

III. CHEMISTRY AND BIOCHEMISTRY

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American Chemical Society Certification

As an approved program of the American Chemical Society, the Department of Chemistry and Biochemistry is able to offer B.S. degrees in both Chemistry and Biochemistry Certified by the American Chemical Society. The certification requirements go beyond the requirements for the college's B.S. degrees.

Guidelines for Chemistry Courses

General Chemistry I and II are standard, college-level chemistry courses for science majors and some health programs. CHEM 105, General Chemistry I has a prerequisite of high school chemistry. If you have not taken high school chemistry, you cannot enroll in General Chemistry I. You should instead take CHEM 101 Introduction to College Chemistry. CHEM 101 uses the same text as CHEM 105 General Chemistry I, but moves slower, and focuses more intentionally on the mathematics necessary for success in General Chemistry. CHEM 101 does not have a lab component and therefore does not meet QuEST requirements. It is offered in the fall semester.

There are two placement options for General Chemistry I. The preferred option is the completion of a preparatory course through the ALEKS learning platform. This course must be completed in full by the Friday before you arrive on campus. An email will be sent to all students registered for CHEM 105 by the end of June with instructions regarding this course. For those students not completing the preparatory course, the Toledo Placement Exam of the American Chemical Society will be administered 8:00 AM on Monday of new student orientation. This exam contains a total of 60 questions: 20 are entirely mathematics, 20 are from general chemistry knowledge, and 20 are from specific chemistry content. A score of 35, out of 60, is sufficient for continued enrollment in General Chemistry I, CHEM 105. You may also remain in CHEM 105 if your score is between 28-34 AND you have at least 14 of 20 points from the math portion of the exam. Those of you who do not earn this score will be required to enroll in Introduction to College Chemistry (CHEM 101). This course will prepare you well for General Chemistry I. The student needing CHEM 101 and his or her advisor will be notified before advising sessions on Monday afternoon of new student orientation.

More information regarding this placement exam can be found at:

http://www.messiah.edu/info/20201/departments_of_chemistry_and_biochemistry/566/general_chemistry_placement_exam

If you have any reason to suspect that your preparation in high school chemistry and algebra is less than adequate, it would be advisable to not schedule another non-chemistry course during the period CHEM 101, Introduction to College Chemistry, will be offered. CHEM 101 is offered MWF, 11:00 – 11:50. This will make the shift into that course, should it be required, very easy.

Guidelines for Mathematical Sciences Courses

MATH 108 and MATH 111 are both entry-level calculus courses. The distinction between the two is that MATH 111 is a 4-credit course that includes trigonometry (generally needed by the science student) and prepares students for subsequent courses in mathematics. MATH 108 is a 3-credit course that emphasizes applications of calculus in science and industry, without discussion of trigonometric functions.

STAT 269 is an introductory statistics course, with a prerequisite of two years of high school algebra. Students who have taken a course in calculus should consider STAT 291 instead, a calculus-based statistics course that counts toward the Statistics minor.

Chemistry, Chemistry with Teaching Certification and Biochemistry Majors:

These majors require MATH 111, which should be taken in the first year. Each of these majors has

additional mathematical sciences requirements, generally taken in the second semester, or perhaps in the second year.

Students with Advanced Placement credit:

Requirements in General Chemistry can be met through Advanced Placement exam credit. See the Registrar's AP credit page for further information.

https://www.messiah.edu/info/22478/transfer_ap_clep_courses/2107/apclepib_equivalencies/2

Requirements for courses in mathematical sciences can be met through Advanced Placement exam credit. Students who have taken AP exams in calculus, computer science, or statistics should go to the math department's website (www.messiah.edu/departments/mathsci/courses/ap_credit.html) to find out how credit is awarded for your scores.

