

# B.S. IN BIOCHEMISTRY/ MOLECULAR BIOLOGY

## B.S. in Biochemistry/Molecular Biology:

This major is the in-depth study of the chemical processes that underlie all living systems in the world. As a collaborative program of the Biological Sciences and Chemistry Departments, it is an ideal choice for students in the health sciences and in pre-professional programs such as medicine, dentistry, law, and pharmacy.

Code	Title	Credits
<b>Major in Biochemistry/Molecular Biology (B.S)</b>		
BIO 124 & BIO 124D	Integrative Biology: Genes, Cells, Change and Integrative Biology: Genes, Cells, Change Lab	4
BIO 128 & BIO 128D	Integrative Biology: Metabolism, Energy, Biodiversity and Integrative Biology: Metabolism, Energy, Biodiversity Lab	4
BIO 332 & BIO 333	Genetics and Genetics Lab	4
BIO 354 & BIO 355	Cell Biology and Cell Biology Lab <sup>3</sup>	4
BIO 396 & BIO 397	Molecular Biology and Molecular Biology Lab <sup>3</sup>	4
Choose one of the following courses: 4		
BIO 388 & BIO 389	Biochemistry I and Biochemistry I Lab	
Or		
CHE 388 & CHE 389	Biochemistry I and Biochemistry I Lab	
Choose one of the following: 4-8		
CHE 113 & CHE 113D & CHE 214 & CHE 215	General Chemistry I and General Chemistry I Lab and General Chemistry II and General Chemistry II Lab	
Or		
CHE 208 & CHE 208D	Accelerated General Chemistry and Accelerated General Chemistry Lab	
CHE 224 & CHE 225	Organic Chemistry I and Organic Chemistry I Lab	4

CHE 226 & CHE 227	Organic Chemistry II and Organic Chemistry II Lab	4
CHE 312 & CHE 313	Quantitative Analysis and Quantitative Analysis Lab	4
CHE 344 & CHE 345	Thermodynamics, Kinetics, and Statistical Mechanics and Thermodynamics, Kinetics, and Statistical Mechanics Lab	4
CHE 396 & CHE 397	Biochemistry II and Biochemistry II Lab	4
MAT 124M	Calculus 1	4
MAT 125	Calculus 2	4
PHY 292 & PHY 292D	General Physics I and General Physics I Lab	4
PHY 296 & PHY 297	General Physics II and General Physics II Lab	4
Choose one of the following courses: 4		
BIO 399 & BIO 495 & BIO 496 & BIO 499	Introduction to Research and Biology Seminar and Biology Research and Biology Symposium	
Or		
CHE 395 & CHE 490 & CHE 494	Chemistry Seminar: Research and Professional Development and Chemistry Seminar: Research and Chemistry Seminar: Research Presentation	
<b>Code</b>	<b>Title</b>	<b>Credits</b>
Major <sup>*,1</sup>		68-72
General Education		49-50
Electives		0-5
<b>Total Credits</b>		<b>122</b>

<sup>1</sup> BIO234 is recommended.

<sup>2</sup> Biochemistry/Molecular Biology students who select Chemistry Seminar will qualify for the ACS-accredited degree by completing CHE364/ CHE365 in addition to those required by the major. Completing any additional 300-level chemistry course (including CHE364/CHE365) also completes the requirements for a Chemistry B.A.

<sup>3</sup> This is a designated research course.

\* Courses whose number is followed by a letter fulfill a General Education requirement.

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## B.S. in Biochemistry/Molecular Biology 2018-2019: Option 1 - CWILT

### First Year

Fall	Credits	Interim	Credits	Spring	Credits
BIO 124 & BIO 124D Integrative Biology: Genes, Cells, Change and Integrative Biology: Genes, Cells, Change Lab	4	GES 160 Inquiry Seminar	3	BIO 128 & BIO 128D Integrative Biology: Metabolism, Energy, Biodiversity and Integrative Biology: Metabolism, Energy, Biodiversity Lab	4
CHE 113 & CHE 113D (or CHE208/Accelera General Chemistr Lab) <sup>1,3</sup> General Chemistr I Lab	4			CHE 214 & CHE 215 (or elective if CHE208/was taken in fall) <sup>3</sup> General Chemistr II General Chemistr II Lab	4
MAT 124M <sup>1</sup> Calculus 1	4			MAT 125 Calculus 2	4
GES 140 Introduct to Wellbein	3			GES 130 Christian Western Culture	4
	15		3		16

### Second Year

Fall	Credits	Interim	Credits	Spring	Credits
CHE 224 & CHE 225 Organic Chemistry I and Organic Chemistry I Lab	4	BIB 101 Introduction to the Bible	3	CHE 226 & CHE 227 Organic Chemistry II and Organic Chemistry II Lab	4
PHY 292 & PHY 292D General Physics I and General Physics I Lab	4			PHY 296 & PHY 297 General Physics II and General Physics II Lab	4
GES 125 Introduction to the Creative Arts	4			CHE 312 & CHE 313 Quantitative Analysis and Quantitative Analysis Lab	4
				Second Language (S) course <sup>2</sup>	4
	12		3		16

### Third Year

Fall	Credits	Interim	Credits	Spring	Credits
BIO 332 & BIO 333 Genetics and Genetics Lab	4	Science, Technology and Society (K) course	3	BIO 354 & BIO 355 Cell Biology and Cell Biology Lab	4
BIO 388 & BIO 389 Biochem I and Biochem I Lab	4			CHE 396 & CHE 397 Biochem II and Biochem II Lab	4

CHE 344 & CHE 345 Thermodynamics, Kinetics, and Statistical Mechanics and Thermodynamics, Kinetics, and Statistical Mechanics Lab	4	Biology or Chemistry Seminar/Research <sup>4</sup>	1
THE 201 Christian Theology	3	Contemp Western Life and Thought (L) course	3
Biology or Chemistry Seminar/Research <sup>4</sup>	1		
	16	3	12

**Fourth Year**

Fall	Credits	Interim	Credits	Spring	Credits
Biology or Chemistry Seminar/Research <sup>4</sup>	1	Interim Off		BIO 396 & BIO 397 Molecular Biology and Molecular Biology Lab	4
Elective (BIO224/recommen	4			Biology or Chemistr Seminar/Research <sup>4</sup>	1
World Cultures (U) course	3			Comparative Systems (G) course	3
Interpreti Biblical Themes (J) course	3			Contemp Christian Issues (P) course	3

Leisure and Lifetime Sports (Q) course	1	Elective	3
Cross Cultural Experi (Z) course	0-3	Artistic Experi (A) course	0-3
	12-15	0	14-17

Total Credits 122-128

- <sup>1</sup> This program assumes a student will use CHE 113D and MAT 124M to meet the general education laboratory science and Mathematics requirements.
- <sup>2</sup> Students must complete through the second semester of a first year language course or equivalent.
- <sup>3</sup> CHE 208/CHE 208D is a one-semester course that meets the requirements for CHE 113/CHE 113D and CHE 214/CHE 215. Students taking CHE 208/CHE 208D may choose an elective in the spring of their freshmen year.
- <sup>4</sup> Choose either the Biology Seminar/Research series (BIO 339, BIO 495, BIO 496, BIO 499) or Chemistry Seminar/Research series (CHE 395, CHE 490 and CHE 494). Students pursuing the ACS-accredited B.S. must complete the chemistry series.

