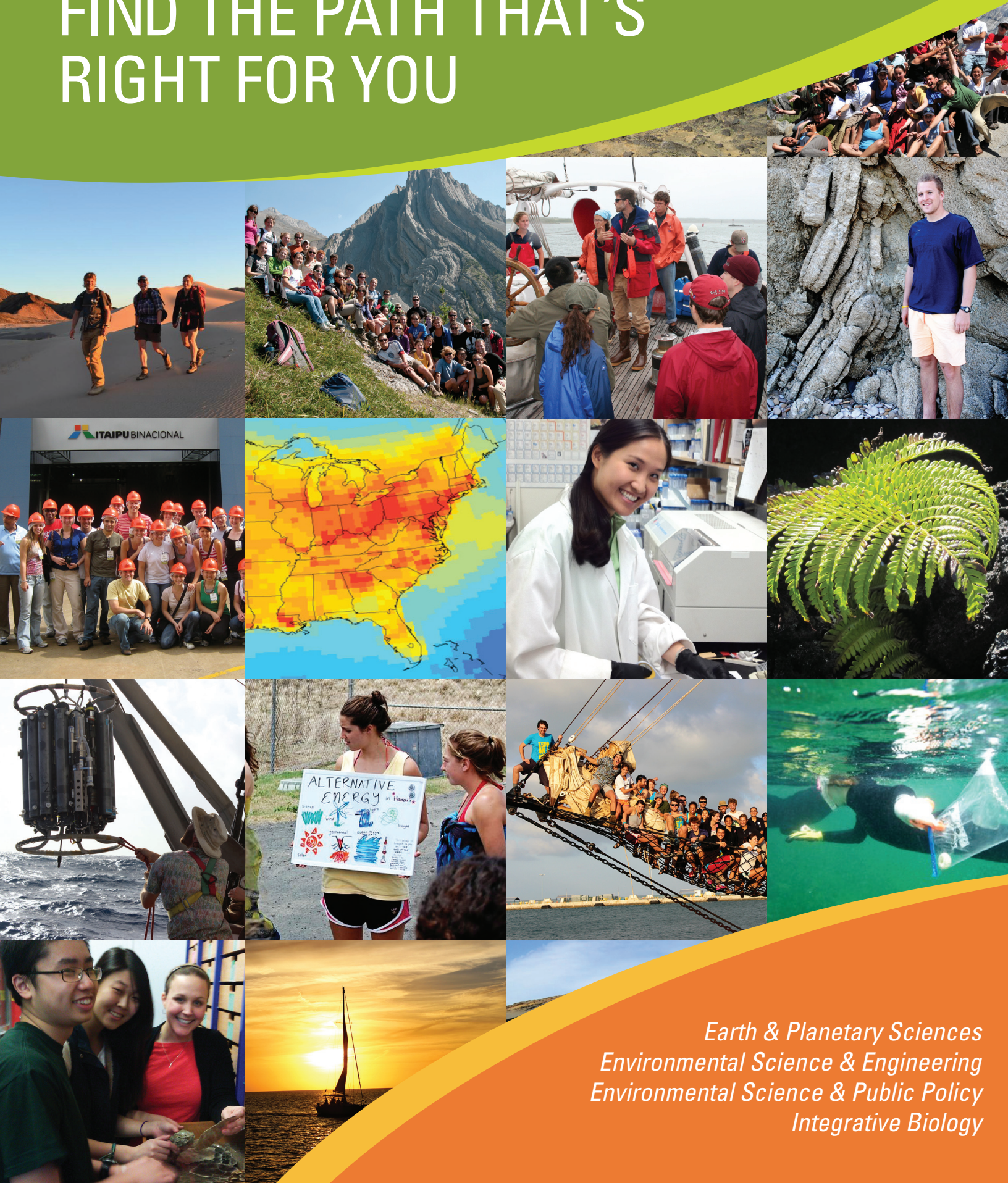
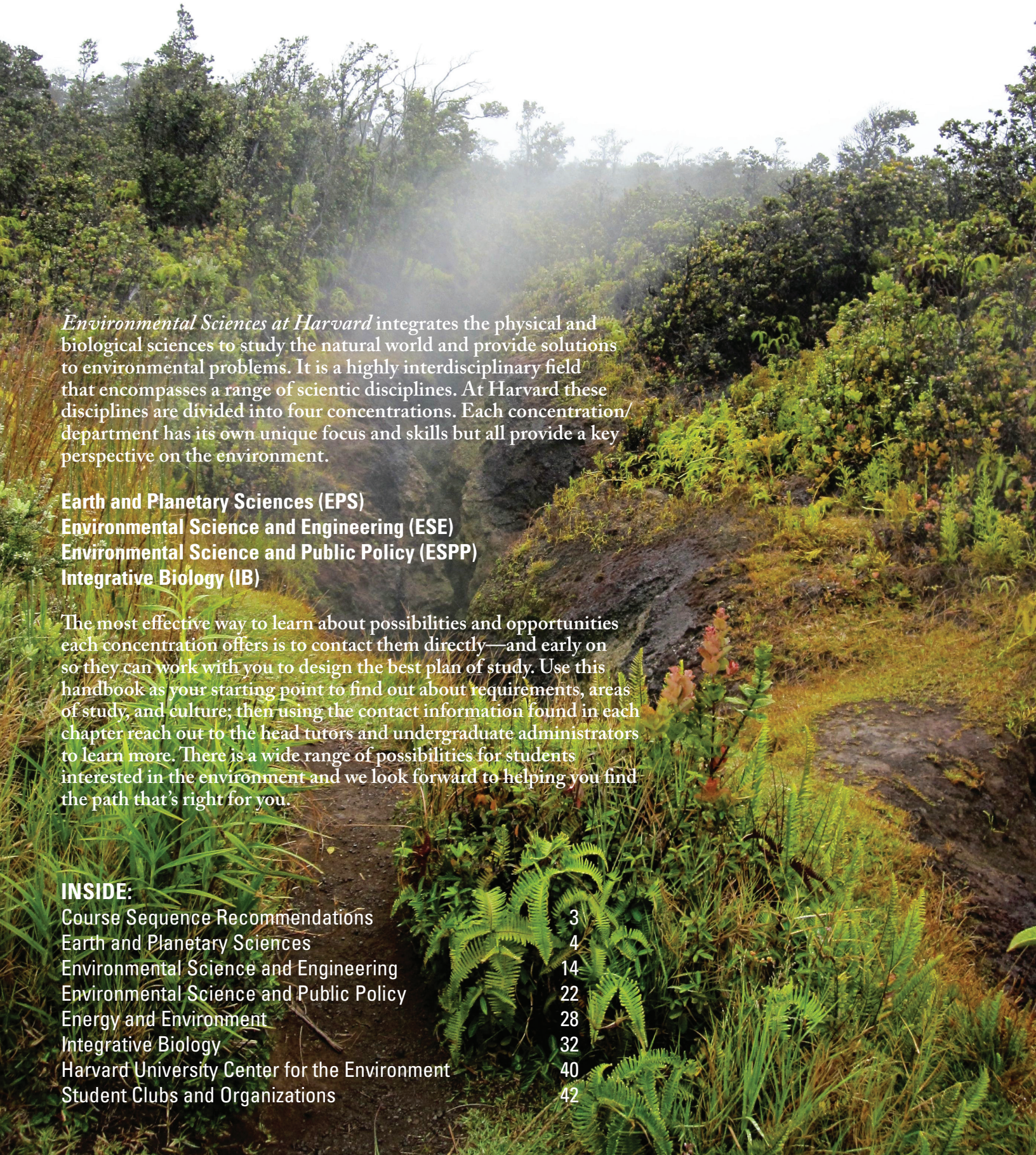
2015-2016 Undergraduate Education • Environmental Sciences at Harvard

FIND THE PATH THAT'S RIGHT FOR YOU



Earth & Planetary Sciences
Environmental Science & Engineering
Environmental Science & Public Policy
Integrative Biology

WELCOME TO
ENVIRONMENTAL SCIENCES AT HARVARD



Environmental Sciences at Harvard integrates the physical and biological sciences to study the natural world and provide solutions to environmental problems. It is a highly interdisciplinary field that encompasses a range of scientic disciplines. At Harvard these disciplines are divided into four concentrations. Each concentration/department has its own unique focus and skills but all provide a key perspective on the environment.

Earth and Planetary Sciences (EPS)
Environmental Science and Engineering (ESE)
Environmental Science and Public Policy (ESPP)
Integrative Biology (IB)

The most effective way to learn about possibilities and opportunities each concentration offers is to contact them directly—and early on so they can work with you to design the best plan of study. Use this handbook as your starting point to find out about requirements, areas of study, and culture; then using the contact information found in each chapter reach out to the head tutors and undergraduate administrators to learn more. There is a wide range of possibilities for students interested in the environment and we look forward to helping you find the path that's right for you.

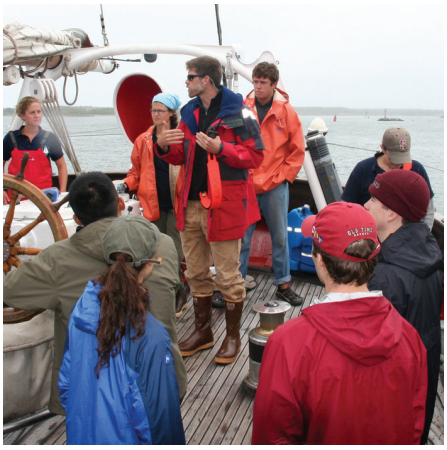
INSIDE:

COURSE SEQUENCE RECOMMENDATIONS

The chart below lists courses each environmental science concentration recommends students consider taking within their first three terms at Harvard. Every student's plan of study and trajectory is different so we encourage you to contact the departments directly for advice on course selection.

	Earth & Planetary Sciences	**Environmental Science & Engineering**	**Environmental Science & Public Policy**	**Integrative Biology**
Introductory Courses	EPS 21 *and* 22	ES 6	ESPP 11 *or* EPS 22 *or* SPU 25 *or* SPU 29 *or* SPU 31 *or* SLS 22 *or* SLS 25	LS 1A (or LPSA or LS 50A) LS 1B (or LS 50B) OEB 10
Chemistry	Physical Sciences 10 & 11 *or* Physical Sciences 1 *or* Chemistry 17 or higher	Physical Sciences 10 & 11	Physical Sciences 1 *or* Physical Sciences 11 *or* EPS 135	Optional
Math	Math 21a,b *or* Applied Math 21a,b	Math 1a,b *and* Math 21a,b *or* Applied Math 21a,b	Minimum requirement is Math1a and 1b; More advanced courses in math and statistics can be chosen; *Begin according to placement.*	Optional
Physics	Physical Sciences 12a,b *or* Physics 15a,b,c *or* Applied Physics 50a,b	Physical Sciences 12a,b or Physics 15a,b *or* Physics 16, 15b *or* Applied Physics 50a,b	Optional	Optional

EARTH & PLANETARY SCIENCES



…understand the consequences of human activities for Earth's atmosphere, its oceans, the land, and the organisms that live on it.

