

ENVIRONMENT AND SUSTAINABILITY: A PROPOSED CROSS-COLLEGE MAJOR IN ENVIRONMENTAL STUDIES AND ENVIRONMENTAL SCIENCES

College of Arts & Sciences (CAS) and College of Agriculture and Life Sciences (CALS)
Committee on Interdisciplinary Curricula in Environmental Studies and Environmental Sciences

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SUMMARY

The Deans of the College of Arts and Sciences and the College of Agriculture and Life Sciences charged a cross-college committee with identifying potential models to offer interdisciplinary curricula in environmental studies and environmental sciences that would be open to students from both colleges, and would be developed in coordination with the existing Environmental and Sustainability Sciences (ESS) major in CALS. The ESS major presently lacks options for students interested in humanities or interpretative social science-focused approaches to environmental studies, and the large number of courses now in the ESS major (23 courses, 72-84 credits) exceeds the ~60-credit cap within CAS. The ESS major currently consists of an 18-course core, plus a five-course concentration in one of four disciplines: Biogeochemical Sciences (BGCS), Environmental Biology and Applied Ecology (EBAE), Environmental Economics (EE), or Environmental Policy and Governance (EPG), with a fifth option of an Individual Student-Designed (ISD) concentration. Here, the committee provides a proposed curriculum for a single common major in Environment and Sustainability that would be available to students from a range of backgrounds and interests from both colleges. It has been envisioned so as to mesh with much of the current ESS structure, with a substantially smaller (10 course) core, larger concentrations (up to 9 courses), and a new concentration in Environmental Humanities. The shared core is designed to provide both broad disciplinary exposure and interdisciplinary integration for all students in environmental studies and sciences. The smaller core is accompanied by shifting some introductory science courses now in the ESS core to those concentrations that prioritize this training. In total, the proposed curriculum includes 16-19 courses (depending on the concentration) that can be completed within 60 credits. Initial feedback from ESS and CAS faculty on a working draft of this report provided cautious support, with interest in further dialogue. Additional recommendations in this report include proposed general resource needs and proposed governance through expansion of the cross-departmental ESS curriculum committee and establishment of a cross-college undergraduate Office of Environmental and Sustainability. The major should not go forward until sufficient resources have been identified, but with continued development and further faculty input, and with investment by CAS and CALS leadership, the committee believes that it should be possible to launch the proposed major in Fall 2017.

BACKGROUND

Cornell has great strength in environmental sciences and studies. Yet, these offerings have long been dispersed across multiple departments, colleges, and majors. This diffusion of environmental courses and curricula has made it difficult for both prospective and current students to discern Cornell's

environmental offerings; it has reduced outside recognition of Cornell's strengths in these areas; and it has limited cross-college faculty collaboration in teaching and research. Independent initiatives in the College of Agriculture and Life Sciences and in the College of Arts and Sciences have sought to strengthen and expand Cornell's presence in undergraduate study of the environment, but these endeavors progressed separately until now, and students in the College of Arts and Sciences do not yet have opportunities to major in environmental science or environmental studies.

In the College of Agriculture and Life Sciences, an inter-departmental major in environmental sciences, now called **Environmental and Sustainability Sciences (ESS)** was formed in 2012 as the merger of two previous CALS majors: the inter-departmental major in environmental science called the Science of Natural and Environmental Systems (SNES) and the departmental major in Natural Resources. This merger responded to the recommendation of the University-wide Environmental Sciences Planning Committee in 2010 that "Cornell better coordinate and integrate environmental science majors."¹ In developing the ESS major, the committee that designed its curriculum and governance structure anticipated that the major might expand in the future, and sought "to create a vision and structure for an integrated undergraduate major that not only merges two existing CALS majors, but also lays the conceptual groundwork for inclusion and engagement from undergraduate instructors and advisors in other departments and majors within CALS and across the University."² The ESS major includes four structured concentrations in Biogeochemical Sciences (BGCS), Environmental Biology and Applied Ecology (EBAE), Environmental Economics (EE), and Environmental Policy and Governance (EPG), along with an Individual Student-Designed concentration (ISD). Now in its third full year, the major has an enrollment of 263 students (admissions are capped by CALS at ~70 students per year), with ~70 faculty advisors drawn from 18 departments in CALS and other colleges. The major's governance is discussed in a separate section below. Briefly, it includes an elected 12-member curriculum committee, administrative support provided by the Department of Natural Resources, and a memorandum of understanding between CALS and the five departments with responsibility for the major's core courses.

In the College of Arts and Sciences, students presently lack formal opportunities to pursue study of the environment. They can minor in ESS, but majors available to these students are limited to exclusive training in physical (Science of Earth Systems) or biological (Biology/concentration in Ecology & Evolutionary Biology) sciences, or to the cross-college major in Biology & Society that provides some interdisciplinary training, but spans all aspects of biology and society with limited focus on the environment. To meet student interest in pursuing environmental studies, two sequential committees were formed in Spring and Fall 2014 to outline a possible major in this area. The first committee recommended a general curriculum to consist of foundational training in natural sciences, social sciences, and humanities³. The second committee developed more specific course recommendations, with courses drawn from both CAS and CALS⁴. Both committees recommended formation of an environmental studies major, while pointing to the potential advantages of developing coordinated, cross-college curricula with the ESS major to avoid redundancy or competition, to provide richer course offerings in the field of environmental studies, and expanded opportunities for CAS students interested in environmental sciences.

¹ Brown, L. and M, Krasny et al. 2010. Re-envisioning the Environmental Sciences at Cornell University: Report to the Deans of the Colleges of Agricultural and Life Sciences and Engineering, and to the Provost.

² Bedford, B. et al. 2012. Report of the Committee for Development of a New Environmental Science and Sustainability (ESS) Undergraduate Major to the College of Agriculture and Life Sciences, Cornell University.

³ Hiltgartner, S. et al. 2014. An Environmental Studies major in the College of Arts & Sciences: Preliminary Thoughts. Memo to Dean Gretchen Ritter, College of Arts & Sciences, Cornell University.

⁴ Goodale, C. et al. 2014. Environmental Studies, College of Arts & Sciences. Memo to Senior Leadership, College of Arts & Sciences, Cornell University.

During Fall 2015, this cross-college committee was charged with developing curricular options for students from both CALS and CAS to pursue a joint major or pair of majors in Environmental Studies and in Environmental Sciences.

CHARGE TO THE COMMITTEE – SUMMER 2015

The Deans of the College of Arts and Sciences (CAS) and the College of Agriculture and Life Sciences (CALS) are convening a cross-college committee to identify potential models to offer interdisciplinary curricula in environmental studies and environmental sciences that would be open to students from both colleges. The resulting curricula will offer students distinct ways to combine the study of natural and biological sciences with social science and humanities fields that explore the social, ethical, and public policy dimensions of environmental issues. The expanded options will include a new major in Environmental Studies in CAS that will be developed in coordination with the existing Environmental and Sustainability Sciences (ESS) major in CALS.

The committee should address key issues that are sure to arise in the development of these cross-college major(s), including the need for students in CAS to have access to an environmental studies major that is academically rigorous while concentrating its upper division coursework in the humanities and social sciences. The committee should thus address the following issues:

- (1) The number of courses or credit hours that will be required, along with the distribution of courses across science, social science, and humanities fields;
- (2) The thematic “tracks” or clusters in which students can choose to concentrate, and the courses that are available or needed to fill such tracks;
- (3) The need for foundational or gateway courses and/or capstone seminars in different areas, how these courses will be covered, and the possibility that such courses would offer common experiences to students across curricula;
- (4) Arrangements for centralized, cross-college advisement of students in the shared major(s); and
- (5) Evaluation of alternative models for cross-college administration of the curricula, including (a) a common cross-college umbrella administration (e.g. like Biology or Biology and Society) for two majors; (b) a common cross-college umbrella administration of one major with two distinct tracks (e.g. “studies” or “sciences”); or (c) lead administration of the cross-college majors by one or the other college (e.g. Environmental Studies administered by CAS and ESS by CALS).

We request that the committee submit a proposal for the major(s) to the College Deans by the end of the fall semester in 2015.