Most financial aid packages stipulate 12 credits/semester; Minnesota state grants reduced when credit load falls below 15 credits/semester. (Interim credits may be split between fall and spring for state grant purposes only.)

## B.S. in Biochemistry/Molecular Biology 2018-2019: Option 2 - Humanities

### First Year

Fall	Credits	Interim	Credits	Spring	Credits
CHE 113 & CHE 113D (or CHE208/208D Accelerated General Chemistry/Lab) <sup>1,3</sup>	4	GES 147 Humanities II: Renaissance and Reformation	4	BIO 128 & BIO 128D Integrative Biology: Metabolism, Energy, Biodiversity and Integrative Biology: Metabolism, Energy, Biodiversity Lab	4
BIO 124 & BIO 124D Integrative Biology: Genes, Cells, Change and Integrative Biology: Genes, Cells, Change Lab	4		CHE 214 & CHE 215 215 (or elective if CHE208/ was taken in the fall) <sup>3</sup>	4	General Chemistr II General Chemistr II Lab
MAT 124M <sup>1</sup> Calculus 1	4		MAT 125 Calculus 2	4	
GES 145 Humanities I: Greco-Roman through Middle Ages	4		GES 244 Humaniti III: Europear Enlighter and Americar Culture to 1877	4	
	16			4	16

### Second Year

Fall	Credits	Interim	Credits	Spring	Credits
CHE 224 & CHE 225 Organic Chemistry I and Organic Chemistry I Lab	4	GES 140 Introduction to Wellbeing	3	CHE 226 & CHE 227 Organic Chemistry II and Organic Chemistry II Lab	4
PHY 292 & PHY 292D General Physics I and General Physics I Lab	4		PHY 296 & PHY 297 General Physics II and General Physics II Lab	4	
GES 246 Humanities IV: Modern and Contemporary Western Culture	4		CHE 312 & CHE 313 Quantitative Analysis and Quantitative Analysis Lab	4	
			Second Language (S) course <sup>2</sup>	4	
	12		3		16

### Third Year

Fall	Credits	Interim	Credits	Spring	Credits
BIO 332 & BIO 333 Genetics and Genetics Lab	4	Science, Technology and Society (K) course	3	BIB 101 Introduction to the Bible	3
BIO 388 & BIO 389 Biochem I and Biochem I Lab	4		BIO 354 & BIO 355 Cell Biology and Cell Biology Lab	4	

or	4	CHE 396 & CHE 397 Biochemistry II and Biochemistry II Lab	4
CHE 388 & CHE 389 Biochem I and Biochem I Lab		Biology or Chemistr Seminar/ Research	1
CHE 344 & CHE 345 Thermodynamics, Kinetics, and Statistical Mechanics and Thermodynamics, Kinetics, and Statistical Mechanics Lab	4	World Cultures (U) course	3
Biology or Chemistr Seminar/ Research	1		
	13	3	15

**Fourth Year**

Fall	Credits Interim	Credits Spring	Credits
Biology or Chemistry Seminar/ Research <sup>4</sup>	1 Interim Off	BIO 396 & BIO 397 Molecular Biology and Molecular Biology Lab	4
Elective (BIO224/ recommen	4	Biology or Chemistr Seminar/ Research	1
Comparative Systems (G) course	3	Contemporary Christian Issues (P) course	3

Interpreti Biblical Themes (J) course	3	Artistic Experienc (A) course	0-3
Leisure and Lifetime Sports (Q) course	1	Elective	4
Cross Cultural Experienc (Z) course	0-3		
	12-15	0	12-15

Total Credits 122-128

- <sup>1</sup> This program assumes a student will use CHE 113D and MAT 124M to meet the general education laboratory science and Mathematics requirements.
- <sup>2</sup> Students must complete through the second semester of a first year language course or equivalent.
- <sup>3</sup> CHE 208/CHE 208D is a one-semester course that meets the requirements for CHE 113/CHE 113D and CHE 214/CHE 215. Students taking CHE 208/CHE 208D may choose an elective in the spring of their freshmen year.
- <sup>4</sup> Choose either the Biology Seminar/Research series (BIO 339, BIO 495, BIO 496, BIO 499) or Chemistry Seminar/Research series (CHE 395, CHE 490 and CHE 494). Students pursuing the ACS-accredited B.S. must complete the chemistry series.

Most financial aid packages stipulate 12 credits/ semester; Minnesota state grants reduced when credit load falls below 15 credits/semester. (Interim credits may be split between fall and spring for state grant purposes only.

**BIO 100 • Principles of Biology.** 3 Credits.  
Basic principles of modern biology. Topics include the scientific method, biology of the cell, genetic principles, anatomy and physiology of humans, plant biology, and environmental biology.  
*Corequisites: Registration in BIO 100D is required. Offered: Occasionally.*

**BIO 100D • Principles of Biology Lab.** 1 Credit.  
Laboratory experience accompanying BIO 100.  
*Corequisites: Registration in BIO 100 is required. Offered: Occasionally.*

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### **BIO 104 • Human Biology.** 3 Credits.

Study of the biological aspects of the human species. Includes basic molecules of life, human cell biology, tissue types, anatomy and physiology of the 10 systems, human embryology and development, human genetics, nutrition, disease, and health.

*Corequisites: Registration in BIO 104D is required. Offered: Fall, Spring.*

### **BIO 104D • Human Biology Lab.** 1 Credit.

Laboratory experience accompanying BIO 104.

*Corequisites: Registration in BIO 104 is required. Offered: Fall, Spring.*

### **BIO 105 • Medical Terminology.** 2 Credits.

Study of medical terms. Students study material independently and take proctored examination to demonstrate knowledge of medical language.

*Prerequisites: Permission of instructor. Offered: Fall, Spring*

### **BIO 114D • Introduction to Biodiversity, Ecology, and Adaptation.** 4 Credits.

An introduction to the diversity, interrelationships, and origins of living organisms. Focuses on three themes: an overview of kinds and diversity of organisms found in six kingdoms, the interaction of organisms with each other and their environment, and the change of organisms through time.

*Offered: Occasionally.*

### **BIO 118 • General Biology.** 3 Credits.

Biological principles governing life processes. Topics include biological molecules, cells, metabolism, genetics, reproduction, and development with primary attention to mammalian organisms, tissues, organs, and life systems with reference to comparative anatomy and physiology.

*Corequisites: Registration in BIO 118D is required. Offered: Fall. Special Notes: Intended for Nursing majors.*

### **BIO 118D • General Biology Lab.** 1 Credit.

Laboratory experience accompanying BIO 118.

*Corequisites: Registration in BIO 118 is required. Offered: Fall.*

### **BIO 120 • Introduction to Molecular and Cellular Biology.** 3 Credits.

An introduction to cellular and subcellular aspects of living organisms. Includes a study of basic chemistry, biological molecules, cells, enzymes, metabolism, classical genetics, and molecular genetics.

