BIOCHEMISTRY, CHEMISTRY, AND PHYSICS DEPARTMENT

The department of biochemistry, chemistry, and physics fosters the professional development of its students through academic excellence, enabling them to compete in a technological society. The department provides its majors with a thorough understanding of basic and modern concepts of chemistry, biochemistry, and physics, the ability to analyze and apply scientific concepts to technical problems, the development of laboratory skills, and the development of a strong sense of professionalism.

The department supports scientific literacy for all majors through its participation in the university core curriculum.

Programs

The department offers several degree programs, all of which can be used to pursue different career options. A degree in chemistry or biochemistry is very versatile and can be used to pursue a variety of professional choices.

Career Options

A degree in chemistry is a gateway to many traditional careers as well as to careers in nontraditional and interdisciplinary fields.

The employment outlook for graduates with degrees in chemical sciences is markedly better than it is in other fields. According to figures published by the American Chemical Society, salaries for entry-level chemistry positions are approximately $72,000. The latest statistics show that of chemists in the domestic workforce, only 3 percent were unemployed.

Medicine/Dental/Pharmacy

Biochemistry and chemistry degrees are both highly desirable for those interested in becoming physicians or dentists. The acceptance rate to professional schools for individuals with these degrees is quite high. Our students continue to be accepted in medical, dental and pharmacy schools all over the country.

Research

Careers in research have always been a primary career option for chemists and biochemists. Positions in the research industry need people with bachelor's, master's and Ph.D. degrees. People in research seek to solve new problems or improve product design. Our bachelor of science degrees prepare students extremely well for post-baccalaureate education in chemistry, biochemistry and molecular biology.

Environmental Science

Chemists are involved in testing, remediation, emission control, chemical safety, waste management, and work in governmental regulatory agencies.

Forensic Science

A degree in chemistry can be used to pursue careers working with law enforcement agencies.

Chemists are used in the analysis of crime scene data. Scientific data is increasingly important to the outcome of trials. Chemists play a major role in this work.

Law

Chemists can pursue careers in law, and a degree in chemistry is well-suited for legal studies. Chemists that go on to law school are especially well-suited for specialization in patent or environmental law and chemical liability. The increasing importance of scientific evidence in legal cases is increasing the demand for lawyers with technical knowledge.

Computational Drug Design

The use of computers in the rational design of new drugs is at the forefront of modern drug discovery. Chemists combine traditional synthetic approaches with sophisticated graphic molecular modeling and computer-driven techniques to develop new lead compounds. All chemical and pharmaceutical companies have needs for individuals trained in this field.

Business/Technical Sales

A chemistry degree is very useful and well-suited for management in scientific industry. Our graduates have pursued M.B.A.s to lead to careers in industries as diverse as environmental waste management and the auto industry. With appropriate selection of electives, the bachelor of arts program would permit a student to complete an MBA with an additional year of study at Niagara University.

Pharmaceutical Sales

All pharmaceutical companies require individuals who are trained in science to be able to sell their products to pharmacists and physicians. Chemists and biochemists are especially well-suited to these highly desirable positions.

Education

The future of technological advancement depends critically on the preparation of superior science teachers at the elementary and secondary levels. Through the College of Education, the department sponsors programs resulting in B.S. degrees leading to New York state provisional certification in the following areas:

- Chemistry Education, Birth–Grade 6
- Chemistry Education, Grades 1–6
- Chemistry Education, Grades 1–9
- Chemistry Education, Grades 5–12
- Chemistry Education, Grades 7–12
- Chemistry, Special Education and Childhood, Grades 1–6
- Chemistry, Special Education and Adolescence, Grades 7–12

Bachelors

- Biochemistry, B.S. (http://catalog.niagara.edu/undergraduate/programs-az/arts-sciences/biochemistry-chemistry-physics/biochemistry-bs/)
- Chemistry, B.A. (http://catalog.niagara.edu/undergraduate/programs-az/arts-sciences/biochemistry-chemistry-physics/chemistry-ba/)
- Chemistry, B.S. (http://catalog.niagara.edu/undergraduate/programs-az/arts-sciences/biochemistry-chemistry-physics/chemistry-bs/)

