Dual MSES-MS Geological Sciences Program Requirements (51 credit hours)

Students in the MSES-MS Geological Sciences program take 51 credit hours (of which, at least 21 credits must be from both O'Neill and Earth & Atmospheric Sciences). Note that double-counting of courses among components is permitted as outlined in each section below, so long as overall credit requirements are met. In double-counting, multiple requirements may be met by a single course, but credits only count once towards credit totals. The dual-degree program is designed to be completed in two (2) years, but must be completed within six (6) years.

Note regarding registration: Students pursuing a second degree outside of O'Neill are expected to register equally through both schools during their time in the dual degree program. In general, students should enroll through the school in which the majority of their credits are being taken for a given term. The O'Neill Graduate Records Office will check dual degree student enrollments each term to ensure enrollments are placed under O'Neill when necessary. The O'Neill Graduate Records Office will reach out to students whose enrollments need switched to adhere to this rule.

Geological Sciences Core: (9 credit hours)
In consultation with an advisor, select 9 credits from the following list:

	P=Prerequisite, C=Corequisite, & R=Recommendations
EAS-X 429 Field Geology in the Rocky Mountains (6 cr.)	
EAS-G 513 Seismology I (3 cr.)	
EAS-G 517 Optical Mineralogy (3 cr.)	
EAS-G 520 Mechanics for the Earth Sciences (3 cr.)	
EAS-G 559 Earth Surface Processes (3 cr.)	
EAS-G 572 Basin Analysis and Hydrocarbons (3 cr.)	
EAS-G 576 Climate Change Science (3 cr.)	
EAS-G 581 Surficial Geology (3 cr.)	
EAS-G 583 Isotope Geochemistry (3 cr.	
EAS-G 587 Organic Geochemistry (3 cr.)	
GEOL-G 524 Carbonate Facies and Environments (3 cr.)	
GEOL-G 561 Paleoecology (3 cr.)	
GEOL-G 589 Geomicrobiology (3 cr.)	
GEOL-G 591 Physical Sedimentology (3 cr.)	

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Environmental Science Core: (9 credit hours)
In consultation with an advisor, select three courses from the following list:

		P=Prerequisite, C=Corequisite, & R=Recommendations
SPEA-E 515	Fundamentals of Air Pollution	**R: E536**
SPEA-E 526	Applied Mathematics for Environmental Science	**R:** differential and integral calculus
SPEA-E 527	Applied Ecology	
SPEA-E 536	Environmental Chemistry	**P:** undergrad chemistry course with lab
SPEA-E 538	Statistics for Environmental Science	
SPEA-E 539	Aquatic Chemistry	**R: E536**
SPEA-E 552	Environmental Engineering	**R: E526, E536**
SPEA-E 564	Organic Pollutants: Environmental Chemistry and Fate	**R: E536** or undergraduate organic chemistry

Economics, Management, and Policy Core Competencies: (Typically 6-9 credit hours)
Students are encouraged to acquire competency in these areas of environmental management. The selection of courses will vary according to the student's professional objectives and an advisor can approve alternative courses that may be relevant.

		P=Prerequisite, C=Corequisite, & R=Recommendations
SPEA-E 513	Environmental Project Management	
SPEA-E 543	Environmental Management	
SPEA-P 507	Data Analysis and Modeling for Public Affairs	**P: E538** or **V506**
SPEA-P 541	Benefit-Cost Analysis	**P: V517**
SPEA-R 512	Climate Law and Policy	
SPEA-R 521	Domestic Environmental Policy	
SPEA-R 531	Water Law	
SPEA-R 532	Water Policy and Economics	
SPEA-R 535	International Environmental Policy	
SPEA-R 564	Environmental and Natural Resource Policy Design and Implementation	
SPEA-R 625	Environmental Economics and Policy	**P: V517**
SPEA-R 626	Energy Policy Seminar	**P: E574**

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Economics, Management, and Policy Core Competencies: (continued)

		P=Prerequisite, C=Corequisite, & R=Recommendations
SPEA-R 643	Natural Resource Management and Policy	
SPEA-R 645	Environmental Law	
SPEA-R 674	Energy Economics and Policy	**P: V517**
SPEA-S 596	Sustainable Development	**P: V517** or equivalent coursework
SPEA-V 517	Public Management Economics	

Tool Skill Courses: (3 credit hours)
Students are encouraged to acquire competency in analytical methods by focusing on tool skills appropriate to their professional objectives. Students pursuing the research option (see below) may use research-course credits to satisfy the Tools requirement, if appropriate.

		P=Prerequisite, C=Corequisite, & R=Recommendations
SPEA-E 518	Vector-based Geographic Information Systems	
SPEA-E 529	Application of Geographic Information Systems	**P: E518**, or other introductory GIS course with lab, or equivalent practical experience
SPEA-E 538	Statistics for Environmental Science	
SPEA-E 554	Groundwater Flow Modeling	
SPEA-E 560	Environmental Risk Analysis	**P: E538**, **V506**, or consent of instructor. A firm foundation in math and/or science is useful. *Also fulfills capstone requirement and counts in concentration.*
SPEA-P 507	Data Analysis and Modeling for Public Affairs	**P: E538** or **V506**
SPEA-P 539	Management Science for Public Affairs	**P: E538** or **V506**
SPEA-P 541	Benefit-Cost Analysis	**P: V517** or consent of instructor
SPEA-P 562	Public Program Evaluation	**P: V506** or equivalent coursework
EAS-G 520	Mechanics for Earth Sciences	
EAS-G 562	Geometric Morphometrics	
EAS-G 582	Computational Methods for Earth Scientists	
EAS-G 583	Isotope Geochemistry	
EAS-G 586	Geochemical Modeling	
EAS-G 612	Inverse Methods in Geophysics	
EAS-G 685	Evolution of Ecosystems	
GEOL-G 563	Quantitative Paleontology	

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Dual Geological Sciences – Environmental Science Concentration: (15-18 credit hours)

This concentration supports the Geological Sciences and MSES degrees with courses in laboratory and environmental chemistry, toxicology, and risk assessment, as well as energy-related courses. Courses taken to satisfy the core requirements may not also satisfy concentration requirements. Students pursuing the research option (see below) may use research-course credits to satisfy part of the concentration requirement.