**Suggested Four-Year Programs of Study
Biochemistry (B.A.)
8 Semester Plan**

Course #	Course name	Credits	Course #	Course name	Credits
First Year – Fall			First Year – Spring		
IDFY 101	First Year Seminar*	3	IDCR 151	Created/Called for Community*	3
CHEM 105	General Chemistry	4	STAT 269 or MATH 112	Introductory Statistics OR Calculus II (4)	3-4
MATH 111	Calculus I	4	CHEM 106	General Chemistry II	4
BIOL 160	Molecular & Cellular Biology	4	Varies	1 st Language*	3
			COMM 105	Introduction to Oral Communication*	3
TOTAL		15	TOTAL		16-17
Sophomore – Fall			Sophomore – Spring		
CHEM 309	Organic Chemistry I	4	Varies	3 rd language or Cross Cultural*	3
CHEM 221	Chemical Analysis I (optional this term)	4	PHYS 211	General Physics I (optional)	4
BIOL 260	Genetics & Development (science elective)	4	CHEM 310	Organic Chemistry II	4
PHIL 101/102	Philosophy*	3	BIBL 20x	Knowledge of the Bible*	3
Varies	2 nd Language*	3	WELL 1xx	Wellness *	1
TOTAL		18	TOTAL		15
Junior – Fall			Junior – Spring		
CHEM 410	Biochemistry I	4	CHEM 409	Advanced Organic Chemistry**	3
PHYS 211/212/201	General Physics I, II or Intro to Physics I	4	PHYS 202/212	Introduction to Physics II or General Physics II (optional)	4
Varies	1 st History/Social Science*	3	Varies	2 nd History/Social Science*	3
ENGL xxx	Literature*	3	CHEM 412	Biochemistry II**	4
			CHEM 390	Junior Chemistry Seminar	1
			CHEM 393	Research Methods (optional)	1
TOTAL		14	TOTAL		16
Senior – Fall			Senior – Spring		
Varies	Science Elective	3-4	CHEM 495	Natural Sciences Capstone	3
CHEM 437	Physical Chemistry I**	3.5	Varies	Art, Theatre, Music or Dance*	3
CHEM 422	Senior Research (optional)	3	IDS xxx	Ethics/Word Views/Pluralism*	3
IDNW xxx	Non-Western Studies*	2-3	Varies	Electives	6
THEO 20x	Christian Beliefs*	3			
CHEM 490	Senior Chemistry Seminar	1			
TOTAL		15.5- 17.5	TOTAL		15

*QuEST requirement

**Interchangeable between Junior and Senior years.

Biochemistry (B.S.) 8 Semester Plan

Course #	Course name	Credits	Course #	Course name	Credits
First Year – Fall			First Year – Spring		
IDFY 101	First Year Seminar*	3	IDCR 151	Created/Called for Community*	3
CHEM 105	General Chemistry	4	MATH 112	Calculus II	4
MATH 111	Calculus I	4	CHEM 106	General Chemistry II	4
BIOL 160	Molecular & Cellular Biology	4	Varies	1 st Language*	3
			COMM 105	Introduction to Oral Communication*	3
	TOTAL	15		TOTAL	17
Sophomore – Fall			Sophomore – Spring		
CHEM 309	Organic Chemistry I	4	Varies	3 rd language or Cross Cultural*	3
CHEM 221	Chemical Analysis I (optional this term)	4	PHYS 211	General Physics I	4
BIOL 260	Genetics & Development	4	CHEM 310	Organic Chemistry II	4
PHIL 101/102	Philosophy*	3	BIBL 20x	Knowledge of the Bible*	3
Varies	2 nd Language*	3	WELL 1xx	Wellness Activity Course*	1
	TOTAL	18		TOTAL	15
Junior – Fall			Junior – Spring		
CHEM 410	Biochemistry I	4	CHEM 321	Chemical Analysis II**	4
Varies	1 st History/Social Science*	3	Varies	2 nd History/Social Science*	3
PHYS 212	General Physics II	4	CHEM 412	Biochemistry II**	4
ENGL xxx	Literature*	3	CHEM 393	Research Methods (optional)	1
THEO 20x	Christian Beliefs *	3	CHEM 390	Junior Chemistry Seminar	1
				Elective	3
	TOTAL	17		TOTAL	16
Senior – Fall			Senior – Spring		
BIOL xxx	Advanced Biology Elective**	4	BIOL xxx	Recommended biology course (optional)	4
CHEM 437	Physical Chemistry I**	3.5	CHEM 495	Natural Sciences Capstone	3
CHEM 422	Senior Research (optional)	2	Varies	Art, Theatre, Music or Dance*	3
IDSW xxx	Non-Western Studies*	2-3	Varies	Elective	3
CHEM 490	Senior Chemistry Seminar	1	CHEM 422	Senior Research (optional)	1
IDS xxx	Ethics/World Views/Pluralism*	3			
	TOTAL	15.5- 16.5		TOTAL	14

