CHEMISTRY

Department Overview

Chemistry is the branch of science that tries to understand the relationships between the detailed structure of a substance and its properties and reactivity. Chemistry is concerned both with naturally occurring substances and with new substances that are created by humans. Chemists work to determine why substances differ in their properties and how these properties can be controlled and used effectively. An important objective in chemical education is to develop in students the ability to solve problems by employing the techniques of the various sub-disciplines of chemistry. A student who is majoring in chemistry at Saint Joseph’s University is introduced to all of the major sub-disciplines: analytical chemistry, biochemistry, inorganic chemistry, organic chemistry, and physical chemistry. Throughout the program, emphasis is placed on chemistry as a laboratory science. Consequently, a student majoring in chemistry learns not only the basic theories of chemistry, but also how to use experimental techniques to solve chemical problems. The modern research-grade instrumentation in our laboratories enhances the experimental experiences of our students. Faculty members teach all of the sections of laboratory courses. In addition, chemistry majors are able to engage in faculty-directed independent research projects in the traditional sub-disciplines of chemistry and environmental chemistry during the academic year and/or in the summer. Students often have the opportunity to present the results of their research in the chemical literature and at local, regional, and national scientific meetings. The curriculum for the chemistry major is designed to prepare students for continuing their educations in graduate and professional schools as well as for employment in the chemical and pharmaceutical industries and government laboratories. The American Chemical Society certifies the curriculum of the Bachelor of Science degree in Chemistry.

Departmental Mission

The Department of Chemistry trains students in both the theoretical and experimental aspects of the major sub-disciplines of chemistry. Our modern research-grade instrumentation makes it possible for students to explore contemporary problems in all of these areas. Chemistry majors are encouraged to engage in faculty-directed independent research projects and to present the results of their studies in the chemical literature and at scientific meetings. The curriculum for a chemistry major prepares the graduates to continue their educations in graduate and professional schools or to work in the chemical and pharmaceutical industries and in government laboratories. Our alumni are aware that through chemistry they can continue to make contributions to society that are of service to others.

Advisory Option—Chemistry Premedical

Students planning to enter medical or dental school should take BIO 101-BIO 102.

Advisory Option—Chemistry and Business

Students who intend to pursue studies toward the M.B.A. or who plan careers in the marketing or management areas of the chemical industry should minor in business.

Chemistry in the GEP

(See Curricula (https://academiccatalog.sju.edu/curricula))

The GEP requires that all students take EITHER one semester of a lab-based natural science course (6 contact hours) OR two semesters of lecture-only natural science courses. Students who wish to satisfy the natural science GEP by completing courses in Chemistry may do so by taking the first semester of the Chemistry majors, lab-based course sequence, CHM 120 and CHM 120L, or one of the lab-based, one-semester chemistry courses for non-science majors, as they become available. Alternatively, students may fulfill one or both semesters of the natural science GEP by completing one or two of the special one-semester lecture-only Chemistry courses designed for non-science majors listed below.

Non-science majors Chemistry GEP lecture-only courses:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHM 100</td>
<td>Chemistry for the Consumer</td>
<td>3</td>
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Non-science majors Chemistry GEP lab-based courses:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHM 115</td>
<td>Chemistry in Daily Life</td>
<td>4</td>
</tr>
<tr>
<td>CHM 115L</td>
<td>Chemistry in Daily Life</td>
<td>0</td>
</tr>
<tr>
<td>CHM 112</td>
<td>Food Chemistry (open to Food Marketing majors only)</td>
<td>4</td>
</tr>
<tr>
<td>CHM 112L</td>
<td>Food Chemistry: Lab (open to Food Marketing majors only)</td>
<td>0</td>
</tr>
</tbody>
</table>

B.A. in Chemistry/B.S. in Secondary Education Dual Major

Requirements for the B.A. in Chemistry In order to become certified to teach at the secondary education level (grades 7-12), students must complete a total of five Education and three Special Education courses, as well as student teaching. For further details, see the Teacher Education section of the catalog. Students interested in the dual major program should speak to their academic advisors and to Chair of the Department of Chemistry as early in their academic careers as possible.

Chemistry and Education combined B.S./M.S.

