highly qualified conservation scientists who understand biological systems from the molecular to the ecosystem level. This comprehensive approach is precisely what modern wildlife management requires. By training researchers who can integrate individual organism biology, population dynamics, and ecosystem processes, graduates will be uniquely positioned to develop innovative solutions to pressing conservation challenges.

The multi-scale approach of this program will prepare professionals who can effectively address complex wildlife management issues. For example, understanding the genomic factors affecting wildlife disease resistance, while simultaneously considering landscape-level habitat connectivity and human land use patterns, is essential for developing comprehensive

management plans. TWRA would benefit tremendously from collaborating with researchers and hiring graduates with this integrative skillset.

Additionally, the program's focus on applied research will produce professionals who understand that effective wildlife management extends beyond biological science to include stakeholder values and policy implementation. Conservation success ultimately depends on professionals who can translate scientific findings into practical management strategies while navigating diverse public interests. This dimension of the proposed program particularly aligns with TWRA's mission to conserve, manage, and protect Tennessee's wildlife resources while providing opportunities for sustainable use.

Tennessee Tech's central location and existing relationships with state and federal agencies make it ideally positioned to implement this program successfully. I anticipate numerous opportunities for collaboration between TWRA and the university on research projects that would directly benefit wildlife conservation in Tennessee.

Sincerely,

Mark McBride
Assist Chief – Game Species Section, Wildlife and Forestry Division
Tennessee Wildlife Resources Agency
email: Mark.K.McBride@TN.gov
phone: 615-440-8472

TENNESSEE WILDLIFE RESOURCES AGENCY
WWW.TNWILDLIFE.ORG
(615) 781-6500

STATE OF TENNESSEE
ELLINGTON AGRICULTURAL CENTER
5107 EDMONDSON PIKE
NASHVILLE, TN 37211

May 22, 2025

To Whom It May Concern,

The Tennessee Wildlife Resources Agency (TWRA) supports the proposed Ph.D. program in Integrative Biology at Tennessee Technological University.

TWRA recognizes the importance of developing highly trained scientists who can address complex biological challenges. Our agency works across Tennessee to conserve wildlife and their habitats, and we rely on strong science to guide our management decisions.

The proposed Ph.D. program at Tennessee Tech will help prepare the next generation of scientists with the skills needed to study and manage biodiversity in Tennessee. The program's focus on integrating field biology, genetics, and ecological research aligns well with the mission of TWRA. We would welcome opportunities to collaborate with the program, whether through internships, research partnerships, or future hiring of graduates.

Tennessee is home to some of the richest biodiversity in the country, and the need for qualified professionals to support its conservation continues to grow. I believe this program will play an important role in meeting that need.

Sincerely,

Josh Campbell

Biodiversity Chief
Tennessee Wildlife Resources Agency

Tennessee Division of Natural Areas
Department of Environment and Conservation
Davy Crockett Tower, 8th Floor
500 James Robertson Parkway
Nashville, TN 37243

30 May 2025

To members of the Tennessee Higher Education Committee (THEC):

On behalf of the TDEC Division of Natural Areas we write in support of Tennessee Technological University's proposal to establish a PhD program in Integrative Biology.

Core missions of the Tennessee Division of Natural Areas (DNA) include identifying, documenting, and promoting the protection of our state's rare species and natural communities, and management of State Natural Areas intended to benefit them. This varied work demands scientists who can think across disciplinary boundaries—those who understand species-level biology but can also place that understanding within broader ecological and land-use contexts – and can communicate the benefits of sound research and management to their peers and the general public. The kind of doctoral training envisioned in this proposed program is well-aligned with the needs of conservation and natural resource agencies, including our own. Effective solutions require professionals who are not only technically skilled but also trained to integrate data from genetics, field biology, spatial ecology, and long-term monitoring. This program would cultivate exactly that kind of professional.

Tennessee Tech's location and longstanding engagement with field-based research make it an ideal institution to host a program of this kind. The Upper Cumberland region is home to a rich diversity of flora and fauna, including many imperiled species and natural communities. A PhD program rooted in this context can train future biologists in both rigorous scientific methods and the practical demands of conservation in the field.

Our division has enjoyed convivial research partnerships with TN Tech academicians and students, notably including several studies of high value rare plants and plant communities, descriptions of crayfish new to science, elucidation of genetic relationships between cryptic species including crayfish and ambystomatid salamanders, salamander development and husbandry, creation of a curated database of bivalves for the Duck River, and the myriad interactions between water and the karst landscapes that define so much of middle Tennessee. For four decades our staff have enjoyed frequent interactions with TTU personnel and regular

collaborations including field research, analysis and publication, and management activities directed at the rare species and communities we seek to understand and conserve for the benefit of all.

TTU has been a stalwart conservation partner not only for our program and our department, but also for numerous other state, federal, and nongovernmental organizations who share this overarching goal. TTU continues to make us a more effective conservation organization.

Presuming the Integrative Biology program moves forward, we anticipate opportunities for the Division of Natural Areas that strengthen our engagement with faculty and students through new research partnerships, expanded data-sharing, and potentially hosting TTU interns or postdoctoral scholars. The program would also help meet a critical statewide need for trained conservation scientists in public agencies and beyond.

Thank you for timely consideration of these comments and please contact us should you have any questions.

