

Bioprocessing Science (BS)

To see more about what you will learn in this program, visit the Learning Outcomes website (<https://apps.oirp.ncsu.edu/pgas/>)!

The B.S Bioprocessing Science degree prepares students for technical careers in biomanufacturing through formal training in fundamental sciences, as well as preparing students for careers in industries whose products are based on biological systems, including biopharmaceutical and biotechnology companies.

Plan Requirements

Code	Title	Hours	Counts towards
Orientation			
ALS 103	Freshman Transitions and Diversity in Agriculture & Life Sciences	1	
or ALS 303	Transfer Transitions and Diversity in Agriculture & Life Sciences		
Communication			
COM 110	Public Speaking	3	
or COM 112	Interpersonal Communication		
Mathematical Sciences			
MA 131	Calculus for Life and Management Sciences A	3	
MA 231	Calculus for Life and Management Sciences B	3	
ST 311	Introduction to Statistics	3	
Natural and Physical Sciences			
BIO 183	Introductory Biology: Cellular and Molecular Biology	4	
CH 101 & CH 102	Chemistry - A Molecular Science and General Chemistry Laboratory	4	
CH 201 & CH 202	Chemistry - A Quantitative Science and Quantitative Chemistry Laboratory	4	
CH 221 & CH 222	Organic Chemistry I and Organic Chemistry I Lab	4	

CH 223 & CH 224	Organic Chemistry II and Organic Chemistry II Lab	4	
BCH 351	General Biochemistry	3	
or BCH 451	Principles of Biochemistry		
MB 351 & MB 352	General Microbiology and General Microbiology Laboratory	4	
PY 211	College Physics I	4	
PY 212	College Physics II	4	
Major Requirements			
BBS 201	Introduction to Biopharmaceutical Science	3	
FS 231	Principles of Food and Bioprocess Engineering	4	
BEC 330	Principles and Applications of Bioseparations	2	
BEC 480	cGMP Fermentation Operations	2	
FS 290	Careers in Food and Bioprocessing Sciences	1	
or BEC 220	Introduction to Drug Development and Careers in Biomanufacturing		
BBS 301	Process Validation Science	3	
FS 403	Analytical Techniques in Food & Bioprocessing Science	4	
FS 416	Quality Control in Food and Bioprocessing	3	
BBS 426	Upstream Biomanufacturing Laboratory	2	
FS 475	Problems and Design in Food and Bioprocessing Science	3	
BIT 410	Manipulation of Recombinant DNA	3-4	

or BEC 440	Expression Systems in Biomanufacturing 1	
BIT Elective or BEC Elective (p. 2)		2
GN 311	Principles of Genetics	4
or ZO 250	Animal Anatomy and Physiology	
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 Additional Breadth (http:// catalog.ncsu.edu/undergraduate/ gep-category-requirements/) (Humanities/Social Sciences/Visual and Performing Arts)		3
GEP Interdisciplinary Perspectives (http://catalog.ncsu.edu/ undergraduate/gep-category- requirements/gep-interdisciplinary- perspectives/)		5
GEP U.S. Diversity (http:// catalog.ncsu.edu/undergraduate/ gep-category-requirements/gep-us- diversity/) (verify requirement)		
GEP Global Knowledge (http:// catalog.ncsu.edu/undergraduate/ gep-category-requirements/ gep-global-knowledge/) (verify requirement)		
Foreign Language Proficiency (http://catalog.ncsu.edu/ undergraduate/gep-category- requirements/foreign-language- proficiency/) (verify requirement)		
Free Electives		
Free Electives (12 Hr S/U Lmt) ²		9
Total Hours		120

¹ A grade of C- or higher is required.

² Students should consult their academic advisors to determine which courses fill this requirement.

