

CHEMISTRY AND PHYSICS

College of Arts and Sciences

CHEMISTRY AND PHYSICS

MAJORS

- Chemistry
- Unified Science Major in Chemistry
- Chemistry Education
- Physics
- Unified Science Major in Physics
- Physics Education
- Nanoscience Chemistry
- Nanoscience Physics

MINORS

- Chemistry
- Biochemistry
- Chemistry Education
- Physics
- Physics Education
- Middle School Science

PRE-PROFESSIONAL PROGRAM

- Pre-Engineering

"Curiosity is one of the permanent and certain characteristics of a vigorous mind."
— Samuel Johnson, *The Rambler*, 1750

THE DEPARTMENT

If you've ever wondered why the world works as it does, you've experienced the sensation that drives most chemistry and physics majors to this field. In both abstract and concrete ways, students in this department are explorers into the mysteries of the universe.

The Department of Chemistry and Physics seeks to provide quality major programs that prepare graduates to compete in graduate school and to find industrial and/or teaching positions. Also, the department offers quality general education and service courses that assure an understanding of the basic scientific process and the relation between science and society. The general education science courses stress the scientific method and are designed to help students learn to use simple mathematical models to analyze complex problems.

DEGREE PROGRAMS

CHEMISTRY

Students majoring in Chemistry may work toward the Bachelor of Science degree, the Bachelor of Science degree (A.C.S. accredited), the Bachelor of Arts degree, or the Bachelor of Science in Education degree (Unified Science). The Bachelor of Science degree (A.C.S. accredited) is designed as a professional degree program for chemists and to prepare students for graduate work toward a master's or Ph.D. in chemistry. This program is fully accredited by the American Chemical Society. The Bachelor of Science or Bachelor of Arts degree program is for students who wish pre-professional training in medicine, veterinary medicine, dentistry or pharmacy. The Bachelor of Science in Education (Unified Science), Secondary Program is designed to prepare students for teaching chemistry in secondary schools and meets Missouri, Iowa and most other state certification requirements.

PHYSICAL SCIENCE

The main objectives of courses in the physical science program are: (a) to provide service courses to meet the special needs of other science majors, teacher education majors and other groups of students; (b) to provide general education courses in physical science to meet science area requirements in general education for all degree programs; and (c) to provide special programs for teacher certification in science.

PHYSICS

The main objectives of courses in the Physics programs are (a) to provide service courses to meet special needs of other science majors, pre-engineering students and teacher education students; (b) to provide general education courses in physics to meet science area requirements in general education for all degree programs; and (c) to provide physics-related training for professions in industry or teaching.

Two different kinds of Physics major programs are available for students depending upon the degree program they choose (Bachelor of Science in Education (Unified Science) or Bachelor of Science degree).

SCIENCE EDUCATION

The major objectives of the science education programs are (a) to provide courses related to the teaching of science to meet the special needs of prospective elementary and secondary school teachers; (b) to provide programs for special science teachers for elementary schools and for science teachers for middle schools and junior high schools; and (c) to provide a graduate program leading to the M.S.Ed. in Science Education for science teachers and science supervisors. (See Graduate Catalog for more details about Northwest's masters programs.)

PRE-PROFESSIONAL PROGRAMS

PRE-ENGINEERING PROGRAM

Students wishing to prepare for entrance to engineering schools should follow a pre-engineering program. The program for each student will be planned with an advisor to meet the requirements of the particular engineering program. Cooperative programs have been established between Northwest and the University of Missouri at both Columbia and Rolla.