*Prerequisites: One semester of Chemistry, or CHE 208/208D (May be taken concurrently). Corequisites: Registration in BIO 121 is required. Offered: Fall, Spring.*

### **BIO 121 • Introduction to Molecular and Cellular Biology Lab.** 1 Credit.

Laboratory experience accompanying BIO 120.

*Corequisites: Registration in BIO 120 is required. Offered: Fall, Spring.*

### **BIO 122 • Introduction to Organismic Biology.** 3 Credits.

An introduction to how living things work. Focuses on two main themes: the correlation between structure and function, and the capacity of organisms to adjust their internal environment in response to short-term and long-term fluctuations in the external environment.

*Corequisites: Registration in BIO 122D is required. Offered: Fall, Spring.*

### **BIO 122D • Introduction to Organismic Biology Lab.** 1 Credit.

Laboratory experience accompanying BIO 122.

*Corequisites: Registration in BIO 122 is required. Offered: Fall, Spring.*

### **BIO 124 • Integrative Biology: Genes, Cells, Change.** 3 Credits.

In a complex world, understanding challenges like infectious disease or environmental change requires a fundamental knowledge of biology. Using relevant examples, students will explore molecules, DNA, biotechnology, evolution, populations, ecosystems, disease, and human systems (e.g. digestive, immune) to gain a perspective on global health and personal responsibility to life.

*Prerequisites: Declared major in Biology, Environmental Science, Environmental Studies, Biochemistry/Molecular Biology, or Secondary Education Life Science OR a declared minor in Biology. Corequisites: BIO 124D. Offered: Fall, Spring.*

### **BIO 124D • Integrative Biology: Genes, Cells, Change Lab.** 1 Credit.

Laboratory experience accompanying BIO 124.

*Prerequisites: Declared major in Biology, Environmental Science, Environmental Studies, Biochemistry/Molecular Biology, or Secondary Education Life Science OR a declared minor in Biology. Corequisites: BIO 124. Offered: Fall, Spring.*

### **BIO 126 • Integrative Biology and Global Health.** 3 Credits.

Cancer. Climate change. Infectious disease. These are some of the challenges before biologists; challenges that require knowledge and skills that are not confined to one sub-discipline to solve. Through real world, case-based problems encompassing cells to ecosystems, this course unpacks what it means to be a biologist today. Concepts include genetics, evolution, population, community and ecosystem ecology and global change.

*Prerequisites: Declared major in Biology, Environmental Studies, Environmental Science, or Secondary Education Life Science. Corequisites: Registration in BIO 127 is required. Offered: Fall, Spring*

### **BIO 127 • Integrative Biology and Global Health Lab.** 1 Credit.

Laboratory experience accompanying BIO 126.

*Corequisites: Registration in BIO 126 is required. Offered: Fall, Spring.*

**BIO 128 • Integrative Biology: Metabolism, Energy, Biodiversity.** 3 Credits.

Living organisms face challenges requiring them to either adapt, move, acclimate or perish. Through real-world examples, students will gain a fundamental understanding of homeostasis, enzymes, metabolism, energy flow, movement, human systems (e.g., circulatory, nervous, excretory), photosynthesis, cellular respiration, extinction, biodiversity, transformation of matter and acclimation.

*Prerequisites:* Declared major in Biology, Environmental Science, Environmental Studies, Biochemistry/Molecular Biology, or Secondary Education Life Science OR Declared minor in Biology. *Corequisites:* Concurrent registration in BIO 128D is required. Offered: Fall, Spring.

**BIO 128D • Integrative Biology: Metabolism, Energy, Biodiversity Lab.** 1 Credit.

Laboratory experience accompanying BIO 128. *Corequisites:* BIO 128. Offered: Fall, Spring.

**BIO 130 • Introduction to Neuroscience.** 3 Credits.

An introduction to the biological basis of behavior. Focuses on two main themes: the cellular, molecular, and genetic processes that form the foundation of nervous system function and the systems-level organization of the nervous system that forms the foundation of human and animal behavior.

*Corequisites:* Registration in BIO 130D is required. Offered: Spring. *Special Notes:* Carries cross-credit in Psychology and Neuroscience.

**BIO 130D • Introduction to Neuroscience Lab.** 1 Credit.

Laboratory experience accompanying BIO 130. *Corequisites:* Registration in BIO 130 is required.

Offered: Spring. *Special Notes:* Carries cross credit with Neuroscience and Psychology.

**BIO 132 • The Science of Birds.** 3 Credits.

An overview of the Minnesota avifauna and bird biology. Bird identification is discussed and practiced in the field. Selected topics from bird biology (migration, flight, reproduction, behavior, food, and conservation) are presented through lectures, numerous slide shows, and videos. These topics provide an introduction to the prevailing themes in modern biology.

*Corequisites:* Registration in BIO 132D is required. Offered: Occasionally Spring.

**BIO 132D • The Science of Birds Lab.** 1 Credit.

Laboratory experience accompanying BIO 132.

*Corequisites:* Registration in BIO 132 is required. Offered: Occasionally Spring.

**BIO 214 • Human Anatomy.** 3 Credits.

Detailed study of the anatomy and histology of the human body in relation to its functional systems. Laboratory includes human cadaver dissections.

*Prerequisites:* One lab science (D) course; BIO 218, (may be taken concurrently). *Corequisites:* Registration in BIO 215 is required. *Special Notes:* Not open to students who have taken BIO 224 /225 or BIO 238/239 except by department consent. Offered: Fall.

**BIO 215 • Human Anatomy Lab.** 1 Credit.

Laboratory experience accompanying BIO 214.

*Corequisites:* Registration in BIO 214 is required. Offered: Fall.

**BIO 216 • Human Physiology.** 3 Credits.

Integration of basic principles of cell biology and mechanisms of physiology to the functions of the major organ systems of the human body; centered around the theme of homeostasis.

*Prerequisites:* BIO 214/215. A course in Chemistry is recommended; BIO 218, (may be taken concurrently). *Corequisites:* Registration in BIO 217 is required. *Special Notes:* Not open to students who have taken BIO 226/227 or BIO 238/239 except by department consent. Offered: Spring.

**BIO 217 • Human Physiology Lab.** 1 Credit.

Laboratory experience accompanying BIO 216.

*Corequisites:* Registration in BIO 216 is required. Offered: Spring.

**BIO 218 • Biology in a Changing World.** 3 Credits.

Through the exploration of interactions between genes and their environments, students articulate integrative topics (e.g., evolution, transformation of matter, and energy, information flow, systems and structure/function), identify career options and desired skill sets, make a growth plan and articulate an intellectual autobiography, including faith integration.

*Prerequisites:* BIO 124; BIO 128. Offered: Fall.

**BIO 224 • Clinical Anatomy.** 3 Credits.

Detailed study of the anatomy and histology of the human body in relation to its functional systems. Laboratory includes human cadaver dissections.

*Prerequisites:* BIO 118/118D. *Corequisites:* Registration in BIO 225 is required. Offered: Spring. *Special Notes:* Not open to students who have taken BIO 214/215 or BIO 238/239.

