From:	Vankeerbergen, Bernadette
To:	Smith, Randy; Reed, Katie
Cc:	Fink, Steven; Jenkins, Mary Ellen; Crocetta, Alison
Subject:	Proposal to Revise the Earth Sciences BS
Date:	Wednesday, October 23, 2019 2:17:40 PM
Attachments:	Earth Science BS Program Revision (updated).docx image001.png NMS Panel Cover letter for Earth Science BS change .pdf

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Dear Randy and Katie,

Please find attached a proposal to revise the Earth Sciences BS. The changes were approved by the ASC Curriculum Committee (ASCC) on Friday, October 18.

We are now advancing the proposal for review by CAA. The attached documents are (1) the actual proposal and (2) the Natural and Mathematical Sciences Panel cover letter to ASCC.

Please use this email as a cover letter indicating that the proposal has been duly reviewed and approved by the appropriate ASC curricular bodies (including the full ASC Curriculum Committee).

Please let me know if you have any questions.

Best regards,
Bernadette

THE OHIO STATE UNIVERSITY

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October 17, 2019

Alison Crocetta
Chair, ASCC

Dear Alison,

The NMS Panel of the ASCC reviewed and discussed the Earth Science-BS program revision request at the regular NMS panel meeting on September 9, 2019.

The proposed revisions to the Earth Science-BS are based on a yearlong process that included data collection from ASC graduation exit surveys, student feedback panels, and a survey of similar programs at peer and aspirational institutions. The changes will permit students to control areas of depth and breath, offer flexibility to complete double majors, provide students with clearer guidance on how to plan a curriculum that meets their career goals, and modernize the course offerings and align them with national trends.
Specifically, the revised curriculum eliminates unnecessary prerequisites and requires students to take a minor, double major, or certificate program. The proposed changes to the curriculum will prepare students better for their respective careers.

The proposed changes to the Earth Science-BS are compelling and well designed. The NMS panel unanimously approved the proposed changes with several contingencies and recommendations, all of which have been addressed.

The NMS Panel forwards the proposal to ASCC for approval.

Sincerely,

Dr. Harald Vaessin
Chair, NMS Panel of ASCC
Professor and Chair, Molecular Genetics

Earth Science BS – Program Revision
Submitted Fall 2019. Implementation Fall 2020.

The School of Earth Sciences offers two major programs, a BS in Earth Sciences and a BA in Earth Sciences. This program revision proposal addresses the BS program only.

The School of Earth Sciences established 4 subprograms within the BS program with Ohio State's quarter-to-semester transition in 2012, Geological Sciences, Earth System Science, Geophysics, and Petroleum Geology and Geophysics. Modest revisions were made in 2014 reflecting changes to better define electives and to ensure breadth for students in the Earth System Science subprogram.

This proposal for program revision is the result of a yearlong process that occurred in 2018-2019, and included data collection from ASC graduation exit surveys and student feedback panels, survey of programs across the country including peer institutions and aspirational institutions, and a learning outcome program assessment analysis as designed by David Mogk, Department of Earth Sciences at Montana State University (see: https://serc.carleton.edu/earthandmind/posts/curriculum_desi2.html). Faculty-wide discussion of the program and proposed revisions were held October 18, January 10, January 30, April 11, and April 18. We also received feedback on draft revisions from the OAA external review team (April 1, 2019) and the Alumni and Friends Advisory Committee (April 15, 2019). A final outline of the revision was presented to the faculty and a formal vote (17-2) on May 3, 2019.

We propose a revision to the preparation for the major, as well as the tracks within the major. Central goals of the revision are to

(1) Permit students to control areas of depth and breadth of their undergraduate curriculum
(2) Offer flexibility to complete a double major by reducing preparation for the major, and in some cases aligning with complementary degree programs in other units
(3) Provide clear guidance to students on how to plan their curriculum to meet career goals
(4) Modernize course offerings and update lists of electives as offered across the University

This plan maintains those aspects of the program our program assessments, ASC exit surveys, and self-study show to be most successful: broad access to laboratory, field, and research experiences for students, as well as a capstone thesis for all students.

Below is a summary of the proposed revisions

Preparation for the major:

(1) An analysis of our existing preparation for the major identified that 2-3 classes had been required that do not serve as prerequisites for subsequent classes. We propose to remove these additional requirements.
(2) EARTHSC 1122 has been determined to be integral to the Geological Sciences track, but not the others, and it is viewed as a component of the major, not preparation. A survey of peer institutions shows that this class is

taught as a major requirement. We therefore propose updating the course, modernizing the content, adjusting its name, renumbering to 2122 to reflect increased rigor, and incorporating it as a part of the major in the geological sciences track. As the updated course content will continue to meet the requirements for the GE, we propose preserving this class's GE status.

(3) An analysis of GE data analysis requirements of other BS majors in NMS incorporate the course as part of the major instead of preparation for the major. We move EARTHSC 2245 from "preparation for the major" to part of the major itself. This helps make the major requirements more transparent to students.

(4) National data show that many Earth scientists discover their major through general education classes. A study of our general education classes shows that most of them cover the necessary prerequisite material to the classes required for the major. Some of these courses, however, do not include labs which offer the hands-on learning necessary for key preparatory learning objectives to be met.

   a. To reduce barriers to pursuing the Earth Science major, we propose that all of our general education courses either serve as the disciplinary introductory course for the major (ES 1105, 1108, 1151, 2205, 2206(S)) or satisfy the Science of Sustainability requirement of the major (2203, 2210, 2155, 2122).
   b. For those discovering the major through a non-lab course, we propose a 1-credit, introductory lab class (EarthSc 1200) that may be taken concurrently or subsequently to the primary 3-credit introductory course as an equivalent to EarthSc 1121 as preparation for the major.
   c. All courses in the major that have previously required EarthSc 1121 for the major will be modified to permit this broader list of possible prerequisites, in which each class has been analyzed relative to the learning objectives of the general education courses and to the introductory lab class (see Table 1)

Major requirements:

