Physical Science Department

Physical Sciences Degrees, Minors, and Certificates

Chemistry

- Bachelor of Science in Chemistry (catalog.dixie.edu/programs/physical-sciences/chemistry-bs/)
- Bachelor of Science in Molecular Biology - Biochemistry (catalog.dixie.edu/programs/physical-sciences/molecular-biology-biochemistry-bs/)
- Bachelor of Arts / Science in Integrated Studies - Chemistry Emphasis (catalog.dixie.edu/programs/interdisciplinary-arts-and-sciences/integrated-studies-chemistry-ba-bs/)
- Minor in Chemistry (catalog.dixie.edu/programs/physical-sciences/chemistry-minor/)
- Minor in Chemistry Education (catalog.dixie.edu/programs/physical-sciences/chemistry-education-minor/)

Physical Science

- Associate of Science in Earth and Environmental Sciences - Environmental Science Emphasis (catalog.dixie.edu/programs/physical-sciences/earth-environmental-science-envsci-as/)
- Associate of Science in Earth and Environmental Sciences - Geoscience Emphasis (catalog.dixie.edu/programs/physical-sciences/earth-environmental-science-geoscience-as/)
- Bachelor of Science in Earth, Energy, and Environmental Science - Environmental Science Emphasis (catalog.dixie.edu/programs/physical-sciences/earth-energy-environmental-science-envsci-bs/)
- Bachelor of Science in Earth, Energy, and Environmental Science - Geoscience Emphasis (catalog.dixie.edu/programs/physical-sciences/earth-energy-environmental-science-geoscience-bs/)
- Bachelor of Science in Physical Science Composite Teaching, Secondary Education Licensure (catalog.dixie.edu/programs/physical-sciences/physical-science-composite-teaching-bs/)
- Bachelor of Arts / Science in Integrated Studies - Earth Science Emphasis (catalog.dixie.edu/programs/interdisciplinary-arts-and-sciences/integrated-studies-earth-science-ba-bs/)
- Minor in Geoscience (catalog.dixie.edu/programs/physical-sciences/geoscience-minor/)
- Sustainability Certificate (catalog.dixie.edu/programs/physical-sciences/sustainability-certificate/)

Click here for Physical Sciences Website (https://science.dixie.edu/) (following this link will take you out of the University Catalog)

CHEM 1001. FYE: Chemistry. 1 Hour.

Strongly recommended for entering freshmen and transfer students with 0-24 credits interested in the BS degree in chemistry. Designed to help students adapt to college life and become integrated into DSU. Students will refine academic skills, learn about college resources and procedures, and explore different fields of study, degree options, and career opportunities. Multiple listed with all other sections of FYE (all 1001 courses and ENGR 1000). Students may only take one FYE course for credit. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Know their way around Dixie State University. This includes knowing: where to find buildings and services that you may need on campus, what campus services are available to you, how to do things like add classes, drop classes, change your major, check your account balance, use your Dmail, and so on, how to get involved in college life, what your rights and responsibilities are as a student. 2. Know some strategies for dealing with the challenges of college life. This includes: managing your time, staying safe on campus, recognizing and dealing with stress, staying healthy, managing your money, networking with other students and professors, staying motivated when the going gets tough. 3. Know how to succeed academically. This includes knowing how to: use a course syllabus, read a college textbook, talk to your professors, take good notes, write good papers, study effectively, recognize and deal with test anxiety, take tests effectively, avoid academic dishonesty, take advantage of your learning style. 4. Understand your major or area of study. This includes knowing: what General Education is, and how to fulfill the GE requirements, how to chose a major that is right for you, what the course requirements are in your major, how to construct a graduation plan, what kinds of careers your major will prepare you for. FA.

CHEM 1010. Introduction to Chemistry (PS). 3 Hours.

Fulfills General Education Physical Science requirement for students majoring in Business, Communication, Fine Arts, Humanities, and other non-Science disciplines. Emphazizes basic chemical concepts within daily life. CHEM 1015 lab course recommended but not required. Inclusive Access Course Material fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Use the language of chemistry. 2. Use the Periodic Table of Elements to predict the behavior of atoms. 3. Apply chemical skills such as balancing an equation or drawing a Lewis dot structure for a covalent compound. 4. Explain how chemical concepts apply to the world around you and your everyday life. FA, SP, SU.
CHEM 1015. Intro to Chemistry Lab (LAB). 1 Hour.
Lab portion of CHEM 1010. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate correct laboratory techniques and the basis of the scientific method. 2. Collect and present data in a systematic manner. 3. Use common laboratory equipment for their designed purpose or technique. 4. Develop critical thinking skills in order to follow detailed laboratory procedures. 5. Apply general chemistry concepts to laboratory experiments. Course fee required. Corequisite: CHEM 1010. FA, SP.

CHEM 1020. Culinary Chemistry (PS). 3 Hours.
Course content will demonstrate how basic scientific principles underlie everyday aspects of food and cooking; learning about fruits, grains, and meats to sauces and candies. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Know the fundamental principles of food preparation and meal management. 2. Be able to share recipes with class members by practicing at home, planning, and preparing food for the class. 3. Apply chemical principles to the understanding of the physical and natural world. 4. Distinguish between chemical and physical processes and properties of matter. 5. Understand how heat relates to chemical processes. 6. Describe the intermolecular forces which influence the properties of gases, liquids, and solids. FA.

CHEM 1110. Elementary General/Organic Chemistry (PS). 4 Hours.
Fulfills General Education Physical Science requirement for students majoring in Health Sciences, Family & Consumer Science, Natural Resources, or Agriculture. Not appropriate for students majoring in Life Sciences, Physical Sciences, pre-Medical, pre-Dental or other pre-professional program. First semester in a 2-course sequence covering fundamental laws and reactions of general inorganic and organic chemistry, including the basic organic functional groups. Successful completion satisfies prerequisite for CHEM 1120. Inclusive Access Course Material (electronic book) fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Explain and apply the major principles and vocabulary of general and organic chemistry, including the relationships between chemicals and life. 2. Describe and use the periodic table to predict the behavior of elements, compounds, and atoms. 3. Apply basic skills such as balancing chemical equations, drawing Lewis dot structures, and predicting the results of radioactive decay. 4. Discuss basic chemical reactions, organic functional groups in larger molecules, and predicting products of basic chemical reactions. Prerequisites: MATH 1010 or MATH 1040 (All grade C- or higher) or Math Placement score 23 or higher. Corequisites: CHEM 1115. FA, SP, SU.

CHEM 1115. Elem General/Organic Chemistry Lab (LAB). 1 Hour.
Lab portion of CHEM 1110. Successful completion satisfies pre-requisite for CHEM 1125. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate correct laboratory techniques and the basis of the scientific method. 2. Collect and present data in a systematic manner. 3. Use common laboratory equipment for their designed purpose or technique. 4. Develop critical thinking skills in order to follow detailed laboratory procedures. 5. Apply classroom knowledge in general and organic chemistry to laboratory methods and experiments. Course fee required. Corequisite: CHEM 1110. FA, SP, SU.

CHEM 1120. Elem Organic / Bio Chemistry. 4 Hours.
Continuation of CHEM 1110. Second semester in a 2-course sequence covering fundamental laws of carbohydrates, lipids, proteins, biochemical energy, enzymes, and molecular biology, as well as the organic functional groups related to these biochemicals. Successful completion prepares students for further study in Chemistry and Life Sciences. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate knowledge of the skills required to make informed personal and social decisions about the issues we face locally as well as globally. 2. Apply knowledge of basic fundamental laws, concepts and theories in the physical sciences and be able to apply them to everyday life. 3. Apply the process of science -- how scientific knowledge is generated and validated -- so that they can make independent, empirical inquiries about the natural world. 4. Utilize knowledge of the process of science by being able to interpret data in the form of tables, graphs and charge and then communicate those findings in oral or written form. Prerequisite: CHEM 1110 (grade C or higher). Corequisite: CHEM 1125. SP.

CHEM 1125. Elem Organic/Bio Chemistry Lab. 1 Hour.
Lab portion of CHEM 1120. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate correct laboratory techniques and the basis of the scientific method. 2. Collect and present data in a systematic manner. 3. Use common laboratory equipment for their designed purpose or technique. 4. Develop critical thinking skills in order to follow detailed laboratory procedures. 5. Apply classroom knowledge in organic and biological chemistry to laboratory methods and experiments. Course fee required. Prerequisite: CHEM 1115 (Grade C or higher). Corequisite: CHEM 1120. SP.