COMMITTEE COMPOSITION AND CONSULTATIONS

The CAS-CALS committee for Interdisciplinary Curricula in Environmental Studies and Environmental Sciences consisted of nine members, including three from humanities fields in CAS (Anindita Banerjee, Sara Pritchard, and Aaron Sachs), three from social science fields in CALS (Rachel Bezner Kerr, Shanjun Li, and Steven Wolf), two ecologists (Christine Goodale and Nelson Hairston), and the ESS Program Coordinator (Suzanne Wapner). All committee members except one are or have been ESS faculty advisors, and four currently serve on the ESS Curriculum Committee (Bezner Kerr, Goodale, Hairston, and Wolf), including the current and past chairs of the ESS Concentration in Environmental Policy and Governance (Bezner Kerr and Wolf, respectively). Wolf also co-developed a Concentration in Environmental Studies in the former Natural Resources Major, and Goodale served on the SNES-Natural Resources merger committee that formed ESS. Three committee members contributed to the 2014 CAS committees on Environmental Studies (Goodale, Pritchard, and Sachs).

Consultations with various other ESS faculty during the fall semester provided additional advice to the committee, with input from Cliff Kraft and Rich Stedman (Dept. of Natural Resources) and Gene Madsen (Microbiology, ESS Chair) for the Introductory courses; Tim Fahey and Matt Hare (Dept. of Natural Resources) for biological requirements; Pat Sullivan and Evan Cooch (Dept. of Natural Resources) for quantitative requirements; Susan Riha and Art DeGaetano (Dept. of Earth and Atmospheric Science) for physical/chemical science requirements and for the ESS Colloquium (Riha); and Jon Conrad, Greg Poe, and Bill Schulze (Dyson School of Applied Economics and Management) for economics requirements. Later input was provided by Johannes Lehmann (Soil & Crop Sciences) on the Colloquium, and Cole Gilbert (Dept. of Entomology), the current Director of Undergraduate Biology, provided information on the advising and administrative structure of the Office of Undergraduate Biology (OUB).

The committee circulated a draft set of recommendations to the current ~70 ESS faculty along with ~20 suggested CAS faculty, and Senior Associate Deans from CAS & CALS in early December. All were invited to attend an open session during exam week (Dec. 10, 2015) to discuss draft recommendations, and to send additional feedback by email. Approximately 30 faculty members attended the open meeting, primarily from CALS/ESS, and roughly a dozen additional comments were received by email. Following limited CAS participation at that meeting, a CAS-focused event was arranged by CAS leadership for the start of spring semester (Jan. 26, 2016), with attendance by ~13 CAS faculty members and another three expressing interest by email, along with eight undergraduates. A *Cornell Daily Sun* report from the event spurred an expression of interest by the Cornell Student Assembly Chair for Academic Policy that should be pursued in a next stage of Cornell community engagement.

OPPORTUNITIES AND CHALLENGES

An integrated cross-college major or connected pair of majors in environmental science and environmental studies could provide many **potential opportunities** to Cornell undergraduates including:

- ***New opportunities for students in both CALS and CAS.*** Attractive, diverse offerings for study of the environment and sustainability should appeal broadly to students from both colleges with a wide range of interests and backgrounds, and should greatly increase the overall number of Cornell students in the major. Providing a pathway to pursue study of the environment will create wholly new opportunities for CAS students, and CALS students will have new options in environmental studies to complement existing options in environmental sciences.
- ***Cross-college expertise.*** An integrated environmental major or connected pair of majors will provide substantive interdisciplinary training in study of the environment that ***coordinate the best faculty expertise and intellectual contributions*** from across the University with potential to foster interdisciplinary faculty collaboration. It will also provide opportunities for students to discuss and experience the diverse environmental perspectives of their fellow students.
- ***Introduction of Environmental Humanities.*** A specific goal of the committee's charge was to integrate the humanities into study of the environment. Representation of the humanities was nearly absent from the formation of ESS except for its requirement for Environmental Ethics for all students, plus one other upper level course from a long list of selections in "Social Science and the Humanities." Differences in perspectives across disciplines can sometimes be difficult to navigate, yet substantial intellectual contributions from humanities faculty can provide essential distinct perspectives for the cross-disciplinary core courses and the curriculum as a whole.
- ***Avoidance of potential redundancies.*** A single cross-college major will prevent both confusion and diffusion of efforts that could result if separate yet overlapping majors or courses were

created in the two colleges that could compete for students, faculty time, and administrative resources. A well-connected pair of majors could achieve many of these same goals but would require substantial coordination of efforts.

- ***Improved strength, clarity, and visibility*** of Cornell’s undergraduate environmental programs both internally and to the outside world. Creation and committed investment in a prominent cross-college major or pair of majors that spans CAS and CALS will demonstrate Cornell’s leadership and prioritization of study of the environment and sustainability, and will provide a single central focus for students, prospective students, faculty, alumni, and others.

Challenges faced in constructing a cross-college major or pair of majors include:

- ***Credit limits.*** The College of Arts & Sciences stipulates that “No major may require more than 60 credits of its students, except that up to 70 hours may be required if not more than 40 of them are in any one department.” In practice, most science-based majors in CAS fall close to the 60 credit limit and some majors in the humanities fall closer to 40 credits. Completion of the ESS major now requires 72-84 credits, which precludes participation by CAS students. The ESS major has so many requirements that many current ESS faculty have recommended reductions. The trims in the curriculum proposed here address both of these concerns.
- ***Disruption to ESS.*** The ESS major required several years of committed effort and investment by a large number of faculty members to develop the major’s complex cross-departmental curriculum and governance, and to revise or create courses. The major is working well as a popular, selective, and commended major in CALS. Revising now to enable participation by CAS students would cause further disruption just as the major is settling from its formation. Our committee strove to respect and to build from this investment, and to retain opportunities for retaining the major’s emphasis on substantive training in environmental sciences while concurrently developing new opportunities for inclusion of students and faculty from CAS and in environmental studies.
- ***Establishing interest from CAS students & faculty.*** The sparse attendance of CAS faculty at the open meeting in early December led some from ESS to question the depth of interest in a new environmental major by CAS faculty and students. Thin CAS attendance could reflect short notice, the smaller number of CAS invitees, and the lack of an existing environmental hub and prior investment for CAS faculty to parallel to the vested CALS engagement in ESS. The wide range of CAS faculty teaching environmental courses (e.g., see courses in “Environmental Humanities, below), and the number of CAS faculty Fellows with Cornell’s Atkinson Center for a Sustainable Future (59) demonstrate substantial interest in the environment by CAS faculty. The January 2016 meeting to discuss the major demonstrated additional interest within CAS that should be assessed more fully with follow-up meetings and discussions with Departmental Chairs, and could be bolstered long-term by support from CAS leadership for departments interested in hiring in these areas.

Information on potential student interest was solicited after the December meeting. In the Biology & Society major, the numbers of CAS students in its Environment & Society Theme are relatively small but are increasing as a proportion of all Biology & Society majors (8/104 Class of 2016; 5/73 for 2017; 4/21 for 2018). Senior Associate Deans of Undergraduate Education from both colleges provided statistics that showed similar – and increasing – numbers of students from both colleges entering with Advanced Placement environmental science credits (Table 1).

Table 1: Number of entering students with AP credits in environmental science, by graduation year and college.

	2009	2012	2019
College of Agriculture & Life Sciences	46	67	85
College of Arts & Sciences	34	53	97

- Balancing Disciplines.** The consensus goal of balancing representation across disciplines in the shared curriculum became complicated in execution, largely because of different traditions and priorities in how to split or combine disciplines. The ESS major was founded to provide core training in environmental sciences structured across three disciplinary divisions: 1) biological sciences, 2) physical & chemical sciences, and 3) social sciences & humanities. The CAS committees on environmental studies also organized environmental training into three categories, divided differently: 1) natural sciences, 2) social sciences, and 3) humanities. To respect the perspectives from both colleges, the committee sought to develop a curriculum with shared core training balanced evenly across the four distinct disciplines that each perspective prioritized: 1) biological sciences, 2) physical/chemical sciences, 3) social sciences, and 4) humanities. Vigorous discussions arose late in the semester over whether or not this structure provided sufficient training in both economics and critical social sciences, with inclusion of both topics in the curriculum proposed here.
- Cross-College Administration.** CAS and CALS differ in a great many ways beyond differences in major credit limits, including typical course credit hours; instructor teaching loads, relief, and credit for co-teaching; timing of student major selection (as incoming freshmen in CALS or in the sophomore year in CAS); and in college requirements for graduation. These differences can be difficult to navigate, but models of cross-college majors administered by a lead department include the Science of Earth Systems major, administered by the Department of Earth and Atmospheric Sciences with ~60 students, and the Biology & Society major administered by the Department of Science and Technology Studies with 275-325 students, a similar size to the current ESS major. CALS currently caps admissions into ESS, but expanded cross-college enrollment could become difficult to manage. The Biology Major, with ~1400 students, provides a helpful model for how a large cross-college major can be administered and provide effective advising via its cross-college and cross-department Office of Undergraduate Biology.
- The Name.** Below, we propose a curriculum for a single common major, but the name for this major formed a semester-long challenge. The terms “environmental science” and “environmental studies” each denote distinct disciplinary traditions for study of the environment; neither single name fits comfortably to cover all concentrations in the overall major. Additional naming complications include potential confusion with renaming and protracted disputes within the SUNY system over the use of the term “Environmental Science(s)” in naming a Cornell major for both the ESS and the preceding SNES Major. Two potential names emerged: “Environmental Studies and Sciences” formed one serviceable solution, including both disciplines equally while retaining the “ESS” acronym and separating “Environmental” from “Sciences” as requested previously by SUNY. Yet, a late suggestion of “**Environment and Sustainability**” gained unanimous committee favor for its inclusive simplicity and for its embrace of the fresher perspective of emphasizing sustainability (e.g., as for Cornell’s Atkinson Center for a Sustainable Future) rather than perpetuating long-standing “studies/sciences” divisions; this name is used here for ease, pending additional discussions beyond this committee.

