

CHEMISTRY (Div III)

Chair: Professor Thomas Smith

- Ben L. Augenbraun, Assistant Professor of Chemistry
- Anthony J. Carrasquillo, Assistant Professor of Chemistry; on leave Spring 2024
- Stephanie Christau, Visiting Assistant Professor of Chemistry
- Amy Gehring, Philip and Dorothy Schein Professor of Chemistry, Director of the Science Center
- Christopher Goh, Associate Dean for Institutional Diversity, Equity and Inclusion, Professor of Chemistry; affiliated with: Institutional Diversity, Equity, and Inclusion, Chemistry
- Sarah L. Goh, Professor of Chemistry
- Kerry-Ann Green, Assistant Professor of Chemistry; on leave 2023-2024
- Katie M. Hart, Assistant Professor of Chemistry
- Jenna L. MacIntire, Lecturer in Chemistry
- Lee Y. Park, William R. Kenan, Jr. Professor of Chemistry; on leave 2023-2024
- Enrique Peacock-López, Halford R Clark Professor of Natural Sciences
- Bob Rawle, Assistant Professor of Chemistry
- Jennifer K. Rosenthal, Instructor in Chemistry
- Thomas E. Smith, Chair and J. Hodge Markgraf '52 Professor of Chemistry
- Laura R. Strauch, Lecturer in Chemistry
- B Thuronyi, Assistant Professor of Chemistry
- Amanda K. Turek, Assistant Professor of Chemistry

MAJOR

Through a variety of individual courses and sequential programs, the department provides an opportunity for students to explore the nature and significance of chemistry, an area of important achievement in our quest for knowledge about ourselves and the world around us. The student of chemistry is able to become aware of the special viewpoint of chemists, the general nature of chemical investigation, some of its important results, how these results are expressed, and something of their significance within the fields of science and in the area of human endeavor as a whole. The Chemistry major provides excellent preparation for graduate study in chemistry, biochemistry, chemical engineering, environmental science, materials science, medicine, and the medical sciences.

A major in chemistry can be achieved in several ways, preferably beginning in the student's first year at Williams, but also beginning in the sophomore year. For students who are interested in fulfilling pre-medical requirements and/or pursuing study abroad, we strongly recommend consultation with the chemistry department as early as possible in order to plan a course of study. Building on a foundation in general chemistry, organic chemistry, and physical chemistry, a student elects additional advanced courses to complete a major that is consistent with their background in other sciences, interests, and goals. A student's program can emphasize any subdiscipline of chemistry including biochemistry, environmental, inorganic, materials, organic, and physical chemistry. Students considering a major in chemistry should consult with a member of the department as early as possible in order to plan a program which best suits their interests and abilities and which makes full use of their previous preparation.

For students beginning their chemistry studies in Fall 2023 or later.

Most students will begin their study in the department in Chemistry 101 (Concepts of Chemistry), which may be taken in the fall or the spring semester. For students with little or no high school chemistry, we offer Chemistry 100 (Chemistry Matters) in the fall semester as preparation for Chemistry 101 in the spring semester. All students interested in taking Chemistry 100 or Chemistry 101 must complete a brief departmental survey to assist in determining the best first semester placement. After Chemistry 101, students will take Chemistry 200 (Advanced Concepts in Chemistry) and Chemistry 201 (Introduction to Organic Chemistry), in either order. After completing these courses, students can move into elective courses.

Completion of a Chemistry major requires nine semester chemistry courses beginning with Chemistry 101. Chemistry 100 can count as one of

these courses. Alternatively, two approved courses from adjacent sciences (those with significant chemical and/or quantitative content) from Biology, Computer Science, Geosciences, Mathematics, Physics, or Statistics can count towards one of their required Chemistry credits. Only one course designated as pass/fail may be counted towards the major. Chemistry 242 (Intermediate Organic Chemistry) is required for the major, as is at least one course selected from Chemistry 361, 363, 364, 366, or 367. Starting at the 300 level, at least three of the courses taken must have a laboratory component. The specific courses selected, will depend on each student's future plans and interests, and can be determined in consultation with the chair or major advisor. In addition, the department has a number of "Independent Research Courses" which, while they do not count toward completion of the major, provide a unique opportunity to pursue an independent research project under the direction of a faculty member.

Required Foundational Courses

101 Concepts of Chemistry

200 Advanced Chemical Concepts

201 Organic Chemistry: Introductory Level

242 Organic Chemistry: Intermediate Level (required for the major)

For students who began their chemistry studies in Fall 2022 or earlier.

All students begin their study in the department with either Chemistry 151, 153, or 155 in the fall semester. Placement at the introductory level is based upon responses on the departmental survey and consultation with the faculty; results of the College Board Advanced Placement Test or the International Baccalaureate Exam are also taken into account.

The first year is completed with Chemistry 156. In the second year at the introductory level, students take Chemistry 251 and Chemistry 256 (those students who complete 155 are exempted from 256). Completion of a Chemistry major requires either nine semester chemistry courses or eight semester chemistry courses plus two approved courses from adjacent sciences (those with significant chemical and/or quantitative content) from Biology, Computer Science, Geosciences, Mathematics, Physics, or Statistics. Only one course designated as pass/fail may be counted towards the major. For all majors, at least one must be selected from Chemistry 361, 363, 364, 366, or 367. Starting at the 300 level, at least three of the courses taken must have a laboratory component. The specific courses selected, will depend on each student's future plans and interests, and can be determined in consultation with the chair or major advisor. In addition, the department has a number of "Independent Research Courses" which, while they do not count toward completion of the major, provide a unique opportunity to pursue an independent research project under the direction of a faculty member.

Foundational Courses

Second Year

Fall: 251 Organic Chemistry: Intermediate Level

Spring: 256 Advanced Chemical Concepts (or 300-level if completed 155)

Elective Courses

319 Integrative Bioinformatics, Genomics, and Proteomics Lab

321 Biochemistry I-Structure and Function of Biological Molecules

322 Biochemistry II-Metabolism

324 Enzyme Kinetics and Reaction Mechanisms

326 Chemical and Synthetic Biology

335 Inorganic/Organometallic Chemistry

336 Materials Chemistry

338 Bioinorganic Chemistry: Metals in Living Systems

341 Toxicology and Cancer

342 Synthetic Organic Chemistry

343 Medicinal Chemistry

344 Physical Organic Chemistry

348 Polymer Chemistry

361 Quantum Chemistry and Chemical Dynamics
363 Environmental Organic Chemistry
364 Instrumental Methods of Analysis
366 Thermodynamics and Statistical Mechanics
367 Biophysical Chemistry
368T Computational Chemistry and Molecular Spectroscopy

Independent Research Courses

393-W31-394 Junior Research and Thesis
397, 398 Independent Study, for Juniors
493-W31-494 Senior Research and Thesis
497, 498 Independent Study, for Seniors

For the purpose of assisting students in selecting a program consistent with their interests and possible continuation of their studies at the graduate level, the following groupings of electives and faculty advisors are suggested. However, a case can be made for selecting courses from the different groups.

Biochemistry: Chemistry 321, Chemistry 322, Chemistry 324, Chemistry 326, Chemistry 341, Chemistry 364, Chemistry 367. Students interested in biochemistry should consult with Professors Gehring, Hart, Rawle, or Thuronyi.

Environmental Chemistry: Chemistry 363, Chemistry 361, Chemistry 364, Chemistry 366. Students interested in environmental chemistry should consult with Professor Carrasquillo.