CHEM 1150. Integrated Chemistry for Health Sciences (PS). 4 Hours.
This is a course designed to introduce relevant chemistry to students interested in the Health Professions. In particular this will meet the needs of pre-Nursing, Dental Hygiene, and other allied health students to become acquainted with key aspects of chemistry. Key aspects of General/ Inorganic, Organic, and Biological Chemistry will be discussed. Four hours of lecture per week. Not appropriate for students majoring in Life Sciences, Physical Sciences, pre-Medical, or pre-Dental programs. Inclusive Access Course Material (electronic book) fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Explain and apply the major principles and vocabulary of general, organic, and biochemistry, including the relationships between chemicals and life. 2. Describe and use the periodic table to predict the behavior of elements, compounds, and atoms. 3. Apply basic skills such as balancing chemical equations, drawing Lewis dot structures, predicting the results of radioactive decay, and identifying organic functional groups. 4. Discuss the chemical processes involved in biological functions such as chemical buffers, protein formation, and carbohydrate metabolism. Prerequisites: MATH 1010 or higher (Grade C- or higher) or equivalent placement score. Corequisites: CHEM 1155. FA, SP.
CHEM 1155. Integrated Chemistry for Health Sciences Laboratory (LAB). 1 Hour.
Lab portion of CHEM 1150. Application of concept in general, organic, and biochemistry to laboratory techniques and experiments. **COURSE
LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Apply correct laboratory techniques and the
basis of the scientific method. 2. Collect and present data in a systematic manner. 3. Utilize common laboratory equipment and demonstrate
knowledge of theory behind the equipment. 4. Develop critical thinking skills in order to follow detailed laboratory procedures. 5. Apply classroom
knowledge in general, organic, and biochemistry to laboratory methods and experiments. Corequisite: CHEM 1150. FA, SP.

CHEM 1200. Preparation for Gen Chemistry (PS). 3 Hours.
For students with little or no background in Chemistry and is designed to prepare students for General Chemistry. Covers basic topics through
lecture and online problems. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1.
Apply chemical principles to the understanding of the physical and natural world. 2. Apply mathematical skills and the mole concept to solve
chemical problems, balancing equations and stoichiometry. 3. Build skills and knowledge required to be successful in university courses in science.
Prerequisite: MATH 1050 (can be concurrently enrolled).

CHEM 1210. Principles of Chemistry I (PS). 4 Hours.
Fulfills General Education Physical Science requirement for students majoring in Life or Physical Sciences, Engineering, and pre-professional
programs (pre-medical, pre-dental, etc.). Provides theoretical and practical framework for further study in the sciences; emphasizes measurement,
stoichiometry, the nature of the atom, chemical periodicity, the states of matter, thermodynamics and bonding. Successful completion satisfies
pre-requisite for CHEM 1220. Completion of a prior Chemistry course is strongly recommended before enrolling in this course. Inclusive Access
Course Material (electronic book) fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs)
At the successful conclusion of this course, students will be able to: 1. Apply chemical principles to the understanding of the physical and natural
world. 2. Utilize mathematical skills and the mole concept to solve chemical problems in balancing reaction equations, mass relationships, stoichiometry
and their application to titrations. 3. Predict atomic structure, chemical bonding or molecular geometry based on theoretical models and results of
empirical studies including periodic trends. 4. Describe the intermolecular forces which influence the properties of gases, liquids, and solids, and
quantitatively determine the physical state of materials. 5. Determine the solubility, concentrations, and ionic properties of compounds dissolved in
aqueous solution. Prerequisites: MATH 1050 or higher (Grade C or higher) or equivalent placement score taken within 2 years prior to enrollment
in this course. Corequisites: CHEM 1215. FA, SP.

CHEM 1215. Principles of Chemistry I Lab (LAB). 1 Hour.
Lab portion of CHEM 1210. Successful completion satisfies pre-requisite for CHEM 1225. **COURSE LEARNING OUTCOMES (CLOs) At the successful
conclusion of this course, students will be able to: 1. Apply chemical principles covered in CHEM 1210 lecture to the understanding of the physical
and natural world. 2. Use basic laboratory equipment and techniques of laboratory measurement and procedure. 3. Apply mathematical models to
the analysis of laboratory data. 4. Record scientific data (including uncertainty) and complete a laboratory report. 5. Distinguish between precision
and accuracy. Course fee required. Corequisite: CHEM 1210. FA, SP.

CHEM 1220. Principles of Chemistry II. 4 Hours.
Continuation of CHEM 1210. Emphasizes kinetics, equilibrium, descriptive chemistry, nuclear chemistry, and special topics. Successful completion
prepares students for and satisfies pre-requisite for CHEM 2310 and further study in life and physical sciences. Inclusive Access Course Material
(electronic book) fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful
conclusion of this course, students will be able to: 1. Describe the nature of molecular interactions by using kinetic data. 2. Apply chemical
principles to the understanding of the physical and natural world. 3. Explain chemical processes and their application to titrations. 4. Describe the
relationship between electrical and chemical energy. 5. Analyze equilibria in aqueous solutions and calculate the concentration of reactants and products at equilibrium. Prerequisites: CHEM 1210 (Grade C- or higher). Corequisites: CHEM 1225. FA, SP.

CHEM 1225. Principles of Chemistry II Lab. 1 Hour.
Lab portion of CHEM 1220. Successful completion satisfies prerequisite for CHEM 2315. **COURSE LEARNING OUTCOMES (CLOs) At the successful
conclusion of this course, students will be able to: 1. Describe the influence of chemical change in the context of environmental situations and
technological applications. 2. Explain the use of basic laboratory equipment and techniques of laboratory measurement and procedure. 3. Apply
mathematical models to the analysis of laboratory data. 4. Discuss experimental observations in the laboratory setting and creating scientific reports
to communicate the information gained. Course fee required. Prerequisites: CHEM 1215 (Grade C- or higher). Corequisites: CHEM 1220. FA, SP.

CHEM 2310. Organic Chemistry I. 4 Hours.
For Chemistry, Biology, pre-Medical, pre-Dental, pre-Optometry, pre-Pharmacy majors, pre-Chiropractic, pre-Medical Technician, and pre-Veterinary
majors. Introduction to functional groups and related reactions, including an introduction to spectroscopy. Successful completion satisfies
prerequisite for CHEM 2320. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Explain
structures (hybridization, geometry, polarity) and compare physical properties (boiling point, melting point, solubility, conformation, stability) of
organic compounds with various functional groups. 2. Name organic molecules using nomenclature, stereochemistry, and spectroscopy to give
systematic names for compounds, draw correct structures, identify and label stereoisomers, recognize the possible stereochemical implications of a
chemical reaction, and characterize and identify organic compounds. 3. Formulate, identify, and/or draw starting materials, reagents, and products
for reactions of alkanes, alkenes, alkynes, and aromatics. 4. Apply mechanistic principles to recognize nucleophiles, electrophiles, acids, and bases,
and correctly draw the mechanisms of selected reactions; use mechanisms to predict regio- and stereoselectivity of products. 5. Apply fundamental
concepts to complex and advanced problems beyond the immediate context, including in making informed decisions in everyday life. Prerequisite:
CHEM 1220 (Grade C- or higher). Corequisite: CHEM 2315. FA, SP.
CHEM 2315. Organic Chemistry I Lab. 1 Hour.
Lab portion of CHEM 2310. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate safe handling and appropriate disposal of laboratory chemicals. 2. Apply knowledge and principles from organic chemistry lecture to hands-on laboratory experiences. 3. Perform appropriate calculations involving mass, moles, equivalents, volume, density, molecular weight, % composition, theoretical yield, % yield, and % recovery. 4. Demonstrate the ability to perform and the following organic laboratory techniques and explain the principles behind them: filtration, rotary evaporation, recrystallization, liquid-liquid extraction, TLC analysis, column chromatography, melting point, boiling point, distillation, and obtaining IR spectra. 5. Run an organic reaction, then isolate, purify, and characterize the products. 6. Write appropriate lab notebook entries which include an introduction, safety information, the reaction to be performed, a data table, a step by step procedure, and accurate and objective observations. 7. Write typewritten discussions which include a restatement of the purpose of the lab, a summary of the procedure used, a discussion of the observations and results obtained, and a conclusion based on this data. Course fee required. Prerequisite: CHEM 1225 (Grade C- or higher). Corequisite: CHEM 2310. FA, SP.

CHEM 2320. Organic Chemistry II. 4 Hours.
A continuation of CHEM 2310. Further study of functional groups and related reactions, including organic reactions necessary for synthesis of larger molecules. Successful completion prepares students for further study in biochemistry and physical chemistry. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Utilize mechanistic principles to recognize nucleophiles and electrophiles, acids and bases, and correctly draw the mechanisms of selected reactions; use mechanisms to predict the regio- and stereo-selectivity of product, and, in depth, the mechanism and kinetics of substitution and elimination reactions (SN1/SN2/E1/E2). 2. Identify, draw, and construct syntheses and reactions of numerous functional groups including: alkyl halides, alcohols, ethers, epoxides, carbonyl compounds, amines, and carbohydrates. 3. Design multi-step reaction sequences to synthesize increasingly complex organic molecules. 4. Pass a standardized Organic Chemistry exam covering the full year's course. 5. Apply fundamental concepts to complex and advanced problems beyond the immediate context, including in making informed decisions in everyday life. Prerequisite: CHEM 2310 (Grade C- or higher). Corequisite: CHEM 2325. FA, SP.

