

# BIOCHEMISTRY, CHEMISTRY, MATHEMATICS, AND PHYSICS

The Biochemistry, Chemistry, Mathematics, and Physics Department serves students majoring or minoring in biochemistry, chemistry, and mathematics and it also provides supporting coursework to students majoring in a variety of other majors. The department also offers graduate coursework in chemistry.

A classic definition of chemistry is "the branch of science concerned with the properties and transformations of matter." Chemistry is sometimes called the "central science" because of its importance in other fields such as materials, biology, agriculture, medicine, geology, nutrition, law enforcement and engineering. Without knowledge of chemistry, humans could not develop advanced technology, grow enough food, combat disease, drink clean water, make clothing, create artwork, or clean up the environment. Understanding chemistry helps humans appreciate the beauty and complexity of the natural world.

Mathematics courses in the department provide students with a strong foundation in using mathematics as a tool to solve complex, real-world problems. Whether a student wants to pursue graduate study, teach math, or apply mathematics in a quantitative STEM field, the study of mathematics adds up to an intellectual experience, which, from the abacus to the rocket, has been essential to civilization. A degree in mathematics from CSS develops a strong analytical ability, exposes students to the power of mathematics as a lens for viewing reality, and empowers students to continue their education after they graduate.

Physics is the study of patterns and rules in the ways that objects and energy interact. Humanity has figured out how to extend and modify these rules across an enormous range of scales: from everyday objects down to atoms and all the way up to groups of galaxies and the universe itself. While there is no physics major at CSS, physics courses provide foundational knowledge to students across a number of undergraduate programs including biochemistry, chemistry, biology, exercise physiology, and elementary education.

## Programs

- Chemistry, B.A. (<http://catalog.css.edu/programs-az/arts-sciences/biochemistry-chemistry-math-physics/chemistry-ba/>)
- Mathematics, B.A. (<http://catalog.css.edu/programs-az/arts-sciences/biochemistry-chemistry-math-physics/mathematics-ba/>)
- Biochemistry, B.S. (<http://catalog.css.edu/programs-az/arts-sciences/biochemistry-chemistry-math-physics/biochemistry-bs/>)
- Chemistry, B.S. (<http://catalog.css.edu/programs-az/arts-sciences/biochemistry-chemistry-math-physics/chemistry-bs/>)
- Chemistry, M.S. (<http://catalog.css.edu/programs-az/arts-sciences/biochemistry-chemistry-math-physics/chemistry-ms/>)
- Chemistry Minor (<http://catalog.css.edu/programs-az/arts-sciences/biochemistry-chemistry-math-physics/chemistry-minor/>)
- Mathematics Minor (<http://catalog.css.edu/programs-az/arts-sciences/biochemistry-chemistry-math-physics/mathematics-minor/>)
- Graduate Chemistry Certificate (<http://catalog.css.edu/programs-az/arts-sciences/biochemistry-chemistry-math-physics/graduate-chemistry-certificate/>)

## Secondary Education

A B.A. in Chemistry with Middle and Secondary Education (<http://catalog.css.edu/programs-az/stender-business-leadership-professional-studies/education/middle-secondary-education/chemistry-ba-middle-secondary-education/>) is also available.

A B.A. in Mathematics with Middle and Secondary Education (<http://catalog.css.edu/programs-az/stender-business-leadership-professional-studies/education/middle-secondary-education/mathematics-ba-secondary-education/>) is also available.

## Contact Information

[chemistry@css.edu](mailto:chemistry@css.edu)

## Accreditation

The Bachelor of Science (B.S.) in Chemistry at The College of St. Scholastica is accredited by the American Chemical Society (ACS), [www.acs.org](http://www.acs.org) (<https://www.acs.org/>).

The Bachelor of Science (B.S.) in Biochemistry at The College of St. Scholastica is accredited by the American Society for Biochemistry and Molecular Biology (ASBMB), [www.asbmb.org](http://www.asbmb.org) (<https://www.asbmb.org/>).

## Biochemistry and Chemistry Program Policies

### Admission

Students majoring or minoring in chemistry or majoring in biochemistry must have an overall 2.0 grade point average and a minimum of grade of C- in all required courses. A minimum grade of C- is required in all courses in the minor.

