

## RESEARCH AND SPECIALIZED STUDIES

### BIOL405

#### Topics in \_\_\_\_\_

Investigates various specialties of biology. Repeatable in different areas.

### BIOL495

#### Independent Readings/Research

Independent readings or research in biology under the direction of the instructor. Consent of instructor required.

### BIOL590

#### Topics in \_\_\_\_\_

Investigates various specialties of biology. Repeatable in different areas.

### BIOL648

#### Workshop

### BIOL691,692,693

#### Research Methods and Biology Seminar

Use of biological literature and methods in current research. Reports are made by each student to the group on topics from current literature and on specific problems in biology. Participation once per week for 3 quarters is required.

### BIOL697

#### Research in Biology

Repeatable to 5 credits.

### BIOL699

#### Master's Thesis

Repeatable to 8 credits.

(1-5)

(5)

(1-5)

(variable)

(1, 1, 1)

(1-5)

(4)

# CHEMISTRY AND BIOCHEMISTRY

Halenz Hall, Room 225  
(616) 471-3247 or 471-3248  
chemistry@andrews.edu  
http://www.andrews.edu/CHEM/

#### Faculty

G. William Mutch, *Chair*  
David E. Alonso  
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Robert A. Wilkins  
Peter A. Wong

| Academic Programs  | Credits |
|--------------------|---------|
| BS: Chemistry      | 60      |
| BS: Biochemistry   | 51      |
| Minor in Chemistry | 30      |

Students who plan to major in chemistry or biochemistry are expected to have entrance credit in the preparatory subjects of chemistry and mathematics (including algebra and trigonometry); a background in physics is desirable. Those who do not have entrance credit or equivalent training in these subjects, particularly mathematics, may not fulfill the department graduation requirements in four years.

Students are encouraged to plan early for an on-campus or off-campus research experience required of all students in the Bachelor of Science degree program in chemistry and strongly recommended for those in the Bachelor of Science degree program in biochemistry. This experience may take the form of a cooperative educational-research experience of up to three non-consecutive quarters in an industrial setting or research in an academic or governmental laboratory setting. Interested students should consult the department chair.

#### AMERICAN CHEMICAL SOCIETY CERTIFICATION

Students desiring American Chemical Society certification must

- Complete the required courses for the Bachelor of Science degree in chemistry as spelled out in this bulletin
- Achieve a minimum GPA of 3.00 in all chemistry courses taken at Andrews University
- Satisfactorily complete a research or cooperative educational experience in chemistry
- Pass at least one advanced course selected from the following: CHEM435, 474, 475, and BCHM401.

A complete statement of certification requirements is available from the department chair.

## Undergraduate Programs

### BS: Chemistry—60

**Major Requirements:** CHEM121, 122, 123, 200, 211, 212, 213, 320, 400, 401, 402, 403, 420, 421, 422, 430, 460.

**Research/Cooperative Experience:** An

on-campus or off-campus research or cooperative educational experience. The student may satisfy this requirement by matriculating in CHEM495, HONS497, 498 or GCAS380.

**Cognate Courses:** COSC125; MATH171, 172, 173, 281, 282; PHYS251, 252, 253, 261, 262, 263.

Courses in economics and marketing are strongly recommended. A reading knowledge of German or French, although not required for professional undergraduate education in chemistry, is strongly recommended for students planning advanced study.

### BS: Biochemistry—51

**Major Requirements:** BCHM401, 402, 412, 413, 423; CHEM121, 122, 123, 200, 211, 212, 213, 401, 402, 403, 421, 435 (422 may be substituted for 435).

**Cognate Courses:** BIOL155, 156, 157; MATH171, 172, 173; PHYS151, 152, 153 (or PHYS251, 252, 253, 261, 262, 263); and two courses selected from BIOL371, 372; FDNT485; ZOOL315, 464, 465.

