

Fiscal Unit/Academic Org	School of Earth Sciences - D0656
Administering College/Academic Group	Arts And Sciences
Co-administering College/Academic Group	Mathematical And Physical Sci
Semester Conversion Designation	Re-envisioned with significant changes to program goals and/or curricular requirements (e.g., degree/major name changes, changes in program goals, changes in core requirements, structural changes to tracks/options/courses)
Current Program/Plan Name	Geological Sciences
Proposed Program/Plan Name	Earth Sciences BS
Program/Plan Code Abbreviation	GEOLSCI-BS
Current Degree Title	Bachelor of Science

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	31	4.3
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	75	50.0	47	3.0
	Maximum	75	50.0	51	1.0

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

Each of the 4 subprograms requires the same Preparation for the Major, and a total of 30-31 semester credit hours in the Major Program. One of the new subprograms -- Earth System Science -- requires that at least 6 credit hours be taken outside Earth Sciences from a list of approved courses. Since the Major Program for our existing B.S. does not require any coursework outside Earth Sciences, there is a change of +6 credit hours in the category of "maximum required credit hours offered outside the unit". For the remaining 3 subprograms, the "credit hours required outside the unit" remains at 0, as it is in our present B.S.

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 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 changes to our assessment practices will be needed.

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.

Program Specialization/Sub-Plan Name Geological Sciences (Existing)

Program Specialization/Sub-Plan Goals

Program Specialization/Sub-Plan Name Petroleum Geology & Geophysics (New)

Program Specialization/Sub-Plan Goals

Program Specialization/Sub-Plan Name Geophysics (New)

Program Specialization/Sub-Plan Goals

Program Specialization/Sub-Plan Name Earth System Science (New)

Program Specialization/Sub-Plan Goals

Pre-Major

Does this Program have a Pre-Major? No

Attachments

- Earth Sci BS Attachment 2_in progress 20 May 1 p.m..doc: Earth Sci BS Program Proposal and Curriculum Map

(Program Proposal. Owner: Krissek, Lawrence Alan)

Comments

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Krissek, Lawrence Alan	05/19/2011 02:30 PM	Submitted for Approval
Approved	Krissek, Lawrence Alan	05/19/2011 02:33 PM	Unit Approval
Pending Approval	Andereck, Claude David	05/19/2011 02:33 PM	College Approval

LETTER FROM PROGRAM-OFFERING UNIT

DATE: 5 January 2011 (updated 8 April 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). In response to feedback from the NMS Divisional Advisory Panel, the faculty discussed and unanimously approved (22 yes, 0 no, 0 abstentions) changing the name of the Anthropology and Archeology subprogram to Geoarcheology at a faculty meeting on 1 April 2011.

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 B.S. program in Earth Sciences (presently Geological Sciences) is the course of study taken by our undergraduates who plan to pursue a career in the Earth Sciences, either by continuing to graduate school in the sciences or by entering the Earth Science workforce immediately after graduation. Over the last 30 years, more than 90% of our undergraduates have earned the B.S., and we anticipate that the majority of our future students will continue to pursue the B.S. degree. As a result, our B.S. program must be designed to prepare students across the broad range of subdisciplines that are incorporated in the modern and expanding field of Earth Sciences. Establishing 4 subprograms, as described below, provides this range of coverage; each subprogram includes courses that introduce the broad range of the Earth Sciences, but each subprogram also requires several courses that develop a depth of knowledge and understanding within its area of concentration.

In converting our courses from quarters to semesters, 5 quarter-credit courses that do not include a lab generally have converted to 3 semester credits; this conversion maintains approximately the same amount of lecture time across the conversion. Our 5 quarter-credit courses that do include a weekly lab (most of which meet for 4 x 48 minute lectures and one 1:48 lab each week) generally have converted to 4 semester credits, with an anticipated meeting schedule of 3 x 50 minute lectures and one lab (~1:40) each week. This conversion maintains approximately the same amount of lecture time across the conversion, and maintains a distribution of lecture vs. lab time that is necessary for the material covered. Earth Sci 421/4421 and 423/4423 are exceptions to this conversion template, in that both are 5 quarter-credit courses with a lab, and both have been converted to 3 semester-credit courses with a lab. This conversion for 421/4421 and 423/4423 was undertaken primarily to: 1) allow us to include a broader range of courses within the core requirements of the Geological Sciences subprogram, the Geophysics subprogram, and the Petroleum Geology & Geophysics subprogram; and 2) make our program requirements for earth materials and petrology more consistent with the requirements for earth materials and petrology at our peer institutions.

An important component of our existing B.S. program is the requirement for Earth Sci 581 and 582, which together provide 6 weeks (9 quarter credits) of training and practical experience in field geology (i.e., field mapping; field description of rocks and geological structures; the construction of professional-quality geologic maps and reports). For 50+ years, these courses have been held during the summer in central Utah; similar summer field geology courses at other locations are a common requirement in Geological Sciences programs across the U.S. and in other countries. In the conversion to semesters, this requirement is maintained in the Geological Sciences subprogram; in addition, the converted versions of Earth Sci 581 and 582 (i.e., Earth Sci 5189.01 and 5189.02) are an elective in the Earth System Science subprogram and the Petroleum Geology and Geophysics subprogram. Earth Science B.S. students are informed of this requirement at the time they declare the major, and generally have at least 1 academic year to prepare financially for the expense of a fulltime summer course. The value of this field training is recognized widely by our alumni, who often cite it as the single most valuable part of their undergraduate program.

The date of the last significant revision of the Geological Sciences (now requested to be Earth Sciences) B.S. program was in the 1990s.

The proposed changes to the B.S. in Earth Sciences can be categorized overall as a significant re-envisioning, although some existing components of the B.S. program are changed only minimally in the conversion. The proposed changes include the following items:

1) change the name of the degree program, from Geological Sciences to Earth Sciences. This name change is proposed so that the name of the B.S. 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”.

2a) establish 4 transcriptable subprograms within the Earth Sciences B.S. degree program. One of these (the Geological Sciences subprogram) is a relatively straightforward conversion of our existing B.S. requirements. The other 3 subprograms (Earth System Science, Geophysics, and Petroleum Geology and Geophysics) are new; their establishment recognizes our unit’s transition from a more traditional Department of Geological Sciences to a more encompassing School of Earth Sciences, as well as important developments within the field of Earth Sciences since the last revision of our B.S. program.

In order to provide students with flexibility to move between these subprograms early in their careers, the preparation for the major is the same for all subprograms. In addition, many of the Earth Science courses used as a core course or included in a set of electives in one program are also used as a core course or an elective in at least one other subprogram, so that a student who decides to change subprograms later in his/her career is likely to be able to apply at least some coursework from his/her previous subprogram to his/her new subprogram.

The details of each subprogram are discussed separately below. A “master list” of all courses used in the 4 subprograms is presented at the beginning of the program proposal, with individual course listings subsequently for each subprogram. Because the expected learning outcomes are the same for all 4 subprograms, a single curricular map included at the end of this proposal.

2b) **Preparation for the Major** – the semester version of the Preparation for the Major is very similar to the quarter version of the Preparation for the Major, and includes required courses in Chemistry, Math, Physics, Biology, and Earth Sciences, as well as a Data Analysis course. Many of these courses, which were 5 credit hours in the quarter format, have been converted to 4 credit hour or 5 credit hour courses in semesters; in order to maintain a Preparation for the Major that is proportionally equivalent in semesters, therefore, we have reduced the total number of courses in the Preparation for the Major from 15 quarter courses to 11 semester courses. The Preparation for the Major totaled ~75 credit hours under quarters, and will total 47-51 credit hours under semesters (depending on the electives chosen), so that the total credit hours in the Preparation for the Major have converted at the desired ratio of ~2/3.

2c) **Geological Sciences subprogram** – this subprogram is essentially the semester version of our existing B.S. in Geological Sciences. The core of the semester version includes the converted versions of the 6 courses that form the core of the quarter version; 2 additional 4000-level courses are required in the core of the semester version, whereas one 500-level course is a required elective in the quarter version. The two 4000-level courses that are now required (Earth Sci 4501 – Paleontology, and Earth Sci 4502 – Stratigraphy and Sedimentology) also are required in Geological Sciences programs at most of our peer institutions, and have been judged as essential preparation for our students preparing for a career in the more traditional subdisciplines of the Earth Sciences. The semester version also maintains the requirement for 2 upper-level elective courses in Earth Sciences; as has been the case

under quarters, these electives provide each student with the opportunity to either focus in more depth on one subdiscipline (e.g., paleontology, petrology, structural geology), or explore Earth Science subdisciplines that are not included in the core of this subprogram (e.g., geochemistry, geophysics).