CURRICULUM OVERVIEW: A SINGLE MAJOR WITH VARIED CONCENTRATIONS

The draft curriculum described below forms a single, cross-college major in Environment and Sustainability (Table 2). It retains the four existing structured concentrations in ESS (BGCS, EBAE, EE, and EPG) as well as the individual student-designed option (ISD), and adds a new concentration in Environmental Humanities (EH). This proposed integrated major provides new options for pursuit of environmental studies by students from both CALS and CAS, and it opens options for students in CAS interested in studying environmental sciences. It aims to harness faculty expertise and student interests from both colleges for substantive and integrated training in the environment across a wide breadth of disciplines and perspectives, with a minimum of administrative redundancy or need for creation of duplicate majors or advising structures. This broad major was designed to provide a shared environmental core, with a range of disciplinary training as well as courses intended to provide both integrated interdisciplinary training and cohort-building for a large group of students across the university. Alternative structures with tracks in a single major or as a paired set of majors were considered and are discussed further below, after describing the proposed single combined major. At ten courses overall, the shared core proposed here is much smaller than the current 18-course ESS core, and it enables participation by students more interested in environmental studies than environmental sciences. Cuts to the core can be compensated by shifting many of the basic science requirements (additional courses in introductory biology, math, and chemistry) currently contained in the ESS core into those concentrations that require this training (e.g., BGCS, EBAE), which expand from five courses now to nine here. Concentrations are also encouraged to include courses that support the major's goals of interdisciplinary training. Many majors at Cornell have a large shared core with small concentrations, similar to the current ESS major, but there is no college or university requirement for this structure, and some majors have concentrations larger than their shared cores (e.g., the Mathematics major). The concentrations proposed here range in size from six to nine additional courses beyond the shared core. This discrepancy could tempt some students to migrate to concentrations with fewer requirements, a concern expressed by several faculty members after circulation of the draft curriculum. We expect that the disciplinary distinctions among the concentrations should minimize this flow, but recommend careful monitoring to discern to what extent students make those choices, with subsequent adjustments if necessary.

In total, the proposed major includes 16-19 courses and 48-71 credits overall, depending on the concentration and student's course selection. All of the proposed concentrations can be completed within 60 credits for the major overall. This total represents a substantial reduction from the current ESS total of 23 courses and 72-84 credits. The courses to be trimmed from the major as a whole vary by concentration; these recommendations should be subject to further input from each concentration's faculty. For some existing concentrations, proposed net reductions come from trimming introductory natural science courses. For others, proposed net reductions come from trimming general courses chosen from long lists within broad disciplinary themes at the junior-senior year level of the current ESS core or in the concentrations, with expectations that some students "double-count" these courses (between the concentration and core requirements) now and that student interests should guide them to many of these upper-level courses regardless of their major requirements.

The Shared Core

The proposed shared core described here (Table 2, and below) contains an interdisciplinary introductory course, one course each in five environmental divisions (biological sciences, physical & chemical sciences, humanities, social sciences, and economics) and in quantitative proficiency, as well as

an interdisciplinary colloquium, an integrated course in sustainability, and an immersive course in field or engaged training. Specific course requirements within each of these categories and their justification are described below.

Table 2: Organization and numbers of courses and credits (CR) in the shared core and concentrations for the proposed cross-college environmental major and comparison with the current ESS major.

	Proposed Major			ESS – Current		
	Courses	CR	Rec.	Courses	CR	Specific Req.
<u>Introductory Course(s)</u>						
Introductory Course	1	3	New/Integ.	1	3	Intro. to Env. Science
	-	-	Moved to SS, below	1	3	Intro to Society & Natural Resources
<u>Disciplinary Training</u>						
Env. Biology	1	3	1 of 3 (Ecol.)	2	7	1 Ecology, 1 Evolution
Env. Physics/Chemistry	1	3-4	1 of 3 (Phys)	3	11-12	2 Chem., 1 Physics
Env. Humanities	1	3-4	1 of 5	1	3-4	Env. Ethics (of 2)
Env. Social Sciences	1	3-4	1 or 2			[Intro SS & NR, above]
Env. Economics	1	3	1 of 2	1	3	Env. Economics
Quantitative	1	3-4	Calc or Stats	3	10-12	1 Calc. 1 Stats. 1 Other
<u>Integrative or Immersive Training</u>						
Colloquium	1	2	Expand	1	1	
Sustainability	1	3	Retain	1	3	Sustainability Science
Field or Engaged Course	1	4	Add SS/H	1	4	Field Biology
<u>Upper Level</u>						
List A – Biological Sciences	-	-	*	1	3-4	
List B – Abiotic (Chem./Phys. Sci.)	-	-	*	1	3-4	
List C – Social Sci. & Humanities	-	-	*	1	3-4	
Core Total	10	30-34		18	57-64	
Concentrations (detail below)						
Biogeochemical Sciences (BGCS)	9	30-35		5	15-20	
Env. Biol. & Applied Ecol. (EBAE)	9	30-37		5	15-20	
Environmental Economics (EE)	8	25-28		5	16	
Environmental Humanities (EH)	6	18-24	New	-	-	
Env. Policy & Governance (EPG)	6-7	19-26		5	16-17	
Indiv. Student-Designed (ISD)	(TBD)			5	15-20	
Major Total	16-19	48-71		23	72-84	

*ESS currently requires students take one course from each of three lists of mostly upper-level courses, including List A – Biological Processes, List B – Abiotic Processes, and List C – Social Science and Humanities. Some of the ESS “List A, B, C” requirements are moved to the proposed concentrations.

Introductory Course: 1 New Course, integrating natural sciences, social sciences, and humanities.

This course should be team-taught each semester by at least two faculty members representing different disciplines, to be drawn from a pool of several scholars who initially will all work together to develop the syllabus and course materials, with funding from the deans to support this course development. The committee feels strongly that it's best to avoid a proliferation of introductory courses and that a one-semester commitment would be ideal. In that one semester, students will be introduced to as many different approaches to study of the environment and sustainability as possible. In other words, the introductory course will model the integrative vision that underlies the major. Our belief is that complex environmental issues and sustainability challenges can be understood and addressed only by scholars and citizens who are able to make connections across multiple disciplines. When the introductory course covers climate change, for instance, students will consider it as a problem with biological, ecological, physical, chemical, economic, political, psychological, sociological, cultural, ethical, and historical dimensions. This course will also serve as an initial cohort-building opportunity for students joining the major.

ESS presently requires a two-course sequence in introductory environmental science (NTRES 1101, Introduction to the Science and Management of Environmental and Natural Resources) and an introductory social science (NTRES 2201, Society & Natural Resources). The single course proposed here could serve as an alternative to NTRES 1101 and should build on its recent innovations for the ESS major, but should include perspectives from the humanities from its design. NTRES 2201 could serve to satisfy an introductory social science requirement within the core (described further below).

Disciplinary Training – Six courses, with one course in each of the following six areas, including five environmental disciplines and a course for quantitative proficiency. Courses were selected to prioritize environmentally focused courses in these disciplinary areas.

Biological Sciences: 1 Course. Recommended: BIOEE 1610 Ecology & the Environment.

Also accepted: BIOEE 1780 Evolution & Diversity or NTRES 2830 DNA Genes and Genetic Diversity.