Students desiring a career in biochemistry might be better served by adding the biochemistry courses to the Bachelor of Science degree in chemistry, but the Bachelor of Science degree in biochemistry can be strengthened by the addition of CHEM320, 400, 420, 430, and 495.

### Minor in Chemistry—30

CHEM121, 122, 123, 211, 212, 213, plus 6 elective credits.

## Graduate Program

The Department of Chemistry and Biochemistry collaborates in offering the Master of Science: Interdisciplinary Studies (Mathematics and Physical Sciences). See the Interdisciplinary Studies section, p. 85.

## Courses

(Credits)

See inside back cover for symbol code.

### BCHM115

\$(4)

#### Concepts in Biochemistry

Survey of major concepts in biochemistry; structures of biologically relevant molecules, their functions, intermediary metabolism. Weekly: 3 lectures and 3 hours lab. Not applicable toward a major or minor in chemistry. Prerequisite: CHEM112.

### BCHM401

(3)

#### Biochemistry I

Study of the fundamental principles of enzyme kinetics and mechanisms based on the structure and chemistry of biomolecules including amino acids and proteins, nucleotides, and nucleic acids, and on the structure and function of biological membranes. Weekly: 3 lectures and 1 recitation. Prerequisite: CHEM213.

### BCHM402

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#### Biochemistry II

Study of the chemistry and metabolism of carbohydrates and lipids and the metabolism of amino acids and nucleotides with emphasis on physiological control in living tissues. Weekly: 3 lectures and 1 recitation. Prerequisite: BCHM401.

