

Proposed changes to the MES Environmental Science BS degree
Department of Marine and Environmental Sciences
15 September 2019

Mission: The Dean's office requested that we do an evaluation of our curriculum and propose changes that will accomplish several goals including: building a better brand around our programs, increasing the total number of students our faculty teach, creating greater structure and formal stacking of our courses so that our advanced courses can be taught at a more advanced level and so we can reduce redundancy and create more efficiencies. Thus, the goal of this academic planning initiative was to develop a set of curriculum products and a brand around our undergraduate curriculum that allows us to define and differentiate our degrees and increase advertising and recruitment to our majors, and do so in a way that meets the needs of our stakeholders (current students, recent graduates, and potential employers) and builds on our current expertise and our future growth trajectory.

Approach: To achieve this goal we undertook three major initiatives. 1) A detailed survey of current students, recent graduates, and potential employers 2) an analysis of programs in the marine and environmental sciences at peer and aspirant institutions around the country, and 3) creation of working groups of our faculty to brainstorm the goals for our future curriculum. Through these analyses we identified several areas where curriculum changes can improve student learning in ways that better meet the needs of students and their potential future employers. All stakeholders identified that students needed greater critical thinking and data analysis skills. In addition, employers found entry-level employees lacking in skills such as time management, communication, and leadership. In particular for environmental science and environmental studies stakeholders, there was an identified need for more skills-focused courses and more courses in the planning and management space. Finally, in general, students felt that current curriculum was too introductory, had too much redundancy, and was lacking in depth (in particular for environmental science/studies students). Taking all of this information into consideration, we propose the following modifications to our current curriculum:

Curriculum changes to BS in Environmental Science: First, we propose to change this major from a BS in Environmental Science to a BS in **Environmental and Sustainability Sciences (ESS)**. This reflects our desire to encourage as many students as possible into the BS program rather than the BA in Environmental Studies, which provides those students with the opportunity to expand their data analysis skills and, in general, increase the quantitative skills and 'hard' skills that the students receive. We have developed a core curriculum (Appendix 1) that all ESS students will take in their first 2 years which includes a new foundations course, a second series of courses in Ecology, Earth Science, and Sustainable Development, and specific skills courses (a new data science course and GIS). Then students will split into one of four concentrations that we describe below, and will unite in their final semester and bring the knowledge and skills they learned in their concentration together in a service learning course that tackles a stakeholder driven environmental problem, as well as a course that is specific to professional development and scientific communication. The four concentrations are:

Environment and Society: students in this concentration take courses in policy, economics, and sociology and develop tools in collecting data at the interface of coupled human and natural systems.

Sustainable Planning and Development: students in this concentration specialize in essential elements of sustainability, which a particular focus on the food, water, and energy nexus.

Conservation, Restoration, and Management: students in this concentration focus on the intersection of ecology, evolution, conservation, and management. This is the closest intersection with our EEB program but is distinct in that it focuses on the very applied aspects of conservation and the close links between conservation and management.

Earth, Oceans, and Environmental Change: This concentration reflects a merging of our current Geoscience and Marine Science curriculum. Students here will take upper level courses in oceanography, earth science, and water resources, and atmospheric science.

Appendix 1: Full curriculum map for BS in Environmental and Sustainability Sciences

College (1 credit)

- ENVR 1000: Introduction to college

Core (~35 credits)

- ENVR 1400+1401: Foundations in Environmental and Sustainability Sciences (5 cr)
- ENVR 1500+1501: Introduction to Biological, Social, and Environmental Data (5 cr)
- ENVR 2200: Earth's Changing Cycles OR ENVR 1200+1201 Dynamic Earth+ Lab (4 or 5 cr)
- EEMB 2302+2303: Ecology + Lab (5 cr)
- ENVR 2515: Sustainable Development (4 cr)
- ENVR 3300 + 3301: Introduction to GIS + lab (5 cr)
- ENVR 4050: Solving emerging environmental challenges through capstone (4 cr) or ENVR 4997: Senior Thesis or ENVR 4970/4971: Honors projects
- ENVR 4000: Professional Development and Communication (4 cr)

