Double Majors with Environmental and Sustainability Studies (ESS)

Environmental and Sustainability Studies works well as a double major with many other WPI degrees. Many of your Engineering, Business, Biology, Chemistry, and Computer Science classes can be double counted for both majors, which means **you can complete 2 majors without doing 2 completely unique sets of coursework**. Here we present some potential double majors you can pursue. If you don't see a combination that interests you, please ask. Course sequences suggested below are examples, but others are possible.

Common Double Majors	
Civil and Environmental Engineering ***AND*** ESS	For students interested in urban/rural planning and design, understanding both the environmental and social impacts of engineered environmental systems is crucial. How can engineering help to address human impacts on the environment through better approaches to issues such as wastewater treatment, controlling air pollution, and waste management? And how might engineered systems impact people and society? Double majors learn and then apply this knowledge to the benefit of global communities.
Mechanical Engineering ***AND*** ESS	While Civil and Environmental engineering often works to address the negative environmental impacts pollution, development, etc., Mechanical Engineering can help develop processes to reduce impact from the start. For example, sustainable design of smart buildings, renewable energy, etc. Research shows that graduates with double majors in social/human ***and*** technical/science fields can advance faster to management/leadership positions and can have greater career satisfaction.
Computer Science ***AND*** ESS	Computer science is helping to frame our understanding of climate and environmental change. Computer models can predict environmental futures as well. All of this requires identifying pertinent data from huge fields of information, assimilating the data and making logical deductions from it. By combining CS with ESS, students will get important insights into how environmental problems are understood and experienced in communities, and how computers can help society predict, adapt to, and mitigate environmental change.
Biology ***AND*** ESS	Students with an ESS/BB degree will combine social and ecological approaches to environmental studies; they will be prepared to work with both communities and nature. Graduates might work in conservation, environmental research, ecology and community studies.
Chemistry ***AND*** ESS	Chemistry can help us to understand, monitor, protect and improve the environment around us. Chemists are developing tools and techniques to make sure that we can see and measure air and water pollution. They have helped to build the evidence that shows how our climate has changed over time. Double majors can focus on the many ways in which chemistry will contribute to mitigating and adapting to climate change, for example, in the areas of energy, food and water.
Physics ***AND*** ESS	Those who have a "physics mindset" often bring a fresh perspective to environmental research. Today an increasing number of physicists are helping to tackle some of the world's most pressing environmental challenges, from renewable energy to monitoring sea level change and ocean circulation to how air pollution changes the radiative properties of the atmosphere to impact climate and humans
Business ***AND*** ESS	Businesses have unparalleled potential to impact the environment in both negative and positive ways. This joint major can help students develop the understanding and skills to

	build connections between the natural environment and individuals, firms, markets, and societies. Graduates might work in corporate sustainability, global supply chains, sustainability certification initiatives, etc.
Robotics ***AND*** ESS	Robots can be designed and used to assist with recycling, to remove trash from oceans and invasive species from water bodies, for environmental monitoring, and more! Check out the WPI Environmental Robotics website! https://www.environmental-robotics.com/
Data Science ***AND*** ESS	Data science has a key role to play in understanding and addressing climate change. From machine learning to data visualization, data science techniques are used to study the effects of climate change on marine biology, land use and restoration, food systems, patterns of change in vector borne diseases, and other climate-related issues.
What others? Industrial, Chemical, and more let's talk!	We have worked with students double majoring in industrial engineering, chemical engineering, those who want to double major with HUA, and more! We are here to support you in any double major you are interested in!

Some benefits of double majors:

1. Research shows that graduates with double majors in social/human and technical/science fields can **advance faster to management/leadership positions**.
2. Research shows that graduates with double social-technical majors can **stand out from their tech-only peers** as having additional critical skill desired by employers (written, oral, and visual communication; critical thinking; intercultural engagement), as well as key content knowledge regarding the social, global, cultural, economic, and policy context linked to technical problems.
3. Research shows that tech students and graduates who have knowledge of the social context and impacts can have **greater university and career satisfaction**.