This program allows a student to complete in five years the requirements for both the B.S. in Chemistry and M.S. in Education degrees with certification to teach chemistry by permitting an undergraduate student to begin graduate coursework in Education during his/her senior year. The program features:

1. an independent faculty-directed research project in chemistry in the summer between the fourth and fifth years, and
2. nine graduate courses in education, including a one-semester student teaching experience.

A student should apply to the Chair of the Department of Chemistry for admission to this program by the first semester of his/her sophomore year. It is anticipated that the graduates of this program will be highly competitive in the rapidly expanding market for qualified high school chemistry teachers.

In order to become certified to teach at the secondary education level (grades 7-12), students must complete a total of five Education and three Special Education courses, as well as student teaching. For further details, see the Teacher Education (https://academiccatalog.sju.edu/arts-sciences/education-unit) section. Students interested in the five-
year program should speak to their academic advisors and to Chair of the Department of Chemistry as early in their academic careers as possible.

Professor: Mark A. Forman, Ph.D.; Roger K. Murray, Ph.D.
Associate: E. Peter Zurbach, Ph.D.; Jean M. Smolen, Ph.D.; Jose Cerda, Ph.D.; Mark F. Reynolds, Ph.D.; Peter M. Graham, Ph.D.; Usha Rao, Ph.D.
Assistant: J. Scott Niezgoda, Ph.D.
Lab Coordinator: Brian M. Forster, Ph.D.; John Longo, M.A., M.S., NRCC
Chair: Forman

**Undergraduate**

- Chemistry Major with ACS Certification (https://academiccatalog.sju.edu/arts-sciences/chemistry/chemistry-bs-american-chemical-society-certification)

**Undergraduate Minors**

- Chemistry Minor (https://academiccatalog.sju.edu/arts-sciences/chemistry/minor/chemistry-minor)

**CHM 100 Chemistry for the Consumer (3 credits)**

This course is designed to help students understand the chemistry that affects them throughout their lives. Topics include: nuclear chemistry, home products, food and drugs, acid rain, energy, climate control, and sustainability. May be taken for science or elective credit without previous chemistry courses. Successful completion of this course will fulfill a lecture-only natural science course requirement for the GEP natural science area.

**Restrictions:** Students cannot enroll who have a major in Biology, Chemistry, Chemical Biology, Food Marketing or Physics.

**Attributes:** GEP Natural Science, Undergraduate

**CHM 112 Food Chemistry (4 credits)**

The study of chemistry as it specifically relates to food. Underlying basic chemical principles will allow the study of particular molecules found in food (carbohydrates, proteins, lipids) and the changes these molecules undergo as they are cooked and absorbed. Topics will also include preservation, food safety, and food additives. This laboratory course will introduce students to the use of laboratory techniques to study food, including the measurement of food properties including pH, flavor, color, and texture. Students will learn how chemical and physical changes can alter food quality. The content material of CHM 112 overlaps with the content of IHS 253 Nutrition: Health and Disease. Students may take either CHM 112 or IHS 253 not both. Successful completion of CHM 112/112L fulfills the GEP science requirement for Food Marketing majors only. It will serve as a free-elective for all other majors. CHM 112L is a co-requisite for CHM 112.

**Restrictions:** Enrollment is limited to students with a major in Food Marketing Co-Op or Food Marketing.

**Attributes:** GEP Natural Science, Science Course w/Lab (Sci Maj)

**CHM 112L Food Chemistry: Lab (0 credits)**

Students who register for this Chemistry lab must also register for the corresponding lecture. For example, if you register for CHM 112L you must, at the same time, register for CHM 112.

**Restrictions:** Enrollment is limited to students with a major, minor, or concentration in Food Marketing Co-Op or Food Marketing.

**Attributes:** GEP Natural Science

**CHM 115 Chemistry in Daily Life (4 credits)**

This course explains the basic theories and need-to-know facts of scientific events one encounters in daily life from a chemistry perspective. In addition to explaining the fundamental concepts of chemistry, the course will cover topics such as acids and bases, oxidation and reduction, household chemicals, nuclear energy, nuclear medicine, biochemistry, and drugs. This laboratory course will cover a wide range of experiments that require mastering a variety of laboratory skills, which utilize many different types of equipment. The proper use of beakers, flasks, pipets, burets, simple calorimeters, balances, and thermometers, to name a few, is critical to a student’s success in the course. Accurate observations and recording of data is stressed and evaluated. Students will submit data and results forms at the conclusion of each experiment. Both qualitative (observations and descriptions) and quantitative (calculations and graphs) methods will be stressed. Successful completion of CHM 115/115L fulfills the GEP science requirement.

