The Department of Biological Sciences at East Stroudsburg University of Pennsylvania offers 7 undergraduate programs and an unusual variety of courses taught by 15 full-time faculty members with terminal (Ph.D.) degrees. External affiliations providing internship and research opportunities for students include relationships with area medical facilities and businesses. There is a longstanding relationship with Sanofi-Pasteur, the world's largest manufacturer of vaccines, where many of our students serve as interns and work as permanent employees. Collaborations with the Delaware Water Gap National Recreation Area, the Wetlands Institute in Stone Harbor, New Jersey, the El Zota biological field station in Costa Rica, and other field sites provide numerous opportunities for undergraduate and graduate research activity. The Marine Science program and ESU provide major funding to support the Marine Science Consortium, located at Wallops Island, Virginia where students enrolled in the Marine Science major take summer courses and conduct research projects. The Northeast Wildlife DNA Laboratory, an affiliate of ESU, provides students with an opportunity to combine field and laboratory research and offers numerous internship opportunities.

The Department of Biological Sciences offers undergraduate degrees under a number of different rubrics.

- B.A. and B.S. in Biology offer a broad foundation based on a core curriculum. With this education an individual has a wide range of career opportunities or may proceed on to graduate school.
  - For those with more specific career goals, we offer a number of concentrations within the B.S. in Biology degree:
    - Integrative Animal Behavior
    - Integrative Organismal Biology
    - Laboratory Medicine
    - Pre-Medicine
    - Pre-Physician Assistant
    - Pre-Physical Therapy
    - B.S. Biology (Secondary Education) is offered for those whose goal is teaching
- B.A. and B.S. in Environmental Studies prepare students to work in government and non-government environmental and conservation agencies.
- B.S. in Marine Science offers field courses at the Marine Science Consortium at Wallops Island, VA, and prepares students for opportunities in government, aquaria, consulting, and research laboratory positions or to pursue advanced degrees.
- B.S. in Biotechnology prepares students in the application of biological systems and organisms to technical and industrial processes.
• B.S. in Medical Technology prepares students for a career in diagnostic laboratory medicine, and includes a twelve month internship at a hospital laboratory.

**Department of Biological Sciences – Mission Statement**

The Department of Biology will provide a quality education with a strong foundation in the basic principles of science to a diverse student population, with opportunities in a wide array of biological disciplines. We will foster an atmosphere that instills enthusiasm and appreciation for biology and encourages scholarly growth and service in students and faculty.

Our primary mission is to provide a quality education for our students. Our goal is to develop highly literate, compassionate, analytically competent persons who possess extensive contemporary biological knowledge. Thus, the faculty is committed to providing the diverse experiences necessary to achieve this goal which also requires dedication and motivation on the part of the student.

**General methods of assessment for Biological Sciences:**

Biology Graduating Senior Survey and records of advisors:
- Successful placement of graduates in graduate school or employment related to major is recorded by advisors, and determined by regular surveys.
- Specific information provided by graduating seniors related to their experience as a Biological Sciences major is used each year to assess perceived quality of instruction, advising, and curricular offerings.
- Past placements include: teaching, research, federal government, state government, local government, private industry, medical technology, graduate programs in medicine and allied health professions, doctoral or specialist programs, private consulting firms

External evaluation of student performance in internships:
- Students in many areas of Biological Sciences (e.g., Medical Technology, Environmental Studies, Pre-Physical Therapy, Pre-Physician Assistant) regularly participate in off-campus internships to gain practical experience in a profession or career. Evaluations by supervisors external to ESU provide a means of assessing student performance off-campus.

**MAPP (Measure of Academic Proficiency and Progress)**
- The MAPP is administered by the Office of Academic and Institutional Effectiveness to all incoming freshmen and all seniors. The test assesses the core areas of critical thinking, reading, writing, and math; results can be isolated by major.

Coursework:
- Successful completion of quizzes, exams, papers, lab reports, oral presentations, and other forms of assessment in coursework required for each program.

**Graduate Programs in Biological Sciences**

The Graduate Faculty in biology offers a Master of Science with a major in Biology. Master of Science students must complete either a research thesis program, a research project program, or a coursework program. Students must establish a comprehensive exam committee, and each committee member will submit three questions that the student must pass.
Recommendations Derived from 2017 Departmental Five-Year Program Review

- Acquire more complete information about undergraduate and graduate students after they receive a degree and leave ESU. This could be implemented via improved surveys and exit questionnaires, and the use of social media.
- Some programs would benefit by curricular changes such as the addition of certain recommended or required courses, such as General Statistics or Biochemistry.
- Outcomes in second courses of sequences (e.g. BIOL 115) would be better met if a grade requirement is implemented for the first course in the sequence.
- Program goals should be reviewed on an annual basis, which considering feedback from annual program-level assessments. A revision of program goals would facilitate the collection of data for assessment purposes.

