

SCHOOL OF EARTH SCIENCES, OHIO STATE UNIVERSITY

REVISIONS TO B.S. PROGRAM: AUTUMN 2020

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PREPARATION FOR THE MAJOR

Course number	Course name	Credit hours	
Chem 1210	<i>General Chemistry 1</i> : First course for science majors, covering dimensional analysis, atomic structure, the mole, stoichiometry, chemical reactions, thermochemistry, electron configuration, bonding, molecular structure, gases, liquids, and solids.	5	
Math 1151	<i>Calculus 1</i> : Differential and integral calculus of one real variable.	5	
Math 1152	<i>Calculus 2</i> : Integral calculus, sequences and series, parametric curves, polar coordinates, (optional: vectors).	5	
Physics 1250	<i>Physics 1</i> : Calculus-based introduction to classical physics: Newton's laws, fluids, thermodynamics, waves; for students in physical sciences, mathematics, and engineering.	5	
One of			
	Bio 1113	<i>Energy Transfer and Development</i> : Exploration of biology and biological principles; evolution and the origin of life, cellular structure and function, bioenergetics, and genetics.	4
Recommended for Museum & Marine Sci Cert	Bio 1114	<i>Biological Sciences: Form, Function, Diversity, and Ecology</i> : Exploration of biology and biological principles; evolution and speciation, diversity in structure, function, behavior, and ecology among prokaryotes and eukaryotes.	4
Necessary for Geophysics	Physics 1251	<i>Physics 2</i> : Calculus-based introduction to electricity and magnetism, simple optics, modern physics including special	5

		relativity and quantum mechanics; for students in physical sciences, mathematics, and engineering.	
Recommended for CWE & Hydro-geology Cert	Chem 1220	<i>Chem 2</i> : Continuation of 1210 for science majors, covering solutions, kinetics, chemical equilibrium, solubility and ionic equilibria, qualitative analysis, thermodynamics, electrochemistry, descriptive chemistry, coordination compounds, and nuclear chemistry.	5
One Introductory Earth Science (4 hours) with lab OR Introductory Earth Science course (3 hours) AND EarthSc 1200 (1 hour)			
EARTHSC 1100		<i>Planet Earth: How It Works</i> : The materials of the Earth's crust, the processes that produce and modify them, the development of the Earth and its life forms through time, and responsible stewardship of the earth's resources.	4
EARTHSC 1121		<i>The Dynamic Earth</i> : Plate tectonics; rock forming processes; climate change; energy resources.	4
EARTHSC 1105		<i>Geology of the National Parks</i> : Geologic processes, materials, and history revealed in geologic settings of the National Parks.	3
EARTHSC 1108		<i>Gemstones</i> : General introduction to gemstones, including the origin of gems, identification techniques, and the history of important gems.	3
EARTHSC 1151		<i>Natural Hazards</i> : Occurrence and causes of earthquakes, volcanoes, and related hazards, and impact on climate, society, and history.	3
EARTHSC 2203		<i>Environmental Geoscience</i> : Concepts and challenges of geological hazards and resources, environmental pollution, and health; regional and long-range planning; and global change and sustainability.	3
EARTHSC 2205		<i>The Planets</i> : Survey of the solar system's planets and moons with focus on surface environments, dynamics, and the ability to host life.	3
EARTHSC 2206(S)		<i>Principles of Oceanography</i> : Introduction to the four basic disciplines of oceanography: geological, chemical, physical, and biological. Relevance of oceanography in contemporary issues.	3
EARTHSC 1200 (new course)		<i>Introductory Earth Science Lab</i> : Laboratory application of basic earth sciences principles to the identification and categorization of rocks and minerals, use and construction of maps to solve geological problems, and analysis of Earth's physical processes.	1
Total semester hours in Preparation for the major			28-29
Note: Where available, an Honors offering can be substituted for the equivalent non-Honors course listed in the Preparation for the Major.			