Warmly,

Sam King,
Administrator
Tennessee Natural
Areas Program
Email:
sam.king@tn.gov
Phone: 629-215-0194

and

David Ian Withers

David Ian Withers,
Zoologist Tennessee
Natural Heritage
Program Email:
david.withers@tn.gov
Phone: 615-289-3520

Tennessee Department of Environment and Conservation

APPENDIX B – CURRICULAR TOOLS AND ASSESSMENTS

1. Annual Student Progress Report
2. TN Tech Integrative Biology PhD Program Student Qualifying Written/Oral Exam Rubric
3. TN Tech Integrative Biology PhD Evaluation of Student Written Examination
4. TN Tech Integrative Biology PhD Evaluation of Student Oral Examination
5. PhD Defense Seminar Evaluation Rubric
6. PhD Final Oral Exam Evaluation Rubric
7. Integrative Biology PhD Program – Graduate Outcomes Survey

Annual Student Progress Report

PhD in Integrative Biology **Student Name:** _____

1. Academic Progress (list coursework completed during this year)

2. Research Progress (summarize research activity and milestones)

3. Scholarly Output

- Publications (published, accepted, or submitted; include citations):
- Conference presentations (oral or poster):
- Grants/fellowships applied for or received:

4. Professional Development (Workshops, trainings, or certifications)

5. Awards/Distinctions

Committee Evaluation:

☐ Satisfactory Progress ☐ Needs Improvement ☐ Unsatisfactory Progress

Committee Signatures & Date:

1. _____ Date: _____
2. _____ Date: _____
3. _____ Date: _____
4. _____ Date: _____
5. _____ Date: _____
6. _____ Date: _____

Student Signature: _____ Date: _____

TN Tech Integrative Biology PhD Program Student Qualifying Written/Oral Exam Rubric

Evaluation Rubric (Integrative Biology). Rubric should be used to score both written and oral questions. A mean score of 3 across exams is required.

Score	Rating	Description
5	**Superior**	Demonstrates a comprehensive and nuanced understanding of the subject. Integrates concepts across subdisciplines of biology and relevant fields. Provides clear, logical, and well-structured arguments with appropriate evidence. Responses show critical thinking, originality, and the ability to synthesize information. Communicates ideas clearly and confidently with precise terminology.
4	**Strong**	Shows a solid understanding of the subject with only minor gaps. Integrates relevant concepts and evidence effectively, with mostly logical and coherent arguments. Demonstrates some synthesis across subdisciplines, though less depth or originality than “Superior.” Communicates ideas clearly with only minor issues in organization, precision, or terminology.
3	**Satisfactory**	Demonstrates a basic but acceptable understanding of the subject. Covers essential concepts but omits important details or makes minor factual errors. Integration of concepts is limited, and arguments may lack depth or be somewhat disorganized. Communication is generally understandable but may have occasional clarity or precision issues.
2	**Weak**	Shows partial or incomplete understanding of the subject. Omits key concepts, makes notable factual errors, or provides poorly supported arguments. Limited ability to connect concepts across biological subfields. Responses are unclear, poorly organized, or use imprecise terminology.
1	**Poor**	Demonstrates little or no understanding of the subject. Demonstrates serious misconceptions, significant factual errors, or irrelevant information. Lacks logical structure or supporting evidence. Fails to integrate concepts and communication is unclear, incomplete, or disorganized.

TN Tech Integrative Biology PhD Evaluation of Student Written Examination

Student Name _____

Directions: Each committee member should complete this form. Committee members have freedom in the written exam format, number of questions, and resources available to students during the exam. However, all answers should be evaluated according to the Integrative Biology Evaluation Rubric (score of 1-5). Students must be capable of answering all questions within an 8-hour period.

Question	Score	Question	Score	Question	Score
1		9		17	
2		10		18	
3		11		19	
4		12		20	
5		13		21	
6		14		22	
7		15		23	
8		16		24	

Decision of Graduate Advisory Committee Member

Please indicate whether the student passed or failed the comprehensive written exam. If applicable, please describe any terms for conditional pass/fail and the timeframe in which those conditions must occur.

Decision: Pass Conditional Pass Conditional Fail Fail

Terms of conditions:

_____
_____
_____
_____

Committee Member Name (Printed) _____

Signature _____ Date _____

Student Signature _____ Date _____

TN Tech Integrative Biology PhD Evaluation of Student Oral Examination

Student Name _____

Directions: Each committee member should complete this form. Committee members have freedom in the oral exam regarding the number and types of questions; however, the exam must be completed in the allotted 3-hour period. The student's overall performance should be evaluated by each committee member according to the Integrative Biology Evaluation Rubric (score of 1-5). If desired committee members may attach additional notes from the exam to this form.

Topic	Score

Decision of Graduate Advisory Committee Member

Please indicate whether the student passed or failed the comprehensive written exam. If applicable, please describe any terms for conditional pass/fail and the timeframe in which those conditions must occur.

Decision: Pass Conditional Pass Conditional Fail Fail

Terms of conditions:

_____
_____
_____
_____

Committee Member Name (Printed) _____

Signature _____ Date _____

Student Signature _____ Date _____

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PhD Defense Seminar Evaluation Rubric

Candidate Name: _____

Date: _____

Category	Excellent (4)	Good (3)	Fair (2)	Needs Improvement (1)	Score
Content Knowledge	Demonstrates deep mastery of subject; addresses broader context and implications clearly.	Strong command of subject; minor gaps.	Adequate understanding; some errors or gaps.	Limited understanding; significant errors.	
Organization & Clarity	Presentation is well-structured, logical, and easy to follow.	Mostly clear and organized; minor lapses.	Somewhat disorganized; parts are unclear.	Disorganized and difficult to follow.	
Visuals & Materials	Visual aids are professional, clear, and enhance understanding.	Generally effective visuals; minor issues.	Visuals somewhat cluttered, unclear, or distracting.	Visuals are poorly designed or missing.	
Oral Communication	Speaks clearly, confidently, and engages audience effectively.	Generally clear with minor issues (pace, filler, tone).	Uneven delivery; difficult to follow at times.	Poor delivery; often unclear or inaudible.	
Critical Thinking & Interpretation	Demonstrates strong ability to analyze, synthesize, and interpret results.	Good interpretation with minor limitations.	Some interpretation but lacks depth.	Minimal interpretation; largely descriptive.	
Handling Questions	Responds confidently, thoughtfully, and accurately.	Answers most questions well; minor gaps.	Struggles with some questions; limited depth.	Frequently unable to answer or shows lack of knowledge.	
Professionalism	Highly professional; demonstrates confidence and respect for the academic setting.	Professional with minor lapses.	Somewhat professional; noticeable issues.	Lacks professionalism.	

