

# **Environmental Science Major Submittal to Faculty Senate**

**April 14, 2016**

## **This package contains:**

- I. The Environmental Science Major Proposal
- II. The Environmental Science Major Assessment Plan
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- IV. Support Letters
  - a. Provost Marie Lynn Miranda
  - b. Dean Peter Rossky, Wiess School of Natural Sciences
  - c. Janet Braam, Chair, Department of Biosciences
  - d. Richard Gordon, Chair, Department of Earth Science
  - e. Dominic Boyer, Director CENHS; Chair, ENST Faculty Steering Committee
  - f. Rob Griffin, Chair, Department of Civil and Environmental Engineering
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- V. ENST 4\*\* Letters of Commitment from Braam and Gordon

# **I. The Environmental Science Major Proposal**

## **Proposal to Transfer the Environmental Science Degree to Natural Sciences and Establish Two Stand-Alone Majors**

### **Prepared by:**

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### **Synopsis:**

This proposal will transfer the existing ENST Environmental Science B.A. second major from its recent home in the Center for Energy and Environmental Research in the Human Sciences (CENHS) back into the School of Natural Sciences, and reform it into two interdisciplinary stand-alone majors: a B.S. and a B.A. in Environmental Science (ENSC). The Departments of Earth Science and BioSciences will jointly administer the modified majors. The highly interdisciplinary majors will be complementary to environmentally related departmental majors and minors at Rice, as well as to the new interdisciplinary ENST minor established in Fall 2015.

### **Background**

Paul Harcombe (Ecology & Evolutionary Biology) and Walter Isle (English) in their roles as co-founders of the Center for the Study of Environment and Society (CSES) established the first course listings in Environmental Studies (ENST) at Rice in 2002. From its inception, CSES reported to the Provost's Office, which enabled a truly interdisciplinary approach to the ENST course listing. Over subsequent years, the ENST course offerings grew to include: (1) Courses funded directly by CSES, usually taught by adjunct lecturers; (2) Courses taught by Rice faculty or staff explicitly for ENST; and (3) Cross-listed courses originating from other departments and tagged with the ENST designation to draw the attention of students with environmental interests. In addition to these courses, CSES also developed a 67-semester-hour double major in Environmental Sciences, offered as a B.A. in Environmental Science within the ENST Program. A total of 13 students have been awarded a B.A. in Environmental Science at Rice, including some prior to the formalization of the ENST double major in 2004; an additional four students are currently enrolled in the double major. Of these 17 students, 13 of them are pursuing or have completed primary majors in either Natural Sciences or Engineering.

In an effort to create a coherent path of study for students interested in the environment, a group of CSES advisory committee members set out to create a minor in ENST in 2007. The intention for this minor, shaped in part by student feedback from CSES-sponsored ENST discussion forums as well as from the counsel of the CSES advisory committee, was to create a holistically oriented and broadly accessible program that by design represented the truly interdisciplinary nature of environmental issues. However, with the economic downturn of 2008, the subsequent departure from Rice of the CSES committee member leading the effort to create the minor, and the loss of key adjunct faculty and courses due to budget cuts, the effort to create a minor in ENST was put

on hold. In 2010, shortly after the minor proposal was paused, an inventory revealed that Rice offered 73 courses either wholly focused on environmental and sustainability-related issues (37) or containing a substantial environmental/sustainability component (36) across 16 departments.

During the summer of 2014, CSES merged into Rice's new Center for Energy and Environmental Research in the Human Sciences (CENHS), the first research center founded within Rice's cross-campus Energy and Environment Initiative (EEI). With the merger, CENHS inherited oversight over the ENST course listings and the double major in Environmental Science. Given the institutional transition, CENHS's Faculty Steering Committee thought it a wise time to review Rice's teaching offerings and learning experiences in the broad area of Environmental Studies, to look at what peer institutions are doing in this area, to listen to the perspectives of our colleagues and students, and to generate a proposal for strengthening the program. CENHS formed the ENST Working Group shortly after the CSES merger (including faculty representing the schools of Architecture, Engineering, Humanities, Natural Sciences and Social Sciences) in order to conduct this review process. Members of the Working Group met with faculty, administrators and students to gather feedback on the strengths and the weaknesses of the current ENST course listings and degree program and to listen to recommendations for improvements. The Working Group organized a town hall meeting in October, which was attended by approximately twenty students, and created several survey questions for the Survey of all Students (contained within Appendix 1). CENHS staff meanwhile assembled an analysis of what eight peer institutions (Brown, Chicago, Dartmouth, Macalester, Middlebury, Princeton, Tufts, and Yale) are offering their students in the area of Environmental Studies.

From the comparative analysis and campus feedback process, the ENST Working Group concluded that Rice lagged behind peer institutions in terms of offering high quality learning experiences in Environmental Studies. Moreover, during the Town Hall meeting and through the Survey of all Students, Rice students voiced a strong desire for Rice to offer an interdisciplinary major or minor in Environmental Studies or Environmental Science that was accessible to more students and would provide them with a structured and holistic understanding of pressing real-world issues like climate change, energy transition and environmental sustainability. In response, the ENST Working Group prepared a proposal to institute a new interdisciplinary minor in Environmental Studies that would be overseen and administered by CENHS. This proposal, found in Appendix 1, was submitted to the Rice Committee on Undergraduate Curriculum (CUC) on January 15, 2015, CUC approved the proposal unanimously on February 20, 2015, passing it on to full senate; the senate approved the proposal unanimously on March 26, 2015, allowing implementation in Fall 2015.

During consideration of the new ENST minor, the CUC raised some important questions and provided feedback regarding the broader portfolio of degree offerings in Environmental Studies at Rice. In particular, an opportunity was recognized "to harmonize programs and eliminate confusion" regarding environmental studies and environmental science at Rice. Another point of confusion is the fact that the merger of CSES and CENHS shifted oversight of the ENST double major in Environmental Science away from Natural Sciences. Upon the formation of the ENST minor an interdivisional agreement was created between the Provost and Schools of Humanities, Natural Sciences and Social Sciences (Appendix 2) to form an ENST steering committee to address these concerns and to help with long term planning of the ENST minor and the environmental science double major. The agreement also stipulates (point #5) that administrative

oversight for the ENST double major will remain in the Natural Sciences due to the nature of the degree program, and the program name will be changed to ENSC.

This proposal is designed to formalize this revised administrative structure, by providing an administrative home for the ENSC degree within the School of Natural Sciences, overseen jointly by Earth Science and BioSciences. We also propose to convert the Environmental Science second major to a pair of stand-alone majors, and to revise and update the degree structure and requirements, offering both B.S. and B.A. options, consistent with the current B.S. and B.A. degree options available in both Earth Science and BioSciences. We anticipate that these changes will increase student access to ENSC degree programs, thereby helping to grow the budding environmental efforts across the Rice campus. Given these changes, we also took the opportunity to revisit the degree program requirements and learning outcomes, resulting in a substantial overhaul and update of the ENSC offerings at Rice. The revised degrees are designed to provide both breadth across the range of environmental topics and depth within a concentration chosen from the host natural science disciplines. Students will also gain direct field experience exploring environmental issues. The more rigorous B.S. degree will conclude with a capstone field and/or research experience.

### **Rationale for revising and transferring Environmental Science degree to Natural Sciences**

The establishment of the new Environmental Studies minor, along with the new university-wide Energy and Environment Initiative, poses an ideal opportunity to revisit the full portfolio of environmental course and degree offerings at Rice, and to enhance these offerings to benefit the student body, and environmental studies across the university and beyond. An immediate concern is the current Environmental Science second major, which is now administered (by CENHS), placing a science major under Humanities/Social Science oversight outside of its more logical home in Natural Science.

As noted by the CUC, this degree program has not had very high enrollment since its inception in 2004. Several factors may contribute to this situation, particularly given the survey results, which show great interest in environmental course and degree offerings at Rice:

- (a) The present Environmental Science degree is offered only as a second major, which raises the hurdles for completion, and essentially restricts the major to students who are already majoring in an allied field with similar course requirements.
- (b) The Environmental Science degree is offered as a B.A., even though the science and math requirements for the program are equivalent to a B.S. in some programs. The classification as a B.A. may deter interested students interested in pursuing a B.S.
- (c) Due to its interdisciplinary nature, ENST has been administered by cross-departmental centers rather than an academic department, which has made it difficult for students to learn of the degree opportunities in environmental studies.
- (d) Furthermore, with the merger of CSES with CENHS, the environmental science degree is now hosted outside of Natural Sciences. This misalignment, although relatively recent, can be confusing to prospective majors.

In summary, a number of aspects of the current structure of Environmental Science degree could deter new majors. We suggest that these challenges can be easily corrected in the present university climate, enhancing access and opportunities in environmental studies at Rice University overall. A key step will be re-aligning the administration of the ENSC Environmental Science major within

the Natural Sciences, and housing it jointly within two departments with an interdepartmental oversight committee. The Departments of Earth Science (ESCI) and BioSciences (BIOS) jointly propose to take over the administration of the ENSC Environmental Science major, bringing it formally back into the School of Natural Sciences. With this transfer, we also propose several changes to the degree program (detailed in the next section).

The transfer of this degree back into the School of Natural Sciences will provide students with direct access to the large number of faculty within both ESCI and BIOS with strong environmental interests, and enthusiasm for contributing to the oversight and advisement of the program in the long run. Students also will have access to Civil & Environmental Engineering (CEVE) courses and faculty. This arrangement can guarantee the longevity of the ENSC degree program, likely leading to an increase in related course offerings in environmental science in support of the program.

We anticipate that this revised major, availability of both a B.A. and B.S. option, and the joint administration between ESCI and BIOS, will be more attractive to traditional students with interests in Environmental Science, lowering the hurdles to entry and completion of the major. In addition, we expect that current ESCI and BIOS students will gain new exposure to the large number of environmentally related course offerings, further growing interest in Environmental Studies across the University.

### **Structure of the ENSC Environmental Science Degrees and courses**

In preparation for the proposed transfer of administration, Richard Johnson oversaw an analysis of Environmental Science degree programs at 30 peer institutions (Appendix 3), identifying several characteristics of top programs that can be used to guide the revision of the current Environmental Science degree program. These include:

- A stand-alone major (or majors, as some offer both a BA and a BS).
- Choice of concentrations within the major
- Strong interdisciplinary emphasis
- Field research experience
- Opportunity to conduct a thesis and/or a capstone project

Although it is a highly interdisciplinary degree, the current ENST B.A. degree lacks several of the other synthesis elements. We suggest that a redesign of the ENSC degree offerings could enhance the quality of the degree, and make it more attractive to prospective majors. Thus, we propose some changes to the existing degree requirements, in particular:

- (a) Offer the ENSC degree (or degrees - see (b)) as a stand-alone major rather than the current second major. This change will make it more accessible to students interested in one degree, but would not preclude students from double majoring as before.
- (b) Establish both B.S. and B.A. options within the ENSC program to provide alternative pathways for students interested in environmental science. The two degree programs will differ by the credits hours required to complete the major requirements – minimum of 73 for the B.S., and minimum of 62 for the B.A. In addition, the B.A. has reduced prerequisite coursework in physics, and the capstone field or research experience (discussed below) is optional.

- (c) Maintain the strong interdisciplinarity currently present in the ENST Environmental Science degree by requiring students to select among courses that span Natural Sciences, Engineering, Humanities, Social Sciences, and Architecture. This requirement would apply to both the B.S. and B.A. degrees.
- (d) Introduce Concentrations within both the B.S. and B.A. programs, to allow students to specialize in one of two fields: Earth Science or Ecology & Evolutionary Biology. This arrangement will provide depth as well as breadth within environmental science and will provide a clear mechanism for student advising. When students select a Concentration, this will designate their administrative home and their primary undergraduate advisor (listed below). This requirement would apply to both the B.S. and B.A. degrees.
- (e) Both the ENSC B.S. and B.A. will require direct field experience (2 credit hours). The B.S. will also require a capstone experience (3 credit hours minimum) involving either an organized field experience as is common in Earth Science (e.g., ESCI 390 or 391) or an independent research experience (e.g., EBIO 403 or 404, or ESCI 481 or 491). Students will have flexibility as to how they meet this capstone requirement, which also could include external internships in environmental science. The capstone experience would be optional for majors pursuing the ENSC B.A.
- (f) A new upper level seminar course will be created, ENST 4xx *SEMINAR: Topics in Environmental Science* that will provide an integration of interdisciplinary topics that span environmental studies. Topics will vary depending on interests and needs of both students and faculty.
- (g) Students pursuing either the ENSC Environmental Science B.S. or B.A. would be eligible to pursue Senior Theses through any of the supporting departments, and would be encouraged to work with faculty in any of the departments that provide environmental research opportunities.

A summary of the proposed degree requirements for the ENSC Environmental Science B.S. and B.A. degrees are listed in the box below. The full text for the Rice General Announcements is provided in Appendix 4 (B.S.) and Appendix 5 (B.A.). The learning outcomes are scaled according to the scientific rigor of the degree, with the B.S. requiring an integrative application of methods and theories and hypothesis testing that is not required for the B.A. This is accomplished through a capstone or research experience. Other differences between the two degrees are noted within the boxed text **by blue font**. Students taking either degree are encouraged to pursue independent research and associated honors theses. A curriculum map relating the stated Program Learning Outcomes and proposed Assessment Plan is provided in Appendix 6\*.

Finally, Rice currently offers a wealth of courses that span the topics of sustainability and environment, offering significant interdisciplinary breadth for students pursuing the revised ENSC Environmental Science B.S., as well as the ENST minor and potential major. A compilation of these courses is presented in Appendix 7.

If this proposal is approved, the Environmental Science degrees would become two of four bachelor degrees offered by ESCI, which currently include a B.S. and a B.A. in Earth Science, and two of seven bachelor degrees offered by BIOS, which currently include B.A. and B.S. options in

*\*The Rice Office of Institutional Effectiveness is working with the proposal proponents to develop these products, with anticipated delivery in early April 2016. We will distribute these to the committee when they have been prepared.*

both Biochemistry & Cell Biology and Ecology & Evolutionary Biology, and a B.A. in Biological Sciences. Civil & Environmental Engineering will also be a partner, given their rich course offerings in Environmental Engineering and related topics.



## Program Learning Outcomes for BS & BA in Environmental Science

Students graduating from this program will:

1. Demonstrate foundational knowledge in the natural sciences that is fundamental to the Environmental Sciences.
2. Be able to integrate knowledge of natural and applied sciences to understand complex natural systems and cycles.
3. Be able to synthesize knowledge from natural sciences and engineering and apply it to the study of the environment.
4. Understand environmental issues from a scientific perspective and be able to solve issues using a variety of interdisciplinary perspectives (e.g., social sciences, economics, humanities, and/or architecture).
5. Be able to apply methods and theories to develop and test hypotheses or to propose and analyze solutions to environmental issues, using sound experimental, statistical, and/or design practices. *[BS only]*

## Degree Requirements for BS and BA in Environmental Science

Environmental science is an interdisciplinary program that addresses environmental issues in the context of what we know about earth, ecology, and society. In addition to its science core, the major also seeks to provide students with some appreciation of social, cultural, and policy dimensions of environmental issues, as well as exposure to the technologies of pollution control. Key components of the ENSC B.S. include:

- Foundation course work (32 semester hours) in mathematics, physics, chemistry, and biology. *[BA requires only 24 semester hours, omitting PHYS two course sequence]*
- A set of six undergraduate core courses (18 credit hours), required of all majors, to acquaint undergraduates with a range of environmental topics encountered by scientists, engineers, managers, and policy makers. Core courses stress the components of the global environment and their interactions, concluding with a topical seminar that integrates across the field.
- One or more field courses within the Natural Sciences (2 credit hour minimum)
- A capstone field course or research experience within the Natural Sciences (3 credit hour minimum). Course does not need to be within student's concentration. *[Not required for BA]*
- Concentration in one area to enhance depth, requiring three courses (9-12 credit hours) in that area of concentration. Student must select field of concentration when enrolling in the major:
  - Ecology & Evolutionary Biology (EBIO)
  - Earth Science (ESCI)
- Additional three courses (9-10 credit hours) of electives spread across three categories to enhance breadth (Students may petition to have alternative electives apply toward the major.):
  - Social Sciences and Economics (one course)
  - Humanities and Architecture (one course)
  - Natural Science and Engineering (one or more courses to achieve minimum credit hours)

**BS - Total credit hours: 32 + 18 + 2 + 3 + (9-12) + (9-10) = 55 + (18-22) = 73 credit hours minimum.**

***[BA - Total credit hours: 24 + 18 + 2 + (9-12) + (9-10) = 44 + (18-22) = 62 credit hours minimum]***

### FOUNDATION COURSES [32 credit hours]

- BIOC 201 *Introductory Biology I* (3) and EBIO 202 *Introductory Biology II* (3)
- CHEM 121 and CHEM 123 **OR** CHEM 151 and CHEM 153 *General Chemistry I with Laboratory* (4)
- CHEM 122 and CHEM 124 **OR** CHEM 152 and CHEM 154 *General Chemistry II with Laboratory* (4)
- MATH 101 or 111 *Single Variable Calculus I* (3) and MATH 102 or 112 *Single Variable Calculus II* (3)
- STAT 280, *Elementary and Applied Statistics* (4) or STAT 305 *Intro to Statistics for the Biosciences* (4)
- PHYS 101 **and** PHYS 103 *Mechanics (with Lab) and Mechanics Discussion* **OR** PHYS 111 *Mechanics (with Lab)* **OR** PHYS 125 *General Physics (with Lab)* (4)
- PHYS 102 **and** PHYS 104 *Electricity and Magnetism (with Lab) and E & M Discussion* **OR** PHYS 112 *Electricity and Magnetism (with Lab)* **OR** PHYS 126 *General Physics II* (4) *[Not required for BA]*

**CORE COURSES** [18 credit hours]

- ENST 100 *Environmental Culture and Society* (3)
- ESCI 107 *Oceans & Global Change* **OR** ESCI 109 *Oceanography* **OR** ESCI 201 *Science Behind Global Warming* (3)
- EBIO 213 *Introduction to Experimental Ecology and Evolutionary Biology* (2)
- EBIO 325 *Ecology* (3)
- ESCI 301 *Introduction to the Earth* (4)
- ENST 4\*\* *SEMINAR: Topics in Environmental Science* (3)