As described above, the core requirements for the Geological Sciences subprogram continue to include Field Geology 1 & 2 (Earth Sci 581/5189.01 and 582/5189.02), which are taught for 6 weeks during the summer in central Utah and are required in the quarter-version of our B.S. The core requirements for the Geological Sciences subprogram also continue to include our decades-long requirement that every B.S. student complete a Senior Thesis.

Students who have completed our existing B.S. program have been very successful in competing for graduate school admission across the range of subdisciplines in the Geological Sciences, and in moving directly into entry-level geoscience positions. Because the Geological Sciences subprogram is very similar to our existing B.S., we anticipate that students who complete the Geological Sciences subprogram in the future will be equally successful.

- 2d) **Earth System Science subprogram** – this subprogram is new, and has been developed to incorporate subdisciplines within the Earth Sciences that extend beyond the more traditionally defined Geological Sciences. This subprogram also provides an opportunity for students to explore relationships between the Earth Sciences and other disciplines, including geography, atmospheric sciences, the biological sciences, economics, natural resources, and engineering.

The core of this subprogram includes courses that explore major “spheres” of the Earth System – the hydrosphere (Earth Sci 4450 and 5206), the cryosphere (Earth Sci 4450), and the near-surface portion of the lithosphere (Earth Sci 4502). Earth Sci 5621 (Introduction to Geochemistry) is required because geochemical cycles are a primary method for tracing interactions between these spheres. This subprogram also requires a Senior Thesis and some component of internship, research, and/or field experience; these requirements ensure that each student has practical experience, as well as experience preparing a written report of professional quality.

The remaining requirements for this subprogram include 2 sets of electives – 1 set (at least 2 courses) within Earth Sciences, and 1 set (at least 2 courses) from a list of approved courses outside Earth Sciences. These electives allow each student to explore his/her areas of interest, and to prepare for a career path of his/her choosing. For example, a student who is interested in a career in policy and/or law might select Earth Science electives in water resources and/or sustainability, and non-Earth Science electives in economics and international studies. In contrast, a student who is interested in graduate school in a science field might select Earth Science electives in advanced aspects of geochemistry, and non-Earth Science electives in environmental engineering and chemistry.

- 2e) **Geophysics subprogram** – this subprogram is new as a designated plan of study, although a very similar set of courses (with a difference of only 1-2 courses) could be chosen that fulfill our present B.S. and the requirements for this subprogram. In most cases, though, it is anticipated that students in this subprogram will choose the more quantitative geophysics and geodynamics courses for their electives, as well as additional physics and/or math courses in their Preparation for the Major. These differences in course selection are likely to produce <50% overlap in the courses taken for this subprogram compared to the courses taken for the Geological Sciences subprogram.

A primary motivation for establishing this subprogram is to explicitly recognize the stronger preparation of these students in the more quantitative fields of geophysics. This explicit recognition is

particularly important as students apply to graduate programs in geophysics, and as they apply for geophysics positions within industries such as energy/petroleum.

2f) **Petroleum Geology & Geophysics subprogram** – this is a new subprogram, although the establishment of a track/concentration in Petroleum Geology & Geophysics has been discussed by our faculty and alumni for several decades. Because the petroleum industry has begun hiring our students again within the past 5 years – and student interest in petroleum geology and geophysics has risen as a result – we view this time as an excellent opportunity to establish a subprogram in Petroleum Geology & Geophysics. In addition, a number of our alumni have expressed an interest in providing significant support for this subprogram and its students.

In general, the requirements for this subprogram combine pertinent parts of the requirements for the Geological Sciences subprogram and for the Geophysics subprogram, and are consistent with the requirements of established Petroleum Geology programs at universities such as UT-Austin, University of Oklahoma, and Oklahoma State. A student who completes this subprogram will be competitive for admission to quality graduate programs in Petroleum Geology & Geophysics, will be well-prepared to begin internships at major oil companies, and will be immediately employable by small to mid-size petroleum companies.

EARTH SCIENCE SEMESTER COURSES AVAILABLE IN EARTH SCIENCES B.S.

	Course Number	Course Title	Credits	Prerequisites / Co-requisites
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	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	Permission of instructor and Rank 4.
Earth Sciences	4999H	Honors Undergraduate Research for Thesis in Earth Sciences	1	Honors Program, Rank 4, 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	5189.03, .04, .05, .06	Field Geology for Educators (various)	2	CANNOT BE USED TO MEET REQUIREMENTS FOR B.S. IN EARTH SCIENCES
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	5580	Standards-Based Earth Science for Educators	1-4	CANNOT BE USED TO MEET REQUIREMENTS FOR B.S. IN EARTH SCIENCES
Earth Sciences	5584	Principles of Oceanography for Educators	2	CANNOT BE USED TO MEET REQUIREMENTS FOR B.S. IN EARTH SCIENCES.
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.
Geod Sci	5781	Geodesy and Geodynamics	3	Permission of instructor.

SEMESTER COURSES OUTSIDE SES AVAILABLE IN EARTH SCIENCES B.S.

Department and Course Number	Course Name	Semester Credit Hours	Prerequisites/Co-requisites
Geog 3900	Global Climate Change: Causes and Consequences	3	
Geog 3901	Global Climate and Environmental Change	3	

Geog 3980	Biogeography: An Introduction to Life on Earth	3	
Geog 5900	Climatology (if not used to satisfy Preparation of the Major)	3	
Geog 5801	Environmental Conservation	3	
Geog 5802	Globalization and Environment	3	
Geog 5220	Fundamentals of Geographic Information Systems	3	
Geog 5223	Design and Implementation of GIS	3	Geog 5220
ATMOSSC 2940	Basic Meteorology	3	Math 1151 and Physics 1250
EEOB 4950	Field Ecology	2	Rank 3 standing or above; 12 semester hours of biological sciences or permission of instructor
EEOB 3310	Evolution	4	Bio 1114 or 1114H
EEOB 5420	Aquatic Ecosystems: Ecology of Inland Waters	1.5	EEOB 3410
EEOB 3410	Ecology	4	Bio 1114 or 1114H

AEDECON 2001	Principles of Food and Resource Economics	3	
AEDECON 4310	Environmental and Natural Resource Economics	3	AEDE 2001 or Econ 2001
AEDECON 4320/ INTSTDS 4320	Energy, the Environment, and the Economy	3	AEDE 2001 or Econ 2001
ENVENG 3200	Fundamentals of Environmental Engineering	3	Chem 1210
ENVENG 2100	Environmental Engineering Analytical Methods	3	Chem 1210 and 1220
CIVILEN 5001	Fundamentals of Geographic Information Systems	4	CE 2050 or written permission of instructor.
ENR 3000	Soil Science	3	
ENR 3280	Water Quality Management	2	
ENR 4260	Soil Resource Management	3	ENR 3000 or permission of instructor
ENR 2367	Communicating Contemporary Environmental and Natural Resource Issues	3	
INTSTDS 4800	Cultural Diplomacy	3	Rank 2 or above, or permission of instructor

CHEM 2210 or 2210H	Analytical Chemistry 1: Quantitative Analysis	5	Chem 1220 and Math 1151
Math 2415	Ordinary and Partial Differential Equations	3	Math 2568
Math 2568	Linear Algebra	3	Math 2153

LIST OF PROGRAM REQUIREMENTS

1) GEOLOGICAL SCIENCES subprogram (transcriptable):