Comments:

PhD Final Oral Exam Evaluation Rubric

Candidate Name: _____
Date: _____

Category	Excellent (4)	Good (3)	Fair (2)	Needs Improvement (1)	Score
Depth of Knowledge	Demonstrates comprehensive mastery of the research area and related fields; places work in broader scientific context.	Strong knowledge; only minor gaps.	Adequate knowledge; some errors or gaps.	Limited knowledge; frequent errors or misconceptions.	____
Understanding of Methods & Data	Thorough understanding of experimental/theoretical methods, data analysis, and limitations.	Good grasp of methods and data; minor gaps.	Basic understanding; some confusion about methods or results.	Limited or incorrect understanding of methods and data.	____
Integrates across subdiscipline	Consistently integrates concepts, applies theory, and evaluates evidence with sophistication across biology subdisciplines.	Demonstrates good reasoning; connects most ideas across many subdisciplines.	Some integration but reasoning is basic or superficial.	Struggles to connect ideas across biology subdisciplines.	____
Response to Questions	Responds confidently, thoughtfully, and accurately; demonstrates ability to think on the spot.	Answers most questions well; minor weaknesses.	Struggles with depth or accuracy; answers sometimes incomplete.	Frequently unable to answer; responses unclear or incorrect.	____
Scholarly Independence	Demonstrates independence as a researcher; articulates next steps and future directions confidently.	Mostly independent; some reliance on guidance.	Some independence, but often defers to advisor or lacks clarity on future work.	Lacks independence; unable to articulate next steps.	____
Communication Skills	Communicates ideas clearly, logically, and professionally throughout the exam.	Generally clear communication; minor issues with clarity or organization.	Uneven communication; difficult to follow at times.	Poor communication; often unclear or disorganized.	____
Professionalism	Highly professional; demonstrates maturity, confidence, and respect for the academic setting.	Professional with minor lapses.	Somewhat professional; noticeable issues with demeanor.	Lacks professionalism; demeanor inappropriate for setting.	____

Comments:

Integrative Biology PhD Program – Graduate Outcomes Survey

Purpose: This survey evaluates the effectiveness of the PhD Program in Integrative Biology by determining graduates' career paths, professional achievements, and perceptions of the program's effect on career-readiness.

Section 1 – Basic Information

1. **Graduation Year:**

   ☐ 20__

2. **Current Employment Status:**

   ☐ Tenure-track faculty

   ☐ Non-tenure-track faculty / lecturer

   ☐ Postdoctoral researcher

   ☐ Research scientist (industry)

   ☐ Government scientist

   ☐ Non-research position (policy, education, communication, etc.)

   ☐ Other (please specify): _____

3. **Current Employer / Organization: _____**
4. **Location (City, State, Country): _____**

Section 2 – Career Progression

5. **Time from graduation to first professional position:**

   ☐ < 3 months

   ☐ 3–6 months

   ☐ 6–12 months

   ☐ > 12 months

6. **Number of professional positions held since graduation:**

   ☐ 1 ☐ 2 ☐ 3 ☐ 4+

7. **Salary Range at First Position After Graduation:**

   ☐ <$40,000

   ☐ $40,000–$59,999

   ☐ $60,000–$79,999

   ☐ $80,000–$99,999

   ☐ $100,000+

Section 3 – Research & Professional Achievements

8. Since graduation, please indicate the number of each of the following:
    a. Peer-reviewed publications: ___
    b. Conference presentations: ___
    c. Research grants/fellowships awarded: ___
    d. Patents or intellectual property filings: ___
9. Awards or recognitions received since graduation: _____

Section 4 – Program Impact

For each statement below, please rate on a scale from 1 (Strongly Disagree) to 5 (Strongly Agree):

Statement	1	2	3	4	5
The program provided me with a strong foundation in integrative biology.	☐	☐	☐	☐	☐
I developed competency in research design and execution.	☐	☐	☐	☐	☐
The program prepared me to write scientific or technical information effectively.	☐	☐	☐	☐	☐
I developed strong oral communication and presentation skills.	☐	☐	☐	☐	☐
I gained the ability to integrate concepts across biological subfields.	☐	☐	☐	☐	☐
I acquired valuable professional skills (grant writing, leadership, project management).	☐	☐	☐	☐	☐
The program fostered my ability to collaborate across disciplines.	☐	☐	☐	☐	☐
My career success is directly linked to the training I received in the program.	☐	☐	☐	☐	☐

Section 5 – Open-Ended Feedback

10. What aspects of the Integrative Biology PhD program contributed most to your professional success?

11. What aspects of the program could be improved to better prepare future students?

12. Any additional comments on your career path or program experience:

APPENDIX C – SYLLABI FOR NEW COURSES

1. BIOL 7210 – Scientific Leadership and Management
2. BIOL 7250 – Spatial and Landscape Ecology
3. BIOL 7270 – Advanced Bioinformatics
4. BIOL 7310 – Population Genetics
5. BIOL 7340 – Advanced Virology and Epidemiology
6. BIOL 7440 – Signal Integration
7. BIOL 7470 – Scientific Systems Modeling
8. BIOL 7990 – Research and Dissertation
9. BIOL 7991 – Dissertation Research Seminar

Tennessee Tech University
Biology Department
BIOL 7210 Scientific Leadership and Management

3 Credits, Fall 202X

Instructor Information

Instructor's Name:

Office:

Telephone Number: 931-

Campus Email: xxxxx@tntech.edu

Course Information

Prerequisites

Graduate standing.

Texts and Resources

No textbook is required for this class. Readings will be posted on iLearn and will be drawn from recent primary literature.

