

Chemistry and Physics Program

Faculty/Staff

Nicholas Madhiri, Chair; Gerald Springer

Aims of the Chemistry Program

The aim of the chemistry program is to develop in students the ability to think critically and creatively. The chemistry curriculum is designed to provide the student with a strong background in the areas of organic chemistry, biochemistry, analytical chemistry and physical chemistry. The major will serve as a solid foundation upon which the candidate can build a professional career or a more specialized graduate program.

Chemistry and Physics Degrees and Certificates

B.A. Chemistry

Program:

Chemistry and Physics

Type:

B.A.

Required Courses

Item #	Title	Credits
CHEM 111	General Chemistry I	4
CHEM 112	General Chemistry II	4
CHEM 201	Research Methods in the Physical Sciences	1
CHEM 221	Modern Analytical Chemistry	4
CHEM 231	Organic Chemistry I	4
CHEM 232	Organic Chemistry II	4
CHEM 341	Physical Chemistry I	4
CHEM 431	Biochemistry I	3
CHEM 432	Biochemistry I Lab	1
CHEM 462	Inorganic Chemistry	3
CHEM 475	Research Methods in Chemistry	4
	CHEM Electives upper division	4
	Sub-Total Credits	40

Required Cognates

Item #	Title	Credits
MATH 181	Calculus I	4
PHYS 121	General Physics I	4
PHYS 122	General Physics II	4
	Sub-Total Credits	12

Recommended cognates:

Item #	Title	Credits
MATH 182	Calculus II	4
MATH 283	Calculus III	4
CSIS 110	Principles of Computer Programming I	3
PHYS 221	General Physics with Calculus I	1
PHYS 222	General Physics with Calculus II	1
Sub-Total Credits		13
Total credits for degree:		65

B.S. Biochemistry**Program:**

Chemistry and Physics

Type:

B.S.

Required Courses

Item #	Title	Credits
BIOL 111	General Biology I	4
BIOL 112	General Biology II	4
BIOL 340	Cell and Molecular Biology I	4
	Biochemistry Electives	4
CHEM 111	General Chemistry I	4
CHEM 112	General Chemistry II	4
CHEM 201	Research Methods in the Physical Sciences	1
CHEM 221	Modern Analytical Chemistry	4
CHEM 231	Organic Chemistry I	4
CHEM 232	Organic Chemistry II	4
CHEM 341	Physical Chemistry I	4
CHEM 431	Biochemistry I	3
CHEM 432	Biochemistry I Lab	1
CHEM 433	Biochemistry II	3
CHEM 434	Biochemistry II Lab	1
CHEM 475	Research Methods in Chemistry	4

	CHEM Electives upper division	4
	Sub-Total Credits	57

Required Cognates

Item #	Title	Credits
MATH 181	Calculus I	4
MATH 182	Calculus II	4
MATH 283	Calculus III	4
PHYS 121	General Physics I	4
PHYS 122	General Physics II	4
	Sub-Total Credits	20

Recommended Cognates

Item #	Title	Credits
PHYS 221	General Physics with Calculus I	1
PHYS 222	General Physics with Calculus II	1
RELT 419	Philosophy of Science	3
	Sub-Total Credits	5

	Total credits for degree:	82
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B.S. Chemistry

Program:

Chemistry and Physics

Type:

B.S.

Required Courses

Item #	Title	Credits
CHEM 111	General Chemistry I	4
CHEM 112	General Chemistry II	4
CHEM 201	Research Methods in the Physical Sciences	1
CHEM 221	Modern Analytical Chemistry	4
CHEM 231	Organic Chemistry I	4
CHEM 232	Organic Chemistry II	4

CHEM 341	Physical Chemistry I	4
CHEM 342	Physical Chemistry II	4
CHEM 431	Biochemistry I	3
CHEM 432	Biochemistry I Lab	1
CHEM 462	Inorganic Chemistry	3
CHEM 475	Research Methods in Chemistry	4
	BS CHEM Electives upper division	4
	Sub-Total Credits	44