ALL BS PROGRAMS

Semester course number	Semester course name	Semester credit hours	Prereqs.
Complete:			
EARTHSC 2000 (new course)	<i>Preparation for Thesis and Careers in the Earth Sciences:</i> In this course, students will be 1) exposed to the wide diversity of research in Earth Sciences and potential careers in the Earth Sciences and 2) prepared for the senior thesis, which is a requirement for Earth Sciences BS majors.	1	---
EARTHSC 2245	<i>Introductory Data Analysis for Earth and Environmental Sciences:</i> Data analysis using cooperative learning environment; topics include data visualization, error analysis, error propagation, probability distributions, hypothesis testing, ANOVA, linear regression, and spatial statistics.	4	MATH 1141, 1151 or above, or concur
EARTHSC 4999.01 (H)	<i>Undergraduate Research for Thesis in Earth Sciences:</i> Undergraduate research or creative activities in variable topics leading to completion of a B.S. thesis. To be taken during the semester when the thesis is turned in.	1 (graded)	Rank 4 in EARTHSC & permission of instructor
EARTHSC 4999.02 (H)	<i>Undergraduate Research for Thesis in Earth Sciences:</i> Undergraduate research or creative activities in variable topics leading to completion of a B.S. thesis.	0-4 (S/U)	Sr standing, or permission of the instructor.
Complete at least 1 focused on the Science of Sustainability if not fulfilled in the preparation for the major			
EARTHSC 2122 (L)	<i>Climate and Life over Billions of years on Earth:</i> Origin and evolution of Earth, including its physical, chemical and biological components; principles of geologic inference and their application to interpreting Earth.	4	
EARTHSC 2155	<i>Energy and Environment:</i> Introduces and examines the fundamentals of energy sources, energy use, energy efficiency, and resulting environmental implications of the various energy supplies.	3	
EARTHSC 2203	<i>Environmental Geoscience:</i> Concepts and challenges of geological hazards and resources, environmental pollution, and health; regional and long-range planning; and global change and sustainability.	3	
EARTHSC 2204	<i>Exploring Water Issues:</i> Water on Earth, human impacts, and scientific and technological issues related to water resource development and conservation.	3	
EARTHSC 2206(S)	<i>Principles of Oceanography:</i> Introduction to the four basic disciplines of oceanography: geological, chemical, physical, and biological. Relevance of oceanography in contemporary issues.	3	
EARTHSC 2210	<i>Energy, Mineral Resources, and Society:</i> Geologic origin, world distribution, and uses of mineral resources critical to society; topics include mineral and fossil fuels, metallic ores, and industrial minerals.	3	
EARTHSC 3411	<i>Water Security for the 21st Century:</i> Examine the major issues that are contributing to the decline in quantity and quality of global freshwater resources and the resulting environmental and societal impacts.	3	
EARTHSC 4425	<i>Energy Resources and Sustainability (limbo):</i> An examination of the problem of decreasing supplies of fossil fuel, alternative energy sources, and possible accommodations	3	A GE or GEC data only course, and

			Soph standing or above
EARTHSC 5663	<i>Global Change and Sustainability (limbo):</i> Analysis of Earth systems, global environmental change and options for sustainability	4	Sr or Grad standing, or permission of instructor
ENR 2100	<i>Introduction to Environmental Science:</i> Introduction to environmental science, the ecological foundation of environmental systems, the ecological impacts of environmental degradation by humans, and strategies for sustainable management of environment and natural resources.	3	
ENR 5451	<i>Water Policy and Governance:</i> This class examines institutions to manage water effectively at a variety of levels -state, federal, and international- and analyzes how they affect water access and use in different areas (agriculture, energy, etc.). Students in the class will also engage in a careful examination of the sources of conflict and cooperation among water stakeholders on a regional and global scale.	3	
Complete the requirements for one subprogram (below) AND complete an approved Certificate, approved Minor, or any second major			

