Microbiology (BS): Microbial Research Concentration

Microbiology is concerned with the growth and development, physiology, classification, ecology, genetics, and other aspects of the life process of an array of microscopic, generally single-celled, organisms and viruses. These organisms frequently serve as model systems for elucidation of fundamental processes that are common to all living cells. Most of the major discoveries that have produced spectacular advances in biology and genomic science during the past decade have resulted from studies of microbial systems. Future developments in biotechnology, production of food and fuel, and human and animal health will rely heavily on understanding microbial processes.

There are 4 avenues to earning a B.S. in Microbiology. Students can opt for a general curriculum (MBIO) or can choose to focus in a particular area by selecting one of three areas of concentration: Microbial Biotechnology (MBIO-MT) or Microbial Research (MBIO-MR) or Microbial Health Sciences (MBIO-HS). These concentrations mirror the three most common career paths of Microbiology majors: work in research laboratories and production facilities, further study in graduate school (at the Masters or Doctoral level), and further study in professional schools such as medical and dental schools.

Plan Requirements

Code	Title	Hours
Orientation		
LSC 103	Exploring Opportunities in the Life Sciences	1
or ENV 100	Student Success in Environmental First Year	
Scientific Communication		
ENG 333	Communication for Science and Research [1]	3
Mathematical Sciences		
MA 131	Calculus for Life and Management Sciences A [1]	3
or MA 141	Calculus I	
ST 311	Introduction to Statistics [1]	3
or ST 371	Introduction to Probability and Distribution Theory	
Natural and Physical Sciences		
CH 101 & CH 102	Chemistry - A Molecular Science and General Chemistry Laboratory [2]	4
CH 201 & CH 202	Chemistry - A Quantitative Science and Quantitative Chemistry Laboratory [2]	4
CH 221 & CH 222	Organic Chemistry I and Organic Chemistry I Lab [2]	4
CH 223 & CH 224	Organic Chemistry II and Organic Chemistry II Lab [2]	4
BIO 181	Introductory Biology: Ecology, Evolution, and Biodiversity [1]	4
BIO 183	Introductory Biology: Cellular and Molecular Biology [1]	4
Select one of the following: [2]		4
PY 201	University Physics I	
PY 205 & PY 206	Physics for Engineers and Scientists I and Physics for Engineers and Scientists I Laboratory	
PY 211	College Physics I	
Select one of the following: [2]		4
PY 202	University Physics II	
PY 208 & PY 209	Physics for Engineers and Scientists II and Physics for Engineers and Scientists II Laboratory	
PY 212	College Physics II	
Major Requirements		
LSC 101	Critical and Creative Thinking in the Life Sciences [1]	2
or ENV 101	Exploring the Environment	
MB 251	General Microbiology [1]	3
MB 254	Inquiry-Guided Microbiology Lab [1]	1
MB 311	Medical Microbiology [1]	3
MB 312	Medical Microbiology Laboratory [1]	1
MB 360	Scientific Inquiry in Microbiology: At the Bench [1]	3
MB 414	Microbial Metabolic Regulation [1]	3
MB 451	Microbial Diversity [1]	3
MB 452	Microbial Diversity Lab [1]	2
MB 480	Current Issues in Microbiology [1]	1
GN 311	Principles of Genetics [1]	4
BCH 451	Principles of Biochemistry [1]	4
Gene Expression [1]		3
BCH 453/553	Biochemistry of Gene Expression	
GN 421/521	Molecular Genetics	
Cell/Physiology [1]		3
BIO 240	Principles of Human Anatomy & Physiology (A): Nervous, Skeletal, Muscular, & Digestive Systems	
BIO 245	Principles of Human Anatomy & Physiology (B): Endocrine, Cardiovascular, Respiratory & Renal Systems	
BIO 414	Cell Biology	
BIO 416	Cancer Cell Biology	
PB 421	Plant Physiology	
Laboratory Elective (p. 2) [1]		3
Microbial Research Electives:		12
BSC 492	Professional Experience	
BSC 493	Research Experience	
GEP Courses		
ENG 101	Academic Writing and Research [1]	4
GEP Humanities (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-humanities/)		6
GEP Social Sciences (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-social-sciences/)		6
GEP Health and Exercise Studies (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/)		2
GEP Elective (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/)		3

GEP Interdisciplinary Perspectives (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-interdisciplinary-perspectives/)	3
GEP Global Knowledge (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-global-knowledge/) (verify requirement)	
GEP Foundations of American Democracy (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-fad/) (verify requirement)	
World Language Proficiency (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/world-language-proficiency/) (verify requirement)	
Free Electives	
Free Electives (12 Hr S/U Lmt) [2]	3
Total Hours	**120**

[1] A grade of C- or higher is required.