**Attributes:** GEP Natural Science, Science Course w/Lab (Sci Maj), Undergraduate

**CHM 115L Chemistry in Daily Life (0 credits)**

**CHM 120 General Chemistry I (3 credits)**

Topics included are chemical formulas, stoichiometry, balancing reactions, ideal gases, thermodynamics, atomic structure, chemical bonding and molecular structure, kinetics, the chemistry of acids and bases, entropy, free energy, and electrochemistry. CHM 120 is a prerequisite to CHM 125. Successful completion of CHM 120 and CHM 120L fulfills the GEP natural science requirement.

**Attributes:** GEP Natural Science, Science Course w/Lab (Sci Maj), Undergraduate

**CHM 120L General Chemistry Lab I (2 credits)**

A lecture-laboratory course to accompany CHM 120-125 with emphasis upon concepts in chemistry, quantitative and qualitative analysis, and introduction to instrumental methods. One four-hour period. Successful completion of CHM 120L is a prerequisite to CHM 125L. CHM 120/121 is a co or prerequisite for CHM 120L. CHM 125/126 is a co or prerequisite for CHM 125L.

**Attributes:** GEP Natural Science, Undergraduate

**CHM 121 General Chemistry Honors I (3 credits)**

The material covered in this honors course is the same as CHM 120-125 but more extensive in depth. Additional topics may be added as time permits. The course assumes that the student has had chemistry in high school. The format of the course may differ from the standard lecture model. CHM 120 or 121 is a prerequisite to CHM 126. Successful completion of CHM 121 and CHM 120L fulfills the GEP natural science requirement.

**Attributes:** GEP Natural Science, Honors Course, Science Course w/Lab (Sci Maj), Undergraduate

**CHM 125 General Chemistry II (3 credits)**

Topics included are chemical formulas, stoichiometry, balancing reactions, ideal gases, thermodynamics, atomic structure, chemical bonding and molecular structure, kinetics, equilibrium, the chemistry of acids and bases, entropy, free energy, and electrochemistry. CHM 120 is a prerequisite to CHM 125. Successful completion of CHM 120 and CHM 120L fulfills the GEP natural science requirement.

**Prerequisites:** CHM 120 or CHM 121

**Attributes:** GEP Natural Science, Science Course w/Lab (Sci Maj), Undergraduate
CHM 125L General Chemistry Lab II (2 credits)
A lecture-laboratory course to accompany CHM 120-125 with emphasis upon concepts in chemistry, quantitative and qualitative analysis, and introduction to instrumental methods. One four-hour period. Successful completion of CHM 120L is a prerequisite to CHM 125L. CHM 120/121 is a co or prerequisite for CHM 120L. CHM 125/126 is a co or prerequisite for CHM 125L.
Prerequisites: CHM 120L or CHM 126 (may be taken concurrently)
Attributes: Undergraduate

CHM 126 General Chemistry Honors II (3 credits)
The material covered in this honors course is the same as CHM 120-125 but more extensive in depth. Additional topics may be added as time permits. The course assumes that the student has had chemistry in high school. The format of the course may differ from the standard lecture model. CHM 120 or 121 is a prerequisite to CHM 126. Successful completion of CHM 121 and CHM 120L fulfills the GEP natural science requirement.
Prerequisites: CHM 120 or CHM 121
Attributes: GEP Natural Science, Honors Course, Science Course w/Lab (Sci Maj), Undergraduate

CHM 150 Freshmen Seminar (3 credits)
This course is designed to introduce students to the fundamental factors governing air, water, and soil pollution, and to briefly discuss the impacts of pollution on public health, both in the US and in the developing world. We will examine various physical, chemical and biological sources of pollution such as heavy metals, volatile organic compounds, pesticides, radionuclides, ionizing and nonionizing radiation, thermal and noise pollution, bacteria, viruses, and parasites. These different agents contribute to the pollution of soil, the atmosphere, and water bodies such as lakes, rivers and oceans, and pose a significant public health problem across the globe. No prior background in the natural sciences will be required of the students. The course will fulfill the First-Year Seminar GEP requirement.
Attributes: First-Year Seminar, Undergraduate

