

# BIOTECHNOLOGY MAJOR (B.S.)

<https://manchester.unh.edu/program/bs/biotechnology-major>

## Description

Biotechnology is the use of living organisms, biological systems, and small chemicals and biomolecules in technology. Biotechnology has applications in the treatment of diseases, the production of food, the protection of ecosystems, and the generation of energy, as well as in the basic science study of many biological questions.

The B.S. in biotechnology at UNH Manchester is designed to:

1. allow students to earn a baccalaureate degree in biotechnology at UNH;
2. allow students to combine study in biotechnology with other programs and disciplines by completing a minor, or a self-designed set of elective courses along with their biotechnology degree;
3. provide an opportunity for students to complete a baccalaureate degree in biology while preparing to pursue a Master's degree in biology, biotechnology, or other fields. These degree programs could be undertaken after completion of the B.A. Alternatively, UNH offers several accelerated Master's programs where excellent senior students in the Biological Sciences major can complete coursework towards their undergraduate and graduate degrees at the same time;
4. allow students to complete a major in biotechnology while taking required courses in education in preparation for the five-year M.A.T. or M.Ed. programs and state certification in secondary science education; or alternative state certification pathway;
5. provide an opportunity for students to complete a baccalaureate degree in biotechnology while completing the required courses for admission to medical, dental, veterinary, physician assistant, pharmacy, physical therapy, optometry, and other professional or graduate programs.
6. allow students to complete a baccalaureate degree in biotechnology while completing the required courses for admission to graduate research programs (M.S. or Ph.D.) in the life sciences and related fields.

Employment opportunities in the public and private sectors include biotechnology research, development, and manufacturing; education; research laboratories; clinical laboratories; forensic laboratories; jobs in diverse areas from research to quality control to sales in the pharmaceutical industry; industrial positions in the food industry; water and wastewater laboratories and facilities; and environmental research and monitoring.

## Requirements

Students must complete a minimum of 128 credits and satisfy the University's Discovery Program and writing requirement. Each course required in the major must be completed with a minimum grade of C-. Students must attain a minimum GPA in the major of 2.0. Transfer students must complete at least 24 credits in the major at UNH.

BIOL 413 Principles of Biology I, BIOL 414 Principles of Biology II can be used to satisfy the biological sciences Discovery requirement

and CHEM 403 General Chemistry I, CHEM 404 General Chemistry II may be used to satisfy the Physical Sciences Discovery requirement. PSYC 402 Statistics in Psychology or MATH 424B Calculus for Life Sciences/MATH 425 Calculus I may be used to satisfy the Quantitative Reasoning Discovery requirement.

The UNH Manchester B.S. in biotechnology program is structured with three levels of coursework.

Code	Title	Credits
<b>Core Courses</b>		
BIOL 411 or BIOL 413	Introductory Biology: Molecular and Cellular Principles of Biology I	4
BIOL 412 or BIOL 414	Introductory Biology: Evolution, Biodiversity and Ecology Principles of Biology II	4
BIOT 501	Ethical Issues in Biology	4
BMCB 658 & BMCB 659	General Biochemistry and General Biochemistry Lab	5
BMS 503 & BMS 504	General Microbiology and General Microbiology Laboratory	5
CHEM 403 & CHEM 404	General Chemistry I and General Chemistry II	8
CHEM 651 & CHEM 653	Organic Chemistry I and Organic Chemistry Laboratory	5
CHEM 652 & CHEM 654	Organic Chemistry II and Organic Chemistry Laboratory	5
GEN 604	Principles of Genetics	4
MATH 424B or MATH 425	Calculus for Life Sciences Calculus I	4
PHYS 401 or PHYS 407	Introduction to Physics I General Physics I	4
PSYC 402	Statistics in Psychology	4
<b>Advanced Biology Courses (600/700 level)</b>		
Select five courses (at least one course from each of the three categories)		20
<b>I. Advanced Biology courses</b>		
BMS 702	Endocrinology	
BMS 705 or BMS 705 & BMS 715	Immunology <sup>1</sup> Immunology and Immunology Laboratory	
BSCI 620	Global Science Exploration	
BSCI 670	Clinical Pathophysiology	
BSCI 680	Pharmacology	
BSCI 692	Evolutionary Medicine	
BSCI 695	Exploring Biology Teaching (1-4 credits)	
BSCI #735	Cell Biology	
BSCI 750	Cancer Biology: From Benchtop Research to Therapeutic Interventions	
GEN 711 or GEN 711W	Genomics and Bioinformatics Genomics and Bioinformatics	
GEN 714	Personal Genomics	
GEN 771	Molecular Genetics	
<b>II. Laboratory Techniques courses</b>		
BIOT 765	Nucleic Acid Techniques	
BIOT 766	Protein and Immunologic Techniques	
BIOT 777	Molecular Biology and Biotechnology	
BMCB 753	Cell Culture	
CHE 651	Biotech Experience/Bio manufacturing (BTEC 220 GBCC)	
GEN 774	Techniques in Plant Genetic Engineering and Biotechnology	
ZOOL 625 & ZOOL 626	Principles of Animal Physiology and Animal Physiology Laboratory	
<b>III. Advanced Microbiology courses</b>		
BIOT 747	Industrial Microbiology and Fermentation	
BMS #601	Bacteriology of Food	
BMS 602 & BMS 603	Pathogenic Microbiology and Pathogenic Microbiology Laboratory	
BMS 706 & BMS 708	Virology and Virology Laboratory	
BSCI 737	Microbial Genomics	

BSCI 740	Aquatic Microbiology	
<b>Total Credits</b>		76

<sup>1</sup> BMS 705 Immunology, may optionally be taken with or without BMS 715 Immunology Laboratory.