[2] At most one passing grade below C- is permitted in these natural sciences courses

Laboratory Elective

Code	Title	Hours
BBS/BEC 426	Upstream Biomanufacturing Laboratory	2
BCH 452	Introductory Biochemistry Laboratory	2
BEC 436	Introduction to Downstream Process Development	2
BEC 462	Fundamentals of Bio-Nanotechnology	3
BEC 463	Fermentation of Recombinant Microorganisms	2
BEC 480	cGMP Fermentation Operations	2
BEC 483		2
BEC 485	cGMP Downstream Operations	2
BEC 488	Animal Cell Culture Engineering	2
BEC 495	Special Topics in Biomanufacturing	1-4
BEC 497	Biomanufacturing Research Projects	1-3
BIO 418	Cell Biology Research Lab	2
BIT 410	Manipulation of Recombinant DNA	4
BIT 463	Fermentation of Recombinant Microorganisms	2
BIT 464	Protein Purification	2
BIT 465	Real-time PCR Techniques	2
BIT 466	Animal Cell Culture Techniques	2
BIT 467	PCR and DNA Fingerprinting	2
BIT 471	RNA Interference and Model Organisms	2
BIT 473	Protein Interactions	2
BIT 474	Plant Genetic Engineering	2
BIT 476	Applied Bioinformatics	2
BIT 477	Metagenomics	2
BIT 479	High-Throughput Discovery	2
BIT 480	Yeast Metabolic Engineering	2
BIT 481	Plant Tissue Culture and Transformation	2
BIT 492	External Learning Experience	1-6
BIT 493	Special Problems in Biotechnology	1-6
BIT 495	Special Topics in Biotechnology	1-3
BME 483	Tissue Engineering Technologies	2
CHE 462	Fundamentals of Bio-Nanotechnology	3
CHE 463	Fermentation of Recombinant Microorganisms	2
CHE 488	Animal Cell Culture Engineering	2
FS 426	Upstream Biomanufacturing Laboratory	2
GN 312	Elementary Genetics Laboratory	1
MB 360	Scientific Inquiry in Microbiology: At the Bench	3
MB 420	Fundamentals of Microbial Cell Biotransformations	2
PB 481	Plant Tissue Culture and Transformation	2
PO 466	Animal Cell Culture Techniques	2

Semester Sequence

This is a sample.

First Year		
Fall Semester		**Hours**
BIO 181	Introductory Biology: Ecology, Evolution, and Biodiversity [1]	4
CH 101 & CH 102	Chemistry - A Molecular Science and General Chemistry Laboratory [2]	4
LSC 101	Critical and Creative Thinking in the Life Sciences [1]	2
MA 131	Calculus for Life and Management Sciences A [1]	3
MB 103	Introductory Topics in Microbiology	1
GEP Health and Exercise Studies (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/)		1
	Hours	**15**
Spring Semester		
BIO 183	Introductory Biology: Cellular and Molecular Biology [1]	4
CH 221 & CH 222	Organic Chemistry I and Organic Chemistry I Lab [2]	4
CH 222	Organic Chemistry I Lab [2]	1
ENG 101	Academic Writing and Research	4
GEP Social Sciences (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-social-sciences/)		3
	Hours	**16**
Second Year		
Fall Semester		
CH 223 & CH 224	Organic Chemistry II and Organic Chemistry II Lab [2]	4
PY 211	College Physics I [2]	4
GEP Social Sciences (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-social-sciences/)		3
MB 251	General Microbiology [1]	3
MB 254	Inquiry-Guided Microbiology Lab [1]	1
	Hours	**15**
Spring Semester		
CH 201 & CH 202	Chemistry - A Quantitative Science and Quantitative Chemistry Laboratory [2]	4
PY 212	College Physics II [2]	4
MB 360	Scientific Inquiry in Microbiology: At the Bench [1]	3
MB 311	Medical Microbiology [1]	3