CHM 210 Organic Chemistry I (3 credits)
Modern organic chemistry in which the treatment of aliphatic and aromatic compounds is integrated as much as possible. Reactions of the functional groups are explained in terms of electronic mechanisms. CHM 125 or CHM 126 is a prerequisite to CHM 210. CHM 210 is a prerequisite to CHM 215.
Prerequisites: CHM 125 or CHM 126 or CHM 1021
Attributes: Undergraduate

CHM 210L Organic Chemistry Lab I (1 credit)
This semester concentrates on experiments designed to introduce students to the various techniques used in the organic laboratory. CHM 210 is a co or prerequisite for CHM 210L.
Attributes: Undergraduate

CHM 215 Organic Chemistry II (3 credits)
Modern organic chemistry in which the treatment of aliphatic and aromatic compounds is integrated as much as possible. Reactions of the functional groups are explained in terms of electronic mechanisms. CHM 125 or CHM 126 is a prerequisite to CHM 210. CHM 210 is a prerequisite to CHM 215.
Prerequisites: CHM 210
Attributes: Undergraduate

CHM 215L Organic Chemistry Lab II (1 credit)
A continuation of CHM 210L utilizing micro scale laboratory techniques in organic chemistry for the preparation, purification and analysis of organic compounds. CHM 210L is a prerequisite to CHM 215L. CHM 215 is a co or prerequisite for CHM 215L.
Prerequisites: CHM 210L and CHM 210
Attributes: Undergraduate

CHM 293 Sophomore Research Studies I (3,6 credits)
Integrated literature and laboratory investigation of an assigned problem under the supervision of a departmental faculty member. Each credit of CHM 293-294 requires four hours each week in the research laboratory. Students need to complete the application form for independent study and have the approval of the Chemistry Department Chair and Associate Dean in order to register.
Attributes: Undergraduate

CHM 294 Sophomore Research Studies II (3,6 credits)
Integrated literature and laboratory investigation of an assigned problem under the supervision of a departmental faculty member. Each credit of CHM 293-294 requires four hours each week in the research laboratory. Students need to complete the application form for independent study and have the approval of the Chemistry Department Chair and Associate Dean in order to register.
Attributes: Undergraduate

CHM 310 Physical Chemistry I (3 credits)
Thermodynamics as applied to gases, liquids, and solutions; thermodynamics of ideal systems; thermochemistry; chemical kinetics; gaseous equilibrium; colligative properties of solutions; quantum mechanics. CHM 215 is a prerequisite to CHM 310. CHM 310 is a prerequisite to CHM 315.
Prerequisites: CHM 215 or CHM 2321
Attributes: Undergraduate

CHM 310L Physical Chemistry Lab I (2 credits)
Experiments are performed to reinforce the concepts learned in CHM 310
Attributes: Undergraduate

CHM 315 Physical Chemistry II (3 credits)
Thermodynamics as applied to gases, liquids, and solutions; thermodynamics of ideal systems; thermochemistry; chemical kinetics; gaseous equilibrium; colligative properties of solutions; quantum mechanics. CHM 215 is a prerequisite to CHM 310. CHM 310 is a prerequisite to CHM 315.
Prerequisites: CHM 310
Attributes: Undergraduate

CHM 315L Physical Chemistry Lab II (2 credits)
THis course covers the theory, methodology, and instrumentation for the study of atomic and molecular species and/or processes. CHM 215, CHM 310, and PHY 106 or permission of the Department of Chemistry chair are prerequisites to CHM 330.
Prerequisites: CHM 215
Attributes: Undergraduate
CHM 300L Instrumental Analysis Lab (2 credits)
CHM 300 is a co-requisite to CHM 300L.
Prerequisites: CHM 215L
Attributes: Undergraduate