Minors

- Chemistry, Minor (http://catalog.niagara.edu/undergraduate/programs-az/arts-sciences/biochemistry-chemistry-physics/chemistry-minor/)
- Physics, Minor (http://catalog.niagara.edu/undergraduate/programs-az/arts-sciences/biochemistry-chemistry-physics/physics-minor/)

Courses

Chemistry

CHE 100 — Chemistry Allied Health Prof (NS) (3 credits)
An examination of chemistry through the substances that impact our lives. This course is intended for anyone seeking to become a better informed citizen of our technological society. This course is reserved for students who have no prior college-level chemistry experience.

CHE 101 — Introductory Chemistry (NS) (3 credits)
*Prerequisite Take CHE*103L*

A beginning course in chemistry designed to present fundamental principles of chemical theory in the context of inorganic and some organic chemistry. This course is reserved for students who have no prior college-level chemistry experience.

CHE 103L — Intro Chem Lab (LAB) (1 credits)
*Prerequisite Take CHE*101*

A laboratory course to be taken concurrently with CHE 101.

CHE 105 — Chemistry and Society I: Public Affairs (NS) (3 credits)
A qualitative, non-laboratory course to relate students to their chemical environment. Classes will include discussions on present problems involving air and water pollution, energy, nuclear material and waste disposal. This course is reserved for students who have no prior college-level chemistry experience.

CHE 106 — Chemistry and Society II: Chemistry for (NS) (3 credits)
A qualitative, non-laboratory course that will present many popular consumer items in a chemical context. Topics will include polymers, fibers, detergents, agricultural chemicals, food, food additives and over-the-counter medication. This course is reserved for students who have no prior college-level chemistry experience.

CHE 107 — Food Chemistry for Nonscientists (NS) (3 credits)
This course introduces the non-science major to chemical and scientific concepts through a study of foods and food-related processes. No previous scientific training is expected. The student should also gain from the course a greater appreciation of why things are done in certain ways, while learning that some practices have absolutely no scientific basis. This course is reserved for students who have no prior college-level chemistry experience.

CHE 108 — Forensic Science (NS) (3 credits)
A presentation of scientific and chemical principles in the context of forensic science, the application of science to law. This course is reserved for students who have no prior college-level chemistry experience.

CHE 110 — World of Chemistry (NS) (3 credits)
The world around us, including our own bodies, is really just a bunch of chemicals. We use them everyday without realizing it. This course will look at some of the more common uses of chemistry in our everyday lives, including food, vitamins, weight control, drugs, crime, etc.

CHE 111 — General Chemistry I (NS) (3 credits)
*Prerequisite Take CHE*113L*

An introduction to physical and chemical principles appropriate for declared and potential science majors. Topics include stoichiometry, nuclear and electronic structure, bonding and thermochemistry.

CHE 112 — General Chemistry II (NS) (3 credits)
*Prerequisite Must have taken CHE*111;*

This course continues the exposition of chemical principles necessary for further study in the chemical and biological sciences. Topics include kinetics, equilibrium, acids and bases, and electrochemistry as well as a periodic survey of the physical and chemical properties of the elements.

CHE 113L — General Chemistry Laboratory I (LAB) (1 credits)
*Prerequisite Take CHE*111*

A laboratory course to be taken concurrently with CHE 111.

CHE 114L — General Chemistry Laboratory II (LAB) (1 credits)
*Prerequisite Must have taken CHE*113L;*

A laboratory course intended to be taken concurrently with CHE 112.

CHE 221 — Organic Chemistry I (NS) (3 credits)
*Prerequisite Take CHE*223L*

This first half of the two-semester sequence deals mainly with bonding and structure, stereochemistry, nomenclature and the chemistry of hydrocarbons. A survey of the most important functional groups is presented. Understanding why and how reactions take place is emphasized.