At least two courses should be selected from the Earth & Atmospheric Sciences Department and at least two courses should be selected from the O'Neill School. An advisor can approve alternative courses that may be relevant.

		P=Prerequisite, C=Corequisite, & R=Recommendations
SPEA-E 502	Water Quality Modeling	
SPEA-E 503	Natural Gas: Technical and Policy Challenges	**P: E574**
SPEA-E 512	Risk Communication	
SPEA-E 514	Changing Landscape of Toxic-Chemical Regulation	
SPEA-E 515	Fundamentals of Air Pollution	
SPEA-E 517	BMP Design for Healthy Urban Watersheds	*Also fulfills capstone requirement.*
SPEA-E 520	Environmental Toxicology	
SPEA-E 536	Environmental Chemistry	
SPEA-E 539	Aquatic Chemistry	
SPEA-E 542	Hazardous Materials	
SPEA-E 544	Subsurface Microbiology and Bioremediation	
SPEA-E 545	Lake and Watershed Management	
SPEA-E 552	Environmental Engineering	
SPEA-E 554	Groundwater Flow Modeling	
SPEA-E 555	Fluid Mechanics	
SPEA-E 560	Environmental Risk Analysis	**P: E538**, **V506**, or consent of instructor. A firm foundation in math and/or science is useful. *Also fulfills capstone requirement and counts in Tool Skill requirement.*
SPEA-E 562	Solid and Hazardous Waste Management	
SPEA-E 564	Organic Pollutants: Environmental Chemistry and Fate	
SPEA-E 574	Energy Systems	
SPEA-E 591	Climate-Change Impacts on Natural Resources	

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Dual Geological Sciences – Environmental Science Concentration: (continued)

		P=Prerequisite, C=Corequisite, & R=Recommendations
GEOG-G 532	Physical Climatology	
GEOG-G 551	Physical Hydrology	
EAS-G 559	Earth Surface Processes	
EAS-G 572	Basin Analysis and Hydrocarbons	
EAS-G 576	Climate Change Science	
EAS-G 581	Surficial Geology	
EAS-G 583	Isotope Geochemistry	
EAS-G 587	Organic Geochemistry	
EAS-G 685	Evolution of Ecosystems	
GEOL-G 561	Paleoecology	
GEOL-G 588	Paleobiogeography	
GEOL-G 589	Geomicrobiology	

Capstone Course (Professional-Degree students): (3 credits hours)

Each candidate for the MSES-MS Geological Sciences dual degree program should take a 3-credit hour course during which they participate in a team to carry out an integrative project that addresses a multidisciplinary problem. Capstone course credit may be double-counted in either Concentration or Tool Skill requirements, if appropriate. The capstone requirement may be met by taking one of the courses listed below or other approved courses with a similar structure.

		P=Prerequisite, C=Corequisite, & R=Recommendations
SPEA-V 600	Capstone	*Sections with an environmental focus.*
SPEA-E 517	BMP Design for Healthy Urban Watersheds	*Also counts in concentration.*
SPEA-E 560	Environmental Risk Analysis	**P: E538**, **V506**, or consent of instructor. A firm foundation in math and/or science is useful. *Also counts in Tool Skill requirement and concentration.*
EAS-G 690	Environmental & Energy Diplomacy	

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Experiential Requirement (Professional-Degree students): (0-3 credit hours)

Each candidate for the MSES-MS Geological Sciences dual degree program must obtain professionally relevant experience through one of the following options:

1. Approved Internship **SPEA-E 589** (0-3 credit hours): The student will work with the O'Neill Career Hub and the Department of Earth & Atmospheric Sciences to arrange for a suitable internship. Internships vary greatly according to the expectations and requirements of the sponsor. Students are expected to give careful attention in the selection of an internship suitable to their professional goals. Typically, students do not use credit hours for the internship, and as a result, have minimal fees for the experience. However, students who want the additional credit hours can receive up to 3 credit hours for an internship involving the appropriate amount of work; these students will owe fees to the relevant school for the 3 credit hours.

2. Professional Experience (3 credit hours): Students who have had significant environmental management, technical or administrative work experience in the past may receive a 3-credit hour reduction and a waiver of the Experiential Requirement. Students must apply to receive Professional Experience credit and their experience must meet O'Neill guidelines. Professional experience credit and transfer credit, together, may not total more than 12 hours. Students receiving prior professional experience credit should carefully plan the balance of their program with their faculty advisors.

Research Requirement (Research-Option students): (6-9 credit hours)

Candidates choosing to focus primarily on research may replace the capstone and experiential (internship) experience with a graduate-level research project that culminates in a master's thesis (following EAS thesis or report option definition but not O'Neill thesis definition) or research project. The research/thesis may be directed by a member of the graduate faculty from either the Department of Earth & Atmospheric Sciences or the O'Neill School, but the advisory committee must include at least one member from both departments. Up to nine hours of research, either from EAS-G 810 or SPEA-E 625, may be counted in either the Concentration or Tool Skill requirements as appropriate. The capstone and experiential (internship) requirements are waived for students taking the research option.