### Retention

Students must earn a minimum of C- in all courses required for the major and remain in good academic standing with the college to maintain status as a chemistry or biochemistry major. Beyond the minimum grade performance, students are expected to be involved in the community life of the department through attendance at its seminars, involvement in chemistry volunteer and outreach activities, participation in social functions, cooperation with program assessment activities, and if qualified, by serving as a teaching or research assistant.

## Chemistry Courses

**CHM 1010 - Chemistry and Sustainability (Conceptions : VCNS - Natural Science) - 0,4 cr.**

Introduces basic concepts of chemistry and their relationship or application to sustainability and social issues.

**CHM 1011 - The Chemistry of Food (Conceptions : VCNS - Natural Science) - 4 cr.**

Provides an opportunity to explore and understand the complex chemical components and reactions involved in growing, processing, consuming and digesting food. Students will read research articles involving food chemistry, watch current videos and presentations on food science and conduct their own research on food-related chemical reactions. Class discussions will involve student presentations, summaries and thoughtful interactions regarding course materials. The culminating project will involve crafting a research summary on a topic of choice and presenting it to the class.

**CHM 1040 - General, Organic, and Biochemistry for Health Sciences (Conceptions : VCNS - Natural Science) - 0,4 cr.**

Introduces concepts of general, organic, and biochemistry in an integrated rather than a sequential order. Topics include the structure and function of atoms, ions and compounds, the periodic table, organic functional groups, biological macromolecules, and an introduction to metabolism. This course is required for Nursing majors and can be applied to the Exercise Physiology major.

**CHM 1110 - General Chemistry I (Conceptions : VCNS - Natural Science) - 0,4 cr.**

Introduces atomic and molecular structure, bonding, stoichiometry, gas laws, chemical periodicity, and chemical reactions.

**Prerequisite Courses:** high school chemistry

**CHM 1120 - General Chemistry II - 0,4 cr.**

Studies solutions, equilibria, coordination chemistry, thermodynamics, electrochemistry, kinetics, nuclear chemistry, and qualitative analysis.

**Prerequisite Courses:** CHM 1110

**CHM 1777 - Topics in Chemistry - 0-16 cr.**

Topics in Chemistry.

**CHM 2200 - Organic Chemistry I - 0,4 cr.**

Introduces structure, properties, and reactions of alkanes, alkenes, alkynes, alcohols, alkyl halides, and ethers.

**Prerequisite Courses:** CHM 1110, C- or higher in CHM 1120.

**CHM 2210 - Organic Chemistry II - 0,4 cr.**

Introduces the structure, properties, and reactions of aldehydes and ketones, carboxylic acids and their derivatives, aromatic compounds, amines, phenols, carbohydrates, amino acids as well as infrared and nuclear magnetic resonance spectroscopy techniques.

**Prerequisite Courses:** C- or higher in CHM 2200.

**CHM 2777 - Topics in Chemistry - 0-4 cr.**

Courses not part of the regular curriculum offered as need and interest arises.

**CHM 2999 - Independent Study - 1-4 cr.**

Topics in Chemistry.

**CHM 3000 - Analytical Chemistry - 0,4 cr.**

Analytical Chemistry is a branch of chemistry that aims to identify the components of a mixture (qualitative analysis) and/or determine the amount of one or more components (quantitative analysis). This course will explore the theory and practice of classical analytical methods and instrumentation with emphasis on solution equilibria, electrochemistry, spectroscopy, and chromatography and their relevance to modern chemical analysis. Application of computers and statistics to analytical problems will be a constant theme throughout the course.

**Prerequisite Courses:** CHM 1120

**CHM 3220 - Intermediate Organic Chemistry - 0,4 cr.**

Studies modern infrared, nuclear magnetic resonance, and mass spectroscopy; molecular orbital theory applied to bonding and pericyclic reactions; organic synthesis; and topic areas including medicinal, bio-organic, or polymer chemistry. (Offered fall semester in odd years: fall 2023, fall 2025, etc.)

**Prerequisite Courses:** C- or higher in CHM 2210 or equivalent.

**CHM 3240 - Biochemistry I - 4 cr.**

Studies the structure and role of proteins, lipids, carbohydrates, and nucleic acids in metabolism. Emphasizes protein structure and function, enzyme operation, metabolic pathways and their cellular role and regulation.

