Chemistry

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Majors:
•Chemistry
•Biochemistry

Minor:
•Chemistry

Teaching Endorsement:
•Chemistry, Grades 6-12

Other programs:
•Pre-professional Health Sciences (PPHS)
•Chemistry or Biochemistry with Pre-Law

Chemistry lies at the heart of many of the technological advances of the 21st century. It is central to our understanding of the workings of our environment and particularly, in the area of biochemistry, to our understanding of life itself. It is a major key to dealing with problems which arise in our health and environment. The chemistry/biochemistry curriculum is designed to provide a solid foundation in the major areas of chemistry—organic, analytical, physical and biological chemistry. An additional aim is to provide the opportunity for research experience for the student majoring in chemistry. Thus, a broad background for the wide variety of career options open to the chemistry or biochemistry major and a solid preparation for study at the graduate level are provided. Detailed curriculum guides are available from the department for several programs leading to specific occupational goals.

Students majoring in chemistry and biochemistry earn a Bachelor of Arts (B.A.) degree. However, students with multiple mathematics and science majors or minors have the option of earning a Bachelor of Science (B.S.) degree. Students should consult with the department chair for further information.

Major in Chemistry

The major includes 31-32 SH in chemistry:

CHEM 223 General Chemistry I 4
CHEM 224 General Chemistry II. . . .4
CHEM 315 Organic Chemistry I 4
CHEM 316 Organic Chemistry II. . . .4
*CHEM 335 Analytical Chemistry . . .4
*CHEM 405 Thermodynamics 3
*CHEM 406 Quantum Mechanics . . .3
CHEM/BIOCH 469 Chemistry Seminar and Research 2
Chemistry or biochemistry elective . 3-4

Careers in Chemistry include biotechnology, environmental chemistry, medicine, middle or high school instructor, pharmaceutical manufacturing, pollution testing, research lab technician and research.

Seventeen semester hours are required in mathematics and physics:

MATH 181 Differential Calculus 3
MATH 192 Integral Calculus 3
MATH 240 Statistics for the Natural Sciences 3
PHYS 251 University Physics I 4
PHYS 262 University Physics II 4

Additional mathematics courses are recommended:

MATH 283 Intermediate Calculus . . .3
MATH 294 Multivariate Calculus 3

Major in Chemistry, Teaching Endorsement for Grades 6-12

This program will prepare students to teach chemistry by instructing them in the standards of the National Science Teachers Assocation (NSTA). The courses listed in the chemistry major (pages 78-79) and the secondary education courses (page 87) make up the program for teacher licensure, grades 6-12.

Additional requirements for teacher endorsement include:

*ENVS 201 Earth Science 3
Choose one of the following:
BIOL 101 Biological Explorations 3
BIOL 173 Concepts in Biology: Unity and Diversity of Life 4
*BIOL 191 Physical Anthropology . . .3
BIOL 202 Microbiology 4
*BIOL 263 Zoology. 4
ENVS 181 Environmental Science . . .3

Major in Biochemistry

The major in biochemistry prepares students for graduate work in biochemistry or positions in the biotechnology industry.

The major includes 31-32 SH in chemistry and biochemistry:

BIOCH 376 Foundational Biochemistry 4
CHEM 223 General Chemistry I 4
CHEM 224 General Chemistry II. . . .4
CHEM 315 Organic Chemistry I 4
CHEM 316 Organic Chemistry II. . . .4
CHEM/BIOCH 469 Biochemistry Seminar and Research 2
Biochemistry or chemistry elective . . 3-4

Choose one of the following courses:
*BIOCH 398 Advanced Cell Biology . . .3
*BIOCH 438 Molecular Genetics 3

Choose one of the following courses:
*CHEM 405 Thermodynamics 3
*CHEM 406 Quantum Mechanics . . .3

The major also requires 25-26 SH in biology, mathematics and physics:

BIOL 173 Concepts in Biology: Unity and Diversity of Life 4
BIOL 225 Molecules, Genes and Cells 4
MATH 181 Differential Calculus 3
MATH 192 Integral Calculus. 3
PHYS 251 University Physics I 4
PHYS 262 University Physics II. 4

Choose one of the following courses:
*BIOL 307 Developmental Biology . . .4
*BIOL 337 Immunology 3
*BIOL 378 Plant Physiology 3
BIOL 447 Mammalian Physiology. . . .4
*ENVS 345 Environmental Toxicology 3

Enrollment in upper-level biology, biochemistry, chemistry and environmental science courses (BIOL, BIOCH, CHEM, ENVS 300s and 400s) requires a minimum cumulative GPA of 2.0 in all science and math courses (BIOL, BIOCH, CHEM, ENVS, MATH, PHYS).

