

Physical Sciences

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Physical Sciences Program Description

The Dixie State University Physical Sciences department offers a variety of courses in Chemistry, Engineering, Environmental Science, Geology, Geography, and Physics that allow students to better understand and appreciate the natural world and our place in it. Many of these courses fulfill the General Education Physical Science requirement for all students. Coursework and academic degrees offered in the Physical Sciences also fulfill prerequisites and requirements for students planning to pursue careers in natural sciences, chemistry, physics, engineering, environmental sciences, earth sciences, and medical and health sciences.

Degrees & Minors

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)

Engineering

- Bachelor of Science in Mechanical Engineering (catalog.dixie.edu/programs/physical-sciences/bachelor-of-science-in-mechanical-engineering)
- Associate of Science in Pre-Engineering (APE) (catalog.dixie.edu/programs/physical-sciences/pre-engineering-ape)
- Maker Certificate (catalog.dixie.edu/programs/physical-sciences/maker-certificate)

Physical Science

- 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 Physics (catalog.dixie.edu/programs/physical-sciences/physics-minor)

The Chemistry Program Learning Outcomes are:

- 1) Will be able to 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) Will be able to demonstrate knowledge of basic fundamental laws, concepts, and theories in the physical sciences and be able to apply them to everyday life.

3) Will understand the process of science — how scientific knowledge is generated and validated — so that they can make independent, empirical inquiries about the natural world.

4) Will be able to demonstrate knowledge of the process of science by being able to interpret data in the form of tables, graphs, and charts and then communicate those findings in oral and or written form.

Physical Science Career Information

Chemistry

Career Opportunities

There are a number of directions a bachelor's degree in chemistry can go. Primarily, it's a launch pad for a graduate degree in chemistry; which could lead to careers in chemical engineering, healthcare, pharmaceuticals, or in the public sector. With just an undergraduate degree, however, chemistry majors can hope for careers in research or as chemical technicians.

Job Outlook*

Employment for chemists is expected to grow by 3% from 2014 to 2024, slower than the average for all occupations. Employment for chemical technicians will grow slightly slower in the same decade, increasing by 2%. The development of cheaper energy is expected to boost the chemical manufacturing activity in the United States, and generate a higher demand for chemical technicians.

Salary Range*

The median annual wage for chemists in 2015 was \$71,260. The lowest 10 percent earned less than \$41,110, and the highest 10 percent earned more than \$125,740. For chemical technicians, the median annual wage was \$44,660. The lowest 10 percent earned less than \$27,260, and the highest 10 percent earned more than \$75,230.

Secondary Education

Job Outlook*

Employment of middle school and high school teachers is expected to grow 6% from 2014 to 2024, about as fast as average for all occupations.

Salary Range*

In 2015, the median annual wage for middle school teachers was \$55,860. The lowest 10 percent earned less than \$37,350, with the highest 10 percent earning more than \$87,060. For high school teachers, the median annual wage was \$57,200. The lowest 10 percent earned less than \$37,800, and the highest earned more than \$91,190.

* Derived from the Occupational Outlook Handbook

Chemistry Courses

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 choose 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. Emphasizes 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. Correctly use the language of chemistry. 2. Use the Periodic Table of Elements to predict the behavior of atoms. 3. Perform 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. Lab fee required. Corequisite: CHEM 1010. FA, SP.

CHEM 1020. Culinary Chemistry. 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 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. Prerequisite: MATH 1010 or MATH 1040 (All grade C- or higher) or Math Placement score 23 or higher. Corequisite: 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. Lab 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. 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. Lab fee required. Prerequisite: CHEM 1115 (Grade C or higher). Corequisite: CHEM 1120. 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. A \$109 Inclusive Access Course Material fee applies to this course. Prerequisite: MATH 1050 (Grade C or higher), or equivalent placement score taken within 2 years prior to enrollment in this course. Corequisite: 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. Lab 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 prerequisite for CHEM 2310 and further study in life and physical sciences. **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 discuss their impact on the technological and environmental concerns of our modern industrialized society. 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. Prerequisite: CHEM 1210 (Grade C- or higher). Corequisite: 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. Prerequisite: CHEM 1215. Corequisite: 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 stereoselectivity 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 3000. Quantitative Chemical Analysis. 4 Hours.

