SHEPHERD UNIVERSITY

SCIENCE EDUCATION SPECIALIZATION HANDBOOK

FOR SPECIALIZATIONS LEADING TO

WEST VIRGINIA CERTIFICATION

Teaching Fields:

Biology, Grades 9-Adult; Chemistry, Grades 9-Adult; & General Science, Grades 5-Adult

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Science Education Program Goals

- In recognition of the need to provide prospective science teachers a program of study wherein science content courses, pedagogy courses, and clinical experiences are connected and integrated, the Secondary Science Education Program adopts and endorses the theme, objectives, and program goals and learner outcomes of the Shepherd University Educator Preparation Program.
- In recognition of the critical importance of science content, and the validity of the constructivist approach to learning it, the Secondary Science Education Program shall provide prospective secondary school science teachers coursework and other experiences that:
  - ✓ Involve them in actively investigating natural phenomena and allow them to construct conceptual schemes that are consistent with currently accepted scientific understanding;
  - ✓ Address issues, events, problems, and topics of current significance in science that are of importance and interest to the community at large;
  - ✓ Introduce them to and involve them in the use of research literature, media, and technological resources that expand their science knowledge base and their ability to access further information;
  - ✓ Build on their current science knowledge base, skills, and attitudes;
  - ✓ Incorporate ongoing reflection on the process and outcomes of the scientific enterprise; and
  - ✓ Encourage and support collaborative work in and out of the science classroom and laboratory.
- In acknowledgment of the necessity to integrate the knowledge base in science with the knowledge bases in pedagogy, learning, and student development, the secondary science education program shall provide prospective secondary school science teachers coursework and other experiences that:
  - ✓ Promote the integration of all pertinent aspects of science and science education;
  - ✓ Occur in a variety of places (e.g., science labs, computer labs, field sites of various sorts, and schools) that are appropriate environments for effective science teaching/learning because they provide real situations where professors and teacher candidates can inquire, investigate, and expand their knowledge and skills; and
  - ✓ Use inquiry, reflection, interpretation of research, and guided practice to build understanding and skill in science teaching.
- In recognition of how essential lifelong learning is, the Secondary Science Education Program shall provide prospective secondary school science teachers coursework and other experiences that:
  - ✓ Provide regular, frequent opportunities for individual and collegial examination and reflection on teaching/learning practices;
  - ✓ Provide systematic opportunities for the teacher candidates to receive feedback about:
    - their preparation to teach in their discipline;
    - choices they make in respect to portfolio and resource unit inclusions;
    - course choices, co-curricular choices, etc.;
    - the various interactions they have with students prior to teaching;
    - their teaching, and to use that feedback in a commitment to excellence;
  - ✓ Support the sharing of teacher/learner experiences through participation in seminars and other such forums;
  - ✓ Provide access to and opportunities for teacher candidates to use current research and experiential knowledge in formal and informal ways; and
  - ✓ Foster a familiarity with current research in the science specialty and in education, especially in the areas of pedagogy and curriculum.
- In recognition of Shepherd University's mission as a state-supported university to educate teachers who can function effectively within the public schools of the State of West Virginia, the instructional goals and objectives of the current West Virginia Science Curriculum Framework, which are:
  - ✓ To develop an understanding of the nature of science;
  - ✓ To cultivate scientific attitudes and values, to develop an understanding of the limits of science, and to evaluate scientific advances and technological applications as they impact science;
  - ✓ To develop thinking skills and processes for investigating the world, solving problems, and making decisions;
  - ✓ To acquire skills for learning through concrete manipulations of the tools and materials of science; and
  - ✓ To demonstrate the interconnectedness of the fields of science by emphasizing the themes of systems, change, and models throughout the curriculum, and establishing connections with other discipline areas and daily life experiences.

- It shall be made known to prospective science teachers that the Secondary Science Education Program shall provide prospective secondary school science teachers coursework and other experiences that:
  - ✓ Allow them to plan and develop activities that guide and facilitate student learning of science content by actively involving them in the processes of discovery and inquiry, and encourage curiosity, chance-taking, and hypothesis formation inside and outside of the classroom/laboratory;
  - ✓ Give them opportunities to select science content and adapt and design learning activities to meet the interests, understanding, abilities, experience, and special needs of their students, and immerse
  - ✓ them in activities that will allow them to more fully appreciate the fact that scientific concepts can be described mathematically, and that computers can greatly facilitate this essential task;
  - ✓ Provide them opportunities to select and develop teaching and assessment strategies that support the development of student understanding and nurture a community of science learners by promoting individual and cooperative problem solving;
  - ✓ Allow them to select and develop teaching strategies which will give their students accurate understanding of the nature of science (its open-endedness, its limitations, its goals, etc.), and help them develop positive attitudes toward the scientific enterprise;
  - ✓ Provide them opportunities to select and develop teaching and assessment strategies that promote the development of an understanding of the mien history has on current science, and encourages students to recognize, appreciate, and use conceptual themes that are common to all of the natural sciences;
  - ✓ Provide them opportunities and reasons to develop critical thinking skills and engage in reflective problem-solving as science students and as science teacher candidates;
  - ✓ Inculcate in teacher candidates a genuine concern for safety in all science teaching environments (field, laboratory, etc.); and
  - ✓ Encourage them to critically examine and evaluate and to select and develop instructional activities that will get their students to critically examine and evaluate scientific and technological products and consider how these products may impact society.

First-year teachers will not be effective unless they have previously conducted serious inquiry into life in the classroom. Only when that inquiry is completed and a tentative philosophy of education is formed should the traditional tasks confronting the first-year teacher be undertaken.

Science Education Co-Curricular Requirements: Professional Engagement

Each teacher candidate in all three Science Specialty programs within the EPP at Shepherd University must address NSTA Standard 6 Professional Knowledge and Skills by deepening their science knowledge and practices as well as broadening their science-specific pedagogical knowledge and understanding by engaging in outside activities not connected to / in addition to coursework requirements as outlined herein.

Science content knowledge and practice requirements (Standard 6b) are fulfilled specifically by performing scientific research and/or attending scientific seminars and providing a written account of such activities. Science pedagogy knowledge and understanding requirements (Standard 6c) are fulfilled by participating in science conferences for grade-schoolers and/or P-12 school science fairs. All professional engagement activities must be supervised, and the activity and supervisor must be approved in advance by the Science Education Coordinator at Shepherd University. Attendance and/or participation at the WVAS (West Virginia Academy of Science), the WVSTA (West Virginia Science Teachers Association), or the “Seeding Your Future” conference at Shepherd University with any Shepherd University School of Natural Science and Math faculty serving as the candidate’s supervisor is pre-approved. Supervisors will serve as references for the candidate’s participation in the activity as described on the approval form and/or in the candidate’s engagement report.

Following the approved activity, teacher candidates must submit written documentation that describes their involvement in the activity and explains how the activity addresses NSTA or other curricular standards, the impact of the activity on their understanding of the process of scientific investigation and/or science teaching, and how this new understanding relates to professional activities as a science teacher. This assessment aligns with NSTA Standards 6b and 6c. Teacher candidates are required to use the prescribed assessment form for their report and meet standards as an overall score for each activity. ***The assessment form is located within the Science Specialization Brightspace site*** *and must be submitted directly to the Coordinator via Brightspace in the Assignments area of the site.* ***For more information, contact the Coordinator directly.***

Important Note: A minimum of two different professional development activities is required to fulfill the Co-Curricular Requirements for Professional Engagement: (1) One that addresses science content and (2) one that addresses science pedagogy. The candidate must clearly identify on each form being submitted which type of professional development is being documented (e.g., science content or science pedagogy).

Shepherd University EPP Admissions Requirements

Juncture I (Admission to EPP) Requirements:

- Must have an overall GPA of 2.75 and a 2.75 Shepherd GPA (incl. Transfer Students).
- Must have a C or better in all Specialty and Professional Courses (speak with your advisor).
- *Must have passed the PRAXIS I CORE/CASE or provided proof of exemption as determined/required by the State of West Virginia. *Please speak with your advisor regarding the exemptions/requirements/deadlines regarding the PRAXIS I CORE/CASE exams*.
- Contact your advisor with any questions about any additional course work or requirements that must be completed before applying for Juncture I.

Juncture II (Admission to ST / Residency II) Requirements:

- Must have an overall GPA of 2.75 and a 2.75 Shepherd GPA (incl. Transfer Students).
- Must have a C or better in all Specialty and Professional Courses (speak with your advisor).
- Must have an overall 2.75 GPA in Specialty and Professional Courses (speak with your advisor).
- You must pass all PRAXIS II Content exams before you will be permitted to student teach or enter Residency II. *Please speak with your advisor regarding the deadlines for passing the PRAXIS II Content exams.*

For additional policies and procedures related to all teacher candidates within the EPP at Shepherd, review the EPP Student Handbook and/or the Practicum Manual and/or School of Education website. For more specific information regarding your program and its requirements, contact your advisor/specialization coordinator.