Depending on their specific academic and career goals and in consultation with their advisor, students may elect to take additional supporting science courses and a full year of physics (e.g., take PHYS 402 Introduction to Physics II in addition to PHYS 401 Introduction to Physics I; or PHYS 408 General Physics II in addition to PHYS 407 General Physics I). These courses are often required for admission to medical, veterinary, and other professional and graduate programs.

Code	Title	Credits
<b>Capstone Experience</b>		
BSCI 701	Senior Seminar I (during either semester of the senior year)	1
Select a capstone experience:		4
BSCI 792	Research	
BSCI 793	Internship	
BSCI #794	Clinical Microbiology Internship	
BSCI 795	Independent Study	
<b>Total Credits</b>		5

BSCI 701 Senior Seminar I will meet weekly during either semester of the senior year in a seminar format. Students will share information about capstone experiences, listen to presentations on timely issues in biology, develop career preparation skills, and receive training in poster production. Other methods of oral presentation and scientific writing are explored as students prepare to present the results of their capstone activities at the Undergraduate Research Conference or other venues.

In addition, all students will take elective courses to fulfill the 128-credit requirement for a B.S. degree. These elective courses could fulfill the requirements for a major or minor in another program or they could fulfill a self-designed interdisciplinary concentration. These courses would be selected in consultation with the advisor and the appropriate faculty advisor in another program.

For more information, contact [Kyle MacLea \(Kyle.MacLea@unh.edu\)](mailto:Kyle.MacLea@unh.edu), program coordinator, or the [Office of Admissions \(unhm.admissions@unh.edu\)](mailto:unhm.admissions@unh.edu), (603) 641-4150.

## Degree Plan

### Sample Course Sequence

Course	Title	Credits
<b>First Year</b>		
<b>Fall</b>		
BIOL 413	Principles of Biology I	4
CHEM 403	General Chemistry I	4
ENGL 401	First-Year Writing	4
MATH 425	Calculus I	4
UMST 401	First Year Seminar	1
<b>Credits</b>		<b>17</b>
<b>Spring</b>		
BIOL 414	Principles of Biology II	4
CHEM 404	General Chemistry II	4
PSYC 402	Statistics in Psychology	4

Discovery Course	4
<b>Credits</b>	<b>16</b>

#### Second Year

<b>Fall</b>		
BIOT 501	Ethical Issues in Biology	4
CHEM 651 & CHEM 653	Organic Chemistry I and Organic Chemistry Laboratory	5
Discovery Course		4
Discovery Course		4
<b>Credits</b>		<b>17</b>

#### Spring

BMS 503 & BMS 504	General Microbiology and General Microbiology Laboratory	5
CHEM 652 & CHEM 654	Organic Chemistry II and Organic Chemistry Laboratory	5
GEN 604	Principles of Genetics	4
Discovery Course		4
<b>Credits</b>		<b>18</b>

#### Third Year

<b>Fall</b>		
600/700 Biotechnology Concentration		4
PHYS 401	Introduction to Physics I	4
Discovery Course		4
Elective Course		4
<b>Credits</b>		<b>16</b>

#### Spring

600/700 Biotechnology Concentration		4
BMCB 658 & BMCB 659	General Biochemistry and General Biochemistry Lab	5
Discovery Course		4
Elective Course		4
<b>Credits</b>		<b>17</b>

#### Fourth Year

<b>Fall</b>		
600/700 Biotechnology Concentration		4
600/700 Biotechnology Concentration		4
Capstone		4
Elective Course		4
<b>Credits</b>		<b>16</b>

#### Spring

600/700 Biotechnology Concentration		4
BSCI 701	Senior Seminar I	1
Elective Course		4
Elective Course		4
<b>Credits</b>		<b>13</b>
<b>Total Credits</b>		<b>130</b>

## Student Learning Outcomes

A student successfully completing the Biotechnology program will be able to:

- Understand the fundamentals of basic biological principles, concepts, and theories.
- Demonstrate the ability to evaluate, apply, and synthesize biological information and ideas.
- Be competent in basic biology and chemistry laboratory skills and with the use of common laboratory equipment and instrumentation.
- Be competent in advanced laboratory techniques and microbiological methods.
- Understand the professional and ethical responsibilities involved with current and emerging topics in biology.
- Demonstrate the ability to communicate technical information related to biological sciences and biotechnology related topics in scientific writing and oral presentations.
- Understand, analyze, and evaluate primary research literature involving biological sciences and biotechnology related topics.
- Understand and apply the process of the scientific method, including being able to formulate hypotheses, design and conduct experiments with adequate controls to test hypotheses, interpret and evaluate data, and draw conclusions.
- Gather, analyze, organize, evaluate, and present scientific data, including the use of technology to solve problems and communicate information.
- Demonstrate the ability to function as a member of a team.
- Understand current and emerging topics in biotechnology.
- Compete effectively for entry-level biotechnology industry employment and for admission to graduate or professional schools in their chosen area and be successful in these endeavors.