The Johns Hopkins University

Department of Environmental Health and Engineering

Undergraduate Programs

Updated 4/18/17

Contents

INTRODUCTION

The field of Environmental Engineering is dedicated to the study and amelioration of environmental problems. Such problems are complex and multifaceted, and successful solutions must operate within the constraints imposed by societal concerns. As a result, the discipline of Environmental Engineering is a highly interdisciplinary endeavor.

The Bachelor of Science in Environmental Engineering degree program is accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org.

Additional information from the Whiting School of Engineering regarding our ABET Accreditation can be found here.

ABET Program Educational Objectives

The BSEE Program Educational Objectives focus on objectives that our graduates are expected to attain within a few years of graduation. The objectives were reviewed and approved by our external advisory committee in May 2015. The objectives are stated as follows:

The Program in Environment Engineering educates students to think critically, communicate clearly, and collaborate effectively as they apply the fundamental scientific principles of engineering to environmental problems. We emphasize the importance of intellectual growth, professional ethics, and service to society. Our graduates are prepared to be successful

(1) engineering professionals in private and governmental organizations, and

(2) students in the best graduate programs.

The objectives may be found on the Departmental web page, the WSE ABET web page and the Undergraduate Advising Manual (Appendix E).

ABET Student Outcomes

Students graduating with a B.S. in Environmental Engineering will have demonstrated:

- (a) an ability to apply knowledge of mathematics, science, and engineering
- (b) an ability to design and conduct experiments, as well as to analyze and interpret data
- (c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- (d) an ability to function on multidisciplinary teams
- (e) an ability to identify, formulate, and solve engineering problems
- (f) an understanding of professional and ethical responsibility
- (g) an ability to communicate effectively
- (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- a recognition of the need for, and an ability to engage in life-long learning
- (j) a knowledge of contemporary issues
- (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice;

and, the following specific Environmental Engineering outcomes:

- EE(1a) Understand and apply the principles upon which engineering practice is based: physical, chemical, and biological science
- EE(1b) Understand and apply the principles upon which engineering practice is based: mathematics and scientific computation
- EE(1c) Understand and apply the principles upon which engineering practice is based: economics
- EE(1d) Understand and apply the principles upon which engineering practice is based: engineering science
- EE(2) - Have the knowledge and skills to design, conduct, and evaluate experiments
- EE(3) - Understand the cross-media (air, water, earth) nature of environmental problems and the need for multidisciplinary approaches to their solution.
- EE(4) - Be able to design systems, components, or processes that provide engineering solutions to environmental problems given realistic economic, social, political, ethical, health, safety, and sustainability constraints
- EE(5)- Demonstrate critical thinking skills and ability for independent study needed to engage in life-long learning
- EE(6) - Possess the knowledge and skills to identify, formulate, and implement solutions to engineering problems using modern engineering tools and synthesizing different fields of knowledge
- EE(7) - Can communicate both orally and in writing, and effectively function in multidisciplinary teams
- EE(8) - Understand contemporary issues, the social nature of environmental problems, and the context in which environmental engineering is practiced in modern society
- EE(9) - Have access to specialized training through coursework and research
- EE(10) - Understand professional ethics and the value of service through participation in technical activities and in professional organizations

Continuous Improvement

The Department of Environmental Health and Engineering strives to continuously improve its curriculum by using performance criteria to regularly assess its program educational objectives (what skills it expects its students to demonstrate). The environmental engineering program uses the results of each assessment to continuously improve upon its curriculum and thus ensure that it is meeting the needs of its students.

Our program was implemented for the first time during the 2002-2003 academic year and is intended to provide a strong foundation in the physical, chemical and biological sciences, as well as in mathematics, engineering science and engineering design. It is broad and flexible enough to accommodate students with a variety of interests in Environmental Engineering. This training should provide an ideal preparation for future employment in business or industry or for subsequent training at the graduate level, either in Environmental Engineering or in a field such as environmental law, public health, or medicine. Advanced training through participation in a senior design project involves synthesizing information from more than one field to solve real-world problems.

Advising

If you have questions about any of our EHE undergraduate degree programs please contact:

Marsha Wills-Karp (mwkarp@jhu.edu) or Professor Ben Hobbs (bhobbs@jhu.edu)

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All undergraduate students majoring in Environmental Engineering must follow a program approved by a faculty member in the Department who is appointed as the student's advisor. It is the responsibility of the student to initiate and attend regular meetings with the advisor.

Each student must meet with his/her advisor at least twice a semester to:

- plan or make changes to his/her course schedule,
- discuss requirements for the major, and
- discuss any problems that relate to academics or academic performance.