Organisms, their effects on the environment, and their ecological and evolutionary responses to the environment often lie at the foundation of why we care about the natural world. Students will explore the ways that changing environments, whether natural or human-caused, and whether rapid or geological, influence the feedbacks between organisms, ecosystems and the environmental functions they carry out. The ESS core presently requires that students complete two introductory biology courses (BIOEE 1610 and BIOEE 1780) as well as one upper-level course (“List A – Biotic Processes”). We recommend a biology course that provides foundational training on the interactions between organisms and their environment (BIOEE 1610), with two acceptable alternatives: a course on evolution and diversity (BIOEE 1780) or genetics for life sciences students (NTRES 2830, now a required course in the EBAE concentration). To meet college distribution requirements, all CALS students must take at least one additional introductory life sciences/biological sciences course beyond this introductory requirement. Concentrations that prioritize training in biology (e.g., EBAE) have the capacity to require additional introductory and upper-level biology courses as part of their concentration.

Physical/Chemical Sciences: 1 Course. Recommended: EAS 1600 Environmental Physics.

Also accepted: PHYS 1101 General Physics, PHYS 2207 Fundamentals of Physics.

Principles of physics and chemistry constrain the nature of the physical environment as well as the actions of organisms within it. Topics such as radiation, energy balance, and mechanics, and the chemistry of soil, air, and water provide foundational background in environmental physics and chemistry. ESS presently requires one course in physical science and two in general chemistry, as well as

one upper-level course (“List B – Abiotic Processes”). The curriculum proposed here requires one introductory course in physical/chemical sciences, recommending the Environmental Physics course designed specifically for ESS students (EAS 1600), with accepted alternative courses from general physics (PHYS 1101, PHYS 2207). *A parallel course in introductory-level environmental chemistry* or introductory earth science might be recommended as other alternatives if such courses were developed. The existing Environmental Chemistry course (PLSCS 3650) is relatively advanced, and has general chemistry as a pre-requisite. The existing general chemistry courses (CHEM 1560, 1570, 2070, 2080) provide standard broad chemistry training appropriate for science majors, but they lack an environmental focus and application. Concentrations that prioritize classic training in chemistry (e.g., BGCS, EBAE) have the capacity to require 1-2 additional foundational chemistry courses within their concentration.

Humanities: 1 Course. Choose 1 of 5 courses: ANTHR 3417 Ecological Anthropology, BSOC 2061/STS 2061/PHIL 2460 Ethics and the Environment, ENGL 3675 Environmental Literature, NTRES 3320 Introduction to Ethics and the Environment, and HIST 2518/AMST 2581/BSOC 2581 Environmental History.

These courses in ethics and cultural studies all address the underlying values and belief systems that drive much of human behavior. Students will consider the subtle ways in which environmental narratives are constructed and will develop relevant critical thinking skills that might help them shift our dominant cultural conversations. While other courses might direct students toward certain kinds of technical solutions, these humanities courses will remind them that sometimes it’s important to reconceptualize the problems. ESS presently requires one course in environmental ethics (NTRES 3320 or STS 2061) as well as one additional course selected from a list of courses in social science and humanities (“List C”). The recommendations here expand the choices for students to include a broader range of disciplines in environmental humanities.

Social Sciences: 2 Courses. These proposed requirements followed much debate, summarized below.

1 Course in Critical Social Science: Recommended: NTRES 2201 Society and Natural Resources or, when re-established: DSOC 2XXX: Environmental Sociology.

1 Course in Economics: Recommended: AEM 1500 An Introduction to the Economics of Environmental and Natural Resources, or ECON 1110 Microeconomics plus AEM 2500 Environmental and Natural Resource Economics.

Broadly, the social sciences examine how people organized in groups (e.g. institutions, markets governments, movements) interact with and shape the natural world. Social institutions both drive and are affected by environmental change, and that transformative environmental change will require an understanding of social processes and relations. Social science perspectives include political, economic, sociological, demographic and psychological theories that help to explain, predict, interpret and change human interactions with the environment.

The ESS core presently requires three courses in the social sciences, including two required courses at the introductory level and one upper-level elective. The first course (NTRES 2201, Society and Natural Resources) now forms the second half of the ESS freshman sequence. It introduces students to a variety of social science perspectives, including sociology, economics, psychology, and political science. The second ESS social sciences requirement is for a course in economics, as either AEM 1500 (An Introduction to the Economics of Environmental and Natural Resources), a course developed specifically for students who lacked background in economics, or AEM 2500 (Environmental and Natural Resource Economics) which has ECON 1110 as a pre-requisite. All current ESS students also must select one additional course from a list of courses in social science and humanities (“List C”; as noted above).

A preliminary recommendation within the committee proposed allowing students to choose from a short list, to include the two introductory social sciences courses required at present by ESS (AEM 1500 Environmental Economics and NTRES 2201 Society and Natural Resources) or to be chosen among these two or a third social sciences course in Environment Sociology. The existing course in environmental sociology, DSOC 3240, has been on hiatus since a recent retirement, but the course is expected to be re-established at a 2000-level through two new faculty hires in the Dept. of Development Sociology. Alternative proposals were to (1) specify economics (AEM 1500 or ECON 1101) as the only means to satisfy a single core requirement in the social sciences, or (2) add economics as a separate required disciplinary category in the shared core.

The draft curriculum circulated in early December presented the options above as “under discussion,” and lacking committee consensus. Shortly after distribution of the draft, several AEM faculty sent swift and strongly expressed responses supporting the importance of economics as essential foundational training for all students in an environmental major. Some described the history and changes within the field of economics, and others highlighted the regular inclusion of economics as required core training in environmental majors at other institutions. A few warned of their reduced interest in teaching or advising in an environmental major if economics were not required of all students in this major. Meanwhile, other ESS faculty argued for the vital importance of other social science disciplines as well as economics, and several faculty members from the Department of Natural Resources expressed support for requiring both economics and a general social science course. Inclusion of both NTRES 2201 and AEM 1500 (or AEM 2500) has precedent in the ESS major and the two majors that preceded it, SNES and Natural Resources, among the many requirements in these 20-23-course majors. One additional 3-credit course could be accommodated within the major proposed here without exceeding the 60-credit limit. This structure gives the social sciences greater representation within the core than the humanities, biological sciences, and physical/chemical sciences; some considered economics a discipline separate from social sciences. Others argued against a specific requirement for economics and favored maintaining the prior balance among disciplines, allowing students to choose among the 2-3 social sciences courses described previously. In addition to these curricular arguments, an additional consideration is the impact of the newly envisioned major on course offerings and enrollment in the Department of Natural Resources. That department gave up its own separate major in favor of the merger into the interdepartmental ESS major. Including NTRES 2201 as a recommended course to fulfill a critical social science requirement in the shared core, rather than just one alternative between environmental economics and other social sciences, would help to alleviate that concern.

After lengthy debate in meetings and by email, the committee met for a last in-person discussion in early February to provide a recommendation. While recognizing persisting reservations over the prioritization of requirements, the recommendation of the two-course requirement listed at the top of this section reflects the committee’s appreciation of viewpoints provided by both critical social sciences and by economics and the committee’s wish to move the major forward with as much faculty buy-in as possible.

Quantitative: 1 Course in statistics or calculus. Choose from statistics (AEM 2100 Introductory Statistics; MATH 1710 Statistical Theory and Application in the Real World; NTRES 3130 Biological Statistics I; STSCI 2100 Introductory Statistics or STSCI 2150 Introductory Statistics for Biology), college-level calculus (MATH 1106, 1110 or higher) or linear algebra (MATH 2310).

Quantitative training provides essential tools for interpreting and addressing many environmental issues. ESS presently requires three courses in quantitative proficiency: one college-level calculus course; one statistics course, and one additional course from a defined list of courses in these areas as well as

math-intensive applications to environmental biology, information science, or computer science. Here, we propose a requirement of a single course in statistics or calculus within the shared core. This course can satisfy the quantitative requirements of both CALS (for calculus or statistics) and CAS (for Mathematics & Quantitative Reasoning). The additional quantitative courses required by ESS at present can be shifted to those concentrations that prioritize this training (e.g., BGCS, EBAE, EE).

Integrative or Engaged Training – Three Courses

Colloquium: 1 Integrative Colloquium, expanded from 1 to 2 credits.

