

# Biochemistry & Chemistry

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Dr. Yelda Hangun-Balkir  
Chair of the Department

The goals of the chemistry and biochemistry department are to provide a program which emphasizes the basic understanding of the constituents of matter, its transformations and the chemical principles involved therein. The department 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

The Department of Chemistry and Biochemistry offers the following programs:

- 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

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	3
MATH 186	Calculus II	3
MATH 285	Calculus III	3
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

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**Total Credits** **66**

The chemistry department 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.

## 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 & BIOL 112	General Biology I and General Biology II	8
BIOL 113 & BIOL 114	General Biology I Laboratory and General Biology II Laboratory	0
BIOL 217	Genetics	4
BIOL 218	Genetics - Lab	0
MATH 185	Calculus I	3
MATH 186	Calculus II	3
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 <sup>1</sup>		3
<b>Total Credits</b>		<b>79</b>

<sup>1</sup> *The advanced biology elective should be chosen from the following courses: BIOL 225 Microbiology, BIOL 320 Animal Physiology, BIOL 321 Molecular Cell Biology, BIOL 405 Neurobiology, or BIOL 426 Immunology.*

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	3
MATH 186	Calculus II	3
MATH 285	Calculus III	3
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:		16
CHEM 302	Analytical Chemistry	
CHEM 309	Physical Chemistry I	
CHEM 310	Physical Chemistry II	
CHEM 311	Physical Chemistry Laboratory	
Chemistry Elective (300 or 400 level Chemistry course)		3-5
<b>Total Credits</b>		<b>54-56</b>

## 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 & BIOL 112	General Biology I and General Biology II	8

BIOL 113 & BIOL 114	General Biology I Laboratory and General Biology II Laboratory	0
BIOL 217	Genetics	4
BIOL 218	Genetics - Lab	0
MATH 185	Calculus I	3
MATH 186	Calculus II	3
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:		21
CHEM 302	Analytical Chemistry	
CHEM 309	Physical Chemistry I	
CHEM 433	Biochemistry I	
CHEM 434	Biochemistry of Cellular Processes	
CHEM 436	Biochemistry Laboratory	
CHEM 457	Nucleic Acid Biochemistry	
CHEM 459	Nucleic Acids BioChemistry Lab	

**Total Credits** **65**

## Minor in Chemistry

Students should complete the following courses (or their corresponding Honors Course) in the Department of Chemistry and Biochemistry for the minor in Chemistry. 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 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

One additional course selected from CHEM 302, CHEM 309, CHEM 310, CHEM 335 or CHEM 421 or CHEM 433. 3

## Minor in Biochemistry

Students should complete the following courses in the Department of Chemistry and Biochemistry 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 or CHEM 457	Biochemistry Laboratory Nucleic Acid Biochemistry	2

## 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	3	MATH 186	3
ENGL 110	3	RELS 110	3
SCI 100	1	LLRN 102 or PHIL 213	3
Social Sciences	3	MLL	3
MLL	3	SCI 101	1
	<b>17</b>		<b>17</b>

#### Second Year

Fall	Credits	Spring	Credits
CHEM 319	3	CHEM 320	3
CHEM 323	2	CHEM 324	2
MATH 285	3	CHEM 335	3
HIST 150	3	CHEM 336	2
ENGL 150	3	MATH 286	3
MUSC 150 or ART 150	3	PHIL 150	3
	<b>17</b>		<b>16</b>

#### Third Year

Fall	Credits	Spring	Credits
CHEM 302	5	CHEM 310	3
CHEM 309	3	CHEM 311	2
PHYS 101 & PHYS 191	4	PHYS 102 & PHYS 192	4
RELS Catholic Studies	3	CHEM 437	3
		RELS Global/Contemporary	3
	<b>15</b>		<b>15</b>

#### Fourth Year

Fall	Credits	Spring	Credits
CHEM 410	2	CHEM 452	5
Social Sciences	3	Electives <sup>1</sup>	11
Humanities Elective	3		

Electives <sup>1</sup>	9	
	<b>17</b>	<b>16</b>

**Total Credits: 130**

<sup>1</sup> For American Chemical Society Certification, 6 credits of electives must include CHEM 433 Biochemistry I and one other advanced chemistry course.

**Bachelor of Arts in Chemistry****First Year**

<b>Fall</b>	<b>Credits</b>	<b>Spring</b>	<b>Credits</b>
CHEM 101		3 CHEM 102	3
CHEM 103		1 CHEM 104	1
ENGL 110		3 Social Sciences	3
LLRN 102 or PHIL 213		3 MATH 186	3
MATH 185		3 RELS 110	3
SCI 100		1 MLL	3
MLL		3 SCI 101	1
	<b>17</b>		<b>17</b>

**Second Year**

<b>Fall</b>	<b>Credits</b>	<b>Spring</b>	<b>Credits</b>
CHEM 319		3 CHEM 320	3
CHEM 323		2 CHEM 324	2
CHEM 437		3 Electives <sup>1</sup>	3
MATH 285		3 ENGL 150	3
Electives <sup>1</sup>		3 PHIL 150	3
HIST 150		3 HSS	3
	<b>17</b>		<b>17</b>

**Third Year**

<b>Fall</b>	<b>Credits</b>	<b>Spring</b>	<b>Credits</b>
PHYS 101 & PHYS 191		4 PHYS 102 & PHYS 192	4
CHEM 302		5 Social Sciences	3
RELS Catholic Studies		3 MUSC 150 or ART 150	3
Electives <sup>1</sup>		3 Electives <sup>1</sup>	6
	<b>15</b>		<b>16</b>