**BIO 225 • Clinical Anatomy Lab.** 1 Credit.

Laboratory experience accompanying BIO 224.

*Corequisites:* Registration in BIO 224 is required. Offered: Spring.

**BIO 226 • Clinical Physiology.** 3 Credits.

Integration of basic principles of cell biology and mechanisms of physiology to the functions of the major organ systems of the human body, centered around the theme of homeostasis.

*Prerequisites:* BIO 224/225; CHE 101/101D. *Corequisites:* Registration in BIO 227 is required. *Offered:* Fall. *Special Notes:* Not open to students who have taken BIO 216/217.

**BIO 227 • Clinical Physiology Lab.** 1 Credit.

Laboratory experience accompanying BIO 226.

*Corequisites:* Registration in BIO 226 is required. *Offered:* Fall.

**BIO 230 • Clinical Microbiology.** 3 Credits.

Microorganisms and viruses with respect to their structure, physiology, genetics, identification, control, host-parasite relationships, and exploitation by humans. Topics include pathogenic organisms and the events and products of vertebrate immune responses.

*Prerequisites:* BIO 224/225; CHE 101/101D. *Corequisites:* Registration in BIO 231 is required. *Offered:* Fall. *Special Notes:* Not open to students who have taken BIO 234/235.

**BIO 231 • Clinical Microbiology Lab.** 1 Credit.

Laboratory experience accompanying BIO 230.

*Corequisites:* Registration in BIO 230 is required. *Offered:* Fall.

**BIO 234 • Microbiology.** 3 Credits.

Microorganisms and viruses with respect to their structure, physiology, genetics, identification, control, host-parasite relationships, and exploitation by humans. Topics include pathogenic organisms and the events and products of vertebrate immune responses.

*Prerequisites:* BIO 118/118D, BIO 120/121; one course in Chemistry; BIO 218, (may be taken concurrently), A second course in Chemistry is recommended. *Corequisites:* Registration in BIO 235 is required. *Special Notes:* Not open to students who have taken BIO 230/231. *Offered:* Spring.

**BIO 235 • Microbiology Lab.** 1 Credit.

Laboratory experience accompanying BIO 234.

*Corequisites:* Registration in BIO 234 is required. *Offered:* Spring.

**BIO 238 • Human Anatomy and Physiology.** 3 Credits.

Anatomy and physiology of the human body, with a major emphasis on the principle of homeostasis.

*Prerequisites:* BIO 100/100D, BIO 104/104D, BIO 118/118D, or BIO 120/121; BIO 218, (may be taken concurrently).

*Corequisites:* Registration in BIO 239 is required. *Special Notes:* One course in Chemistry recommended. Not open to students who have taken BIO 214/215, BIO 216/217, BIO 224/225, BIO 226/227. *Offered:* Spring.

**BIO 239 • Human Anatomy and Physiology Lab.** 1 Credit.

Laboratory experience accompanying BIO 238.

*Corequisites:* Registration in BIO 238 is required. *Offered:* Spring.

**BIO 244 • Pathophysiology and Pharmacology.** 3 Credits.

An integrated exploration of disease processes and the drugs used to treat them. The functional and structural changes that accompany a particular injury, disease, or syndrome are correlated with the study of drugs and their actions on the body.

*Prerequisites:* BIO 214/215, BIO 216/217 (may be taken concurrently), two semesters of Chemistry; BIO 218, (may be taken concurrently). *Corequisites:* Registration in BIO 245 is required. *Offered:* Occasionally.

**BIO 245 • Pathophysiology and Pharmacology Lab.** 1 Credit.

Laboratory experience accompanying BIO 244.

*Corequisites:* Registration in BIO 244 is required. *Offered:* Occasionally.

**BIO 248 • Clinical Pathophysiology and Pharmacology.** 3 Credits.

An integrated exploration of disease processes and the drugs used to treat them. The functional and structural changes that accompany a particular injury, disease, or syndrome are correlated with the study of drugs and their actions on the body.

*Prerequisites:* Acceptance into the Nursing program or consent of instructor. *Corequisites:* Registration in BIO 249 is required. *Offered:* Spring. *Special Notes:* Not open to students who have taken BIO 244/245.

**BIO 249 • Clinical Pathophysiology and Pharmacology Lab.** 1 Credit.

Laboratory experience accompanying BIO 248.

*Corequisites:* Registration in BIO 248 is required. *Offered:* Spring.

**BIO 316 • Wildlife Ecology and Management.** 3 Credits.

Analysis of terrestrial vertebrate populations, communities, and habitats. Exploration of how these analyses are applied to the manipulation, exploitation, protection, and restoration of animal populations and communities.

*Prerequisites:* Two of BIO 122/122D, BIO 128/128D, ENS 104/104D; BIO 218 (may be taken concurrently) or major in Environmental Science or major in Environmental Studies; Junior or senior standing. *Corequisites:* Concurrent registration in ENS 317 is required. *Special Notes:* Carries cross-credit in Environmental Science. *Offered:* Spring, even # years.

**BIO 317 • Wildlife Ecology and Management Lab.** 1 Credit.

Laboratory experience accompanying BIO 316.

Includes some outdoor and off-campus investigations. *Corequisites:* Registration in BIO 316 is required. *Offered:* Spring, even # years.



**BIO 318KZ • Ecology in the Tropics: Natural History and Future Prospects.** 4 Credits.

Travel in Kenya or Ecuador surveying the land, climate, plants, animals, homes, transportation, and industries, noting especially the impact of human presence. Ecuador includes the Amazon rainforest, Andean cloud forests, volcanic mountains, highlands, towns, cities, and the Galapagos Islands. Kenya includes Nairobi, African savanna, the Rift valley, and Masai Mara.  
*Prerequisites: Laboratory Science (D) course; Mathematics (M) course. Offered: Interim. Special Notes: Carries cross-credit in environmental science and general studies.*

**BIO 324 • Human Ecology.** 3 Credits.

Interrelationships between humans and the natural environment. Overpopulation, resource use, and pollution studied from biological, social, and economic standpoints, and skill development in the critical examination of the impacts of humans and our technology on the natural world.  
*Prerequisites: One year of Biology; one year of Chemistry; BIO 218, (may be taken concurrently). Corequisites: Registration in BIO 325 is required. Offered: Occasionally.*

**BIO 325 • Human Ecology Lab.** 1 Credit.

Laboratory experience accompanying BIO 324.  
*Corequisites: Registration in BIO 324 is required. Offered: Occasionally.*

**BIO 326 • Vertebrate Histology.** 3 Credits.

Microscopic structure of cells, tissues, and organs in vertebrate animals, with special emphasis on the way structural units are integrated. At all times efforts are made to correlate structure with specific physiological functions.  
*Prerequisites: BIO 120/121; BIO 122/122D; BIO 218, (may be taken concurrently). Corequisites: Registration in BIO 327 is required. Offered: Spring, odd # years.*

**BIO 327 • Vertebrate Histology Lab.** 1 Credit.

Laboratory experience accompanying BIO 326.  
*Corequisites: Registration in BIO 326 is required. Offered: Spring, odd # years.*