NOTE: All Environmental Engineering Majors must fill out and obtain their advisor's signature on a checkout sheet at the beginning of each semester. Submit signed check out sheets to EHE in person (Ames Hall 313) or via email (mailto:ehe_wse@jhu.edu) prior to registering each semester.

Note **that undergraduate advising week is the week BEFORE undergraduate registration week.** Please schedule an appointment with your advisor to ensure you are able to review your progress and course selection plans prior to the undergraduate registration week. For more information on how to register, important announcements, and deadlines please visit http://web.jhu.edu/registrar

Responsible Conduct of Research Course

Please visit the WSE Advising Office website for details:
http://engineering.jhu.edu/wse-research/resources-policies-forms/responsible-conduct-of-research/

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General Regulations for the Environmental Engineering Major

All undergraduate students majoring in Environmental Engineering must follow a program approved by a faculty member in the department who is appointed as the student's advisor.

Course and Grade Regulations

The Department of Environmental Health and Engineering requires that:

- all courses taken after the first semester of the freshman year and counted toward the 125 credits required for Environmental Engineering be taken for a letter grade (that is, they may not be taken with the Satisfactory/Unsatisfactory option). The University regulations can be found in the JHU catalog. Whereas the University allows one S/U course each semester *outside the student's major*, the department does not allow any S/U courses (except those in the first semester of the Freshman year) to count toward the requirements for graduation.
- grades of C- or better be obtained in all required Engineering, Mathematics and Science courses (i.e., grades of D or D+ will not be accepted). This also applies to required electives in those three areas. No more than ten D credits may be counted toward graduation requirements.
- no more than 12 credits completed prior to matriculation or in summer sessions at other accredited colleges or universities may be accepted. Transfer students are not subject to this restriction. They must obtain credit for courses they wish to transfer during their first year at Hopkins. University regulations also require a minimum of two years residence for a Hopkins degree.

Advanced Placement

The Whiting School's Office of Academic Affairs decides what AP credits can be counted toward an engineering degree. Please visit the link below if you have questions about your AP credits:
http://engineering.jhu.edu/undergraduate-studies/academic-policies-procedures-undergraduate/

CHEMISTRY:

A score of four or five on the AP Chemistry exam exempts a student from taking the Intro Chemistry I and II sequence (030.101, 030.102). In that case, Chemistry Lab is waived. Students with AP Chemistry are encouraged to enroll in 030.103 Applied Chemical Equilibrium and Reactivity with Lab to ensure a solid foundation in college level chemistry.

PHYSICS:

A score of four or five on Physics C (parts one and two) exempts a student from the Physics I and II sequence (171.101, 171.102), **but the corresponding Physics Labs (173.111, 173.112) are required.** No AP credit is awarded for Physics B. For additional information about AP credits, please consult your Engineering

101 Program Planning Guide provided by the Whiting School of Engineering. Note: AP credit for Physics I or II is 4 credits each, whereas Physics I and II with lab at JHU are 5 credits each. For students with AP credit, this means that an additional course in Physics must be taken to make up for the 1 or 2 credit shortfall in the Physics credits.

BIOLOGY:

AP Biology credits may only count towards satisfying an introductory required biology class (100 level). Please note that AP Biology credits may not satisfy the Ecology course requirement.

AP credits may not count towards Humanities and Sciences or replace Statistics courses.

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ENVIRONMENTAL ENGINEERING MAJOR CURRICULUM

Environmental Engineering Curriculum

With the assistance of a faculty advisor, each student will plan a curriculum suited to his or her ultimate career goals. The program also encourages individual study and research.

Focus Areas within the Environmental Engineering Major

Students must select among four different focus areas:
• Environmental Management and Economics
• Environmental Engineering Science
• Environmental Transport
• Environmental Health Engineering

The Environmental Engineering curriculum is structured as follows, and involves a total of 125 credits:

Mathematics (M) with a focus on applications (19 credits)

Required Courses:

- 110.108 Calculus I (Physical Sciences and Engineering)
- 110.109 Calculus II (Physical Sciences and Engineering)
- 110.202 Calculus III (Physical Sciences and Engineering) or 110.211 Honors Multivariable Calculus and Linear Algebra
- 550.291 Linear Algebra and Differential Equations or 110.302 Differential Equations with Applications
- An advanced course (300 level or higher) in probability and statistics (The Department of Applied
- Mathematics and Statistics offers a number of suitable courses)

Basic Science (BS) (24-25 credits)

Required Courses:

- 171.101 General Physics for Physical Science Majors I
- 171.102 General Physics for Physical Science Majors II
- 173.111 General Physics Laboratory I
- 173.112 General Physics Laboratory II
- One year of introductory chemistry (e.g., 030.101 Introductory Chemistry I and 030.102 Introductory Chemistry II)
- 030.105 Introductory Chemistry Laboratory I
- 030.106 Introductory Chemistry Laboratory II
- 570.205 Ecology
- An additional course in the biological sciences, such as 020.151 General Biology I, or 570.328 Geography and Ecology of Plants.

