BACHELOR OF SCIENCE (BS) DEGREE WITH A MAJOR IN EARTH SCIENCE

Program Learning Outcomes for the BS Degree with a Major in Earth Science

Upon completing the BS degree with a major in Earth Science, students will be able to:

1. Understand the structure and composition of the earth and planets, their evolution, and changing the Earth today.
2. Learn basic field geological measurements and recording.
3. Learn earth observations and recording outdoor scientific information.

Requirements for the BS Degree with a Major in Earth Science

For general university requirements, see Graduation Requirements (ga.rice.edu/undergraduate-students/academic-policies-procedures/graduation-requirements). Students pursuing the BS degree with a major in Earth Science must complete:

- A minimum of 20-22 courses (69-73 credit hours) depending on course selection to satisfy major requirements.
- A minimum of 129-133 credit hours to satisfy degree requirements.
- A minimum of 60 credit hours outside of major requirements.
- A minimum of 8-12 courses (28-40 credit hours, depending on course selection) taken at the 300-level or above.
- The requirements for one area of specialization (see list below).

The areas of specialization for the BS degree with a major in Earth Science are:

- Geology (p. ), or
- Geochemistry (p. ), or
- Geophysics (p. ), or
- Environmental Earth Science (p. ), or
- Self-Designed (p. 3)

The courses listed below satisfy the requirements for this major. In certain instances, courses not on this official list may be substituted upon approval of the major’s academic advisor (or official certifier). Students and their academic advisors should identify and clearly document the courses to be taken.

Summary

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>Total Credit Hours Required for the Major in Earth Science</td>
<td>68-73</td>
<td></td>
</tr>
<tr>
<td>Total Credit Hours Required for the BS Degree with a Major in Earth Science</td>
<td>129-133</td>
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</table>

Footnotes and Additional Information

* Includes coursework completed as distribution credit, FWIS, LPAP, upper-level, residency (hours taken at Rice), 60 hours outside of the major (if applicable), and any additional academic program requirements. The "hours outside of the major" requirement may include all of the above university requirements.
Areas of Specialization

To fulfill the remaining Earth Science major requirements, students must complete the requirements for one of the following areas of specialization.

Area of Specialization: Geology

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<thead>
<tr>
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<tbody>
<tr>
<td>Required Courses</td>
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</tr>
<tr>
<td>MATH 211</td>
<td>ORDINARY DIFFERENTIAL EQUATIONS AND LINEAR ALGEBRA</td>
<td>3</td>
</tr>
<tr>
<td>ESCI 390</td>
<td>GEOLOGY FIELD CAMP (at least 3 credit hours)</td>
<td>3</td>
</tr>
<tr>
<td>COMP 110 / NSCI 230</td>
<td>COMPUTATION IN SCIENCE AND ENGINEERING</td>
<td>3</td>
</tr>
<tr>
<td>ESCI 412</td>
<td>ADVANCED PETROLOGY</td>
<td>3</td>
</tr>
<tr>
<td>or ESCI 430</td>
<td>TRACE-ELEMENT AND ISOTOPE GEOCHEMISTRY FOR EARTH AND ENVIRONMENTAL SCIENCE</td>
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Elective Requirements

Group A

Select 2 from the following:

- ESCI 421: PALEOCEANOGRAPHY
- ESCI 427: SEQUENCE STRATIGRAPHY
- ESCI 431: GEOMORPHOLOGY
- ESCI 435: MECHANICS OF SEDIMENT TRANSPORT
- ESCI 504: SILICICLASTIC DEPOSITIONAL SYSTEMS
- ESCI 506: CARBONATE DEPOSITIONAL SYSTEMS
- ESCI 552: MARINE GEOLOGY SYSTEMS

Group B

Select 2 from the following:

- ESCI 410: OPTICAL MINERALOGY AND PETROGRAPHY
- ESCI 411: ADVANCED PETROLOGY II
- ESCI 418 / CEVE 418: QUANTITATIVE HYDROGEOLOGY
- ESCI 419: MATERIALS CHARACTERIZATION
- ESCI 426: INTERPRETATION OF REGIONAL 2-D SEISMIC DATA
- ESCI 429: MAGMATIC, VOLCANIC AND HYDROTHERMAL PROCESSES
- ESCI 430: TRACE-ELEMENT AND ISOTOPE GEOCHEMISTRY FOR EARTH AND ENVIRONMENTAL SCIENCE
- ESCI 472: EARTH SYSTEMS MODELING: NUMERICAL TECHNIQUES AND APPLICATIONS