**BIO 328 • Invertebrate Biology.** 3 Credits.

A survey of invertebrate groups from protozoa to prochordates with emphasis on organizational, functional, and ecological significance. Special attention is given to the morphology, life histories, and physiology of invertebrates within the context of survival in specialized environments.  
*Prerequisites: BIO 122/122D or BIO 128/128D; BIO 218, (may be taken concurrently) or major in Environmental Science or major in Environmental Studies. Corequisites: Registration in BIO 329 is required. Offered: Spring odd # years.*

**BIO 329 • Invertebrate Biology Lab.** 1 Credit.

Laboratory experience accompanying BIO 328.  
*Corequisites: Registration in BIO 328 is required. Offered: Spring odd # years.*

**BIO 330 • Ecology.** 3 Credits.

Structure and function of wild nature. Topics include interrelationships of organisms with their environments, factors that regulate such interrelationships, and various roles that humans play in modifying patterns and processes of nature at organism, community, and ecosystem levels.  
*Prerequisites: Two of BIO 122/122D, BIO 128/128D, ENS 104/104D; BIO 218 (may be taken concurrently) or major in Environmental Science or major in Environmental Studies. Corequisites: Registration in BIO 331 is required. Special Notes: This is a tagged research course. Offered: Fall, odd # years.*

**BIO 331 • Ecology Lab.** 1 Credit.

Laboratory experience accompanying BIO 330.  
*Corequisites: Registration in BIO 330 is required. Offered: Fall, odd # years. Special Notes: This is a tagged research course.*

**BIO 332 • Genetics.** 3 Credits.

Principles that control inheritance, with examples chosen from plant and animal research, population genetics, cytogenetics, molecular genetics, and current work on human genetics.  
*Prerequisites: Two courses in Chemistry; BIO 100/100D or BIO 120/121; BIO 218, (may be taken concurrently). Corequisites: Registration in BIO 333 is required. Offered: Fall.*

**BIO 333 • Genetics Lab.** 1 Credit.

Laboratory experience accompanying BIO 332.  
*Corequisites: Registration in BIO 332 is required. Offered: Fall.*

**BIO 336 • Entomology and Parasitology.** 3 Credits.

A comparative study of the major invertebrate groups from anatomical, physiological, and ecological perspectives with attention to insects and parasitic invertebrates.  
*Prerequisites: BIO 122/122D; BIO 126/127; BIO 218, (may be taken concurrently). Corequisites: Registration in BIO 337 is required. Offered: Occasionally.*

**BIO 337 • Entomology and Parasitology Lab.** 1 Credit.

Laboratory experience accompanying BIO 336.  
*Corequisites: Registration in BIO 336 is required. Offered: Occasionally.*

**BIO 338 • Endocrinology.** 3 Credits.

Processes by which hormones exert control over many aspects of reproduction, development, growth, metabolism, and behavior. Topics include the chemical nature of hormones, receptors and signaling pathways, morphology and histology of endocrine organs, regulation of hormone synthesis and secretion, and mechanism of action in target tissues.  
*Prerequisites: BIO 120/121; BIO 122/122D; BIO 218, (may be taken concurrently). One course in Physiology is recommended. Corequisites: Registration in BIO 339 is required. Offered: Fall, even # years.*

**BIO 339 • Endocrinology Lab.** 1 Credit.

Laboratory experience accompanying BIO 338. Work is largely experimental, using bioassay procedures.

*Corequisites: Registration in BIO 338 is required. Offered: Fall even # years.*

**BIO 342 • Aquatic Biology.** 3 Credits.

Biological and physical aspects of natural, freshwater ecosystems, including fish and other aquatic animals, aquatic plants, algae, and their interrelationships with each other and the unique aqueous environment in which they live.

*Prerequisites: Two of BIO 122/122D, BIO 128/128D or ENS 104/104D; BIO 218 (may be taken concurrently) or major in Environmental Science or major in Environmental Studies. Corequisites: Registration in BIO 343 is required. Offered: Fall, even # years.*

**BIO 343 • Aquatic Biology Lab.** 1 Credit.

Laboratory experience accompanying BIO 342.

Includes some outdoor and off-campus investigations.

*Corequisites: Registration in BIO 342 is required. Offered: Fall even # years.*

**BIO 346 • Animal Behavior.** 3 Credits.

Behavior from primitive invertebrates to advanced mammals, highlighting trends in behavior systems.

Natural setting studies in the ethology tradition, comparative psychology studies, and biosociological principles with their implications for human social systems.

*Prerequisites: One course in Biology or PSY 100; BIO 218, (may be taken concurrently). Corequisites: Registration in BIO 347 is required. Special Notes: Carries cross-credit in Psychology. Offered: Fall, even # years.*

**BIO 347 • Animal Behavior Lab.** 1 Credit.

Laboratory experience accompanying BIO 346.

*Corequisites: Registration in BIO 346 is required. Offered: Fall even # years.*

**BIO 354 • Cell Biology.** 3 Credits.

The molecular organization and function of cells and their organelles. Understanding how cell biology information is obtained experimentally.

*Prerequisites: Two courses in Biology, including BIO 120/121; two courses in Chemistry (Organic recommended); BIO 218, (may be taken concurrently). Corequisites: Registration in BIO 355 is required. Special Notes: This is a tagged research course. Offered: Spring.*

**BIO 355 • Cell Biology Lab.** 1 Credit.

Laboratory experience accompanying BIO 354.

*Corequisites: Registration in BIO 354 is required. Offered: Spring.*

**BIO 358 • Neurobiology.** 3 Credits.

Nervous system of animals and humans. Includes comparative anatomy and physiology of humans with other vertebrates and invertebrates, as well as interactions of sensory, motor, and integrative mechanisms of nervous system control.

*Prerequisites: BIO 100/100D, BIO 104/104D, BIO 120/121. BIO 122/122D recommended; BIO 218, (may be taken concurrently). Corequisites: Registration in BIO 359 is required. Offered: Fall, even # years.*

**BIO 359 • Neurobiology Lab.** 1 Credit.

Laboratory experience accompanying BIO 358.

*Corequisites: Registration in BIO 358 is required. Offered: Fall even # years.*

**BIO 362 • Developmental Biology.** 3 Credits.

The basic question of developmental biology is "How does a single fertilized egg give rise to all the different cell, tissue, and organ types of the adult organism?"

The developmental processes that give rise to these different cell, organ, and tissue types along with the mechanisms underlying those processes are studied at the cellular, genetic, molecular, and biochemical levels.

*Prerequisites: BIO 120/121 and one other Biology course; two courses in Chemistry; BIO 218, (may be taken concurrently). Corequisites: Registration in BIO 363 is required. Special Notes: This is a tagged research course. Offered: Spring, even # years.*

**BIO 363 • Developmental Biology Lab.** 1 Credit.

Laboratory experience accompanying BIO 362.

Includes surgical manipulation of living organisms to elucidate developmental principles.

*Corequisites: Registration in BIO 362 is required. Offered: Spring even # years.*

**BIO 368 • Structure and Development of Vertebrates.** 3 Credits.

An integrated and systematic approach to descriptive embryology and comparative anatomy of vertebrate species.

