2023-2024

THE GREEN BOOK

What You Need to Know About Environmental Sciences at Harvard College

Earth & Planetary Sciences

Environmental Science & Engineering

Environmental Science & Public Policy

Integrative Biology

Energy & Environment

What's Inside

- Earth & Planetary Sciences
- Environmental Science & Engineering
- Environmental Science & Public Policy
- Integrative Biology
- Energy & Environment (secondary field)

Environmental Sciences is an interdisciplinary field that integrates the physical and biological sciences.

At Harvard, these disciplines are divided into four concentrations and one secondary field. Each has its own focus and requirements, but all provide ways to study the natural world and find solutions to environmental problems.

Course Sequence Recommendations for Primary, Double, or Joint Concentrators

For students who are considering a primary, double, or joint in environmental sciences, the chart below lists courses that should, when possible, be taken within the first three terms at Harvard.

	Earth & Planetary Sciences	Environmental Science & Engineering	Environmental Science & Public Policy	Integrative Biology
Introductory Courses	EPS-ESE 6 [or] EPS 10 [or] GENED 1018, 1085, 1094, 1098, 1137, 1158, 1167 [or] Any 50-level EPS course	ESE 6	EPS-ESE 6 [or] EPS 50 [or] GENED 1085 [or] GENED 1094 [or] GENED 1137 [or] GENED 1158	LS 1a (or LPSa or LS 50a) LS 1b (or LS 50b) OEB 10
Chemistry	Physical Sciences 11 [Plus one from either list] Chemistry 17, 20, 40, or 60	Two from: Physical Sciences 11; Life Sciences 1a, Life and Physical Sciences a, Chemistry 10, Chemistry 17, or Chemistry 20	Physical Sciences 11	Optional
Mathematics	Math 21a,b, 22a,b, 23a,b, or Applied Math 22a,b [Plus one from list below] EPS 100 or 102 [or] APMTH 111 or 120 [or] CS 109a [or] STAT 109, 110, or 111	Math 21 a,b [or] Math 22 a,b [or] Math 25 a,b	Minimum requirement is Math 1a and 1b; More advanced courses in math and statistics can be chosen; *Begin according to placement.*	Optional
Physics	Physical Sciences 12a [or] Physics 15a [or] Physics 16 [or] Physics 19 [Plus one from either list] Physical Sciences 12b, Physics 15b, or Physics 15c	Physical Sciences 12a,b [or] Physics 15a,b [or] Physics 15b, 16 [or] Applied Physics 50a,b	Optional	Optional

Earth and Planetary Sciences: EPS

EPS is focused on events and processes that have shaped the Earth's evolution and its current state, from the deep Earth to its oceans and atmosphere. Our approach is to apply interdisciplinary tools to investigate processes from tectonic plate to climate to microbial scale, and across the full sweep of geological time, from the early Earth to the modern world. Using a combination of theoretical, computational, laboratory, and field-based methods, we study natural experiments in Earth's history, and ultimately test the limits of the Earth's resilience in the geological past and in our progressively warming world.

EPS provides training in the basic sciences, followed by upper-level courses that focus on disciplines within Earth and planetary sciences including:

- **Atmospheric and Ocean Science**
- **Energy and Climate**
- **Environmental Geoscience**
- **Geobiology**
- **Geochemistry**
- **Geology**
- **Planetary Sciences**
- **Solid Earth Geophysics**

Advising and Research

- Small classes that provide direct access to faculty and engaged student participation
- Individual faculty advisor for each EPS concentrator
- Personalized reports produced twice a year to track academic progress
- Paid semester and summer research opportunities in lab settings
- Real-world field experience during school breaks
- Option to conduct original research with guidance from EPS faculty, potentially leading to a senior thesis (for more information about the senior thesis, visit https://eps.harvard.edu/senior-thesis)
- Please visit our website to learn more about research opportunities: https://eps.harvard.edu/undergraduate-research-opportunities

Culture

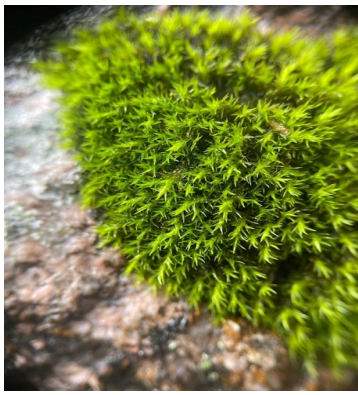
- A mid-size department with a high faculty-to-student ratio
- A tight-knit community with opportunities for informal interactions (daily cookies, weekly pizza) and academic engagement (colloquia, seminars)
- Annual department-funded field trips to locations such as the Canadian Rockies, Iceland, and sailing in the Atlantic or Pacific Oceans
- Harvard's senior survey results show that EPS consistently ranks at the top in student satisfaction
- To learn more about the EPS department, please visit our website: https://eps.harvard.edu/pages/undergraduate