MAJORS

CHEMISTRY

A.C.S. Accredited, B.S. – no minor required

Required Courses

General Chemistry I and Laboratory
 General Chemistry II and Laboratory
 Laboratory Safety
 Quantitative Analysis and Laboratory
 Organic Chemistry I and Laboratory
 Organic Chemistry II and Laboratory
 Instrumental Analysis and Laboratory
 Physical Chemistry I and Laboratory
 Physical Chemistry II and Laboratory
 Advanced Inorganic Chemistry
 Inorganic Synthesis Laboratory
 General Biochemistry
 Chemistry Seminar
 Chemistry electives from courses
 numbered above 400

Collateral Courses

General Statistics I
 Calculus II
 Multivariate Calculus
 Fund. of Classical Physics II and Lab
 Departmental approved courses from the
 areas of business, modern language,
 statistics or computer science

Directed General Education Courses

Calculus I
 Fund. of Classical Physics I and Lab
 Biological sciences: one course

B.S. – no minor required

Required Courses

General Chemistry I and Laboratory
 General Chemistry II and Laboratory
 Laboratory Safety
 Quantitative Analysis and Laboratory
 Organic Chemistry I and Laboratory
 Organic Chemistry II and Laboratory
 Physical Chemistry I and Laboratory
 Physical Chemistry II and Laboratory
 Advanced Inorganic Chemistry
 Chemistry Seminar

Collateral Courses

General Statistics I
 Calculus II
 Fund. of Classical Physics II and Lab
 Departmental approved electives chosen
 from physics, chemistry, mathematics,
 biology or computer science

Directed General Education Courses

Calculus I
 Fund. of Classical Physics I and Lab
 Biological sciences: one course

B.A. – minor required

Required Courses

General Chemistry I and Laboratory
 General Chemistry II and Laboratory
 Quantitative Analysis and Laboratory
 Organic Chemistry I and Laboratory
 Organic Chemistry II
 Chemistry Seminar
 Chemistry electives from courses
 numbered above 300

Directed General Education Courses

College Algebra
 General Physics I and Laboratory OR
 General Physics II and Laboratory
 Biological sciences: one course

UNIFIED SCIENCE MAJOR IN CHEMISTRY

B.S. Ed. – no minor required, Secondary Program, (Certifies grades 9-12, Endorsement Area: Chemistry)

Required Courses in Endorsement Area: Chemistry

General Chemistry I and Laboratory
 General Chemistry II and Laboratory
 Laboratory Safety
 Quantitative Analysis and Laboratory
 Organic Chemistry I and Laboratory
 Special Investigations in Chemistry
 Physical Chemistry II
 Chemistry Seminar
 Elementary Biochemistry and Laboratory
 OR General Biochemistry and
 Laboratory
 Chemistry Practicum

Required Collateral Courses for the Unified Science Major

History of Science and Technology
 General Botany and Laboratory
 Environmental Issues
 Fund. of Classical Physics I and Lab
 Fund. of Classical Physics II and Lab
 Historical Geology
 General Statistics I
 Calculus II

Directed General Education Courses

Calculus I
 General Zoology and Laboratory
 General Earth Science and Laboratory
Professional Education Requirements
 Methods in Secondary School Science

CHEMISTRY EDUCATION

*B.S. Ed., Secondary Program
(Certifies grades 9-12)*

Required Courses

General Chemistry I and Laboratory
General Chemistry II and Laboratory
Laboratory Safety
Quantitative Analysis and Laboratory
Organic Chemistry I and Laboratory
Chemistry Practicum
Special Investigations in Chemistry
Physical Chemistry II and Laboratory
General Biochemistry and Laboratory
Chemistry Seminar
Physical Chemistry I and Laboratory OR
Organic Chemistry II and Laboratory

Collateral Courses

General Statistics I
Calculus II
Fund. of Classical Physics I and Lab
Environmental Issues
History of Science and Technology

Directed General Education Courses

Calculus I
General Biology and Laboratory
General Earth Science and Laboratory

Professional Education Requirements

Methods in Secondary School Science

PHYSICS

B.S. – no minor required

Required Courses

Fund. of Classical Physics I and Lab
Fund. of Classical Physics II and Lab
Classical Mechanics I and Laboratory
Electricity and Magnetism I and
Laboratory
Electronics and Laboratory
Intro to Modern Physics and Laboratory
Modern Physics II
Computational Physics and Laboratory
Physics Undergraduate Research
OR Physics Practicum OR Special
Investigation in Physics OR Selected
Advanced Topics in Physics
Physics electives from courses
numbered above 300