These are intellectually exciting times for Earth and planetary sciences, which are of unprecedented importance to contemporary society. Our environment is increasingly subject to stresses placed upon it. As never before, we must understand the consequences of human activities for Earth's atmosphere, its oceans, the land, and the organisms that live on it. Exploring for, extracting, and conserving natural resources are vital to the global political economy. We must mitigate ill effects of earthquakes, landslides, volcanic eruptions, and severe weather by learning to predict their time and place.

WHY EARTH AND PLANETARY SCIENCES?

The field of Earth and Planetary Sciences (EPS) deals with questions that require a combination of scientific innovation, deep understanding, and an interdisciplinary approach involving all the core sciences. EPS's research environment is an unparalleled resource for undergraduate education. Concentrators may work with faculty and graduate students on major research projects as a research or field assistant, in the context of course work, or as part of an undergraduate research project. Class sizes are small and student-professor contact is frequent and informal. Students are encouraged to participate in department-sponsored field trips; experiences that build a tight-knit community among undergraduates, graduate students, and faculty. By the time they graduate, each EPS concentrator has become personally acquainted with numerous faculty members in the department, and many complete their studies with a senior thesis based on original research. Earth and Planetary Sciences provides a challenging and sophisticated environment with many career opportunities in the private sector, government, and academic research.

EPS OFFERS:

- A science that addresses important societal challenges
- A mid-size department, accessible and friendly
- High faculty to student ratio
- Individual faculty advisor for each EPS concentrator
- Flexible course of study
- Training in the basic sciences leading to focused study in selected subfields
- World-wide summer field research camps and January field experiences
- Research/lab opportunities and summer internships with funding
- Opportunities to conduct original research with guidance from EPS faculty, resulting in a senior thesis

ACTIVITIES:

- Department-sponsored field trips: Canadian Rockies, Hawaii, and sailing off the coast of California or Massachusetts
- Weekend field trips to geological sites
- Seminars/tutorials/special presentations
- Opportunities for informal interaction with faculty and students
- Daily 3:00 pm cookies and tea, weekly Friday 5:00 pm pizza
- GeoSociety: a student-run organization whose activities complement the work in and out of the classroom.
  To learn more contact James Duncan (jduncan@college.harvard.edu) or Cecilia Sanders (csanders@college.harvard.edu).

WHY I CHOSE EPS

From the very first time I walked into Hoffman Labs, I knew the EPS department was special. As a confused and nervous freshman, I never expected to find such a welcoming and open community, and I've never stopped being grateful for it. From hiking up volcanoes to researching earthquakes, I've had more wonderful experiences with the department than I can count, and I've gotten to share them with a group of incredible, passionate, caring individuals. The department has been absolutely fundamental in shaping my life at college, and I couldn't have asked for a better experience.

TAYLOR BENNINGER '16
EPS SECONDARY
SOCIOLOGY PRIMARY

Coming to Harvard, in itself, was very daunting for me. I had great aspirations for Law School and politics, only to take my first government class and hate every minute of it. Only after this sad reality did I allow myself to study something I have always been passionate about: rocks. This is where I found the little hidden gem that is the Earth and Planetary Sciences department. I have always loved rocks, collecting them and filling my pockets since the age of five. The idea of the Earth making objects as sturdy as highly-metamorphosed rocks to beautiful and precious gemstones has always been something that amazes me. So, my first meeting with my advisor, I asked him why he studied the Earth. To which he told me what he asked himself when he enter college: "I asked myself, do I want to read about history, or make it?" From that question forward, I have been exploring all that the department offers. Now, with the EPS department's boundless resources I can get right on the front lines in Hawaii and the Canadian Rockies and experience the Earth systems first hand on the many trips the department offers.

Not only this, but the faculty in EPS are the best I have had the pleasure of knowing at Harvard. I once made a joke to the EPS Academic Programs Manager that I would "suffer through chemistry for [her]," but it was so much more that. This department has consistently challenged me and made me love rocks and minerals and how they form even more intensely. I truly love the Earth and Planetary Sciences department, and if you give it a chance, I am almost positive you can come to call it a safe haven as well. I came for the rocks, but I stayed for the validating feeling that EPS is where I belong—thanks to the people and the experience.

MATTIE NEWMAN '17
EPS PRIMARY

As the saying goes, you have to kiss a lot of frogs. I went through many departments at Harvard before finding EPS. Originally I was drawn by the subject matter. EPS covers everything from energy resources to the ocean floor, from the history of life on earth to weather patterns. What I was not expecting was to find a department so dedicated to student's education and so successful at making that experience meaningful. The professors and staff are passionate about the material and are always happy to talk to students. Tutorials and field trips introduce students to current research in the field and bring them up close to the material they study in class. It is everything you want in a department: great students, passionate professors, and material that really matters to the world. My only complaint is I did not find the EPS department sooner.

ELLEN ROBO '16
JOINT EPS AND PHYSICS

I first stumbled upon EPS by mistake—a fortuitous mistake. Before even enrolling in an introductory class, I was swept away on a summer field trip to Hawaii with 60 other like-minded, incredible individuals that have since become some of my closest friends at Harvard. Over the past year, EPS has continued to evolve into an unparalleled facet of my academic and social experience. From spending three weeks camping in Death Valley for a geologic field camp to frequent weekend trips throughout New England, EPS is home to many of my fondest memories at Harvard, both inside and outside the classroom. Additionally, EPS embodies what other academic departments at Harvard strive to be. It's the small things that set EPS apart—the yearly swag order that has my closet decorated with EPS flannels, hats, and fleece vests; the free coffee and cookies in Hoffman Lounge that have me spending way more hours in the department than I should be; the ample opportunities to work alongside faculty through small, intimate classes, frequent office hours, and lab assistant positions; the GeoSoc club that brings students together for social gatherings when we're finished with—or procrastinating—problem sets. EPS has a niche for everyone, whether you're interested in solid earth tectonics and geology, the fluid earth and climate sciences, or just a challenging concentration with incredible people, unbelievable travel experiences, dedicated professors and administrators, and a true sense of family and comfort.

FORREST LEWIS '17
EPS SECONDARY
ESPP PRIMARY

At some point in my former life I must have appreciated the divine workings of a random rock, and therefore years later felt impelled to take an intro geology course as a general requirement. What followed was the discovery of a wonderful community of people and my own intense fascination with the Earth sciences—as well as a total switch out of my original concentration!

It has been such a gift to have been a part of this department. I have learned a great deal from a wealth of people dedicated not only to advancing their field of study, but to lending time and encouragement to we as students. It is to be all at once challenged and supported, guided and yet granted independence.

I am immensely grateful to have found an environment that is altogether academically engaging, energizing, and fun!

NIZHONI O'CONNELL '15
EPS PRIMARY

EARTH AND PLANETARY SCIENCES COURSE SEQUENCE

Earth and Planetary Sciences includes a diverse set of core science disciplines and strong linkages to the other science departments, as well as the School of Engineering & Applied Sciences, the Center for the Environment, the Microbial Sciences Initiative, and the Origins of Life Initiative.

Because Earth's natural systems (atmosphere, oceans, biosphere, solid Earth) are interconnected, the department spans the boundaries between biology, chemistry, engineering, physics, mathematics, and the Earth sciences. EPS students are trained rigorously in the basic sciences by taking the same foundational courses as students in astrophysics, chemistry, engineering sciences, and physics.

The chart below lists courses EPS recommends students consider taking within their first three terms at Harvard. Each student's plan of study and trajectory is different so we encourage you to contact us directly for advice on course selection.

EPS/GEN-ED	EPS 21	**The Dynamic Earth: Geology and Tectonics Through Time** *and*
	EPS 22	**The Fluid Earth: Oceans, Atmosphere, Climate and Environment** *and/or*
	SPU 12	**Natural Disasters** *or*
	SPU 14	**How to Build a Habitable Planet** *or*
	SPU 25	**Energy and Climate for the 21st Century** *or*
	SPU 29	**The Climate-Energy Challenge** *or*
	SPU 30	**Life as a Planetary Phenomenon** *or*
	SPU 31	**Energy Resources and the Environment** *or*
		NB: only one Gen Ed course may substitute for one of the required introductory courses if the class is taken before any other EPS course
MATH	Math 21a	**Multivariable Calculus** *and*
	Math 21b	**Linear Algebra and Differential Equations** *or*
	Applied Math 21a	**Mathematical Methods in the Sciences** *and*
	Applied Math 21b	**Mathematical Methods in the Sciences**
CHEMISTRY	Physical Sciences 1	**Chemical Bonding, Energy, and Reactivity: An Introduction to the Physical Sciences** *and*
	Physical Sciences 10	**Quantum and Statistical Foundations of Chemistry** *and/or*
	Physical Sciences 11	**Foundations and Frontiers of Modern Chemistry: A Molecular and Global Perspective** *or*
	Chemistry 17	**Principles of Organic Chemistry** *or higher or*
	ES 164	**Environmental Chemistry**
PHYSICS	*Preferred*	
	Physical Sciences 12a	**Mechanics from an Analytic, Numerical and Experimental Perspective** *and*
	Physical Sciences 12b	**Electromagnetism and Statistical Physics from an Analytic, Numerical and Experimental Perspective** *or*
	Physics 15a	**Introductory Mechanics and Relativity** *and*
	Physics 15b	**Introductory Electromagnetism** *and*
	Physics 15c	**Wave Phenomena**
	Accepted	
	Physical Sciences 2	**Mechanics, Elasticity, Fluids, and Diffusion** *and*
	Physical Sciences 3	**Electromagnetism, Circuits, Waves, Optics, and Imaging**

EARTH AND PLANETARY SCIENCES CONCENTRATION REQUIREMENTS
(14 HALF COURSES+TUTORIAL)

1. EARTH & PLANETARY SCIENCES (2 half-courses)	EPS 21	*and*	EPS 22

SPU12, SPU 14, SPU 25, SPU 29, SPU 30, and SPU 31 may substitute for either EPS 21 or 22, only one substitution is permitted.

