Biological & Chemical Sciences

Dr. Antoine N. Nicolas
Chair of the Department

The mission of the Department of Biological and Chemical Sciences at Manhattan College is to give our students an appreciation of the methods, potentials, achievements, and limitations of the biological and chemical sciences, and to instill in them the intellectual and ethical skills to use this information effectively. To accomplish this, the Department provides a combination of required and elective courses consistent with a liberal education and maintains a tradition of strong support for independent study and undergraduate research.

Programs in:
Biology
Biochemistry and Chemistry
Environmental Science

BIOLOGY

In order to meet the educational needs of students in all majors, the biology curriculum at Manhattan College offers a variety of general courses for non-majors as well as more rigorous and specialized studies for our biology majors. To ensure a broad training, the curriculum for biology majors includes prescribed areas of required studies, plus some electives in advanced courses of cell and molecular biology, as well as organismal biology. In recognition that the best learning comes via *doing*, nearly all of our courses have associated, co-requisite, laboratory components. Many of these lab courses provide training in modern molecular biology techniques, while others provide fundamental training via anatomical, taxonomic, and ecological investigations. We also support off-campus studies that generally include class field trips to venues such as the American Museum of Natural History, the New York Botanical Gardens, and to the nearby, thousand-plus acre Van Cortland Park, a city park that preserves upland forests and wetlands. Our advanced research students present their findings at regional, national, and international meetings. Pre-professional students with interests in clinical studies generally "shadow" medical professionals in clinical settings.

Students preparing for professional school admission should consult the Kakos School of Arts and Science (http://catalog.manhattan.edu/undergraduate/science/) section of the catalog for requirements.

B.S. Degree

The B.S. degree is the preferred degree for students who wish to prepare for professional or graduate school. Students plan an individual program of study of their Biology courses and free electives after consultation with their assigned biology faculty advisor.

Required Courses for the B.S. Degree

BIOL 111	General Biology I (Co-requisite BIOL 191)	3
BIOL 191	General Biology I Lab (Co-requisite BIOL 111)	1
BIOL 112	General Biology II (Co-requisite BIOL 192)	3
BIOL 192	General Biology II Lab (Co-requisite BIOL 112)	1
BIOL 217	Genetics (Co-requisite BIOL 297)	3
BIOL 297	Genetics Lab (Co-requisite BIOL 217)	1
BIOL 223	Ecology (Co-requisite BIOL 293)	3
BIOL 293	Ecology Lab (Co-requisite BIOL 223)	1
BIOL 231	Evolution (Co-requisite BIOL 291)	3
BIOL 291	Evolution Laboratory (Co-requisite BIOL 231)	1
BIOL 404	Biology Colloquium I	1
BIOL 414	Biology Colloquium II	1
Cell & Molecular Biology (choose any two 4-credit courses)		**8**
BIOL 225	Microbiology (Co-requisite BIOL 295)	
BIOL 295	Microbiology Lab (Co-requisite BIOL 225)	
BIOL 302	Developmental Biology (Co-requisite BIOL 382)	
BIOL 382	Developmental Biology Lab (Co-requisite BIOL 302)	
BIOL 319	Cellular BioChemistry/Physiology (Co-requisite BIOL 399)	
BIOL 399	Cellular BioChemistry/Physiology Laboratory (Co-requisite BIOL 319)	
BIOL 321	Molecular Cell Biology (Co-requisite BIOL 391)	
BIOL 391	Molecular Cell Biology Lab (Co-requisite BIOL 321)	
BIOL 405	Neurobiology (Co-requisite BIOL 485)	
BIOL 485	Neurobiology Laboratory (Co-requisite BIOL 405)	
BIOL 426	Immunology (Co-requisite BIOL 496)	
BIOL 496	Immunology Laboratory (Co-requisite BIOL 426)	
Organismal Biology (choose any two 4-credit lecture/lab courses)		**8**
BIOL 301	Comparative Chordate Anatomy (Co-requisite BIOL 381)	
BIOL 381	Compar Chordate Anatomy Lab (Co-requisite BIOL 301)	
BIOL 304	Invertebrate Zoology (Co-requisite BIOL 384)	
BIOL 384	Invertebrate Zoology Lab (Co-requisite BIOL 304)	
BIOL 305	Plant Biology (Co-requisite BIOL 385)	
BIOL 385	Plant Biology Laboratory (Co-requisite BIOL 305)	
BIOL 320	Animal Physiology (Co-requisite BIOL 390)	
BIOL 390	Animal Physiology Laboratory (Co-requisite BIOL 320)	
BIOL 326	Animal Behavior (Co-requisite BIOL 396)	
BIOL 396	Animal Behavior Laboratory (Co-requisite BIOL 326)	
BIOL 409	Marine Biology (Co-requisite BIOL 489)	
BIOL 489	Marine Biology Laboratory (Co-requisite BIOL 409)	
BIOL 431	Freshwater Ecology (Co-requisite BIOL 491)	

BIOL 491	Freshwater Ecology Laboratory (Co-requisite BIOL 431)	
BIOL 432	Estuarine and Coastal Ecology (Co-requisite BIOL 492)	
BIOL 492	Estuarine & Coastal Ecology Laboratory (Co-requisite BIOL 432)	
Biology Electives (choose a combination of courses to total at least 4 credits)		**4**
Any 1 of Cell & Molecular or Organismal courses listed above		
BIOL 207	Anatomy and Physiology I (Co-requisite BIOL 287)	
BIOL 287	Anatomy & Physiology I Lab (Co-requisite BIOL 207)	
BIOL 208	Anatomy and Physiology II (Co-requisite BIOL 288)	
BIOL 288	Anatomy & Physiology II Lab (Co-requisite BIOL 208)	
BIOL 318	Advances in Nutrition	
BIOL 310	Research in Biology for Juniors	
BIOL 311	Research in Biology for Juniors	
BIOL 317	Research in Biology for Juniors	
BIOL 360	Independent Study in Biology for Juniors	
BIOL 375	Internship for Juniors	
BIOL 400	Research in Biology	
BIOL 406	Special Topics: in Biology (Co-requisite BIOL 486; may fulfill molecular or organismal requirement)	
BIOL 486	Topics in Biology Laboratory (Co-requisite BIOL 406)	
BIOL 410	Research in Biology for Seniors	
BIOL 411	Research in Biology for Seniors	
BIOL 413	Research in Biology for Seniors	
BIOL 460	Independent Study in Biology	
BIOL 475	Internship for Seniors	
Total Credits		**42**