*QuEST requirement

**Interchangeable between Junior and Senior years.

**Biochemistry (B.S.) ACS Certified
8 Semester Plan**

Course #	Course name	Credits	Course #	Course name	Credits
First Year – Fall			First Year – Spring		
IDFY 101	First Year Seminar*	3	IDCR 151	Created/Called for Community*	3
CHEM 105	General Chemistry	4	MATH 112	Calculus II	4
MATH 111	Calculus I	4	CHEM 106	General Chemistry II	4
BIOL 160	Molecular & Cellular Biology	4	Varies	1 st Language*	3
			COMM 105	Introduction to Oral Communication*	3
TOTAL		15	TOTAL		17
Sophomore – Fall			Sophomore – Spring		
CHEM 309	Organic Chemistry I	4	Varies	3 rd language or Cross Cultural*	3
CHEM 221	Chemical Analysis I (optional this term)	4	PHYS 211	General Physics I	4
BIOL 260	Genetics & Development	4	CHEM 310	Organic Chemistry II	4
PHIL 101/102	Philosophy*	3	BIBL 20x	Knowledge of the Bible*	3
Varies	2 nd Language*	3	WELL 1xx	Wellness Activity Course*	1
TOTAL		18	TOTAL		15
Junior – Fall			Junior – Spring		
CHEM 410	Biochemistry I	4	CHEM 321	Chemical Analysis II**	4
Varies	1 st History/Social Science*	3	Varies	2 nd History/Social Science*	3
PHYS 212	General Physics II	4	CHEM 412	Biochemistry II**	4
ENGL xxx	Literature*	3	Varies	Elective	3
THEO 20x	Christian Beliefs *	3	CHEM 393	Research Methods	1
			CHEM 390	Junior Chemistry Seminar	1
TOTAL		17	TOTAL		16
Senior – Fall			Senior – Spring		
BIOL xxx	Advanced Biology Elective**	4	CHEM xxx	Advanced Chemistry Elective**	3-3.5
CHEM 437	Physical Chemistry I**	3.5	CHEM 495	Natural Sciences Capstone	3
CHEM 422	Senior Research	2	Varies	Art, Theatre, Music or Dance*	3
IDSW xxx	Non-Western Studies*	2-3	CHEM 422	Senior Research	1
CHEM 490	Senior Chemistry Seminar	1	IDS xxx	Ethics/World Views/Pluralism*	3
CHEM 361	Inorganic Chemistry**	4	BIOL xxx	Recommended biology course (optional)	
TOTAL		16.5- 17.5	TOTAL		13 – 13.5