Math requirement (8 or 9 credits)

- Calculus 1 (Choose one): MATH 1241 (Calculus 1, 4 cr), MATH 1251 (Calculus and differential Equations for Biology, 4 cr), or MATH 1341: Calculus for Science and Engineering, 4 cr
- Statistics (choose one): ENVR 2500+2501 (Biostatistics, 5 cr), ECON 2350 (Statistics, 4 cr), POLS 2400 (Quantitative techniques, 4 cr), SOCL 2320 (Statistical Analysis in Sociology 4 cr)

Environment and Society Concentration (40 credit minimum)

- SOCL 1246: Environment and Society (4 cr)
- POLS 2395: Environmental Policy and Politics (4 cr)
- SOCL 3485: Environment, Technology, and Society (4 cr)
- ENVR 5450: Applied Social-Ecological Systems Modeling (4 cr)
- PPUA: 5260: Ecological Economics (4 cr)
- 4 elective courses chosen from list D

Sustainable Planning and Development (40 credit minimum)

- ENVR 3200: Water Resources (4 cr)
- ENVR 3150: Food Security and Solutions (4 cr)
- PPUA 5268: International Environmental Policy
- ENVR 5210: Environmental Planning (4 cr)
- ENVR 5350: Sustainable Climate and Energy Solutions
- Five elective courses chosen from list C

Appendix 1: Full curriculum map for BS in Environmental and Sustainability Sciences

Conservation, Restoration, and Management (40 credit minimum)

- EEMB 2400: Evolution (4 cr)
- EEMB 3455: Ecosystems Ecology (4 cr) or CIVE 3430: Engineering microbiology and Ecology (4 cr)
- EEMB 3460: Conservation Biology (4 cr)
- EEMB 4001: Restoration and Landscape Ecology (4 cr)
- ENVR 5220: Ecosystem-based management (4 cr)
- Five elective courses chosen from list B

Earth, Oceans, and Environmental Change (40 credit minimum)

- CHEM 1161/1162/1163: Chemistry for Science Majors (5 cr) or CHEM 1211/1212 or CHEM 1151/1152
- Physics 1 (Choose one):
 - PHYS 1161/1162/1163: Physics 1 (5 cr)
 - PHYS 1145: Physics for Life Sciences 1 (5 cr)
 - PHYS 1151/1152/1153: Physics for Engineering 1
 - ENVR 3418: Geophysics

CHOOSE ONE FROM EACH OF THE CATEGORIES BELOW

- Earth systems:
 - Either Dynamic Earth + Lab or Earth's changing cycles (whichever wasn't taken earlier)
- Earth Materials and Landforms:
 - ENVR 2340+2341: (Earth Landforms and Processes + Lab, 5 cr) or ENVR 2310+2311 (Earth materials + lab, 5 cr)
- Freshwater:
 - ENVR 3200: Water Resources or ENVR 4500+4501: Applied Hydrogeology + lab
- Oceans:
 - ENVR 3600: Oceanography (4 cr) or ENVR 3125: Global Oceanic Change (4 cr)
- Environmental Change:
 - ENVR 5110: Climate and Atmospheric Change (4 cr) or ENVR 3125: Global Oceanic Change (4 cr)
- Three elective courses chosen from list A