A) PREPARATION FOR THE MAJOR

Quarter course #	Quarter course name	Quarter credit hours	Semester course number	Semester course name	Semester credit hours
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
Math 152	Calculus 2	5	Math 1152	Calculus 2	5
Math 153	Calculus 3	5			
Bio 113	Energy Transfer and Development	5	Bio 1113	Energy Transfer and Development	4
Physics 131	Particles and Motion	5	Physics 1250	Physics 1	5
Physics 132	Electricity and Magnetism	5			
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
Minimum of 4 additional courses in sciences and mathematics, chosen from: Chem 123 and above Math 254 and above Physics 133 and above EEOB 400 (Evolution) Geog 520 (Climatology) Geog 580 (Cartography) Other options require approval by an SES advisor.		20	Complete either Chem 1220 or Physics 1251		5
			Minimum of 2 additional courses in sciences and mathematics, chosen from: Chem 1220 and above Math 2153 and above Physics 1251 and above EEOB 3310 (Evolution) Geog 5900 (Climatology) Geog 5200 (Cartography) Other options require approval by an SES advisor.		10

Total quarter hours in Preparation for the major	75	Total semester hours in Preparation for the major	51
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 REQUIREMENTS AND ADVISING SHEETS

Quarter course #	Quarter course name	Quarter credit hours	Semester course number	Semester course name	Semester credit hours	Prereqs.
Complete a minimum of 40 quarter credit hours, including the following requirements:			Complete a minimum of 31 semester credit hours, including the following requirements:			
a) Complete the following courses:			a) Complete the following courses:			
Earth Sci 421	Intro Mineralogy	5	Earth Sci 4421	Earth Materials	3	Chem 1210
Earth Sci 423	Intro Petrology	5	Earth Sci 4423	Intro Petrology	3	Earth Sci 1121 & 4421
Earth Sci 530	Structural Geology	5	Earth Sci 4530	Structural Geology	4	Earth Sci 1121 & Physics 1250
Earth Sci 570	Senior Thesis	1	Earth Sci 4999 or 4999H	Undergraduate Research for Thesis in Earth Sciences	1	Rank 4 in Earth Sci & permission of instructor
Earth Sci 581	Field Geology 1	5	Earth Sci 5189.01	Field Geology 1	3	Earth Sci 4423 & 4530 & permission of instructor

Earth Sci 582	Field Geology 2	4	Earth Sci 5189.02	Field Geology 2	3	Earth Sci 5189.02
			Earth Sci 4501	Paleontology	4	Earth Sci 1122 & 3 cr hrs in bio sciences
			Earth Sci 4502	Stratigraphy and Sedimentology	4	Earth Sci 1121 & 1122
b) Complete at least one of the following courses:						
Earth Sci 501	Paleontology	5				
Earth Sci 502	Stratigraphy and Sedimentology	5				
Earth Sci 550	Geomorphology	5				
Earth Sci 560	Geophysics	5				
c) Complete at least 2 courses (minimum of 10 credit hours) in Earth Sciences at the 600-level or above:			b) Complete at least 2 courses (minimum of 6 semester credit hours) in Earth Sciences at the 5000-level or above:			
Earth Sci upper-level electives		10	Earth Sci upper-level electives (Note: Earth Sci 5189.03, 5189.04, 5189.05, 5189.06, 5580, and 5584 cannot be used to meet this requirement)		6	
TOTAL QUARTER CREDIT HOURS		40	TOTAL SEMESTER CREDIT HOURS		31	

ADVISING SHEETS: The next 4 pages contain the quarter advising sheet for the Geological Sciences B.S., and the semester advising sheet for the Geological Sciences subprogram of the Earth Sciences B.S.

SEMESTER ADVISING SHEET

STUDENT NAME: _____ ID _____

EARTH SCIENCES B.S. – GEOLOGICAL SCIENCES SUBPROGRAM

	Semester (Au, Sp, Su)	Year	Credits	Grade
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I) PREPARATION FOR THE MAJOR:

a) Complete the following courses:

EarthSci 1121:	_____	_____	4	_____
EarthSci 1122:	_____	_____	4	_____
EarthSci 2245:	_____	_____	4	_____
Biology 1113:	_____	_____	4	_____
Chemistry 1210:	_____	_____	5	_____
Physics 1250:	_____	_____	5	_____
Math 1151:	_____	_____	5	_____
Math 1152:	_____	_____	5	_____

b) Complete either Chemistry 1220 or Physics 1251:

Chemistry 1220 or Physics 1251	_____	_____	5	_____
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c) Complete a minimum of 2 additional courses in the sciences and mathematics, chosen from Chem 1220 (if not used to satisfy Requirement “b”) and above; Math 2153 and above; Physics 1251 (if not used to satisfy Requirement “b”) and above; EEOB 3310; Geog 5900 and 5200. Other options require approval by an SES advisor.

_____:	_____	_____	_____	_____
_____:	_____	_____	_____	_____

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

II) MAJOR PROGRAM REQUIREMENTS:

Complete a minimum of 31 semester credit hours, including the following requirements:

a) Complete the following courses:

EarthSci 4421:	_____	_____	3	_____
EarthSci 4423:	_____	_____	3	_____
EarthSci:4501:	_____	_____	4	_____
EarthSci 4502:	_____	_____	4	_____
EarthSci 4530:	_____	_____	4	_____
EarthSci 5189.01:	_____	_____	3	_____
EarthSci 5189.02:	_____	_____	3	_____
EarthSci 4999 or 4999H:	_____	_____	1	_____

b) Complete at least 2 additional courses (6 credits minimum) in Earth Sciences at the 5000-level or above:
(Note: Earth Sci 5189.03, 5189.04, 5189.05, 5189.06, 5580, and 5584 cannot be used to meet this requirement)

EarthSci _____:	_____	_____	_____	_____
EarthSci _____:	_____	_____	_____	_____

QUARTER ADVISING SHEET

STUDENT NAME: _____ ID _____

GEOLOGICAL SCIENCES

B.S. Checklist _____ **Qtr (Au, Wi, Sp, Su)** _____ **Year** _____ **Credits** _____ **Grade** _____

I) PREPARATION FOR THE MAJOR:

a) Complete the following courses:

EarthSci 121:	_____	_____	_____5_____	_____
EarthSci 122:	_____	_____	_____5_____	_____
EarthSci 245: or Stat 145 or Stat 245	_____	_____	_____5_____	_____
Biology 113:	_____	_____	_____5_____	_____
Chemistry 121:	_____	_____	_____5_____	_____
Chemistry 122:	_____	_____	_____5_____	_____
Physics 131:	_____	_____	_____5_____	_____
Physics 132:	_____	_____	_____5_____	_____
Math 151:	_____	_____	_____5_____	_____
Math 152:	_____	_____	_____5_____	_____
Math 153:	_____	_____	_____5_____	_____

b) Complete a minimum of 4 additional courses in the sciences and mathematics, chosen from Chem 123 and above; Math 254 and above; Physics 133 and above; EEOB 400; Geog 520 and 580. Other options require approval by an SES advisor.

_____:	_____	_____	_____	_____
_____:	_____	_____	_____	_____
_____:	_____	_____	_____	_____
_____:	_____	_____	_____	_____

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

II) MAJOR PROGRAM REQUIREMENTS:

Complete a minimum of 40 quarter credit hours, including the following requirements:

a) Complete the following courses:

EarthSci 421:	_____	_____	_____5_____	_____
EarthSci 423:	_____	_____	_____5_____	_____
EarthSci 530:	_____	_____	_____5_____	_____
EarthSci 581:	_____	_____	_____5_____	_____
EarthSci 582:	_____	_____	_____4_____	_____
EarthSci 570:	_____	_____	_____1_____	_____

b) Complete at least 1 of the following: Earth Sci 501, 502, 550, 560:

EarthSci _____:	_____	_____	_____5_____	_____
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c) Complete at least 2 additional courses (10 credits minimum) in Earth Sciences at the 600-level or above:

EarthSci _____:	_____	_____	_____	_____
EarthSci _____:	_____	_____	_____	_____

**C.) EXAMPLE 4 YEAR PLANS, EARTH SCIENCES B.S.
Geological Sciences Subprogram**

Years 1 & 2 -- Quarters

Yr 1 Autumn	Winter	Spring
Chem 121 (GEC) 5 cr. Math 151 (GEC) 5 cr. Physics 131 5 cr. ASC Survey 1 cr. Total = 16 cr.	Chem 122 5 cr. Math 152 (GEC) 5 cr. Physics 132 5 cr. Total = 15 cr.	Writing 1 (GEC) 5 cr. Bio 113 (GEC) 5 cr. Math 153 5 cr. Total = 15 cr.
Yr 2 Autumn	Winter	Spring
Writing 2 (GEC) 5 cr. Earth Sci Prep 1 5 cr. GEC elective 5 cr. Total = 15 cr.	Earth Sci Prep 2 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. Earth Sci Prep 3 5 cr. Total = 15 cr.

