

<b>Fiscal Unit/Academic Org</b>	School of Earth Sciences - D0656
<b>Administering College/Academic Group</b>	Arts And Sciences
<b>Co-administering College/Academic Group</b>	Mathematical And Physical Sci
<b>Semester Conversion Designation</b>	Converted with minimal changes to program goals and/or curricular requirements (e.g., sub-plan/specialization name changes, changes in electives and/or prerequisites, minimal changes in overall structure of program, minimal or no changes in program goals or content)
<b>Current Program/Plan Name</b>	Geological Sciences
<b>Proposed Program/Plan Name</b>	Earth Sciences BA
<b>Program/Plan Code Abbreviation</b>	GEOLSCI-BA
<b>Current Degree Title</b>	Bachelor of Arts

## Credit Hour Explanation

Program credit hour requirements		A) Number of credit hours in current program (Quarter credit hours)	B) Calculated result for 2/3rds of current (Semester credit hours)	C) Number of credit hours required for proposed program (Semester credit hours)	D) Change in credit hours
Total minimum credit hours required for completion of program		40	26.7	30	3.3
Required credit hours offered by the unit	Minimum	40	26.7	24	2.7
	Maximum	40	26.7	30	3.3
Required credit hours offered outside of the unit	Minimum	0	0.0	0	0.0
	Maximum	0	0.0	6	6.0
Required prerequisite credit hours not included above	Minimum	40	26.7	30	3.3
	Maximum	40	26.7	30	3.3

**Explain any change in credit hours if the difference is more than 4 semester credit hours between the values listed in columns B and C for any row in the above table**

The semester version of the B.A. provides an opportunity for students to take up to 6 semester credit hours of approved coursework at the 3000-level or above outside Earth Sciences, whereas the quarter version of the B.A. did not allow coursework outside Earth Sciences. Introducing this increased flexibility in course selection has created what appears to be a large change in the maximum credit hours required outside Earth Sciences, although this increase in credit hours that can be taken outside Earth Sciences is offset by the option to take fewer credit hours within Earth Sciences. Faculty in the School of Earth Sciences favor this increased flexibility, because it will allow our B.A. students to prepare better for a broad range of career paths.

## Program Learning Goals

Note: these are required for all undergraduate degree programs and majors now, and will be required for all graduate and professional degree programs in 2012. Nonetheless, all programs are encouraged to complete these now.

### Program Learning Goals

- Students critically read and evaluate Earth Science literature.
- Students present Earth Science information in a clear and logical manner, both orally and in writing.
- Students apply knowledge of Earth Science data, and the applications of these data, to understand the dynamic physical, chemical, and biological processes of the Earth and its history.
- Students apply knowledge of appropriate techniques, field methods, field mapping, and numerical methods to measure, portray, analyze, and interpret Earth Science data in specific subdisciplines.
- Students identify Earth Science problems and develop solutions.
- Students apply knowledge of modern applications from chemistry, physics, biology, mathematics, statistics, and computing to the solution of Earth Science problems.

## Assessment

Assessment plan includes student learning goals, how those goals are evaluated, and how the information collected is used to improve student learning. An assessment plan is required for undergraduate majors and degrees. Graduate and professional degree programs are encouraged to complete this now, but will not be required to do so until 2012.

**Is this a degree program (undergraduate, graduate, or professional) or major proposal? Yes**

**Does the degree program or major have an assessment plan on file with the university Office of Academic Affairs? Yes**

**Summarize how the program's current quarter-based assessment practices will be modified, if necessary, to fit the semester calendar.**

No modifications are planned or required.

## Program Specializations/Sub-Plans

If you do not specify a program specialization/sub-plan it will be assumed you are submitting this program for all program specializations/sub-plans.

## Pre-Major

**Does this Program have a Pre-Major? No**

## Attachments

- Earth Sciences BA Semester Proposal Attach2 rev 9 March.doc: Earth Sci B.A. Attachment 2 + Curricular Map  
*(Program Proposal. Owner: Krissek, Lawrence Alan)*
- Earth Sci BA EXAMPLE 4 YEAR PLANS rev 9 March.doc: Earth Sci B.A. Example 4 year plans  
*(Other Supporting Documentation. Owner: Krissek, Lawrence Alan)*
- Earth Sciences BA cover letter.doc: NMS Division of Arts and Sciences cover letter  
*(Letter from the College to OAA. Owner: Andereck, Claude David)*

## Comments

## Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Krissek, Lawrence Alan	01/05/2011 05:08 PM	Submitted for Approval
Approved	Krissek, Lawrence Alan	01/05/2011 05:09 PM	Unit Approval
Revision Requested	Andereck, Claude David	01/26/2011 05:10 PM	College Approval
Submitted	Krissek, Lawrence Alan	02/27/2011 10:25 PM	Submitted for Approval
Approved	Krissek, Lawrence Alan	02/27/2011 10:27 PM	Unit Approval
Revision Requested	Andereck, Claude David	03/05/2011 12:12 PM	College Approval
Submitted	Krissek, Lawrence Alan	03/09/2011 05:44 PM	Submitted for Approval
Approved	Krissek, Lawrence Alan	03/09/2011 05:45 PM	Unit Approval
Revision Requested	Andereck, Claude David	03/10/2011 10:26 AM	College Approval
Submitted	Krissek, Lawrence Alan	03/10/2011 10:40 AM	Submitted for Approval
Approved	Krissek, Lawrence Alan	03/10/2011 10:41 AM	Unit Approval
Approved	Andereck, Claude David	03/10/2011 10:51 AM	College Approval
Pending Approval	Hanlin, Deborah Kay Vankeerbergen, Bernadette Chantal Meyers, Catherine Anne Jenkins, Mary Ellen Bigler Nolen, Dawn	03/10/2011 10:51 AM	ASCCAO Approval

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March 10, 2011

Larry Krissek  
Chair, Arts and Sciences CCI

Dear Larry:

It is a pleasure to forward to you for consideration by the CCI and the Sciences Subcommittee the proposal for the BA major in Earth Sciences under semesters. The School of Earth Sciences is requesting that this major, formerly known as "Geological Sciences," be re-titled "Earth Sciences" in alignment with the name of the school. The major has been modified from its present quarter version mainly by raising the required course level minimums, and by allowing a limited number of courses outside Earth Sciences to count with permission.