LIST A: Earth, Oceans and Environmental Change electives

- ENVR2310+2311: Earth Materials + Lab (5 cr)
- ENVR 2340+2341: Earth Landforms and Processes + Lab (5 cr)
- ENVR 3125: Global Oceanic Change (4 cr)
- ENVR 3200: Water Resources (4 cr)
- ENVR 3418: Geophysics (4 cr)
- ENVR 3410: Environmental Geochemistry (4 cr)
- ENVR 3600: Oceanography
- ENVR 4500 + 4501: Applied Hydrogeology + Lab (5 cr)
- ENVR 5190: Soil Science (4 cr)
- ENVR 5240+5241: Sedimentary Basin Analysis + Lab (5 cr)
- ENVR 5242+5243: Ancient Marine Life + Lab (5 cr)
- ENVR 5270 + 5271: Glacial and Quaternary History (5 cr)
- CIVE 5280: Remote Sensing of the Environment
- CIVE 3435: Environmental Pollution Fate and Transport
- ENVR 5201/5202 Environmental Science/Geology Field Seminar (Dialog)

LIST B: Conservation, Restoration, and Management electives

- EEMB 2420: Fisheries Biology, Policy, and Conservation (4 cr)
- EEMB 3466: Disease Ecology (4 cr)
- ENVR 3150: Food Security and Solutions (4 cr)
- ENVR 3200: Water Resources (4 cr)
- EEMB 3465: Ecological and Conservation Genomics (4 cr)
- EEMB 3475: Wildlife Ecology (4 cr)
- ENVR 4500 + 4501: Applied Hydrogeology + Lab (5 cr)
- ENVR 5563: Advanced Spatial Analysis (4 cr)
- ENVR 5190: Soil Science (4 cr)
- EEMB 4000 + ENVR 3151: Advanced Conservation Biology and Food Sustainability in the Mediterranean (Dialog)
- ENVR 5350: Sustainable Climate and Energy Solutions
- ENVR 5450: Applied Social-Ecological Systems Research

LIST C: Sustainable Planning and Development Electives

- EEMB 2420: Fisheries Biology, Policy, and Conservation (4 cr)
- INTL 2464: Natural Resources and Sustainable Development (4 cr)
- EEMB 3460: Conservation Biology (4 cr)
- EEMB 3470: Coastal Ecology and Sustainability (4 cr)
- EEMB 4001: Landscape and Restoration Ecology (4 cr)
- ENVR 5563: Advanced Spatial Analysis (4 cr)
- ENVR 5220: Ecosystem based Management (4 cr)
- ENVR 5450: Applied Social-Ecological Systems Research
- ENVR: 4500+4501: Applied Hydrogeology + Lab (5 cr)
- PPUA 5260: Ecological Economics (4 cr)
- ENVR 5190: Soil Science (4 cr)
- CIVE 5275: Life cycle assessment of materials, products, and infrastructure (4 cr)
- ENVR 3201 + 3202: Coastal Sustainability: ecology and CHN systems in Southeast Asia and The Blue Economy of the Gulf of Maine (Dialog)
- EEMB 4000 + ENVR 3151: Advanced Conservation Biology and Food Sustainability in the Mediterranean (Dialog)

LIST D: Environment and Society electives

- EEMB 2420: Fisheries Biology, Policy, and Conservation (4 cr)
- INTL 2464: Natural Resources and Sustainable Development (4 cr)
- ENVR 3150: Food Security and Solutions (4 cr)
- EEMB 3460: Conservation Biology (4 cr)
- EEMB 3470: Coastal Ecology and Sustainability (5 cr)
- ENVR 5220: Ecosystem based Management (4 cr)
- ENVR 5350: Sustainable Climate and Energy Solutions
- ENVR 5210: Environmental Planning (4 cr)
- PPUA 5268: International Environmental Policy
- CIVE 5275: Life cycle assessment of materials, products, and infrastructure (4 cr)
- PPUA 5264: Energy Transitions and Climate Resilience: Technology, Policy, and Social Change (4 cr)
- INTL 5100: Climate and Development
- ENVR 3201 + 3202: Coastal Sustainability: ecology and CHN systems in Southeast Asia and The Blue Economy of the Gulf of Maine (Dialog)
- EEMB 4000 + ENVR 4151: Advanced Conservation Biology and Food Sustainability in the Mediterranean (Dialog)