**Prerequisite Courses:** CHM 2210

**CHM 3430 - Biochemistry II - 2 cr.**

Reviews aspects of modern biochemistry as reflected in current research literature. Topics vary but aspects of protein structure, enzyme function and mechanism, signal transduction, metabolism concepts applied to nutrition and metabolic disorders, gene function and regulation are typically presented.

**Prerequisite Courses:** C- or higher in CHM 3240.

**CHM 3431 - Biochemistry II Lab - 2 cr.**

Applies techniques including UV-Vis and fluorescence spectroscopy, protein purification, chromatographic separations, electrophoresis, enzyme kinetics, immunoassays, and antioxidant assays.

**Prerequisite Courses:** CHM 3430

**CHM 3460 - Physical Chemistry I - 4 cr.**

Introduces thermodynamics, statistical mechanics, kinetics, and phase equilibria.

**Prerequisite Courses:** PSC 2011 and MTH 2222

**CHM 3470 - Physical Chemistry II - 0,4 cr.**

Covers postulates of quantum mechanics, particle in a box, harmonic oscillator, rigid rotor, and hydrogen atom with application to electronic structure of atoms and molecules and to atomic and molecular spectroscopy. (Offered spring semester in even years: spring 2024, spring 2026, etc.).

**Prerequisite Courses:** A grade of C- or higher in CHM 3460.

**CHM 3510 - Polymer Chemistry - 2 cr.**

A study of the major aspects of polymer chemistry including the history, synthesis, structure, characterization, and properties of synthetic polymers and other macromolecules.

**Prerequisite Courses:** CHM 2210

**CHM 3777 - Topics in Chemistry - 0-4 cr.**

Courses not part of the regular curriculum offered as need and interest arises.

**CHM 3999 - Independent Study - 0-4 cr.**

Independent Study.

**CHM 4000 - Senior Assessment - 0 cr.**

Assesses Chemistry and Biochemistry majors' knowledge and understanding of major-related topics in a standardized exam during their senior year as part of the Department's assessment program.

**CHM 4010 - Teaching Assistant Training - 0,1 cr.**

Prepares teaching assistants in areas of classroom management, departmental policies, safety procedures, handling of hazardous materials and waste disposal. One day-long workshop and several follow up sessions for a total of 12-13 hours.

**Prerequisite Courses:** junior standing and permission of instructor, and employed status as chemistry TA.

**CHM 4020 - Inorganic Chemistry - 0,4 cr.**

Considers acid-base concepts, bonding, ligand field theory, molecular orbital and symmetry principles, reactions, energetics, coordination compounds, organometallic and bioinorganic chemistry. Laboratory focuses on synthesis and reactions of a broad range of inorganic and organometallic compounds. (Offered fall semester in even years: fall 2022, fall 2024, etc.).

**Prerequisite Courses:** CHM 2200 and CHM 3000, C- or higher in CHM 1120.

**CHM 4060 - Undergraduate Research - 1-4 cr.**

Introduces students to original laboratory research in collaboration with a faculty member; requires literature searching, experimental planning, a minimum of 8 hours laboratory work a week, a final written report and an oral presentation of the work.

**Prerequisite Courses:** junior standing, application according to departmental policy and permission of the instructor.

**CHM 4120 - Instrumental Analysis - 0,4 cr.**

Studies instrumentation for chemical analysis and method selection.

Topics covered include ultraviolet-visible spectroscopy, atomic absorption and emission, polarography and voltammetry, thermal analysis, and chromatography. (Offered spring semester in odd years: spring 2023, spring 2025, etc.).

**Prerequisite Courses:** C- or higher in CHM 3000.

**CHM 4330 - Environmental Chemistry - 2 cr.**

Introduces the chemical interactions among earth, air, water, and living environments, with some emphasis on ecological damage, toxicology, ecosystem interdependence and repair of environmental damage.

**Prerequisite Courses:** C- or higher in CHM 1120; CHM 2210 and 3000 suggested.

**CHM 4777 - Topics in Chemistry - 0-4 cr.**

Topics.

**CHM 4999 - Independent Study - 0-4 cr.**

Specialized or personalized instruction under the guidance of a faculty member. Requires a written plan of the work to be undertaken and consent of instructor and department chair.

**CHM 6001 - Bonding and Materials - 3 cr.**

An in-depth survey of different bonding models, including molecular orbital theory, band theory, and non-covalent interactions. The course will then focus on how those theories apply to advanced materials such as porous solids, photovoltaics, and nanoparticles.