*QuEST requirement

**Interchangeable between Junior and Senior years

Biochemistry (B.A.)/PharmD

6 Semester Plan

Course #	Course name	Credits	Course #	Course name	Credits
First Year – Fall			First Year – Spring		
IDFY 101	First Year Seminar*	3	BIOL 161	Animal Form and Function	3
CHEM 105	General Chemistry I	4	IDCR 151	Created/Called for Community*	3
MATH 111	Calculus I	4	PHIL 101/102	Philosophy*	3
BIOL 160	Molecular & Cellular Biology	4	CHEM 106	General Chemistry II	4
Varies	1 st Language*	3	Varies	2 nd Language*	3
		TOTAL			16
Sophomore – Fall			Sophomore – Spring		
CHEM 309	Organic Chemistry I	4	ENGL xxx	Literature*	3
SOCI 101	Principles of Sociology*	3	CHEM 310	Organic Chemistry II	4
CHEM 221	Chemical Analysis I	4	PHYS 202	Introductory Physics II	4
BIBL 20x	Knowledge of the Bible*	3	HIST xxx	History*	3
PHYS 201	Introductory Physics I	4	CHEM 390	Junior Chemistry Seminar	1
			Varies	3 rd Language or Cross Cultural*	3
		TOTAL			18
Junior – Fall			Junior – Spring		
ART xxx	Art*	3	IDNW xxx	Non-western Studies*	2-3
CHEM 410	Biochemistry I	4	CHEM 495	Capstone: Natural Sciences	3
CHEM 490	Senior Chemistry Seminar	1	THEO xxx	Christian Beliefs*	3
BIOL 386	Human Anatomy	4	CHEM 412	Biochemistry II	4
WELL 1xx	Wellness Activity Course*	1	BIOL 382	Microbiology for Health Professions	4
IDST xxx	Ethics/World Views/Pluralism*	3			
		TOTAL			16-17

*QuEST requirement

The Oral Communication course is missing from this three-year plan. This course can be taken during the first year at the University of the Sciences and transferred back in for the Messiah College degree. Other options include taking it, or another required course, over the summer.

Chemistry (B.A) 8 Semester Plan

Course #	Course name	Credits	Course #	Course name	Credits
First Year – Fall			First Year – Spring		
CHEM 105	General Chemistry I	4	CHEM 106	General Chemistry II	4
MATH 111	Calculus I	4	MATH 112	Calculus II	4
IDFY 101	First Year Seminar*	3	IDCR 151	Created and Called for Community*	3
Varies	1 st Language*	3	COMM 105	Oral Communications*	3
			Varies	2 nd Language*	3
TOTAL		14	TOTAL		17
Sophomore – Fall			Sophomore – Spring		
CHEM 309	Organic Chemistry I	4	CHEM 310	Organic Chemistry II	4
CHEM 221	Chemical Analysis I	4	PHYS 211/212	General Physics I or General Physics II	4
Varies	1 st History/Social Science*	3	Varies	3 rd Language / Cross Cultural*	3
BIBL 2xx	Knowledge of the Bible*	3	Varies	2 nd History/Social Science*	3
PHYS 211	General Physics I (optional)	4	WELL 1xx	Wellness Activity Course*	1
TOTAL		18	TOTAL		16
Junior – Fall			Junior – Spring		
CHEM 437	Physical Chemistry I	3.5	CHEM 3xx	Chemistry Elective**	3-4
PHYS 212	General Physics II (optional)	4	CHEM 393	Research Methods (optional)	1
PHIL 101/102	Philosophy*	3	CHEM 390	Junior Chemistry Seminar	1
Varies	Elective	3	ENGL xxx	Literature*	3
THEO 2xx	Christian Beliefs*	3	IDSW xxx	Non-Western Studies*	2-3
			Varies	Electives	6
TOTAL		16.5	TOTAL		17-18
Senior – Fall			Senior – Spring		
CHEM 3xx	Chemistry Elective**	4	CHEM 3xx	Chemistry Elective**	3-4
CHEM 422	Senior Research (optional)	3	CHEM 495	Natural Sciences Capstone	3
CHEM 490	Senior Chemistry Seminar	1	IDS xxx	Ethics/World Views/Pluralism*	3
Varies	Elective	3	Varies	Electives	6
Varies	Art, Theatre, Music or Dance*	3			
TOTAL		14	TOTAL		15-16