Careers

Common employment for graduates with EPS degrees include:

- **Energy:** Working in both the renewable and fossil energy sectors
- **Public Service:** Environmental monitoring and analysis, operation and management of environmental facilities, administration of environmental regulations
- **Research:** Conducted at universities or non-profit and governmental research agencies
- **Legal:** Environmental litigation or support in a government agency such as the EPA
- **Education:** Teaching at the elementary school through university levels
- **Medical:** EPS concentration requirements fulfill many of the medical school admission requirements
- **Other:** Broadway keyboardist and musical director, presidential management fellow at the National Park Service, landscape architect, financial portfolio manager





EPS Course List

EPS/FOUNDATIONAL	
EPS-ESE 6	Introduction to Environmental Science and Engineering
EPS 10	A Brief History of the Earth
GENED 1018	How to Build a Habitable Planet
GENED 1085	Energy Resources and the Environment
GENED 1094	Confronting Climate Change: A Foundation in Science, Technology, and Politics
GENED 1098	Natural Disasters
GENED 1137	The Challenge of Human-Induced Climate Change: Transitioning to a Post Fossil Fuel Future
GENED 1158	Water and the Environment
GENED 1167	Climate Crossroads
MATH	*Foundational*
Math 21a	Multivariable Calculus
Math 21b	Linear Algebra and Differential Equations
Math 22a	Vector Calculus and Linear Algebra I
Math 22b	Vector Calculus and Linear Algebra II
Math 23a	Linear Algebra and Real Analysis I
Math 23b	Linear Algebra and Real Analysis II
Applied Math 22a	Solving and Optimizing
Applied Math 22b	Integrating and Approximating
	Data Analysis, Statistics, and Computation
EPS 100/102	The Missing Matlab Course: A Practical Introduction to Programming and Data Analysis/ Data Science and Statistical Inference in the Earth and Environmental Sciences
Applied Math 111/120	Introduction to Scientific Computing/Applied Linear Algebra and Big Data
CS 109a	Data Science 1: Introduction to Data Science
Statistics 109/110/111	Introduction to Statistical Modeling/Introduction to Probability/Introduction to Statistical Inference
CHEMISTRY	*Foundational*
Physical Sciences 11	Foundations and Frontiers of Modern Chemistry: A Molecular and Global Perspective
	Higher Level
Chemistry 17	Principles of Organic Chemistry
Chemistry 20	Organic Chemistry
Chemistry 40	Inorganic Chemistry
Chemistry 60	Foundations of Physical Chemistry
PHYSICS	*Foundational*
Physical Sciences 12a	Mechanics and Statistical Physics from an Analytic, Numerical, and Experimental Perspective
Physics 15a	Introductory Mechanics and Relativity
Physics 16	Mechanics and Special Relativity
Physics 19	Introduction to Theoretical Physics
	Higher Level
Physical Sciences 12b	Electromagnetism and Quantum Physics from an Analytic, Numerical, and Experimental Perspective
Physics 15b	Introductory Electromagnetism and Statistical Physics
Physics 15c	Wave Phenomena

CONCENTRATION REQUIREMENTS

Primary/Double: 14 courses (56 credits) + Department Tutorial
A minimum of six EPS courses, with at least one course at the 50- or 100-level sampling all three sub-disciplines in Atmosphere(s) and Oceans; Earth History and Geobiology; and Geology, Geophysics and Planetary Science; senior thesis optional

Joint-Allied: 11 courses (44 credits) + Department Tutorial
A minimum of five EPS courses; senior thesis required

Secondary: 5 courses (20 credits) + Department Tutorial
A minimum of two foundational courses and three upper-level EPS courses

For Primary, Double, and Joint-Allied Concentrators

2 COURSES — **EARTH & PLANETARY SCIENCES FOUNDATIONAL COURSES**
- EPS-ESE 6 or EPS 10 *or*
- GENED 1018, 1085, 1094, 1098, 1137, 1158, 1167 *or*
- Any 50-level EPS course

No more than one of these from EPS 10 or GENED 1018, 1085, 1094, 1098, 1137, 1158, 1167

2 COURSES — **MATH**
- Math 21a & 21b *or*
- Math 22a & 22b *or*
- Math 23a & 23b *or*
- Applied Math 22a & 22b

1 COURSE — **DATA ANALYSIS, STATISTICS, AND COMPUTATION**
- EPS 100 or 102 *or*
- Applied Math 111 or 120 *or*
- CS 109a *or*
- Statistics 109, 110, or 111

1 COURSE — **CHEMISTRY**
- Physical Sciences 11

1 COURSE — **PHYSICS**
- Physical Sciences 12a *or*
- Physics 15a *or*
- Physics 16 *or*
- Physics 19

1 COURSE — **HIGHER CHEMISTRY OR PHYSICS**
- Chemistry 17, 20, 40, or 60 *or*
- Physical Sciences 12b, Physics 15b, or Physics 15c