Geochemistry Area of Specialization Electives

Select 2-4 courses from the following or from any ESCI course offerings at the 300-level or above:

- BIOC 211: INTERMEDIATE EXPERIMENTAL BIOSCIENCES
- CAAM 210: INTRODUCTION TO ENGINEERING COMPUTATION
- CEVE 401: CHEMISTRY FOR ENVIRONMENTAL ENGINEERING AND SCIENCE LAB
- CEVE 434 / CEVE 534: FATE AND TRANSPORT OF CONTAMINANTS IN THE ENVIRONMENT
- CEVE 550: ENVIRONMENTAL ORGANIC CHEMISTRY
- CHEM 211 & CHEM 213: ORGANIC CHEMISTRY I and ORGANIC CHEMISTRY DISCUSSION
- CHEM 212 & CHEM 214: ORGANIC CHEMISTRY II and ORGANIC CHEM DISCUSSION II
- CHEM 415: CHEMICAL KINETICS AND DYNAMICS
- CHEM 495: TRANSITION METAL CHEMISTRY
- COMP 110 / NSCI 230: COMPUTATION IN SCIENCE AND ENGINEERING
- EBIO 202: INTRODUCTORY BIOLOGY II
- MATH 212: MULTIVARIABLE CALCULUS

Total Credit Hours: 24

Area of Specialization: Geochemistry

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<tr>
<td>Required Courses</td>
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<td></td>
</tr>
<tr>
<td>BIOC 201</td>
<td>INTRODUCTORY BIOLOGY</td>
<td>3</td>
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Area of Specialization: Geophysics

Courses chosen from the list of ESCI course offerings must be 3 credit hours or more.
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<tr>
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<tr>
<td>ESCI 391</td>
<td>EARTH SCIENCE FIELD EXPERIENCE (at least 3 credit hours)</td>
<td>3</td>
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<tr>
<td>MATH 211</td>
<td>ORDINARY DIFFERENTIAL EQUATIONS AND LINEAR ALGEBRA</td>
<td>3</td>
</tr>
<tr>
<td>STAT 280</td>
<td>ELEMENTARY APPLIED STATISTICS</td>
<td>4</td>
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</tbody>
</table>

**Elective Requirements**

Select 3-4 from the following with at least 2 courses (6 credit hours) taken from ESCI course offerings:

- CEVE 401 CHEMISTRY FOR ENVIRONMENTAL ENGINEERING AND SCIENCE LAB
- CEVE 406 / ENST 406 INTRODUCTION TO ENVIRONMENTAL LAW
- CEVE 412 HYDROLOGY AND WATER RESOURCES ENGINEERING
- CEVE 434 FATE AND TRANSPORT OF CONTAMINANTS IN THE ENVIRONMENT
- CHEM 211 ORGANIC CHEMISTRY I
- & CHEM 213 ORGANIC CHEMISTRY DISCUSSION
- EBIO 202 INTRODUCTORY BIOLOGY II
- ESCI 340 / EBIO 340 / ENST 340 GLOBAL BIOGEOCHEMICAL CYCLES
- ESCI 410 OPTICAL MINERALOGY AND PETROGRAPHY
- ESCI 418 QUANTITATIVE HYDROGEOLOGY
- ESCI 419 MATERIALS CHARACTERIZATION
- ESCI 421 PALEOCEANOGRAPHY
- ESCI 425 / CHEM 425 / ENST 425 ORGANIC GEOCHEMISTRY
- ESCI 426 QUANTITATIVE HYDROGEOLOGY
- ESCI 429 MAGERMATIC, VOLCANIC AND HYDROTHERMAL PROCESSES
- ESCI 431 GEOMORPHOLOGY
- ESCI 435 MECHANICS OF SEDIMENT TRANSPORT
- ESCI 442 EXPLORATION GEOPHYSICS
- ESCI 452 GIS FOR SCIENTISTS AND ENGINEERS
- ESCI 463 STRUCTURE AND EVOLUTION OF TECTONIC SYSTEMS
- ESCI 467 GEOMECHANICS
- ESCI 472 EARTH SYSTEMS MODELING: NUMERICAL TECHNIQUES AND APPLICATIONS
- ESCI 504 SILICICLASTIC DEPOSITIONAL SYSTEMS
- ESCI 506 CARBONATE DEPOSITIONAL SYSTEMS
- ESCI 540 EARTH'S ATMOSPHERE
- ESCI 552 MARINE GEOLOGY SYSTEMS
- PHYS 201 WAVES, LIGHT, AND HEAT
- PHYS 231 ELEMENTARY PHYSICS LAB