Cognate Requirements for the B.S. Degree

CHEM 101	General Chemistry I (Co-requisite CHEM 103)	3
CHEM 103	General Chemistry Laboratory I (Co-requisite CHEM 101)	1
CHEM 102	General Chemistry II (Co-requisite CHEM 104)	3
CHEM 104	General Chemistry Laboratory II (Co-requisite CHEM 102)	1
CHEM 319	Organic Chemistry I	3
CHEM 323	Organic Chemistry Laboratory I (Co-requisite CHEM 319)	2
CHEM 320	Organic Chemistry II	3
CHEM 324	Organic Chemistry Laboratory II (Co-requisite CHEM 320)	2
Calculus I		4
MATH 155	Calculus for the Life Sciences I	
or MATH 185	Calculus I	
Calculus II		4
MATH 156	Calculus for the Life Sciences II	
or MATH 186	Calculus II	

Physics I		4
PHYS 107 & PHYS 193	Introduction to Physics I and Introduction to Physics I Lab	
or		
PHYS 101 & PHYS 191	Physics I and Physics I Lab	
Physics II		4
PHYS 108 & PHYS 194	Introduction to Physics II and Introduction to Physics II Lab	
or		
PHYS 102 & PHYS 192	Physics II and Physics II Lab	
Total Credits		**34**

B.A. Degree

Recognizing that many students have a distinct interest in Biology, yet possess diverse career goals, the Department offers the B.A. degree in biology with a relatively large number of electives. Students should use these electives to either minor in another science or concentrate in any of the humanities, social science or business disciplines. This program is not recommended for students wishing to go on to medical/professional school, graduate studies in Biology, or physical therapy programs unless other prerequisites are met. The B.A. program is intended to help students obtain employment in medical and pharmaceutical sales, medical writing, conservation and environmental biology, or careers in public health and safety.

Required Courses for the B.A. Degree

BIOL 111	General Biology I (Co-requisite BIOL 191)	3
BIOL 191	General Biology I Lab (Co-requisite BIOL 111)	1
BIOL 112	General Biology II (Co-requisite BIOL 192)	3
BIOL 192	General Biology II Lab (Co-requisite BIOL 112)	1
BIOL 217	Genetics (Co-requisite BIOL 297)	3
BIOL 297	Genetics Lab (Co-requisite BIOL 217)	1
BIOL 223	Ecology (Co-requisite BIOL 293)	3
BIOL 293	Ecology Lab (Co-requisite BIOL 223)	1
BIOL 231	Evolution (Co-requisite BIOL 291)	3
BIOL 291	Evolution Laboratory (Co-requisite BIOL 231)	1
BIOL 404	Biology Colloquium I	1
BIOL 414	Biology Colloquium II	1
Biology Electives (choose a combination of courses from the list below to total at least 14 credits)		**14**
Total Credits		**36**

Biology Electives for the B.A. with Their Co-Requisite Labs[1] (choose a combination to total at least 14 credits)

BIOL 207	Anatomy and Physiology I (Co-requisite BIOL 287)	3
BIOL 287	Anatomy & Physiology I Lab (Co-requisite BIOL 207)	1
BIOL 208	Anatomy and Physiology II (Co-requisite BIOL 288)	3
BIOL 288	Anatomy & Physiology II Lab (Co-requisite BIOL 208)	1
BIOL 225	Microbiology (Co-requisite BIOL 295)	3
BIOL 295	Microbiology Lab (Co-requisite BIOL 225)	1
BIOL 301	Comparative Chordate Anatomy (Co-requisite BIOL 381)	3
BIOL 381	Compar Chordate Anatomy Lab (Co-requisite BIOL 301)	1
BIOL 302	Developmental Biology (Co-requisite BIOL 382)	3
BIOL 382	Developmental Biology Lab (Co-requisite BIOL 302)	1
BIOL 304	Invertebrate Zoology (Co-requisite BIOL 384)	3
BIOL 384	Invertebrate Zoology Lab (Co-requisite BIOL 304)	1
BIOL 305	Plant Biology (Co-requisite BIOL 385)	3
BIOL 385	Plant Biology Laboratory (Co-requisite BIOL 305)	1
BIOL 318	Advances in Nutrition	2
BIOL 319	Cellular BioChemistry/Physiology (Co-requisite BIOL 399)	3
BIOL 399	Cellular BioChemistry/Physiology Laboratory (Co-requisite BIOL 319)	1
BIOL 320	Animal Physiology (Co-requisite BIOL 390)	3
BIOL 390	Animal Physiology Laboratory (Co-requisite BIOL 390)	1
BIOL 321	Molecular Cell Biology (Co-requisite BIOL 391)	3
BIOL 391	Molecular Cell Biology Lab (Co-requisite BIOL 321)	1
BIOL 326	Animal Behavior (Co-requisite BIOL 396)	3
BIOL 396	Animal Behavior Laboratory (Co-requisite BIOL 326)	1
BIOL 405	Neurobiology (Co-requisite BIOL 485)	3
BIOL 485	Neurobiology Laboratory (Co-requisite BIOL 405)	1
BIOL 409	Marine Biology (Co-requisite BIOL 489)	3
BIOL 489	Marine Biology Laboratory (Co-requisite BIOL 409)	1
BIOL 426	Immunology (Co-requisite BIOL 496)	3
BIOL 496	Immunology Laboratory (Co-requisite BIOL 426)	1
BIOL 431	Freshwater Ecology (Co-requisite BIOL 491)	3
BIOL 491	Freshwater Ecology Laboratory (Co-requisite BIOL 431)	1
BIOL 432	Estuarine and Coastal Ecology (Co-requisite BIOL 492)	3
BIOL 492	Estuarine & Coastal Ecology Laboratory (Co-requisite BIOL 432)	1
BIOL 441	Cardiovascular Biology	3
BIOL 310	Research in Biology for Juniors	2
BIOL 311	Research in Biology for Juniors	2
BIOL 317	Research in Biology for Juniors	3