**FIELD EXPERIENCE** [2 credit hours minimum]

- ESCI 103 *Field Trips for the Earth*
- EBIO 306 *Undergraduate Independent Study (with field component)*
- EBIO 316 *Lab Module in Ecology*
- EBIO 317 *Lab Module in Behavior*
- EBIO 319 *Tropical Field Biology*
- EBIO 320 *Ecology and Conservation of Brazilian Wetlands Lab*
- EBIO 327 *Biological Diversity*
- EBIO 330 *Insect Biology Lab*
- EBIO 337 *Field Bird Biology*
- EBIO 324 *Conservation Biology Lab*
- ESCI 380/FOTO 390 *Visualizing Nature*
- ESCI 334 *Geological Field Techniques*
- ENST 379/EBIO 379 *Underwater Ecology*
- FWIS 187 *Exploring the Science and History of Houston's Bayous*

**PICK ONE OR MORE CAPSTONE COURSES FROM LIST** [3 cr hour minimum] [*Not required for BA*]

- ESCI 390 *Geologic Field Camp*
- ESCI 391 *Earth Science Field Experience*
- EBIO 403 OR 404 *Undergraduate Honors Research*
- ESCI 481 *Undergraduate Research in Earth Science (w/ Honors possible)*

**COURSES WITHIN CONCENTRATION** [declare one concentration; 9-12 credit hours]

***Ecology & Evolutionary Biology Concentration***

- *Select two courses from the following list:*

- EBIO 270 *Ecosystem Management*
- EBIO 323/ENST 323 *Conservation Biology*
- EBIO 372 *Coral Reef Ecosystems*

- *Select at least one course from the following list:*

- EBIO 270 *Ecosystem Management (if not selected above)*
- EBIO 321 *Animal Behavior*
- EBIO 323/ENST 323 *Conservation Biology (if not selected above)*
- EBIO 326 *Insect Biology*
- EBIO 329 *Animal Biology & Physiology*
- EBIO 331 *Biology of Infectious Diseases*
- EBIO 334/BIOC 334 *Evolution*
- EBIO 336 *Plant Diversity*
- EBIO 338 *Design and Analysis of Biological Experiments*
- EBIO 365 *Introductory Phycology*

- EBIO 366 *Applied Phycology*
- EBIO 372 *Coral Reef Ecosystems (if not selected above)*
- ESCI 340/EBIO 340/ENST 340 *Global Biogeochemical Cycles*

***Earth Science Concentration***

- *Select two courses from the following list:*

- ESCI 321 *Earth Systems and Cycles*
- ESCI 323 *Earth Structure and Deformation*
- ESCI 340/EBIO 340/ENST 340 *Global Biogeochemical Cycles*

- *Select at least one course from the following list:*

- ESCI 321 *Earth Systems and Cycles (if not selected above)*
- ESCI 322 *Earth Chemistry and Materials*
- ESCI 323 *Earth Structure and Deformation (if not selected above)*
- ESCI 340/EBIO 340/ENST 340 *Global Biogeochemical Cycles (if not selected above)*
- ESCI 380/FOTO 390 *Visualizing Nature (if not selected for field course)*
- ESCI 452/CEVE 453 *Geographic Information Science*
- ESCI 418/CEVE 418 *Quantitative Hydrogeology*
- ESCI 421 *Paleoceanography*
- ESCI 430 *Principles of Trace-Element and Isotope Geochemistry*
- ESCI 431 *Geomorphology*
- ESCI 425/CHEM 425/ENST 425 *Organic Geochemistry*
- ESCI 435 *Mechanics of Sediment Transport*
- ESCI 467 *Geomechanics*

**ADVANCED ELECTIVES [9-10 credit hours]**

***Social Sciences – pick one course from ANTH, ECON, POLI, SOCI***

***Humanities and Architecture – pick one course from ARCH, ENGL, HIST, HUMA, SPAN***

***Natural Science and Engineering – pick at least one course to achieve 73 credit hour minimum [62 for BA]***

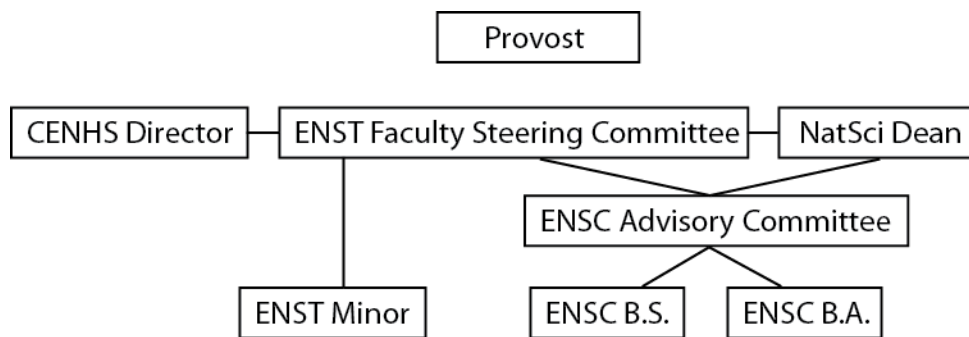
**Relationship to existing degree programs at Rice University**

The revised ENSC Environmental Science B.S. and B.A. are based on a core of science and engineering courses, but also require interdisciplinary course work through directed electives selected among Social Science, Humanities and/or Architecture, as well as Natural Science and Engineering. The ENSC degrees differs from B.S. and B.A. degrees offered in individual departments by their interdisciplinary nature and the opportunity to take a range of environmental courses in the natural sciences, engineering, humanities and social science. Other environmentally directed offerings, such as the Environmental Earth Science track of the ESCI B.S. and the BioSciences B.S. and B.A. degrees in Ecology & Evolutionary Biology both emphasize rigorous training in the host disciplines, supported by elective courses, and thus lack the interdisciplinarity of the ENSC degree. CEVE offers B.S. and B.A. degrees, emphasizing a strong core of CEVE courses, followed by directed electives within focus areas or tracks, allowing students to specialize in, among other fields, Environmental Engineering, Hydrology and Water Resources, and Urban Infrastructure, Reliability and Management. CEVE is now host to the new Energy, Water, and Sustainability Minor, which also emphasizes CEVE courses and directed electives in the three topic areas. Thus, the highly interdisciplinary ENSC Environmental Science B.S. and B.A. will be

distinct degree offerings that will be attractive to students seeking broader exposure to environmentally related topics in a wide range of areas, spanning Humanities and Social Sciences as well as Natural Sciences and Engineering. Note, the recently established ENST Minor in Environmental Studies complements but does not compete with the ENSC B.S. and B.A. degrees.

### Administration and assessment

Academic administration of the ENSC Environmental Science B.S. and B.A. degrees will be joint between the Departments of Earth Science and BioSciences. The overall ENSC Program will be managed by a newly established ENSC Advisory Committee, which will oversee the entire program, working together to maintain consistency and to address questions and issues that arise. The ENSC Advisory Committee will meet at least once a year in the Spring semester to evaluate the status of the ENSC Program, to review feedback from students from the surveys described below, and to guide changes to the degree requirements, e.g. updates to the elective course lists, etc. Initial members of the ENSC Advisory Committee will be: Julia Morgan (ESCI, temporarily represented by Carrie Masiello during Juli’s spring 2016 sabbatical), Amy Dunham (BIOS), and Rob Griffin (CEVE). In addition, each host department will identify an undergraduate advisor who will oversee the students who select the concentration within their department. The undergraduate advisors will be: André Droxler (ESCI) and Evan Siemann (BIOS-EEB). The undergraduate advisors will also serve on the ENSC Advisory Committee.



As shown schematically above, the ENSC Advisory Committee will report both to the Dean of Natural Sciences and to the ENST Faculty Steering Committee, currently chaired by the Director of CENHS (Dominic Boyer). This arrangement will ensure the integrity of Environmental Science and Environmental Studies offerings across Rice University. A dedicated staff person working within the CENHS Office will assist in the administrative labor and management of the ENSC B.A. and B.S., as well as the new ENST minor. The ENST Faculty Steering Committee will assess the success and effectiveness of the program through a brief open-ended questionnaire distributed to graduating students with ENSC Environmental Science majors, asking for their assessment of the learning experience. Responses will be circulated to faculty teaching in the program as necessary, and to the ENSC sub-committee prior to their annual meetings. CENHS will keep records of the responses over time in order to track progress.

## Faculty participation

We anticipate that the following faculty and lecturers will teach science and engineering courses that will contribute to the stand alone ENSC Environmental Science degrees. We have not listed the numerous faculty in Humanities, Social Sciences, and Architecture, who will provide cross-disciplinary elective courses. Given the large number of courses currently offered (see Appendix 6), this list is necessarily partial, as it does not include everyone who teaches environmental-related courses at Rice, but it defines a core of faculty:

- Pedro Alvarez (CEVE)
- Philip Bedient (CEVE)
- Jim Blackburn (CEVE)
- Daniel Cohan (CEVE)
- Gerald Dickens (ESCI)
- André Droxler (ESCI)
- Leonardo Dueñas-Osorio (CEVE)
- Brandon Dugan (ESCI)
- Amy Dunham (BIOS)
- Scott Egan (BIOS)
- Rob Griffin (CEVE)
- Cassidy Johnson (BIOS)
- Richard Johnson (Sociology/CHBE)
- Cin-Ty Lee (ESCI)
- Qilin Li (CEVE)
- Caroline Masiello (ESCI/CHEM/BIOS)
- Thomas Miller (BIOS)
- Julia Morgan (ESCI)
- Jeffrey Nittrouer (ESCI)
- Joseph Novak (BIOS)
- Jamie Padgett (CEVE)
- Volker Rudolf (BIOS)
- Julia Saltz (BIOS)
- Evan Siemann (BIOS)
- Scott Solomon (BIOS)
- Adrienne M. Simoes Correa (BIOS)
- Mason Tomson (CEVE)
- Laurence Yeung (ESCI)
- Kyriacos Zygourakis (CHBE)

## Future plans

There is strong interest in furthering environmental science and environmental studies at Rice University. Enhancing access to the Environmental Science majors is one part of the picture, and one that will likely lead to new offerings, including cross-disciplinary team-taught courses available to a wide pool of Rice students. We also anticipate the opportunity to develop a more holistically oriented Environmental Studies (ENST) B.A. degree over the next few years.

## Appendix 1

Proposal for ENST Minor in Environmental Studies and CUC feedback (*see attached pdf*)

## Appendix 2

ENST Interdivisional Agreement (*see attached pdf*)

### Appendix 3 - Environmental Science Degree Program Analysis

A review was carried out by undergraduate interns Veronica Johnson and Ansley Jones with oversight from Richard Johnson, of Environmental Science major degree programs across the top 30 universities (according to US News rankings) plus an additional set of peers (**Table 1**, the complete list can be found in **Table 2**). Of the top 30 schools, 21 have an Environmental Science major (either a B.A., B.S. or both), and 9 do not have any kind of Environmental Science degree. Rice University's Wiess School of Natural Sciences currently offers a B.A. in Environmental Science, which is only available as a second major.

In our research, we identified several characteristics of top programs that should be considered for a revamped Environmental Science degree program at Rice. These include:

- A stand-alone major (or majors, as some offer both a BA and a BS).
- Choice of concentrations within the major
- Strong interdisciplinary emphasis
- Field research experience
- Opportunity to conduct a thesis and/or a capstone project

We have developed a comparison table of degree programs (see **Table 2**) that includes characteristics such as home department, focus tracks/specializations, credits required to complete the program, etc. Further, we studied the course requirements within the various programs, and those results are presented in **Table 3**. In general, we learned that the majority of programs require two introductory math classes, two introductory chemistry classes, and one introductory physics class. Many schools also require at least one biology class, such as Ecology & Evolutionary Biology, Biodiversity, and Cell and Molecular Biology. Of the programs we analyzed, fifty-nine percent offer some form of field experience, and seventy-seven percent provide research opportunities that culminate in a thesis or capstone project.

Few of the programs provide clear learning outcomes on their web sites. Of those that do, some of the key program learning outcomes are for students to:

- Develop a rigorous science background from which to pursue graduate-level training in professional programs
- Conceptualize environmental problems in a broad, interdisciplinary framework.
- Apply quantitative and qualitative critical thinking skills to environmental problems spanning local to global scales.
- Combine methods, perspectives, and practices in the natural sciences and engineering with those in the social sciences and humanities.
- Discriminate between different views to separate cause from effect, recognize overarching themes, and differentiate fact from opinion.
- Synthesize information in a way that promotes positive changes in human activity and offers solutions to existing and emerging environmental problems.
- Communicate effectively in a variety of forms and formats.

**Table 1: List of Peer Universities in Our Study**

<b>University</b>	<b>Do they offer (an) environmental science degree program(s)?</b>
Princeton University	No
Harvard University	No
Yale University	No
Columbia University	Yes
Stanford University	Yes
University of Chicago	Yes
Massachusetts Institute of Technology	No
Duke University	Yes
University of Pennsylvania	No
California Institute of Technology	No
Dartmouth College	Yes
Johns Hopkins University	No
Washington University in St. Louis	Yes
Cornell University	Yes
Brown University	Yes
University of Notre Dame	Yes
Vanderbilt University	Yes
University of California-Berkeley	Yes
Emory University	Yes
Georgetown University	No
University of California-Los Angeles	Yes
University of Virginia	Yes
Carnegie Mellon University	No

<b>University</b>	<b>Do they offer (an) environmental science degree program(s)?</b>
University of Southern California	Yes
Tufts University	No
University of Michigan-Ann Arbor	Yes
University of North Carolina-Chapel Hill	Yes
Boston College	Yes
Northwestern University	Yes
University of Vermont	Yes
Michigan State	Yes
Trinity University	No
Macalester College	No
Middlebury College	No



**Table 2: Comparison Table of Program Characteristics**

School	Link to Program	BS or BA?	Name of Major	Department of Degree	Total Credits or Courses for Program	Focus Tracks/Specializations
University of California Berkeley	<a href="#">UC Berkeley Curriculum</a>	BS	Environmental Sciences	Department of Environmental Science, Policy, and Management	120 credits	Biological Science, Physical Science, Social Science
Brown	<a href="#">Brown Curriculum</a>	Both	Environmental Science	Institute at Brown for Environment and Society	30 courses to graduate— 14 courses in the BA program, 19 courses in the BS program	Air, Climate and Energy; Conservation Science and Policy; Land, Water and Food Security; Sustainability in Development
University of Vermont	<a href="#">Vermont Curriculum</a>	BS	Environmental Sciences	Biology, Rubenstein School of Environment and Natural Resources, The College of Agriculture and Life Sciences	120 credits to graduate— 49-60 credits in the BS program, depending on the track and focus area	Agriculture and Environment, Conservation Biology and Biodiversity, Ecological Design, Environmental Analysis and Assessment, Environmental Biology, Environmental Chemistry, Environmental Geology, Environmental Resources, Water Resources
University of Chicago	<a href="#">University of Chicago Curriculum</a>	BS	Environmental Science	Department of Geophysical Sciences	42 quarter-courses to graduate— 24 courses in the BS program	Climatology, Conservation, Biogeochemistry, Public Policy
Michigan State	<a href="#">Michigan State Environmental Geosciences Curriculum</a>	BS	Environmental Geosciences	Department of Geological Sciences	120 credits	Geophysics
Michigan State University	<a href="#">Michigan State Environmental Sciences and Management Curriculum</a>	BS	Environmental Sciences and Management	Lyman Briggs College	120 credits	
University of Virginia	<a href="#">University of Virginia Curriculum</a>	Both	Environmental Sciences	Environmental Sciences	120 credits to graduate— 30 credits within the BA program, 40 credits within the BS program	Environmental and Biological Conservation

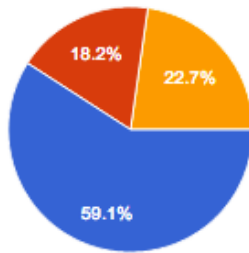
School	Link to Program	BS or BA?	Name of Major	Department of Degree	Total Credits or Courses In Program	Focus Tracks/Specializations
Emory University	<a href="#">Emory Curriculum</a>	Both	Environmental Sciences	Department of Environmental Sciences	32 courses to graduate— 11 courses for the BA program, 16 courses for the BS program	Conservation and Resource Management, Environment and Health, Urban Ecology, Environmental Policy
Dartmouth College	<a href="#">Dartmouth Curriculum</a>	BA	Environmental Earth Sciences	Department of Earth Sciences	35 courses to graduate— 13 courses within the BA program	
Columbia University	<a href="#">Columbia Curriculum</a>	BA	Environmental Sciences	Department of Earth and Environmental Sciences	124 credits to graduate— 47 credits within the BA program	Environmental Biology, Environmental Geology, Environmental Geochemistry, Hydrology, Climate Change, Energy and Resources
Duke University	<a href="#">Duke Curriculum</a>	BS	Environmental Sciences	Nicholas School of the Environment	34 courses to graduate— 16 courses within the BS program	None
Washington University in St. Louis	<a href="#">WashU Curriculum</a>	BA	Environmental Earth Sciences	Department of Earth and Planetary Sciences	36 courses to graduate— 18 courses in the BA program, 5 courses within focus area, or "theme" 45 courses to graduate—	Climate and Energy, Human-Altered Environments, Life in its Environment
Northwestern University	<a href="#">Northwestern Curriculum</a>	BA	Environmental Sciences	College of Art and Sciences	21-23 courses in the BA program, depending on track	Science, Policy

School	Link to Program	BS or BA?	Name of Major	Department of Degree	Total Credits or Courses in Program	Focus Tracks/Specializations
Cornell University	<a href="#">Cornell Curriculum</a>	BS	Environmental Science and Sustainability	The College of Agriculture and Life Sciences	120 credits	Environmental Biology and Applied Ecology, Environmental Policy and Governance, Environmental Economics, Biogeochemical Sciences, Individual Student-Designed Concentration
Vanderbilt University	<a href="#">Vanderbilt Curriculum</a>	BA	Earth and Environmental Sciences	The Department of Earth and Environmental Sciences under College of Art and Sciences	120 credits to graduate—32 credits for general requirements in the BA program Total 38-41 credits for option 1 track Total 43-44 credits for option 2 track Total 47-48 credits for option 3 track	Option I provides a background for careers or post-graduate work in related fields such as teaching, law, or business and for some graduate programs and employment opportunities in earth and environmental sciences. Option 2 prepares students well for graduate work and careers in the earth and environmental sciences. Option III (Honors) is designed for excellent, highly motivated students who want to pursue research as undergraduates.
Notre Dame University	<a href="#">Notre Dame Curriculum</a>	BS	Environmental Earth Sciences	Department of Civil and Environmental Engineering and Earth Sciences UCLA's Institute of the Environment and Sustainability	129 credits	None
University of California-Los Angeles	<a href="#">UCLA Curriculum</a>	BS	Environmental Science	Departments of Atmospheric and Oceanic Sciences, Civil and Environmental Engineering, Earth, Planetary and Space Sciences, Ecology and Evolutionary Biology, Environmental Health Sciences and Geography.	180 quarter units to graduate— Preparation for the Major: 56-57 units; Major requirements: 50-52 units Minor/Concentration: 20 units TOTAL: 126-129 units	Atmospheric and Oceanic Sciences (minor), Conservation Biology (minor), Environmental Engineering (minor), Environmental Health (concentration), Environmental Systems and Society (concentration), Geography/Environmental Studies (minor), Earth and Environmental Science (minor)