BA / Biology Teaching Field [Grades 9-Adult] (YRL Residency)
Four-Year Course Progression (Eff. Fall 2024)

FALL		FIRST YEAR		SPRING		FIRST YEAR	
Sub./Course No.	**Tier**	**Title**	**Credit**	**Sub./Course No.**	**Tier**	**Title**	**Credit**
ENGL 101	1	Writing-Rhetoric I	3	ENGL 102	1	Writing-Rhetoric II	3
Core Curriculum	1	MATH XXX (MA)*	3-4	Core Curriculum	2	Choose Wellness (WE) with Advisor*	3
BIOL 211		Fundamentals I: Molecular & Cellular Function	4	BIOL 212		Fundamentals II: Diversity of Life	4
EDUC 150*	1	Seminar in Education (FYEX)	1	CHEM 209/209L	1	General Chem/Lab II (LS)	4
CHEM 207/207L	1	General Chem/Lab I (LS)	4	Core Curriculum	1	Choose HIST 1XX w Advisor*	3
Take Praxis I CASE (See below.)*		**TOTAL**	**15-16**			**TOTAL**	**17**

FALL		SECOND YEAR		SPRING		SECOND YEAR	
Sub./Course No.	**Tier**	**Title**	**Credit**	**Sub./Course No.**	**Tier**	**Title**	**Credit**
EDUC 200*		Foundations of Education	3	BIOL 305		Cell Biology	4
BIOL 303		General Ecology	4	STEM Elective 1		Choose STEM with Advisor*	3-4
Core Curriculum (SO)	2	Choose CK, GL, OR MD w Advisor [PSYC 101 Recommended] *	3	Core Curriculum (Humanities)	2	Choose CK, GL, OR MD with Advisor*	3
COMM 202		Fundamentals of Speech (HM-GL)	3	Core Curriculum (Arts)		Choose CK, GL, OR MD with Advisor*	3
PHYS or GCSI XXX		Physics Elective*	4	**EDUC 360***	2	Survey of Exceptional Children (SO-MD)	3
Take Praxis I CASE (See below.)*		**TOTAL**	**17**	***Take Praxis I CASE (See below.)****		**TOTAL**	**16-17**

FALL		THIRD YEAR			SPRING		THIRD YEAR	
Sub./Course No.	**Tier**	**Title**	**Credit**		**Sub./Course No.**	**Tier**	**Title**	**Credit**
EDUC 320*	2	Social / Psychological Conditions of Learning	4	JUNCTURE 1 / ADMISSION TO EPP REQUIRED TO PROCEED	STEM Elective 2		Choose STEM with Advisor*	3-4
BIOL 344		Genetics	3		STEM Elective 3		Choose STEM with Advisor*	4
EDUC 380		Innovative Technology	3		STEM Elective 4		Choose STEM with Advisor*	4
BIOL XXX		Biology Elective*	3-4		**EDUC 370**		Creating Learning Environments	3
APPLY FOR JUNCTURE 1		**TOTAL**	**14-15**		***Take Praxis II (REQUIRED)***		**TOTAL**	**14-15**

FALL		FOURTH YEAR		SPRING		FOURTH YEAR	
Sub./Course No.	**Tier**	**Title**	**Credit**	**Sub./Course No.**	**Tier**	**Title**	**Credit**
STEM Elective 5		Choose STEM with Advisor*	4	EDUC 460		Residency II, Grades 9-12 (CP)	9
EDUC 400		Inclusion in the Regular Classroom	3	EDUC 461**		Student Teaching Seminar (WM)	3
EDUC 443		Reading in the Content Area	3				
EDUC 423		Special Methods of Teaching Science	3			**TOTAL**	**12**
EDUC 375		Residency I	0				
APPLY FOR JUNCTURE 2		**TOTAL**	**13**			**DEGREE TOTAL**	**120**
EDUC 461 is designated as the Writing in the Major [WM] course for Education.						**Science Education / Biology 9-Adult, B.A.**	

***NOTE: All Electives must be approved by the Science Specialization Coordinator for each student. Coursework must include information processing and other supporting content as required for teacher certification.**

Secondary Education: Biology Specialty

Required Coursework from the Core

- **CHEM 207 - General Chemistry I (3 cr)** CHEM 207 and its companion lab, CHEM 207L, are the first part of a two-semester sequence that serves as an introduction to modern chemistry for students majoring in the sciences. The course provides a basis for, and is a prerequisite for, advanced courses in chemistry, biochemistry and molecular biology. Science majors, premedical and other pre-professional students should take this course. The topics covered include measurements and units, atomic and molecular structure, periodic properties of the elements, chemical bonding, stoichiometry, chemical reactivity, thermochemistry, and the structure and properties of gases, liquids and solids. This course, along with CHEM 207L, CHEM 209, and CHEM 209L, fulfills the Core Curriculum Laboratory Sciences requirement. Prerequisites: Background in high school chemistry or CHEM 105 or permission of instructor. Prerequisite/ Co-Requisite: MATH 105, MATH 108, MATH 205, MATH 207, or appropriate placement score, or permission of instructor. Co-Requisite**: It is recommended, but not required, that CHEM 207L be taken concurrently.**
- **CHEM 207L - General Chemistry I Laboratory** (1 cr) CHEM 207L is a laboratory course that is designed to accompany CHEM 207. The course provides a basis for, and is a prerequisite for, advanced courses in chemistry, biochemistry and molecular biology. Science majors, premedical and other pre-professional students should take this course. The topics covered include measurements and units, basic laboratory techniques, quantitative analysis, qualitative analysis, spectrophotometric analysis, gravimetric analysis, stoichiometry, thermochemistry and chromatography. This course, along with CHEM 207, CHEM 209, and CHEM 209L, fulfills the Core Curriculum Laboratory Sciences requirement. Prerequisites: Background in high school chemistry or CHEM 105 or permission of instructor. Prerequisite/corequisite: MATH 105, MATH 108, MATH 205, MATH 207, or appropriate placement score, or permission of instructor. Co-Requisite: It is recommended, but not required, that CHEM 207 be taken concurrently.
- **CHEM 209 - General Chemistry II** (3 cr) CHEM 209 and its associated lab, CHEM 209L, are the second part of a two-semester sequence hat serves as an introduction to modern chemistry for students majoring in the sciences. The course provides a basis for, and is a prerequisite for, advanced courses in chemistry, biochemistry and molecular biology. Science majors, premedical and other pre-professional students should take this course. The topics covered include equilibrium, acid-base chemistry, solutions and solubility, electrochemistry, chemical kinetics, nuclear chemistry and an introduction to organic chemistry. This course, along with CHEM 207, CHEM 207L, and CHEM 209L, fulfills the Core Curriculum Laboratory Sciences requirement. Prerequisites: CHEM 207. Co-Requisite: It is recommended, but not required, that CHEM 209L be taken concurrently.
- **CHEM 209L - General Chemistry II Laboratory** (1 cr) CHEM 209L is a laboratory course that is designed to accompany CHEM 209. The course provides a basis for, and is a prerequisite for, advanced courses in chemistry, biochemistry and molecular biology. Science majors, premedical and other pre-professional students should take this course. The topics covered include volumetric analysis, chromatography, spectroscopy, acid-base chemistry, electrochemistry, colligative properties and organic and inorganic synthesis. This course, along with CHEM 207, CHEM 207L, and CHEM 209, fulfills the Core Curriculum Laboratory Sciences requirement. Prerequisites: CHEM 207 and CHEM 207L. Co-Requisite: It is recommended, but not required, that CHEM 209 be taken concurrently.