(1) An analysis of student exit survey data shows a need to improve career guidance and integrate career readiness into the curriculum. Some students also struggle to complete the thesis requirement. To address this, we propose:

   a. A new, 1 credit "introduction to the major" class to be taken in the first Autumn semester after declaring the major (EarthSc 2000). This course will provide a guide to career options, career readiness skills, how to find a thesis topic and advisor, as well as exposure to subdisciplines so students can identify their options within the major.
   b. A "depth and breadth" requirement, in which students either complete an approved Certificate ("depth"), Minor ("depth and breadth", or any double major ("breadth"). Those students completing a certificate within the School of Earth Sciences will be able to complete their degree with as much as 11 fewer credit hours as currently, while students earning a minor with minimal additional prerequisites (e.g.

any in NMS) will complete their degree with 8-10 fewer credit hours, while those choosing one of several complementary majors will complete their degree with no additional credit hours (e.g. Biology, Environmental Science, Physics), while unrelated double majors will need to complete an increase in hours, where the number will be based on the size of the second major and preparation for that major. (See Table 2)

(2) In alignment with national trends, all students will complete a course in the Science of Sustainability.

Subprogram revisions:

(3) Our tracks are not serving the needs of our students because they need to be modernized and are not sufficiently differentiated from each other to align with the diverse career paths available in Earth Sciences. We therefore revise each subprogram to clarify their purpose to students and offer genuine choices.
   a. The Geological Science subprogram undergoes the least amount of change. The largest change is that Paleontology (EarthSc 4501) is now an elective
   b. We revise and rename the "Earth System Science" subprogram
      i. The revision gives the program clear disciplinary objectives.
      ii. We rename the subprogram to align with the Board of Trustees-approved division within the School of Earth Sciences, "Climate, Water, and the Environment," whose faculty will take the lead in the bulk of the instruction of this program.
   c. The Geophysics subprogram is revised to ensure students have sufficient quantitative skills and fundamental physics experience to solve novel problems in geophysical fields.

(4) We will sunset the Petroleum Geology and Geophysics track, instead having these students either complete the Geological Sciences or Geophysics track and a Petroleum Geology certificate. This subprogram will be maintained for any students declaring their major before this program revision is approved.

New courses proposed as part of this Program revision

EARTHSC 1200, 1-hour Introductory lab, to ensure all students begin the major with hands-on experience with natural samples and geological processes. This course may be taking subsequently or concurrently with EARTHSC 1105, 1108, 1151, 2155, 2210, 2203, 2204, 2205, 2206, 2210, or ENR 2100

EARTHSC 2000 1-hour introduction to the major, to ensure all students begin the major with appropriate background and scope on the diversity of the earth sciences

New courses proposed as part of associated Certificate programs

EARTHSCI 5191.01 *Museum internship*, a flexible credit hour internship to be part of the Museum Certificate

EARTHSC 5501 *Museum databases*, also part of the Museum Certificate

EARTHSC/ASTRO 5205 *Planetary science* (cross listed and team taught with Astronomy) to be part of the Planetary Science certificate

Course revisions as part of this Program revision:

Renumbering and renaming of EARTHSC 1122(H) 'Historical Geology' to EARTHSC 2122(H) 'Climate and Life over Billions of years on Earth'

Broadening of prerequisites in alignment with additional courses that meet the prerequisite expectations for the course. Changes apply to the courses below, as highlighted in red.

Table 1: Courses with changes in prerequisites required to implement this plan

Course Number	Title	Existing Prerequisites	New Prerequisites	Justification
EARTHSC 1100	Planet Earth: How It Works		No credit for 1121	Similarity in content
EARTHSC 1121	The Dynamic Earth		No credit for 1100	Similarity in content
EARTHSC 4423	Intro Petrology	EARTHSC 1121 & 4421	EARTHSC 1100, 1121, OR 1200; AND 4421	Students need introductory lab
EARTHSC 4450	Water, Ice and Energy in the Earth System	EARTHSC 1100 or 1121 or Geog 3901 or 3900 or 5900; or permission of instructor	EARTHSC 1100, 1105, 1108, 1121, 1151, 2203, 2204, 2205, GEOG 3901, OR GEOG 5900; or permission of instructor	Students need prior exposure to the Earth System, broadly defined.
EARTHSC 4501	Paleontology	EARTHSC 1122 & 3 cr hrs in bio sciences	EARTHSC 1122 or 2122 & 3 cr hrs in bio sciences	Reflect numbering change
EARTHSC 4502	Stratigraphy and Sedimentology	EARTHSC 1121 & 1122	EARTHSC 1100, 1121, OR 1200; AND EARTHSC 1122 or 2122	Students need introductory lab; reflect numbering change
EARTHSC 4530	Structural Geology	EARTHSC 1121 & Physics 1250	EARTHSC 1100, 1121, OR 1200; Physics 1250	Students need introductory lab
EARTHSC 4560	Applied Geophysics	EARTHSC 1121, Math 1151 & Physics 1250	EARTHSC 1100, 1105, 1108, 1121, 1151, 2203, OR 2205, Math 1151 & Physics 1250	Students need introductory content from any of these courses
EARTHSC 5206	Advanced Oceanography	EARTHSC 1100, 1105, OR 1121; or Grad standing or permission of instructor	Junior standing or higher in any STEM major discipline; or Grad Standing; or permission of instructor	This is what marks success for students in this class
EARTHSC 5310	Remote Sensing in the Earth Sciences	EARTHSC 1121, and MATH 1141 or 1151 or above, and Physics 1250 or above; or	EARTHSC 1100, 1105, 1108, 1121, 1151, 2203, OR 2205; and MATH 1141 or	Students need introductory content from