CHEM 2325. Organic Chemistry II Lab. 1 Hour.
Lab portion of CHEM 2320. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Practice safe handling and appropriate disposal of laboratory chemicals. 2. Apply knowledge and principles from organic chemistry lecture to hands-on laboratory experiences. 3. Perform appropriate calculations involving mass, moles, equivalents, volume, density, molecular weight, % composition, theoretical yield, and % yield. 4. Demonstrate the ability to perform the following organic laboratory techniques and explain the principles behind them: filtration, rotary evaporation, recrystallization, liquid-liquid extraction, TLC analysis, column chromatography, melting point, boiling point, distillation, and obtaining IR spectra. 5. Run a variety of organic reactions, then isolate, purify, and characterize the products. 6. Use data from a mass spectrum, IR spectrum, 1H and 13C NMR spectra, chemical test results, and a boiling or melting point to determine the identity of an unknown organic compound. 7. Write an appropriate lab notebook entry including an introduction, important safety information, the reaction to be performed, a data table, a step-by-step procedure, and accurate and objective observations. 8. Write a typewritten discussion which includes a restatement of the purpose of the lab, a summary of the procedure used, a discussion of the observations and results obtained, and a conclusion based on this data. 9. Perform chemical demonstrations suitable for an audience of elementary school children. Course fee required. Prerequisite: CHEM 2315 (Grade C- or higher). Corequisite: CHEM 2320. FA, SP.

CHEM 2700R. Field Methods in Chemistry Research. 1 Hour.
A preparatory course for undergraduate participation in field research projects in chemistry. Repeatable for a maximum of 3 credits. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Collect and organize scientific data from field investigations. 2. Gain familiarity with the context of the particular data set under consideration and will discover how the concepts and skills they are acquiring in their other coursework can be developed through interdisciplinary research. 3. Be prepared for participation in a research project. Course fee required. Prerequisite: CHEM 1215 (Grade B- or higher).

CHEM 2990. Chemistry Seminar and Professional Development. 1 Hour.
Seminar course aimed to help students who have declared a chemistry major prepare for future careers in their field. Seminar and workshop activities will include potential career paths in chemistry and biochemistry, professional development and research experience opportunities, preparing cover letters and resumes/CVs, and the process of applying to graduate programs and jobs. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify potential opportunities as a chemistry degree graduate. 2. Prepare and evaluate professional materials that will be needed to apply for summer and post-graduate jobs and programs. 3. Interact and collaborate with faculty, peer students, and guest speakers in a professional setting. 4. Develop professional skills for interviews and collaborative settings. Prerequisite: Declared as Chemistry or Molecular Biology-Biochemistry major. FA.
CHEM 3060. Physical Chemistry I. 4 Hours.
A problem-oriented course in atomic and molecular structure, states of matter, and chemical kinetics. Introduction to efficient retrieval of information from the physical chemical literature and thinking critically about the material. Students will understand the difference between classical and quantum mechanics, understanding the time, length, and energy scales on which chemical processes occur, and connect common approximation methods to standard chemical frameworks. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand the time, length, and energy scales on which chemical processes occur. 2. Understand the differences between classical and quantum mechanics. 3. Connect operators to observables. 4. Distinguish probabilities, amplitudes, averages, expectation values, and observables. 5. Understand the origin and implications of quantum coherence. 6. Interpret spectra. 7. Connect common approximation methods to standard chemical frameworks (Born-Oppenheimer, molecular orbitals). 8. Develop molecular-level critical thinking skills. Prerequisites: CHEM 2220 and PHYS 2210 (Grade C or higher). SP (even).

CHEM 3065. Physical Chemistry I Lab. 1 Hour.
A problem-oriented course in atomic and molecular structure, states of matter, and chemical kinetics. Introduction to efficient retrieval of information from the physical chemical literature and thinking critically about the material. Students will understand the difference between classical and quantum mechanics, understanding the time, length, and energy scales on which chemical processes occur, and connect common approximation methods to standard chemical frameworks. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand the time, length, and energy scales on which chemical processes occur. 2. Understand the differences between classical and quantum mechanics. 3. Connect operators to observables. 4. Distinguish probabilities, amplitudes, averages, expectation values, and observables. 5. Understand the origin and implications of quantum coherence. 6. Interpret spectra. 7. Connect common approximation methods to standard chemical frameworks (Born-Oppenheimer, molecular orbitals). 8. Develop molecular-level critical thinking skills. Course fee required. Prerequisites: CHEM 2230 and CHEM 2235 (both Grade C or higher), and PHYS 2210 and PHYS 2215 (both Grade C or higher). Corequisite: CHEM 3060. FA (odd).

CHEM 3070. Physical Chemistry II. 4 Hours.
Introduction to microscopic and bulk thermodynamics, partition functions, theory of electrolytes and electrochemistry, and chemical kinetics. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Problem solve and critically think about thermodynamic and kinetic problems and extrapolate solutions based on learned theory. 2. Understand that thermodynamics gives relationship between macroscopic observables and that these can be evaluated using statistical mechanics. 3. Clearly define the conditions of the kinetic-molecular theory and be able to calculate the pressure of an ideal gas from its premises. 4. Take their learning of thermodynamics and kinetics and be able to communicate current knowledge in the field in written form. 5. Define the rate of a reaction. Understand the definition of a rate constant and rate coefficient. Integrate the rate equation for simpler systems. Prerequisites: CHEM 3060 (Grade C or higher) and MATH 2210 (Grade C or higher). FA (odd).

CHEM 3075. Physical Chemistry II Lab. 1 Hour.
A problem-oriented course in atomic and molecular structure, states of matter, and chemical kinetics. Introduction to efficient retrieval of information from the physical chemical literature and thinking critically about the material. Students will understand the kinetics and thermochemistry. The will gain understanding in statistical distributions, mechanistic pathways, and energy scales on which chemical processes occur, and connect common approximation methods to standard chemical frameworks. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Problem solve and critically think about thermodynamic and kinetic problems and extrapolate solutions based on learned theory. 2. Understand that thermodynamics gives relationship between macroscopic observables and that these can be evaluated using statistical mechanics. 3. Clearly define the conditions of the kinetic-molecular theory and be able to calculate the pressure of an ideal gas from its premises. 4. Take their learning of thermodynamics and kinetics and be able to communicate current knowledge in the field in written form. 5. Define the rate of a reaction. Understand the definition of a rate constant and rate coefficient. Integrate the rate equation for simpler systems. Course fee required. Prerequisite: CHEM 2220 and CHEM 2230 and PHYS 2210 (all Grade C or higher). Corequisite: CHEM 3070. SP (even).

CHEM 3100. Inorganic Chemistry. 4 Hours.
Covers current theory and concepts in inorganic chemistry with an emphasis on general trends and periodic properties of the elements and their compounds. Topics include bonding and structure, acid-base theories, redox properties, molecular symmetry, coordination compounds, and crystal-field theory. Students will expand their knowledge of the role of metals in nature and use gained knowledge and critical thinking skills for problem solving. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Apply bonding theories to describe the structure and bonding of inorganic compounds. 2. Use symmetry and group theory to describe bonding and other chemical properties. 3. Understand and predict periodic trends in main group and d-block elements. 4. Explain the mechanisms and predict the products of some common inorganic reactions. 5. Demonstrate the ability to solve basic problems in each of the major areas of inorganic chemistry. Prerequisites: CHEM 2230 and CHEM 2235. FA.

CHEM 3300. Instrumental Analysis. 4 Hours.
Focuses on understanding the theory and practice of modern analytical instrumentation. Course emphasis will be placed on chromatography, optical spectroscopy, mass spectrometry, microscopy as well as sample preparation techniques, statistical data treatment, and quality assurance of data. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Discuss the principles of the measurement by various instruments. 2. Generate data analysis, data manipulation and data interpretation. 3. Design analyses for specific problems with various analytes. 4. Produce scientific reports and presentations. Course fee required. Prerequisite: CHEM 3000 (Grade C or higher). SP (odd).
CHEM 3510. Biochemistry I. 3 Hours.
Covers cellular metabolism of biologically-important molecules (carbohydrate, lipids, proteins, and nucleic acids) as well as regulation of these metabolic processes. Principles will be taught using structure/function relationships. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify the properties of water and how the aqueous environment influences the behavior of biological macromolecules. 2. Duplicate the structures of amino acids, explain their chemical properties and their organization into polypeptides and proteins. 3. Describe key principles of protein function, structure and characterization. 4. Discuss enzymes and how they catalyze reactions, as well as enzyme kinetics. 5. Describe structure and basic function of carbohydrates and lipids, and describe their roles in biological systems, including through the use of of signal transduction pathways. Prerequisites: BIOL 1610 AND BIOL 1615; AND CHEM 2320 AND CHEM 2325 (all Grade C- or higher). Corequisite: CHEM 3515. FA.

CHEM 3515. Biochemistry I Lab. 1 Hour.
Introduction to current biochemical techniques including spectrophotometry, chromatography, and electrophoresis. Includes analysis and manipulation of nucleic acids. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Confirm proficiency in micropipetting and solution preparation. 2. Investigate protein expression and purification, SDS-PAGE electrophoresis, and Western blotting. 3. Predict enzymatic kinetics and formulate associated calculations. 4. Analyze and process data and draw appropriate conclusions. 5. Generate scientific ideas by writing them in clear, concise, logical, and an accurate manner. Course fee required. Prerequisite: CHEM 2325 (Grade C or higher). Corequisite: CHEM 3510. FA.