ESS presently offers a 1-credit Colloquium in the major that students typically take in their sophomore year (ESS 2100, Colloquium in Environmental and Sustainability Sciences; S/U only). It includes weekly speakers drawn from across Cornell and the Ithaca area across a very broad range of topics, most recently spanning film, literature, alternative energy, art, urban rivers, and food provisioning. It presently requires only student attendance. Preceding versions of this colloquium series included small group discussions and other activities, with topics that varied by year and enabled repeat participation by both sophomore and senior students, as required under the SNES major.

An expanded colloquium to foster student dialogue and other related assignments can provide an opportunity for in-depth exchange and critical thinking about environmental challenges and different solutions to address them, but it would require sufficient TA support and organization to work effectively. It should also serve as a course for cohort-building and for broadening perspectives for students from across the major. The committee proposes encouraging a revised colloquium requirement to expand the existing offering from a 1-credit to a 2-credit class (e.g., two 50 minute sessions per week). One weekly meeting would include a seminar on important environmental issues by speakers on and off-campus from different fields and sectors (government, industry, NGOs, international organizations, writers and artists, etc.). A second weekly meeting could be a discussion section run by course instructors and TAs, where students discuss the lecture topic and related reading assignments, perhaps culminating in an integrative term paper or group assignment. The committee recommends that the colloquium should maintain its broad range of topical and disciplinary perspectives. It could be organized by a team of two faculty from different disciplines to foster cross-college and interdisciplinary collaborations, or simply with inputs from a diverse range of faculty members on speaker selection and topic coverage. Past versions of the colloquium had a structure similar that proposed here, but maintaining that level of interaction was challenged by a large increase in class size after the SNES/Natural Resources merger and the need for TA support to maintain student engagement. Financial resources should be provided to cover the initial course development, with ongoing resources provided to cover speaker expenses and teaching assistants to help organize the seminars and discussion sections.

Sustainability: 1 Course. NTRES 3301 Sustainability (Science), or BEE 3299 Sustainable Development. Limited to junior/senior ESS majors.

We include a sustainability course to support students' capacity to engage pressing socio-ecological challenges in an integrated manner. This recommendation builds on the integrative course in sustainability sciences newly developed for the ESS major, to be expanded to specifically include humanities content.

The course will be co-taught to include multiple disciplinary perspectives reflecting the breadth of the major. As envisioned, this upper-division course will advance cohort-building across the concentrations in the major. Learning goals include i) gaining familiarity with core concepts and terminology of sustainability, ii) developing critical evaluation skills needed to understand the principles

and practices of sustainability science, and iii) understand the potential and the limitations of sustainability science approaches to address the complex environmental problems facing society.

Field or Engaged Learning: 1 Course.

Field and engaged learning are especially appropriate for environmental majors regardless of concentration. The ESS major presently requires NTRES 2100 Field Biology as a core course for all students. This course provides important disciplinary knowledge of local organisms and ecosystems, and serves as an important course for cohort-building in ESS. However, it is stretched to capacity by accommodating the current ESS students and may not meet the needs of a broader set of students.

We recommend requiring one "field" class, expanded to include offerings in both natural sciences and in other forms of field-based learning. With the new "Engaged Cornell" initiative, we see exciting opportunities to expand offerings in these areas. Importantly, the committee recommends encouraging development of new field and engaged learning courses under the umbrella of environment and sustainability, especially in the humanities and social science, or integrated courses that combine multiple disciplinary approaches. A preliminary list of courses to satisfy this requirement includes:

Biology/Ecology: Recommended: NTRES 2100 Field Biology; or BIOEE 3610 Field Ecology or ecosystem-based courses with field labs composing more than half of class time.

Social Sciences and Humanities: NTRES 4300 Environmental and Policy Processes. Additional courses to be considered include existing international community engaged environmental courses in India, Thailand, or Ecuador, some Study Abroad field science courses, or some internships.

A subcommittee of the major's faculty should be responsible for further vetting and curation of approved "Field or Engaged" courses.

Concentrations

The committee recommends *maintaining the existing concentrations in ESS* and creating *a new concentration in Environmental Humanities (EH)*. The existing concentrations include Biogeochemical Sciences (BGCS), Environmental Biology and Applied Ecology (EBAE), Environmental Economics (EE), Environmental Policy and Governance (EPG), and an Individual Student-Designed (ISD) concentration. The committee recommends retaining the ISD concentration, but did not address it in further detail. The ESS Orientation Guide provides details on the existing ESS concentrations (e.g., learning goals and course lists in various categories) that are not repeated here. Committee effort centered on developing needs for new concentration(s) and on assessing how all of the existing structured ESS concentrations could maintain their current educational goals in the context of the reductions to the shared core training discussed above. The suggestions for existing concentrations provided here are intended as illustrations of what these concentrations could look like, but the faculty participants involved with each concentration must consider these arrangements and which courses they wished to prioritize as essential training for their disciplines. *The committee encourages each concentration's faculty to also consider inclusion of courses to expand interdisciplinarity at the concentration-level*, in support of the major's overall goals of both breadth and depth.

The concentrations described here range in size from six to nine courses. Requiring a narrow range of numbers of courses for the concentrations has an appeal for consistency within the major and for prevention of student movement to concentrations solely for fewer requirements. However the discrepancy in concentration size reflects differences in philosophies and expectations for disciplinary training that make consistency difficult. These difference could be presented as-is, empowering students to choose education plans that best fit their interests and career goals. However, some faculty expressed

continued concern about these differences in terms of consistency and fairness across all students in the major. In response to this concern and to the wish to increase interdisciplinarity at the concentration level, proposed requirements for one concentration were increased from five courses in the early draft, to six courses here. The committee encourages monitoring and adjusting of requirements if the temptation of fewer requirements produced too many gratuitous shifts in student enrollments.

The committee discussed whether additional new concentrations might be needed to fulfill student interest in environmental studies, beyond the newly proposed concentration in Environmental Humanities and the proposed modified versions of two ESS social science concentrations in Environmental Economics and Environmental Policy & Governance. In particular, the committee recognized some potential interest in a concentration in interpretative social sciences. However, the committee opted not to propose a new concentration in this area at this time, because many of the main courses in these fields were included in the EH and the EPG concentrations. Should needs remain or arise, the ESS governance structure specifically provides for creation of new concentrations over time if student and faculty demand demonstrate sufficient interest. At this time, establishing EH as the only new concentration appeared to suffice to cover most disciplinary interests while minimizing the proposed changes and development needed for a single cross-college major. The need to add new concentrations is less pressing given the existing option of an Individual Student-Designed concentration.

A New Concentration: Environmental Humanities

Here, we propose a new concentration in “Environmental Humanities.” The concentration is intended to encompass both the humanities and the social sciences, especially in their qualitative or “interpretive” dimensions. A more accurate (but too unwieldy) name for this concentration might be “Humanistic, artistic, and socio-cultural approaches to environmental studies.” The goal is to emphasize that the humanities, arts, and social sciences have a crucial role to play not just in producing solutions to environmental problems but in understanding how those problems arose and sometimes in reconceptualizing them. All environmental issues have social and cultural dimensions. And there are personal and psychological angles to consider as well. When negotiators from around the world come together to discuss climate change, their arguments hinge not just on their understanding of renewable energy and cost-benefit analyses and the modeling of sea-level rise, but also on the stories they tell themselves about climate; on the way in which they have been affected by the history of colonialism and imperialism; on dominant ethical frameworks; on political will; on their assumptions about human and natural agency; and maybe even on something as hard to pin down as their sense of humor. To paraphrase one of the lead negotiators in 2015, if climate change is about ecosystems, climate negotiations are about ego-systems. The Environmental Humanities concentration is designed for those students drawn toward disciplines like history, ethics, aesthetics, literature, sociology, and anthropology in their search for answers to the question of why so many brilliant technical solutions to environmental problems have foundered in particular social, cultural, and political contexts.

This new concentration is proposed to consist of six courses beyond the shared core (Table 3), of which five courses are to be selected from the list below (“list H”) to include at least one course at the 4000 level and at least two more at the 3000 level or higher. Any course listed under the Humanities core requirement not taken to satisfy that core can be taken to fulfill the concentration requirements. In addition, a sixth course in quantitative social or natural science (list to be developed) should be selected to demonstrate student breadth and foster interdisciplinary education.

Table 3: Number of courses and credits for the Environmental Humanities concentration.

Environmental Humanities	Draft Major	
List H, 2000 or higher	2	6-8
List H, 3000 or higher	2	6-8
List H, 4000	1	3-4
Quantitative Social or Natural Science course	1	3-4
Concentration Total	6	18-24
Grand total (major + conc.)	16	48-58

List H - Courses in Environmental Humanities

See also, environmental humanities courses in the core not taken to satisfy the humanities requirement.