Note: Premedical students could substitute 020.305 Biochemistry, 020.315 Biochemistry Laboratory, 020.306 Cell Biology, and 020.316 Cell Biology Laboratory, for Ecology or General Biology. Premedical students should also take additional chemistry courses as electives, such as 030.205 Introductory Organic Chemistry I, 030.206 Introductory Organic Chemistry II, and 030.225 Organic Chemistry Laboratory.

Humanities and Social Sciences (HS) (18 credits)

A minimum of six courses totaling 18 credits in Humanities or Social Sciences (catalog code H or S). The six courses must include 1) one course that specifically develops writing skills (e.g., a how to write class), 2) 570.334 Engineering Microeconomics, and 3) four additional H&S courses with at least two at the 300 level or higher. 570.404 and/or 570.406 can be taken as part of these requirements. Please note that the writing course will fulfill one of the two writing intensive courses required by the university (W courses). Note also that most medical schools require a year of English literature and/or composition.

Required course:

- 570.334 Engineering Microeconomics

Elective examples from EHE:

- 570.406 Environmental History
- 570.427 Natural Resources, Society, and Environment

Writing course examples:

- 220.146 (H, W) Introduction to Science Writing
- 220.202 (H, W) Introduction to Nonfiction
- 060.113 or 060.114 Expository Writing (either one; both cannot be counted for H/S credit)
- 220.105 or 220.106 Introduction to Fiction and Poetry I

General Engineering (GE) (16 credits)

Required courses:

- 570.108 Introduction to Environmental Engineering
- An introductory course in computing (570.210, Introduction to Computation and Mathematical Modeling or an equivalent course)
- A course in thermodynamics (e.g., 540.203 Engineering Thermodynamics, 510.312 Physical Chemistry of Materials I: Thermodynamics, or 530.231 Mechanical Engineering Thermodynamics)
- A course in Statics (either 560.201 Statics and Mechanics of Materials or 530.201 Statics and Mechanics of Materials)
- 570.351 Introduction to Fluid Mechanics

Design Experience and Engineering Laboratory (D) (9 credits)

Required courses:

- 570.305 Environmental Engineering Systems Design
- 570.419, 570.421 Environmental Engineering Design I, II

The Design and Synthesis sequence is a five-credit project course (2 credits fall semester, 3 credits spring semester) and involves a comprehensive study of the engineering design process from problem definition to final design. The course involves team projects that include written and oral presentations. Students will form

small teams that will work with local companies or government agencies in executing the project. Prerequisite: senior standing in Environmental Engineering.

Environmental Engineering Requirements (EER) (27 credits)

Required courses (12 credits):

- 570.239 Current and Emerging Environmental Issues
- 570.303 Environmental Engineering Principles and Applications
- 570.304 Environmental Engineering and Science Laboratory
- 570.353 Hydrology

Environmental Engineering Electives (EEE) (15 credits):

Students need to take a total of 5 EE electives (totaling 15 credits.) They should take:

- at least 2 EE electives in one focus area
- 1 EE elective in each of 2 other focus areas
- The 5th EE elective course can be in any of the four focus areas.

Courses to be selected in consultation with advisor. **Any changes in courses must be accompanied by a Waiver/Substitution Form.**

Environmental Management and Economics (Note: 600 level courses require permission of instructor)

- 570.418/618 Multiobjective Programming and Planning
- 570.496 Optimization Models in Environmental Systems
- 570.497 Risk & Decision Analysis (Not offered Fall 2016)
- 570.490 Solid Waste Engineering and Management
- 570.491 Hazardous Waste Engineering and Management

Environmental Engineering Science

- 570.411 Engineering Microbiology
- 570.442 Environmental Organic Chemistry
- 570.443 Aquatic Chemistry

Environmental Transport

- 270.405 Modeling the Hydrologic Cycle
- 570.412 Landscape Hydrology
- 570.647 Hydrologic Transport in the Environment
- 570.657 Air Pollution

Environmental Health Engineering

- 182.625 Principles of Occupational and Environmental Hygiene*
- 182.638 Environmental and Health Concerns in Water Use and Reuse*
- 280.350 Fundamentals of Epidemiology
- 221.624 Urban Health in Developing Countries*
- 180.600 Water and Sanitation in Tropical Environments*

* These courses are offered on the Bloomberg School of Public Health campus.