CHM 340 Biochemistry (3 credits)
A basic introduction to the chemistry of living systems emphasizing their major metabolic activities. Structure and function of proteins, lipids, and carbohydrates. Basic principles of intermediary metabolism and photosynthesis. CHM 215 is a prerequisite for CHM 340.
Prerequisites: CHM 215
Attributes: Undergraduate

CHM 340L Biochemistry Lab (1 credit)
Laboratory applications of the topics covered in CHM 340. CHM 215L is a prerequisite to CHM 340L. CHM 300 is a co-requisite to CHM 340L.
Prerequisites: CHM 215L and CHM 340 (may be taken concurrently)
Attributes: Undergraduate

CHM 350 Inorganic Chemistry (3 credits)
This course includes the study of atomic structure, bonding, molecular orbital theory, symmetry and group theory, the chemistry of the main group elements, and the structure and reactivity of transition metal complexes. CHM 215 is a prerequisite to CHM 350.
Prerequisites: CHM 215 or CHM 2321
Attributes: Undergraduate

CHM 350L Inorganic Chemistry Lab (2 credits)
This course focuses on synthetic inorganic chemistry and emphasizes the use of modern analytical techniques for the characterization of inorganic and organometallic compounds. This course satisfies the GEP Writing Intensive requirement. CHM 215L is a prerequisite to CHM 350L. CHM 300 is a co-requisite for CHM 350L.
Prerequisites: CHM 215L
Attributes: Undergraduate, Writing Intensive Course- GEP

CHM 360 Nanochemistry (3 credits)
This course covers the synthesis, characterization and physical properties of materials chemistry systems on the length scale of individual molecules. Emphasis is placed on the distinction between macro- and nanoscale properties of matter. Course topics to include (but not limited to): quantum confinement in semiconductor nanocrystals; localized surface plasmon resonance (LSPR), superhydrophobicity in self-assembled monolayers; electronic and mechanical properties of 2D materials
Prerequisites: CHM 215 and (MAT 161 or MAT 155) and (PHY 102 (may be taken concurrently) or PHY 106 (may be taken concurrently))

CHM 390 Chemistry Seminar (0 credits)
Lectures by outside and local speakers and discussions of special topics in chemistry. Enrollment is required each semester for junior and senior chemistry majors. Graded on a P/NP basis.
Attributes: Undergraduate

CHM 393 Junior Research I (3,6 credits)
Integrated literature and laboratory investigation of an assigned problem under the supervision of a departmental faculty member. Each credit of CHM 393-394 requires four hours each week in the research laboratory. Students need to complete the application form for independent study (available in the Dean’s Office) and have the approval of the Chemistry Department chair and Associate Dean in order to register.
Attributes: Undergraduate

CHM 394 Junior Research II (3,6 credits)
Integrated literature and laboratory investigation of an assigned problem under the supervision of a departmental faculty member. Each credit of CHM 393-394 requires four hours each week in the research laboratory. Students need to complete the application form for independent study (available in the Dean’s Office) and have the approval of the Chemistry Department chair and Associate Dean in order to register.
Prerequisites: CHM 393 or CHM 293 or CHM 2901
Attributes: Undergraduate

CHM 400 Biogeochemistry (3 credits)
This course examines the chemical processes that control the distribution, speciation, and transfer of essential elements and energy in natural systems. Topics include: the concept of the Earth as a biogeochemical system; the use of quantitative methods to model the chemical fluxes of elements on a global scale; dominant chemical reactions in natural environments, evolution of metabolic pathways; the biogeochemical cycling of water, carbon, nitrogen, phosphorus, sulfur, and select heavy metals under natural and anthropogenically-influenced conditions. CHM 340 is a prerequisite or a co-requisite to CHM 400. This prerequisite may be waived with permission of the Chemistry Department Chair.
Prerequisites: CHM 340 (may be taken concurrently)
Attributes: Undergraduate

CHM 410 Biophysical Chemistry (3 credits)
This course utilizes the concepts of physical chemistry to understand the properties of biological systems.
Prerequisites: CHM 310 or CHM 320
Attributes: Undergraduate

CHM 410L Biophysical Chemistry Lab (1 credit)