**CHM 6002 - Topics in Thermodynamics - 3 cr.**

An array of thermodynamic concepts will be implemented to solve current challenges in research, environmental chemistry, and industry. Examine the mathematical framework, theory and applications. Construct solutions of relevant thermodynamic questions such as energy efficiency and environmental stewardship.

**CHM 6003 - Advanced Spectroscopy - 3 cr.**

Survey of analytical spectroscopy including fundamental physical principles, signal generation, data acquisition, and interpretation. The course will progress through the measurement of electronic transitions (atomic and molecular), vibrational molecular transitions, molecular scattering, mass (atomic and molecular), and molecular nuclear magnetic resonance.

**CHM 6004 - Chemical Information and Communication - 3 cr.**

Designed to prepare graduate chemistry students to communicate proficiently. The focus is on strategies for reading critically, organizing and summarizing scientific ideas, drawing chemical structures, and communicating to diverse audiences about the field of chemistry. Ethics related to scientific communication will be discussed. Projects may include writing abstracts, literature reviews, grant proposal outlines, eposters, and oral presentations.

**CHM 6005 - Topics in Kinetics - 3 cr.**

Acquire a molecular understanding of the fundamental theories underlying chemical reaction as well its implementation. The fundamentals of reaction rates, collision theory, activated complex and transport properties will be applied to a current kinetic problem. In addition, the kinetics framework will be compared to several practical cases and discussed.

**CHM 6101 - Medical Biochemistry - 3 cr.**

Biochemically distinguish protein structure and function in relation to selected human diseases. Describe the biochemical consequences underlying disease such as sickle cell anemia, diabetes, Alzheimer's and cancer. Recognize that biochemistry integrates knowledge of the chemical processes in living cells with strategies to understand disease and identify potential therapies.

**CHM 6102 - Bioanalytical Chemistry - 3 cr.**

The goal of the course is to deepen student knowledge in the field of bioanalytical chemistry through the identification of complex bioanalytical challenges facing modern scientists and proposal of novel methodologies to solve them. To accomplish this goal, the course will explore the history of bioanalytical measurements, current bioanalytical assays, and emerging bioanalytical techniques and methodologies. Students will develop the skills to: i) critically evaluate the primary literature to identify current bioanalytical challenges, ii) think creatively to propose novel methods or techniques to overcome a challenge in their chosen sub-field (e.g. genomics, proteomics, metabolomics, lipidomics, bioinformatics, or single-cell analysis), and iii) clearly and persuasively communicate their ideas to the scientific community in written and oral formats.

**CHM 6103 - Chemical Education - 3 cr.**

Provides students with the background and knowledge to apply the most current teaching theories and tactics in the chemistry classroom. Students will gain experience and confidence in utilizing multiple educational approaches to teach chemistry. Best practices for teaching will be explored and discussed, including an emphasis on inclusive and adaptive strategies for every classroom. Students will leave with practical and applicable resources, instructional methods, and hands-on approaches to sharing their knowledge of chemistry with others.

**CHM 6104 - Energy and Environment - 3 cr.**

Tackle global and societal challenges of providing the world's energy needs while minimizing environmental damage. The scope is intentionally broad and recognizes the complexity of issues and competing challenges relating to renewable energy production and storage, emerging technologies, and land use.

**CHM 6105 - Introduction to Computational Chemistry - 3 cr.**

Several of the essential computational chemistry techniques will be discussed. The theoretical basis of Molecular Dynamics and Monte Carlo simulations will be analyzed and applied to real-world applications such as pharmaceuticals, materials science, phase equilibria and nano-technology. Connections between theory, computer simulations, experiments will be highlighted with hands-on activities.

**CHM 6107 - Advanced Instrumental - 3 cr.**

A survey of the theory, scope, and limitations of the most commonly applied instrumental techniques of chemical analysis. Topics may include spectroscopy, chromatography, mass spectrometry, and electrochemistry, viewed through a lens of practical instrument use. Emphasis between these methods and factors such as noise, resolution, sensitivity, error and economic considerations will be a common theme.

**CHM 6110 - Pharmaceutical Chemistry - 3 cr.**

Discover the important role that chemists contribute to the research and development of pharmaceuticals. Students will investigate drug discovery by integrating knowledge from organic, analytical and medicinal chemistry.