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| <p><b>BCHM412</b> \$ (1)<br/><i>Biochemistry Laboratory</i><br/>Introduction to quantitative and qualitative methods for determining protein, glycogen, and lipids in fresh tissue. Weekly: 4 hours lab. Prerequisite: BCHM401.</p>  | <p><b>CHEM341,342</b> \$ (4, 4)<br/><i>Environmental Chemistry</i><br/>A survey of environmental and energy-related problems. Topics include air and water pollution, energy and other resources, solid wastes and recycling, and toxic chemicals. Weekly: 3 lectures and 4 hours lab. Not applicable towards a major in chemistry or biochemistry. Prerequisites: CHEM123; CHEM 213 or 200 recommended.</p>  | <p>electrolytes, kinetics of enzyme-catalyzed reactions, spectroscopic and other methods in structural and conformational studies of proteins. Weekly: 3 lectures and 4 hours lab. Prerequisite: CHEM421.</p>   |
| <p><b>BCHM413</b> \$ g (1)<br/><i>Biochemistry Laboratory</i><br/>Additional methods for the quantitative and qualitative determination of protein, glycogen, and lipids in fresh tissue. Methods for determining the kinetics of enzyme catalytic activity. Weekly: 4 hours lab. Prerequisite: BCHM401.</p>   | <p><b>CHEM400</b> \$ g (4)<br/><i>Chemical Separations and Analysis</i><br/>Theory of analytical separations by solvent extraction, counter current distribution, and various chromatographies. After separation, the components of mixtures are analyzed by a variety of spectroscopic techniques. Weekly: 2 lectures and 8 hours lab. Prerequisites: CHEM200, 213; PHYS153 (or 253, 263).</p>   | <p><b>CHEM460</b> \$ g (4)<br/><i>Quantum Chemistry</i><br/>Wave mechanics, atomic and molecular structure, chemical bonding, and atomic and molecular spectroscopy. Weekly: 3 lectures and 4 hours lab. Prerequisites: CHEM422; MATH282.</p>   |
| <p><b>BCHM423</b> (3)<br/><i>Neurochemistry</i><br/>Study of the 4 principal neurotransmitter systems—acetylcholine, catecholamines, serotonin, and gamma-aminobutyric acid—with an emphasis on biosynthesis, excitation-secretion coupling, interaction with receptor, and degradation. Weekly: 3 lectures and 1 recitation. Prerequisite: BCHM402.</p>   | <p><b>CHEM401,402,403</b> (1,1,1)<br/><i>Seminar in Chemistry</i><br/>Autumn quarter: Introduction to the use of chemical literature as a source of information. Winter and Spring quarters: Presentation by the student of at least one lecture on a topic of current chemical interest. Staff and off-campus visitors also contribute to the lecture series. Prerequisite: CHEM213. Open to majors only.</p>  | <p><b>CHEM474</b> \$ (4)<br/><i>Topics in Advanced Chemistry</i><br/>Study of one of the following topics in chemistry:<br/>A. Methods of Synthetic Organic Chemistry. Weekly: 2 lectures and 6 hours lab.<br/>B. Industrial Chemical Processes. Weekly: 4 lectures.<br/>C. Polymer Chemistry. Weekly: 3 lectures and 3 hours lab. Prerequisite: CHEM213.</p>   |
| <p><b>CHEM111,112</b> \$ (5,5)<br/><i>Introductory Chemistry</i><br/>General Education course for liberal arts students and for prospective nurses covering principles of inorganic, organic, and biological chemistry. Weekly: 4 lectures and 3 hours lab. Not applicable toward a major or minor in chemistry.</p>   | <p><b>CHEM410</b> \$ g (3)<br/><i>Forensic Chemistry</i><br/>Principles of chemistry as applied to the methods of analysis and identification of drugs. Rules of evidence as they apply to testimony in court. Observation of drug-related court procedures. Weekly: 1 lecture and 6 hours lab. Participation must be arranged with the instructor at least 2 months prior to beginning of course. Prerequisites: CHEM200, 213; 400 recommended.</p>  | <p><b>CHEM475</b> g (3)<br/><i>Advanced Topics in Physical Chemistry</i><br/>Advanced study of molecular spectroscopy, statistical thermodynamics, chemical dynamics, or the applications of quantum mechanics. Prerequisites: CHEM460; or permission of instructor and CHEM421 or 422.</p>   |
| <p><b>CHEM121,122,123</b> \$ (4,4,4)<br/><i>General Chemistry</i><br/>Stoichiometry, atomic and molecular structure, bonding, periodicity, states of matter, solutions, equilibrium, oxidation-reduction, electrochemistry, kinetics, thermodynamics, acid-base, descriptive, and nuclear chemistry. Weekly: 3 lectures, 2 recitations, and 3 hours lab. Prerequisites: High-school algebra I and II; high-school chemistry and physics recommended.</p> | <p><b>CHEM410</b> \$ g (3)<br/><i>Forensic Chemistry</i><br/>Principles of chemistry as applied to the methods of analysis and identification of drugs. Rules of evidence as they apply to testimony in court. Observation of drug-related court procedures. Weekly: 1 lecture and 6 hours lab. Participation must be arranged with the instructor at least 2 months prior to beginning of course. Prerequisites: CHEM200, 213; 400 recommended.</p>  | <p><b>CHEM495</b> g (2-6)<br/><i>Independent Research</i><br/>Students must consult with each professor about available topics and receive approval of research supervisor before enrollment. Minimum of 3 hours lab per week per credit and a well-written, detailed report are required. Prerequisite: Minimum of 30 credits of chemistry. Repeatable to 6 credits.</p>   |