2. MATHEMATICS (2 half-courses)	Math 21a & 21b		*or*	Applied Math 21a & 21b	
3. CHEMISTRY (1-2 half-courses)	Physical Sciences 10 & 11	*or*	Physical Sciences 1 and one additional half-course in Chemistry	*or*	Chem 17 or higher or Engineering Sciences 164
4. PHYSICS (2-3 half-courses)	Physics 12a & 12b or Physics 15a, 15b &15c	*or*	Applied Physics 50a *or* 50b	*or*	Physical Sciences 2 & 3
5. UPPER LEVEL EPS COURSES (4 half-courses)	Four additional half courses in EPS , three of which must be numbered 99 or above.				
6. FURTHER HALF-COURSES (1-3 half courses)	Additional half courses in EPS or related fields may be required to complete the requirement of at least 14 half courses. Related fields include applied math, astrophysics, biology, chemistry, computer sciences, engineering sciences, ESPP, mathematics, physics, and statistics which count toward the respective concentration requirements.				
7. TUTORIAL (Minimum 5 sessions)	Schedule for 2015-2016 October 7 November 4 December 2 February 3 March 2 April 6				
8. HONORS ELIGIBILITY	EPS 99r Senior Thesis Tutorial				

See student handbook to learn about subdisciplines in Atmospheric and Ocean Science, Energy and Climate, Environmental Geoscience, Geobiology, Geochemistry, Geology, Planetary Sciences, and Solid Earth Geophysics.

EARTH AND PLANETARY SCIENCES SECONDARY REQUIREMENTS
(5 HALF COURSES + TUTORIAL)

The EPS secondary field is intended to provide a strong foundation in one or more subfields of Earth science (Atmospheric and Ocean Science, Energy and Climate, Environmental Geoscience, Geobiology, Geochemistry, Geology, Planetary Sciences, and Solid Earth Geophysics) to students who have sufficient preparation in physics, chemistry, and mathematics. Secondary field students are required to take the departmental tutorial, an ongoing series of lectures by faculty scheduled periodically through the academic year.

1. INTRODUCTORY COURSES (2 HALF COURSES)

EPS 21	TERM/YEAR:
EPS 22	TERM/YEAR:

2. UPPER-LEVEL COURSES IN EPS (3 HALF COURSES)*

COURSE:	TERM/YEAR:
COURSE:	TERM/YEAR:
COURSE:	TERM/YEAR:

*To be chosen from EPS 51, 56, 74, 91, 99, 100, 107, 109, 112, 131, 132, 133, 134, 135, 136, 141, 145, 146, 150, 152, 160, 161, 162, 166, 171, 181, 182, 186, 187, and 189.

3. DEPARTMENT TUTORIAL *Required (Generally taken in the sophomore year. Need to attend 5 EPS tutorials.). Non-credit*

Schedule for 2014-2015:

- ☐ OCTOBER 7
- ☐ NOVEMBER 4
- ☐ DECEMBER 2
- ☐ FEBRUARY 3
- ☐ MARCH 2
- ☐ APRIL 6

WHERE YOUR EPS DEGREE CAN TAKE YOU

MEDICAL DOCTOR
DANNY KIM '10
4TH YEAR MD/MPH STUDENT, UCSF SCHOOL OF MEDICINE, PRIME-US

I chose to study EPS for a couple reasons: content and community. One, as a pre-med, I liked that my EPS courses covered requirements for applying to medical school, but I could expand my horizons with interesting chemistry courses that engaged with the Earth and our environment. Two, the sense of community within EPS is quite special. The annual field trips and frequent pizza parties are so fun and helped build a lot of friendships. It makes a huge difference when you can take classes (and still meet medical school course requirements) with friends who seek to grasp and enjoy the material—as opposed to more traditional "pre-med" science courses where some of my peers seemed more intent on achieving grades.

POLICY ADVISOR
KATE TOMFORD '99
CHIEF SUSTAINABILITY POLICY ADVISOR
ILLINOIS ENERGY OFFICE
ILLINOIS DEPARTMENT OF COMMERCE AND ECONOMIC OPPORTUNITY

As a freshman at Harvard in 1996, I chose to concentrate in Earth and Planetary Sciences to pursue interests I had developed through a summer geology and glaciology field course that I attended in Alaska during high school. Concentrating in EPS provided me with opportunities to take courses across a variety of science departments at Harvard, to interact closely with professors in small classes, and to learn through hands-on experiences in the field, geochemistry labs, and computer labs. Perhaps most importantly for my job today as a policy advisor for the State of Illinois, EPS gave me a comprehensive understanding of the complex interdependencies among the Earth's physical, chemical, and biological systems. Policymakers are constantly challenged to design regulations and programs based on their interpretation of scientic results, and EPS is an excellent foundation for this work in the dynamic fields of energy, climate, and environmental policy.

PORTFOLIO MANAGER
ARTHUR WHITE '94, PHD

I did not know my ideal job nor the trajectory I would follow when I entered my first year at Harvard. I chose what I was most interested in pursuing, while always keeping a thought to what I might be able to do next. After surviving Prof. Brian Wernicke's Introduction to Geological Sciences, spring 1991, I realized that a geology concentration with EPS, offered me a chance to think about some of the really big questions governing the mechanics of our world while combining scientific discipline with outdoor adventure. I was thrilled. My senior-year thesis with Prof. Ulrich Petersen on ore deposits in South America led to a PhD opportunity to study the orogenic evolution of the East Greenland Caledonides. Subsequently, I found myself transitioning from academia back to finance, and now I am a portfolio manager overseeing a book of complex investments in the natural resource, energy, and commodity space.

HIGH SCHOOL SCIENCE TEACHER
DAVID OLESH '06

I chose EPS for two reasons: great people and great field trips. The professors and students in the department formed a true community within Harvard, something rare in the undergraduate's academic world. The field trips cemented the community feeling and gave us a glimpse of the awesome diversity of forms and processes over the natural world. As a kid from a paved over city, EPS taught me a lot. Now I share the spirit and knowledge I gained in EPS with a new generation of environmental scholars as an Earth Science teacher in a New York City high school.

LANDSCAPE ARCHITECT
TIM WONG '05

I entered Harvard with a love of the outdoors, so it was natural for me to choose EPS as my concentration. My classes in geology taught me how to study the land: an often neglected skill nowadays. After graduation I worked at an environmental consulting firm, cleaning up oil spills and doing environmental assessments. Then I entered graduate school to study landscape architecture, which is the practice of designing parks and outdoor spaces. My background in Earth Science has allowed me to make designs that meld with the land and the natural environment.

GRADUATE STUDENT
PATRICIA LEVI '12
MASTERS OF SCIENCE
GRADUATE STUDENT, TECHNOLOGY AND POLICY MIT

I found EPS at the end of a long search for a concentration that would allow me to explore my interest in climate change science as well as policy. The small class sizes, opportunities for awesome field trips, and, especially, the tight-knit community of the department made it an absolute joy to be an EPS concentrator. I currently work on climate change through the lens of electricity policy and regulation, with a current focus on rural electrification in India as part of my graduate studies. I constantly draw on what I learned as an EPS student.

EPS gave me an understanding of the complex interplay of climate, energy, and geological systems, which allows me to assess climate and energy policies and discussions in their full context. The background I received in the basic sciences and math has allowed me to pick up new expertise—from microgrid design to renewable energy finance—with relative ease. Through my research in EPS, I also gained a deep appreciation for how scientific knowledge is created, which is invaluable in thinking about how such knowledge can be best communicated to and used by policymakers to craft sound policy.

PROFESSOR
JENNIFER SMITH '96
DEAN OF THE COLLEGE OF ARTS AND SCIENCES
ASSOCIATE PROFESSOR OF EARTH AND PLANETARY SCIENCES AND ENVIRONMENTAL STUDIES
WASHINGTON UNIVERSITY IN ST. LOUIS

What drew me initially to EPS was the desire to do science outside; to apply the fundamentals of chemistry, physics, and biology to the integrated study of the natural world. My interest in the historical (and prehistorical) context for the environmental challenges we face today led me to graduate school, where I studied climate-driven changes in water resource availability over the past few hundred thousand years in Egypt. I continue to pursue similar studies (in Sudan, Iraq, and Syria, among other places) as a professor.

EPS CAREERS:

Common employment for graduates with EPS degrees include:

- Education: Teaching at the elementary school through university level
- Legal: Environmental litigation or support in a government agency such as the US Environmental Protection Agency
- Research: Research at university, non-profit, and governmental research facilities
- Public Service: Environmental monitoring and analysis, operation and management of environmental facilities, administration of environmental regulations
- Medical/Veterinary: an EPS degree will prepare you for a career in the medical or veterinary realms

EPS CONTACTS

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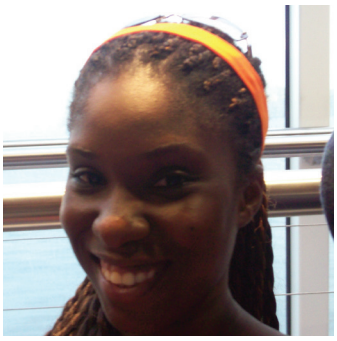

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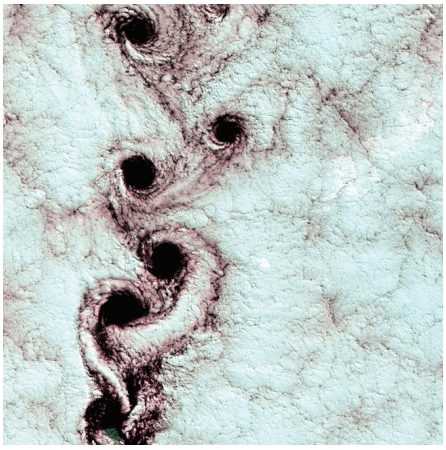
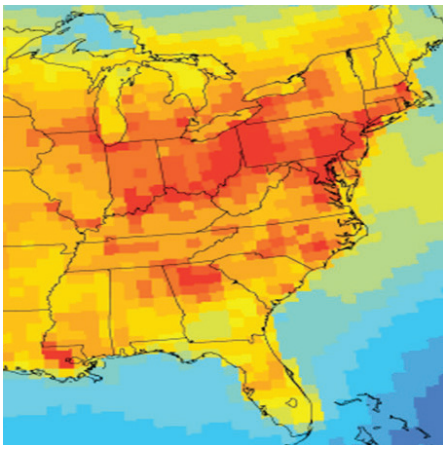
ENVIRONMENTAL SCIENCE & ENGINEERING





Our society's influence on the natural world's ecosystems and resources has never been more prominent or problematic than it is today. In order to better understand and address environmental challenges, environmental scientists and engineers provide technical solutions and advance innovations in environmental measurements, modeling, and control through the application of scientific and engineering principles.