CHE 222 — Organic Chemistry II (NS) (3 credits)
*Prerequisite Must have taken CHE*221;*

The second half of this two-semester sequence covers the extensive chemistry of the major functional groups. Synthesis and spectroscopic structure determination become key areas of interest. A unifying mechanistic approach continues to bring understanding of how reactions occur.

CHE 223L — Organic Chemistry Laboratory I (LAB) (1 credits)
*Prerequisite Take CHE*221*

A laboratory course intended to be taken concurrently with CHE 221.

CHE 224L — Organic Chemistry Laboratory II (LAB) (1 credits)
*Prerequisite Must have taken CHE*223L;*

A laboratory course intended to be taken concurrently with CHE 222.

CHE 227 — Analytical Chemistry (NS) (3 credits)
*Prerequisite Must have taken CHE*112;*

The study of the theory and practice of common analytical methods. Topics to be covered include volumetric and gravimetric methods of analysis, potentiometric methods, and spectrophotometric techniques. The emphasis will be on gaining an appreciation of the total analytical process and its application to actual analyses.

CHE 229L — Analytical Chemistry Laboratory (LAB) (1 credits)
*Prerequisite Must have taken CHE*114L;*

A laboratory course intended to be taken concurrently with CHE 227.

CHE 242 — Inorganic Chemistry (NS) (3 credits)
Prerequisite Take CHE 111 and CHE 112.

This course is designed to continue and expand on the inorganic topics initiated in CHE 111-112. Topics discussed include binding and structure, ionic interactions, coordination chemistry, solid state chemistry, organometallic chemistry, boranes, and bioinorganic chemistry.

CHE 244L — Inorganic Chemistry Laboratory (LAB) (1 credits)
*Prerequisite Take CHE*242*

This laboratory is designed to be taken concurrently with CHE 242. Laboratory experiences are chosen to illustrate chemical principles discussed in class and to expose the student to some of the techniques and methods of characterization used in the synthesis of main group and transition metal compounds.

CHE 310 — Spectroscopy (NS) (3 credits)
*Prerequisite take che*221 che*222*

This course is designed for students to learn the techniques of separation (column chromatography, Thin-Layer Chromatography (TLC), High-Pressure Liquid Chromatography (HPLC), Gas- Chromatography (GC)) followed by characterization of molecules using spectroscopic techniques (Mass Spectrometry (MS), Infra-red Spectrometry (IR), Ultra-Violet Visible Spectrometry (UV-Vis), and Nuclear Magnetic Resonance (NMR)). An emphasis is placed on the isolation and structural elucidation of organic molecules.

CHE 325 — Medicinal Chemistry (NS) (3 credits)
*Prerequisite take che*222*

This course will focus on the fundamentals of medicinal chemistry, drug design, and application. Topics covered will include structure activity relationships, pharmacokinetics (what the body does to drugs), pharmacodynamics (what drugs do to the body), and computational approaches to drug analysis. Several classifications of drugs and their impact on human health and society will also be presented.

CHE 331 — Physical Chemistry I (NS) (3 credits)
*Prerequisite Take CHE*227 CHE*229L MAT*112 PHY*122*

The first in a three-semester sequence that surveys the physical and mathematical foundations of chemical science. In this course the principles of thermodynamics and dynamics are emphasized.

CHE 332 — Physical Chemistry II (NS) (3 credits)
*Prerequisite Must have taken CHE*331;*

The second in a three-semester sequence that surveys the physical and mathematical foundations of chemical science. In this course the fundamental concepts of statistical thermodynamics and quantum mechanics are emphasized. Connections between the mathematical formalism of physical chemistry and the macroscopic and spectroscopic properties of matter will be drawn.

CHE 333L — Physical Chemistry Laboratory I (LAB) (1 credits)
*Prerequisite Take CHE*331*

This is the laboratory designed to be taken concurrently with CHE 331. The experiments performed in this laboratory course complement material studied in CHE 331. This laboratory requires the use of modern computer platforms and software for data analysis.