Collateral Courses

Calculus II
Multivariate Calculus
Differential Equations
Computer Programming I OR Scientific
Programming

Directed General Education Courses

Calculus I
General Chemistry I and Laboratory
Biological science: one course from
general biology, botany or zoology

UNIFIED SCIENCE MAJOR IN PHYSICS

*B.S. Ed. – no minor required, Secondary
Program (Certifies grades 9-12,
Endorsement Area: Physics)*

Required Courses in Endorsement Area: Physics

Fund. of Classical Physics I and Lab
Fund. of Classical Physics II and Lab
Intro to Modern Physics and Laboratory
Physics Practicum
Modern Physics II
Electronics and Laboratory
Electricity and Magnetism I and
Laboratory OR Classical Mechanics
and Laboratory
Physics Electives (300-level and above)

Required Collateral Courses for the Unified Science Major

History of Science and Technology
General Botany and Laboratory
Environmental Issues
General Chemistry I and Laboratory
General Chemistry II and Laboratory
Historical Geology
Calculus II
Multivariate Calculus
Computer Programming I OR Scientific
Programming

Directed General Education Courses

Calculus I
General Zoology and Laboratory
General Earth Science and Laboratory

Professional Education Requirements

Methods in Secondary School Science

PHYSICS EDUCATION

*B.S. Ed. – minor required, Secondary
Program (Certifies grades 9-12)*

Fund. of Classical Physics I and Lab
Fund. of Classical Physics II and Lab
Classical Mechanics I and Laboratory
OR Electricity and Magnetism I and
Laboratory

Electronics and Laboratory
Intro to Modern Physics and Laboratory
Modern Physics II
Computational Physics and Laboratory
Physics Practicum

Collateral Courses

Environmental Issues
History of Science and Technology
Calculus II
Multivariate Calculus
General Chemistry I and Laboratory
Computer Programming I OR Scientific
Programming

Directed General Education Courses

Calculus I
General Biology and Laboratory
General Earth Science and Laboratory

Professional Education Requirements

Methods in Secondary School Science

NANOSCIENCE

B.S. – no minor required

This is an interdisciplinary major in conjunction with the Departments of Biological Sciences, Chemistry and Physics, and Mathematics and Statistics. Three emphasis areas are available for this major: Nanoscale Biology, Nanoscale Chemistry and Nanoscale Physics.

Required Core Courses

Microbiology
Cell Biology
Genetics
Molecular Biology
General Statistics I
Calculus II
General Chemistry I and Laboratory
General Chemistry II and Laboratory
Laboratory Safety
Organic Chemistry I and Laboratory
Biochemistry and Laboratory
Classical Physics II and Laboratory
Nanoscale Science I
Nanoscale Science II

Nanoscale Chemistry Emphasis**Required Courses**

Organic Chemistry II and Laboratory OR
Quantitative Analysis and Laboratory
Physical Chemistry I and Laboratory
Physical Chemistry II
Advanced Inorganic Chemistry and
Inorganic Synthesis Laboratory

Directed General Education Courses

General Botany and Laboratory
Calculus I
Classical Physics I and Laboratory
Introduction to Ethics

Nanoscale Physics Emphasis**Required Courses**

Computer Programming I
Introduction to Modern Physics I and
Laboratory
Modern Physics II
Electronics and Laboratory OR
Computational Physics and
Laboratory
Undergraduate Research

Directed General Education Courses

General Botany and Laboratory
Calculus I
Classical Physics I and Laboratory
Introduction to Ethics

MINORS**CHEMISTRY****Required Courses**

General Chemistry I and Laboratory
General Chemistry II and Laboratory
Quantitative Analysis and Laboratory
Organic Chemistry I and Laboratory
Chemistry elective courses above 300
level

Directed General Education Courses

College Algebra
General Physics I and Laboratory OR
General Physics II and Laboratory

BIOCHEMISTRY

Students majoring in chemistry are not permitted to select this minor.