Beyond my own review of the documents, the proposal has been discussed by colleagues from other NMS units at a meeting on January 26, 2011. Feedback from these discussions has now been incorporated in the proposal.

If you have any questions, I would be happy to address them.

Sincerely,



David Andereck  
Professor of Physics  
Associate Dean of Natural and Mathematical Sciences, College of Arts and Sciences

## **LETTER FROM PROGRAM-OFFERING UNIT**

DATE: 5 January 2011

TO: NMS, ASC, and OAA Reviewers

FROM: Lawrence Krissek, Associate Director for Administration, School of Earth Sciences (Acting Director, 23 December 2010 to ~15 January 2011)

on behalf of W. Berry Lyons, Director, School of Earth Sciences

SUBJECT: Conversion of Geological Sciences undergraduate programs (B.S., B.A., and minors) from quarters to semesters

At the undergraduate level, the School of Earth Sciences presently offers a B.S. in Geological Sciences, a B.A. in Geological Sciences, and a minor in Geological Sciences with 6 tracks: Archeology and Anthropology, Economic Geology, Environmental Studies, Geochemistry, Geophysics, and Mineralogy and Petrology. During the conversion to semesters, we request that the names of all our programs be changed from Geological Sciences to Earth Sciences, so that the names of our degree and minor programs match the name of our School. This detail was not included at the time the School of Earth Sciences was established, so the quarter-to-semester conversion provides an opportunity to establish uniformity between the name of our unit and the names of our undergraduate programs.

In addition to changing the names of our undergraduate degrees and minors, the extent of change during the quarter-to-semester conversion ranges from minimal (for the B.A. and the existing minor tracks) to a significant re-envisioning (for the B.S., where 4 tracks are proposed, and for the minor, with the addition of 2 new tracks). The conversion of our graduate programs will be addressed in a separate letter.

The process that developed the conversions proposed here was led by Prof. Larry Krissek, the SES Associate Director for Administration and chair of the SES Curriculum Committee. Because of the importance of this conversion, the process used the entire faculty as a committee-of-the-whole, with additional input from students, alumni, and potential employers of our graduates. Information from benchmark institutions and from a survey of curricular requirements at 150+ Earth Science/Geological Science departments in the U.S. also was used to guide our discussions.

Beginning in Winter 2010, faculty were informed of the developing boundary conditions (particularly the credit hours required for a degree, and the new General Education requirements) for semester-based degree programs and minors at faculty meetings and via e-mail, and were encouraged to think creatively about the form and content of our undergraduate programs under semesters. The primary focus of discussions within SES was the B.S. program, since the B.S. is the degree taken by the vast majority of our students and is the degree that prepares students for careers as professional earth scientists.

As a result of changes within our faculty in the past decade, combined with the establishment of the School of Earth Sciences, the range of topics considered by our faculty and students has broadened significantly beyond the traditional geological sciences. This breadth of content and interests is not reflected in our present B.S. curriculum, so our discussions quickly focused on whether to establish tracks within our B.S. program. After extensive discussions in small groups and at several faculty meetings, the

faculty voted – on 4 March 2010 – to explore the development of tracks within our B.S. program. That vote was 22 in favor, 2 against, and no abstentions.

Ad hoc faculty “working groups” subsequently developed plans for 4 tracks within our B.S. – Geological Sciences, Earth System Science, Geophysics, and Petroleum Geology and Geophysics. The proposals for the first 3 tracks were discussed at several faculty meetings during Spring 2010, and these tracks were approved by a unanimous faculty vote at a faculty meeting on 9 June 2010 (15 yes, 0 no, 0 abstentions). The proposal for the Petroleum Geology and Geophysics track was developed by another ad hoc “working group” during Summer 2010, was discussed extensively by e-mail during August and September 2010, and was approved by a near-unanimous vote at a faculty meeting on 7 October 2010 (21 yes, 1 no, 0 abstentions).

Conversion of our B.A. was discussed at several faculty meetings and by small groups during Spring 2010, with the conclusion that our existing B.A. should be converted with relatively minimal changes. This conversion proposal was approved by unanimous vote at a faculty meeting on 9 June 2010 (15 yes, 0 no, 0 abstentions).

Conversion of our undergraduate minors also was discussed at several faculty meetings and by small groups during Spring 2010. In addition to concluding that the 6 existing tracks should be converted with relatively minimal changes, the faculty also agreed that we should institute 2 additional tracks: 1) a more generalized Earth Sciences track, and 2) a track in Paleontology. The conversion proposal for the 6 existing tracks and the new Earth Sciences track was approved by a near-unanimous vote at a faculty meeting on 9 June 2010 (14 yes, 1 no, 0 abstentions); the proposal for the new track in Paleontology was approved unanimously by e-mail vote in late June (15 yes, 0 no, 0 abstentions). The conversion proposal for the Environmental Studies track subsequently underwent minor revision, and the revised proposal for that track was approved by a near-unanimous vote at a faculty meeting on 7 October 2010 (20 yes, 1 no, 1 abstention).

The details of these conversions are included in the appropriate program templates and proposals. Please contact us if you have any questions.

Thank you for your attention to these proposals.

W. Berry Lyons  
Professor and Director  
School of Earth Sciences

Lawrence Krissek  
Professor and Associate Director for Administration  
School of Earth Sciences

## **PROGRAM RATIONALE STATEMENT**

The date of the last significant revision of the Geological Sciences (now Earth Sciences) B.A. major program was in the 1990s.

The proposed changes to the B.A. in Earth Sciences are minimal; perhaps the most significant proposed change is in the name of the degree, from Geological Sciences to Earth Sciences. This name change is proposed so that the name of the degree matches the name of our unit; the name change also is appropriate given the fact that our faculty, research areas, course offerings, and student interests have broadened from the traditional Geological Sciences to the more-encompassing Earth Sciences. We are requesting this name change for all degrees (B.S., B.A., minors, and graduate degrees) presently named “Geological Sciences”.