**Fourth Year**

<b>Fall</b>	<b>Credits</b>	<b>Spring</b>	<b>Credits</b>
CHEM 309		3 CHEM 310	3
CHEM Elective		3 CHEM 311	2
RELS Global/Contemporary		3 HSS Elective	3
HSS Elective		3 Electives <sup>1</sup>	6

Electives <sup>1</sup>	3	
	<b>15</b>	<b>14</b>

**Total Credits: 128**

<sup>1</sup> 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**

<b>Fall</b>	<b>Credits</b>	<b>Spring</b>	<b>Credits</b>
CHEM 101		3 CHEM 102	3
CHEM 103		1 CHEM 104	1
BIOL 111		4 BIOL 112	4
BIOL 113		0 BIOL 114	0
MATH 185 <sup>1</sup>		3 MATH 186 <sup>1</sup>	3
ENGL 110		3 RELS 110	3
LLRN 102 or PHIL 213		3 Social Sciences	3
SCI 100		1 SCI 101	1
	<b>18</b>		<b>18</b>

**Second Year**

<b>Fall</b>	<b>Credits</b>	<b>Spring</b>	<b>Credits</b>
CHEM 319		3 CHEM 320	3
CHEM 323		2 CHEM 324	2
PHYS 101 & PHYS 191 <sup>2</sup>		4 CHEM 433	3
BIOL 217		4 PHYS 102 & PHYS 192 <sup>3</sup>	4
MLL		3 MLL	3
	<b>16</b>		<b>15</b>

**Third Year**

<b>Fall</b>	<b>Credits</b>	<b>Spring</b>	<b>Credits</b>
CHEM 302		5 CHEM 310	3
CHEM 309		3 CHEM 311	2
CHEM 457		3 CHEM 434	3
CHEM 436		2 PHIL 150	3
HIST 150		3 ADV BIOL Elective <sup>4</sup> CHEM 459	3-4 2
	<b>16</b>		<b>16-17</b>

**Fourth Year**

<b>Fall</b>	<b>Credits</b>	<b>Spring</b>	<b>Credits</b>
CHEM 437		3 CHEM 335	3



ENGL 150	3 MUSC 150 or ART 150	3
Electives <sup>5</sup>	6 Social Sciences	3
RELS Catholic Studies	3 RELS Global/Contemporary	3
	Electives	3
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	<b>15</b>	<b>15</b>

**Total Credits: 129-130**

- <sup>1</sup> *MATH 155 & MATH 156 may replace MATH 185 & MATH 186.*
- <sup>2</sup> *PHYS 107 & PHYS 197 may replace PHYS 101 & PHYS 191.*
- <sup>3</sup> *PHYS 108 & PHYS 198 may replace PHYS 102 & PHYS 192.*
- <sup>4</sup> *The advanced biology elective should be chosen from the following courses: BIOL 225 Microbiology, BIOL 320 Animal Physiology, BIOL 321 Molecular Cell Biology, BIOL 405 Neurobiology, or BIOL 426 Immunology.*
- <sup>5</sup> *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**

<b>Fall</b>	<b>Credits</b>	<b>Spring</b>	<b>Credits</b>
BIOL 111		4 BIOL 112	4
BIOL 113		0 BIOL 114	0
CHEM 101		3 CHEM 102	3
CHEM 103		1 CHEM 104	1
ENGL 110		3 Social Sciences	3
LLRN 102 or PHIL 213		3 RELS 110	3
SCI 100		1 SCI 101	1
MATH 185 <sup>1</sup>		3 MATH 186 <sup>1</sup>	3
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	<b>18</b>		<b>18</b>

**Second Year**

<b>Fall</b>	<b>Credits</b>	<b>Spring</b>	<b>Credits</b>
CHEM 319		3 CHEM 320	3
CHEM 323		2 CHEM 324	2
HIST 150		3 PHIL 150	3
BIOL 217		4 CHEM 433	3
MLL		3 MLL	3
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	<b>15</b>		<b>14</b>

**Third Year**

<b>Fall</b>	<b>Credits</b>	<b>Spring</b>	<b>Credits</b>
PHYS 101 & PHYS 191 <sup>2</sup>		4 CHEM 434	3

CHEM 457	3 PHYS 102 & PHYS 192 <sup>3</sup>	4
CHEM 436	2 CHEM 459	2
ENGL 150	3 Electives <sup>5</sup>	6-7
Electives <sup>4</sup>	3	
	<b>15</b>	<b>15-16</b>

**Fourth Year**

<b>Fall</b>	<b>Credits</b>	<b>Spring</b>	<b>Credits</b>
CHEM 302		5 Social Sciences	3
CHEM 309		3 RELS Global/Contemporary	3
MUSC 150 or ART 150		3 Electives	9-10
RELS Catholic Studies		3	
Electives		3	
	<b>17</b>		<b>15-16</b>

**Total Credits: 127-129**

- <sup>1</sup> MATH 155 & MATH 156 may replace MATH 185 & MATH 186.
- <sup>2</sup> PHYS 107 & PHYS 197 may replace PHYS 101 & PHYS 191.
- <sup>3</sup> PHYS 108 & PHYS 198 may replace PHYS 102 & PHYS 192.
- <sup>4</sup> 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. CHEM 456 Advanced Topics in Biochemistry is highly recommended as a natural science elective for all biochemistry majors.
- <sup>5</sup> Total credit count could vary due to natural science electives in biology that include a laboratory component.