Required Courses

General Chemistry I and Laboratory
General Chemistry II and Laboratory
Organic Chemistry I and Laboratory
Organic Chemistry II and Laboratory
General Biochemistry and Laboratory

Collateral Courses

Cell Biology OR Genetics

Directed General Education Courses

College Algebra
General Biology and Laboratory OR
General Botany and Laboratory OR
General Zoology and Laboratory OR
Plant Science

Note:

1. Students with a Cellular/Molecular Emphasis must take five hours of chemistry electives from 300-level or above courses, excluding Elementary Biochemistry and Lab.
2. Students with a comprehensive major in Pre-Professional Zoology must take three hours of chemistry electives from 300-level or above courses, excluding Elementary Biochemistry and Lab.

CHEMISTRY EDUCATION

(Certifies grades 9-12)

Required Courses

General Chemistry II and Laboratory
Laboratory Safety
Organic Chemistry I and Laboratory
Physical Chemistry II and Laboratory OR
Quantitative Analysis and Laboratory
Elementary Biochemistry and Laboratory
OR General Biochemistry and
Laboratory
Special Investigations in Chemistry
History of Science and Technology

Directed General Education Courses

General Statistics I
General Chemistry I and Laboratory

Professional Education Requirement

Methods in Secondary School Science

PHYSICS**Required Courses**

Fund. of Classical Physics I and Lab
Fund. of Classical Physics II and Lab
Calculus II
Physics electives from courses
numbered above 300

Directed General Education Course

Calculus I

PHYSICS EDUCATION

B.S. Ed. (Certifies grades 9-12)

Required Courses

Fund. of Classical Physics I and Lab
Fund. of Classical Physics II and Lab
Introduction to Modern Physics and Lab
Calculus II
History of Science and Technology
Physics electives from courses
numbered above 300

Directed General Education Course

Calculus I

Professional Education Requirement

Methods in Secondary School Science

MIDDLE SCHOOL SCIENCE

B.S. Ed., Major in Middle School (Certifies grades 5-9). Additional concentration area is required.

Required Courses

General Botany and Laboratory OR
 General Zoology and Laboratory
 General Earth Science and Laboratory
 Descriptive Astronomy and Laboratory
 The Physical Sciences and Laboratory OR
 General Chemistry and Laboratory OR
 General Physics and Laboratory OR
 General Physics II and Laboratory
 Laboratory Safety
 History of Science and Technology

Directed General Education Course

General Biology and Laboratory

Professional Education Requirement

Methods in Middle School Science

COURSE DESCRIPTIONS

CHEMISTRY

General Chemistry

Beginning course for those who have had no chemistry in high school. Must be taken concurrently with General Chemistry Laboratory. Serves as a refresher course for science majors and satisfies the general laboratory physical science requirement. Involves a study of elements, compounds and fundamental chemical laws.

General Chemistry Laboratory

Beginning laboratory course which must be taken concurrently with General Chemistry lecture.

General Chemistry I

Beginning course for science majors with a good high school background in chemistry. Must be taken concurrently with General Chemistry I Laboratory. This course covers fundamental chemical principles such as atoms, molecules, chemical reactions, stoichiometry, and gas laws as it progresses toward detailed study of quantum chemistry, periodic relationships, and molecular structure and properties.

General Chemistry I Laboratory

Laboratory course which must be taken concurrently with General Chemistry I.

General Chemistry II

A continuation of General Chemistry I. Must be taken concurrently with General Chemistry II Laboratory. This course involves a study of kinetics, principles of equilibrium and thermodynamics.

General Chemistry II Laboratory

Laboratory course which must be taken concurrently with General Chemistry II.

Laboratory Safety

A comprehensive introduction to the protocols and practices for working safely in a modern chemistry laboratory. The course seeks to facilitate students' knowledge of institutional, state and federal regulations and an awareness of safe practices for chemical handling and disposal, potential hazards, emergency response and personal protection.