**Area of Specialization: Environmental Earth Science**

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<td>BIOC 201</td>
<td>INTRODUCTORY BIOLOGY</td>
<td>3</td>
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<tr>
<td>COMP 110 / NSCI 230</td>
<td>COMPUTATION IN SCIENCE AND ENGINEERING</td>
<td>3</td>
</tr>
<tr>
<td>or CAAM 210</td>
<td>INTRODUCTION TO ENGINEERING COMPUTATION</td>
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**Required Courses**

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<tr>
<td>COMP 110 / NSCI 230</td>
<td>COMPUTATION IN SCIENCE AND ENGINEERING</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 201</td>
<td>WAVES, LIGHT, AND HEAT</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 231</td>
<td>ELEMENTARY PHYSICS LAB</td>
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</table>

**Area of Specialization: Self-Designed**

The department recognizes the interdisciplinary nature of modern earth science and the opportunity for students to specialize in nontraditional and emerging fields. Therefore, students can design their own specialty track, normally in close consultation with one faculty member and
followed by approval from the department's undergraduate advisor. In addition to required earth science courses and related courses, these tracks will generally comprise 18 additional hours that target a coherent theme from an approved list of 300- or higher-level courses, from inside or outside the department. Interested students are expected to submit a statement of rationale by the beginning of their third year.

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**Self-Designed Electives**

Select 2 from the following:

- BIOC 201 INTRODUCTORY BIOLOGY
- CAAM 210 INTRODUCTION TO ENGINEERING COMPUTATION
- CHEM 311 PHYSICAL CHEMISTRY I
- CHEM 312 PHYSICAL CHEMISTRY II
- COMP 110/NSCI 230 ENGINEERING
- MATH 211 ORDINARY DIFFERENTIAL EQUATIONS AND LINEAR ALGEBRA
- MATH 212 MULTIVARIABLE CALCULUS
- PHYS 201 WAVES, LIGHT, AND HEAT

**Directed Electives in Self-Designed Specialization**

Students must complete a total of 6 courses at the 300-level or higher targeting a coherent theme selected with the approval of the department's undergraduate advisor.

| Total Credit Hours | 27 |

**Policies for the BS Degree with a Major in Earth Science**

**Transfer Credit**

For Rice University's policy regarding transfer credit, see Transfer Credit (ga.rice.edu/undergraduate-students/academic-policies-procedures/transfer-credit). Some departments and programs have additional restrictions on transfer credit. The Office of Academic Advising maintains the university's official list of transfer credit advisors on their website: http://oaa.rice.edu. Students are encouraged to meet with their academic program's transfer credit advisor when considering transfer credit possibilities.

**Departmental Transfer Credit Guidelines**

Students pursuing the major in Earth Science should be aware of the following departmental transfer credit guidelines:

- Requests for transfer credit will be considered by the program director (and/or the program's official transfer credit advisor) on an individual case-by-case basis.

For additional information, please see the Earth Science major page, on the Department of Earth, Environmental, and Planetary Sciences website: http://earthscience.rice.edu/academics/undergraduate-program/

**Opportunities for the BS Degree with a Major in Earth Science**

**Undergraduate Independent Research**

The department encourages, but does not require, Earth Science undergraduate majors to pursue independent supervised research in ESCI 481. This can also be carried out as part of the Earth Science Honors Thesis Program.

**Academic Honors**

The university recognizes academic excellence achieved over an undergraduate’s academic history at Rice. For information on university honors, please see Latin Honors (ga.rice.edu/undergraduate-students/honors-distinctions/university) (summa cum laude, magna cum laude, and cum laude) and Distinction in Research and Creative Work (ga.rice.edu/undergraduate-students/honors-distinctions/university). Some departments have department-specific Honors awards or designations.