CHEM 3520. Biochemistry II. 3 Hours.
Continuation of Biochemistry I. Introduction into catabolic and anabolic processes of animal and plant metabolism. Includes protein and nucleic acid biosynthesis and signal transduction. Discussion of current biochemical methods. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify the molecules involved in the major biochemical metabolic pathways such as glycolysis, gluconeogenesis, citrate cycle, respiratory electron transport system, etc. 2. Explain the reactions and recognize rate-regulatory steps involved in the aforementioned pathways. 3. Discuss the origin of mitochondria and their essential role in oxidative phosphorylation. 4. Analyze the energy yield from the catabolism of any compound. 5. Explain how a membrane is synthesized by the incorporation of monoacylglycerols and their modifications and the synthesis and degradation of fatty acids mirror each other in their chemical reactions. Prerequisite: CHEM 3510 (Grade C or higher). Corequisite: CHEM 3525. SP.

CHEM 3525. Biochemistry II Lab. 1 Hour.
A laboratory course to be taken concurrently with CHEM 3520. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Compose a comprehensive laboratory report based on multiple experiments. 2. Examine and quantify multiple metabolites found in cells. 3. Produce a Western blot independently. 4. Generate primers to amplify a gene and characterize using agarose gels. Course fee required. Prerequisite: CHEM 3515 (Grade C or higher). Corequisite: CHEM 3510. FA.

CHEM 4100. Advanced Inorganic Chemistry. 3 Hours.
A continuation of CHEM 3100. Topics may include more in-depth emphasis on molecular symmetry, group theory, organometallic reactions, bonding and structure, acid-base theories, redox properties, coordination compounds, and crystal-field theory. Students will expand their knowledge of the role of metals in nature and use gained knowledge and critical thinking skills for problem solving. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Apply bonding theories to describe the structure and bonding of inorganic compounds. 2. Use symmetry and group theory to describe bonding and other chemical properties. 3. Understand and predict periodic trends in main group and d-block elements. 4. Explain the mechanisms and predict the products of some common inorganic reactions. 5. Demonstrate the ability to solve basic problems in each of the major areas of inorganic chemistry. Prerequisite: CHEM 3100 (Grade C or higher). SP (odd).

CHEM 4200. Environmental Chemistry. 3 Hours.
This course will focus on the fundamental principles of chemistry necessary for understanding of the source, fate, and reactivity of compounds in natural and polluted environments. Emphasis will be placed on the environmental implications of energy utilization and on the chemistry of the atmosphere, hydrosphere, and lithosphere. Environmental issues that will be discussed include air pollution, stratospheric ozone depletion, pollution and treatment of water sources, and the utilization of insecticides and herbicides. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Describe the chemistry of the atmosphere and environmental and health consequences of indoor and outdoor pollution. 2. Describe the nature, reactivity, and environmental fates of toxic organic chemicals. 3. Discuss the chemistry of natural waters and their pollution and purification. 4. Evaluate environmental chemistry issues and generating a comprehensive scientific report. Prerequisite: CHEM 2320 (Grade C or higher). FA (odd).
CHEM 4310. Adv Organic Chemistry I. 3 Hours.
A problem-oriented course that explores organic structure, stereochemistry, and thermodynamics and kinetics in organic reaction mechanisms. Introduction to efficient retrieval of information from the organic chemical literature, and to thinking critically about the material. Introduction to molecular orbital theory and aromaticity and resulting spectroscopic properties. Offered based upon sufficient student need. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Predict the conformational preferences of common organic structures accounting for steric and electronic interactions. 2. Assign symmetry elements to molecules and determine symmetry point groups. 3. Describe stereochemical relationships and predict stereochemical outcomes for organic reactions. 4. Make logical predictions about the reactivity patterns to be expected from organic molecules. 5. Predict relative acidity of molecules. 6. Write kinetic rate laws for reactions and use these to evaluate proposed reaction mechanisms. 7. Draw molecular orbital diagrams for simple organic molecules. 8. Use Frontier Molecular Orbitals to understand and predict reactions. 9. Determine whether a pericyclic reaction is thermally or photochemically allowed using Molecular Orbital theory. 10. Learn to predict the products formed in various classes of pericyclic reactions. 11. Propose reasonable explanations for observed products. 12. Propose informative and incisive experimental tests to distinguish between mechanistic proposals. Prerequisite: CHEM 2310 (Grade C or higher); AND CHEM 2320 (Grade C or higher); AND CHEM 2325 (Grade C or higher). FA (even).

CHEM 4510. Chemistry of Materials. 3 Hours.
Provides the molecular understanding of materials structure and properties, including solid-state chemistry, chemical bonding in bulk materials, and properties of materials as function of local and extended structures. Topics include inorganic solids, organic and coordination polymers, organic conductors, hybrid materials, optical and magnetic materials, and biomaterials. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand inter- and intramolecular chemical bonding in bulk systems. 2. Assign symmetry elements to molecules and determine symmetry point groups. 3. Predict local and extended network structures in solids, liquids, and glasses. 4. Use structural information to predict properties of bulk systems. 5. Understand emerging properties from atomic to nano to bulk systems. 6. Predict and determine optical, electronic and magnetic properties of materials. 7. Learn techniques for structural and property determination. 8. Conceptualize relationships between natural, anthropogenic, and biological materials. Prerequisites: CHEM 2310, CHEM 2320, CHEM 2325; and either CHEM 3100 or CHEM 4310, or instructor permission. FA, SP.

CHEM 4610. Nutritional Biochemistry. 3 Hours.
A course in advanced biochemistry using nutrition as a model. The course will focus on human nutrition and metabolism. The functional and regulatory roles of macronutrients and micronutrients will be stressed. Additional components of the course will emphasize how nutrition science relates to nutrition information available to the lay public and drives nutrition policy. Students will be guided through an exploration of recent scientific literature in the areas of biochemistry and nutrition, and ways in which one informs the other. Current challenges in the field of nutrition will be related to the lecture material. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand the basic concepts of biochemistry-bonds between molecules, digestion and absorption, actions of enzymes, protein, carbohydrate, and fat metabolism, actions of hormones, and regulation of gene expression. 2. Understand and explain the digestion, absorption, and metabolism of the energy providing nutrients -- carbohydrate, lipid, and protein. 3. Understand and explain the interrelationship of the energy providing nutrients (carbohydrate, lipids, and fat) in the various metabolic pathways and their roles in supporting disease prevention. 4. Understand and explain the role of micronutrients (vitamins and minerals) in disease prevention. Prerequisites: CHEM 2310, CHEM 2320, CHEM 2325; and either CHEM 3100 or CHEM 4310, or instructor permission. FA, SP.

CHEM 4800R. Independent Research. 1-3 Hours.
An independent research course that allows the students to explore science through the scientific method, and allows close interaction between the student and faculty member to address scientific problems through experiment design and execution. Projects are at the discretion of the faculty member, in line with the student's interests in the various scientific areas. Repeatable up to 6 credits subject to graduation and program restrictions. Variable credit: 1-3. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Use the scientific method to develop hypotheses, design experiments, and draw conclusions from results. 2. Design and modify experiments during the progress of a research project. 3. Interpret results from experiments, modify the hypothesis. 4. Draw conclusions according to research goals. 5. Perform research independently, and interact with other students and faculty that are engaged in the project. 6. Utilize outside resources (scientific databases, literature, etc) to interpret results and compare to existing and previous work in the field of your research project. Prerequisites: CHEM 2310 AND CHEM 2320 AND CHEM 2325; AND ENGL 2010 or ENGL 2010A; AND instructor permission. FA, SP, SU.

CHEM 4910. Chemistry Senior Seminar. 1 Hour.
A seminar course where students will share their research results or literature searches with fellow students and faculty in written and oral formats. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Use the scientific method to develop hypotheses, search literature or utilize results from experimentation, and defend in an oral presentation to faculty and students. 2. Become extremely familiar with using literature to support a topic or idea and discuss pros/cons and scientific validity of prior results. 3. Communicate results and discuss relevant scientific topics in oral presentations in a scientific group setting. 4. Interact with other students and faculty that are engaged in scientific discussion to analyze data, results, and different perspectives, participate in scientific discussion. 5. Utilize outside resources (scientific databases, literature, etc.) to help interpret results and compare to existing and previous work in the field. 6. Prepare written reports that effectively summarize a chosen scientific topic using the vast literature and compiled data. Prerequisites: CHEM 2320 and CHEM 2325 (Grade C or higher); and ENGL 2010 (Grade C or higher); Advanced Standing; and Instructor Permission. FA, SP.
ENVS 1010. Intro to Environmental Science (PS). 3 Hours.
Fulfills General Education Physical Science requirement. Introduction to the field of environmental science, focusing on how an understanding of the natural world around us and the application of scientific method can help us address problems facing our planet. Subject areas include environmental policy, natural resources, energy, and human impact to the environment. Inclusive Access Course Material (electronic book) fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Evaluate environmental issues using a scientific approach. 2. Explain and apply the scientific method. 3. Demonstrate knowledge of the process of science by being able to interpret data in the form of tables, graphs, and charts and communicate those finding in oral and/or written form. 4. Describe a variety of environmental problems and solutions in a scientific context. 5. Evaluate environmental issues using a scientific approach. FA, SP, SU.

ENVS 1210. Introduction to Environmental Science. 3 Hours.
A scientific foundation in Environmental Science with exploration of the social and political aspects that may impact implementation of policies. Topics include ecology, biodiversity, sustainable practices, environmental health and quality, and threats to current environmental conditions. Inclusive Access Course Material (electronic book) fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Develop the physical and natural world using scientific principles. 2. Develop analytical and critical thinking skills. 3. Evaluate the “big questions” regarding sustainable practices, resources, and biodiversity. 4. Critique and communicate the impact of possible solutions to environmental issues from multiple perspectives. 5. Synthesize potential approaches to combat global effects of climate change. Corequisites: ENVS 1215. FA, SP.