School	Link to Program	BS or BA?	Name of Major	Department of Degree	Total Credits or Courses in Program	Focus Tracks/Specializations
University of Michigan-Ann Arbor	<a href="#">University of Michigan Curriculum</a>	Both	Earth and Environmental Science	College of Literature, Science, and the Arts	120 credits to graduate—same core requirements for BA and BS, but BS requires 60 credits in math/science	Geology, Environmental Geoscience, Energy and Mineral Resources, Geochemistry, Geophysics, Oceanography, Paleontology and Geobiology
University of North Carolina	<a href="#">UNC Curriculum</a>	BS	Environmental Sciences	Curriculum for the Environment and Ecology	120 credits	Water and Climate, Ecology and Natural Resources, Energy and Sustainability, Environment and Health
Boston College	<a href="#">Boston College Curriculum</a>	BS	Environmental Geoscience	Department of Earth and Environmental Sciences	120 credits	None
Stanford University	<a href="#">Stanford Curriculum</a>	BS	Energy and Environmental Sciences	School of Earth, Energy, and Environmental Sciences	180 quarter credits	Anthrosphere; Biosphere; Energy, Science, and Technology; Land Systems; Sustainable Food and Agriculture; Oceans
University of Southern California	<a href="#">USC Curriculum</a>	Both	Environmental Science and Health	Dornsife College of Letters, Arts, and Sciences	128 credits to graduate—72 hours within the BS program, 52 hours within the BA program	None

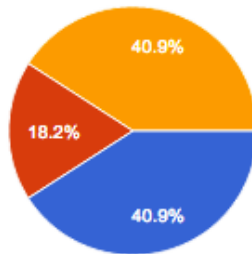
### Table & Figure 3: Course Comparisons

#### Thesis/research



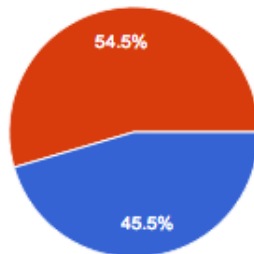
Required	13	59.1%
Optional	4	18.2%
Not Required	5	22.7%

#### Field experience



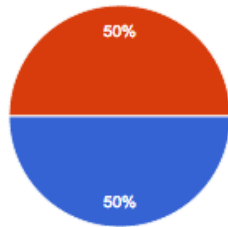
Required	9	40.9%
Optional	4	18.2%
Not Required	9	40.9%

#### GIS included in curriculum



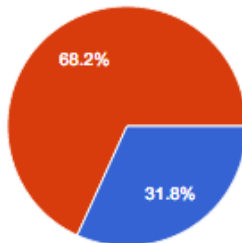
Yes	10	45.5%
No	12	54.5%

**Statistics included in curriculum**



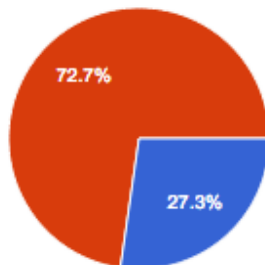
Yes 11 50%  
No 11 50%

**Economics included in curriculum**



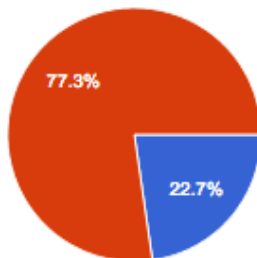
Yes 7 31.8%  
No 15 68.2%

**"Introduction to Environmental Science" Course**



Yes 6 27.3%  
No 16 72.7%

**"Environmental Chemistry" Course**



Yes 5 22.7%  
No 17 77.3%

## **Appendices 4 and 5: Proposed General Announcements Text:**

### ***Tab 2: Undergraduate Requirements***

#### **Program Learning Outcomes for the BS Degree with a Major in Environmental Science**

Upon completing the BS degree, students majoring in Environmental Science will be able to:

1. Demonstrate foundational knowledge in the natural sciences that is fundamental to the Environmental Sciences.
2. Be able to integrate knowledge of natural and applied sciences to understand complex natural systems and cycles.
3. Be able to synthesize knowledge from natural sciences and engineering and apply it to the study of the environment.
4. Understand environmental issues from a scientific perspective and be able to solve issues using a variety of interdisciplinary perspectives (e.g., social sciences, economics, humanities, and/or architecture).
5. Be able to apply methods and theories to develop and test hypotheses or to propose and analyze solutions to environmental issues, using sound experimental, statistical, and/or design practices.

#### **Requirements for the BS Degree with a Major in Environmental Science**

For general university requirements, see [Graduation Requirements](#). Students pursuing the BS degree with a major in Environmental Science (ENSC) must complete:

- A minimum of 25-28 courses (a minimum of 73 credit hours) depending on course selection to satisfy major requirements.
- A minimum of 133 credit hours to satisfy degree requirements.
- The requirements for one major concentration.

The ENSC major offers two major concentrations which enhance depth in that field. Upon declaration of the ENSC major, students are also required to declare one of the following major concentrations:

- Ecology and Evolutionary Biology
- Earth Science

Environmental science is an interdisciplinary program that addresses environmental issues in the context of what we know about earth, ecology, and society. In addition to its science core, the major also seeks to provide students with some appreciation of social, cultural, and policy dimensions of environmental issues. The ENSC major requirements for the B.S. degree are listed below.

#### **CORE REQUIREMENTS**

Students must complete a total of 18-21 courses (52-53 credit hours) depending on course selection to satisfy the ENSC major's Core Requirements for the B.S. degree.

## Tab 2: Undergraduate Requirements continued

### Foundation Coursework

Students must complete a total of 11-13 courses (32 credit hours) depending on course selection as listed below.

- BIOC 201 *Introductory Biology I* [ 3 credit hours ]
- EBIO 202 *Introductory Biology II* [ 3 credit hours ]
- CHEM 121 *General Chemistry I* [ 3 credit hours ] **and** CHEM 123 *General Chemistry I Lab* [ 1 credit hour ]
- CHEM 122 *General Chemistry II* [ 3 credit hours ] **and** CHEM 124 *General Chemistry I Lab* [ 1 credit hour ]
- MATH 101 *Single Variable Calculus I* [ 3 credit hours ]  
    **or** MATH 111 *Fundamental Theorem of Calculus* [ 3 credit hours ]
- MATH 102 *Single Variable Calculus II* [ 3 credit hours ]  
    **or** MATH 112 *Calculus and its Applications* [ 3 credit hours ]
- STAT 280 *Elementary and Applied Statistics* [ 4 credit hours ]  
    **or** STAT 305 *Intro to Statistics for the Biosciences* [ 4 credit hours ]
- PHYS 101 *Mechanics (with Lab)* [ 4 credit hours ] **and** PHYS 103 *Mechanics Discussion* [ 0 credit ]  
    **or** PHYS 111 *Mechanics (with Lab)* [ 4 credit hours ]  
    **or** PHYS 125 *General Physics (with Lab)* [ 4 credit hours ]
- PHYS 102 *Electricity and Magnetism (with Lab)* [ 4 credit hours ] **and** PHYS 104 *E & M Discussion* [ 0 credit ]  
    **or** PHYS 112 *Electricity and Magnetism (with Lab)* [ 4 credit hours ]  
    **or** PHYS 126 *General Physics II* [ 4 credit hours ]

**Note:** CHEM 121 and CHEM 123 can be satisfied by completing CHEM 151 *Honors General Chemistry I* [ 3 credit hours ] and CHEM 153 *Honors General Chemistry I Lab* [ 1 credit hour ]. Similarly, CHEM 122 and CHEM 124 can be satisfied by completing CHEM 152 *Honors General Chemistry II* [ 3 credit hours ] and CHEM 154 *Honors General Chemistry II Lab* [ 1 credit hour ].

### Core Courses

Students must complete a total of 6 courses (18 credit hours) from the following. The core courses acquaint students with a range of environmental topics encountered by scientists, engineers, managers, and policy makers. Core courses stress the components of the global environment and their interactions, culminating with a topical seminar that integrates across the field.

- ENST 100 *Environmental Culture and Society* [ 3 credit hours ]
- ESCI 107 *Oceans & Global Change* [ 3 credit hours ]  
    **or** ESCI 109 *Oceanography* [ 3 credit hours ]  
    **or** ESCI 201 *Science Behind Global Warming* [ 3 credit hours ]
- EBIO 213 *Introduction to Experimental Ecology and Evolutionary Biology* [ 2 credit hours ]
- EBIO 325 *Ecology* [ 3 credit hours ]
- ESCI 301 *Introduction to the Earth* [ 4 credit hours ]
- ENST 4xx *SEMINAR: Topics in Environmental Science* [ 3 credit hours ]



## **Tab 2: Undergraduate Requirements continued**

### **Field Experience**

Students must complete between 1-2 courses (2-3 credit hours) depending on course selection from the following:

- ESCI 103 *Field Trips for the Earth* [ 1 credit hour ]
- EBIO 306 *Undergraduate Independent Study (with field component)* [ 1-3 credit hours ]
- EBIO 316 *Lab Module in Ecology* [ 1 credit hour ] EBIO 317 *Lab Module in Behavior* [ 1 credit hour ]
- EBIO 319 *Tropical Field Biology* [ 2 credit hours ]
- EBIO 320 *Ecology and Conservation of Brazilian Wetlands Lab* [ 2 credit hours ]
- EBIO 324 *Conservation Biology Lab* [ 1 credit hour ]
- EBIO 327 *Biological Diversity* [ 1 credit hour ]
- EBIO 330 *Insect Biology Lab* [ 1 credit hour ]
- EBIO 337 *Field Bird Biology* [ 1 credit hour ]
- ESCI 334 *Geological Field Techniques* [ 3 credit hours ]
- ESCI 380/FOTO 390 *Visualizing Nature* [ 3 credit hours ]
- ENST 379/EBIO 379 *Underwater Ecology* [ 1 credit hour ]
- FWIS 187 *Exploring the Science and History of Houston's Bayous* [ 3 credit hours ]

### **ECOLOGY AND EVOLUTIONARY BIOLOGY MAJOR CONCENTRATION**

Students must complete a total of 3-4 courses (9-12 credit hours) as listed below to satisfy the Ecology and Evolutionary Biology major concentration requirements.

#### **Core Requirements**

Students must complete 2 courses (6 credit hours) from the following:

- EBIO 270 *Ecosystem Management* [ 3 credit hours ]
- EBIO 323/ENST 323 *Conservation Biology* [ 3 credit hours ]
- EBIO 372 *Coral Reef Ecosystems* [ 3 credit hours ]

#### **Electives**

Students must complete at least 1 course (3 credit hours) from the following. Note that the course not completed in the Core Requirements list for the Ecology and Evolutionary Biology major concentration may be completed to satisfy the concentration's Electives requirement.

- EBIO 270 *Ecosystem Management* [ 3 credit hours ]
- EBIO 321 *Animal Behavior* [ 3 credit hours ]
- EBIO 323/ENST 323 *Conservation Biology* [ 3 credit hours ]
- EBIO 326 *Insect Biology* [ 3 credit hours ]
- EBIO 329 *Animal Biology & Physiology* [ 3 credit hours ]
- EBIO 331/BIOC 331 *Biology of Infectious Diseases* [ 3 credit hours ]
- EBIO 334/BIOC 334 *Evolution* [ 3 credit hours ]
- EBIO 336 *Plant Diversity* [ 3 credit hours ]
- EBIO 338 *Design and Analysis of Biological Experiments* [ 3 credit hours ]
- EBIO 365 *Introductory Phycology* [ 3 credit hours ]
- EBIO 366 *Applied Phycology* [ 3 credit hours ]
- EBIO 372 *Coral Reef Ecosystems* [ 3 credit hours ]
- ESCI 340/EBIO 340/ENST 340 *Global Biogeochemical Cycles* [ 3 credit hours ]

## Tab 2: Undergraduate Requirements continued

### EARTH SCIENCE MAJOR CONCENTRATION

Students must complete a total of 3-4 courses (9-12 credit hours) as listed below to satisfy the Earth Science major concentration requirements.

#### Core Requirements

Students must complete 2 courses (6-7 credit hours depending on course selection) from the following:

- ESCI 321 *Earth Systems and Cycles* [ 3 credit hours ]
- ESCI 323 *Earth Structure and Deformation* [ 4 credit hours ]
- ESCI 340/EBIO 340/ENST 340 *Global Biogeochemical Cycles* [ 3 credit hours ]

#### Electives

Students must complete at least 1 course (3 credit hours) from the following. Note that the course not completed in the Core Requirements list for the Earth Science major concentration may be completed to satisfy the concentration's Electives requirement.

- ESCI 321 *Earth System Evolution and Cycles* [ 3 credit hours ]
- ESCI 322 *Earth Chemistry and Materials* [ 4 credit hours ]
- ESCI 323 *Earth Structure and Deformation* [ 4 credit hours ]
- ESCI 340/EBIO 340/ENST 340 *Global Biogeochemical Cycles* [ 3 credit hours ]
- ESCI 380/FOTO 390 *Visualizing Nature* (if not selected for field course) [ 3 credit hours ]
- ESCI 418/CEVE 418 *Quantitative Hydrogeology* [ 3 credit hours ]
- ESCI 421 *Paleoceanography* [ 3 credit hours ]
- ESCI 425/CHEM 425/ENST 425 *Organic Geochemistry* [ 3 credit hours ]
- ESCI 430 *Principles of Trace-Element and Isotope Geochemistry* [ 3 credit hours ]
- ESCI 431 *Geomorphology* [ 3 credit hours ]
- ESCI 435 *Mechanics of Sediment Transport* [ 3 credit hours ]
- ESCI 452/CEVE 453 *Geographic Information Science* [ 3 credit hours ]
- ESCI 467 *Geomechanics* [ 3 credit hours ]

### ADVANCED ELECTIVES

Students must complete 1 course (3-4 credit hours depending on course selection) from each of the following areas for a total of 3 courses (9-10 credit hours depending on course selection) to enhance breadth and to satisfy the ENSC major's Advanced Electives requirement. Students may also petition to complete alternative courses to be applied toward the Advanced Electives requirement.

#### Social Sciences

Students must complete 1 course (3 credit hours) from the following:

- ANTH 332/ENST 332 *The Social Life of Clean Energy* [ 3 credit hours ]
- ANTH 348 *Anthropologies of Nature* [ 3 credit hours ]
- ANTH 381 *Medical Anthropology* [ 3 credit hours ]
- ECON 437/ENST 437 *Energy Economics* [ 3 credit hours ]
- ECON 480/ENST 480 *Environmental Economics* [ 3 credit hours ]
- POLI 331 *Environmental Politics and Policy* [ 3 credit hours ]
- POLI 362 *Comparative Urban Politics and Policy* [ 3 credit hours ]
- POST 401 *Energy Policy* [ 3 credit hours ]
- SOCI 304/ENST 302 *Environmental Issues: Rice into the Future* [ 3 credit hours ]
- SOCI 313 *Demography* [ 3 credit hours ]

## **Tab 2: Undergraduate Requirements continued**

- SOCI 423 *Sociology of Food* [ 3 credit hours ]
- SOCI 367/ENST 367 *Environmental Sociology* [ 3 credit hours ]

### **Humanities and Architecture**

Students must complete 1 course (3 credit hours) from the following:

- ARCH 313/ENST 313 *Case Studies in Sustainable Design* [ 3 credit hours ]
- ARCH 322/ENST 322 *Case Studies in Sustainability* [ 3 credit hours ]
- ENGL 358 *Consumption and Consumerism* [ 3 credit hours ]
- ENGL 367/SWGS 367 *American Ecofeminism* [ 3 credit hours ]
- ENGL 459 *Literature and Ecology* [ 3 credit hours ]
- HIST 376 *Natural Disasters in the Caribbean* [ 3 credit hours ]
- HIST 425 *20th Century American Conservatism* [ 3 credit hours ]
- HUMA 202/ENST 202 *Culture, Energy and the Environment* [ 3 credit hours ]
- SPAN 403 *Literature and the Environment in Latin America* [ 3 credit hours ]

### **Natural Science and Engineering**

Students must complete 1 course (3-4 credit hours) from the following courses. In addition, students may complete 1 course listed in the major concentration requirements outside of the student's declared concentration.

- CEVE 302 *Sustainable Design* [ 3 credit hours ]
- CEVE 307/ENST 307/ESCI 307 *Energy and the Environment* [ 3 credit hours ]
- CEVE 308 *Air Pollution Control* [ 3 credit hours ]
- CEVE 401 *Environmental Chemistry* [ 4 credit hours ]
- CEVE 404 *Atmospheric Particulate Matter* [ 3 credit hours ]
- CEVE 406/ENST 406 *Introduction to Environmental Law* [ 3 credit hours ]
- CEVE 411 *Atmospheric Processes* [ 3 credit hours ]
- CEVE 412 *Hydrology and Water Resources Engineering* [ 3 credit hours ]
- CEVE 420 *Environmental Remediation and Restoration* [ 3 credit hours ]
- CEVE 434 *Fate and Transport of Contaminants in the Environment* [ 3 credit hours ]
- CEVE 484 *Environmental Risk Assessment and Human Health* [ 3 credit hours ]
- CHEM 211 *Organic Chemistry I* [ 3 credit hours ] **and** CHEM 213 *Organic Chemistry Discussion* [ 0 credit ]
- ENST 281/CHBE 281 *Engineering Sustainable Communities* [ 3 credit hours ]

### **CAPSTONE REQUIREMENT**

To satisfy the remaining ENSC major requirements, students pursuing the B.S. degree must complete 1 course (at least 3 credit hours) from the following.