Inorganic Chemistry: Chemistry 335, Chemistry 336, Chemistry 338, Chemistry 361, Chemistry 364, Chemistry 366. Students interested in inorganic chemistry should consult with Professors C. Goh, Green, or Park.

Materials Chemistry: Chemistry 335, Chemistry 336, Chemistry 348, Chemistry 361, Chemistry 364, Chemistry 366. Students interested in materials science should consult with Professors S. Goh or Park.

Organic Chemistry: Chemistry 341, Chemistry 342, Chemistry 343, Chemistry 344, Chemistry 348, Chemistry 363, Chemistry 364, Chemistry 361, Chemistry 366. Students interested in organic chemistry should consult with Professors S. Goh, Green, Smith, Thuronyi, or Turek.

Physical Chemistry: Chemistry 361, Chemistry 364, Chemistry 366, Chemistry 368T. Students interested in physical chemistry should consult with Professors Augenbraun, Carrasquillo, or Peacock-López.

While any accepted route through the major would permit a student to proceed to graduate study in chemistry, four electives should be considered a minimum, and at least a semester of research is strongly recommended.

The department's curriculum is approved by the American Chemical Society (ACS), a professional body of academic, industrial, and research chemists. The ACS suggests the following courses for someone considering graduate study or work in chemistry or a related area:

For students beginning in 2023 or later: CHEM 101, CHEM 200, CHEM 201, CHEM 242

For students beginning in 2022 or earlier: CHEM 151,3/5, CHEM 156, CHEM 251, CHEM 256

At the upper level, the ACS recommends 321, 335, 364, (one of 361, 366 or 367) and at least 3 courses (all of which must have a laboratory component or at least one must be a research course of 393 or above) from our remaining upper level electives: 319, 322, 324, 326, 336, 341, 342, 343, 344, 348, 361, 363, 366, 367, 368T, 393, 394, 397, 398, 493, 494, 497, 498, BIMO 401. Students are strongly encouraged (though not required) to pursue independent research in some form. In addition, students have also completed 2 semesters of calculus and 2 semesters of physics. Students completing these requirements can be designated Certified ACS Majors.

BIOCHEMISTRY AND MOLECULAR BIOLOGY (BIMO)

Students interested in Biochemistry and Molecular Biology should consult with the general statement under the Biochemistry and Molecular Biology Program (BIMO) in the Courses of Instruction. Students interested in completing the BIMO program are also encouraged to complete the biochemistry courses within the chemistry major by taking 321, 322, 324, 326, and 367 in addition to the first and second year required courses.

BIOINFORMATICS, GENOMICS, AND PROTEOMICS (BiGP)

Students interested in Bioinformatics, Genomics, and Proteomics should consult the general statement under Bioinformatics, Genomics, and

Proteomics in the Courses of Instruction. Students interested in these areas are also encouraged to complete the biochemistry courses within the chemistry major by taking 319, 321, 322, 324 and 367 in addition to the first and second year required courses.

THE DEGREE WITH HONORS IN CHEMISTRY

The degree with honors in Chemistry provides students with an opportunity to undertake an independent research project under the supervision of a faculty member, and to report on the nature of the work in two short oral presentations and in a written thesis.

Chemistry majors who are candidates for the degree with honors take the following in addition to a major outlined above:

Chemistry 493-W31-494 Senior Research and Thesis

The principal considerations in admitting a student to a program of independent research are mastery of fundamental materials and skills, ability to pursue independent study successfully, and demonstrated student interest and motivation. In addition, to enroll in these courses leading to a degree with honors, a student must have at least a B- average in all chemistry courses or the permission of the chair. At the end of the first semester of the senior year, the department reviews the student's progress and determines whether the student is a candidate for a degree with honors. The designation of a degree with honors in Chemistry or a degree with highest honors in Chemistry is based primarily on a departmental evaluation of the accomplishments in these courses and on the quality of the thesis. Completion of the research project in a satisfactory manner and preparation of a well-written thesis usually results in a degree with honors. In cases where a student has demonstrated unusual commitment and initiative resulting in an outstanding thesis based on original results, combined with a strong record in all of their chemistry courses, the department may elect to award a degree with highest honors in Chemistry.

EXCHANGE AND TRANSFER STUDENTS

Students from other institutions wishing to register for courses in chemistry involving college-level prerequisites should do so in person with a member of the Chemistry Department. Registration should take place by appointment during the spring semester prior to the academic year in which courses are to be taken. Students are requested to have with them transcripts of the relevant previous college work.

COURSES FOR NON-MAJORS WITH NO PREREQUISITES

Students with principal interests outside of the sciences may extend a secondary school foundation in chemistry by electing a basic two-semester introductory course of a general nature or they may elect semester courses designed for non-majors. All courses in chemistry satisfy the divisional distribution requirement.

STUDY ABROAD

Students who wish to complete a chemistry major (or chemistry requirements for pre-medical study) as well as to study abroad during their junior year are encouraged to begin taking chemistry in their first semester at Williams, and should consult with members of the department as early as possible.

FAQ

Students **MUST** contact departments/programs **BEFORE** assuming study away credit will be granted toward the major or concentration.

Can your department or program typically pre-approve courses for major/concentration credit?

Yes, in some cases, if appropriate course information is available in advance (e.g. syllabi and/or course descriptions), though students should be sure to contact the department. We can give provisional approval in some cases if enough detail is available, but we always ask to see the details after the course is completed before signing off on the major credit.

What criteria will typically be used/required to determine whether a student may receive major/concentration credit for a course taken while on study away?

Course title and description, complete syllabus, including readings/assignments, and complete description of laboratory program. The biggest question is whether or not there is a lab component of the course and whether it is sufficient to fulfill the equivalent lab experience of Williams courses.

Does your department/program place restrictions on the number of major/concentration credits that a student might earn through study away?

No official restrictions, but we advise our students to take the majority of their chemistry courses at Williams.

Does your department/program place restrictions on the types of courses that can be awarded credit towards your major?

Yes. We have several special requirements. Only one non-lab class can be used toward the upper-level major requirements. This is usually the restriction that causes difficulty with study abroad—where appropriate lab courses may not be available. One of the lab courses must also meet our departmental "quantitative requirement." In principle, this could be met by a course taken abroad, but we would likely be more conservative in authorizing this equivalency.

Are there specific major requirements that cannot be fulfilled while on study away?

No. In principle, all major requirements could be filled abroad, but laboratory programs abroad are not always sufficiently rigorous to meet our

standards. We look for at least 40 hours of wet-lab time for the lab component. Importantly, this cannot be work in a professor's research lab, but must be "exercises" giving our students practice with standard techniques and methods of analysis.

Are there specific major requirements in your department/program that students should be particularly aware of when weighing study away options? (Some examples might include a required course that is always taught in one semester, laboratory requirements.)

Yes. The lab requirements that I've mentioned above are the main complicating factors. Also our first two years of ("introductory") chemistry courses are taught in an unconventional way. If a student had not yet completed all four of those courses before studying abroad, they would need to be aware of special timing that might complicate things. For our first two years of instruction, we teach one semester of introductory chemistry followed by two semesters of organic chemistry, and top things off with a final semester of a course that is somewhat specific to Williams. There are ways to take "equivalent" courses elsewhere, but we would need to work very closely with the student to ensure that all of the pieces fit together appropriately.

Give examples in which students thought or assumed that courses taken away would count toward the major or concentration and then learned they wouldn't:

None to date, but there may have been times when the lab component of a course was not sufficient and we were only able to assign major credit for a non-lab course instead of a course-with-a-lab.