BIOL 360	Independent Study in Biology for Juniors	2
BIOL 375	Internship for Juniors	2
BIOL 400	Research in Biology	1
BIOL 406	Special Topics: in Biology (Co-requisite BIOL 486)	3
BIOL 486	Topics in Biology Laboratory (Co-requisite BIOL 406)	1
BIOL 410	Research in Biology for Seniors	2
BIOL 411	Research in Biology for Seniors	2
BIOL 413	Research in Biology for Seniors	3
BIOL 460	Independent Study in Biology	1-3
BIOL 475	Internship for Seniors	3

[1] A student may take 9 Biology credits in Research and/or Independent Study. However, a maximum of 3 credits may be in Independent Study.

Cognate Requirements for the B.A. Degree

CHEM 101	General Chemistry I (Co-requisite CHEM 103)	3
CHEM 103	General Chemistry Laboratory I (Co-requisite CHEM 101)	1
CHEM 102	General Chemistry II (Co-requisite CHEM 104)	3
CHEM 104	General Chemistry Laboratory II (Co-requisite CHEM 102)	1
CHEM 319	Organic Chemistry I	3
CHEM 320	Organic Chemistry II	3
MATH 100	Pre-Calculus Mathematics	4
MATH 230	Elementary Statistics	3
Physics I		4
PHYS 107 & PHYS 193	Introduction to Physics I and Introduction to Physics I Lab	
or		
PHYS 101 & PHYS 191	Physics I and Physics I Lab	
Physics II		4
PHYS 108 & PHYS 194	Introduction to Physics II and Introduction to Physics II Lab	
or		
PHYS 102 & PHYS 192	Physics II and Physics II Lab	
Total Credits		**29**

Minor in Biology

A minor requires 15 credits in Biology courses planned in consultation with and approval of the Chair of the Department of Biological and Chemical Sciences. Eight of these credits must be the General Biology lecture/lab sequence (BIOL 111/191 and BIOL 112/192). The remaining credits must be chosen from courses that satisfy the B.S. major requirements.

Minor in Neuroscience

The interdisciplinary minor in neuroscience includes courses in Psychology and Biology to allow students to gain knowledge and skills about the development, structure, and function of the brain and nervous system, its impact on behavior and cognition, and how these processes change throughout the lifespan in healthy and diseased states. Students must consult with their Department Chair and complete a minor declaration form. One class from the major can count as a major requirement and minor course.

All Neuroscience minors will be assigned a Neuroscience advisor from either Biology or Psychology. Students from other majors (across schools) are also encouraged to apply for the minor and courses will be determined on a case-by-case basis. Students from majors other than Biology or Psychology should reach out to the Department Chair of either major and complete a minor declaration form. Due to the extensive lab requirements, students are encouraged to declare and begin the Neuroscience minor as early as possible to minimize scheduling conflicts and inefficient course selection.

Biology students need to fulfill the following to earn a minor in Neuroscience **(Total 17 credits):**

*(Prerequisite: PSYC 150/153/203)

- Neurobiology (BIOL 405/485) or Behavioral Neuroscience (PSYC 435).
- One of the following (with lab): Anatomy and Physiology I (BIOL 207/287), Evolution (BIOL 231/292), Animal Physiology (BIOL 320/390), Comparative Chordate Anatomy (BIOL 301/381), Animal Behavior (BIOL 326/396).
- Three of these Psychology courses: *Psychopathology (PSYC 421), *Artificial Psychology (PSYC 332), *Motivation and Emotion (PSYC 333), *Sensation and Perception (PSYC 467).

Grade Requirements

Majors and minors must attain a minimum grade of C in all biology courses. Prerequisites for upper level Biology courses: C or better in General Biology I (BIOL 111 and BIOL 191) and C or better in General Biology II (BIOL 112 and BIOL 192) or the equivalents are required.

Registration for Advanced Courses

Permission of the biology faculty advisor is required for registration in all courses at the 300 and 400 levels.

Courses for Non-Biology Majors

The following courses are offered for and are restricted to students majoring in departments other than Biology.

BIOL 103	Introduction to Biology (Co-requisite BIOL 183)	2
BIOL 183	Introduction to Biology Lab (Co-requisite BIOL 103)	1
BIOL 131	Principles of Biology I (Co-requisite BIOL 181)	3
BIOL 181	Principles of Biology I Lab (Co-requisite BIOL 131)	1

BIOL 132	Principles of Biology II (Co-requisite BIOL 182)	3
BIOL 182	Principles of Biology II Lab (Co-requisite BIOL 132)	1
BIOL 221	Introductory Nutrition	3
BIOL 222	Biology for Engineers (Co-requisite BIOL 292)	2
BIOL 292	Biology for Engineers Lab (Co-requisite BIOL 222)	1
BIOL 441	Cardiovascular Biology	3

PLANS OF STUDY

Bachelor of Science in Biology

First Year

Fall	Credits	Spring	Credits
BIOL 111	3	BIOL 112	3
BIOL 191	1	BIOL 192	1
CHEM 101	3	CHEM 102	3
CHEM 103	1	CHEM 104	1
MATH 155 or 185	4	MATH 156 or 186	4
SCI 100	1	SCI 101	1
ENGL 110	3	RELS 110	3
	16		**16**