Technical Electives (TE) (minimum of 12 credits) (selected in consultation with an advisor)

- At least three (E), (Q) or (N) courses at or above the 300 level subject to approval by the department and totaling at least twelve credits. (For ABET requirements at least one from: Solid Waste; Hazardous Waste; Air Pollution; Environmental Health Engineering, if not satisfied as part of the Environmental Engineering electives.)
- Up to six credits of independent study or research may be applied toward engineering requirements (e.g. 570.501/502 Undergraduate Research, 570.505 Undergraduate Independent Study, or 570.499 Senior Thesis). Note earlier comments for premed majors.

It is strongly recommended that students take additional advanced classes in computing and numerical methods. Environmental Engineering Science students are strongly encouraged to take at least one course in organic chemistry (e.g., 030.205 Introductory Organic Chemistry I). The organic chemistry course will meet the Technical Elective requirement.

Guidance for Technical Electives for Environmental Engineering Major

1. Technical electives (TEs) are intended to provide students with courses with technical content and extend mastery in appropriate subject matter.
2. TEs require use of fundamental science or mathematics, have appropriate prerequisites (e.g., university-level calculus, physics, chemistry, or other N or Q courses) and generally at a 300 level or higher.
3. TEs must have the appropriate level of rigor which is defined as encompassing both of the following requirements: (a) 5-10 homework assignments; and (b) a culminating project (final project, group project, paper) or final examination. Lecture-only classes (no homework or exams) will not qualify as a TE for the EE major.
4. TEs require accumulation and depth of analytical skill or knowledge. In general, this precludes survey courses or courses that have no technical prerequisites that are taught by multiple professors or a series of guest lecturers, or cover a broad spectrum of a topic instead of building mastery in one area.

Exceptions are possible only with the approval of either the Departmental Chair or Director of Undergraduate Studies.

Sample Environmental Engineering Program

This program satisfies the Environmental Engineering BS with a concentration area in environmental engineering science. This program is based on the assumption that students have not previously completed A.P. courses in Calculus, Physics, Chemistry, etc.

First year----------

Semester 1

110.108 Calculus I (Physical Sciences and Engineering)	4 (M)
030.101 Introductory Chemistry I	3 (BS)
030.105 Introductory Chemistry Laboratory I	1 (BS)
570.108 Introduction to Environmental Engineering	3 (GE)
H/S Elective 1	3 (HS)
Total	14

Semester 2

110.109 Calculus II (Physical Sciences and Engineering)	4 (M)
030.102 Introductory Chemistry II	3 (BS)
030.106 Introductory Chemistry Laboratory II	1 (BS)
171.101 General Physics for Physical Sciences Majors I	4 (BS)
173.111 General Physics Laboratory I	1 (BS)
570.210 Intro. to Computation and Math. Modeling	3 (GE)
Total	16 (Annual 30)

Second year

Semester 1

550.291 Linear Algebra and Differential Equations	4 (M)
171.103 General Physics for Physical Science Majors II	4 (BS)
173.112 General Physics Laboratory II	1 (BS)
560.201 Statics and Mechanics of Materials	4 (GE)
570.205 Ecology	3 (BS)
Total	16

Semester 2

110.202 Calculus III (Calculus of Several Variables)	4 (M)
510.312 Physical Chemistry of Materials I: Thermodynamics	3 (GE)
570.239 Current and Emerging Environmental Issues	3 (EER)
H/S Elective 2	3 (HS)
H/S Elective 3	3 (HS)
Total	16 (Annual 32)

Sample Environmental Engineering Program Cont.

Third year

Semester 1

570.303 Environmental Engineering Principles and Applications	3 (EER)
570.305 Environmental Engineering Systems Design	4 (D)
570.334 Engineering Microeconomics	3 (HS Elective 4)
570.351 Introduction to Fluid Mechanics	3 (GE)
Environmental Engineering or Technical Elective	3 (EEE or
TE) Total	16

Semester 2

Probability/Statistics course	3 (M)
020.151 General Biology	3 (BS)
570.304 Environmental Engineering and Science Lab.	3 (EER) H/S
Elective 5	3 (HS)
Environmental Engineering 3	3 (EEE or
TE) Technical Elective	3 (EEE or
TE)	
Total	18 (Annual 34)

