III. CHEMISTRY AND BIOCHEMISTRY

Contents

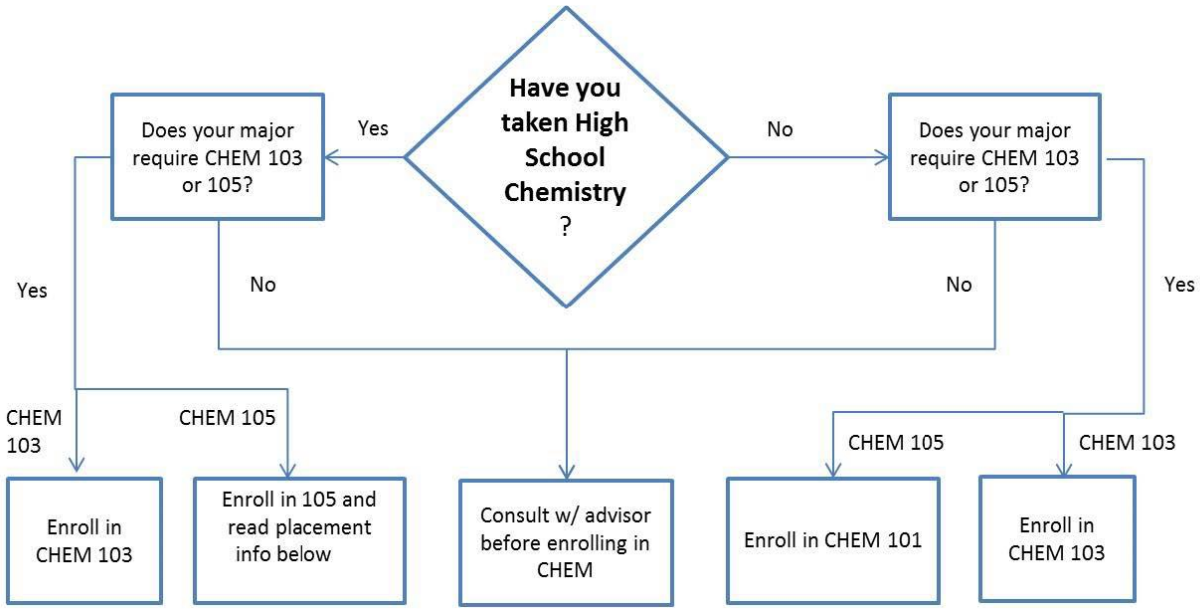
American Chemical Society Certification

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. In addition, all students will be given a 15 minute math readiness quiz on the first day of General Chemistry I lecture. For those students NOT completing the summer work, this quiz will serve as the placement vehicle for this course. Students who do not earn a sufficiently high score will be required to enroll in Introduction to College Chemistry (CHEM 101). For those students who have completed the summer work, performance on this math quiz will be used to advise students towards the path that will best insure their success. The CHEM 101 course will prepare you well for General Chemistry I. All students needing CHEM 101, as well as his or her advisor, will be notified before advising sessions on Monday afternoon of new student orientation.



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	MATH 111/103	Calculus I and Supplemental Calculus	4-5
PHIL 101/102	Philosophy*	3	CHEM 106	General Chemistry II	4
BIOL 170	Cell and Animal Physiology	4	Varies	1st Language*	3
			COMM 105	Introduction to Oral Communication*	3
	TOTAL	**14**		**TOTAL**	**17-18**
Sophomore – Fall			**Sophomore – Spring**		
CHEM 309	Organic Chemistry I	4	Varies	3rd language or Cross Cultural*	3
CHEM 221	Chemical Analysis I***	4	PHYS 211	General Physics I (optional)	4
BIOL 260	Genetics (science elective)	4	CHEM 310	Organic Chemistry II	4
Varies	2nd Language*	3	STAT 269 or MATH 112	Introductory Statistics **OR** Calculus II (4)	3-4
			WELL 1xx	Wellness *	1
	TOTAL	**15**		**TOTAL**	**15-16**
Junior – Fall			**Junior – Spring**		
CHEM 410	Biochemistry I	4	CHEM 409	Advanced Organic Chemistry**	3
PHYS 212/201	General Physics II or Intro to Physics I	4	PHYS 202	Introduction to Physics II (optional)	4
Varies	1st History/Social Science*	3	Varies	2nd History/Social Science*	3
ENGL xxx	Literature*	3	CHEM 412	Biochemistry II**	4
BIBL 20x	Knowledge of the Bible*	3	CHEM 390	Junior Chemistry Seminar	1
			SCIE 393	Research Methods (optional)	1
	TOTAL	**17**		**TOTAL**	**16**
Senior – Fall			**Senior – Spring**		
Varies	Science Elective	3-4	SCIE 495	Natural Sciences Capstone	3
CHEM 437	Physical Chemistry I**	3.5	Varies	Art, Theatre, Music or Dance*	3
CHEM 422	Junior/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.