This course is focusing on understanding the principles of analytical chemistry and the application of these principles in various scientific disciplines. This course is addressing aspects of modern chemical analysis with emphasis on chemical equilibrium. Volumetric, gravimetric, and instrumental methods are described. Course will cover basic statistics, chemical equilibrium, gravimetric analysis, volumetric analysis, acid-base chemistry, complexation, spectrophotometry, and separations. There is a lecture and a laboratory component to this course. ****COURSE LEARNING OUTCOMES (CLOs)** At the successful conclusion of this course, students will be able to: 1. Apply stoichiometry and chemical equilibrium for analysis. 2. Discuss and apply chemical measurement calibration. 3. Apply statistical methods for evaluating and interpreting data. 4. Identify the proper analytical technique for sample analysis. Course fee required. Prerequisite: CHEM 1220 (Grade C or higher). FA (even).

CHEM 3060. Physical Chemistry 1. 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 1220 and PHYS 2210 (Grade C or higher). FA (odd).

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 2320 and CHEM 2325 (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). SP (even).

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. They 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 1220 and CHEM 2320 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 2320 and CHEM 2325. 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 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 3520. SP.

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 3520 (Grade C or higher). FA (odd).

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.

Engineering Courses

ENGR 1000. Intro to Engineering. 2 Hours.

For students considering an Engineering career. Introduces the functions and career paths for various branches of Engineering and the nature and challenges of the Engineering profession, including educational requirements of various fields, as well as history, ethics, and the engineering method. Also serves as a First Year Experience (FYE) seminar, introducing students to skills and resources designed to make them more successful university students. FA.

ENGR 1050. Intro to Engineering Design. 3 Hours.

For pre-engineering students. Covers basic principles behind the engineering design process, including all be introduced to solid modeling software, gathering design information, development of design alternatives, working in teams to support the entire design process, evaluating design alternatives, and communicating design outcomes. Ethics of design will be presented, and students will develop three simple projects, two of which will be in teams. Prerequisite: MATH 1060 or MATH 1080. SP.

ENGR 2010. Statics. 3 Hours.

For pre-Engineering students. Covers the equilibrium of bodies, that is, those that are either at rest or move with a constant velocity. Covers properties of vectors as they apply to force systems, including trusses, frames, and machines. Applications of friction and forces in beams. Prerequisites: MATH 1220 (can be concurrently enrolled). FA.

ENGR 2030. Dynamics. 3 Hours.

For pre-Engineering students. Covers the kinematics of a particle in both rectilinear and curvilinear motion, as well as application of Newton's laws of motion to the kinetics of particles in detail for several types of motion. Force and acceleration, and energy and momentum are used as methods for solving dynamic problems. Planar kinematics and kinetics of rigid bodies are covered. Prerequisite: ENGR 2010. Offered upon sufficient student need.

ENGR 2140. Strength of Materials. 3 Hours.

For pre-Engineering students. Introduces the internal effects (stress, strain, elastic and inelastic behavior, shear and bending movement) of loads (axial, torsion, and bending) on engineering systems. Prerequisite: ENGR 2010. Offered upon sufficient student need.

ENGR 2250. Electrical Circuits. 3 Hours.

For pre-Engineering students. Presents basic concepts of electric circuit theory, including voltage, current, power, resistance, capacitance, and inductance. Covers circuit analysis techniques, including Kirchoff's Laws, node voltages, and mesh currents for direct and alternating current. Circuits discussed include first and second order inductive and capacitive circuits (RC, RL, RLC). Operational amplifiers are introduced into circuit analysis. Phasers are used in conjunction with AC circuits. Prerequisites: MATH 2280 (can be concurrently enrolled), and MATH 1220. Offered upon sufficient student need.

ENGR 2255. Electrical Circuits Lab. 1 Hour.

Introductory lab course for pre-Engineering students. Discusses electrical circuit measurements and analysis methods. Through several laboratories students are introduced to instrumentation important to the understanding of electrical circuit analysis and the safety required with the use of instrumentation. Several different circuits will be analyzed including LC and RC circuits, resistive networks, operational amplifiers, and AC circuits. Includes basic circuit design and analysis techniques using circuit analysis software. Prerequisites: MATH 1220, and MATH 2270. Corequisite: ENGR 2250. Offered upon sufficient student need.

ENGR 2300. Engineering Thermodynamics. 3 Hours.

For pre-Engineering students. Covers fundamentals of thermal energy and work, thermodynamic properties of fluids and equations of state, open and closed systems, first and second laws of thermodynamics, and applications to thermal and mechanical processes. Prerequisites: MATH 2210 (can be concurrently enrolled) and MATH 1220. Offered upon sufficient student need.

ENGR 2990. Seminar in Engineering. 0.5-3 Hours.

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. Note that this course is an elective and does not fulfill general education or program requirements. Prerequisite: Instructor Permission.