CHEM 100 (F) Chemistry Matters (QFR)

Chemistry matters! From fueling the world's economy to preventing the next pandemic to forecasting future climate change, chemistry touches all aspects of daily life. This course provides an introduction to chemical principles and applications for students with little or no high school chemistry background. Through the lens of contemporary issues and applications (e.g. energy, environment, materials, medicine, etc.), students will be introduced to concepts fundamental to studying matter at the molecular level. Particular emphasis will be placed on skills essential for students to understand chemistry in these contexts, including quantitative reasoning and the development of chemical literacy and intuition. Laboratory meetings will be used to reinforce lecture material through experimentation at the bench and active learning exercises.

Class Format: lecture, three times per week and laboratory, three hours per week

Requirements/Evaluation: problem set assignments, laboratory work and analysis, quizzes/exams and a final assessment

Prerequisites: Students are required to take the online Chemistry Placement Survey prior to registering for the course (chemistry.williams.edu/placement).

Enrollment Limit: 32; 16/lab

Enrollment Preferences: First-year students with little or no high school chemistry experience.

Expected Class Size: 32

Grading: yes pass/fail option, no fifth course option

Unit Notes: CHEM 100 may be taken concurrently with MATH 102--see under Mathematics; CHEM 100 or its equivalent is a prerequisite to CHEM 101.

Distributions: (D3) (QFR)

Quantitative/Formal Reasoning Notes: This course fulfills the QFR requirement with regular problem sets and in class activities in which quantitative/formal reasoning skills are practiced.

Fall 2024

LEC Section: 01 MWF 9:00 am - 9:50 am Katie M. Hart

LAB Section: 02 W 1:00 pm - 4:00 pm

LAB Section: 03 R 1:00 pm - 4:00 pm

CHEM 101 (F)(S) Concepts of Chemistry (QFR)

This course broadens and deepens the foundation in chemistry of students who have had one or more years of chemistry at the high school level. Most students begin study of chemistry at Williams with this course. Familiarity with stoichiometry, basic concepts of equilibria, the model of an atom, Lewis structures and VSEPR, and gas laws is expected. Principal topics for this course include modern atomic theory, molecular structure and bonding, states of matter, chemical equilibrium (acid-base and solubility), and an introduction to atomic and molecular spectroscopies. Laboratory periods will largely focus on experiment design, data analysis, literature, scientific writing, and other skills critical to students' development as

scientists. The course is of interest to students who anticipate professional study in chemistry, related sciences, or one of the health professions, as well as to those who want to explore the fundamentals of chemistry as part of their general education. This course may be taken pass/fail; however, students who are considering graduate study in science or in the health professions should elect to take this course for a grade.

Class Format: lecture, three times per week and laboratory, four hours per week

Requirements/Evaluation: problem sets and/or quizzes, laboratory work, and exams

Prerequisites: Students are required to take the online Chemistry Placement Survey prior to registering for the course (chemistry.williams.edu/placement) or CHEM 100.

Enrollment Limit: 45; 16/lab

Enrollment Preferences: first-year students

Expected Class Size: 45/lecture

Grading: yes pass/fail option, no fifth course option

Unit Notes: CHEM 101 or its equivalent is a prerequisite for both CHEM 200 and CHEM 201 and is required for the BIMO concentration.

Distributions: (D3) (QFR)

Quantitative/Formal Reasoning Notes: This course fulfills the QFR requirement with regular and substantial problem sets in which quantitative/formal reasoning skills are practiced and evaluated.

Attributes: BIMO Required Courses

Fall 2024

LEC Section: 01 MWF 10:00 am - 10:50 am Bob Rawle

LEC Section: 02 MWF 11:00 am - 11:50 am Ben L. Augenbraun

LAB Section: 03 M 1:00 pm - 5:00 pm

LAB Section: 04 T 1:00 pm - 5:00 pm

LAB Section: 05 W 1:00 pm - 5:00 pm

LAB Section: 06 R 1:00 pm - 5:00 pm

LAB Section: 07 M 1:00 pm - 5:00 pm

LAB Section: 08 W 1:00 pm - 5:00 pm

Spring 2025

LEC Section: 01 MWF 9:00 am - 9:50 am Lee Y. Park

LAB Section: 02 M 1:00 pm - 5:00 pm

LAB Section: 03 T 1:00 pm - 5:00 pm

CHEM 115 (F) AIDS: The Disease and Search for a Cure

Cross-listings:

Primary Cross-listing

Since the discovery of the human immunodeficiency virus (HIV-1) in 1983, modern techniques of molecular biology have revealed much about its structure and life cycle. The intensity of the scientific investigation directed at HIV-1 is unprecedented in history. We now know more about this virus than any other pathogen. However, the early optimism concerning the prospects for an effective AIDS vaccine has not yet materialized, and HIV strains that are resistant to drug therapies are common. We are now four decades into the AIDS pandemic, and the World Health Organization estimates that there are more than 38 million HIV-infected persons worldwide. After an introduction to chemical structure, we examine the molecular biology of the HIV virus, the molecular targets of anti-HIV drugs, and the prospects for a cure. We look at how HIV-1 interacts with the human immune system and discuss strategies for developing an effective HIV vaccine.

Class Format: three hours per week

Requirements/Evaluation: problem sets, a midterm, quizzes, a final exam, and a presentation/discussion

Prerequisites: none; designed for the non-science major who does not intend to pursue a career in the natural sciences

Enrollment Limit: 32

Enrollment Preferences: seniors, juniors, sophomores, then first-year students

Expected Class Size: 32

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3)

This course is cross-listed and the prefixes carry the following divisional credit:

CHEM 115(D3)

Attributes: PHLH Biomedical Determinants of Health

Not offered current academic year

CHEM 200 (S) Advanced Chemical Concepts (QFR)

This course treats an array of topics in modern chemistry, emphasizing broad concepts that connect and weave through the various subdisciplines of the field--biochemistry, inorganic chemistry, organic chemistry, and physical chemistry. It provides the necessary background in chemical science for students who are planning advanced study or a career in chemistry, biological science, geoscience, environmental science, or a health profession. Topics include coordination complexes, thermodynamics, electrochemistry, and kinetics. Laboratory sections will give students hands-on experience involving synthesis, characterization, and reactivity studies of coordination and organic complexes; spectroscopic analyses; thermodynamics; electrochemistry; and kinetics. Students will hone their skills in the presentation of results through written reports and worksheets.

Class Format: lecture, three times per week and laboratory, four hours per week

Requirements/Evaluation: homework assignments, laboratory work, quizzes, midterm exam, and a final exam

Prerequisites: CHEM 101

Enrollment Limit: 35; 16/lab

Enrollment Preferences: first-year students, then sophomores

Expected Class Size: 35

Grading: no pass/fail option, no fifth course option

Unit Notes: CHEM 200 is required for the BIMO concentration

Distributions: (D3) (QFR)

Quantitative/Formal Reasoning Notes: This course fulfills the QFR requirement with regular and substantial problem sets in which quantitative/formal reasoning skills are practiced and evaluated.