GEOLOGICAL SCIENCES SUBPROGRAM

Course number	Course name	Credit hours	Prereqs.
Everyone takes:			
EARTHSC 2122 (former 1122)	<i>Climate and Life over Billions of years on Earth:</i> Origin and evolution of Earth, including its physical, chemical and biological components; principles of geologic inference and their application to interpreting Earth.	4	If not used to satisfy the Science of Sustainability requirement
EARTHSC 4421	<i>Earth Materials:</i> Internal and external symmetry of minerals; relationship of physical properties to crystal structure; introduction to modern and traditional identification methods; sight identification of about 30 minerals.	3	Chem 1210
EARTHSC 4423	<i>Intro Petrology:</i> Origin, occurrence, association, and mineral composition of the common rocks; laboratory includes work by megascopic and microscopic methods.	3	EARTHSC 1100 OR 1121 OR 1200 & 4421
EARTHSC 4502	<i>Stratigraphy and Sedimentology:</i> Principles of, and procedures in, stratigraphy and sedimentation, illustrated by field and laboratory studies of sedimentary rocks.	4	EARTHSC 1100 OR 1121 OR 1200 & 1122 or 2122
EARTHSC 4530	<i>Structural Geology:</i> An introduction to the principles of rock deformation, the classification and physical origin of rock structures, and crustal tectonic processes.	4	EARTHSC 1100 OR 1121 OR 1200 & Physics 1250
EARTHSC 5189.01	<i>Field Geology 1:</i> Concentrated training in the basic essentials of field observation and mapping; the work is done in central Utah, with headquarters in Ephraim. Requires full time of student.	3	EARTHSC 1100 OR 1121 OR 1200, & 4530 & permission of instructor
EARTHSC 5189.02	<i>Field Geology 2:</i> Concentrated training in the basic essentials of field observation and mapping; the work is done in central Utah, with headquarters in Ephraim. Continuation of 5189.01. Requires full time of student.	3	EARTHSC 4423, 5189.02
TOTAL CREDITS, at least 20 of which must be at the 3XXX level or above	Core for all Earth Science BS students: 9-10 Geological Sciences courses: 24		33-34
Minimum Required Hours to complete degree, including certificate/minor			39-40
Complete an approved certificate, minor, or any second major			

CLIMATE, WATER, AND THE ENVIRONMENT SUBPROGRAM

Course number	Course name	Credit hours	Prereqs.
Everyone takes (3 hours)			
EARTHSC 4450	<i>Water, Ice and Energy in the Earth System:</i> Earth's energy budget and the transfer of water between reservoirs. Processes that regulate water transfer, common measurement approaches, and the importance of water in geological processes, global change, and as a resource.	3	EARTHSC 1100, 1105, 1108, 1121, 1151, 2203, 2204, 2205, GEOG 3901, OR GEOG 5900; AND Chem 1210 OR Physics 1250; or permission of instructor
One Course on Earth Materials (3-4 hours):			
EARTHSC 2212	<i>Intro to Earth Materials (limbo):</i> A study of the common minerals and rocks, their associations, occurrences, identifying properties, and origin.	4(L)	EARTHSC 1121 and CHEM 1210 or above
EARTHSC 4421	<i>Earth Materials:</i> Internal and external symmetry of minerals; relationship of physical properties to crystal structure; introduction to modern and traditional identification methods; sight identification of about 30 minerals.	3(L)	CHEM 1210 or above
EARTHSC 4502	<i>Stratigraphy and Sedimentology:</i> Principles of, and procedures in, stratigraphy and sedimentation, illustrated by field and laboratory studies of sedimentary rocks.	4(L)	EARTHSC 1100, 1121, OR 1200; AND EARTHSC 1122 or 2122
Two Climate Classes (5-6 hours, including at least one EARTHSC course):			
EARTHSC 5206	<i>Advanced Oceanography:</i> Advanced study of geological, chemical, physical, and biological oceanography; their interactions; and their interactions with relevant current issues such as global change modeling, fisheries management, and energy exploration.	3	EARTHSC 1100 or 1105 or 1121 or graduate standing or permission of instructor
EARTHSC 5650	<i>Glaciology:</i> The fundamental processes controlling ice flow, glacier mass balance and the interaction of glaciers and ice sheets with the solid earth, ocean and atmosphere. Observational and computational methods are also addressed.	3	EARTHSC 4450 or permission of instructor
GEOG 3900	<i>Global Climate Change: Causes and Consequences:</i> Examines the natural and human factors that force changes in our climate and environment and explores strategies for a sustainable environment in the future.	3	---
GEOG 3901	<i>Global Climate and Environmental Change:</i> Examines both natural and social factors that force changes in our climate and environment and explores strategies for a sustainable environment in the future.	3	---
GEOG 5900	<i>Climatology:</i> An introduction to the fundamental physical and mathematical principles governing both day-to-day weather and the average of weather, or climate. Objectives are to understand the physical processes of the earth-atmosphere system, describe its weather features and climate characteristics today, and	3	---