UPPER-LEVEL EPS COURSES
4 COURSES **Primary/Double:** Four additional EPS courses, three of which must be numbered 99 or above
3 COURSES **Joint-Allied:** Three additional EPS courses, two of which must be numbered 99 or above

1-2 COURSES — **ADDITIONAL COURSES**
In EPS or selected courses in related fields to complete the requirement of at least 14 courses for primary/double or 11 courses for joint-allied

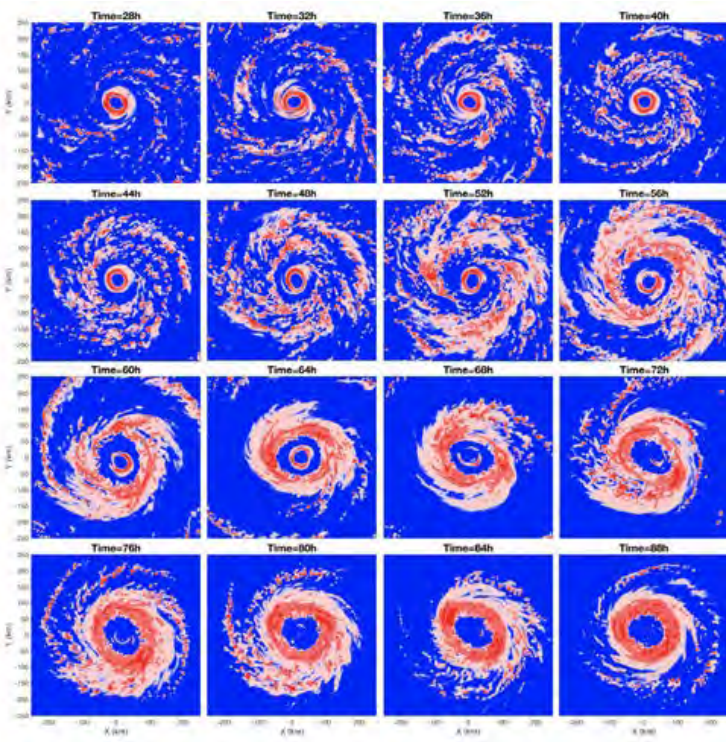
HONORS ELIGIBILITY
EPS 99 Senior Thesis Tutorial and successful completion of a thesis required

For Secondary Field Students

2 COURSES **EARTH & PLANETARY SCIENCES FOUNDATIONAL COURSES**

- EPS-ESE 6 or EPS 10 *or*
- GENED 1018, 1085, 1094, 1098, 1137, 1158, 1167 *or*
- Any 50-level EPS course
- *No more than one of these from EPS-ESE 6, EPS 10, or GENED 1018, 1085, 1094, 1098, 1137, 1158, or 1167*

3 COURSES **UPPER-LEVEL EPS COURSES**



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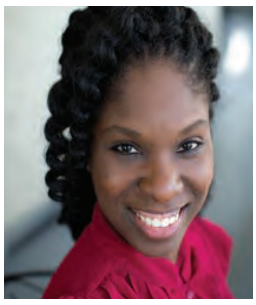

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Environmental Science and Engineering: ESE

Students in Environmental Science and Engineering study the fundamental processes underlying environmental systems and explore the nexus between scientific knowledge, regulatory frameworks, and engineering solutions for some of the world's most pressing environmental problems. This program is structured around the view that the environmental system is comprised of a complex set of chemical, physical, and biological processes, made even more complicated by the various activities of human society. Throughout their coursework, students learn to understand complex environmental problems in an integrated fashion through a range of approaches from theory and modeling to experiments and observations. As part of the Harvard John A. Paulson School of Engineering and Applied Sciences (SEAS), students in ESE are encouraged to participate in experiential learning and state-of-the-art research with faculty. ESE is uniquely positioned to serve as a point of convergence for science and engineering, and exemplifies the pursuit of a technical liberal arts degree.

Students interested in Environmental Science & Engineering have the option to pursue a Bachelor of Arts (AB) in Environmental Science and Engineering or an ABET-accredited Bachelor of Science (SB) in Engineering Sciences on the ESE track. While students in either degree program take many of the same upper-level ESE courses, the AB program offers the opportunity to study complementary disciplines from other natural and social sciences, and the SB program provides a broader basis in engineering fundamentals with courses from other engineering areas and design. The broad-based, multidisciplinary curriculum of the Environmental Science and Engineering program offers rigorous preparation for students preparing for careers in engineering, green technology, public service, business, or government.

