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:

• allow students to earn a baccalaureate degree in biotechnology at UNH;
• 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;
• 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;
• allow students to complete a major in biotechnology while taking required courses in education for the five-year M.A.T. or M.Ed. programs and state certification in secondary science education; or alternative state certification pathway;
• 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.
• 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 jobs in diverse areas from research to quality control to sales in the pharmaceutical industry; clinical laboratories; forensic laboratories; biotechnology research, development, and manufacturing; education; or alternative state certification pathway.

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

Requirements

Degree Requirements

Minimum Credit Requirement: 128 credits

Minimum Residency Requirement: 32 credits must be taken at UNH

Minimum GPA: 2.0 required for conferral*

Core Curriculum Required: Discovery & Writing Program Requirements

Foreign Language Requirement: No

All Major, Option and Elective Requirements as indicated.

Major 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.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 411</td>
<td>Introductory Biology Molecular and Cellular</td>
<td>4</td>
</tr>
<tr>
<td>or BIOL 413</td>
<td>Principles of Biology I</td>
<td></td>
</tr>
<tr>
<td>BIOL 412</td>
<td>Introductory Biology Evolution, Biodiversity and Ecology</td>
<td>4</td>
</tr>
<tr>
<td>or BIOL 414</td>
<td>Principles of Biology II</td>
<td></td>
</tr>
<tr>
<td>BIOT 501</td>
<td>Ethical Issues in Biology</td>
<td>4</td>
</tr>
<tr>
<td>BMCB 658</td>
<td>General Microbiology</td>
<td>5</td>
</tr>
<tr>
<td>&amp; BMCB 659</td>
<td>and General Microbiology Lab</td>
<td></td>
</tr>
<tr>
<td>BMES 503</td>
<td>General Microbiology</td>
<td>5</td>
</tr>
<tr>
<td>&amp; BMES 504</td>
<td>and General Biochemistry Lab</td>
<td></td>
</tr>
<tr>
<td>CHEM 403</td>
<td>General Chemistry I</td>
<td>8</td>
</tr>
<tr>
<td>&amp; CHEM 404</td>
<td>and General Chemistry II</td>
<td></td>
</tr>
<tr>
<td>CHEM 651</td>
<td>Organic Chemistry I</td>
<td>5</td>
</tr>
<tr>
<td>&amp; CHEM 653</td>
<td>and Organic Chemistry Laboratory</td>
<td></td>
</tr>
<tr>
<td>CHEM 652</td>
<td>Organic Chemistry II</td>
<td>5</td>
</tr>
<tr>
<td>&amp; CHEM 654</td>
<td>and Organic Chemistry Laboratory</td>
<td></td>
</tr>
<tr>
<td>GEN 604</td>
<td>Principles of Genetics</td>
<td>4</td>
</tr>
<tr>
<td>MATH 424B</td>
<td>Calculus for Life Sciences</td>
<td>4</td>
</tr>
<tr>
<td>or MATH 425</td>
<td>Calculus I</td>
<td></td>
</tr>
<tr>
<td>PHYS 401</td>
<td>Introduction to Physics</td>
<td>4</td>
</tr>
<tr>
<td>or PHYS 407</td>
<td>General Physics I</td>
<td></td>
</tr>
<tr>
<td>PSYC 402</td>
<td>Statistics in Psychology</td>
<td>4</td>
</tr>
</tbody>
</table>

Advanced Biology Courses (600/700 level)

Select five courses (at least one course from each of the three categories) 20

1. Advanced Biology courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMES 702</td>
<td>Endocrinology</td>
</tr>
<tr>
<td>BMES 705</td>
<td>Immunology</td>
</tr>
<tr>
<td>or BMES 705</td>
<td>Immunology</td>
</tr>
<tr>
<td>&amp; BMES 715</td>
<td>and Immunology Laboratory</td>
</tr>
<tr>
<td>BSCI 620</td>
<td>Global Science Exploration</td>
</tr>
<tr>
<td>BSCI 670</td>
<td>Clinical Pathophysiology</td>
</tr>
<tr>
<td>BSCI 680</td>
<td>Pharmacology</td>
</tr>
<tr>
<td>BSCI 692</td>
<td>Evolutionary Medicine</td>
</tr>
<tr>
<td>BSCI 695</td>
<td>Exploring Biology Teaching (1-4 credits)</td>
</tr>
<tr>
<td>BSCI 735</td>
<td>Cell Biology</td>
</tr>
<tr>
<td>BSCI 750</td>
<td>Cancer Biology From Benchtop Research to Therapeutic Interventions</td>
</tr>
<tr>
<td>GEN 711</td>
<td>Genomics and Bioinformatics</td>
</tr>
<tr>
<td>or GEN 711W</td>
<td>Genomics and Bioinformatics</td>
</tr>
<tr>
<td>GEN 714</td>
<td>Personal Genomics</td>
</tr>
</tbody>
</table>
### II. Laboratory Techniques courses