*Prerequisites: Two courses in Biology, including BIO 122/122D; BIO 218, (may be taken concurrently). Corequisites: Registration in BIO 369 is required. Offered: Fall, odd # years.*

**BIO 369 • Structure and Development of Vertebrates Lab.** 1 Credit.

Laboratory experience accompanying BIO 368.

Observational studies of live embryos, microscopic examination of representative vertebrate embryos, and dissection of representative vertebrate types.

*Corequisites: Registration in BIO 368 is required. Offered: Fall odd # years.*

**BIO 372 • Plant Taxonomy and Ecology.** 3 Credits.

Identification and distribution of flowering plants, including field work, keying, and laboratory preservation. Biogeography and factors important in plant distribution.

*Prerequisites:* Two of BIO 122/122D, BIO 128/128D, ENS 104/104D; BIO 218, (may be taken concurrently) or major in Environmental Science or major in Environmental Studies. *Corequisites:* Registration in BIO 373 is required. *Offered:* Fall, odd # years.

**BIO 373 • Plant Taxonomy and Ecology Lab.** 1 Credit.

Laboratory experience accompanying BIO 372.

*Corequisites:* Registration in BIO 372 is required. *Offered:* Fall odd # years.

**BIO 376 • Animal Physiology.** 3 Credits.

Comparative physiology of animal nerves, muscles, hormones, circulation, respiration, excretion, digestion, and the way those systems function intact with processes of feeding, energetics, osmoregulation, metabolism, locomotion, biomechanics, and temperature regulation necessary for an organism's survival.

*Prerequisites:* BIO 120/121; BIO 122/122D; BIO 126/127; two courses in Chemistry; BIO 218, (may be taken concurrently). *Corequisites:* Registration in BIO 377 is required. *Offered:* Spring, even # years

**BIO 377 • Animal Physiology Lab.** 1 Credit.

Laboratory experience accompanying BIO 376.

*Corequisites:* Registration in BIO 376 is required. *Offered:* Spring even # years.

**BIO 380 • Environmental Plant Biology.** 3 Credits.

Presently our Earth is experiencing rapid change. In fact, it is hard to make it through a day without hearing about temperature extremes, significant weather events, drought conditions and environmental degradation. We often consider the role of the human in such change, but what about plants? Plants play significant roles in the environment - driving and responding to carbon, water availability, nutrient levels and light. Through exploring how abiotic factors influence photosynthetic pathways, productivity and the movement of matter and energy, we will discover how plants respond to these rapid environmental changes. Course includes experiences working with data and statistics.

*Prerequisites:* Two of BIO 122/122D, BIO 128/128D, ENS 104/104D; BIO 218, (may be taken concurrently) or major in Environmental Science or major in Environmental Studies. *Corequisites:* Registration in BIO 383 is required. *Special Notes:* This is a tagged research course. *Offered:* Spring, odd # years.

**BIO 383 • Environmental Plant Biology Lab.** 1 Credit.

Laboratory experience accompanying BIO 380.

Includes some outdoor and off-campus investigations. *Corequisites:* Registration in BIO 380 is required. *Offered:* Spring, odd # years.

**BIO 384 • Immunology.** 3 Credits.

The basis of the immune system throughout the animal kingdom is the ability to recognize or discriminate "self" from "nonself." Study includes the molecular and cellular mechanisms that allow organisms to recognize, control, and eliminate such "nonself" entities as bacterial pathogens, foreign tissue grafts, and even transformed (cancerous) cells.

*Prerequisites:* BIO 120/121; BIO 122/122D; two semesters of Chemistry, BIO 218, (may be taken concurrently); BIO 234/235, BIO 332/333, or BIO 354/355 is strongly recommended. *Corequisites:* Registration in BIO 387 is required. *Special Notes:* This is a tagged research course. *Offered:* Fall, odd # years.

**BIO 387 • Immunology Lab.** 1 Credit.

Laboratory experience accompanying BIO 384.

*Corequisites:* Registration in BIO 384 is required. *Offered:* Fall, odd # years.

**BIO 388 • Biochemistry I.** 3 Credits.

Physical and chemical properties of living systems with an emphasis on macromolecular interaction, structure, and function. Structure, classification, purification, and function of nucleic acids, proteins, carbohydrates, and lipids, including membrane transport and enzymology.

*Prerequisites:* BIO 120/121; BIO 218, (may be taken concurrently); CHE 226/227, BIO 354/355 recommended. *Corequisites:* Registration in BIO 389 is required. *Special Notes:* Not open to students who have taken CHE 304/305, Carries cross-credit in Chemistry. *Offered:* Fall.

**BIO 389 • Biochemistry I Lab.** 1 Credit.

Laboratory experience accompanying BIO 388.

Techniques include spectroscopy, chromatography, centrifugation, electrophoresis, and enzyme kinetics.

*Corequisites:* Registration in BIO 388 is required. *Offered:* Fall.

**BIO 396 • Molecular Biology.** 3 Credits.

Modern advanced molecular genetic research. Topics covered include regulation of gene expression during development, molecular biology of cancer, animal virology, eukaryotic gene organization, and methods in gene manipulation.

*Prerequisites:* BIO 332/333; one additional biology course; CHE 224/225; CHE 226/227. *Corequisites:* registration in BIO 397 is required *Special Notes:* This is a tagged research course. *Offered:* Spring

**BIO 397 • Molecular Biology Lab.** 1 Credit.

Laboratory experience accompanying BIO 396.

Consists of research projects utilizing recombinant DNA/genetic engineering techniques.

*Corequisites:* Registration in BIO 396 is required. *Offered:* Spring.

**BIO 399 • Introduction to Research.** 1 Credit.

An introduction to research methodology in the biological sciences, with experience in the use of biological literature and an examination of how to distinguish and evaluate different types of scientific writing and presentations. Experience in the development of a research proposal.

*Prerequisites:* BIO 218, (may be taken concurrently); major in Biology or related field; Junior standing. *Special Notes:* Carries cross-credit in Environmental Studies. Offered: Fall, Spring.

**BIO 400 • Ultrastructure.** 3 Credits.

Electron microscopy as a tool in the sciences with emphasis on its use in biological investigation. Students prepare a portfolio of micrographs on a variety of material. Demonstrations, discussions, seminars, field trips, and individual practice.

*Prerequisites:* BIO 120/121; BIO 218, (may be taken concurrently). *Corequisites:* Registration in BIO 401 is required. Offered: Occasionally.

**BIO 401 • Ultrastructure Lab.** 1 Credit.

Laboratory experience accompanying BIO 400.

*Corequisites:* Registration in BIO 400 is required. Offered: Occasionally.

**BIO 409 • Advanced Human Gross Anatomy.** 4 Credits.

For the undergraduate pre-health professions student. A regional approach to the study of anatomy through the supervised and directed student dissection of human cadavers. Identification of detailed structures and understanding their significance to the body.