ESS MAJOR Requirements and Courses that Count

University Requirements
Minimum Academic Credit 45/3 Units Residency 24/3 Units
Humanities and Arts 6/3 Units Interactive Qualifying Project 3/3 Unit Major Qualifying Project 3/3 Unit (4/3 Unit for double major) **Social Science 2/3 Unit** Physical Education 1/3 Unit

***Note: For double majors, you can double count courses across your majors, but you cannot triple count. For example, you can't count the same course for two different majors and a separate minor; or a major, minor, and graduate degree. You could only count the course towards two of those. For those taking grad courses towards a graduate degree, such Community Climate Adaptation, courses whose credit hours total no more than 40% of the credit hours required for the master's degree, and which meet all other requirements for each degree, may be used to satisfy requirements for both degrees.

***Note: Please note that when the registrar does a degree audit, it is impossible for them to take into account all of the nuances of the ESS interdisciplinary degree, especially for double majors, as we count the Environmental Science and Engineering section differently depending on the double major. So, please don't worry if an audit you request shows gaps. Please send your tracking sheet to your ESS advisor to review, and make sure the classes you are including are on the Guidance Sheet.

ESS Core Courses 3/3 Unit
Any three courses with ENV prefix

Math and Basic Science 8/3 Unit

***Note: May replace 1/3 unit of basic engineering for any below with the permission of the Environmental Studies Program Review Committee.

Calculus 2/3	Statistics 1/3	Chemistry 2/3	Biology 2/3	Other 1/3
MA1020 MA 1021 MA1022	MA2610 MA2611 MA2612	Any course with the prefix CH	Any course with the prefix BB (one must be at the 2000 level)	Any other basic science or math

Social Science and Humanities 3/3 Unit

Please note that courses that count in this section do not have to have economics, policy, political science, history, or philosophy in the title. It can be in the content. For example, you might take an art course and the course includes art history or the philosophy of art, which would allow you to count the art course for this section, under history or philosophy.

Economics 1/3	Policy/Political Science 1/3	History/Philosophy 1/3
All courses with prefix ECON or SD in the course catalog count, or other social science or humanities courses with significant economics content	All courses with prefix GOV om the course catalog, or other social science or humanities courses with significant policy/political science content	All courses with prefix HI or PY in the course catalog, or other social science or humanities courses with significant history or philosophy content

Please note that for double majors only, you can double count your HUA courses for the HUA requirement for courses in this section.

Environmental Social Science and Humanities 6/3 Unit

***Notes: (1) ENV courses with an X (e.g. ENV200X) count, ask about where they fit
(2) ID2050 can count towards one course if your IQP is environmentally focused or it can fit in basic social science and humanities
(3) See us if you don't see a course that you think should count.
(4) Please note that for double majors only, you can double count your HUA with courses for the HUA requirement for courses in this section, if the HUA courses are environmentally focused.