Attributes: BIMO Required Courses

Spring 2025

LEC Section: 01 MWF 9:00 am - 9:50 am Enrique Peacock-López

LEC Section: 02 MWF 10:00 am - 10:50 am Enrique Peacock-López

LAB Section: 03 M 1:00 pm - 5:00 pm

LAB Section: 04 T 1:00 pm - 5:00 pm

LAB Section: 05 W 1:00 pm - 5:00 pm

LAB Section: 06 R 1:00 pm - 5:00 pm

LAB Section: 07 T 8:00 am - 12:00 pm

CHEM 201 (F) Organic Chemistry: Introductory Level (QFR)

This course provides the necessary background in organic chemistry for students who are planning advanced study or a career in chemistry, the biological sciences, or the health professions. It initiates the systematic study of the common classes of organic compounds with emphasis on theories of structure and reactivity. Specific topics include basic organic structures and bonding, delocalization and conjugation, acidity & basicity, nucleophilic addition and substitution reactions, stereochemistry and molecular energetics. The theory and interpretation of infrared (IR) and nuclear magnetic resonance (NMR) spectroscopy, as well as the fundamentals of molecular modeling as applied to organic molecules are presented. The coordinated laboratory work includes organic synthesis, purification and separation techniques, as well as characterization by IR and NMR spectroscopy.

Class Format: lecture, three times per week and laboratory, four hours per week

Requirements/Evaluation: quantitative problem solving, laboratory performance, three midterm exams, and a final exam

Prerequisites: CHEM 101 or CHEM 151, 153, or 155

Enrollment Limit: 40; 12/lab

Enrollment Preferences: Seniors, juniors, sophomores, first-year students

Expected Class Size: 40

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantitative/Formal Reasoning Notes: This course fulfills the QFR requirement with regular and substantial problem solving in which quantitative/formal reasoning skills are practiced and evaluated.

Attributes: BIMO Required Courses

Fall 2024

LEC Section: 01 MWF 9:00 am - 9:50 am Kerry-Ann Green

LEC Section: 02 MWF 10:00 am - 10:50 am Amanda K. Turek

LAB Section: 03 M 1:00 pm - 5:00 pm

LAB Section: 04 T 1:00 pm - 5:00 pm

LAB Section: 05 W 1:00 pm - 5:00 pm

LAB Section: 06 R 1:00 pm - 5:00 pm

LAB Section: 07 M 1:00 pm - 5:00 pm

LAB Section: 08 T 1:00 pm - 5:00 pm

LAB Section: 09 W 1:00 pm - 5:00 pm

LAB Section: 10 T 8:00 am - 12:00 pm

CHEM 242 (S) Organic Chemistry: Intermediate Level

This course is a continuation of CHEM 156/201 and it concludes the systematic study of the common classes of organic compounds with emphasis on theories of structure and reactivity. Specific topics include radical chemistry, an introduction to mass spectrometry and ultraviolet spectroscopy, the theory and chemical reactivity of conjugated and aromatic systems, the concepts of kinetic and thermodynamic control, an extensive treatment of the chemistry of the carbonyl group, alcohols, ethers, polyfunctional compounds, the concept of selectivity, the fundamentals of organic synthesis, an introduction to carbohydrates, carboxylic acids and derivatives, acyl substitution reactions, amines, and an introduction to amino acids, peptides, and proteins. The coordinated laboratory work includes application of the techniques learned in the introductory level laboratory, along with new functional group analyses, to the separation and identification of several unknown samples. Skills in analyzing NMR, IR, and MS data are practiced and further refined.

Class Format: lecture, three times per week and laboratory, four hours per week

Requirements/Evaluation: midterm exams, problem sets, laboratory performance, including written lab reports, and a final exam

Prerequisites: CHEM 200 and CHEM 201 (or CHEM 156); or permission of instructor

Enrollment Limit: 40; 12/lab

Enrollment Preferences: seniors, juniors, then sophomores

Expected Class Size: 40

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Attributes: BIMO Required Courses

Spring 2025

LEC Section: 01 MWF 9:00 am - 9:50 am Thomas E. Smith

LEC Section: 02 MWF 10:00 am - 10:50 am B Thuronyi

LAB Section: 03 M 1:00 pm - 5:00 pm

LAB Section: 04 T 1:00 pm - 5:00 pm

LAB Section: 05 W 1:00 pm - 5:00 pm

LAB Section: 06 R 1:00 pm - 5:00 pm

LAB Section: 07 M 1:00 pm - 5:00 pm

LAB Section: 08 W 1:00 pm - 5:00 pm

CHEM 319 (S) Integrative Bioinformatics, Genomics, and Proteomics Lab (QFR)

Cross-listings: BIOL 319 / CSCI 319 / PHYS 319 / MATH 319

Secondary Cross-listing

What can computational biology teach us about cancer? In this lab-intensive experience for the Genomics, Proteomics, and Bioinformatics program, computational analysis and wet-lab investigations will inform each other, as students majoring in biology, chemistry, computer science, mathematics/statistics, and physics contribute their own expertise to explore how ever-growing gene and protein data-sets can provide key insights into human disease. In this course, we will take advantage of one well-studied system, the highly conserved Ras-related family of proteins, which play a central role in numerous fundamental processes within the cell. The course will integrate bioinformatics and molecular biology, using database searching, alignments and pattern matching, and phylogenetics to reconstruct the evolution of gene families by focusing on the gene duplication events and gene rearrangements that have occurred over the course of eukaryotic speciation. By utilizing high through-put approaches to investigate genes involved in the inflammatory and MAPK signal transduction pathways in human colon cancer cell lines, students will uncover regulatory mechanisms that are aberrantly altered by siRNA knockdown of putative regulatory components. This functional genomic strategy will be coupled with independent projects using phosphorylation-state specific antisera to test our hypotheses. Proteomic analysis will introduce the students to de novo structural prediction and threading algorithms, as well as data-mining approaches and Bayesian modeling of protein network dynamics in single cells. Flow cytometry and mass spectrometry may also be used to study networks of interacting proteins in colon tumor cells.

Class Format: The lab for this course will meet for two afternoons per week. Some lab sessions will be shorter than 3 hours.

Requirements/Evaluation: lab participation, several short homework assignments, one lab report, a programming project, and a grant proposal

Prerequisites: BIOL 202; students who have not taken BIOL 202 but have taken BIOL 101 and a CSCI course, or CSCI/PHYS 315, may enroll with permission of instructor. No prior computer programming experience is required.

Enrollment Limit: 12

Enrollment Preferences: seniors, then juniors, then sophomores

Expected Class Size: 12

Grading: yes pass/fail option, no fifth course option

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

BIOL 319(D3) CHEM 319(D3) CSCI 319(D3) PHYS 319(D3) MATH 319(D3)

Quantitative/Formal Reasoning Notes: Through lab work, homework sets and a major project, students will learn or further develop their skills in programming in Python, and about the basis of Bayesian approaches to phylogenetic tree estimation.

Attributes: BIGP Courses BIMO Interdepartmental Electives

Not offered current academic year

CHEM 321 (F) Biochemistry I: Structure and Function of Biological Molecules (QFR)

Cross-listings: BIOL 321 / BIMO 321

Secondary Cross-listing

This course introduces the foundational concepts of biochemistry with an emphasis on the structure and function of biological macromolecules. Specifically, the structure of proteins and nucleic acids are examined in detail in order to determine how their chemical properties and their biological behavior result from those structures. Other topics covered include catalysis, enzyme kinetics, mechanism and regulation; the molecular organization of biomembranes; and the flow of information from nucleic acids to proteins. In addition, the principles and applications of the methods used to characterize macromolecules in solution and the interactions between macromolecules are discussed. The laboratory provides a hands-on opportunity to study macromolecules and to learn the fundamental experimental techniques of biochemistry including electrophoresis, chromatography, and principles of enzymatic assays.