CHOOSE ONE OF THE FOLLOWING:

- **MATH 314 Statistics (3 cr)**
- **MATH 105 College Algebra (3 cr)**
- **MATH 108 Precalculus (4 cr)**
- **MATH 205 Calculus with Applications (4 cr)**
- **MATH 207 Calculus (4 cr)**

BIOLOGY SPECIALIZATION COURSES (23-24 CREDITS)

- **BIOL 211 – Fundamentals of Biology I: Molecular and Cellular Function* (4 cr)** This introductory course for science majors covers the fundamental principles of biochemistry, genetics, molecular biology and cell biology that apply to all living organisms. Topics addressed in this course include metabolism, cell and membrane function, cellular respiration, photosynthesis, cell cycle, meiosis, classical and molecular genetics, and evolution.
- **BIOL 212 – Fundamentals of Biology II: Diversity of Life* (4 cr)** This introductory course for science majors explores the diversity of life and organismal biology. Topics addressed in this course include microbial diversity and physiology; plant and animal diversity, growth, reproduction and physiology; and ecology. Prerequisites: BIOL 211.
- **NOTE: Students who have taken BIOL 103 and BIOL 104 with a grade of B or better in both can apply to substitute these courses for BIOL 211 and BIOL 212.*
- **BIOL 305 – Cell Biology (4 cr)** Cells are considered as the basic structural and functional unit of biological organization. Selected cell structures and activities are discussed from the molecular, cytological, ultrastructural, and metabolic points of view. Topics include bioenergetics, macromolecular structure, transport processes, regulation of cellular activities, and internal organization of cells. Prerequisites: BIOL 211 and BIOL 212; AND CHEM 207, CHEM 207L, CHEM 209, CHEM 209L.
- **BIOL 344 – Genetics (4 cr)** Mechanisms of inheritance, the nature of genes, and genetic systems are examined in relation to the capacities of living systems for continuity, self-regulation, and adaptive change. Molecular, cellular, and organismal reproduction are considered as processes of information storage, transfer, and generation. The development of the gene concept is traced from its origin as a mathematical abstraction, through progressive definition as a unit of nuclear structure and function, to final characterization as nucleic acid. Prerequisites: BIOL 305.
- **BIOL 303 – General Ecology (4 cr)** This course is designed to be an introduction into ecological topics spanning population, community, and ecosystem levels of organization. Students will gain an understanding of population growth, community interactions, and energy flow, within the overarching framework of the biotic and abiotic factors that regulate species' distributions, behavior, and evolution. All topics will be discussed in the context of the relationship between humans and the natural environment. Previously numbered BIOL 420. Prerequisites: BIOL 211 and BIOL 212; or permission of instructor.
- **BIOL electives 225 and above [except BIOL 392] = (3-4 cr)** Recommended BIOL Electives: BIOL 225, BIOL 226, BIOL 301, BIOL 302, BIOL 404, BIOL 406, BIOL 411, BIOL 412, BIOL 415, BIOL 418, BIOL 422, BIOL 425.

PHYSICS ELECTIVES (4 CREDITS) – CHOOSE ONE OF THE FOLLOWING

- **PHYS 201 – College Physics (3 cr) AND PHYS 201 L (1 cr)**
  - **PHYS 201 -** An algebra- and trigonometry-based treatment of the fundamentals of selected classical physics topics including motion, force, Newton's laws, energy, momentum, gravitation, rotation, acoustics, fluid dynamics, and thermodynamics. Co-Requisite: PHYS 201L must be taken concurrently with PHYS 201.
  - **PHYS 201 L - A** two hour per week laboratory course focusing on selected classical physics topics including motion, force, Newton's laws, energy, momentum, gravitation, rotation, acoustics, fluid dynamics, and thermodynamics. Co-Requisite: Must be taken concurrently with PHYS 201.
- **PHYS 221 – General Physics I (3 cr) AND PHYS 221 L (1 cr)**
  - **PHYS 221 -** A calculus-based treatment of fundamentals of selected classical physics topics including motion, force, Newton's laws, energy, momentum, gravitation, rotation, acoustics, fluid dynamics, and thermodynamics. PHYS 221L must be taken concurrently with PHYS 221. Prerequisite/ Co-Requisite: MATH 207.
  - **PHYS 221 L -** A two hour per week laboratory course focusing on selected classical physics topics including motion, force, Newton's laws, energy, momentum, gravitation, rotation, acoustics, fluid dynamics, and thermodynamics. Co-Requisite: Must be taken concurrently with PHYS 221.
- **PHYS 301 – Energy (4 cr)** In this course students will learn fundamentals of how energy is converted from one form to another and utilized to do useful work. These fundamentals are essential to our energy-intensive civilization and important for understanding humankind's impact on the environment and utilization of natural resources. Topics will include thermodynamics processes, heat engines, heat transfer, electromagnetic induction, nuclear physics, and the photoelectric effect. Previously titled Physics of Energy (3cr). Prerequisites: Any 4-credit Core Curriculum science class, or Permission of Instructor.
- **PHYS 302 – Physical Computing (4 cr)** In this course students will learn how to build digital devices to sense and interact with the world around them. Such devices are a ubiquitous part of the built environment and increasingly mediate humankind's interactions and relationships with both the built and the natural environments. Topics will include electric circuits, passive and active electronic components, microcontroller programming, analog-to-digital and digital-to-analog conversion, and wired and wireless serial communication. At the end of the semester students will work in groups to fabricate and demonstrate physical computers of their own design. Prerequisites: Any 4-credit Core Curriculum science class, or Permission of Instructor.
- **GSCI 103 – General Physical Science (4 cr)** A survey course designed to explore the major physical phenomena in the natural sciences, encompassing a study of motion, energy, electromagnetism, waves (light and sound), and atomic and nuclear physics. The course will meet in three one-hour lectures and one two-hour laboratory session.

STEM AND SUPPORTING CONTENT ELECTIVES (18-20 CREDITS)

BIOL, CHEM, CIS, CIT, CPE, DATA, ENGR, ENVS, GSCI, MATH, PHYS, PSYC courses / may include up to 4 credits of research course(s) as approved by the Science Education Coordinator. [Excludes 392 Co-Op Courses]

Visit the following link for a current / detailed description of this program / these course choices:
[Biology Teaching Field Grades 9-Adult, B.A.]

BA / Chemistry Teaching Field [Grades 9-Adult] (YRL Residency)
Four-Year Course Progression (Eff. Fall 2024)

FALL		FIRST YEAR		SPRING		FIRST YEAR	
Sub./Course No.	**Tier**	**Title**	**Credit**	**Sub./Course No.**	**Tier**	**Title**	**Credit**
ENGL 101	1	Writing-Rhetoric I	3	ENGL 102	1	Writing-Rhetoric II	3
Core Curriculum	1	MATH 205 OR 207*	4	Core Curriculum	2	Choose Wellness with Advisor*	3
BIOL or ENVS		Life Science Elective I*	4	BIOL or ENVS		Life Science Elective II*	4
EDUC 150*	1	Seminar in Education	1	CHEM 209/209L	1	General Chem/Lab II	4
CHEM 207/207L	1	General Chem/Lab I	4	Core Curriculum	1	Choose HIST 1XX w Advisor*	3
Take Praxis I CASE (See below.)*		**TOTAL**	**16**			**TOTAL**	**17**

FALL		SECOND YEAR		SPRING		SECOND YEAR	
Sub./Course No.	**Tier**	**Title**	**Credit**	**Sub./Course No.**	**Tier**	**Title**	**Credit**
EDUC 200*		Foundations of Education	3	CHEM 316/316L		Organic Chem/Lab II	4
CHEM 315/315L		Organic Chem/Lab I	4	PHYS 202L, 222L, or 301		Physics Elective II*	4
Core Curriculum (Social Sciences)	2	Choose CK, GL, OR MD with Advisor*	3	Core Curriculum (Wellness)	2	Choose CK, GL, OR MD with Advisor*	3
COMM 202		Fundamentals of Speech (HM-GL) (Req.)	3	Core Curriculum (Arts)	2	Choose CK, GL, OR MD with Advisor*	3
PHYS 201/L or 221/L		Physics Elective I*	4	**EDUC 360***	2	Survey of Exceptional Children (SO-MD)	3
Take Praxis I CASE (See below.)*		**TOTAL**	**17**	***Take Praxis I CASE (See below.)****		**TOTAL**	**17**

FALL		THIRD YEAR			SPRING		THIRD YEAR	
Sub./Course No.	**Tier**	**Title**	**Credit**		**Sub./Course No.**	**Tier**	**Title**	**Credit**
EDUC 320*	2	Social / Psychological Conditions of Learning	4	JUNCTURE 1 / ADMISSION TO EPP REQUIRED TO PROCEED	CHEM 301/301L		Inorganic Chemistry/Lab I	4
CHEM 329/329L		Biochemistry/Lab I	4		CHEM or GCSI or ENVS		Environmental Chemistry Elective*	3-4
EDUC 380		Innovative Technology	3		STEM Elective 2		Choose STEM with Advisor*	3-4
STEM Elective I		Choose STEM with Advisor*	3-4		**EDUC 370**		**Creating Learning Environments**	**3**
Core Curriculum (Humanities)	2	Choose CK, GL, OR MD with Advisor*	3					
APPLY FOR JUNCTURE 1		**TOTAL**	**17-18**		***Take Praxis II (REQUIRED)***		**TOTAL**	**13-15**

FALL		FOURTH YEAR		SPRING		FOURTH YEAR	
Sub./Course No.	**Tier**	**Title**	**Credit**	**Sub./Course No.**	**Tier**	**Title**	**Credit**
STEM Elective 3		Choose STEM with Advisor*	3-4	EDUC 458		Residency II, Gr. 9-12 (CP)	9
EDUC 400		Inclusion in the Regular Classroom	3	EDUC 461**		Student Teaching Seminar (WM)	3
EDUC 443		Reading in the Content Area	3				
EDUC 423		Special Methods of Teaching Science	3			**TOTAL**	**12**
EDUC 375		Residency I	0				
APPLY FOR JUNCTURE 2		**TOTAL**	**12-13**			**DEGREE TOTAL**	**120**

***EDUC 461 is designated as the Writing in the Major [WM] course for Education.**

Science Education / Chemistry 9-Adult, B.A.