Required Cognates

Item #	Title	Credits
CSIS 110	Principles of Computer Programming I	3
MATH 181	Calculus I	4
MATH 182	Calculus II	4
MATH 283	Calculus III	4
PHYS 121	General Physics I	4
PHYS 122	General Physics II	4
	Sub-Total Credits	23

Recommended Cognates

Item #	Title	Credits
MATH 321	Differential Equations	3
PHYS 221	General Physics with Calculus I	1
PHYS 222	General Physics with Calculus II	1
	Intermediate Foreign Language	6
	Sub-Total Credits	11

	Total credits for degree:	78
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B.S. Physical Science with Chemistry Emphasis Secondary Teaching Area

Program:

Chemistry and Physics

Type:

B.S.

B.S. Physical Science with Chemistry Emphasis Secondary Teaching Area

Teaching Certification Program

The following Physical Science major is for teaching certification only. Requirements for certification are listed in the Education section of this *Bulletin*.

You must make formal application for admittance to the Teacher Education Program. Applications are available at the Education Department Office.

Item #	Title	Credits
CHEM 111	General Chemistry I	4
CHEM 112	General Chemistry II	4
CHEM 201	Research Methods in the Physical Sciences	1
CHEM 231	Organic Chemistry I	4
CHEM 232	Organic Chemistry II	4
CHEM 341	Physical Chemistry I	4
CHEM 431	Biochemistry I	3
CHEM 432	Biochemistry I Lab	1
CHEM 462	Inorganic Chemistry	3
CHEM 475	Research Methods in Chemistry	4
PHYS 112	Introductory Astronomy	4
PHYS 121	General Physics I	4
PHYS 122	General Physics II	4
PHYS 221	General Physics with Calculus I	1
PHYS 222	General Physics with Calculus II	1
	CHEM Minor Electives 6 hours upper division	10
	Sub-Total Credits	56
	Total credits for degree:	56

Minor in Chemistry

Program:

Chemistry and Physics

Type:

Minor

Required Courses

Item #	Title	Credits
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CHEM 111	General Chemistry I	4
CHEM 112	General Chemistry II	4
	CHEM Minor Electives 6 hours upper division	10
	Sub-Total Credits	18
	Total credits for degree:	18

Chemistry and Physics Classes

CHEM 105: Survey of Chemistry

An introduction to the fundamental principles of chemistry, plus additional introductory topics from organic and biochemistry with an emphasis on human metabolism. Not applicable to major, minor, or teaching sequence. Lab fee.

Credits: 4

Lab Hours: 3

Lecture Hours: 3

Prerequisites: Appropriate mathematics placement score or MATH 013 with a grade of C- or higher.

Program: [Chemistry and Physics](#)

Semester Offered: Fall

CHEM 111: General Chemistry I

This course develops basic topics such as atomic structure, periodicity, chemical equations, chemical bonding, solutions, nomenclature, and states of matter. Lab Fee.

Credits: 4

Lab Hours: 3

Lecture Hours: 3

Prerequisites: MATH 110 with a grade of C- or higher, or high school Algebra II with grade of B or higher or permission of chemistry faculty, or corequisite: MATH 121 or higher.

Program: [Chemistry and Physics](#)

Semester Offered: Fall

CHEM 112: General Chemistry II

A continuation of CHEM 111. Included are discussions of kinetics, acids and bases, equilibrium, electrochemistry, and introduction to nuclear and organic chemistry. Lab fee.

Credits: 4

Lab Hours: 3

Lecture Hours: 3

Prerequisites: CHEM 111 with a grade of C- or higher.

Program: [Chemistry and Physics](#)

Semester Offered: Spring

CHEM 201: Research Methods in the Physical Sciences

An introduction to the library research skills used in the physical sciences, especially chemistry. The use of primary and secondary sources including the use of on-line databases will be discussed as well as publication styles. Students will engage in activities to sharpen critical thinking. In this course, majors in the physical sciences begin the process of senior portfolio development.

Credits: 1

Prerequisites: ENGL 121 and PHYS 121, 122 or CHEM 111, 112

Program: [Chemistry and Physics](#)

Semester Offered: Spring

CHEM 221: Modern Analytical Chemistry

A course in which quantitative and instrumental techniques of chemical analysis are combined. Emphasis will be on developing analytical skills.

