The Biochemistry degree emphasizes the chemical basis of biological analysis, organic chemistry, and laboratory techniques. Both degrees include chemical thermodynamics and atomic structure, chemical structures, computational chemistry, materials chemistry, organic synthesis, and environmental systems, with students developing skills in interdisciplinary inquiry that include cell biology, genetics, and biochemical laboratory techniques. In contrast, the Chemistry degree places more emphasis on advanced instrumental analysis, quantum mechanics, spectroscopy, and inorganic chemistry.

**General Requirements for the Major or Minor**

General university degree requirements stipulate that 1) at least four units of the major or three units of the minor be taken in residence at Puget Sound; 2) students earn a GPA of 2.0 in courses taken for the major or the minor; and 3) all courses taken for a major or minor must be taken for graded credit. Any exceptions to these stipulations are indicated in the major and minor degree requirements listed below.

**Requirements for Bachelor of Arts Degree in Chemistry**

1. PHYS 121, 122;  
2. MATH 180, 181, 280;  
3. CHEM 115, 230; or CHEM 110, 120, 231;  
4. CHEM 250, 251, 340, 341, 420  
5. One-half unit Chemistry elective at the 300 or 400 level;  

**Requirements for Bachelor of Science Degree in Chemistry**

1. PHYS 121, 122;  
2. MATH 180, 181, 280;  
3. CHEM 115, 230; or CHEM 110, 120, 231;  
4. CHEM 250, 251, 330, 340, 341, 420, 490 (1 unit)  
5. One-half unit Chemistry elective at the 300 or 400 level;  

**Requirements for Bachelor of Science Degree in Biochemistry**

1. PHYS 121, 122  
2. MATH 180, 181, 280  
3. CHEM 115, 230; or CHEM 110, 120, 231;  
4. CHEM 250, 251, 340, 460, 461;  
5. BIO 111, 212, 213  
6. One of CHEM 330, 341 or 420  
7. One unit of a 300- or 400-level CHEM or BIOL elective (BIOL 361 may not be used to satisfy this requirement).

**Requirements for the Minor**

1. CHEM 115, 230; or CHEM 110, 120, 231;  
2. CHEM 250;  
3. Two units of Chemistry electives numbered 251 or above.

**Notes**

1. The student must earn a grade of C or higher in all courses for the major or minor.  
2. Students wishing to obtain an American Chemical Society certified degree should complete the BS requirements and include CHEM 460 as an elective.  
3. The Chemistry Department reserves the right to determine a time limit, on an individual basis, for the acceptability of courses into a major or minor program.  
4. Majors in Biochemistry are encouraged to participate in undergraduate research in the Chemistry or Biology Departments.  
5. Biochemistry majors may not earn additional majors in Chemistry or in Molecular and Cellular Biology.
6. BS Chemistry majors may not use CHEM 390 to fulfill the chemistry elective requirement.

Course Offerings

Unless otherwise specified, each course carries 1 unit of credit and is offered at least once each academic year. Please see “Frequency of Course Offerings” on page 10.

110/120 General Chemistry I, II 1 unit each A two-semester, introductory course designed to give a solid introduction to chemical principles. The first semester covers topics of atomic structure, stoichiometry, thermochemistry, atomic theory, bonding, intermolecular forces, phase changes, introduction to reactions, gases, and thermodynamics. Second semester topics include equilibria, kinetics, acids and bases, buffers, oxidation-reductions, electrochemistry, and aspects of inorganic chemistry, organic chemistry, and biochemistry. Both CHEM 110 and CHEM 120 satisfy the Natural Scientific Approaches core requirement. CHEM 110 offered Fall term only; CHEM 120 offered Spring term only.

115/230 Integrated Chemical Principles and Analytical Chemistry 1 unit each An accelerated track designed for well-prepared students, particularly those planning to major in the molecular sciences (chemistry, biochemistry, molecular and cellular biology). The first semester topics include nuclear chemistry, atomic structure, stoichiometry, bonding, intermolecular forces and phase changes, reactions, gases, inorganic chemistry, thermochemistry, thermodynamics, and kinetics. The second semester topics emphasize quantitative chemical analysis, advanced equilibria, acids and bases, buffers, electrochemistry, and separation techniques. Prerequisite: Successful completion of a rigorous high school chemistry program (in the junior or senior year). Both CHEM 115 and CHEM 230 satisfy the Natural Scientific Approaches core requirement. CHEM 115 offered fall term only; CHEM 230 offered spring term only.

231 Analytical Methods 0.5 unit This course is designed for students who have previously taken a one-year course in introductory chemistry (CHEM 110/120 or equivalent) but who have not had a detailed introduction to quantitative chemical analysis. Topics include the statistical treatment of data, the use of standards, advanced equilibria, and separation techniques. This course is exempt from tuition overload. Credit for CHEM 231 will not be granted to students who have completed CHEM 230. Prerequisite: CHEM 120 or equivalent. Offered Spring term only.