MB 312	Medical Microbiology Laboratory [1]	1
	Hours	**15**
Third Year		
Fall Semester		
ENG 333	Communication for Science and Research	3
GN 311	Principles of Genetics [1]	4
ST 311	Introduction to Statistics	3
BSC 492 or BSC 493	Professional Experience [1] or Research Experience	3
GEP Health and Exercise Studies (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/)		1
	Hours	**14**
Spring Semester		
Cell/Physiology Elective [1]		3
BCH 451	Principles of Biochemistry [1]	4
Laboratory Elective (p. 2) [1]		3
GEP Elective (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/)		3
BSC 492 or BSC 493	Professional Experience [1] or Research Experience	3
	Hours	**16**
Fourth Year		
Fall Semester		
MB 414	Microbial Metabolic Regulation [1]	3
BSC 492 or BSC 493	Professional Experience [1] or Research Experience	3
MB 480	Current Issues in Microbiology [1]	1
GEP Humanities (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-humanities/)		3
MB 451 & MB 452	Microbial Diversity and Microbial Diversity Lab [1]	4
	Hours	**14**
Spring Semester		
Gene Expression Elective [1]		3
BSC 492 or BSC 493	Professional Experience [1] or Research Experience	3
GEP Interdisciplinary Perspectives (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-interdisciplinary-perspectives/)		3
Free Elective		3
GEP Humanities (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-humanities/)		3
	Hours	**15**
	Total Hours	**120**

[1] A grade of C- or higher is required.

[2] At most one passing grade below C- is permitted in these natural sciences courses

Career Opportunities

Many students majoring in the Department of Biological Sciences take advantage of scholarship and honors programs available at NC State, including the University Honors Program and the University Scholars Program. In addition, we offer a discipline-based Undergraduate Honors Program in Biological Sciences (DBS Honors Program). The DBS Honors Program requires students to design a challenging program of advanced study, including eight credits of honors coursework in biology and at least two semesters of research or teaching scholarship. Participants write an honors thesis and are required to present their scholarly work at a local, regional, or national meeting. Invitations to join the DBS Honors Program are sent in the first three weeks of the Fall and Spring semesters. Students in any major in the Department of Biological Sciences who have earned an overall GPA of 3.60 after completing 30-65 credit hours at NC State will receive an invitation to join the DBS Honors Program; transfer students in any of our majors who have earned an overall GPA of 3.60 in 15 credit hours at NC State also will receive an invitation.

Students who graduate from the Department of Biological Sciences are well prepared for employment in various government agencies and private industries. Graduates may continue their education with studies leading to advanced degrees in many areas of the biological sciences, including cell biology, ecology, microbiology, genetics, zoology, neurobiology, and biomedical disciplines. Many choose to seek advanced degrees in medicine, dentistry, optometry, veterinary medicine, public health, and other health-related fields. Students who plan to seek certification for pre-college teaching may want to pursue a second major in the Department of Science, Technology, Engineering & Mathematics Education.

Career Titles

- Biochemist
- Biologist
- Biology Professor
- Biomedical Engineer
- Biophysicist
- Dermatologist (MD)
- Epidemiologists
- Family Practitioner (MD)
- Food & Drug Inspector
- Food Technologist
- Forensic Science Technicians
- General Internists (MD)
- Geneticist
- Gynecologist (MD)
- Medical Technologist
- Microbiologist
- Obstetrician (MD)
- Pathologist (MD)
- Pediatrician (MD)
- Pharmacologist
- Sales Representative (Chemicals & Drugs)
- Surgeons (MD)
- Surgical Assistants
- Toxicologist
- Water Pollution Control Inspector

Learn More About Careers

NCcareers.org (https://nccareers.org/)

Explore North Carolina's central online resource for students, parents, educators, job seekers and career counselors looking for high quality job and career information.

Occupational Outlook Handbook (https://www.bls.gov/ooh/)
Browse the Occupational Outlook Handbook published by the Bureau of Labor Statistics to view state and area employment and wage statistics. You can also identify and compare similar occupations based on your interests.

Career One Stop Videos (https://www.careeronestop.org/)
View videos that provide career details and information on wages, employment trends, skills needed, and more for any occupation. Sponsored by the U.S. Department of Labor.

Focus 2 Career Assessment (https://careers.dasa.ncsu.edu/explore-careers/career-assessments/) (NC State student email address required)
This career, major and education planning system is available to current NC State students to learn about how your values, interests, competencies, and personality fit into the NC State majors and your future career. An NC State email address is required to create an account. Make an appointment with your career counselor (https://careers.dasa.ncsu.edu/about/hours-appointments/) to discuss the results.

Focus 2 Apply Assessment (https://www.focus2career.com/Portal/Register.cfm?SID=1929) (Available to prospective students)
A career assessment tool designed to support prospective students in exploring and choosing the right major and career path based on your unique personality, interests, skills and values. Get started with Focus 2 Apply and see how it can guide your journey at NC State.