Class Format: lecture, three times per week and laboratory, four hours per week

Requirements/Evaluation: quizzes, a midterm exam, a final exam, problem sets and performance in the laboratories including lab reports

Prerequisites: BIOL 101, CHEM 200 and CHEM 201; or either CHEM 155 or 256 and CHEM 251

Enrollment Limit: 12/lab

Enrollment Preferences: junior and senior Biology and Chemistry majors and BIMO concentrators

Expected Class Size: 36

Grading: no pass/fail option, no fifth course option

Unit Notes: Cannot be counted towards the Biology major in addition to BIOL 222

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

BIOL 321(D3) BIMO 321(D3) CHEM 321(D3)

Quantitative/Formal Reasoning Notes: This course fulfills the QFR requirement with regular problem sets in which quantitative/formal reasoning skills are practiced.

Attributes: BIGP Courses BIMO Required Courses

Fall 2024

LEC Section: 01 MWF 10:00 am - 10:50 am B Thuronyi

LAB Section: 02 T 1:00 pm - 3:40 pm

LAB Section: 03 R 1:00 pm - 5:00 pm

CHEM 322 (S) Biochemistry II: Metabolism (QFR)

Cross-listings: BIMO 322 / BIOL 322

Secondary Cross-listing

This lecture course provides an in-depth presentation of the complex metabolic reactions that are central to life. Emphasis is placed on the biological flow of energy including alternative modes of energy generation (aerobic, anaerobic, photosynthetic); the regulation and integration of the metabolic pathways including compartmentalization and the transport of metabolites; and biochemical reaction mechanisms including the structures and mechanisms of coenzymes. This comprehensive study also includes the biosynthesis and catabolism of small molecules (carbohydrates, lipids, amino acids, and nucleotides). Laboratory experiments introduce the principles and procedures used to study enzymatic reactions, bioenergetics, and metabolic pathways.

Class Format: Lecture three hours per week and laboratory three hours per week.

Requirements/Evaluation: several exams and performance in the laboratories including lab reports that emphasize conceptual and quantitative and/or graphic analysis of data

Prerequisites: BIOL 101, plus either: CHEM 156 and CHEM 256, or CHEM 155 and CHEM 156, or CHEM 200 and CHEM 201, or permission of instructor

Enrollment Limit: 48

Enrollment Preferences: junior and senior Biology and Chemistry majors and BIMO concentrators

Expected Class Size: 48

Grading: no pass/fail option, no fifth course option

Unit Notes: cannot be counted towards the Biology major in addition to BIOL 222

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

BIMO 322(D3) CHEM 322(D3) BIOL 322(D3)

Quantitative/Formal Reasoning Notes: The laboratory program is quantitative covering data analyses, numerical transformations, graphical displays.

Attributes: BIGP Courses BIMO Required Courses

Spring 2025

LEC Section: 01 TR 11:20 am - 12:35 pm Caitlyn E. Bowman-Cornelius

LAB Section: 02 M 1:00 pm - 3:50 pm Caitlyn E. Bowman-Cornelius

LAB Section: 03 W 1:00 pm - 3:50 pm Caitlyn E. Bowman-Cornelius

LAB Section: 04 R 1:00 pm - 3:50 pm Caitlyn E. Bowman-Cornelius

CHEM 324 (F) Enzyme Kinetics and Reaction Mechanisms

Enzymes are complex biological molecules capable of catalyzing chemical reactions with very high efficiency, stereo-selectivity and specificity. The study of enzymatically-catalyzed reactions gives insight into the study of organic reaction mechanisms in general, and into the topic of catalysis especially. This course explores the methods and frameworks for determining enzymatic reaction mechanisms. These methods are based on a firm foundation of organic reaction mechanisms and chemical kinetics. We will investigate the major types of biochemical reactions, focusing on their catalytic mechanisms and how those mechanisms can be elucidated. We will lay the foundation for this mechanistic consideration with discussion of transition state theory, structure-reactivity relationships, steady state and pre-steady kinetics, use of isotopes, genetic modification, and other tools for probing enzymatic reactions. We will also examine the catalytic roles of a variety of vitamins and cofactors.

Class Format: three hours per week

Requirements/Evaluation: problem sets, quizzes, a midterm exam, a paper, and a final exam

Prerequisites: CHEM/BIOL/BIMO 321 or permission of instructor

Enrollment Limit: 20

Enrollment Preferences: Chemistry majors or BIMO concentrators

Expected Class Size: 20

Grading: no pass/fail option, yes fifth course option

Distributions: (D3)

Attributes: BIMO Interdepartmental Electives

Not offered current academic year

CHEM 326 (S) Chemical and Synthetic Biology

This course surveys the rapidly evolving, interdisciplinary and interconnected fields of chemical and synthetic biology. Chemical biology uses precise molecular-level manipulations to influence living systems from the bottom up, often by introducing components that are foreign to nature. Synthetic biology takes advantage of existing molecular technology and adopts an engineering mindset to reprogram life. Students will achieve literacy through immersion in chemical and synthetic biology. We will prioritize broad exposure to these fields, their vocabulary, culture, practices and ideas, through extensive engagement with the primary literature that expert practitioners use to teach themselves. The course model is instructor-facilitated peer-to-peer instruction, emphasizing skills important for autonomous and collaborative work in real-world scientific and professional fields. Topics we will cover include synthetic genomes, metabolic engineering, chemical synthesis and manipulation of biomacromolecules, directed evolution, and reworking of the central dogma of biology.

Class Format: two and a half hours of whole-class meetings and one hour of small-group meetings per week and online discussion using Perusall

Requirements/Evaluation: Course work includes consistent and intensive engagement with primary literature, discussions, weekly short presentations, formal and informal writing assignments, and an independent research project. The workload is designed to be distributed evenly throughout the semester. There are no exams. The course will be specifications-graded.

Prerequisites: CHEM/BIOL/BIMO 321 or permission of the instructor

Enrollment Limit: 12

Enrollment Preferences: seniors, then junior Chemistry and Biology majors with a demonstrated interest in chemical or synthetic biology

Expected Class Size: 12

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Attributes: BIMO Interdepartmental Electives

Not offered current academic year

CHEM 335 (S) Inorganic/Organometallic Chemistry

This course covers fundamental aspects of the chemistry of main group elements and transition metals, and highlights how these properties are key to understanding the roles of these elements in applications such as the catalysis of synthetic organic transformations, the functions of enzymatic processes, the production of commodity chemicals such as plastics, and the actions of metal-based drugs such as cis-platin. The course introduces concepts of symmetry and group theory, and their systematic application to the study of the structure, bonding, and spectroscopy of inorganic and organometallic compounds. The course also covers the kinetics and mechanism of selected inorganic and organometallic reactions. Class discussions will involve exploration of the primary literature and review articles around recent developments and applications in inorganic chemistry, such as finding molecular solutions to water oxidation, the capture of solar energy, to cancer treatments and the optimization of industrial-scale reactions.