Years 3 & 4 – Semesters

Yr 3 Autumn	Spring	Summer
GE elective 3 cr. GE elective 3 cr. Earth Sci 4421 (7 weeks) 3 cr. Earth Sci 4423 (7 weeks) 3 cr. Earth Sci Prep 4 3 cr. Total = 15 cr.	GE elective 3 cr. Earth Sci 4530 4 cr. Earth Sci 4501 4 cr. GE elective 3 cr. Total = 14 cr.	Earth Sci 5189.01 3 cr. Earth Sci 5189.02 3 cr. (Note: courses only offered in summer in Utah.) Total = 6 cr.
Yr 4 Autumn	Spring	
GE elective 3 cr. Earth Sci 4502 4 cr. Earth Sci elective 1 3 cr. GE elective 3 cr. GE elective 3 cr. Total = 16 cr.	GE elective 3 cr. GE elective 3 cr. GE elective 3 cr. Earth Sci elective 2 3 cr. Earth Sci 4999 or 4999H 1 cr. Total = 13 cr.	

91 quarter credits (~60 semester units) + 64 semester units = 124 semester units total.

31 credits of Earth Science upper-level coursework.

Requirements of both quarter-version and semester-version of major met.

All requirements of quarter-version GEC met.

Years 1 – 4 in semesters

Yr 1	Autumn	Spring	
GE elective	3 cr.	GE elective	3 cr.
Math 1151(GE)	5 cr.	Math 1152	5 cr.
Chem 1210	5 cr.	Chem 1220	5 cr.
ASC Survey	1 cr.		
Total = 17 cr.		Total = 13 cr.	
Yr 2	Autumn	Spring	
GE elective	3 cr.	Earth Sci prep 1	3 cr.
Bio 1113 (GE)	4 cr.	GE elective	3 cr.
Earth Sci 1121 (GE)	4 cr.	Earth Sci 1122 (GE)	4 cr.
Physics 1250	5 cr.	Earth Sci 2245 (GE)	4 cr.
Total = 16 cr.		Total = 14 cr.	
Yr 3	Autumn	Spring	Summer
GE elective	3 cr.	GE elective	3 cr.
GE elective	3 cr.	GE elective	3 cr.
Earth Sci 4421 (7 weeks)	3 cr.	Earth Sci 4501	4 cr.
Earth Sci 4423 (7 weeks)	3 cr.	Earth Sci 4530	4 cr.
Earth Sci prep 2	3 cr.		
Total = 15 cr		Total = 14 cr.	Total = 6 cr.
Yr 4	Autumn	Spring	
GE elective	3 cr.	Earth Sci elective 2	3 cr.
GE elective	3 cr.	Earth Sci 4999 or 4999H	1 cr.
Earth Sci 4502	4 cr.	GE elective	3 cr.
Earth Sci elective 1	3 cr.	GE elective	3 cr.
		GE elective	3 cr.
Total = 13 cr.		Total = 13 cr.	

Total = 121 semester credits, with all semester-version GE requirements met and 31 semester credits of upper-level Earth Science coursework to meet requirements of the major.

2) EARTH SYSTEM SCIENCE subprogram (transcriptable):

A) PREPARATION FOR THE MAJOR

Quarter course #	Quarter course name	Quarter credit hours	Semester course number	Semester course name	Semester credit hours
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
Math 152	Calculus 2	5	Math 1152	Calculus 2	5
Math 153	Calculus 3	5			
Bio 113	Energy Transfer and Development	5	Bio 1113	Energy Transfer and Development	4
Physics 131	Particles and Motion	5	Physics 1250	Physics 1	5
Physics 132	Electricity and Magnetism	5			
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
Minimum of 4 additional courses in sciences and mathematics, chosen from: Chem 123 and above Math 254 and above Physics 133 and above EEOB 400 (Evolution) Geog 520 (Climatology) Geog 580 (Cartography) Other options require approval by an SES advisor.		20	Complete either Chem 1220 or Physics 1251		5
			Minimum of 2 additional courses in sciences and mathematics, chosen from: Chem 1220 and above Math 2153 and above Physics 1251 and above EEOB 3310 (Evolution) Geog 5900 (Climatology) Geog 5200 (Cartography) Other options require approval by an SES advisor.		10

Total quarter hours in Preparation for the major	75	Total semester hours in Preparation for the major	51
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 REQUIREMENTS AND ADVISING SHEETS

Semester course number	Semester course name	Semester credit hours	Prereqs.
Complete a minimum of 30 semester credit hours, including the following requirements:			
a) Complete the following courses:			
Earth Sci 4450	Water, Ice and Energy in the Earth System	3	Earth Sci 1100 or 1121 or Geog 3901 or 3900 or 5900; or permission of instructor
Earth Sci 4502	Stratigraphy and Sedimentology	4	Earth Sci 1121 & 1122
Earth Sci 5206	Advanced Oceanography	3	Earth Sci 1100 or 1105 or 1121 or graduate standing or permission of instructor
Earth Sci 5621	Introduction to Geochemistry	3	Rank 4 standing in Earth Sci or related field; Chem 1220 or above or permission of instructor
Earth Sci 4999/4999H	Undergraduate Research for Thesis in Earth Sciences	1	Rank 4 standing in Earth Sci & permission of instructor

b) Complete each of the following 3 requirements:			
1) Complete at least 3 semester credits of Internship, Research, and/or Field Experience from one or a combination of the following:		3	Earth Sci 5191: Rank 3 or above & permission of instructor Earth Sci 4998/4998H: Permission of instructor (and Honors Program for 4998H) Field course: Varies; minimum is Earth Sci 1100 or 1121
Earth Sci 5191	Internship in the Earth Sciences		
Earth Sci 4998 or 4998H	Undergraduate Research in the Earth Sciences		
Earth Sci 5XXX	An approved field course (e.g., Earth Sci 5602.02, 5670, 5189.01)		
2) Complete at least 2 Earth Sci courses (minimum of 6 semester credits) at the 4000-level or above (Note: Earth Sci 5580, 5584, and 5189.03, 5189.04, 5189.05, 5189.06 cannot be used to satisfy B.S. requirements)		6	Varies
3) Complete at least 2 courses (minimum of 6 semester credits) from outside Earth Sciences, chosen from the following: (Other courses require approval by an Earth Sciences advisor)		6	
Geog 3900	Global Climate Change: Causes and Consequences	3	

Geog 3901	Global Climate and Environmental Change	3	
Geog 3980	Biogeography: An Introduction to Life on Earth	3	
Geog 5900 (if not used to satisfy Preparation of the Major)	Climatology	3	
Geog 5801	Environmental Conservation	3	
Geog 5802	Globalization and Environment	3	
Geog 5220	Fundamentals of Geographic Information Systems	3	
Geog 5223	Design and Implementation of GIS	3	Geog 5220
ATMOSSC 2940	Basic Meteorology	3	Math 1151 and Physics 1250
EEOB 4950	Field Ecology	2	Rank 3 standing or above; 12 semester hours of biological sciences or permission of instructor
EEOB 3310	Evolution	4	Bio 1114 or 1114H
EEOB 5420	Aquatic Ecosystems: Ecology of Inland Waters	1.5	EEOB 3410

EEOB 3410	Ecology	4	Bio 1114 or 1114H
AEDECON 2001	Principles of Food and Resource Economics	3	
AEDECON 4310	Environmental and Natural Resource Economics	3	AEDE 2001 or Econ 2001
AEDECON 4320/ INTSTDS 4320	Energy, the Environment, and the Economy	3	AEDE 2001 or Econ 2001
ENVENG 3200	Fundamentals of Environmental Engineering	3	Chem 1210
ENVENG 2100	Environmental Engineering Analytical Methods	3	Chem 1210 and 1220
CIVILEN 5001	Fundamentals of Geographic Information Systems	4	CE 2050 or written permission of instructor.
ENR 3000	Soil Science	3	
ENR 3280	Water Quality Management	2	
ENR 4260	Soil Resource Management	3	ENR 3000 or permission of instructor

ENR 2367	Communicating Contemporary Environmental and Natural Resource Issues	3	
INTSTDS 4800	Cultural Diplomacy	3	Rank 2 or above, or permission of instructor
CHEM 2210 or 2210H	Analytical Chemistry 1: Quantitative Analysis	5	Chem 1220 and Math 1151

ADVISING SHEETS: The next 2 pages contain the semester advising sheet for the Earth System Science subprogram of the Earth Sciences B.S. Because this is a new subprogram, there is no quarter advising sheet.