*QuEST requirement

**Interchangeable between Junior and Senior years

Chemistry (B.S.) 8 Semester Plan

Course #	Course name	Credits	Course #	Course name	Credits
First Year – Fall			First Year – Spring		
CHEM 105	General Chemistry I	4	CHEM 106	General Chemistry II	4
MATH 111	Calculus I	4	MATH 112	Calculus II	4
IDFY 101	First Year Seminar*	3	IDCR 151	Created and Called for Community*	3
Varies	1 st Language*	3	COMM 105	Oral Communications*	3
			Varies	2 nd Language*	3
TOTAL		14	TOTAL		17
Sophomore – Fall			Sophomore – Spring		
CHEM 309	Organic Chemistry I	4	CHEM 310	Organic Chemistry II	4
CHEM 221	Chemical Analysis I	4	PHYS 211/222	General Physics I or General Physics II	4
Varies	1 st History/Social Science*	3	MATH 2xx	Linear and Differential Methods or Calculus III	3-4
BIBL 2xx	Encountering the Bible OT/NT*	3	WELL 1xx	Wellness Activity Course*	1
PHYS 211	General Physics I (optional)	4	Varies	3 rd Language / Cross Cultural*	3
TOTAL		18	TOTAL		15-16
Junior – Fall			Junior – Spring		
CHEM 437	Physical Chemistry I**	3.5	CHEM 438	Physical Chemistry II**	3.5
CHEM 361	Inorganic Chemistry**	4	CHEM 393	Research Methods (optional)	1
PHYS 212	General Physics II (optional)	4	CHEM 390	Junior Chemistry Seminar	1
PHIL 101/102	Philosophy*	3	CHEM 321	Chemistry Analysis II**	4
			IDSW xxx	Non-Western Studies*	2-3
			Varies	2 nd History/Social Science*	3
TOTAL		14.5	TOTAL		14.5-15.5
Senior – Fall			Senior – Spring		
CHEM 410	Biochemistry I or Elective**	4	CHEM 342	Advanced Synthesis Lab**	3
CHEM 422	Senior Research (optional)	3	CHEM 495	Natural Sciences Capstone	3
CHEM 490	Senior Chemistry Seminar	1	IDS xxx	Ethics/World View/Pluralism*	3
THEO 2xx	Christian Beliefs*	3	Varies	Electives	6
Varies	Art, Theatre, Music or Dance*	3			
ENGL xxx	Literature*	3			
TOTAL		17	TOTAL		14

*QuEST requirement

**Interchangeable between Junior and Senior years

**Chemistry (B.S.) ACS Certified
8 Semester Plan**

Course #	Course name	Credits	Course #	Course name	Credits
First Year – Fall			First Year – Spring		
CHEM 105	General Chemistry I	4	CHEM 106	General Chemistry II	4
MATH 111	Calculus I	4	MATH 112	Calculus II	4
IDFY 101	First Year Seminar*	3	IDCR 151	Created and Called for Community*	3
Varies	1 st Language*	3	COMM 105	Oral Communications*	3
			Varies	2 nd Language*	3
TOTAL		14	TOTAL		17
Sophomore – Fall			Sophomore – Spring		
CHEM 309	Organic Chemistry I	4	CHEM 310	Organic Chemistry II	4
CHEM 221	Chemical Analysis I	4	PHYS 211/212	General Physics I or General Physics II	4
Varies	1 st History/Social Science*	3	MATH 2xx	Linear and Differential Methods or Calculus III	3-4
BIBL 2xx	Encountering the Bible OT/NT*	3	WELL 1xx	Wellness Activity Course*	1
PHYS 211	General Physics I (optional this term)	3	Varies	3 rd Language / Cross Cultural*	3
TOTAL		17	TOTAL		15-16
Junior – Fall			Junior – Spring		
CHEM 437	Physical Chemistry I	3.5	CHEM 438	Physical Chemistry II**	3.5
CHEM 361	Inorganic Chemistry**	4	CHEM 393	Research Methods	1
PHYS 212	General Physics II (optional this term)	4	CHEM 390	Junior Chemistry Seminar	1
PHIL 101/102	Philosophy*	3	CHEM 321	Chemistry Analysis II**	4
Varies	2 nd History/Social Science*	3	IDSW xxx	Non-Western Studies*	2-3
				Elective	3-4
TOTAL		17.5	TOTAL		14.5-16.5
Senior – Fall			Senior – Spring		
CHEM 410	Biochemistry I	4	CHEM 342	Advanced Synthesis Lab**	3
CHEM 422	Senior Research	2	CHEM 495	Natural Sciences Capstone	3
CHEM 490	Senior Chemistry Seminar	1	IDS xxx	Ethics/World View/Pluralism*	3
THEO 2xx	Christian Beliefs*	3		Electives	6
Varies	Art, Theatre, Music or Dance*	3	CHEM 422	Senior Research	1
ENGL xxx	Literature*	3			
TOTAL		16	TOTAL		16