Environmental Science Courses

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. A \$77 Inclusive Access Course Materials fee applies to this course. FA, SP, SU.

ENVS 2000R. 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 class will be held over a 3-4 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. Prerequisite: ENVS 1010 (can be concurrently enrolled), or Instructor permission.

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. Acquire skills in collecting and organizing scientific data from field investigations. 2. Gain familiarity with the context of the particular data set under consideration and discover how the concepts and skills they are acquiring in their other coursework can be developed through interdisciplinary research. 3. Prepare for participation in a research project. Course fee required. Prerequisite: ENVS 1010 (Grade B- or higher).

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. Acquire skills in understanding literary and scientific readings, while collecting and organizing scientific data from field investigations. They will 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. 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. Acquire skills in understanding literary and scientific readings, while collecting and organizing scientific data from field investigations. They will 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. 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. A separate study abroad fee will cover program costs while in South Africa, it does not cover international flights. 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).

Geography Courses

GEOG 1000. Physical Geography (PS). 3 Hours.

Fulfills Physical Science General Education Requirement. Focuses on the physical dynamics of the natural environment, including atmosphere, lithosphere, biosphere, hydrosphere and their integrated patterns of global distribution. Successful completion enables students to be familiar with climates, landforms, soils, water, plants, animals and how they all interact to make up the surface of the earth, provide resources for society, and create natural hazards. One field trip required. GEOG 1005 OR GEO 2000R lab course recommended. 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. 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 findings in oral and or written form. 5. Identify the various types of maps and charts used by geographers to help them better understand how earth's systems work together. 6. Identify and describe the functions of the four main subsystems of the earth. 7. Explain the various aspects of weather and climate and how they relate to the lithosphere and biosphere today as well as the future. 8. Explain the major internal and external processes that are acting upon the earth as well as the materials that make up the earth. 9. Identify and describe various landforms created by those processes. 10. Be able to identify the various types of ecosystems that are the result of weather/climate - lithosphere/tectonic interactions. Course fee required. FA, SP, SU.

GEOG 1000S. Physical Geography (PS). 3 Hours.

Fulfills Physical Science General Education Requirement. Focuses on the physical dynamics of the natural environment, including atmosphere, lithosphere, biosphere, hydrosphere and their integrated patterns of global distribution. Successful completion enables students to be familiar with climates, landforms, soils, water, plants, animals and how they all interact to make up the surface of the earth, provide resources for society, and create natural hazards. One field trip required. GEOG 1005 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. ****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. 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 findings in oral and or written form. 5. Identify the various types of maps and charts used by geographers to help them better understand how earth's systems work together. 6. Identify and describe the functions of the four main subsystems of the earth. 7. Explain the various aspects of weather and climate and how they relate to the lithosphere and biosphere today as well as the future. 8. Explain the major internal and external processes that are acting upon the earth as well as the materials that make up the earth. 9. Identify and describe various landforms created by those processes. 10. Be able to identify the various types of ecosystems that are the result of weather/climate - lithosphere/tectonic interactions. FA, SP.

GEOG 1005. Physical Geography Lab (LAB). 1 Hour.

Lab portion of GEOG 1000. One field trip required. Lab fee required. Corequisite: GEOG 1000. FA, SP, SU.

GEOG 1020. Introduction to Weather (PS). 3 Hours.

Fulfills General Education Physical Science requirement. Survey of the atmosphere and related phenomenon, including the impact of weather on human activities as well as understanding of basic weather principles. GEOG 1025 lab course recommended but not required. Offered upon sufficient student need.

GEOG 1025. Introduction to Weather Lab (LAB). 1 Hour.

A laboratory course to be taken concurrently with GEOG 1020. Lab fee required. Corequisite: GEOG 1020. Offered upon sufficient student need.

GEOG 1300. World Regional Geography. 3 Hours.

The study of different places, countries, and regions of the world. Addresses topics relating to natural environment, ethnic diversity, and regional differences in subjects related to culture, gender, age, class, social structure, spatial organization, and economic activities. Current social conditions within the world's major culture realms are analyzed and compared. ****COURSE LEARNING OUTCOMES (CLOs)** At the successful conclusion of this course, students will be able to: 1. Understand and apply four key concepts -- location, place, link, and region -- to geographical issues of spatial organization. 2. Understand the language of maps -- scale, projection, symbolization -- and map types -- reference & thematic -- for use in problems of spatial analyses. 3. Understand and use basic ideas about basic physical-human processes that interact geographically in the world: environmental settings, population and settlement, cultural patterns, geopolitical frameworks, economic and social development. 4. Apply these concepts and understandings to describe and analyze the basic physical and human characteristics of a region. 5. Examine the global consequences of the basic physical-human geographic forces while understanding persistent geographic diversity. SP.