ENVS 1210R. Field Experience: Environmental Science (LAB). 1 Hour.
Fulfills General Education Laboratory Sciences requirement. Provides an opportunity for students to meet each other in a field-research setting and discuss a major environmental issue. The course will be held over a 4-5 day weekend (overnight stays required). Each semester the class will focus on a particular issue related to the environment that is of interest to the region where the class is being held. Repeatable up to 2 credits. Offered on sufficient student need. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate knowledge of basic fundamental laws, concepts, and theories in the physical sciences. 2. Explain and apply the scientific method. 3. Demonstrate knowledge of the process of science by being able to utilize data in the form of tables, graphs, and charts through interpretation and then communicate those finding in oral and or written form. 4. Introduce a variety of environmental problems and solutions in a scientific context. 5. Enable students to understand environmental issues using a scientific approach. 6. Improve basic scientific literacy. Course fee required. Prerequisite: ENVS 1010 (can be concurrently enrolled), or Instructor permission.

ENVS 2110. Environmental Pollution and Remediation Techniques. 3 Hours.
The environmental Pollution and Remediation Technique course gives the students the skills to diagnose land and groundwater pollution issues. In this course students will learn about the common types of land (soil) and groundwater pollutants and the remediation methods currently employed by remediation industry. This course uses case studies of the local environment to take an in-depth look at the real and local pollution issues. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify common types of land and groundwater pollutants. 2. Apply the fundamental principles of remediation to remove and/or process pollution. 3. Devise protocols to minimize and mitigate pollution to avoid remediation processes. 4. Evaluate the key indicators for sustainable remediation approaches. Prerequisites: ENVS 1210 and ENVS 1215 and MATH 1050 or higher (All grade C- or higher); and CHEM 1210 and CHEM 1215 (Both may be taken concurrently). SP.

ENVS 2700R. Field Methods in Environmental Science. 1 Hour.
A preparatory course for undergraduate participation in collaborative research projects in environmental science. Repeatable for a maximum of 3 credits. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Develop skills in collecting and organizing scientific data from field investigations. 2. Consider how concepts and skills acquired in coursework can be developed through interdisciplinary research. 3. Develop a hypothesis for a research project in the environmental or related sciences, and devise a protocol to test that hypothesis. Course fee required. Prerequisite: ENVS 1210 and ENVS 1215 (Both grade C- or higher).

ENVS 2990R. Seminar in Environmental Science. 1 Hour.
Seminar course aimed to help students who have declared the EEES major prepare for future careers in their field. Seminar and workshop activities will include potential career paths in the EEES areas, professional development and research experience opportunities, preparing cover letters and resumes/CVs, and the process of applying to graduate programs and jobs. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify potential opportunities as a chemistry degree graduate. 2. Prepare and evaluate professional materials that will be needed to apply for summer and post-graduate jobs and programs. 3. Interact and collaborate with faculty, peer students, and guest speakers in a professional setting. 4. Develop professional skills for interviews and collaborative settings. Prerequisite: ENVS 1210 (Grade C- or higher). SP.
ENVS 3280. Environmental Policy, Regulations, Health, and Safety. 3 Hours.
This course studies the interrelationships of people, public and private sector business, policy, politics and the environment. The Environmental Policy and Regulation course examines the real-world environmental issues from a policy perspective. In this course students will explore how to effectively communicate over environmental problems which is a significant factor in politics. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify and explain local and national environmental issues from a policy perspective. 2. Evaluate and critique global and local environmental strategies and policies. 3. Survey and analyze legal approaches to pollution control, environmental planning and natural resource management. 4. Develop communication skills through public speaking, and engaging the public on environmental issues. Prerequisite: ENVS 2210 (Grade C- or higher). FA (odd).

ENVS 3410. Air Quality and Control Technologies. 3 Hours.
The Air Quality & Control Technologies course is a multidisciplinary course consisting of math, physics and chemistry. Topics include sufficient information on major chemical compounds cause outdoor and indoor air pollution; health and environmental effects of air pollution; pollution prevention; and theory and practice of air pollution control technologies to reduce particulate matter, volatile organic compound (VOC), nitrogen oxide emissions, and sulfur dioxide emissions. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Distinguish the elements and mechanisms of air pollution. 2. Describe current air pollution issues at different scales (from local to global). 3. Survey the adverse effects of primary and secondary air pollutants on human health and the environment. 4. Evaluate methods for control, and prevention of air pollution to meet desired needs within realistic constraints such as economic, environmental, political, health and safety, and sustainability. 5. Assess the mechanisms responsible for the performance effectiveness of each air quality control technology. Prerequisite: ENVS 2210 and CHEM 1210 (Both grade C- or higher). SP (even).

ENVS 3510. Waste Management. 3 Hours.
This course is an in-depth course in waste management. Waste Management 3510 talks about the generation, prevention, characterization, monitoring, treatment, handling, reuse and disposal of solid wastes. In this course students will learn about the integrated sustainable waste management strategies including recycling, landfilling and energy recovery. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify environmental problems caused by waste mismanagement. 2. Categorize sources, types and compositions of solid wastes. 3. Evaluate methods for solid waste collection, transportation, and disposal. 4. Describe and analyze current and proposed waste collection systems. Prerequisites: ENVS 2210 and GEO 2050 (Both grade C- or higher). SP (odd).

ENVS 3910. Costa Rica Natural History. 3 Hours.
An interdisciplinary course that introduces students to the geography, cultural history, literature, ecology and biodiversity of Costa Rica. The course will meet for an hour a week during the semester, then the participants will travel to Costa Rica for a 2-week study abroad experience. The students will live and study at field research stations in Costa Rica. Pre-trip preparation will include selected literary and scientific readings to prepare students to understand their experiences in Costa Rica. Lectures and laboratory/field experiences will focus on incorporating these readings into observations and experiences while in Costa Rica. The fee covers most costs while in Costa Rica, airfare is not included. Offered upon sufficient student need. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify evidence that meets the criteria of science in recognizing and differentiating hypotheses, theories and/or laws using the resources of Costa Rica. 2. Collect and organize scientific data from field investigations. 3. Consider how concepts and skills acquired in coursework can be developed through interdisciplinary research. Course fee required.

ENVS 3920. Peruvian Amazon Natural History. 3 Hours.
An interdisciplinary course that introduces students to the geography, cultural history, literature and biodiversity of the Amazon region of Peru. The course will meet for an hour a week during the semester, then the participants will travel to Peru for a 10 day study abroad experience. Participants live and study at field research stations in Peru. Pre-trip preparation will include selected literary and scientific readings to prepare students to understand their experiences in Peru. Lectures and laboratory/field experiences will focus on incorporating these readings into observations and experiences while in Peru. Offered upon sufficient student need. Fee covers program costs while in Peru, it does not cover international flights round-trip to Iquitos, Peru ($800-$1200). Offered upon sufficient student need. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify evidence that meets the criteria of science in recognizing and differentiating hypotheses, theories and/or laws using the resources of the Peruvian Amazon. 2. Collect and organize scientific data from field investigations. 3. Consider how concepts and skills acquired in coursework can be developed through interdisciplinary research. Course fee required.

ENVS 3930. South Africa Natural History. 3 Hours.
An interdisciplinary course that introduces students to the geography, cultural history, literature and biodiversity of South Africa. The course will meet for an hour a week during the semester, then the participants will travel to South Africa for a study abroad experience. Participants live and study at field research stations. Pre-trip preparation will include selected literary and scientific readings to prepare students to understand their experiences. Lectures and laboratory/field experiences will focus on incorporating these readings into observations and experiences while in South Africa. Offered upon sufficient student need. For international travel, see studyabroad.dixie.edu for additional travel costs that may apply. Offered upon sufficient student need. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Acquire skills in understanding literary and scientific readings, while collecting and organizing scientific data from field investigations. 2. Gain familiarity with the context of the particular data set under consideration and will discover how the concepts and skills they are acquiring in their other coursework can be developed through interdisciplinary research. SP (even).
ENVS 4080. Environmental Monitoring and Characterization. 4 Hours.
Environmental Monitoring and Characterization course emphasizes on the fundamental principles used in the environmental assessment processes. In this course students will learn the theoretical and practical knowledge in various sector of environmental monitoring. Upon completion of this course, students should be able to describe significant environmental regulations, current sampling and laboratory techniques and quality control measures. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Explain the principles of environmental assessment and monitoring including characterizing the sampling sites, developing sampling plans for the collection of various media and selecting the contaminant transportation method. 2. Demonstrate standard field and laboratory sampling techniques and safety. 3. Apply data handling methods to interpret results from monitoring and characterization sites. 4. Apply knowledge of environmental sciences to implementation of laws, regulations, and policies. Prerequisites: ENVS 3410 and ENVS 2700R (Both grade C- or higher). SP (odd).