Credits: 4

Lab Hours: 3

Lecture Hours: 3

Prerequisites: CHEM 112 with grade of C- or higher

Program: [Chemistry and Physics](#)

Semester Offered: Fall, even years

CHEM 231: Organic Chemistry I

This course deals with the theory and applications of basic organic chemistry. Included is the study of alkanes, alkenes, alkynes, simple aromatics, alkyl halides, alcohols, ethers, and spectroscopic methods. Lab fee.

Credits: 4

Lab Hours: 3

Lecture Hours: 3

Prerequisites: CHEM 112 with a grade of C- or higher

Program: [Chemistry and Physics](#)

Semester Offered: Fall

CHEM 232: Organic Chemistry II

A continuation of the study of basic organic chemistry. Includes carboxylic acids, aldehydes, ketones, amines, heterocyclics, unsaturated carbonyl compounds, carbohydrates, phenols, glycols and epoxides. Lab fee.

Credits: 4

Lab Hours: 3

Lecture Hours: 3

Prerequisites: CHEM 231 with a grade of C- or higher

Program: [Chemistry and Physics](#)

Semester Offered: Spring

CHEM 298: Individual Study Topics

This course offers the lower division student opportunity for independent study under the direction of a faculty member. This study may involve research, laboratory, or library work. Content and methods of study must be arranged prior to registration. May be repeated for a total of 2 credits.

Credits: 1 - 2

Prerequisites: Permission of the department chair

Program: [Chemistry and Physics](#)

CHEM 299: Directed Group Study Topics

Provides academic departments an opportunity to offer courses in specialized or experimental areas, either lower or upper division, not listed in the undergraduate *Bulletin*. May be repeated for a total of 3 credits.

Credits: 1 - 3

Prerequisites: Approval by department chair

Program: [Chemistry and Physics](#)

CHEM 310: Environmental and Geological Chemistry

Chemistry of how geological and anthropogenic activities impact Earth's hydrosphere, continents, and atmosphere. . Lab fee. (Offered periodically)

Credits: 4

Lab Hours: 3

Lecture Hours: 3

Prerequisites: CHEM 112 or equivalent with a grade of C- or higher, MATH 181 or permission of instructor

Program: [Chemistry and Physics](#)

Semester Offered: Periodically

CHEM 341: Physical Chemistry I

Rigorous mathematical treatment of gas laws, physical states of matter, solutions, thermodynamics, equilibrium, chemical potential, electrochemistry, and an introduction to quantum mechanics. Lab fee.

Credits: 4

Lab Hours: 3

Lecture Hours: 3

Prerequisites: CHEM 112 or equivalent with a grade of C- or higher, MATH 181

Program: [Chemistry and Physics](#)

Semester Offered: Fall, odd years

CHEM 342: Physical Chemistry II

Further development of atomic and molecular quantum mechanics, spectroscopy, kinetics and reaction mechanisms, and statistical thermodynamics. Lab fee.

Credits: 4

Lab Hours: 3

Lecture Hours: 3

Prerequisites: CHEM 341 with a grade of C- or higher

Program: [Chemistry and Physics](#)

Semester Offered: Spring even years

CHEM 421: Modern Analytical Instrumentation

A course in modern analytical instrumentation, including electroanalytical, spectroscopic, separations, and kinetic methods. Application of spreadsheet and computer simulation software. Laboratory emphasis. Lab fee. (Offered periodically)

Credits: 4

Lab Hours: 6

Lecture Hours: 2

Prerequisites: CHEM 221 with a grade of C- or higher or CHEM 231 with a grade of C- or higher

Program: [Chemistry and Physics](#)

Semester Offered: Periodically

CHEM 431: Biochemistry I

A course in the molecular logic of life; in particular the molecular structure, nomenclature, properties, and functions of carbohydrates, lipids, proteins, and nucleic acids. Properties and mechanisms of enzymes, vitamins, and co-enzymes, biological membrane structure and function, and introduction to bioenergetics.