Harvard has long been a pioneer in environmental education and research. This tradition continues today with faculty that are committed to teaching and researching engineered solutions to problems in the atmospheric, terrestrial, and aquatic compartments of the environment.

Undergraduate research and design projects in Environmental Science and Engineering cut across departments and schools, and cover topics in environmental technology, atmospheric sciences, environmental chemistry, pollutant cycling and toxicology, microbiology, energy, climate, and oceanography.

WHY ENVIRONMENTAL SCIENCE & ENGINEERING?

Students in Environmental Science and Engineering (ESE) study the fundamental processes and technologies underlying environmental systems, including natural and polluted waters and soils, the atmosphere, climate, and energy. Students learn to apply these principles to develop solutions to complex environmental problems and to mitigate human impacts on the environment.

Students interested in Environmental Science & Engineering have the option to pursue the ESE track of a Bachelor of Arts (A.B.) in Engineering Sciences or an ABET-accredited Bachelor of Science (S.B.) in Engineering Sciences. While students in either degree program take many of the same upper-level ESE courses, the A.B. program offers the opportunity to study complementary disciplines from other natural and social sciences, and the S.B. program provides a broader basis in engineering fundamentals with courses from other engineering areas and design. The broad-based, multidisciplinary curriculum of the Engineering Sciences concentration offers rigorous preparation for students planning to work as practicing engineers or researchers, entering graduate school, and for those preparing for careers in business, education, government, or law. The program's structure encourages students to make the most of Harvard's resources, such as taking courses in other departments, collaborating with researchers from other fields or schools, and taking advantage of the wealth of extracurricular activities available.

ENVIRONMENTAL ENGINEERS USE SCIENTIFIC AND ENGINEERING PRINCIPLES TO:

- Protect human health from adverse environmental conditions
- Protect local and global environments from deleterious effects of human activities
- Measure, model, and improve environmental quality
- Evaluate and model climate change and climate/energy interactions

ESE OFFERS:

- The opportunity to pursue the technical depth of an engineering degree within the liberal arts and residential life setting of Harvard College
- A direct connection to the cutting-edge research at the Harvard John A. Paulson School of Engineering and Applied Sciences (SEAS) including undergraduate research opportunities during the regular term and over the summer
- An individual senior capstone design project for all S.B. students, and the opportunity for A.B. students to conduct original research with guidance from SEAS faculty resulting in a senior thesis
- Small classes that give students direct access to professors
- A dedicated advising team for each student, including an individual faculty adviser and the Assistant Director of Undergraduate Studies for Environmental Science and Engineering
- Opportunities to learn outside of the classroom through extracurricular activities. For example, Engineers Without Borders is working to improve drinking water quality for a community in the Dominican Republic, and all SEAS students are eligible to apply for Nectar Funding Grants to support their independent co-curricular initiatives in engineering and applied science

WHY I CHOSE ESE

The reason I chose this concentration is that not only is it the smallest track within the engineering department (allowing all the students to know each other as well as the professors) but it is one of the most flexible concentrations. I can take my electives with the Earth and Planetary Sciences Department, which in itself is such a small concentration allowing students to take advantage of a large number of resources. The subject itself is of great interest since I would like to have the skills in the future to get involved in environmental engineering projects, particularly those in underdeveloped countries. In the future, I would like to work on development projects that provide clean energy to rural areas in under-developed countries with scarce resources.

LAILA KASURI '13
ESE PRIMARY

I choose ESE because I wanted to learn about issues concerning the environment from an engineering perspective. I am interested in learning the problems facing the environment and how we as engineers can help solve them.

ALISON LEE '12
ESE PRIMARY

I chose ESE for a number of reasons. First of all, I was interested in environmental science and climate issues in general when I was initially looking at and applying to colleges, and I knew that I wanted to study them at a more advanced level. But I think the real appeal of ESE for me was the hands-on, applied aspect that engineering offers. I learn better with labs and when I understand the applications of what I'm learning about to the real world. ESE offers a really great combination of all those things, which made it a really ideal concentration for me.

CAROLINE QUAZZO '12
ESE PRIMARY

I chose ESE because of its future. There are so many important decisions to be made about energy and resources in the near future and I want to be a part of it. I chose ESE because it is a constantly changing field, bringing forth new problems and it is our job to create the solutions.

SARAH CAMPBELL '12
ESE PRIMARY

I joined ESE because I wanted to go into business and wanted the technical background to succeed in the green tech industry. With Harvard's engineering department, as well as the University's myriad opportunities, I was able to explore technological advances in the environmental field. Harvard treats its engineers well, with food, mentorship, and a small but growing community. I'm proud to be a Harvard engineer!

HEIDI LIM '14
ESE PRIMARY

I have chosen to concentrate in ESE for three main reasons. ESE is: (1) Exciting because it is a new and developing engineering field—combining a variety of classic engineering disciplines with developing social questions that will define important global decisions in the coming decades; (2) Professionally significant because governments and companies alike are focusing increasing efforts on environmental considerations; (3) Socially responsible because the conservation and proper use of Earth's environment has become one of the world's most important moral questions.

GREGORIO GOMEZ '15
ESE PRIMARY

"I am interested in learning the problems facing the environment and how we as engineers can help solve them."

ENVIRONMENTAL SCIENCE AND ENGINEERING COURSE SEQUENCE

The curriculum for the Engineering Sciences concentration is highly structured, with advanced courses building on the knowledge acquired in math, science, and introductory engineering coursework. ESE courses provide opportunities for students to receive rigorous training in engineering design, computer modeling, and mathematical, chemical, and biological analysis of natural systems, with examples drawn from aquatic, terrestrial, and atmospheric environments.

The chart below lists the recommended courses for potential ESE concentrators to consider taking within their first four terms at Harvard. Students are cautioned that it is more important to derive a solid understanding of these basic subjects than to complete them quickly without thorough knowledge, as this material is used extensively in many subsequent courses. Each student's plan of study and trajectory through the curriculum is unique, so we encourage you to contact the Assistant Director of Undergraduate Studies for advice on course selection.

ES	ES 6	**Introduction to Environmental Science and Engineering**
CS	CS 50	**Introduction to Computer Science I**
MATH	Math 1a	**Introduction to Calculus** *and*
	Math 1b	**Calculus, Series, and Differential Equations**
	and	
	Math 21a	**Multivariable Calculus** *and*
	Math 21b	**Linear Algebra and Differential Equations**
	or	
	Applied Math 21a	**Mathematical Methods in the Sciences** *and*
	Applied Math 21b	**Mathematical Methods in the Sciences**
		Begin according to placement
CHEMISTRY	Physical Sciences 10	**Quantum and Statistical Foundations of Chemistry** *and*
	Physical Sciences 11	**Foundations and Frontiers of Modern Chemistry: A Molecular and Global Perspective**
PHYSICS	Applied Physics 50a	**Physics as a Foundation for Science and Engineering Part I** *and*
	Applied Physics 50b	**Physics as a Foundation for Science and Engineering Part II**
	or	
	Physical Sciences 12a	**Mechanics** *and*
	Physical Sciences 12b	**Electromagnetism and Statistical Physics**
	or	
	Physics 15a	**Introductory Mechanics and Relativity** *and*
	Physics 15b	**Introductory Electromagnetism**
	or	
	Physics 16	**Mechanics and Special Relativity** *and*
	Physics 15b	**Introductory Electromagnetism**

ENVIRONMENTAL SCIENCE AND ENGINEERING CONCENTRATION REQUIREMENTS
(14-16 HALF-COURSES FOR AB, 20 HALF-COURSES FOR SB)

AB IN ENGINEERING SCIENCES—ENVIRONMENTAL SCIENCE AND ENGINEERING TRACK (14-16 HALF-COURSES)

GENERAL ENGINEERING SCIENCES REQUIREMENTS:

1. MATHEMATICS (2-4 half-courses, *begin according to placement*)	Math 1a & 1b	*and*	Applied Math 21a & 21b *or* Math 21a & 21b *or* Math 23a & 23b
2. PHYSICS (2 half-courses)	Physical Sciences 12a *or* Physics 15a or 16 *or* Applied Physics 50a	*and*	Physical Sciences 12b *or* Physics 15b *or* Applied Physics 50b
3. COMPUTER SCIENCE (1 half-course)	Computer Science 50, 51, *or* 61		
4. SOPHOMORE FORUM	Sophomore year. *Non-credit. Spring term.*		

ENVIRONMENTAL SCIENCE AND ENGINEERING TRACK REQUIREMENTS:

5. REQUIRED (3 half-courses, *begin according to placement*)	Engineering Sciences 6	*and*	CHEMISTRY: *(Select 2 from below)* Physical Sciences 1 Physical Sciences 10 *(recommended)* Physical Sciences 11 *(recommended)* Life Sciences 1a
6. ESE CORE (3 half-courses)	*Select three from:* Engineering Sciences 109, 112, 131, 132, 133, 135, 160, 161, 162, 163, 164, 165		
7. APPROVED ELECTIVES (3 half-courses)	*Select three from:* Engineering Sciences 91r (one term only), 103, 109, 112, 123, 131, 132, 133, 135, 137, 160, 161, 162, 163, 164, 165, 169, 181, 220, 265, 267, 268, 269 Earth and Planetary Sciences 134, 136, 186, 187, 208, 236 *No more than one from* Engineering Sciences 50, 51, 53, or Earth and Planetary Sciences 22 *No more than one from* Engineering Sciences 52, 153, 154 *No more than one from* Engineering Sciences 111, 115, 121, 150, Statistics 110, Applied Math 101, 104, 105, or 147		

SB IN ENGINEERING SCIENCES—ENVIRONMENTAL SCIENCE AND ENGINEERING TRACK (20 HALF COURSES)

GENERAL ENGINEERING SCIENCES REQUIREMENTS:

1. MATHEMATICS (4 half-courses, *begin according to placement*)	Math 1a & 1b		
	Applied Math 21a & 21b *or* Math 21a & 21b *or* Math 23a & 23b		
	If starting in Mathematics 1b, 21a or 23a, or Applied Mathematics 21a **Probability and Statistics:** *One of* Applied Mathematics 101, Engineering Sciences 150, or Statistics 110		
	If starting in Mathematics 21a or 23a or Applied Mathematics 21a **Applied Mathematics:** *One of* Applied Mathematics 104, 105, 106, *or* 107		
2. PHYSICS (2 half-courses)	Physical Sciences 12a *or* Physics 15a or 16 *or* Applied Physics 50a	*and*	Physical Sciences 12b *or* Physics 15b *or* Applied Physics 50b
3. COMPUTER SCIENCE (1 half-course)	Computer Science 50, 51, *or* 61		
4. ENGINEERING DESIGN (2 half-courses)	Engineering Sciences 96	*and*	Engineering Sciences 100hf
5. SOPHOMORE FORUM	Sophomore year. *Non-credit. Spring term.*		

ENVIRONMENTAL SCIENCE AND ENGINEERING TRACK REQUIREMENTS:

6. CHEMISTRY (2 half-courses)	*Select two from:* Life Sciences 1a Physical Sciences 1 Physical Sciences 10 *(recommended)* Physical Sciences 11 *(recommended)*
7. ESE CORE (5 half-courses)	Engineering Sciences 6 *Select four from:* Engineering Sciences 103, 109, 112, 123, 131, 132, 133, 135, 160, 161, 162, 163, 164, 165, 169
8. ENGINEERING BREADTH (3 half-courses)	Choose one upper-level (>100) course from each of the following depth areas *(see the Student Handbook for complete list of eligible courses in each area)*: a. Mechanics and Materials b. Electrical c. Engineering Physics and Chemistry
9. ENGINEERING ELECTIVE (1 half-course)	Select one half-course on engineering topics from any engineering depth area *(see the Student Handbook for complete list of eligible courses)*

WHERE YOUR ESE DEGREE CAN TAKE YOU

ENVIRONMENTAL ENGINEER
MARY BOGGS '06

An ESE degree has helped prepare me for a career in designing and applying remedial solutions to environmentally-hazardous scenarios across the country. The ESE degree helped me by teaching me the science/chemistry/physics behind the air, water, and soil, as well as how to think when attempting to design the solution. I am currently employed at Weston Solutions as an environmental engineer and so far, I have participated in air quality monitoring on the Louisiana Delta in the aftermath of the Deepwater Horizon Oil Spill, the characterization of a volatile organic carbon plume in a confined aquifer underneath the Aberdeen Proving Grounds in Maryland, the cleanup of lead dust in residences in a small borough in eastern Pennsylvania, and the conduction of a chemical inventory of unknown substances found in both abandoned warehouses and existing residences. I feel I am making a difference by helping the local and national communities in cleaning up our planet and solving these complex problems.

REMEDIATION CONSULTANT
JIM GRUNDY '09

A degree from the ESE program gives you the technical background and writing skills to excel in the field of environmental remediation consulting. The focus on preparation of scientific reports and papers during the undergraduate ESE program translates well to writing of remedial specifications and regulatory reports, while the subjects learned in the ESE program give you the tools needed to solve remediation problems both in the office and in the field. The ESE program also teaches undergraduates time management and efficiency skills, which are very important skills for success in the competitive world of environmental consulting.

CORPORATE STRATEGY ANALYST
ZANDER SEBENIUS '13

Spending four years in the ESE department helped me to develop the passion and tools necessary to change the way that we generate and consume energy. Since graduating in 2013, I have working in the Corporate Strategy Group at Flextronics, one of the largest electronics manufacturing companies in the world. I have applied my ESE-derived knowledge about renewable energy technology to help Flextronics develop its five-year energy business plan, develop a new LED lighting business, and create a new engagement model for Flextronics to work with innovative start-ups. Moreover, the rigorous ESE curriculum has trained me to problem solve effectively and venture into unexplored areas—in both science and business—with full confidence of success.

MANAGEMENT CONSULTANT
ALEXANDER PADDINGTON '07

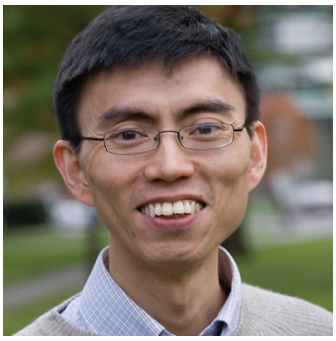
Since graduation I have been working in management consulting for Oliver Wyman in New York with an ESE degree, able to leverage quantitative background and branch out and work in financial services. I have focused on consulting to the largest financial services firms in the world on strategy, operational and risk concerns. I have also been able to leverage my engineering background for more quantitative projects, many involving complex Excel models including valuation of distressed RMBS and ABS securities.

ESE CAREERS:

Common employment sectors (with example job responsibilities) for graduates with ESE degrees include:

- Education and Research: Teaching at the high school through university level, cutting-edge environmental research at universities and government research centers
- Public Service: Environmental monitoring and analysis, operation and management of environmental facilities, administration of environmental regulations
- Engineering Consulting: Design of treatment facilities and remediation processes, investigations of pollutant transport, studies of energy efficiency and sustainability
- Industry: Evaluate and implement corporate environmental strategies and regulatory compliance
- Non-Governmental Organizations: Technical environmental projects to support the organization's mission, public education and outreach, environmental policy advocacy

ESE CONTACTS



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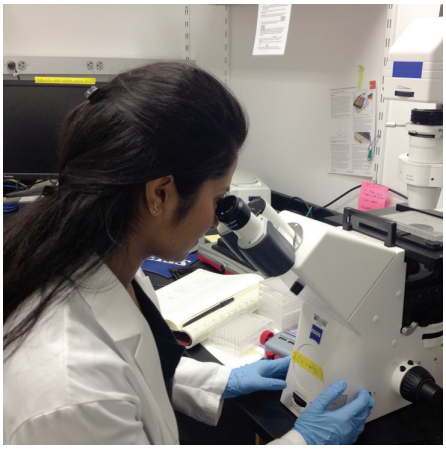
ENVIRONMENTAL SCIENCE & PUBLIC POLICY



The concentration in Environmental Science and Public Policy (ESPP) is designed to provide a multidisciplinary introduction to current challenges and issues of the environment. It is founded on the premise that the ability to form rational judgments concerning many of the complex challenges involving the environment that confront today's society requires both an understanding of the underlying scientific and technical issues and an appreciation for the relevant economic, political, legal, historical, and ethical dimensions.

WHY ENVIRONMENTAL SCIENCE & PUBLIC POLICY?

All students have to satisfy a core of requirements in the physical, biological, and social sciences and mathematics. Concentrators in consultation with their advisor develop an individual plan of study for a series of advanced courses around a particular field of specialization. Through their field of specialization, students develop expertise in a particular field of study relating to the environment. In the senior year, students undertake a capstone project in which they conduct an in-depth examination of a particular environmental issue consistent with their field of specialization, applying skills and knowledge gained in their courses and tutorial experiences.

The concentration is overseen by a Committee on Degrees functioning as a Board of Tutors including representatives from several FAS Departments and from other Schools as appropriate to ensure the requisite breadth of the program. The faculty serve as concentration advisors, thesis advisors and are valuable resource for concentrators.

Our concentrators appreciate the breadth and flexibility of course requirements and their close interactions with faculty. Concentrators also enjoy being in the field, and we offer opportunities for concentrators to conduct work in the field in both course and group settings. We also support independent student research under faculty guidance.

ESPP OFFERS:

- Interdisciplinary approach to solving environmental problems
- Create and develop your field of specialization with faculty guidance
- All ESPP concentrators have an individual faculty advisor
- Wide range of career options
- Wintersession Field Trip for concentrators
- Flexible course offerings
- Many options for supervised independent student research projects
- Faculty oversight provided by faculty members from FAS (including the departments of EPS, Economics and OEB), the Business School, the Graduate School of Design, the Kennedy School of Government, the School of Public Health and the School for Engineering and Applied Sciences
- Faculty led Junior Tutorial/Seminar program with small class sizes and low student/faculty ratio. Topics include:
    - World Food Systems and the Environment
    - The Technology, Economics and Public Policy of Renewable Energy
    - Current Issues in U.S. Environmental Law
    - Environmental Crises, Climate Change and Population Flight
    - Environmental Health: Your World and Your Life at Risk
    - Conservation Biology
    - Economic Evaluation of Environmental Regulation
    - Biotechnology, Sustainability and Public Policy
    - China's Energy Economy: Perspectives from the Past: Challenges for the Future

"…designed to provide a multidisciplinary introduction to current challenges and issues of the environment."

WHY I CHOSE ESPP

As a freshman, ESPP appealed to me as a concentration in which I could receive individual attention and guidance through an expansive set of resources spanning multiple departments. Upon declaring my concentration sophomore fall, it was clear to me that by fulfilling the ESPP degree requirements I would gain a broad education in the natural world and a deep understanding of how to analyze and solve problems surrounding our complex interactions with it. I will take with me the invaluable experiences of the two ESPP 90 Seminars I have taken. These small, focused classes have afforded me the opportunity to interact with guest lecturers from across the globe—experts in innovation and technology, genetically modified organisms, environmental health, particulate air pollution, Superfund sites, and indoor air quality. In addition to their work, these experts discussed their experiences and career paths, providing advice that was as valuable as the cutting-edge research they shared with us.

ETHAN ADDICOTT '14
ESPP PRIMARY

The ESPP experience has been valuable to me because it has given me the opportunity to approach environmental issues from a wide range of perspectives--economic, scientific, political, historical, legal, ethical, and philosophical. My favorite aspect of the ESPP program is its breadth; it truly represents an interdisciplinary approach to a complex set of issues. I have also enjoyed the intimate size of the program, which has encouraged me to form relationships with both professors and students with whom I share common interests and passions.