ENVS 4800R. Independent Research. 1-3 Hours.
An independent research course that allows the students to explore science through the scientific method, and allows close interaction between the student and faculty member to address scientific problems through experiment design and execution. Projects are at the discretion of the faculty member, in line with the student's interests in the various scientific areas. Repeatable up to 6 credits subject to graduation and program restrictions. Variable credit: 1-3. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Use the scientific method to develop hypotheses, search literature or utilize results from experimentation, and defend in an oral presentation to faculty and students. 2. Discuss relevant scientific topics in oral presentations in a scientific group setting. 3. Collaborate with other environmental science students and faculty that are engaged in scientific research to analyze data, results, and varying perspectives, and participate in scientific discussions. 4. Utilize outside resources (scientific databases, literature, etc.) to help interpret results and compare to existing and previous work in the field. 5. Prepare written reports that effectively summarize a chosen scientific topic related to the environmental sciences using the vast literature and compiled data. SP.

GEO 1010. Introduction to Geology (PS). 3 Hours.
Fulfills Physical Science General Education requirement. Focuses on the physical dynamics of the natural environment, delineating its geosphere, hydrosphere, atmosphere, and biosphere components, and their global patterns of interaction. Highlights the processes of science that underpin this systemic view of the world. Emphasizes issues of resource availability, along with their political and social ramifications. Particular emphasis is placed on the challenges natural hazards present to civilization, worldwide. The extraordinary geology of the region surrounding DSU is featured in many textbook and lecture examples. One field trip required. GEO 1015 OR GEO 2000R lab course recommended. Inclusive Access Course Material (electronic book) fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Explain how the scientific method works and outlining how it is employed. 2. Explain the formation of the Earth and Solar System. 3. Explain and model the fundamentals of how plate tectonics works, including the formation of geologic structures and the mechanics of earthquakes. 4. Explain what minerals are and how they are classified. 5. Identify the three types of rocks (igneous, sedimentary, and metamorphic), explaining how they form, and detailing their classifications. 6. Explain how surface processes work, generate and transport sediment, and shape the Earth's surface. 7. Explain how stratigraphic and radiometric dating work and are used in determining the age of a rock. 8. Explain how and why Earth's climate varies over time and how humans affect the climate. 9. Identify various geological natural resources and explaining how they form and are obtained. Corequisites: GEO 1015. FA, SP, SU.

GEO 1010S. Introduction to Geology (PS, GC). 3 Hours.
Fulfills Physical Science General Education requirement. Focuses on the physical dynamics of the natural environment, delineating its geosphere, hydrosphere, atmosphere, and biosphere components, and their global patterns of interaction. Highlights the processes of science that underpin this systemic view of the world. Emphasizes issues of resource availability, along with their political and social ramifications. Particular emphasis is placed on the challenges natural hazards present to civilization, worldwide. The extraordinary geology of the region surrounding DSU is featured in many textbook and lecture examples. One field trip required. GEO 1015 OR GEO 2000R lab course recommended. This course was selected to participate in Dixie State University's Supplemental Instruction (SI) Program. This course adds one weekly class SI session but does not increase credit hours. SI is a series of weekly review sessions, led by peer SI leaders and designed to help students succeed in their academic pursuits. SI is provided for students who want to improve their understanding of course material and improve their grades. Inclusive Access Course Material fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Explain how the scientific method works and outlining how it is employed. 2. Explain the formation of the Earth and Solar System. 3. Explain and model the fundamentals of how plate tectonics works, including the formation of geologic structures and the mechanics of earthquakes. 4. Explain what minerals are and how they are classified. 5. Identify the three types of rocks (igneous, sedimentary, and metamorphic), explaining how they form, and detailing their classifications. 6. Explain how surface processes work, generate and transport sediment, and shape the Earth's surface. 7. Explain how stratigraphic and radiometric dating work and are used in determining the age of a rock. 8. Explain how and why Earth's climate varies over time and how humans affect the climate. 9. Identify various geological natural resources and explaining how they form and are obtained. FA, SP.
GEO 1015. Introduction to Geology Lab (LAB). 1 Hour.
A laboratory course to be taken concurrently with Geology 1010. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Explain and employ the scientific method. 2. Identify and classify minerals and for what they are used. 3. Identify the three types of rocks (igneous, sedimentary, and metamorphic), explaining how they form, and detailing their classifications. 4. Explain how stratigraphic and radiometric dating work and are used in determining the age of a rock. 5. Explain and modeling the fundamentals of how plate tectonics works, including the formation of geologic structures and the mechanics of earthquakes. 6. Identify pertinent features generated by surface processes from photographs and diagrams. Course fee required. Corequisite: GEO 1010. FA, SP.

GEO 1020. Life of the Past (PS). 3 Hours.
Fulfills General Education Physical Science requirement for non-Science majors. General survey of historical Geology focusing on the relationship between the tectonic history of the Earth, the evolution of life through time, and the histories of the Earth and life and the complex interactions between them. GEO 1025 lab course recommended but not required. One field trip required. Offered upon sufficient student need. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand what science is, how science works, and how science progresses. 2. Understand the basis of physical sciences (especially geology) and evolution, and communicate scientific ideas via written and/or oral assignments. 3. Demonstrate knowledge of and appreciation for the internal and external processes on Earth today. 4. Identify and describe Earth materials and landforms. 5. Apply basic geologic principles to understand the orders, rates, and superimposition of dynamic geologic processes. 6. Integrate and apply information learned in lecture and exercises in the field. Course fee required.

GEO 1040. Introduction to Dinosaurs (PS). 3 Hours.
Fulfills General Education Physical Science requirement. Utilizes the popular subject matter of dinosaurs to teach basic principles of geology, biology, physics, chemistry, and astronomy, with some basic math (algebra). Successful completion of this interdisciplinary course contributes to an understanding of science and scientific concepts as well as their applications in a multitude of disciplines. GEO 1045 lab course recommended but not required. One field trip required. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Explain and employ the scientific method. 2. Explain and model the fundamentals of how plate tectonics works, including the formation of geologic structures. 3. Identify the three types of rocks (igneous, sedimentary, and metamorphic), explaining how they form, and detailing their classifications. 4. Identify the types of fossils and detailing how they form, how they occur in sedimentary rocks, and how sedimentary rocks tell about ancient environments. 5. Explain how stratigraphic and radiometric dating work and are used in determining the age of a rock or fossil. 6. Identify various vertebrate skeletal anatomical structures. 7. Identify and explaining the principles of evolution and systematics as a classification system based on evolution. 8. Accurately reading cladograms and explaining how they are generated. 9. Identify the kinds of dinosaurs (in a systematic and anatomical framework). 10. Explain how we understand dinosaurs as living animals - their restoration, behavior, diet, reproduction, physiology, growth, and extinction. Course fee required. FA.

GEO 1045. Introduction to Dinosaurs Laboratory (LAB). 1 Hour.
A laboratory course to be taken concurrently with GEO 1040. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Explain and employ the scientific method. 2. Identify and classify sedimentary rocks, and explaining how their sediments are generated and how they affect fossilization. 3. Explain and model the fundamentals of how plate tectonics works, including the formation of geologic structures. 4. Identify the types of fossils. 5. Explain how sedimentary processes work and can be recognized, and the basics of taphonomy. 6. Explain how stratigraphic and radiometric dating work and are used in determining the age of a rock. 7. Identify various vertebrate anatomical structures and hypothesizing their functional morphologies. 8. Explain evolution by natural selection. 9. Employ the fundamentals of phylogenetic practices. 10. Identify basic characteristics of ornithischian and saurischian dinosaurs and hypothesize their functions. Course fee required. Corequisite: GEO 1040. FA.

GEO 1050. Geology of the National Parks (PS). 3 Hours.
Fulfills General Education Physical Science requirement. General survey of Physical Geology emphasizing the geology of Utah’s scenic national parks and monuments, as well as state parks, to investigate the geologic history of and processes shaping the region, inherent geologic hazards, and natural resource use and availability. Inclusive Access Course Material fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate knowledge of the skills required to make informed personal and social decisions about the issues that we will face locally as well as globally. 2. Demonstrate knowledge of basic fundamental laws, concepts, and theories in the physical sciences and be able to apply them to everyday life. 3. Be able to explain and apply the scientific method. 4. Demonstrate knowledge of the process of science by being able to utilize data in the form of tables, graphs, and charts through interpretation and then communicate those finding in oral and or written form. 5. Develop a basic understanding of the internal and external processes acting on the earth. 6. Identify and describe the origin and development of landforms found in the various National Parks of the southwest. 7. Identify and describe the earth materials. 8. Apply the principles of geologic time to analyze the rates of geologic processes related to the National Parks of the southwest. 9. Integrate information learned in class and laboratory studies to evaluate geologic processes in the field. Corequisite: GEO 1055. SP.
**GEO 1055. Geology National Parks Lab (LAB). 1 Hour.**
Field trip portion of GEO 1050. A seven day field trip featuring national parks and monuments, usually over Spring Break, to experience geologic processes shaping the landscape, interpret past environments/climates that created the resources utilized by society, and observe first-hand how our Earth has changed through geologic time and, in fact, is ever-changing. Requires hiking on park trails over uneven surfaces for average of three miles a day. Elevations up to 8300 feet. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to:**
1. Demonstrate knowledge of basic fundamental laws, concepts, and theories in the physical sciences and be able to apply them to everyday life.
2. Demonstrate knowledge of the process of science to interpret data in the form of tables, graphs, and charts and communicate those finding in oral and or written form.
3. Develop a basic understanding of the internal and external processes acting on the earth.
4. Identify and describe the origin and development of landforms found in the various National Parks of the southwest.
5. Apply the principles of geologic time to analyze the rates of geologic processes related to the National Parks of the southwest.
6. Integrate information learned in class and laboratory studies to evaluate geologic processes in the field.
Course fee required. Corequisite: GEO 1050. SP.