Second Year

Fall	Credits	Spring	Credits
BIOL 231	3	BIOL 217	3
BIOL 291	1	BIOL 297	1
BIOL 223	3	CHEM 320	3
BIOL 293	1	CHEM 324	2
CHEM 319	3	Social Sciences	3
CHEM 323	2	Modern Language	3
Modern Language	3		
	16		**15**

Third Year

Fall	Credits	Spring	Credits
BIOL Molecular Elective	4	BIOL Organismal Elective	4
PHYS 107	3	PHYS 108	3
PHYS 193	1	PHYS 194	1
HIST 150	3	PHIL 150	3
ENGL 150	3	MUSC 150 or ART 150	3
RELS Catholic Studies	3	CMPT 155	3
	17		**17**

Fourth Year

Fall	Credits	Spring	Credits
BIOL 404	1	BIOL 414	1
BIOL Organismal Elective	4	BIOL Molecular Elective	4
BIOL Elective	4	PHIL 213 or 214	3
RELS Global/Contemporary	3	Electives	7
Social Sciences	3		
Elective	3		
	18		**15**

Total Credits: 130

Bachelor of Arts in Biology

First Year

Fall	Credits	Spring	Credits
BIOL 111	3	BIOL 112	3
BIOL 191	1	BIOL 192	1
CHEM 101	3	CHEM 102	3
CHEM 103	1	CHEM 104	1
SCI 100	1	SCI 101	1
MATH 100	4	RELS 110	3
ENGL 110	3	Social Sciences	3
	16		**15**

Second Year

Fall	Credits	Spring	Credits
BIOL 231	3	BIOL 217	3
BIOL 291	1	BIOL 297	1
BIOL 223	3	MATH 230	3
BIOL 293	1	CHEM 320	3
CHEM 319	3	HIST 150	3
Modern Language	3	Modern Language	3
Free Elective	3		
	17		**16**

Third Year

Fall	Credits	Spring	Credits
BIOL Elective	4	BIOL Elective	4
PHYS 107	3	PHYS 108	3
PHYS 193	1	PHYS 194	1
MUSC 150 or ART 150	3	ENGL 150	3
Social Sciences	3	PHIL 150	3
Free Elective	3	CMPT 155	3
	17		**17**

Fourth Year

Fall	Credits	Spring	Credits
BIOL 404	1	BIOL 414	1
BIOL Elective	4	BIOL Elective	2
RELS Catholic Studies	3	RELS Global/Contemporary	3
Free Electives	8	PHIL 213 or 214	3
		Free Electives	7
	16		**16**

Total Credits: 130

BIOCHEMISTRY & CHEMISTRY

The goals of the chemistry and biochemistry major are to provide a program which emphasizes the basic understanding of the constituents of matter, its transformations and the chemical principles involved therein. The majors also promotes the study of the chemical and biochemical systems and the manner and methods by which they are investigated. To accomplish this goal, students are provided with a basic framework of knowledge by which they can carry out further study, research and understand the implication of scientific discoveries, inventions and their impact upon human welfare. They learn to think analytically and independently and are encouraged to apply this knowledge ethically throughout their lifetimes to civic, personal and professional problems. As a result, students are prepared for careers in the various disciplines and sub-disciplines of chemistry and biochemistry, in the teaching of these disciplines and for pursuing higher studies in basic and applied sciences or to follow professional careers in medicine, dentistry, law and other areas.

Undergraduate research is encouraged and the department is equipped with state-of-the-art instrumentation that is available for student use. Included are a Fourier-transform infrared spectrophotometer, an X-ray crystallography apparatus, a diode-array UV/visible spectrophotometer, a Fourier-transform nuclear magnetic resonance spectrophotometer, an atomic absorption unit, several high performance liquid chromatographs, gas chromatographs, and a molecular modeling laboratory.

Students who transfer into the chemistry and biochemistry programs are required to take at least half of their required chemistry credits at Manhattan College.

Degree Plans

- Major in Chemistry
  - Bachelor of Science Degree
  - Bachelor of Arts Degree
- Major in Biochemistry
  - Bachelor of Science Degree
  - Bachelor of Arts Degree
- Minor in Chemistry
- Minor in Biochemistry
- Concentration in Nanoscience

A minimum grade of C is required for all courses in the major or minor. The following courses are not allowed for the any of the majors or minors in Chemistry or Biochemistry: CHEM 100 Foundations of Chemistry, CHEM 105 General Chemistry I, or CHEM 106 General Chemistry II.

B.S. Major in Chemistry

Students in this program must maintain a 2.8 GPA in the major by the end of the fourth semester. Students who do not maintain this GPA are advised not to continue in the chemistry major. The following courses are required:

CHEM 101	General Chemistry I	3
CHEM 102	General Chemistry II	3
CHEM 103	General Chemistry Laboratory I	1
CHEM 104	General Chemistry Laboratory II	1
CHEM 302	Analytical Chemistry	5
CHEM 309	Physical Chemistry I	3
CHEM 310	Physical Chemistry II	3
CHEM 311	Physical Chemistry Laboratory	2
CHEM 319	Organic Chemistry I	3
CHEM 320	Organic Chemistry II	3
CHEM 323	Organic Chemistry Laboratory I	2
CHEM 324	Organic Chemistry Laboratory II	2
CHEM 335	Inorganic Chemistry	3
CHEM 336	Inorganic Chemistry Laboratory	2
CHEM 410	Physical Chemistry Laboratory II	2
CHEM 437	Computers, Structure and Bonding	3
CHEM 452	Advanced Spectroscopy	5
MATH 185	Calculus I	4
MATH 186	Calculus II	4
MATH 285	Calculus III	4
MATH 286	Differential Equations	3
PHYS 101	Physics I	3
PHYS 191	Physics I Lab	1
PHYS 102	Physics II	3
PHYS 192	Physics II Lab	1
Humanities/Social Science Elective		3
Total Credits		**72**

The chemistry major is approved by the American Chemical Society and will certify students as having complied the Society requirements provided they have completed the minimum requirements for the B.S. plus CHEM 433 Biochemistry I and one additional 400 level Chemistry course (CHEM 415 Advanced Organic Chemistry or CHEM 421 Advanced Topics: in Chemistry or CHEM 427 Advanced Physical

Chemistry or CHEM 434 Biochemistry of Cellular Processes or CHEM 435 Advanced Inorganic Chemistry).