***Interchangeable between Sophomore and Junior 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 111/103	Calculus I and Supplemental Calculus	4-5	CHEM 106	General Chemistry II	4
BIOL 170	Cell and Animal Physiology	4	Varies	1st Language*	3
			COMM 105	Introduction to Oral Communication*	3
	TOTAL	**15-16**		**TOTAL**	**17**
Sophomore – Fall			**Sophomore – Spring**		
CHEM 309	Organic Chemistry I	4	Varies	3rd language or Cross Cultural*	3
CHEM 221	Chemical Analysis I***	4	PHYS 211	General Physics I	4
BIOL 260	Genetics	4	CHEM 310	Organic Chemistry II	4
WELL 1xx	Wellness Activity Course*	1	BIBL 20x	Knowledge of the Bible*	3
Varies	2nd Language*	3	PHIL101/102	Philosophy*	3
	TOTAL	**16**		**TOTAL**	**17**
Junior – Fall			**Junior – Spring**		
CHEM 410	Biochemistry I	4	CHEM 321	Chemical Analysis II**	4
Varies	1st History/Social Science*	3	Varies	2nd History/Social Science*	3
PHYS 212	General Physics II	4	CHEM 412	Biochemistry II**	4
ENGL xxx	Literature*	3	SCIE 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	SCIE 495	Natural Sciences Capstone	3
CHEM 422	Junior/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	Junior/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.

***Interchangeable between Sophomore and Junior 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 111/103	Calculus I and Supplemental Calculus	4-5	CHEM 106	General Chemistry II	4
BIOL 170	Cell and Animal Physiology	4	Varies	1st Language*	3
			COMM 105	Introduction to Oral Communication*	3
	TOTAL	**15-16**		**TOTAL**	**17**
Sophomore – Fall			**Sophomore – Spring**		
CHEM 309	Organic Chemistry I	4	Varies	3rd language or Cross Cultural*	3
CHEM 221	Chemical Analysis I***	4	PHYS 211	General Physics I	4
BIOL 260	Genetics	4	CHEM 310	Organic Chemistry II	4
WELL 1xx	Wellness Activity Course*	1	BIBL 20x	Knowledge of the Bible*	3
Varies	2nd Language*	3	PHIL 101/102	Philosophy*	3
	TOTAL	**16**		**TOTAL**	**17**
Junior – Fall			**Junior – Spring**		
CHEM 410	Biochemistry I	4	CHEM 321	Chemical Analysis II**	4
Varies	1st History/Social Science*	3	Varies	2nd History/Social Science*	3
PHYS 212	General Physics II	4	CHEM 412	Biochemistry II**	4
ENGL xxx	Literature*	3	CHEM 361	Inorganic Chemistry**	4
THEO 20x	Christian Beliefs *	3	SCIE 393	Research Methods	1
			CHEM 390	Junior Chemistry Seminar	1
	TOTAL	**17**		**TOTAL**	**17**
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	SCIE 495	Natural Sciences Capstone	3
CHEM 422	Junior/Senior Research	2	Varies	Art, Theatre, Music or Dance*	3
IDSW xxx	Non-Western Studies*	2-3	CHEM 422	Junior/Senior Research	1
CHEM 490	Senior Chemistry Seminar	1	IDS xxx	Ethics/World Views/Pluralism*	3
Varies	Elective	3	BIOL xxx	Recommended biology course (optional)	
	TOTAL	**15.5-16.5**		**TOTAL**	**13 – 13.5**