Advising and Research

- A dedicated advising team for each student, including an individual faculty adviser and the Assistant Director of Undergraduate Studies in Environmental Science and Engineering
- A direct connection to the cutting-edge research and facilities at the Harvard John A. Paulson School of Engineering and Applied Sciences (SEAS), including the Active Learning Labs (ALL)
- All SB students complete a senior thesis through their individual senior capstone design project, and AB students have the opportunity to conduct original research with guidance from SEAS faculty resulting in a senior thesis
- https://www.seas.harvard.edu/environmental-science-engineering

Culture

- Small classes that give students direct access to professors
- Interaction with students and faculty from other engineering areas (e.g., Mechanical, Electrical, Biomedical) through Engineering Sciences classes and club activities
- Weekly lunches sponsored by the Harvard College Engineering Society every Friday
- Opportunities to learn outside of the classroom through extracurricular activities (e.g., Engineers without Borders; SEAS Research Cores)

Careers

Here are some examples of what our recent graduates are doing:

- **Engineering Consulting**: Helping private and public sector entities with GHG reduction; Restoring soil, surface water, and groundwater through remediation; Designing critical infrastructure; Designing buildings with healthier materials and lower carbon footprints
- **Renewable Energy**: Transforming the energy industry by investing in solar access in overlooked areas; Designing and deploying large-scale renewable power projects; Helping businesses and institutions transition to renewable energy
- **Green Technology**: Capturing methane emission and producing fertilizers from organic waste; Transforming CO2 into cost-competitive fuels and chemical products; Leading EV battery programs from development to large-scale production; Developing energy-efficient hydroponic systems
- **Finance:** Investing in climate technologies; Facilitating technological/strategic partnerships between industry leaders and green startups
- **Public Service:** Protecting the environment and managing critical infrastructure as environmental engineers (US Forest Service, US Army Corps of Engineers, EPA, etc...); Assisting elected officials in the legislative and executive branch
- **Further Study**: About 50% of our graduates pursue further study (Masters in engineering, public health, business administration; PhD; JD). Most graduates work for 2-5 years before pursing graduate degrees.

Core ESE Courses

ESE 6	Introduction to Environmental Science and Engineering
ESE 50	The Fluid Earth: Oceans, Atmosphere, Climate, and Environment
ESE 101	Global Warming Science 101
ESE 102	Data Analysis and Statistical Inference in the Earth and Environmental Sciences
ESE 109	Earth Resources and the Environment
ESE 115	Ecosystem Patterns and Processes: Parallels in Natural and Built Environments
ESE 129	Climate and Atmospheric Physics Laboratory
ESE 131	Introduction to Physical Oceanography and Climate
ESE 132	Introduction to Meteorology and Climate
ESE 133	Atmospheric Chemistry
ESE 138	Mysteries of Climate Dynamics
ESE 160	Space Science and Engineering: Theory and Applications
ESE 161	Applied Environmental Toxicology
ESE 162	Hydrology
ESE 163	Pollution Control in Aquatic Ecosystems
ESE 164	Environmental Chemistry
ESE 166	State-of-the-Art Instrumentation in Environmental Sciences
ESE 168	Human Environmental Data Science: Agriculture, Conflict, and Health
ESE 169	Seminar on Global Pollution Issues
ES 96	Engineering Problem Solving and Design Project *(required for SB juniors)*
ES 100	Engineering Design Project *(required for SB seniors)*
ES 105hfr	Humanitarian Design Projects
ES 112	Thermodynamics
ES 123	Introduction to Fluid Mechanics and Transport Processes
ES 183	Introduction to Heat Transfer

CONCENTRATION REQUIREMENTS

AB in Environmental Science and Engineering (14 courses)

2-4 COURSES **MATHEMATICS** *(begin according to placement; Math 18/19 series not allowed)*

- Math 21a & 21b *or*
- Math 22a & 22b *or*
- Math 25a & 25b *or*

2 COURSES **PHYSICS**

One from: Physical Sciences 12a, Physics 15a, Physics 16, Applied Physics 50a
One from: Physical Sciences 12b, Physics 15b, Applied Physics 50b

2 COURSES **CHEMISTRY**

Select 2:

- Physical Sciences 11 *(recommended)*
- LPSa *or* Life Sciences 1a
- Chemistry 10, 17, *or* 20

SOPHOMORE FORUM

Sophomore year. Non-credit. Spring term.

1 COURSE **ESE INTRODUCTORY COURSE**

- Environmental Science and Engineering 6

With permission, may be substituted with an additional course in environmental physics, environmental chemistry, or ESE 50

2 COURSES **ESE BREADTH**

Strongly recommended to select one course in environmental physics and one course in environmental chemistry. With permission, students may substitute alternative ESE courses.

- Environmental Physics: ESE 101, 129, 131, 132, 162 *or* ES 112
- Environmental Chemistry: ESE 133, 161, 164

5 COURSES **APPROVED ELECTIVES**

With permission, up to two courses may be substituted with a relevant upper-level course.