BASIL WILLIAMS '14
ESPP PRIMARY

Initially, I was daunted by the ESPP requirements and breadth of subjects covered within the concentration. However, looking back now, I cannot overstate the positive value of the cross-curricular nature of it. The social side of ESPP appealed to me more when I decided to be an ESPP concentrator but over the last three years, I have appreciated the importance of the scientific aspects and enjoyed the challenge of getting to grips with them. As a freshman, I would not have been confident to discuss aspects of environmental science such as attributing real-life climate changes to scientific theory, explaining connections in evidence from across the globe and clarifying many myths of climate science. Coupling this scientific base with the ESPP classes that focus on economics and politics, I have experienced three years of concepts and case studies broadening my knowledge and understanding tremendously. This summer, I am working with a research institute on a tool to track adaptation and measure development from climate change interventions in Nepal and I have already applied a vast amount of this knowledge from across the entire breadth of ESPP. It is a great feeling to bring it all together out in the field. I would have to say that my favorite experience in ESPP so far has been ESPP 90j - the seminar on Environmental Crises and Population Flight. I took this seminar in my junior year, which meant I had had time to learn and connect some of the concepts within environmental science and so I could definitely get more out of the readings and discussions that took place in the seminar. The seminar concept itself allows students to probe deeper into one area of ESPP, enjoy lively discussions with classmates, from whom you can learn a great deal, and learn from a professor who has unrivaled knowledge in the field.

HANNAH MORRILL '14
ESPP PRIMARY

I knew I wanted to do a secondary in ESPP almost before I had picked my concentration. Growing up in Oregon, I was raised with an appreciation for the natural world and had always been interested in the intersection between people and their environments. While my real strengths and passions were on the social side of things (which is why I ultimately concentrated in anthropology) I knew that the tangible skill set I would gain from studying environmental policy and science courses would add a level of both specialty and credibility to my undergraduate degree. The best part was that these courses were so flexible; I fulfilled some of my requirements with courses I took while studying abroad in Ecuador, as well as others more related to my thesis. In addition, the guidance and expertise of the professors in the department has been an invaluable asset in moving towards my academic and professional goals. For me, having a deeper understanding of the natural world (from ecology to climate change) has resulted in a deeper understanding of the human world, and I feel have truly benefitted from studying ESPP.

ANNELI TOSTAR '15
ESPP SECONDARY

I chose ESPP because it allowed me to study environmental issues from a wide variety of perspectives. I loved that I got to take engineering, economics, public policy, and science classes. The ESPP 90 seminars were my favorite courses because I got to use the background from my other classes to dive deeper into one subject. Looking at problems from so many different lenses really helped me become a better problem solver and more creative thinker. I enjoyed being in a smaller concentration like ESPP because I was able to really get to know all of my classmates and professors. It was great to have familiar faces in class and on field trips.

MEGHAN GOODWIN '15
ESPP PRIMARY

ENVIRONMENTAL SCIENCE AND PUBLIC POLICY COURSE SEQUENCE

A true interdisciplinary concentration, we have course requirements in the physical, biological, and social sciences and mathematics. It is important for students to take the foundational courses in their first and second year so that they are prepared for more advanced courses later. Students are encouraged to take more advanced courses where appropriate. Please contact the undergraduate coordinator or Head Tutor with questions about placement and course selections.

The chart below lists courses ESPP recommends students consider taking within their first three terms at Harvard. Each student's plan of study and trajectory is different so we encourage you to contact us directly for advice on course selection.

INTRO-DUCTORY COURSES	ESPP 11	**Sustainable Development** *or*
	EPS 22	**The Fluid Earth: Oceans, Atmosphere, Climate, and Environment** *or*
	SPU 25	**Energy and Climate for the 21st Century** *or*
	SPU 29	**The Climate-Energy Challenge** *or*
	SPU 31	**Energy Resources and the Environment** *or*
	SLS 22	**Human Influence on Life in the Sea** *or*
	SLS 25	**Trees, Forests and Global Change**
MATH	There are several options for fullling the requirement of two-half courses in mathematics or statistics. The minimum requirement is Math 1a and 1b. More advanced courses can be chosen. *Begin according to placement.*	
BIOLOGICAL SCIENCES	OEB 10	**Foundations of Biological Diversity** *or*
	LS 1a	**An Integrated Introduction to the Life Sciences: Chemistry, Molecular Biology, and Cell Biology** *or*
	LS 1b	**An Integrated Introduction to the Life Sciences: Genetics, Genomics, and Evolution** *or*
	OEB 55	**Ecology: Populations, Communities and Ecosystems**
PHYSICAL SCIENCES	Physical Sciences 1	**Chemical Bonding, Energy, and Reactivity: An Introduction to the Physical Sciences** *or*
	Physical Sciences 11	**Foundations and Frontiers of Modern Chemistry: A Molecular and Global Perspective** *or*
	EPS 135	**Physics and Chemistry: In the Context of Energy and Climate at the Global and Molecular Level**

ENVIRONMENTAL SCIENCE AND PUBLIC POLICY CONCENTRATION REQUIREMENTS
(13-14 HALF-COURSES)

1. ESPP INTRODUCTORY COURSE (1 half-course)	ESPP 11 Sustainable Development *or* EPS 22 The Fluid Earth: Oceans, Atmosphere, Climate, and Environment *or* SPU 25 Energy and Climate for the 21st Century *or* SPU 29 The Climate-Energy Challenge *or* SPU 31 Energy Resources and the Environment *or* SLS 22 Human Influence on Life in the Sea *or* SLS 25 Trees, Forests and Global Change		
2. PHYSICAL SCIENCES (1 half-course)	Physical Sciences 1 *or* Physical Sciences 11 *or* EPS 135		
3. MATHEMATICS (2 half-courses, *begin according to placement*)	Math 1a & 1b	*or*	Math 1b *and one of the following:* Math 18, Math 19a, Math 21a Stats 100, Stats 102, Stats 104, OEB 153 *or* Applied Math 21a
	Math 19 or Math 21a or AP Math 21a *and one of the following:* Stats 100, Stats 102, Stats 104, OEB 153	*or*	Math 19a & 19b *or* Math 21a & 21b *or* Applied Math 21a & 21b
4. BIOLOGICAL SCIENCES (1 half-course)	OEB 10 *or* LS 1a *or* LS 1b *or* OEB 55		
5. SOCIAL SCIENCES (1 half-course)	ESPP 77	*or*	ESPP 78
6. ECONOMICS (1 half-course)	EC1661 *or* EC 1687 *(Depending on a student's background, an additional course in Microeconomics may be required in order to take EC 1661 or EC 1687.)*		
7. ADVANCED COURSES (4 half-courses, in the student's field of specialization)	At least one half-course must be from the social sciences/policy, and at least one half-course must be chosen from the natural sciences or engineering. One half-course must be in EPS unless a student has taken EPS 22, SPU 25, SPU 29 or SPU 31 as their Introductory Course (see 1 above).		
8. JUNIOR SEMINAR (1 half-course)	ESPP 90 (Consistent with focus field of specialization.)		
9. SENIOR PROJECT (1-2 half-courses)	ESPP 91r Non-Honors (1 half-course), Capstone Project (In the capstone project, students conduct an in-depth examination of a particular environmental issue consistent with their field of specialization (the typical requirement is a term-paper or equivalent).	*or*	ESPP 99 Honors (2 half-courses), Senior Thesis (For students wishing to be considered for honors, the capstone project consists of a two half-course senior thesis.)

ENVIRONMENTAL SCIENCE AND PUBLIC POLICY SECONDARY REQUIREMENTS
(5 HALF-COURSES AND COLLOQUIUM PARTICIPATION)

Through the ESPP secondary field, students become well-versed in the broad, interconnected issues of environment and public policy through course work and a colloquium. Students choose courses in biology, chemistry, earth and environmental sciences, economics, government, engineering, and mathematics, complementing their primary studies with courses that will provide balanced exposure to environmental science and policy perspectives.

REQUIREMENTS

The ESPP secondary field requires the successful completion of 5 half-courses, including one foundational course and four upper-level courses. Students must also participate in a program colloquium, as outlined below.

STUDENTS CHOOSE ONE OF THE FOLLOWING FOUNDATIONAL COURSES:

- ESPP 11: Sustainable Development *or*
- EPS 22: The Fluid Earth: Oceans, Atmosphere, Climate and Environment *or*
- SPU 25: Energy and Climate for the 21st Century *or*
- SPU 29: The Climate-Energy Challenge *or*
- SPU 31: Energy Resources and the Environment *or*
- SLS 22: Human Influences on Life in the Sea *or*
- SLS 25: Trees, Forests, and Global Change

STUDENTS MUST CHOOSE AT LEAST FOUR ADDITIONAL UPPER-LEVEL COURSES.

At least two courses must be chosen from each of two elective categories: Social Sciences and Public Policy, and Natural Sciences and Engineering. The complete list of course options can be found on the ESPP website: http://espp.fas.harvard.edu/.

COLLOQUIUM

During each semester there are several opportunities for ESPP secondary field students to come together to explore various environmental topics through facilitated discussions. These discussions require preparatory readings and/or prior attendance at a public lecture on campus, and students are required to attend at least one session per semester once they have been accepted into the program.

ENERGY & ENVIRONMENT SECONDARY FIELD REQUIREMENTS
(4 HALF-COURSES AND COLLOQUIUM PARTICIPATION)

The energy-environment challenge is a defining issue of our time, and one of Harvard's greatest contributions to meeting that challenge will be the education of a new generation of leaders in science, business, law, design, and public service. To this end, the Environmental Science and Public Policy (ESPP) program, in coordination with the Harvard University Center for the Environment (HUCE), is pleased to offer the secondary field in Energy and Environment (E&E). Through coursework and a colloquium, students engaged in the E&E secondary field will increase their exposure to, and literacy in, the interdisciplinary nature of issues related to energy and the environment.

In the context of the E&E secondary field, "Energy" refers to the production, distribution, and use of energy by individuals and society for a variety of purposes. This includes the various technologies, policies, and challenges associated with meeting increasing global energy demands. "Environment" refers to the understanding of the relationships and balances of the natural and constructed world at multiple scales, including how anthropogenic activities and policies affect the relationships between energy demand, environmental quality, and climate change. Students from a wide range of concentrations, including the humanities, are invited to participate in the program to explore how different disciplinary perspectives on energy and environment intersect and inform one another.

REQUIREMENTS

The E&E secondary field requires the successful completion of 4 half-courses, including one foundational course and three upper-level courses. Students must also participate in a program colloquium, as outlined below.

STUDENTS CHOOSE ONE OF THE FOLLOWING FOUNDATIONAL COURSES, ALL OF WHICH INCLUDE CONTENT RELATED TO BOTH ENERGY AND ENVIRONMENT:

- SPU 25: Energy and Climate for the 21st Century *or*
- SPU 29: The Climate-Energy Challenge *or*
- SPU 31: Energy Resources and the Environment *or*
- SLS 22: Human Influences on Life in the Sea *or*
- ESPP 11: Sustainable Development *or*
- ES 6: Environmental Science and Technology

STUDENTS MUST CHOOSE AT LEAST THREE ADDITIONAL UPPER-LEVEL COURSES.