SEMESTER ADVISING SHEET

STUDENT NAME: _____ ID _____

EARTH SCIENCES B.S. –EARTH SYSTEM SCIENCE SUBPROGRAM

Semester (Au, Sp, Su) Year Credits Grade

I) PREPARATION FOR THE MAJOR:

a) Complete the following courses:

EarthSci 1121:	_____	_____	4	_____
EarthSci 1122:	_____	_____	4	_____
EarthSci 2245:	_____	_____	4	_____
Biology 1113:	_____	_____	4	_____
Chemistry 1210:	_____	_____	5	_____
Physics 1250:	_____	_____	5	_____
Math 1151:	_____	_____	5	_____
Math 1152:	_____	_____	5	_____

b) Complete either Chemistry 1220 or Physics 1251:

Chemistry 1220 or Physics 1251	_____	_____	5	_____
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c) Complete a minimum of 2 additional courses in the sciences and mathematics, chosen from Chem 1220 (If not used to satisfy Requirement “b”) and above; Math 2153 and above; Physics 1251 (if not used to satisfy Requirement “b”) and above; EEOB 3310; Geog 5900 and 5200. Other options require approval by an SES advisor.

_____:	_____	_____	_____	_____
_____:	_____	_____	_____	_____

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

II) MAJOR PROGRAM REQUIREMENTS:

Complete a minimum of 30 semester credit hours, including the following requirements:

a) Complete the following courses:

EarthSci 4450:	_____	_____	3	_____
EarthSci 4502:	_____	_____	4	_____
EarthSci 5206:	_____	_____	3	_____
EarthSci 5621:	_____	_____	3	_____
EarthSci 4999 or 4999H:	_____	_____	1	_____

b) Complete at least 3 credits from Earth Sci 5191 (Internship), Earth Sci 4998 or 4998H, or an approved field course (a combination of courses is acceptable):

EarthSci _____:	_____	_____	_____	_____
EarthSci _____:	_____	_____	_____	_____

c) Complete at least 2 additional courses (6 credits minimum) in Earth Sciences at the 4000-level or above. (Note: Earth Sci 5580, 5584, and 5189.03, 5189.04, 5189.05, 5189.06 cannot be used to satisfy B.S. requirements).

EarthSci _____:	_____	_____	_____	_____
EarthSci _____:	_____	_____	_____	_____

d) Complete at least 2 additional courses (6 credits minimum) from outside Earth Sciences, chosen from Geog 3900, Geog 3901, Geog 3980, Geog 5900 (if not used to satisfy Preparation for the Major), Geog 5801, Geog 5802, Geog 5220, Geog 5223, ATMOSCC 2940, EEOB 4950, EEOB 3310, EEOB 5420, EEOB 3410, AEDECON 2001, AEDECON 4310, AEDECON 4320, ENVENG 3200, ENVENG 2100, CIVILEN 5001, ENR 3000, ENR 3280, ENR 4260, ENR 2367, INTSTDS 4800, INTSTDS 4320, Chem 2110 (other courses require approval by an Earth Sciences advisor):

_____:	_____	_____	_____	_____
_____:	_____	_____	_____	_____

**C.) EXAMPLE 4 YEAR PLANS, EARTH SCIENCES B.S.
Earth System Science Subprogram**

Years 1 & 2 -- Quarters

Yr 1 Autumn	Winter	Spring
Chem 121 (GEC) 5 cr. Math 151 (GEC) 5 cr. Physics 131 5 cr. ASC Survey 1 cr. Total = 16 cr.	Chem 122 5 cr. Math 152 (GEC) 5 cr. Physics 132 5 cr. Total = 15 cr.	Writing 1 (GEC) 5 cr. Bio 113 (GEC) 5 cr. Math 153 5 cr. Total = 15 cr.
Yr 2 Autumn	Winter	Spring
Writing 2 (GEC) 5 cr. Earth Sci Prep 1 5 cr. GEC elective 5 cr. Total = 15 cr.	Earth Sci Prep 2 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. Earth Sci Prep 3 5 cr. Total = 15 cr.

Years 3 & 4 – Semesters

Yr 3 Autumn	Spring
GE elective 3 cr. GE elective 3 cr. Earth Sci 4450 3 cr. Earth Sci 4502 4 cr. Earth Sci Prep 4 3 cr. Total = 16 cr.	GE elective 3 cr. Non-Earth Sci elective 1 3 cr. Earth Sci 5206 3 cr. Earth Sci elective 1 3 cr. GE elective 3 cr. GE elective 3 cr. Total = 18 cr.
Yr 4 Autumn	Spring
Earth Sci 5621 3 cr. Earth Sci elective 2 4 cr. Research or Internship 3 cr. GE elective 3 cr. GE elective 3 cr. Total = 16 cr.	GE elective 3 cr. GE elective 3 cr. GE elective 3 cr. Non-Earth Sci elective 2 3 cr. Earth Sci 4999 or 4999H 1 cr. Total = 13 cr.

91 quarter credits (~60 semester units) + 63 semester units = 123 semester units total.
30 credits of coursework in Earth Sciences and other approved areas to meet requirements of semester-version of major.
All requirements of quarter-version GEC met.

Years 1 – 4 in semesters

Yr 1	Autumn	Spring
GE elective	3 cr.	GE elective 3 cr.
Math 1151(GE)	5 cr.	Math 1152 5 cr.
Chem 1210	5 cr.	Chem 1220 5 cr.
ASC Survey	1 cr.	
Total = 17 cr.		Total = 13 cr.
Yr 2	Autumn	Spring
GE elective	3 cr.	Earth Sci prep 1 3 cr.
Bio 1113 (GE)	4 cr.	GE elective 3 cr.
Earth Sci 1121 (GE)	4 cr.	Earth Sci 1122 (GE) 4 cr.
Physics 1250	5 cr.	Earth Sci 2245 (GE) 4 cr.
Total = 16 cr.		Total = 14 cr.
Yr 3	Autumn	Spring
GE elective	3 cr.	GE elective 3 cr.
GE elective	3 cr.	GE elective 3 cr.
Earth Sci 4450	3 cr.	Earth Sci 5206 3 cr.
Earth Sci 4502	4 cr.	Earth Sci elective 1 3 cr.
Earth Sci prep 2	3 cr.	Non-Earth Sci elective 1 3 cr.
Total = 16 cr		Total = 15 cr.
Yr 4	Autumn	Spring
GE elective	3 cr.	Non-Earth Sci elective 2 3 cr.
GE elective	3 cr.	Earth Sci 4999 or 4999H 1 cr.
Earth Sci 5621	3 cr.	GE elective 3 cr.
Earth Sci elective 2	4 cr.	GE elective 3 cr.
Research or Internship	3 cr.	GE elective 3 cr.
Total = 16 cr.		Free elective 1 cr.
		Total = 14 cr.

Total = 121 semester credits, with all semester-version GE requirements met and 30 semester credits of coursework in Earth Sciences and other approved areas to meet requirements of the major.