- ESE 101, 102, 109, 115, 129, 131, 132, 133, 136, 138, 160*, 161, 162, 163*, 164, 166*, 168, 169*
- Data analysis, statistics, and scientific computing (no more than one): AM 10, 101, 120; CS 32, 50, 109a; SCI 5; STAT 110
- ES 91r (one term), 96*, 105hfr (two terms), 112, 123, 181, 183
- Introductory Engineering Science Courses: ES 50, 51, 53 (no more than one)
- EPS 53, 134, 187; OEB 55, 120, 157
- Upper-level Applied Math: AM 105, 115 (no more than one)

DESIGN EXPERIENCE

All students must take an approved course (*) with significant design experience as one of their ESE Breadth or Approved Electives. This requirement may also be satisfied with a design component within a senior thesis or independent research project (ES 91r).

SB in Engineering Sciences—Environmental Science and Engineering Track (20 Courses)

General Engineering Sciences Requirements:

4 COURSES **MATHEMATICS** *(begin according to placement)*

- Math 1a & 1b
- Math 21a & 21b *or* Math 22a & 22b *or* Math 23a & 23b *or* Applied Math 21a & 21b *or* Applied Math 22a & 22b

PROBABILITY AND STATISTICS *(if starting in Math 1b or higher)*

- Applied Mathematics 101 [*or*]
- Engineering Sciences 150 [*or*]
- Statistics 110

APPLIED MATHEMATICS *(if starting in Math 21a or equivalent)*

- Applied Math 104, 105, *or* 107

2 COURSES **PHYSICS**

- *One from:* Physical Sciences 12a, Physics 15a, Physics 16, *or* Applied Physics 50a
- *One from:* Physical Sciences 12b, Physics 15b, *or* Applied Physics 50b

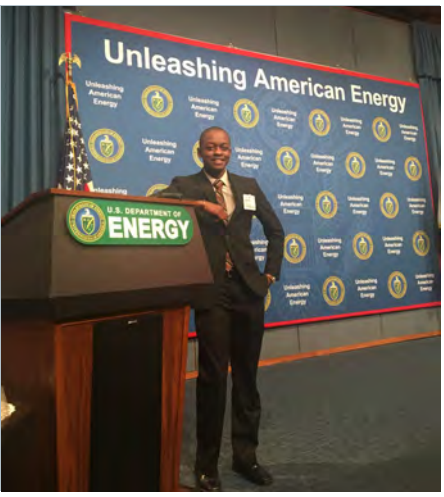
1 COURSE **COMPUTER SCIENCE**

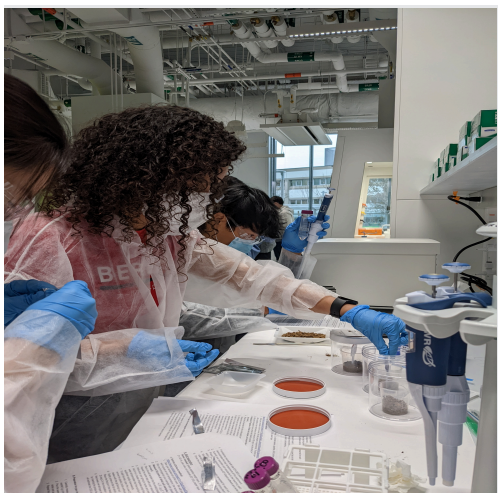
- Computer Science 32 or 50; Applied Math 10

2 COURSES **ENGINEERING DESIGN**

- Engineering Sciences 96 *and* Engineering Sciences 100hf

SOPHOMORE FORUM *Sophomore year. Non-credit. Spring term.*





Environmental Science and Engineering Track Requirements:

2 COURSES **CHEMISTRY**

Select two from:

- Physical Sciences 11 *(recommended)*
- LPSa *or* Life Sciences 1a
- Chemistry 10, 17, *or* 20

5 COURSES **ESE CORE**

- Environmental Science and Engineering 6 *and*

Select four from:

- Environmental Science and Engineering 109, 115, 131, 133, 136, 160, 161, 162, 163, 164, 166, 168, 169; Engineering Sciences 112, 123

3 COURSES **ENGINEERING BREADTH**

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):*

- Mechanics and Materials
- Electrical
- Engineering Physics and Chemistry

1 COURSE **ENGINEERING ELECTIVE**

Select one course on engineering topics from any engineering depth area *(see the Student Handbook for complete list of eligible courses)*

ESE Contacts

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Environmental Science and Public Policy: ESPP

The concentration in Environmental Science and Public Policy 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 judgements 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.

All students have to satisfy a core of requirements in the physical, biological, and social sciences and mathematics. Students in consultation with their faculty advisor identify a field of specialization with a set of advanced courses to provide in-depth understanding of a particular area of environmental science and/or policy. Through their field of specialization, students develop expertise in a particular field of study relating to the environment.