B.S. Major in Biochemistry

Students in this program must maintain a 2.8 GPA in the major by the end of the fourth semester. Students who do not maintain this GPA are advised not to continue in the biochemistry major. The following courses are required:

CHEM 101	General Chemistry I	3
CHEM 102	General Chemistry II	3
CHEM 103	General Chemistry Laboratory I	1
CHEM 104	General Chemistry Laboratory II	1
CHEM 302	Analytical Chemistry	5
CHEM 309	Physical Chemistry I	3
CHEM 310	Physical Chemistry II	3
CHEM 311	Physical Chemistry Laboratory	2
CHEM 319	Organic Chemistry I	3
CHEM 320	Organic Chemistry II	3
CHEM 323	Organic Chemistry Laboratory I	2
CHEM 324	Organic Chemistry Laboratory II	2
CHEM 335	Inorganic Chemistry	3
CHEM 433	Biochemistry I	3
CHEM 434	Biochemistry of Cellular Processes	3
CHEM 436	Biochemistry Laboratory	2
CHEM 437	Computers, Structure and Bonding	3
CHEM 457	Nucleic Acid Biochemistry	3
CHEM 459	Nucleic Acids BioChemistry Lab	2
BIOL 111	General Biology I	3
BIOL 191	General Biology I Lab	1
BIOL 112	General Biology II	3
BIOL 192	General Biology II Lab	1
BIOL 217	Genetics	3
BIOL 297	Genetics Lab	1
MATH 185	Calculus I	4
MATH 186	Calculus II	4
PHYS 101	Physics I	3
PHYS 191	Physics I Lab	1
PHYS 102	Physics II	3
PHYS 192	Physics II Lab	1
Advanced Biology Elective [1]		3
Total Credits		**81**

- 1. *The advanced biology elective should be chosen from the following courses:* BIOL 225 *Microbiology,* BIOL 312 *Advanced Biology for Biochemists,* BIOL 319 *Cellular BioChemistry/Physiology,* BIOL 320 *Animal Physiology,* BIOL 321 *Molecular Cell Biology, or* BIOL 405 *Neurobiology.*

Students planning to enter either medical or dental school should consult with the Premedical Advisory Committee and should acquaint themselves with the entrance requirements of medical or dental schools. Students pursuing the B.S. degree in biochemistry may, through the judicious choice of electives, comply with the American Chemical Society requirements for certification.

B.A. Major in Chemistry

Students in this program must successfully complete the following courses with a minimum grade of C.

CHEM 101	General Chemistry I	3
CHEM 102	General Chemistry II	3
CHEM 103	General Chemistry Laboratory I	1
CHEM 104	General Chemistry Laboratory II	1
CHEM 319	Organic Chemistry I	3
CHEM 320	Organic Chemistry II	3
CHEM 323	Organic Chemistry Laboratory I	2
CHEM 324	Organic Chemistry Laboratory II	2
MATH 185	Calculus I	4
MATH 186	Calculus II	4
MATH 285	Calculus III	4
PHYS 101	Physics I	3
PHYS 191	Physics I Lab	1
PHYS 102	Physics II	3
PHYS 192	Physics II Lab	1
After completion of the preceding courses, students must take the following:		
CHEM 302	Analytical Chemistry	5
CHEM 309	Physical Chemistry I	3
CHEM 310	Physical Chemistry II	3
CHEM 311	Physical Chemistry Laboratory	2
CHEM 437	Computers, Structure and Bonding	3
Chemistry Elective (300 or 400 level Chemistry course)		3-5
Humanities/Social Science Electives		9
Natural Science/Mathematics Electives		6-8
Total Credits		**72-76**

B.A. Major in Biochemistry

Students in this program must successfully complete the following courses with a minimum grade of C.

CHEM 101	General Chemistry I	3
CHEM 102	General Chemistry II	3
CHEM 103	General Chemistry Laboratory I	1
CHEM 104	General Chemistry Laboratory II	1
CHEM 319	Organic Chemistry I	3
CHEM 320	Organic Chemistry II	3
CHEM 323	Organic Chemistry Laboratory I	2
CHEM 324	Organic Chemistry Laboratory II	2
BIOL 111	General Biology I	3
BIOL 191	General Biology I Lab	1
BIOL 112	General Biology II	3
BIOL 192	General Biology II Lab	1
BIOL 217	Genetics	3
BIOL 297	Genetics Lab	1
MATH 185	Calculus I	4
MATH 186	Calculus II	4
PHYS 101	Physics I	3
PHYS 191	Physics I Lab	1
PHYS 102	Physics II	3
PHYS 192	Physics II Lab	1
After completion of the preceding courses, students must take the following:		
CHEM 302	Analytical Chemistry	5
CHEM 309	Physical Chemistry I	3
CHEM 433	Biochemistry I	3
CHEM 434	Biochemistry of Cellular Processes	3
CHEM 436	Biochemistry Laboratory	2
CHEM 457	Nucleic Acid Biochemistry	3
CHEM 459	Nucleic Acids BioChemistry Lab	2
Humanities/Social Science Electives		6
Natural Science/Mathematics Electives		6-8
Total Credits		**79-81**

Minor in Chemistry

Students should complete the following courses (or their corresponding Honors Course) in the Department of Biological and Chemical Sciences. A minimum grade of C is required for all courses. A student may not count the same credits towards minors in both biochemistry and chemistry.