- ESCI 390 *Geologic Field Camp*
- ESCI 391 *Earth Science Field Experience* [ 1-6 credit hours ]
- EBIO 403 *Undergraduate Honors Research* [ 2 credit hours ]  
    **or** 404 *Undergraduate Honors Research* [ 2 credit hours ]
- ESCI 481 *Undergraduate Research in Earth Science* [ 1-6 credit hours ]

## **Tab 2: Undergraduate Requirements continued**

### **Independent**

### **Research**

In addition to the required capstone field or research experience required for the major, students are encouraged to undertake independent research on environmentally related topics as part of their degree programs, in EBIO 403, EBIO 404, ESCI 481. Students also can enroll in senior honors thesis programs within their cooperation with one or more faculty. Course options for independent research, repeatable for credit, include: concentrations, or by arrangement with other departments, and/or through the Rice Undergraduate Scholars Program. Students completing a thesis will be eligible for the Award of Distinction in Research and Creative Works. Details for each program can be found here:

- **EBIO Honors Research** (<https://biosciences.rice.edu/Content.aspx?id=2147484071>)
- **ESCI Senior Honors Thesis** (<http://earthscience.rice.edu/academics/undergraduate-program/honors-thesis>)
- **Rice Undergraduate Scholars Program** (<http://rusp.rice.edu/about/>)

### **Program Learning Outcomes for the BA Degree with a Major in Environmental Science**

Upon completing the BA degree, students majoring in Environmental Science will be able to:

1. Demonstrate foundational knowledge in the natural sciences that is fundamental to the Environmental Sciences. This understanding should be adequate to support the incorporation of environmental science knowledge into the study and practice of a field other than environmental science.
2. Be able to integrate knowledge of natural and applied sciences to understand complex natural systems and cycles.
3. Be able to synthesize knowledge from natural sciences and engineering and understand how it applies to the study of the environment.
4. Understand environmental issues from a scientific perspective and be able to solve issues using a variety of interdisciplinary perspectives (e.g., social sciences, economics, humanities, and/or architecture).

### **Requirements for the BA Degree with a Major in Environmental Science**

For general university requirements, see [Graduation Requirements](#). Students pursuing the BS degree with a major in Environmental Science (ENSC) must complete:

- A minimum of 22-24 courses (a minimum of 62 credit hours) depending on course selection to satisfy major requirements.
- A minimum of 122 credit hours to satisfy degree requirements.
- The requirements for one major concentration.

The ENSC major offers two major concentrations which enhance depth in that field. Upon declaration of the ENSC major, students are also required to declare one of the following major concentrations:

- Ecology and Evolutionary Biology
- Earth Science

## **Tab 2: Undergraduate Requirements continued**

Environmental science is an interdisciplinary program that addresses environmental issues in the context of what we know about earth, ecology, and society. In addition to its science core, the major also seeks to provide students with some appreciation of social, cultural, and policy dimensions of environmental issues. The ENSC major requirements for the B.A. degree are listed below.

### **CORE REQUIREMENTS**

Students must complete 16-17 courses (44-45 credit hours) depending on course selection to satisfy the ENSC major's Core Requirements for the B.A. degree.

#### **Foundation Coursework**

Students must complete a total of 9 courses (24 credit hours) depending on course selection as listed below.

- BIOC 201 *Introductory Biology I* [ 3 credit hours ]
- EBIO 202 *Introductory Biology II* [ 3 credit hours ]
- CHEM 121 *General Chemistry I* [ 3 credit hours ] **and** CHEM 123 *General Chemistry I Lab* [ 1 credit hour ]
- CHEM 122 *General Chemistry II* [ 3 credit hours ] **and** CHEM 124 *General Chemistry I Lab* [ 1 credit hour ]
- MATH 101 *Single Variable Calculus I* [ 3 credit hours ]  
    **or** MATH 111 *Fundamental Theorem of Calculus* [ 3 credit hours ]
- MATH 102 *Single Variable Calculus II* [ 3 credit hours ]  
    **or** MATH 112 *Calculus and its Applications* [ 3 credit hours ]
- STAT 280 *Elementary and Applied Statistics* [ 4 credit hours ]  
    **or** STAT 305 *Intro to Statistics for the Biosciences* [ 4 credit hours ]

**Note:** CHEM 121 and CHEM 123 can be satisfied by completing CHEM 151 *Honors General Chemistry I* [ 3 credit hours ] and CHEM 153 *Honors General Chemistry I Lab* [ 1 credit hour ]. Similarly, CHEM 122 and CHEM 124 can be satisfied by completing CHEM 152 *Honors General Chemistry II* [ 3 credit hours ] and CHEM 154 *Honors General Chemistry II Lab* [ 1 credit hour ].

#### **Core Courses**

Students must complete a total of 6 courses (18 credit hours) from the following. The core courses acquaint students with a range of environmental topics encountered by scientists, engineers, managers, and policy makers. Core courses stress the components of the global environment and their interactions, culminating with a topical seminar that integrates across the field.

- ENST 100 *Environmental Culture and Society* [ 3 credit hours ]
- ESCI 107 *Oceans & Global Change* [ 3 credit hours ]  
    **or** ESCI 109 *Oceanography* [ 3 credit hours ]  
    **or** ESCI 201 *Science Behind Global Warming* [ 3 credit hours ]
- EBIO 213 *Introduction to Experimental Ecology and Evolutionary Biology* [ 2 credit hours ]
- EBIO 325 *Ecology* [ 3 credit hours ]
- ESCI 301 *Introduction to the Earth* [ 4 credit hours ]
- ENST 4xx *SEMINAR: Topics in Environmental Science* [ 3 credit hours ]

## **Tab 2: Undergraduate Requirements continued**

### **Field Experience**

Students must complete between 1-2 courses (2-3 credit hours) depending on course selection from the following:

- ESCI 103 *Field Trips for the Earth* [ 1 credit hour ]
- EBIO 179 *Aquatic Ecology with Scuba*
- EBIO 306 *Undergraduate Independent Study (with field component)* [ 1-3 credit hours ]
- EBIO 316 *Lab Module in Ecology* [ 1 credit hour ]
- EBIO 317 *Lab Module in Behavior* [ 1 credit hour ]
- EBIO 319 *Tropical Field Biology* [ 2 credit hours ]
- EBIO 320 *Ecology and Conservation of Brazilian Wetlands Lab* [ 2 credit hours ]
- EBIO 324 *Conservation Biology Lab* [ 1 credit hour ]
- EBIO 327 *Biological Diversity* [ 1 credit hour ]
- EBIO 330 *Insect Biology Lab* [ 1 credit hour ]
- EBIO 337 *Field Bird Biology* [ 1 credit hour ]
- ESCI 380/FOTO 390 *Visualizing Nature* [ 3 credit hours ]
- ESCI 334 *Geological Field Techniques*[ 3 credit hours ]
- ESCI 390 *Geologic Field Camp*
- ESCI 391 *Earth Science Field Experience* [ 1-6 credit hours ]
- ENST 379/EBIO 379 *Underwater Ecology* [ 1 credit hour ]
- FWIS 187 *Exploring the Science and History of Houston's Bayous* [ 3 credit hours ]

### **ECOLOGY AND EVOLUTIONARY BIOLOGY MAJOR CONCENTRATION**

Students must complete a total of 3-4 courses (9-12 credit hours) as listed below to satisfy the Ecology and Evolutionary Biology major concentration requirements.

#### **Core Requirements**

Students must complete 2 courses (6 credit hours) from the following:

- EBIO 270 *Ecosystem Management* [ 3 credit hours ]
- EBIO 323/ENST 323 *Conservation Biology* [ 3 credit hours ]
- EBIO 372 *Coral Reef Ecosystems* [ 3 credit hours ]

#### **Electives**

Students must complete at least 1 course (3 credit hours) from the following. Note that the course not completed in the Core Requirements list for the Ecology and Evolutionary Biology major concentration may be completed to satisfy the concentration's Electives requirement.

- EBIO 270 *Ecosystem Management* [ 3 credit hours ]
- EBIO 321 *Animal Behavior* [ 3 credit hours ]
- EBIO 323/ENST 323 *Conservation Biology* [ 3 credit hours ]
- EBIO 326 *Insect Biology* [ 3 credit hours ]
- EBIO 329 *Animal Biology & Physiology*[ 3 credit hours ]
- EBIO 331/BIOC 331 *Biology of Infectious Diseases* [ 3 credit hours ]
- EBIO 334/BIOC 334 *Evolution* [ 3 credit hours ]
- EBIO 336 *Plant Diversity* [ 3 credit hours ]
- EBIO 338 *Design and Analysis of Biological Experiments*

## **Tab 2: Undergraduate Requirements continued**

- EBIO 365 *Introductory Phycology* [ 3 credit hours ]
- EBIO 366 *Applied Phycology* [ 3 credit hours ]
- EBIO 372 *Coral Reef Ecosystems* [ 3 credit hours ]
- ESCI 340/EBIO 340/ENST 340 *Global Biogeochemical Cycles* [ 3 credit hours ]

### **EARTH SCIENCE MAJOR CONCENTRATION**

Students must complete a total of 3-4 courses (9-12 credit hours) as listed below to satisfy the Earth Science major concentration requirements.

#### **Core Requirements**

Students must complete 2 courses (6-7 credit hours depending on course selection) from the following:

- ESCI 321 *Earth Systems and Cycles* [ 3 credit hours ]
- ESCI 323 *Earth Structure and Deformation* [ 4 credit hours ]
- ESCI 340/EBIO 340/ENST 340 *Global Biogeochemical Cycles* [ 3 credit hours ]

#### **Electives**

Students must complete at least 1 course (3 credit hours) from the following. Note that the course not completed in the Core Requirements list for the Earth Science major concentration may be completed to satisfy the concentration's Electives requirement.

- ESCI 321 *Earth System Evolution and Cycles* [ 3 credit hours ]
- ESCI 322 *Earth Chemistry and Materials* [ 4 credit hours ]
- ESCI 323 *Earth Structure and Deformation* [ 4 credit hours ]
- ESCI 340/EBIO 340/ENST 340 *Global Biogeochemical Cycles* [ 3 credit hours ]
- ESCI 380/FOTO 390 *Visualizing Nature* (if not selected for field course) [ 3 credit hours ]
- ESCI 418/CEVE 418 *Quantitative Hydrogeology* [ 3 credit hours ]
- ESCI 421 *Paleoceanography* [ 3 credit hours ]
- ESCI 425/CHEM 425/ENST 425 *Organic Geochemistry* [ 3 credit hours ]
- ESCI 430 *Principles of Trace-Element and Isotope Geochemistry* [ 3 credit hours ]
- ESCI 431 *Geomorphology* [ 3 credit hours ]
- ESCI 435 *Mechanics of Sediment Transport* [ 3 credit hours ]
- ESCI 452/CEVE 453 *Geographic Information Science* [ 3 credit hours ]
- ESCI 467 *Geomechanics* [ 3 credit hours ]

### **ADVANCED ELECTIVES**

To fulfill the remaining ENSC major requirements for the B.A. degree, students must complete 1 course (3-4 credit hours depending on course selection) from each of the following areas for a total of 3 courses (9-10 credit hours depending on course selection) to enhance breadth. Students may also petition to complete alternative courses to be applied toward the Advanced Electives requirement.

#### **Social Sciences**

Students must complete 1 course (3 credit hours) from the following:

- ANTH 332/ENST 332 *The Social Life of Clean Energy* [ 3 credit hours ]
- ANTH 348 *Anthropologies of Nature* [ 3 credit hours ]
- ANTH 381 *Medical Anthropology* [ 3 credit hours ]

## **Tab 2: Undergraduate Requirements continued**

- ECON 437/ENST 437 *Energy Economics* [ 3 credit hours ]
- ECON 480/ENST 480 *Environmental Economics* [ 3 credit hours ]
- POLI 331 *Environmental Politics and Policy* [ 3 credit hours ]
- POLI 332 *Urban Politics* [ 3 credit hours ]
- POLI 362 *Comparative Urban Politics and Policy* [ 3 credit hours ]
- POST 401 *Energy Policy* [ 3 credit hours ]
- SOCI 304/ENST 302 *Environmental Issues: Rice into the Future* [ 3 credit hours ]
- SOCI 313 *Demography* [ 3 credit hours ]
- SOCI 423 *Sociology of Food* [ 3 credit hours ]
- SOCI 367/ENST 367 *Environmental Sociology* [ 3 credit hours ]

### **Humanities and Architecture**

Students must complete 1 course (3 credit hours) from the following:

- ARCH 313/ENST 313 *Case Studies in Sustainable Design* [ 3 credit hours ]
- ARCH 322/ENST 322 *Case Studies in Sustainability* [ 3 credit hours ]
- ENGL 358 *Consumption and Consumerism* [ 3 credit hours ]
- ENGL 367/SWGS 367 *American Ecofeminism* [ 3 credit hours ]
- ENGL 459 *Literature and Ecology* [ 3 credit hours ]
- HIST 376 *Natural Disasters in the Caribbean* [ 3 credit hours ]
- HIST 425 *20th Century American Conservatism* [ 3 credit hours ]
- HUMA 202/ENST 202 *Culture, Energy and the Environment* [ 3 credit hours ]
- SPAN 403 *Literature and the Environment in Latin America* [ 3 credit hours ]

### **Natural Science and Engineering**

Students must complete 1 course (3 credit hours) from the following courses. In addition, students may complete 1 course listed in the major concentration requirements outside of the student's declared concentration.

- CEVE 302 *Sustainable Design* [ 3 credit hours ]
- CEVE 307/ENST 307/ESCI 307 *Energy and the Environment* [ 3 credit hours ]
- CEVE 308 *Air Pollution Control* [ 3 credit hours ]
- CEVE 310 *Principles of Engineering* [ 3 credit hours ]
- CEVE 401 *Environmental Chemistry* [ 4 credit hours ]
- CEVE 404 *Atmospheric Particulate Matter* [ 3 credit hours ]
- CEVE 406/ENST 406 *Introduction to Environmental Law* [ 3 credit hours ]
- CEVE 411 *Atmospheric Processes* [ 3 credit hours ]
- CEVE 412 *Hydrology and Water Resources Engineering* [ 3 credit hours ]
- CEVE 420 *Environmental Remediation and Restoration* [ 3 credit hours ]
- CEVE 434 *Fate and Transport of Contaminants in the Environment* [ 3 credit hours ]
- CEVE 484 *Environmental Risk Assessment and Human Health* [ 3 credit hours ]
- CHEM 211 *Organic Chemistry I* [ 3 credit hours ] **and** CHEM 213 *Organic Chemistry Discussion* [ 0 credit ]
- ENST 281/CHBE 281 *Engineering Sustainable Communities* [ 3 credit hours ]
- PHYS 101 *Mechanics (with Lab)* [ 4 credit hours ] **and** PHYS 103 *Mechanics Discussion* [ 0 credit ]
- PHYS 102 *Electricity and Magnetism (with Lab)* [ 4 credit hours ] **and** PHYS 104 *E & M Discussion* [ 0 credit ]



## **Tab 2: Undergraduate Requirements continued**

### **Independent Research**

In addition to the required capstone field or research experience required for the major, students are encouraged to undertake independent research on environmentally related topics as part of their degree programs, in cooperation with one or more faculty. Course options for independent research, repeatable for credit, include: EBIO 403, EBIO 404, ESCI 481. Students also can enroll in senior honors thesis programs within their concentrations, or by arrangement with other departments, and/or through the Rice Undergraduate Scholars Program. Students completing a thesis will be eligible for the Award of Distinction in Research and Creative Works. Details for each program can be found here:

- **EBIO Honors Research** (<https://biosciences.rice.edu/Content.aspx?id=2147484071>)
- **ESCI Senior Honors Thesis** (<http://earthscience.rice.edu/academics/undergraduate-program/honors-thesis>)
- **Rice Undergraduate Scholars Program** (<http://rusp.rice.edu/about/>)

### **Program Learning Outcomes for the Minor in Environmental Studies**

Upon completing the minor in Environmental Studies, students will be able to:

1. Understand the fundamental science that drives earth/natural systems, and that frames and makes comprehensible current environmental issues.
2. Evaluate the nexus of human activity with environmental processes to examine and understand sustainable (or unsustainable) practices.
3. Develop a cross-disciplinary perspective to better understand environmental issues and solutions through a focus within the natural sciences and/or engineering and a focus within the humanities, social sciences, and/or architecture.

### **Requirements for the Minor in Environmental Studies**

Students pursuing the minor in Environmental Studies (ENST) must complete:

- A minimum of 6 courses (18 credit hours) to satisfy minor requirements.
- A minimum of four courses (12 credit hours) at the 300-level or above.

The Environmental Studies minor was specifically created to provide undergraduates from a broad range of academic backgrounds with a cohesive program offering foundational literacy in the social, cultural, and scientific dimensions of environmental issues, and a cross-disciplinary holistic understanding of the challenges and solutions for creating a sustainable world. Students completing the minor will be able to synthesize frameworks, tools, and perspectives from multiple disciplines; master sustainability terminology; understand major environmental issues from multiple perspectives; develop and assess environmental solutions in an informed and logical manner; and convey knowledge and insights about environmental issues in multiple formats. Students seeking advice regarding the Environmental Studies minor may contact Dr. Dominic Boyer ([dcb2@rice.edu](mailto:dcb2@rice.edu)) or the coordinator for the Center for Energy and Environmental Research in the Human Sciences ([cenhs@rice.edu](mailto:cenhs@rice.edu)).

### **CORE REQUIREMENTS**

Students must complete a total of 2 courses (6 credit hours) as listed below to satisfy the ENST minor's Core Requirements.

## **Tab 2: Undergraduate Requirements continued**

- **Core Course**

Students must complete the following course (3 credit hours): ENST 100 *Environment, Culture and Society* [ 3 credit hours ]

### **Introductory Courses**

Students must complete 1 course (3 credit hours) from the list below. Current/former EBIO majors are eligible to substitute EBIO 325 in place of EBIO 124 to meet the introductory course requirement from the natural sciences.

- EBIO 124 *Introduction to Ecology and Evolutionary Biology* [ 3 credit hours ]
- ESCI 101 *The Earth* [ 3 credit hours ]
- ESCI 107 *Oceans and Global Change* [ 3 credit hours ]
- ESCI 109 *Oceanography* [ 3 credit hours ]

### **ELECTIVE COURSES**

To fulfill the remaining ENST minor requirements, students must complete a total of 4 additional elective courses (12 credit hours). At least 2 courses (6 credit hours) must be completed from each of the categories listed below. Given the wide range of courses at Rice related to Environmental Studies, students are encouraged to contact the Minor Director to suggest courses to include on the list of approved electives.