Advising and Research

- All students are matched with a faculty member who serves as their advisor
- Students create and develop their field of specialization with faculty guidance
- All students undertake an independent research project in their senior year—either capstone or honors thesis, both with faculty guidance
- Students are offered the opportunity to participate in local field trips led by faculty

Culture

- A mid-size concentration with access to wide range of faculty who oversee the program, including members of FAS departments in EPS, Economics, Government, and OEB, the Business School, Graduate School of Design, the Kennedy School, the School of Public Health, and SEAS
- A welcoming community residing in the Harvard University Center for the Environment where students, faculty, and staff gather for academic and social events (formal and informal)

Careers

Common employment for graduates with ESPP degrees include:

- **Education and Research:** Teaching at the high school through university levels, environmental research at university and government agencies
- **Energy:** Working in both the renewable and fossil energy sectors
- **Non-Governmental Organization:** Public education and outreach, environmental policy advocacy
- **Public Service:** Environmental monitoring and analysis, operation and management of environmental facilities, administration of environmental regulations
- **Medical:** ESPP requirements track with pre-med and many graduates have pursued medical school
- **Legal:** Some graduates pursue law school motivated by environmental concerns



ESPP Course List

INTRODUCTORY COURSE OPTIONS

EPS-ESE 6	Introduction to Environmental Science and Engineering
EPS 50	The Fluid Earth: Oceans, Atmosphere, Climate, and Environment
GENED 1085	Energy Resources and the Environment
GENED 1094	Confronting Climate Change: A Foundation in Science, Technology, and Politics
GENED 1137	The Challenge of Human-Induced Climate Change: Transitioning to a Post Fossil Fuel Future
GENED 1158	Water and the Environment

MATH

There are several options for fulfilling the requirement of two courses in mathematics or statistics. The minimum requirement is Math 1a and 1b. (See page 21 for options). More advanced courses can be chosen. Begin according to placement.

BIOLOGICAL SCIENCE COURSE OPTIONS

OEB 10	Foundations of Biological Diversity
OEB 55	Ecology: Populations, Communities and Ecosystems
OEB 56	Conservation Biology

PHYSICAL SCIENCE COURSE OPTIONS

Physical Sciences 11	Foundations and Frontiers of Modern Chemistry: A Molecular and Global Perspective

SOCIAL SCIENCE COURSE OPTIONS

ESPP 77	Technology, Environment, and Society
ESPP 78	Environmental Politics

ECONOMICS

EC1661	Economics of Climate Change and Environmental Policy

JUNIOR SEMINARS

ESPP 90g	The Law and Policy of Climate Change: Influencing Decision Makers
ESPP 90h	Climate. Crops, and Commonwealth
ESPP 90m	Natural Climate Solutions: Feasible or Fantasy?
ESPP 90n	Addressing the Global Climate Crisis: Challenges for Both Developed and Developing Economies
ESPP 90p	Climate Responsibility and Climate Action
ESPP 90s	The Technology, Economics, and Public Policy of Renewable Energy

CONCENTRATION REQUIREMENTS

Primary: 13-14 courses (52-56 credits)
Senior Thesis: Required for Honors

Joint (Allied Field): 12 courses (48 credits)
Senior Thesis: Required

Secondary Field: 5 Courses (20 credits) & Non-Credit Colloquium

For ESPP Primary and Joint-Allied Concentrators

1 COURSE — **INTRODUCTORY COURSE**
The introductory course is designed to provide a multidisciplinary examination of a current environmental challenge.
- EPS-ESE 6, EPS 50, GENED 1085, GENED 1094, GENED 1137, *or* GENED 1158

1 COURSE — **PHYSICAL SCIENCES**
- Physical Sciences 11

2 COURSES — **MATH**
- Math 1a & 1b; *or* Math 19a & 19b; Math 21a & 21b; *or* Applied Math 21a & 21b; *or* Math 1b & either Math 21a *or* Applied Math 21a; Math 1b & Stat 100 *or* 102 *or* 104
- Please visit https://espp.fas.harvard.edu/mathstat-course-options for the complete list of math/statistics course options.

1 COURSE — **BIOLOGY**
- OEB 10, OEB 55, *or* OEB 56

1 COURSE — **SOCIAL SCIENCES**
- ESPP 77 *or* ESPP 78

1 COURSE — **ECONOMICS**
- Economics 1661

1 COURSE — **JUNIOR SEMINAR**
- ESPP 90

4 COURSES — **ADVANCED-LEVEL COURSES/FIELD OF SPECIALIZATION**
Student's field of specialization; four advanced courses
At least one course must be chosen from social sciences/policy and from natural sciences/engineering. One course must be in EPS unless a student has taken EPS-ESE 6, EPS 50, GENED 1085, GENED 1094, GENED 1137, or GENED 1158 as their introductory course.