**CHM 6111 - Chemistry of the Elements - 3 cr.**

An in-depth look at the elements that make up our universe, including their nucleosynthesis, classification, periodic trends, isolation, and chemical reactivity.

**CHM 6112 - Advanced Organic Chemistry - 3 cr.**

A survey of common flavorant organic compounds: natural and/or synthetic, from an advanced organic chemistry perspective. An exploration of the nature of functional group(s) present, structure-activity relationship, biosynthesis, total synthesis and spectroscopic characterization for each of the flavorant molecules. Discussion of a brief history of the flavorant and current or potential uses. Overall, the goal is to integrate elements of advanced synthetic organic chemistry along with a general understanding of the flavorant compounds discussed in historical and contemporary societal contexts.

**CHM 6113 - Organometallic Reactions and Structures - 3 cr.**

An overview of organometallic structure and mechanisms with an emphasis on organo-transition metal chemistry. The course will address structure and bonding of different ligand types and in different geometries. Elementary reactions will be used to build models of catalytic cycles for new reactions based on precedent.

**CHM 6777 - Topics in Chemistry - 0-3 cr.**

Topics in Chemistry.

## Mathematics Courses

**MTH 1101 - Mathematics for Elementary Education Majors I (Foundations : VFMA - Mathematics) - 3 cr.**

Examines the concepts and diverse modalities by which students learn patterns and functions, problem-solving, probability, sets, number sense, computational procedures, relationships of integers, properties of real numbers, and number theory. Understanding of multiple problem-solving methods for the concepts covered and understanding the mathematical properties and processes involved is the primary focus of the course.

**MTH 1102 - Mathematics for Elementary Education Majors II (Foundations : VFMA - Mathematics) - 3 cr.**

Examines the concepts and diverse modalities by which students learn properties and relationships of 2D and 3D geometric figures, measurement, usage of geometric learning tools, data investigations, randomness and uncertainty, and algebraic representation. Understanding of multiple problem-solving methods for the concepts covered and understanding the mathematical properties and processes involved are key focuses of the course.

**MTH 1110 - Mathematics in Society and Nature (Foundations : VFMA - Mathematics) - 4 cr.**

Covers mathematical topics of use and/or interest to students who do not need a technical course in algebra to succeed in sciences or pre-calculus. Topics cover a broad range, such as the interpretation of graphical information, growth models, a basic introduction to data, probability and statistics, game theory, voting theory, number systems, geometry and fractals, and mathematics in nature.

**Prerequisite Courses:** three years of high school math or instructor's permission.

**MTH 1111 - College Algebra (Foundations : VFMA - Mathematics) - 4 cr.**

Topics include a brief review of elementary algebra, introduction to polynomial, exponential, logarithmic and trigonometric functions using both symbolic and graphic approaches. Emphasis is on applications in a variety of disciplines and solutions of real-world problems. Students planning to continue mathematics receive appropriate preparation.

**Prerequisite Courses:** three years of high school math or instructor's permission.

**MTH 1122 - Precalculus (Foundations : VFMA - Mathematics) - 4 cr.**

Precalculus mathematics, further properties of polynomial and rational functions, exponential and logarithmic functions, trigonometric functions and their graphs, trigonometric identities and equations, inverse trigonometric functions, introduction to analytic geometry. Formal mathematical language designed to help students succeed in college calculus courses.

**Prerequisite Courses:** MTH 1111 or Math ACT above 24.

**MTH 2221 - Calculus I (Foundations : VFMA - Mathematics) - 4 cr.**

Limits, continuity and fundamental theory of differentiation, symbolic and numerical calculations of derivatives, applications of derivatives; definite integrals and Riemann sums.

**Prerequisite Courses:** MTH 1122, Precalculus or ACT Math score of at least 29.

**MTH 2222 - Calculus II (Foundations : VFMA - Mathematics) - 4 cr.**

Study of numerical integration, applications of definite integrals, improper integrals, sequences and infinite series, basic ideas and methods for solving differential equations.

**Prerequisite Courses:** MTH 2221

**MTH 2401 - Discrete Mathematics I (Foundations : VFMA - Mathematics) - 4 cr.**

Elementary graph theory including matrix representation; coding and sorting applications; combinations and permutations; voting and apportionment; introduction to logic; elementary algorithm analysis and design; mathematical induction.