CHE 334L — Physical Chemistry Laboratory II (LAB) (1 credits)
*Prerequisite Must have taken CHE*333L;*

This is the laboratory designed to be taken concurrently with CHE 332. The experiments performed in this laboratory course complement material studied in CHE 332. This laboratory builds on techniques learned in CHE 333L. There will be a greater emphasis on computer methodologies to explore the theoretical models of physical chemistry.

CHE 338 — Instrumental Analysis (NS) (3 credits)
*Prerequisite Take CHE*227 CHE*331*

One-semester course which rigorously examines the three major areas of modern instrumental methods of chemical analysis ? spectroscopy, chromatography, and electrochemistry. Emphasis will be placed on theory, instrumentation, operation, and application of each technique.

CHE 340L — Instrumental Analysis Laboratory (LAB) (1 credits)
*Prerequisite Must have taken CHE*333L and CHE*229L;*

A laboratory course intended to be taken concurrently with CHE 338.

CHE 345 — Biochemistry I (NS) (3 credits)
*Prerequisite Must have taken CHE*222;*

An introduction to biochemistry on an advanced level. The first course in the two-semester sequence covers the classes of compounds found in the cell. Enrollment in this course is restricted to students with junior or senior status.

CHE 346 — Biochemistry II (NS) (3 credits)
*Prerequisite Must have taken CHE*345;*

The second semester of the biochemistry sequence. This course covers metabolic pathways and those processes essential to the living cell.

CHE 347L — Biochemistry Laboratory I (LAB) (1 credits)
*Prerequisite Must have taken CHE*224L;*

A laboratory course intended to be taken concurrently with CHE 345.

CHE 348L — Biochemistry Laboratory II (LAB) (1 credits)
*Prerequisite Must have taken CHE*347L;*

A laboratory course intended to be taken concurrently with CHE 346.

CHE 350 — Spec Topics: (NS) (4.00 credits)
This course may be used to offer a variety of special topics in chemistry and biochemistry.

CHE 350-01 — Top: Mastery Based Chemistry 1 (NS) (4.00 credits)
This course may be used to offer a variety of special topics in chemistry and biochemistry.

CHE 350-02 — Top: Mastery Based Chemistry 1 (NS) (4.00 credits)
This course may be used to offer a variety of special topics in chemistry and biochemistry.

CHE 377 — Environmental Chemistry (3 credits)
*Prerequisite CHE*227*

This course covers topics specific to the behavior of chemicals in the Environment. Topics include fate and transport of pollutants in the environment; techniques for quantitative measurement of major and trace chemical components in water, air, and soil/solid wastes; and approaches to the remediation of contaminated sites.

CHE 379L — Environmental Chem Lab (1 credits)
*Prerequisite CHE*229L*

A laboratory course that explores practical application of concepts in Environmental Chemistry.

CHE 403 — Honors Thesis I (3 credits)
Individual research of a substantive nature pursued in the student's major field of study. The research will conclude in a written thesis or an original project, and an oral defense.

CHE 404 — Honors Thesis II (WI) (3 credits)
Individual research of a substantive nature pursued in the student's major field of study. The research will conclude in a written thesis or an original project, and an oral defense.

CHE 435 — Biophysical Chemistry (NS) (3 credits)
*Prerequisite Must have taken CHE*331 and CHE*345;*

A survey of physical chemistry in biochemistry. Thermodynamics and physical properties of biochemical systems will be studied. Structure function relation of biopolymers, enzyme kinetics, drug-nucleic acid interactions, and models of mutation and chemical carcinogenesis will be explored.

CHE 441 — Physical Chemistry III: Advanced (NS) (3 credits)
This course develops the mathematical formalism introduced in CHE 331 and CHE 332. A more rigorous approach to molecular orbital theory is taken. The nature of the chemical bond is explored more fully and the relationship between atomic structure and chemical reactivity is probed more deeply. This course will have a significant computational component.