Special Topics in Chemistry

In-depth study of special topics which may include environmental chemistry, atomic and molecular structure, kinetics, industrial chemistry, polymer chemistry, computer applications in the laboratory, surface chemistry and colloidal chemistry.

Organic Chemistry

An introductory course in general organic chemistry designed for students majoring in fields other than chemistry who desire a general course. The carbon compounds, together with their relations to the life processes, are covered in this course. Must be taken concurrently with Organic Chemistry Laboratory.

Organic Chemistry Laboratory

Laboratory course which must be taken concurrently with Organic Chemistry.

Quantitative Analysis

This course involves a study of the theory, methods and techniques for the quantitative separation and determination of the amounts of materials present in certain natural and manufactured products. Must be taken concurrently with Quantitative Analysis Laboratory.

Quantitative Analysis Laboratory

Laboratory course which must be taken concurrently with Quantitative Analysis.

An Introduction to Forensic Science

This course covers the basic techniques used to analyze forensic evidence. Basic concepts of chemistry, biology, and physics are used to understand how forensic science techniques function. The interdisciplinary nature of forensic science problems is emphasized.

Organic Chemistry I

This is a general course in organic chemistry for students majoring in chemistry. It must be taken concurrently with Organic Chemistry I Laboratory.

Organic Chemistry I Laboratory

Laboratory course in organic chemistry which must be taken concurrently with Organic Chemistry I.

Organic Chemistry II

This is a continuation of Organic Chemistry I.

Organic Chemistry II Laboratory

This course involves a study of the qualitative determination of functional groups and identification of compounds by gas chromatography, infrared spectroscopy and nuclear magnetic resonance.

Elementary Biochemistry

A non-rigorous treatment of selected aspects of biologically oriented chemistry. Emphasis will be on acquainting the student with many of the substances of which living organisms consist, with their interrelationships, and with some of the better known biochemical changes which they undergo. Must be taken concurrently with Elementary Biochemistry Laboratory.

Elementary Biochemistry Laboratory

This is a laboratory course to be taken concurrently with Elementary Biochemistry.

Forensic DNA Science

Covers the theory and techniques used to analyze DNA in forensic evidence. Basic concepts of chemistry and biology are used to understand how DNA analysis functions. Emphasis will be on collecting specimens, isolating and analyzing DNA, and statistical analysis to link the specimen to individual.

Chemistry Practicum

The practicum provides students with experience in teaching a chemistry laboratory. Students will assist faculty with the preparation and instruction of chemistry labs.

Chemistry Internship

Students with junior or senior standing with a major or minor in chemistry may enroll in an intern program (paid or unpaid) with a chemical or pharmaceutical company or for an academic research experience.

Macromolecular Structure

Covers modern methods that have defined the molecular basis for macromolecular interactions and their function in biochemistry. Emphasis focuses on the physical principles of macromolecular structure and interactions, and will describe modern methods.

Special Investigations in Chemistry

Special projects and experiments in chemistry which are not included in the regular coursework.

Fundamentals of Alternative Energy

Provides an overview of the field of alternative energy. The course starts with current world usage and supplies of conventional fuels. Emphasis is then placed on currently used alternative fuels and fuel conversion technologies, as well as the future of alternative energy.

Instrumental Analysis

A study of modern techniques and theories of analysis including an introduction to basic instrumental analysis. Must be taken concurrently with Instrumental Analysis Laboratory.

Instrumental Analysis Laboratory

Must be taken concurrently with Instrumental Analysis.

Fundamentals of Industrial Biotechnology

Covers the main aspects of industrial biotechnology including the production of bioplastics, biofuels, nutraceuticals, and pharmaceuticals.

Fundamentals of Industrial Biotechnology Laboratory

Hands-on experience with the use of industrial biotechnology to produce industrially-important chemicals including bioplastics, biofuels, nutraceuticals, and pharmaceuticals.