**Prerequisite Courses:** MTH 1111, Java Programming language or instructor's permission.

**MTH 2442 - Introduction to Data Analysis and Applied Statistics (Foundations : VFMA - Mathematics) - 4 cr.**

Covers the fundamentals of data analysis and applied statistics with particular emphasis on the reasoning behind techniques and the entirety of a data focused investigative process. Students will have the opportunity to work with real data, use a statistical programming language, and perform entire analyses on data from asking initial questions to communicating final conclusions. Common statistical topics include inference with resampling methods, inference with probability distributions, and simple linear regression.

**MTH 2777 - Topics in Math - 2-4 cr.**

Topics.

**MTH 3302 - Contemporary Geometry - 4 cr.**

Foundations of Euclidean geometry, solid geometry; introductions to non-Euclidean geometry; spherical geometry. Course includes dynamic geometry investigations using appropriate software.

**Prerequisite Courses:** MTH 2401

**MTH 3321 - Multivariable Calculus - 4 cr.**

Topics include functions of several variables, gradients, partial derivatives and multiple integrals, vector fields, Green's and Stoke's theorems, and applications.

**Prerequisite Courses:** MTH 2222

**MTH 3322 - Linear Algebra - 4 cr.**

Further study of systems of linear equations, matrices and determinants, vector spaces and subspaces, linear transformations, eigenvalues and eigenvectors, diagonalization.

**Prerequisite Courses:** MTH 2222

**MTH 3323 - Differential Equations - 4 cr.**

Introduction to the theory of differential equations, varied methods to solve linear, nonlinear equations, quantitative analysis of solutions of equations.

**Prerequisite Courses:** MTH 2222 and MTH 3321

**MTH 4332 - Abstract Algebra I - 4 cr.**

Introduction to groups, ring and field theory; group homomorphism and isomorphism, Cayley's theorem, and quotient groups, Lagrange's theorem; rings, ideals, ring homomorphism and basic properties of fields.

**Prerequisite Courses:** MTH 3322

**MTH 4411 - Probability and Statistics I - 4 cr.**

A survey course in mathematical probability and statistics. It includes probability distributions and densities, mathematical expectations, functions of random variables, introduction to estimation theory and hypothesis testing and applications.

**Prerequisite Courses:** MTH 2222

**MTH 4421 - Principles of Analysis I - 4 cr.**

Introduction to real analysis. It includes completeness of the real number system, topology of the real line, sequences, convergence, limits, continuity, differentiability and the Riemann integral, the Fundamental Theorem of Calculus.

**Prerequisite Courses:** MTH 3321 and MTH 3322

**MTH 4501 - Senior Seminar I - 1 cr.**

The introduction to a math major's Senior Project. Students will work with their faculty mentor to generate project ideas, develop a project plan, and do background research on their topic.

**MTH 4502 - Senior Seminar II - 1 cr.**

The culmination of a math major's Senior Project. Students will finish their project paper and give a 30-minute presentation on their project at the end of the term.

**MTH 4555 - Math Internship - 1-8 cr.**

Internship in Mathematics.

**MTH 4777 - Topics in Math - 2-4 cr.**

Concentrated study of various subject areas.

**Prerequisite Courses:** permission of instructor.

**MTH 4999 - Independent Study - 1-4 cr.**

Research projects for upper-division students.

**Prerequisite Courses:** permission of instructor.

## Physics Courses

**PSC 1201 - Concepts of Physics (Conceptions : VCNS - Natural Science) - 4 cr.**

A discovery course in which student groups design experiments, collect and analyze data which will help them to understand the processes of science and the basic concepts and laws of Newtonian mechanics, properties of matter, electricity and magnetism and energy, and waves. Conceptual understanding is stressed; some simple algebra is used. Mainly for elementary and middle school teacher education students.

**PSC 1202 - Cosmic Systems - 4 cr.**

A study of the universe as a set of interacting, evolving systems: galaxies, stars, the solar system and the Earth with its rocks, oceans and atmosphere. Study includes investigations of the matter-energy cycles in these systems and the effects of natural and human interventions upon them. In-class investigations and discovery activities and field trips are part of this course. Mainly for elementary and middle school teacher education students.

**PSC 1209 - Overview of Astronomy - 1 cr.**

Covers a broad introduction to astronomy including a study of the Earth-Moon system, the solar system, stars, and galaxies. The course is focused on topics required in the State of Minnesota space science standards for K-6 teachers.