CHEM 101	General Chemistry I	3
CHEM 102	General Chemistry II	3
CHEM 319	Organic Chemistry I	3
CHEM 320	Organic Chemistry II	3
One additional course selected from CHEM 302, CHEM 309, CHEM 310, CHEM 335, CHEM 421 or CHEM 433		3
Total Credits		**15**

Minor in Biochemistry

Students should complete the following courses in the Department of Biological and Chemical Sciences for the minor in Biochemistry. A minimum grade of C is required for all courses. A student may not count the same credits towards minors in both biochemistry and chemistry.

CHEM 319	Organic Chemistry I	3
CHEM 320	Organic Chemistry II	3
CHEM 433	Biochemistry I	3
CHEM 434	Biochemistry of Cellular Processes	3
CHEM 436	Biochemistry Laboratory	2
or CHEM 457	Nucleic Acid Biochemistry	
Total Credits		**14**

Concentration in Nanoscience

Students should complete the following courses in the Department of Biological and Chemical Sciences for the concentration in Nanoscience. A minimum grade of C is required for all courses.

CHEM 112	Introduction to Materials Chemistry	3
CHEM 333	Solid State Materials	4
CHEM 444	Characterization of Materials	3
Total Credits		**10**

PLANS OF STUDY

Bachelor of Science in Chemistry

First Year

Fall	Credits	Spring	Credits
CHEM 101	3	CHEM 102	3
CHEM 103	1	CHEM 104	1
MATH 185	4	MATH 186	4
ENGL 110	3	RELS 110	3
SCI 100	1	LLRN 102 (or PHIL 213 or PHIL 214)	3

Social Science[1]	3	SCI 101	1
	15		**15**

Second Year

Fall	Credits	Spring	Credits
CHEM 319	3	CHEM 320	3
CHEM 323	2	CHEM 324	2
MATH 285	4	CHEM 335	3
HIST 150	3	CHEM 336	2
ENGL 150	3	MATH 286	3
MUSC 150 or ART 150	3	PHIL 150	3
	18		**16**

Third Year

Fall	Credits	Spring	Credits
CHEM 302	5	CHEM 310	3
CHEM 309	3	CHEM 311	2
PHYS 101	3	CHEM 437	3
PHYS 191	1	PHYS 102	3
RELS Catholic Studies	3	PHYS 192	1
Modern Language	3	RELS Global/Contemporary	3
		Modern Language	3
	18		**18**

Fourth Year

Fall	Credits	Spring	Credits
CHEM 410	2	CHEM 452	5
Social Science[1]	3	Electives[2]	11
Humanities/Social Science Elective	3		
Electives[2]	9		
	17		**16**

Total Credits: 133

- 1. *ECON 150 or POSC 150 or PSYC 150 or SOC 150.*
- 2. For American Chemical Society Certification, 6 credits of electives must include CHEM 433 and one additional Chemistry course (CHEM 415, 421, 427, 434, 435).

Bachelor of Arts in Chemistry

First Year

Fall	Credits	Spring	Credits
CHEM 101	3	CHEM 102	3
CHEM 103	1	CHEM 104	1
ENGL 110	3	MATH 186	4

LLRN 102 (or PHIL 213 or PHIL 214)	3	RELS 110	3
MATH 185	4	Social Science [1]	3
SCI 100	1	SCI 101	1
	15		**15**

Second Year

Fall	Credits	Spring	Credits
CHEM 319	3	CHEM 320	3
CHEM 323	2	CHEM 324	2
CHEM 437	3	ENGL 150	3
MATH 285	4	PHIL 150	3
Electives[2]	3	Elective[2]	3
HIST 150	3	Humanities / Social Science Elective	3
	18		**17**

Third Year

Fall	Credits	Spring	Credits
PHYS 101	3	PHYS 102	3
PHYS 191	1	PHYS 192	1
CHEM 302	5	MUSC 150 (or ART 150)	3
RELS Catholic Studies	3	Social Science [1]	3
Elective[2]	3	Electives[2]	6
	15		**16**

Fourth Year

Fall	Credits	Spring	Credits
CHEM 309	3	CHEM 310	3
CHEM Elective	3	CHEM 311	2
RELS Global / Contemporary	3	Humanities / Social Science Elective	3
Humanities / Social Science Elective	3	Electives	6
Modern Language	3	Modern Language	3
Elective [2]	3		
	18		**17**

Total Credits: 131

- 1 ECON 150 or POSC 150 or PSYC 150 or SOC 150.
- 2 *Of the 24 free elective credits allowed in the BA Chemistry program, at least six credits must be earned in the humanities or social sciences and six credits in the natural sciences or mathematics.*

Bachelor of Science in Biochemistry

First Year

Fall	Credits	Spring	Credits
CHEM 101	3	CHEM 102	3
CHEM 103	1	CHEM 104	1
BIOL 111	3	BIOL 112	3
BIOL 191	1	BIOL 192	1
MATH 185[1]	4	MATH 186[1]	4
ENGL 110	3	RELS 110	3
SCI 100	1	SCI 101	1
	16		**16**

Second Year

Fall	Credits	Spring	Credits
CHEM 319	3	CHEM 320	3
CHEM 323	2	CHEM 324	2
PHYS 101[3]	3	CHEM 433	3
PHYS 191[3]	1	PHYS 102[4]	3
LLRN 102 (or PHIL 213 or PHIL 214)	3	PHYS 192[4]	1
Modern Language	3	Modern Language	3
Social Science [2]	3		
	18		**15**

Third Year

Fall	Credits	Spring	Credits
CHEM 302	5	CHEM 310	3
CHEM 309	3	CHEM 311	2
CHEM 457	3	CHEM 434	3
CHEM 436	2	CHEM 459	2
HIST 150	3	BIOL 217	3
		BIOL 297	1
		PHIL 150	3
	16		**17**

Fourth Year

Fall	Credits	Spring	Credits
ENGL 150	3	CHEM 335 (or CHEM 437)	3
Advanced Biology Elective[5]	3-4	MUSC 150 (or ART 150)	3
Electives[6]	6	RELS Global / Contemporary	3
RELS Catholic Studies	3	Electives	6