Undergraduate Student Learning Outcomes and Assessment Methods

Biology B.S./B.A. Program

All graduates from the Biology Program should be able to:

1. correctly apply the scientific method: design a hypothesis and use the scientific method to answer a question, use basic analytical skills, including statistics, in the scientific process
   - Assessment methods: Biol 114 (quiz), Biol 111/112 (lecture, quiz), Biol 200 (data collection and analysis), Biol 340/422 (statistical decision making, hypothesis construction, using statistics to analyze results in 4 lab experiments), Biol 330 (frequency calculations of genotypes)

2. summarize, critically interpret, and present data in both mathematical and graphical formats
   - Assessment methods: Biol 112 (collection of data and analysis of results, experimental lab on EKG recordings), Biol 200 (1 data presentation report, 2 full length laboratory reports; in forest structure lab, students interpret tree measurements and use those as metrics to compare forest structure at differing elevations using graphic presentation and a full length laboratory report; Bio 340 (graphing, basic statistical presentation, using Excel to present all results in 4 lab experiments)

3. communicate within the scientific community: find, retrieve, read, and comprehend scientific literature, and create effective written and oral presentations that integrate and explain scientific results and conclusions
   - Assessment methods: Biol 111/112 (lab reports with data collected and computations), Bio 200 (3 laboratory reports done, one on data presentation and two full-length laboratory reports in the format of research papers), Biol 340/422 (written publication skills, data retrieval from literature, research paper), Biol 495/496 (present a technical poster or oral presentation), Biol 281 (read, comprehend, orally present newest data on biotechnology research)
4. recognize and relate the different levels of structure in biology from atoms through the biosphere
   • Assessment methods: Biol 111/112 (all hierarchical levels of structure, repeated reference to various levels throughout course), Bio 200 (ecology is defined as being concerned with whole organisms and their interactions with the biosphere)

5. correlate structure with function at multiple levels
   • Assessment methods: Biol 114 (relationship presented at many levels of organization), Biol 111/112 (relationship between cell, tissue, organ structure to function; discussed for every system)

6. recognize the hierarchy in the diversity of life and identify the characteristics of major lineages of organisms
   • Assessment methods: Biol 114/115 (unity vs. diversity, systematics and taxonomy), Biol 200 (biodiversity, community diversity indices, biodiversity is addressed in a lecture dedicated to that topic, diversity indices are reviewed and calculated in aquatic insect diversity laboratory)

7. understand evolutionary theory and its role as the unifying theme in the biological sciences
   • Assessment methods: Biol 115; Biol 200 (Addressed through many lecture topics including the introduction and biodiversity lectures and a laboratory devoted to population genetics, class uses a computer simulation program to investigate population genetics)

8. explain how genetic information is copied, transmitted between generations, and utilized during an organism’s lifespan
   • Assessment methods: Biol 114; Biol 200 (there is a laboratory that specifically addresses population genetics; the above laboratory uses a computer simulation program to investigate topics in population genetics such as genetic drift); Biol 330 (Genetics)

9. understand ecological relationships among organisms and between organisms and their environment
   • Assessment methods: Biol 200 (addressed throughout this class in lectures on competition, social organization, populations and ecological communities; lecture topics as described above and laboratories, both field and computer simulations, on forest structure, mixed-species foraging flocks and competition, predator-prey relationships and aquatic insect community characteristics

10. demonstrate the skills and knowledge required for success in obtaining employment or in pursuing graduate/professional training in the biological sciences
    • Assessment methods: Biol 340/422 (lab techniques, calculation skills, writing skills, editing); Biol 495/496 (senior seminar addressing oral presentation, professionalism, interview skills, interpretation of scientific literature)
Biotechnology B. S. Program

The field of Biotechnology is concerned with the application of biological systems and organisms to technical and industrial processes. Its status as the most rapidly expanding area of biology has resulted in substantial changes in the typical biology curriculum. Biotechnology training is necessary for students to compete and meet the technological challenges facing industry in the 21st century. The Biotechnology major is designed to educate students in the tools necessary to be active participants in the field of biotechnology and in pharmaceutical industries. It stresses basic biotechnology concepts and in-depth training in an area coinciding with the career goals of the student. Biotechnology applications are broad and include human health, plant and animal agriculture, and environmental bioremediation. The concentration is designed to provide students with an in-depth experience and understanding of methods, techniques, and instrumentation used in biotechnology. The core courses combine theory and practical training. Techniques such as electrophoresis, ELISA, western blotting, PCR, DNA fingerprinting, cell culture, transformation, and monoclonal antibody production will be covered. ESU is geographically and academically positioned to be a leader in biotechnology instruction. There is a large concentration of biotechnology and pharmaceutical companies in the region which provide both program support and a demand for graduates.