1 COURSE — **CAPSTONE PROJECT** (Non-honors) *or*
2 COURSES — **SENIOR THESIS** (Honors)
- ESPP 91 (1 course) Capstone project, students conduct an in-depth examination of an environmental issue consistent with their field of specialization.
- ESPP 99 (2 courses) Senior Thesis Tutorial (required for honors)

For ESPP Secondary Field Students

1 COURSE

INTRODUCTORY COURSE

- EPS-ESE 6, EPS 50, GENED 1085, GENED 1094, GENED 1137, *or* GENED 1158

4 COURSES

ADVANCED COURSES

- 2 advanced courses in the social sciences/policy
- 2 advanced courses in the natural sciences/engineering
- *List of advanced course options available on ESPP website*

COLLOQUIUM

- During each semester, there are several opportunities for 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 enrolled in the program.

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Integrative Biology: IB

The distinguished ecologist George Evelyn Hutchinson described the history and dynamics of life as an evolutionary play in an ecological theater. The concentration in Integrative Biology (the concentration overseen by the Department of Organismic & Evolutionary Biology, OEB) is dedicated to Hutchinson's vision, and is therefore inherently interdisciplinary, encompassing mathematical and computational biology, functional and genetic approaches to morphology and development, as well as genetics, evolution, and ecology.

IB students have many chances to study in the field. Courses take students to Australia (OEB 11 Tropical Ecology), Mexico (OEB 190 Birds), Brazil (OEB 103 Plant Systematics), Panama (OEB 51 Invertebrates), and Costa Rica (OEB 167 Reptiles & Amphibians).

IB provides opportunities to engage with a wide range of topics:

- **Ecology**
- **Animal Behavior**
- **Anatomy and Physiology**
- **Evolutionary Biology**
- **Paleobiology**
- **Plant Biology**
- **Development & Evolution**
- **Courses on specific groups: insects, fish, mammals, reptiles & amphibians, birds, invertebrates**

Advising and Research

- All students, in both concentration and secondary, are advised by IB's Assistant Director of Undergraduate Studies, Dr. Andrew Berry
- Funded semester and summer research opportunities in lab and/or field
- Wide-ranging opportunities to do independent senior thesis research with faculty from OEB or related departments
- Harvard provides strong financial support for undergraduate research: https://uraf.harvard.edu/uraf-administered-programs

Culture

- With 35 members of the faculty in OEB and around 40 students per year in IB (for a total of around 120 concentrators), IB provides plenty of opportunities—through coursework, research, and more—to become a part of the OEB family
- IB students run their own undergraduate group, OEBug (OEB Undergraduate Group), which organizes weekend activities, social events, and more
- Because of the many opportunities to go away for a week or more on course field trips, students in IB often get to know each other well, and form a tight community

Careers

As with any science degree from Harvard, IB provides a platform for exploring just about anything after Harvard. Common destinations for graduates with IB degrees include:

- **Public Service:** Whether through environmental NGOs or through organizations like the National Park Service, IB graduates often end up working in public service
- **Research:** Typically in PhD programs in the US or overseas, but sometimes through Master's programs
- **Legal:** Every year, some IB graduates go to law school, often motivated by environmental concerns
- **Education:** Teaching at the elementary school through university levels, sometimes through organizations like Teach for America
- **Medical:** IB concentration requirements fulfill most of the medical school admission requirements
- **Veterinary:** Most of Harvard's pre-vet students concentrate in IB

IB Course List

LIFE SCIENCES

Life Sciences 1a	An Integrated Introduction to the Life Sciences: Chemistry, Molecular Biology, and Cell Biology (fall)
Life & Physical Sciences a	Foundational Chemistry & Biology (fall)
Life Sciences 50a	Integrated Science (fall)
Life Sciences 1b	An Integrated Introduction to the Life Sciences: Genetics, Genomics, and Evolution (spring)
Life Sciences 50b	Integrated Science (spring)

**Pre-medical students should consider Physical Sciences 11 (spring) to allow them to take the Organic Chemistry sequence (Chemistry 17-27) as sophomores.*

OEB

OEB 10	Foundations of Biological Diversity (fall)
OEB 11	Introduction to Tropical Ecology (spring, with January field trip to Australia)
OEB courses	OEB 50-290 on wide-ranging topics including ecology, evolution, animal behavior, plant biology, paleobiology, genetics, population genetics, deep sea biology, entomology, herpetology, ornithology, etc...
Senior Thesis	Required for highest honors

IB Contact

CONCENTRATION AND SECONDARY FIELD ADVISOR

Andrew Berry

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16 Divinity Avenue, Cambridge, MA, 02138
617-495-0684
berry@oeb.harvard.edu

CONCENTRATION REQUIREMENTS

Primary: 13 courses (52 credits)

Senior Thesis: optional (typically completed by around 45% of concentrators)

IB does not participate in joint concentrations

Secondary: 5 courses (20 credits)