GEOG 2000R. Natural History of Zion National Park (LAB). 1 Hour.

Fulfills General Education Laboratory Sciences requirement. Provides an opportunity for students to study in a field-research setting and learn about the natural history of Zion National Park. Topics will include plants, animals, geology, environmental issues and human history. The class will be held over a 4-5 day period (overnight stays required). 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 an understanding of the time and processes necessary for geologic change. 2. Identify and demonstrate an understanding of the differences between plants found in the variety of ecosystems found in and near Zion National Park. 3. Identify and demonstrate an understanding of the differences between animals found in the variety of ecosystems found in and near Zion National Park. 4. Develop the ability to research an environmental issue in Zion National Park. Course fee required. FA, SP, SU.

GEOG 2990. Seminar in Geography. 0.5-3 Hours.

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. Note that this course is an elective and does not fulfill general education or program requirements. Prerequisite: Instructor permission.

GEOG 3600. Introduction to Geographic Information Systems. 3 Hours.

Introduces the history, theory, and operation of Geographic Information Systems (GIS). Includes an introduction to GIS data sources, database design, data input, spatial analysis, and map production. Offers valuable preparation for careers in geology, geography, geographic information systems, geomatics, planning, surveying, marketing, environmental science, biology, engineering, and other related fields. ****COURSE LEARNING OUTCOMES (CLOs)** At the successful conclusion of this course, students will be able to: 1. Learn the history, theory, and operation of Geographic Information Systems (GIS). 2. Be introduced to GIS data sources, database design, data input, spatial analysis, and map production. 3. Learn how GIS is used in for careers for geology, geography, geographic information systems, geomatics, planning, surveying, marketing, environmental technology, biology, engineering, and other related fields. 4. Explain the technical and theoretical aspects of GIS-based modeling. 5. Gather and develop appropriate spatial and non-spatial data from various sources for use in GIS through lab exercises and an applied project. Corequisite: GEOG 3605. SP.

GEOG 3605. Introduction to Geographic Information Systems Laboratory. 1 Hour.

A laboratory component of GEOG 3600 to have experience working with GIS software, data sources, database design, data input, spatial analysis, and map production. ****COURSE LEARNING OUTCOMES (CLOs)** At the successful conclusion of this course, students will be able to: 1. Demonstrate the technical skills of GIS to acquire, analyze, and visualize the results of geographic problem solving. 2. Acquire an in-depth knowledge of the technical aspects involved in spatial data handling and analysis. 3. Gather and develop appropriate spatial and non-spatial data from various sources for use in GIS through lab exercises and an applied project. 4. Apply the GIS to their own field of interest to solve real-world problems. Course fee required. Corequisite: GEOG 3600. FA.

GEOG 3930. Remote Sensing of Landscape: China. 3 Hours.

This course will serve as an introduction to China's landscapes through a combination of field trip to China and remote sensing images interpretation and analysis in class. China is a massive country with a variety of amazing landscapes, and this course offers students a great active learning opportunity to study different landforms in China and explore the world using Remote Sensing. The coursework will be divided in to two parts: 1) The once-a-week lecture (1 hour/week) will introduce all the topics about the basics of landform, physical geography of China, principles of remote sensing, interpretation of aerial photograph and satellite image, and the introduction of the regions of interests (Guilin in China); 2) The ten-day field trip (planned for May) will include all the ground survey and hands-on activities like GPS positioning and landform identification led by the instructor and faculty from the host University in Guilin. 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. Explain at a basic level fundamental physical principles of remote sensing, being familiar with remotely sensed data. 2. Develop an ability to read and interpret geology and geomorphology from air photos and satellite data as well as relating the geographic features on the aerial photograph or satellite images to the same feature on topographic maps and on the ground through interpretation. 3. Identify the local terrains of St. George area through aerial photograph and satellite image interpretation. 4. Applying the insights gained from examining local features to Remote Sensing data acquired over remote parts of China to produce a comparative assessment of land cover and land use. 5. Obtain a basic understanding of the physical and human geography of China. SP.

GEOG 4200. Geography of Utah. 3 Hours.

