

propagating tissues in the research lab. Topics include sterile techniques, nutrition, media preparation, establishment and maintenance of primary and secondary cultures, enumeration, and analysis. Weekly: 2 lectures and 1 lab. Prerequisite: BIOL166. Pre- or corequisite: CHEM231. *Spring*

BIOL475 \$? (3)**Biology of Bacteria**

Study of the properties of bacteria that illustrate their function and relationship to other living systems. Topics include structure and function, classification, and interaction with the environment. Weekly: 2 lectures and two 2-hour labs. Prerequisites: BIOL166. Organic Chemistry background recommended. *Fall*

ZOOL425 \$? (3)**Parasitology**

Emphasis on better known parasites of humans and animals. Attention given to ecological factors concerned with host-parasite contact, pathogenicity and pathology, and treatment and effect on parasitized populations. Weekly: 2 lectures and 1 lab. Prerequisites: BIOL166. *Fall*

ZOOL475 \$? (3)**Neurobiology**

The neural basis of behavior, with some emphasis on the human nervous system, including cellular and molecular approaches to neuron function, development of neurons and circuits, and neuroendocrine mechanisms. Labs develop skills in electrophysiology and neuroanatomy. Weekly: 2 lectures and 1 lab. Prerequisite: BIOL166. *Fall*

RESEARCH AND SPECIALIZED STUDIES

BIOL405 (1-4)**Topics in _____**

Investigates various specialties of biology. Repeatable in different areas. *Fall, Spring, Summer*

BIOL495 (1-4)**Independent Readings/Research**

Independent readings or research in biology under the direction of the instructor. Consent of instructor required. *Fall, Spring, Summer*

GRADUATE

BIOL516 (4)**Behavior of Marine Organisms****(offered only at Marine Station)**

Study of inter- and intra-specific behavior of marine animals and their behavioral response to the physical environment. Involves lab experience, field observation, and a research project. Instructor's permission required. *Summer*

BIOL550 (3)**Issues in Origins and Speciation**

A comparative survey of the assumptions, attitudes, methods, and conclusions of science and religion in the handling of data. Attention is given to current scientific data and their relationship to an understanding of earth history and the present diversity of life. *Spring*

BOT515 \$ Alt (3)**Plant Cell Biology**

Functional activities of plant tissues provide the basis for this study of the ultrastructure of a

variety of plant cell types. Attention is given to the cytoskeleton and other organelles involved in plant cell morphogenesis. Weekly: 2 lectures and 1 lab. Prerequisite: BOT470. *Spring*

BOT525 \$ Alt (3)**Molecular Laboratory Techniques**

Acquaints students with modern lab techniques of molecular biology. The manipulation and study of nucleic acids and proteins using model systems involving plant-microbe interactions. *Fall*

BOT530 \$ Alt (3)**Advanced Systematic Botany**

Literature and philosophy of plant classification, processes of speciation in higher plants, sources and interpretation of data, biosystematic methods, and plant nomenclature. Weekly: 2 lectures and 1 lab. Prerequisite: BOT475. *Spring*

ZOOL500 \$ Alt (3)**Protozoology**

Protozoa, including morphology, physiology, systematics, ecology, reproduction, and host-parasite relationships; emphasis on the parasitic protozoa, but free-living forms also considered; current problems encountered in protozoan research and methods of studying protozoa. Weekly: 2 lectures and 1 lab. Prerequisite: ZOOL425. *Fall*

ZOOL520 Alt (2)**Molecular and Developmental Neurobiology**

A seminar course that deals in depth with current and relevant issues in the areas of molecular and developmental neurobiology. Offered alternate years. *Spring*

ZOOL565 \$ Alt (3)**Environmental Physiology**

Study of the physiological responses of animals to their environments. Topics include environmental periodicities and biological clocks, thermal budgets, water balances, and adaptations to extreme environments. Weekly: 2 lectures and 1 lab/problem session. *As scheduled*

BIOL590 (1-4)**Topics in _____**

Investigates various specialties of biology. Repeatable in different areas. *As scheduled*

BIOL648 (1-4)**Workshop****BIOL681, 682** (1, 1)**(merges 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 2 semesters is required. BIOL681: *Fall*; BIOL682: *Spring*