		grad standing; or permission of instructor	1151 or above, and Physics 1250 or above; or grad standing; or permission of instructor	any of these courses
EARTHSC 5550	Geomorphology	EARTHSC 1121; EARTHSC 1122; or permission of instructor	EARTHSC 1100, 1121, OR 1200; AND EARTHSC 1122 or 2122; or permission of instructor	Students need introductory lab; reflect numbering change
EARTHSC 5651	Hydrogeology	EARTHSC 1121 and Math 1152 or above	EARTHSC 1100, 1105, 1108, 1121, 1151, 2203, OR 2205; and Math 1152 or above	Students need introductory content from any of these courses
EARTHSC 5655	Land Surface Hydrology	Math 1152 or above, Chem 1210 or above, and Physics 1250 or above.	Math 1152 or above, and Physics 1250 or above.	No chemistry required for course content
EARTHSC 5661	Petroleum Geology	EARTHSC 4423 & 4502 or 6502; or written permission of instructor	EARTHSC 4502 or 6502; or permission of instructor	Students do not need 4423 for this course.
EARTHSC 5687	Borehole Geophysics	EARTHSC 1121, Math 1141 or 1151 or above, and Physics 1250 or above	EARTHSC 1100, 1105, 1108, 1121, 1151, 2203, OR 2205; Math 1141 or 1151 or above, and Physics 1250 or above	Students need introductory content from any of these courses
EARTHSC 5780	Reflection Seismology	EARTHSC 1121, Math 1141 or 1151 or above, and Physics 1250 or above	EARTHSC 1100, 1105, 1108, 1121, 1151, 2203, OR 2205; Math 1141 or 1151 or above, and Physics 1250 or above	Students need introductory content from any of these courses
EARTHSC 5189.01	Field Geology I	EARTHSC 4423 and 4530 AND permission of instructor	EARTHSC 1100, 1121 OR 1200, EARTHSC 4530	Students need introductory lab content only for this portion; 4423 offers an unnecessary barrier for some
EARTHSC 5189.02	Field Geology II	EARTHSC 5189.01	EARTHSC 4421, 4423, and 5189.01	Adjusts for 5189.01 change

Table 2: Summary of credit hours required for the current program and required under the revised program

Current program credit hour requirements

	Geological Science	Earth System Science	Geophysics	Petroleum Geology and Geophysics
Preparation for the major	51	51	51	51
(overlap with existing GE)	15 (math & nat sci)	15	15	15
Major Requirements	31	30	30-31	30
Credit hours beyond GE requirements	51+31-15 =67	66	66-67	66

Revised Program credit hour requirements

	Geological Science	Climate Water and Environment	Geophysics
Preparation for the major	28	28-29	29
Credit hours that overlap with existing GE	15-19	15-19	15
Major Requirements	33-34	32-35	30-31
Minimum additional for Certificate	6	6	6
Minimum additional for complementary minor	12 (e.g. Environmental Science), up to 3 overlap with our preparation for the major	12 (e.g. Environmental Science), up to 3 overlap with our preparation for the major	12 (e.g. physics, applied math), with no additional preparation
Minimum Additional for unrelated 2nd major	30	30	30
Credit hours: Preparation + Major + certificate/minor/major	=67 w/cert =70 w/minor =76 w/related major =97 w/unrelated major Note: 15-19 hours overlap with GE	=67-70 w/cert =70-74 w/related minor Note: 15-19 hours overlap with GE	=65-66 w/cert =71-72 w/related minor Note: 15 hours overlap with GE

New certificates proposed, which may be used to fulfill the "focus and depth" requirement

Natural History Museum Curation (2 new course proposals)
Planetary Science, joint with Astronomy (1 new course proposal)
Petroleum Geology
Hydrogeology
Marine Science
Geodetic Geoscience (to be submitted 2020)
Paleontology (to be submitted 2020)

Approved minors & certificates

Any NMS minor
Anthropology
Engineering Sciences (ENG)
Geographic Information Systems (Geography)
Petroleum Engineering (CEBE)
Environmental Engineering
Surveying and Mapping
Education
Global Public Health
Science, Engineering and Public Policy
Environment, Economy, Development, and Sustainability (ENR)
Environmental Science (ENR)
Society and Environmental Science (ENR)
Soil Science (ENR)
Science and Technology Studies
Professional Writing

SCHOOL OF EARTH SCIENCES, OHIO STATE UNIVERSITY
REVISIONS TO B.S. PROGRAM: AUTUMN 2020

A) PREPARATION FOR THE MAJOR

Course number		Course name	Credit hours
Chem 1210		*General Chemistry 1:* 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		*Calculus 1:* Differential and integral calculus of one real variable.	5
Math 1152		*Calculus 2:* Integral calculus, sequences and series, parametric curves, polar coordinates, (optional: vectors).	5
Physics 1250		*Physics 1:* 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	*Energy Transfer and Development:* 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	*Biological Sciences: Form, Function, Diversity, and Ecology:* 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	*Physics 2:* Calculus-based introduction to electricity and magnetism, simple optics, modern physics including special relativity and quantum mechanics; for students in physical sciences, mathematics, and engineering.	5
Recommended for CWE & Hydro-geology Cert	Chem 1220	*Chem 2:* 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		*Planet Earth: How It Works:* 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		*The Dynamic Earth:* Plate tectonics; rock forming processes; climate change; energy resources.	4
EARTHSC 1105		*Geology of the National Parks:* Geologic processes, materials, and history revealed in geologic settings of the National Parks.	3
EARTHSC 1108		*Gemstones:* General introduction to gemstones, including the origin of gems, identification techniques, and the history of important gems.	3
EARTHSC 1151		*Natural Hazards:* Occurrence and causes of earthquakes, volcanoes, and related hazards, and impact on climate, society, and history.	3
EARTHSC 2203		*Environmental Geoscience:* 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		*The Planets:* 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)		*Principles of Oceanography:* Introduction to the four basic disciplines of oceanography: geological, chemical, physical, and biological. Relevance of oceanography in contemporary issues.	3
EARTHSC 1200 (new course)		*Introductory Earth Science Lab:* 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)	*Preparation for Thesis and Careers in the Earth Sciences:* In this course, student 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	*Introductory Data Analysis for Earth and Environmental Sciences:* 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)	*Undergraduate Research for Thesis in Earth Sciences:* Undergraduate research or creative activities in variable topics leading to completion of a B.S. thesis. To be taken during semester when thesis is turned in.	1 (graded)	Rank 4 in EARTHSC & permission of instructor
EARTHSC 4999.02 (H)	*Undergraduate Research for Thesis in Earth Sciences:* 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 instructor.
Complete at least 1 focused on the Science of Sustainability if not fulfilled in the preparation for the major			
EARTHSC 2122 (L)	*Climate and Life over Billions of years on Earth:* 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	*Energy and Environment:* Introduces and examines the fundamentals of energy sources, energy use, energy efficiency, and resulting environmental implications of the various energy supplies.	3	
EARTHSC 2203	*Environmental Geoscience:* 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	*Exploring Water Issues:* Water on Earth, human impacts, and scientific and technological issues related to water resource development and conservation.	3	
EARTHSC 2206(S)	*Principles of Oceanography:* Introduction to the four basic disciplines of oceanography: geological, chemical, physical, and biological. Relevance of oceanography in contemporary issues.	3	
EARTHSC 2210	*Energy, Mineral Resources, and Society:* 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	*Water Security for the 21st Century*: Examine the major issues that are contributing to the decline in quantity and quality of global freshwater resources and the resultant environmental and societal impacts.	3	
EARTHSC 4425	*Energy Resources and Sustainability (limbo)*: An examination of the problem of decreasing supplies of fossil fuel, alternative energy sources, and possible accommodations	3	A GE or GEC data anly course, and Soph standing or above