2000 and 3000

AMST 2331/STS 2331 Agriculture, History, and Society
 ANTHR 3230/ARKEO 3230 Humans and Animals
 ANTHR 3417 Nature/Culture: the Politics of Human-Environment Relations
 ANTHR 3422/AIS 3422 Culture, Politics, and Environment in the Circumpolar North
 COML 2021/EAS 2021 Humans and Climate Change
 COML/ FGSS 3xxx Gender, Geography, and Environmental Futures (Banerjee, under development)
 COMM 2850 / STS 2851 Communication, Environment, Science, and Health
 COMM 3210 Communication and the Environment
 DSOC 3240/STS 3240/SOC3240 Environment, Society and Land
 ENGL 3560/AIS 3560/AMST 3562 Thinking from a Different Place: Indigenous Philosophies
 ENGL 3675/AMST 3675 The Environmental Imagination in American Literature
 HIST 2131 Energy in History
 HIST xxxx History of Environmental Justice (Sachs, under development)
 NTRES 2320 Nature and Culture

4000

ANTHR 4267/ARKEO 4267 Origins of Agriculture
 ANTHR 4410 Indigenous Peoples, Ecological Sciences, and Environmentalism
 ARTH 4445/VISST 4445 Nature, Cultural Landscape and Gardens in Early Modern Italy & France
 COML 4900 Energy, Empire, Modernity
 COMM 4660/STS 4660 Public Communication of Science and Technology
 DEA 4420/ARCH 4601 Ecological Literacy and Design
 GERST 4260/COML 4240/ENGL 4260/GOVT 4279 The Animal
 GOVT 4061/AMST 4061 Politics of Slow-Moving Crisis
 GOVT 4102/AMST 4102 Urban Ecology and Politics
 HIST 4376/GOVT 4367/STS 4621 Geopolitics on Ice
 HIST 4922 Ocean: The Sea in Human History
 NES 2687 Environmental Issues in the Contemporary Middle East
 STS 4131/BSOC 4131/HIST 4131 Comparative Environmental History

Biogeochemical Sciences (BGCS)

Studies in Biogeochemical Sciences provide students with a foundation in physical and chemical processes and how they interact with ecosystems to control the transport and fate of naturally-occurring elements and pollutants in the environment.

The BGCS concentration in ESS presently has six requirements within and beyond the current ESS core, including a requirement as to which “abiotic” (List B) course BGCS students must take at the junior/senior level (Table 4). If faculty in this concentration wished to maintain much of its current training in physical/chemical sciences, it could trim its BGCS elective requirement from two to one course, and then add up to four of the introductory science courses trimmed from the proposed shared core (e.g., two chemistry and two quantitative courses; or two chemistry, one quantitative, and one introductory biology course). Or, to meet the goal of enhanced interdisciplinarity, the concentration could allocate these four courses among, e.g., two chemistry, another quantitative, and an upper-level course in social science or the humanities (List C). Using the last example, the net difference between the existing and proposed full ESS-BGCS training would be a reduction of four courses: 1 intro bio, 1 math, 1 list A (biotic processes), and 1 BGCS elective.

Table 4: Potential organization and numbers of courses and credits for the Biogeochemical Sciences concentration for the draft cross-college environmental major and the current ESS major.

	Draft Major		ESS Current	
	<u>Course</u>	<u>CR</u>	<u>Course</u>	<u>CR</u>
Biogeochemical Sciences (BGCS)				
BGCS List 1 – A Water, Geo., or Atmos., Course	1	3-4	1	3-4
BGCS List 2 – Environmental Informatics	1	3-4	1	3-4
BGCS List 3 – An Ecosystem Course	1	3-4	1	3-4
BGCS List 1, 2, or 3	1	3-4	2	6-8
List B – <i>Biogeochemistry</i> or <i>Environmental Chem.</i>	1	3	*	*
Additional Chemistry & Quantitative courses	3	12-13		
Additional interdisciplinary course (e.g. List C)	1	3-4		
Concentration Total	9	30-35	5*	15-20
Grand total (major + BGCS conc.)	19	60-69	23	72-84

* = course selection within the ESS Core presently required by the concentration.

Environmental Biology and Applied Ecology (EBAE)

The EBAE concentration provides students with the scientific basis for understanding the sustainability of various ecological system. Students will learn advanced principles of biology and ecology and their application to problems of environmental management.

The EBAE concentration presently has six requirements within and beyond the current ESS core, including a requirement as to which “biotic” (List A) course that EBAE students must take (Table 5). If faculty in this concentration wished to maintain much of its current training in natural sciences, it could trim its EBAE elective requirement from two to one course, and then add up to four of the introductory science courses trimmed from the proposed shared core. Or, to meet the goal of enhanced interdisciplinarity, the concentration could allocate these four courses among three introductory science courses (e.g. 1 quantitative, 1 intro chemistry, 1 more introductory biology or quantitative) and an upper-level course in social science or the humanities (List C). Using the last example, the net difference between the existing and proposed ESS-EBAE training would be the reduction of four courses: 1 intro bio or math, 1 chemistry, 1 list B (abiotic processes), and 1 EBAE elective.

Table 5: Potential organization and numbers of courses and credits for the Environmental Biology and Applied Ecology concentration for the draft cross-college environmental major and the current ESS major.

Environmental Biology & Applied Ecology (EBAE)	Draft Major		ESS Current	
	<u>Course</u>	<u>CR</u>	<u>Course</u>	<u>CR</u>
Advanced Ecology (BIOEE 3610 or NTRES 3100)	1	3-4	1	3-4
EBAE List 1 – An Ecosystem Course	1	3-4	1	3-4
EBAE List 2 – An Organism Course	1	3-4	1	3-4
EBAE List 1 or 2 (4000+)	1	3-4	2	6-8
+1 Intro Bio: NTRES 2830, BIOEE 1610, BIOEE 1780	1	3-5	*	*
Additional Chem, Quant, or Intro Bio)	3	12-13		
Additional interdisciplinary course (e.g. List C)	1	3-4		
Concentration Total	9	30-37	5*	15-20
Grand total (major + EBAE conc.)	19	60-71	23	72-84

* = course selection within the ESS Core presently required by the concentration.

Environmental Economics (EE)

ESS students with a concentration in Environmental Economics will study how society allocates scarce resources and disposes of residuals that affect environmental quality and climate.

The EE concentration presently has five requirements beyond the current ESS core (Table 6). If faculty in this concentration wished to focus its proposed training on economics, it could maintain all of its current concentration requirements and while adding another in economics (ECON 3120, ECON 3140, or AEM 4110) and adding one of the introductory quantitative courses to be trimmed from the proposed shared core and an upper-level interdisciplinary course (List A, B, or C). The net difference between the existing and this proposed ESS-EE training would be the reduction of five courses, dropping six courses required now (1 quantitative, 1 intro bio, 2 chemistry, and 2 list A, B, or C) and adding one more concentration-focused course.

Table 6: Potential organization and numbers of courses and credits for the Environmental Economics concentration for the draft cross-college environmental major and the current ESS major.

Environmental Economics (EE)	Draft Major		ESS Current	
	<u>Course</u>	<u>CR</u>	<u>Course</u>	<u>CR</u>
ECON 1110: Intro Micro	1	3	1	3
ECON 1120: Intro Macro	1	3	1	3
ECON 3010 or 3030: Intermediate Micro	1	4	1	4
AEM 4500/ECON 4810: Resource Economics	1	3	1	3
AEM 4510/ECON4820: Environ. Economics	1	3	1	3
ECON 3120, ECON3140, or AEM 4110	1	3-4		
Additional Quantitative	1	3-4		
Additional interdisciplinary course (List A, B, or C)	1	3-4		
Concentration Total	8	25-28	5	16
Grand total (major + EE conc.)	18	55-62	23	72-84

Environmental Policy & Governance (EPG)

ESS students with a concentration in Environmental Policy and Governance will study the design, construction, implementation and evaluation of environmental policy and management.

The EPG concentration presently has five requirements beyond the current ESS core (Table 7). If faculty in this concentration wished to focus to retain its existing training in social and some natural sciences, it could require students to select take four required courses in environmental sociology, governance, policy, and law (DSOC 3240, NTRES 3311, NTRES 4300 or 3300, and CRP/NTRES 4440), along with a course in upper-level social science and humanities (List C) and natural sciences (List A or B), and/or possibly one additional quantitative course.