#### ***From the Schools of Architecture, Humanities, and Social Sciences***

Students must complete a total of 2 courses (6 credit hours) from the following:

- ANTH 332/ENST 332 *The Social Life Of Clean Energy* [ 3 credit hours ]
- ARCH 313/ENST 313 *Case Studies in Sustainable Design* [ 3 credit hours ]
- ARCH 322/ENST 322 *Case Studies in Sustainability: The Regenerative Repositioning Of New or Existing Rice Campus Buildings* [ 3 credit hours ]
- ECON 437/ENST 437 *Energy Economics* [ 3 credit hours ]
- ECON 480/ENST 480 *Environmental Economics* [ 3 credit hours ]
- ENGL 358 *Consumption & Consumerism* [ 3 credit hours ]
- ENGL 459 *Topics in Literature And Ecology* [ 3 credit hours ]
- FOTO 390/ESCI 380 *Visualizing Nature* [ 3 credit hours ]
- HART 302 *From the Sublime to the Sustainable: Art, Architecture And Nature* [ 3 credit hours ]
- HIST 425 *20th Century American Conservation Movement* [ 3 credit hours ]
- HUMA 202/ENST 202 *Culture, Energy and the Environment: An Introduction To Energy Humanities* [ 3 credit hours ]
- SOCI 304/ENST 302 *Environmental Issues: Rice into the Future* [ 3 credit hours ]
- SPAN 403 *Literature And the Environment in Latin America* [ 3 credit hours ]

#### ***From the Schools of Engineering and Natural Sciences***

Students must complete a total of 2 courses (6 credit hours) from the following:

- CEVE 302/ENGI 302 *Sustainable Design* [ 3 credit hours ]
- CEVE 307/ENST 307 / ESCI 307 *Energy and the Environment* [ 3 credit hours ]
- CEVE 310 *Principles of Environmental Engineering* [ 3 credit hours ]
- CEVE 406/ENST 406 *Introduction to Environmental Law* [ 3 credit hours ]
- CHBE 281/ENST 281 *Engineering Sustainable Communities* [ 3 credit hours ]
- EBIO 204/ENST 204 *Environmental Sustainability: Design & Practice Of Community Agriculture* [ 1 credit hour ]

**Tab 2: Undergraduate Requirements continued**

- EBIO 270 *Ecosystem Management* [ 3 credit hours ]
- EBIO 319 *Tropical Field Biology* [ 2 credit hours ]
- EBIO 320 *Ecology And Conservation of Brazilian Wetland Laboratory* [ 2 credit hours ]
- EBIO 323/ENST 323 *Conservation Biology* [ 3 credit hours ]
- EBIO 325 *Ecology* [ 3 credit hours ]
- EBIO 327 *Biological Diversity Lab* [ 1 credit hour ]
- EBIO 329 *Animal Biology & Physiology* [ 3 credit hours ]
- EBIO 372 *Coral Reef Ecosystems* [ 3 credit hours ]
- EBIO 379/ENST 379/LPCR 379 *Lab Module in Aquatic Ecology with Scuba* [ 1 credit hour ]
- ELEC 365/MSNE 365 *Nanomaterials for Energy* [ 3 credit hours ]
- ESCI 321 *Earth System Evolution and Cycles* [ 4 credit hours ]
- ESCI 340/EBIO 340/ENST 340 *Global Biogeochemical Cycles* [ 3 credit hours ]
- ESCI 380/FOTO 390 *Visualizing Nature* [ 3 credit hours ]
- ESCI 407 *Introduction To Biogeochemistry II* [ 3 credit hours ]
- ESCI 425/CHEM 425/ENST 425 *Organic Geochemistry* [ 3 credit hours ]
- ESCI 450/CEVE 450 *Remote Sensing* [ 3 credit hours ]
- ESCI 452 *GIS for Geoscientists* [ 3 credit hours ]

## Appendix 6 – Curriculum Map and Assessment Plan

*\*The Rice Office of Institutional Effectiveness is working with the proposal proponents to develop these products, with anticipated delivery in early April 2016. We will distribute these to the committee when they have been prepared.*

### Degree Map

ENSC BS degree map	Needed Credits	132
	Total Credits	132

#### Yr 1

Fall	14		Spring	16	
MATH 101	3	Calculus I	MATH 102	3	Calculus II
CHEM 121	4	General Chemistry I with Lab	CHEM 122	4	General Chemistry II with Lab
ENST 100	3	Environmental Culture and Society	ESCI 109	3	Oceanography
LPAP	1	Lifetime Physical Activity Elective	FWIS	3	First Year Writing-Intensive Seminar
OPEN	3	Open Elective	DIST	3	Distribution

#### Yr 2

Fall	16		Spring	17	
BIOC 201	3	Introductory Biology I	EBIO 202	3	Introductory Biology II
PHYS 125	4	General Physics I (with Lab)	PHYS 126	4	General Physics II (with Lab)
ESCI 321	4	Earth Systems and Cycles	EBIO 325	3	Ecology
EBIO 213	2	Intro Lab in EEB	ESCI 323	4	Earth Structure and Deformation
DIST	3	Distribution	DIST	3	Distribution

#### Yr 3

Fall	18		Spring	18	
CEVE 310	3	Principles of Environmental Engineering	ESCI 334	3	Geological Field Techniques
ESCI 340	3	Global Biogeochemical Cycles	DIST	3	Distribution
DIST	3	Distribution	OPEN	3	Open Elective
OPEN	3	Open Elective	OPEN	3	Open Elective
OPEN	3	Open Elective	OPEN	3	Open Elective
OPEN	3	Open Elective	OPEN	3	Open Elective

## Yr 4

Fall	18		Spring	15	
ENST 4xx	3	SEMINAR: Topics in Environmental Science	ECON 480	3	Environmental Economics
ESCI 391	3	Earth Science Field Experience	HIST 376	3	Natural Disasters in the Caribbean
CEVE 307	3	Energy and Environment	OPEN	3	Open Elective
DIST	3	Distribution	OPEN	3	Open Elective
OPEN	3	Open Elective	OPEN	3	Open Elective
OPEN	3	Open Elective			

## Appendix 7 - Sustainability Course Inventory

Rice offers more than 125 courses focused on sustainability and the environment and/or on understanding or solving one or more major sustainability or environmental challenges. In addition, Rice offers more than 400 courses that include sustainability and environmental topics as a component of the course, although these are not their primary objectives. Together, these courses span 44 of 67 academic departments, spanning most of the schools in the university. Combined, these courses comprise nearly 10% of all undergraduate and graduate course offerings.

An inventory of courses was conducted during the summer of 2015 by undergraduate Ansley Jones on behalf of Richard Johnson for Rice's Administrative Center for Sustainability and Energy Management (ACSEM). The list was synopsised and updated in support of this proposal to update and transfer the ENST Environmental Science major to Natural Sciences. In the interest of space, only the course titles are listed below. Richard Johnson at ACSEM can provide the methodology for the inventory upon request.

### *Category A: Social Sciences*

- ANTH & ESCI 330-GEOARCHAEOLOGY
- ANTH 332/ 532-THE SOCIAL LIFE OF CLEAN ENERGY
- ANTH 344/544-CITY/CULTURE
- ANTH 348/548-ANTHROPOLOGIES OF NATURE
- ANTH 355/555-LANDSCAPE ARCHAEOLOGY
- ANTH 358/558-THE FOURTH WORLD: ISSUES OF INDIGENOUS PEOPLE
- ANTH 381/581 MEDICAL ANTHROPOLOGY
- ANTH 386/586-MEDICAL ANTHROPOLOGY OF FOOD AND HEALTH
- ANTH 389/589-THE ARCHAEOLOGY OF FOOD
- ASIA 329/SOCI 372/SWGS 322-HUMAN DEVELOPMENT IN GLOBAL AND LOCAL COMMUNITIES
- ECON & ENST 437/601-ENERGY ECONOMICS
- ECON 447/547-ADVANCED TOPICS IN ENERGY ECONOMICS
- ECON 461-URBAN ECONOMICS
- ECON & ENST 480-ENVIRONMENTAL ECONOMICS
- GLHT & POST 411-INTERGRATED APPROACHES TO SUSTAINABLE DEVELOPMENT
- HUMA/SOCI 371-POVERTY, JUSTICE, AND HUMAN CAPABILITIES
- POLI 330-MINORITY POLITICS
- POLI & ENST 331-ENVIRONMENTAL POLITICS AND POLICY
- POLI 332-URBAN POLITICS
- POLI & ENST 441-COMMON PROPERTY RESOURCES
- POST 401/501-ENERGY POLICY
- PSYC 435-POLLUTION AND PSYCHOLOGICAL DEVELOPMENT
- SOCI 301-SOCIAL INEQUALITY
- SOCI 304 & ENST 302-ENVIRONMENTAL ISSUES: RICE INTO THE FUTURE
- SOCI 308-HOUSTON: THE SOCIOLOGY OF A CITY
- SOCI 310-URBAN SOCIOLOGY
- SOCI 313/513-DEMOGRAPHY
- SOCI 315-POPULATION AND SOCIETY
- SOCI & ENST 316-ENVIRONMENTAL FILM
- SOCI 342-SOCIOLOGY OF GLOBALIZATION
- SOCI 343/543-RACE, SOCIETY AND POPULATION CHANGE

- SOCI 350-URBAN TRANSPORTATION
- SOCI & ENST 367-ENVIRONMENTAL SOCIOLOGY
- SOCI & ENST 415-THE ENVIRONMENTAL MOVEMENT
- SOCI 425-POPULATION HEALTH SEMINAR
- SOCI 470-INEQUALITY AND URBAN LIFE

*Category B: Humanities and Architecture*

- ARCH 105/ENST 100-ENVIRONMENT, CULTURE AND SOCIETY
- ARCH & ENST 313/613-CASE STUDIES IN SUSTAINABLE DESIGN
- ARCH 314/514-TECHNOLOGY III - THE ENVELOPE
- ARCH 316/516-TECHNOLOGY IV -THE ENVIRONMENT
- ARCH 317/617-LANDSCAPE AND SITE STRATEGIES FOR HOUSTON
- ARCH & ENST 321/621-CASE STUDIES IN SUSTAINABILITY: THE HIGH PERFORMANCE BUILDING
- ARCH & ENST 322/622-CASE STUDIES IN SUSTAINABILITY: THE REGENERATIVE REPOSITIONING OF NEW OR EXISING RICE CAMPUS BUILDINGS
- ARCH 401-ADVANCED TOPICS IN ARCHITECTURE - THE METROPOLIS
- ARCH 455-HOUSING AND URBAN PROGRAMS: ISSUES IN POLICY
- ARCH 457/657-AFFORDABLE HOUSING: A PRACTICUM IN DEVELOPMENT
- ARCH 462 & HART 467-NATURE IN-VITRO: BODIES, GARDENS AND BUILT FORMS
- ASIA 329/SOCI 372/SWGS 322-HUMAN DEVELOPMENT IN GLOBAL AND LOCAL COMMUNITIES
- ASIA & FILM 438-GLOBAL ENVIRONMENTAL MEDIA
- ASIA 488-ASIA AND ENERGY
- CHIN 314-CONTEMPORARY CHINA: CULTURE AND SOCIETY SINCE 1978
- ENGL 269/ENST 265-GREEN WORLDS: SCIENCE FICTION AND THE ENVIRONMENT
- ENGL 358-CONSUMPTION AND CONSUMERISM
- ENGL & ENST 368-LITERATURE AND THE ENVIRONMENT
- ENGL 369/SWGS 329-THE AMERICAN WEST AND ITS OTHERS
- ENGL 459-TOPICS IN LITERATURE AND ECOLOGY
- ENGL 472-NATIVE AMERICAN LITERATURE
- ENST 301-INTRODUCTION TO THE ENVIRONMENT: ENVIRONMENTAL HISTORY AND ENVIRONMENTAL LITERATURE
- ESCI 380 & FOTO 390-VISUALIZING NATURE
- FILM 321-LIFE IN REAL-TIME
- FSEM/HIST 110-DEEP HISTORY: FROM THE ORIGINS OF HUMANITY TO THE PRESENT
- FWIS 135-GLOBAL AND LOCAL ECOLOGIES IN 19TH CENTURY BRITIAN
- FWIS 143-SUSTAINABILITY IN AMERICA
- FWIS 146-EARTH SCIENCE IN ACTION
- FWIS 169-WHAT ARE HUMAN RIGHTS?
- FWIS 170-PERSPECTIVES ON GLOBAL HEALTH
- FWIS 179-AMERICAN LITERATURE IN THE ERA OF ENVIRONMENTALISM
- FWIS 187-EXPLORING THE SCIENCE AND HISTORY OF HOUSTON'S BAYOUS
- FWIS 188-WATER AND SOCIETY
- HIST 125-SUBURBANIZING THE COUNTRYSIDE: A U.S. HISTORY, 1877-2010
- HIST 209-AMERICAN URBAN HISTORY, 1609 TO TODAY
- HIST 321-US ENVIRONMENTAL HISTORY
- HIST 328-POVERTY AND SOCIAL JUSTICE IN LATIN AMERICA

- HIST 358-HUMANITARIANISM SINCE THE 19TH CENTURY TO THE PRESENT
- HIST 369-GERMS, CITIES, AND DOCTORS IN LATIN AMERICA
- HIST 376-NATURAL DISASTERS IN THE CARIBBEAN
- HIST & ENST 399-THE ROOTS OF UNSUSTAINABILITY: PROGRESS, GROWTH AND TECHNOLOGY IN THE TWENTIETH CENTURY
- HIST 419-THE COLD WAR AND CLIMATE CHANGE
- HIST 425-20TH CENTURY AMERICAN CONSERVATION MOVEMENT
- HIST 455-HISTORY OF HUMAN RIGHTS
- HIST 479-HISTORY: BIOLOGICAL APPROACHES
- HIST 481-HEALTH AND WELFARE DURING INDUSTRIALIZATION
- HART 302/568-FROM THE SUBLIME TO THE SUSTAINABLE: ART, ARCHITECTURE AND NATURE
- HART 465-LATIN AMERICAN BODIES: ON MODERNISM
- HUMA & ENST 202-CULTURE, ENERGY, AND THE ENVIRONMENT: AN INTRODUCTION TO ENERGY HUMANITIES
- HUMA 203-CULTURES OF FUEL
- HUMA 320-FROM PHYSICS LABS TO OIL FUTURES: SOCIAL STUDIES OF ENERGY
- HURC 302-HURC CULTURES OF ENERGY UNDERGRADUATE COURSE
- PHIL 315-ETHICS, MEDICINE, AND PUBLIC POLICY
- SPAN 402-THE CITY IN LATIN AMERICA
- SPAN 403-LITERATURE AND THE ENVIRONMENT IN LATIN AMERICA
- SWGS 308-THE FUTURE OF FOOD: FEMINIST, QUEER, AND CRITICAL APPROACHES
- SWGS/ASIA/HIST 384-MODERN GIRL AND ASIA IN THE WORLD
- SWGS 422-GENDER AND GLOBAL ECONOMIC JUSTICE
- SWGS 470-ADVANCED SEMINAR IN POVERTY, JUSTICE, AND CAPABILITIES

*Category C: Natural Sciences*

- ANTH & ESCI 330-GEOARCHAEOLOGY
- ASTR 243-LIVING WITH A STAR: THE PHYSICS OF THE SUN-EARTH CONNECTION
- BIOC 122-FUNDAMENTAL CONCEPTS IN BIOLOGY
- BIOC & BIOE & GLHT 361-METABOLIC ENGINEERING FOR GLOBAL HEALTH ENVIRONMENTS
- BIOC 424/524-MICROBIOLOGY & BIOTECHNOLOGY
- BIOC 425/525-PLANT MOLECULAR GENETICS AND DEVELOPMENT
- CHEM 395-ADVANCED MODULE IN GREEN CHEMISTRY
- CHEM & ENST & ESCI 425-ORGANIC GEOCHEMISTRY
- EBIO & ESCI & ENST 113-ENVIRONMENTAL CRISIS SEMINAR
- EBIO 124-INTRODUCTION TO ECOLOGY AND EVOLUTIONARY BIOLOGY
- EBIO & ENST & LPCR 179-INTRODUCTION TO AQUATIC ECOLOGY WITH SCUBA
- EBIO 204-ENVIRONMENTAL SUSTAINABILITY: THE DESIGN & PRACTICE OF COMMUNITY AGRICULTURE
- EBIO 213-INTRO LAB MOD ECOLOGY AND EVOLUTIONARY BIOLOGY
- EBIO 270/570-ECOSYSTEM MANAGEMENT
- EBIO 319-TROPICAL FIELD BIOLOGY
- EBIO 320-ECOLOGY AND CONSERVATION OF BRAZILIAN WETLANDS LABORATORY
- EBIO & ENST 323/523-CONSERVATION BIOLOGY
- EBIO 327-BIOLOGICAL DIVERSITY
- EBIO 372-CORAL REEF ECOSYSTEMS



- EBIO 381-ECOLOGY AND EVOLUTIONARY BIOLOGY OUTREACH DEVELOPMENT
- ENST 315-ENVIRONMENTAL HEALTH
- ESCI & ENST 101-THE EARTH
- ESCI & ENST 102-HISTORY OF THE EARTH AND LIFE
- ESCI 106-INVESTIGATING EARTH'S SURFACE
- ESCI 107-OCEANS AND GLOBAL CHANGE
- ESCI 108-CRISES OF THE EARTH
- ESCI 110-ENERGY, THE ENVIRONMENT, AND SOCIETY
- ESCI & ENST 114-NATURAL DISASTER SEMINAR
- ESCI & ENST 201-THE SCIENCE BEHIND EARTH GLOBAL WARMING AND CLIMATE CHANGE
- ESCI 321- EARTH SYSTEM EVOLUTION AND CYCLES
- ESCI & EBIO & ENST 340-GLOBAL BIOGEOCHEMICAL CYCLES
- ESCI 380 & FOTO 390-VISUALIZING NATURE
- ESCI 421/621-PALEOCEANOGRAPHY
- ESCI 422/622-PALEOCLIMATE AND MODERN CLIMATE CHANGE
- ESCI 424-EARTH SCIENCE AND THE ENVIRONMENT
- ESCI 431/631-GEOMORPHOLOGY
- ESCI 435/635-MECHANICS OF SEDIMENT TRANSPORT
- HEAL 222-PRINCIPLES OF PUBLIC AND COMMUNITY HEALTH
- HEAL 380/580-DISPARITIES IN HEALTH IN AMERICA
- HEAL 485-SEMINAR ON INTERNATIONAL HEALTH PROBLEMS