EARTHSC 5663	*Global Change and Sustainability (limbo)*: Analysis of Earth systems, global environmental change and options for sustainability	4	Sr or Grad standing, or permission of instructor
ENR 2100	*Introduction to Environmental Science:* 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	*Water Policy and Governance:* 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			

1) GEOLOGICAL SCIENCES subprogram:

Course number	Course name	Credit hours	Prereqs.
	Everyone takes:		
EARTHSC 2122 (former 1122)	*Climate and Life over Billions of years on Earth:* 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	*Earth Materials:* 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	*Intro Petrology:* 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	*Stratigraphy and Sedimentology:* 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	*Structural Geology:* 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	*Field Geology 1:* 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	*Field Geology 2:* 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	
Complete an approved certificate, minor, or any second major			

Minimum Required Hours to complete degree, including certificate/minor	39-40	

2) Climate, Water, and the Environment subprogram:

Course number	Course name	Credit hours	Prereqs.
Everyone takes (3 hours)			
EARTHSC 4450	*Water, Ice and Energy in the Earth System:* 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	*Intro to Earth Materials (limbo):* 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	*Earth Materials:* 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	*Stratigraphy and Sedimentology:* 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	*Advanced Oceanography:* 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	*Glaciology:* 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	*Global Climate Change: Causes and Consequences:* 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	*Global Climate and Environmental Change:* 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	*Climatology:* 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 outline how they might change in the future as a result of global warming.	3	---
ENR 5268	*Soils and Climate Change:* 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	*Hydrogeology:* Geologic and hydrologic factors controlling the occurrence, movement, storage, and chemical quality of surface water and ground water; 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	*Land Surface Hydrology:* 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	*Aquatic Geochemistry*: 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	*Watershed Hydrology:* 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	*Aquatic Ecosystems:* Ecology of Inland Waters: 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	*Water Quality Management:* 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	*Soil Resource Management:* 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	ENR 3000 or permission of instructor
Two Environment Classes (6 hours, including at least one EARTHSC course)			
EARTHSC 5621	*Introduction to Geochemistry:* 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	*Geo-Environment and Human Health:* Examine geo-environmental processes that are contributing to human health degradation and the resultant societal impacts.	3	EARTHSC 2245 or GE data analysis course or equivalent; Soph standing or above; or permission of instructor
ENVENG 3200	*Fundamentals of Environmental Engineering:* 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	*Environmental Engineering Analytical Methods:* Application of analytical methods to calculate, measure and interpret chemical characteristics of water, soil, and air.	3	Chem 1210 and 1220
ENR 3000	*Soil Science:* 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	
Complete an approved certificate, minor, or any second major			

Minimum Required Hours to complete degree, including certificate/minor	38-42	

3) Geophysics Subprogram

Complete the following courses (14-15 credit hours):

MATH 2153 or MATH 2173	*Calculus III:* Multivariable differential and integral calculus. *Engineering Mathematics B:* Multiple integrals, line integrals, vector fields, second order ordinary differential equations.	4 3	MATH 1152, 1172, 1534, 1544, 1181H, or 4181H
PHYSICS 2300	*Intermediate Mechanics 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; noninertial systems and fictitious forces.	4	PHYSICS 1251, PHYSICS 1251 1251H, or PHYSICS 1261. Concur: Math 2153, 2173, or above.
EARTHSC 4530	*Structural Geology:* 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	*Applied Geophysics:* 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	*Geostatistics:* 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	*Geodynamics:* 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	*Deep Earth Geophysics:* 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	*Introduction to Geodesy* (limbo)	3	EARTHSC 1121, Math 1152
GEOSCIM 5781	*Geodesy & Geodynamics:* 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	*Remote Sensing in the Earth Sciences:* 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	*Borehole Geophysics:* 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	*Quantitative Reservoir Modeling:* 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	*Reflection Seismology:* 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	
Complete an approved certificate, minor, or any second major			
Minimum Required Hours to complete degree, including certificate/minor		36-39	

PART II: *Current* Advising Sheets

First Last name.xxx

EARTH SCIENCES B.S. DEGREE (GEOLOGICAL SCIENCES TRACK)

B.S. Checklist	Term	Year	Credits	Check
EarthSci 1121:			4	
EarthSci 1122:			4	
Biology 1113:			4	
Chemistry 1210:			5	
Physics 1250:			5	
Chem 1220/Phys 1251:			5	
Math 1151:			5	
Math 1152:			5	
EarthSci 2245:	Sp		4	
_____:				
_____:				
EarthSci 4421:	Au		3	
EarthSci 4423:	Au		3	
EarthSci 4530:	Sp		4	
EarthSci 5189.01:	Su		3	
EarthSci 5189.02:	Su		3	
EarthSci 4999.01:			1	
EarthSci 4501:	Sp		4	
EarthSci 4502:	Au		4	
EarthSci 5XXX			3–4	
EarthSci 5XXX			3–4	