250/251 Organic Chemistry I, II 1 unit each These courses cover the basic chemistry of carbon-containing molecules. Modern principles of chemical bonding are used to develop an understanding of the structure of organic molecules and the reactivity of organic compounds. Thus, the course is organized along the lines of reaction mechanisms rather than by functional groups. The laboratory portion of the course introduces the student to the various techniques involved in the isolation, identification, and synthesis of organic compounds. The laboratory parallels the course lectures so that there is a practical application of theoretical principles. Extensive use is made of chromatographic and spectroscopic techniques. Prerequisite: CHEM 120 or 230 or equivalent. Each course satisfies the Natural Scientific Approaches core requirements. CHEM 250 offered Fall term only; CHEM 251 offered Spring term only.

320 Chemistry of the Elements This course focuses on the elements and their organization into the periodic table. Students examine the origin of the elements, the periodic and group relationships, and the role of the elements and their compounds in medicine, materials, and society. Much of the course material is directly drawn from the scientific literature. Prerequisite: CHEM 251. Offered occasionally.

330 Instrumental Analysis Introduction to basic theory and applications of modern instrumental methods of analysis. Includes an introduction to electronics, x-ray, ultraviolet, visible, infrared, Raman, mass, and nuclear magnetic resonance spectrometry; atomic absorption and plasma emission; chromatography, thermal, and electrochemical methods. Prerequisite: CHEM 230 or 231, and PHYS 122. CHEM 251 is strongly recommended. Offered Fall term only.

333 Environmental Analytical Chemistry The course emphasizes the analytical process in making environmental chemistry measurements. An overview of methods used for the chemical analysis of air, soil, and water will be covered. Special attention will be given to sampling, quality assurance, spectroscopic measurements and chromatographic separations with mass spectral determination. This course will build on the analysis techniques presented in the prerequisite courses and apply them to the specific challenges when dealing with complex environmental systems. This course will have a laboratory component to give hands on experience to illustrate some of these analytical challenges. The lab meets during the regularly scheduled course periods. This class will have field trips to local and state laboratories and environmental facilities. Prerequisites: CHEM 230 or 231 and 250. Offered occasionally.

338 Biochemical Analysis: The Lipid Membrane This course introduces analytical techniques and instrumental methods that are commonly used to characterize biological systems. Techniques surveyed may include chromatography, mass spectrometry, X-ray diffraction, NMR, circular dichroism, fluorescence spectroscopy, and molecular dynamics simulations. The course focuses on applications of these methods to a specific system or research area, which may vary from year to year, e.g. lipid membrane, toxicology, proteomics, etc. This course does not require but is complimentary to CHEM 330 and CHEM 460. Prerequisite: CHEM 250 and CHEM 230 or 231 or permission of instructor. Offered occasionally.

340 Physical Chemistry I Chemical thermodynamics and its applications to macroscopic systems. Analysis of microscopic properties of atoms and molecules using kinetic molecular theory with emphasis on Maxwell-Boltzmann distribution functions. Prerequisite: CHEM 230 or 231, MATH 181, PHYS 121. MATH 280 is strongly recommended. Offered Fall term only.

341 Physical Chemistry II Introduction to quantum mechanics with applications to molecular spectroscopy. Statistical thermodynamics linking microscopic and macroscopic chemical behavior. Laboratory experiments emphasize fundamental instrumentation and theory associated with physical chemistry. Prerequisite: CHEM 230 or 231, MATH 280. Offered Spring term only.

345 Chemistry and Physics of Atmospheres The main work of the course is to understand the Earth’s atmosphere from the perspective of physical chemistry. Tools include the use of thermodynamics to understand global atmospheric circulation, and quantum mechanics to interpret the spectra of atmospheric gases and aerosols. Applications include the interpretation of remote sensing data, with a focus on selected topics in the Earth climate system, including anthropogenic influences. The course concludes with a brief survey of other planetary atmospheres and atmospheric evolution. Prerequisite: CHEM 230 or 231, MATH 181. CHEM 340 is strongly recommended. Offered occasionally.

347 The Devil’s Playground: The Chemistry of Surfaces Surfaces play an important role in our lives. Enzymatic reactions at biological interfaces, heterogeneous catalysis, transport of contaminants in soils, and atmospheric aerosol chemistry are all controlled by interactions at
surfaces. This course explores the physical and chemical phenomena that occur between the three states of matter-solid, liquid, and gas. Particular emphasis is placed on interactions with solid surfaces. Topics include, but are not limited to, reactions on surfaces, kinetics of surface reactions, binding of molecules to surfaces, and techniques of surface analysis. The importance of surface phenomena to environmental and catalytic chemistry is discussed. Prerequisite: CHEM 251; recommended co-requisite of CHEM 340. Offered occasionally.