In terms of content, two changes are proposed relative to our quarter-based B.A. The first is a limit on the number of 2000-level Earth Science credits that can be counted toward the major. Our faculty agree that this will require our B.A. students to complete a more challenging and rigorous program of Earth Science coursework than has sometime been the case in the past. The second change is the addition of an option to count no more than 6 credits of coursework at the 3000-level and above outside Earth Sciences toward this degree. Adding this option will benefit students by allowing them to build a stronger base in the supporting sciences, or by allowing them to incorporate components outside the traditional natural sciences (e.g., economics, public policy, political science). This will allow each student to prepare better for employment, graduate school and/or professional school (e.g., law school or an M.Ed. program) in his/her area of interest, especially if that area of interest falls outside the traditional Geological Sciences. This option will also improve program quality by allowing students to take advantage of strong courses outside the School of Earth Sciences.

**LIST OF PROGRAM REQUIREMENTS, SEMESTER COURSES, AND EQUIVALENT  
QUARTER COURSES**

Segment of major program	Quarter course #	Quarter course name	Quarter credit hours	Semester course number	Semester course name	Semester credit hours
<b>Preparation for major</b>						
	Chem 121	General Chemistry 1	5	Chem 1210	General Chemistry 1	5
	Chem 122	General Chemistry 2	5			
	Math 151	Calculus 1	5	Math 1151	Calculus 1	5
	Bio 113	Energy Transfer and Development	5	Bio 1113	Energy Transfer and Development	4
	Bio 114	Form, Function, Diversity, and Ecology	5	Bio 1114	Form, Function, Diversity, and Ecology	4
	Earth Sci 121	The Dynamic Earth	5	Earth Sci 1121	The Dynamic Earth	4
	Earth Sci 122	Earth through Time	5	Earth Sci 1122	Earth through Time	4
	Stat 145, 245 or Earth Sci 245	Data Analysis	5	Earth Sci 2245	Introductory Data Analysis for Earth and Environmental Sciences	4
Note: Where available, an Honors offering can be substituted for the equivalent non-Honors course listed in the Preparation for the Major.						
<b>Major Program</b>						
		Minimum of 40 credit hours in Earth Sciences at 200-level and above, excluding Earth Sci 580 and Earth Sci 583.	40	2000-level	Minimum of 30 semester credits in Earth Sciences and other approved fields, with maximum of 10 credits at the 2000-level in Earth Sciences and a maximum of 6 credits at the 3000-level and above outside Earth Sciences. Coursework outside Earth	30

				3000-level and above	Sciences is subject to approval by an Earth Sciences advisor. Earth Sci 4580 cannot be used toward the B.A. in Earth Sciences. No more than a combined total of 3 credits of internship (x191), research (x998, x998H, x999, x999H) and individual study (x193) can be counted toward the major.	

**LIST OF EARTH SCIENCE SEMESTER COURSES AVAILABLE IN EARTH SCIENCES B.A.**

	Course Number	Course Title	Credits	Prerequisites / Co-requisites
Earth Sciences	2155	Energy and Environment	4	
Earth Sciences	2203	Environmental Geoscience	3	
Earth Sciences	2204	Exploring Water Issues	3	
Earth Sciences	2205	The Planets	3	
Earth Sciences	2206	Principles of Oceanography	3	
Earth Sciences	2210	Energy, Mineral Resources and Society	3	
Earth Sciences	2212	Introduction to Earth Materials	4	Earth Sci 1121, Earth Sci 121 or Geol Sci 121; and Chem 121 or above.
Earth Sciences	3193	Individual Studies	1-5	Permission of instructor.
Earth Sciences	3310	Earth Systems Data Collection and Analysis	4	GE or GEC data analysis course; soph standing and above.



Earth Sciences	3315	Evolution: Contemporary and Interdisciplinary Perspectives	3	One biology, one anthropology or one earth sciences course.
Earth Sciences	3411	Water Security for the 21st Century	3	GEC or GE data analysis course; soph standing and above.
Earth Sciences	4189.01	Field Geology for Educators: Appalachian Mountains	2	Earth Sci 1100, Earth Sci 100, Geol Sci 100 or equiv and permission of instructor.
Earth Sciences	4189.02	Field Geology for Educators: Bahamas	2	Earth Sci 1100, Earth Sci 100, Geol Sci 100 or equiv and permission of instructor.
Earth Sciences	4189.03	Field Geology for Educators: Lake Erie	2	Earth Sci 1100, Earth Sci 100, Geol Sci 100 or equiv and permission of instructor.
Earth Sciences	4189.04	Field Geology for Educators: Unspecified	1-3	Earth Sci 1100, Earth Sci 100, Geol Sci 100 or equiv and permission of instructor.
Earth Sciences	4194	Group Studies	1-4	Permission of instructor.
Earth Sciences	4194H	Honors Group Studies	1-4	Permission of instructor.
Earth Sciences	4310	Remote Sensing in the Earth Sciences	3	Earth Sci 121 or Earth Sci 1121; Physics 131 or 1250 or above; Math 151 or 1251 or above.
Earth Sciences	4421	Earth Materials	3	Chem 121: prerequisite or concurrent
Earth Sciences	4423	Introductory Petrology	3	Earth Sci 1121 or Earth Sci 121 or Geol Sci 121; and Earth Sci 4421 or 421 or Geol Sci 421.
Earth Sciences	4425	Energy Resources and Sustainability	3	GE or GEC data analysis course; soph standing and above.
Earth Sciences	4450	Water, Ice, and Energy in the Earth System	3	Earth Sci 1100 or Earth Sci 100 or Earth Sci 1121 or 121, or Geol Sci 100 or Geol Sci 121, or Geog 210 or 220 or 3901 or 3900 or H410 or 420 or 5900 or 520 or permission of instructor.
Earth Sciences	4501	Paleontology	4	Earth Sci 1122 or Earth Sci 122 or Geol Sci 122 and 3 cr hrs in biological sciences.