**GEO 1080. Introduction to Oceanography. 3 Hours.**
Fulfills General Education Physical Science requirement. Conveys the essential principles of ocean science, including an understanding of the earth's oceans focusing on sea floor topography and composition, plate tectonics, seawater dynamics and chemistry, atmospheric and ocean currents, waves, coastal land forms, and marine life as well as recognition of the close linkage of weather, climate, and humans to the oceans. GEO 1085 lab course recommended but not required. Offered upon sufficient student need. Inclusive Access Course Material (electronic book) fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful completion of this course, students will be able to:**
1. Differentiate science from non-science by recognizing hypotheses, theories, and/or laws that meet the criteria of science and use the scientific process/method.
2. Describe geologic and geographic features of Oceanic features and their formation as part of plate tectonics, including a full description of the Theory of Plate Tectonics, the history of its development, its mechanisms and processes that shape Earth both internally and externally.
3. Explain the formation and potential geologic hazards of the geographic landforms in each section of the major Oceanic provinces.
4. Identify the Ocean's biological, physical, and chemical constituents including economically important natural resources, describe their importance and renewability, where they are located and how they might be recovered, managed, and protected.
5. Articulate an understanding of both relative (stratigraphic) and absolute (radiometric) geologic time using these concepts to interpret physical and biological events in Earth history, and how these events relate to biological evolution including natural and anthropogenic activities. FA.

**GEO 1085. Intro to Oceanography Lab (LAB). 1 Hour.**
A laboratory course in oceanography. Lab fee required for travel to marine laboratories and coastal regions in California. Offered upon sufficient student need. **COURSE LEARNING OUTCOMES (CLOs) At the successful completion of this course, students will be able to:**
1. Develop an integrated understanding of oceanographic processes and the following CLOs through an intensive 4-day field experience.
2. Differentiate science from non-science by recognizing hypotheses, theories, and/or laws that meet the criteria of science and use the scientific process/method.
3. Describe the theory of plate tectonics, including the history of its development, its mechanisms and processes that shape Earth both internally and externally, including distinguishing geologic and geographic features of Oceanic features and their formation as part of plate tectonics.
4. Explain the formation and potential geologic hazards of the geographic landforms in each section of the major Oceanic provinces.
5. Identify the Ocean's biological, physical, and chemical constituents including economically important natural resources, describe their importance and renewability, where they are located and how they might be recovered, managed, and protected.
6. Articulate an understanding of both relative (stratigraphic) and absolute (radiometric) geologic time using these concepts to interpret physical and biological events in Earth history, and how these events relate to biological evolution as well as natural and anthropogenic activities. Course fee required.

**GEO 1110. Physical Geology (PS). 3 Hours.**
Fulfills a General Education Physical Science requirement for students majoring in the Sciences or Engineering, including Civil Engineering, Geology, Range Management, Forestry, etc. Covers the study of the physical features of the earth and the processes that shape those features. Successful completion gives students the background necessary for further study in the sciences. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to:**
1. Demonstrate knowledge of basic fundamental laws, concepts, and theories in the physical sciences required to make informed personal and social decisions about local and global issues.
2. Explain and apply the scientific method.
3. Distinguish the major rock forming minerals as well as the rocks in the three major groups and explain both their formation and use as natural resources.
4. Identify major rock forming minerals as well as the rocks in the three major groups and explain both their formation and use as natural resources.
5. Apply the principles of geologic time to analyze the rates of geologic processes. Corequisites: GEO 1115. SP.

**GEO 1115. Physical Geology Lab (LAB). 1 Hour.**
Lab portion of GEO 1110. Three Saturday field trips required. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to:**
1. Integrate information learned in class studies to evaluate geologic processes in the field.
2. Identify some of the major rock forming minerals as well as the rocks in the three major groups and explain both their formation and use as natural resources.
3. Distinguish between the major internal and external processes acting upon the earth and identify various landforms created by those processes.
4. Create geologic cross sections from topographic and geologic maps.
5. Apply the principles of geologic time to analyze the rates of geologic processes. Course fee required. Corequisite: GEO 1110. FA.
GEO 1220. Historical Geology. 3 Hours.
Conceptual examinations of how the atmosphere, biosphere, hydrosphere, and lithospheres interact to create major structural and stratigraphic features (emphasizing North America) and how life has evolved through deep time. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Outline the history of how modern geology was developed. 2. Explain how stratigraphic and radiometric dating work and are used in determining the age of a rock. 3. Explain the natures of sedimentary rocks and their depositional environments and how they can be interpreted and inferred from the stratigraphic record. 4. Explain what fossils are and how they are useful in interpreting the stratigraphic record. 5. Explain how evolution works and has produced the lineages recorded in the fossil record. 6. Explain and modeling the fundamentals of how plate tectonics works. 7. Outline the major geological events during Earth history. 8. Outline the major evolutionary events during Earth history. Prerequisite: GEO 1110. Corequisite: GEO 1225. SP.

GEO 1225. Historical Geology Lab. 1 Hour.
Lab accompanying GEO 1220. Local field trip required. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Outline the history of how modern geology was developed. 2. Explain how stratigraphic and radiometric dating work and are used in determining the age of a rock. 3. Explain the natures of sedimentary rocks and their depositional environments and how they can be interpreted and inferred from the stratigraphic record. 4. Explain what fossils are and how they are useful in interpreting the stratigraphic record. 5. Explain how evolution works and has produced the lineages recorded in the fossil record. 6. Explain and modeling the fundamentals of how plate tectonics works. 7. Outline the major geological events during Earth history. 8. Outline the major evolutionary events during Earth history. Course fee required. Prerequisite: GEO 1115. Corequisite: GEO 1220. SP.

Fulfills General Education Laboratory Sciences requirement. Provides an opportunity for students to study topics such as depositional environments, plate tectonics, gradation, rock dating, geologic time, Earth history, and environmental issues in a field research setting through travel to Grand Canyon, Zion, and Bryce Canyon National Parks. The class will be held over a 4-5 day period. Overnight stays at the Tanner Field Station required. Repeatable up to 2 credits. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Examine evidence of climate change both in ancient and modern times. 2. Learn basic scientific processes used to develop hypotheses and theories. 3. Gain greater insight into the enormous length of geologic time and evidences that support this claim. 4. Learn the different ways that scientists can determine geologic ages. 5. Understand agents of gradation, particularly how the hydrologic cycle helps to shape the Earth. 6. Learn how the different subsystems of the Earth system interact as open systems as they exchange not just energy, but matter. 7. Know where and when the basic rock and mineral types form and how they are related to tectonic and hydrologic cycles. 8. Be able to identify common rocks and minerals. 9. Demonstrate the relationship between geological processes and resources and human activities. 10. Understand how plate tectonics works, including the role of the different types of plate boundaries and the forces that help drive the system. 11. Learn how tectonism has helped shape the Earth's surface. Course fee required. FA, SU.

GEO 2050. Earth Materials. 4 Hours.
Required for all geoscience degree programs. An introduction to the origin, classification, identification, and physical and chemical properties of minerals and rocks, including topics related to crystallography, mineral chemistry, petrology, and the importance of mineral and rock resources to society. Three lectures and one 3 hour laboratory per week. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Evaluate, identify, and classify minerals in hand samples and thin sections based on their physical properties. 2. Classify and categorize minerals based on chemistry and atomic structure. 3. Analyze variations in mineral chemistry and explain the chemical rules that dictate mineral structures. 4. Employ graphical methods to quantify and interpret mineral chemistry. 5. Describe how mineral chemistry and structure control physical and optical properties. 6. Evaluate various igneous, sedimentary, and metamorphic rocks and interpreting their environments of formation using their component mineral assemblages and textures. 7. Summarize how, where, and why minerals are important to manufacturing, economics, and politics. Course fee required. Prerequisites: GEO 1110 and GEO 1115 (Both Grade C or higher). FA.

GEO 2700R. Field Methods in Geoscience Research. 1 Hour.
A preparatory course for undergraduate participation in collaborative research projects in the geosciences. Repeatable for a max of 3 credits. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Develop skills in collecting and organizing scientific data from field investigations. 2. Consider how concepts and skills acquired in coursework can be developed through interdisciplinary research. 3. Develop a hypothesis for a research project in the geosciences or related sciences, and devise a protocol to test that hypothesis. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Develop skills in collecting and organizing scientific data from field investigations. 2. Consider how concepts and skills acquired in coursework can be developed through interdisciplinary research. 3. Develop a hypothesis for a research project in the geosciences or related sciences, and devise a protocol to test that hypothesis. Prerequisites: GEO 1110 and GEO 1115 (Both grade C- or higher).