*Prerequisites:* BIO 214/215, BIO 224/225, or consent of instructor. Offered: Interim

**BIO 481 • Internship in Biology.** 1-4 Credits.

A learning/practicing experience in which the student applies biological understanding and skills in an off-campus professional setting.

*Prerequisites:* Major or minor in Biology; Junior or senior standing. Offered: Fall, Spring

**BIO 493 • Literature Review in Biology.** 1 Credit.

Thorough review of the primary and secondary literature pertaining to a particular question, problem, or phenomenon in the biological sciences. Culminates in written report that is presented orally in BIO 499.

*Prerequisites:* BIO 399; Senior standing; consent of instructor. Offered: Fall, Spring

**BIO 495 • Biology Seminar.** 1-2 Credits.

Readings and discussions of topics that relate biology to one's Christian faith.

*Prerequisites:* BIO 399; Senior standing. Offered: Fall

**BIO 496 • Biology Research.** 1 Credit.

Students collect original data through independent laboratory research or field research under the supervision of a faculty member.

*Prerequisites:* BIO 399; Completion or co-completion of a tagged research course; Consent of instructor. *Special Notes:* May be repeated once for credit. Offered: Fall, Spring.

**BIO 497 • Advanced Biology Research.** 1 Credit.

Working under the supervision of a faculty mentor, students analyze the results of their original research completed in BIO 496 and write up their findings in a formal scientific paper. Results will be presented in class and possibly outside venues. PQ; BIO 496.

*Offered:* Fall.

**BIO 499 • Biology Symposium.** 1 Credit.

The presentation of scientific research and literature. Culminates in departmental symposium in which students present their original research or literature review.

*Prerequisites:* BIO 493 or BIO 496. *Special Notes:* Carries cross-credit in Environmental Studies. Offered: Fall, Spring.

**CHE 101 • Introduction to Chemistry.** 3 Credits.

Overview of atoms—their composition, their ability to form bonds, and their ability to interact as molecules. Designed for nursing and allied health fields.

*Corequisites:* Registration in CHE 101D is required. Offered: Fall, Spring.

**CHE 101D • Introduction to Chemistry Lab.** 1 Credit.

Laboratory experience accompanying CHE 101.

*Corequisites:* Registration in CHE 101 is required. Offered: Fall, Spring.

**CHE 107 • Modern Alchemy: Chemistry for Non-Scientists.** 3 Credits.

The chemical world including, for example, food, agriculture, household chemicals, plastics, drugs, environmental concerns, and energy production. An overview of chemical concepts with an emphasis on applications of chemistry and their implications for society.

*Corequisites:* Registration in CHE 107D is required. Offered: Interim.

**CHE 107D • Modern Alchemy: Chemistry for Non-Scientists Lab.** 1 Credit.

Laboratory experience accompanying CHE 107.

*Corequisites:* Registration in CHE 107 is required. Offered: Interim.

**CHE 113 • General Chemistry I.** 3 Credits.

Chemical properties and principles, structure and reactivity, stoichiometry, thermodynamics, atomic and molecular theory, and states of matter. Laboratory includes application of these principles in exploring chemical properties and reactivity, and computer data collection and modeling.

*Prerequisites:* Two years of High school Math; High school Chemistry or consent of instructor. *Corequisites:* Registration in CHE 113D is required. *Offered:* Fall

**CHE 113D • General Chemistry I Lab.** 1 Credit.

Laboratory experience accompanying CHE 113. *Corequisites:* Registration in CHE 113 is required. *Offered:* Fall.

**CHE 200 • Laboratory Safety and Chemical Hygiene.** 1 Credit.

High standards of safety and chemical hygiene make the science laboratory a safe, comfortable, interesting place to work. This course reviews the standards and federal/state guidelines pertaining to safety and hygiene in the laboratory.

*Prerequisites:* One year of High school Chemistry; one semester of college-level science. *Offered:* Fall, Spring.

**CHE 208 • Accelerated General Chemistry.** 3 Credits.

Chemical properties and principles, stoichiometry, structure, reactivity, atomic theory, states of matter, solutions, thermodynamics, kinetics, equilibria, acids and bases, electrochemistry, descriptive inorganic chemistry, and nuclear chemistry. Intended for science and engineering students who have a strong math background.

*Prerequisites:* MAT 124M (may be taken concurrently). *Corequisites:* Registration in CHE 208D is required. *Offered:* Fall. *Special Notes:* Meets the same requirements of CHE 113/113D and CHE 214/215.

**CHE 208D • Accelerated General Chemistry Lab.** 1 Credit.

Laboratory experience accompanying CHE 208. *Corequisites:* Registration in CHE 208 is required. *Offered:* Fall.

**CHE 214 • General Chemistry II.** 3 Credits.

Study of solutions, chemical kinetics, thermodynamics, solution equilibria, acids and bases, electrochemistry, descriptive inorganic chemistry, and nuclear chemistry.

*Prerequisites:* CHE 113/113D. *Corequisites:* Registration in CHE 215 is required. *Offered:* Spring

**CHE 215 • General Chemistry II Lab.** 1 Credit.

Laboratory experience accompanying CHE 214. *Corequisites:* Registration in CHE 214 is required. *Offered:* Spring.

**CHE 224 • Organic Chemistry I.** 3 Credits.

Structure, classification, and function of organic compounds; bonding theory, stereochemistry, organic reaction mechanisms, energy relations, and spectroscopy.

*Prerequisites:* CHE 214/215 or CHE 208/208D. *Corequisites:* Registration in CHE 225 is required. *Offered:* Fall

**CHE 225 • Organic Chemistry I Lab.** 1 Credit.

Laboratory experience accompanying CHE 224. Includes introduction to techniques of measurement, analysis, separation, synthesis, and purification of organic compounds.

*Corequisites:* Registration in CHE 224 is required. *Offered:* Fall.

**CHE 226 • Organic Chemistry II.** 3 Credits.

Mechanism and classification of organic reactions, particularly carbon-carbon bond-forming reactions involving carbonyl compounds. Mechanistic organic chemistry applied to polymers and biochemical pathways.

*Prerequisites:* CHE 224/225. *Corequisites:* Registration in CHE 227 is required. *Offered:* Spring

**CHE 227 • Organic Chemistry II Lab.** 1 Credit.

Laboratory experience accompanying CHE 226. Laboratory includes synthesis, separation, purification, and identification of organic compounds. *Offered:* Spring.

*Corequisites:* Registration in CHE 226 is required.

**CHE 304 • Essentials of Biochemistry.** 3 Credits.

A survey of the structure, function, interactions, and chemical properties of the four major macromolecules: proteins, nucleic acids, lipids, and carbohydrates. Examination of primary metabolic pathways, bioenergetics, regulation, and homeostasis.

*Prerequisites:* CHE 224/CHE 225; BIO 120/BIO 121. *Not open to students who have taken BIO 388/BIO 389 or CHE 388/CHE 389.* *Corequisites:* Registration in CHE 305 is required. *Offered:* Fall

**CHE 305 • Essentials of Biochemistry Lab.** 1 Credit.

Laboratory experience accompanying CHE 304. *Corequisites:* Registration in CHE 304 is required. *Offered:* Fall.