Course Welcome and Description

Welcome to Scientific Leadership and Management! This course is designed to equip graduate students with essential skills for success in academic and professional careers. The instructor and guest speakers will present practical skills for professional development including networking, résumés and interviews, career options, stress management, work productivity, ethical conduct, peer review, written and oral communication, leadership and group dynamics, and public outreach. You will engage in discussions covering graduate school success, scientific writing, job interviews, comprehensive exams, dissertation defenses, teaching/research philosophies, and faculty interviews (with special emphasis for PhD students).

Course Objectives/Student Learning Outcomes

- Demonstrate effective time management and stress management skills applicable to graduate study and professional careers.
- Apply ethical norms of conduct used by professional scientists in research and professional settings.
- Understand and participate in the peer review process and demonstrate best practices in written and oral communications with both scientific and general audiences.
- Analyze and understand the various administrative, teaching, research, service and outreach duties of professional employees in scientific fields.
- Develop a professional CV/resume and demonstrate competency in job interview skills.
- Create a teaching philosophy and research statement appropriate for academic positions.

Major Teaching Methods

On-campus with lecture and discussion

Special Instructional Platform/Materials [e.g. laptop, etc.]

None.

Topics to be Covered

- **Professional Skills Development**: Time management, stress management, productivity strategies, work-life balance, and mindfulness techniques for graduate students and early career professionals
- **Academic and Research Ethics**: Understanding ethical norms in scientific research, responsible conduct of research, data management best practices, and navigating ethical dilemmas in academic settings
- **Communication and Networking**: Developing oral and poster presentation skills, effective networking strategies, conference participation, peer review processes, and public outreach and science communication
- **Career Preparation**: Resume and CV development, interview skills, teaching and research philosophy statements, faculty interview processes, and exploring diverse career paths in science
- **Leadership and Professional Development**: Leadership skills, diversity and equity in sciences, conflict resolution, and understanding administrative, teaching, research, and service responsibilities

Grading and Evaluation Procedures

- Autobiography (10%) -- Due September 8: A professional autobiography introducing yourself, your background, research interests, and career goals.
- Data Management Plan (30%) -- Due October 6: A comprehensive plan for managing research data according to best practices and institutional requirements.

- Time Management Plan (15%): A detailed strategy for managing time effectively during graduate study and balancing multiple responsibilities.
- Writing Assignment/Peer Review (15%): A writing assignment with peer review component focusing on scientific communication skills.
- Research Philosophy Statement (30%): A comprehensive statement outlining research philosophy, approach, and future directions appropriate for academic job applications.
- Teaching Philosophy Statement (20%): A statement describing teaching philosophy, pedagogical approaches, and commitment to student learning for academic positions.
- CV/Resume (10%): A professional curriculum vitae or resume appropriate for career goals.
- Participation (10%): Active participation in class discussions, group activities, and peer feedback sessions.

Grading Scale

Table 1: Overview of grade range

Letter Grade	Grade Range
A	90-100
B	80-89.9
C	70-79.9
D	60-69.9
F	60 and below

Course Policies

Student Academic Integrity Policy

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Attendance Policy

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Disability Accommodation

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Additional Resources

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Emergency Preparedness Protocols

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Tennessee Tech University
Biology Department
BIOL 7250 Spatial and Landscape Ecology

3 Credits, Spring 202X

Instructor Information

Instructor's Name:

Office:

Telephone Number: 931-

Campus Email: xxxxx@tntech.edu

Course Information

Prerequisites

Graduate standing.

Texts and Resources

No textbook is required for this class. Readings will be posted on iLearn and will be drawn from recent primary literature.

Course Welcome and Description

Animals are inextricably influenced by the complexity, stochasticity, and juxtaposition of landscape features. The spatial arrangement of biotic and abiotic features shapes the availability of resources and predation risk, which in turn affects individual behavior and space use. This class will introduce you to common concepts in spatial and landscape ecology and demonstrate how to accurately measure spatial metrics at the individual and landscape-scale. We will cover critical concepts including space use, habitat selection, occupancy, and scale, while providing hands-on experience with spatial analyses in program R.

Course Objectives/Student Learning Outcomes

- Understand the concepts and consequences of spatiotemporal dynamics on scale and inference.
- Quantitatively evaluate abiotic and biotic processes that structure animal behaviors, animal occurrence, and other ecological phenomena of interest at multiple spatial scales in program R.
- Apply theory, methodology, and application of landscape ecology to contemporary issues in conservation biology and resource management, with a specific focus on your research.
- Critically evaluate and discuss peer-reviewed literature in spatial and landscape ecology.
- Lead effective scientific discussions and contribute meaningfully to group learning.
- Integrate course concepts into independent research projects.

Major Teaching Methods

On-campus with lecture and discussion

Special Instructional Platform/Materials [e.g. laptop, etc.]

None.

Topics to be Covered

- Basic R programming
- Data management and manipulation
- Spatial data management and transformations
- Study design and spatial scale
- Home ranges
- Resource selection functions
- Movement modeling
- Occupancy modeling
- Student-selected advanced topics

Grading and Evaluation Procedures

- Reading Assignments (25%): This course emphasizes readings from the recent primary literature. Every student is expected to have read the assignments before class and be prepared to discuss the papers. Responsibility for leading discussion will be rotated among students. Discussion leaders should raise questions or issues to be discussed, be prepared with an evaluation of the significant contributions of the paper, and facilitate discussion among the group.
- Discussion Participation (25%): Discussions are only effective when everyone is prepared and has perspectives to contribute. Everyone is expected to have read the assignment before class and given thought to the paper's content and context. A good strategy for being prepared is to write down a couple of questions or observations about each paper as you are reading it.

- Project Paper and Presentation (50%): Details to be provided later in semester. This project should incorporate class concepts into your thesis/dissertation research or a relevant research topic.

Grading Scale

Table 2: Overview of grade range

Letter Grade	Grade Range
A	90-100
B	80-89.9
C	70-79.9
D	60-69.9
F	60 and below

Course Policies

Student Academic Integrity Policy

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Emergency Preparedness Protocols

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Tennessee Tech University
Biology Department
BIOL 7270 Advanced Bioinformatics

3 Credits, Fall 202X

Instructor Information

Instructor's Name:

Office:

Telephone Number: 931-

Campus Email: xxxxx@tntech.edu

Course Information

Prerequisites

Graduate standing.