Environmental Economics 1/3	Environmental Policy 1/3	Environmental Philosophy 1/3	Environmental History 1/3
ECON2117 Environmental Economics **ECON21XX** Ecological Economics and Policy **DEV1200** International Development and Society **GOV2319** Global Environmental Politics **ENV2400** Environmental Problems and Human Behavior **ENV2600** Environmental Problems in the Developing World **ENV2710** Designing for Climate Resilience and Justice **ENV2900** The Green Economy and Models for Alternative Forms of Development **ENV 2110** Regenerative Sustainability: Living Landscapes, Planetary Resources, and Policies **ECON 3100** Economics of Climate Change **ECON 220X** Ecological Systems and Economic Policy **INTL 1300** Introduction to Latin America **ENV2800 / IGS596** GIS for Climate Resilience **IGS 510** Human Dimensions of Global Environmental Change **IGS 590** Capstone Seminar: Comparative Climate Action **FYI 1100/FY1101** Great Problem Seminar (all GPS courses count as two courses towards the major)	**GOV 2311** Environmental Policy and Law **GOV2319** Global Environmental Politics **DEV1200** International Development and Society **ENV130X** Smart and Sustainable Cities **ENV 1500** Introduction to GIS/Geographical Information Systems **ENV/PSY 2500** Psychology for Sustainability **ENV2600** Environmental Problems in the Developing World **ENV2201** Planning for Sustainable Communities **ENV2710** Designing for Climate Resilience and Justice **ENV2720** AI and the Environment **ENV 2120** Documentary Filmmaking for Advocacy and Policy **ENV2310** Environmental Governance and Innovation **ENV2700** Social Media, Social Movements, + the Environment **ENV 3100** Adventures in Sustainable Urbanism **ENV 2110** Regenerative Sustainability: Living Landscapes, Planetary Resources, and Policies **GOV2311** Environmental Policy and Law **GOV2312** International Environmental Policy **INTL 1300** Introduction to Latin America **INTL 2310** Modern Latin America **ENV2800 / IGS596** GIS for Climate Resilience **IGS 510**	**DEV1200** International Development and Society **GOV 2311** Environmental Policy and Law **ENV2720** AI and the Environment **ENV/PSY 2500** Psychology for Sustainability **PY2713** Bioethics **PY2717** Philosophy and the Environment **INTL 2110** Global Justice **INTL 2310** Modern Latin America **WR 1011** Writing about Science and Technology **WR 3300** Cross Cultural Communication **FYI 1100/FY1101** Great Problem Seminar (all GPS courses count as two courses towards the major) **SP 3533** Ecocrítica: Environmental Cultural Production in Latin America **RE 2731 ETHICS**	**ENV/PSY 2500** Psychology for Sustainability **ENV2700** Social Media, Social Movements, + the Environment **ENV2710** Designing for Climate Resilience and Justice **ENV 2120** Documentary Filmmaking for Advocacy and Policy **HI 1350** Introduction to Environmental History **HI 2350**: Topics in the History of Science **HI 2400** Topics in Environmental History **HI 2401** US Environmental History **HI 2403** Global Environmental History **BB 292X/HI 331X** Urban Ecology and Environmental Justice **HI 3317** Topics in Environmental History **HI 3344** Pacific Worlds **INTL 1300** Introduction to Latin America **INTL 2310** Modern Latin America **EN 2237** Literature and the Environment **ENV2800 / IGS596** GIS for Climate Resilience **IGS 510** Human Dimensions of Global Environmental Change **IGS 590** Capstone Seminar: Comparative Climate Action **WR 1011** Writing about Science and Technology **WR 3300** Cross Cultural Communication **FYI 1100/FY1101**

	Human Dimensions of Global Environmental Change **IGS 590** Capstone Seminar: Comparative Climate Action **WR 1011** Writing about Science and Technology **WR 3300** Cross Cultural Communication **FYI 1100/FY1101** Great Problem Seminar (all GPS courses count as two courses towards the major)		Great Problem Seminar (all GPS courses count as two courses towards the major) **ENV130X** Smart and Sustainable Cities **ENV 3100** Adventures in Sustainable Urbanism **SP 3533** Ecocrítica: Environmental Cultural Production in Latin America **GOV 2311** Environmental Policy and Law

Note: *<u>If your IQP has an environmental focus</u>* (either central or as a significant component), your ID2050 *<u>can count as one course</u>* (⅓) towards the Environmental Social Science and Humanities Section. Discuss with your ESS advisor about which of the four areas it would best fit: history, philosophy, economic, or policy.

Environmental Science and Engineering 9/3 Unit **(plan your joint major here, these are sample course series)** *****Note:** (1) Double majors can do a 4/3 MQP, with 2/3 towards ESS focus & 2/3 towards tech focus (2) See us if you don't see a course that you think should count	
Architectural Engineering	*Building Sustainable, Resilient Mechanical Systems* **AREN 3024** Building Physics **AREN 3003** Principles of HVAC design for building **AREN 3006** Advanced HVAC Design **AREN 3020** Architectural Design IV Building Energy Simulation **AREN 302**2 Architectural Design V Building Envelope Design *Building Efficient, Resilient Electrical Systems* **AREN 2025** Building Electrical Systems **AREN 2004** Architectural Design II Light and Lighting Systems *Foundational Sustainable, Resilient Design Skills* **AREN 2002** Architectural Design I **AREN 3002** Architectural Design III *Urban and Environmental Planning: community development, natural and built environment, and sustainability* **CE 3070** Introduction to Urban and Environmental Planning **CE 3074** Environmental Analysis **CE 4071** Land Use Development and Controls *Statics, Stress and Structure and Soils: for design of green infrastructure* **CE 2000** Analytical Mechanics I (Equivalent to ES 2501) **CE 2001** Analytical Mechanics II (Equivalent to ES 2502) **CE 2002** Introduction to Analysis and Design **CE 3010** Structural Engineering **CE3041** Soil Mechanics
Biology	*Environmental Biology, Ecology, Bio/Plant Diversity, and Animal Behavior*