*QuEST requirement

**Interchangeable between Junior and Senior years

Chemistry (B.A.) with Teaching Certification 8 Semester Plan

Course #	Course name	Credits	Course #	Course name	Credits
First Year – Fall			First Year – Spring		
CHEM 105 ^a	General Chemistry I	4	CHEM 106	General Chemistry II	4
MATH 111 ^a	Calculus I	4	MATH 112	Calculus II	4
COMM 105	Oral Communication*	3	ENGL122-176a	Literature	3
IDFY 101	First Year Seminar*	3	ESS 201	Earth and Space Science	3
Varies	1 st Language*	3	IDCR 151	Created and Called for Community*	3
		TOTAL			17
Sophomore – Fall			Sophomore – Spring		
CHEM 221	Chemical Analysis I	4	CHEM 310	Organic Chemistry II	4
CHEM 309	Organic Chemistry I	4	PHYS 211	General Physics I	4
EDUC 201	Education and American Society	3	EDSP 207 ^c	Intro to Special Ed	3
Varies	2 nd Language*	3	EDUC 203 ^c	Educational Psychology	3
BIBL 2xx	Encountering the Bible*	3	TEP 210 ^c	Soph. Field Experience	0
			Varies	3 rd language or Cross Cultural	3
		TOTAL			17
Junior – Fall			Junior – Spring		
CHEM 437	Physical Chemistry I**	3.5	CHEM xxx	Chemistry Elective	3-4
CHEM xxx	Chemistry Elective	4	CHEM 390	Junior Chemistry Seminar	1
PHYS 212	General Physics II	4	ENGL 330 ^c	TESOL Methodology	3
Varies	1 st History/Social Science*	3	EDUC 331 ^c	Instructional Design/ Assessment	3
WELL 1xx	Wellness Activity Course*	1	EDSP 307 ^c	Inclusion Practices	3
			EDUC 310 ^c	Junior Field Experience	0
			PHIL 101/102	Philosophy	3
		TOTAL			16-17
Senior – Fall			Senior – Spring		
CHEM xxx	Chemistry Elective	4	Professional Semester		
CHEM 495	Natural Sciences Capstone	3	HDFS 311	Adolescent Development	3
THEO 223	Global Christian Theology	3	TEP 435 ^c	Student Teaching	8
Varies	Art, Theatre, Music or Dance*	3	EDUC 420 ^c	Professional Issues in Education	2
EDUC 208	ELL Instruction	3	TEP 407 ^c	Secondary Science Curriculum/Instruction	1
CHEM 490	Senior Chemistry Seminar	1	TEP 410	Secondary Pre-student teaching	0
SCIE 407	Teaching Lab Sciences	1			
		TOTAL			14

*QuEST requirement

**Interchangeable between Junior and Senior years

^a Indicates requirement for admission to the TEP.

^c Indicates courses to be taken concurrently.