BIOL697 (1-4)**Research in Biology**

Repeatable to 4 credits. *Arranged*

BIOL699 (3)**Master's Thesis**

Repeatable to 6 credits. *Arranged*

CHEMISTRY AND BIO-CHEMISTRY

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
Desmond H. Murray
D. David Nowack
Steven E. Warren
Robert A. Wilkins
Peter A. Wong

Academic Programs	Credits
BS: Chemistry	38
BS: Chemistry (Approved by the American Chemical Society (ACS) Committee on Professional Training)	44
BS: Biochemistry	34
Minor in Chemistry	20

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 programs 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 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: CHEM470, 474, and 475.

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

Undergraduate Programs

Core Courses—30

CHEM131, 132, 200, 231, 232, 241, 242, 311, 312, 411, 412, 431, 441, BCHM421

BS: Chemistry—38

Major Requirements: Core plus CHEM415, 440.

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 IDSC380.

Cognate Courses: CPTR125 or CPTR161; MATH141, 142; PHYS241, 242, 271, 272.

BS: Chemistry—44

(American Chemical Society approved)

Major Requirements: Core plus CHEM440, 415, 432, 442; and one course selected from the following: CHEM470, 474, or 475.

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 IDSC380.

Cognate Courses: MATH141, 142, 286; CPTR125 or CPTR161; PHYS241, 242, 271, 272.

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—34

Major Requirements: Core plus BCHM422, 430.

Cognate Courses: BIOL165, 166; MATH141, 142; PHYS141, 142 (or PHYS241, 242, 271, 272); and two courses selected from BIOL371, 372; FDNT340; 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 CHEM415, 440, and 495.

Minor in Chemistry—20

CHEM131, 132, 231, 232, plus 4 credits of majors level chemistry or biochemistry.

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. 96.

Courses

See inside front cover for symbol code.