Class Format: lecture, three hours per week and laboratory, four hours per week

Requirements/Evaluation: problem sets, exams, presentation, group-based literature reviews, and laboratory work

Prerequisites: CHEM 155 or CHEM 256 and CHEM 251; or CHEM 200 and CHEM 201

Enrollment Limit: 16; 8/lab

Enrollment Preferences: senior and junior chemistry majors

Expected Class Size: 16

Grading: no pass/fail option, yes fifth course option

Distributions: (D3)

Spring 2025

LEC Section: 01 TR 9:55 am - 11:10 am Kerry-Ann Green

LAB Section: 02 M 1:00 pm - 5:00 pm

CHEM 336 (F) Materials Chemistry

Materials have defined much of what is possible in our daily lives. Materials scientists are at the center of imagining and delivering progress, as they improve existing materials and develop new ones to meet today's needs. Materials science focuses on the relationships between the structure, processing, properties, and performance of materials. In this course, we will explore how the properties and potential applications of a solid are related to its atomic and molecular structure, as well as to its organization on larger length scales than are traditionally considered in chemistry. We will cover a variety of different types of materials including metals, ceramics, polymers, and composites. We will examine some of the latest developments in materials science, including new strategies for the synthesis of materials on different length scales, as well as a variety of potential applications of emerging technologies.

Class Format: lecture, three hours per week

Requirements/Evaluation: problem sets, reviews of research articles, two exams, and oral presentations

Prerequisites: CHEM 155 or CHEM 256 and CHEM 251; or CHEM 200 and CHEM 201

Enrollment Limit: 20

Enrollment Preferences: Chemistry majors

Expected Class Size: 20

Grading: no pass/fail option, yes fifth course option

Distributions: (D3)

Attributes: MTSC Courses

Fall 2024

LEC Section: 01 TR 8:30 am - 9:45 am Lee Y. Park

CHEM 342 (S) Synthetic Organic Chemistry

The origins of organic chemistry are to be found in the chemistry of living things and the emphasis of this course is on the chemistry of naturally-occurring compounds. This course presents the logic and practice of chemical total synthesis while stressing the structures, properties and preparations of terpenes, polyketides and alkaloids. Modern synthetic reactions are surveyed with an emphasis on the stereochemical and mechanistic themes that underlie them. To meet the requirements for the semester's final project, each student chooses an article from the recent

synthetic literature and then analyzes the logic and strategy involved in the published work in a final paper. A summary of this paper is also presented to the class in a short seminar. There will be no laboratory component in 2022. Instead, one of the three class meetings each week will focus on discussion and presentation of reactions, mechanisms, and syntheses from the chemical literature.

Class Format: lecture, three hours per week and conference, 1.5 hours per week

Requirements/Evaluation: problem sets, midterm exams, class participation, class presentations, and a final project

Prerequisites: CHEM 155 or CHEM 256 and CHEM 251 or permission of instructor; or CHEM 200 and CHEM 242 or permission of instructor

Enrollment Limit: 16

Enrollment Preferences: Chemistry majors, seniors and juniors

Expected Class Size: 16

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Attributes: BIMO Interdepartmental Electives

Not offered current academic year

CHEM 344 (S) Physical Organic Chemistry

The structure of a molecule is inherently linked to its reactivity, and these correlations form the basis for understanding organic reaction mechanisms. This course advances the understanding from previous organic courses through a detailed examination of the concepts that underlie these structure/reactivity relationships, including molecular strain and stability, acid/base chemistry, steric and electronic effects, and aromaticity. These concepts will also be explored in the context of specific classes of reaction mechanisms. Classical and modern experimental and theoretical tools used to elucidate reaction mechanisms will also be presented, including reaction kinetics, isotope effects, and linear free energy relationships. By studying the primary literature, we will see how these experiments have been applied to the elucidation of reaction mechanism, while also learning to design a set of experiments for study of mechanisms of contemporary interest.

Class Format: lecture, three times per week and laboratory, four hours per week

Requirements/Evaluation: problem sets, exams, laboratory reports, presentations, and class participation

Prerequisites: CHEM 155 or CHEM 256 and CHEM 251; or CHEM 200 and CHEM 201

Enrollment Limit: 8

Enrollment Preferences: Chemistry majors: seniors, juniors, sophomores

Expected Class Size: 8

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Attributes: BIMO Interdepartmental Electives

Spring 2025

LEC Section: 01 MWF 11:00 am - 11:50 am Amanda K. Turek

LAB Section: 02 W 1:00 pm - 5:00 pm Amanda K. Turek

CHEM 345 (F) Supramolecular Organic Chemistry

Supramolecular chemistry is the study of chemical systems, often with practical applications, that are composed of two or more molecular components held together by non-covalent interactions. More specifically, we will focus on the use of "synthetic influence" over organic compounds and reactions to make tailor-made building blocks that will produce functional molecular assemblies. The various analytical methodologies used to probe these relatively weaker and more dynamic chemical systems will be studied. We will also examine (and be inspired by) the supramolecular chemistry found in nature, as the field was originally defined by the host-guest interactions used to explain receptor-substrate binding in many biological systems. Today, the field has intersected with numerous disciplines which we will explore; these include analytical molecular recognition and sensing, self-assembly molecular engineering, catalysis, and organic-based molecular devices, among others. We will also explore more complex supramolecular topics such as dynamic covalent chemistry and the mechanical bond. Students will be expected to delve into the chemical literature and analyze the research of pioneering chemists in the field (past and present) by choosing one prominent journal article, culminating in a final literature review paper.

Class Format: lecture/discussion

Requirements/Evaluation: problem sets, research article review homework assignments, class/discussion participation, exams, and a final literature review paper

Prerequisites: CHEM 251 and CHEM 256

Enrollment Limit: 20

Enrollment Preferences: Chemistry majors

Expected Class Size: 20

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Not offered current academic year

CHEM 348 (S) Polymer Chemistry

From synthetic to natural macromolecules, we encounter polymers everywhere and every day. This course explores the multitude of synthetic techniques available and discusses how structure defines function. Topics include polymer types, concept of molecular weight, structure-property relationships and polymer synthesis methods including condensation and chain (anionic, cationic, radical) polymerizations. Fundamentals of composition and physical properties of polymers, and methods of characterization are also covered. Examples of polymer functionalization, self-assembly, and surface modification are also discussed.

Class Format: lecture, three hours per week and laboratory, four hours per week

Requirements/Evaluation: problem sets, participation, two exams, laboratory work, and a final project

Prerequisites: CHEM 251 or CHEM 242

Enrollment Limit: 12/lab

Enrollment Preferences: Chemistry majors

Expected Class Size: 12

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Attributes: BIMO Interdepartmental Electives MTSC Courses

Spring 2025

LEC Section: 01 TR 8:30 am - 9:45 am Sarah L. Goh

LAB Section: 02 T 1:00 pm - 5:00 pm Sarah L. Goh

CHEM 361 (S) Quantum Chemistry and Chemical Dynamics (QFR)

This course introduces quantum mechanics, which serves as the basis for understanding molecular structure and spectroscopy. We will begin by discussing the Schrodinger wave equation and then apply this to understanding the translational, vibrational, and rotational structure of molecules. This leads to a discussion of atomic/molecular electronic structure and spectroscopy. Computational methods will be taught to illustrate key quantum mechanical concepts, interpret experimental data, and extend hypotheses. Applications will be chosen from contemporary research fields, including photochemistry, laser spectroscopy, environmental/atmospheric chemistry, organometallic chemistry, and physical organic chemistry.

Requirements/Evaluation: class participation, problem sets, exams, and laboratory work

Prerequisites: CHEM 155 or CHEM 256; or CHEM 200; or permission of instructor; and strongly recommend MATH 150 or MATH 151

Enrollment Limit: 16; 8/lab

Enrollment Preferences: seniors, then juniors

Expected Class Size: 16

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantitative/Formal Reasoning Notes: This course fulfills the QFC requirement and relies heavily upon mathematics and quantitative reasoning in all elements, including problem sets, examinations, and laboratories.