Earth Sciences	4502	Stratigraphy and Sedimentation	4	Earth Sci 1121 or 121 or Geol Sci 121; Earth Sci 1122 or 122 or Geol Sci 122.
Earth Sciences	4530	Structural Geology	4	Earth Sci 1121 or Earth Sci 121 or Geol Sci 121; and Physics 131 or Physics 1250 or above.
Earth Sciences	4560	Applied Geophysics	3	Earth Sci 1121 or Earth Sci 121 or Geol Sci 121; Math 1251 or Math 151 or above; and Physics 1250 or Physics 131 or above.
Earth Sciences	4570	Senior Thesis	1	Sr standing in Earth Sci and permission of instructor.
Earth Sciences	4584	Principles of Oceanography for Educators	2	10 hrs in physical sciences or biological sciences and permission of instructor.
Earth Sciences	4880	Seminar in Geophysics	1-3	Permission of instructor.
Earth Sciences	4998	Undergraduate Research in Earth Sciences	1-5	Permission of instructor.
Earth Sciences	4998H	Honors Undergraduate Research in Earth Sciences	1-5	Honors Program and permission of instructor.
Earth Sciences	4999	Undergraduate Research for Thesis in Earth Sciences	1-5	Permission of instructor.
Earth Sciences	4999H	Honors Undergraduate Research for Thesis in Earth Sciences	1-5	Honors Program and permission of instructor.
Earth Sciences	5189.01	Field Geology I	3	Earth Sci 4423, Earth Sci 6423, Earth Sci 423, or Geol Sci 423; Earth Sci 4530, Earth Sci 6530, Earth Sci 530, or Geol Sci 530; and written permission of instructor.
Earth Sciences	5189.02	Field Geology II	3	Earth Sci 5189.01, Earth Sci 581 or Geol Sci 581

Earth Sciences	5191	Internship in the Earth Sciences	1-3	Junior standing or above; permission of instructor.
Earth Sciences	5193.XX	Individual Studies (various topics)	1-5	Permission of instructor.
Earth Sciences	5194	Group Studies	1-5	Permission of instructor.
Earth Sciences	5203	Geo-environment and Human Health	3	GE or GEC data analysis course or equivalent; soph standing and above or permission of instructor.
Earth Sciences	5206	Advanced Oceanography	3	Earth Sci 1100 or Earth Sci 100 or Geol Sci 100 or Earth Sci 1105 or Earth Sci 105 or Geol Sci 105 or Earth Sci 1121 or Earth Sci 121 or Geol Sci 121 or graduate student standing or permission of instructor.
Earth Sciences	5550	Geomorphology	4	Earth Sci 1121 or Earth Sci 121 or Geol Sci 121; Earth Sci 1122 or Earth Sci 122 or Geol Sci 122; or permission of instructor.
Earth Sciences	5600	Siliciclastic Depositional Systems	4	Earth Sci 4502 or Earth Sci 6502 or Earth Sci 502 or Geol Sci 502 or equivalent.
Earth Sciences	5601.01	Sedimentary Petrology: Sandstones	4	Earth Sci 4502 or Earth Sci 6502 or Earth Sci 502 or Geol Sci 502 or equivalent, or permission of instructor.
Earth Sciences	5601.02	Sedimentary Petrology: Carbonate Rocks and Shales	4	Earth Sci 4502 or Earth Sci 6502 or Earth Sci 502 or Geol Sci 502 or equivalent, or permission of instructor.
Earth Sciences	5602.01	Carbonate Depositional Systems I	2	Earth Sci 4502 or Earth Sci 6502 or Earth Sci 502 or Geol Sci 502, or equiv.
Earth Sciences	5602.02	Carbonate Depositional Systems II	2	Earth Sci 5602.01 or Earth Sci 602.01 or Geol Sci 602.01 and permission of instructor.
Earth Sciences	5603	Stratigraphy	4	Earth Sci 4502, Earth Sci 6502, Earth Sci 502 or Geol Sci 502, or equivalent.
Earth Sciences	5604	Sequence Stratigraphy	3	Earth Sci 4502, Earth Sci 6502, Earth Sci 502 or Geol Sci 502, or equivalent.
Earth Sciences	5605	Paleoceanography	3	Sr or Grad standing in earth sci or related fields.
Earth Sciences	5613	Micropaleontology	4	Earth Sci 4501 or Earth Sci 501 or Geol Sci 501 or equivalent.
Earth Sciences	5614	Paleobiology	4	Earth Sci 4501 or Earth Sci 501 or Geol Sci 501 or equivalent.
Earth Sciences	5615	Paleoecology	4	Earth Sci 5614 or Earth Sci 614 or Geol Sci 614 or permission of instructor.

Earth Sciences	5617	Petrology of Earth and Planets	4	Earth Sci 4423 or Earth Sci 6423 or Earth Sci 423 or Geol Sci 423 or equiv.
Earth Sciences	5618	Advanced Historical Geology	2	Earth Sci 4502 or Earth Sci 6502 or Earth Sci 502 or Geol Sci 502 or equiv.
Earth Sciences	5621	Introduction to Geochemistry	3	Sr standing in earth sci or related fields; Chem 123 or above or permission of instructor.
Earth Sciences	5622	Stable Isotope Biogeochemistry	3	Sr standing in any science program or grad standing in any of the sciences or permission of instructor.
Earth Sciences	5625	Igneous Petrology	4	Earth Sci 4423 or Earth Sci 6423 or Earth Sci 423 or Geol Sci 423 or equivalent.
Earth Sciences	5627	Global Biogeochemical Cycles	3	Earth Sci 5621 or Earth Sci 621 or Geol Sci 621 or permission of instructor.
Earth Sciences	5628	Environmental Isotope Geochemistry	3	Earth Sci 5621 or Earth Sci 621 or Geol Sci 621 or permission of instructor.
Earth Sciences	5629	Principles of Petrology	3	Sr or Grad standing in earth science or related fields, or permission of instructor.
Earth Sciences	5636	Advanced Topics in Mineralogy and Crystallography	3	Earth Sci 4421 or Earth Sci 6421 or Earth Sci 421 or Geol Sci 421 or equivalent, or permission of instructor.
Earth Sciences	5641	Geostatistics	3	Math 1251 or Math 153 or above, or permission of instructor.
Earth Sciences	5642	Geomathematical Analysis	3	Earth Sci 5641 or Earth Sci 641 or Geol Sci 641; and Math 1251 or Math 153 or above, or written permission of instructor.
Earth Sciences	5644	Tectonic Evolution of Continents	3	Earth Sci 4423 or Earth Sci 6423 or Earth Sci 423 or Geol Sci 423; and Earth Sci 4502 or Earth Sci 6502 or Earth Sci 502 or Geol Sci 502; and Earth Sci 4530 or Earth Sci 6530 or Earth Sci 530 or Geol Sci 530; or written permission of instructor.
Earth Sciences	5645	Advanced Structural Geology	4	Earth Sci 4530 or Earth Sci 6530 or Earth Sci 530 or Geol Sci 530 or equiv.
Earth Sciences	5646	Geodynamics	3	Earth Sci 4530 or Earth Sci 6530 or Earth Sci 530 or Geol Sci 530 or equiv.; Math 1252 or Math 153 or above; and Physics 1250 or Physics 131 or above; or permission of instructor.
Earth Sciences	5650	Glaciology	4	Earth Sci 4450 or permission of the instructor.