*QuEST requirement

**Interchangeable between Junior and Senior years

***Interchangeable between Sophomore and Junior 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 172	Diversity of Life and Plant Science	4
CHEM 105	General Chemistry I	4	IDCR 151	Created/Called for Community*	3
STAT 269	Introductory Statistics	3	MATH 111/103	Calculus I and Supplemental Calculus	4-5
BIOL 170	Cell and Animal Physiology	4	CHEM 106	General Chemistry II	4
Varies	1st Language*	3	Varies	2nd Language*	3
	TOTAL	**17**		**TOTAL**	**18-19**
Sophomore – Fall			**Sophomore – Spring**		
CHEM 309	Organic Chemistry I	4	COMM 105	Fundamentals of Oral Communication*	3
SOAN 101 or PSYC 101	Principles of Sociology* or Introduction to Psychology	3	ECON 120 or 220	Macroeconomics or Microeconomics*	3
CHEM 221	Chemical Analysis I	4	CHEM 310	Organic Chemistry II	4
BIBL 20x	Knowledge of the Bible*	3	HIST xxx	History*	3
PHYS 201	Introductory Physics I	4	PHIL 101/102	Philosophy*	3
			Varies	3rd Language or Cross Cultural*	3
	TOTAL	**18**		**TOTAL**	**19**
Junior – Fall			**Junior – Spring**		
Varies	ART, MUGE, THEA fulfilling QuEST*	3	BIOL 265	Microbiology**	4
CHEM 410	Biochemistry I	4	BIOL 465	Gross Anatomy	4
BIOL 460	Physiology**	4	SCIE 495	Capstone: Natural Sciences	3
WELL 1xx	Wellness Activity Course*	1	IDNW xxx	Non-western Studies* (must be 3 credits)	3
IDST xxx	Ethics/World Views/Pluralism*	3	THEO xxx	Christian Beliefs*	3
ENGL xxx	Literature*	3			
	TOTAL	**18**		**TOTAL**	**17**

*QuEST requirement

** Exchangeable between semesters

1 extra free elective credit is required in this program. This could be another wellness activity course, or any other course transferred in or taken during 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 111/103	Calculus I and Supplemental Calculus	4-5	MATH 112	Calculus II	4
IDFY 101	First Year Seminar*	3	IDCR 151	Created and Called for Community*	3
Varies	1st Language*	3	COMM 105	Oral Communications*	3
			Varies	2nd Language*	3
	TOTAL	**14-15**		**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	General Physics I	4
Varies	1st History/Social Science*	3	Varies	3rd Language / Cross Cultural*	3
BIBL 2xx	Knowledge of the Bible*	3	Varies	2nd History/Social Science*	3
Varies	Elective	3	WELL 1xx	Wellness Activity Course*	1
	TOTAL	**15**		**TOTAL**	**15**
Junior – Fall			**Junior – Spring**		
CHEM 437	Physical Chemistry I	3.5	CHEM 3xx	Chemistry Elective**	3-4
PHYS 212	General Physics II	4	SCIE 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**	**16-18**
Senior – Fall			**Senior – Spring**		
CHEM 3xx	Chemistry Elective**	4	CHEM 3xx	Chemistry Elective**	3-4
CHEM 422	Junior/Senior Research (optional)	3	SCIE 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 111/103	Calculus I and Supplemental Calculus	4-5	MATH 112	Calculus II	4
IDFY 101	First Year Seminar*	3	IDCR 151	Created and Called for Community*	3
Varies	1st Language*	3	COMM 105	Oral Communications*	3
			Varies	2nd Language*	3
	TOTAL	**14-15**		**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	General Physics I	4
Varies	1st 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
Varies	Elective	3	Varies	3rd 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
PHYS 212	General Physics II	4	CHEM 390	Junior Chemistry Seminar	1
PHIL 101/102	Philosophy*	3	CHEM 321	Chemistry Analysis II**	4
Varies	2nd History/Social Science*	3	CHEM 361	Inorganic Chemistry**	4
SCIE 393	Research Methods (optional)	1	IDSW xxx	Non-Western Studies*	2-3
	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	Junior/Senior Research (optional)	3	SCIE 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**	**15**