Explores human and physical phenomena that make Utah distinctive. Lectures examine webs of relationships among Utah's people, places, and environments. Students examine Utah's contrasting physical and social environments and explore what is meant by a sense of place. Offered upon sufficient student need. ****COURSE LEARNING OUTCOMES (CLOs)** At the successful conclusion of this course, students will be able to: 1. Be familiar with most aspects of Utah today in the context of themes of geography and other social behavioral sciences. 2. Analyze components of the landscape including: bedrock versus sediment; evidence of surface and ground water; and classifications of major climatic and vegetation regimes and understand how these physical factors have influenced and continue to influence Utah's peoples. 3. Evaluate social and demographic patterns and interpret census data, urban plans, and population pyramids. 4. Understand relationships among Utah's people, places and environments, past and present. 5. Anticipate and better understand how webs of relationships among physical, behavioral, and social conditions will undoubtedly influence their own choices and their futures.

Geology Courses

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 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. Explaining 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. Course fee required. 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. Explaining 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 1025. Life of the Past Laboratory (LAB). 1 Hour.

A laboratory course to be taken concurrently with GEO 1020. Lab fee required. 2 lab hours per week. Offered upon sufficient student need. Corequisite: GEO 1020.

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 findings 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 fee required. Corequisite: GEO 1050. SP.

GEO 1060. Introduction to Environmental Geology (PS). 3 Hours.

Fulfills General Education Physical Science requirement for non-Science majors. Emphasizes relationship between human beings and the geologic environment, including geologic hazards, mineral and energy resources, and environmental issues, including causes and impacts of environmental threats. Offered upon sufficient student need.

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 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.

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.

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 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 findings in oral and or written form. 5. Distinguish between the major internal and external processes acting upon the earth. 6. Identify and describe various landforms created by those processes. 7. Identify and describe the earth materials. 8. Apply the principles of geologic time to analyze the rates of geologic processes. Corequisite: GEO 1115. FA.

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. 3. Identify the various processes from topographic maps. 4. Draw geologic cross sections from topographic maps. 5. Realize that the earth is a dynamic planet and is undergoing constant change due to the many internal and external 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.

GEO 2000R. Applied Geologic Investigation of Grand Canyon, Zion, and Bryce National Parks (LAB). 1 Hour.

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. Acquire skills in collecting and organizing scientific data from field investigations. 2. Gain familiarity with the geoscientific 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. Participate in a research project facilitated by the Colorado Plateau Field Institute (CPFI). Course fee required. Corequisite: GEO 1115.

GEO 2990. Seminar in Geology. 0.5-3 Hours.

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. Note that this course is an elective and does not fulfill general education or program requirements.

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. Prerequisites: GEO 1110 (Grade C or higher) AND GEO 1115 (Grade C or higher). Offered upon sufficient student need.

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," poriferans, 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 (even).

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. Prerequisites: GEO 1110/1115 AND CHEM 1210/1215. Offered upon sufficient student need.

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 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 structural deformation (extensional and shear fractures, fault-related folds) and ductile structural deformation (flow folds, foliation and rock fabrics). 2. Conduct a geometric structural analysis by acquiring reliable measurements of the geometry of structures with a compass; presenting and manipulating data using stereo-graphic projection; interpreting stress and kinematic histories from structural measurements; and inferring geometry of subsurface and missing parts of structures, in order to construct a viable geologic cross-section. 3. Identify and interpret sense-of-shear indicators associated with both brittle and ductile structures in the field, then reconstruct the deformation path of a structural feature or deformed region as part of a kinematic structural analysis. 4. Generate a dynamic structural analysis by deriving the normal and shear stress components for rock failure from the lab, then using these results to 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 by measuring the orientation, slip rate, and direction of the fault and combining these measurements with GPS and EDM results on strain accumulation rates. 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 (All grade C or higher).

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. The fee covers airfare, lodging, transportation, activities, trip insurance and most meals. ****COURSE LEARNING OUTCOMES (CLOs)** At the successful conclusion of this course, students will be able to: 1. Find evidence that meets the criteria of science in recognizing and differentiating hypotheses, theories and/or laws using the Plate Tectonic setting and glacier resources of Iceland. 2. Apply the concepts of both stratigraphic and radiometric dating to interpret physical and biologic events in Earth history using geologic processes, biologic evolution and/or anthropogenic landscape and climate change 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 describe their importance, their renewability, how they are recovered and their impacts on global climate change, politics, and economics. 5. Describe the theory of plate tectonics including the history of its development, details of its mechanisms and processes, and the central role tectonics plays in shaping our planet both internally and externally, including tectonic hazards, as evidenced in Iceland. Course fee required. SP.

Physics Courses

PHYS 1010. Elementary Physics (PS). 3 Hours.