Autumn 2019

Spring 2020

Summer 2020

Autumn 2020

Spring 2021

Summer 2021

Autumn 2021

Spring 2022

Summer 2022

Autumn 2022

Spring 2023

EARTH SCIENCES B.S. DEGREE, EARTH SYSTEM SCIENCE

B.S. Checklist	Term	Year	Credits	Check
ES 1121:			4	
ES 1122:			4	
Biology 1113:			4	
Chemistry 1210:			5	
Physics 1250:			5	
Chem 1220/Phys 1251:			5	
Math 1151:			5	
Math 1152:			5	
EarthSci 2245:	Sp		4	
_____:				
_____:				
EarthSci ____:			3	
EarthSci ____:			4	
EarthSci ____:			3	
EarthSci ____:			4	
EarthSci 4999.01:			1	
EarthSci 5191/4998/5xxx:			3	
ES 4/5xxx:				
ES 4/5xxx:				
_____:				
_____:				

Autumn 2019

Spring 2020

Summer2020

Autumn 2020

Spring 2021

Summer2021

Autumn 2021

Spring 2022

Autumn 2022

Spring 2023

EARTH SCIENCES B.S. DEGREE (GEOPHYSICS TRACK)

B.S. Checklist	Term	Year	Credits	Check
EarthSci 1121:	_____	_____	4	_____
EarthSci 1122:	_____	_____	4	_____
Biology 1113:	_____	_____	4	_____
Chemistry 1210:	_____	_____	5	_____
Physics 1250:	_____	_____	5	_____
Physics 1251:	_____	_____	5	_____
Math 1151:	_____	_____	5	_____
Math 1152:	_____	_____	5	_____
EarthSci 2245:	Sp	_____	4	_____
_____:	_____	_____	_____	_____
_____:	_____	_____	_____	_____
EarthSci 4421:	Au	_____	3	_____
EarthSci 4423:	Au	_____	3	_____
EarthSci 4999.01:	_____	_____	1	_____
EarthSci :	_____	_____	_____	_____
EarthSci :	_____	_____	_____	_____
EarthSci :	_____	_____	_____	_____
EarthSci :	_____	_____	_____	_____
EarthSci :	_____	_____	_____	_____
EarthSci :	_____	_____	_____	_____
EarthSci :	_____	_____	_____	_____
EarthSci :	_____	_____	_____	_____

Part I

Part II

11 hours

Autumn 2019

Spring 2020

Summer2020

Autumn 2020

Spring 2021

Summer2021

Autumn 2021

Spring 2022

Summer2022

Autumn 2022

Spring 2023

EARTH SCIENCES B.S. DEGREE (PETROLEUM G&G TRACK)

B.S. Checklist	Term	Year	Credits	Check
EarthSci 1121:			4	
EarthSci 1122:			4	
Biology 1113:			4	
Chemistry 1210:			5	
Physics 1250:			5	
Chem1220/Phys 1251:			5	
Math 1151:			5	
Math 1152:			5	
EarthSci 2245:	Sp		4	
_____:				
_____:				
EarthSci 4421:	Au		3	
EarthSci 4423:	Au		3	
EarthSci 4502:	Au		4	
EarthSci 4530:	Sp		4	
EarthSci 5661:	Sp		4	
EarthSci 4999.01:			1	
Pick one: EarthSci 5687/4560:	Sp		3	
Pick one: EarthSci 5780:	Au		4	
Pick three (9 hours minimum): EarthSci 5189.01:	Su		3	
Pick three (9 hours minimum): EarthSci 5189.02:	Su		3	
Pick three (9 hours minimum): EarthSci 4/5XXX			3 or 4	
Pick three (9 hours minimum): EarthSci 4/5XXX			3 or 4	
Pick three (9 hours minimum): EarthSci 4/5XXX			3 or 4	

Autumn 2019

Spring 2020

Summer2020

Autumn 2020

Spring 2021

Summer2021

Autumn 2021

Spring 2022

Summer2022

Autumn 2022

Spring 2023

Earth Science B.S. Sample 4-Year Plan, Geological Sciences Subprogram					
	Autumn Semester	**Cr Hrs**	**Spring Semester**	**Cr Hrs**	
Year 1	ARTSSCI 1100	1	EARTHSC Intro or CHEM 1210 (prep)	3-5	
	EARTHSC Intro (prep) or CHEM 1210	3-5	MATH 1152 (prep/GE – Open Opt)	5	
	MATH 1151 (prep/GE)	5	EARTHSC 1200 (prep), if needed	1	
	GE Foreign Language I	4	GE Foreign Language 2	4	
	First Year Seminar/Elective	1	GE Writing Level 1	3	
	Semester Total Hours	**14-16**	**Semester Total Hours**	**16-18**	**1st Year** 32
Year 2	EARTHSC 2000 (major)	1	EARTHSC SUSTAIN (major)	3	
	CHEM 1220 or BIOLOGY 1113 or 1114 (GE/prep)	4-5	EARTHSC 2245 (major)	4	
	EARTHSC 2122 (major)	4	GE Writing Level 2	3	
	GE Foreign Language 3	4	PHYSICS 1250 (prep)	5	
	Semester Total Hours	**13-14**	**Semester Total Hours**	**15**	**2nd Year** 28-29
Year 3	EARTHSC 4421 (major)	3	EARTHSC 4530 (major)	4	
	EARTHSC 4423 (major)	3	Certificate class	3	
	EARTHSC 4502 (major)	4	GE Cultural & Ideas or Historical. Study	3	
	GE Social Sciences	3	GE Social Sciences	3	
	GE VPA	3	Elective	3	
	Semester Total Hours	**16**	**Semester Total Hours**	**16**	**3rd Year 32**
Summer	EARTHSC 5189.01 (major)	3			
	EARTHSC 5189.02 (major)	3			
	Semester Total Hours	**6**			
Year 4	Certificate class	3	EARTHSC 4999.01 (major)	1	
	GE Historical Study	3	GE Bio Sci w/lab, if needed or Elective	3-4	
	GE Literature	3	Elective – Upper Division, if needed	3	
	Research	0-3	Elective	3	
	Elective	3	Elective	3	
			Elective	3	
	Semester Total Hours	**12-15**	**Semester Total Hours**	**16-17**	**4th Year** 34-38
					Total Hours 124-131