Texts and Resources

No textbook is required for this class. Readings will be posted on iLearn and will be drawn from recent primary literature.

Course Welcome and Description

This course will introduce you to essential skills for analyzing DNA and RNA sequences generated by Next Generation Sequencing (NGS) technologies. You will learn to implement advanced computational workflows, integrate multi-omics datasets, and apply statistical and machine learning methods to answer complex biological questions. Through hands-on activities and a capstone project, you will develop the skills needed to design reproducible bioinformatics pipelines and communicate your findings effectively.

Course Objectives/Student Learning Outcomes

- Implement and optimize advanced computational workflows using Unix/Linux and high-performance computing (HPC) environments, including job scheduling, containerization (e.g., Docker, Singularity), and workflow management systems (e.g., Snakemake, Nextflow).

- Critically evaluate and apply advanced algorithms in sequence alignment, genome assembly, variant calling, structural variation, and phylogenomic inference.
- Integrate and analyze multi-omics datasets (e.g., genomics, transcriptomics, proteomics, epigenomics, and metagenomics) to answer complex biological questions.
- Apply statistical and machine learning methods for modeling high-dimensional biological data, pattern recognition, and predictive analysis.
- Develop reproducible and scalable bioinformatics pipelines, leveraging version control (e.g., Git), workflow automation, and cloud computing resources.
- Navigate and curate advanced biological databases and resources, including metadata handling, API queries, and large-scale repository management.
- Interpret and communicate bioinformatics results in the context of biological research, producing publication-quality reports with integrated visualizations and reproducible notebooks.
- Design and critique bioinformatics research projects, demonstrating the ability to select appropriate methodologies, assess limitations, and propose future directions.

Major Teaching Methods

On-campus with lecture and discussion

Special Instructional Platform/Materials [e.g. laptop, etc.]

None.

Topics to be Covered

- Unit 01: High-Performance Computing & Workflow Automation (Advanced HPC usage, job scheduling, workflow management systems, containerization)
- Unit 02: Advanced Sequence Analysis (Long-read vs. short-read data integration, hybrid genome assembly, scaffolding, polishing, and evaluating assembly quality)
- Unit 03: Functional Genome Annotation & Comparative Genomics (Structural and functional annotation pipelines, orthology inference, pan-genome construction, synteny, and genome dynamics)
- Unit 04: Advanced Variant Analysis (Structural variants, copy number variations, population-scale variant calling, haplotype phasing, and GWAS/QTL applications)
- Unit 05: Transcriptomics and Multi-omics Integration (Bulk RNA-seq, single-cell RNA-seq, epigenomics, and integration of multi-omics datasets for regulatory network inference)
- Unit 06: Machine Learning and AI in Bioinformatics (Feature engineering, deep learning for sequence/structure prediction, dimensionality reduction, clustering, and classification)
- Unit 07: Data Visualization, Reproducibility, and Communication (Creating reproducible pipelines with GitHub, RMarkdown/Jupyter notebooks, interactive visualizations, and publication-quality figures)
- Unit 08: Translational and Applied Bioinformatics (Applications in clinical genomics, precision medicine, metagenomics, microbiome studies, and evolutionary biology)

- Unit 09: Research Project Design & Execution (Capstone project integrating course concepts with focus on workflow reproducibility, scalability, and biological interpretation)

Grading and Evaluation Procedures

- **Assignments (40%):** Students will complete various computational assignments throughout the semester designed to reinforce concepts covered in lectures and provide hands-on experience with bioinformatics tools and methods.
- **Final Exam (30%):** A comprehensive final exam will assess understanding of key concepts, algorithms, and applications covered throughout the course.
- **Final Project (30%):** Students will design and implement an independent capstone project that integrates course concepts, with emphasis on workflow reproducibility, scalability, and biological interpretation.

Grading Scale

Table 3: Overview of grade range

Letter Grade	Grade Range
A	90-100
B	80-89.9
C	70-79.9
D	60-69.9
F	60 and below

Course Policies

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Emergency Preparedness Protocols

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Tennessee Tech University
Biology Department
BIOL 7310 Population Genetics

3 Credits, Spring 202X

Instructor Information

Instructor's Name:

Office:

Telephone Number: 931-

Campus Email: xxxxx@tntech.edu

Course Information

Prerequisites

Graduate standing.

Texts and Resources

Molecular Population Genetics - Michael Hahn

Course Welcome and Description

This course explores the principles of population genetics, focusing on the genetic structure of populations and the forces that shape genetic variation over time. Topics include the measurement and description of genetic variation, recombination and linkage disequilibrium, population structure, coalescent theory, natural selection, demographic inference, and molecular tools such as SNP genotyping, RNA sequencing, and eDNA metabarcoding. Emphasis will be placed on both theoretical foundations and hands-on analysis using real genetic datasets from natural populations.

Course Objectives/Student Learning Outcomes

- Students will describe and quantify genetic variation within and among populations using population genetic principles and analytical frameworks.

- Students will analyze how evolutionary forces, including mutation, genetic drift, migration, and natural selection, shape genetic variation and apply concepts such as Hardy-Weinberg equilibrium, population structure, and coalescent theory to real genetic data.
- Students will gain practical skills in using molecular and bioinformatic tools, including BLAST, QIIME2, and RNA-Seq, to analyze genomic data and interpret population genetic patterns.
- Students will demonstrate their understanding of population genetic methods through hands-on in-class activities and a final presentation that integrates course concepts to address biological questions.

Major Teaching Methods

On-campus with lecture and discussion

Special Instructional Platform/Materials [e.g. laptop, etc.]