Fourth year

Semester 1

570.353 Hydrology	3 (EER)
570.419 Environmental Engineering Design I	2 (D)
Environmental Engineering or Technical Elective	3 (EEE
or TE) Environmental Engineering or Technical Elective	3
(EEE or TE) Environmental Engineering or Technical Elective	
3 (EEE or TE)	
Total	14

Semester 2

570.421 Environmental Engineering Design II	3 (D) H/S
Elective 6	3 (HS)
Environmental Engineering or Technical Elective	3 (EEE or
TE) Environmental Engineering or Technical Elective	3 (EEE or
TE) Environmental Engineering or Technical Elective	3 (EEE or
TE)	
Total	15 (Annual 29)

Math (M) = 19 credits; Humanities and Social Sciences (HS) = 18 credits; Basic Science (BS) =
24 credits; General Engineering (GE) = 16 credits; Environmental Engineering Requirement (EER) = 12 credits; Environmental Engineering Electives (EEE) = 15 credits; Technical Electives (TE) = 12 credits; Design (D) = 9 credits; **Total Credits = 125**

HUMANITIES AND SOCIAL SCIENCE REQUIREMENTS FOR ENVIRONMENTAL ENGINEERING MAJORS

The Whiting School of Engineering requires a minimum of six courses (each of at least three credits) in Humanities or Social Sciences (catalog code H or S).

Students taking elements of a foreign language are granted an H area designator for both semesters only if the second semester course is successfully completed (see the Johns Hopkins Catalog, page 43). For example, a student successfully completing 090.101 and 090.102 *Elementary German* would get 8 H credits. (Note that while four H credits are given for 090.102 alone, no H credits are given for 090.101 alone).

Writing Requirement

Whiting School undergraduates must take two courses (6 credits) that carry the writing intensive (W) designation. You must work with your advisor to confirm that your courses are approved writing courses. One of the W courses must specifically develop writing skills as a "How to Write" course. Courses that satisfy this "How to Write" requirement include:

- 220.146 (H, W) Introduction to Science Writing
- 220.202 (H, W) Introduction to Nonfiction
- 060.113 or 060.114 Expository Writing (either one; both cannot be counted for H/S credit)
- 220.105 or 220.106 Introduction to Fiction and Poetry I

Students wishing to use any other course to satisfy this writing requirement must have written permission (an email is acceptable) from their advisor.

Note: EN.661.110 Professional Communication for Science, Business and Industry is NOT a "How to Write Course." Additionally, it does not carry an "H" or "S" designator and may not be counted as an H/S elective.

Economics Requirement

To help the student gain an appreciation of the broad economic context in which he/she will operate, one calculus-based introductory course in economics, 570.334 *Engineering Microeconomics*, is required.

Distribution and Depth Requirements

The Humanities and Social Science portion of the program is also of great importance in broadening the student's education and in stimulating the development of an inquisitive and critical mind. In addition to the two mandatory writing courses (one "How to Write and on simply designated W):

- four (4) elective courses in Humanities and Social Science courses must be chosen.
- They must be designated in ISIS H or S
- Two of these courses must be at the 300 level or higher.
- Environmental engineering majors are strongly encouraged to consider taking 570.404 and/or 570.406 as part of these requirements.
- With the approval of the student's advisor, intermediate level language courses may be taken to satisfy this depth requirement.
- The Whiting School (and the Department) allow the first two semesters of any elementary course in a

- foreign language to count toward the fulfillment of the H/S requirement as long as both semesters are successfully completed.

Summary

In summary, the Environmental Engineering program requires:

- a minimum of six full courses (18 credits) in Humanities and Social Sciences
- one writing course (as defined above)
- one course in economics (570.334)
- four additional Humanities and Social Sciences courses, (two of which must be at the 300 level or higher)

DOUBLE-MAJORS AND MINORS

Information for Environmental Engineering Majors

Environmental Engineering majors may elect to double-major or to complete a minor from any department in the School of Engineering or the School of Arts and Sciences that offers one. Students wishing to pursue a double major should inform the Whiting School's Office of Academic Advising. It is the student's responsibility to ensure that all appropriate requirements are met (it is recommended that a faculty advisor from each major be asked to sign off on the student's planned academic program). Students wishing to pursue a minor should confer with the department through which the minor is offered to ascertain the exact requirements.

The minor in Entrepreneurship and Management focuses on business and management from a ultidisciplinary viewpoint and is designed to provide Hopkins engineering students with the knowledge and skills to become leaders in technology companies. Students interested in the Entrepreneurship and Management minor should contact the Center for Leadership Education (http://web.jhu.edu/leadership or cle@jhu.edu) for more information. More traditional subspecialty minors are available through the departments of Civil Engineering, Computer Science, and Applied Mathematics and Statistics.

