

# Chemistry & Biochemistry

## *Shinquin Program in Chemistry and Biochemistry*

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### **Majors:**

- Bachelor of Science in Chemistry (<http://catalog.norwich.edu/archives/2016-17/residentialprogramscatalog/collegeofscienceandmathematics/chemistryandbiochemistry/#curriculumtext>)
- Bachelor of Science in Biochemistry (<http://catalog.norwich.edu/archives/2016-17/residentialprogramscatalog/collegeofscienceandmathematics/chemistryandbiochemistry/#biochemistrytext>) (fulfills all pre-medical and pre-dental required courses)

### **Mission:**

Within the mission of Norwich University and the College of Science and Mathematics, the mission of the Chemistry and Biochemistry Department is to offer laboratory-intensive courses that provide an understanding of the chemical and biochemical aspects of the physical environment and to prepare students majoring in the discipline for careers in chemistry and biochemistry related fields as well as for further educational opportunities.

The progress of all students majoring in chemistry and biochemistry will be evaluated by the department at the end of the first and second years. Students receiving an unsatisfactory evaluation will be requested to change majors.

### **Goals:**

- Graduates will have a good understanding and broad knowledge of chemistry in all five areas of the discipline: analytical, biochemistry, inorganic, organic, and physical.
- Graduates will be capable of performing independently and competently in the laboratory.
- Graduates will be prepared for successful employment in a profession employing chemistry and will be prepared for graduate or professional school.

### **Outcomes:**

- Chemistry and biochemistry majors will complete the ETS standardized chemistry major field exam and score on average in the 50<sup>th</sup> percentile or above.
- Chemistry and biochemistry majors will develop the ability to read the primary literature; to follow procedures found in the literature; to perform a variety of modern laboratory techniques and produce quality results, and to communicate results orally and in writing.
- Ninety percent of graduates who wish to pursue graduate or professional education will be accepted into programs; 100% of graduates desiring employment or commissioning directly from the undergraduate programs will be employed or commissioned within six months of graduation.

### **Careers for these Majors:**

A degree in chemistry or biochemistry serves as an excellent foundation for careers both in and out of science. It can be of particular benefit to students interested in pursuing any of the following careers:

- Agricultural Chemist
- Air Pollution Monitor
- Assayer
- Bio-Analyst
- Biochemist
- Biologist
- Biomedical Engineer
- Biostatistician
- Brewmaster
- Clinical Chemist
- Crime Lab Assistant
- Dentist
- DNA Analyst
- Doctor
- Teacher
- Epidemiologist
- Food and Drug Inspector
- Food Chemist
- Food Safety Auditor
- Food Scientist
- Forensic Chemist
- Laboratory Manager
- Medical Laboratory Technologist
- Patent Agent
- Pest Control Technician
- Petroleum Chemist
- Pharmaceutical Chemist
- Pharmacist
- Pharmacologist

- Quality Control Specialist
- Regulatory Affairs Specialist
- Research Assistant
- Sales Representative
- Science Advisor
- Toxicologist
- University Professor
- Water Purification Chemist
- Water Quality Analyst