At least one course must be chosen from each of two elective categories: Social Sciences and Humanities, and Natural Sciences and Engineering. The complete list of course options can be found on ESPP website: http://espp.fas.harvard.edu/.

COLLOQUIUM

During each semester there are several opportunities for E&E secondary field students to come together to explore various energy and environmental topics through facilitated discussions. These discussions require preparatory readings and/or prior attendance at a public lecture on campus, and students are required to attend at least one session per semester once they have been accepted into the program.

WHERE YOUR ESPP DEGREE CAN TAKE YOU

ATTORNEY
AMY KOBELSKI '00

I've really come to appreciate the depth and breadth of my Environmental Science and Public Policy education as a trial and appellate litigation attorney. The economics and public policy aspects were perhaps most foreign to me when I entered college, and I've found them to be particularly useful in reading and understanding legislation and—truly—the world around me every day. My concentration proved extremely valuable in defending a $100 million environmental legal malpractice action, but I also worked on antitrust matters that drew heavily on my economics background. ESPP gave me a phenomenal foundation on which to build specific knowledge as required by my career as a litigator. Moreover, my focus on environmental economics is something I think about nearly everyday when reading about world events.

CORPORATE PROFESSIONAL
CLAIRE BROIDO JOHNSON '95
CHIEF OF NEW MARKETS AND SERVICES FOR NEXT STEP LIVING, INC.

I think my undergraduate education was incredibly helpful in preparing me for my current position. I have worked in the energy and environment space since I graduated from Harvard undergrad. I started in the non-profit and government sector, then realized that I could make the most impact in business and the environment. I worked with electric utilities then went back to HBS. After HBS, I co-founded a company called SunEdison. I think the most important advice that I can offer incoming or current ESPP students is 1) talk to as many people as you can about different career options as the environmental field is so interdisciplinary and there is no ONE perfect track, and 2) work really hard at everything you do; gather as many tools in your toolbox so you are prepared for any situation.

SURGEON
DR. JOSEPH LYNCH '98
ORTHOPAEDIC SURGEON, US NAVY

The ESPP program was extremely valuable in preparing me for my current career. ESPP provided breath in the sciences and allowed study of subjects which are unique, intriguing, and current. For those pursing medicine, ESPP was an ideal concentration as it facilitates completion of the typical "pre-med" requirements, but more importantly it affords an opportunity to explore one's talents in the sciences as applied to other fields. One of my fondest memories of Harvard was the concentration and the educational requirements of the degree—phenomenal!

PHD CANDIDATE
JULIET LAMB '05
DOCTORAL CANDIDATE IN FISHERIES AND WILDLIFE BIOLOGY, CLEMSON UNIVERSITY

My undergraduate study was extremely useful. I have encountered many other graduate students and professionals in conservation biology who do not have any academic background in policy or law. In a field as integrative and interdisciplinary as fisheries and wildlife biology, I feel that I am at a huge advantage in having a solid understanding of the economic, legal, and governance aspects of conservation in addition to its scientific components. As an undergraduate, I shifted from a pre-veterinary focus dominated by broad chemistry, biology, and physics courses to a more organismic track. My happiest years in ESPP came at the end of my tenure, when I had begun to explore the small and focused classes in ESPP, OEB, EPS, etc. I wish I had identified earlier that my interests were in species and ecosystem conservation rather than veterinary medicine, because I would have been able to tailor my education more directly to my career. In my Master's and PhD studies, I have never been as impressed with the classes I've taken as I was with some of my ESPP classes.

PROFESSOR
JACLYN HATALA MATTHES '07
ASSITANT PROFESSOR OF GEOGRAPHY, DARTMOUTH COLLEGE

My undergraduate education provided not only essential technical preparation for my present research, but was also the source of the intellectual motivation to pursue a career in environmental science in the first place. Before I "discovered" the ESPP concentration during my sophomore year, I felt a bit at a loss about how to negotiate my various interests in many scientific disciplines. The ESPP concentration allowed me to put together an interdisciplinary course of study with a rigorous foundation in ecology, chemistry, physics, and statistics. I also appreciated the breadth of study in ESPP through the requirements in economics and policy, and I have drawn on my experience in these courses while interacting with colleagues from different academic fields in my current work. I found the process of developing, researching, and writing a senior thesis and the mentorship that I received during this experience particularly enjoyable, and it inspired me to pursue a career in environmental research.

EDUCATION MANAGER
MARY FORD '96
NATIONAL AUDUBON SOCIETY

I'm the Education Manager at the National Audubon Society, and concentrating in ESPP was my first step towards this fascinating, fullling career. The interdisciplinary nature of ESPP taught me to think broadly about how to accomplish conservation, and gave me solid grounding in science, policy, economics, and communication skills. The comfort I gained in all those disciplines has served me well throughout my career, which has ranged from studying orangutans in Borneo, to working in a national park in Siberia, to teaching preschool, to working at World Wildlife Fund and Audubon.

PROFESSOR
FORREST BRISCOE '96
ASSISTANT PROFESSOR
SMEAL COLLEGE OF BUSINESS
THE PENNSYLVANIA STATE UNIVERSITY

I wouldn't trade the ESPP experience for anything. It gave me a community—a really interesting group of people, places, ideas—not too big, not too small—that really fostered my growth at Harvard. One thing I valued a great deal was the chance to work with and get to know the faculty in ESPP. I was interested in exploring both the science side and the policy side, and was able to work on projects with cutting edge researchers in both areas. In ESPP this dove-tailed nicely with what I was doing in my classes, so it felt like everything was integrated and very relevant to the real world. Today, I teach in business school, and do research on how businesses and other organizations relate to a range of social problems. ESPP was actually great preparation for way I do now: it really got me thinking about how hard it is to apply scientific rigor to problems that have a heavy human component.

ECONOMIST
GERNOT WAGNER '02
ENVIRONMENTAL DEFENSE FUND

I could not imagine a better preparation than ESPP to tackle the profound and often maddeningly complex challenges facing our planet. I am still in touch with my professors and teaching fellows who mentored me throughout college, and they continue to guide me in my career to this day.

PHD CANDIDATE
MOLLIE HOGAN '01
DOCTORAL CANDIDATE IN HEALTH SERVICES
UNIVERSITY OF WASHINGTON

I work in global health measurement, and was well prepared for this area of work by ESPP, particularly via the courses on human health and the environment and the quantitative courses (such as calculus, ecology, economics). My senior thesis prepared me well for a career in critical independent research. After three years working as a technical officer measuring child health inequalities at the World Health Organization in Geneva, I worked in Thailand for almost four years on a health system priority setting project at the Ministry of Health. I am now working on my doctorate at the University of Washington in Health Services, focusing on the measurement of maternal mortality worldwide.

PROFESSOR
NOELLE ECKLEY SELIN ' 99
ASSISTANT PROFESSOR OF ENGINEERING SYSTEMS AND ATMOSPHERIC CHEMISTRY
DEPARTMENT OF EARTH, ATMOSPHERIC AND PLANETARY SCIENCES
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

My ESPP experience gave me a thorough grounding in both the scientific and policy questions important to understanding the environment. After graduating, I spent a few years working on environmental policy issues in the US and Europe. When I decided to start a PhD program in atmospheric science, I had a solid scientific background in addition to a strong policy focus. I am now a faculty member in an interdisciplinary department, where my work builds on both my science and policy backgrounds. ESPP is a unique program, and my experiences as an ESPP concentrator at Harvard were a strong influence on where I am today. I even still refer back to my senior thesis!

"Today, I teach in a business school, and do research on how businesses and other organizations relate to a range of social problems. ESPP was actually great preparation for what I do now."

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INTEGRATIVE BIOLOGY

George Evelyn Hutchinson described the history and dynamics of life as an evolutionary play in an ecological theater. The concentration in Integrative Biology (the new name, starting Fall '14, for the Organismic & Evolutionary Biology concentration) is inherently interdisciplinary, encompassing mathematical and computational biology, functional and genetic approaches to morphology and development, as well as genetics, evolution, and ecology.

IB asks questions about the function, evolution, and interaction of organisms, both now, in the past, and in the future. What kinds of organisms are there and how are they related? How is an organism's functional design and behavior related to both its physical environment and its interactions with other organisms? What are the genetic and developmental mechanisms underlying an organism's morphology, or how is evolution influenced by development and vice versa? The concentration's new name reflects both the OEB department's broad research scope and scientific priority: to understand natural systems across levels of biological analysis. A detailed understanding of cellular processes, for example, can help us understand an organism's ecology.

The beauty of biology is revealed through the evolution of its complexity and the interactions of organisms in their environment...

WHY I CHOSE OEB/IB

I loved OEB/IB for the flexibility it gave me to explore any and every aspect of biology—I could pick classes that genuinely interested me without feeling restrained by departmental requirements. OEB/IB classes themselves are phenomenal, and their faculty are incredibly invested in the students and courses they teach—this is evident both in the quality of their teaching and their willingness to mentor students. And, the OEB/IB community is incredible—you are surrounded by peers who love what they do, who are diverse in their interests and talents, and who and are collaborative and non-competitive. Being an OEB/IB concentrator was one of the best decisions I made at Harvard—the faculty, the peers, and the coursework made my academic experience at Harvard wonderful.

BONNIE WONG '13

OEB/IB is an amazing department, there's a huge variety of classes to take and all the professors are enthusiastic and accessible. Definitely take advantage of courses that have cool field trips or the summer school programs abroad. The best part about OEB/IB is its broad perspective; you learn why things in biology are the way they are, rather than simply learning about the applications (though you learn that as well).

JUSTINE CHOW '10

"OEB is an amazing department, there's a huge variety of classes to take and all the professors are enthusiastic and accessible."

INTEGRATIVE BIOLOGY COURSE SEQUENCE

The study of IB can be approached in many ways, reflecting primary interest in specific groups (e.g., plants, animals, micro-organisms); in a particular level of organization (e.g., ecological systems, evolutionary genetics); in an approach (e.g., biomechanics, developmental biology); or even in a desire to sample broadly across many topics.

Recognizing the value of learning about organisms in their natural habitats, IB offers a number of courses with significant field components. For some, this involves short trips to local environments of interest; for others, spring break sees the course re-locate to the Tropics. For example, OEB 51 (Invertebrate Biology) goes to coral reefs in Panama, and OEB 167 (Herpetology) to Costa Rica.