*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 111/103	Calculus I and Supplemental Calculus	4-5	MATH 112	Calculus II	4
IDFY 101	First Year Seminar*	3	IDCR 151	Created and Called for Community*	3
Varies	1st Language*	3	COMM 105	Oral Communications*	3
			Varies	2nd Language*	3
	TOTAL	**14-15**		**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	General Physics I	4
Varies	1st 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
PHIL 101/102	Philosophy*	3	Varies	3rd 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
PHYS 212	General Physics II	4	CHEM 390	Junior Chemistry Seminar	1
Varies	Elective	3	CHEM 321	Chemistry Analysis II**	4
Varies	2nd History/Social Science*	3	CHEM 361	Inorganic Chemistry**	4
SCIE 393	Research Methods	1	IDSW xxx	Non-Western Studies*	2-3
	TOTAL	**14.5**		**TOTAL**	**14.5-15.5**
Senior – Fall			**Senior – Spring**		
CHEM 410	Biochemistry I	4	CHEM 342	Advanced Synthesis Lab**	3
CHEM 422	Junior/Senior Research	2	SCIE 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	Junior/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 111/103	Calculus I and Supplemental Calculus[a]	4-5	MATH 112	Calculus II[a]	4
COMM 105	Oral Communication[a]	3	ENGL122-176a	Literature[a]	3
IDFY 101	First Year Seminar[a]	3	Varies	2nd Language*	3
Varies	1st Language*	3	IDCR 151	Created and Called for Community*	3
	TOTAL	**17-18**		**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
PHIL 101/102	Philosophy*	3	EDSP 207[c]	Intro to Special Ed	3
GEOL 201	Foundations of Geology	4	EDUC 203[c]	Educational Psychology	3
BIBL 2xx	Encountering the Bible*	3	TEP 210[c]	Soph. Field Experience	0
			Varies	3rd language or Cross Cultural	3
	TOTAL	**18**		**TOTAL**	**17**
Junior – Fall			**Junior – Spring**		
CHEM 437	Physical Chemistry I**	3.5	CHEM xxx	Chemistry Elective	3-4
EDUC 346	Sociocultural Perspectives on Education	3	CHEM 390	Junior Chemistry Seminar	1
PHYS 212	General Physics II	4	WELL 1xx	Wellness Activity Course*	1
CHEM xxx	Chemistry Elective	4	EDUC 331[c]	Instructional Design/ Assessment	3
HDFS 311	Adolescent Development	3	EDSP 307[c]	Inclusion Practices	3
			TEP 310[c]	Junior Field Experience	0
			Varies	1st History/Social Science*	3
	TOTAL	**17.5**		**TOTAL**	**14-15**
Senior – Fall			**Senior – Spring**		
CHEM xxx	Chemistry Elective	4		Professional Semester	
SCIE 495	Natural Sciences Capstone	3	TEP 435[c]	Student Teaching	9
THEO 223	Global Christian Theology*	3	EDUC 420[c]	Professional Issues in Education	2
Varies	Art, Theatre, Music or Dance*	3	TEP 407[c]	Student Teaching Seminar	1
EDUC 208	ELL Instruction	3	TEP 410[c]	Secondary Pre-student teaching	0
SCIE 407	Teaching Lab Sciences	1			
	TOTAL	**17**		**TOTAL**	**12**

*QuEST requirement

**Interchangeable between Junior and Senior years

*QuEST Requirement

**Interchangeable between Junior and Senior years

[a] Indicates requirement for admission to the TEP.

[C] Indicates courses to be taken concurrently.