3) GEOPHYSICS subprogram (transcriptable):

A) PREPARATION FOR THE MAJOR

Quarter course #	Quarter course name	Quarter credit hours	Semester course number	Semester course name	Semester credit hours
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
Math 152	Calculus 2	5	Math 1152	Calculus 2	5
Math 153	Calculus 3	5			
Bio 113	Energy Transfer and Development	5	Bio 1113	Energy Transfer and Development	4
Physics 131	Particles and Motion	5	Physics 1250	Physics 1	5
Physics 132	Electricity and Magnetism	5			
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
Minimum of 4 additional courses in sciences and mathematics, chosen from: Chem 123 and above Math 254 and above Physics 133 and above EEOB 400 (Evolution) Geog 520 (Climatology) Geog 580 (Cartography) Other options require approval by an SES advisor.		20	Complete either Chem 1220 or Physics 1251		5
			Minimum of 2 additional courses in sciences and mathematics, chosen from: Chem 1220 and above Math 2153 and above Physics 1251 and above EEOB 3310 (Evolution) Geog 5900 (Climatology) Geog 5200 (Cartography) Other options require approval by an SES advisor.		10

Total quarter hours in Preparation for the major	75	Total semester hours in Preparation for the major	51
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 REQUIREMENTS AND ADVISING SHEETS

Semester course number	Semester course name	Semester credit hours	Prereqs.
Complete a minimum of 31 semester credit hours in Earth Sciences, including the following requirements:			
a) Complete the following courses (13 semester credit hours):			
Earth Sci 4421	Earth Materials	3	Chem 1210
Earth Sci 4423	Intro Petrology	3	Earth Sci 1121 & 4421
Earth Sci 4560	Applied Geophysics	3	Earth Sci 1121, Math 1251 & Physics 1250
Earth Sci 5680	Deep Earth Geophysics	3	Math 1252 and Physics 1251
Earth Sci 4998 or 4998H or 4999 or 4999H or 5191	Undergraduate Research, Undergraduate Research for Thesis, or Internship	1	Permission of instructor (Honors Program for 4998H and 4999H)

b) Complete 2 of the following courses (6-7 semester credit hours):

Earth Sci 4310	Remote Sensing in the Earth Sciences	3	Earth Sci 1121; Physics 1250; Math 1251
Earth Sci 5646	Geodynamics	3	Earth Sci 4530; Math 1252; Physics 1250; or permission of instructor.
Earth Sci 5687	Energy Geophysics	3	Earth Sci 1121; Math 1251; Physics 1250
Earth Sci 5780	Reflection Seismology	4	Earth Sci 1121; Math 1251; Physics 1250

c) Complete at least 12 semester hours, chosen from the following courses:

Earth Sci 4310 (if not used to meet Requirement “b”)	Remote Sensing in the Earth Sciences	3	Earth Sci 1121; Physics 1250 or above; Math 1251 or above.
Earth Sci 4450	Water, Ice, and Energy in the Earth System	3	Earth Sci 1100 or Earth Sci 1121, or Geog 3901 or 3900 or 5900 or permission of instructor.
Earth Sci 4501	Paleontology	4	Earth Sci 1122 and 3 cr hrs in biological sciences.
Earth Sci 4502	Stratigraphy and Sedimentation	4	Earth Sci 1121; Earth Sci 1122
Earth Sci 4530	Structural Geology	4	Earth Sci 1121; Physics 1250 or above

Earth Sci 5189.01	Field Geology I	3	Earth Sci 4423; Earth Sci 4530; and written permission of instructor.
Earth Sci 5189.02	Field Geology II	3	Earth Sci 5189.01
Earth Sci 5206	Advanced Oceanography	3	Earth Sci 1100 or Earth Sci 1105 or Earth Sci 1121 or graduate student standing or permission of instructor.
Earth Sci 5621	Introduction to Geochemistry	3	Sr standing in earth sci or related fields; Chem 1220 or above or permission of instructor.
Earth Sci 5629	Principles of Petrology	3	Sr or Grad standing in earth science or related fields, or permission of instructor.
Earth Sci 5641	Geostatistics	3	Math 1251 or above, or permission of instructor.
Earth Sci 5642	Geomathematical Analysis	3	Earth Sci 5641; and Math 1251 or above, or written permission of instructor.
Earth Sci 5646 (if not used to meet Requirement "b")	Geodynamics	3	Earth Sci 4530; Math 1252 or above; Physics 1250 or above; or permission of instructor.
Earth Sci 5650	Glaciology	4	Earth Sci 4450 or permission of the instructor.
Earth Sci 5651	Hydrogeology	4	Earth Sci 1121; Math 1252 or above
Earth Sci 5687 (if not used to meet Requirement "b")	Energy Geophysics	3	Earth Sci 1121; Math 1251 or above; Physics 1250 or above.
Earth Sci 5780 (if not used to meet Requirement "b")	Reflection Seismology	4	Earth Sci 1121; Math 1251 or above; Physics 1250 or above.

ADVISING SHEETS: The next 2 pages contain the semester advising sheet for the Geophysics subprogram of the Earth Sciences B.S. Because this is a new subprogram, there is no quarter advising sheet.

SEMESTER ADVISING SHEET

STUDENT NAME: _____ ID _____

EARTH SCIENCES B.S. –GEOPHYSICS SUBPROGRAM

Semester (Au, Sp, Su) Year Credits Grade

I) PREPARATION FOR THE MAJOR:

a) Complete the following courses:

EarthSci 1121:	_____	_____	4	_____
EarthSci 1122:	_____	_____	4	_____
EarthSci 2245:	_____	_____	4	_____
Biology 1113:	_____	_____	4	_____
Chemistry 1210:	_____	_____	5	_____
Physics 1250:	_____	_____	5	_____
Math 1151:	_____	_____	5	_____
Math 1152:	_____	_____	5	_____

b) Complete either Chemistry 1220 or Physics 1251:

Chemistry 1220 or Physics 1251	_____	_____	5	_____
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c) Complete a minimum of 2 additional courses in the sciences and mathematics, chosen from Chem 1220 (if not used to satisfy Requirement “b”) and above; Math 2153 and above; Physics 1251 (if not used to satisfy Requirement “b”) and above; EEOB 3310; Geog 5900 and 5200. Other options require approval by an SES advisor.

_____:	_____	_____	_____	_____
_____:	_____	_____	_____	_____

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

II) MAJOR PROGRAM REQUIREMENTS:

Complete a minimum of 31 semester credit hours in Earth Sciences, including the following requirements:

a) Complete the following courses (13 credit hours):

EarthSci 4421:	_____	_____	3	_____
EarthSci 4423:	_____	_____	3	_____
EarthSci:4560:	_____	_____	3	_____
EarthSci 5680:	_____	_____	3	_____
Research or Internship (Earth Sci 4998, 4998H, 4999, 4999H, or 5191)	_____	_____	1	_____

b) Complete 2 of the following 4 courses (6-7 credit hours):

EarthSci 4310 :	_____	_____	3	_____
EarthSci 5646:	_____	_____	3	_____
EarthSci 5687:	_____	_____	3	_____
EarthSci 5780:	_____	_____	4	_____

c) Complete at least 12 additional credit hours, chosen from the following courses:

Earth Sci 4310 (if not used to meet Requirement “b”), Earth Sci 4450, Earth Sci 4501, Earth Sci 4502, Earth Sci 4530, Earth Sci 5189.01, Earth Sci 5189.02, Earth Sci 5206, Earth Sci 5621, Earth Sci 5629, Earth Sci 5641, Earth Sci 5642, Earth Sci 5646 (if not used to meet Requirement “b”), Earth Sci 5650, Earth Sci 5651, Earth Sci 5687 (if not used to meet Requirement “b”), Earth Sci 5780 (if not used to meet Requirement “b”)

EarthSci _____:	_____	_____	_____	_____
EarthSci _____:	_____	_____	_____	_____
EarthSci _____:	_____	_____	_____	_____
EarthSci _____:	_____	_____	_____	_____

**C.) EXAMPLE 4 YEAR PLANS, EARTH SCIENCES B.S.
Geophysics Subprogram**

Years 1 & 2 -- Quarters

Yr 1 Autumn	Winter	Spring
Chem 121 (GEC) 5 cr. Math 151 (GEC) 5 cr. Physics 131 5 cr. ASC Survey 1 cr. Total = 16 cr.	Chem 122 5 cr. Math 152 (GEC) 5 cr. Physics 132 5 cr. Total = 15 cr.	Writing 1 (GEC) 5 cr. Bio 113 (GEC) 5 cr. Math 153 5 cr. Total = 15 cr.
Yr 2 Autumn	Winter	Spring
Writing 2 (GEC) 5 cr. Earth Sci Prep 1 5 cr. GEC elective 5 cr. Total = 15 cr.	Earth Sci Prep 2 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. Earth Sci Prep 3 5 cr. Total = 15 cr.