Fulfills General Education Physical Science requirement for students not majoring in Physics, other Sciences, or Engineering. Covers the basic concepts of physics in an historical perspective, providing many practical examples that demonstrate the role of physics in their everyday life. PHYS 1015 lab course recommended but not required. ****COURSE LEARNING OUTCOMES (CLOs)** At the successful conclusion of this course, students will be able to: 1. Demonstrate a conceptual understanding of Newton's laws of motion; momentum and energy conservation; electricity and magnetism; and modern physics. Prerequisite: ACT Math Placement score 23 or higher; OR MATH 1010 (Grade C or higher). FA, SP, SU.

PHYS 1015. Elementary Physics Lab (LAB). 1 Hour.

Lab portion of PHYS 1010. Offered upon sufficient student need. ****COURSE LEARNING OUTCOMES (CLOs)** At the successful conclusion of this course, students will be able to: 1. Apply the principles learned in Physics 1010 to real life situations. Course fee required. Corequisite: PHYS 1010.

PHYS 1040. Elementary Astronomy (PS). 3 Hours.

Fulfills General Education Physical Science requirement intended for students not majoring in Physics, other Sciences, or Engineering. Covers a general study of the solar system, including the formation of the solar systems and a brief description of its parts. Also covers a brief history of astronomy and a general study of the known universe. A \$99 Inclusive Access Course Material fee applies to this course. ****COURSE LEARNING OUTCOMES (CLOs)** At the successful conclusion of this course, students will be able to: 1. Develop an understanding and appreciation of the laws of the Universe. 2. Build quantitative and qualitative reasoning skills. 3. Extend critical thinking skills. 4. Relate basic physics and chemistry to the origin and development of planetary systems and galaxies. 5. Become familiar with the night sky and how its appearance changes with time and position. 6. Gain an appreciation of the history of astronomy and the evolution of scientific ideas. 7. Build the understanding that physical laws and processes are universal and can be explored using the scientific method. Course fee required. Corequisite: PHYS 1045. FA, SP.

PHYS 1045. Elementary Astronomy Lab (LAB). 1 Hour.

Lab portion of PHYS 1040. Lab fee required. Corequisite: PHYS 1040. FA, SP.

PHYS 2010. College Physics I (PS). 4 Hours.

Fulfills General Education Physical Science requirement for students majoring in some Science programs, and pre-Medical, pre-Dental, and other pre-professional programs. Covers the basics of mechanics, heat, and sound. First course in a two-semester sequence required for further study in science fields. ****COURSE LEARNING OUTCOMES (CLOs)** At the successful conclusion of this course, students will be able to: 1. Demonstrate an understanding of motion by setting up and solving a variety of kinematics problems. 2. Apply Newton's laws of motion to a variety of problems involving physical systems. 3. Apply conservation laws to solve problems involving physical systems. 4. Apply kinematics, dynamics, and conservation laws to solve problems involving rotational motion. 5. Apply the equations of motion to a variety of problems involving oscillatory and wave motion. Prerequisite: MATH 1060 or MATH 1080 (Grade C or higher), or equivalent placement score taken within 2 years prior to enrollment in this course. Corequisite: PHYS 2015. FA.

PHYS 2015. College Physics I Lab (LAB). 1 Hour.

Lab portion of PHYS 2010. ****COURSE LEARNING OUTCOMES (CLOs)** At the successful conclusion of this course, students will be able to: 1. Apply the principles learned in Physics 2010 to real life situations. Course fee required. Corequisite: PHYS 2010. FA.

PHYS 2020. College Physics II. 4 Hours.

Second course in a two-semester sequence required for further study in science fields for students majoring in some Science programs, and pre-Medical, pre-Dental, and other pre-professional programs. Covers the basics of electricity, magnetism, light, and modern physics. Uses lecturers, videos, and demonstrations. ****COURSE LEARNING OUTCOMES (CLOs)** At the successful conclusion of this course, students will be able to: 1. Apply both ray and wave optics to solve problems for basic optical systems. 2. Demonstrate an understanding of electricity by setting up and solving a variety of problems involving electrostatics and electrodynamics. 3. Apply the laws of magnetism to a variety of problems including physical systems which contain both electric and magnetic phenomena. 4. Demonstrate an understanding of relativity theory by setting up and solving a variety of problems involving speeds near the speed of light. 5. Set up and solve problems leading up to and including simple quantum mechanics as it applies to atomic, nuclear, and particle physics. Prerequisite: PHYS 2010 (Grade C or higher). Corequisite: PHYS 2025. SP.