Topics to be Covered

- Course Overview – Pop Gen Models
- Bioedit / Blast Activity
- Experimental Design
- Experimental Design cont.
- Sequence Manipulation
- Describing Genetic Variation
- Genetic Variation Activity
- Population Structure
- Structure Analysis
- DAPC Analysis
- Coalescence
- Coalescent tree-building
- Selection signatures
- Adaptation, polygenic traits & selection scans
- Selection scan
- Demographic Histories & effective population size (Ne)
- Effective Population Size Estimation
- eDNA and Metabarcoding
- RNA Seq

Grading and Evaluation Procedures

- Exams (40%) – There will be two exams. Each will be worth 20% of your final grade.
- Class Activities (40%) – There will be regular in-class activities. You will be graded on participation as well as turned-in assignments. You are encouraged to work in groups, but the assignments you turn in must be your own work.
- Final Presentation (20%) - Each student will complete an independent project exploring a population genetics concept covered in the course. Using a real genetic dataset—either one provided, publicly available, or generated through your own research—you will develop a research question, conduct an analysis, and present your findings to the class during the final weeks of the semester. Projects may focus on topics such as genetic variation, population structure, selection, effective population size, or demographic inference. The goal is to apply the methods and tools learned in class to investigate a question of interest and communicate your results clearly and thoughtfully. More details and a grading rubric will be provided mid-semester.

Grading Scale

Table 4: Overview of grade range

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B	80-89.9
C	70-79.9
D	60-69.9-xx
F	60 and below

Course Policies

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Tennessee Tech University
Department of Biology
BIOL 7340
Advanced Virology and Epidemiology

3 Credit Hours, Spring 202X

Instructor Information

Instructor's Name:

Office:

Lab:

Telephone Number:

Campus Email: xxxxx@tntech.edu

Course Information

Prerequisites

Graduate standing.

Texts and Resources

Texts and Resources: No Textbook is required for this class. However, the following textbooks are recommended:

- Principles of Virology, 5th Edition (2-volume set), (2020). S. J. Flint, V. R. Racaniello, G. F. Rall, A. M. Skalka, and T. Hatziioannou.
- Molecular and cellular biology of viruses, 1st edition. (2024). Lostroh, P.
- Essentials of Epidemiology in Public Health, 4th Edition (2019). Ann Aschengrau & George R. Seage III
- Epidemiology 101, 2nd Edition (2019). Robert Friis

Course Welcome and Description

Welcome to advanced virology and epidemiology.

In this course, we will explore the fundamental science of public health and medicine to understand how scientists can trace the source of infectious diseases, identify risk factors and track the spread of a global pandemic focusing on viruses as our model organism.

To do so, we will review viral classification, virus-host interactions, and viral spread and transmission from an evolutionary and epidemiological perspective.

Course Objectives/Student Learning Outcomes

- Describe and differentiate major virus families, their replication and transmission route.
- Explain different stages of virus-host interactions and identify risk factors for transmission.
- Define and explain the core principles, scope and historical development of epidemiology as the main pilar of public health.
- Apply epidemiological concepts to evaluate emerging viral threats, including genetic, ecological and social factors that may contribute to the emergence and transmission of viral pathogens.
- Calculate key measures, identify bias and assess casualties to interpret fundamental epidemiological measures, errors and cause-effect relationships between exposures and health outcomes.
- Understand and design infectious disease surveillance.
- Design and analyze genomic epidemiology studies
- Critically evaluate public data and research.
- Efficiently communicate epidemiological concepts to both the general public and a scientific audience.

Major Teaching Methods

On campus lecture.

Topics to be Covered

- Slides and topic handbooks will be available via iLearn.
- Topics to be Covered
- Viral taxonomy, replication and transmission.
- Virus-host interactions and immune responses
- Introduction and history of infectious disease epidemiology
- Measures of disease frequency and public health surveillance
- Descriptive epidemiology: causation, measures of association, and bias and confounding.
- Screening and prevention and outbreak investigation.
- Genomic epidemiology.

- In-vitro and In-silico methods to study viral epidemiology.
- Ethics in epidemiology

Grading and Evaluation Procedures

Students taking this course will be required to prepare a scientific poster about a virus of their choice (except for specific viruses discussed during lectures).

Student grades will be awarded based on the following point-earned system. Subjective grade adjustments to individual students' grades will **not** be made.

This class will utilize four lecture exams to test students' knowledge of the material discussed. Exams will be based on material discussed in class.

Additionally, a poster project provides an opportunity for graduate students to bridge the gap between classroom learning and their independent research endeavors. Students will identify key concepts, methodologies, or theoretical frameworks from their coursework and demonstrate how these insights inform, enhance, or reshape their thesis or dissertation work.

Graded Item	**Total Points of Final Grade**
Lecture Exam 1	17.5% (175 pts)
Lecture Exam 2	17.5% (175 pts)
Lecture Exam 3	17.5% (175 pts)
Lecture Exam 4	17.5% (175 pts)
Graduate Student Poster	20% (175 pts)

Grading Scale

Letter Grade	Grade Range
A	≥ 90%
B	80-89%
C	70-79%
D	60-69%
F	59% and below

Course Policies

Student Academic Integrity Policy

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Attendance Policy

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Instructional and Assignment Use of Artificial Intelligence

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Disability Accommodation

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Additional Resources

Technical Help

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Tutoring

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Counseling and Health Services

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Emergency Preparedness Protocols

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Tennessee Tech University
Biology Department
BIOL 7440 Signal Integration

3 Credits, Fall 202X

Instructor Information

Instructor's Name:

Office:

Telephone Number: 931-

Campus Email: xxxxx@tntech.edu

Course Information

Prerequisites

Graduate standing. Completion of undergraduate genetics course or consent of instructor.

Texts and Resources

No textbook is required for this class. Readings will be posted on iLearn and will be drawn from recent primary literature.

Course Welcome and Description

Using plants as a model system, you will gain comfort in using publicly available databases and in interpreting molecular data to explore how organisms perceive external and internal cues such as light or nutrition to alter developmental programming within the cell. You will compile molecular information to develop hypotheses on the impacts of a changing environment on development and/or behavior, and will learn to select techniques and to design molecular experiments to test your hypotheses. In this course, you will gain working knowledge of the cues to which organisms respond, protein and gene regulation, cellular signal integration, and existing tools that scientists use to explore such questions.