Physical Chemistry I

The study of atomic and molecular phenomena through the scrutiny and interpretation of the physical laws that govern the structure and behavior of matter as it exchanges energy within and between itself and its surroundings in the atomic and molecular domains. Topics include the foundation of quantum chemistry, atomic and molecular structure, spectroscopy, and computational chemistry. It is strongly suggested that Physical Chemistry I be taken prior to Physical Chemistry II.

Physical Chemistry I Laboratory

Laboratory course in physical chemistry that must be taken concurrently with Physical Chemistry I.

Physical Chemistry II

The study of thermodynamic systems and processes and the rates at which chemical reactions occur through the scrutiny and interpretation of the physical laws that govern the structure and behavior of matter as it exchanges energy within and between itself and its surroundings in the macroscopic domain. Topics include thermochemistry, thermodynamics, equilibrium, solutions, gases, chemical dynamics and chemical kinetics.

Physical Chemistry Laboratory II

Laboratory course in physical chemistry that must be taken concurrently with Physical Chemistry II.

Advanced Inorganic Chemistry

Modern aspects of inorganic chemistry, includes coordination chemistry, molecular orbital theory, group theory and catalysis, magnetic properties of elements and compounds.

Inorganic Synthesis Laboratory

An introduction to fundamental methods and techniques used in the synthesis and manipulation of inorganic compounds. These techniques will include the synthesis, methods of purification and characterization of inorganic compounds.

General Biochemistry

An introductory course in biochemistry which deals with selected topics in the field. The description and functions of amino acids, proteins, fats, nucleic acids and certain carbohydrates will be discussed. Enzymes and their role in metabolic processes will be emphasized.

General Biochemistry Laboratory

Experiments illustrating biochemical techniques and principles will be performed.

Special Topics

This is an in-depth study of special topics offered according to student need and interest. Topics include environmental chemistry, atomic and molecular structure, kinetics, industrial chemistry, polymer chemistry, computer applications in the laboratory, surface chemistry and colloidal chemistry.

Chemistry Seminar

Students will prepare written and oral reports on a literature search of a chemistry topic.

PHYSICAL SCIENCE**The Physical Sciences**

This is an introductory, general education course in the physical sciences for students with very little background in science. The topics covered are selected from the fields of chemistry and physics, and their relationships to other sciences, technology and society. Students who have had good science background in high school should not take this course.

Physical Science Laboratory

A laboratory course which must be taken concurrently with Physical Science.

Computational Methods in Science

Methods used in the computational analysis, interpretation, and presentation of data generated from scientific inquiry. Topics covered will encompass, but will not be limited to, spreadsheets, graphical, and statistical analysis of data, concept mapping, use of databases, scientific writing, and symbolic calculation techniques.

Descriptive Astronomy

This is an introductory general education course in astronomy. Topics covered involve the descriptive study of the physical universe including the earth-moon system, the solar system, general stellar system, stellar structure and evolution, galactic systems and cosmological models. The laboratory work emphasizes basic techniques and instruments used in observational astronomy.

Descriptive Astronomy Laboratory

A laboratory course which must be taken concurrently with Descriptive Astronomy.

Independent Study in the Physical Sciences

Independent study in areas of physical sciences not covered in the introductory courses.

Practicum in Physical Science

This practicum provides students with experience in assisting faculty members with instruction of physical science in classes and laboratories.

PHYSICS**General Physics I**

This is a laboratory course in general physics designed to provide the necessary background in physics to fill general education requirements and to fill general physics needs for pre-professional programs. Major topics covered are structure and properties of matter, motion, mechanics, work, energy, momentum, elasticity, waves, temperature and heat.

General Physics I Laboratory

This laboratory must be taken concurrently with General Physics I.

General Physics II

This is a continuation of General Physics I. Major topics covered are electricity, electronics, optics, radioactivity, and atomic and nuclear structure.