***NOTE: All Electives must be approved by the Science Specialization Coordinator for each student. Coursework must include information processing and other supporting content as required for teacher certification.**

Secondary Education: Chemistry Specialty

Required Coursework from the Core

CHOOSE ONE OF THE FOLLOWING [8 cr]:

BIOL 103 PLUS BIOL 104

- **BIOL 103 (4 cr) -** Not for biology majors. With BIOL 104, satisfies Core Curriculum lab science requirement. Integrated approach to the biology of plants, animals, and microorganisms. Half of the course is centered around ecological principles, and the other half is centered around organismic homeostatic (regulatory) principles. Laboratory topics and sequence are integrated with lecture. Previously BIOL 101-General Biological Science.
- **BIOL 104 (4 cr) -** Not for biology majors. With BIOL 103, satisfies Core Curriculum lab science requirement. Integrated approach to the biology of plants, animals, and microorganisms. Half of the course is centered around reproductive principles bearing on evolution, and the other half is centered around cell physiology. Laboratory topics and sequence are integrated with lecture. Previously BIOL 102-General Biological Science.

BIOL 211 PLUS BIOL 212

- **BIOL 211 (4 cr) -** This introductory course for science majors covers the fundamental principles of biochemistry, genetics, molecular biology and cell biology that apply to all living organisms. Topics addressed in this course include metabolism, cell and membrane function, cellular respiration, photosynthesis, cell cycle, meiosis, classical and molecular genetics, and evolution.
- **BIOL 212 (4 cr) -** This introductory course for science majors explores the diversity of life and organismal biology. Topics addressed in this course include microbial diversity and physiology; plant and animal diversity, growth, reproduction and physiology; and ecology. Prerequisites: BIOL 211. **(8 cr)**

ENVS 201 PLUS ENVS 201 L PLUS ENVS 202 PLUS ENVS 202L

- **ENVS 201 (3 cr) -** This course introduces fundamental concepts in environmental studies, with specific focus on human impacts on ecosystem function and biotic interactions. Students explore interactions between humans and earth's biotic resources, examining topics such as ecosystem conservation, population growth and regulation, food production and pest control. Anthropogenic environmental issues such as biodiversity decline, soil degradation and environmental toxicology and related governmental policies are explored within a social framework that considers both the different environmental impacts and experiences of humans based on geographical region and culture. Previously titled Dimensions of Environmental Science I (4cr). Co-Requisite: ENVS 201L, or permission of Department Chair.
- **ENVS 201 L (1 cr) -** A two hour per week laboratory course focusing on field techniques, equipment and scientific methodologies used in environmental studies, including such topics as microscopy, organism classification, experimental design and interpretation, ecological footprints, biodiversity and food web analysis. Co-Requisite: ENVS 201, or permission of Department Chair.
- **ENVS 202 (3 cr) -** This course introduces fundamental concepts in environmental studies, with specific focus on energy, earth systems and human resource utilization. Students explore interactions between humans and earth's abiotic resources, examining topics such as natural resource extraction, renewable and non-renewable energy production, hydrologic resource use and associated global environmental impacts. Human-induced environmental issues such as global climate change, non-renewable resource consumption and toxic and solid waste production are discussed, as well as key governmental policies around these issues. Concepts are framed within a social context that reveals how humans of different cultures and geographical regions both contribute to and experience various environmental problems differentially. Previously titled Dimensions of Environmental Science II (4cr). Co-Requisite: ENVS 202L, or permission of Department Chair.
- **ENVS 202 L (1 cr) -** A two hour per week laboratory course focusing on field techniques, equipment and scientific methodologies used in environmental studies, including topics such as scientific measurements, energy conversions and calculations, use of topographic maps, compass, and multimeter, water quality analysis, electrical generators, solar and wind power. Co-Requisite: ENVS 202, or permission of Department Chair.

MATHEMATICS (4 CREDITS)

CHOOSE ONE OF THE FOLLOWING:

- **MATH 205 – Calculus with Applications (4 cr) -** Topics in differential and integral calculus, with stress on their applications in business, biology, social, and behavioral sciences. Prerequisites: MATH 108 or satisfactory math placement score.
- **MATH 207 – Calculus I (4 cr) -** Fundamental concepts of calculus, using analytic geometry. After preliminaries about the real number system, intervals, and functions, properties of limits are carefully stated. These are used to develop standard differentiation formulas. Applications of the derivative (as a rate of change) are stressed in a wide variety of problems. Introduction to integration via anti-differentiation and area and the fundamental theorem. Applications of the integral (volumes, arc length, surface area, etc.). Prerequisites: MATH 108 or satisfactory math placement score.

PHYSICS CORE (8 CREDITS)

CHOOSE ONE OF THE FOLLOWING:

- **PHYS 201 – College Physics (3 cr) AND PHYS 201 L (1 cr)**
  - **PHYS 201 -** An algebra- and trigonometry-based treatment of the fundamentals of selected classical physics topics including motion, force, Newton's laws, energy, momentum, gravitation, rotation, acoustics, fluid dynamics, and thermodynamics. Co-Requisite: PHYS 201L must be taken concurrently with PHYS 201.
  - **PHYS 201 L -** A two hour per week laboratory course focusing on selected classical physics topics including motion, force, Newton's laws, energy, momentum, gravitation, rotation, acoustics, fluid dynamics, and thermodynamics. Co-Requisite: Must be taken concurrently with PHYS 201.
- **PHYS 221 – General Physics I (3 cr) AND PHYS 221 L (1 cr)**
  - **PHYS 221 -** A calculus-based treatment of fundamentals of selected classical physics topics including motion, force, Newton's laws, energy, momentum, gravitation, rotation, acoustics, fluid dynamics, and thermodynamics. PHYS 221L must be taken concurrently with PHYS 221. Prerequisite/ Co-Requisite: MATH 207.
  - **PHYS 221 L -** A two hour per week laboratory course focusing on selected classical physics topics including motion, force, Newton's laws, energy, momentum, gravitation, rotation, acoustics, fluid dynamics, and thermodynamics. Co-Requisite: Must be taken concurrently with PHYS 221.

CHOOSE ONE OF THE FOLLOWING:

- **PHYS 202 – College Physics II (3 cr) AND PHYS 202 L (1 cr)**
  - **PHYS 202 -** An algebra- and trigonometry-based treatment of the fundamentals of selected classical and modern physics topics including acoustics, fluid dynamics, thermodynamics, electromagnetism, optics, relativity, and quantum mechanics. Prerequisites: PHYS 201. Co-Requisite: PHYS 202L must be taken concurrently with PHYS 202.
  - **PHYS 202 L -** A two hour per week laboratory course focusing on selected classical and modern physics topics including acoustics, fluid dynamics, thermodynamics, electromagnetism, optics, relativity, and quantum mechanics. Prerequisites: PHYS 201L. Co-Requisite: Must be taken concurrently with PHYS 202.
- **PHYS 222 – General Physics II (3 cr) AND PHYS 222 L (1 cr)**
  - **PHYS 222 -** A calculus-based treatment of the fundamentals of selected classical and modern physics topics including acoustics, fluid dynamics, thermodynamics, electromagnetism, optics, relativity, and quantum mechanics. Prerequisites: PHYS 221. Co-Requisite: PHYS 222L must be taken concurrently with PHYS 222.
  - **PHYS 222 L -** A two hour per week laboratory course focusing on selected classical and modern physics topics including acoustics, fluid dynamics, thermodynamics, electromagnetism, optics, relativity, and quantum mechanics. Must be taken concurrently with PHYS 222. Prerequisites: PHYS 221L.
- **PHYS 301 – Energy (4 cr)** In this course students will learn fundamentals of how energy is converted from one form to another and utilized to do useful work. These fundamentals are essential to our energy-intensive civilization and important for understanding humankind's impact on the environment and utilization of natural resources. Topics will include thermodynamics processes, heat engines, heat transfer, electromagnetic induction, nuclear physics, and the photoelectric effect. Previously titled Physics of Energy (3cr). Prerequisites: Any 4-credit Core Curriculum science class, or Permission of Instructor.