Course Objectives/Student Learning Outcomes

- Analyze and explain gene regulation mechanisms by comparing and contrasting *cis*- and *trans*-acting factors, including how genetic variation in these factors can lead to different behaviors and developmental outcomes.

- Construct and evaluate conceptual models for molecular environmental regulation that incorporate various types of *trans*-acting factors (e.g. transcription factors, non-coding RNAs), clearly identifying assumptions and demonstrating how existing evidence can support multiple hypotheses.
- Access and interpret molecular data by evaluating and using publicly available databases to address specific research questions and by analyzing cellular and molecular data (e.g. gels, graphs).
- Design and critique experiments by using knowledge of existing systems to develop new hypotheses, selecting appropriate molecular techniques to test those hypotheses, and predicting outcomes of future experiments based on existing data.
- Evaluate the relative merit of using particular molecular techniques or scientific studies to address research questions, demonstrating critical assessment of methodology and approach.
- Communicate complex scientific concepts effectively by guiding others to understand molecular biology topics in an active-learning instructional format.

Major Teaching Methods

On-campus with lecture and discussion

Special Instructional Platform/Materials [e.g. laptop, etc.]

None.

Topics to be Covered

- Plant chromosomal structure (including tetraploidy and hexaploidy)
- Gene structure (including regulatory and coding regions)
- *Trans*-acting gene regulation by transcription factors and non-coding RNAs
- *Cis*-acting drivers of variation in gene expression
- "Integrator" genes and molecular pathways
- Environmental modulation of gene regulation
- Gene models
- Molecular techniques
- Hypothesis generation

Grading and Evaluation Procedures

- **Self Evaluation (15%):** Students will self-evaluate on core skills (professionalism and intellectual courage) and focus areas (use of molecular tools and data interpretation, and communicating technical information in an active-learning instructional format). At the end of the semester, you will provide evidence of your growth in these areas. Core skills comprise 7.5% and focus areas comprise 7.5%.

- **Instructional Module and Mini-Lecture (30%):** Graduate students will generate and present an active-learning instructional module and associated mini-lecture on a research article of their choice that is suitable for teaching basic molecular concepts to an undergraduate classroom.
- **Molecular Model (30%):** Students will compile molecular information learned in class and gathered from publicly available databases to build conceptual models, clearly indicating assumptions and possible alternatives based on the data. Using their model, students will devise molecular experiments to test their hypotheses.
- **Quizzes and Assignments (25%):** Students will complete periodic assignments for each module, which will include short scientific write-ups of data figures, preparatory searches of online information, and review and synthesis of research article components. Short quizzes will be completed at the end of each module to assess basic understanding. Two quiz-like exams will allow students to demonstrate mastery of concepts important for modeling, with opportunities to show mastery later if a solid effort was made on the initial assessment.

Grading Scale

Table 5: Overview of grade range

Letter Grade	Grade Range
A	90-100
B	80-89.9
C	70-79.9
D	60-69.9
F	60 and below

Course Policies

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Tennessee Tech University
Biology Department
BIOL 7470 Scientific Systems Modeling

3 Credits, Spring 202X

Instructor Information

Instructor's Name:

Office:

Telephone Number: 931-

Campus Email: xxxxx@tntech.edu

Course Information

Prerequisites

Graduate standing. Completion of undergraduate, calculus-based probability and statistics course or consent of instructor.

Texts and Resources

No textbook is required for this class. Readings will be posted on iLearn and will be drawn from recent primary literature.

Course Welcome and Description

Mathematical modeling is a fantastic tool to explore complex systems. Beginning with in-depth discussion of biological phenomena as systems with inflows, outflows, and modifiers, you will select constants and equations to mimic a system of your choice using the STELLA modeling platform. You will use Excel and R to parameterize and evaluate your models, and to simulate model components. You will present your models in the form of a poster and runnable model description written in R Markdown and with links to Github. We will also discuss the integration of process-based models with artificial intelligence.

Course Objectives/Student Learning Outcomes

- Describe process-based models, how they are used in scientific contexts, and their limitations, including discussion of AI as a modeling tool.
- Generate in-depth, logical conceptual models of scientific systems and identify appropriate equations to describe relationships between driving and response variables.

- Conduct model parameterization and evaluation using Excel and R, including extracting data from literature using ImageJ and gathering data from literature or experiments to develop models.
- Create systems models to answer scientific questions using both graphical (STELLA) and code-based (R) modeling tools, demonstrating various methods for linking equations to simulate systems.
- Generate scientific communication describing model background, creation, and results in the form of a research poster and a runnable model description in R Markdown with organized files on Github.
- Apply technical skills across multiple platforms including STELLA Modeling Platform (ISEE), ImageJ, Excel, R Statistical Computing Platform, and Github.

Major Teaching Methods

On-campus with lecture and discussion

Special Instructional Platform/Materials [e.g. laptop, etc.]

None.

Topics to be Covered

- Process-based models
- Conceptual models
- Equation anatomy and behavior
- Model parameterization and evaluation
- Model and equation uses and limitations
- Modeling tools (STELLA, R, R Markdown, AI, Github)

Grading and Evaluation Procedures

- **Self Evaluation (15%):** Students will self-evaluate on core skills (professionalism) and focus areas (growth as a technical communicator and modeler). At the end of the semester, you will provide evidence of your growth in these areas in the form of a poster, model description, and associated organized files. Core skills comprise 7.5% and focus areas comprise 7.5%.
- **Folder & File Organization, Running Record (5%):** Students will maintain organized files on Microsoft Teams with proper documentation and running records of their modeling process.
- **Journal Article References (5%):** Students will gather and properly cite 2+ journal articles related to their system of interest.
- **Poster Rough Drafts (15%):** Students will complete 2 rough drafts of their poster, incorporating feedback to improve scientific communication skills. Drafts will be graded using the same rubric as the final poster, with an improvement policy allowing earlier grades to be updated as skills develop.
- **Conceptual Model Checkpoints (20%):** Students will complete 5 conceptual model checkpoints throughout the semester, progressively building their model in STELLA and demonstrating understanding of the modeling process.