PHYS 2025. College Physics II Lab. 1 Hour.

Lab portion of PHYS 2020. ****COURSE LEARNING OUTCOMES (CLOs)** At the successful conclusion of this course, students will be able to: 1. Apply the principles learned in Physics 2025 to real life situations. Course fee required. Prerequisite: PHYS 2015 (Grade C or higher). Corequisite: PHYS 2020. SP.

PHYS 2210. Physics/Scientists Engineers I (PS). 4 Hours.

Fulfills General Education Physical Science requirement for students majoring in physical science, engineering, and some biological/plant sciences. First course in an intensive two-semester sequence. Covers basic principles of physics, emphasizing mechanics with the objective of developing students' capacities to analyze problems in physics and to express solutions in mathematical form utilizing mathematics up to and including calculus. Successful completion satisfies prerequisite for ENGR 2000. A \$109 Inclusive Access Course Material fee applies to this course. ****COURSE LEARNING OUTCOMES (CLOs)** At the successful conclusion of this course, students will be able to: 1. Explain the major threads of physics concepts for forces. 2. Explain the major threads of physics concepts for conservation laws. 3. Explain the major threads of physics concepts for Newton's Laws. 4. Explain the major threads of physics concepts for work and energy. 5. Demonstrate how to correctly solve physics problems by using mathematics. 6. Identify key elements in the functioning of a physical system by construction of a model. Prerequisite: MATH 1210 (Grade C or higher) or MATH 1220 (can be concurrently enrolled). Corequisite: PHYS 2215. FA.

PHYS 2215. Physics/Scientists Engineers I Lab (LAB). 1 Hour.

Lab portion of PHYS 2210. Lab fee required. Corequisite: PHYS 2210. FA.

PHYS 2220. Physics/Scientists EngineersII. 4 Hours.

Second course in a two-semester sequence required for students majoring in physical science, engineering, and some biological/plant sciences. Covers basic principles of physics, emphasizing electricity and magnetism; optics, and relativity with the objective of developing students' capacities to analyze problems in physics and to express solutions in mathematical form utilizing mathematics up to and including calculus. Successful completion of this series satisfies Physics requirements for Physical Science and Engineering. ****COURSE LEARNING OUTCOMES (CLOs)** At the successful conclusion of this course, students will be able to: 1. Understand waves and optics, the electric charge and Coulomb's law, the electric field, Gauss' law, current and conductivity, electric potential, circuits, the magnetic field, Faraday's law of induction, Maxwell's equations, electromagnetic waves, and relativity. 2. Solve physical and mathematical problems relating to these subjects utilizing the mathematical concepts of algebra, trigonometry, and calculus evaluated by performance on homework assignments and examinations. Prerequisite: MATH 1220; and PHYS 2210. Corequisite: PHYS 2225. SP.

PHYS 2225. Physics/Scientists Engineers II Lab. 1 Hour.

Lab portion of PHYS 2220. Lab fee required. Prerequisite: PHYS 2215. Corequisite: PHYS 2220. SP.

PHYS 2710. Introductory Modern Physics. 3 Hours.

For students majoring in Physics and some Engineering fields, also recommended for Chemistry and other Science majors. Includes relativity; wave-particle duality; and an introduction to quantum physics, atomic physics, and nuclear physics. Prerequisites: MATH 2280; and PHYS 2220/2225. Offered upon sufficient student need.

PHYS 2990. Seminar in Physics. 0.5-3 Hours.

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. Note that this course is an elective and does not fulfill general education or program requirements. Prerequisite: Instructor permission.

PHYS 3400. Classical Mechanics. 3 Hours.

Study of Newtonian Mechanics, work and energy, systems of particles, Lagrange's and Hamilton's equations, harmonic oscillators, accelerated reference frames, and rigid body rotations. Offered upon sufficient student need. Prerequisite: PHYS 2220 (Grade C or higher).

PHYS 3600. Thermofluids: Thermodynamics. 4 Hours.

Fundamentals of thermodynamics required for Mechanical Engineering majors. Students learn to apply the laws of thermodynamics to open and closed systems through lecture and laboratory experiments. Topics include: energy transfer, laws of thermodynamics, power cycles, refrigeration and heat pump cycles, gas mixtures, psychrometrics, combustion, and chemical and phase equilibrium. ****COURSE LEARNING OUTCOMES (CLOs)** At the successful conclusion of this course, students will be able to: 1. Understand basic concepts of thermodynamics; properties of pure substances; mass and energy analysis; laws of thermodynamics; entropy; power cycles; refrigeration and heat pump cycles; gas mixtures; HVAC and psychrometrics; and combustion and chemical reactions. Prerequisites: PHYS 2210 AND MATH 2210 AND CHEM 1210 (All Grade C- or higher). SP.