Earth Science B.S. Sample 4-Year Plan, Climate, Water, Environment Subprogram						
	Autumn Semester	**Cr Hrs**	**Spring Semester**	**Cr Hrs**		
Year 1	ARTSSCI 1100	1	EARTHSC Intro or CHEM 1210 (prep/GE)	3-5		
	EARTHSC Intro or CHEM 1210 (prep/GE)	3-5	MATH 1152 (prep/GE)	5		
	Math 1151 (prep/GE)	5	EARTHSC 1200 (prep)	1		
	GE Foreign Language I	4	GE Foreign Language 2	4		
	First Year Seminar/Elective	1	GE Writing Level 1	3		
	Semester Total Hours	**14-16**	**Semester Total Hours**	**16-18**	**1st Year**	**30**
Year 2	EARTHSC 2000 (major)	1	Climate class #1 (major)	3		
	GE Social Sciences	3	EARTHSC 2245 (major)	4		
	EARTHSC SUSTAIN (major)	3	GE Writing Level 2	3		
	GE Foreign Language 3	4	EARTHSC 4450	3		
	CHEM 1220 (prep/GE)	4-5	GE VPA	3		
	Semester Total Hours	**15-17**	**Semester Total Hours**	**16**	**2nd Year**	**31-33**
Year 3	EARTHSC 4421/2212/4502 (major)	3-4	Climate class #2 (major)	3		
	Environment class #1 (major)	3	Certificate class	3		
	Water class #1 (major)	3	GE Cultural & Ideas or Historical Study	3		
	GE Social Sciences	3	GE Literature	3		
	Biological Natural Sci (GE)	4	PHYSICS 1250	5		
	Semester Total Hours	**16-17**	**Semester Total Hours**	**17**	**3rd Year**	**33-34**
Year 4	Certificate class	3	EARTHSC 4999.01 (major)	1		
	Environment class #2 (major)	3	Water class #2 (major)	3		
	GE Historical Study	3	Research	0-2		
	Research	0-3	Elective – Upper Div hours	3		
	Elective	3	Elective – Upper Div hours	3		
	Elective	3	Elective	3		
			Elective	3		
	Semester Total Hours	**15-18**	**Semester Total Hours**	**16-18**	**4th Year**	**31-36**
					Total Hours	**123-129**

Earth Science B.S. Sample 4-Year Plan, Geophysics Subprogram						
	Autumn Semester	**Cr Hrs**	**Spring Semester**	**Cr Hrs**		
Year 1	ARTSCCI 1100	1	MATH 1152 (prep/GE)	5		
	MATH 1151 (prep/GE)	5	PHYSICS 1251 (prep/GE)	5		
	PHYSICS 1250 (prep)	5	GE Foreign Language 2	4		
	GE Foreign Language I	4	GE Writing Level 1	3		
	First Year Seminar/Elective	1				
	Semester Total Hours	**16**	**Semester Total Hours**	**17**	**1st Year**	**33**
Year 2	EARTHSC 2000 (major)	1	EARTHSC SUSTAIN (major)	3		
	MATH 2153 (major)	4	EARTHSC 2245 (major)	4		
	PHYSICS 2300 (major)	4	GE Writing Level 2	3		
	EARTHSC 1121 (prep)	4	CHEM 1210 (prep/GE)	5		
	GE Foreign Language 3	4				
	Semester Total Hours	**17**	**Semester Total Hours**	**15**	**2nd Year**	**32**
Year 3	Geophysics Elective (major)	3-4	EARTHSC 4530 (major)	4		
	Certificate class	3	EARTHSC 4560 (major)	3		
	GE Social Sciences	3	GE Cultural & Ideas or Historical. Study	3		
	GE Literature	3	GE Social Sciences	3		
	Elective	3	Elective	3		
	Semester Total Hours	**15-16**	**Semester Total Hours**	**16**	**3rd Year**	**31-32**
Year 4	Certificate class	3	EARTHSC 4999.01	1		
	GE Historical Study	3	Geophysics Elective (major)	3		
	GE VPA	3	Elective – UD hours, if needed	3		
	Research	0-3	Elective – UD hours, if needed	3		
	GE Bio Sci w/lab, if needed or Elective (GE)	3-4	Elective – UD hours, if needed	3		
	Semester Total Hours	**12-16**	**Semester Total Hours**	**13**	**4th Year**	**25-29**
					Total Hours	**121-126**

Transition policy: The School of Earth Sciences commits to permitting any student already declared as a BS Earth Sciences major to complete their current subprogram plan, through 4 years after the adoption of this revision. Any current student may transition to the new plan once implemented upon request, with reasonable accommodations made for substitutions as necessary.

Any student following this revised plan with prior credit for EarthSc 1122 will have the "Science of Sustainability" requirement fulfilled, but will need 4 additional EarthSc at the 2XXX level or above to satisfy the minimum 30-credit hours for the major. The 50% overlap restriction with certificates will still apply.

SCHOOL OF EARTH SCIENCES
UNDERGRADUATE MAJOR ASSESSMENT PLAN

22 July 2005

updated
19 September 2019

ASSESSMENT PLAN OF STUDENT LEARNING OUTCOMES IN MAJOR PROGRAMS

College: Mathematical and Physical Sciences ____

Department(s): Earth Sciences _____

Major: Earth Sciences _____

Level (Undergraduate/Graduate): Undergraduate_____

Contact Person and e-mail: W. Ashley Griffith; <griffith.233@osu.edu>__

Director: Matthew Saltzman_____

Director Signature: _____

Date: _____

Assessment Plan Summary (75-150 words):

The School of Earth Sciences has two undergraduate degree programs, the B.A. and B.S. The B.A. program is relatively unstructured whereas the B.S. program is structured. Responsibility for assessment of these two programs is given to the Curriculum Assessment Committee. This is the only responsibility of this committee, and it will annually produce a report for action by the Chairperson and faculty.