Students who fail to earn a C- in any coursework required for their major should promptly schedule a meeting with their advisor.

Pre-Professional Health Sciences Program

The chemistry or biochemistry major may be chosen for premedical, predental,

prepharmacy, or preclinical chemistry programs. The biochemistry major is excellent preparation for these fields. Students who major in chemistry should take, in addition to the standard chemistry major above, the following courses:

BIOCH 376 Foundational Biochemistry 4
BIOL 173 Concepts in Biology: Unity and Diversity of Life 4
BIOL 225 Molecules, Genes and Cells 4

Recommended electives:
*BIOCH 398 Advanced Cell Biology . . . 3
*BIOCH 438 Molecular Genetics 3
BIOL 245 Animal Form and Function . 4
BIOL 447 Mammalian Physiology. . . .4

Chemistry or Biochemistry with Pre-Law

The chemistry and biochemistry majors may be chosen as pre-law degree programs (see Pre-law minor, page 99). Preparation in chemistry and/or biochemistry provides an excellent foundation for environmental or patent law, or work in public policy in relation to science.

Minor in Chemistry

Students who would like a broad background in chemistry without the complete major may choose the minor in chemistry.

For biology and environmental sustainability majors, the minor consists of the following 22-24 SH:

CHEM 223 General Chemistry I 4
CHEM 224 General Chemistry II. . . .4
CHEM 315 Organic I 4
CHEM 316 Organic II 4

Choose one of the following courses:
*CHEM 335 Analytical Chemistry . . .4
*CHEM 405 Thermodynamics 3
*CHEM 406 Quantum Mechanics . . .3

Choose one of the following courses:
BIOCH 376 Foundational Biochemistry 4
*CHEM 285 Environmental Chemistry. . . 4
CHEM 458 Special Topics in Chemistry 3

For all other majors, the minor consists of 20 SH in chemistry or biochemistry at the CHEM 223 level or higher.

Chemistry (CHEM)

102 Matter and Energy **3**

This course addresses basic concepts of chemistry in relation to social, environmental, and political issues. The design of the course will result in a natural presentation of many elements of the Virginia Science Standards of Learning. Prerequisite: high school algebra or equivalent.

223 General Chemistry I **4**

A study of water, solutions, atomic and molecular structure, chemical bonding, and chemical reactions. Laboratory work involves quantitative, computational, and spectroscopic analyses of chemical systems that are relevant to the 'real world'. Three lectures and one laboratory period or field-trip per week. Prerequisite: high school chemistry or equivalent.

224 General Chemistry II **4**

A careful study of chemical reactions with respect to enthalpy, entropy, equilibrium, kinetics, and electrochemistry. Laboratory work involves the student-directed development of a technique for the quantitative and spectroscopic analyses of an environmentally important substance. Three lectures and one laboratory period or field-trip per week. Prerequisite: CHEM 223.

***285 Environmental Chemistry** **4**

An introduction to concepts in atmospheric, aquatic, and terrestrial chemistry, pollution, and energy production and consumption. Students and faculty work together with members of the community at large to investigate local environmental issues, and to educate the community about these issues. Laboratory work includes common field sampling and analytical techniques, and statistical analysis of chemical data. Students are expected to design, conduct, and report on experimentation to confirm measurements of environmental analytes using multiple strategies. Three lectures and one laboratory period or field-trip per week. Prerequisite: CHEM 224. (Spring 2011)

315 Organic Chemistry I: Basic Principles of Organic Chemistry **4**

Organic chemistry is the study of the relationship between the three-dimensional structure and the reactivity of carbon compounds. The chemical and physical properties of organic compounds will be linked to an understanding of orbital theory, electronegativity, strain, and sterics. Reactions of simple organic compounds will be described in terms of electron movement (mechanisms) and kinetic vs. thermodynamic parameters. The laboratory will emphasize development of purification, isolation, and identification techniques, particularly chromatography, infrared spectroscopy, mass spectroscopy, and nuclear magnetic spectroscopy. Three lectures and one four-hour laboratory per week. Prerequisite: CHEM 224, with a minimum grade of C-.