Earth Sciences	5651	Hydrogeology	4	Earth Sci 1121 or Earth Sci 121 or Geol Sci 121; and Math 1252 or Math 153 or above.
Earth Sciences	5655	Land Surface Hydrology	3	Math 1252 or Math 153 or above; and Chem 121 or above; and Physics 1250 or Physics 131 or above.
Earth Sciences	5660	Geology of Metallic Deposits	4	Earth Sci 4423 or Earth Sci 6423 or Earth Sci 423 or Geol Sci 423.
Earth Sciences	5661	Petroleum Geology	4	Earth Sci 4423 or Earth Sci 6423 or Earth Sci 423 or Geol Sci 423; and Earth Sci 4502 or Earth Sci 6502 or Earth Sci 502 or Geol Sci 502; or written permission of instructor.
Earth Sciences	5663	Global Change and Sustainability in the Earth System	4	Sr or grad standing in Earth Sci, or permission of instructor.
Earth Sciences	5670	General and Economic Geology of Selected Areas	2-4	Earth Sci 4502 or Earth Sci 6502 or Earth Sci 502 or Geol Sci 502; and Earth Sci 4530 or Earth Sci 6530 or Earth Sci 530 or Geol Sci 530; and Earth Sci 5550 or Earth Sci 550 or Geol Sci 550; or permission of instructor.
Earth Sciences	5676	Elemental Chemical Analysis using Inductively Coupled Plasma Optical Emission and Mass Spectrometry	3	Junior standing or above; and Chem 123 or above; and permission of instructor.
Earth Sciences	5680	Deep Earth Geophysics	3	Math 1252 or Math 153 or above; and Physics 1251 or Physics 133 or above.
Earth Sciences	5687	Energy Geophysics	3	Earth Sci 1121 or Earth Sci 121 or Geol Sci 121; and Math 1251 or Math 151 or above; and Physics 1250 or Physics 131 or above.
Earth Sciences	5703	Principles of Biostratigraphy	2	Earth Sci 4501 or Earth Sci 501 or Geol Sci 501 or Earth Sci 5613 or Earth Sci 613 or Geol Sci 613 or Earth Sci 5614 or Earth Sci 614 or Geol Sci 614; and Earth Sci 5603 or Earth Sci 603 or Geol Sci 603 or equiv; or written permission of instructor.
Earth Sciences	5713	Taxonomy and Phylogeny in the Fossil Record	2	Earth Sci 5614 or Earth Sci 614 or Geol Sci 614 or permission of instructor.

Earth Sciences	5714	Biometry	2	Earth Sci 5614 or Earth Sci 614 or Geol Sci 614; and Earth Sci 5641 or Earth Sci 641 or Geol Sci 641 or equiv; or permission of instructor.
Earth Sciences	5717	Critical Issues in World Freshwater Resources	4	Earth Sci 5651 or Earth Sci 651 or Geol Sci 651; Earth Sci 5752 or Earth Sci 752 or Geol Sci 752 recommended.
Earth Sciences	5718	Aquatic Geochemistry	3	Chem 122 or above; and Math 1251 or Math 152 or above; or equivs.
Earth Sciences	5719	Environmental Organic Geochemistry	3	Earth Sci 5718 or Earth Sci 718 or Geol Sci 718; and Chem 520; or permission of instructor.
Earth Sciences	5746	Seminar in Rheological Properties of Solids	1	Earth Sci 4530 or Earth Sci 6530 or Earth Sci 530 or Geol Sci 530; and Math 2253 or Math 254 or above; or permission of instructor. .
Earth Sciences	5751	Quantitative Ground-Water Flow Modeling	4	Earth Sci 5651 or Earth Sci 651 or Geol Sci 651.
Earth Sciences	5752	Contaminants in Aqueous Systems	4	Earth Sci 5651 or Earth Sci 651 or Geol Sci 651.
Earth Sciences	5754	Risk Assessment and Management in Earth Systems	4	Earth Sci 5651 or Earth Sci 651 or Geol Sci 651 or equivalent course in engineering or environmental sciences, or permission of instructor.
Earth Sciences	5779	Seminar in Physical Properties of Minerals and Rocks	1	Earth Sci 4421 or Earth Sci 6421 or Earth Sci 421 or Geol Sci 421; Earth Sci 5680 or Earth Sci 680 or Geol Sci 680; or equivs; or written permission of instructor.
Earth Sciences	5780	Reflection Seismology	4	Earth Sci 1121 or Earth Sci 121 or Geol Sci 121; and Math 1251 or Math 151 or above; and Physics 1250 or Physics 131 or above.
Earth Sciences	5781	Gravity Exploration	3	Earth Sci 5687 or Earth Sci 687 or Geol Sci 687 or written permission of instructor.