**Honors Research**

Undergraduates are encouraged to embark on an undergraduate honors thesis. The purpose of the honors thesis is for students to develop and demonstrate their creative and independent research potential. Students are recommended to begin in the fall of their junior year to provide ample time for research projects to be developed, executed, and written. Students are expected to enroll in at least two semesters of the course ESCI 481, spanning their senior year. Juniors who have identified a research project and mentor can also enroll in ESCI 481. Students should sign up for ESCI 481 for 3 credits.

**Criteria for Participating in Undergraduate Honors Thesis Research**

- Strong performance in ESCI courses, in particular, ESCI 321, ESCI 322, ESCI 323, ESCI 324, and ESCI 334
- A grade of A- or better in ESCI 481
- Letter of recommendation of a faculty research mentor
- Research proposal

**Requirements for Completing an Undergraduate Honors Thesis**

**Spring Semester of Junior Year**

Each honors thesis candidate should choose a research topic, identify a faculty research advisor, and initiate independent research. The student should select a thesis committee, consisting of a faculty advisor, one member of the honors thesis committee, and one other faculty member of their choosing. Candidates are expected to turn in a preliminary written proposal (2 pages) at the end of their spring semester, accompanied by a formal application, both of which will be evaluated by the honors thesis committee for consideration of acceptance into the honors thesis program in their senior year. Required courses:

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<tr>
<td>ESCI 401</td>
<td>SEMINAR: UNDERGRADUATE HONORS THESIS</td>
<td>1</td>
</tr>
<tr>
<td>ESCI 403</td>
<td>SEMINAR: DEPARTMENT RESEARCH</td>
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</table>

And if they have research project and mentor identified, they can also take:
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<tr>
<td>ESCI 481</td>
<td>UNDERGRADUATE RESEARCH IN EARTH SCIENCE</td>
<td>3</td>
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**Fall Semester of Senior Year**

Students accepted into the honors thesis program continue to develop and refine their proposed research in concert with their research advisor and thesis committee. Students participate in meetings with other honors thesis candidates to discuss basic research protocols and philosophies, and meet independently with their chosen scientific advisor, and generate data, experiments or models. Students will give oral presentations of their research proposals in public by mid-semester, in the presence of their examining committee. At the end of the semester, students must submit final versions of their proposals, describing motivation, hypothesis, methodology, and preliminary results. The honors thesis committee will evaluate the proposals, and if approved, students can continue in the honors thesis program. Required courses:

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<td>ESCI 401</td>
<td>SEMINAR: UNDERGRADUATE HONORS THESIS</td>
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</tr>
<tr>
<td>ESCI 404</td>
<td>SEMINAR: DEPARTMENT RESEARCH</td>
<td>1</td>
</tr>
<tr>
<td>ESCI 481</td>
<td>UNDERGRADUATE RESEARCH IN EARTH SCIENCE</td>
<td>3</td>
</tr>
</tbody>
</table>

**Spring Semester of Senior Year**

Students continue and complete their research. A mid-semester progress report must be submitted to the thesis committee for feedback. At the end of the spring semester, students submit their final theses, and give public oral exit talks. To complete the honors thesis program, student theses must be approved by the honors thesis committee. Required courses:

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</table>

Further details about the program, and expectations and criteria for the thesis proposal and final thesis can be found on the Department of Earth, Environmental, and Planetary Sciences website (earthscience.rice.edu).

**Application Process**

Students must apply and be accepted to participate in the senior honors research program. The application form can be downloaded from Department of Earth, Environmental, and Planetary Sciences website (earthscience.rice.edu), and should be submitted along with a ~two page thesis proposal at the end of the spring semester of the junior year. Students will be informed of their acceptance into the honors thesis program before the start of the following fall semester.

**Other Points of Consideration**

Students who are accepted into the 'RUSP Rice Undergraduate Scholars Program' can substitute ESCI 481 courses for semesters 2 and 3 with HONS 470 and HONS 471. However, the students will have to meet all other requirements of the honors thesis set by the department.

Other expectations, conditions, and opportunities related to carrying out an Earth Science Honors Thesis can be found on the Department of Earth, Environmental, and Planetary Sciences website (earthscience.rice.edu).

For additional information, please see the Earth Science major page, on the Department of Earth, Environmental, and Planetary Sciences website: http://earthscience.rice.edu/academics/undergraduate-program/.