PHYS 3605. Thermofluids: Thermodynamics Lab. 0.5 Hours.

Lab portion of MECH 3600. ****COURSE LEARNING OUTCOMES (CLOs)** At the successful conclusion of this course, students will be able to: 1. Know heat engine experiment; gas laws; flame temperature; humidity and dew point; and air conditioning. Corequisite: PHYS 3600. SP.

PHYS 3710. Intermediate Modern Physics. 3 Hours.

For students majoring in Physics and Physical Science education. Includes a basic study of relativity and wave-particle duality, as well as an introduction to quantum physics, atomic physics, and nuclear physics. Prerequisite: MATH 1220 (Grade C or higher) AND PHYS 2220 (Grade C or higher). Offered upon sufficient student need.

PHYS 3720. Modern Physics II. 3 Hours.

Second course in a two-semester sequence for students majoring in Physics and Physical Science education. Continuation of Physics 3710 with an emphasis on applications of quantum mechanics and relativity. ****COURSE LEARNING OUTCOMES (CLOs)** At the successful conclusion of this course, students will be able to: 1. Have a greater knowledge of the applications of modern physics including spectroscopy, electron conduction in solids, nuclear physics and cosmology. Prerequisite: PHYS 3710 (Grade C or higher). SP (odd).

PHYS 4800R. Independent Research. 1-3 Hours.

Students will devise and perform original, preferably unique research projects in Physics. The culmination of this project will be a publication-quality paper on their research that uses primary scientific literature pertinent to the student's field and individual projects. Repeatable for a maximum of 6 credits subject to graduation restrictions. Offered upon sufficient student need. ****COURSE LEARNING OUTCOMES (CLOs)** At the successful completion 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 process of a research project. 3. Interpret results from experiments, modify the hypothesis. 4. Interact with other students and faculty that are engaged in the project. 5. Utilize outside resources (scientific databases, literature, etc.) to help interpret results and compare to existing and previous work in the field of your research project. Prerequisites: Instructor permission and Junior or Senior standing. FA, SP.

Science Courses

SCI 1001. FYE: Science/Pre-Professional. 1 Hour.

A First Year Experience course strongly recommended for all entering freshmen and transfer student with 0-24 credits. Designed to help students succeed in science and other courses, adapt to university life, and become integrated into Dixie State University. Students will refine academic skills, create and foster social networks, learn about university resources, and explore different fields of study, degree options, and career opportunities as well as learning what science is and some of the career paths one can take in science. Multiple listed with all other sections of First Year Experience (all 1001 courses, ENGR 1000). Students may only take one FYE course for credit. FA, SP.

SCI 2600. Lab Safety for Teachers. 1 Hour.

Scientific school laboratory safety certification course required for secondary education majors to receive teaching endorsements in the sciences. Course will include the necessary knowledge required for pre-service teachers to safely teach lab science, including identifying the most common safety issues and providing affordable solutions. Offered upon sufficient student need.A.

SCI 4130. Science Teaching Methods. 3 Hours.

Required of students pursuing a Biology Secondary Education degree. Designed to assist pre-service teachers plan, teach, and evaluate activities for biology classes. Students will examine objectives, instructional methods, and curriculum for biology in secondary schools. Students will gain experience in developing, adapting, evaluating and using strategies and materials for teaching biology. Special characteristics of the science discipline will be considered. Students will be exposed to a diversity of laboratory and outdoor environmental materials and methods. This course does not fulfill a Biology elective for the Bachelor of Science in Biology degree. Offered based upon sufficient student need. Prerequisite: Admission to the Dixie State University Secondary Education Licensure program.

SCI 4700. Secondary Science Teaching Methods. 3 Hours.

Acquaintance and practice with various teaching and assessment methods in science. Development of science curricula emphasizing the integrated linkages between subjects. Development of science lesson and unit plans. It is recommended that students complete this course immediately prior to student teaching. FA.

SCI 4800R. Independent Research. 1-3 Hours.

Students will devise and perform original, preferably unique research projects in their respective Physical Science fields. The culmination of this project will be a publication-quality paper on their research that uses primary scientific literature pertinent to the student's field and individual projects. Repeatable for a maximum of 6 credits subject to graduation restrictions. Prerequisite: Instructor permission and Senior standing. Offered upon sufficient student need.