	outline how they might change in the future as a result of global warming.		
ENR 5268	<i>Soils and Climate Change</i> : Soil processes, abrupt climate change, trace gases and their properties, global C cycle, gaseous emissions, C-neutral fuels, carbon sequestration, Kyoto Treaty, trading of C credits.	2	---
Two Water Classes (6-7 hours, including at least one EARTHSC course):			
EARTHSC 5651	<i>Hydrogeology</i> : Geologic and hydrologic factors controlling the occurrence, movement, storage, and chemical quality of surface water and groundwater; exploration, evaluation, development and management of water resources.	4 (L)	EARTHSC 1100, 1105, 1108, 1121, 1151, 2203, OR 2205; and Math 1152 or above
EARTHSC 5655	<i>Land Surface Hydrology</i> : Physical processes of land surface hydrology in the context of the global hydrologic cycle. Consideration of the processes and mechanisms responsible for water and energy fluxes, with examples from various river basins.	3	Math 1152 or above, Chem 1210 or above, and Physics 1250 or above
EARTHSC 5718	<i>Aquatic Geochemistry</i> : Examination of the processes that control chemical equilibria in natural waters: acid/base reactions, metal complexation/speciation and oxidation-reduction processes. Intended for students in EarthSci, CivilEn, and the Grad EnvSci program.	3	Chem 1220 (122) or above; and Math 1151 (152) or above; or equivalents.
ENR 4285	<i>Watershed Hydrology</i> : Covers hydrologic processes in watersheds, including precipitation, evapotranspiration, infiltration, runoff, and streamflow. We will evaluate how watershed characteristics, climate, and land use control these processes. In addition, we will discuss and practice current physical, chemical, and computational techniques for characterizing the hydrologic functioning of watersheds.	3 (L)	Chem 1210, and Math 1151 or 1156
EEOB 5420	<i>Aquatic Ecosystems: Ecology of Inland Waters</i> : A study of the physical, chemical, and biological factors influencing the biological productivity of inland waters, and of techniques and equipment used in evaluating them.	1.5	EEOB 3410
ENR 3280	<i>Water Quality Management</i> : Causes, consequences, and solutions of pollution in lakes, rivers, wetlands, and groundwater; analysis of the physical, chemical, and biological indicators of water quality.	2	
ENR 4260	<i>Soil Resource Management</i> : Degradation of the soil by erosion, compaction and salinity. Methods of preventing degradation and remediating existing problems. Special emphasis on conservation tillage, crop rotations, and irrigation management.	3	
Two Environment Classes (6 hours, including at least one EARTHSC course)			
EARTHSC 5621	<i>Introduction to Geochemistry</i> : Introduction to the chemistry of the solid Earth and hydrosphere describing the processes controlling the distribution of elements.	3	Rank 4 standing in EARTHSC or related field; Chem 1220 or above or permission of instructor
EARTHSC 5203	<i>Geo-Environment and Human Health</i> : Examine geo-environmental processes that are contributing to human health degradation and the resulting societal impacts.	3	EARTHSC 2245 or GE data analysis course or equivalent; Soph standing or above; or permission of instructor

ENVENG 3200	<i>Fundamentals of Environmental Engineering:</i> Quantitative assessment of water quality, air quality, and solid/hazardous waste management, with an emphasis on minimizing human health and environmental impacts through sustainable design.	3	Chem 1210
ENVENG 2100	<i>Environmental Engineering Analytical Methods:</i> Application of analytical methods to calculate, measure and interpret chemical characteristics of water, soil, and air.	3	Chem 1210 and 1220
ENR 3000	<i>Soil Science:</i> Introduction to soil physical, chemical, and biological properties related to land use, environmental quality, and crop production.	3	
TOTAL CREDITS (at least two of which must be a lab course)	Core for all Earth Science BS students: 9-10 CWE requirements: 23-26		32-36
Minimum Required Hours to complete degree, including certificate/minor			38-42
Complete an approved certificate, minor, or any second major			