The chart below lists courses IB recommends students consider taking within their first three terms at Harvard. Each student's plan of study and trajectory is different so we encourage you to contact us directly for advice on course selection.

LIFE SCIENCES	Life Sciences 1A	**An Integrated Introduction to the Life Sciences: Chemistry, Molecular Biology, and Cell Biology** *(fall)*
	or	
	Life & Physical Sciences A	**Foundational Chemistry & Biology** *(fall)*
	or	
	Life Sciences 50A	**Integrated Science** *(fall)*
	and	
	Life Sciences 1B	**An Integrated Introduction to the Life Sciences: Genetics, Genomics, and Evolution** *(spring)*
	or	
	Life Sciences 50B	**Integrated Science** *(spring)*

*Pre-medical students should consider Physical Sciences 1 (spring) to allow them to take the Organic Chemistry sequence (Chemistry 17-27) as sophomores.

OEB	OEB 10	**Foundations of Biological Diversity** *(fall)*
	Senior Thesis	*Required for highest honors*

INTEGRATIVE BIOLOGY CONCENTRATION REQUIREMENTS
(13 HALF COURSES)

3 HALF COURSES IN INTRODUCTORY BIOLOGY:

LIFE SCIENCES 1A (or LIFE & PHYSICAL SCIENCES A or LIFE SCIENCES 50A)
LIFE SCIENCES 1B (or LIFE SCIENCES 50B)
OEB 10

4 HALF COURSES INTRODUCING BROAD FIELDS OF BIOLOGY

To be chosen from OEB 50, 51, 52, 53, 54, 55, 56, 57, 59; MCB 52, 54, 60, 80, Life Sciences 2, 110, SCRB 10.

COURSE:	TERM/YEAR:
COURSE:	TERM/YEAR:
COURSE:	TERM/YEAR:
COURSE:	TERM/YEAR:

2 ADVANCED-LEVEL HALF COURSES IN BIOLOGY *(one of which may be a supervised research or reading course)*

COURSE:	TERM/YEAR:
COURSE:	TERM/YEAR:

4 ADDITIONAL HALF COURSES IN RELATED FIELDS

To be chosen from offerings in applied mathematics, chemistry, mathematics (above the level of Math 1a), computer science (above the level of Computer Science 1), physics, and statistics.

COURSE:	TERM/YEAR:
COURSE:	TERM/YEAR:
COURSE:	TERM/YEAR:
COURSE:	TERM/YEAR:

INTEGRATIVE BIOLOGY SECONDARY REQUIREMENTS
(5 HALF COURSES)

A Secondary Field in Integrative Biology (IB) is offered by the Department of Organismic and Evolutionary Biology (OEB). Members of faculty in OEB study biological systems at all levels from molecules to ecosystems, united by a shared foundation in evolutionary biology. Our department offers courses in a broad range of topics, including (in alphabetical order): anatomy, behavior, biomechanics, development, ecology, entomology, evolution, forestry, genetics, genomics, marine biology, microbiology, molecular evolution, mycology, oceanography, paleontology, physiology, plant sciences, systematics, and zoology. OEB is also happy to give secondary field credit for relevant courses taken during a Study Abroad semester.

Students may have an interest in pursuing a secondary field of study in a particular sub-discipline, or may prefer to sample broadly across the offerings of the department. Rather than draft a set of requirements for each possible field of study, the department chose a flexible set of requirements that should maximize students' freedom to craft their own programs in consultation with an academic adviser.

A secondary field requires the completion of five half-courses in OEB. For this purpose all courses listed in the OEB section of the *Courses of Instruction*, including cross-listed courses, as well as Life Sciences 1b and Life Sciences 2, will count as courses in OEB.

OEB HALF COURSES

COURSE:	TERM/YEAR:
COURSE:	TERM/YEAR:
COURSE:	TERM/YEAR:
COURSE:	TERM/YEAR:
COURSE:	TERM/YEAR:

IB CONTACT

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HARVARD UNIVERSITY CENTER FOR THE ENVIRONMENT

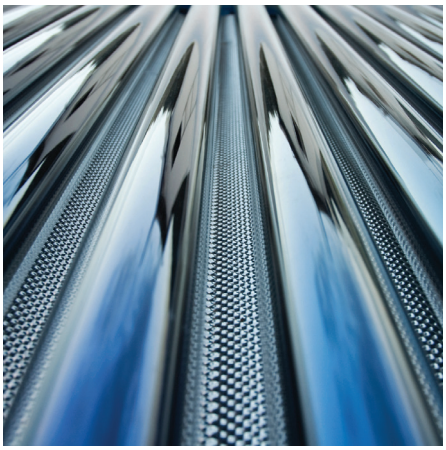
The Harvard University Center for the Environment (HUCE) encourages research and education about the environment and its many interactions with human society.

The Center draws its strength from faculty members and students across the University who make up a remarkable intellectual community of scholars, researchers, and teachers of diverse fields including chemistry, earth and planetary sciences, engineering and applied sciences, biology, public health and medicine, government, business, economics, religion, and the law. The most pressing problems facing our natural environment are complex, often requiring collaborative investigation by scholars versed in different disciplines. By connecting scholars and practitioners from different disciplines, the Center for the Environment seeks to raise the quality of environmental research and teaching at Harvard and beyond.

Through a variety of grants and fellowships, the Center supports research related to the environment at every level, from undergraduates through senior faculty members. By sponsoring symposia, public lectures, and informal student convocations, the Center connects people with an interest in the environment.

SECONDARY FIELD IN ENERGY AND ENVIRONMENT

The Environmental Science and Public Policy Concentration, in coordination with HUCE, offered the Secondary Field in Energy and Environment (E&E) to increase Harvard students' exposure to, and literacy in, the interconnecting set of issues related to energy and the environment while maintaining their focus in their home concentrations. Through debate and dialogue in coursework and seminars, students will identify the obstacles, highlight the opportunities, and define the discussion for an energy-environment strategy for the 21st century and beyond.



Students from a wide range of concentrations, including the humanities, are invited to participate in the program to explore how different disciplinary perspectives on energy and environment intersect and inform one another. To learn more or apply, visit: www.espp.fas.harvard.edu/energy-environment.

HUCE LECTURE SERIES AND SPECIAL EVENTS

HUCE hosts a number of lecture series, symposia, conferences and special events each academic year. To watch videos from past talks, visit www.environment.harvard.edu/huce-videos. To learn more about energy and environmental events at Harvard and the greater Boston area, visit: www.environment.harvard.edu/events/calendar/list.

FUNDING SOURCES

Undergraduate students can apply for the Undergraduate Summer Research Fund, which provides financial support for student research projects related to energy and the environment.

The fund supports two types of research experiences for students: independent research projects, and research assistantships based on faculty-directed research. Award amounts are usually between $500-$3,000.

To learn more about funding sources, visit: www.environment.harvard.edu/student-resources/undergraduate-summer-research-fund.

ENVIRONMENTAL COURSE GUIDE

HUCE annually updates the Environmental Course Guide, a list of Harvard courses most relevant to energy and environmental studies. The Course Guide is searchable by keyword, school, research area, and semester. Visit www.environment.harvard.edu/student-resources/course-guide/courses to access the guide.

FACULTY ASSOCIATE DIRECTORY

Nearly 250 Harvard faculty from a variety of disciplines are affiliated with HUCE. As leading scholars in their fields, they provide expert knowledge on a number of energy and environmentally-related topics.

Faculty Associates represent these schools across the University:

- Faculty of Arts and Sciences
- Graduate School of Design
- Harvard Business School
- Harvard Divinity School
- Harvard Graduate School of Education
- Harvard John A. Paulson School of Engineering and Applied Sciences
- Harvard Kennedy School
- Harvard Law School
- Harvard Medical School
- Harvard T.H. Chan School of Public Health

The database of Faculty Associates, available on our website, is searchable alphabetically, by research area, school, department, and keyword: www.environment.harvard.edu/about/directory/faculty/

GET CONNECTED

Website: Stay connected to the Center's news and events at www.environment.harvard.edu

Newsletter: Published annually, *Environment@Harvard* details faculty and student environmental research. Want to join our mailing list? Sign up at the bottom of our website.

Events Calendar: Want to know what events are happening at Harvard and beyond? Subscribe to the Center's weekly events e-mail via the footer of our website.

Facebook: Visit the Harvard University Center for the Environment Facebook page to learn more about our upcoming events and special programs. "Like" our page today.

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Harvard University Center for the Environment

ENVIRONMENTAL STUDENT CLUBS & ORGANIZATIONS

CONSERVATION SOCIETY
https://about.me/hccs

CRIMSON BIKES
http://crimsonbikes.org/about

THE ENERGY & ENVIRONMENT PROFESSIONAL INTEREST COUNCIL (EEPIC)
http://www.hcs.harvard.edu/heen/

ENGINEERING SOCIETY
www.hcs.harvard.edu/~hces/

ENVIROED
http://www.hcs.harvard.edu/eed/

ENVIRONMENTAL ACTION COMMITTEE
http://www.hcs.harvard.edu/~eac/

GEOLOGICAL SOCIETY
http://www.hcs.harvard.edu/~geosoc
http://www.facebook.com/harvardgeosoc

GLOBAL ENERGY INITIATIVE
http://harvardgei.com

HARVARD COUNCIL ON BUSINESS AND THE ENVIRONMENT
http://harvardcouncil.com/

HARVARD ENERGY JOURNAL CLUB
http://www.hcs.harvard.edu/hejc/

MOUNTAINEERING CLUB
www.harvardmountaineering.org

NATURAL RESOURCES GROUP COMPUTER SOCIETY
hcnrg@hcs.harvard.edu

OEB UNDERGRADUATE GROUP (OEBUG)
https://lists.hcs.harvard.edu/mailman/listinfo/oebug

OUTING CLUB
http://www.facebook.com/HarvardOC
http://www.harvardoutingclub.org/

RESOURCE EFFICIENCY PROGRAM
http://www.green.harvard.edu/programs/undergraduate-resource-efficiency-program

REVIEW OF ENVIRONMENT & SOCIETY
http://www.hcs.harvard.edu/~res/

SCIENCE CLUB FOR GIRLS
http://www.hcs.harvard.edu/scfg/

SCIENCE REVIEW
http://harvardsciencereview.com/

SOCIETY OF BLACK SCIENTISTS AND ENGINEERS
http://www.hcs.harvard.edu/hsbse/wp/

SOCIETY OF LATINO ENGINEERS AND SCIENTISTS
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