	(Credits)		(Credits)
BCHM120 (was BCHM115) <i>Introduction to Biological Chemistry</i> A survey of major concepts in biochemistry such as structures of biological molecules, their functions, energy metabolism, regulation of biochemical pathways; for nursing, dietetics, and allied health students. Weekly: 3 lectures, and a 3-hour lab. Not applicable towards a major or minor in chemistry or biochemistry. Prerequisite: CHEM110 <i>Spring</i>	\$ (4)	CHEM200 <i>Quantitative Analysis</i> Lecture topics include statistics, chemical equilibrium, titrimetric procedures, gravimetric procedures, and electrochemistry. Laboratory experiments include gravimetric procedures and titrimetric procedures of acid and base systems and redox systems, electrochemistry, and an introduction to instrumental methods. Weekly: 2 lectures and 2 4-hour labs. Prerequisites: CHEM132. <i>Spring</i>	\$ (4)
BCHM421 (was BCHM401, 402) <i>Biochemistry I</i> Study of the fundamental principles of enzyme kinetics and mechanisms based on the structure and chemistry of biomolecules including amino acids, carbohydrates, lipids, proteins, nucleotides, nucleic acids, and biological membranes. 4 lectures. Prerequisite: CHEM232. <i>Fall</i>	? (4)	CHEM231 (was CHEM211, 212) <i>Organic Chemistry I</i> The chemistry of carbon-containing compounds with emphasis on nomenclature, molecular structure, spectra-structure relationships, and a mechanistic approach to organic reactions. Weekly: 3 lectures and 2 recitations. Prerequisites: CHEM132. <i>Fall</i>	(3)
BCHM422 (was BCHM402, 423) <i>Biochemistry II</i> Continuation of BCHM421 including selected topics of hormone and regulatory biochemistry, and the study of the four primary neurotransmitter systems—acetylcholine, catecholamines, serotonin, and gamma-aminobutyric acid. Weekly: 3 lectures. Prerequisite: BCHM421. <i>Spring</i>	? (3)	CHEM232 (was CHEM212, 213) <i>Organic Chemistry II</i> This course is a continuation of CHEM231. Weekly: 3 lectures and 2 recitations. Prerequisites: a grade of C- or better in CHEM231. <i>Spring</i>	(3)
BCHM430 (was BCHM412, 413) <i>Biochemistry Lab</i> Introduction to quantitative and qualitative methods for the isolation, purification and identification of biological materials and applications of enzyme kinetics. Weekly: 4 hours of lab. Prerequisite: BCHM421 and registration in BCHM422. <i>Spring</i>	\$? (1)	CHEM241 <i>Organic Chemistry Laboratory I</i> Experiments related to the course content of CHEM231. Weekly: one 4-hour laboratory. Prerequisite: concurrent or previous enrollment in CHEM231. <i>Fall</i>	\$ (1)
CHEM110 (was CHEM111, 112) <i>Introduction to Inorganic and Organic Chemistry</i> An introduction to the principles and applications of inorganic and organic chemistry; for nursing, dietetics, and allied health students. Meets the natural/physical science general education restricted choice requirement. Weekly: 3 lectures, 1 recitation, and a 3-hour lab. <i>Fall</i>	\$ (4)	CHEM242 <i>Organic Chemistry Laboratory II</i> Experiments related to the course content of CHEM232. Weekly one 4-hour laboratory. Prerequisite: concurrent enrollment in CHEM232. <i>Spring</i>	\$ (1)
CHEM131 (was CHEM121, 122) <i>General Chemistry I</i> This first course in chemistry is for students planning to major in science and engineering. Topics include stoichiometry, atomic and molecular structure, bonding, states of matter, solutions, chemical kinetics, and chemical equilibrium. Weekly: 3 lectures, 2 recitations, and a 3-hour lab. Prerequisite: High school algebra II; High school chemistry or physics strongly recommended. <i>Fall</i>	\$ (4)	CHEM300 <i>Laboratory Glassblowing</i> 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 4 hours of lab. Not applicable towards a major or minor in chemistry or toward the General Education requirement in natural science. Not offered in 2000-2001 school year.	Alt \$ (2)
CHEM132 (was CHEM122, 123) <i>General Chemistry II</i> A continuation of CHEM131 with topics including thermodynamics, acid and base chemistry, descriptive and nuclear chemistry.	\$ (4)	CHEM311 <i>Seminar in Chemistry</i> Departmental seminar series devoted to topics in current chemical research by students, faculty, and guest speakers. This course is required of and open only to junior chemistry and biochemistry majors, and attendance for both semesters is required for one credit; freshmen and sophomores are encouraged to attend. Grading is on an S/U basis. A deferred grade (DG) is assigned Fall Semester and is removed upon successful completion of CHEM312. Weekly: 1 seminar. Prerequisite: CHEM232. <i>Fall</i>	(.5)