	BB 1002 Environmental Biology **BB 1035** Introduction to Biotechnology **BB 1045** Biodiversity **BB 2030** Plant Diversity **BB 2040** Principles of Ecology **BB 2050** Animal Behavior **BB 2550** Cell Biology **BB 2904** Ecology, Environment and Animal Behavior **BB 2915** Searching for Solutions in Soil: Microbial and molecular investigations **BB 2917** Hunting for Phage or **BB 2916** Phage Hunters: the Quest **BB 2920** Genetics **BB 292X/HI 331X** Urban Ecology and Environmental Justice **BB 294X** Ecology, Behavior, and Environmental History **BB 2950** Molecular Biology **BB 3003** Medical Microbiology: Plagues of the Modern World **BB 3010** Simulation in Biology **BB 3120** Plant Physiology **BB 3140** Evolution: Pattern and Process **BB 4900** Capstone Experience in Biology and Biotechnology
Civil/Env Engineering	*Environmental Engineering, with some focus on sustainability* **CE 1030 Civil Engineering and Computer Fundamentals** **CE 3059** Environmental Engineering **CE 3060** Water Treatment **CE 3061** Wastewater Treatment **CE 3062** Hydraulics **CE 4060** Environmental Engineering Lab **CE 4061** Hydrology **CE 4063** Transport and Transformations in the Environment **CE 4600** Hazardous and Industrial Waste Management **CE 4610** Solid Waste Management **CE 402X** Resilient Infrastructure for a Changing Climate **CEE 575** Climate and the Earth System *Urban and Environmental Planning: community development, natural and built environment, and sustainability* **CE 3070** Introduction to Urban and Environmental Planning **CE 3074** Environmental Analysis **CE 4071** Land Use Development and Controls *Statics, Stress and Structure and Soils: for design of green infrastructure* **CE 2000** Analytical Mechanics I (Equivalent to ES 2501) **CE 2001** Analytical Mechanics II (Equivalent to ES 2502) **CE 2002** Introduction to Analysis and Design **CE 3010** Structural Engineering **CE3041** Soil Mechanics
Mechanical Engineering	*Statics and Stress Analysis: for design of green infrastructure* **ES 2001** Introduction to Materials Science **ES 2501** Introduction to Static Systems **ES 2502** Stress Analysis *Thermal Fluid Series: for design of renewable energy systems* **ES 2800** Environmental Impacts of Engineering Decisions **ES 3001/PH2101** Introduction to Thermal Dynamics **ES 3003** Heat Transfer **ES 3004** Fluid Dynamics **ME 4429** Thermofluid Application and Design **ME 4810** Automotive Materials and Process Design **ME 5105** Renewable Energy

	MTE 5390 Solar Cells
Business	*Via Concentration for Innovation in Social Change* Required (2): **ETR 2900** (Social Entrepreneurship) **OBC 4367** (Leadership, Ethics, and Social Responsibility) Select (4) from below, with at least two with an ETR prefix: **BUS 1100** Engineering Innovation and Entrepreneurship **ETR 1100** Engineering Innovation & Entrepreneurship **ETR 2910/ECON 2910** Economics and Entrepreneurship **ETR 4930** Growing and Managing New Ventures **ENV 2201** Planning for Sustainable Communities **ENV 2310** Environmental Governance and Innovation **ENV 2400** Environmental Problems and Human Behavior **ENV 2600** Environmental Problems in the Developing World **GOV 2311** Environmental Policy and Law **GOV 2312** International Environmental Policy **GOV 2319** Global Environmental Politics
Computer Science	*Environmental Modeling and Predictions* **CS 1101/2** Introduction on Program Design **CS 1004** Introduction to Programming for non-majors **CS 3041** Human Computer Interaction **CS 3043** Social Implications of Information Processing **CS 4341** Introduction to Artificial Intelligence **CS 4432** Database Systems **CS 4433** Big Data **CS 4802/582; BCB 4002/502** Biovisualization
Chemical Engineering	*CHE Courses where environmental content is core* **CHE 3702** Energy Challenges in the 21st Century **CHE 4063** Transport and Transformations in the Environment *CHE Courses with an Environmental Concentration* Science **GE 2341** Geology **BB 1002** Environmental Biology **BB 2040** Principles of Ecology Engineering Science and Design **CHE 3301** Introduction to Biological Engineering **CHE 3201** Kinetics and Reactor Design **CHE 4402** Unit Operations of Chemical Engineering II **ES 3002** Mass Transfer **ES 2800** Environmental Impacts of Engineering Decisions **CE 3060** Water Treatment **CE 3061** Waste Water Treatment **CE 4060** Environmental Engineering Lab **CE 4061** Hydrology **CE 3059** Environmental Engineering **CE 3070** Introduction to Urban and Environmental Planning **CE 3074** Environmental Analysis *CHE Courses with an Energy Concentration* Science **CH 3510** Chemical Thermodynamics **CH 3550** Chemical Dynamics **PH 2101** Principles of Thermodynamics Engineering Science and Design **CHE 3702** Energy Challenges in the 21st Century **CHE 3201** Kinetics and Reactor Design