Earth Sciences	5782	Magnetic Exploration	3	Earth Sci 5687 or Earth Sci 687 or Geol Sci 687 or written permission of instructor.
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**CURRICULUM MAP OF SEMESTER COURSES AVAILABLE IN EARTH SCIENCES B.A.**

	Course Number	Course Title	Read/evaluate Earth Sci literature	Present Earth Sci information	Apply Earth Sci data	Apply appropriate techniques/methods	Identify Earth Sci problems, develop solutions	Apply other sciences
Earth Sciences	2155	Energy and Environment	B	B	B	B	B	B
Earth Sciences	2203	Environmental Geoscience	B	B	B	B	B	B
Earth Sciences	2204	Exploring Water Issues	B	B	B	B	B	B
Earth Sciences	2205	The Planets	B	B	B	B		B
Earth Sciences	2206	Principles of Oceanography	B	B	B	B	B	B
Earth Sciences	2210	Energy, Mineral Resources and Society	B	B	B	B	B	B
Earth Sciences	2212	Introduction to Earth Materials		B	B	B		B
Earth Sciences	3193	Individual Studies	B	B	B	B		B

	Course Number	Course Title	Read/ evaluate Earth Sci literature	Present Earth Sci information	Apply Earth Sci data	Apply appropriate techniques/ methods	Identify Earth Sci problems, develop solutions	Apply other sciences
Earth Sciences	3310	Earth Systems Data Collection and Analysis		I	I	I	I	I
Earth Sciences	3315	Evolution: Contemporary and Interdisciplinary Perspectives	I		I	I	I	I
Earth Sciences	3411	Water Security for the 21st Century	I	I	I	I	I	I
Earth Sciences	4189.01	Field Geology for Educators: Appalachian Mountains		I	I	I	I	I
Earth Sciences	4189.02	Field Geology for Educators: Bahamas		I	I	I	I	I
Earth Sciences	4189.03	Field Geology for Educators: Lake Erie		I	I	I	I	I
Earth Sciences	4189.04	Field Geology for Educators: Unspecified	I	I	I	I	I	I
Earth Sciences	4194	Group Studies	I	I	I	I	I	I
Earth Sciences	4194H	Honors Group Studies	I	I	I	I	I	I



	Course Number	Course Title	Read/evaluate Earth Sci literature	Present Earth Sci information	Apply Earth Sci data	Apply appropriate techniques/methods	Identify Earth Sci problems, develop solutions	Apply other sciences
Earth Sciences	4310	Remote Sensing in the Earth Sciences	I	I	I	I		I
Earth Sciences	4421	Earth Materials	I	I	I	I	I	I
Earth Sciences	4423	Introductory Petrology	I	I	I	I	I	I
Earth Sciences	4425	Energy Resources and Sustainability	I	I	I	I	I	I
Earth Sciences	4450	Water, Ice, and Energy in the Earth System	I	I	I	I	I	I
Earth Sciences	4501	Paleontology	I	I	I	I	I	I
Earth Sciences	4502	Stratigraphy and Sedimentation	I	I	I	I	I	I
Earth Sciences	4530	Structural Geology	I	I	I	I	I	I
Earth Sciences	4560	Applied Geophysics	I	I	I	I	I	I



	Course Number	Course Title	Read/evaluate Earth Sci literature	Present Earth Sci information	Apply Earth Sci data	Apply appropriate techniques/methods	Identify Earth Sci problems, develop solutions	Apply other sciences
Earth Sciences	5193.xx	Individual Studies	I - A	I - A	I - A	I - A	I - A	I - A
Earth Sciences	5194	Group Studies	I - A	I - A	I - A	I - A	I - A	I - A
Earth Sciences	5203	Geo-environment and Human Health	A	A	A	A	A	A
Earth Sciences	5206	Advanced Oceanography	A	A	A	A	A	A
Earth Sciences	5550	Geomorphology	I-A	I-A	I-A	I-A	I-A	I-A
Earth Sciences	5600	Siliciclastic Depositional Systems	A	A	A	A	A	A
Earth Sciences	5601.01	Sedimentary Petrology: Sandstones	A	A	A	A	A	A
Earth Sciences	5601.02	Sedimentary Petrology: Carbonate Rocks and Shales	A	A	A	A	A	A
Earth Sciences	5602.01	Carbonate Depositional Systems I	A	A	A	A	A	A
Earth Sciences	5602.02	Carbonate Depositional Systems II	A	A	A	A	A	A
Earth Sciences	5603	Stratigraphy	A	A	A	A	A	A

	Course Number	Course Title	Read/evaluate Earth Sci literature	Present Earth Sci information	Apply Earth Sci data	Apply appropriate techniques/methods	Identify Earth Sci problems, develop solutions	Apply other sciences
Earth Sciences	5604	Sequence Stratigraphy	A	A	A	A	A	A
Earth Sciences	5605	Paleoceanography	A	A	A	A	A	A
Earth Sciences	5613	Micropaleontology	A	A	A	A	A	A
Earth Sciences	5614	Paleobiology	A	A	A	A	A	A
Earth Sciences	5615	Paleoecology	A	A	A	A	A	A
Earth Sciences	5617	Petrology of Earth and Planets	A	A	A	A	A	A
Earth Sciences	5618	Advanced Historical Geology	A	A	A	A	A	A
Earth Sciences	5621	Introduction to Geochemistry	A	A	A	A	A	A
Earth Sciences	5622	Stable Isotope Biogeochemistry	A	A	A	A	A	A
Earth Sciences	5625	Igneous Petrology	A	A	A	A	A	A
Earth Sciences	5627	Global Biogeochemical Cycles	A	A	A	A	A	A

	Course Number	Course Title	Read/evaluate Earth Sci literature	Present Earth Sci information	Apply Earth Sci data	Apply appropriate techniques/methods	Identify Earth Sci problems, develop solutions	Apply other sciences
Earth Sciences	5628	Environmental Isotope Geochemistry	A	A	A	A	A	A
Earth Sciences	5629	Principles of Petrology	A	A	A	A	A	A
Earth Sciences	5636	Advanced Topics in Mineralogy and Crystallography	A	A	A	A	A	A
Earth Sciences	5641	Geostatistics	A	A	A	A	A	A
Earth Sciences	5642	Geomathematical Analysis	A	A	A	A	A	A
Earth Sciences	5644	Tectonic Evolution of Continents	A	A	A	A	A	A
Earth Sciences	5645	Advanced Structural Geology	A	A	A	A	A	A
Earth Sciences	5646	Geodynamics	A	A	A	A	A	A
Earth Sciences	5650	Glaciology	A	A	A	A	A	A
Earth Sciences	5651	Hydrogeology	A	A	A	A	A	A
Earth Sciences	5655	Land Surface Hydrology	A	A	A	A	A	A