GEO 2990R. Seminar in Geology. 1 Hour.
For students wishing instruction that is not available through other regularly scheduled courses in this discipline. Occasionally, either students request some type of non-traditional instruction, or an unanticipated opportunity for instruction presents itself. This seminar course provides a variable credit context for these purposes. As requirements, this seminar course must first be pre-approved by the department chair; second, it must provide at least nine contact hours of lab or lecture for each credit hour offered; and third, it must include some academic project or paper (i.e., credit is not given for attendance alone). This course may include standard lectures, travel and field trips, guest speakers, laboratory exercises, or other non-traditional instruction methods. Repeatable up to 3 credits subject to graduation restrictions. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify potential opportunities as a geology degree graduate. 2. Evaluate professional materials that will be needed to apply for summer and post-graduate jobs and programs. 3. Collaborate with faculty, peer students, and guest speakers in a professional setting. 4. Develop professional skills for interviews and collaborative settings. SP.
GEO 3000. Advanced Geologic Investigation of Grand Canyon, Zion, and Bryce National Parks. 3 Hours.
Provides students an opportunity to engage in an advanced study topics such as depositional environments, plate tectonics, gradation, rock dating, geologic time, Earth history, and environmental issues in a field research setting through travel to Grand Canyon, Zion, and Bryce Canyon National Parks. The class will involve field trips, including overnight stays at the Tanner Field Station required. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Assess the interrelationships of stratigraphy, structural geology, and surficial processes on landscape evolution. 2. Evaluate the formative processes of the geology of the western Colorado Plateau as demonstrated by its national parks. 3. Record stratigraphic and structural data in field notes to construct geologic maps, and present and interpret the data in a written report. 4. Interpret topographic and geologic maps and relate the map to what you see in the field. 5. Identify minerals and rocks in the field, determine the processes that formed them by analyzing their features, and interpret their significance by reconstructing the geologic history of the area. 6. Compare and contrast the stratigraphic sections of sedimentary rock between national parks to delineate changes in, and extent of, depositional environments and illustrate these changes by constructing a fence diagram. Prerequisites: GEO 1110 and GEO 2050 (Both Grade C- or higher). FA (odd), SP (even).

GEO 3060. Environmental Geology. 3 Hours.
Geological attributes of environmental settings with emphasis on the analysis of geologic conditions pertinent to resource availability, urban planning, recognition and assessment of geologic hazards, and environmental issues through geochemical investigation of Earth's atmosphere, hydrosphere and lithosphere. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Apply a Systems Science perspective to Geological topics. 2. Enhance critical thinking skills in the context of Earth sciences. 3. Utilize multiple sources of information to understand geology and make scientific analyses. 4. Develop and present research topics and findings. 5. Consider human interactions with the physical Earth, both human impacts on the environment and environmental hazards to human society. Prerequisites: GEO 1110 (Grade C or higher) AND GEO 1115 (Grade C or higher). FA (odd).

GEO 3180. Paleontology. 4 Hours.
Reviews theories, principles, and applications of paleontology, as well as the characteristics of important groups of fossil organisms and their geologic distributions and paleoecologies. Course includes lab. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Explain the nature of the fossil record. 2. Explain and employ the principles of evolution, speciation, systematics, and extinction. 3. Explain and employ the principles of functional morphology and paleoecology. 4. Explain and employ the principles of paleobiogeography and biostratigraphy. 5. Identify the fundamental characteristics and evolutionary histories of various groups of organisms, including plants, "protists," porifera, cnidarians, "lophophorates" (brachiopods and bryozoans), arthropods, molluscs, echinoderms, and chordates via their body and trace fossils. Course fee required. Prerequisites: GEO 1220 and GEO 1225, or instructor permission. FA (odd).

GEO 3400. Water Resources. 3 Hours.
A detailed examination of the water cycle, including: precipitation, surface water, ground water, glaciers, water conservation, water management, and water pollution with special emphasis on the water resources of Utah and neighboring areas. Offered upon sufficient student need. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify the water resources management issues (water quality and water quantity) in local and global regions. 2. Apply the basic principles of water resources, including hydrologic cycle, surface and groundwater hydrology to understand critical water needs. 3. Utilize quantitative models in water resources and hydrology. 4. Apply the scientific methods and critical thinking to analyze the hydrologic data in water resources management (e.g. surface water, groundwater, water quality). Prerequisites: GEO 1110/1115 AND CHEM 1210/1215.

GEO 3550. Sedimentology & Stratigraphy. 4 Hours.
Explores the origins, classification, and occurrences of sedimentary rocks and their distributions in space and time. Course emphasizes the description and interpretation of sedimentary rocks and the philosophy and application of stratigraphic principles. Offered upon sufficient student need. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Describe and identify sedimentary rocks. 2. Develop a broad understanding and specific knowledge of sedimentary processes. 3. Collect, analyze, and communicate field data providing context to the occurrence of sedimentary materials. 4. Apply scientific models regarding the origin and distribution of sedimentary materials. 5. Develop an awareness of the importance of sedimentary processes in creating the local landscape. Course fee required. Prerequisites: GEO 1220 AND GEO 1225.

GEO 3700. Structural Geology. 4 Hours.
Examination of the geometries, mechanisms, and mechanics of rock deformation, including stress and strain relationships, fault and fold classification and description and relation to major tectonic features of Earth with application to geological engineering, petroleum geology, mining, water recovery and waste disposal. Labs present techniques to interpret and evaluate deformed rock in map, cross section, and three-dimensional views. Three lecture hours and one 3-hour lab per week. Field trips required. Offered upon sufficient student need. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify in the field and interpret both brittle and ductile structural deformation. 2. Conduct a geometric structural analysis that results in the production of a viable geologic cross-section. 3. Construct a kinematic structural analysis in the field and reconstruct possible deformation paths of a given feature. 4. Generate a dynamic structural analysis, formulate constitutive equations for deformation, and quantify the contribution of each deformational mechanism in a region. 5. Perform a fault study to forecast earthquake potential. 6. Assess and justify the best location to drill for water, oil, or gas, predict the location of mineral resources, and/or judge the environmental impact of toxic waste disposal from a set of structural data. Prerequisites: GEO 1110 and 1115; and MATH 1050 or higher level MATH (All grade C or higher).
GEO 3710. Hydrology. 3 Hours.
This course includes the study of some important aspects in the field of hydrology including hydrological cycle and its components such as precipitation, infiltration and evapotranspiration. In this course, students will learn how to collect hydrological data, understand and employ the common numerical methods, and analyze the data to estimate the hydrologic cycle components. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify and differentiate the essential components of the hydrologic cycle. 2. Complete engineering hydrology computations and water balance. 3. Analyze experimental hydrological data. 4. Collaborate with other students and serve as effective members of multidisciplinary project teams. Prerequisite: GEO 3550 (Grade C- or higher). SP (odd).

GEO 3910. Applied Geologic Investigation of Iceland. 3 Hours.
Iceland, the land of fire and ice, offers students an experiential learning opportunity to study nearly every basic topic in Geology. Both tectonic processes powered by Earth's internal energy such as plate boundaries, volcanoes, earthquakes, and geysers, and gradation processes powered by the sun such as glaciers, rivers, shorelines, weathering and erosion are observed first hand. Environmental issues like resource use and its relationship to climate change and utilizing geothermal as a green energy resource to generate electricity are also examined. Course participants will meet for an hour a week during the semester then travel to Iceland for a six day travel abroad experience. Pre-trip classes include the above topics to prepare students to understand their experiences in Iceland. For international travel, see studyabroad.dixie.edu for additional travel costs that may apply. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify evidence that meets the criteria of science in recognizing and differentiating hypotheses, theories and/or laws using the resources of Iceland. 2. Apply the concepts of both stratigraphic and radiometric dating to interpret physical and biologic events in Earth history as evidenced in Iceland. 3. Identify Iceland's geologic and geographic landforms and explain both their formation (origin) and potential geologic hazards. 4. Identify Iceland's economically important Earth materials and natural resources and their impacts on global climate change, politics, and economics. 5. Describe how the geology of Iceland is explained by the theory of plate tectonics. SP.

GEO 4800R. Independent Research. 1-3 Hours.
An independent research course that allows the students to explore science through the scientific method, and allows close interaction between the student and faculty member to address scientific problems through experiment design and execution. Projects are at the discretion of the faculty member, in line with the student's interests in the various scientific areas. Repeatable up to 6 credits subject to graduation and program restrictions. Variable credit: 1-3. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Use the scientific method to develop hypothesis for a research project in the environmental sciences, design experiments or identify resources from which to collect data, and draw conclusions from results. 2. Design and modify experiments throughout the progress of a research project. 3. Complete research projects independently while also interacting with other students and faculty that are engaged in the project. 4. Utilize outside resources (scientific databases, literature, etc) to interpret results and compare to existing and previous work in the field of your research project. Prerequisite: GEO 2700R (Grade C- or higher). FA, SP, SU.

GEO 4910. Senior Seminar. 1 Hour.
A seminar course where students will share their research results or literature searches with fellow students and faculty in written and oral formats. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Use the scientific method to develop hypotheses, search literature or utilize results from experimentation, and defend in an oral presentation to faculty and students. 2. Discuss relevant scientific topics in oral presentations in a scientific group setting. 3. Collaborate with other geoscience students and faculty that are engaged in scientific research to analyze data, results, and varying perspectives, and participate in scientific discussions. 4. Utilize outside resources (scientific databases, literature, etc.) to help interpret results and compare to existing and previous work in the field. 5. Prepare written reports that effectively summarize a chosen scientific topic related to the environmental sciences using the vast literature and compiled data. SP.