The Environmental Engineering Minor

Environmental engineering has become an important part of engineering practice in most engineering fields and across a professional spectrum from the private sector through governmental agencies to academia. An
undergraduate minor in environmental engineering has been established to enable engineering students to pursue an interest in this field and to incorporate aspects of environmental engineering into their own careers in other engineering disciplines. Students in any undergraduate engineering major in the GWC Whiting School of Engineering are eligible for admission to the program, which is administered through the Department of Environmental Health and Engineering (EHE). Students in undergraduate majors other than engineering can enroll in the Environmental Science minor, also offered by the Department of Environmental Health and Engineering.

Each student in the Environmental Engineering Minor program will be assigned an advisor in the Department of Environmental Health and Engineering to work with them in developing a program that meets the requirements for the minor that is consistent with the educational requirements of their major field of
engineering study. Requirements of the Minor Program consist of

- a set of "core" science and mathematics courses, already common to the civil and chemical engineering majors,
- four required courses (total of 11 credits) in environmental engineering, and
- two elective courses, one of which is taken at the freshman or sophomore level and the other of which is taken at the junior or senior level.

Students with a strong interest in Environmental Engineering may also wish to consider the Whiting School's Honors B.S./M.S.E. Program. Under this program, outstanding students completing ABET-accredited B.S. programs in engineering disciplines can apply for direct continuation into the M.S.E. Program in Environmental Engineering, which is administered by the Department of Environmental Health and Engineering.

Below are the course requirements for the Environmental Engineering Minor.

EE MINOR CORE COURSES (advanced placement credits and/or equivalent courses in other schools or departments are acceptable, subject to advisor approval)

110.108 Calculus I	4 credits
110.109 Calculus II	4
110.202 Calculus III	4
550.291 Linear Algebra and Differential Equations	4
030.101 Introductory Chemistry I	3
030.102 Introductory Chemistry II	3
030.105 Introductory Chemistry Laboratory	1
030.106 Introductory Chemistry Laboratory	1
171.101 General Physics I	4
171.102 General Physics II	4
173.111 General Physics Laboratory	1
173.112 General Physics Laboratory	1

EE MINOR CURRICULUM (a total of 18 credits is required)

Required Courses (total of 12 credits)

- 570.303 (N,E), Environmental Engineering Principles and Applications, 3 credits, fall
- 570.304 (N,E), Environmental Engineering and Science Laboratory, 3 credits, spring
- 570.305 (N,E), Environmental Engineering Systems Design, 4 credits, fall

EE MINOR Elective Courses (total of 6 credits). One course from each of two groups is required. Group A** - Introductory courses at the freshman and sophomore level. One course required.*

- 570.108 Introduction to Environmental Engineering
- 570.205 Ecology

- 570.239 Current and Emerging Environmental Issues
- 570.317 Paleoecology
- 570.328 Geography and Ecology of Plants
- 020.151 General Biology I
- 270.220 The Dynamic Earth: An Introduction to Geology
- 500.111 Energy and the Environment

Group B** - Engineering science courses that are developed for juniors and seniors, and also introductory graduate level courses. One course required. **Double counting of these courses with specified required courses in the student's major is not allowed.**

- 270.320 The Environment and your Health
- 570.353 Hydrology
- 570.411 Engineering Microbiology
- 570.442 Environmental Organic Chemistry
- 570.443 Aquatic Chemistry
- 570.445 Physical/Chemical Processes in Environmental Engineering I
- 570.446 Biological Processes for Water and Wastewater Treatment
- 570.491 Hazardous Waste Management
- 030.201 Intermediate Organic Chemistry
- 030.204 Intermediate Chemistry
- 030.301 Physical Chemistry I
- 270.369 Introduction to Geochemistry
- 270.401 Geochemical Kinetics
- 270.410 Global Climate Change: Introduction
- 540.301 Chemical Kinetics and Reactor Design
- 540.303 Transport Phenomena I
- 550.310 Introduction to Probability and Statistics
- 560.435 Probability and Statistics in Civil Engineering

*Substitution for one required course may be possible under special circumstances, with explicit approval of the environmental engineering minor advisor.