- **Final Poster & Model Description (40%):** Students will create a final research poster and comprehensive model description that includes annotated code available on Github and a runnable R Markdown document describing the model background, creation process, and results.

Grading Scale

Table 6: Overview of grade range

Letter Grade	Grade Range
A	90-100
B	80-89.9
C	70-79.9
D	60-69.9
F	60 and below

Course Policies

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Tennessee Tech University
Biology Department
BIOL 7990 Research and Dissertation

1-6 Credit(s), Fall/Spring/Summer 202X

Instructor Information

Instructor's Name:

Office:

Telephone Number: 931-

Campus Email: xxxxx@tntech.edu

Course Information

Prerequisites

Graduate standing.

Texts and Resources

No textbook is required for this class.

Course Welcome and Description

The purpose of this class is to allow students to get hands-on experience in conducting scientific research. Students are expected to undertake the activities agreed upon with their dissertation advisor, which may include: mastering and recording research techniques and scientific processes, creating and defining hypotheses for investigation, evaluating data and outcomes, and sharing discoveries and their broader implications.

Course Objectives/Student Learning Outcomes

- Demonstrate proficiency in selecting, implementing, and documenting appropriate research methodologies and techniques relevant to their field of study.
- Formulate theoretically-grounded, testable hypotheses and design appropriate frameworks to investigate and interpret results within the broader scholarly context.
- Execute sustained, original research demonstrating intellectual independence, ethical research practices, and the ability to navigate challenges inherent in advanced scientific inquiry.

Major Teaching Methods

Hands on scientific research underseen by dissertation advisor.

Special Instructional Platform/Materials [e.g. laptop, etc.]

None.

Topics to be Covered

- Research Design and Methodology – Selection, application, and documentation of appropriate research methods, experimental design, and data collection techniques specific to the student's dissertation topic.

- Hypothesis Development and Testing – Formulation of research questions and testable hypotheses, implementation of analytical frameworks, and interpretation of findings within theoretical and empirical contexts.

- Independent Research Experience – Hands-on engagement in all phases of the research process, including problem identification, project management, troubleshooting methodological challenges, and developing skills essential for independent scholarly inquiry.

Grading and Evaluation Procedures

This course employs a Pass/Fail grading system based on the student's progress toward research and dissertation completion. Students are expected to meet predefined progress milestones established collaboratively with their dissertation advisor at the beginning of the term. These milestones may include completing literature reviews, finalizing research designs, collecting and analyzing data, drafting dissertation chapters, or other benchmarks appropriate to the student's stage of doctoral study.

Evaluation and grading are determined through the dissertation advisor's comprehensive judgment of the student's progress on their research or dissertation. Assessment criteria include advancement toward agreed-upon milestones and demonstration of appropriate research competencies, such as critical thinking, methodological rigor, scholarly writing, and intellectual independence. The advisor will consider both the quality of work produced and the student's commitment to the research process, including responsiveness to feedback, adherence to timelines, and overall scholarly development.

Grading Scale

Table 7: Overview of grade range

Letter Grade	Description
Pass	Satisfactory progress on student's research or dissertation; student has met expected progress milestones.
Fail	Unsatisfactory progress on student's research or dissertation; failure to meet expected progress milestones.

Course Policies

Student Academic Integrity Policy

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Tennessee Tech University
Biology Department
BIOL 7991 Dissertation Research Seminar

1 Credit, Fall/Spring 202X

Instructor Information

Instructor's Name:

Office:

Telephone Number: 931-

Campus Email: xxxxx@tntech.edu

Course Information

Prerequisites

Graduate standing.

Texts and Resources

No textbook is required for this class.

Course Welcome and Description

The purpose of this course is to provide Ph.D. students with the valuable opportunity to present their thesis research to a public audience. You will prepare a 50-minute presentation allowing for 5-10 minutes of audience-directed questions. This seminar format will help you develop critical skills in scientific communication and prepare you for professional presentations in your career.

Course Objectives/Student Learning Outcomes

- Prepare and deliver a comprehensive 50-minute presentation on thesis research to a public audience.
- Organize and present complex research findings in a clear, logical, and engaging manner.
- Respond effectively to audience questions and demonstrate mastery of subject matter.
- Create high-quality visual aids that enhance presentation effectiveness.
- Evaluate and provide constructive feedback on peer presentations.
- Demonstrate knowledge of subject matter and quality of research through professional delivery.

Major Teaching Methods

Student-presented seminars with faculty evaluation and peer feedback.

Special Instructional Platform/Materials [e.g. laptop, etc.]

None.

Topics to be Covered

- Student thesis research presentations as scheduled throughout the semester.
- Students are expected to attend all department seminars in addition to preparing for their own presentations.

Grading and Evaluation Procedures

Students taking this course will be required to prepare and deliver a 50-minute presentation on their thesis research, allowing for 5-10 minutes of audience-directed questions.

Grades for student-presented seminars will be assigned by three anonymous faculty reviewers based on the following criteria:

Graded Item	Evaluation Criteria
Quality of Presentation and Visual Aids	Clarity, design, and effectiveness of slides and other visual materials
Organization of Presentation	Logical flow, structure, and coherence of content
Quality of Research	Rigor, significance, and contribution of research
Knowledge of Subject Matter	Depth of understanding and ability to address questions
Delivery of Presentation	Speaking skills, engagement, timing, and professionalism

Grading Scale

Table 8: Overview of grade range

Letter Grade	Description
Pass	Satisfactory completion of presentation meeting all evaluation criteria
Fail	Unsatisfactory presentation not meeting minimum standards

Course Policies

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