		Social Sciences[2]	3
	15-16		**18**

Total Credits: 131-132

- 1 *MATH 155 & MATH 156 may replace MATH 185 & MATH 186.*
- 2 ECON 150 or POSC 150 or PSYC 150 or SOC 150.
- 3 *PHYS 107 & PHYS 197 may replace PHYS 101 & PHYS 191.*
- 4 *PHYS 108 & PHYS 198 may replace PHYS 102 & PHYS 192.*
- 5 *The advanced biology elective should be chosen from the following courses:* BIOL 225 *Microbiology,* BIOL 312 *Advanced Biology for Biochemists*, BIOL 319 *Cellular Biochemistry/Physiology,* BIOL 320 *Animal Physiology,* BIOL 321 *Molecular Cell Biology or* BIOL 405 *Neurobiology.*
- 6 *CHEM 456 Advanced Topics in Biochemistry is highly recommended as a natural sciences elective for all biochemistry majors. CHEM 456 is required for the Honors Biochemistry Degree.*

Bachelor of Arts in Biochemistry

First Year

Fall	**Credits**	**Spring**	**Credits**
CHEM 101	3	CHEM 102	3
CHEM 103	1	CHEM 104	1
BIOL 111	3	BIOL 112	3
BIOL 191	1	BIOL 192	1
ENGL 110	3	MATH 186[1]	4
MATH 185[1]	4	RELS 110	3
SCI 100	1		
	16		**15**

Second Year

Fall	**Credits**	**Spring**	**Credits**
CHEM 319	3	CHEM 320	3
CHEM 323	2	CHEM 324	2
HIST 150	3	CHEM 433	3
LLRN 102 (or PHIL 213 or PHIL 214)[2]	3	PHIL 150	3
Social Sciences[2]	3	Modern Language	3
Modern Language	3		
	17		**14**

Third Year

Fall	**Credits**	**Spring**	**Credits**
CHEM 457	3	CHEM 434	3

CHEM 436	2	CHEM 459	2
PHYS 101[3]	3	PHYS 102[4]	3
PHYS 191[3]	1	PHYS 192[4]	1
ENGL 150	3	Electives[5]	3
Electives[5]	3	BIOL 217	3
		BIOL 297	1
	15		**16**

Fourth Year

Fall	**Credits**	**Spring**	**Credits**
CHEM 302	5	Electives[5]	3
CHEM 309	3	Social Sciences[6]	12-13
MUSC 150 (ART 150)	3	Social Sciences	3
RELS Catholic Studies	3		
Electives[5]	3		
	17		**18-19**

Total Credits: 128-129

- 1 *MATH 155 & MATH 156 may replace MATH 185 & MATH 186.*
- 2 ECON 150 or POSC 150 or PSYC 150 or SOC 150.
- 3 *PHYS 107 & PHYS 197 may replace PHYS 101 & PHYS 191.*
- 4 *PHYS 108 & PHYS 198 may replace PHYS 102 & PHYS 192.*
- 5 *Of the 21 free elective credits allowed in the BA biochemistry program, at least six credits must be earned in the humanities or social sciences and six credits in the natural sciences or mathematics.*
- 6 *CHEM 456 Advanced Topics in Biochemistry is highly recommended as a natural science elective for all biochemistry majors.*

Environmental Science

Environmental issues represent some of the most important challenges facing the planet in the 21st century. As the nation's focus on the environment continues to grow, there is an ever-increasing demand for environmental science jobs. If you're seeking a career in this field, you can look forward to a far more robust job market than graduates of many other disciplines according to the Bureau of Labor Statistics.

The goal of the Environmental Science program is to provide a foundation for understanding issues and solving problems involving our natural environment. It is an interdisciplinary science program that focuses on the state of the environment and serious environmental problems that the world faces. The program provides students with a strong science background focused on the environmental issues. Students will be expected to take a variety of courses in numerous departments. Through a series of academic courses and co-curricular activities, you will get hands-on experience and obtain the critical thinking and problem-solving skills necessary in order to solve the complex, interdisciplinary environmental problems facing the local community and society at large.

The Environmental Sciences Program offers Bachelor of Science degree and a Bachelor of Arts degree in Environmental Sciences.

Our interdisciplinary science program is supported by a team of academic departments. Professors work closely with Environmental Sciences undergraduates as their study becomes more specialized. Such individual attention leads to fruitful partnerships when students become involved in research and other student-centered learning activities. Through coursework, projects and activities, you will develop scientific research, writing, and presentation skills.

Degree Plans
The following programs are offered:

- Major in Environmental Science
  - Bachelor of Science Degree
  - Bachelor of Arts Degree
- Minor in Environmental Science

Individual Attention and Mentoring

Students will receive individual attention during their entire undergraduate career. Each student plans a course of study in close cooperation with a faculty advisor, and the student's progress is closely coordinated with developing interests. Undergraduates are strongly encouraged to pursue independent research as an essential part of their educational program.

Career Choices

According to Bureau of Labor Statistics, employment of environmental scientists is projected to grow faster than the average for all occupations. You will be prepared to enter government, academic, private or non-profit careers or to continue your education in a variety of scientific disciplines. Graduates would be trained to work in fields including environmental consulting, laboratory or field research, environmental education, medical school, environmental law, engineering, toxicology and waste management.

Major in Environmental Science

A minimum grade of C is required for all courses in the major. Students in this program must maintain a 2.8 GPA in the major by the end of the fourth semester. Students who do not maintain this GPA are advised not to continue in the major.

The following courses are required for all bachelors degrees (B.A. and B.S.). In addition, students pursuing a B.S. degree take 3 major elective courses* and students pursuing a B.A. degree take 2 major elective courses*.