General Physics II Laboratory

This laboratory must be taken concurrently with General Physics II.

Fundamentals of Classical Physics I

An introduction to classical kinematics, mechanics gravitation, energy, momentum, waves, heat and thermodynamics. Recommended for majors in science, mathematics and engineering.

Fundamentals of Classical Physics I Laboratory

The laboratory must be taken concurrently with Fundamentals of Classical Physics I.

Science and Technology of Musical Sound

Course examines underlying physics concepts such as waves, vibration and resonance, as well as musical applications including voice, strings, pipes, percussion and computer applications.

Special Topics in Physics

An in-depth study of special physics topics.

Fundamentals of Classical Physics II

A continuation of Fundamentals of Classical Physics I. Major topics include classical electricity, magnetism, electromagnetic waves, light and geometrical and physical optics.

Fundamentals of Classical Physics II Laboratory

This laboratory must be taken concurrently with Fundamentals of Classical Physics II.

Classical Mechanics I

An introduction to classical mechanics. General topics include elements of Newtonian mechanics, motion of a particle in one dimension, motion of a particle in two and three dimensions, the motion of a system of particles, rigid bodies and gravitation.

Classical Mechanics I Laboratory

This computer laboratory is an introduction to computational methods as applied to solving differential and integral equations in mechanics.

Statics

Analysis of two- and three-dimensional force systems. Application of equilibrium principles to simple trusses, frames and machines. Additional topics chosen from distributed forces, centroids, friction and virtual work.

Electricity and Magnetism I

Classical electricity and magnetism including Coulomb's law, Gauss' law, Poisson's equation, charge-field potential differential and integral relationships, Biot-Savart law, Ampere's law, Lenz's law and vector properties of electric and magnetic fields.

Electricity and Magnetism I Laboratory

This laboratory must be taken concurrently with Electronics and Magnetism.

Electronics

A study of the theory and applications of analog and digital electronics. Topics include transistors, operational amplifiers, TTL and CMOS logic gates and applications of these devices in various electronic circuits.

Electronics Laboratory

This laboratory must be taken concurrently with Electronics.

Introduction to Modern Physics

An introduction to the subjects of photoelectricity, relativity, quantum theory, X-rays, radioactivity, nuclear physics and cosmic radiation.

Introduction to Modern Physics Laboratory

This laboratory must be taken concurrently with Introduction to Modern Physics.

Modern Physics II

A continuation of Introduction to Modern Physics. Major topics covered are statistical physics, molecular structure, solid state physics and astrophysics.

Quantum Mechanics

The philosophy and methods of selected topics from quantum mechanics. Topics include Schrodinger's equation, simple barrier problems, angular momentum, linear oscillator, hydrogen atom and elementary perturbation.

Optics

A study of modern optics, including reflection, refraction, interference, diffraction, polarization, lasers, holography, non-linear optics, optical detectors and modern applications.

Optics Laboratory

Laboratory must be taken concurrently with Optics.

Computational Physics

Introduction to computational methods used to solve problems in physics. Numerical techniques for the analysis of experimental data and the solution of ordinary and partial differential equations will be studied. These numerical methods will be applied to the solution of a variety of problems that arise in classical physics. Visualization and simulation techniques will be studied and the power of these methods to enhance physical understanding will be emphasized.

Computational Physics Laboratory

Laboratory must be taken concurrently with Computational Physics.

Undergraduate Research

An independent research project done under supervision of a faculty member. The results of the research project are to be summarized in a paper or presentation at the discretion of the faculty member.

Physics Practicum

This practicum provides physics majors with experience in using, repairing and building equipment as well as experience in assisting physics faculty in instruction in classes and laboratories. All physics majors are required to earn at least one semester hour credit in the practicum.

Special Investigations in Physics

Special projects and special experiments in physics which are not included in the regular courses.

Energy Conversions with Alternative Energy

Covers the physics behind the different ways that energy can be transformed from one form to another. Emphasis is placed on technologies used in the field of alternative energy. Co-firing biomass with coal is also discussed.

