

BIOTECHNOLOGY

Biotechnology is an interdisciplinary field that uses a combination of biology and technology to design and produce new molecules, plants, animals and microorganisms with improved characteristics. Biotechnology offers seemingly unlimited opportunities to combine genes from related or unrelated species to produce useful organisms with desirable properties that were not previously found in nature.

Background

Biotechnology may be thought of as a collection of technologies using animal and/or plant cells, biological molecules, molecular biology processes and genetic engineering for applications in medicine, agriculture and the pharmaceutical industry. The technologies include the use of recombinant DNA for gene cloning and gene transfers between organisms; culture of plant and animal cells and tissues; fusion of animal cells or plant protoplast; the regeneration of whole plants from single cells and the large-scale fermentation processes that use some of these novel organisms for the production of pharmaceuticals, diagnostic tests for diseases, feed additives, enzymes and hormones.

Examples of successful biotechnology include the development of crop plants that are resistant to herbicides or insects, the production of human growth hormone and insulin by genetically engineered bacteria and the development of unique vaccines.

The Program and Curriculum

The biotechnology program is offered through both the College of Agriculture, Food Systems, and Natural Resources and the College of Science and Mathematics and leads to a Bachelor of Science degree.

The recommended course of study includes both the education in science and mathematics, as well as introduction to the special skills that are needed to enter the rapidly expanding and changing field of biotechnology. In addition to the required courses, students may select from a variety of specialized elective science courses to help develop a particular area of interest. Students majoring in biotechnology are required to perform a research project in the laboratory of a faculty advisor. The results of the research project are incorporated into a senior thesis and presented at the Biotechnology Seminar.

Biotechnology students must maintain at least a 2.5 overall grade point average (GPA) after 60 credits in order to remain in the program.

The Faculty and Facilities

A faculty advisor is assigned to each student to assist in scheduling, registration and career development. Faculty in each of the cooperating life-science departments have been identified to serve as academic and research advisors for students who select the biotechnology major. The faculty advisor and the director of the biotechnology program regularly review the progress of each student.

The faculty who advise, teach and serve as research mentors for the biotechnology program are spread among several academic

departments in the College of Agriculture, Food Systems, and Natural Resources, the College of Science and Mathematics and the College of Health Professions. The departments include plant sciences; biological sciences, biology, chemistry, biochemistry and molecular biology; animal and range sciences; plant pathology; veterinary and microbiological sciences; and pharmaceutical sciences. Several scientists at the North Dakota State University Center for Nanoscale Science and Engineering and at the on-campus USDA facilities also serve as research mentors.

Laboratory facilities and specialized equipment are used for instruction and research. These include animal and plant tissue culture facilities, small animal housing, electron and confocal microscopes, automated DNA sequencing equipment, equipment for performing microarray experiments, and NDSU Core Labs. The Core Labs are shared cutting-edge research facilities and include the Advanced Imaging and Microscopy Core, Core Biology Facility, Core Synthesis and Analytical Services and the Electron Microscopy Core Laboratory, among many other state-of-the-art facilities and equipment.

Career Opportunities

Biotechnology continues to rapidly develop into new research areas. Surveys indicate there will be a continuing high demand for well-educated personnel. Job opportunities are found in life science departments in colleges and universities; private and government research institutes; food production, pharmaceutical and agri-chemical industries; and in the biotechnology industries. Graduates of this program have the educational background and laboratory experience to take advantage of any of these job opportunities. Graduates of the biotechnology program are now successful and productive scientists at pharmaceutical, agri-chemical and biotechnology companies, and at government and private research institutions throughout the country.

The majority (approximately 60 percent) of graduates from the biotechnology program choose to continue their education in graduate or professional schools. Graduates of the biotechnology program have earned master's and doctoral degrees in many diverse areas, including cellular and molecular biology, biology, microbiology, plant sciences, animal physiology, cancer biology and virology at many of the most respected universities in the United States. Graduates of our program are now established and productive professors, physicians and veterinarians.

High School Preparation

Students entering the biotechnology program should have a strong background in mathematics, including trigonometry, biology, chemistry, physics, writing and computer courses. A composite ACT score of 26 or higher is recommended.

Biotechnology Sample Curriculum

Please note this is a sample plan of study; actual student schedules will vary depending on start year, individual goals, applicable transfer credit, and course availability. Students are encouraged to work with their academic advisor on a regular basis to review degree progress and customize their own plan of study.

General Education Requirements	Credits
Communication	12
COMM 110 Fundamentals of Public Speaking	
ENGL 110 College Composition I	
ENGL 120 College Composition II	
Upper Division Writing	
Quantitative Reasoning	
STAT 330 Introductory Statistics	3
Science & Technology	
CHEM 121, 121L General Chemistry I and Lab	4
CHEM 122, 122L General Chemistry II and Lab	4
PHYS 211, 211L College Physics I and Lab or PHYS 251, 251L University Physics I and Lab	4
Humanities & Fine Arts	6
Social & Behavioral Sciences	6
Wellness	2
Cultural Diversity	-
Global Perspective	-
TOTAL	39
Major Requirements	
<u>Biotechnology Requirements:</u>	
BIOC 460, 460L Foundations of Biochemistry and Molecular Biology I and Lab	4
BIOC 461 Foundations of Biochemistry and Molecular Biology II	3
BIOC 474 Methods in Recombinant DNA Technology	3
CHEM 465 Survey of Physical Chemistry	4
MICR 350, 350L General Microbiology and Lab	5
MICR 470 Basic Immunology	3
MICR 471 Immunology and Serology Lab	2
MICR 482 Bacterial Genetics and Phage	3
MICR 491 Seminar Biotechnology	1-5
MICR 494 Individual Study (Senior Research)	2-4
MICR 494 Individual Study (Senior Thesis)	1
<u>Supporting Requirements:</u>	
AGRI 150 Agriculture Orientation	1
AGRI 189 Skills for Academic Success	1
BIOL 150, 150L General Biology I and Lab	4
BIOL 151, 151L General Biology II and Lab	4
CHEM 121, 121L General Chemistry I and Lab	4
CHEM 122, 122L General Chemistry II and Lab	4
CHEM 341, 341L Organic Chemistry I and Lab	4
CHEM 342 Organic Chemistry II	3
CSCI 114 Microcomputer Packages or CSCI 122 Introduction to Programming Concepts	3
PLSC 315, 315L Genetics and Lab	4
STAT 330 Introductory Statistics	3
<u>Select one pair from each of the following:</u>	
MATH 146, 147 Applied Calculus I and Applied Calculus II or MATH 165, 166 Calculus I and Calculus II	8
PHYS 211, 211L College Physics I and Lab or PHYS 251, 251L University Physics I and Lab	4 or 5
PHYS 212, 212L College Physics II and Lab or PHYS 252, 252L University Physics II and Lab	4 or 5
<u>Major Elective in Physiology - Select 3 credits from the following:</u>	
BOT 380 Plant Physiology or MICR 480 Bacterial Physiology or ZOO 460 Animal Physiology	3
TOTAL	85-93
Additional Requirements as required from either the College of AFSNR or the College of Science and Mathematics.	
Additional Arts, Humanities and Social Science Electives	6
Electives needed to reach 120 credits for degree	variable
Minimum Degree Credits to Graduate	120

View NDSU equivalencies of transfer courses at: www.ndsu.edu/transfer/equivalencies

For Further Information

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