	Course Number	Course Title	Read/evaluate Earth Sci literature	Present Earth Sci information	Apply Earth Sci data	Apply appropriate techniques/methods	Identify Earth Sci problems, develop solutions	Apply other sciences
Earth Sciences	5660	Geology of Metallic Deposits	A	A	A	A	A	A
Earth Sciences	5661	Petroleum Geology	A	A	A	A	A	A
Earth Sciences	5663	Global Change and Sustainability in the Earth System	A	A	A	A	A	A
Earth Sciences	5670	General and Economic Geology of Selected Areas	A	A	A	A	A	A
Earth Sciences	5676	Elemental Chemical Analysis using Inductively Coupled Plasma Optical Emission and Mass Spectrometry	A	A	A	A	A	A
Earth Sciences	5680	Deep Earth Geophysics	A	A	A	A	A	A
Earth Sciences	5687	Energy Geophysics	A	A	A	A	A	A
Earth Sciences	5703	Principles of Biostratigraphy	A	A	A	A	A	A

	Course Number	Course Title	Read/evaluate Earth Sci literature	Present Earth Sci information	Apply Earth Sci data	Apply appropriate techniques/methods	Identify Earth Sci problems, develop solutions	Apply other sciences
Earth Sciences	5713	Taxonomy and Phylogeny in the Fossil Record	A	A	A	A	A	A
Earth Sciences	5714	Biometry	A	A	A	A	A	A
Earth Sciences	5717	Critical Issues in World Freshwater Resources	A	A	A	A	A	A
Earth Sciences	5718	Aquatic Geochemistry	A	A	A	A	A	A
Earth Sciences	5719	Environmental Organic Geochemistry	A	A	A	A	A	A
Earth Sciences	5746	Seminar in Rheological Properties of Solids	A	A	A	A	A	A
Earth Sciences	5751	Quantitative Ground-Water Flow Modeling	A	A	A	A	A	A
Earth Sciences	5752	Contaminants in Aqueous Systems	A	A	A	A	A	A
Earth Sciences	5754	Risk Assessment and Management in Earth Systems	A	A	A	A	A	A
Earth Sciences	5779	Seminar in Physical Properties of Minerals and Rocks	A	A	A	A	A	A

	Course Number	Course Title	Read/evaluate Earth Sci literature	Present Earth Sci information	Apply Earth Sci data	Apply appropriate techniques/methods	Identify Earth Sci problems, develop solutions	Apply other sciences
Earth Sciences	5780	Reflection Seismology	A	A	A	A	A	A
Earth Sciences	5781	Gravity Exploration	A	A	A	A	A	A
Earth Sciences	5782	Magnetic Exploration	A	A	A	A	A	A

Learning Outcomes:

- A) Students critically read and evaluate Earth Science literature
- B) Students present Earth Science information in a clear and logical manner, both orally and in writing.
- C) Students apply knowledge of Earth Science data, and the applications of these data, to understand the dynamic physical, chemical, and biological processes of the Earth and its history.
- D) Students apply knowledge of appropriate techniques, field methods, field mapping, and numerical methods to measure, portray, analyze, and interpret Earth Science data in specific subdisciplines.
- E) Students identify Earth Science problems and develop solutions.
- F) Students apply knowledge of modern applications from chemistry, physics, biology, mathematics, statistics, and computing to the solution of Earth Science problems.

Key: B = Beginning level; I = Intermediate level; A = Advanced level



**SEMESTER ADVISING SHEET**

STUDENT NAME: \_\_\_\_\_ ID \_\_\_\_\_

**EARTH SCIENCES**

<b>B.A. Checklist</b>	<b>Semester (Au, Sp, Su)</b>	<b>Year</b>	<b>Credits</b>	<b>Grade</b>
EarthSci 1121:	_____	_____	4	_____
EarthSci 1122:	_____	_____	4	_____
Biology 1113:	_____	_____	4	_____
Biology 1114:	_____	_____	4	_____
Chemistry 1210:	_____	_____	5	_____
Math 1151:	_____	_____	5	_____
EarthSci 2245:	_____	_____	4	_____

Note: Where available, an Honors offering can be substituted for the equivalent non-Honors course listed in the Preparation for the Major.

<sup>2</sup> EarthSci _____:	_____	_____	_____	_____
<sup>2</sup> EarthSci _____:	_____	_____	_____	_____
<sup>2</sup> EarthSci _____:	_____	_____	_____	_____
<sup>2</sup> EarthSci _____:	_____	_____	_____	_____
<sup>2</sup> EarthSci _____:	_____	_____	_____	_____
<sup>2</sup> EarthSci _____:	_____	_____	_____	_____
<sup>2</sup> EarthSci _____:	_____	_____	_____	_____
<sup>2</sup> EarthSci _____:	_____	_____	_____	_____
<sup>2</sup> EarthSci or _____:	_____	_____	_____	_____
<sup>2</sup> EarthSci or _____:	_____	_____	_____	_____

<sup>2</sup>Complete 30 semester credits in Earth Sciences and other approved fields, with maximum of 10 credits at the 2000-level in Earth Sciences and a maximum of 6 credits at the 3000-level and above outside Earth Sciences. Coursework outside Earth Sciences is subject to approval by an Earth Sciences advisor. Earth Sci 4580 cannot be used toward the B.A. in Earth Sciences. No more than a total of 3 credits of the combination of internship (x191), research (x998, x999) and individual study (x193) can be counted toward the major.