If none of the other trimmed ESS core courses were added to the EPG concentration, the net difference between the existing and proposed ESS-EPG training would be the reduction of seven courses: 1-2 quantitative, 1 introductory biology, 2 chemistry, 1 list A or B course, and 1 list C course (from 2, one each in the ESS Core and EPG concentration).

Table 7: Potential organization and numbers of courses and credits for the Environmental Policy and Governance concentration for the draft cross-college environmental major and the current ESS major.

Environmental Policy & Governance (EPG)	Draft Major		ESS Current	
	<u>Course</u>	<u>CR</u>	<u>Course</u>	<u>CR</u>
Env. Sociology (DSOC 3240)	1	3	1	3
Env. Governance (NTRES 3311)	1	3	1	3
Env. Policy (NTRES 4300 or NTRES 3300)	1	3-4	1 (4300)	4
Env. Law (CRP/NTRES 4440)	1	4	1	4
ESS List C, one course, \geq 3000 level	1	3-4	1	3-4
ESS List A or B (Biotic or Abiotic Processes)	1	3-4		
<i>Additional Quantitative</i>	<i>1</i>	<i>3-4</i>		
Concentration Total	6-7	19-26	5	16-17
Grand total (major + EPG conc.)	16	50-57	23	73-81

Alternative Major Structures

In considering various options for how to structure curricula as a single major or a connected pair of majors (Figure 1, below), our committee focused on the single major option for several reasons. First, past efforts have already developed plans for two unconnected majors, resulting in the current ESS major in CALS and various drafts for an Environmental Studies major in CAS (illustrated in Fig. 1, below, “Current/Past Proposed”). For this cross-college effort, the committee focused on the single major to provide a structure for substantive multi-disciplinary education and foster conversation between the environmental sciences and studies, while optimizing expansion of educational opportunities without splitting new or existing concentrations into tracks or separate majors (Fig. 1, Option A). The single major option would provide the most cohesion and integration of various disciplinary perspectives for all students. Splitting the major into separate majors or tracks (Fig. 1, Options B-D) could hinder that integration and ultimately reinforce disciplinary separation and hierarchies. The five structured concentrations described above as part of a single major could be classified into designations along the

lines of “Studies,” “(Natural) Sciences,” and “Social Sciences” or related names (Option B). However, the committee concluded that these classifications would likely complicate the major structure with labels without necessarily imparting substantial formal meaning or inclusion on a diploma or transcript. Separating “Studies” and “Science(s)” tracks or majors could hinder important conversations across these longstanding divides, and create challenges regarding where to place the two existing social science concentrations, Environmental Economics and Environmental Policy and Governance. These two concentrations have long been part of the SNES and ESS environmental science majors, where these concentrations followed cores with many natural science requirements. The “Science” precedent of these concentrations and preferences by some of their faculty could place these concentrations with a “Science” track or major (Option C, D), with further discussion likely needed regarding inclusion of introductory natural sciences and quantitative training. If so, a “Studies” track or major would contain only one concentration in Environmental Humanities compared with the four in “Science(s),” and that structure would not meet the goal of expanding social science options in environmental studies. Alternatively, one or both of the EE and EPG concentrations could be shifted to an “environmental studies” track of major, or could be duplicated with both “studies” and “science” versions; however, these sorts of changes would require more substantial development and negotiation among the faculty engaged in these concentrations.

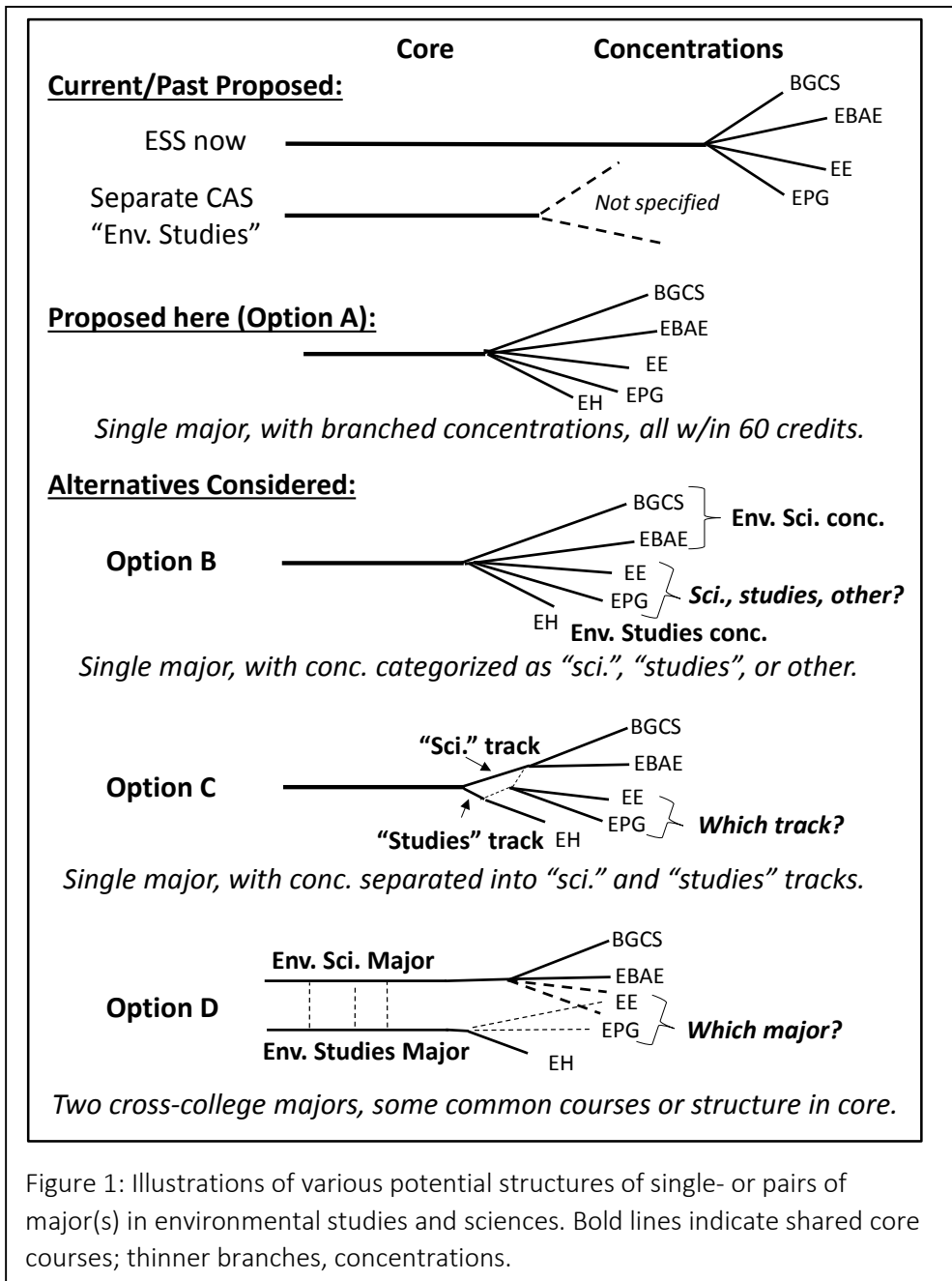


Figure 1: Illustrations of various potential structures of single- or pairs of major(s) in environmental studies and sciences. Bold lines indicate shared core courses; thinner branches, concentrations.

Administratively, a single major would avoid duplication and would streamline coordination of efforts across different curriculum committees and other organizational support. The committee knew of few if any precedents for administration of a connected pair of cross-college majors at Cornell; that lack of model does not preclude development of a novel arrangement, but would require additional time and energy to establish and maintain. Cross-college administration can be difficult for even a single major.

GOVERNANCE

Considerations of governance fell into two broad topics of curricular and administrative governance. **At present**, the ESS major governs curriculum and other academic matters with a 12-member curriculum committee (ESS CC) elected from its faculty advisor pool. The committee consists of a CALS-appointed Chair and an elected Co-chair, elected representatives from each of the four structured concentrations, and 8 elected at-large faculty members. The ESS CC composition was specifically designed to include some disciplinary representation through the Concentration representatives, as well as general elected participation by those faculty in the major. Alternative structures based on representation by department were deemed unwieldy with the large number of departments involved and the challenge of apportioning departmental involvement (e.g., one representative per department regardless of involvement? Or if weighted by departmental involvement, how to weight?). The ESS CC meets monthly to discuss various ongoing curricular issues. The Department of Natural Resources now provides administrative support with 1.25 FTE for both ESS and Natural Resources, with expected reductions to 1.0 FTE for ESS once the last students in the former Natural Resources major graduate in 2016. Natural Resources also supports additional expenses for the ESS major (currently, ~\$8500) for events (orientation, graduation, etc.), printing and mailing, phone and internet, and general office supplies through the department's block grant from CALS. A memorandum of understanding across the five departments with lead responsibility for the major's required core courses (Departments of Development Sociology, Earth & Atmospheric Sciences, Ecology & Evolutionary Biology, Natural Resources, and the Dyson School of Applied Economics and Management) with CALS leadership provides some stability in teaching staff and other course resources.