Credits: 3

Lecture Hours: 3

Prerequisites: CHEM 232 with a grade of C- or higher.

Co-Requisites: Corequisite: CHEM 432 (required for chemistry and biochemistry majors).

Program: [Chemistry and Physics](#)

Semester Offered: Fall

CHEM 432: Biochemistry I Lab

This course is designed to accompany CHEM 431. Experiments demonstrate the theoretical principles discussed in CHEM 431, including structure, pH, and molecular interactions of carbohydrates, lipids, proteins, enzymes, nucleic acids, and the specific methods of analysis associated with these molecules. Lab fee.

Credits: 1

Program: [Chemistry and Physics](#)

Semester Offered: Fall

CHEM 433: Biochemistry II

This course focuses on the metabolic pathways of biomolecules, accompanied by bioenergetic requirements, regulatory mechanisms and flow of genetic information. Includes photosynthesis, metabolism of amino acids, fatty acids, lipids, nucleic acids and proteins, and application of recombinant DNA. Intended for students taking chemistry as their major or minor. Also

suitable for biology majors with a strong chemistry background and pre-professionals.

Credits: 3

Lecture Hours: 3

Prerequisites: CHEM 431 with a grade of C- or higher.

Co-Requisites: Corequisite: CHEM 434 (required for chemistry and biochemistry majors).

Program: [Chemistry and Physics](#)

Semester Offered: Spring

CHEM 434: Biochemistry II Lab

This course is designed to accompany CHEM 433. Emphasis will be important experimental techniques not covered in CHEM 432, including electrophoresis, adsorption chromatography, thin-layer chromatography and DNA analysis. Lab fee .

Credits: 1

Lab Hours: 3

Program: [Chemistry and Physics](#)

Semester Offered: Spring

CHEM 462: Inorganic Chemistry

A course including a study of the elements and their periodic relationships, acid-base theories, current bonding theories, coordination compounds, and other selected topics. (Offered periodically)

Credits: 3

Lecture Hours: 3

Prerequisites: CHEM 341 or CHEM 112 with permission of instructor.

Program: [Chemistry and Physics](#)

Semester Offered: Periodically

CHEM 475: Research Methods in Chemistry

This course is a capstone course, designed to involve the chemistry major in the process of research, including literature searching, formation of hypotheses, and experimental design. Preparation and presentation of report, completion of portfolio. Lab fee. (Offered periodically)

Credits: 4

Lab Hours: 6

Lecture Hours: 2

Prerequisites: Either CHEM 221 or CHEM 341 with a grade of C- or higher, CHEM 232 with a grade of C- or higher, and permission of the chemistry faculty.

Program: [Chemistry and Physics](#)

Semester Offered: Periodically

CHEM 498: Individual Study Topics

The subject of study is selected by conference between the student and the chemistry faculty, and will consist mainly of independent study and/or laboratory work summarized by a comprehensive report. Content and method of study must be arranged prior to registration. May be repeated for a total of 3 credits.

Credits: 1 - 3

Prerequisites: Permission of the department chair

Program: [Chemistry and Physics](#)

CHEM 499: Directed Group Study Topics

Provides academic departments an opportunity to offer courses in specialized or experimental areas, either lower or upper division, not listed in the undergraduate *Bulletin*. Student may be allowed to repeat the course for credit.

Credits: 1 - 3

Prerequisites: Approval by department chair

Program: [Chemistry and Physics](#)

ENGR 111: Introduction to Engineering and Design

Introduction to the profession of engineering, computer based engineering, calculation tools, analysis of team dynamics, the

design process, systems engineering, and principles of project management. This is taught via distance learning from Walla Walla University, Edward F. Cross School of Engineering.

Credits: 2

Program: [Chemistry and Physics](#)

Semester Offered: Fall

ENGR 115: Introduction to CAD

Introduction to computer aided design, and computer aided engineering (CAD and CAE). Includes coverage of hand sketching, drafting standards, pictorial representations, and principles of descriptive geometry. Covers both 2- and 3-D CAD, discipline specific computer applications will be represented as available. Taught during the first 10 weeks of the semester live via webcast from Walla Walla University, Edward F. Cross School of Engineering.