**B.S. in Biochemistry Curriculum Map 2016-2017 Catalog**

Print PDF Curriculum Map

<b>Freshman</b>			
<b>Fall</b>	<b>Cr.</b>	<b>Spring</b>	<b>Cr.</b>
CH 103 General Chemistry I (General Education Lab Science)	4	CH 104 General Chemistry II (General Education Lab Science)	4
MA 107 Precalculus Mathematics <sup>1</sup>	4-3	MA 121 Calculus I (General Education Math)	4
EN 101 Composition and Literature I	3	EN 102 Composition and Literature II	3
BI 101 Principles of Biology I	4	BI 102 Principles of Biology II	4
Semester Total Credits	15-14	Semester Total Credits	15
<b>Sophomore</b>			
<b>Fall</b>	<b>Cr.</b>	<b>Spring</b>	<b>Cr.</b>
CH 225 Organic Chemistry I	4	CH 226 Organic Chemistry II	4
PS 201 General Physics I <sup>2</sup>	4	PS 202 General Physics II <sup>2</sup>	4
BI 202 Genetics	4	MA 122 Calculus II (General Education Math)	4
EN 201 World Literature I (General Education Literature) <sup>3</sup>	3	EN 202 World Literature II	3
CH 214 Communication in Chemistry (or in 3rd year)	1-0		
Semester Total Credits	16-15	Semester Total Credits	15
<b>Junior</b>			
<b>Fall</b>	<b>Cr.</b>	<b>Spring</b>	<b>Cr.</b>
CH 204 Quantitative Analysis (or Free Elective)	4	CH 314 Instrumental Methods (or Free Elective)	3
CH 214 Communication in Chemistry (or in 2nd year)	0-1	CH 315 Analysis Laboratory (taken with CH 314)	1-0
CH 327 Physical Chemistry I (or Free Elective)	3	CH 328 Physical Chemistry II (or Free Elective)	3
CH 324 Biochemistry I	4	BI 306 Cell Biology (or CH 325 Biochemistry II)	4
History (General Education)	3	Social Science (General Education)	3
Free Elective (or BI 304 Physiology)	3		
Semester Total Credits	17-18	Semester Total Credits	14-13
<b>Senior</b>			
<b>Fall</b>	<b>Cr.</b>	<b>Spring</b>	<b>Cr.</b>
CH 413 Chemistry Seminar (Capstone)	1	CH 422 Chemical Synthesis and Examination II (Capstone)	3
BI 304 Physiology (or Free Elective)	4-3	CH 325 Biochemistry II or BI 306 Cell Biology	4
Arts & Humanities (General Education)	3	Free Elective (or CH 314 / CH 315 Instrumental Analysis)	3-4
PH Ethics (General Education)	3	Free Elective (or CH 328 Physical Chemistry II)	3
Free Elective (or CH 204 Quantitative Analysis)	3-4		
Free Elective (or CH 327 Physical Chemistry I)	3		
Semester Total Credits	17	Semester Total Credits	13-14
Total Credits For This Major: 122-121			

<sup>1</sup> MA 107 can be substituted with a Free Elective credit if Math Placement Test places a student into MA 121

<sup>2</sup> PS 211 - PS 212 may be substituted for PS 201 - PS 202

<sup>3</sup> EN 112 or EN 204 may be substituted for one semester of EN 201 - EN 202.

**B.S. in Chemistry - Curriculum Map 2016-2017 Catalog**

Print PDF Curriculum Map ([http://catalog.norwich.edu/residentialprogramscatalog/collegeofscienceandmathematics/chemistryandbiochemistry/chem\\_1472073537868.pdf](http://catalog.norwich.edu/residentialprogramscatalog/collegeofscienceandmathematics/chemistryandbiochemistry/chem_1472073537868.pdf))

<b>Freshman</b>			
<b>Fall</b>	<b>Cr.</b>	<b>Spring</b>	<b>Cr.</b>
CH 103 General Chemistry I (General Education Lab Science)	4	CH 104 General Chemistry II (General Education Lab Science)	4
MA 121 Calculus I (General Education Math)	4	MA 122 Calculus II (General Education Math)	4
EN 101 Composition and Literature I	3	EN 102 Composition and Literature II	3
Arts and Humanities (General Education)	3	MA 241 Mathematical Computation and Modeling <sup>1</sup>	3
Semester Total Credits	14	Semester Total Credits	14
<b>Sophomore</b>			
<b>Fall</b>	<b>Cr.</b>	<b>Spring</b>	<b>Cr.</b>
CH 225 Organic Chemistry I or 327 Physical Chemistry I (and CH 337 Physical Chemistry Laboratory I) <sup>4</sup>	4	CH 226 Organic Chemistry II or 328 Physical Chemistry II (and CH 338 Physical Chemistry Laboratory II) <sup>4</sup>	4
EN 201 World Literature I (General Education Literature) <sup>2</sup>	3	EN 202 World Literature II	3
PS 211 University Physics I	4	PS 212 University Physics II	4
CH 214 Communication in Chemistry (or in 3rd year) <sup>4</sup>	1-0	MA 224 Differential Equations	4
BI 101 Principles of Biology I	4		
Semester Total Credits	16-15	Semester Total Credits	15