CHEMISTRY CONTENT SPECIALIZATION (20 CREDITS)

- **CHEM 207 – General Chemistry 1 (3 cr)** CHEM 207 and its companion lab, CHEM 207L, are the first part of a two-semester sequence that serves as an introduction to modern chemistry for students majoring in the sciences. The course provides a basis for, and is a prerequisite for, advanced courses in chemistry, biochemistry and molecular biology. Science majors, premedical and other pre-professional students should take this course. The topics covered include measurements and units, atomic and molecular structure, periodic properties of the elements, chemical bonding, stoichiometry, chemical reactivity, thermochemistry, and the structure and properties of gases, liquids and solids. This course, along with CHEM 207L, CHEM 209, and CHEM 209L, fulfills the Core Curriculum Laboratory Sciences requirement. Prerequisites: Background in high school chemistry or CHEM 105 or permission of instructor. Prerequisite/ Co-Requisite: MATH 105, MATH 108, MATH 205, MATH 207, or appropriate placement score, or permission of instructor. Co-Requisite**: It is recommended, but not required, that CHEM 207L be taken concurrently.**
- ***CHEM 207L - General Chemistry I Laboratory*** *(1 cr) CHEM 207L is a laboratory course that is designed to accompany CHEM 207. The course provides a basis for, and is a prerequisite for, advanced courses in chemistry, biochemistry and molecular biology. Science majors, premedical and other pre-professional students should take this course. The topics covered include measurements and units, basic laboratory techniques, quantitative analysis, qualitative analysis, spectrophotometric analysis, gravimetric analysis, stoichiometry, thermochemistry and chromatography. This course, along with CHEM 207, CHEM 209, and CHEM 209L, fulfills the Core Curriculum Laboratory Sciences requirement. Prerequisites: Background in high school chemistry or CHEM 105 or permission of instructor. Prerequisite/corequisite: MATH 105, MATH 108, MATH 205, MATH 207, or appropriate placement score, or permission of instructor. Co-Requisite:* ***It is recommended, but not required, that CHEM 207 be taken concurrently.***
- ***CHEM 209 - General Chemistry II*** *(3 cr) CHEM 209 and its associated lab, CHEM 209L, are the second part of a two-semester sequence that serves as an introduction to modern chemistry for students majoring in the sciences. The course provides a basis for, and is a prerequisite for, advanced courses in chemistry, biochemistry and molecular biology. Science majors, premedical and other pre-professional students should take this course. The topics covered include equilibrium, acid-base chemistry, solutions and solubility, electrochemistry, chemical kinetics, nuclear chemistry and an introduction to organic chemistry. This course, along with CHEM 207, CHEM 207L, and CHEM 209L, fulfills the Core Curriculum Laboratory Sciences requirement. Prerequisites: CHEM 207. Co-Requisite:* ***It is recommended, but not required, that CHEM 209L be taken concurrently.***
- ***CHEM 209L - General Chemistry II Laboratory*** *(1 cr) CHEM 209L is a laboratory course that is designed to accompany CHEM 209. The course provides a basis for, and is a prerequisite for, advanced courses in chemistry, biochemistry and molecular biology. Science majors, premedical and other pre-professional students should take this course. The topics covered include volumetric analysis, chromatography, spectroscopy, acid-base chemistry, electrochemistry, colligative properties and organic and inorganic synthesis. This course, along with CHEM 207, CHEM 207L, and CHEM 209, fulfills the Core Curriculum Laboratory Sciences requirement. Prerequisites: CHEM 207 and CHEM 207L. Co-Requisite:* ***It is recommended, but not required, that CHEM 209 be taken concurrently.***
- **CHEM 315 – Organic Chemistry I (3 cr)** This course introduces the fundamental concepts of structure and reactivity of organic compounds. Topics covered include the chemistry of alkanes, alkyl halides, alkenes, and other functional groups. Reaction mechanisms, stereochemistry, and spectroscopy of organic compounds are emphasized. Previously titled Organic Chemistry. Prerequisites: CHEM 207. Co-Requisite: **It is strongly recommended, but not required, that CHEM 315L be taken concurrently**.
- **CHEM 315 L – Organic Chemistry I Laboratory (1 cr)** This course introduces organic synthesis, mechanistic studies, molecular modeling, and modern techniques for the separation and characterization of organic compounds. TLC, GC-MS, IR, NMR, distillation, and polarimetry are emphasized. Prerequisites: CHEM 207L and CHEM 209L. Prerequisite/ Co-Requisite: **Current or prior enrollment in CHEM 315 is required.**
- **CHEM 316 - Organic Chemistry II (3 cr)** This course is a continuation of the topics introduced in CHEM 315, with a focus on alkynes, aromatic compounds, and compounds with oxygen-based functional groups. This course focuses on and emphasizes understanding the reaction mechanisms these molecules undergo during synthetic reactions. Previously titled Organic Chemistry. Prerequisites: CHEM 209 and CHEM 315. Co-Requisite: **It is strongly recommended, but not required that CHEM 316L be taken concurrently.**
- **CHEM 316 L – Organic Chemistry II Laboratory (1 cr)** This course continues exploring routes of organic synthesis, mechanistic studies, molecular modeling, and modern techniques for the separation and characterization of organic compounds. Distillation, GC-MS, IR, and NMR studies are expanded. Prerequisites: CHEM 315 and CHEM 315L. Prerequisite/ Co-Requisite: **Current or prior enrollment in CHEM 316 is required**.
- **CHEM 329 – Biochemistry I (3 cr)** Biochemical structure and function with initial emphasis placed on the properties of carbohydrates, lipids, and proteins and the relationship between structure and function. This is followed by an introduction to enzymes and the mechanisms of enzyme action. A discussion of the structure and function of biological membranes is then presented. Attention is then given to the nucleic acids and includes the genetic role, structure, and replication of DNA and the role of RNA in protein synthesis. Prerequisites: CHEM 315 and BIOL 305.
- **CHEM 329 L – Biochemistry I Laboratory (1 cr)** A three-hour per week laboratory course to be taken with CHEM 329 - Biochemistry I. The course will comprise an overview and application of techniques associated with biochemical research, data gathering, and analysis. The students will be introduced to various computer-based methodologies of data analysis, molecular modelling and presentation. In addition, the course will involve development of experimental design, reproducible lab techniques, and record keeping. Prerequisite/ Co-Requisite: **CHEM 329.**

ENVIRONMENTAL CHEMISTRY ELECTIVES (3 - 4 CREDITS)

CHOOSE FROM THE FOLLOWING:

- **CHEM 250 – Introduction to Forensic Science (3 cr) OR CHEM 350 – Forensic Chemistry (3 cr)**
- **CHEM 301 – Inorganic Chemistry (3 cr) PLUS CHEM 301 L Inorganic Chemistry Laboratory (1 cr)**
- **CHEM 333 – Environmental Chemistry (3 cr) PLUS CHEM 333 L Environmental Chemistry Laboratory (1 cr)**
- **ENVS 202 – Foundations in Environmental Science (3 cr) PLUS ENVS 202 L Foundations in Environmental Science Laboratory (1 cr)**
- **GSCI 104 – General Physical Science (4 cr) OR GSCI 301 – Physical Geology (4 cr) OR GSCI 302 – General Astronomy (4 cr)**

STEM AND SUPPORTING CONTENT ELECTIVES (9 - 12 CREDITS)

BIOL, CHEM, CIS, CIT, CPE, DATA, ENGR, ENVS, GSCI, MATH, PHYS, PSYC courses / may include up to 4 credits of research course(s) as approved by the Science Education Coordinator. [Excludes 392 Co-Op Courses]

Visit the following link for a current and detailed description of this program / these course choices:
Chemistry Teaching Field Grades 9-Adult, B.A.