GEOPHYSICS SUBPROGRAM

Course number	Course name	Credit hours	Prereqs.
Complete the following courses (14-15 credit hours):			
MATH 2153 or MATH 2173	<i>Calculus III:</i> Multivariable differential and integral calculus. <i>Engineering Mathematics B:</i> Multiple integrals, line integrals, vector fields, second order ordinary differential equations.	4 3	MATH 1152, 1172, 1534, 1544, 1181H, or 4181H
PHYSICS 2300	<i>Intermediate Mechanics I:</i> Vectors and kinematics; foundations of Newtonian mechanics; momentum, work, and energy; conservative and nonconservative forces; potentials; angular momentum; rotation about a fixed axis; rigid body motion; non inertial systems and fictitious forces.	4	PHYSICS 1251, PHYSICS 1251 1251H, or PHYSICS 1261. Concur: Math 2153, 2173, or above.
EARTHSC 4530	<i>Structural Geology:</i> An introduction to the principles of rock deformation, the classification and physical origin of rock structures, and crustal tectonic processes.	4	EARTHSC 1100 OR 1121 OR 1200 & Physics 1250
EARTHSC 4560	<i>Applied Geophysics:</i> Methods and techniques of pure and applied geophysics; geological interpretation of geophysical data.	3	EARTHSC 1100, 1105, 1108, 1121, 1151, 2203, OR 2205, Math 1151 & Physics 1250
Complete additional geophysics courses, up to 30 credit hours total (~2-3 courses):			
EARTHSC 5641	<i>Geostatistics:</i> Applications of statistical methods to geoscience data, including linear error propagation, least-squares estimation, confidence interval estimation, analysis of variance. Role of computer graphics in data analysis.	3	Stat 5301 and Math 1152 or above, or permission of instructor
EARTHSC 5646	<i>Geodynamics:</i> Application of mathematical and physical methods to the solution of geologic problems in heat flow, plate tectonics, interior dynamics, mountain building, ground-water flow, river mechanics.	3	Math 1152, Physics 1250 & EARTHSC 4530, or permission of instructor
EARTHSC 5680	<i>Deep Earth Geophysics:</i> Methods and techniques for study of Earth's crust and interior, involving potential fields, seismology, and heat flow.	3	Math 1152 and Physics 1251
GEOSCIM 5612	<i>Introduction to Geodesy (limbo)</i>	3	EARTHSC 1121, Math 1152
GEOSCIM 5781	<i>Geodesy & Geodynamics:</i> Crustal motion geodesy, reference frame realization and station trajectory analysis, plate motion and Euler's theorem, earthquake deformation cycle, elastic and viscoelastic responses to surface loading, numerical methods.	3	Math 1152 or above, or Physics 1251, or permission of instructor
EARTHSC 5310	<i>Remote Sensing in the Earth Sciences:</i> The overall learning of geodetic (active) and passive remote sensing technologies and in-depth data analytics of their processing to apply to research in Earth sciences and engineering. This course is focused on students learning the theory and data processing methods to enable the use of contemporary satellite or airborne platform-equipped observations for science and engineering applications.	3	EARTHSC 1100, 1105, 1108, 1121, 1151, 2203, OR 2205; and MATH 1141 or 1151 or above, and Physics 1250 or above; or grad standing; or permission of instructor
EARTHSC 5687	<i>Borehole Geophysics:</i> Principles and applications of borehole geophysical practices in the energy industry and in scientific drilling.	3	EARTHSC 1100, 1105, 1108, 1121, 1151, 2203, OR 2205; Math 1141

			or 1151 or above, and Physics 1250 or above
EARTHSC 5751	<i>Quantitative Reservoir Modeling:</i> Principles of analytical and numerical techniques in modeling single- and multiphase flow in gas, oil, and water (aquifer) reservoirs. Development of Matlab code for two- and three-dimensional flow in porous media.	4	EARTHSC 2245 & Math 1152, or permission of instructor
EARTHSC 5780	<i>Reflection Seismology:</i> Basics of reflection seismic data processing and interpretation, using petroleum industry standard seismic processing software, hardware, and data.	4	EARTHSC 1100, 1105, 1108, 1121, 1151, 2203, OR 2205; Math 1141 or 1151 or above, and Physics 1250 or above
TOTAL CREDITS	Core for all Earth Science BS students: 9-10 credits Geophysics required courses: 14-15 credits Additional elective classes: 6-8 for a minimum of 30 (up to 33)		30-33
Minimum Required Hours to complete degree, including certificate/minor			36-39
Complete an approved certificate, minor, or any second major			