Junior			
Fall	Cr.	Spring	Cr.
CH 204 Quantitative Analysis (or CH 324 Biochemistry I)	4	CH 314 Instrumental Methods (or Free Elective)	3
CH 214 Communication in Chemistry (or in 2nd year)	0-1	CH 315 Analysis Laboratory (taken with CH 314)	1-0
CH 327 Physical Chemistry I (or Math/Science elective)	3	CH 328 Physical Chemistry II (or Free Elective)	3
CH 337 Physical Chemistry Laboratory I	1-0	CH 338 Physical Chemistry Laboratory II	1-0
Social Science (General education)	3	Math/ Science elective (or CH 438 Advanced Inorganic)	3
History (General Education)	3	PH Ethics (General Education)	3
Free Elective	3	Free Elective	3
Semester Total Credits	17	Semester Total Credits	17-15
Senior			
Fall	Cr.	Spring	Cr.
CH 413 Chemistry Seminar (Capstone)	1	CH 422 Chemical Synthesis and Examination II (Capstone)	3
CH 421 Chemical Synthesis and Examination I	3	CH 438 Advanced Inorganic Chemistry (or Math/Science Elective)	3
CH 324 Biochemistry I (or CH 204 Quantitative Analysis)	4	Free Elective (or CH 314 / CH315 Instrumental Analysis)	3-4
Math/Science elective (or CH 327 / CH 337 Physical Chemistry I)	3-4	Free Elective (or CH 328 / CH 338 Physical Chemistry II)	3-4
Free Elective	3	Free Elective	3
Semester Total Credits	14-15	Semester Total Credits	15-17
Total Credits For This Major: 122			

- 1 MA 241 may be substituted for EG 110
- 2 EN 112 or EN 204 may be substituted for one semester of EN 201 - EN 202.

### Chemistry Minor Curriculum Map 2016-2017 Catalog

This minor is not available to students majoring in Chemistry or Biochemistry.

CH Elective	3
CH Elective	3
CH Elective (200 level or higher)	3
CH Elective (200 level or higher)	3
CH Elective (200 level or higher)	3
CH Elective (200 level or higher)	3
Total Cr.	18

### Courses

#### CH 100 Introduction to Forensic Science 4 Cr.

An introductory survey course of Forensic Science/Criminalistics. The course will focus on scientific principles behind the recognition, collection, preservation, analysis, and interpretation of physical evidence found at a crime scene. The emphasis will be put on providing students with an understanding of the capabilities and limitations of forensic science as it is currently practiced. Lecture 3 hours, laboratory 3 hours. Recommended for students not majoring in science and engineering. Offered fall and spring semesters.

#### CH 101 Introduction to General Chemistry 4 Cr.

CH 101 is the first of a two semester course series in chemistry covering topics in General, Organic and Biochemistry (GOB). It is a fundamental course in general chemistry, introducing students to the principles of chemical structure and reactivity. Topics include accuracy and precision in measurement, atomic and molecular structure, chemical bonding and reactions, and chemical equilibrium. The laboratory element complements the lecture material with emphasis placed on collaborative problem solving. Prerequisite: Math placement score of 001 or higher. Not more than one of CH 101 or CH 103 may count as degree credit. Lecture 3 hours, laboratory 3 hours. Offered spring semesters.