- CHEM312** (5) phase changes, solutions, molecular transport, chemical dynamics, and electrochemistry. Weekly: 3 lectures. Prerequisites: CHEM200, MATH142, PHYS142 (or 242, 272). *Fall*
- CHEM312** (5) *Seminar in Chemistry*
Continuation of CHEM311. This course is required of and open only to junior chemistry and biochemistry majors; freshmen and sophomore are encouraged to attend. Grading is on S/U basis. Weekly: 1 seminar. Prerequisite: CHEM311. *Spring*
- CHEM340** \$ (4) chemical bonding, atomic and molecular spectroscopies, and applications to chemical dynamics and statistical thermodynamics. Weekly: 3 lectures. Prerequisites: CHEM431, MATH286; MATH240 strongly recommended. *Spring*
- CHEM340** (was CHEM341, 342) \$ (4) *Environmental Chemistry*
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 a 4-hour lab. Not applicable towards a major in chemistry or biochemistry. Prerequisites: CHEM132; CHEM232 or CHEM200 strongly recommended. *Fall*
- CHEM410** \$? (2) *Forensic Chemistry*
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 2 3-hour labs. Participation must be arranged with the instructor at least 2 months prior to beginning of course. Prerequisites: CHEM200, 232. *Spring Semester*
- CHEM411** (5) *Seminar in Chemistry*
First half of semester consists of two meetings per week: one is an introduction to chemical literature and computer searching of Chemical Abstracts and chemical databases, the other meeting is the regular seminar series presented by students, faculty, and invited speakers. During the semester, each student prepares and presents a seminar. This course is required of and open only to senior chemistry and biochemistry majors, and attendance for both semesters is required for one credit. A deferred grade (DG) is assigned Fall Semester and is removed upon successful completion of CHEM412. Weekly: Two meetings during first half of semester, one meeting remainder of semester. Prerequisite: CHEM312. *Fall*
- CHEM412** (5) *Seminar in Chemistry*
Continuation of CHEM411. During the semester, each student prepares and presents a seminar. This course is required of and open only to seniors. Prerequisite: CHEM411. *Spring*
- CHEM415** ? (4) *Advanced Inorganic Chemistry*
Atomic and molecular structure, symmetry, group theory, solid state, acids and bases; structure, bonding, spectra, and reaction mechanisms of d-metal complexes, systematic chemistry of non-metals; organometallic chemistry and catalysis. Weekly: 4 lectures. Prerequisites: CHEM232, 431. *Spring*
- CHEM431** ? (3) *Physical Chemistry I*
Fundamental concepts in chemical thermodynamics, free energy, chemical equilibria,
- CHEM432** ? (3) (was CHEM422, 460) *Physical Chemistry II*
Wave mechanics, atomic and molecular structure, chemical bonding, atomic and molecular spectroscopies, and applications to chemical dynamics and statistical thermodynamics. Weekly: 3 lectures. Prerequisites: CHEM431, MATH286; MATH240 strongly recommended. *Spring*
- CHEM440** \$? (4) (was CHEM400, 430) *Instrumental Analysis*
Theory and practice of analytical separations and chemical analyses by chromatographic, optical and electrochemical methods. Introduction to interface of instruments with microcomputers. Instruments used include emission and absorption spectrometers, lasers, mass spectrometer, chromatographs, microcomputers, analog and digital devices. Weekly: 2 lectures and 2 4-hour labs. Prerequisites: CHEM200, MATH142. *Fall*
- CHEM441** \$? (1) (was part of CHEM421, 422) *Physical Chemistry Laboratory I*
Experiments related to the course content of CHEM431. Weekly: one 4-hour laboratory. Prerequisite: concurrent enrollment in CHEM431. *Fall*
- CHEM442** \$? (1) *Physical Chemistry Laboratory II*
Experiments related to the course content of CHEM432. Weekly one 4-hour laboratory. Prerequisite: concurrent enrollment in CHEM 432. *Spring*
- CHEM470 (new)** \$? (2) *Modern Synthetic Techniques*
An advanced laboratory course designed to incorporate a wide variety of modern synthetic techniques of organic, organometallic, and inorganic chemistry. Weekly: 2 4-hour labs. Prerequisites: CHEM474,415 or concurrent enrollment in CHEM415. *Spring*
- CHEM474** (2) *Advanced Topics in Organic Chemistry*
Study of the principles of modern synthetic organic chemistry with applications from one or more of the following areas: natural product, medicinal, or polymer chemistry. Weekly: 2 lectures. Prerequisites: CHEM232. *Fall*
- CHEM475** ? (2) *Advanced Topics in Physical Chemistry*
Advanced study of molecular spectroscopy, statistical thermodynamics, chemical dynamics, or the application of quantum mechanics. Prerequisites: CHEM432 or CHEM431 and permission of the instructor. Not offered in 2000-2001 school year.
- CHEM495** ? (1-4) *Independent Research*
An opportunity for chemistry and biochemistry majors to gain research experience by joining with a faculty member in study of an area of special interest.
- ## GRADUATE
- CHEM530** (2-4) *Topics in Teaching Chemistry*
Each time the course is offered, it treats one of the following areas:
- Concepts in Chemistry
Fundamental ideas of chemistry.
 - Demonstrations
Simple experiments which illustrate chemical principles.
 - Problem-Solving Strategies
Exploration into the mental processes and logic behind problem solving.
- None of the above areas are to occur twice in one student's program. Prerequisite: CHEM232. Repeatable to 6 credits.
- CHEM540** (2-4) *Topics in Chemistry*
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 60 hours of work is required for each credit. Prerequisites: CHEM431. Repeatable to 6 credits.