BA / General Science Teaching Field [Grades 5-Adult] (YRL Residency)
Four-Year Course Progression (Eff. Fall 2024)

FALL		FIRST YEAR		SPRING		FIRST YEAR	
Sub./Course No.	**Tier**	**Title**	**Credit**	**Sub./Course No.**	**Tier**	**Title**	**Credit**
ENGL 101	1	Writing-Rhetoric I	3	ENGL 102	1	Writing-Rhetoric II	3
Core Curriculum		Choose Math (MA) with Advisor*	3-4	Core Curriculum	2	Choose Wellness (WE) with Advisor *	3
Core Curriculum		Choose Life Science I (LS) with Advisor*	4	Core Curriculum		Choose Life Science II (LS) with Advisor*	4
EDUC 150*	1	Seminar in Education (FYEX)	1	CHEM 209/209L	1	General Chem/Lab II	4
CHEM 207/207L	1	General Chem/Lab I	4	Core Curriculum	1	Choose HIST 1XX w Advisor*	3
Take Praxis I CASE (See below.)*		**TOTAL**	**15-16**			**TOTAL**	**17**

FALL		SECOND YEAR		SPRING		SECOND YEAR	
Sub./Course No.	**Tier**	**Title**	**Credit**	**Sub./Course No.**	**Tier**	**Title**	**Credit**
EDUC 200*		Foundations of Education (SO-MD)	3	PHYS or GCSI Elective		Physical Elective*	4
PHYS or GCSI Elective		Physical Elective*	4	GSCI Elective		Earth and Space Science Elective: Astronomy *	4
Core Curriculum (Social Sciences)	2	Choose CK, GL, OR MD with Advisor*	3	Core Curriculum (Humanities)	2	Choose CK, GL, OR MD with Advisor*	3
COMM 202	1	Fundamentals of Speech (HM-GL)	3	Core Curriculum (Arts)	2	Choose CK, GL, OR MD with Advisor*	3
BIOL 303 OR ENVS 403		Ecological Science Elective*	4	**EDUC 360***	2	Survey of Exceptional Children (SO-MD)	3
Take Praxis I CASE (See below.)*		**TOTAL**	**17**	***Take Praxis I CASE (See below.)****		**TOTAL**	**17**

FALL		THIRD YEAR			SPRING		THIRD YEAR	
Sub./Course No.	**Tier**	**Title**	**Credit**		**Sub./Course No.**	**Tier**	**Title**	**Credit**
EDUC 320*	2	Social / Psychological Conditions of Learning	4	JUNCTURE 1 / ADMISSION TO EPP REQUIRED TO PROCEED	General Science Elective 2		Select with Advisor * Approval Required *	4
GSCI Elective		Earth and Space Science Elective 2: Geology *	4		General Science Elective 3		Select with Advisor * Approval Required *	4
General Science Elective 1		Select with Advisor * Approval Required *	3-4		GSCI XXXX or ENVS 202		Earth and Space Science Elective 3: Meteorology *	4
EDUC 380		Innovative Technology	3		**EDUC 370**		Creating Learning Environments	3
APPLY FOR JUNCTURE 1		**TOTAL**	**14-15**		***Take Praxis II (REQUIRED)***		**TOTAL**	**15**

FALL		FOURTH YEAR		SPRING		FOURTH YEAR	
Sub./Course No.	**Tier**	**Title**	**Credit**	**Sub./Course No.**	**Tier**	**Title**	**Credit**
General Science Elective 4		Select with Advisor * Approval Required *	4	EDUC 459		Residency II, Gr. 5-12 (CP)	9
EDUC 400		Inclusion in the Regular Classroom	3	EDUC 461**		Student Teaching Seminar (WM)	3
EDUC 443		Reading in the Content Area	3				
EDUC 423		Special Methods of Teaching Science	3			**TOTAL**	**12**
EDUC 375		Residency I	0				
APPLY FOR JUNCTURE 2		**TOTAL**	**13**			**DEGREE TOTAL**	**120**
*****EDUC 461 is designated as the Writing in the Major [WM] course for Education.***						**Science Educ. / Gen. Science 5-Adult, B.A.**	

***NOTE: All Electives must be approved by the Science Specialization Coordinator for each student. Coursework must include information processing and other supporting content as required for teacher certification.**

General Science Specialty Courses

Required Coursework from the Core

- **CHEM 207 - General Chemistry I (3 cr)** CHEM 207 and its companion lab, CHEM 207L, are the first part of a two-semester sequence that serves as an introduction to modern chemistry for students majoring in the sciences. The course provides a basis for, and is a prerequisite for, advanced courses in chemistry, biochemistry and molecular biology. Science majors, premedical and other pre-professional students should take this course. The topics covered include measurements and units, atomic and molecular structure, periodic properties of the elements, chemical bonding, stoichiometry, chemical reactivity, thermochemistry, and the structure and properties of gases, liquids and solids. This course, along with CHEM 207L, CHEM 209, and CHEM 209L, fulfills the Core Curriculum Laboratory Sciences requirement. Prerequisites: Background in high school chemistry or CHEM 105 or permission of instructor. Prerequisite/ Co-Requisite: MATH 105, MATH 108, MATH 205, MATH 207, or appropriate placement score, or permission of instructor. Co-Requisite**: It is recommended, but not required, that CHEM 207L be taken concurrently.**
- **CHEM 207L - General Chemistry I Laboratory** (1 cr) CHEM 207L is a laboratory course that is designed to accompany CHEM 207. The course provides a basis for, and is a prerequisite for, advanced courses in chemistry, biochemistry and molecular biology. Science majors, premedical and other pre-professional students should take this course. The topics covered include measurements and units, basic laboratory techniques, quantitative analysis, qualitative analysis, spectrophotometric analysis, gravimetric analysis, stoichiometry, thermochemistry and chromatography. This course, along with CHEM 207, CHEM 209, and CHEM 209L, fulfills the Core Curriculum Laboratory Sciences requirement. Prerequisites: Background in high school chemistry or CHEM 105 or permission of instructor. Prerequisite/corequisite: MATH 105, MATH 108, MATH 205, MATH 207, or appropriate placement score, or permission of instructor. Co-Requisite: **It is recommended, but not required, that CHEM 207 be taken concurrently.**
- **CHEM 209 - General Chemistry II** (3 cr) CHEM 209 and its associated lab, CHEM 209L, are the second part of a two-semester sequence that serves as an introduction to modern chemistry for students majoring in the sciences. The course provides a basis for, and is a prerequisite for, advanced courses in chemistry, biochemistry and molecular biology. Science majors, premedical and other pre-professional students should take this course. The topics covered include equilibrium, acid-base chemistry, solutions and solubility, electrochemistry, chemical kinetics, nuclear chemistry and an introduction to organic chemistry. This course, along with CHEM 207, CHEM 207L, and CHEM 209L, fulfills the Core Curriculum Laboratory Sciences requirement. Prerequisites: CHEM 207. Co-Requisite: **It is recommended, but not required, that CHEM 209L be taken concurrently.**
- **CHEM 209L - General Chemistry II Laboratory** (1 cr) CHEM 209L is a laboratory course that is designed to accompany CHEM 209. The course provides a basis for, and is a prerequisite for, advanced courses in chemistry, biochemistry and molecular biology. Science majors, premedical and other pre-professional students should take this course. The topics covered include volumetric analysis, chromatography, spectroscopy, acid-base chemistry, electrochemistry, colligative properties and organic and inorganic synthesis. This course, along with CHEM 207, CHEM 207L, and CHEM 209, fulfills the Core Curriculum Laboratory Sciences requirement. Prerequisites: CHEM 207 and CHEM 207L. Co-Requisite: **It is recommended, but not required, that CHEM 209 be taken concurrently.**

CHOOSE ONE OF THE FOLLOWING [3 – 4 cr]:

- **MATH 314 Statistics (3 cr)**
- **MATH 105 College Algebra (3 cr)**
- **MATH 108 Precalculus (4 cr)**
- **MATH 205 Calculus with Applications (4 cr)**
- **MATH 207 Calculus (4 cr)**

REQUIRED LIFE SCIENCE CORE (8 CREDITS)

CHOOSE ONE OF THE FOLLOWING:

- **BIOL 103 PLUS BIOL 104 (8 cr)**
  - **BIOL 103 (4 cr) -** Not for biology majors. With BIOL 104, satisfies Core Curriculum lab science requirement. Integrated approach to the biology of plants, animals, and microorganisms. Half of the course is centered around ecological principles, and the other half is centered around organismic homeostatic (regulatory) principles. Laboratory topics and sequence are integrated with lecture. Previously BIOL 101-General Biological Science.
  - **BIOL 104 (4 cr) -** Not for biology majors. With BIOL 103, satisfies Core Curriculum lab science requirement. Integrated approach to the biology of plants, animals, and microorganisms. Half of the course is centered around reproductive principles bearing on evolution, and the other half is centered around cell physiology. Laboratory topics and sequence are integrated with lecture. Previously BIOL 102-General Biological Science.
- **BIOL 211 PLUS BIOL 212 (8 cr)**
  - **BIOL 211 (4 cr) -** This introductory course for science majors covers the fundamental principles of biochemistry, genetics, molecular biology and cell biology that apply to all living organisms. Topics addressed in this course include metabolism, cell and membrane function, cellular respiration, photosynthesis, cell cycle, meiosis, classical and molecular genetics, and evolution.
  - **BIOL 212 (4 cr) -** This introductory course for science majors explores the diversity of life and organismal biology. Topics addressed in this course include microbial diversity and physiology; plant and animal diversity, growth, reproduction and physiology; and ecology. Prerequisites: BIOL 211. **(8 cr)**
- **ENVS 201 PLUS ENVS 201 L PLUS ENVS 202 PLUS ENVS 202L (8 cr)**
  - **ENVS 201 (3 cr) -** This course introduces fundamental concepts in environmental studies, with specific focus on human impacts on ecosystem function and biotic interactions. Students explore interactions between humans and earth's biotic resources, examining topics such as ecosystem conservation, population growth and regulation, food production and pest control. Anthropogenic environmental issues such as biodiversity decline, soil degradation and environmental toxicology and related governmental policies are explored within a social framework that considers both the different environmental impacts and experiences of humans based on geographical region and culture. Previously titled Dimensions of Environmental Science I (4cr). Co-Requisite: ENVS 201L, or permission of Department Chair.
  - **ENVS 201 L (1 cr) -** A two hour per week laboratory course focusing on field techniques, equipment and scientific methodologies used in environmental studies, including such topics as microscopy, organism classification, experimental design and interpretation, ecological footprints, biodiversity and food web analysis. Co-Requisite: ENVS 201, or permission of Department Chair.
  - **ENVS 202 (3 cr) -** This course introduces fundamental concepts in environmental studies, with specific focus on energy, earth systems and human resource utilization. Students explore interactions between humans and earth's abiotic resources, examining topics such as natural resource extraction, renewable and non-renewable energy production, hydrologic resource use and associated global environmental impacts. Human-induced environmental issues such as global climate change, non-renewable resource consumption and toxic and solid waste production are discussed, as well as key governmental policies around these issues. Concepts are framed within a social context that reveals how humans of different cultures and geographical regions both contribute to and experience various environmental problems differentially. Previously titled Dimensions of Environmental Science II (4cr). Co-Requisite: ENVS 202L, or permission of Department Chair.
  - **ENVS 202 L (1 cr) -** A two hour per week laboratory course focusing on field techniques, equipment and scientific methodologies used in environmental studies, including topics such as scientific measurements, energy conversions and calculations, use of topographic maps, compass, and multimeter, water quality analysis, electrical generators, solar and wind power. Co-Requisite: ENVS 202, or permission of Department Chair.

REQUIRED EARTH & SPACE SCIENCE CORE (11 - 16 CREDITS)

MUST HAVE AT LEAST ONE 300-LEVEL COURSE FROM AMONG THE THREE GROUPS / MUST HAVE AT LEAST ONE COURSE FROM EACH GROUP.

- **ASTRONOMY [4 – 8 CREDITS] – CHOOSE ONE:**
  - **GSCI 302 – General Astronomy (4 cr) -** A descriptive course dealing with the physical nature of the planets and stars as seen through modern astronomy. The history of astronomical observation and development of modern principles along with properties of electromagnetic radiation and gravitation are included in the course. Three hours lecture and two hours lab per week.
  - **GSCI 101 – Astronomy I (4 cr) PLUS GSCI 102 – Astronomy II (4 cr)**
    - **GSCI 101 -** An introductory survey course in astronomy covering aspects of observational astronomy and the solar system. Historical developments, discoveries, and advances also will be discussed, compared, and contrasted. Three one-hour lectures and one two-hour lab per week.

        - **GSCI 102 -** This course will cover aspects of astronomy such as stellar formation and evolution, galaxies, and cosmology. Recent discoveries with fundamental implications for modern astronomy also will be explored. Three one-hour lectures and one two-hour lab per week.

- **GEOLOGY [4 CREDITS] – CHOOSE ONE:**
    - **GSCI 301 – Physical Geology (4 cr) -** A combined course in physical and historical geology dealing with the composition, structure and history of planet Earth. Minerals, rocks, tectonic processes, and physical characteristics of the earth's surface will be emphasized in the physical component. Evolution, fossils, and the changing conditions and organisms throughout geologic time constitute the historical component. Three hours lecture and two hours lab per week.
    - **GSCI 104 – General Physical Science (4 cr) -** A survey course in physical science encompassing astronomy, meteorology, and geology. The principles and applications presented are characteristic of introductory courses in those separate areas. Scientific approaches to problem-solving and the interdependency of the areas of science are emphasized. This course will meet in three one-hour lectures and one two-hour laboratory session.

- **METEOROLOGY [3 – 4 CREDITS] – CHOOSE ONE:**
    - **GSCI 303 – Meteorology (4 cr) -** A course dealing with the composition and structure of the atmosphere, the energy which drives it, and the physical processes involved in weather phenomena. The gathering and analysis of pertinent data are emphasized. Weather forecasting and climatology are also considered. Three hours lecture and two hours lab per week.
    - **ENVS 202 – Foundations in Environmental Science II (3 cr) -** This course introduces fundamental concepts in environmental studies, with specific focus on energy, earth systems and human resource utilization. Students explore interactions between humans and earth's abiotic resources, examining topics such as natural resource extraction, renewable and non-renewable energy production, hydrologic resource use and associated global environmental impacts. Human-induced environmental issues such as global climate change, non-renewable resource consumption and toxic and solid waste production are discussed, as well as key governmental policies around these issues. Concepts are framed within a social context that reveals how humans of different cultures and geographical regions both contribute to and experience various environmental problems differentially. Previously titled *Dimensions of Environmental Science II* (4cr). Co-Requisite: ENVS 202L, or permission of Department Chair.
    - **GSCI 104 – General Physical Science (4 cr) -** A survey course in physical science encompassing astronomy, meteorology, and geology. The principles and applications presented are characteristic of introductory courses in those separate areas. Scientific approaches to problem-solving and the interdependency of the areas of science are emphasized. This course will meet in three one-hour lectures and one two-hour laboratory session.

- **PHYSICAL SCIENCE [8 CREDITS] – CHOOSE FROM THE FOLLOWING:**
    - **PHYS 201 – College Physics (3 cr) AND PHYS 201 L (1 cr) AND PHYS 202 – College Physics II (3 cr) AND PHYS 202 L (1 cr)**
        - **PHYS 201 -** An algebra- and trigonometry-based treatment of the fundamentals of selected classical physics topics including motion, force, Newton's laws, energy, momentum, gravitation, rotation, acoustics, fluid dynamics, and thermodynamics. Co-Requisite: PHYS 201L must be taken concurrently with PHYS 201.
        - **PHYS 201 L -** A two hour per week laboratory course focusing on selected classical physics topics including motion, force, Newton's laws, energy, momentum, gravitation, rotation, acoustics, fluid dynamics, and thermodynamics. Co-Requisite: Must be taken concurrently with PHYS 201.
        - **PHYS 202 -** An algebra- and trigonometry-based treatment of the fundamentals of selected classical and modern physics topics including acoustics, fluid dynamics, thermodynamics, electromagnetism, optics, relativity, and quantum mechanics. Prerequisites: PHYS 201. Co-Requisite: PHYS 202L must be taken concurrently with PHYS 202.
        - **PHYS 202 L -** A two hour per week laboratory course focusing on selected classical and modern physics topics including acoustics, fluid dynamics, thermodynamics, electromagnetism, optics, relativity, and quantum mechanics. Prerequisites: PHYS 201L. Co-Requisite: Must be taken concurrently with PHYS 202.
    - **PHYS 221 – General Physics I (3 cr) AND PHYS 221 L (1 cr) AND PHYS 222 – General Physics II (3 cr) AND PHYS 222 L (1 cr)**
        - **PHYS 221 -** A calculus-based treatment of fundamentals of selected classical physics topics including motion, force, Newton's laws, energy, momentum, gravitation, rotation, acoustics, fluid dynamics, and thermodynamics. PHYS 221L must be taken concurrently with PHYS 221. Prerequisite/ Co-Requisite: MATH 207.
        - **PHYS 221 L -** A two hour per week laboratory course focusing on selected classical physics topics including motion, force, Newton's laws, energy, momentum, gravitation, rotation, acoustics, fluid dynamics, and thermodynamics. Co-Requisite: Must be taken concurrently with PHYS 221.
        - **PHYS 222 -** A calculus-based treatment of the fundamentals of selected classical and modern physics topics including acoustics, fluid dynamics, thermodynamics, electromagnetism, optics, relativity, and quantum mechanics. Prerequisites: PHYS 221. Co-Requisite: PHYS 222L must be taken concurrently with PHYS 222.
        - **PHYS 222 L -** A two hour per week laboratory course focusing on selected classical and modern physics topics including acoustics, fluid dynamics, thermodynamics, electromagnetism, optics, relativity, and quantum mechanics. Must be taken concurrently with PHYS 222. Prerequisites: PHYS 221L.
    - **CHOOSE TWO OF THE FOLLOWING:**
        - **GSCI 103 – General Physical Science (4 cr) -** A survey course designed to explore the major physical phenomena in the natural sciences, encompassing a study of motion, energy, electromagnetism, waves (light and sound), and atomic and nuclear physics. The course will meet in three one-hour lectures and one two-hour laboratory session.
        - **PHYS 301 – Energy (4 cr) -** In this course students will learn fundamentals of how energy is converted from one form to another and utilized to do useful work. These fundamentals are essential to our energy-intensive civilization and important for understanding humankind's impact on the environment and utilization of natural resources. Topics will include thermodynamics processes, heat engines, heat transfer, electromagnetic induction, nuclear physics, and the photoelectric effect. Previously titled Physics of Energy (3cr). Prerequisites: Any 4-credit Core Curriculum science class, or Permission of Instructor.
        - **PHYS 302 – Physical Computing (4 cr) -** In this course students will learn how to build digital devices to sense and interact with the world around them. Such devices are a ubiquitous part of the built environment and increasingly mediate humankind's interactions and relationships with both the built and the natural environments. Topics will include electric circuits, passive and active electronic components, microcontroller programming, analog-to-digital and digital-to-analog conversion, and wired and wireless serial communication. At the end of the semester students will work in groups to fabricate and demonstrate physical computers of their own design. Prerequisites: Any 4-credit Core Curriculum science class, or Permission of Instructor.
- **ECOLOGICAL SCIENCES [4 CREDITS] – CHOOSE FROM THE FOLLOWING:**
    - **ENVS 401 – Conservation Ecology (4 cr) -** An environmentally focused course emphasizing the varied aspects of the structure, function, and perpetuation of ecosystems. Societal impact on ecosystem structure will be considered through discussion and laboratory analysis, with the recognition of ecosystem disruption a major course focus. Representative topic areas include analysis of aquatic marine populations, types of ecosystems, population regulation, and energy flow. Prerequisites: ENVS 201 and ENVS 202 (including labs), or BIOL 208 and BIOL 209.
    - **BIOL 303 – General Ecology (4 cr) -** This course is designed to be an introduction into ecological topics spanning population, community, and ecosystem levels of organization. Students will gain an understanding of population growth, community interactions, and energy flow, within the overarching framework of the biotic and abiotic factors that regulate species' distributions, behavior, and evolution. All topics will be discussed in the context of the relationship between humans and the natural environment. *Previously numbered BIOL 420.* Prerequisites: BIOL 211 and BIOL 212; or permission of instructor.