**Additional course electives are possible but require approval of the environmental engineering minor advisor.

The Minor in Engineering for Sustainable Development

Engineers will be increasingly called upon to help devise solutions to the tremendous problems of poverty, inequality, and social and environmental dislocation that afflict major parts of the globe in the 21st century. Working as an engineer in this context involves negotiating highly complex social, economic and political realities and dealing with a wide range of institutions and actors, including national and local governments, multilateral lenders such as the World Bank, diverse non-governmental organizations (NGOs) and local communities. It also increasingly involves working in interdisciplinary teams with social scientists, public health and medical workers, humanitarian aid workers, bankers, politicians and the like. "Sustainable" development implies a development path that is socially equitable, culturally sensitive, and environmentally appropriate over a multi-generational time frame.

The Minor in Engineering for Sustainable Development exposes engineering students to some of the key issues related to development, methods of information-gathering in diverse and difficult settings, and working effectively with non-engineers on complex problems. We begin with a one-semester core course that surveys the various issues involved, followed by an individually-designed but coherent program organized around a particular theme, disciplinary approach or region of the world. We conclude with a one-semester seminar in which students come together and share their experiences and insights from their various program trajectories.

The Minor in Engineering for Sustainable Development Program: Structure and Content

Students pursuing the minor are required to take seven courses.

- core course is 570.110 Introduction to Engineering for Sustainable Development.
- five additional courses will be selected in a program devised in consultation with the Minor advisor.

  Of the five additional courses:
  - Three must be grouped around a specific theme, region or within a specific discipline. Themes might include, for example, public health, environment, or economic development. Regions include Africa, Latin America or Asia. Disciplinary concentrations might be in Anthropology, Economics, Geography, History, Political Science, Public Health or Sociology.
  - Three of the courses must be at the 300-level or above.
  - One of the courses must cover methods for gathering and evaluating information in a development context. Examples include:
    - 070.319 The Logic of Anthropological Inquiry
    - 070.347 Discourse Analysis: Stories and their Structures
    - 280.345 Biostatistics in Public Health
    - 280.350 Introduction to Epidemiology
    - 230.202 Research Methods for the Social Sciences

All courses must be completed with a grade of C- or better to qualify for the minor. At least two semesters of foreign language study are strongly recommended but not required. Students who participate in a Study Abroad program for a semester can, with the minor advisor's consent, use this experience to count in place of one of the required courses.

The value of this program will be enhanced by some form of hands-on experiential project, whether at a field site in a developing country, in support of field-workers in other divisions of the university or in distressed

communities in Baltimore. This experience is not required for the minor. It might take one of the following forms:

- Field work in collaboration with Engineers Without Borders.
- Providing technical support to "clients" at Hopkins (for example, at the Bloomberg School of Public Health) who are engaged in field projects in developing countries. This might involve, for example, developing dedicated software for data management, devising robust and easy-to-use test kits for environmental toxins or medical conditions, or facilitating interactive analysis and project planning between researchers in Baltimore and the field personnel.
- Participating in programs being developed by the JHU Center for Social Concern, with its growing service learning component. This would allow students to work on projects in Baltimore which offer an ample field for identifying and responding to social and environmental problems.

The Minor in Engineering for Sustainable Development Program Eligibility

The minor is open to undergraduates in any of the engineering disciplines in the Whiting School of Engineering. Students in Arts & Sciences may also pursue the minor with the permission of the program director.

For further information, contact: Dr. Erica Schoenberger,ericas@jhu.edu, 410-516-6158.

Minor in Environmental Sciences

The environmental sciences minor has been developed to encourage and facilitate studies in environmental sciences by students completing degrees in the other science and engineering disciplines. The environmental sciences (ES) minor requires:

- completion of a set of courses in the core sciences,
- two introductory courses dealing with the environment, and
- three or more upper-level environmental sciences courses, as described below.

Core Sciences (ES Minor)

Because of the interdisciplinary nature of environmental science, it is important that professionals from various areas of expertise acquire a common language and set of core concepts to make discussion and cooperation possible. The following courses represent the minimum set of requirements:

Mathematics (12 credits)

- 110.108 Calculus I
- 110.109 Calculus II

At least one of these four courses:

- 110.201 Linear Algebra
- 110.202 Calculus III
- 110.302 Differential Equations with Applications
- 550.291 Linear Algebra and Differential Equations

Biology (3 credits)

- One course, such as 020.151 General Biology

Physics (10 credits)

- 171.101 Physics I
- 171.102 Physics II
- 173.111 General Physics Lab I
- 173.112 General Physics Lab II

Chemistry (13 credits)

- 030.101 Intro Chemistry
- 030.104 Intro Organic Chemistry
- 030.105 Intro Chemistry Lab
- 030.106 Intro Chemistry Lab

Environmental Sciences:

Students must take two introductory courses dealing with the environment and three or more of the upper-level environmental science courses on the following lists:

Introductory Courses (6 credits)

- 570.110 Introduction to Engineering for Sustainable Development
- 570.205 Ecology
- 570.239 Current and Emerging Environmental Issues
- 270.110 Freshman Seminar: Sustainable and Non-Sustainable Resources
- 270.220 The Dynamic Earth: An Introduction to Geology
- 270.221 The Dynamic Earth Lab

Upper-Level Courses (9 credits)

- 570.239 Current and Emerging Environmental Issues
- 570.328 Geography and Ecology of Plants
- 570.353 Hydrology
- 570.411 Environmental Microbiology
- 570.424 Air Pollution
- 570.441 Environmental Inorganic Chemistry
- 570.442 Environmental Organic Chemistry
- 570.443 Aquatic Chemistry
- 570.445 Physical and Chemical Processes in Environmental Eng I
- 570.446 Biological Processes for Water and Wastewater Treatment
- 570.491 Hazardous Waste Engineering and Management
- 270.302 Aqueous Geochemistry
- 270.321 Intro Oceanography
- 270.350 Sedimentary Geology
- 270.311 Geobiology
- 270.313 Isotope Geochemistry
- 270.314 Field Course in Soil Formation
- 270.375 Groundwater
- 270.394 Global Geochemical Cycles and Climate Change

Pairing a Major with the Environmental Sciences Minor

Many of the most creative and productive advances in environmental sciences in recent years have come from scientists trained in traditional disciplines (biology, chemistry, geology, physics, and engineering) who have devoted themselves to the study of environmental problems. Completion of the degree requirements of a traditional discipline provides depth and rigor that, when supplemented with additional academic training in environmental science, can be applied to professional work in a variety of environmental subjects, as the following examples show:

Biological Processes: Response of ecosystems to change, microbial degradation of pollutants, biogeochemical cycling of greenhouse gases. Illustrative majors: Biology, Biomedical Engineering, Biophysics, Biochemical Engineering.

Physical Processes: Erosion of hillslopes, rivers, and coastlines; sediment production, transport, and fate; groundwater, movement of contaminant plumes; oceanography; atmospheric physics; aerosol formation; global warming. Illustrative majors: Civil Engineering, Chemical and Biomolecular Engineering, Mechanical Engineering, Physics, Earth and Planetary Sciences.

Environmental Chemistry: Environmental fate of pollutants, water and wastewater treatment, geochemistry, atmospheric chemistry, ozone depletion, acid rain. Illustrative majors: Chemistry, Chemical and Biomolecular Engineering, Earth and Planetary Sciences, Materials Science and Engineering.

Environmental Systems: Environmental modeling, risk assessment, environmental systems design, pollution control strategies. Illustrative majors: Civil Engineering, Applied Mathematics and Statistics.

THE CONCURRENT 5-YEAR BACHELOR'S/MASTER'S PROGRAM

The Department of Environmental Health and Engineering offers a concurrent five-year BS/MS and BS/MSE program. The department strongly prefers applications to be submitted by the end of the fall semester of the junior year.

To apply for admission, the student must submit an online application at http://grad.jhu.edu/apply/combined-degree-student/. In addition, the student will need to present a statement of purpose, three letters of recommendation, and college transcripts.

Upon acceptance into the program, students will be asked to develop an outline of their proposed academic program with their advisor. Please contact your advisor if you have questions or would like to consider applying to the program.

A note about double counting for BSE-MSE students. BSE-MSE students are not permitted to double count credits taken in their undergrad program towards their Master's program required credits. However, if
1) a course that is required for the Master's program is taken as an undergrad during their time at Hopkins and
2) they did not use the course to count towards their undergrad graduation requirements credits then they are permitted to use these credits towards their Master's program requirements. In order to complete an EHE Master's, 30 credits of graduate level, approve courses are required.

BSE-MSE students who take a required course in their undergrad program but do not use it to count towards their undergrad program required graduation credits may count that course towards their 30 credit Master's program credit requirement.

Students 1) must work with their advisors to confirm that the Hopkins courses are required for their Master's program and 2) they must submit a copy of their Junior checkout sheet demonstrating that they did not previously use the Master's level course to fulfill undergraduate graduation credit requirements.

Advisors for the 2017-2018 Academic Year (please visit ISIS to see your assignment):

Class of:	Advisors:
2021 (Freshman)	Edward Bouwer
2020 (Sophomores)	Ben Hobbs
2019 (Juniors)	Alan Stone
2018 (Seniors)	Sarah Preheim
Undecided Students	Ed Bouwer