#### CH 102 Introduction to Organic and Biochemistry 4 Cr.

CH 102 is the second part of a two semester course series in chemistry covering topics in General, Organic and Biochemistry (GOB). This course introduces students to the nomenclature, structure and reactivity of organic compounds and the structure and function of the major classes of biological compounds and their role in metabolic pathways. Laboratory exercises compliment the lecture material. Prerequisites: CH 101 or CH 103. Not more than one of CH 102 or CH 104 may count as degree credit. CH 102 may not be taken for credit after successful completion of CH 205. Lecture 3 hours, laboratory 3 hours. Offered fall semesters.

#### CH 103 General Chemistry I 4 Cr.

Introduction to chemical characteristics and behavior, stressing atomic structure, stoichiometry, chemical equilibrium and kinetics, and descriptive chemistry of important elements. Laboratory includes qualitative and quantitative exercises, and syntheses. Lecture 3 hours, laboratory 3 hours. Credit will not be granted for more than one of the following sequences: CH 103 - CH 104, CH 101 - CH 102, or CH 103 - CH 102. Prerequisites: One year of high school chemistry and a score of 2 or higher on the Norwich University Mathematics Placement Test or a "C" or higher in MA 103. Offered fall semesters.

#### CH 104 General Chemistry II 4 Cr.

Continuation of the study of chemical characteristics and behavior, stressing atomic structure, stoichiometry, chemical equilibrium and kinetics, and descriptive chemistry of important elements. Laboratory includes qualitative and quantitative exercises, and syntheses. Lecture 3 hours, laboratory 3 hours. Credit will not be granted for more than one of the following sequences: CH 103 - CH 104, CH 101 - CH 102, or CH 103 - CH 102. Prerequisites: CH 103. Offered spring semesters.

#### CH 1XL Chemistry Lab Elective 4 Cr.

#### CH 1XX Chemistry Elective 3 Cr.

#### CH 204 Quantitative Analysis 4 Cr.

A course on the general principles and laboratory practices of quantitative analysis, applied principally in colorimetric and volumetric determinations. Studies of theory and practical procedures associated with gravimetric analysis, potentiometric titrations, and use of pH-meters. Lecture 3 hours, laboratory 4 hours. Prerequisites: CH 103, CH 104. Offered fall semesters of even numbered years.

**CH 205 Survey of Organic Chemistry 4 Cr.**

An Introduction to the chemistry of carbon-containing compounds and the instrumentation of organic chemistry. An introduction to the chemistry of carbon-containing compounds and the instrumentation of organic chemistry. Laboratory work involves elementary manipulation of organic laboratory equipment, preparation and identification of typical organic compounds, and the characteristics of the major functional groups. Lecture 3 hours, laboratory 2 hours. Prerequisites: CH 104. Offered spring semesters of even numbered years.

**CH 214 Communication in Chemistry 1 Cr.**

This course illustrates the organization of the chemical literature, the efficient search of the literature and a formal introduction to scientific writing. Offered fall semesters.

**CH 225 Organic Chemistry I 4 Cr.**

An introduction to the study of carbon compounds; preparation and identification of typical compounds. Lecture 3 hours, laboratory 3 hours. Prerequisites: CH 104 or by petition. Offered fall semesters.

**CH 226 Organic Chemistry II 4 Cr.**

A continuation of the study of carbon compounds; preparation and identification of typical compounds. Lecture 3 hours, laboratory 3 hours. Prerequisite: CH 225. Offered spring semesters.

**CH 2XX Chemistry Elective 3 Cr.****CH 314 Instrumental Methods 3 Cr.**

A course on the Theory of Modern Instrumental Methods. Lecture 3 hours. Prerequisites: CH 204. Offered spring semesters of odd numbered years.

**CH 315 Analysis Laboratory 1 Cr.**

A course that provides upper class laboratory experience in chemical methods of measurement and analysis. Laboratory 3 hours. Prerequisite: CH 204. Offered spring semesters of odd numbered years.

**CH 324 Biochemistry I 4 Cr.**

A course on the chemical phenomena and energy effects in life processes. Topics include structure and function of biomolecules, metabolism (catabolism and anabolism), photosynthesis and recombinant DNA technologies. Lecture 3 hours, laboratory 3 hours. Prerequisites: BI 101, CH 226. Offered fall semesters.