CHM 420 Environmental Chemistry (3 credits)
Investigation of both pristine and polluted environments using chemistry as a foundation. Topics include: atmospheric chemistry, water quality, soil composition, fate of toxic metals and organic pollutants, and using chemistry as a solution for pollution. CHM 215 is a prerequisite to CHM 420.
Prerequisites: CHM 2321 and CHM 210
Attributes: Undergraduate

CHM 420L Environmental Chemistry Lab (1 credit)

CHM 430 Mechanisms in Organic Chem (3 credits)
Application of the electron pushing formalism for manipulating Lewis structure representations of organic structures. Emphasis is placed on mechanistic rationalization of complex organic transformations. Classes of mechanisms include elimination, substitution, rearrangement, oxidation-reduction, enolate alkylation, and others. CHM 215 is a prerequisite to CHM 430.
Prerequisites: CHM 215
Attributes: Undergraduate

CHM 435 Tech Applications of Chemistry (3 credits)
Course will focus on current and future technologies that utilize fundamental and advanced theories of chemistry. Topics will include, but are not limited to, microwave ovens, liquid crystal displays (LCD), light emitting diode displays (LED), plasma screens, charge coupled devices (CCD), field effect transistors (FET), positron emission tomography (PET), magnetic resonance imagining (MRI), battery systems, data storage devices, and solar panels. CHM 215 is a pre-requisite to CHM 435)
Prerequisites: CHM 215
**CHM 440 Organometallic Chemistry (3 credits)**
This course will focus on the structure and reactivity of organometallic transition metal complexes. Topics include catalysis, reaction mechanisms, applications to organic chemistry, and characterization by spectroscopic methods. CHM 350 is a prerequisite to CHM 440.
*Prerequisites:* CHM 350
*Attributes:* Undergraduate

**CHM 445 Thermodynamics & Stat Mechanic (3 credits)**

**CHM 450 Polymer Chemistry (3 credits)**

**CHM 460 Water Chemistry (3 credits)**
This course examines the behavior of chemical species in natural and engineered water systems. Topics include: the chemical composition of surface and subsurface water; geochemical controls on water composition; equilibrium and kinetic processes in aquatic systems; fate and reactions of inorganic and organic constituents in water; acid-base chemistry, complexation chemistry, and redox chemistry in water; the applications of isotopic and other tracers in the study of aquatic systems; and water pollution. CHM 210 is a prerequisite to CHM 460.
*Prerequisites:* CHM 125 or CHM 126
*Attributes:* Undergraduate

**CHM 470 Special Topics (3 credits)**
Advanced study on a topic that is arranged with a chemistry faculty member. Permission of the Department of Chemistry chair is required.
*Attributes:* Undergraduate

**CHM 480 Adv Biochem: Inorganic Chem (3 credits)**
Advanced study on a topic that is arranged with a chemistry faculty member. Permission of the Department of Chemistry chair is required.
*Prerequisites:* CHM 215
*Attributes:* Undergraduate

**CHM 490 Spectroscopy (3 credits)**
Advanced study on a topic that is arranged with a chemistry faculty member. Permission of the Department of Chemistry chair is required.
*Prerequisites:* CHM 330
*Attributes:* Undergraduate

**CHM 491 Chemistry Internship I (3 credits)**

**CHM 492 Chemistry Internship II (3 credits)**

**CHM 493 Senior Research I (3,6 credits)**
Integrated literature and laboratory investigation of an assigned problem under the supervision of a departmental faculty member. Includes a seminar, a poster presentation, and written reports. Each credit of CHM 493 and CHM 494 requires four hours each week in the research laboratory. CHM 493 is a prerequisite for CHM 494. Students need to complete the application form for independent study (available in the Dean's Office) and have the approval of the Chemistry Department chair and Associate Dean in order to register.
*Attributes:* Undergraduate

**CHM 494 Senior Research II (3,6 credits)**
Integrated literature and laboratory investigation of an assigned problem under the supervision of a departmental faculty member. Includes a seminar, a poster presentation, and written reports. Each credit of CHM 493 and CHM 494 requires four hours each week in the research laboratory. CHM 493 is a prerequisite for CHM 494. Students need to complete the application form for independent study (available in the Dean's Office) and have the approval of the Chemistry Department chair and Associate Dean in order to register.
*Prerequisites:* CHM 493
*Attributes:* Undergraduate