Spring 2025

LEC Section: 01 MWF 11:00 am - 12:15 pm Ben L. Augenbraun

LAB Section: 02 T 1:00 pm - 5:00 pm Ben L. Augenbraun

LAB Section: 03 R 1:00 pm - 5:00 pm Ben L. Augenbraun

CHEM 363 (F) Environmental Fate of Organic Chemicals

Cross-listings: ENVI 363

Primary Cross-listing

This course introduces students to the methods used to assess the risks posed by organic chemicals to human, animal, and ecosystem health. Our goal is to develop a quantitative understanding for how specific features of organic molecular structure directly dictate a given molecule's environmental fate. We will begin by using thermodynamic principles to estimate the salient physiochemical properties of molecules (e.g., vapor pressure, solubility, charging behavior, etc.) that impact the distribution, or partitioning, of organic chemicals between air, water, soils, and biota. Then, using quantitative structure activity relationships, we will predict the degradation kinetics resulting from natural nucleophilic, photochemical, and biological processes that determine chemical lifetime in the environment.

Class Format: lecture, three hours per week and laboratory, four hours per week

Requirements/Evaluation: weekly problem sets, laboratory exercises, two midterm exams, a final exam, participation in lecture and lab

Prerequisites: CHEM 155 or CHEM 256 and CHEM 156; or CHEM 200 and CHEM 201

Enrollment Limit: 12

Enrollment Preferences: junior and senior Chemistry and Environmental Studies majors with a demonstrated interest in environmental chemistry

Expected Class Size: 12

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

This course is cross-listed and the prefixes carry the following divisional credit:

ENVI 363(D3) CHEM 363(D3)

Attributes: ENVI Natural World Electives EVST Environmental Science

Fall 2024

LEC Section: 01 TR 9:55 am - 11:10 am Anthony J. Carrasquillo

LAB Section: 02 T 1:00 pm - 5:00 pm Anthony J. Carrasquillo

LAB Section: 03 R 1:00 pm - 5:00 pm Anthony J. Carrasquillo

CHEM 364 (S) Instrumental Methods of Analysis

Instrumental methods of analysis provide scientists with different lenses to observe and elucidate fundamental chemical phenomena and to measure parameters and properties at the atomic, molecular, and bulk scales. This course introduces a framework for learning about a variety of instrumental techniques that typically include chromatography, mass spectrometry, thermal methods, atomic and molecular absorption and emission spectroscopy, X-ray diffraction, and optical and electron microscopies. Students complete laboratory projects and gain hands-on experience and project planning skills to study molecules and materials of interest. This practical experience is complemented by lectures that cover the theory and broader applications of these techniques. Students also explore the primary literature and highlight recent advances in instrumental methods that address today's analytical questions. The skills learned are useful in a wide variety of scientific areas and will prepare you well for research endeavors.

Class Format: lecture, two times per week and laboratory, four hours per week

Requirements/Evaluation: Weekly data analysis, laboratory assignments and reports, readings for class, problem sets, one oral presentation of an application of instrumental methods, a final independent literature project and presentation; demonstrated progress in research skills, and project engagement.

Prerequisites: CHEM 251 and CHEM 256 (or permission of instructor); or CHEM 200 and CHEM 201 (can be taken concurrently with CHEM 201)

Enrollment Limit: 16/lab

Enrollment Preferences: Chemistry and Environmental Studies majors

Expected Class Size: 16

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Attributes: BIMO Interdepartmental Electives ENVI Natural World Electives MTSC Courses

Not offered current academic year

CHEM 366 (F) Thermodynamics and Statistical Mechanics (QFR)

The thermodynamic laws provide us with our most powerful and general scientific principles for predicting the direction of spontaneous change in physical, chemical, and biological systems. This course develops the concepts of energy, entropy, free energy, temperature, heat, work, and chemical potential within the framework of classical and statistical thermodynamics. The principles developed are applied to a variety of problems: chemical reactions, phase changes, energy technology, industrial processes, and environmental science. Laboratory experiments provide quantitative and practical demonstrations of the theory of real and ideal systems studied in class.

Class Format: lecture, three times per week and laboratory, four hours per week

Requirements/Evaluation: class participation, oral presentations, problem sets, laboratory work, and an independent project

Prerequisites: CHEM 155 or CHEM 256; or CHEM 200; and basic knowledge of applied integral and differential calculus

Enrollment Limit: 16/lab

Enrollment Preferences: Chemistry majors: seniors, juniors, then sophomores

Expected Class Size: 16

Grading: no pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantitative/Formal Reasoning Notes: This course fulfills the QFC requirement and relies heavily upon mathematics and quantitative reasoning in all elements, including problem sets, examinations, and laboratories.

Attributes: BIMO Interdepartmental Electives

Fall 2024

LEC Section: 01 MWF 11:00 am - 12:15 pm Enrique Peacock-López

LAB Section: 02 T 1:00 pm - 5:00 pm Enrique Peacock-López

CHEM 367 (S) Biophysical Chemistry

In this course, physical chemistry concepts are presented from the viewpoint of their practical application to a set of biochemical problems, which are explored side-by-side in the lecture and highly-integrated lab program. Major emphasis is placed on quantitative thermodynamic models of equilibrium processes, and students will learn how to develop and apply mathematical models to data. The main topics covered include: 1) conformations of biological macromolecules and the forces that stabilize them; 2) spectroscopic techniques for the study of structure and function; and 3) macromolecular interactions and binding.

Class Format: lecture, three hours per week and laboratory, four hours per week

Requirements/Evaluation: problem sets and/or quizzes, laboratory work, and exams

Prerequisites: CHEM 155 or CHEM 256 and CHEM 251; or CHEM 200 and CHEM 201; and BIMO 321 (or permission of instructor), with MATH 140 or equivalent preferred

Enrollment Limit: 18; 9/lab

Enrollment Preferences: junior and senior Chemistry majors

Expected Class Size: 18

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Attributes: BIMO Interdepartmental Electives

Spring 2025

LEC Section: 01 TR 9:55 am - 11:10 am Bob Rawle

LAB Section: 02 M 1:00 pm - 5:00 pm Bob Rawle

LAB Section: 03 W 1:00 pm - 5:00 pm Bob Rawle

CHEM 368 (S) Computational Chemistry and Molecular Spectroscopy (QFR)

This tutorial provides an introduction to the principles of computational quantum mechanics and their application to problems of chemical interest such as chemical bonding, chemical reactivity, and molecular spectroscopy. Emphasis is placed upon modern electronic structure calculations, their fundamentals, practical considerations, interpretation, and applications to current research questions. Under guidance in sessions and through independent work, students will use computational methods to explore assigned weekly research problems. The research results will be presented to and discussed with the tutorial partner at the end of each week.

Requirements/Evaluation: tutorial participation, presentations, and submitted papers

Prerequisites: CHEM 361 or equivalent background in Physics

Enrollment Limit: 10

Enrollment Preferences: Chemistry majors

Expected Class Size: 10

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantitative/Formal Reasoning Notes: This course fulfills the QFC requirement with problem sets for assignments in which quantitative/formal reasoning skills are practiced.

Not offered current academic year

CHEM 393 (F) Junior Research and Thesis: Chemistry

Chemistry junior research and thesis.