Quality of course offerings for both of these degrees will be monitored using University S.E.I.s for every course. One or more courses (e.g., ES 4502) has an oral and written expression component, and this course will be annually evaluated for both B.A. and B.S. students. Two capstone courses, the senior thesis (ES 4999.01) and field camp (ES 5189.01 and 02), for the B.S. program will be annually evaluated to determine whether students can apply knowledge from their classroom courses. All graduating B.A. and B.S. students will complete an exit survey.

Quadrennially written surveys will be conducted of four-year subsets of Alumni (B.A., B.S.) in order to assess the effectiveness of their Ohio State University experience.

Assessment Method Inventory

Please indicate the assessment methods in your plan; check all that apply.

Direct methods:

_____ National standardized examination (please identify) _____
_____ Certification or licensure examinations
_____ Local comprehensive or proficiency examinations
_____ Embedded testing
_____ Pre-post testing
___X Other classroom assessment methods (please identify) _S.E.I._____
_____ Practicum, internship, or research evaluation of student work
_____ Portfolio evaluation of student work
___X_ Senior thesis or major project
___X_ Capstone course
___X_ Other: Monitor oral and written expression in courses with these components

Indirect methods:

__X__ Student Survey [entry; mid; exit] (please identify) ____exit_____
__X__ Alumni survey (please identify years post-graduation) __8, 9, 10, 11 years prior
_____ Job or post-baccalaureate education placement
_____ Student evaluation of instruction
_____ Student interview or focus group
_____ Student or alumni honors
_____ Peer review of program
_____ External program review
_____ Grade, curriculum, and/or syllabus review
_____ Employer feedback
_____ Outreach participation0
_____ Comparison or benchmarking
_____ Other:

Evaluators (please indicate if specific to a particular method):

_____ GTA
_____ Contract instructor
_____ Adjunct faculty
___X_ Faculty
_____ External evaluator

_____ Individual evaluator

_____ Multiple evaluators

INTRODUCTION AND EDUCATIONAL MISSION STATEMENT

The School of Earth Sciences at The Ohio State University was founded in 1873 by the university's first president, Edward Orton. The School is located in Orton Hall and Mendenhall Laboratory. Orton Hall is the home of the Orton Geological Library and the Orton Geological Museum.

The School of Earth Sciences is committed to providing students with knowledge and skills acquired in the classroom, the laboratory, and the field, to enable them to understand and help solve major problems in the Earth sciences. As a corollary, our department is committed to conducting world-class research to advance scientific knowledge and science in support of societal needs, which in turn raises the quality of student learning. Excellence in teaching involves (1) presentation of state-of-the-art, relevant, and stimulating educational materials in courses at all levels in the curriculum; (2) ongoing evaluation of teaching quality, both by peers and students to insure education at its highest possible level; and (3) periodic review of the curriculum in all degree programs. Furthermore, teaching quality is enhanced by research-active faculty teaching at all levels of the curriculum.

This mission statement is integral to the issue of this document, undergraduate major assessment. A knowledgeable faculty must strive for effective transfer of their knowledge to students. We are collectively dedicated to make students aware of the importance of the Earth Sciences to contemporary issues and needs and to high quality education of our students.

GOALS AND OUTCOMES OF UNDERGRADUATE B.A. AND B.S. PROGRAMS

B.A. PROGRAM GOALS AND OUTCOMES

The goal of the B.A. program in Earth Sciences is to provide students the opportunity to acquire a broad background in Earth Science that will allow them to apply their knowledge to a variety of career paths. The B.A. program is diverse and relatively unstructured, with only a moderate background in basic sciences and mathematics required. B.A. students typically do not have the goal of beginning a career as a professional or academic geoscientist. For example, they may be working toward a second degree in Law and plan to specialize in Environmental Law, or they may be preparing for a career in K-12 science education.

Alternatively, they may be actively earning degrees in another program, such as Chemistry, Biology, History, or English, and simply wish to broaden the scope of their education; or they seek preparation for employment with an organization (perhaps a museum or in a park system) where a structured education in Earth Sciences is not required.

The goals and objectives of the B.A. degree in Earth Sciences are the following:

1. Preparedness in the Earth Sciences.

a. Students will be able to critically read and evaluate Earth Science literature.
b. Students will be able to present geological information in a clear and logical manner both orally and written.
c. Students will be able to apply knowledge of Earth Science data and application of these data to understand the physical, chemical, and biological processes and their evolution on Earth. Earth Science data include basic knowledge (Earth materials, mineralogy, petrology of igneous, metamorphic, and sedimentary rocks, paleontological principles, structural geology, surface and subsurface mapping, and movement of Earth fluids) and access to and manipulation of more recently available Earth Science databases.
d. Students will be able to understand the processes and interactions of the lithosphere, hydrosphere, biosphere, atmosphere, and cryosphere, including their impact on today's society, and their geological history.
e. Students will be able to apply knowledge of introductory techniques, field methods, and numerical methods used to measure, portray, analyze, and interpret both the present and past Earth.

2. Preparedness in the basics of ancillary sciences germane to the Earth Sciences.
   a. Students will be able to apply knowledge of an introduction to skills from chemistry, physics, biology, mathematics, statistics, and computing to know how these sciences are applied in the Earth Sciences.

3. Preparedness for vital social skills for a productive professional life.
   a. Students will be able to work as part of a team.
   b. Students will be able to understand and practice scientific ethics.

Because of the diversity of the more unstructured B.A. program and the disparate goals of students in this program, it is difficult to measure the success of the B.A. program. Further, the eventual career paths of graduates vary considerably so that more standardized assessment metrics do not apply.