356 Organic Synthesis This course explores methods and strategies that are used in the analysis and synthesis of moderately complex organic molecules. The first part of the course focuses on the use of advanced spectroscopic techniques (with a particular emphasis on 2D NMR techniques) in structure determination. The second part of the course focuses on the use of modern synthetic methods in organic synthesis, with emphasis on the formation of carbon-carbon bonds and the control of stereochemistry. These methods are applied to the synthesis of natural products through application of retrosynthetic analysis. Prerequisite: CHEM 251. Offered occasionally.

357 Organometallic Chemistry This course focuses on the fundamental reactivity of organotransition metal complexes. Topics include oxidative addition, reductive elimination, and the unique behavior of compounds possessing metal-carbon bonds. Applications of organometallic chemistry to industrial catalysis and organic synthesis are also discussed. Prerequisite: CHEM 251. Offered occasionally.

363 Materials Chemistry This course emphasizes the synthesis, characterization, and properties of organic materials. In particular, the focus is on the impact of structural changes upon macroscopic properties (mechanical strength, optical behavior, etc.). The first part of the course focuses on polymer science and draws heavily on students’ knowledge of synthetic and mechanistic organic chemistry. The second part of the course emphasizes liquid crystals and other related materials. Specific applications of materials to areas such as microolithography (patterning of computer chips), liquid crystal displays, and drug delivery are discussed, with many examples coming from the primary literature. Prerequisite: CHEM 251. Offered occasionally.

371 The Chemistry of Food This course explores the science of food and cooking. Topics include flavor, physical properties, nutrition, cooking methods, and reactions. In-class demonstrations and hands-on experiments allow for a tactile and sensory experience. Modern issues in food are discussed, including organic farms, GMO food, and the science behind recent dietary fads. Optional field trips occur throughout the semester. Prerequisite: CHEM 230/231 and CHEM 251. Offered occasionally.

377 Biomolecular Interactions The course emphasizes intermolecular interactions of biological macromolecules such as proteins with other molecules. The first part of the course addresses fundamental chemical concepts underlying these types of noncovalent interactions, description of various protein complexes, and a hands-on application of molecular docking protocols to calculate structures of complexes using data from the biochemical literature. The second part of the course focuses on student independent projects utilizing protein structures and data from the literature. Molecular docking is used as a tool to test predictions about the wider biological implications of altering biomolecular interactions. Prerequisite: CHEM 251 and 460 preferred, or permission of instructor. Offered occasionally.

390 Directed Research Credit, variable up to 1 unit Theoretical or experimental research done in an area of chemistry, with guidance from a mentor in the Chemistry department. Prerequisite: a research contract must be completed prior to registration.

420 Advanced Inorganic Chemistry This course presents both theoretical and descriptive concepts related to inorganic chemical compounds including periodic relationships, structure and bonding, molecular symmetry, acid base chemistry, electrochemistry, and inorganic reaction mechanisms. Laboratory experiments illustrate common synthetic and characterization processes for inorganic compounds. These concepts and techniques are brought together through the topics of coordination chemistry, organometallic chemistry, bioinorganic chemistry, and solid state chemistry. Prerequisite: MATH 181, CHEM 230 or 231, CHEM 340, PHYS 122. Offered Spring term only.

455 Computational Organic Chemistry This course explores computational approaches that have provided information about these processes. Particular emphasis is placed on interactions with solid surfaces. Topics that are used in the analysis and synthesis of moderately complex organic molecules. The first part of the course focuses on the use of advanced spectroscopic techniques (with a particular emphasis on 2D NMR techniques) in structure determination. The second part of the course focuses on the use of modern synthetic methods in organic synthesis, with emphasis on the formation of carbon-carbon bonds and the control of stereochemistry. These methods are applied to the synthesis of natural products through application of retrosynthetic analysis. Prerequisite: CHEM 251. Offered occasionally.

460 Physical Biochemistry This course explores the chemistry of various metabolic processes including glycolysis, citric acid cycle, oxidative phosphorylation, electron transport, fatty acid and amino acid synthesis and degradation, DNA synthesis, RNA synthesis and processing, and protein synthesis and processing. Particular attention is paid to the experimental approaches that have provided information about these processes. Prerequisite: CHEM 460. Offered Spring term only. Credit for CHEM 461 will not be granted to students who have completed BIOL 361.

490 Senior Research Thesis 0.5 or 1 unit Theoretical and/or experimental research done in an area of chemistry over two semesters (~150 research hours). The topic depends upon the student’s interest; however, it should be compatible with a faculty member’s area of expertise. Students must write and orally defend a thesis. In special cases, a student may register for 0.5 unit for each of two semesters.

493 Seminar No credit This course offers the student the opportunity to hear guest speakers discuss a variety of subjects within the general discipline of chemistry.

495 Independent Study Credit, variable Course offered to individual students and designed to meet their needs. The student may contact an instructor to arrange a program of study. Registration is confirmed by a written contract between the student and the instructor.