| <p><b>CHEM200</b> \$ (5)<br/><i>Quantitative Analysis</i><br/>Equilibrium problems, gravimetric, volumetric, and redox analysis. Weekly: 3 lectures and 8 hours lab. Prerequisite: CHEM123.</p>  | <p><b>CHEM420</b> \$ g (5)<br/><i>Inorganic Chemistry II</i><br/>Atomic and molecular structure and symmetry; structure, bonding, spectra and reaction mechanisms of d-metal complexes, organometallic compounds, solid state and bioinorganic chemistry. Weekly: 4 lectures and 4 hours lab. Prerequisites: CHEM213, 320, 422 or 435.</p>  | <p><b>CHEM530</b> (variable)<br/><i>Topics in Teaching Chemistry</i><br/>Each time the course is offered, it treats one of the following areas:<br/>A. Concepts in Chemistry<br/>Fundamental ideas of chemistry.<br/>B. Demonstrations<br/>Simple experiments which illustrate chemical principles.<br/>C. Problem-Solving Strategies<br/>Exploration into the mental processes and logic behind problem solving.<br/>None of the above areas is to occur twice in one student's program. Prerequisite: CHEM213. Repeatable to 4 credits.</p> |
| <p><b>CHEM211,212,213</b> \$ (4,4,4)<br/><i>Organic Chemistry</i><br/>The chemistry of carbon-containing compounds with emphasis on molecular structure, spectra-structure relationships, and a mechanistic approach to organic reactions. Weekly: 3 lectures, 1 recitation, and 4 hours lab. Prerequisite: CHEM123.</p>   | <p><b>CHEM421,422</b> \$ g (4,4)<br/><i>Physical Chemistry</i><br/>Fundamental concepts in chemical thermo-dynamics, free energy, and chemical equilibria; phase changes, solutions, kinetic theory, chemical dynamics, and electrochemistry. Weekly: 3 lectures and 4 hours lab. Prerequisites: CHEM200, MATH173; PHYS153 (or 253, 263).</p>   | <p><b>CHEM540</b> (variable)<br/><i>Topics in Chemistry</i><br/>Independent readings to be chosen in consultation with the instructor. A written report and an oral presentation covering the materials read are required. A minimum of 30 hours of work is required for each credit. Prerequisites: CHEM421. Repeatable to 4 credits.</p>  |
| <p><b>CHEM300</b> Alt \$ (3)<br/><i>Laboratory Glassblowing</i><br/>Practice of fundamental glassblowing skills common to both scientific and creative glassblowing. Two projects are required. The student may choose between scientific and creative projects. Weekly: 1 lecture demonstration and 6 hours lab. Not applicable toward a major or minor in chemistry nor toward the General Education requirement in science.</p>                       | <p><b>CHEM430</b> \$ g (4)<br/><i>Instrumental Analysis</i><br/>Chemical analysis by optical and electrochemical methods. Introduction to interface of instruments with microcomputers. Instruments and devices used include UV-visible, fluorescence, and atomic absorption spectrophotometers, D.C. and A.C. polarographs, microcomputers, operational amplifiers, and other integrated circuits. Weekly: 2 lectures and 8 hours lab. Prerequisites: CHEM200; MATH173; PHYS153 (or 253, 263); PHYS400 is recommended.</p> | <p><b>CHEM540</b> (variable)<br/><i>Topics in Chemistry</i><br/>Independent readings to be chosen in consultation with the instructor. A written report and an oral presentation covering the materials read are required. A minimum of 30 hours of work is required for each credit. Prerequisites: CHEM421. Repeatable to 4 credits.</p>  |
| <p><b>CHEM320</b> (3)<br/><i>Inorganic Chemistry I</i><br/>Unified approach to descriptive inorganic chemistry and principles. Includes periodicity, ionic solids, aqueous and redox chemistry, coordination compounds, hard and soft acid/base principle, halides, nitrides, sulfides, and hydrides. Weekly: 3 lectures. Prerequisite: CHEM123.</p>   | <p><b>CHEM435</b> \$ g (4)<br/><i>Biophysical Chemistry</i><br/>Application of Gibb's free energy and chemical equilibria to biochemical systems, mass transport phenomena, membrane potentials, properties of</p>  | <p><b>CHEM540</b> (variable)<br/><i>Topics in Chemistry</i><br/>Independent readings to be chosen in consultation with the instructor. A written report and an oral presentation covering the materials read are required. A minimum of 30 hours of work is required for each credit. Prerequisites: CHEM421. Repeatable to 4 credits.</p>  |