Years 3 & 4 – Semesters

Yr 3 Autumn	Spring
GE elective 3 cr. GE elective 3 cr. Earth Sci 4421 (7 weeks) 3 cr. Earth Sci 4423 (7 weeks) 3 cr. Earth Sci Prep 4 3 cr. Total = 15 cr.	GE elective 3 cr. Earth Sci elective b-1 3 cr. Earth Sci 4560 3 cr. Earth Sci elective c-1 3 cr. GE elective 3 cr. GE elective 3 cr. Total = 18 cr.
Yr 4 Autumn	Spring
Earth Sci 5680 3 cr. Earth Sci elective b-2 3 cr. Research or Internship 1 cr. Earth Sci elective c-2 3 cr. GE elective 3 cr. GE elective 3 cr. Total = 16 cr.	GE elective 3 cr. GE elective 3 cr. GE elective 3 cr. Earth Sci elective c-3 3 cr. Earth Sci elective c-4 3 cr. Total = 15 cr.

91 quarter credits (~60 semester units) + 64 semester units = 124 semester units total.

31 credits of Earth Science upper-level coursework.

Requirements of semester-version of major met.

All requirements of quarter-version GEC met.

Years 1 – 4 in semesters

Yr 1	Autumn		Spring
GE elective	3 cr.	GE elective	3 cr.
Math 1151(GE)	5 cr.	Math 1152	5 cr.
Chem 1210	5 cr.	Chem 1220	5 cr.
ASC Survey	1 cr.		
Total = 17 cr.		Total = 13 cr.	
Yr 2	Autumn		Spring
GE elective	3 cr.	Earth Sci prep 1	3 cr.
Bio 1113 (GE)	4 cr.	GE elective	3 cr.
Earth Sci 1121 (GE)	4 cr.	Earth Sci 1122 (GE)	4 cr.
Physics 1250	5 cr.	Earth Sci 2245 (GE)	4 cr.
Total = 16 cr.		Total = 14 cr.	
Yr 3	Autumn		Spring
GE elective	3 cr.	GE elective	3 cr.
GE elective	3 cr.	GE elective	3 cr.
Earth Sci 4421 (7 weeks)	3 cr.	Earth Sci 4560	3 cr.
Earth Sci 4423 (7 weeks)	3 cr.	Earth Sci elective b-1	3 cr.
Earth Sci prep 2	3 cr.	Earth Sci elective c-1	3 cr.
Total = 15 cr.		Total = 15 cr.	
Yr 4	Autumn		Spring
GE elective	3 cr.	Earth Sci elective c-3	3 cr.
GE elective	3 cr.	Earth Sci elective c-4	3 cr.
Earth Sci 5680	3 cr.	GE elective	3 cr.
Earth Sci elective b-2	3 cr.	GE elective	3 cr.
Earth Sci elective c-2	3 cr.	GE elective	3 cr.
Research or Internship	1 cr.		
Total = 16 cr.		Total = 15 cr.	

Total = 121 semester credits, with all semester-version GE requirements met and 31 semester credits of upper-level Earth Science coursework to meet requirements of the major.

4) PETROLEUM GEOLOGY & GEOPHYSICS subprogram (transcriptable):

A) PREPARATION FOR THE MAJOR

Quarter course #	Quarter course name	Quarter credit hours	Semester course number	Semester course name	Semester credit hours
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
Math 152	Calculus 2	5	Math 1152	Calculus 2	5
Math 153	Calculus 3	5			
Bio 113	Energy Transfer and Development	5	Bio 1113	Energy Transfer and Development	4
Physics 131	Particles and Motion	5	Physics 1250	Physics 1	5
Physics 132	Electricity and Magnetism	5			
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
Minimum of 4 additional courses in sciences and mathematics, chosen from: Chem 123 and above Math 254 and above Physics 133 and above EEOB 400 (Evolution) Geog 520 (Climatology) Geog 580 (Cartography) Other options require approval by an SES advisor.		20	Complete either Chem 1220 or Physics 1251		5
			Minimum of 2 additional courses in sciences and mathematics, chosen from: Chem 1220 and above Math 2153 and above Physics 1251 and above EEOB 3310 (Evolution) Geog 5900 (Climatology) Geog 5200 (Cartography) Other options require approval by an SES advisor.		10

Total quarter hours in Preparation for the major	75	Total semester hours in Preparation for the major	51
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 REQUIREMENTS AND ADVISING SHEETS

Semester course number	Semester course name	Semester credit hours	Prereqs.
Complete a minimum of 30 semester credit hours in Earth Sciences, including the following requirements:			
a) Complete the following courses (18 semester credit hours):			
Earth Sci 4421	Earth Materials	3	Chem 1210
Earth Sci 4423	Intro Petrology	3	Earth Sci 1121 & 4421
Earth Sci 4502	Stratigraphy and Sedimentology	4	Earth Sci 1121 & 1122
Earth Sci 4530	Structural Geology	4	Earth Sci 1121 & Physics 1250
Earth Sci 5661	Petroleum Geology	4	Earth Sci 4423 & 4502; or written permission of instructor

b) Complete 1 of the following courses (3-4 semester credit hours):			
Earth Sci 5687	Energy Geophysics	3	Earth Sci 1121; Math 1251; Physics 1250
Earth Sci 5780	Reflection Seismology	4	Earth Sci 1121; Math 1251; Physics 1250
c) Complete Earth Sci 5189.01, Earth Sci 5189.02, and at least 1 other course in List A (below), OR Complete at least 3 courses from List A. (minimum of 9 semester credit hours)			
Earth Sci 5189.01	Field Geology 1	3	Earth Sci 4423 & 4530 & permission of instructor
Earth Sci 5189.02	Field Geology 2	3	Earth Sci 5189.02
List A (electives)			
Earth Sci 4310	Remote Sensing in the Earth Sciences	3	Earth Sci 1121; Physics 1250 or above; Math 1251 or above.
Earth Sci 4560	Applied Geophysics	3	Earth Sci 1121, Math 1251 & Physics 1250
Earth Sci 5604	Sequence Stratigraphy	3	Earth Sci 4502
Earth Sci 5641	Geostatistics	3	Math 1251 or above, or permission of instructor.
Earth Sci 5642	Geomathematical Analysis	3	Earth Sci 5641; and Math 1251 or above, or written permission of instructor.
Earth Sci 5646	Geodynamics	3	Earth Sci 4530; Math 1252 or above; Physics 1250 or above; or permission of instructor.

Earth Sci 5651	Hydrogeology	4	Earth Sci 1121; Math 1252 or above
Earth Sci 5687 (if not used to meet Requirement "b")	Energy Geophysics	3	Earth Sci 1121; Math 1251 or above; Physics 1250 or above.
Earth Sci 5780 (if not used to meet Requirement "b")	Reflection Seismology	4	Earth Sci 1121; Math 1251 or above; Physics 1250 or above.
Earth Sci 5751	Quantitative Groundwater Flow Modeling	4	Earth Sci 5651
Earth Sci 5781	Gravity Exploration	3	Earth Sci 5687 or written permission of instructor
Earth Sci 5782	Magnetic Exploration	3	Earth Sci 5687 or written permission of instructor
Geod Sci 5781	Geodesy and Geodynamics	3	Permission of instructor.
Math 2415	Ordinary and Partial Differential Equations	3	Math 2568
Math 2568	Linear Algebra	3	Math 2153

ADVISING SHEETS: The next 2 pages contain the semester advising sheet for the Petroleum Geology and Geophysics subprogram of the Earth Sciences B.S. Because this is a new subprogram, there is no quarter advising sheet.

SEMESTER ADVISING SHEET

STUDENT NAME: _____ ID _____

EARTH SCIENCES B.S. –PETROLEUM GEOLOGY & GEOPHYSICS SUBPROGRAM

Semester (Au, Sp, Su) Year Credits Grade

I) PREPARATION FOR THE MAJOR:

a) Complete the following courses:

EarthSci 1121:	_____	_____	4	_____
EarthSci 1122:	_____	_____	4	_____
EarthSci 2245:	_____	_____	4	_____
Biology 1113:	_____	_____	4	_____
Chemistry 1210:	_____	_____	5	_____
Physics 1250:	_____	_____	5	_____
Math 1151:	_____	_____	5	_____
Math 1152:	_____	_____	5	_____

b) Complete either Chemistry 1220 or Physics 1251:

Chemistry 1220 or Physics 1251	_____	_____	5	_____
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c) Complete a minimum of 2 additional courses in the sciences and mathematics, chosen from Chem 1220 (if not used to satisfy Requirement “b”) and above; Math 2153 and above; Physics 1251 (if not used to satisfy Requirement “b”) and above; EEOB 3310; Geog 5900 and 5200. Other options require approval by an SES advisor.