### *Category D: Engineering*

- BIOE 360-APPROPRIATE DESIGN FOR GLOBAL HEALTH
- BIOC & BIOE & GLHT 361-METABOLIC ENGINEERING FOR GLOBAL HEALTH ENVIRONMENTS
- CEVE 101-FUNDAMENTALS OF CIVIL AND ENVIRONMENTAL ENGINEERING
- CEVE & ENST & ESCI 307/507-ENERGY AND THE ENVIRONMENT
- CEVE 308/508-INTRODUCTION TO AIR POLLUTION CONTROL
- CEVE 310/510-PRINCIPLES OF ENVIRONMENTAL ENGINEERING
- CEVE 313-UNCERTAINTY AND RISK IN URBAN INFRASTRUCTURES
- CEVE 314 & BIOE 365-SUSTAINABLE WATER PURIFICATION FOR THE DEVELOPING WORLD
- CEVE 320/529-ETHICS AND ENGINEERING LEADERSHIP
- CEVE 401/501-CHEMISTRY FOR ENVIRONMENTAL ENGINEERING AND SCIENCE LAB
- CEVE 404/504-ATMOSPHERIC PARTICULATE MATTER
- CEVE & ENST 406-INTRODUCTION TO ENVIRONMENTAL LAW
- CEVE 411/511-ATMOSPHERIC PROCESSES
- CEVE 412-HYDROLOGY AND WATER RESOURCES ENGINEERING
- CEVE & ESCI 418-QUANTITATIVE HYDROGEOLOGY
- CEVE 420/520-ENVIRONMENTAL REMEDIATION RESTORATION
- CEVE 424/524-TIME-DEPENDENT SYSTEM RELIABILITY METHODS AND APPLICATIONS
- CEVE 434/534-FATE AND TRANSPORT OF CONTAMINANTS IN THE ENVIRONMENT
- CEVE 452-URBAN TRANSPORTATION SYSTEMS
- CEVE 460/560-BRIDGE ENGINEERING AND EXTREME EVENTS
- CEVE 484/684 & STAT 484- ENVIRONMENTAL RISK ASSESSMENT & HUMAN HEALTH
- CHBE 100-INTRODUCTION TO CHEMICAL AND BIOMOLECULAR ENGINEERING
- CHBE & ENST 281-ENGINEERING SUSTAINABLE COMMUNITIES
- CHBE & COMP 381-ICT DESIGNS FOR A SUSTAINABLE WORLD
- CHBE 382/582-INNOVATION AND SUSTAINABILITY
- CHBE 404-CHEMICAL ENGINEERING DESIGN
- ELEC 201-INTRODUCTION TO ENGINEERING DESIGN
- ELEC & MSNE 365-NANOMATERIALS FOR ENERGY
- ELEC 438-WIRELESS NETWORKING FOR UNDER-RESOURCED URBAN COMMUNITIES
- ENGI 120-INTRODUCTION TO ENGINEERING DESIGN
- ENGI 128-INTRODUCTION TO ENGINEERING SYSTEMS
- ENGI 205-TOPICS IN GLOBAL LEADERSHIP & TECHNOLOGY - INNOVATE: TECHNOLOGY GLOBALIZATION & INNOVATION IN CHINA
- ENGI 220-INTRODUCTION TO ENGINEERING DESIGN II
- ENGI & CEVE 302/502-SUSTAINABLE DESIGN
- ENGI 314-RCEL SEMINAR
- GLHT 201-BIOENGINEERING AND WORLD HEALTH
- GLHT & POST 411-INTERGRATED APPROACHES TO SUSTAINABLE DEVELOPMENT
- GLHT 448-TECHNOLOGY COMMERCIALIZATION IN DEVELOPING COUNTRIES FOR ENGINEERING
- GLHT 451-GLOBAL HEALTH DESIGN CHALLENGES I

- GLHT 452-GLOBAL HEALTH DESIGN CHALLENGES II
- MECH 408-CAPSTONE DESIGN PROJECT II
- MECH 471-APPLICATIONS OF THERMODYNAMICS
- STAT 485/685-ENVIRONMENTAL STATISTICS AND DECISION MAKING

## **II. The Environmental Science Major Assessment Plan**

## Environmental Sciences Major Assessment Plan

The following plan is intended to guide the assessment of the effectiveness of the Program Learning Outcomes (PLOs) of the Environmental Sciences Major (BS and BA) by the Environmental Sciences (ENSC) Advisory Committee. The Assessment Plan is divided up into sections based on each PLO. The PLOs for the Environmental Sciences Major are as follows:

- PLO 1: Students will demonstrate foundational knowledge in the natural sciences that is fundamental to the Environmental Sciences. (For the BA, this understanding should be adequate to support incorporation of environmental science knowledge into the study and practice of a field other than environmental science).
- PLO 2: Students will be able to integrate knowledge of natural and applied sciences to understand complex natural systems and cycles.
- PLO 3: Students will be able to synthesize knowledge from natural sciences and engineering and apply it to the study of the environment.
- PLO 4: Students will understand environmental issues from a scientific perspective and be able to solve issues using a variety of interdisciplinary perspectives (e.g., social sciences, economics, humanities, and/or architecture).
- PLO 5: Students will be able to apply methods and theories to develop and test hypotheses or to propose and analyze solutions to environmental issues, using sound experimental, statistical, and/or design practices (Bachelor of Science only).

Within each section for each PLO, the Assessment Plan identifies:

- **Embedded Location** describing where the student work to be assessed for each PLO originate.
- **Materials** describing the course materials to be examined to determine whether the students have achieved the PLO.
- **Measure(s)** describing how and with what rubric the materials will be assessed to see if students have achieved the PLO.
- **Standard** defining how success will be measured collectively to determine whether students have achieved the PLO.
- **Responsible** identifying who is responsible for assessing the student work to determine if it meets the expectations.
- **Timeline** describing which outcomes are going to be assessed in which year.
- **Who Receives Results and Who Is Responsible for Follow-Up** listing the parties who will receive a copy of the assessment results and who will responsible for implementing changes and updates.

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## PLO 1 Assessment Plan

**PLO 1: Students will demonstrate foundational knowledge in the natural sciences that is fundamental to the Environmental Sciences. (For the BA, this understanding should be adequate to support incorporation of environmental science knowledge into the study and practice of a field other than environmental science).**

### **EMBEDDED LOCATION:**

- ESCI 301 and EBIO 202.

### **MATERIALS:**

- Term exams (two per semester) in ESCI 301; lab reports for ESCI 301, specifically those on surface processes, groundwater flow, and environmental issues. Final exam in EBIO 202.

### **MEASURE:**

- Prior to the start of the academic year, the ENSC Advisory Committee will share a rubric (see ***PLO 1, Year 1 Rubric 1***) with the faculty of the courses ESCI 301 and EBIO 202 to ensure that the competencies specific to PLO 1 are embedded within the design of the course. After completion of the ESCI 301 and EBIO 202 courses, the Advisory Committee will review the effectiveness of the courses by sampling the materials described above. For ESCI 301, they will use selected final exam questions and lab reports to assess student comprehension of geologic processes that influence environmental processes and events. For EBIO 202, the Advisory Committee will use selected final exam questions to assess the extent to which students understand basic ecological principles and have a working knowledge of the diversity of life. If the Advisory Committee determines that the competencies are not being met, they will work with the faculty to adjust the content of the courses accordingly.

### **STANDARD:**

- For Rubric 1, the average response from faculty should be at least a 2 across each course reviewed. For the sampled material, more than 75% of students must demonstrate necessary understanding. The standard is set by the department and can be revised.

### **RESPONSIBLE:**

- ENSC Advisory Committee

### **TIMELINE:**

- Year 1

### **WHO RECEIVES RESULTS AND WHO IS RESPONSIBLE FOR FOLLOW-UP:**

- Results gathered by the ENSC Advisory Committee and their accompanying recommendations will go to the ENST Faculty Steering Committee for review. The ENSC Advisory Committee will be responsible for implementing program changes in concert with the faculty of individual courses.

**Rice University  
 Environmental Science (ENSC) Advisory Committee  
 ENSC MAJOR PLO 1 – Foundational Knowledge  
 Year 1, Rubric 1**

**Course Number and Title:**

**Instructor(s):**

**Semester and Year:**

Using a 4-point scale, please rate whether based on a review of the sample materials the students in this course demonstrated the following knowledge and skills. A zero indicates that students did not demonstrate this knowledge and/or skill, and a three indicates that this knowledge and/or skill was clearly demonstrated.

**Through some form of oral or written communication, students who complete this course will demonstrate that they can:**

<b>Theory</b>	
Identify and apply relevant theories, principles, laws, or models to a specific problem.	0    1    2    3
Explain how a specific problem relates to broader influences and/or larger questions.	0    1    2    3
<b>Research or Design</b>	
Identify and characterize the significant dimensions and scope of a problem.	0    1    2    3
Evaluate evidence and scholarship in a field of inquiry by identifying and accessing relevant information, and evaluating its validity.	0    1    2    3

## **PLO 2 Assessment Plan**

**PLO 2: Students will be able to integrate knowledge of natural and applied sciences to understand complex natural systems and cycles.**

### **EMBEDDED LOCATION:**

- ESCI 321, ESCI 340, EBIO 213, and EBIO 323.

### **MATERIALS:**

- Final papers from ESCI 340, exams from ESCI 320, lab report #3 and #4 (on differences in abiotic factors and diversity among local ecosystems) for EBIO 213, and materials to be determined for EBIO 323.

### **MEASURE:**

- Prior to the start of the academic year, the ENSC Advisory Committee will share a rubric (see ***PLO 2, Year 2 Rubric 1***) with the faculty of the courses ESCI 321, ESCI 340, EBIO 213, and EBIO 323 to ensure that the competencies specific to PLO 2 are embedded within the design of the course. After completion of the courses, the Advisory Committee will review the effectiveness of the courses by sampling the materials described above using a rubric as a guide (see ***PLO 2, Year 2 Rubric 2***) to determine whether students are demonstrating the competencies specific to PLO 2. If the Advisory Committee determines that the competencies are not being met, they will work with the faculty to adjust the content of the courses accordingly.

### **STANDARD:**

- For Rubric 1, the average response from faculty should be at least a 2 across each course reviewed. For Rubric 2, at least 75% of the students must score greater than or equal to 2 on the sampled work. The standard is set by the department and can be revised.

### **RESPONSIBLE:**

- ENSC Advisory Committee

### **TIMELINE:**

- Year 2

### **WHO RECEIVES RESULTS AND WHO IS RESPONSIBLE FOR FOLLOW-UP:**

- Results gathered by the ENSC Advisory Committee and their accompanying recommendations will go to the ENST Faculty Steering Committee for review. The ENSC Advisory Committee will be responsible for implementing program changes in concert with the faculty of individual courses.



**Rice University  
 Environmental Science (ENSC) Advisory Committee  
 ENSC MAJOR PLO 2 – Understand Complex Natural Systems and Cycles  
 Year 2, Rubric 1**

**Course Number and Title:**

**Instructor(s):**

**Semester and Year:**

Using a 4-point scale, please rate whether based on a review of the sample materials the students in this course demonstrated the following knowledge and skills. A zero indicates that students did not demonstrate this knowledge and/or skill, and a three indicates that this knowledge and/or skill was clearly demonstrated.

**Through some form of oral or written communication, students who complete this course will demonstrate that they can:**

<b>Theory</b>	
Identify and apply relevant theories, principles, laws, or models to a specific problem.	0    1    2    3
Explain how a specific problem relates to broader influences and/or larger questions.	0    1    2    3
<b>Research or Design</b>	
Identify and characterize the significant dimensions and scope of a problem.	0    1    2    3
Evaluate evidence and scholarship in a field of inquiry by identifying and accessing relevant information, and evaluating its validity.	0    1    2    3
Apply ideas and/or information synthesized from multiple disciplines to a specific problem.	0    1    2    3
<b>Communication</b>	
Identify appropriate audiences and methods of communication for formal presentations and informal interactions.	0    1    2    3

**Rice University  
 Environmental Science (ENSC) Advisory Committee  
 ENSC MAJOR PLO 2 – Understand Complex Natural Systems and Cycles  
 Year 2, Rubric 2**

**Course Number and Title:**

**Instructor(s):**

**Semester and Year:**

Using a 4-point scale, please rate whether based on a review of the sample materials the students in this course demonstrated the following knowledge and skills. A zero indicates that students did not demonstrate this knowledge and/or skill, and a three indicates that this knowledge and/or skill was clearly demonstrated.

**Through a review of a sampling of student work, did students who completed this course demonstrate the ability to:**

<b>Theory</b>	
Identify and apply relevant theories, principles, laws, or models to a specific problem.	0    1    2    3
Explain how a specific problem relates to broader influences and/or larger questions.	0    1    2    3
<b>Research or Design</b>	
Identify and characterize the significant dimensions and scope of a problem.	0    1    2    3
Evaluate evidence and scholarship in a field of inquiry by identifying and accessing relevant information, and evaluating its validity.	0    1    2    3
Apply ideas and/or information synthesized from multiple disciplines to a specific problem.	0    1    2    3
<b>Communication</b>	
Identify appropriate audiences and methods of communication for formal presentations and informal interactions.	0    1    2    3

## **PLO 3 Assessment Plan**

**PLO 3: Students will be able to synthesize knowledge from natural sciences and engineering and apply it to the study of the environment.**

### **EMBEDDED LOCATION:**

- Within the elective track for natural sciences and engineering, the ENSC Advisory Committee will draw samples from the two most commonly completed elective courses originating in engineering and the two most commonly completed elective courses originating in the natural sciences, for a total of four courses reviewed.

### **MATERIALS:**

- Quizzes, tests, projects, presentations, papers, designs, lab modules, problem sets, etc. (varies by course) as appropriate for the selected elective courses within the natural sciences/engineering elective track.

### **MEASURE:**

- After identifying the courses for review, the Advisory Committee will share a rubric (see ***PLO 3, Year 3 Rubric 1***) with the faculty for these courses to ensure that the competencies specific to PLO 3 are embedded within the design of the course. The Advisory Committee will work with the faculty to identify the appropriate works to sample for evaluation at the end of the courses. After completion of the courses, the ENSC Advisory Committee will review the effectiveness of the courses through the aforementioned samples using a rubric as a guide (see ***PLO 3, Year 3 Rubric 2***) to determine whether students are demonstrating the competencies specific to PLO 3. If the Advisory Committee determines that the competencies are not being met, they will work with the faculty to adjust the content of the foundational course accordingly, or take other corrective action as necessary to ensure that the learning outcome is met.

### **STANDARD:**

- Elective courses: For Rubric 1, the average response from faculty should be at least a 1.5 across each course reviewed. For Rubric 2, the sample average of student work must be greater than or equal to 1.75. The standard is set by the department and can be revised.

### **RESPONSIBLE:**

- ENSC Advisory Committee

### **TIMELINE:**

- Year 3

### **WHO RECEIVES RESULTS AND WHO IS RESPONSIBLE FOR FOLLOW-UP:**

- Results gathered by the ENSC Advisory Committee and their accompanying recommendations will go to the ENST Faculty Steering Committee for review. The ENSC Advisory Committee will be responsible for implementing program changes in concert with the faculty of individual courses.

**Rice University  
Environmental Science (ENSC) Advisory Committee  
ENSC MAJOR PLO 3 – Synthesize/Apply Knowledge from NatSci/ENGI  
Year 3, Rubric 1**

**Course Number and Title:**  
**Instructor(s):**  
**Semester and Year:**

Using a 4-point scale please rate your expectation that students in this course will be able to demonstrate the following knowledge and skills. A zero indicates that students are not expected to demonstrate this knowledge and/or skill, and a three indicates that this knowledge and/or skill is a central component of the course.

**Through some form of oral or written communication, students who complete this course will demonstrate that they can:**

<b>Theory</b>				
Identify and apply relevant theories, principles, laws, or models from the natural sciences or engineering to a specific environmental problem.	0	1	2	3
<b>Research or Design</b>				
Identify and characterize the significant dimensions and scope of an environmental problem.	0	1	2	3
Select and apply an inquiry method, strategy, or design that takes the student from problem to solution in the study of an environmental topic.	0	1	2	3
Compare alternative solutions and select more practical or realistic ones for an environmental problem.	0	1	2	3
Apply ideas and/or information synthesized from engineering or natural science disciplines to specific environmental problems or challenges.	0	1	2	3
Work as self-directed researchers and/or problem solvers in addressing an environmental challenge or a problem with a meaningful environmental component.	0	1	2	3

**Rice University  
 Environmental Science (ENSC) Advisory Committee  
 ENSC MAJOR PLO 3 – Synthesize/Apply Knowledge from NatSci/ENGI  
 Year 3, Rubric 2**

**Course Number and Title:**

**Instructor(s):**

**Semester and Year:**

Using a 4-point scale, please rate whether based on a review of the sample materials the students in this course demonstrated the following knowledge and skills. A zero indicates that students did not demonstrate this knowledge and/or skill, and a three indicates that this knowledge and/or skill was clearly demonstrated.

**Through a review of a sampling of student work, did students who completed this course demonstrate the ability to:**

<b>Theory</b>	
Identify and apply relevant theories, principles, laws, or models from the natural sciences or engineering to a specific environmental problem.	0    1    2    3
<b>Research or Design</b>	
Identify and characterize the significant dimensions and scope of an environmental problem.	0    1    2    3
Select and apply an inquiry method, strategy, or design that takes the student from problem to solution in the study of an environmental topic.	0    1    2    3
Compare alternative solutions and select more practical or realistic ones for an environmental problem.	0    1    2    3
Apply ideas and/or information synthesized from engineering or natural science disciplines to specific environmental problems or challenges.	0    1    2    3
Work as self-directed researchers and/or problem solvers in addressing an environmental challenge or a problem with a meaningful environmental component.	0    1    2    3

## PLO 4 Assessment Plan

**PLO 4: Students will understand environmental issues from a scientific perspective and be able to solve issues using a variety of interdisciplinary perspectives (e.g., social sciences, economics, humanities, and/or architecture).**

### **EMBEDDED LOCATION:**

1. ENST 100
2. The two most commonly completed elective courses within each of the elective tracks for:
  - a. humanities and architecture;
  - b. social sciences.