**CHE 306 • Advanced Organic Chemistry.** 3 Credits.

Bonding, kinetics, mechanisms of reactions, stereochemistry, and structure determination of organic compounds.

*Prerequisites:* CHE 226/227; CHE 344/345. *Corequisites:* Registration in CHE 307 is required. *Offered:* Occasionally

**CHE 307 • Advanced Organic Chemistry Lab.** 1 Credit.

Laboratory experience accompanying CHE 306. *Corequisites:* Registration in CHE 306 is required. *Offered:* Occasionally.

**CHE 312 • Quantitative Analysis.** 3 Credits.

Principles and practice of modern quantitative analysis. Acid-base and ionic equilibria. Statistics, method selection and development, chromatography, and electrochemistry.

*Prerequisites:* CHE 214/215 or CHE 208/208D.

*Corequisites:* Registration in CHE 313 is required. Offered: Spring.

**CHE 313 • Quantitative Analysis Lab.** 1 Credit.

Laboratory experience accompanying CHE 312.

*Corequisites:* Registration in CHE 312 is required. Offered: Spring.

**CHE 320 • Instrumental Analysis.** 3 Credits.

Methods of instrumental analysis. Study of chemical and physical principles and practical application of spectroscopy, spectrometry, chromatography and electroanalysis. Fundamental electronic circuitry and computer data acquisition and control.

*Prerequisites:* CHE 312/313 or CHE 226/CHE 227

*Corequisites:* Registration in CHE 321 is required. Offered: Fall.

**CHE 321 • Instrumental Analysis Lab.** 1 Credit.

Laboratory experience accompanying CHE 320.

*Corequisites:* Registration in CHE 320 is required. Offered: Fall.

**CHE 344 • Thermodynamics, Kinetics, and Statistical Mechanics.** 3 Credits.

Physical chemistry of the laws of thermodynamics and their application to phase and chemical equilibria. Chemical kinetics of reaction rates and reaction mechanisms. Statistical mechanics as it relates spectroscopy with thermodynamics and kinetics.

*Prerequisites:* CHE 214/215 or CHE 208/208D; PHY 292/292D; PHY 296/297; MAT 125. *Corequisites:*

Registration in CHE 345 is required. Offered: Fall

**CHE 345 • Thermodynamics, Kinetics, and Statistical Mechanics Lab.** 1 Credit.

Laboratory experience accompanying CHE 344.

Includes hands-on experience with physiochemical systems and computational modeling.

*Corequisites:* Registration in CHE 344 is required. Offered: Fall.

**CHE 348 • Quantum Chemistry and Spectroscopy.** 3 Credits.

Physical chemistry of the laws of quantum mechanics applied to atoms and molecules. Quantum mechanical solutions of model systems and their application to chemical spectroscopy.

*Prerequisites:* CHE 208/208D or CHE 214/215; PHY 292/292D; PHY 296/297; MAT 125. *Corequisites:*

Registration in CHE 349 is required. Offered: Spring

**CHE 349 • Quantum Chemistry and Spectroscopy Lab.** 1 Credit.

Laboratory experience accompanying CHE 348.

Includes hands-on experience with physiochemical systems and computational modeling.

*Corequisites:* Registration in CHE 348 is required. Offered: Spring.

**CHE 364 • Advanced Inorganic Chemistry.** 3 Credits.

Chemistry of elements and their compounds, including symmetry, bonding theories, solid-state chemistry, coordination compounds, organometallics, and bioinorganic compounds.

*Prerequisites:* CHE 344/345; One year of Organic

Chemistry or Junior standing. *Corequisites:* Registration in CHE 365 is required. Offered: Spring

**CHE 365 • Advanced Inorganic Chemistry Lab.** 1 Credit.

Laboratory experience accompanying CHE 364.

Laboratory includes synthesis and characterization of inorganic compounds.

*Corequisites:* Registration in CHE 364 is required. Offered: Spring.

**CHE 388 • Biochemistry I.** 3 Credits.

Physical and chemical properties of living systems with an emphasis on macromolecular interaction, structure, and function. Structure, classification, purification, and function of nucleic acids, proteins, carbohydrates, and lipids, including membrane transport and enzymology. *Prerequisites:* CHE 226/227; CHE 344/345; BIO 120/121. *BIO 354/355 recommended. Corequisites:* Registration in CHE 389 is required. Offered: Fall. *Special Notes:* Not open to students who have taken CHE 304/305; Carries cross-credit in Biology.

**CHE 389 • Biochemistry I Lab.** 1 Credit.

Laboratory experience accompanying CHE 388.

Techniques include spectroscopy, chromatography, centrifugation, electrophoresis, and enzyme kinetics.

*Corequisites:* Registration in CHE 388 is required. Offered: Fall.

**CHE 393 • Research.** 1-4 Credits.

Utilization of the techniques and understanding of chemical principles on a term project. Use of original literature to formulate and conduct an original laboratory or computational research project under the supervision of a chemistry faculty member.

*Prerequisites:* Consent of department. *Repeatable course May only be taken for credit once. Offered:* Fall, Interim, Spring.



**CHE 395 • Chemistry Seminar: Research and Professional Development.** 1 Credit.

Students search the chemical literature and develop a proposal for their capstone research project. Discussion of chemical careers, graduate and professional school preparation, and ethical conduct in science.

*Prerequisites: CHE 200 (may be taken concurrently); Junior standing; must be a Chemistry or Biochemistry/Molecular Biology major. Offered: Fall.*

**CHE 396 • Biochemistry II.** 3 Credits.

Metabolic pathways, bioenergetics, metabolic regulation, and metabolism of macromolecules (carbohydrates, lipids, amino acids, and nucleotides). Macromolecular synthesis of RNA, DNA, and proteins, including an introduction to biotechnology.

*Prerequisites: CHE 388/389 or BIO 388/389. Corequisites: Registration in CHE 397 is required. Offered: Spring*

**CHE 397 • Biochemistry II Lab.** 1 Credit.

Laboratory experience accompanying CHE 396. Laboratory includes procedures and experiments for the isolation and characterization of enzymes, RNA and DNA, molecular cloning, PCR, and gene expression. *Corequisites: Registration in CHE 396 is required. Offered: Spring.*

**CHE 490 • Chemistry Seminar: Research.** 2 Credits.

Students pursue an original research project in Chemistry or Biochemistry supported by a faculty mentor. Required time commitment is approximately 3.5 hours per week per credit, including weekly meeting with faculty mentor.

*Prerequisites: CHE 395; Consent of instructor. Offered: Fall, Spring.*

**CHE 491 • Research.** 1-4 Credits.

Students pursue an original research project in Chemistry or Biochemistry supported by a faculty mentor. Required time commitment is approximately 3.5 hours per week per credit, including weekly meeting with faculty mentor.

*Prerequisites: CHE 490; Consent of department. Offered: Fall, Interim, Spring.*

**CHE 494 • Chemistry Seminar: Research Presentation.**

1 Credit.

Students prepare and deliver formal presentations of their research results. Seminar meets weekly for discussion of current topics.

*Prerequisites: CHE 490. Offered: Fall, Spring*