- **BIOT 765**  
  Nucleic Acid Techniques  
  GEN 774  
  Techniques in Plant Genetic Engineering and Biotechnology  
- **BIOT 766**  
  Protein and Immunologic Techniques  
  ZOOL 625  
  Principles of Animal Physiology  
  &  
  ZOOL 626W  
  Animal Physiology Laboratory  
- **BIOT 777**  
  Molecular Biology and Biotechnology  
  BMCB 753  
  Cell Culture  
- **CHBE 651**  
  Biotech Experience/Biomanufacturing (BTEC 220 GBCC)  
- **GEN 774**  
  Techniques in Plant Genetic Engineering and Biotechnology  
- **GEN 777**  
  Molecular Biology and Biotechnology  
- **BMCB 753**  
  Cell Culture  
- **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.

### III. Advanced Microbiology courses

- **BMS 602**  
  Pathogenic Microbiology  
  &  
  BMS 603  
  Pathogenic Microbiology Laboratory  
- **BMS 705**  
  Immunology  
  &  
  BMS 708  
  Virology  
  &  
  Virology Laboratory  
- **BSCI 737**  
  Microbial Genomics  
- **BSCI 740**  
  Aquatic Microbiology  
- **BSCI 792**  
  Research  
- **BSCI 793**  
  Internship  
- **BSCI 794**  
  Clinical Microbiology Internship  
- **BSCI 795**  
  Independent Study

**Total Credits:** 76

---

1 BMS 705 Immunology, may optionally be taken with or without BMS 715 Immunology Laboratory.

---

**Capstone Experience**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BSCI 701</td>
<td>Senior Seminar I (during either semester of the senior year)</td>
<td>1</td>
</tr>
</tbody>
</table>

Select a capstone experience:

- BSCI 792 Research  
- BSCI 793 Internship  
- BSCI 794 Clinical Microbiology Internship  
- BSCI 795 Independent Study

**Total Credits:** 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 their advisor.

## Degree Plan

### Sample Course Sequence

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First Year</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fall</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIOL 413</td>
<td>Principles of Biology I</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 403</td>
<td>General Chemistry I</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 401</td>
<td>First-Year Writing</td>
<td>4</td>
</tr>
<tr>
<td>MATH 425</td>
<td>Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>UMST 401</td>
<td>First Year Seminar</td>
<td>1</td>
</tr>
</tbody>
</table>

**Credits:** 17

### Spring

- **BIOL 414** Principles of Biology II  
- **CHEM 404** General Chemistry II  
- **PSYC 402** Statistics in Psychology  
- **Discovery Course**  

**Credits:** 4

---

**Second Year**

### Fall

- **BIOT 501** Ethical Issues in Biology  
- **CHEM 651** Organic Chemistry I  
  &  
  CHEM 653  
  and Organic Chemistry Laboratory  
- **Discovery Course**  
- **Discovery Course**  

**Credits:** 17

### Spring

- **BMS 503** General Microbiology  
  &  
  BMS 504  
  and General Microbiology Laboratory  
- **CHEM 652** Organic Chemistry II  
  &  
  CHEM 654  
  and Organic Chemistry Laboratory  
- **GEN 604** Principles of Genetics  
- **Discovery Course**  

**Credits:** 4

---

**Third Year**

### Fall

- **600/700 Biotechnology Concentration**  
- **PHYS 401** Introduction to Physics I  
- **Discovery Course**  
- **Elective Course**  

**Credits:** 16

### Spring

- **600/700 Biotechnology Concentration**  
- **BMCB 658** General Biochemistry  
  &  
  BMCB 659  
  and General Biochemistry Lab  
- **Discovery Course**  
- **Elective Course**  

**Credits:** 4

---

**Fourth Year**

### Fall

- **600/700 Biotechnology Concentration**  
- **600/700 Biotechnology Concentration**  
- **Capstone**  
- **Elective Course**  

**Credits:** 16

### Spring

- **600/700 Biotechnology Concentration**  
- **BSCI 701** Senior Seminar I  
- **Elective Course**  

**Credits:** 4

---
Elective Course


Credits


Total Credits


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.