Credits: 1

Program: [Chemistry and Physics](#)

Semester Offered: Spring

ENGR 116: CAD Project

A full-scale project emphasizing teamwork where possible, and written and oral engineering communications. The project is introduced in ENGR 111 and builds on the skills developed in ENGR 115. Taught during the last five weeks of the semester through Walla Walla University, Edward F. Cross School of Engineering.

Credits: 1

Program: [Chemistry and Physics](#)

Semester Offered: Spring

PHYS 101: Introductory Physics

A laboratory science course for the student with no previous background in physics. A conceptual, rather than mathematical, approach is emphasized, though some arithmetic calculations are required. Topics include mechanics, heat, sound, electromagnetism, light, and modern physics.

Credits: 4

Lab Hours: 3

Lecture Hours: 3

Prerequisites: SAT mathematics score of at least 530 or an ACT mathematics score of at least 21 or MATH 013 with a grade of C- or higher.

Program: [Chemistry and Physics](#)

Semester Offered: Fall

PHYS 112: Introductory Astronomy

An introductory study of the solar system; stellar structure and evolution; star clusters, galaxies, quasars, the large scale structure of the universe, and cosmology. A conceptual, rather than mathematical, approach is emphasized, though some arithmetic calculations are required.

Credits: 4

Lab Hours: 3

Lecture Hours: 3

Prerequisites: SAT mathematics score of at least 530 or an ACT mathematics score of at least 21 or MATH 013 with a grade of C- or higher.

Program: [Chemistry and Physics](#)

Semester Offered: Periodically

PHYS 114: Physical Science

An introductory science course covering the fundamentals of physics, chemistry, astronomy, and each science that will focus on hands-on activities and real-life applications. The course covers fundamental aspects of physical science as required by the Texas Department of Education.

Credits: 4

Lab Hours: 3

Lecture Hours: 3

Prerequisites: SAT mathematics score of at least 530 or an ACT mathematics score of at least 21 or MATH 013 with a grade

of C- or higher.

Program: [Chemistry and Physics](#)

Semester Offered: Spring

PHYS 121: General Physics I

An introduction to motion in one dimension, vectors in 2 and 3 dimensions, the laws of motion, work and energy, momentum and collisions, uniform circular motion, gravity, rotational equilibria and dynamics involving torque and angular momentum, solids and fluids, thermal physics and heat, thermodynamical laws, vibrations, waves, and sound. Math level is algebra and trigonometry.

Credits: 4

Lab Hours: 3

Lecture Hours: 3

Prerequisites: [MATH 121](#)

Program: [Chemistry and Physics](#)

Semester Offered: Fall

PHYS 122: General Physics II

Topics include: electric force and electric field, electric potential, capacitance, resistance and resistivity, direct and alternating currents, Kirchhoff's Rules, Ohm's Law, magnetism and Ampere's Law, Faraday's Law, electromagnetic waves, reflection and refraction of light, mirrors and lenses, relativity, quantum physics, atomic and nuclear physics, and elementary particles.

Credits: 4

Lab Hours: 3

Lecture Hours: 3

Prerequisites: PHYS 121 with a grade of C- or higher Continuation of PHYS 121.

Program: [Chemistry and Physics](#)

Semester Offered: Spring

PHYS 221: General Physics with Calculus I

A one hour addition to the topics of PHYS 121 where calculus is thoroughly used. A student taking PHYS 121 and PHYS 221 will have the equivalent of a 4-hour university course in calculus-based general physics (topics as in PHYS 121).

Credits: 1

Prerequisites: [MATH 181](#)

Program: [Chemistry and Physics](#)

Semester Offered: Periodically Fall

PHYS 222: General Physics with Calculus II

A one hour addition to the topics of PHYS 122 where calculus is thoroughly used. A student taking PHYS 122 and PHYS 222 will have the equivalent of a 4-hour university course in calculus-based general physics (topics as in PHYS 122).

Credits: 1

Prerequisites: [MATH 181](#)

Program: [Chemistry and Physics](#)

Semester Offered: Periodically Spring