### **MATERIALS:**

1. Final papers from ENST 100.
2. Quizzes, tests, projects, presentations, papers, designs, lab modules, problem sets, etc. (varies by course) as appropriate for the two most commonly completed elective courses within each of the two aforementioned elective tracks.

### **MEASURE:**

- ENST 100: Prior to the start of the academic year, the ENSC Advisory Committee will share a rubric (see ***PLO 4, Year 4 Rubric 1a***) with the faculty of the foundational course ENST 100 “Environment, Culture, and Society” to ensure that the competencies specific to PLO 4 are embedded within the design of the course. Given that the faculty members for ENST 100 are also within the oversight structure of the major, we anticipate this process to run smoothly.

After completion of the ENST 100 course, the Advisory Committee will review the effectiveness of ENST 100 “Environment, Culture, and Society” by sampling submitted student final papers using a rubric as a guide (see ***PLO 4, Year 4 Rubric 1b***) to determine whether students are demonstrating the competencies specific to PLO 4. If the Advisory Committee determines that the competencies are not being met, they will work with the ENST 100 faculty to adjust the content of the foundational course accordingly.

- The Advisory Committee will review ENSC major student enrollment in elective courses and identify the two most commonly completed elective courses within each of the two aforementioned elective tracks. The Advisory Committee will then share a rubric (see ***PLO 4, Year 4 Rubric 2a***) with the faculty for these courses to ensure that the competencies specific to PLO 4 are embedded within the design of the course. The Advisory Committee will work with the faculty to identify the appropriate works to sample for evaluation at the end of the courses. After completion of the courses, the Advisory Committee will review the effectiveness of the courses through the aforementioned samples using a rubric as a guide (see ***PLO 4, Year 4 Rubric 2b***) to determine whether students are demonstrating the competencies specific to PLO 4. If the Advisory Committee determines that the competencies are not being met, they will work with the faculty to adjust the content of the foundational course accordingly, or take other corrective action as necessary to ensure that the learning outcome is met.

**STANDARD:**

1. ENST 100: For Rubric 1a, each response must be at least a 2. For Rubric 1b, the sample average must be greater than or equal to 2 in each category.
2. Elective courses: For Rubric 2a, the average response from faculty should be at least a 1.5 across each course reviewed. For Rubric 2b, the sample average of student work must be greater than or equal to 2.

The standard is set by the department and can be revised.

**RESPONSIBLE:**

- ENSC Advisory Committee

**TIMELINE:**

- Year 4

**WHO RECEIVES RESULTS AND WHO IS RESPONSIBLE FOR FOLLOW-UP:**

- Results gathered by the ENSC Advisory Committee and their accompanying recommendations will go to the ENST Faculty Steering Committee for review. The ENSC Advisory Committee will be responsible for implementing program changes in concert with the faculty of individual courses.



**Rice University  
 Environmental Science (ENSC) Advisory Committee  
 ENSC MAJOR PLO 4 – Interdisciplinary Perspectives  
 Year 4, Rubric 1a**

**Course Number and Title: ENST 100: “Environment, Culture, and Society”**

**Instructor(s):**

**Semester and Year:**

Using a 4-point scale please rate your expectation that students in this course will be able to demonstrate the following knowledge and skills. A zero indicates that students are not expected to demonstrate this knowledge and/or skill, and a three indicates that this knowledge and/or skill is a central component of the course.

**Through some form of oral or written communication, students who complete this course will demonstrate that they can:**

<b>Theory</b>	
Utilize terms, theories, and concepts from the humanities, social sciences, arts, and architecture and apply them to environmental issues.	0    1    2    3
<b>Communication</b>	
Apply critical thinking and develop long-form cohesive arguments and articulate insights related to the interrelation between social and environmental systems.	0    1    2    3

**Rice University  
 Environmental Science (ENSC) Advisory Committee  
 ENSC MAJOR PLO 4 – Interdisciplinary Perspectives  
 Year 4, Rubric 1b**

**Course Number and Title: ENST 100: “Environment, Culture, and Society”**

**Instructor(s):**

**Semester and Year:**

Using a 4-point scale, please rate whether based on a review of the sample materials the students in this course demonstrated the following knowledge and skills. A zero indicates that students did not demonstrate this knowledge and/or skill, and a three indicates that this knowledge and/or skill was clearly demonstrated.

**Through a review of a sampling of final papers, did students who completed this course demonstrate the ability to:**

<b>Theory</b>	
Utilize terms, theories, and concepts from the humanities, social sciences, arts, and architecture and apply them to environmental issues.	0    1    2    3
<b>Communication</b>	
Apply critical thinking and develop long-form cohesive arguments and articulate insights related to the interrelation between social and environmental systems.	0    1    2    3

**Rice University  
Environmental Science (ENSC) Advisory Committee  
ENSC MAJOR PLO 4 – Interdisciplinary Perspectives  
Year 4, Rubric 2a**

**Course Number and Title:**  
**Instructor(s):**  
**Semester and Year:**

Using a 4-point scale please rate your expectation that students in this course will be able to demonstrate the following knowledge and skills. A zero indicates that students are not expected to demonstrate this knowledge and/or skill, and a three indicates that this knowledge and/or skill is a central component of the course.

**Through some form of oral or written communication, students who complete this course will demonstrate that they can:**

<b>Theory</b>	
Utilize terms, theories, and concepts from the humanities, social sciences, arts, and/or architecture and apply them to environmental issues.	0    1    2    3
<b>Research or Design</b>	
Apply ideas and/or information synthesized from multiple disciplines to specific environmental problems or challenges.	0    1    2    3
<b>Communication</b>	
Develop long-form cohesive arguments and/or articulate insights related to the interrelation between social and environmental systems.	0    1    2    3

**Rice University  
Environmental Science (ENSC) Advisory Committee  
ENSC MAJOR PLO 4 – Interdisciplinary Perspectives  
Year 4, Rubric 2b**

**Course Number and Title:**

**Instructor(s):**

**Semester and Year:**

Using a 4-point scale, please rate whether based on a review of the sample materials the students in this course demonstrated the following knowledge and skills. A zero indicates that students did not demonstrate this knowledge and/or skill, and a three indicates that this knowledge and/or skill was clearly demonstrated.

**Through a review of a sampling of student work, did students who completed this course demonstrate the ability to:**

<b>Theory</b>	
Utilize terms, theories, and concepts from the humanities, social sciences, arts, and/or architecture and apply them to environmental issues.	0    1    2    3
<b>Research or Design</b>	
Apply ideas and/or information synthesized from multiple disciplines to specific environmental problems or challenges.	0    1    2    3
<b>Communication</b>	
Develop long-form cohesive arguments and/or articulate insights related to the interrelation between social and environmental systems.	0    1    2    3

## **PLO 5 Assessment Plan**

**PLO 5: Students will be able to apply methods and theories to develop and test hypotheses or to propose and analyze solutions to environmental issues, using sound experimental, statistical, and/or design practices (Bachelor of Science only).**

### **EMBEDDED LOCATION:**

- Capstone courses: ESCI 390, ESCI 391, EBIO 403, EBIO 404, and ESCI 481.

### **MATERIALS:**

- Final report (ESCI 390, ESCI 391) or thesis (EBIO 403, EBIO 404, and ESCI 481).

### **MEASURE:**

- Prior to the start of the academic year, the ENSC Advisory Committee will share a rubric (see ***PLO 5, Year 2 and 4 Rubric 1***) with the faculty of the capstone courses ESCI 390, ESCI 391, EBIO 403, EBIO 404, and ESCI 481 to ensure that the competencies specific to PLO 5 are embedded within the design of the course. After completion of the courses, the Advisory Committee review the retained final assignments for lateral assessment of student performance in the degree. If the Advisory Committee determines that the competencies are not being met, they will work with the faculty to adjust the content of the courses accordingly.

### **STANDARD:**

- For Rubric 1, the average response from faculty should be at least a 2 across each course reviewed. For the assessment, 80% of students must score 80% or above on final report or thesis. The standard is set by the department and can be revised.

### **RESPONSIBLE:**

- ENSC Advisory Committee

### **TIMELINE:**

- Year 2 and Year 4.

### **WHO RECEIVES RESULTS AND WHO IS RESPONSIBLE FOR FOLLOW-UP:**

- Results gathered by the ENSC Advisory Committee and their accompanying recommendations will go to the ENST Faculty Steering Committee for review. The ENSC Advisory Committee will be responsible for implementing program changes in concert with the faculty of individual courses.

**Rice University  
 Environmental Science (ENSC) Advisory Committee  
 ENSC MAJOR PLO 5 – Methods Application and Hypothesis Testing (BS  
 only)  
 Year 2 and 4, Rubric 1**

**Course Number and Title:**  
**Instructor(s):**  
**Semester and Year:**

Using a 4-point scale please rate your expectation that students in this course will be able to demonstrate the following knowledge and skills. A zero indicates that students are not expected to demonstrate this knowledge and/or skill, and a three indicates that this knowledge and/or skill is a central component of the course.

**Through some form of oral or written communication, students who complete this course will demonstrate that they can:**

<b>Theory</b>	
Identify and apply relevant theories, principles, laws, or models to a specific problem.	0 1 2 3
Explain how a specific problem relates to broader influences and/or larger questions.	0 1 2 3
Critically analyze existing theory and/or models in light of their research/design experience.	0 1 2 3
<b>Research or Design</b>	
Identify and characterize the significant dimensions and scope of a problem.	0 1 2 3
Evaluate evidence and scholarship in a field of inquiry by identifying and accessing relevant information, and evaluating its validity.	0 1 2 3
Select and apply an inquiry method or strategy that takes the researcher from problem to solution.	0 1 2 3
Select and apply appropriate research or design techniques and use appropriate instruments to conduct research or develop a design for a specific problem.	0 1 2 3
Compare alternative solutions and select more practical or realistic ones.	0 1 2 3

Apply ideas and/or information synthesized from multiple disciplines to a specific problem.	0	1	2	3
Work as self-directed researchers and problem solvers.	0	1	2	3
<b>Communication</b>				
Identify appropriate audiences and methods of communication for formal presentations and informal interactions.	0	1	2	3
Demonstrate effective presentation skills and understanding of appropriate forms of dissemination for different audiences.	0	1	2	3
Solicit and respond appropriately to feedback from audiences within and beyond the academic community.	0	1	2	3

**III. The Environmental Science Major  
Curriculum Map (draft – OIE working on  
this as per Caroline Pendleton)**



**Environmental Science Major Curriculum Map (BA, BS)**

<b>Course</b>	<b>PLO 1</b>	<b>PLO 2</b>	<b>PLO 3</b>	<b>PLO 4</b>	<b>PLO 5</b>
	Students will demonstrate foundational knowledge in the natural sciences that is fundamental to the Environmental Sciences. (For the BA, this understanding should be adequate to support the incorporation of environmental science knowledge into the study and practice of a field other than environmental science.)	Students will be able to integrate knowledge of natural and applied sciences to understand complex natural systems and cycles.	Students will be able to synthesize knowledge from natural sciences and engineering and apply it to the study of the environment.	Students will understand environmental issues from a scientific perspective and be able to solve issues using a variety of interdisciplinary perspectives (e.g., social sciences, economics, humanities, and/or architecture).	Students will be able to apply methods and theories to develop and test hypotheses or to propose and analyze solutions to environmental issues, using sound experimental, statistical, and/or design practices. (Bachelor of Science only)
ANTH 332 The Social Life of Clean Energy	Not Relevant	Reinforced	Reinforced	Mastered	Introduced
CEVE 308 Air Pollution Control	Introduced	Introduced	Reinforced	Introduced	Introduced
CEVE 404 Atmospheric Particulate Matter	Reinforced	Mastered	Mastered	Reinforced	Introduced
CEVE 484 Environmental Risk Assessment and Human Health	Introduced	Introduced	Mastered	Mastered	Mastered
CHBE 281 Engineering Sustainable Communities	Mastered	Reinforced	Reinforced	Reinforced	Reinforced
CHBE 281 Engineering Sustainable Communities	Introduced	Reinforced	Mastered	Reinforced	Reinforced
CHEM 211 Organic Chemistry I	Introduced	Not Relevant	Not Relevant	Not Relevant	Not Relevant
CHEM 211 Organic Chemistry I	Introduced	Not Relevant	Not Relevant	Not Relevant	Not Relevant
CHEM 213 Organic Chemistry Discussion	Introduced	Not Relevant	Not Relevant	Not Relevant	Not Relevant
CHEM 213 Organic Chemistry Discussion	Introduced	Not Relevant	Not Relevant	Not Relevant	Not Relevant
CHEM 425 Organic Geochemistry	Mastered	Mastered	Mastered	Not Relevant	Introduced

<b>Course</b>	<b>PLO 1</b>	<b>PLO 2</b>	<b>PLO 3</b>	<b>PLO 4</b>	<b>PLO 5</b>
EBIO 270 Ecosystem Management	Introduced	Reinforced	Reinforced	Reinforced	Reinforced
EBIO 306 Undergraduate Independent Study	Reinforced	Mastered	Not Relevant	Mastered	Reinforced
EBIO 316 Lab Module in Ecology	Reinforced	Reinforced	Reinforced	Reinforced	Mastered
EBIO 319 Tropical Field Biology	Reinforced	Reinforced	Reinforced	Reinforced	Reinforced
EBIO 320 Ecology and Conservation of Brazilian Wetlands Lab	Reinforced	Reinforced	Reinforced	Reinforced	Reinforced
EBIO 320 Ecology and Conservation of Brazilian Wetlands Lab	Reinforced	Mastered	Reinforced	Introduced	Not Relevant
EBIO 321 Animal Behavior	Reinforced	Introduced	Introduced	Not Relevant	Introduced
EBIO 323 Conservation Biology	Reinforced	Reinforced	Reinforced	Introduced	Introduced
EBIO 324 Conservation Biology Lab	Mastered	Reinforced	Mastered	Mastered	Mastered
EBIO 325 Ecology	Mastered	Reinforced	Not Relevant	Reinforced	Reinforced
EBIO 326 Insect Biology Lab	Reinforced	Reinforced	Introduced	Not Relevant	Reinforced
EBIO 327 Biological Diversity	Reinforced	Reinforced	Reinforced	Reinforced	Reinforced
EBIO 330 Insect Biology Lab	Reinforced	Reinforced	Reinforced	Reinforced	Reinforced
EBIO 331 Biology of Infectious Diseases	Reinforced	Reinforced	Not Relevant	Reinforced	Reinforced
EBIO 337 Field Bird Biology	Introduced	Reinforced	Reinforced	Reinforced	Reinforced
EBIO 337 Field Bird Biology	Reinforced	Reinforced	Reinforced	Reinforced	Mastered
EBIO 338 Design and Analysis of Biological Experiments	Not Relevant	Introduced	Reinforced	Reinforced	Reinforced
EBIO 340 Global Biogeochemical Cycles	Mastered	Mastered	Reinforced	Introduced	Introduced
EBIO 365 Introductory Phycology	Introduced	Reinforced	Not Relevant	Not Relevant	Not Relevant
EBIO 366 Applied Phycology	Introduced	Reinforced	Reinforced	Reinforced	Reinforced
EBIO 367 Introductory Phycology Lab	Introduced	Reinforced	Reinforced	Not Relevant	Not Relevant
EBIO 368 Applied Phycology Lab	Introduced	Reinforced	Reinforced	Reinforced	Reinforced
EBIO 372 Coral Reef Ecosystems	Reinforced	Mastered	Reinforced	Introduced	Reinforced
EBIO 379 Underwater Ecology	Reinforced	Introduced	Reinforced	Introduced	Reinforced

<b>Course</b>	<b>PLO 1</b>	<b>PLO 2</b>	<b>PLO 3</b>	<b>PLO 4</b>	<b>PLO 5</b>
EBIO 403 or 404 Undergraduate Honors Research	Mastered	Mastered	Not Relevant	Not Relevant	Mastered
EBIO 403 or 404 Undergraduate Honors Research	Mastered	Mastered	Mastered	Mastered	Mastered
EBIO 403 or 404 Undergraduate Honors Research	Not Relevant	Not Relevant	Not Relevant	Not Relevant	Reinforced
EBIO 403 or 404 Undergraduate Honors Research	Mastered	Mastered	Not Relevant	Not Relevant	Mastered
EBIO 403 or 404 Undergraduate Honors Research	Mastered	Mastered	Mastered	Not Relevant	Mastered
ENST 100 Environment, Culture & society	Introduced	Introduced	Introduced	Introduced	Not Relevant
ENST 202 Culture, Energy & the Environment	Reinforced	Introduced	Reinforced	Mastered	Not Relevant
ENST 281 Engineering Sustainable Communities	Introduced	Reinforced	Mastered	Reinforced	Reinforced
ENST 302 Environmental Issues: Rice into the Future	Introduced	Introduced	Reinforced	Reinforced	Reinforced
ENST 340 Global Biogeochemical Cycles	Mastered	Mastered	Reinforced	Introduced	Introduced
ESCI 107 Oceans and Global Change	Introduced	Introduced	Introduced	Introduced	Not Relevant
ESCI 109 Oceanography	Introduced	Introduced	Introduced	Introduced	Not Relevant
ESCI 301 Introduction to the Earth	Introduced	Introduced	Introduced	Reinforced	Reinforced
ESCI 321 Earth Systems and Cycles	Reinforced	Reinforced	Reinforced	Reinforced	Reinforced
ESCI 322 Earth Chemistry and Materials	Reinforced	Reinforced	Reinforced	Reinforced	Reinforced
ESCI 323 Earth Structure & Deformation	Reinforced	Reinforced	Reinforced	Reinforced	Reinforced
ESCI 334 Geological Field Techniques	Reinforced	Mastered	Not Relevant	Not Relevant	Reinforced
ESCI 340 Global Biogeochemical Cycles	Mastered	Mastered	Reinforced	Introduced	Introduced
ESCI 391 Earth Science Field Experience	Reinforced	Reinforced	Reinforced	Reinforced	Mastered
ESCI 418 Quantitative Hydrogeology	Introduced	Reinforced	Reinforced	Not Relevant	Introduced

<b>Course</b>	<b>PLO 1</b>	<b>PLO 2</b>	<b>PLO 3</b>	<b>PLO 4</b>	<b>PLO 5</b>
ESCI 421 Paleooceanography	Reinforced	Mastered	Reinforced	Not Relevant	Not Relevant
ESCI 425 Organic Geochemistry	Mastered	Mastered	Mastered	Not Relevant	Introduced
ESCI 430 Principles of Trace-Elements and Isotope Geochemistry	Mastered	Mastered	Mastered	Mastered	Mastered
FWIS 187 Exploring the Science and History of Houston's Bayous	Introduced	Introduced	Introduced	Reinforced	Not Relevant
PHYS 101 Mechanics	Mastered	Introduced	Introduced	Not Relevant	Not Relevant
PHYS 101 Mechanics	Introduced	Introduced	Not Relevant	Not Relevant	Not Relevant
PHYS 101 Mechanics	Introduced	Introduced	Introduced	Not Relevant	Introduced
PHYS 102 Electricity and Magnetism	Mastered	Introduced	Introduced	Not Relevant	Not Relevant
PHYS 102 Electricity and Magnetism	Introduced	Not Relevant	Not Relevant	Not Relevant	Introduced
PHYS 103 Mechanics discussion	Mastered	Introduced	Introduced	Not Relevant	Not Relevant
PHYS 104 E&M Discussion	Mastered	Introduced	Introduced	Not Relevant	Not Relevant
PHYS 104 E&M Discussion	Mastered	Not Relevant	Not Relevant	Not Relevant	Reinforced
POLI 332 Urban Politics	Not Relevant	Introduced	Not Relevant	Reinforced	Reinforced
PSYC 339 Statistical Methods-Psychology	Not Relevant	Not Relevant	Not Relevant	Not Relevant	Reinforced
SOCI 304 Environmental Issues: Rice into the Future	Introduced	Introduced	Reinforced	Reinforced	Reinforced
SOCI 367 Environmental Sociology				Introduced	Introduced
SPAN 403 Literature and the Environment in Latin America	Not Relevant	Not Relevant	Not Relevant	Introduced	Not Relevant

## **IV. Support Letters**

To: Committee on the Undergraduate Curriculum  
From: Marie Lynn Miranda  
Subject: Major in Environmental Science  
Date: February 8, 2016

I write to enthusiastically support the ENSC working group's proposal to modify and improve Rice's Environmental Science major. This working group has carefully thought about the effective design of an expanded, coherent environmental science curriculum at Rice, and I would like to see this program go forward.