CHE 443 — Advanced Organic Chemistry (NS) (3 credits)
*Prerequisite Mut have taken CHE*222 and CHE*331;*

This course deals with advanced topics not covered in CHE 221-222. Certain topics previously covered are treated in greater depth. Examples of areas which are covered include: spectroscopy, heterocycles, polynuclear aromatics, photochemistry, electrocyclic reactions, and polymers.

CHE 445L — Advanced Organic Chemistry Laboratory (LAB) (1 credits)
*Prerequisite Must have taken CHE*224L;*

This laboratory is designed to be taken concurrently with CHE 443.

CHE 446 — Physical Organic Chemistry (NS) (3 credits)
*Prerequisite Take CHE*332*

Mechanisms of organic reactions are discussed. Physico-chemical principles are used to discuss effects of structure on modes of reaction.

CHE 449 — Senior Research (2 credits)
The student may elect an original laboratory research program or an independent study program. Both options involve the supervision of a faculty mentor and both require and oral presentation and a written report.

CHE 449L — Senior Research (LAB) (2 credits)
The student may elect an original laboratory research program or an independent study program. Both options involve the supervision of a faculty mentor and both require and oral presentation and a written report.

CHE 450L — Senior Research (LAB) (2 credits)
The student may elect an original laboratory research program or an independent study program. Both options involve the supervision of a faculty mentor and both require and oral presentation and a written report.

CHE 465 — Computational Chemistry (NS) (3 credits)
*Prerequisite Must have taken CHE*111, CHE*112, CHE*113L, CHE*114L,*

This course will explore the vast array of computational methods that are available to study chemical and biochemical problems. These methods will include molecular mechanics, molecular dynamics, quantum mechanical methods including ab initio and semi-empirical methods as well as free energy perturbation methods, The potential energy surfaces involved in chemical reactions will also be studied.

CHE 466 — Biochemical Molecular Modeling (AS) (3 credits)
Molecular modeling methods and techniques will be studied using state of the art software including SYBYL. The course will involve projects and applications using these computational methods. Basic principles of drug design will also be explored. General chemistry (2 semesters), Organic Chemistry (2 semesters), Biochemistry (1 semester) and Physical Chemistry (1 semester) are all prerequisites for this course. Three semesters of calculus and 2 semesters of computer programming are also recommended.

CHE 467 — Career Seminar (1 credits)
This course prepares upper-level students for practical professional aspects of being a chemist/biochemist. Topics include discipline-specific job searching, resume and cover-letter writing, interview skills, professional behavior, and communications.

CHE 468 — Seminar (NS) (3 credits)
A three-semester requirement of all chemistry majors. The requirement is fulfilled by regular participation in a weekly meeting which includes presentations by faculty and students.

CHE 469 — Written and Oral Reports (WI) (2 credits)
This course prepares students for practical professional aspects of being a chemist/biochemist. The synthesis and communication of chemistry and biochemistry topics are emphasized through a written paper and presentation on a topic of the students' choice, and through participation in the peer review process.

CHE 493 — Chemistry Internship (12.00 credits)
A junior or senior work-study program providing relevant employment experience. The student must work full time for one semester. Registration will occur at the beginning of this full-time semester. The objective of the program is to integrate classroom theory and practical work experience, thus lending relevance to learning and providing the student with a realistic exposure to career opportunities. This sequence is designed for students wishing to begin their internship during the summer months. Students interested in taking an internship should see their adviser.

CHE 494 — Chemistry Internship (6 credits)
A junior or senior work-study program providing relevant employment experience. The student must work full time for one semester. Registration will occur at the beginning of this full-time semester. The objective of the program is to integrate classroom theory and practical work experience, thus lending relevance to learning and providing the student with a realistic exposure to career opportunities. This sequence is designed for students wishing to begin their internship during the summer months. Students interested in taking an internship should see their adviser.