All graduates of the Biotechnology program should be able to:

1. correctly apply scientific method to design a hypothesis and use the scientific method to answer a question; use basic analytical skills, including statistics, in the scientific process
   - Assessment methods: Biol 114 (quiz), Biol 112/112 (lecture), Biol 340/422 (hypotheses, lab experiments), Biol 430 (bacterial culture, exams and projects), Biol 495/496 (interpretation of literature, present a technical poster), Biol 437 (how the flu vaccine works), Biol 439 (DNA fingerprinting), Biol 411 (identification of genetically modified foods, DNA fingerprinting)

2. summarize, critically interpret, and present data in both mathematical and graphical formats
   - Assessment methods: Biol 111/112 (data collection, EKG lab), Biol 340 (statistical analysis of new antibiotic resistance lab), Biol 340/422 (graphing, basic statistical presentation, lab reports, using Excel in experiments), Biol 495/496 (read and interpret scientific literature, interpret graphs, tables, and figures, oral presentation), Biol 439 (DNA restriction digestion), Biol 416, 424 (calculate prevalence rates)

3. demonstrate knowledge and comprehension of core concepts which include, but are not limited to, biotechnology and its applications, genetics, microbiology, molecular biology, immunology, and biochemistry.
   - Assessment methods: coursework in Biol 437 (natural immunity), 430 (fermentation), internship (principles of diagnostic tests), Biol 424 (chemical carcinogens), Biol 439 (genetic mutations), Biol 411 (identification of genetically modified foods, DNA fingerprinting), Biol 439 (molecular biology)
4. demonstrate knowledge of basic principles, concepts and techniques of biotechnology which include, but are not limited to, techniques used in immunology, molecular biology, microbiology, and cell culture.
   - Assessment methods: Biol 114 (microscopy), Biol 340 (enzyme kinetics, respirometry, part of experimental reports), Biol 430 (chemical structure of DNA), Biol 430 (isolation, identification of bacteria), Biol 437 (natural immunity, detection of specific antibody in the serum), Biol 439 (genetic mutations, DNA amplification), Biol 380 (mammalian and plant cell culture techniques), Biol 411 and Biol 439 (Southern blot, cloning, and electrophoresis techniques, PCR, ELISA)

5. demonstrate proficiency in laboratory techniques essential to biotechnology which include, but are not limited to, SDS-Page, Western Blot, ELISA, PCR, DNA extraction and purification, Southern Blot, microorganisms identification, cell culture and aseptic techniques.
   - Assessment methods: Biol 340 (liquid handling, spectroscopy, electrode measurements), Biol 437 (ELISA techniques), Biol 380 (mammalian and plant cell culture techniques), Biol 411 and Biol 439 (Southern blot, cloning, and electrophoresis techniques, PCR, ELISA)

6. demonstrate the ability to recognize and relate the different levels of structure in biology from atoms through the biosphere.
   - Assessment methods: Biol 115, Biol 111 (all hierarchical levels)

7. demonstrate the ability to correlate structure with function at multiple levels.
   - Assessment methods: coursework Biol 114, 340/422 (presented at multiple levels), Biol 424

8. demonstrate the ability to recognize the hierarchy in the diversity of life and identify the characteristics of major lineages of organisms.
   - Assessment methods: Biol 114 and 115 (systematics and taxonomy)

9. knowledge of ethical principles regarding the use of biotechnology.
   - Assessment methods: Biol 340 (discussion of plagiarism, paper edits); Biol 437 (cloning of human tissues or organs for transplant), Bio 439 (ethics of patenting human genes), Biol 495 (debate the issue of genetically modified food, open discussion and team debates), Biol 281 (learn and discuss the ethical issues surrounding patents, GMO’s, and medical procedures)

10. demonstrate the ability to understand, analyze and evaluate original research literature and to communicate this understanding using appropriate technology.
    - Assessment methods: Bio 340/422 (lab reports, data retrieval from literature, research paper), Biol 495/496 (read, comprehend, orally present original data), Biol 281 (read, comprehend, orally present newest data on biotechnology research)