**QUARTER ADVISING SHEET**

STUDENT NAME: \_\_\_\_\_ ID \_\_\_\_\_

**GEOLOGICAL SCIENCES**

<b>B.A. Checklist</b>	<b>Qtr (Au, Wi, Sp, Su)</b>	<b>Year</b>	<b>Credits</b>	<b>Grade</b>
EarthSci 121:	_____	_____	5	_____
EarthSci 122:	_____	_____	5	_____
Biology 113:	_____	_____	5	_____
Biology 114:	_____	_____	5	_____
Chemistry 121:	_____	_____	5	_____
Chemistry 122:	_____	_____	5	_____
Math 151:	_____	_____	5	_____
<sup>1</sup> Stats 145 or EarthSci 245:	_____	_____	5	_____
<sup>2</sup> EarthSci _____:	_____	_____	_____	_____
<sup>2</sup> EarthSci _____:	_____	_____	_____	_____
<sup>2</sup> EarthSci _____:	_____	_____	_____	_____
<sup>2</sup> EarthSci _____:	_____	_____	_____	_____
<sup>2</sup> EarthSci _____:	_____	_____	_____	_____
<sup>2</sup> EarthSci _____:	_____	_____	_____	_____
<sup>2</sup> EarthSci _____:	_____	_____	_____	_____
<sup>2</sup> EarthSci _____:	_____	_____	_____	_____
<sup>2</sup> EarthSci _____:	_____	_____	_____	_____

<sup>1</sup>Circle one

<sup>2</sup>Complete 40 credit hours of Earth Science at the 200 level or higher. If each course is 5 credits, this will be 8 courses. More than 8 blanks are provided in case some of the courses are fewer than 5 credits.

## **TRANSITION POLICY**

Students who began their degree under quarters will not be penalized as we move to semesters, either in terms of progress towards their degree or their expected date of graduation. Arrangements will be made for individual students on a case-by-case basis by advisors within Earth Sciences, but we anticipate few complications because of the flexibility provided by the structure of our B.A. program, combined with the anticipated regularity and variety of 2000-, 3000-, 4000-, and 5000-level course offerings within SES. Few of these upper-level courses occur within well-defined sequences, so a student should be able to move easily between individual upper-level courses within SES. In addition, students have the opportunity to take upper-level courses outside SES, which provides additional paths for timely progress toward completion. As a result, we do not see the need for any bridge courses in Earth Sciences.

## EXAMPLE 4 YEAR PLANS, EARTH SCIENCES B.A.

Years 1 & 2 -- Quarters

Yr 1 Autumn	Winter	Spring
Writing 1 5 cr. Math 151 (GEC) 5 cr. GEC elective 5 cr. ASC Survey 1 cr. Total = 16 cr.	GEC elective 5 cr. GEC elective 5 cr. Chem 121 5 cr. Total = 15 cr.	GEC elective 5 cr. Chem 122 5 cr. GEC elective 5 cr. Total = 15 cr.
Yr 2 Autumn	Winter	Spring
GEC elective 5 cr. Bio 113 (GEC) 5 cr. GEC elective 5 cr. Total = 15 cr.	GEC elective 5 cr. Earth Sci 245 (GEC) 5 cr. Earth Sci 121 (GEC) 5 cr. Total = 15 cr.	Earth Sci 122 (GEC) 5 cr. GEC elective 5 cr. Bio 114 5 cr. Total = 15 cr.

Years 3 & 4 – Semesters

Yr 3 Autumn	Spring
GE elective 3 cr. GE elective 3 cr. Earth Sci Upper-level 1 4 cr. Earth Sci Upper-level 2 4 cr. Free Elective 3 cr. Total = 17 cr.	GE elective 3 cr. Earth Sci Upper-level 3 4 cr. Earth Sci Upper-level 4 4 cr. GE elective 3 cr. Total = 14 cr.
Yr 4 Autumn	Spring
GE elective 3 cr. Earth Sci Upper-level 5 4 cr. Earth Sci Upper-level 6 4 cr. Free Elective 4 cr. Total = 15 cr.	GE elective 3 cr. Earth Sci Upper-level 7 4 cr. Earth Sci Upper-level 8 4 cr. Free Elective 4 cr. Total = 15 cr.

91 quarter credits (~60 semester units) + 61 semester units = 121 semester units total.

32 credits of Earth Science upper-level coursework (or other approved upper-level coursework).

All requirements of quarter-version GEC met.

Years 1 – 4 in semesters

Yr 1	Autumn	Spring
GE elective	3 cr.	GE elective 3 cr.
GE elective	3 cr.	GE elective 3 cr.
Math 1151(GE)	5 cr.	GE elective 3 cr.
Chem 1210	5 cr.	GE elective 3 cr.
ASC Survey	1 cr.	Free elective 3 cr.
Total = 17 cr.		Total = 15 cr.
Yr 2	Autumn	Spring
GE elective	3 cr.	GE elective 3 cr.
Bio 1113 (GE)	4 cr.	Bio 1114 4 cr.
Earth Sci 1121 (GE)	4 cr.	Earth Sci 1122 (GE) 4 cr.
GE elective	3 cr.	Earth Sci 2245 (GE) 4 cr.
Total = 14 cr.		Total = 15 cr.
Yr 3	Autumn	Spring
GE elective	3 cr.	GE elective 3 cr.
GE elective	3 cr.	GE elective 3 cr.
Earth Sci Upper-level 1	4 cr.	Earth Sci Upper-level 3 4 cr.
Earth Sci Upper-level 2	4 cr.	Earth Sci Upper-level 4 4 cr.
		GE elective 3 cr.
Total = 14 cr		Total = 17 cr.
Yr 4	Autumn	Spring
GE elective	3 cr.	Earth Sci Upper-level 7 4 cr.
Earth Sci Upper-level 5	4 cr.	Earth Sci Upper-level 8 4 cr.
Earth Sci Upper-level 6	4 cr.	Free Elective 3 cr.
Free Elective	5 cr.	Free Elective 3 cr.
Total = 15 cr.		Total = 14 cr.

Total = 121 semester credits, with all semester-version GE requirements met and 32 semester credits of upper-level Earth Science coursework (or other approved upper-level coursework).