Selected Advanced Topics

Special investigation of experimental or theoretical areas which are not included in the regular courses. Often involves actual research projects.

NANOSCALE SCIENCE**Nanoscale Science I**

A course dedicated to the interface of chemistry and physics at the nanometer scale. Topics will focus on the relationship between nanoscale structure and macroscopic properties, nanoscale instrumentation and characterization, creation of materials and devices, and the role and perception of nanotechnology in society.

Nanoscale Science II

A course dedicated to the interface of biology and physics at the nanometer scale. Topics will focus on the application of physical concepts to biological systems in the developing field of nanobiotechnology.

SCIENCE EDUCATION**Methods in Elementary School Science**

This course is designed to acquaint the prospective teacher with science subject matter and science curricular materials used in modern elementary school science programs. The course provides classroom experiences in the use of scientific equipment and material available in many elementary school science programs. Individualized and small group activities are provided to give experience in using a variety of methods in teaching science.

History of Science and Technology

This course will develop a conceptual framework for scientific and technological literacy. The goals of the course will relate to the acquisition of knowledge, the development of learning skills and the development of values and ideas. Characteristics of science, technology and society instruction will be stressed.

Methods in Secondary School Science

This course is designed to acquaint prospective science teachers with the methods and materials needed in teaching science at the secondary level. The course provides individualized experiences related to the teaching of the subject fields each student has elected for his or her major or minor area.

Methods in Middle School Science

A course to assist prospective middle school science teachers with the methods and materials needed in teaching science at the middle school level.

CAREER OPPORTUNITIES

CHEMISTRY

Chemistry majors have a wide variety of options awaiting them after graduation. Many students choose to continue their studies in graduate school or professional schools such as medical or dental school. A number of Northwest students earn a Bachelor of Science in Education degree, which allows them to teach chemistry at the high school level. Other Northwest graduates pursue careers in industry, in such venues as chemical companies, pharmaceutical companies, independent research laboratories and many others. Here are some places that Northwest graduates have worked:

- ABC Laboratories
- Anheuser-Busch, St. Louis
- Midwest Research Laboratories

PHYSICS

With a degree in physics, many graduates continue their education, while others enter the job market.

Career opportunities in physics include:

- Computer hardware specialist
- Independent laboratories
- NASA
- Specialist in modern communications technology
- Specialist in semiconductor technology

SCIENCE EDUCATION

Science education offers or supports a variety of programs that prepare teachers for the following career areas:

- Elementary education-science concentration
- Middle school science
- Secondary school chemistry and physics

UNDERGRADUATE RESEARCH

Students studying Chemistry and Physics have an opportunity to participate in undergraduate research. Some past projects include "Musical Acoustics of the Guitar," "Chemistry Labs with Computers," "Analysis of Lead in Drinking Water," "The Gene for Powdery Mildew Resistance in Korean Melons" and "Active Components Present in a Traditional Medicine Used for Treatment of Sarcoidosis in Bangladesh."

INTERNSHIP OPPORTUNITIES

Many Northwest students have the opportunity to do research (some with pay) between their junior and senior years. Students have interned at places such as these:

- Anheuser-Busch
- Argonne National Laboratories
- Crime Laboratories
- Iowa State University
- Mississippi State University
- Pharmaceutical Quality Assurance Departments
- Texas A&M
- University of Arkansas
- University of Mississippi
- University of Nebraska
- University of Nebraska Medical Center

STUDENT ORGANIZATIONS

Student Affiliation of the American Chemical Society

The club organizes field trips and has social get-togethers. Members also organize the annual Chemistry Olympiad for high school students. The organization sponsors regional and national conventions that allow members to interact with other chemistry students and chemists.

Gamma Sigma Epsilon

The National Chemistry Honor Society for students with strong academics in chemistry.

National Science Teachers Association Student Affiliate

An organization for future science teachers.

DEPARTMENT OF CHEMISTRY AND PHYSICS

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