B.S. PROGRAM GOALS AND OBJECTIVES

The B.S. program in Earth Sciences is designed to offer a comprehensive undergraduate background in the Earth Sciences and a basic understanding in science and mathematics. The School's objective for B.S. majors is to prepare them via our core curriculum for careers as professional earth scientists in industry, government, or academia. The most rewarding Earth Science careers require a graduate degree, with the M. S. degree generally regarded as the professional degree. All B.S. majors in Earth Sciences take required core courses (all including a laboratory component) in physical geology, historical geology, mineralogy, petrology, structural geology, stratigraphy and sedimentation, paleontology, field geology and mapping, and a senior thesis (which involves research and writing, may involve field work). Field geology and the senior thesis are capstone courses for the B.S. degree in Earth Sciences. During a student's third year as a major, B.S. students take a least two upper level (4000+) courses in the Earth Sciences. At this time, they select a Senior Thesis research project. With a senior thesis advisor, a student selects a research area and a project. The Senior Thesis involves close collaboration with a faculty member

both to conduct the research and to convey the results of this research in a Senior Thesis document. The field geology courses (ES 5189.01 and 5189.01) are held over a six week period in Central Utah.

The goals and objectives of the B.S. degree program are the following:

1. Preparedness in Earth Sciences.
   a. Students will be able to critically read and evaluate Earth Science literature.
   b. Students will be able to present Earth Science information in a clear and logical manner both orally and written.
   c. Students will be able to apply knowledge of Earth Science data and application of these data to understand the physical, chemical, and biological processes and their evolution on Earth. Geologic data include basic knowledge (Earth materials, mineralogy, petrology of igneous, metamorphic, and sedimentary rocks, paleontological principles, structural geology, surface and subsurface mapping, and movement of Earth fluids) and access to and manipulation of more recently available Earth Science databases.
   d. Students will be able to understand the processes and interactions of the lithosphere, hydrosphere, biosphere, atmosphere, and cryosphere, including their impact on today's society, and Earth history.
   e. Students will be able to apply knowledge of appropriate techniques, field methods, field mapping, and numerical methods to measure, portray, analyze, and interpret both the present and past Earth.
   f. Students will develop the necessary knowledge and skills for admission to graduate school or employment following graduation.
   g. Students will develop an in-depth undergraduate/beginning graduate student knowledge of one or more specialized area in the Earth Sciences (through the Senior Thesis).
   h. Students will be able to identify Earth Science problems and to develop solutions.

2. Preparedness in the basics of ancillary sciences germane to the Earth Sciences .
   a. Students will be able to apply knowledge of modern applications from chemistry, physics, biology, mathematics, statistics, and computing to the solution of geological problems.

3. Preparedness for vital social skills for a productive professional life.
   a. Students will be able to work as part of a team.
   b. Students will be able to understand and practice scientific ethics.

METHODS FOR ASSESSMENT OF ACHIEVEMENT OF GOALS OF THE B.A. AND B.S. DEGREE PROGRAMS IN EARTHSCIENCES

We employ a multi-faceted approach to assessment that includes quarterly, annual, and quadrennial metrics. The degree program applicable for each metric is indicated. In each case, documentation will be gathered and evaluated by the Curriculum Assessment Committee that will annually produce a report for action by the Chairperson and faculty. The only responsibility of the Curriculum Assessment Committee is acquisition of data for assessment and evaluation of these data to determine effectiveness of our degree programs.

QUARTERLY (Initiate at beginning of 2005-2006 AY)

1. Monitor S.E.I. results for all departmental courses. [B.A. and B.S. programs]. With this method the following goals and objectives will be assessed: B.A. Program: quality of instruction for 1.c, 1.d, 1.e ; B.S. Program: quality of instruction for 1.c, 1.d, 1.e, 1.g.

ANNUALLY (Initiate at beginning of 2005-2006 AY)

1. Monitor our "capstone" courses. [B.S. program]

   a. Report on quality from the Faculty Senior Thesis Evaluation Committee using a standard set of questions for all Senior Theses. With this method the following goals and objectives will be assessed: B.S. Program: 1.a, 1.b, 1.c, 1.d, 1.e, 1.f, 1.g, 1.h, 2.a, 3.b.

   b. Evaluation by field camp instructors of the knowledge level and interpretive abilities for each student, using a standard set of questions for all students. With this method the following goals and objectives will be assessed: for B.S. Program: 1.b, 1.c, 1.d, 1.e, 1.f, 1.h, 3.a, 3.b.

2. Monitor oral and written expression capabilities in courses that have writing as a routine part of the course (e.g., Earth Sciences 4502), using a standard set of questions for all students. [B.A. and B.S. programs] With this method the following goals and objectives will be assessed: B.A. Program: 1.a, 1.b, 1.c, 1.d; B.S. Program: 1.a, 1.b, 1.c, 1.d.

INDIVIDUAL FOR EACH STUDENT (Initiate at beginning of 2005-2006 AY)

1. Conduct a written exit survey of all graduating B.A. and B.S. majors concerning their opinions about the teaching and content of major courses, opinions about the teaching and content of basic math and science courses, opinions about teaching and content of GE courses, and their plans following graduation (graduate study or employment). A standard set of questions specific for each degree program will be used, and students will be given the option of a follow-up discussion with a member of the

   Curriculum Evaluation Committee or School Director. [B.A. and B.S. programs] With this method the all of the goals and objectives will be assessed for both the B.A. and B.S. programs.

QUADRENNIALLY (Initiate at beginning of 2005-2006 AY)

1. Conduct quadrennial written surveys (the goal is to eventually have these surveys provided online) of four-year subsets of Alumni (B.A., B.S., also M.S. and Ph.D.) who

graduated 8, 9, 10 and 11 years ago. The purpose of this survey is for an alumnus/alumna to address the effectiveness of their Ohio State University education in Earth Sciences, both as a base of general science and Earth Sciences education and for their profession(s). [B.A. and B.S. programs] With this method the lasting impact of all of the goals and objectives will be assessed for both the B.A. and B.S. programs.