CHE 495 — Chemistry Internship (3 credits)
A junior or senior work-study program providing relevant employment experience. The student must work part time for four semesters. Registration will occur during the second and fourth semesters of the experience. The objective of the program is to integrate classroom theory and practical work experience, thus lending relevance to learning and providing the student with a realistic exposure to career opportunities. Students must enroll for two semesters to receive credit.

CHE 496 — Chemistry Internship (3 credits)
A junior or senior work-study program providing relevant employment experience. The student must work part time for four semesters. Registration will occur during the second and fourth semesters of the experience. The objective of the program is to integrate classroom theory and practical work experience, thus lending relevance to learning and providing the student with a realistic exposure to career opportunities. Students must enroll for two semesters to receive credit.

Physics

PHY 101 — Survey of Physics (NS) (3 credits)
An introduction to the fundamental concepts of physics including historical developments and the basic laws and principles of physics as derived from both macroscopic and microscopic phenomena.

PHY 102 — Survey of Physics (NS) (3 credits)
An introduction to the fundamental concepts of physics including historical developments and the basic laws and principles of physics as derived from both macroscopic and microscopic phenomena.

PHY 108 — CSI NU: Physical Forensics (NS) (3 credits)
This course is an introduction to the principles of physics in the context of forensic science, the application of science to law. Application of logic and probability to analyze forensic evidence will also be discussed.

PHY 121 — General Physics (NS) (3 credits)
An intensive study of the principles of mechanics, wave motion, sound, and heat followed in the second semester by physics; vectors and calculus are used throughout. Must be accompanied by laboratory.

PHY 122 — General Physics (NS) (3 credits)
An intensive study of the principles of mechanics, wave motion, sound, and heat followed in the second semester by physics; vectors and calculus are used throughout. Must be accompanied by laboratory.

PHY 123L — General Physics (NS) (1 credits)
The course explores basic topics such as motion in 1 and 2 dimensions, Newton's Laws, kinematics, and momentum in a hands-on laboratory setting. The experiments are designed to illustrate and expand upon topics taught in PHY121.

PHY 124L — General Physics (NS) (1 credits)
The course explores topics in electrostatics, electrical circuits, Kirchoff's Laws, and some topics in modern physics. The experiments are designed to illustrate and expand upon topics taught in PHY122.

PHY 323 — Modern Physics I (NS) (3 credits)
*Prerequisite Must have taken PHY*121, PHY*122, PHY*123L, PHY*124L,*

In this introduction to quantum mechanics, we review the inadequacy of classical physics and the need for a probabilistic description of nature. Schrodinger's equation will be solved and statistical thermodynamics will be introduced. Time permitting this course will touch on electron spin and Feynman's sum over histories approach.

PHY 399 — Topics: (NS) (4.00 credits)
*Prerequisite take phy*121*

This special topics course will be an introduction to various applications of physics. For example, topics may include aspects of modern physics, the concepts of the Hamiltonian and Lagrangian, and the thermodynamics of gases and aerosols.

Earth Science

ESC 172 — Earth Science Meteorology (NS) (3 credits)
The constituents and structure of the atmosphere; meteorological elements; weather and climate; air masses; fronts and circulation of the atmosphere; instrumentation and map reading.

ESC 174 — Earth Science: Physical Geology (NS) (3 credits)
A study of the origin of the Earth, its structure, how it has changed in history, and the processes that caused the change. This course is intended for non-science majors and no prior knowledge of scientific principles or techniques is presumed of the student. Major topics include: study and classification of rocks and minerals, soil composition and formation, and seismic activity.

ESC 175 — Earth Science: Solar System (NS) (3 credits)
A descriptive introduction to the science of solar systems for both science and liberal arts majors. Celestial mechanics, Kepler's laws of planetary motion, artificial satellites, motion of earth and moon, and related topics. Description of the other planets, other elements of the solar system.

ESC 176 — Earth Science: Stellar Astronomy (NS) (3 credits)
A description of stars in the universe for both science and liberal arts majors. Stellar distance, motion, mass, size, magnitude, temperature and classification of stars, binary stars. Stellar evolution and earth, original and evolution of the universe, cosmology.