ENSC 101	Intro to Environmental Science	3
ENSC 301	Environmental Science I	3
ENSC 302	Environmental Science II	4
CHEM 101	General Chemistry I	3
CHEM 103	General Chemistry Laboratory I	1
CHEM 102	General Chemistry II	3
CHEM 104	General Chemistry Laboratory II	1

CHEM 302	Analytical Chemistry	5
CHEM 319	Organic Chemistry I	3
CHEM 323	Organic Chemistry Laboratory I	2
BIOL 111	General Biology I	3
BIOL 191	General Biology I Lab	1
BIOL 112	General Biology II	3
BIOL 192	General Biology II Lab	1
BIOL 223	Ecology	3
BIOL 293	Ecology Lab	1
MATH 185	Calculus I (MATH 155 or MATH 185)	4
MATH 186	Calculus II (MATH 156 or MATH 186)	4
MATH 336	Applied Statistics	3
PHYS 107	Introduction to Physics I	3
PHYS 193	Introduction to Physics I Lab	1
PHYS 108	Introduction to Physics II	3
PHYS 194	Introduction to Physics II Lab	1
CMPT 155	Computer Applications for Life Sciences	3
PHP 418	Introduction to Environmental Health	3
Total Credits		**65**

Students pursing the B.S. degree will also need to take:

CHEM 335	Inorganic Chemistry	3
CHEM 460	Chemical Research	1

*Major Elective Courses

SCI 202	Introduction Geology	3
SCI 210	Introductory Oceanography	3
SCI 221	Introduction Meteorology	3
CHEM 309	Physical Chemistry I	3
CHEM 433	Biochemistry I	3
CHEM 111	Nanoscience I	3
CHEM 320	Organic Chemistry II	3
CHEM 323	Organic Chemistry Laboratory I	2
BIOL 217	Genetics	3
BIOL 297	Genetics Lab	1
BIOL 225	Microbiology	3
BIOL 295	Microbiology Lab	1
BIOL 231	Evolution	3
BIOL 291	Evolution Laboratory	1
BIOL 305	Plant Biology	3
BIOL 385	Plant Biology Laboratory	1

BIOL 320	Animal Physiology	3
BIOL 390	Animal Physiology Laboratory	1
ENGS 204	Environmental Engineering Principles I	3
ENVL 517	Environmental Law	3
SOC 334	Sustainable Development	3
POSC 223	Environmental Politics	3
PHP 418	Introduction to Environmental Health	3
ENVG 510	Hazardous Waste Management	3
ENVG 506	Water and Wastewater Treatment Processes	3

Minor in Environmental Science

The minor in Environmental Science requires the following courses for a total of 17 credits. A minimum grade of C is required for all courses.

ENSC 101	Intro to Environmental Science	3
CHEM 101	General Chemistry I	3
CHEM 103	General Chemistry Laboratory I	1
CHEM 102	General Chemistry II	3
CHEM 104	General Chemistry Laboratory II	1
ENSC 301	Environmental Science I	3
CHEM 319	Organic Chemistry I	3

PLANS OF STUDY

Bachelor of Science in Environmental Science

First Year

Fall	Credits	Spring	Credits
ENSC 101	3	CHEM 102	3
CHEM 101	3	CHEM 104	1
CHEM 103	1	BIOL 112	3
BIOL 111	3	BIOL 192	1
BIOL 191	1	MATH 156 or 186	4
MATH 155 or 185	4	SCI 101	1
SCI 100	1	RELS 110 or ENGL 110	3
	16		**16**

Second Year

Fall	Credits	Spring	Credits
BIOL 223	3	CHEM 335	3
BIOL 293	1	MATH 336	3
CHEM 319	3	Modern Language	3
CHEM 323	2	ECON/POSC/PSYC/SOC	3
Modern Language	3	PHP 418	3

ENGL 110 (or RELS 110)	3		
CMPT 155	3		
	18		**15**

Third Year

Fall	**Credits**	**Spring**	**Credits**
ENSC 301	3	ENSC 302	4
CHEM 302	5	PHYS 108	3
PHYS 107	3	PHYS 194	1
PHYS 193	1	PHIL 150	3
Free Elective	3	PHIL 213 or LLRN 102	3
		RELS Catholic Studies	3
	15		**17**

Fourth Year

Fall	**Credits**	**Spring**	**Credits**
Major Elective	3-4	Major Elective	3-4
Major Elective	3-4	2 Free Electives	6
RELS Contemporary Studies	3	MUSC 150 or ART 150	3
ECON/POSC/SOC/PSYC	3	ENGL 150	3
HIST 150	3	Research	1
	15-17		**16-17**

Total Credits: 128-131

Bachelor of Arts in Environmental Science

First Year

Fall	**Credits**	**Spring**	**Credits**
ENSC 101	3	CHEM 102	3
CHEM 101	3	CHEM 104	1
CHEM 103	1	BIOL 112	3
BIOL 111	3	BIOL 192	1
BIOL 191	1	MATH 156 or 186	4
MATH 155 or 185	4	SCI 101	1
SCI 100	1	RELS 110 or ENGL 110	3
	16		**16**

Second Year

Fall	**Credits**	**Spring**	**Credits**
BIOL 223	3	MATH 336	3
BIOL 293	1	PHP 418	3
CHEM 319	3	ECON/POSC/SOC/PSYC 150	3
CHEM 323	2	Modern Language	3
Modern Language	3	CMPT 155	3

ENGL 110 (or RELS 110)	3		
	15		**15**

Third Year

Fall	**Credits**	**Spring**	**Credits**
ENSC 301	3	ENSC 302	4
CHEM 302	5	PHYS 108	3
Free Elective	3	PHYS 194	1
PHYS 193	1	PHIL 150	3
PHYS 107	3	RELS Catholic Studies	3
		PHIL 213 or LLRN 102	3
	15		**17**

Fourth Year

Fall	**Credits**	**Spring**	**Credits**
Major Elective	3-4	Major Elective	3-4
2 Free Electives	6	RELS Contemporary Global	3
ECON/POSC/SOC/PSYC 150	3	MUSC or ART 150	3
HIST 150	3	Free Elective	3
		ENGL 150	3
	15-16		**15-16**

Total Credits: 124-126