BIT Elective or BEC Electives

Code	Title	Hours	Counts towards
BBS 426	Upstream Biomanufacturing Laboratory	2	
BBS 526	Upstream Biomanufacturing Laboratory	2	
BEC 330	Principles and Applications of Bioseparations	2	
BEC 426	Upstream Biomanufacturing Laboratory	2	
BEC 436	Introduction to Downstream Process Development	2	
BEC 440	Expression Systems in Biomanufacturing 1	3	
BEC 441	Expression Systems in Biomanufacturing II	3	
BEC 462	Fundamentals of Bio- Nanotechnology	3	
BEC 463	Fermentation of Recombinant Microorganisms	2	
BEC 475	Global Regulatory Affairs for Medical Products	3	
BEC 480	cGMP Fermentation Operations	2	
BEC 483	Tissue Engineering Technologies	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	
BEC 526	Upstream Biomanufacturing Laboratory	2	

BEC 536	Introduction to Downstream Process Development	2	BIT 471	RNA Interference and Model Organisms	2
BEC 540	Expression Systems in Biomanufacturing 1	3	BIT 473	Protein Interactions	2
BEC 541	Expression Systems in Biomanufacturing II	3	BIT 474	Plant Genetic Engineering	2
BEC 562	Fundamentals of Bio-Nanotechnology	3	BIT 476	Applied Bioinformatics	2
BEC 563	Fermentation of Recombinant Microorganisms	2	BIT 477	Metagenomics	2
BEC 575	Global Regulatory Affairs for Medical Products	3	BIT 478	Mapping the Brain	2
BEC 580	cGMP Fermentation Operations	2	BIT 479	High-Throughput Discovery	2
BEC 583	Tissue Engineering Technologies	2	BIT 480	Yeast Metabolic Engineering	2
BEC 585	cGMP Downstream Operations	2	BIT 481	Plant Tissue Culture and Transformation	2
BIO 572	Proteomics	3	BIT 492	External Learning Experience	1-6
BIT 402	Biotechnology Networking and Professional Development	1	BIT 493	Special Problems in Biotechnology	1-6
BIT 410	Manipulation of Recombinant DNA	4	BIT 495	Special Topics in Biotechnology	1-3
BIT 462	Gene Expression Analysis: Microarrays	2	BIT 501	Ethical Issues in Biotechnology	1
BIT 463	Fermentation of Recombinant Microorganisms	2	BIT 502	Biotechnology Networking and Professional Development	1
BIT 464	Protein Purification	2	BIT 510	Core Technologies in Molecular and Cellular Biology	4
BIT 465	Real-time PCR Techniques	2	BIT 562	Gene Expression Analysis: Microarrays	2
BIT 466	Animal Cell Culture Techniques	2	BIT 563	Fermentation of Recombinant Microorganisms	2
BIT 467	PCR and DNA Fingerprinting	2	BIT 564	Protein Purification	2
BIT 468	Genome Mapping	2	BIT 565	Real-time PCR Techniques	2
			BIT 566	Animal Cell Culture Techniques	2
			BIT 567	PCR and DNA Fingerprinting	2
			BIT 568	Genome Mapping	2
			BIT 569	RNA Purification and Analysis	2
			BIT 571	RNA Interference and Model Organisms	2

BIT 572	Proteomics	3
BIT 573	Protein Interactions	2
BIT 574	Plant Genetic Engineering	2
BIT 577	Metagenomics	2
BIT 578	Mapping the Brain	2
BIT 579	High-Throughput Discovery	2
BIT 580	Yeast Metabolic Engineering	2
BIT 581	Plant Transformation	2
BIT 590	Independent Study in Biotechnology	1-3
BIT 595	Special Topics	1-6
BME 583	Tissue Engineering Technologies	2
CH 572	Proteomics	3
CHE 462	Fundamentals of Bio-Nanotechnology	3
CHE 463	Fermentation of Recombinant Microorganisms	2
CHE 488	Animal Cell Culture Engineering	2
CHE 562	Fundamentals of Bio-Nanotechnology	3
CHE 563	Fermentation of Recombinant Microorganisms	2
FS 426	Upstream Biomanufacturing Laboratory	2
FS 526	Upstream Biomanufacturing Laboratory	2
MB 420	Fundamentals of Microbial Cell Biotransformations	2
MB 520	Fundamentals of Microbial Cell Biotransformations	2
PB 481	Plant Tissue Culture and Transformation	2
PO 466	Animal Cell Culture Techniques	2

PO 566	Animal Cell Culture Techniques	2
--------	--------------------------------	---

Semester Sequence

This is a sample.