Requirements/Evaluation: N/A

Prerequisites: N/A

Enrollment Limit: N/A

Enrollment Preferences: N/A

Expected Class Size: N/A

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Fall 2024

HON Section: 01 TBA Thomas E. Smith

CHEM 394 (S) Junior Research and Thesis: Chemistry

Chemistry junior research and thesis.

Requirements/Evaluation: N/A

Prerequisites: N/A

Enrollment Limit: N/A

Enrollment Preferences: N/A

Expected Class Size: N/A

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Spring 2025

HON Section: 01 TBA Thomas E. Smith

CHEM 397 (F) Independent Study, for Juniors: Chemistry

Chemistry independent study for juniors.

Requirements/Evaluation: N/A

Prerequisites: N/A

Enrollment Limit: N/A

Enrollment Preferences: Junior chemistry majors only

Expected Class Size: N/A

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Fall 2024

IND Section: 01 TBA Thomas E. Smith

CHEM 398 (S) Independent Study, for Juniors: Chemistry

Chemistry independent study for juniors.

Requirements/Evaluation: N/A

Prerequisites: N/A

Enrollment Limit: N/A

Enrollment Preferences: Junior chemistry majors only

Expected Class Size: N/A

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Spring 2025

IND Section: 01 TBA Thomas E. Smith

CHEM 493 (F) Senior Research and Thesis

Individual research projects in a field of interest to the student are carried out under the direction of a faculty member and culminate in a thesis; this is part of a full-year thesis (493-494). Students in this program are strongly encouraged to keep 1:10 p.m. to 2:25 p.m. on Friday free for departmental colloquia.

Requirements/Evaluation: N/A

Prerequisites: N/A

Enrollment Limit: N/A

Enrollment Preferences: N/A

Expected Class Size: N/A

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Fall 2024

HON Section: 01 F 1:10 pm - 2:25 pm Thomas E. Smith

CHEM 494 (S) Senior Research and Thesis

Individual research projects in a field of interest to the student are carried out under the direction of a faculty member and culminate in a thesis; this is part of a full-year thesis (493-494). Students in this program are strongly encouraged to keep 1:10 p.m. to 2:25 p.m. on Friday free for departmental colloquia.

Requirements/Evaluation: N/A

Prerequisites: N/A

Enrollment Limit: N/A

Enrollment Preferences: N/A

Expected Class Size: N/A

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Spring 2025

HON Section: 01 F 1:10 pm - 2:25 pm Thomas E. Smith

CHEM 497 (F) Independent Study, for Seniors: Chemistry

Chemistry independent study for seniors. Individual research projects in a field of interest to the student are carried out under the direction of a faculty member.

Requirements/Evaluation: N/A

Prerequisites: N/A

Enrollment Limit: N/A

Enrollment Preferences: Senior chemistry majors only

Expected Class Size: N/A

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Fall 2024

IND Section: 01 TBA Thomas E. Smith

CHEM 498 (S) Independent Study, for Seniors: Chemistry

Chemistry independent study for seniors. Individual research projects in a field of interest to the student are carried out under the direction of a faculty member.

Requirements/Evaluation: N/A

Prerequisites: N/A

Enrollment Limit: N/A

Enrollment Preferences: Senior chemistry majors only

Expected Class Size: N/A

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Spring 2025

IND Section: 01 TBA Thomas E. Smith

Winter Study -----

CHEM 18 (W) Introduction to Research in Biochemistry

An independent experimental project in biochemistry is carried out in collaboration with a member of the Department with expertise in biochemistry. Biochemistry is a branch of chemistry that deals with the molecular details of living systems including the interaction of biologically important molecules. In the Chemistry Department, studies are underway to investigate the structure/function relationship of proteins, the interaction between proteins and RNA and DNA, the molecular basis of bacterial gene regulation, the lipid composition of model membranes, and the molecular underpinnings of viral infection.

Requirements/Evaluation: a 10-page paper

Prerequisites: Completion of a Chemistry introductory level course and permission of the instructor and department; interested students must consult with the faculty instructor.

Enrollment Limit: 4

Enrollment Preferences: expression of student interest

Expected Class Size: NA

Grading: pass/fail only

Attributes: EXPE Experiential Education Courses STUX Winter Study Student Exploration

Not offered current academic year

CHEM 20 (W) Introduction to Research in Inorganic Chemistry

Students in this course will carry out an independent research project in collaboration with a member of the Department with expertise in inorganic chemistry. Representative projects include the synthesis and study of polymers to encapsulate heavy metals with an eye to environmental remediation and the synthesis of coordination complexes as models of enzymes and as catalysts for the oxidation of organic compounds. The interdisciplinary nature of the project will expose students to a range of inorganic and organic synthetic protocols and analytical and spectroscopic techniques for the characterization of new materials and the monitoring of catalysis. In addition to lab work, participants will engage in an exploration of careers in chemistry and a discussion of topics of interest to chemists, such as ethics and creating a diverse workforce.

Requirements/Evaluation: a 10-page paper

Prerequisites: Completion of a Chemistry introductory level course and permission of the instructor and department; interested students must consult with the faculty instructor.

Enrollment Limit: 8

Enrollment Preferences: expression of student interest

Expected Class Size: NA

Grading: pass/fail only

Not offered current academic year

CHEM 23 (W) Introduction to Research in Organic Chemistry

An independent experimental project in polymer organic chemistry is carried out in collaboration with a member of the Department. Representative projects focus on controlled synthesis of block copolymers as self-assembled nanocarriers. Students involved in this work will learn techniques involved in organic synthesis, including analysis by NMR, IR, and SEC.

Requirements/Evaluation: 10-page paper

Prerequisites: Completion of a Chemistry introductory level course and permission of the instructor and department; interested students must consult with the faculty instructor.

Enrollment Limit: 4/lab

Enrollment Preferences: expression of student interest

Expected Class Size: NA

Grading: pass/fail only

Not offered current academic year

CHEM 24 (W) Introduction to Research in Physical Chemistry

An independent experimental or theoretical project in physical chemistry is carried out in collaboration with a member of the Department with expertise in physical chemistry. Current research projects in the Department include computer modeling of non-linear, chaotic chemical and biochemical systems, atmospheric chemical dynamics, molecular modeling of water clusters, molecular dynamics simulations, and laser spectroscopy of chlorofluorocarbon substitutes.

Requirements/Evaluation: 10-page paper

Prerequisites: Completion of a Chemistry introductory level course and permission of the instructor and department; interested students must consult with the faculty instructor.

Enrollment Limit: 6

Enrollment Preferences: expression of student interest

Expected Class Size: NA

Grading: pass/fail only

Attributes: EXPE Experiential Education Courses STUX Winter Study Student Exploration

Not offered current academic year

CHEM 31 (W) Senior Research and Thesis: Chemistry

To be taken by students registered for Chemistry 493, 494.

Requirements/Evaluation: None

Prerequisites: None

Enrollment Limit: 20

Enrollment Preferences: students registered for Chemistry 493, 494

Expected Class Size: NA

Grading: pass/fail only

Not offered current academic year

CHEM 99 (W) Independent Study: Chemistry

Open to upperclass students. Students interested in doing an independent project (99) during Winter Study must make prior arrangements with a faculty sponsor. The student and professor then complete the independent study proposal form available online. The deadline is typically in late September. Proposals are reviewed by the pertinent department and the Winter Study Committee. Students will be notified if their proposal is approved prior to the Winter Study registration period.

Class Format: independent study

Grading: pass/fail only

Not offered current academic year