Academic governance of the proposed major might be achieved most efficiently through a modest expansion of the ESS CC. At a minimum, the ESS CC should include a new representative of the Environmental Humanities concentration; additional representatives from CAS could be added by small expansion of the at-large pool, or CAS members could join the ESS CC by running as part of the annual election cycle for open at-large seats. ESS CC terms usually span three years, with roughly one-third of the seats replaced each year, along with any replacements necessitated by retirements, sabbaticals, or related changes. If separate tracks or majors were constructed for Environmental Studies and Environmental Sciences, they might be best coordinated as an overall single curriculum committee rather than forming new, separate committees that would duplicate some tasks and require substantial effort for their construction and ongoing coordination.

Administrative support for the major proposed here could occur through a modification of the departmental structure used now, or with a cross-departmental model for advisement and resource support modeled after the Office of Undergraduate Biology (OUB). The potential size of the major and need to span a range of cross-college issues point toward the OUB model for administration. At present, the ~270 (ESS only) to ~300 students (including SNES & Natural Resources) in ESS make it the third largest of the two dozen majors in CALS, after Applied Economics and Management (~700 students) and Biological Sciences (~580 CALS students). At a minimum, modifications to the current administrative structure should include cross-college support for the major's direct expenses, expansion of FTE support in proportion to student enrollment and new cross-college advising needs, and a revisit to the MOU

commitments altered to provide substantive cross-college support and to recognize the need for additional two-way dialogue between departmental-based assignments of course instructors and other course support, and the ESS CC requirements of various courses, among other topics.

The Office of Undergraduate Biology provides a useful model for administration of a large cross-college major. A parallel undergraduate Office of Environment and Sustainability (or similar name) could be developed to administer the major proposed here. The OUB staff and physical presence on campus provide a hub for student advising, and its Director also chairs the cross-college Biology Curriculum Committee, composed of Directors of Undergraduate Studies of various Concentrations in Biology. With roughly 1400 students across Cornell in the Biology Major, OUB staffing includes a half-time faculty Director, four full-time staff members focused on student advising, one administrative assistant, and a curriculum assistant/building coordinator. Stimson Hall provides physical advising and lab space. The advising staff conducts a large amount of direct advising of students and coordinates broader advising activities such as assigning faculty advisors, coordinating honors and URM mentoring programs, and providing freshman advising for all incoming students across the university. First-year Biology students also receive structured group peer advising from Junior or Senior students paired with a faculty advisor and organized by OUB staff. The OUB works with CAS Admissions to identify incoming freshmen with interests in biology, so that these incoming students can participate in Freshman Orientation and first-year advising in Biology. Regardless of where the proposed major is administered, *the OUB's identification and advisement strategy should be paralleled for incoming students interested in environmental studies and sciences*. If the proposed cross-college major were roughly to double in size to 600-700 students through the expansions proposed here, it might be expected to require roughly proportional staffing support of ~2.5 to 3 full-time advising staff and a part-time director. Considering possible physical locations, an office near the intersection of the CAS and CALS buildings on campus has a compromise appeal. Other location factors to be considered include proximity to the OUB to enhance flow of information across offices with similar functions, or co-location with the Atkinson Center for a Sustainable Future to consolidate the University's environmental presence.

In addition to its role in advising, the OUB works with departments to maintain the core courses in the Biology major. The OUB provides some administrative support for seven Biology core courses, while departments are responsible for their instruction; this divided responsibility and departmental teaching credit forms challenges for all cross-college majors and should be addressed in similar ways across these majors. The OUB provides additional incentives for departmental engagement with the Biology major through coordination of applications for most of the teaching assistantships associated with these major's core courses, which are paid through a complicated variety of legacy funding structures. *TAs are allocated by the OUB to these core courses, not to the departments with lead responsibility for teaching them*. However, instructors have a large role in selecting TAs for their courses, which often indirectly provides support for the graduate programs in the departments that provide the course instruction. An important aspect of this approach for TA allocation is that it empowers the major by providing strong incentives for cross-departmental cooperation and engagement. *The committee recommends that a cross-college undergraduate Office of Environment and Sustainability should be empowered with similar capacity to allocate TAs for the major's core courses so to provide continuing incentives for departmental engagement and cooperation*.

RESOURCES FOR THE MAJOR

The committee identified several general areas in need of resource support. These include:

- Establishment of an undergraduate **Office of Environment and Sustainability** to support the

advising and administration of the major. It should be staffed roughly in proportion to student enrollment, as described above, with 2.5 to 3 advising and administrative staff and a part-time Director. Staffing needs might be slightly greater-than-proportional during the period of establishment of this office to ease its development. Or, its staff could be expanded as enrollments increased. A Director, with teaching and administrative relief negotiated from his or her home department, should have a central role on the ESS CC (as Chair, DUS, or other position) to tightly connect the academic and administrative aspects of the program.

- **Faculty time and teaching release for developing three integrated, co-taught interdisciplinary courses in the shared core** (described above), including the Introductory course (for Freshman fall), and revisions to the Colloquium (Sophomore/Junior year) and the Sustainability (Junior/Senior year) course to include substantive interdisciplinary training, while minimizing the overlap across these courses. This work might be supported with structured meetings of potential instructors during spring or summer 2016. Investment in the introductory course is essential to launch the major.
- **Faculty time and teaching release for developing Field or Engaged courses** in the social sciences and humanities or spanning these disciplines and the natural sciences. Support from “Engaged Cornell” or ACSF might be appropriate.
- Instructor and TA incentives for developing **introductory core courses in Environmental Chemistry or to survey Environmental Humanities** (e.g., in parallel to the NTRES 2201 survey of environmental social sciences).
- **Full credit to faculty instructors** in both colleges and home departments of instructor faculty for developing and teaching team-taught core courses (regardless of number of faculty) and for teaching courses within the major on a recurrent basis.
- Support by University and College leadership for departments interested in **hiring** into environmental humanities positions, or by both colleges into new joint positions or positions that maintain courses central to the major’s core or concentrations (e.g., Environmental Law).
- **Teaching assistantships**, assigned through the major, in numbers proportional to enrollments in the major’s three integrated courses (Introduction, Colloquium, and Sustainability), its required core courses (e.g., EAS 1600 Environmental Physics, AEM 1500 Environmental Economics, etc.) and for Field/Engaged courses.
- **Annual operating costs for the major’s core courses.** Expenses include travel for some visiting speakers (Colloquium) and buses for field trips (Introductory course, select Field courses).
- **Annual expenses for administering the major**, including orientation and graduation events, printing, mailing, phone and internet, and general office supplies used for the major.
- **Devoted marketing resources** for the major, including website development, to publicize the major, expand applications, and ensure a highly qualified student body.
- **Specific budgeting should be developed before launching the major.** An early responsibility of the proposed Director could be to specify exact funding required for the general needs identified here.

TIMELINE

The committee considers Fall 2017 to be a more realistic start date for the proposed major than Fall 2016. Three main tasks are seen as essential prior to launch of the major:

- 1) **Broad discussions between CAS and CALS leadership and associated faculty and students in CAS and ESS** to demonstrate interest and commitment to an expanded cross-college major. The open discussion for faculty input in December 2015 and January 2016 provided a useful start, but additional opportunities for feedback and engagement on the shape and scope of a joint major should be cultivated by CAS and CALS leadership throughout spring term 2016 and beyond. It should encompass both those invested in the current ESS structure (i.e., ESS Chairs and broader faculty and students, and the MOU-signing departments, especially the Department of Natural Resources) and those who might be brought in to participate in an expanded cross-college major.
- 2) **Development of multi-disciplinary courses**, especially an integrated introductory course, requires supported time before they will be ready for the first cohort of students.
- 3) **Establishment of a cross-college advising and administrative structure** through an Office of undergraduate Environment and Sustainability, including a suitably located office space.