First Year

Fall Semester		Hours
ALS 103	Freshman Transitions and Diversity in Agriculture & Life Sciences	1
BIO 183 or BIO 181	Introductory Biology: Cellular and Molecular Biology or Introductory Biology: Ecology, Evolution, and Biodiversity	4
ENG 101	Academic Writing and Research	4
COM 110 or COM 112	Public Speaking or Interpersonal Communication	3
GEP Social Sciences (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-social-sciences/)		3
GEP Health and Exercise Studies (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/)		1
Hours		16

Spring Semester

CH 101	Chemistry - A Molecular Science	3
CH 102	General Chemistry Laboratory	1
BBS 201	Introduction to Biopharmaceutical Science	3
MA 131	Calculus for Life and Management Sciences A	3
Free Elective ¹		3
GEP Humanities (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-humanities/)		3
Hours		16

Second Year

Fall Semester		Hours
CH 221	Organic Chemistry I	3
CH 222	Organic Chemistry I Lab	1
MA 231	Calculus for Life and Management Sciences B	3
PY 211	College Physics I	4
BEC 220 or FS 290	Introduction to Drug Development and Careers in Biomanufacturing or Careers in Food and Bioprocessing Sciences	1
GEP Interdisciplinary Perspectives (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-interdisciplinary-perspectives/)		3
Hours		15

Spring Semester

CH 223	Organic Chemistry II	3
CH 224	Organic Chemistry II Lab	1
FS 231	Principles of Food and Bioprocess Engineering	4
PY 212	College Physics II	4

Free Elective ¹		3
Hours		15
Third Year		
Fall Semester		
CH 201	Chemistry - A Quantitative Science	3
CH 202	Quantitative Chemistry Laboratory	1
MB 351	General Microbiology	3
MB 352	General Microbiology Laboratory	1
Free Elective ¹		3
Anatomy/Physiology Elective (p. 1)		4
Hours		15
Spring Semester		
BCH 351	General Biochemistry	3
BEC 330	Principles and Applications of Bioseparations	2
BIT Elective or BEC Elective (p. 2)		2
BEC 440 or BIT 410	Expression Systems in Biomanufacturing 1 or Manipulation of Recombinant DNA	3-4
GEP Additional Breadth (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/) (Humanities/Social Sciences/Visual and Performing Arts)		3
Hours		14
Fourth Year		
Fall Semester		
ST 311	Introduction to Statistics	3
BBS 301	Process Validation Science	3
BBS 426	Upstream Biomanufacturing Laboratory	2
BEC 480	cGMP Fermentation Operations	2
GEP Humanities (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-humanities/)		3
GEP Health and Exercise Studies (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/)		1
Hours		14
Spring Semester		
FS 475	Problems and Design in Food and Bioprocessing Science	3
FS 416	Quality Control in Food and Bioprocessing	3
FS 403	Analytical Techniques in Food & Bioprocessing Science	4
GEP Social Sciences (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-social-sciences/)		3
GEP Interdisciplinary Perspectives (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-interdisciplinary-perspectives/)		2
Hours		15
Total Hours		120

¹ Students are strongly encouraged to complete a minor in a closely related field, and should consult with an advisor in the minor department for the most current requirements. A list of can be viewed online at <http://oucc.ncsu.edu/minors> (<http://oucc.ncsu.edu/minors/>). Free elective courses taken as credit only may not apply toward a minor.

Career Opportunities

Consumer demand for safe, high quality, nutritious foods and biopharmaceutical products, as well as for educational programs designed to promote healthy eating, creates a variety of career opportunities in the food, pharmaceutical and the allied health industries. Industrial opportunities include management, research and development, process supervision, quality control and assurance, procurement, distribution, and sales. Public health opportunities include educational program development, delivery, and assessment. In addition, graduates hold positions with government agencies and many with advanced degrees have teaching and/or research positions in colleges and universities.

Bioprocessing Science

The Bioprocessing Science degree is a unique program designed to provide graduates with a special skill set specific to bioprocessing and biomanufacturing. Graduates from this degree program will have exciting opportunities to biomanufacture medicines, vaccines, enzymes and other products that improve the quality of life.

Scholarships

The department provides both merit and financial need scholarships to encourage and assist students preparing for careers in Food, Bioprocessing, or Nutrition Science.