316 Organic Chemistry II: Reactions and Mechanisms **4**

This class builds on the reactions and mechanisms described in CHEM 315 so that 'new' mechanisms can be deduced based on the key principles of conformational preference, sterics, polarity and bond strength. Aromatic compounds as well as oxygen and nitrogen containing compounds are studied so that the chemistry of biomolecules can be introduced. Structure determination of increasingly complex compounds by instrumental techniques, such as GC-MS, NMR, and IR, will also be emphasized. The laboratory will involve multi-step transformations, purifications, and advanced structure determination using primarily instrumental techniques. Three lectures and one four-hour laboratory per week. Prerequisite: CHEM 315.

***335 Analytical Chemistry** **4**

Foundational principles of volumetric, spectrometric, chromatographic, and calorimetric analysis. Laboratory involves the analysis of several biologically and/or industrially relevant molecules with quantitative and instrumental techniques; students eventually design and conduct their own experimentation using NMR, IR, UV-Vis and/or fluorescence spectroscopy. Two lectures and two laboratory periods per week. Prerequisite: CHEM 224. (Fall 2010)

***405 Thermodynamics** **3**

A computation intensive foundational study of chemical thermodynamics and kinetics. Topics include gases, enthalpy, entropy, Gibbs free energy, chemical and phase equilibria, statistical thermodynamics, electrochemistry and chemical kinetics. Three lectures per week. Prerequisite: MATH 150 OR MATH 192. (PHYS 405) (Fall 2009)

***406 Quantum Mechanics** **3**

A quantitative study of quantum mechanics as related to atomic and molecular structure and spectroscopy. Three lectures per week. Prerequisite: MATH 192. (PHYS 406) (Spring 2010)

458 Special Topics in Chemistry **3**

Topics vary by faculty and student interest. Typically, courses involve two lectures and one lab period per week. Laboratory work revolves around the development of a research project. Instructor permission required.

469 Chemistry/Biochemistry Seminar and Research **2**

An investigation of a research topic, including designing, conducting, analyzing and reporting an independent investigation in science. Students meet with the instructor to develop the research project and to read, discuss and critique research articles related to the field of inquiry. Students write an extended review article on the topic. Prerequisite: CHEM 316 and departmental approval.

499 Independent Study **1-3**

Independent study including preparation and presentation of a scholarly research paper, introduction to research, advanced syntheses, etc. May include topical seminars by staff or visiting lecturers. Prerequisite: departmental approval.

Biochemistry (BIOCH)

152 Human Biochemistry **2**

Study of organic and inorganic compounds, especially those important in cellular intermediary metabolism and other biological processes. Prerequisite: CHEM 102, 2 years of high school chemistry (or AP Chemistry), or EMU chemistry placement exam.

376 Foundational Biochemistry **4**

A survey of structure – function relationships of biological molecules and systems. Emphasis is placed on enzymology, intermediary metabolism, and metabolic control. Laboratory focuses on protein chemistry and involves an extended independently guided research project in which students develop their own hypotheses and test them using the techniques learned early in the course. Three lecture periods and one lab per week. Prerequisite: CHEM 316.

***398 Advanced Cell Biology** **3**

A study of cellular architecture, communication, transport, motility, division, growth and death. Particular emphasis is placed on the study of cancer at the cellular level, and on a quantitative (mathematical) understanding of cellular movements. Students read and report on research articles. Laboratory involves light and fluorescence microscopy, and directed research projects of the student's choosing. Two lecture periods and one lab per week. Prerequisite: BIOL 225. (Spring 2011)

***438 Molecular Genetics** **3**

A study of the mechanisms of gene structure, stability, replication, transmission, and expression in eukaryotes. Themes include molecular evolution, viruses (including HIV), and heritable diseases. Students read and report on research articles. The laboratory involves an introduction to common techniques employed in molecular biology followed by directed research projects of the student's choosing. Two lecture periods and one lab per week. Prerequisite: BIOL 225. (Spring 2010)

469 Biochemistry/Chemistry Seminar and Research **2**

An investigation of a research topic, including designing, conducting, analyzing and reporting an independent investigation in science. Students meet with the instructor to develop the research project and to read, discuss and critique research articles related to the field of inquiry. Students write an extended review article on the topic. Prerequisite: CHEM 316 and departmental approval.

**Indicates courses offered in alternate years.*