- **GENERAL SCIENCE ELECTIVES [14 – 16 CREDITS]:** BIOL, CHEM, CIS, CIT, CPE, DATA, ENGR, ENVS, GSCI, MATH, PHYS, PSYC courses / may include up to 4 credits of research course(s) as approved by the Science Education Coordinator. [Excludes 392 Co-Op Courses]

Visit the following link for a current / detailed description of this program / these course choices:
General Science Teaching Field Grades 5-Adult, B.A.

2020 NSTA/ASTE Standards for Science Teacher Preparation

Developed by Patricia Morrell, Meredith Park Rogers, Eric Pyle, Gillian Roehrig, William Veal

Standard 1: Content Knowledge
Effective teachers of science understand and articulate the knowledge and practices of contemporary science and engineering. They connect important disciplinary core ideas, crosscutting concepts, and science and engineering practices for their fields of licensure.

Below are the elements of the standard.

Preservice teachers will:

1a) Use and apply the major concepts, principles, theories, laws, and interrelationships of their fields of licensure and supporting fields. Explain the nature of science and the cultural norms and values inherent to the current and historical development of scientific knowledge.

1b) Demonstrate knowledge of crosscutting concepts, disciplinary core ideas, practices of science and engineering, the supporting role of science-specific technologies, and contributions of diverse populations to science.

1c) Demonstrate knowledge of how to implement science standards, learning progressions, and sequencing of science content for teaching their licensure level PK-12 students.

Standard 2: Content Pedagogy
Effective teachers of science plan learning units of study and equitable, culturally-responsive opportunities for *all* students based upon their understandings of how students learn and develop science knowledge, skills, and habits of mind. Effective teachers also include appropriate connections to science and engineering practices and crosscutting concepts in their instructional planning.

Below are the elements of the standard.

Preservice teachers will design lessons:

2a) Using science standards and a variety of appropriate, student-centered, and culturally-relevant science disciplinary-based instructional approaches that follow safety procedures and incorporate science and engineering practices, disciplinary core ideas, and crosscutting concepts.

2b) Incorporating appropriate differentiation strategies, wherein *all* students develop conceptual knowledge and an understanding of the nature of science. Lessons should engage students in applying science practices, clarifying relationships, and identifying natural patterns from empirical experiences.

2c) Using engineering practices in support of science learning wherein all students design, construct, test, and optimize possible solutions to a problem.

2d) Aligning instruction and assessment strategies to support instructional decision making that identifies and addresses student misunderstandings, prior knowledge, and naïve conceptions.

2e) Integrating science-specific technologies to support *all* students' conceptual understanding of science and engineering.

Standard 3: Learning Environments
Effective teachers of science are able to plan for engaging *all* students in science learning by identifying appropriate learning goals that are consistent with knowledge of how students learn science and are aligned with standards. Plans reflect the selection of phenomena appropriate to the social context of the classroom and community, and safety considerations, to engage students in the nature of science and science and engineering practices. Effective teachers create an anti-bias, multicultural, and social justice learning environment to achieve these goals.

Below are the elements of the standard.

Preservice teachers will:

3a) Plan a variety of lesson plans based on science standards that employ strategies that demonstrate their knowledge and understanding of how to select appropriate teaching and motivating learning activities that foster an inclusive, equitable, and anti-bias environment.

3b) Plan learning experiences for *all* students in a variety of environments (e.g., the laboratory, field, and community) within their fields of licensure.

3c) Plan lessons in which *all* students have a variety of opportunities to investigate, collaborate, communicate, evaluate, learn from mistakes, and defend their own explanations of: scientific phenomena, observations, and data.

Standard 4: Safety
Effective teachers of science demonstrate biological, chemical, and physical safety protocols in their classrooms and workspace. They also implement ethical treatment of living organisms and maintain equipment and chemicals as relevant to their fields of licensure.

Below are the elements of the standard.

Preservice teachers will:

4a) Implement activities appropriate for the abilities of *all* students that demonstrate safe techniques for the procurement, preparation, use, storage, dispensing, supervision, and disposal of all chemicals/materials/equipment used within their fields of licensure.

4b) Demonstrate an ability to: recognize hazardous situations including overcrowding; implement emergency procedures; maintain safety equipment; provide adequate student instruction and supervision; and follow policies and procedures that comply with established state and national guidelines, appropriate legal state and national safety standards (e.g., OSHA, NFPA, EPA), and best professional practices (e.g., NSTA, NSELA).

4c) Demonstrate ethical decision-making with respect to safe and humane treatment of all living organisms in and out of the classroom, and comply with the legal restrictions and best professional practices on the collection, care, and use of living organisms as relevant to their fields of licensure.

Standard 5: Impact on Student Learning
Effective teachers of science provide evidence that students have learned and can apply disciplinary core ideas, crosscutting concepts, and science and engineering practices as a result of instruction.
Effective teachers analyze learning gains for individual students, the class as a whole, and subgroups of students disaggregated by demographic categories, and use these to inform planning and teaching.

Below are the elements of the standard.

Preservice teachers will:

5a) Implement assessments that show *all* students have learned and can apply disciplinary knowledge, nature of science, science and engineering practices, and crosscutting concepts in practical, authentic, and real-world situations.

5b) Collect, organize, analyze, and reflect on formative and summative evidence and use those data to inform future planning and teaching.

5c) Analyze science-specific assessment data based upon student demographics, categorizing the levels of learner knowledge, and reflect on results for subsequent lesson plans.

Standard 6: Professional Knowledge and Skills
Effective teachers of science strive to continuously improve their knowledge of both science content and pedagogy, including approaches for addressing inequities and inclusion for *all* students in science. They identify with and conduct themselves as part of the science education community.

Below are the elements of the standard.

Preservice teachers will:

6a) Engage in critical reflection on their own science teaching to continually improve their instructional effectiveness.

6b) Participate in professional development opportunities to deepen their science content knowledge and practices.

6c) Participate in professional development opportunities to expand their science-specific pedagogical knowledge.