**CH 325 Biochemistry II 4 Cr.**

A continuation of the study of the chemical phenomena and energy effects in life processes. Topics include structure and function of biomolecules, metabolism (catabolism and anabolism), photosynthesis and recombinant DNA technologies. Lecture 3 hours, laboratory 3 hours. Prerequisite: CH 324. Offered even numbered spring semesters.

**CH 327 Physical Chemistry I 3 Cr.**

A course on the physical properties and structure of matter; general principles and theories of chemical interaction. Major areas studied are chemical applications of thermodynamics; phase equilibria; electrochemistry; reaction kinetics; description of electronic structure of atoms and molecules. Lecture 3 hours. Prerequisites: CH 104; MA 122 (required) college physics (recommended). Offered even numbered fall semesters.

**CH 328 Physical Chemistry II 3 Cr.**

A continuation of the study of the physical properties and structure of matter; general principles and theories of chemical interaction. Major areas studied are chemical applications of thermodynamics; phase equilibria; electrochemistry; reaction kinetics; description of electronic structure of atoms and molecules. Lecture 3 hours. Prerequisite: CH 327. Offered odd numbered spring semesters.

**CH 337 Physical Chemistry Laboratory I 1 Cr.**

Laboratory investigations with written formal reports on the physical properties and chemical behavior of substances. Laboratory 3 hours. Prerequisite or co-requisite: CH 327. Offered fall semesters of even numbered years.

**CH 338 Physical Chemistry Laboratory II 1 Cr.**

Laboratory investigations with written formal reports on the physical properties and chemical behavior of substances. Laboratory 3 hours. Prerequisite or co-requisite: CH 328. Offered spring semesters of odd numbered years.

**CH 413 Chemistry Seminar 1 Cr.**

Part of a capstone experience that provides individual assignments, written reports, oral reports, and class discussions on chemical topics of current interest. Reading, writing, speaking and critical thinking skills are emphasized. Lecture 1 hour. Prerequisites: Junior 2 Chemistry and Biochemistry majors only.

**CH 421 Chemical Synthesis and Examination I 3 Cr.**

A capstone experience in which organic, inorganic and compounds of biological interest are synthesized and examined with respect to purity and properties. The objectives are to develop an integrated perspective on the general field of chemistry and to develop proficiency in practical laboratory procedures and in reporting results. Laboratory and occasional lectures 8 hours. Prerequisites: open to senior CH and BCH students. Offered fall semesters.

**CH 422 Chemical Synthesis and Examination II 3 Cr.**

A capstone experience in which organic, inorganic and compounds of biological interest are synthesized and examined with respect to purity and properties. The objectives are to develop an integrated perspective on the general field of chemistry and to develop proficiency in practical laboratory procedures and in reporting results. Laboratory and occasional lectures 8 hours. Prerequisites: open to senior CH and BCH students. Offered spring semesters.

**CH 425 Thesis 1-3 Cr.**

This course allows the student to conduct research on a project approved by the faculty of the chemistry and biochemistry programs. The student can be expected to perform the necessary experiments, organize and interpret the data and to communicate the results of the project with a comprehensive report. Prerequisites: CH 226 and permission of the department. The student may re-enroll in CH 425 for up to 6 credits.

**CH 438 Advanced Inorganic Chemistry 3 Cr.**

A course on the chemistry of the elements: properties, characteristics, and behavior. Lecture 3 hours. Prerequisites: CH 327 - CH 328. Offered spring semesters of even numbered years.

**CH 439 Advanced Organic Chemistry 3 Cr.**

An advanced and thorough development of topics introduced in CH 226. Lecture 3 hours. Prerequisites: CH 226. Offered on occasion.

**CH 450 Topics in Chemistry 3 Cr.**

A course in which a selected limited topic in advanced chemistry is covered in depth. Offered on occasion. Prerequisite: permission of the instructor.