11. demonstrate the ability to clearly define questions or problems and develop comprehensive solutions individually and/or collaboratively.
- Assessment methods: Bio 340/422 (lab reports, data retrieval from literature, research paper), Biol 430 (communicate scientific findings through oral presentation of research paper), Biol 495/496 (read, comprehend, orally present original data, effectively target an audience)

12. demonstrate technical skills and knowledge required for success in obtaining employment or in pursuing graduate work in related fields of science.
- Assessment methods: Biol 340/422 (writing skills, calculation skills, editing, lab techniques), Biol 495/496 (oral presentations, clarity, professionalism), Biol 430, 439, 411 (proficiency with laboratory skills, research project, practical exam, internship)

**Medical Technology B. S. Program**

This degree program is designed for students who are preparing for careers in diagnostic laboratory medicine. It also prepares students for other roles in the health professions as well as the background necessary to pursue studies beyond the baccalaureate degree.

All graduates of the Medical Technology program should be able to:

1. correctly apply scientific method to design a hypothesis and use the scientific method to answer a question; use basic analytical skills, including statistics, in the scientific process
   - Assessment methods: Biol 114 (quiz), Biol 112/112 (lecture), Biol 495/496 (interpretation of literature, present a technical poster), Biol 330 (frequency testing of genotypes), Biol 437 (how the flu vaccine works), Biol 439 (DNA fingerprinting), Bio 424 (cell death by apoptosis), Biol 430 (bacterial culture)

2. summarize, critically interpret, and present data in both mathematical and graphical formats
   - Assessment methods: Biol 111/112 (data collection, EKG lab), Biol 495/496 (read and interpret scientific literature, interpret graphs, tables, figures), Biol 439 (DNA restriction digestion), Biol 416, 424 (calculate prevalence rates), Biol 430 (new antibiotic resistance lab)

3. demonstrate knowledge and comprehension of core concepts of human-related biology courses which include, but are not limited to, human anatomy and physiology, genetics, microbiology, molecular biology, immunology, and mechanisms of diseases.
   - Assessment methods: coursework in Biol 330 (bacterial metabolic processes), 331 (chemical structure of DNA), 437 (natural immunity), 430 (fermentation), internship (principles of diagnostic tests), Biol 424 (chemical carcinogens), Biol 416 (coevolution of humans and their parasites), Biol 439 (genetic mutations)

4. demonstrate knowledge of basic principles, concepts and techniques used in clinical laboratory which include, but are not limited to, immunology, molecular biology, microbiology, clinical chemistry and hematology.
   - Assessment methods: Biol 114 (microscopy), Biol 111/112 (microscopy, hematology), Biol 430 (chemical structure of DNA), Biol 330 (bacterial metabolic
pathways, gram stains), Biol 430 (fermentation, isolation, identification of bacteria), Biol 437 (natural immunity, detection of specific antibody in the serum), Biol 439 (genetic mutations), Biol 416 (IFA techniques), Biol 439 (DNA amplification), hospital internship (using PCR to detect MRSA)

5. demonstrate proficiency in laboratory techniques essential to medical technology.
   • Assessment methods: Biol 330 (aseptic techniques), Biol 437 (ELISA techniques), Biol 416 (microscopy)

6. demonstrate the ability to recognize and relate the different levels of structure in biology from atoms through the biosphere.
   • Assessment methods: Biol 111/112 (all hierarchical levels of structure presented throughout course)

7. demonstrate the ability to correlate human anatomical structure with function at multiple levels.
   • Assessment methods: coursework Biol 114, 111, (presented at multiple levels), Biol 424 (relate pathology to structural damage)

8. demonstrate knowledge of ethical principles regarding the work in clinical laboratory.
   • Assessment methods: Biol 331 (discussions of genetic testing), Biol 437 (cloning of human tissues or organs for transplant), Bio, 439 (ethics of patenting human genes), Biol 424 (ethical issues related to drug ads)

9. demonstrate mastery of technical skills and knowledge required for success in obtaining employment in clinical laboratory sciences or related fields.
   • Assessment methods: Biol 495/496 (oral presentations, clarity, professionalism), Biol 430, 437, 439, 416 (proficiency with laboratory skills), hospital internship (resume and job interviews at workshops and professional meetings)

**Marine Sciences B. S. Program**

The Marine Science Program is designed to train students to enter the workplace or graduate school in fields relating to ocean science. Majors are required to take several marine science core classes, seminars, and at least four field classes through the Marine Science Consortium at Wallops Island. The Consortium was established in 1968 to promote teaching and research in marine and environmental sciences. These goals are achieved by pooling faculty, staff, students, and other resources of the 12 member universities. The consortium provides the opportunity for undergraduates to obtain substantial field experience, while attending a university not directly along the coast. In addition, it allows student access to specialists from other universities who teach at Wallops Island through the consortium.