_____:	_____	_____	_____	_____
_____:	_____	_____	_____	_____

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

II) MAJOR PROGRAM REQUIREMENTS:

Complete a minimum of 30 semester credit hours in Earth Sciences, including the following requirements:

a) Complete the following courses (18 credit hours):

EarthSci 4421: _____ _____ 3 _____
EarthSci 4423: _____ _____ 3 _____
EarthSci:4502: _____ _____ 4 _____
EarthSci 4530: _____ _____ 4 _____
EarthSci:5661: _____ _____ 4 _____

b) Complete 1 of the following 2 courses (3-4 credit hours):

EarthSci 5687: _____ _____ 3 _____
EarthSci 5780: _____ _____ 4 _____

**c) Complete Earth Sci 5189.01 and 5189.02 and at least 1 course from List A (minimum of 9 credit hours)
OR**

Complete at least 3 courses (minimum of 9 credit hours) from List A:

EarthSci 5189.01: _____ _____ 3 _____
EarthSci 5189.02: _____ _____ 3 _____

List A: Earth Sci 4310, Earth Sci 4560, Earth Sci 5604, Earth Sci 5641, Earth Sci 5642, Earth Sci 5646, Earth Sci 5651, Earth Sci 5687 (if not used to meet Requirement “b”), Earth Sci 5780 (if not used to meet Requirement “b”), Earth Sci 5751, Earth Sci 5781, Earth Sci 5782, Geod Sci 5781, Math 2415, Math 2568

EarthSci _____: _____ _____ _____
EarthSci _____: _____ _____ _____
EarthSci _____: _____ _____ _____
EarthSci _____: _____ _____ _____
_____: _____ _____ _____
_____: _____ _____ _____
_____: _____ _____ _____

**C.) EXAMPLE 4 YEAR PLANS, EARTH SCIENCES B.S.
Petroleum Geology & Geophysics Subprogram**

Years 1 & 2 -- Quarters

Yr 1 Autumn	Winter	Spring
Chem 121 (GEC) 5 cr. Math 151 (GEC) 5 cr. Physics 131 5 cr. ASC Survey 1 cr. Total = 16 cr.	Chem 122 5 cr. Math 152 (GEC) 5 cr. Physics 132 5 cr. Total = 15 cr.	Writing 1 (GEC) 5 cr. Bio 113 (GEC) 5 cr. Math 153 5 cr. Total = 15 cr.
Yr 2 Autumn	Winter	Spring
Writing 2 (GEC) 5 cr. Earth Sci Prep 1 5 cr. GEC elective 5 cr. Total = 15 cr.	Earth Sci Prep 2 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. Earth Sci Prep 3 5 cr. Total = 15 cr.

Years 3 & 4 – Semesters

Yr 3 Autumn	Spring
GE elective 3 cr. GE elective 3 cr. Earth Sci 4421 (7 weeks) 3 cr. Earth Sci 4423 (7 weeks) 3 cr. Earth Sci Prep 4 3 cr. Total = 15 cr.	GE elective 3 cr. Earth Sci elective b 3 cr. Earth Sci 4530 4 cr. GE elective 3 cr. GE elective 3 cr. Total = 16 cr.
Yr 4 Autumn	Spring
Earth Sci 4502 4 cr. Earth Sci elective c-1 3 cr. Earth Sci elective c-2 3 cr. GE elective 3 cr. GE elective 3 cr. Total = 16 cr.	GE elective 3 cr. GE elective 3 cr. GE elective 3 cr. Earth Sci 5661 4 cr. Earth Sci elective c-3 3 cr. Total = 15 cr.

91 quarter credits (~60 semester units) + 62 semester units = 122 semester units total.

30 credits of Earth Science upper-level coursework.

Requirements of semester-version of major met.

All requirements of quarter-version GEC met.

Years 1 – 4 in semesters

Yr 1	Autumn	Spring
GE elective	3 cr.	GE elective 3 cr.
Math 1151(GE)	5 cr.	Math 1152 5 cr.
Chem 1210	5 cr.	Chem 1220 5 cr.
ASC Survey	1 cr.	
Total = 17 cr.		Total = 13 cr.
Yr 2	Autumn	Spring
GE elective	3 cr.	Earth Sci prep 1 3 cr.
Bio 1113 (GE)	4 cr.	GE elective 3 cr.
Earth Sci 1121 (GE)	4 cr.	Earth Sci 1122 (GE) 4 cr.
Physics 1250	5 cr.	Earth Sci 2245 (GE) 4 cr.
Total = 16 cr.		Total = 14 cr.
Yr 3	Autumn	Spring
GE elective	3 cr.	GE elective 3 cr.
GE elective	3 cr.	GE elective 3 cr.
Earth Sci 4421 (7 weeks)	3 cr.	Earth Sci 4530 4 cr.
Earth Sci 4423 (7 weeks)	3 cr.	Earth Sci elective b 3 cr.
Earth Sci prep 2	3 cr.	Earth Sci elective c-1 3 cr.
Total = 15 cr		Total = 16 cr.
Yr 4	Autumn	Spring
GE elective	3 cr.	Earth Sci elective c-3 3 cr.
GE elective	3 cr.	Earth Sci 5661 4 cr.
Earth Sci 4502	4 cr.	GE elective 3 cr.
Earth Sci elective c-2	3 cr.	GE elective 3 cr.
Free elective	1 cr.	GE elective 3 cr.
Total = 14 cr.		Total = 16 cr.

Total = 121 semester credits, with all semester-version GE requirements met and 30 semester credits of upper-level Earth Science coursework to meet requirements of the major.

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 few of our courses are contained in sequences, and because most of our courses are converting on a 1-to-1 basis.

Students who have declared the major, but who have only partially completed the Preparation for the Major at the time of conversion, will be expected to complete 4 elective courses within the Preparation for the Major (i.e., the requirement under quarters). However, SES advisors will waive the 4th elective course if the student's progress is being delayed by that requirement. Because Earth Sci 121 and Earth Sci 122 are converting directly to Earth Sci 1121 and 1122, respectively, we do not see a need for any bridge courses in Earth Sciences. For students who have partially completed the Math, Chemistry, or Physics requirements at the time of conversion, our students will rely on the bridge courses developed by those departments.

The Earth Science courses presently required for our B.S. degree are converting on a 1-to-1 basis, and will be offered regularly under semesters because those courses also are included as core requirements in one or more of our semester subprograms. As a result, a student will be able to complete the quarter-version requirements using the semester-equivalent courses; alternatively, a student who began under quarters will be able to apply the quarter-equivalent required courses to the requirements of one of the new subprograms, if he/she chooses to move into one of those subprograms.

Most of the upper-level Earth Science courses that presently are available as electives in our quarter B.S. also are converting on a 1-to-1 basis. We expect the variety and frequency of offerings for these courses under semesters to be similar to the variety and frequency of these offerings in quarters; as a result, we expect students will have no difficulty meeting the requirements for upper-level electives in either the quarter-version or the semester-version of the B.S.

CURRICULAR MAP OF COURSES AVAILABLE IN EARTH SCIENCES B.S.

	Course Number	Course Title	Read/evaluate Earth Sci literature	Present Earth Sci info	Apply Earth Sci data	Apply appropriate techniques/methods	Identify Earth Sci problems, develop solutions	Apply other sciences
Earth Sciences	4194	Group Studies	I	I	I	I	I	I
Earth Sciences	4194H	Honors Group Studies	I	I	I	I	I	I
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

	Course Number	Course Title	Read/ evaluate Earth Sci literature	Present Earth Sci info	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 info	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 info	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 info	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 info	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 info	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
Geod Sci	5781	Geodesy and Geodynamics	A	A	A	A	A	A
Electives from other departments (Geog, AtmosSC, EEOB, ENR, Chem, Math, etc.)								I-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 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