	CHE 3301 Introduction to Biological Engineering **CHE 4402** Unit Operations of Chemical Engineering II **ES 3001** Introduction to Thermodynamics **ES 3003** Heat Transfer **ES 3005** Radiation Heat Transfer Applications **ME 4710** Gas Turbines for Propulsion and Power Generation **CHE 506** Kinetics for Catalysis **CHE 507** Chemical Reactor Design **CHE 531** Fuel Cell Technology **CHE 561** Advanced Thermodynamics **FPE 520** Fire Modeling **FPE 521** Fire Dynamics *Transport Series: evaluation of contaminants, development of biofuels* **ES 2800** Environmental Impacts of Engineering Decisions **ES 3001** Introduction to Thermal Dynamics **ES 3002** Mass Transfer **ES 3003** Heat Transfer **ES 3004** Fluid Dynamics
Chemistry	**CH 1010** Chemical Properties, Bonding, and Forces **CH 1020** Chemical Reactions **CH 1030** Kinetics, Equilibrium, and Thermodynamics **CH 2310** Organic Chemistry I **CH 2320** Organic Chemistry II **CH 2330** Organic Chemistry III **CH 2360** Organic Laboratory **CH 2640** Experimental Chemistry: Instrumental Analysis
Physics	**PH 1110** General Physics-Mechanics or **PH 1111** Principles of Physics-Mechanics **PH 1120** General Physics-Electricity and Magnetism or **PH 1121** Principles of Physics-Electricity and Magnetism **PH 2101** Principles of Thermodynamics **PH 2201** Intermediate Mechanics I **PH 2202** Intermediate Mechanics II **PH 2502** Introduction to Astrophysics **PH 2540** Solar Systems **PH 2550** Atmospheric and Space Environments **PH 2651** Intermediate Physics Laboratory **PH 3401** Quantum Mechanics I **PH 3402** Quantum Mechanics II **PH 3502** Solid State Physics **PH 3503** Nuclear Physics **PH 3999** Intro to Nuclear Science **PH 115X** Introductory Physics of Living Systems **PH 350X** Optical Properties of Solids
Other	*These "other" courses count, and we are always open to evaluating others* **GE 2341** Geology **FYI 1100/FY1101** Great Problem Seminar (all GPS courses count as two courses towards the major)
Robotics	*Robots Work in Recycling Facilities - Stationary Robots* **RBE 3001** Fundamentals **RBE 549-F01** - Computer Vision **RBE 470X-C01** - Artificial Intelligence for Robotics **RBE 450X-AL01** - Vision-based Robotic Manipulation *Picking Ocean Trash - or from beaches, shores - mobile robot* **RBE 3001** Fundamentals **RBE 3002-BX01** - Unified Robotics IV