**PSC 1210 - Introduction to Physical Science - 2 cr.**

This course provides the basic content and concepts required for elementary and middle school teachers as outlined in the Minnesota Teacher Licensure standards. It will cover the major principles of Physical Science, including motion, waves, light, electricity, magnetism, properties of matter, chemical reactions, thermodynamics, and chemical kinetics. Tutorials and interactive activities, and discussion of concepts demonstrating basic principles of physical science will be presented to the student for analysis, thus allowing students to construct their own meaning of higher level concepts as presented in the text.

**PSC 1301 - Explorations in Astronomy (Conceptions : VCNS - Natural Science) - 4 cr.**

Explores a range of topics in astronomy including objects in our solar system, stars & stellar life cycles, galaxies, and cosmology. The course will present recent discoveries and observations, as well as discuss current issues in modern astronomy including cultural conflicts over how and where astronomy is practiced.

**PSC 1501 - A Short Course in Physics - 4 cr.**

Selected topics from introductory physics for students who wish or need an understanding of physical concepts for their professional or personal enrichment. Some hands-on activities. Topics include force and motion, energy, waves, momentum, fluid mechanics, heat, sound, light, electricity and magnetism. Problem solving at the level of elementary algebra.

**PSC 2001 - Physics I - 0,4 cr.**

Covers algebra-based general physics including Newtonian mechanics (motion, force, energy, momentum), harmonic motion, fluids, and thermodynamics. Students must have ease and familiarity with basic algebraic and trigonometric techniques. Includes one 2-hour laboratory per week.

**Prerequisite Courses:** A grade of C (2.0 on a 4.0 scale) or better in College Algebra (MTH 1111) or a C or better in a more advanced college math course or a math ACT score of 24 or higher or by permission of the instructor.

**PSC 2002 - Physics II - 0,4 cr.**

Continues the study of algebra-based general physics including content in electricity and magnetism, geometric optics, sound and light waves, and selected topics in modern physics. Includes one 2-hour laboratory per week.

**Prerequisite Courses:** A grade of C (2.0 on a 4.0 scale) or better in PSC 2001.

**PSC 2011 - General Physics I - 4 cr.**

This course and its continuation PSC 2012 serve as a two-semester introduction to classical and modern physics using calculus. Topics include principles of classical mechanics: descriptions of motion, force, torque, and rotational motion, energy, momentum, and their conservation: fluid mechanics, simple harmonic motion, wave motion, and sound.

**Prerequisite Courses:** Courses: Either completion of MTH 2221 or concurrent enrollment in MTH 2221.

**PSC 2012 - General Physics II - 4 cr.**

Introduces the principles of electricity and magnetism, geometric optics, sound and light waves, and selected topics in modern physics. This is the second course in a two-course calculus-based general physics sequence. The physical principles and applications involved in these studies tend to be more abstract than the laws of mechanics that were studied in the first course in the sequence. In this course, many of the principles studied involve forces whose effects cannot be seen directly. Some of the forces studied only affect minute, invisible particles. Students will study models of unseen events and particles using graphs, sketches, analogies, mathematics, and descriptions. They will study the effects of the laws of physics using abstract models. Includes a 2-hour laboratory per week.

**Prerequisite Courses:** A grade of C (2.0 on a 4.0 scale) or better in PSC 2011; either completion of MTH 2222 or concurrent enrollment in MTH 2222.

**PSC 2777 - Topics in Physical Science - 0-4 cr.**

Occasional or special-purpose courses in physics, electronics, history or cultural aspects of science, on a level appropriate to the freshman or sophomore student.

**PSC 3777 - Topics in Physical Science - 0-4 cr.**

Occasional or special-purpose courses in physics, electronics, history or cultural aspects of science, on a level appropriate to the junior or senior student.

**PSC 4777 - Advanced Topics in Physical Science - 1-4 cr.**

Occasional or special-purpose courses in physics, electronics, history or cultural aspects of science, on a level appropriate to the junior or senior student.

**PSC 4999 - Independent Study/Project in Physical Science - 0-4 cr.**

Students desiring to improve knowledge or expertise in one of above categories may select projects for study in depth under guidance of a department member.

**Prerequisite Courses:** approval of a supervising faculty member.