Any five courses taught by OEB faculty

For Primary Concentrators

3 COURSES — **FOUNDATIONAL COURSES**

- LS 1a/LPSa/LS50a; LS1b/LS50b; OEB10

4 COURSES — **MATH, APPLIED MATH, COMPUTER SCIENCE, STATISTICS, PHYSICS, CHEMISTRY**

- Any four courses (at or above the level of Math 1b in Math and of CS 20 in Computer Science)

3 COURSES — **MID-LEVEL COURSES**

- Three courses chosen from OEB 11, OEB 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 65; MCB 60, 63, 80; SCRB 10; LS 2

3 COURSES — **ADVANCED-LEVEL COURSES**

- Any three courses from any area in the Life Sciences (including OEB, HEB, MCB, etc...) that are not listed above as mid-level courses

HONORS ELIGIBILITY

Honors and high honors may be attained on the basis of within-concentration GPA; highest honors requires a senior thesis

For Secondary Fielders

Any five courses taught by OEB faculty

Energy & Environment: E&E

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.

The Environmental Science and Public Policy Concentration, in coordination with Harvard University Center for the Environment (HUCE), offers 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 a focus on their home concentration.

E&E Course List

FOUNDATIONAL

EPS-ESE 6	Introduction to Environmental Science and Engineering
EPS 50	The Fluid Earth: Oceans, Atmosphere, Climate, and Environment
GENED 1085	Energy Resources and the Environment
GENED 1094	Confronting Climate Change: A Foundation in Science, Technology, and Politics
GENED 1137	The Challenge of Human-Induced Climate Change: Transitioning to a Post Fossil Fuel Future
GENED 1158	Water and the Environment

UPPER-LEVEL COURSES

At least one course must be chosen from each of two elective categories:

- Social Sciences and Humanities
- Natural Sciences and Engineering

Secondary Field Requirements (4 Courses)

1 COURSE

FOUNDATIONAL COURSE

- EPS-ESE 6, EPS 50, GENED 1085, GENED 1094, GENED 1137, GENED 1158

3 COURSES

UPPER-LEVEL

- One from Social Sciences and Humanities
- One from Natural Sciences and Engineering
- *The complete list of options can be found on the ESPP website: http://espp.fas.harvard.edu/.*

COLLOQUIUM

- During each semester, there are several opportunities for 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 enrolled in the program.

E & E SECONDARY FIELD CONTACT
Lorraine Maffeo
Undergraduate Program Administrator

HUCE, Room 444A
617-496-6995
maffeo@fas.harvard.edu

E & E SECONDARY FIELD CONTACT
Diana Sharpe
Associate Director of Undergraduate Studies

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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 most pressing problems facing our natural environment are complex, often requiring collaborative investigation by scholars versed in different disciplines. 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, design, and law. 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.

GET CONNECTED

Stay connected to the Center's news and events at www.environment.harvard.edu, including a mailing list and weekly events calendar, social media platforms, and an annual newsletter.

Through a variety of programs and funding opportunities, the Center connects people and supports research related to the environment at every level, from undergraduates through senior faculty members. The following resources may be of particular interest to undergraduate students:

Secondary Field in Energy And Environment

The Environmental Science and Public Policy Concentration, in coordination with HUCE, offers 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. Students from a broad spectrum of concentrations identify the obstacles, highlight the opportunities, and define the discussion for an energy-environment strategy for the 21st century and beyond. To learn more or apply, visit: www.espp.fas.harvard.edu/energy-environment.

Summer Undergraduate Research Fund

Students can apply for the Summer Undergraduate Research Fund, which provides financial support for independent student research projects and faculty research assistantships related to energy and the environment. Award amounts are usually between $500-$3,500. To learn more about funding sources, visit: www.environment.harvard.edu/summer-undergraduate-research-fund-0.

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/course-guide to access the guide.

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/videos. To learn more about energy and environmental events at Harvard and the Greater Boston area, visit: www.environment.harvard.edu/events/calendar/list.

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

How to Find Us

EPS

Hoffman Laboratories

20 Oxford Street
Cambridge, MA 02138

617-384-9760

eps.harvard.edu

ESE

Harvard John A. Paulson School of Engineering and Applied Sciences

Pierce Hall
29 Oxford Street
Cambridge, MA 02138

617-495-1246

seas.harvard.edu/programs/engineering/environmental-science-and-engineering

ESPP

Harvard University Center for the Environment

26 Oxford Street
Fourth Floor
Cambridge, MA 02138

617-496-6995

espp.fas.harvard.edu

E&E

26 Oxford Street
Fourth Floor
Cambridge, MA 02138

617-496-6995

espp.fas.harvard.edu/energy-environment

IB

BioLabs 1082

16 Divinity Avenue
Cambridge, MA 02138

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lifesciences.fas.harvard.edu/ib