	RBE 595-F01 - ST: Sensor Fusion and Perception for Autonomous Vehicles **RBE 550-F01** - Motion Planning **RBE 450X-AL01** - Vision-based Robotic Manipulation **RBE 501** - Robot Dynamics *Environmental Monitoring* **RBE 3001** Fundamentals **RBE 3002-BX01** - Unified Robotics IV **RBE 595-S01 - ST:** Artificial Intelligence for Autonomous Vehicles **RBE 595-S07 - ST:** Swarm Intelligence **RBE 501** - Multi Robot Systems *Teleoperated* **RBE 460X-B01** - Human Factors and Human-Robot Interface **RBE 595-A02 - ST:** Haptic
Data Science	**The Environmental Science and Engineering 9/3 Unit can be filled with DS disciplinary elective courses, including courses in:** ● **Business, Computer Science, Mathematical Sciences at the 2000 level or above** ● **Courses in the Data Science series: DS 1010, 2010, 3010** ● **One or more DS courses at the 3000 level** **Basic Science can be filled by math courses.**

MQP Options for ESS Majors

The potential for a *Combined IQP and MQP for DOUBLE MAJORS*	
What?	Students who are double majors in Social Science and Policy Studies (which includes ESS) can have one 3-unit project count as their MQP and IQP if the project satisfies IQP requirements and is an application of environmental and sustainability studies knowledge and analytical techniques. Therefore, if your IQP project will have an environmental, sustainability, climate, nature, agricultural, or other related focus, you can check with your ESS advisor to see if it can also count as your MQP.
When?	If you want to explore this option, reach out to your ESS advisor 2 TERMS BEFORE you go on IQP. Your advisor will have to get in touch with the project center director and IQP advisor to see if the project has a significant environmental focus. In addition, your ESS advisor will need to review details on the project topic, sponsor, methodology, theoretical and analytical approach, as well as the advising needs.
How?	The student will need the ESS and IQP advisors' support to register the project as an SSPS MQP. At the conclusion of the project when the CDR comes in, the registrar's office will mark the IQP requirement as completed as well.
From the UG Catalog	For reference, this is laid out in the Undergraduate Catalog on page 12: **The Interactive Qualifying Project.** If one of the majors of a double major is in Social Science and Policy Studies, a single project bearing at least one

	unit credit may be used to satisfy both the MQP requirement for the SSPS major and the IQP requirement. In order to be used to satisfy both requirements, the combined social science MQP and IQP must meet the goals of both projects. It must be interactive in nature involving an aspect of technology, and must also be an application of social science knowledge and analytical techniques. In order to select a single project that satisfies both the goals of the MQP and the goals of the IQP, the decision to pursue a social science double major needs to be made fairly early in the student's career.
4/3 MQP for DOUBLE MAJORS	
What?	Students who are double majors must do a 4/3 MQP, where a project is ⅔ ESS and ⅔ in their other major. This looks different for each student. For some, this is an interdisciplinary co-advised MQP with advisors from both majors. For others, they may do a project in their non-ESS major, and work with their ESS advisor to build in environmental and sustainability content, analyses, and methodology.
How?	The student will need to contact their ESS and other major advisors in their junior year (or before) to discuss ideas and approaches.
3/3 MQP for SINGLE ESS MAJORS	
What?	Students with a sole major in ESS will need to complete a 3/3 MQP. This can be done in one term or over multiple terms with their ESS advisor or with a faculty member who is affiliated with ESS.
How?	The student will need to contact their ESS and IQP advisors in their junior year (or before) to discuss ideas and approaches.

Important Note about ESS Audits via Registrar's Office and Workday

Please note that when the registrar does a degree audit, it is impossible for them to take into account all of the nuances of the ESS interdisciplinary degree, especially for double majors, as we count the Environmental Science and Engineering section differently depending on the double major. So, please don't worry if an audit you request shows gaps. Please send your tracking sheet to your ESS advisor to review, and make sure the classes you are including are on the Guidance Sheet.

ESS MINOR Requirements and Courses that Count

ESS Core Courses 1 Unit
Any Course with ENV prefix

Environmental Social Science and Humanities 1 Unit
***Note: 2 courses in Environmental Science or Environmental Engineering can count here
***Note: can double count 3 courses between your major and minor

Select for Breadth: a broad set of courses focused on the environment OR **Select for Depth:** a more narrowly focused set of courses in a thematic area (e.g. environmental history)
What Counts? All courses with an **ENV prefix** All **environmentally focused SSPS and HUA** courses (see lists above of what counts towards the major) Up to 2 **environmentally focused engineering and physical science** courses (e.g. ecology, environmental engineering) must be approved by ESS major director