All graduates from the Marine Sciences Program should:
1. be able to demonstrate an understanding of how geologic and physical forces influence chemistry and biology in the oceans and how all aspects are fundamentally connected.
   - Assessment methods: coursework in Introduction to Oceanography (lab on Coriolis forces, geostrophic Flow, quiz on ocean currents, lectures on thermodynamics in the ocean)

2. understand how oceanographic technologies are used in marine research.
   - Assessment methods: coursework in Marine Ecology (field exercises), Field Methods in Oceanography, Biological Oceanography

3. understand the fundamental differences of living in water compared to living on land and how these differences influence many aspects of ocean life.
   - Assessment methods: coursework in Marine Ecology (biodiversity lab)

4. recognize the diversity of marine life and the evolutionary relationships between major marine groups.
   - Assessment methods: coursework in Marine Biology (all labs), Marine Evolutionary Ecology, Marine Animal Behavior

5. be prepared to compete for jobs related to marine sciences or to perform well in graduate school, if accepted.
   - Assessment methods: coursework in Investigations in Marine Science; creating resume and career planning exercises

6. be able to maintain organisms in aquaria and be familiar with various equipment for small-scale and commercial-scale aquaculture.
   - Assessment methods: coursework in Marine Aquaculture (all lab activities), Marine Ecology, and Marine Biology (labs requiring student projects in aquaria)

**Environmental Studies B. S. Program**

All graduates of the Environmental Studies Bachelor of Science program should be able to:

1. correctly apply the scientific method, design a hypothesis and use the scientific method to answer a question, use basic analytical skills, including statistics, in the scientific process
   - Assessment methods: coursework in Biol 484/494, Biol 114

2. recognize and relate the different levels of biological structure from atoms through the biosphere
   - Assessment methods: coursework in Biol 114, 115, Chem 121/123, 124/126, Phys 117/118

3. correlate structure with function at multiple levels
   - Assessment method: coursework in Biol 114, 115, Chem 121/123, 124/126, Phys 117/118
4. recognize the hierarchy in the diversity of life and identify the characteristics of major lineages of organisms
   • Assessment methods: coursework in Biol 114, 114, 210

5. understand evolutionary theory and its role as the unifying theme in the biological sciences
   • Assessment method: Biol 114

6. demonstrate knowledge and comprehension of tools to measure physical, chemical and biological parameters as needed in a work or research environment.
   • Assessment methods: students must demonstrate proficiency in field and laboratory techniques related to the above including but not exclusive of basic nutrient analysis, weather measurements, analysis of biological diversity including identification of organisms within the environment; knowledge of the overall effects of human activities on the functioning of ecosystems; knowledge of the function of watersheds and the relationship to anthropogenic activities within the watershed.
   • Coursework that provides these measurement tools includes Math 110 (statistics), General Chemistry I & 2 (Chem 121, 123, 124, 126), Environmental Quality Chemistry (Chem 373), Environmental Biology (Biol 210), a field biology option (Biol 200, 220 or 221), Plant Responses to Environmental Stress (Biol 322), Microbiology (Biol 330) and several of the upper level biology courses under the animal, plant and aquatic options.

7. demonstrate knowledge of basic principles in conservation as needed in a work or research environment.
   • Assessment method: this training is provided in Conservation Biology (Biol 463)

8. demonstrate the ability to research current scientific literature, summarize information on a particular topic, and present the current state of the science to an audience at the college level.
   • Assessment method: this training is provided in the ENVR Senior Seminar course (Biol 497), as well as in Biol 484, Biol 494, and the GE class CMST 111.

9. demonstrate “real-world” knowledge in their chosen subfield via an internship.
   • Assessment methods: All majors are required to arrange and complete an internship (Biol 484), typically taken during the summer between their junior and senior year. This internship is assessed in 4-parts: daily journal, bi-weekly report, final report and supervisor evaluation. Each component is worth 25% of the letter grade awarded.

10. demonstrate an interdisciplinary understanding of environmental studies that includes the interaction of biology, chemistry, physics, geography, policy and government.
    • Assessment methods: coursework that reinforces the primarily biology core includes those required in geography, American government, chemistry, physics, and other general education electives
11. obtain employment or enter graduate school with work related to environmental science
   • Assessment methods: Overall assessment of student success within the program should involve a graduation follow-up 12 months post-graduation as to the position or graduate school the student has acquired. Follow-ups could also be administered three and five year after graduation.