The proposal includes curricula at the needed scientific and mathematical depth for students to understand the mechanics of the functioning of the environment on local to global scales. In addition, it includes the social sciences components necessary to understand the feedbacks between humans and the environment.

This proposal addresses four existing problems within the existing Environmental Science double-only major. First, it moves the Environmental Science (ENSC) degree into the School of Natural Sciences and away from CEHNS in the Humanities, a curricular misalignment that all parties agree needs addressing (see letter of support from Dominic Boyer, current CEHNS director). Second, by making ENSC a stand-alone degree, it increases the number of students who can select this major. The current double-only arrangement de facto acts to limit Environmental Science majors to those who have met a number of the degree requirements already through another major. Third, the placement of students within a department (either ESCI or BIOS) provides them with a secure departmental home, increasing the resources available to them, and additionally guaranteeing them more faculty attention. The final revisions present in this proposal are curricular, better aligning the courses listed in the major with those offered.

The revised major includes a number of experiential learning opportunities, including a required field course for both the B.A. and B.S. options. The B.S. degree ends with a capstone field or research experience within the Natural Sciences. Both of these requirements dovetail nicely with the university's goal of expanding the experiential learning portion of our curriculum.

The study of the environment at Rice has always involved faculty in many schools. I would especially like to note the structure of the ENSC degree's management, which recognizes the need for continued conversation among environmental researchers and educators across campus. The inclusion of Engineering faculty on the ENSC advisory committee and the connection of ENSC and the Environmental Studies (ENST) minor with CENHS is designed to strengthen intra-institutional communication among environmental researchers in the Natural Sciences, Social Sciences, Humanities, Engineering, and Architecture. This communication is especially important for a field as broad as the environment which has stakeholders across campus.



Peter J. Rossky, Ph.D.  
Dean, Wiess School of Natural Sciences  
Harry C. and Olga K. Wiess Chair  
Professor of Chemistry

January 11, 2016

To: The Undergraduate Curriculum Committee, Rice University

From: Peter J. Rossky, Dean, Wiess School of Natural Sciences

A handwritten signature in blue ink, appearing to read "Peter J. Rossky".

Re: Support for the reorganization and transfer of degrees in Environmental Science

The purpose of this memo is to provide my full and enthusiastic support for the proposal to transfer the existing ENST Environmental Science B.A. program from its recent home in the Center for Energy and Environmental Research in the Human Sciences (CENHS) back to the School of Natural Sciences, and reform it into two interdisciplinary stand-alone majors: a B.S. and a B.A. in Environmental Science (ENSC). Under this proposal, the Departments of Earth Science and BioSciences, both in the Wiess School of Natural Sciences, would jointly administer these stand-alone majors. I want to note here that I deeply appreciate the considerable efforts of the faculty team responsible for developing this coherent plan for these modern ENSC degrees.

There is without question student demand for a stand-alone major in Environmental Science. Considering the obvious societal need for a more complete understanding of the scientific basis and humanistic implications of environmental change, this major will fill an important gap in the areas of concentration available to our students and bring us more closely into line with programs in this area at other leading universities.

With this memo, I also affirm that the School of Natural Sciences will make available the necessary resources (courses and instructors) on an on-going basis so that the core Natural Sciences courses required for these degree programs are offered with appropriate frequency to enable students to complete the major in a timely fashion. I do this with complete confidence, as all of the required courses are also parts of other majors.

I am certain that approval of this change in our degree offerings will advance the interests of our students and enhance their opportunities for impactful and satisfying contributions to society as workforce professionals.



TO: Undergraduate Curriculum Committee  
FROM: Janet Braam, Chair, Department of BioSciences  
RE: Letter of Support for Environmental Science Degrees  
DATE: January 13, 2016

On behalf of BioSciences, I emphasize our strong support of the proposed changes to the Environmental Science degree program, including the transfer of the program back to Natural Sciences and establishment of stand-alone majors (B.S. and B.A.) to be jointly administered by BioSciences and Earth Science.

We believe that this is an excellent opportunity for Rice to make more of its diverse course offerings related to environmental systems. Our Department offers five major degree paths (BS and BA in Biochemistry & Cell Biology, BS and BA in Ecology & Evolutionary Biology, and BA in Biological Sciences) and two minors (Biochemistry & Cell Biology and Ecology & Evolutionary Biology). BioSciences will continue to offer courses that contribute to the prerequisite and core and requirements for the new Environmental Science degrees on a regular basis. In addition, we anticipate being able to offer at least a subset of the elective courses every year, dependent on instructional resources and student enrollments.

This is an important initiative for Rice and a very timely one given mounting environmental challenges facing our planet and its species. The Department of BioSciences is deeply committed to the success of the new Environmental Science degree program.





January 15, 2016

Dr. Susan McIntosh  
Rice University  
Department of Anthropology  
6100 Main Street - MS 20  
Houston, TX 77005

Dear Dr. McIntosh,

I enthusiastically support the transfer of the ENSC degree to the School of Natural Sciences. The Departments of Earth Science and BioSciences will co-administer the degree and will implement Point 5 in last year's ENST Interdivisional Agreement (Appendix 2 of the proposal).

The Earth Science faculty is also supportive of the revised degree requirements, which provide more focused concentrations for students to choose, and variety in class selection from the interdisciplinary nature of this degree. With the revised ENSC degree, majors will be able to select environmentally focused electives from the Schools of Architecture, Humanities, and Social Sciences.

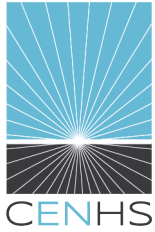
The new Environmental Science degree will offer two stand-alone majors. Students can choose between a B.S. and a B.A., which makes the program accessible to a wider audience of students. Another benefit of the ENSC degrees is that students will gain a strong grounding in the basic sciences they need to pursue careers in environmental science. The revision of the ENSC degree is well timed given the growth of the Energy and Environment Initiative (EEI) at Rice.

The Department of Earth Science is committed to offering required ESCI courses on a continuing basis. Both core courses such as ESCI 107, 109, and 301 and field experience courses such as ESCI 103, 321, 323, 334, 340, and 380 are expected to be offered at least once a year. Students majoring in Environmental Science with an Earth Science concentration will have many opportunities to complete their degree requirements. The general consensus among our faculty is that the Earth Science department is well situated to contribute to the revised ENSC majors, given the importance of understanding Earth processes in environmental studies, as well as the naturally interdisciplinary nature of our field. ESCI faculty are also excited to have new opportunities to enhance the department's presence in environmental studies and EEI, and increase interactions with other departments across the university.

Sincerely,

A handwritten signature in cursive script that reads "Richard G. Gordon".

Richard G. Gordon  
W.M. Keck Professor of Geophysics  
Chair, Department of Earth Science



**Dominic Boyer**  
Director, CENHS, the Center for Energy and Environmental Research in the Human Sciences  
Professor, Department of Anthropology

14 January 2016

To: University Committee on the Undergraduate Curriculum

From: Dominic Boyer, Director, CENHS

Re: Proposal to Transfer the Environmental Science Degree to Natural Sciences and Establish Two Stand-Alone Majors

I enthusiastically endorse the proposal to transform the existing ENST Environmental Science B.A. second major into a new regular ENSC major (with B.A. and B.S. tracks) and to return primary oversight for the reformed degree program from CENHS to the Wiess School of Natural Sciences. The history of this initiative dates back to the work of the ENST Faculty Working Group convened by CENHS during the 2014-2015 academic year. The main objectives of the Working Group were 1) to gather information from faculty and students across campus about their satisfaction with Rice's existing courses and degree program offerings in Environmental Studies and Sciences and 2) to compare Rice data with data gathered from peer institutions in order to make a series of recommendations about the best strategy for improving Rice's undergraduate program in Environmental Studies over the next 3-5 years. A detailed report on the findings and recommendations of the ENST Working Group is included in the ENST minor proposal that has been attached to the ENSC major proposal. But, in short, the Working Group found that Rice was lagging significantly behind peer comparators not in terms of quality and availability of courses but rather in terms of the quality and accessibility of our degree program, which, at that time, was solely composed of the ENST Environmental Science B.A. second major. Since that program's inception in 2004, Rice has only graduated 13 ENST second majors (with four more currently enrolled). Averaging less than 1.5 majors/year suggests a program that has, for a variety of reasons, not served our undergraduate body particularly well.

I find that the current proposal offers a very thoughtful and well-designed strategy for remedying this situation, one that is very much in line with the recommendations of the

Dominic Boyer • CENHS • Rice University

Mail Stop 20 • P.O. Box 1892 • Houston, Texas 77251-1892  
Phone: 713-348-2061 • Fax: 713-348-5455 • E-mail: dcb2@rice.edu



Department of Civil and Environmental Engineering  
George R. Brown School of Engineering

January 8, 2016

To: Julia Morgan, Professor of Earth Science

Re: Environmental Science Major Realignment

Dear Juli:

I write to express my support for the proposal being submitted to realign the major in Environmental Science as a two-track program operated by the Earth Science and Biosciences Departments. Students across campus will benefit from the opportunity to learn a holistic and interdisciplinary approach to the study of the environment with a focus in physical sciences. Majors in my Department may find this an attractive complementary degree program, as it would allow them to gain new perspectives and expertise from a broad range of areas. It is important to note that this degree would not duplicate the more specialized existing degree programs in my Department. It also is important to note that at this time, the support I express is strictly my own, as my Departmental Curriculum Committee has not yet met to discuss this, nor has the council of Engineering Department Chairs.

Provided that we can resolve enrollment cap issues (i.e., if needed, find resources and new instructors to keep class sizes below fifty), my Department will continue to offer the course that contributes to the requirements (CEVE 310) with sufficient frequency that interested majors will be able to fulfill the requirements within a four-year period. The same is true for elective options of the new degree (CEVE 302, CEVE 308, CEVE 401, etc.).

This is an important initiative for Rice, building upon the cross-campus model of the Energy and Environment Initiative. I look forward to contributing to its success. If I can be of any further, please do not hesitate to contact me.

With best regards,

A handwritten signature in black ink, appearing to read "Robert J. Griffin".

Robert J. Griffin, Ph.D.  
Professor and Chair

**From:** marina@rice.edu  
**Subject:** Re: following up re ENSC degree  
**Date:** February 9, 2016 at 9:09 AM  
**To:** Caroline Masiello masiello@rice.edu



Carrie,

it will be alright to add Stat 280 or Stat 305 to the foundation courses. STAT 280 and STAT 305 are our intro courses. They are both 4 credit hours courses, offered as 3 lectures + 1 lab, and can accommodate additional students.

Please see here for additional info

<http://statistics.rice.edu/feed/Courses.aspx>

Best wishes,  
marina

Quoting Caroline Masiello <[masiello@rice.edu](mailto:masiello@rice.edu)>:

I think a reasonable question from your department would be, "what if enrollment is >> 10 in the ENSC major?" About 10 majors per year in the beginning is our guess, but we could be wrong. If the enrollment in the major grows, what could we do to support your department so that students could get this important material?

Carrie

Dr. Caroline Masiello  
Professor, Earth Science  
Joint: BioSciences and Chemistry  
713-348-5234

On Feb 8, 2016, at 10:40 PM, Marina Vannucci <[marina@rice.edu](mailto:marina@rice.edu)> wrote:

Caroline,

I am sorry i could not get to your email today. I returned after being out of town for several days and there were so many things to do. I have a full schedule for tomorrow too. I am free 1-1.30pm. Perhaps we can chat on the phone?

Marina

Sent from my iPad

On Feb 8, 2016, at 10:26 AM, Caroline Masiello <[masiello@rice.edu](mailto:masiello@rice.edu) <<mailto:masiello@rice.edu>>> wrote:

Dear Marina,

I'm faculty in Earth Science, taking over shepherding the updates to the ENSC degree program through the CUC and Faculty Senate. I noticed that the requirement for a statistics class has been pulled from the ENSC degree requirements. Would you have a minute to talk with me about what your department would need for us to reinstate this in the ENSC program?

I can come to your office at your convenience. Thank you in advance for your help,

Dr. Caroline Masiello  
Professor, Earth Science  
Joint: BioSciences and Chemistry  
713-348-5234

---

Marina Vannucci  
Professor and Chair  
Department of Statistics  
Rice University  
6100 Main Street  
Houston, TX 77005

ENST working group (now ENST Faculty Steering Committee). Coming on the heels of the launch of Rice's new holistically-oriented ENST minor this past Fall, the proposed reform to the Environmental Science major will create a much more attractive and accessible program, with the option of both B.S. and B.A. degrees and, most importantly, relieved of the peculiar stipulation that the degree be taken only as a second major.

In addition, the transfer of primary oversight and administration of the reformed major to ESCI, BIOS and CEE faculty makes good sense in terms of guaranteeing the academic excellence of the program. Although CENHS collaborates actively with units across campus in the context of Rice's wider ecology of energy and environmental research and teaching, our core faculty are largely based in the Schools of Humanities, Social Sciences and Architecture. The expertise base in Natural Sciences is thus much more commensurate with the mission of the ENSC major. The only concern expressed about the oversight transfer from the CENHS and ENST Faculty Steering Committees was that we take steps to ensure that the ENST and ENSC degree programs do not bifurcate and instead remain closely and collaboratively aligned with one another. Environmental Studies is a holistically inclined, comprehensively interdisciplinary venture of which Environmental Science is a particularly vibrant and important domain. I believe that this proposal reflects that cohesive structure by proposing an ENSC Advisory Committee that will be overseen in turn by the ENST Faculty Steering Committee (the creation of last year's interdivisional agreement, which has permanent representation of decanally appointed faculty from the Schools of Architecture, Engineering, Humanities, Natural Sciences and Social Sciences). This will allow the new ENSC major to have the expert oversight it requires while at the same time remaining an active participant in the broader ENST research and teaching community at Rice.

In sum, I have only praise for this timely intervention to improve Rice's current Environmental Sciences B.A. program. It is a faculty-led initiative that will be welcomed by Rice undergraduates. I would like to extend my thanks to all the faculty in ESCI, BIOS and CEE involved in the preparation of this proposal and especially Prof. Juli Morgan for her work as lead author.

With thanks,



Dominic Boyer  
Director, CENHS

Dominic Boyer • CENHS • Rice University

Mail Stop 20 • P.O. Box 1892 • Houston, Texas 77251-1892  
Phone: 713-348-2061 • Fax: 713-348-5455 • E-mail: dcb2@rice.edu

## **V. ENST 4\*\* Letters of Commitment**

**From:** Janet Braam braam@rice.edu  
**Subject:** ENSC major  
**Date:** March 22, 2016 at 2:10 PM  
**To:** Caroline Masiello masiello@rice.edu  
**Cc:** Janet Braam braam@rice.edu

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Dear Carrie - please share this email with the Undergraduate Curriculum Committee.

Dear Members of the Committee on the Undergraduate Curriculum,

BioSciences wholeheartedly supports the expansion of the Environmental Science major at Rice as is proposed currently. Our support includes the willingness to offer ENST 4\*\* (number TBD), titled "Seminar: Topics in Environmental Science" with enough frequency that all students registered for the major will be able to fulfill the requirements within a four year period. We understand that this means that we will need to commit faculty time to teaching this seminar course.

Sincerely,

Janet Braam  
Wiess Professor and Department Chair  
BioSciences at Rice  
Rice University  
6100 Main Street  
Houston TX 77005-1892  
713 348-4277  
<http://bioc.rice.edu/~braam/>





**Department of Earth Science**  
Wiess School of Natural Sciences

March 21, 2016

Committee on Undergraduate Curriculum  
Rice University  
6100 Main Street  
Houston, TX 77005

Dear Members of the Committee on the Undergraduate Curriculum,

I am writing on behalf of the department of Earth Science. Our department wholeheartedly supports the expansion of the Environmental Science major at Rice as is proposed currently. Our support includes the willingness to offer ENST 4\*\* (number TBD), titled "Seminar: Topics in Environmental Science" with enough frequency that all students registered for the major will be able to fulfill the requirements within a four year period. We understand that this means that we will likely need to commit one faculty member's time per year to teaching this seminar course.

Cordially,

A handwritten signature in cursive script that reads "Richard G. Gordon".

Richard G. Gordon, Ph.D.  
W.M. Keck Professor of Geophysics  
Chair, Department of Earth Science